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NSW Treasury

Eraring Power Station

Preliminary Environmental Site Assessment

Ref: 0194708RP02 Final

27 June 2013

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The world's leading sustainability consultancy

Eraring Power Station

Preliminary Environmental Site Assessment

NSW Treasury - Project Symphony

27 June 2013

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Environmental Resources Management Australia Pty Ltd Quality System

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NSW Treasury – Project Symphony

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EXECUTIVE SUMMARY

ERM was engaged by NSW Treasury to provide advice in relation to potential soil and groundwater contamination issues which may be relevant to the sale of certain electricity generation assets owned and operated by Eraring Energy. The subject of this report is the Eraring Power Station.

The specific objectives for ERM's scope of works were to:

- *assess the nature and extent of potential soil, sediment and groundwater contamination issues which may be present at the site and relevant receiving environments;*
- *assess the potential financial liabilities associated with those issues (assuming ongoing commercial / industrial use as a power generating facility);*
- *identify what additional works may be required to establish a baseline of soil, sediment and groundwater conditions present at the site to support the potential sale of the asset.*

ERM met these objectives via the completion of a Preliminary Environmental Site Assessment (ESA) which included background research from a variety of sources as well as management and staff interviews and site visits undertaken on 18 and 19 March 2013.

The Preliminary ESA identified that limited previous intrusive ESAs appear to have been completed on the Site and a number of potential contamination sources were identified as follows:

- *CCP management facility (ash dam);*
- *transformer area;*
- *coal storage area;*
- *fuel oil installation;*
- *operational and decommissioned USTs;*
- *attemperation reservoir;*
- *truck wash out pits;*
- *workshops;*
- *former northern gas turbine area;*
- *sewage treatment area; and*
- *Lake Macquarie, Whiteheads Lagoon, the Return Water Pond and Crooked Creek sediments and sediments associated with drainage channels to Lake Eraring.*

Decommissioned and operational USTs, as well as the truck washout pits and immediate surrounds, were also considered secondary areas of potential concern.

Based on the results of the Preliminary ESA undertaken by ERM, and consideration of Government's intended approach to establishing a baseline of soil and groundwater contamination, a programme of intrusive (Stage 2) assessment of potential soil and groundwater contamination issues is provided. The most appropriate sampling design is considered to be a combination of systematic (grid based) and judgemental (targeted) sampling of soil and groundwater at locations across the Site and sediments and surface water in several areas of potential on and off-site impact; namely, Lake Macquarie, Whiteheads Lagoon, the Return Water Pond, Crooked Creek and drainage channels to Lake Eraring.

Based on the information available at the time of preparation of this report, ERM has not identified any actual or known material contamination issues which are currently undergoing or likely to require remediation. Preliminary remediation costs have not therefore been prepared at this point in time. There is however the potential for contamination arising from identified areas of concern to give rise to material cost, which can be confirmed following the proposed Stage 2 investigations. It is proposed that remedial costs be revisited following completion of the proposed Stage 2 investigations.

1 INTRODUCTION

1.1 BACKGROUND

On 24 November 2011, the New South Wales (NSW) State Government (Government) announced that it would divest the State-owned electricity generation assets and the Cobbora Coal Mine development. More specifically, the Government intends to:

- sell the electricity generation assets of Macquarie Generation, Eraring Energy and Delta Electricity, including the assets related to the generation trading ('GenTrader') agreements of Eraring Energy and Delta Electricity;
- sell the electricity generation development sites at Bayswater B, Munmorah and Tomago; and
- sell or lease the Cobbora Coal Mine development.

In order to support the sale of certain electricity generation assets owned and operated by Eraring Energy (a State Owned Corporation – SOC), NSW Treasury (Treasury) on behalf of the State of New South Wales, engaged ERM as the Site Contamination Environmental Adviser (the 'Adviser') to provide advice in relation to potential soil and groundwater contamination issues which may be relevant to the transaction at certain specified sites. The subject of this report is Eraring Power Station (the 'Site').

1.2 OBJECTIVE

The specific objectives for ERM's scope of works were to:

- assess the nature and extent of potential soil, sediment and groundwater contamination issues which may be present at the Site and relevant receiving environments;
- assess the potential financial liabilities associated with those issues (assuming ongoing existing landuse for the areas concerned, in accordance with the zoning presented in the City of Lake Macquarie council Local Environmental Plan 2004);
- identify what additional works may be required to establish a baseline of soil, sediment and groundwater conditions present at the Site to support the potential sale of the asset.

1.3 SCOPE OF WORK

The scope of this Preliminary ESA was outlined in the Request for Proposal (RFP) issued by Treasury on 14 February 2013 and following discussions with Treasury and a potential bidder and their advisors during the course of the works, the scope was amended. A copy of the revised scope of work is included as *Annex E*.

1.4 MATERIAL THRESHOLD

ERM adopts a technically rigorous approach to assessing potential risks and liabilities during Environmental Due Diligence (EDD), and typically focuses on what is *material* to the transaction. In this situation, a material threshold was applied to items contained within the EDD reports.

Based on ERM's experience of similar projects and discussions with the Client, ERM adopted a material threshold of $0.5M (+ GST if applicable) per contamination source.

Material costs are those costs for that item to meet relevant requirements of NSW EPA under its current land use to remediate or manage the contamination issue. Remediation or management includes additional assessment, environmental monitoring, management, containment or other remediation measures.

In addition, any issue that ERM considers could have the potential to lead to prosecution by the regulatory authorities that could lead to significant business disruption or reputational impact will be considered material.

1.5 APPROACH AND METHODOLOGY

ERM's approach to the assessment was to break the work down into individual tasks as follows.

1.5.1 *Project Initiation Meeting*

In order to ensure that ERM and Treasury were fully aligned in terms of the scope and anticipated deliverables, the ERM Partner in Charge and Project Manager attended a project initiation meeting with Treasury.

1.5.2 *Introductory meetings with the individual SOCs*

In order to facilitate cooperation with the SOC and to seek assistance from the asset maintenance and environmental team throughout the project, ERM completed introductory meetings with key contacts within Eraring Energy.

1.5.3 Review of Existing Data

Relevant environmental information on the specific SOC asset was made available to ERM via an electronic dataroom. ERM reviewed relevant information on all sites and a list of all documents reviewed is included in *Section 11*.

In addition, ERM conducted background research using publicly available information on each of the sites. Background research included those items identified in *Section 3* below, and *Annex E*.

A site setting review was also undertaken to understand both the sensitivity of the surrounding area to environmental impact and the potential impact on the site resulting from neighbouring activities, past and present. Key areas addressed included site description and activities, site history, geology, hydrogeology and hydrology (refer to *Section 2*).

ERM did not review capping, closure and other day to day operational costs for the Coal Combustion Products (CCP) Management Facility (Ash Dam) as this was considered to be an operational cost associated with the management of a primary waste stream associated with normal operations, as required under relevant planning approvals (refer to *Section 3.5*), rather than with the management of a site contamination issue.

1.5.4 Site Visits and Management Interviews

ERM mobilised to site and completed site management interviews and a site visit to Eraring Power Station on 18 and 19 March 2013.

The assessment focussed on potentially material contamination issues that were considered likely to require further assessment relevant to Bidders and to identify where a baseline assessment may be required. Topics that were evaluated as non-material were not assessed in detail.

1.5.5 Preparation of Stage 1 ESA Reports

The Stage 1 ESA Reports were prepared in general accordance with NSW OEH (2011) on the basis of information collected during the previous tasks. In preparing these reports, (and in particular the proposed scope of work for Stage 2 assessments and remedial cost estimation) ERM utilised a combination of experience gained in the planning and delivery of similar vendor due diligence projects for government, professional judgement of suitably qualified contaminated land professionals and reference to relevant guidelines made or approved under the *Contaminated Land Management Act* (1997), the *National Environment Protection (Assessment of Site Contamination) Measure* (1999 and the *National Environment Protection (Assessment of Site Contamination) Amendment Measure* 2013 (No. 1)), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) and guidelines and technical notes relating to the *Protection of the Environment Operations (Underground Petroleum*

Storage Systems) Regulation 2008 (made under the *Protection of the Environment Operations Act* 1997).

1.6 FOLLOWING A PROCESS OF REVIEW BY TREASURY AND OTHER KEY ADVISORS, DRAFT REPORTS WERE FINALISED FOR ISSUE. REPORT STRUCTURE

This report has been structured in order to align generally with the requirements for a Preliminary Environmental Site Assessment outlined with NSW EPA (2011) *Guidelines for consultants reporting on contaminated sites.* Where necessary, minor additions and modifications to the structure have been made to accommodate the fact that this assessment is being undertaken for a specific purpose (that being Vendor Environmental Due Diligence - VEDD).

2 SITE DESCRIPTION AND SURROUNDING ENVIRONMENT

2.1 SITE IDENTIFICATION

Eraring Power Station is owned and operated by Eraring Energy, a State Owned Corporation (SOC) that manages a diverse set of electricity generating assets located throughout NSW, Australia.

Eraring Power Station is situated adjacent to the western shore of Lake Macquarie, near the township of Dora Creek, south west of Newcastle, NSW. The approximate coordinates of the Power Station are 361834 m E and 6340642 m S. The Lot and Deposited Plan (DP) information relevant to the site, along with the current land zoning for each parcel of land as per The Lake Macquarie Local Environmental Plan 2004, is outlined in *Table 2.1* (below). A Site Location Map is provided as *Figure 1*, and land zoning information is provided as *Figure 2*.

Table 2.1 Lot, Deposited Plan and Land Zoning Information

Lot	Deposited Plan	Folio Identifier	Area (ha)	Zoning	Land Use
1612	587100	1612/587100	0.2014	4 (1) Industrial Core	Outlet Canal
3	548546	3/548546	15.3592	9 Natural Resources	Eraring Power Station
4	262501	4/262501	1.7920	7 (2) Conservation (Secondary)	Outlet Canal
19	262501	19/262501	5.5450	4 (1) Industrial Core	Lake Macquarie Centre
23	262501	23/262501	0.5382	1 (2) Rural (Living)	Vacant Land
24	262501	24/262501	1.5360	1 (2) Rural (Living)	Vacant Land
25	262501	25/262501	1.6610	1 (2) Rural (Living)	Vacant Land
26	262501	26/262501	1.7970	1 (2) Rural (Living)	Vacant Land
27	262501	27/262501	0.8358	1 (2) Rural (Living)	Vacant Land
1	817425	1/817425	10.7200	9 Natural Resources & 4 (1) Industrial Core	Eraring Power Station
100	828283	100/828283	32.4000	9 Natural Resources & 4 (1) Industrial Core	Eraring Power Station

Lot	Deposited Plan	Folio Identifier	Area (ha)	Zoning	Land Use
101	828283	101/828283	2.7140	9 Natural Resources & 4 (1) Industrial Core	Eraring Power Station
211	840670	211/840670	1.7800	4 (1) Industrial Core	Eraring Power Station
50	840671	50/840671	5.4360	4 (1) Industrial Core	Eraring Power Station
51	840671	51/840671	0.3371	4 (1) Industrial Core	Eraring Power Station
11	1050120	11/1050120	879.4000	4(1) Industrial Core & 9 Natural Resources & 7 (2) Conservation (Secondary)	Eraring Power Station
3	621697	3/621697	1.5980	4 (1) Industrial Core	Inlet Canal
2	621697	2/621697	14.3200	4 (1) Industrial Core	Inlet Canal
1	621697	1/621697	7.8900	4 (1) Industrial Core	Inlet Canal
1	816174	1/816174	11.5300	4 (1) Industrial Core	Inlet Canal
301	806475	301/806475	25.6300	4 (1) Industrial Core, 7 (1) Conservation (Primary) & 7 (2) Conservation (Secondary)	Outlet Canal
302	806475	302/806475	5.8780	4 (1) Industrial Core & 7 (2) Conservation (Secondary)	Outlet Canal
20	734860	20/734860	2.8580	9 Natural Resource & 4 (1) Industrial Core	Eraring Power Station
21	734860	21/734860	0.1307	9 Natural Resources & 4 (1) Industrial Core	Eraring Power Station

Lot	Deposited Plan	Folio Identifier	Area (ha)	Zoning	Land Use
1	1109558	1/1109558	23.6500	9 Natural Resources	Eraring Power Station
2	1109558	2/1109558	6.3730	9 Natural Resources	Eraring Power Station
318	39722	318/39722	12.5800	9 Natural Resources & 6 (1) Open Space	Coal Haul Road

2.2 *SITE DESCRIPTION*

The total site area of the Eraring Power Station is approximately 1147 hectares (ha), which includes water canals, but excludes areas for associated mines. The power station operational area itself occupies approximately 150 ha. A Site Layout Plan is provided as *Figure 3*.

The inventory at Eraring Power Station includes approximately 180 buildings which include:

- Administration buildings;
- Control rooms;
- Workshops;
- Warehouses; and
- Various plant buildings.

Eraring Power Station comprises four coal fired units (Units 1 to 4) which have a total generated output of 2,880 MW for the station. All four units were upgraded between 2009 and 2012 to raise the gross unit capacity of each unit from 660 MW to 720 MW and 750 MW under overload. The station employs a once through cooling system using salt water from Lake Macquarie. Four 330 kV and 500 kV transmission lines provide connection to the electricity grid.

A list of Eraring Power Stations major plant, systems and equipment is provided below, with more detailed descriptions on the operational nature of the Site provided in *Section 3.3:*

- Boilers
- Steam Turbines
- Boiler Feed Pumps

- Generators
- Generator Transformer
- Black Start Gas Turbine
- Coal Handling Plant
- Coal Mills
- Coal Combustion Product Management Facility (Ash Dam)
- Cooling Water System
- Stacks

Engineering inspections completed for the Site (Worley Parsons, 2013) have reported that plant, most of which was commissioned 30 years ago, is generally in good condition. The condition of individual equipment or systems ranges from very good (associated with key equipment of systems recently installed or refurbished as part of upgrade works) through to reasonable for its age. The Power Station area itself is completely sealed with concrete hardstand of sound integrity.

Outside of the Power Station area, the Site contains the following features:

- An open canal providing water to the Power Station is sourced from an inlet at Bonnells Bay, running along the eastern side of Lake Eraring, delivering water to a pumping station in the east of the Site.
- An Attemperation Reservoir located in the east of the Site.
- Cooling water from the Power Station is discharged via an outfall tunnel which runs from the southern corner of the Power Station area to Myuna Bay.
- To the north-east of the Power Station area is a Switchyard, settling basin and oil retention weir, and cooling towers.
- The Coal Storage Area is situated in the central portion of the Site, and includes a coal unloading bay, bulldozer fuelling area and two surface water retention ponds.
- Also within the central portion of the Site (to the south of the Coal Storage area) is a sewage treatment works, water reservoirs, and four 1ML fuel ASTs known as the Fuel Oil Installation.
- The northern portion of the Site includes the Former (Northern) Gas Turbine area, which includes two fuel ASTs (estimated at greater that 1ML capacity each), four transformers, oil water separators and an oil containment dam.

- Also within the northern portion of the Site is a weighbridge, truck wash-out pits, oil water separators, and a rail loop.

- The Coal Combustion Product (CCP) Management Facility (Ash Dam) is found in the eastern portion of the site, with waste disposal areas (including asbestos) located on the south-west and north-west of the dam.

- A large network of internal sealed and unsealed roads, coal conveyor belts and above ground pipelines for fuel and fly ash transfer are also located throughout the Site.

2.3 *TOPOGRAPHY*

The elevation of the Site ranges between approximately 30 m above sea level at the Power Station area, to 40 m above sea level at the CCP Management Facility. The Power Station area is flat and situated within a natural depression, with the remainder of the site sloping up to the north, east and south. The study area is broadly bounded to the west by the Watagan and Sugarloaf Ranges.

It was understood that the Ash Dam slopes from 137.2 Relative Level (RL) at the western end to to 131 RL at the eastern side, with the internal eastern embankment has been raised locally to 132 RL for the northern part only (Aurecon, 2013).

Between 1996 and May 2010, seepage from the toe drains (as measured at weirs TD1 and TD8) has generally decreased, with rates recorded between 650 L/min to 20 L/min In 2011, the seepage rate was fairly stable at approximately one third of the maximum rate measured since 1996, calculated between 50 L/min and 220 L/min (Aurecon, 2011). Seepage measured from the ash deposits downstream of the dam (at the Wangi v-notch) also recorded a general decline in the base flow rate from a high of about 1500 L/min towards the end of 1997, to about 500 L/min in early 2007 (Aurecon, 2011). No further information regarding slope or hydraulic gradient of the Ash Dam was identified during the Premilinary ESA.

2.4 *GEOLOGY*

Regional Geology

Newcastle Coalfield Regional Geology Geological Series Sheet 9231 and part of 9131,9132 and 9232 (Edition 1) 1995 indicates that the site overlies late Permian, early Triassic age sandstone and siltstone of the Terrigal Formation and conglomerate, sandstone, siltstone and claystone of the Clifton Subgroup, subsequently overlain by the Quaternary age gravel, sand, silt and clay.

Soil

The study area is located on the Lake Macquarie landscape map (1:100,000), *NSW Soil and Land Information System.* This landscape is derived from the Narrabeen Group, alluvium overlying muddy sand estuarine sediment that features moderately deep, sulfidic, extratidal, non gravelly, loamy and sandy Hydrosol soils.

From a review of previously completed intrusive soil and groundwater investigation completed (Geo-Logix, 2011 a, b and c), site soils were generally found to contain a layer of shallow (up to approximately 3.0 m depth) fill material consisting of gravel, silt, sand and clay overlying clayey sand with gravel and gravelly clay to 10.0 m below ground level (m bgl). The intrusive works also reported the presence of intermittent weathered conglomerate and weathered sandstone along with coal seams within the natural lithology.

A review of acid sulphate soil information (accessed at http://www.asris.csiro.au/mapping/viewer.htm on 24 May, 2013) indicated that there was a low probability (with very low confidence) of encountering acid sulphate soils at the site, however a high probability of encountering acid sulphate soils was reported for land immediately west and south of the site.

2.5 HYDROGEOLOGY

The NSW Natural Resource Atlas online bore register identifies groundwater bores within a 10 km radius of the site are registered for irrigation, farming, private domestic and stock use. The standing water level in the bores is recorded as The standing water level in the bores is recorded as less than 15 m bgl. Licensed bores located within a 5 km radius of the site are listed in Table 2.2 (below).

Table 2.2 Licensed Groundwater Bores within a 5 km radius

Bore ID	Distance from Site (km)	Direction from site	Use
GW029567	0.34	North	Domestic Irrigation Stock
GW202325	3.58	North	Monitoring Bore
GW033618	4.07	North West	Stock
GW033619	4.17	North West	Stock
GW053438	2.8	West	Domestic Stock
GW064033	4.73	West	Domestic Stock
GW052111	2.77	South West	Domestic Stock
GW064143	4.1	South West	Domestic Stock
GW078608	3.77	South West	Domestic Stock

From a review of previously completed intrusive soil and groundwater investigation completed (Geo-Logix, 2011), groundwater was encountered beneath the Site at depths varying between approximately 4.1 m bgl and 9.0 m bgl. An assessment of groundwater conditions beneath the Unit 1 Turbine House indicated that groundwater conditions were following to the northeast at a gradient of 0.011 m/m (Geo-Logix, 2011b), an assessment of groundwater conditions beneath the stores building indicated that groundwater was flowing towards the southeast at a gradient of 0.027m/m (Geo-Logix, 2011a), whilst an assessment of groundwater conditions beneath the vehicle and mobile plant workshop indicated that groundwater flowed to the southwest at a gradient of 0.02 m/m. Based on a review of previous intrusive investigations undertaken at the site, the groundwater flow direction could not be confirmed. However based on the proximity of surface waters and local topography, it was likely to flow in a south easterly direction, towards Lake Eraring.

2.6 HYDROLOGY

The site surface water flows and drainage features are presented in suface water flow maps available from the dataroom (reference numbers 10.01.05.03.13 and 10.01.05.03.14) and provided as *Annex F*. Based on a review of these maps, site hydrological features can also be summarised as follows:

- A cooling water system intersects the site from the south, up to the power station and discharges into Myuna Bay;
- The contaminated water system is comprised of four collection pits, an oil water separator and several collection or retention ponds. The Boomerang Pond, the Demin Plant Effluent Pits and overflow from the oil water separator and holding pond discharge into the Ash Dam. Seepage water from the Ash Dam is collected south of the Ash Dam at the toe drain collection pond which ultimately drains to Myuna Bay. Emergency overflow from the Ash Dam seepage can also occur in to Crooked Creek; and
- Surface water flows have been identified at several locations across the site, and discharge to several surface water bodies including Muddy Lake and Whiteheads Lagoon / Myuna Bay.

2.7 SURROUNDING ENVIRONMENT

Eraring Power Station is sited in a natural depression on the western shore of Lake Macquarie, near the township of Dora Creek with tracts of vegetated land separating the power station from the neighbouring communities.

The surrounding environment includes:

- Myuna Bay to the east;
- Northern Railway along the western boundary. Based on discussions with site personnel, it was understood that a freshwater wetland (listed under *State Environmental Planning Policy 14*) was also located to the west of the site;
- Lake Eraring and Bonnells Bay to the south; and
- A mixture of private and Crown Lands to the north.

Principal landholders adjacent to the site include:

- NSW Department of Lands – Crown Land to the north;
- Centennial Coal – Coorabong Colliery to the west and Myuna Colliery to the north east;
- Rail Services Australia – rail corridor which is adjacent to the west of the power station;
- Transgrid and Energy Australia – electricity supply infrastructure;
- NSW Sport and Recreation – Myuna Bay Sport and Recreation Centre to the east;
- Private Residents – rural properties of Myuna Bay and Eraring to the east; and
- Private residents – residential properties of Dora Creek to the south.

Given the industrial land use, it is noted that the Centennial Coal properties, the railway corridor and the electricity supply infrastructure could present off-site sources of contamination to the surrounding environment, and potentially the Site. It is noted that a perimeter network of groundwater monitoring wells will be established as part of the Phase 2 work scope to allow for an assessment of background conditions and potential off-site sources of impact (refer to *Section 8* for further information regarding the sampling plan).

Given the proximity of Lake Macquarie, surface water run-off was likely to flow in an easterly direction, hence the Site generally intercepts the railway corridor and Centennial Coal properties from residential, ecological and recreational receptors. The potential for impact at the western site boundary from off-site sources could not be excluded, however it is noted that the magnitude of the industrial operations at the Site potentially presents a higher risk to surrounding land than the aforementioned industrial properties.

2.8 *SENSITIVE RECEPTORS*

A summary of sensitive receptors identified as relevant to the Site include:

- Indoor and outdoor human health receptors in the form of industrial on-site users.
- Indoor and outdoor human health residential receptors, the nearest of which comprise part of the Dora Creek residential community, located 480 metres south of the attemperation pond.
- Intrusive maintenance workers both on and on-site.
- Recreational users of Whiteheads Lagoon, and the Myuna Bay Sports and Recreational Centre located east of the site.
- Recreational users of Lake Macquarie, including Myuna Bay and its tributaries, located south and east of the site.
- Ecological receptors, including marine ecological receptors in Lake Macquarie, a freshwater wetland to the west and vegetated areas, particularly to the north and west.

3 SITE HISTORY AND REGULATORY SETTING

3.1 SUMMARY OF SITE HISTORY

Information provided by Eraring Energy management and a review of aerial photographs (refer below) indicates that prior to construction of the Eraring Power Station, the Site and surrounds were primarily occupied by a mixture of small farms and native vegetation. The primary exceptions to this were the western portion of the current ash dam and the area to the south of the current switchyard. The western portion of the current ash dam was previously utilised as an ash dam for the nearby former Wangi Power Station. The area to the south of the switchyard, was used for recreational purposes (playing fields and pony club grounds) prior to construction of Eraring Power Station. Playing fields remain present in the same area at the time of report.

Site works for the construction of Eraring Power Station commenced in 1977, with Units 1 and 2 entering commercial operation in 1982, Unit 3 in 1983 and Unit 4 1984. The 'black start' gas turbine was first introduced into the grid in 2009.

3.2 SUMMARY OF HISTORICAL AERIAL PHOTOGRAPHS

A review of historic aerial photographs was conducted by ERM and is summarised in *Table 3.1* (below) copies of the photographs reviewed are included in *Annex D*.

Table 3.1 Aerial Photograph Review

Year	Site	Surrounding Area
1950	The Site is largely undeveloped and vegetated with the exception of the area surrounding the current outlet canal and pockets of small cleared fields closer to the current operational area. A larger cleared area is located near the current coal stockpile area. The use of the cleared area is unable to be defined. There is no evidence of any significant built features within the Site. Undefined and unsealed tracks are located throughout the footprint of what is now the Site and buffer lands.	Generally vegetation becomes more scattered to the east of the Site. The Great Northern Railway corridor is located to the west of the site. Some limited residential development is evident along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek.
1966	The area of the current power station has been further cleared to consist of small fields and pockets of vegetation. Small buildings appear to be located in the southern area of the site however their use is not able to be identified. The large cleared area identified in the previous aerial photograph has undergone further clearing however its use is still unable to be identified. Several tracks / roadways run in both a north/south and east/west direction throughout the site and have	The areas to the north and west of the Site remain predominantly vegetated with trees. Some further residential and other development along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek is visible.

Year	Site	Surrounding Area
	become more formalised then the previous aerial photo. A body of water appears in the vicinity of the current ash dam (understood to be an ash disposal area associated with the Wangi Power station which operated from 1956 - 1986).	
1975	The Site has undergone further clearing with the majority of the southern half of the site comprising cleared open space and pockets of scattered vegetation. Apart from increased clearing the Site appears to be largely unchanged with exception of the ash dam which has increased in size. There are no clear signs of any activities associated with the Eraring Power Station at this stage, with the northern portion of the site still heavily vegetated. Previous informal dirt tracks are no longer visible.	The areas to the north and west of the site remain predominantly vegetated with trees. Residential and other development along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek is visible.
1984	The previous fields and small buildings have been replaced with the Eraring Power Station. The main infrastructure of the power station is now visible including the main building, inlet and outlet canal, coal storage area, storage tanks and transmission lines. The site layout appears to be very similar to the current site arrangement. An increased portion of the ash dam now appears to be water.	The areas to the north and west of the site remain predominantly vegetated with trees. Residential and other development along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek is visible.
1996	The infrastructure associated with the power station is largely the same as was seen from the previous aerial photograph. The ash dam contains significantly more water than previously shown, with capping appearing to have taken place on the eastern side of the dam. A rail loop to the north of the coal storage area that brings coal to the site has now been established.	The areas to the north and west of the site remain predominantly vegetated with trees. Residential and other development along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek is visible.
2009 (reviewed via Google Earth)	The site layout is similar to 1996. The attemperation pond has been constructed to the south of the main operational area and adjacent to the inlet canal. Clearance works have also been undertaken across the canal from the attemperation pond however the purpose of this is unclear. Rehabilitation of the eastern portion of the ash dam has commenced with the area containing scattered vegetation. The active area of the ash dam appears considerably drier than in previous photographs.	The areas to the north and west of the site remain predominantly vegetated with trees. Residential and other development along the foreshore of Lake Macquarie near the Site and around the township of Dora Creek is visible.

3.3 *HISTORICAL TITLES SEARCH*

Historical title deeds are used to identify previous owners of the site, their inferred land use and the potential for contamination from these land uses. A summary of the title deed provided for the site is outlined below. The findings of the titles search is also provided in full in *Annex D*.

Based on discussions with the Land, Engineering & Surveying Investigational Searcher engaged to compile the findings of the historical titles search, it was understood that the site was originally a 2000 acre grant that was subdivided into hundreds of 'residental acreage lots' which were acquired by The Electricity Commission of NSW and consolidated in the 1970s.

Prior to the aquisition and consolidation by The Electricity Commission of NSW, the site was largely owned by individuals. Between 1920 and 1970 (approximately) land comprising the site was largely occupied by farmers, vegetable growers and an orchadists, confirming the previous agricultural use of the site. Occupations listed for previous owners of land comprising the site included mine workers (from 1922 to 1954 at Lots 15 & 24 Section R DP 6747, from 1927 to 1947 at Lots 10 & 11 Section K DP 6747, Lots 9 & 12 Section K DP 6747, from 1966 to 1970 at Lot 7 and part of Lot 6 Section R DP 6747, and from 1968 to 1970 at Lot 5 Section E DP 6747), a coach painter (from 1946 to 1949 at Lots 10 and 11 Section R DP 6747), a machinist (from 1923 to 1946 at Lot 10 and 11 Section R DP 6747), a motor mechanic (from 1972 to 1973 at Lots 15 & 16 DP 4800), a boiler maker (from 1978 to 1981 at Part of Lot 3 DP 590371 and Lots 2 & 3 Section E DP 6747) railway employees, a plumber, fisherman, an architect, theatre exhibitors, labourers and carpenters.

Prior to ownership of the land transferring to these individuals, site proprietors were listed as The Excelsior Land Investment and Building Company and Bank Limited, Closer Settlement Limited, Lake Lands Limited or otherwise was listed as Crown Land.

Based on the review of historic titles, there are no particular likely uses of land that indicate potential material contamination.

3.4 *COUNCIL INFORMATION*

According to Baker and McKenzie (2013), the Lake Macquarie Local Environmental Plan 2004 (LEP 2004) currently designates the zoning and regulates land use for the Eraring Power Station. Lake Macquarie City Council (LMCC) is in the process of preparing a new City-wide draft Lake Macquarie Local Environmental Plan 2013 (Draft LEP). The land use and zoning designations in the Draft LEP that are applicable to the Eraring Power Station and its associated activities are, in some instances, materially different to those that apply under LEP 2004. Eraring Energy has advised the LMCC of these differences in its submission on the Draft LEP dated 21 December 2012. Eraring Energy has also confirmed that as of 9 April 2013, LMCC was still in

the process of reviewing the submissions made on the Draft LEP. Based on a review of online information provided by LMCC, the Draft LEP will not be published (finalised) until late 2013 or early 2014 and therefore will not form part of considerations for the proposed work scope.

Section 149 Certificates

The Section 149 certificates for each of the 26 parcels of land that comprise the site were requested from LMCC as part of the Preliminary ESA. Information relevant to potential contamination issues as prescribed by Section 59 (2) of the *Contaminated Land Management Act 1997* for each of the parcels of land is summarised in *Table 3.2* (below). Copies of the Section 149 certificates are presented in full in *Annex D.*

Table 3.2 Information relevant to potential contamination issues as prescribed by Section 59 (2) of the Contaminated Land Management Act 1997

Identifier		Issues under the Section 149 relevant to potential contamination				
Lot	**DP**	**The land (or part of the land) is significantly contaminated**	**The land is subject to a management order**	**The land is the subject of an approved voluntary management proposal**	**The land is subject to an ongoing maintenance order**	**The land is the subject of a site audit statement.**
1612	**587100**	No	No	No	No	No
3	**548546**	No	No	No	No	No
4	**262501**	No	No	No	No	No
19	**262501**	No	No	No	No	No
23	**262501**	No	No	No	No	No
24	**262501**	No	No	No	No	No
25	**262501**	No	No	No	No	No
26	**262501**	No	No	No	No	No
27	**262501**	No	No	No	No	No
1	**817425**	No	No	No	No	No
100	**828283**	No	No	No	No	No
101	**828283**	No	No	No	No	No
211	**840670**	No	No	No	No	No
50	**840671**	No	No	No	No	No
51	**840671**	No	No	No	No	No
11	**1050120**	No	No	No	No	No
3	**621697**	No	No	No	No	No
2	**621697**	No	No	No	No	No
1	**621697**	No	No	No	No	No
1	**816174**	No	No	No	No	No
301	**806475**	No	No	No	No	No
302	**806475**	No	No	No	No	No
20	**734860**	No	No	No	No	No
21	**734860**	No	No	No	No	No
1	**1109558**	No	No	No	No	No

1. Refer to *Annex D* for copies of the certificates2

Based on a review of the Section 149 certificate information, there were no identified potential material contamination issues relevant to the site at the time of this Preliminary ESA.

3.5 ENVIRONMENTAL APPROVALS, LICENSES AND MANAGEMENT

Eraring operates under a range of State and Commonwealth Government environmental legislation, which is outlined in its register of applicable environmental legislation. It is noted that whilst a comprehensive review of planning approvals and general environmental management was beyond ERM's scope of work for this assessment, in some instances these approvals and management system provide context for potential contamination sources (eg ash disposal) and hence a summary of salient points in relation to these issues has been set out in this report.

3.5.1 Planning Approvals

The original Eraring Power Station Environmental Impact Statements were prepared by the Electricity Commission of NSW in August 1975 (comprising two 660MW generating units) and December 1977 (Eraring Power Station Units 3 and 4). Since the original development, a number of modifications and additional approvals have been granted by either the Minister of Planning and Infrastructure and/or Lake Macquarie City Council.

A summary of approvals issued under Part 3A Major Project Applications of the *Environmental Planning and Assessment Act 1979* include:

- Capacity Upgrade and Attemperation Reservoir (Approved 26 June 2008): Capacity increase and performance improvements at the existing Eraring Power Station, comprising; replacement upgrade of plant components such that the nominal capacity of each turbine is increased from 660 MW to 750 MW; and construction and operation of up to a 920 ML cooling water attemperation reservoir.

- Upgrade/Expansion of the Coal Combustion Product Management Facility (Approved 29 April 2008): Staged expansion of the CCP management facility in conjunction with changes in the CCP disposal method from lean phase to dense phase. The project also included the installation of new infrastructure comprising CCP collection, storage, conditioning and pumping facilities.

- Emergency Gas Turbine Generator and Ash Dam Expansion at the Eraring Power Station (Approved 14 December 2006): Construction and operation of a 42 MW emergency turbine generator.

In addition to these, a number of Part 4 applications have been approved for the Site generally relating to the construction or demolition of structures, tree removal or subdivision of land.

3.5.2 Environmental Protection Licences

Eraring Energy holds two Environmental Protection Licences (EPL) issued under Section 55 of the Protection of the Environment Operations (POEO) Act. Under the POEO Act, licences are required for "scheduled activities". Eraring Power Station's license to operate includes management and monitoring requirements, operational limits, criteria for limiting emissions and reporting requirements.

Eraring Energy holds EPL 1429 for the premise described as 3 and 28 Rocky Point Road and 45 Point Piper Road, Eraring, NSW, 2264. This includes Lot 3/8 DP6467, Lot 13/16 DP6747, Part Lot 13/16 DP 6747, Lot 11 DP105120, Lot 7/16 DP 262501, Lot 301 DP808475, and Lot 302 DP 808475. The EPL authorises the electricity generation as well as chemical storage, coal works and sewage treatment systems. Non-compliances reported under EPL 1429 as presented on the EPA website are summarised in *Table 3.3* (below). We note that most of these non-compliances are not relevant to contamination considerations but are noted for completeness.

Table 3.3 Reported EPL Non-Compliances

Date received	Licence condition number	Type of non compliance
Sep-11	M2.1	Only 11 of 12 results were available for sampling points 4 and 5 for particulates deposited matter due to vandalism. Poles now coated with material to discourage climbing.
Mar-06	M2.1	Testing for flouride and undifferentiated particles was carried out in accordance with prescribed methods to the extent permitted by the configuration of access galleries and ports at Monitoring Points 11, 12, 13 & 14.
Mar-06	M6.1	Daily discharge volumes were not available for a period of time during the control system changeover from the old analogue to the new digital ICMS. This included time taken after the changeover to calibrate and fine tune the data input system.
Mar-06	M point 16	Ambient Air monitoring station at Dora Creek - data for temperature at 2M and 10M, rainfall and solar radiation was not available until June 2005 due to delays by contractor in installing instrumentation
Mar-06	M point 13	Discharge and Monitoring Point 13 - Boiler 3 discharge to stack as shown on site plan ER328067A. Yearly analysis for Volatile Organic Compounds was not undertaken.
Mar-05	M6.1	Water discharge volumes not available due to lightning damage to instruments
Mar-05	M2.1	Fluoride and Particulates not measured strictly in accordance with approved methods

Date received	Licence condition number	Type of non compliance
Mar-05	O1.1(a)	Accidential release of R22 refrigerant gas 27/4/2004
Feb-04	M2.1	The location of AAQ monitoring sites do not comply with prescribed standard
Feb-04	M2.1	Stack emission test points do not comply with prescribed standard
Feb-04	M6.1	Water discharge volumes only reported monthly not daily as required due to operational problems with instrument data loggers
Feb-04	M21	June 2003 high rainfall caused dust deposition gauges to overflow. No results available
Feb-04	L3.3	January 2003 copper discharge 6.1 ug/L exceeded the limit 5 ug/L
Mar-01	M2.1	Multi point calibration completed late
Mar-01	M2.1	Two fluoride emission tests conducted using the old test method. Station is now using the correct method USEPA Method 13B
Mar-01	M3	NFR sampling procedure suspect, new procedure adopted

The non-compliances reported to the EPA largely relate to inadequacies in the sampling approach or methodology. Accidential release of R22 refrigerant gas was reported for 27 April, 2004 (receipt date March 2005) and copper discharge exceeding the allowable limit was reported for January 2003 receipt date February 2004). No further information regarding the nature or specific location of these non-conformances was available.

Eraring Energy also holds EPL 4279 for the premise described as Eraring Coal Delivery Facility, Eraring Power Station, Construction Road, Dora Creek, NSW 2264. This includes Lot 100 DP 828283, and Lot 50, 51 DP 840671. The EPL authorises Coal Works.

3.5.3 Environmental Management

Eraring Energy has an Environmental Management System (EMS) for the management of current and potential environmental issues. The Eraring EMS is certified to ISO 14001:2004 Environmental Management Systems – Specifications and Guidance for Use. The most recent recertification assessment was undertaken by NCS International in July 2012 and certification was reaffirmed.

In addition to the EMS, a Land Management Plan (AECOM, 2010) has been implemented at Eraring Power Station. This Plan documents the overarching strategy for management of the Site, including biodiversity, soil and groundwater contamination, rehabilitation, weed management and controlled burns. Relevant parts of the Land Management Plan have been summarised in *Section 5.2* of this report.

A Pollution Incident Response Management Plan has been prepared for both EPL 1429 and 4297 in response to the POEO Amendment (Pollution Incident Response Management Plans) Regulation 2012.

Eraring Energy undertakes internal and external audits to assess ongoing compliance and environmental performance at the station. Environmental audits undertaken include:

- ISO 14001 Audits;
- National Greenhouse and Energy Reporting Scheme Verification Audits; and
- Internal Compliance Audits.

4 OPERATIONS

4.1 GENERAL DESCRIPTION OF PROCESSSES

The facility consists of a four unit coal fired thermal power station and a black start gas turbine power plant, currently fired on distillate. The four coal fired units have a total generated output of 2,880 MW for the station as a whole, with all four units having been upgraded between 2009 and 2012 to raise the gross unit capacity of each unit from 660MW to 720MW. The gas turbine has a nominal output of 40MW and is located in a bunded area east of Unit 3.

Most relevant design and layout features of Units 1 to 4 at Eraring Power Station include:

- Unitised boilers and turbine generators.
- Two chimneys, each serving two boilers.
- Once through cooling using salt water from Lake Macquarie, supplemented with a large scale reservoir for outlet attemperation.
- A Yokogawa integrated control and monitoring system (ICMS) serving all units.
- Semi-clad balanced draught, natural circulation, sub-critical, type boilers incorporating reheat.
- Tandem compound, reheat, condensing steam turbines driving hydrogen cooled generators arranged longitudinally in a fully enclosed turbine building.
- 330kV electrical connection for units 1 and 2 and a 500kV connection for Units 3 and 4 into the Transgrid Switchyards via overhead conductors;
- Fabric filters for fly ash collection.
- Open and covered coal stockpiles.

4.1.1 *Turbine Generators*

Eraring Power Station's four Turbo Generators were originally rated at 660-megawatt each. The steam-driven turbines are of the tandem compound reheat type with single-flow high pressure, double-flow intermediate pressure and two double-flow low-pressure exhaust cylinders. Operating speed is 3,000rpm.

The four associated boilers are single-furnace, twin-drum type using natural circulation with divided back pass and balanced draught. A turbine steam by-pass system stabilises boiler firing at low load and enables easy matching of steam to turbine metal temperature during start-up reducing thermal stresses and start-up times.

Between 2009 and 2012, each Boiler and Turbine has been upgraded for 720 megawatt capacity.

4.1.2 Fuel Supply

Eraring Power Station receives black coal by road, rail and overland conveyor from three local coal mines. Annual consumption of coal is approximately 5.6 Mt.

4.1.3 Transmission

Each generator is connected to a pair of generator transformers. These raise the generated voltage of 23 kV to the transmission voltage of 330 kV in Units 1 and 2, and to 500 kV in Units 3 and 4. Electricity is transmitted overhead to the 330 kV and 500 kV switchyards which form part of the interconnected transmission system. Units 3 and 4 at Eraring Power Station were the first generators to be connected to a 500 kV switchyard. 500 kV has been established as the appropriate voltage to meet bulk power supply needs.

4.1.4 Ash Disposal

Eraring Power Station utilises dry pneumatic conveying equipment to collect and convey fly ash collected from the boiler flue gas to two storage silos; one for coarse, and one for fine, fly ash. The fine fly ash is a more saleable product, with a significant percentage (45% in 2011/2012) of the ash generated recycled for other purposes.

For the bottom furnace ash on Units 1, 2 and 4, dry Magaldi Ash Conveyors (MACs) have been installed over the past three years. Unit 3 is still operating with the original water-impounded ash hoppers. All units discharge their bottom ash into the ash sluice trenches which transfer the ash to an ash pit and then to the Eraring CCP Management Facility.

Fly ash that is not sold is transported from the fly ash storage silos to the CCP Management Facility as high concentration slurry. The current rate of ash production exceeds 1.2 Mt per year.

Further information on ash disposal is provided in *Section 4.5.*

4.1.5 Water Supply

The main cooling water supply for Eraring Power Station is from Lake Macquarie. Saltwater cools the turbines through the condensers via six 'once through' circulating water systems and is returned to Lake Macquarie via an outlet canal. This process is discussed further in *Section 3.12*. Routine inspections, condition monitoring and maintenance have resulted in the water supply infrastructure being in good condition (Worley Parsons, 2013).

Domestic potable water is supplied to the site from Hunter Water. This source supplies the site via a 375mm main and associated 300 mm water meter located at the intersection of Cross Street and Rocky Point Road. Water travels to the Break Pressure Tank, which provides a barrier between the power station and Water Supply. The site also contains a Water Reclamation Plant (WRP) that recycles effluent to provide feedwater for its boilers. The WRP is able to treat 4.7ML of effluent per day to create 3.75ML of reclaimed water. This effluent is sourced internally and externally and is discussed further in Section 3.12.

4.1.6 Other Activities

Associated with the operation and maintenance of the Eraring Power Station are a number of Maintenance Workshops located within the facility. The two main workshops included the 'Daywork Main Workshop' and 'Ash and Dust Common Workshop'. It is understood a range of materials were historically stored at these locations, including the chlorinated solvents (trichloroethylene (TCE)) used for degreasing and parts washing.

Truck wash-out pits were observed to the north of the aboveground distillate and sump oil tanks. At the time of the ERM Site visit, the pits were observed to be in poor condition with build-up of oil and waste in the base of the pits. Waste water from these pits is transferred to the oil retention lagoon prior to transfer into the CCP. Based on a review of a Contaminated Water Briefing Paper prepared by Ring (2004), it was understood that oily sludge retrieved from the oil water interceptor is dried out and then stockpiled on unsealed hardstand adjacent to the truckwash bays, prior to being buried on site (location unspecified). However it is noted that based on discussions with Eraring environmental staff, this material is disposed at an off-site, licenced facility. Given the elevated hydrocarbons concentrations generally associated with this sludge, the stockpiling activities could pose as as a potential point source of contamination, and a potential breach of licencing conditions. It is noted that four sampling locations have been designated for this area, to assess for potential soil and groundwater impact (refer to *Section 8*).

4.2 *INVENTORY OF CHEMICALS & WASTES*

Eraring Energy issued a 'Notice of Dangerous Goods on the Premises' on 12 January 2012 that included details of dangerous goods held on site, figures indicating their locations and as dangerous goods and combustible materials manifest including photographs and description of each location/depot.

External audits of hazardous materials are understood to be undertaken every two years by an external consultant, and secondary containment and signage of dangerous goods has found to be suitable.

The dangerous goods notification indicated the presence of 35 above ground storage tanks (ASTs) ranging in volume from 1000L to 1.2ML, with the largest associated with the storage of distillate and fuel oil for start ups. The smaller ASTs were reported to store a range of liquids including:

- Liquid Carbon Dioxide (2 x 7000 L ASTs);
- Sodium Hydroxide (1 x1000 L, 1 x 6000 L, 2 x 115 000 L ASTs);
- Ferrous Chloride (2 x 30 000 L, 2 x 100 000 L ASTs);
- Sulphuric Acid (2 x 80 000 L, 1 x 13 000 L ASTs);
- Sodium Hypochlorite (1 x 9200 L, 1 x 10 000 L AST);
- Aqueous Ammonia (1 x60 000 L AST);
- Nitrogen Gas (1 x 200L AST);
- Fuel Farm Overflow (1 x 36 000 L AST);
- Diesel (4 x 6000 L, 1 x 10 450 L ASTs);
- Transformer Oil (4 x 25 000 L ASTs); and
- HPU Turbine Hydraulic Fluid (4 x 4500 L ASTs).

While not documented within the Site's dangerous goods and combustible materials manifest, two formerly operational but now decommissioned ASTs of an estimated 1.5 ML are located within the Former (Northern) Gas Turbine area of the site. It is understood these tanks are now empty, but historically contained fuel oil servicing the twin gas turbines that were operated using a combination of distillate and sump oil.

An additional four underground storage tanks (USTs) are also indicated on the current dangerous goods notification, containing diesel, petrol and combustibles. USTs are understood to be approximately 30 years old and of single steel wall construction. Based on previous investigations completed by Geo-Logix (2011a, b and c), details of the USTs currently present on site are summarised in *Table 4.1*.

Table 4.1 Summary of USTs present on site

Location	Capacity (litres)	Product	Status
Stores Building[1]	58,900	None currently, previously ULP	Previously used for refuelling site vehicles. Understood to have been decommissioned in-situ.
Stores Building[1]	33,500	None currently, previously diesel	Previously used for refuelling site vehicles. Understood to have been decommissioned in-situ.
Stores Building[1]	Unknown	LP	Temporarily decommissioned with rust inhibitor solution.
Unit 1 Turbine House[2]	20,000	Waste Oil	In use.
Unit 1 Turbine House[2]	50,000	Lubrication Oil	In use.
Vehicle and Mobile Plant Workshop[3]	4,500	Waste Oil	In use.

1. Geo-Logix (2011a).
2. Geo-Logix (2011b).
3. Geo-Logix (2011c).

Decommissioning reports were not available for any of the USTs abandoned in-situ, hence no further comments could be made regarding the suitability of the decommissioning works undertaken on the site. It is noted that under the Underground Petroleum Storage Systems (UPSS) Regulation 2008, USTs should be preferentially decommissioned by removal unless in-situ decommissioning can be adequately justified. Based on a review of the Geo-Logix (2011a) report, the diesel and ULP USTs previously used for refuelling on-site could not be decommissioned by removal due to the potential risk to subsurface services. Based on discussions with Eraring Energy personnel, it was understood that integrity tests have been completed on the main turbine refuse oil UST and the garage refuse oil storage that remain in use. Groundwater sampling is proposed for the existing monitoring wells currently surrounding the USTs. Additional, grid based sampling has also been designated for areas surrounding the stores building, Unit 1 turbine house and the workshop (refer to *Section 8*).

Polychlorinated Biphenyls (PCBs) have historically been widely used throughout the transmission network in transformers, capacitors and light fittings at the Site. Eraring Energy has a procedure for the use, handling and disposal of PCBs, and a PCB removal program was undertaken during the late 1990s. Equipment containing PCBs was recorded in a PCB register to facilitate management phase out and disposal, which indicates that there are currently twelve transformers with between 2.1 and 4 ppm of PCBs in transformer oil. Eraring Energy plans to manage the transformers with these low level PCBs through appropriate disposal at the end of the equipment's life. Based on discussions with the Eraring Energy environmental team, PCBs on site were stored within the transformers and no other separate, storage area was used.

Scheduled and non-scheduled PCBs that were identified were reported by Eraring Energy to be managed via disposal at an appropriately licenced, off-site facility. Historic handling, disposal and operational loss of PCBs may have resulted in soil and groundwater contamination.

Eraring Energy has developed an asbestos register that identified the location, condition and management of known asbestos at Eraring Power Station (Version 3, dated June 2011). This register is presented as *Annex G* of this report. Based on a review of the asbestos register, the presence of asbestos containing material on site can be summarised as follows:

- Gaskets and stop valves associated with pipeworks and cylinders at the turbine and associated plant;
- Cell diaphragms in the hydrogen plant;
- Asbestos containing waste water from the air removal pumps at the turbine;
- Gaskets associated with the boiler;
- Electrical insulation material at switchboards, transformers, rotors and stators across the site;
- In brake linings;
- Asbestos containing sealing gaskets at the bulk caustic and acid tanks;
- Bonded asbestos cement pipework associated with the contaminated water system;
- Bonded asbestos cement pipework associate with ash, duct and slurry management;
- The toe drain foundation of the Ash Dam contain asbestos;
- Asbestos sheeting used in the construction of residential houses; and
- The northern and southern asbestos disposal areas (refer to *Section 4.5*).

The asbestos containing material identified in the register were generally considered to pose a low to negligible exposure risk. The register also identified inspection and management strategies for the asbestos material identified.

Due to the presence of asbestos in building materials and equipment there is the potential for asbestos to have resulted in soil contamination. Given the asbestos pipework associated with the ash, dust and contaminated water treatment systems, there was potential for asbestos fibres to be associated with material in the Ash Dam as well as waste water and stormwater drainage.

4.3 PRODUCT SPILL AND LOSS HISTORY & OTHER DISCHARGES

Eraring Energy has implemented an Incident Management Procedure as part of its EMS, which sets out the requirements for the management and reporting of environmental incidents and complaints. Reportable incidents are documented in EPL Annual Returns. A summary of non-conformances available in the data room is provided below:

- October 2011 – 2B Generator Failure and Fire: A failure of the 2B Generator Transformer resulted in a rupture of the transformer casing and fire. As a consequence, an unknown volume of transformer oil was released on-site. The application of water during fire fighting resulted in a quantity of oil being washed into drains and into the outlet canal, and subsequently quantities of oil were visible in Lake Macquarie following the incident. A slight oil sheen was observed on the shoreline of local communities in the Silver Water and Sunshine areas (refer also to *Section 4.6.2*).

- December 2011 – Oil Release to Stormwater: Following fire protection deluge tests, oil was observed in a stormwater drain leading to the outlet canal (refer also to *Section 4.6.2*).

- December 2011 – Ferrous Chloride Release to Outlet Canal: Several hundred litres of ferrous chloride was discharged to the outlet canal following the return to service of the 4A condenser. Monitoring of Myuna Bay did not report any impacts (refer also to *Section 4.6.2*).

- January 2012 – Minor Contaminated Water Leaks: Reported into the stormwater at contaminated water pit 2. The pump was stopped and the coupling repaired.

- January 2012 – Discharge at Outlet Canal: Approximately 500 litres of ferrous chloride solution was discharged at the outlet canal, due to Unit 4 being out of service.

- February 2012 – A Leaking Fly Ash Pipeline: A fly ash reject pipeline to the coal combustion plant was leaking on the western side of the Hill Road Bridge. The pipe was repaired and realigned, with longer term plans to replace the pipe. No environmental harm was reported for this incident.

- February 2012 – Oil Leak: An undisclosed amount of oil was reported as having leaked from the temporary transfer lines connecting contaminatied pit 1 to contaminated pit 2. The spill was cleaned up and no environmental harm was reported.

- February 2012 – Foam Discharged to Lake Macquarie: Foam was reported as having discharged from the power station outlet canal to Lake Macquarie, because pump B had been switched off for no apparent reason. The pump was restarted and no environmental harm was reported as a result of this incident.

- March 2012 – Minor Oil Spill at the Warehouse: A minor oil spill (less than one litre) occurred when a pall filter was delivered to the warehouse. The spill was contained and cleaned.

- March 2012 – Hydraulic Hose Failing: A hydraulic hose failed on the back of an oil truck causing an oil leak approximately 0.6 to 1.0 km long. The oil spill was contained and cleaned with oil sorb equipment.

- March 2012 – Operation of Diesel Generator Cooling Towers: Foam built up in the tower basin and spilt into surrounding areas when the diesel generator cooling towers were put into service. The spill was contained with a chemical spill kit.

- March 2012 – Ferrous Chloride Spill: A ferrous chloride bulk storage spill occurred during delivery by bulk tanker. Product was noticed coming from the overflow line of Tank A. Unloading ceased when the spill was noticed.

- April 2012 - Overflow from Drainage Testing: Overflow occurred during deluge testing into stormwater drains. No environmental harm was reported.

- June 2012 – Foam Observed at Outlet Canal: Foam was reported at the cooling water outlet canal in Myuna Bay. The antifoam flow was restored and the issue resolved.

- June 2012 – Oil Slick on Canal Road: An oil slick from a vehicle was found adjacent to a stormwater drain on Canal Road. Absorbant matting was applied to spill as part of clean up efforts.

- July 2012 –Chemical Waste Leak: Reported for the pipework leading from the polisher regeneration plant to the ask dam. The discharge occurred to the stormwater drain behind the Daywork Maintenance workshop.

- August 2012 – Oil Leak at Ash Plant: Approximately 100L of oil was reported in the ash plant. The leak was isolated and repaired and no further environmental harm was reported.

- August 2012 – Coal Combustion Silo Overflow: A coal combustion product silo overflow was reported, with dry dust spilling onto the bunded floor below. The dust sprayed with water to prevent airborne dust escaping and then removed using a vaccuum truck.

- September 2012 – Oil Release: Approximately 300L of oil was released due to a flange failure on the 4A auxiliary cooling pump, with some oil reaching the low level cooling water canal. No observable oil was found upon inspection of the outfall.

- September 2012 – Overfilling and Oil Release from Refuse Tank: The failure of the number four generating unit resulted in the overfilling of the refuse oil tank, with oil being emitted from the tank vent. Approximately 200L of oil was lost to the surrounding concrete surface external to the bunded area. Some oil reached the stormwater drains, however inspection of the outlet canal, lake and foreshore found no evidence of oil.

- October 2012 – Ferrous Chloride Release to Outlet Canal: Approximately 500L of ferrous chloride was released to the outlet canal following the return to service of Unit 3.

- October 2012 – Hydraulic System Leak: The unit 3 hydraulic system was found to have been continually leaking onto the basement floor outside the bunded area. The leak was repaired and visual spills was cleaned.

- October 2012 – Overflow of the Hazardous Disposal Area: The hazardous disposal area was reported to be overflowing with waste substances being stored outside the bunded area.

Based on a review of the recordable incidents outlined above, the issues were generally managed immediately (i.e. cleaned up), and ongoing management measures were not implemented. A combination of targeted as well as a 50 metre, grid-based sampling approach was proposed for the operational area of the site. It is envisioned that this would suitably characterise the operational area, as well as any significant contamination hot spots that may have resulted from past spills and loss. Sediment and surface water sampling is also proposed for Lake Macquarie, Whiteheads Lagoon the Return Water Pond and Crooked Creek, to assess for off-site migration of contaminants.

4.4 FUEL MANAGEMENT

Eraring Power Station uses light fuel oil for its boiler auxiliary fuel requirements but is also able to use refined recycled oil. The main consumption of oil is for:

- Lighting of burners when starting up the boilers;

- Warming and initial steam raising in the boiler during start-up;

- Additional capacity;

- Supporting combustion at low load and/or when coal quality dictates; and

- Mill changes.

The fuel oil installation for Eraring Power Station known as Depots 23 to 26 (Fuel Oil Tanks #1 to #4) are 1,200,000 L steel ASTs used for the storage of diesel (Depot 23) and Fuel Oil (Depots 24, 25 and 26). Fuel stored within these ASTs is delivered to the Site via road tanker. These depots supply fuel oil via

an above ground 300mm (estimated) diameter pipeline to the Gas Turbine, the bulldozer refuelling station, the two 6000L ASTs for the diesel generators (depots: H7 & H8) and the two 6000L ASTs for the fire pumps (depots: H9 & H10). Each of the four tanks are individually bunded with drainage from the bund draining to one of two oil/water separators. Tank levels are checked weekly and reconciled against delivery and usage records. No other information regarding potential fuel loss was available in the form of fuel reconciliation assessments or the results of formal integrity testing.

A summary of ASTs located within the site, including content and volume is supplied within *Section 4.2*. A summary of USTs located within the site, including construction, content and volume is supplied within *Section 4.2*.

4.5 WASTE AND ASH DISPOSAL

The *Eraring Power Station Waste Register* classifies wastes produced onsite and details storage and disposal requirements. Veolia is the licenced contractor that undertakes waste, liquid waste and recycling management at the site. Suitably licenced contractors are used to remove and dispose hazardous waste off site. A breakdown of waste produced at Eraring Power Station from 2010/2011 includes:

- 1 296 041 tonnes of ash;
- 16 182 tonnes of vegetation and construction material waste; and
- 4 tonnes of oily rags and filters.

It should be noted that based on discussions with Eraring Energy environmental personnel, these oily rags were unlikely to have come in contact with transformer oil, hence the oily rags were likely to have been from general maintenance activities.

Historically refuse was dumped onsite. A review of site drawings and visual confirmation during the Site visit indicates a capped general waste dump is located to the western edge of the ash dam. Firm historic information regarding this facility is unavailable however it is suggested in previous reports by Worley Parsons (2013) that the area may contain scrap metal, builders waste and construction waste and empty drums. Most waste is currently removed from site by Veolia. Waste currently stored onsite include crushed concrete, wood, cardboard, and seaweed collected from the inlet screens, which is used for rehabilitation surrounding the Ash Dam. An historic sewage disposal event has been recorded, which is not permitted in the EPL. Based on discussions with Eraring Energy environmental personnel, diposal of drums (or similar) containing chemicals was not undertaken at the site.

Asbestos disposal has been reported in two designated landfill areas adjacent to the Ash Dam, as described below:

- Northern Asbestos Disposal – Located west of the Ash Dam. Based on a review of a Pacific Power site drawing (dated 2000; Dataroom reference 10.01.03.01.02), this disposal site was closed in 1997 and was bound by a gate and fence which carried identification and signage of the former disposal site. This area was understood to be capped and vegetated.

- Southern Asbetos Disposal – Located south west of the Ash Dam, immediately north of an internal access road. Based on a review of a Pacific Power site drawing (dated 2000; Dataroom reference 10.01.03.01.02), this disposal site was closed and had been capped with used fabric filter bags. The former disposal site was identified by four corner posts and warning sites. A review of an Eraring Energy site drawing (dated 2005; Dataroom reference 10.01.03.01.01) indicated that the southern disposal area covered a total area of approximately 6330 m^2, and was comprised of 19 trenches which had likely been progressively filled from 1987 to 2005.

Due to the general waste disposal surrounding the southern asbestos disposal area, and the capping of this areas with filter bags, sixteen sampling lcoations were proposed for this area to better delineate any known sources and contaminants present in this area. Given that the contents of the northern asbestos disposal area were perceived as being consistent, with clear fencing around the boundary, one down gradient groundwater monitoring well has been proposed for this area to characterise any potential migration of contaminants (refer to *Section 8*).

Ash is currently not deposited on these areas however would receive ash as the dam nears capacity. A capped general waste dump is also located to the western edge of the ash dam. The disposal of such products is permitted under the EPL 1429. Asbestos waste is now removed from the site by a licenced contractor and taken to Lake Macquarie City Council's Awaba Tip. An asbestos register for the site has been created that lists the location, condition and management of known site asbestos.

The Ash Dam is located on the northeast side of the facilities' footprint. Inputs into the dam include ash slurry, water from Boomerang Pond (dirty water), rainfall, and runoff. Underground mine water is also discharged into the dam from the neighbouring Awaba mine to the north of the site. During periods of extended rain, overflow from the oil retention lagoon enters the dam. A Selenium Pollution Reduction Program was completed in 2005, which involved diversion of rain water into the dam, and hence also minimised discharge from the dam and which also involved capping and revegetating more than 60 hectares of the Ash Dam. As a result of the program, selenium discharges from the dam were reduced by approximately 45% to approximately 150 kilograms per year.

Approval to upgrade and expand the CCP was obtained in 2008. Ash was previously pumped into the dam at a ratio of approximately 30:70 solids to water. A dryer product is now pumped into the dam at a ratio of approximately 70:30 solids to water. Flyash placed into the ash dams is recycled at an adjacent plant operated by Flyash Australia. It is used in construction as a cement substitute. Boral also operates a facility to mine and recycle bottom ash (from coal combustion processes) which is used in various industries. A goal of 80% reuse by 2015 has been set as part of the dam's long-term strategy. Current reuse rates are approximately 47%. The capacity of the ash dam is forecast to be reached by 2032 if recycling targets can be met.

Monthly groundwater monitoring undertaken by Aurecon identified elevated levels of selenium in groundwater down gradient of the CCP since January 2012 peaking at 0.0402 mg/L in February 2012. Results are in excess of ANZECC 95% protection levels for freshwater (0.011 mg/L). No EPL specific limits are given for groundwater analytes.

4.6 WATER AND WASTEWATER MANAGEMENT

4.6.1 Water Supply

Cooling water is taken directly from Lake Macquarie, which is Australia's largest coastal lake. Water enters the inlet canal in Bonnells Bay and piped below Dora Creek towards the generators.

The site is connected to the town water supply, while also utilising wastewater that is treated onsite. This water is sourced from both internal sources and external sources including the Myuna Bay Sport and Recreation Facility and Hunter Water's Dora Creek Wastewater Treatment Works.

Approximately 3.5 ML of non-potable water is recycled per day. Recycled water is used for fire servicing, plant washing, or further demineralisation to make suitable for use in the Power Station boilers.

4.6.2 Water Discharges And Treatment

A Surface Water Management Plan has been developed for the site (AECOM, 2008) that guidelines for the management of surface water across the site. This plan is summarised in *Section 5.1*.

The key legislative requirement for water management at Eraring Power Station is the EPL (1429) which requires monitoring of: water discharges; ambient water quality in Lake Macquarie; and water discharge from the CCP to the 'Glory Hole' (then outlet canal). Section 5 and 9 of the EPL also list water management requirements and cooling water discharges.

No non-compliances were recorded between 2009 and 2011. Four water related non-compliances were recorded during the 2011/2012 reporting period. Of these four, three were related to major incidents including:

- The failure of 2B Generator transformer in October 2011;
- An oil spill resulting from fire protection deluge tests in December 2011; and
- The discharge of ferrous chloride to the outlet canal in December 2011.

These incidents were documented as environmental incidents (as discussed previously in *Section 4.3*) and investigated accordingly. The other non-compliance was the exceedance of the EPL limit for Copper at the outlet canal. This was caused by errors in sampling and analysis at trace levels (Worley Parsons, 2013). Other recent reported incidents include:

- Failure of the 4A auxiliary cooling water pump resulting in 300 L of oil was lost due to pipe flange failure (2 September 2012). A small amount of oil entered the cooling water canal;
- The failure of a generating unit causing allowing water to enter the refuse oil tank causing overfilling and emitting oil from the tank vent; and
- The return to service of unit three causing the release of 500 L of ferrous chloride to the outlet canal.

Laboratory analytical data for surface and groundwater sampling undertaken between 2006 and 2013 was made available to ERM during the course of this investigation. This data was compared against the EPL limits, ANZECC (2000) ecological criteria and the Australian Drinking Water guidelines. A summary of the exceedences reported for this review is included in *Section 5.1.1*.

Cooling Water System Discharges

Cooling water is returned to Lake Macquarie via the outlet canal in Myuna Bay. The water is generally limited to temperatures below 35°C, as stated in the EPL. Water may be discharged at temperatures up to 37.5°C for 131 hours over the annual reporting period. These hours were not used during 2012, which has been linked to reduced demands and outages from unit upgrades and the construction of the attemperation reservoir. Ambient water monitoring has shown that temperature variation at the discharge point is consistent with natural variations within Lake Macquarie.

Ash Dam Water System Discharges

A toe drain collects seepage from the dam, which is recirculated, back into the dam. Emergency discharge of the Ash dam water enters Crooked Creek at EPL Discharge Point 17 via a weir. Under non-emergency conditions, water levels in the Ash Dam are controlled using water from the outlet canal. Water is pumped via the Outlet Canal Make up Pump if the Ash Dam becomes too dry resulting in dust. Water from the Ash Dam is pumped into the Glory Hole and into the outlet canal if the water level of the Ash Dam becomes too high. The water is filtered to remove cenospheres using floating booms in three underflow weirs. A vacuum truck is used to remove the cenospheres.

4.6.3 Stormwater and Contaminated Water System

A stormwater system for the site exists which is separated from the site's contaminated water systems. A clean water diversion surrounds the Ash Dam to minimise the amount of rain water from entering the area and hence to minimise the amount of ash dam water discharging to Lake Macquarie. A catchment to the north of the site ("*No Name Creek Catchment*") enters the site at the coal loading facility and is diverted to a wetland via the Muddy Lake Settling Pond, which contains an oil detector with an automatic alarm.

A Demineralisation Plant and Reclaimed Water System are located adjacent to the Glory Hole which are bunded and alarmed. Minor incidents have occurred in the past which have resulted in uncontained discharges in this area.

A Contaminated Water Briefing Paper was prepared by Ring (2004) that outlines the treatment process and system issues. This report indicates that the contaminated water drains that are serviced by this system are located in all areas where drainage has the potential to be contaminated with oil. These drains are gravity fed to four contaminated water pits. System issues identified in this report include:

- Coal fines and fly ash are present in the system which traps oil and forms a sludge that accumulates in the oil water separator and impedes its performance;

- There is no formal process for disposing contaminated sludge. The sludge is dried out and then stockpiled on unsealed hardstand adjacent to the truckwash bays. Based on the findings of this briefing paper this dried sludge is ultimately buried on site, however based on discussions with Eraring Energy environmental personnel this material is ultimately disposed off-site at a licenced facility. Given the elevated hydrocarbons concentrations generally associated with this sludge, the stockpiling activities were identified as a potential point source of contamination, and a potential breach of licencing conditions;

- The amount of oil currently received by the drainage system exceeds the limitations of the original design specifications, and carry over from the oil water separator to the retention lagoon has been observed from time to time. These conditions can potentially increase the likelihood of oil discharge from this system;

- The structural integrity of the contaminated water tanks was described as poor, however the report suggests imminent repair or replacement of the tanks;

- Bunding associated with the oil water separator system were observed to be in poor condition, providing inadequate containment; and

- The process for disposing waste oils is unclear, increasing the potential for spills and the potential for oil to reach the stormwater system.

No further recommendations or details of potential system upgrades are provided in this report.

An audit undertaken by AECOM (2011) recommended that *"the clean and contaminated water circuits at Eraring are confusing with respect to location, drainage and flow. A full site revision is required."* Works to address this recommendation are reported to be still being scoped and implemented. Corroded pipes in the stormwater system were identified and repaired in November 2012. Works to repair a pump and level controls at the Muddy Lake contaminated water inlet seepage weir and pump were commenced in November 2011. Further upgrades are planned for 2013 including the installation of hydrocarbon, acid and alkalis detection systems, including shut-off valves (Civil Budget, Projects and Asset Management, November 2012) and bunding improvements. Other future projects include chemical sewerage plant upgrade, civil stormwater improvements long Canal Road, oil trap facilities at stormwater outlets and modifications to reduce the overflow of contaminated water.

An audit undertaken by AECOM (2011) reported that oil had been recorded on the surface of the treated water lagoon (final settling pond), and recommendations were made to remove this oil when observed. This audit also recommended more proactive action for overflowing bunding in the drum storage area. Oil was also reported for the stormwater drain behind the water reclamation plant.

Based on subsequent discussions with Eraring Energy environmental personnel, the contaminated water treatment system was recently subject to a multi-million dollar upgrade, which included improvement works to the contaminated water pits, pumping system, bypass lines, expansion of the oil and water separator system and upgrade of the retention ponds. It was understood that these works were completed in 2011 (approximately). Upgrade of the stormwater system is also currently in progress. It is anticipated that the combined targeted and grid-based sampling approach, as

well as sediment and surface water sampling in Lake Macquarie, Whiteheads Lagoon, the Return Water Pond, drainage channels flowing toward Lake Eraring and Crooked Creek will be sufficient to characterise any significant impact associated with historic and current operation of this system.

4.6.4 Sewage

The site treats effluent sourced from both internal sources and external sources including the Myuna Bay Sport and Recreation Facility and Hunter Waters Dora Creek Wastewater Treatment Works. Wastewater from the Myuna Bay Sport and Recreation Facility enters the site via the Pasveer Channel and moves to the Effluent Holding Pond where it is combined with oily water from the Oil Retention Lagoon Transfer Pond. Micro filtration chlorination and reverse osmosis is undertaken in the Reclamation Plant. Waste effluent is separated and directed through two sludge-settling ponds and treaded again. Concentrated salts are directed to the Ash Dam.

A soil testing program has been undertaken from audit recommendations (AECOM 2010, 2012) to identify whether the soil at the site's spray irrigation area had the capacity to absorb effluent and to assess the potential for off site migration of effluent contaminated soil or water. The investigation found that some metals were above site criteria. The soil bund to the north was effective in limiting offsite migration of the surface runoff.

4.6.5 Sediment

Regular surface water sampling has been undertaken by Eraring Energy at various locations surrounding within Lake Macquarie as part of their EPL (1429) requirements. With the exception of the oil sheen observed in Lake Macquarie following the 2B Generator failure in 2011, no documentation or other information provided by Eraring Energy employees was identified about major incidents that resulted in significant environmental issues from the outlet canal.

Experiments on the benthic bivalve *Anadara trapezia* (Sydney Cockle) indicated that Lake Macquarie had significantly higher concentrations of trace metals in its sediment than compared to other NSW estuarine systems. Elevated metals concentrations above background levels were attributable to the Site, in particular selenium concentratioms at Whiteheads Lagoon which were associated with the overflow channel from the ash dam (Burt et. al., 2006). Selenium, cadmium, copper, and zinc concentrations were measured in tissue samples collected from mullet (*Mugil cephalus*) at the southern basin of Lake Macquarie. Selenium, cadmium, and copper in Lake Macquarie mullet tissue were considered elevated when compared to those in mullet collected from the Clyde River estuary, a relatively pristine location. Furthermore, selenium concentrations in mullet are above recommended acceptable limits for safe human consumption (Kirby et. al., 2001). Elevated concentrations of cadmium and selenium were also detected in the muscle and gonad tissues of five

species collecgted in Whitehead's Lagoon in a separate study undertaken by Roach et. al. (2008).

Trace metals in surficial sediments were significantly more elevated than background concentrations (selenium 3–19 times background levels, cadmium 14–42 times background, copper 1.5–3.6 times background, and zinc 0.77–2.2 times background). Selenium concentrations in surficial sediments were expected to be related to fly ash from the power station, whilst the remaining heavy metal concentrations were likely from power generation activities as well as urban and sewage inputs (Kirby et. al., 2001, Lake Macquarie City Council, 1995).

A study undertaken by Batley (1987) also identified increased copper concentrations in waters and sediments from Lake Macquarie, attributable to fly ash. However, elevated concentrations of zinc, lead, cadmium and copper detected in surface sediments and waters from the northern end of the lake were attributable to discharges from the (former) lead-zinc smelter on Cockle Creek (Batley, 1987). A study completed by Carroll (1995) revealed considerably lower concentrations of selenium that were consistent with reported reductions of selenium discharged into the lake from the lead-zinc smelter. The study found that 44% of selenium in surficial sediments from the lake is associated with sediment phases in which selenium has the potential to become remobilized and hence possibly bioavailable. The investigation also acknowledges that overflow from ash dams as well as atmospheric deposition of fly ash from their stacks, may also be potential contributors of heavy metals to the lake (Carroll, 1995).

Based on an Eraring Energy (2008) publication, prior to 1991, ash dam seepage was discharged directly into Crooked Creek and Whitehead's Lagoon resulting in elevated concentrations of selenium in the Lake Macquarie catchment. Whilst selenium is naturally occurring, at the time of the direct discharge levels of selenium in local fish was three times higher than average concentrations. Management of seepage water was subsequently altered so that water containing selenium is recirculated several times in a closed system as a slurry.

5 SITE CONTAMINATION HISTORY

The provision of a detailed account of the contamination history at the Eraring Power Station is limited based upon the absence of previously conducted environmental assessments into potential gross contamination issues at the Site. The current processes being undertaken upon the Site have not changed greatly since operation of the Site commenced in 1982. Therefore potential and actual areas of contamination can be assessed based upon current operations, in conjunction with chemical and waste inventory (*Section 4.2*), spill and incident information (*Section 4.3*), and a review of the limited soil and groundwater investigations completed to date (*Section 5.1*). Potential and actual soil and groundwater areas of concern are presented in *Section 6.1*.

The Eraring Power Station site does not appear on the Contaminated Land Management Record database managed by NSW EPA. It is also noted that Eraring Power Station has not been reported to NSW EPA under Section 60 of the CLM Act. One neighbouring site (the Myuna Colliery - located on Wangi Point Road to the south east of the Site) has been reported to NSW EPA. Given the location of this site relative to Eraring Power Station and anticipated groundwater flow direction, it is not expected that this site would present a significant risk of contaminant migration onto the Site.

5.1 SITE MANAGEMENT PLANS

Groundwater Management Plan – Coal Combustion Product Management Facility, Eraring Power Station, Rocky Point Road, Eraring. (AECOM, 2009)

A Groundwater Management Plan (GMP) was developed as part of the project approval for the upgrade of the Coal Combustion Product (CCP) Facility by ENSR Australia Pty Limited (AECOM). It was developed for the ongoing management of the groundwater that is potentially affected by the CCP Facility, with the primary objective being the protection and maintenance of groundwater quality in the catchment of the CCP Facility. The site's EPL does not have any requirements to monitor groundwater, however it is understood that the Development Consent conditions for the CCP include the requirement of an ongoing groundwater monitoring program.

The upgrade involved an increase in the capacity of the CCP Facility and the introduction of a more concentrated CCP mix of 70% CCP and 30% water (dense phase), as compared to the original CCP mix of 30% CCP and 70% water (lean phase).

Based on a review of available information, AECOM recommended the following for the revised GMP. The inclusion of monitoring wells GM/D1, GM/D2, D26, D29, MW01, MW02, MW03, MW05 and MW06 for future monitoring events. Heavy metals (arsenic, cadmium, chromium, copper, selenium, lead and zinc), total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), Sulphide, chloride and fluoride should be monitored biannually. Cations (calcium, magnesium, sodium, potassium), boron, manganese, alkalinity, pH, conductivity, temperature, total dissolved solids, nitrate, phosphorus and anion/cation balance should be monitored quarterly. Monitoring for iron is no longer necessary as the concentrations have remained generally consistent and naturally occurring. Based on a review of the most recent round of monitoring data made available to ERM (data from the 2011 monitoring rounds), whilst most of these measures appear to have been implemented, the additional sampling locations were not incorporated into the program.

A representative of Eraring Energy stated that one groundwater monitoring location was upstream of the ash dam. This location and information regarding the quality of the groundwater was unable to be located at this reported point.

Groundwater Management Plan – Attemperation Reservoir, Eraring Power Station, Rocky Point Road, Eraring (AECOM, 2009)

The GMP was developed as part of the project approval process for the construction of the Attemperation Reservoir (AR) facility, and sought to produce a program for the protection and maintenance of groundwater quality in the catchment of the facility. It was understood that the site's EPL does not have any requirements to monitor groundwater however it is understood that the Development Consent conditions for the Attemperation Reservoir include the requirement of an ongoing groundwater monitoring program.

The design of the AR Facility required that it not intercept the underlying groundwater and that it be lined with at least 0.75 m of clay (or an equivalent lining). All seepage was to be collected by the piped underdrainage system , and must be returned to either the reservoir or the salt water intake canal, and not directly to the environment. The operation of the AR Facility was therefore not expected to adversely impact the groundwater beneath the site.

The scope of works included a review of the groundwater monitoring regime prior to construction and commissioning of the AR Facility. The conceptual hydrogeological model for the investigation anticipated groundwater to flow to the south southeast, towards Lake Macquarie. The five monitoring wells were assessed for adequacy. AECOM concluded that the location of the wells (GW1-GW5) were adequate for monitoring groundwater conditions at the AR Facility and provide reasonable coverage. No monitoring wells located further down gradient from the AR Facility (toward Myuna Bay, which is considered to be a potential receptor) were currently included in the monitoring program.

AECOM stated that this is not considered to be a significant issue as GW3 to GW5 are located on the down gradient side of the AR Facility. It was recommended that additional down gradient wells may need to be added to the monitoring well network if in future these wells are found to be impacted.

The five groundwater sampling locations are monitored monthly. A number of analytes have been sampled for including dissolved metals, unfiltered metals, PAHs, TPH/BTEX and Phenolic Compound Surrogates. Analisis was undertaken by ALS. Eleven one page reports were made available for review, dated between January 2010 and September 2012.

Based on review of the available data, the recommendation for the future groundwater monitoring program for the wells in the vicinity of the AR Facility catchment (GW1 to GW5) involved six monthly monitoring for pH, conductivity, temperature, standing water level (SWL), total dissolved solids (TDS), chloride, fluoride, sulfate, alkalinity, major ions, boron, metals (arsenic, cadmium, chromium, copper, selenium, manganese, iron, lead, mercury and zinc), total anions, total cations, nitrate, nitrite, phosphorus. Analysis of polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPH) was also recommended following 12 months of operation of the attemperation reservoir, to confirm that ongoing analysis for these potential contaminants of concern is not required. Due to naturally elevated background concentrations of several parameters, historical data and background concentrations were considered a more appropriate gauge of elevated concentrations than comparing data to the guidline values provided by ANZECC (2000).

Surface Water Management Plan, Eraring Energy Lands, Eraring Power Station, NSW. (AECOM, 2008)

The surface water management plan (SWMP) was developed to identify and provide guidelines for the management of surface water across Eraring owned lands. The primary objective of the SWVP is to protect clean waterways and improve the management of used waterways resulting from site activities, and is guided by the requirements of the Environmental Protection Licence (EPL) 1429.

Surface water has been identified and divided into two groups, clean water and used water. Routine water monitoring is conducted to satisfy the requirements of the EPL at sites both within the Power stations boundaries and around Lake Macquarie and Whiteheads Lagoon.

The surface water monitoring protocol is shown in Table 3 of the document and outlines what analytes are tested, and how often they are tested at each sampling point.

5.1.1 Qualitative Assessment of Monitoring Data

Historical monitoring data was made available to ERM by Eraring Energy environmental personnel for review as part of the Preliminary ESA. The following monitoring data was reviewed as part of this investigation:

- Groundwater monitoring wells GW1 to GW5 surrounding the Attemperation Reservoir, with data from between August 2009 to March 2013.

- Groundwater monitoring wells GM/D1, GM/D2, D26, D29, MW01, MW02, MW03, MW05 and MW06 surrounding the CCP facility, with data from between January 2010 to December 2011.

- Surface water monitoring at various locations across the site, with data from between January 2006 to April 2013.

Baseline levels were not available for review for either location hence the data could not be compared against background concentrations, which were understood to be naturally elevated. Based on a visual, qualitative assessment of the data against the ANZECC ecological screening criteria (which were more conservative than the recreational and protection of 95% of marine ecosystem criteria), relevant criteria presented in the Australia Drinking Water guidelines, and acceptance criteria presented in the EPL, the following trends were noted. A summary of the exceedences observed as part of the review are also presented in *Annex D*.

- Elevated concentrations of copper, lead and zinc exceeding the ANZECC criteria were commonly observed immediately surrounding the Attemperation Reservoir. Lead and arsenic concentrations also exceeded the Australia Drinking Water criteria.

- Elevated concentrations of copper, lead and zinc exceeding the ANZECC criteria were commonly observed immediately surrounding the CCP. Lead and arsenic concentrations also exceeded the Australia Drinking Water criteria.

- Concentrations of suspended solids and selenium regularly exceeded the EPL acceptance limit at surface sampling locations, particularly at the Ash Dam toe drain sampling location, at the Ash Dam return canal sampling location and at the utilisation area sampling point adjacent to the sewerage treatment works. Selenium concentrations also commonly exceeded the adopted ANZECC criteria and the Australia Drinking Water guideline value, however it is noted that concentrations of selenium decreased from 2006 to 2013.

5.2 *PREVIOUS ENVIRONMENTAL INVESTIGATIONS*

The Eraring Power Station has undergone a limited amount of intrusive soil and groundwater assessments to date as set out below. No comprehensive or systematic assessment of Site conditions has been undertaken, with works generally completed to achieve compliance with underground petroleum storage system (UPSS) legislation, or the Land Management Plan employed at the site (targeting the Attemperation Reservoir and CCP Management Facility). The following section summarises the relevant reports reviewed by ERM. *Contamination Investigation Report – Stores Building UPSS (Geo-Logix, August 2011)*

An investigation of soil and groundwater conditions surrounding the UPSS adjacent to the Stores Building at Eraring Power Station was undertaken in March 2011. The objective of the investigation was to assess the contamination status of soil and groundwater surrounding the UPSS and determine the appropriate method of decommissioning the UPSS infrastructure. The UPSS comprised three USTs and associated delivery piping and two dispensers. Two USTs (58 000 L unleaded petrol (ULP) and 33 500 L diesel) were being used for the storage of fuel for Eraring Energy work vehicles at the time of the investigation. A leaded petrol (LP) UST of unknown size was understood to have been temporarily decommissioned by filling with rust inhibitor solution. The USTs were located to the west of the Stores Building.

Investigation of soils surrounding the USTs via the advancement of four test pits to a maximum depth of 2.5 m below ground level (bgl) identified petroleum contamination to UST backfill sands. Based on results of the investigation and limitations encountered due to site geology, further investigation was completed in May 2011. The scope of work comprised the drilling of six additional soil borings surrounding the USTs, installation of four groundwater monitoring wells (screened between 7.5 and 10 m bgl) and collection and laboratory analysis of soil and groundwater samples for contaminants of potential concern comprising petroleum hydrocarbons, polycyclic aromatic hydrocarbons and heavy metals.

Petroleum hydrocarbons were detected at concentrations greater than the assessment criteria in shallow soil in the immediate vicinity of the dispensers. The impact was considered likely to be limited in extent, however it is noted that deeper samples were not analysed at locations where shallow soil impact was detected. Elevated concentrations of petroleum hydrocarbons were detected in groundwater immediately down-gradient of the USTs. Groundwater was calculated to be flowing to the southeast beneath the office space in the Stores Building and towards a manmade outfall canal, south of the Stores Building.

In order to assess the potential for contaminated groundwater to discharge into the canal two additional wells were installed downgradient of the USTs. Petroleum was not detected in the two wells. The potential for intrusion of volatile vapours emanating from groundwater into overlying office space of the stores building was assessed through the installation and sampling of four shallow soil vapour wells. Petroleum related compounds were not detected in soil gas.

Based on the results of the investigation and limitation of UST removal by high risk subsurface infrastructure, the report concluded the USTs are suitable for in-situ decommissioning as current conditions are not presenting a risk to human health or the environment. The conclusions drawn were subject to ongoing monitoring requirements to ensure conditions are not worsening over time, including semi annual groundwater sampling for a period of two years, and sampling of soil vapour wells in the event an increasing trend was established to assess vapour intrusion pathway. Additional monitoring data was not available for groundwater monitoring wells installed in the vicinity of the Stores Building UPSS, hence current groundwater conditions and the potential presence of ongoing impact could not be verified.

Groundwater Monitoring Well Installation Report – Unit 1 Turbine House Basement (Geo-Logix, August 2011)

This investigation involved the installation of three wells surrounding the UPSS, in the Unit 1 Turbine House basement. The UPSS infrastructure targeted as part of this investigation was identified as a 20,000 litre waste oil UST and a 50,000 litre lubrication oil UST.

Four monitoring wells (EPSMW8 to EPSMW11) were advanced to between 4.1 metres below ground level (mbgl) and 9.0 mbgl. Standing water levels were recorded between 2.918 and 4.173 mbgl. Phase Separated Hydrocarbon (PSH) was not detected at any of the locations, however it is noted that the monitoring wells generally did not screen across the water table. An organic odour was recorded during groundwater sampling at EPSMW11, however no other visual or olfactory evidence of impact was recorded for the field work.

A review of the analytical data concluded that concentrations of petroleum hydrocarbons and polycyclic aromatic hydrocarbons were not detected in soil or groundwater samples above the laboratory limit of reporting.

Groundwater Monitoring Well Installation Report - Vehicle and Mobile Plant Workshop (Geo-Logix, June 2011)

An investigation of soil and groundwater conditions surrounding the waste oil storage tank adjacent to the Vehicle and Mobile Plant Workshop on the north-western portion of the main power station area was undertaken in May 2011. The UPSS consisted of a 4500 L UST and associated delivery piping. The wells were installed in order to complete the groundwater monitoring well network at the site as per the requirements of the UPSS Regulation (2008).

Three groundwater monitoring wells (EPSMW1 to EPSMW3) were installed in the completed soil borings to depths between 4.5 and 5.0 metres below grade. Soil and groundwater samples collected from monitoring wells were analysed for contaminants of potential concern, comprising petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and dissolved heavy metals.

Petroleum hydrocarbons and polycyclic aromatic hydrocarbons were not detected at concentrations greater than the laboratory reporting limits in soil samples from all borings, or in groundwater samples from all monitoring wells. Dissolved metals were detected at concentrations greater than the assessment criteria in the groundwater sample taken from the monitoring well. The elevated concentrations were considered likely to be naturally occurring.

UPSS infrastructure adjacent to 23 000 L refuse oil UST

Based upon the observations of groundwater monitoring infrastructure made during the site visit, and interviews with site personnel, it is understood a report on UPSS infrastructure installed adjacent to 23,000L refuse oil UST (collects all lubricating oil drainage and refuse oil within the turbine building) was produced, but could not be located for review.

6 SUMMARY OF FINDINGS

Based upon a review of current and historic site operations, previously completed environmental assessments, and chemicals and wastes stored and/or disposed of on the Site, a number of actual and/or potential areas of environmental concern have been identified. The following sections provides an assessment of each of these areas.

6.1 AREAS OF ENVIRONMENTAL CONCERN

6.1.1 Coal Combustion Product (CCP) Management Facility (Ash Dam)

The CCP is approximately 150 ha in area and is located in the eastern portion of the Site (refer to *Figure 2*). Potentially contaminating activities for this AEC are associated with inputs to, and migration from, the CCP such as ash slurry, water and fines from the dirty water collection/treatment system, mine water from the adjacent Awaba Mine and overflows from the oil retention lagoon.

As discussed previously in *Section 5.1.1*, results of surface and groundwater monitoring in the vicinity of the CCP indicate that seepage from the CCP is saline and contains heavy metals which can be attributed to the nature of the ash material stored within the CCP. Given the nature of inputs to the CCP, seepage also has the potential to contain petroleum hydrocarbons. Seepage from the toe of the CCP is collected and recirculated back into the CCP. Identified receptors include underlying groundwater and Lake Macquarie.

Groundwater monitoring is undertaken in the area between the toe of the CCP and Lake Macquarie for a range of potential constituents of concern including heavy metals, total recoverable hydrocarbons, polycyclic aromatic hydrocarbons (including BTEX constituents) and phenols, with inferred groundwater flow direction from the CCP towards the Lake. Selenium concentrations in groundwater exceed the ANZECC 95% protection levels for freshwater. However, while some environmental assessment has been undertaken in this area, it is not considered that suitable characterisation of environmental conditions has been established, and further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions.

In addition to the issues associated with the inputs to discharge from the CCP, potential areas of concern are also located within the CCP related to the disposal of waste materials (other than fly ash), including;

- Asbestos Disposal Areas (Northern and Southern) - Prior to 1997 asbestos materials from the site were dumped in two areas within the CCP. These areas are understood to not have been used since 1997, since which time any asbestos materials have been disposed of off-site by licenced contractors. Both of the on-site disposal areas have been capped (non-engineered capping) and are marked with some signage. Sketches of the

locations were available however it does not appear that survey plans showing the extent of these disposal areas have been created, or that any physical marker layers or overarching asbestos management plans are in place.

- Filter Bag Disposal Area - The filter bag disposal area remains active and is located on top of the southern asbestos disposal area.

- General Waste Disposal Area near Ash Dam - A general waste area has been identified south west of the Ash Dam. The extent of the general waste disposal area could not be confirmed based a review of the information available during the current investigation. An assessment of the extent of the general waste disposal area will be undertaken as part of the Phase 2 scope of work.

The disposal of these waste materials, and lack of definition or delineation of the extent potential impact, add to the potential for material environmental issues in this area to exist, and require further assessment.

6.1.2 Transformer Area

The Transformer Area houses the main transformers for the Site and is located immediately west of the boiler and turbine units. In addition to the potentially contaminating activity of transformer operation, also located within this area are four current 25,000L ASTs and two decommissioned ASTs of similar size, used for the storage of transformer oil. It is also understood that while a PCB removal program was undertaken during the late 1990s, PCB oil was used extensively prior to this and currently used transforer oil in twelve transformers still contains low concentrations of PCBs.

While the transformers are now contained within new bund systems that drain to the water treatment system, there have been reports of transformers leaking and replacements have been undertaken over time. In addition to this, a failure of the 2B Generator Transformer and associated fire in 2011 resulted in the release of transformer oil to the surrounding environment. The use of fire fighting foam containing perfluorooctane sulfonate (PFOS) also represents a potentiual contaminant of concern for this area. These release events have the potential to impacts soils and groundwater beneath the Site.

There have been no soil and groundwater investigations completed within the Transformer Area to achieve an appropriate degree of environmental characterisation for the purposes of this assessment. Given the absence of previous environmental investigations, historic release events and the volume and content of transformer oils curremtly and historically contained within the area, further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions.

6.1.3 Coal Storage Area

The coal storage area is approximately 25 ha in size and is used for stockpiling of coal prior to being transferred via conveyor to the boilers. Potential contamination sources or activities include the refuelling of equipment (bulldozers) used to move coal around, and contaminated stormwater runoff from this area which is captured in the 'Dirty Water' collection/treatment system (known as the 'Boomerang' and 'Sausage' retention ponds). These retention ponds are lined with reclaimed, natural clays of low permeability. The retention ponds are also cleaned out on a regular basis and any fines collected are deposited in the CCP.

While there have been no soil and groundwater investigations completed within the Coal Storage Area, based upon the potential sources of contamination and low likelihood of receptor exposure, and that this area will continue to be used for coal storage, considered to be relatively low risk in the context of this assessment.

6.1.4 Fuel Oil Installation and Associated Pipeworks/ASTs

The Fuel Oil Installation comprises four 1,200,000L steel ASTs installed in the early 1980s, and used for the storage of diesel and fuel oil. These ASTs supply fuel oil via an above ground 300mm (estimated) diameter pipeline to the Gas Turbine, the bulldozer refuelling station, and various smaller ASTs across the Site. The volume of fuel being stored and transferred across the site represents a significant source of potential contamination.

Each of the four tanks are individually bunded with drainage from the bund draining to one of two oil/water separators. Tank levels are checked weekly and reconciled against delivery and usage records. However given the limitations of wet stock reconciliation when dealing with such large volumes, and that leaks from above ground piping have been reported, with a replacement program undertaken in 2010/2011, there is a potential for leaks to have caused the migration of contaminants to the underlying soil and groundwater.

There have been no soil and groundwater investigations completed in the area of the Fuel Oil Installation or adjacent to any of the associated pipeworks or site ASTs to achieve a suitable degree of environmental characterisation. Given the absence of previous environmental investigations, the age of infrastructure, volume of stored and transferred fuel, and the potential for historic release events to impact soil and groundwater receptors, further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions.

6.1.5 Operational and Decommissioned USTs

A total of six USTs are indicated as being present on site, which contain or have previously contained diesel, petrol and combustibles. USTs are understood to be approximately 30 years old and of single steel wall construction. Eraring Energy site personnel reported that USTs have either been decommissioned or that integrity tests have been completed on the main turbine refuse oil UST and the garage refuse oil storage that remain in use. Documentation was not available to confirm management advice.

Soil and groundwater investigations have been completed in the areas of below ground tank infrastructure to ensure compliance with relevant underground petroleum storage system (UPSS) legislation, and ensure protection of soil and groundwater receptors. During a previous investigation (Geo-Logix, 2011a) additional groundwater monitoring was recommended to assess ongoing trends for existing contamination detected in the vicinity of the UPSS infrastructure. It was understood that this sampling had not been undertaken. Documentation relevant to the decommissioning works was also not available, hence the suitability of the rememdiation works could not be confirmed. Based upon the environmental characterisation achieved, the USTs were considered to be relatively low risk in the context of this assessment. However, monitoring should be undertaken in the vicinity of the USTs, in particular the stores building, to delineate potential impact.

6.1.6 Attemperation Reservoir

The attemperation reservoir has the potential for seepage and off-site migration of saline water, however a number of groundwater monitirng wells have been installed around the reservoir to monitor conditions.

Based upon the environmental characterisation achieved to date, this area is considered to represent a relatively low risk in the context of this assessment.

6.1.7 Truck Wash-Out Pits

Truck wash-out pits located north of the Coal Storage Area and Fuel Oil Installation were observed to be in poor condition with build-up of oil and waste in the base of the pits. Waste water from these pits is transferred to the oil retention lagoon prior to transfer into the CCP. It was also understood that sludge from the contaminated water treatment system has been dried out and then stockpiled on unsealed hardstand adjacent to the truckwash bays (Ring, 2004), hence given the elevated hydrocarbon concentrations likely associated with this material there was potential for impact to surrounding soils due to these activities.

There had been no soil and groundwater invesitgations previously completed within the area of the Truck Wash-Out Pits. Oil and waste accumulated at the base of the pits, as well as stockpiling of sludge from the contaminated water treatment system on an area of unsealed hardstand adajacent to the pits, presents potential sources of contamination. Hence further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions in this area.

6.1.8 Workshops

Maintenance workshops are located throughout the Site, with two main workshops located to the east of the boiler and turbine units and in close proximity to the black start gas turbine. Other workshops are located adjacent to the north-east, and north west corner of the turbine building. In their current configuration and use appear to be managed well and have little potential to cause significant soil and/or groundwater impacts. Parts washing facilities were observed and all appeared to be in good order and are regularly serviced by third party contractors. It was discussed that previously (1980s and 1990s), potentially contaminating activities including the storage and use of TCE and other solvents for degreasing and parts washing was undertaken. Based on discussions with Eraring Energy environmental personnel, whilst TCE and other solvents were used in workshop areas, no further information was available regarding any other storage or disposal measures.

Historic spills and releases of solvents and the potential for inappropriate disposal have the potential to impacts soils and groundwater beneath the Site. There were no records available to demonstrate whether these solvents were disposed of appropriately, however it was indicated that it is unlikely they would have been disposed of to ground.

There have been no soil and groundwater investigations completed within the Workshop areas to achieve an appropriate degree of environmental characterisation for the purposes of this assessment. Given the absence of previous environmental investigations, and the known presence of chlorinated solvent use on site, further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions.

6.1.9 Former (Northern) Gas Turbine Location

The Former (Northern) Gas Turbine area, located in the north of the Site, is the historical location of twin gas turbines that were operated using a combination of distillate and fuel oil, with the fuel supplied from two 1.5ML ASTs (approximate). The area also includes four transformers (decommissioned) and one space for a former transformer is understood to have been removed due to leakage, oil water separators and an oil containment dam.

There have been no soil and groundwater investigations completed in the area of the Former (Northern) Gas Turbine, and limited information was avaiable with respect to tankage or former operations. Given the absence of previous environmental investigations, the age of infrastructure, volume of stored and transferred fuel, and the potential for historic release events to impact soil and groundwater receptors, further investigation would be required rule out potential material environmental issues associated with soil and groundwater conditions.

6.1.10 Sewage Treatment Works

The site treats effluent sourced from both internal sources and external sources, utilising an Effluent Holding Pond, and micro filtration chlorination and reverse osmosis which is undertaken in the Reclamation Plant. Waste effluent is separated and directed through two sludge-settling ponds and treated again, with concentrated salts directed to the CCP. A soil testing program has been undertaken from audit recommendations (AECOM 2010, 2012) to identify whether the soil at the site's spray irrigation area had the capacity to absorb effluent and whether this effluent contaminated soil or water left site. The investigation found that the some metals were above site criteria. The soil bund to the north was effective in limiting offsite migration of the surface runoff.

While there have been limited soil and groundwater investigations completed related to the Sewage Treatment Works, based upon the potential sources of contamination and low likelihood of receptor exposure, this area is considered to represent a relatively low risk in the context of this assessment.

6.1.11 Sediments in Lake Macquarie, Whiteheads Lagoon, Crooked Creek, the Return Water Pond and Drainage Channels

Current water monitoring does not indicate a significant potential for impacts within Lake Macquarie as a result of the warm water outfall.

Previous incidents have resulted in the loss of contaminants that have entered the Lake, and there is the potential for legacy issues related to historical operation of the Power Station (and potentially other off-site sources). Given the large cost associated with any clean-up or studies of sediments, an investigation is considered to be required to address this issue and assess whether potential material environmental issues exist. It is also considered that sediment sampling is more likely to provide an indication of potential off-site impacts potentially related to the Site than sampling of surface water. This is due to the significant dilution which is likely to occur when such large volumes of water pass through the outfall and also the potential for alternate sources of impacts to surface water.

It was understood that prior to 1991, ash dam seepage was discharged directly into Crooked Creek and Whitehead's Lagoon. It was further understood that emergency overflow can still be potential discharged to Crooked Creek. Hence sediment sampling has also been proposed for Whiteheads Lagoon and Crooked Creek and the Return Water Pond to assess for potential impact. Sediment samples from drainage channels flowing to Lake Eraring will also assist in characterising any potential off-site migration of contaminants.

6.2 *SUMMARY OF KEY ISSUES*

Of the potential areas of concern identified in *Section 4*, the following issues have been identified as being potentially the most significant in the context of the transaction:

- Coal Combustion Product Management Facility (Ash Dam) and associated waste disposal areas
- Transformer Area;
- Fuel Oil Installation and Associated Pipeworks and ASTs;
- Workshops;
- Former (Northern) Gas Turbine Location; and
- Lake Macquarie, Whiteheads Lagoon, Return Water Pond and Crooked Creek sediments and sediments associated with drainage channels to Lake Eraring.

Decommissioned and operational USTs, as well of the truck washout pits and immediate surrounds, were also considered secondary areas of potential concern.

7 *PRELIMINARY REMEDIATION COSTINGS*

Based on the information available at the time of preparation of this report, ERM has not identified any actual or known material contamination issues which are currently undergoing or likely to require remediation. Preliminary remediation costs have not therefore been prepared at this point in time. It is proposed that remedial costs be revisited following completion of the proposed Stage 2 investigations.

8 RECOMMENDATIONS FOR STAGE 2 ASSESSMENT

Based on the results of the Preliminary ESA undertaken by ERM and consideration of Government's intended approach to the assignment of liability relating to soil and groundwater contamination issues, a programme of intrusive (Phase 2) assessment of potential soil, groundwater, sediment and surface water contamination issues is proposed to assess current conditions at the site and relevant off-site receiving environments.

The following sections set out the proposed scope for the Phase 2 works in general accordance with the requirements set out in NSW EPA (2011).

It is noted that the Phase 2 scope of work presented herein is preliminary, and the final agreed scope of works for the Phase 2 assessment will be detailed in a separate Sampling Analysis and Quality Control Plan (SAQP that is in preparation at the time of writing) which should be viewed in conjunction with this report.

8.1 DATA QUALITY OBJECTIVES

Prior to commencement of the Phase I works, Data Quality Objectives (DQOs) were established for the project in line with the requirements and process outlined in NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme (2nd edition).*

These DQOs were developed to define the type and quality of data required from the site assessment program to achieve the project objectives outlined in Section 1. The DQOs were selected with reference to relevant guidelines published by the NSW Environmental Protection Authority (EPA), Australian and New Zealand Environment and Conservation Council (ANZECC) and National Environment Protection Council (NEPC), which define minimum data requirements and quality control procedures. The application of the seven-step DQO approach identified in NSW DEC (2006) is presented in full in *Annex C.*

8.2 SAMPLING RATIONALE

Based on a review of the available data, the most appropriate sampling design is considered to be a combination of systematic (grid based) and judgemental (targeted) sampling. It is noted that intrusive investigations may be limited to areas where access and site activities enable investigations to occur without unacceptable health and safety risks to personnel and / or unacceptable disruption to site operations. The sampling plan will be discussed with site management prior to the commencement of works to assess this risk.

Given the scale of the site (greater than 1000 ha), a tiered systematic sampling approach is proposed with different sampling densities to be adopted relative to the contamination risk and logistical constraints in different areas of the site. ERM proposes to divide the site into four general areas with sampling approaches to be adopted as outlined in *Table 8.1*.

Table 8.1 Proposed Systematic Sampling Approach

Area	Approach
Accessible operational areas	Boreholes to be advanced on a 50 x 50 m grid in areas not covered by targeted sampling (see below).
Inaccessible operational areas	Boreholes to be advanced around perimeter where possible and in areas not covered by targeted sampling (see below).
Non-operational areas	Visual inspection and additional soil bores / monitoring wells focused primarily on assessing background conditions and identifying potential for migration both on and off-site (including Lake Macquarie and Wangi Wangi Colliery
Waterways	Targeted sampling only (see below)

8.2.1 Systematic Sampling Locations

Boreholes will be advanced on an approximately square grid pattern (50 x 50 m) across the accessible operational area in order to establish an adequate baseline assessment of soil and groundwater conditions where one does not currently exist. The accessible operational area (Area EI) is shown *Figure 2.3, Annex A* and includes the central area of the Site excluding hazardous operational areas.

8.2.2 Targeted Sampling Locations

It is proposed that additional targeted sampling locations will be advanced in or adjacent to the areas of potential concern identified during the Preliminary ESA and site visits. The areas of potential concern are shown in *Figure 3, Annex A*, and the proposed targeted sampling locations are shown in *Figures 2.1 to 2.7, Annex A*. The rationale for the targeted sampling locations in each area of potential concern is summarised below in *Table 8.1*.

Table 8.2 Proposed Targeted Sampling Approach

Area of Environmental Concern	Issue	Analytes	Proposed Boreholes & Monitoring Wells
Coal Combustion Product Management Facility	Contamination of soil and groundwater from CCP leachate and waste disposal in landfills.	Standard Suite* plus PCBs and VOC suite targeted in waste disposal areas.	• 13 Soil/groundwater wells • 8 Soil Bores • Sampling of 13 existing wells • Survey of waste disposal areas
Transformer Area	Contamination of soil and groundwater from transformer oil	Standard Suite*plus PCBs & PFOS/PFOA	• 9 Soil/groundwater wells • 15 Soil Bores
Fuel Oil Installation	Contamination of soil and groundwater from loss of fuel and oil	Standard Suite*	• 8 Soil/Groundwater Wells
Fuel Pipelines and Site ASTs	Contamination of soil and groundwater from loss of fuel and oil	Standard Suite*	• 8 Soil/Groundwater Wells
Workshops	Contamination of soil and groundwater from loss of parts washing solvents	Standard Suite*plus VOCs (TCE)	• 8 Soil/Groundwater Wells • 16 Soil Bores
Former (Northern) Gas Turbine Location	Contamination of soil and groundwater from loss of fuel and transformer oil	Standard Suite*plus PCBs	• 10 Soil/Groundwater Wells
Lake Macquarie Sediments & Surface Water	Contaminants within discharge	Standard Suite*plus PCBs, TOC# and PSD##	• 18 Sediment locations (up to 4 samples per core) .
Whitehead Lagoon, Return Water Pond & Crooked Creek Sediments & Surface Water	Contaminants within discharge	Standard Suite*plus PCBs, TOC# and PSD##	• 22 Sediment locations (up to 4 samples per core) .
Coal Storage Area	Potential leaching of contaminants from stockpiled coal and retention ponds	Standard Suite*	• 10 Soil/Groundwater Wells

Area of Environmental Concern	Issue	Analytes	Proposed Boreholes & Monitoring Wells
Operational and Decommissioned USTs	Contamination of soil and groundwater from loss of fuel	Standard Suite*	• Sampling of 13 existing wells
Non Operational Areas (incl. Sewage Treatment Works, Acid Sulfate Soils, Former Fire Training Area, and Truck Washout Pits)	Contamination of soil and groundwater from leaks and overflows.	Standard Suite* plus 10 samples for PSD, TOC, pH, CEC.	• 43 Soil/Groundwater Wells • 3 Soil Bores • Sampling from 5 existing at the Attemperation Reservoir. • 4 sediment samples north of Wangi road • Measurement of field parameters in surface water at up to 14 locations near Attemperation Reservoir and borrow pit in relation to acid sulfate soils.

Notes:
* - Standard Suite is as set out in *Section 8.3.1*
# - TOC – Total Organic Carbon
- PSD – Particle Size Distribution.

8.2.3 Waterways

Sediment sampling is proposed to target potential contamination from cooling discharges or other potential instances of off-site migration of contaminants from the Site and includes sampling in two aquatic zones of 'putative effect' including:

- within the Whitehead Lagoon downgradient from the southern boundary of the Site, including within Crooked Creek (one of the potential transmission pathways) and Myuna Bay (a potential depositional zone; receptor); and

- within Lake Macquarie within an area beyond the high energy of the outlet canal (potential depositional zone), including allocation of "unaffected" control sites further away.

The proposed design would be sufficiently robust as a Control-Impact statistical framework which is spatially-nested (meaning sites are within putative impact 'close to'; 'nearby' or 'far from' zones of potential effect). It is presumptive at the outset of this screening exercise to propose that contamination has occurred and, if it had in a linear way, so the need for transect sampling is not yet warranted in ERM's opinion (but may be based on significantly elevated results from this screening program).

With regard to potential sampling within Lake Eraring, a review of the topography of the area indicates that Lake Eraring falls within a separate catchment to the vast majority of the Power Station infrastructure and lands. ERM therefore considers the potential for impacts from other sources to be significantly greater that potential impacts from Eraring Power Station. To further assess this issue it is proposed that sediment samples be collected from the base of four drainage channels on Eraring land to the north of Wangi road which drain to Lake Eraring, this will allow for assessment of potential impacts with a lower chance of confounding effects associated with external sources and will inform the requirement for further sampling within Lake Eraring.

8.2.4 Potential Acid Sulfate Soils

Surface water sampling including pH and redox potential has been proposed at a total of ten locations in the vicinity of the Attemperation Pond and Borrow Pit and four downgradient locations. Two groundwater monitoring wells have also been proposed in areas adjacent to the Attemperation Pond, in cleared areas north and south of the canal. I It is further noted that all wells included in the Stage 2 ESA will have field parameters (including pH and redox potential) measured prior to sampling. Should these measurements or other field observations indicate that acid sulfate soil conditions may be present further assessment of these issues will be considered.

8.2.5 Existing Groundwater Wells

It is proposed that existing groundwater monitoring wells will be sampled during Phase II soil and groundwater investigation works. Where existing groundwater monitoring wells have been identified the locations of these wells is presented on *Figures 2.1 to 2.7, Annex A*.

Sampling will only occur where the groundwater monitoring wells are deemed to be suitable. The suitability of the existing groundwater monitoring wells will be assessed based on the following steps:

- ground truthing of the groundwater monitoring wells;
- bore logs will be reviewed to confirm that the wells were appropriately constructed and screened within the groundwater bearing strata; and
- the groundwater monitoring wells will be gauged to confirm the total depth of the well against the bore logs and the depth of groundwater.

If the existing monitoring wells cannot be located, or their condition not deemed fit for the purposes of this investigation (e.g. not screened at the appropriate depth or if the well casing presents with a blockage or obstruction),then these wells will be replaced during the Phase 2 drilling program.

The sampling process and analytical suite for existing wells deemed suitable will be in accordance with that adopted for newly installed wells.

8.3 PROPOSED SAMPLING METHODOLOGIES

The soil, sediment and groundwater investigation works will generally involve the following key steps:

- underground service location and mark-out;
- proposed borehole location mark-out;
- coring of hard standing surfaces;
- drilling and soil sampling of subsurface material using push tube and / or auger drilling;
- installation of 50 mm diameter groundwater monitoring wells in selected boreholes screened appropriately to intersect the aquifer of interest and facilitate measurement of NAPL (if present);
- backfilling of boreholes;
- reinstatement of hardstanding surfaces;

- surveying the location of boreholes and monitoring wells; and
- development, measurement of water levels and sampling of the groundwater monitoring wells.
- Where required, sediment samples will be collected using a remotely operated stainless steel grab unit lowered from a sampling vessel or other equivalent method as deemed appropriate based on site conditions.

A comprehensive methodology providing further details of the intrusive site works investigation process is outlined in *Annex C.*

8.3.1 Laboratory Analysis

Primary samples will be couriered under chain of custody documentation to ALS Environmental Pty Ltd (ALS), a NATA accredited analytical laboratory. Inter-laboratory duplicate samples will be couriered under chain of custody documentation to Envirolab Services Pty Ltd (Envirolab) also a NATA accredited analytical laboratory. Soil and groundwater samples will be analysed for a suite of potential contaminants of concern listed below with some samples in specific areas being secheduled for additional analysis as outlined in *Table 8.2.*

- metals and metalloids (arsenic, cadmium, chromium, copper, nickel, lead, mercury, selenium and zinc);
- Total Recoverable Hydrocarbons (TRH);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Phenols;
- Volatile Organic Compounds (including benzene, toluene, ethylbenzene and xylenes -BTEX); and
- asbestos (presence / absence – soil only).

Additional contaminants of concern may be analysed if required based on observations made in the field.

8.4 PROPOSED FIELD SCREENING PROTOCOLS

The following field screening protocols are proposed for the Phase 2 works:

8.4.1 Soil and Sediment

Soils and sediments will be logged by an appropriately trained and experienced scientist/engineer to record the following information: soil/sediment type, colour, grain size, sorting, angularity, inclusions, moisture condition, structure, visual signs of contamination (including staining and fragments of fibrous cement sheeting or similar) and odour in general accordance with AS 1726-1993.

A duplicate of each soil sample will be collected for field screening and will be placed in a sealed zip lock bag and screened in accordance with ERM Standard Operating Procedures (SOPs – available upon request) using a Photo Ionisation Detector (PID) fitted with a 10.6 eV lamp, calibrated at the beginning of each working day. Where the presence of VOCs or other impact is indicated by field screening, additional laboratory analysis may be undertaken.

8.4.2 Groundwater

Prior to sampling or gauging each monitoring well, the well cap will be partially removed to allow the headspace to be screened using a calibrated PID over a period of one minute. The presence of odours will also be noted following removal of the well cap and described by reference to their intensity and character. Following a period of no pumping (as a minimum 24 hours) all wells will be dipped to gauge the depth to groundwater and, if necessary, the presence and thickness of Non-aqueous Phase Liquids (NAPLs). Wells will be purged using a thoroughly decontaminated peristaltic pump under low flow conditions and during this process a calibrated water quality parameter meter will be used to record field measurments of pH, conductivity, redox potential, temperature and dissolved oxygen.

8.5 BASIS FOR SELECTION OF ASSESSMENT CRITERIA

The adopted assessment criteria have generally been sourced from guidelines made or approved under the Contaminated Land Management (CLM) Act 1997 where alternative sources have been utilised appropriate justification has been provided.

8.5.1 Soil

Soil data will be assessed against investigation criteria published in the documents:

- National Environmental Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)* Schedule B1 Guideline on the Investigation Levels for Soil and Groundwater (NEPM). Health Investigation Level (HIL) 'D' – Commercial/Industrial, HIL 'C' – Public Open Space and Ecological

Investigation / Screening Levels (ESLs) (as applicable). It is noted that whilst the HIL 'C' screening criteria are generally not applicable to undeveloped, urban bushlands and reserves, they will be adopted at sampling locations in non-operational areas considered to present a more sensitive land use category. Application of the HILs will be considered on a case by case basis in accordance with the new NEPM to reflect local conditions encountered at the time of the intrusive works. Health Screening Levels for Vapour Intrusion and Direct Soil Contact (HSL) 'D' – Commercial/Industrial and Health Screening Levels for Vapour Intrusion and Direct Soil Contact Intrusive Maintenance Worker (Shallow Trench) will also be adopted;

- NSW Environment Protection Authority (EPA) (1994) *Guidelines for Assessing Service Station Sites*. Threshold concentrations for sensitive land use – soils; and

- Where no Australian endorsed assessment criteria is available reference to the National Institute of Public Health and the Environment (RIVM) (2001) *Technical Evaluation of the Intervention Values for Soil/sediment and Groundwater: Human and Ecotoxicological Risk Assessment and Derivation of Risk Limits for Soil, Aquatic Sediments and Groundwater* - Human Toxicological Serious Risk Concentrations in soil (SRC_{human} soil) will be made it is noted that these guideline values have no regulatory standing in NSW and hence further assessment of any exceedences of these criteria may be required.

8.5.2 Groundwater

Groundwater data will be assessed against investigation criteria published in the following documents:

- Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Trigger values for marine water, level of protection 95% species and Trigger values for marine water, level of protection 99% species (for bioaccumulation of mercury);

  National Health and Medical Research Council (NHMRC) and National Resource Management Ministerial Council (NRMMC) (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, Commonwealth of Australia, Canberra;

- Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) (2011) *Technical Report No. 10, Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*. Health Screening Levels for Vapour Intrusion (HSL) 'D' –

Commercial/Industrial and Health Screening Levels for Vapour Intrusion Intrusive Maintenance Worker (Shallow Trench); and

- Where no Australian endorsed assessment criteria is available reference to the National Institute of Public Health and the Environment (RIVM) (2001) *Technical Evaluation of the Intervention Values for Soil/sediment and Groundwater: Human and Ecotoxicological Risk Assessment and Derivation of Risk Limits for Soil, Aquatic Sediments and Groundwater*. Human Toxicological Serious Risk Concentrations in Groundwater (SRC_{human} groundwater). It is noted that these guideline values have no regulatory standing in NSW and hence further assessment of any exceedences of these criteria may be required.

8.5.3 Sediment

Sediment quality data will be assessed against investigation criteria published in:

- ANZECC / ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* - Interim Sediment Quality Guidelines (ISQGs).

9 *CONCLUSIONS*

The Preliminary ESA undertaken by ERM has identified that limited previous intrusive ESAs appear to have been completed on the sites and a number of potential contamination sources were identified as follows:

- CCP management facility (ash dam) and associated waste disposal areas;
- transformer area;
- coal storage area;
- fuel oil installation;
- operational and decommissioned USTs;
- attemperation reservoir;
- truck wash out pits;
- workshops;
- former northern gas turbine area;
- sewage treatment area;
- sediments in Lake Macquarie, Whiteheads Lagoon, the Return Water Pond and Crooked Creek, and sediments associated with drainage channels to Lake Eraring

Based on the results of the Preliminary ESA and consideration of Government's intended approach to establishing a baseline of soil and groundwater contamination, a programme of intrusive (Phase 2) assessment of potential soil and groundwater contamination issues is provided. The most appropriate sampling design is considered to be a combination of systematic (grid based) and judgemental (targeted) sampling of soil, groundwater and sediments at locations across the Sites.

Based on the information available at the time of preparation of this report, ERM has not identified any actual or known material contamination issues which are currently undergoing or likely to require remediation. Preliminary remediation costs have not therefore been prepared at this point in time. There is however the potential for contamination arising from identified areas of concern to give rise to material cost, which can be confirmed following the proposed Stage 2 investigations. It is proposed that remedial costs be revisited following completion of the proposed Stage 2 investigations.

10 LIMITATIONS

This report is based solely on the scope of work described in *Section 1.3* and performed pursuant to a contract between ERM and NSW Treasury ("Scope of Work"). The findings of this report are solely based on, and the information provided in this report is strictly limited to the information covered by, the Scope of Work.

In preparing this report for the Client, ERM has not considered any question, nor provides any information, beyond the Scope of Work.

This report was prepared between 15 March 2013 and 27 June 2013 and is based on conditions encountered and information reviewed at the time of preparation. The report does not, and cannot, take into account changes in law, factual circumstances, applicable regulatory instruments or any other future matter. ERM does not, and will not, provide any on-going advice on the impact of any future matters unless it has agreed with the Client to amend the Scope of Work or has entered into a new engagement to provide a further report.

Unless this report expressly states to the contrary, ERM's Scope of Work was limited strictly to identifying typical environmental conditions associated with the subject site(s) and does not evaluate structural conditions of any buildings on the subject property, nor any other issues. Although normal standards of professional practice have been applied, the absence of any identified hazardous or toxic materials or any identified impacted soil or groundwater on the site(s) should not be interpreted as a guarantee that such materials or impacts do not exist.

This report is based on one or more site inspections conducted by ERM personnel and information provided by the Client or third parties (including regulatory agencies). All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved. Whilst normal checking of data accuracy was undertaken, except to the extent expressly set out in this report ERM:

a) did not, nor was able to, make further enquiries to assess the reliability of the information or independently verify information provided by;

b) assumes no responsibility or liability for errors in data obtained from, the Client, any third parties or external sources (including regulatory agencies).

Although the data that has been used in compiling this report is generally based on actual circumstances, if the report refers to hypothetical examples those examples may, or may not, represent actual existing circumstances.

Only the environmental conditions and or potential contaminants specifically referred to in this report have been considered. To the extent permitted by law and except as is specifically stated in this report, ERM makes no warranty or representation about:

a) the suitability of the site(s) for any purpose or the permissibility of any use;

b) the presence, absence or otherwise of any environmental conditions or contaminants at the site(s) or elsewhere; or

c) the presence, absence or otherwise of asbestos, asbestos containing materials or any hazardous materials on the site(s).

Use of the site for any purpose may require planning and other approvals and, in some cases, environmental regulator and accredited Site Auditor approvals. ERM offers no opinion as to the likelihood of obtaining any such approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.

The ongoing use of the site or use of the site for a different purpose may require the management of or remediation of site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.

This report should be read in full and no excerpts are to be taken as representative of the whole report. To ensure its contextual integrity, the report is not to be copied, distributed or referred to in part only. No responsibility or liability is accepted by ERM for use of any part of this report in any other context.

This report:

a) has been prepared and is intended only for the Client and any party that ERM has agreed with the Client in the Scope of Work may use the report;

b) has not been prepared nor is intended for the purpose of advertising, sales, promoting or endorsing any client interests including raising investment capital, recommending investment decisions, or other publicity purposes;

c) does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in or in relation to the site(s); and

d) does not purport to provide, nor should be construed as, legal advice.

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Annex A

Figures

0 2 4km

N

Client:	NSW Treasury		**Figure 1 - Site Locality**
Drawing No:	0194708s_ERP02_G001_R0.mxd		
Date:	05/06/2013	Drawing Size: A4	0194708 - Project Symphony
Drawn By:	GC	Reviewed By: NA	Eraring Site

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Environmental Resources Management ANZ

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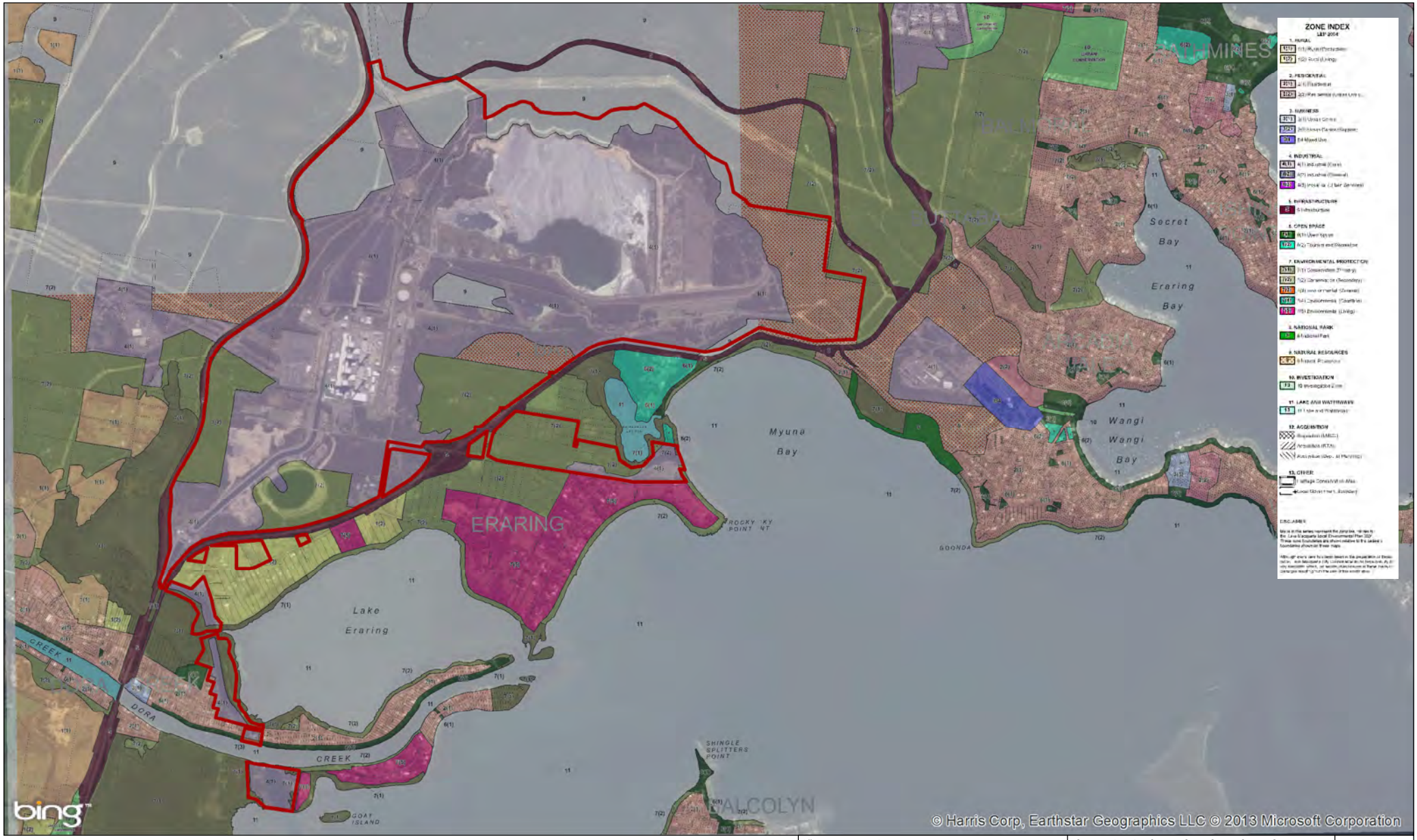
ERM



Legend

Approximate Site Boundary

0 250 500 750m

N

Client:	NSW Treasury		**Figure 2 - Cadastral and Zoning Plan**
Drawing No:	0194708s_ERP02_G002_R0.mxd		
Date:	05/06/2013	Drawing Size: A4	0194708 - Project Symphony
Drawn By:	GC	Reviewed By: NA	Eraring Site

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Environmental Resources Management ANZ

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ERM

LEGEND

- PROPERTY & BUILDING OUTLINES
- LAKE SHORE
- CREEKS & CLEAN RUN OFF
- RAILWAY LINE
- OVERHEAD TRANSMISSION LINES (LAYER MAY BE TURNED ON OR OFF)
- EASEMENT OF CROWN LAND
- COOLING WATER CANALS
- COLLECTED & RE-USED WATER
- ERARING ENERGY PROPERTY (LAYER MAY BE TURNED ON OR OFF)
- ERARING ENERGY PROPERTY LEASED TO THIRD PARTY
- BOARD APPROVED SURPLUS PROPERTY
- APPROVED NON OPERATIONAL PROPERTY
- LAND SURPLUS TO GENERATOR SALE PROCESS

1. Transformer Area
2. Unit 1 Turbine House USTs
3. Coal Combustion Product (CCP) Management Facility (Ash Dam)
4. Coal Storage Area
5. Decommissioned USTs
6. Fuel Oil Installation and Associated Pipeworks
7. Sediments in Lake Macquarie
8. Garage UST for Waste Oil
9. Sewage Treatment works
10. Former Northern Gas Turbine Location
11. Truck Wash-out Pits

Source:
Eraring Energy Ref: ER837155

Drawing Not to Scale

N

Client:	NSW Treasury		
Drawing No:	0194708s_ERP02_C001_R0.cdr		
Date:	04/06/2013	Drawing size:	A3
Drawn by:	GC	Reviewed by:	NA

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 3 - Site Layout and Potential Areas of Concern

0194708 - Project Symphony
Eraring Site

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ERM

Annex B

Photographs

Photograph 1

Eraring Power Station

Photograph 2

Eraring Power Station – Boiler Stack and four Steam Turbine Generators (Turbine Building).

Photograph 3

CCP Management Facility (facing north).

Photograph 4

CCP Management Facility (facing south).

Photograph 5

Above Ground Storage Tanks (Transformer Oil) – Transformer Area.

Photograph 6

1.0ML Fuel Storage Tanks – Oil Installation Area.

Photograph 7

Oil pipeline between Fuel Oil Installation and Turbine Building (moving from above ground to culverted channel).

Photograph 8

Former (Northern) Gas Turbine location.

Photograph 9

Former (Northern) Gas Turbine location.

Photograph 10

Oil/water Separator – former (Northern) Gas Turbine location.

Photograph 11

Truck Wash-out Pits.

Photograph 12

Former (Northern) Gas Turbine location.

Photograph 13

Ash and Dust Plant Common Workshop.

Photograph 14

Daywork Main Workshop.

Photograph 15

6000L ASTs for on-site fire pumps (Depots H9 and H10), east of the Turbine Building.

Photograph 16

Oil Retention Lagoon.

Photograph 17

Over/under weir - Oil Retention Lagoon.

Photograph 18

Black Start Gas Turbine and Surface standing.

Photograph 19

Water Reservoirs.

Photograph 20

High level water supply canal.

Photograph 21

'Glory Hole' - Water entering the Outlet Canal.

Annex C

Data Quality Objectives And Detailed Investigation Methodology

C.1 STEP 1: STATE THE PROBLEM

Objectives

The objectives of the Preliminary ESA are as stated in *Section 1.2*.

C.2 STEP 2: IDENTIFY THE DECISIONS

Decision Statements

Overall, the principal decision to be made is whether there are actual or potential material contamination issues related the proposed sale of the power generation assets. Additional decisions to be made include:

- Is there sufficient data to provide an environmental baseline at the time of the transaction?
- What is the nature and extent of soil, sediment and/or groundwater impact on / beneath the sites?
- Does the impact at the sites represent a risk to human health, based on the current and continued use of the sites?
- Is the impact at the sites likely to warrant regulation under the *Contaminated Land Management Act 1997* and remediation?
- Is material remediation likely to be required?

Assessment Criteria

The proposed sources of site assessment criteria are presented in *Section 8.5*.

C.2.1 Waste Classification For Off-Site Disposal

Any excess soil or groundwater generated during the Phase II program will be classified in accordance with the NSW Department of Environment, Climate Change and Water (2009) *Waste Classification Guidelines, Part 1: Classifying Waste* and relevant associated Chemical Control Orders.

C.3 STEP 3: IDENTIFY INPUTS TO DECISION

The inputs required to make the above decisions are as follows:

- Existing relevant environmental data, taking into consideration the number and location of existing soil and groundwater sampling locations, the construction of existing groundwater monitoring wells and the date of the most recent groundwater monitoring event;

- direct measurement of environmental variables including soil type, soil gas concentrations, odours, staining, water strike and groundwater level and water quality parameters;
- laboratory measurement of soil and groundwater samples for one or more of the identified potential contaminants of concern;
- field and laboratory quality assurance/quality control data;
- the relevant soil and water quality criteria outlined previously; and
- assessment of whether the concentrations of the contaminants of concern are greater than or equal to or less than the adopted criteria.

C.4 STEP 4: DEFINE THE STUDY BOUNDARIES

Spatial Boundaries

The site locations and descriptions are provided in *Section 2*.

Constraints within the Study Boundaries

Constraints on the delivery of the Phase II program within the study boundaries may include:

- location of underground services or infrastructure;
- the condition of existing monitoring wells; and
- obtaining permission/access to enter and sample in off-site areas (where deemed necessary.

C.5 STEP 5: DEVELOP A DECISION RULE

The DQOs have been designed to facilitate the collection of adequate soil, sediment and groundwater data to address the decisions in Step 2 of the DQO process. It was noted that some project constraints may impact on the implementation of the Phase II program, for example access to an off-site area may not be granted within the required time frame. Deviations from the Phase II program will be discussed in the Phase II report, acknowledging the source of any available information and any limitations on the assessment.

Field and Laboratory QA/QC

The suitability of soil and groundwater data will be assessed based on acceptable limits for field and laboratory QA/QC samples outlined in relevant guidelines made or endorsed under the *Contaminated Land Management Act* (1997). In the event that acceptable limits are not met by laboratory analyses, the field observations relating to the nature of the samples will be reviewed and if no obvious source for the non-conformance is identified, such as an error in sampling, preservation of sample/s or heterogeneity of sample/s, liaison with the laboratories will be undertaken in an effort to identify the issue that had given rise to the non-conformance.

If the soil and groundwater data is deemed to be unsuitable additional analyses may be undertaken on the original sample/s, on duplicate samples or on other samples, if required to meet the objectives of the assessment. If no explanation for the non-conformance is identified, the concentrations for the affected samples will be considered as an estimate.

Assessment Criteria

The sources of applicable assessment criteria are presented *Section 8.5*. Individual soil, sediment and groundwater data, along with the 95% Upper Confidence Limit (UCL) of the mean concentration (if required) will be compared to the assessment criteria. Exceedence of the assessment criteria will not necessarily indicate the requirement for remediation or a risk to human health and the environment. If individual or 95% UCL concentrations exceed the assessment criteria, consideration of the extent of the impact, the potential for site users to be exposed and regulatory compliance will be considered.

Comparison of the laboratory Limit of Reporting (LOR) to the assessment criteria will be undertaken to confirm that the assessment criteria are less than the laboratory LOR any exceptions to this will be appropriately noted and justified.

C.6 STEP 6: SPECIFY LIMITS ON DECISION ERRORS

The acceptable limits on decision errors applied during the review of the results will be based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness (PARCC) in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, *Schedule B (3) - Guidelines on Laboratory Analysis.*

The potential for significant decision errors will be minimised by:

- completing a robust Quality Assurance/Quality Control (QA/QC) assessment of the validation data and application of the probability that 95% of data will satisfy the DQIs, therefore a limit on the decision error would be 5% that a conclusive statement may be incorrect;

- assessing whether appropriate sampling and analytical density has been achieved for the purposes of providing a baseline of soil, sediment and groundwater conditions at the point of transaction; and

- ensuring that the criteria set was appropriate for the ongoing use of the site as a power generation facility.

C.7 STEP 7: DEVELOP (OPTIMISE) THE PLAN FOR COMPLETING THE WORKS

The DQOs have been developed based on a review of existing data, discussions with the NSW Treasury and Eraring Energy. If data gathered during the assessment indicates that the objectives of the assessment programme are not being met, the sampling design (including sampling pattern, type of samples and analytes) will be adjusted accordingly using feedback (where necessary) from project stakeholders.

C.8 DETAILED SOIL AND GROUNDWATER INVESTIGATION METHODOLOGY

C.8.1 Sub-Surface Clearance

All proposed drilling locations will be cleared of underground and above ground utilities in accordance with ERM's Sub-Surface Clearance (SSC) Procedure. The key steps involved in ERM's SSC procedure include:

- assigning a SSC Experienced Person (EP) who is responsible for all SSC activities;

- obtaining Dial Before You Dig Plans and marking out public utilities if required;

- obtaining site utility plans (where available) and obtaining approval from the site contact for the proposed drilling locations;

- conducting a site walkover to identify any visual clues of site services;

- checking all locations for the presence of underground services using a cable location tool;

- where possible soil bores will be located to avoid working in critical areas, defined as areas with 3 m of a subsurface obstruction; and

- each soil bore will be cleared using a hand auger or Non-Destructive Drilling (NDD) to a depth of 1.2 m bgl in non-critical zones or 2.3 m bgl in areas classed as critical zones.

C.8.2 Soil Bore Drilling

Soil bores will be drilled in accordance with ERM SOPs using the general methodology outlined below

- Where necessary hardstand drilling locations will be penetrated using a concrete corer prior to physical borehole clearance and drilling;
- each soil bore will be cleared using a hand auger or Non-Destructive Drilling (NDD) techniques to the depth required by ERM's SSC Procedure;
- a drilling rig, incorporating direct push-tube methodology will be used to advance the boreholes to the target depth or until deemed refusal is encountered;
- prior to the commencement of drilling and between drilling locations, all down-hole drilling equipment will be decontaminated to minimise potential for cross contamination between the sampling locations.

C.8.3 Soil Sampling Protocol

Soil samples will be collected and logged in accordance with ERM SOPs. In summary the following work procedures will be followed:

- the soil will be logged by an appropriately trained and experienced scientist/engineer to record the following information: soil/rock type, colour, grain size, sorting, angularity, inclusions, moisture condition, structure, visual signs of contamination (including staining and fragments of fibre cement sheeting) and odour in general accordance with AS 1726-1993;
- soil samples will be collected from the surface and at 0.5 m intervals thereafter, or from each lithological unit (whichever is greater);
- suitable PPE including fresh disposable nitrile gloves will be used during sampling and equipment decontamination;
- a duplicate of each soil sample collected for field screening will be placed in sealed zip lock bags and screened in accordance with ERM SOPs using a PID fitted with a 10.6 eV lamp, calibrated at the beginning of each working day. Where the presence of VOCs or other impact is suspected, additional laboratory analysis may be undertaken;
- A representative soil samples will be collected (to the extent practicable) in accordance with techniques described in Australian Standard AS4482 (Part 2) to maintain the representativeness and integrity of the samples. The samples will be placed in pre-treated laboratory supplied sample containers. The containers will be filled, where practical, to minimise headspace, before being sealed and appropriately labelled. Labels will include the following information:

- sample identification number;
- job number; and
- Date of collection.

- field quality control/quality assurance (QA/QC) samples will be collected including field duplicates, inter-laboratory duplicates, rinsate blanks, trip blanks and trip spikes (as required).
- Sample jars will be sealed and immediately placed in a cooler on ice to minimise potential degradation of organic compounds.

C.8.4 Soil Bore Reinstatement

Upon completion soil bores will be backfilled and the surface covering reinstated to match existing.

C.8.5 Waste Materials Generated During Drilling

All non-liquid waste materials generated during drilling works will be stored on-site in drums or other appropriate sealed containers at a designated staging area. If evidence of significant contamination is observed during drilling (e.g. staining or odour) an attempt will be made to store any potentially impacted wastes separately. All wastes will be disposed off-site to an appropriately licenced landfill by an approved and appropriately licensed waste removal contractor

C.9 GROUNDWATER INVESTIGATION

C.9.1 Groundwater Well Installation

Selected boreholes will be converted to groundwater monitoring wells in accordance with ERM SOPs. The following methodology will be implemented to install the new monitoring wells.

- the wells will be constructed of 50 mm diameter factory slotted screen (0.4 mm slots) and blank uPVC well materials. The wells will be screened within groundwater bearing strata and constructed to allow the ingress of non-aqueous phase liquids (NAPLs) which may be present;
- the well casing and screen will be inserted into the borehole. Washed and graded filter sand will be poured into the annulus between the well screen and borehole wall, ensuring that the sand covers the entire screened level and extends at least 0.5 metres above the top of the screen;
- bentonite pellets will then poured on top of the sand at a minimum thickness of one metre and hydrated to effectively seal off the well from surface water or perched / shallow groundwater inflows; and

- each well will be grouted using cement /bentonite grout to within 0.5 m of the surface and the final 0.5 m reinstated with concrete and a heavy duty cover, well casing will be sealed with air-tight, lockable 'envirocaps';

- the well cap will be labelled with the groundwater monitoring well I.D.;

- following monitoring well installation, each well will be developed to remove any fine materials or contaminants potentially introduced during drilling. Wells will be considered developed when either a minimum of 10 well volumes had been removed, or when water quality parameters stabilise or if the well is pumped dry prior to this. Where sufficient well volumes cannot be obtained, attempts will be made to remove fines and construction material by purging the well over several days to allow for recharge.

C.9.2 Groundwater Purging And Sampling Protocol

Where new monitoring wells are installed, groundwater purging and sampling will occurr at least one week after well installation and development to allow subsurface conditions to stabilise.

The well cap will be partially removed to allow the headspace to be screened using a calibrated PID over a period of one minute. The presence of odours will also be noted following removal of the well cap and described by reference to their intensity and character. Following a period of no pumping (as a minimum 24 hours) all wells will be dipped to gauge the depth of groundwater and if necessary the presence and depths of NAPLs. Wells will be purged using a thoroughly decontaminated peristaltic pump under low flow conditions until sufficient water has been removed to obtain stabilised readings of pH, conductivity, redox potential, temperature and dissolved oxygen which was calibrated prior to use. The stabilisation criteria are as described in *Table C.1* below.

Table C.1 Water quality parameter stabilisation criteria

Parameter	Stabilisation criteria
pH	± 0.1 pH units
Electric Conductivity (EC)	± 3% (µS/cm or mS/cm)
Temperature	± 0.5°C
Oxidation Reduction Potential (ORP)	± 10 mV
Dissolved Oxygen (DO)	± 0.3 mg/L

It is noted that both ORP and DO are typically slower to stabilise than the other parameters, and may be particularly unstable when not using a closed flow through cell. In this case, greater weight will be given to pH and EC as the 'stabilising' parameters.

Low-flow sampling techniques will be used to obtain samples that are representative of the local groundwater environment at the site. The inlet of the low-flow pump will be placed approximately 50 cm from the base of the well in order to obtain a representative sample of the aquifer. Water samples will be collected using equipment dedicated to each monitoring well to eliminate the potential for cross-contamination between sample locations.

The following order of sampling will be adopted:

- samples to be analysed for volatile compounds placed into 40 mL amber vials;
- samples to be analysed for semi-volatile compounds placed in 250 mL solvent washed amber bottles; and
- samples to be analysed for metals filtered through disposable cartridges containing 0.45 µm filters and placed in 125 mL plastic bottles preserved with nitric acid.

If NAPL is observed in any groundwater wells, attempts will be made to collect a representative sample of the NAPL for characterisation using a dedicated disposable bailer.

The containers will be filled, where practical, to minimise headspace, before being sealed and appropriately labelled. Labels will include the following information:

- sample identification number;
- job number; and
- date of collection.

Sample jars will be sealed and placed in a cooler on ice immediately to minimise potential for degradation of the sample.

C.9.3 Waste Materials Generated During Groundwater Development/Purging

Water from development of the wells will be collected and stored in appropriately labelled dedicated drums or an intermediary bulk container (IBC) within the designated staging area. The water will be classified and disposed off-site in accordance with relevant NSW Waste Classification Guidelines.

C.10 SEDIMENT INVESTIGATION

Sediment samples will be collected in general accordance with the methodologies outlined in CSIRO (2005) *Handbook for Sediment Quality Assessment* via the use of either a stainless steel grab sampler or via direct push coring utilising polycarbonate sampling tubes (dependent on water depth and site specific conditions). Sample handling, labellind and decontamination procedures will be aligned with those adopted for soil sampling and those outlined in CSIRO (2005).

C.11 SURVEY

All groundwater wells (excluding existing groundwater monitoring wells) will be surveyed to Australian Height Datum (AHD) for elevation and Map Grid of Australia (MGA) coordinates for location. For groundwater monitoring wells, the elevation of the highest point of the top of the PVC casing will be measured. A notch will be embedded in the casing to indicate the location surveyed. This mark will be the measuring point for future groundwater elevation measurements. This will allow for the appropriate groundwater elevations calculations and groundwater flow direction interpretations.

Annex D

Results Of Historical Searches

Annex E

Revised Scope Of Works

DRAFT SCOPE FOR STATE'S CONTAMINATION CONSULTANT

(as provided by the State to Origin on 20 March 2013)

ORIGIN COMMENTS (as at 25 March 2013)

COMMERICAL-IN-CONFIDENCE. DRAFT AS AT 4 MARCH 2013

[Origin note: Origin requires clear definitions for "Adviser" (which in other documents is referred to as "Consultant"), "Project" and "site".]

1. ROLE OF THE SITE CONTAMINATION ENVIRONMENTAL ADVISER

The Adviser will be required to provide specialist environmental advice in relation to the Project.

In this scope, **Receiving Environment** means soil, groundwater, sediments, and other receptors as considered appropriate for the assessment.

1.1 Scope of Works

The Adviser will be responsible for **Stage 1** works as detailed below:

- It is expected that there could be three stages of the work:
  - **Stage 1** Environmental Site Assessment (**ESA**) - Investigation of potential contamination issues.
  - **Stage 2** Environmental Site Assessment - Intrusive Receiving Environment investigation(s) - if and where required.
  - **Stage 3** Environmental Site Assessment - Remediation requirements.

  [Origin note: The baseline report must provide Stage 1 and Stage 2 assessments. Origin is considering the appropriateness of Stage 3 further.]

- **Stage 1 Environmental Site Assessment) - Investigation of potential issues**

  Stage 1 is a desktop activity (i.e. no intrusive Receiving Environment sampling and analysis) and includes:

  - Development of a site history by interviews with employees and review of information such as (but not limited to):
    - Relevant documents identified by employees
    - Relevant documents in the due diligence Data Room
    - Relevant due diligence RFIs (provided by Origin) and responses
    - Relevant publicly available literature relating to potential contamination of the Site.
    - The database managed by the NSW Office of Environment and Heritage for information on notices issued by the NSW EPA under the Protection of the Environment Operations Act 1997 and the Contaminated Land Management Act 1997
    - Current and historical aerial photographs

- Historical Titles
- Section 149 certificates from the relevant local Council
- Civil engineering works records

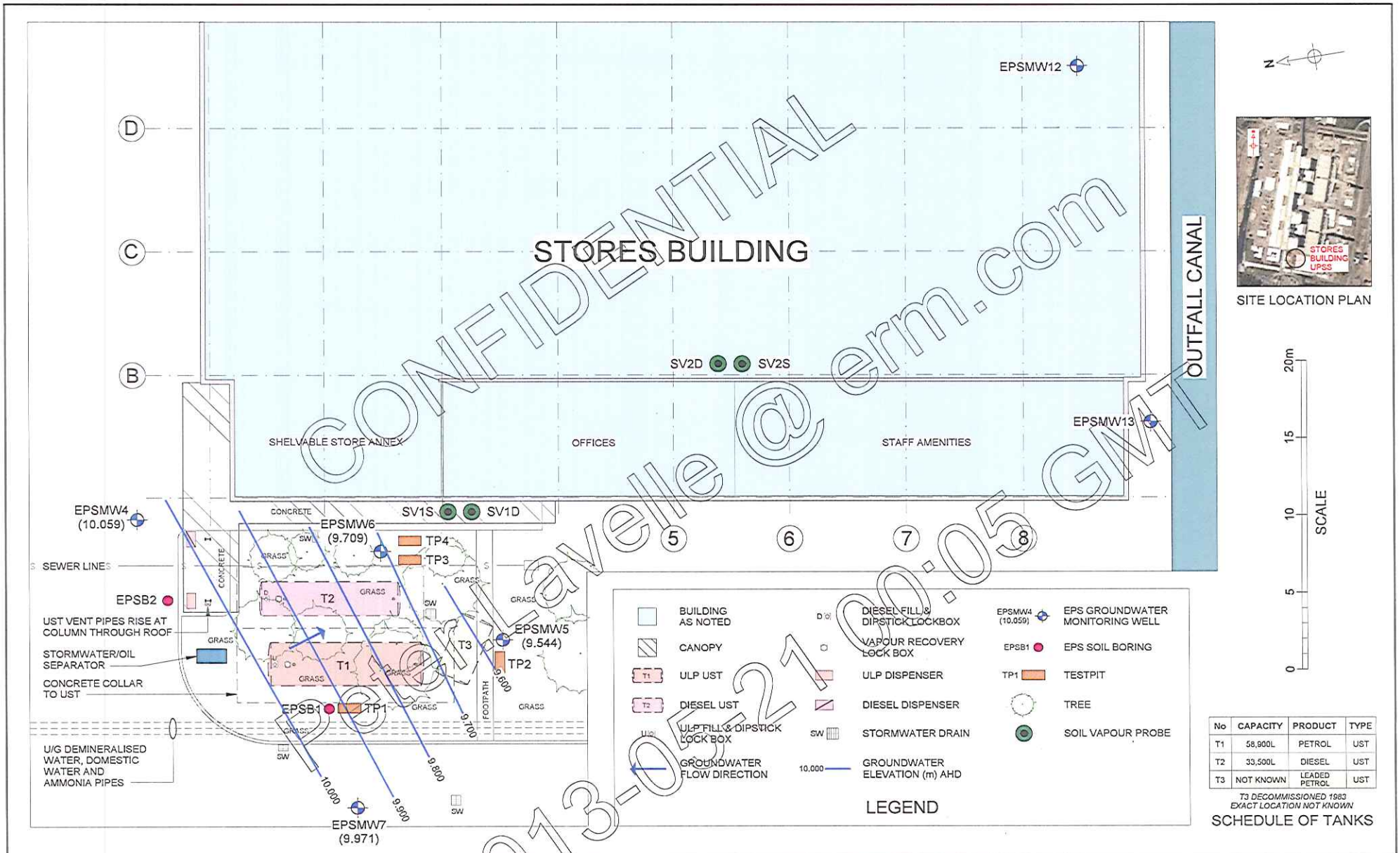
- Review of existing Receiving Environment reports for the site and immediate surrounding areas (where provided by Eraring).
- Desktop assessment of the environment in which the site is set such as (but not limited to):
  - environmentally sensitive characteristics of the site and surrounding areas; and
  - site drainage, geology, hydrogeology, soil, sediment and groundwater conditions at the site and surrounding areas
- Inspection of the site and surrounding areas to the extent practical given access constraints to third party property ***[Origin note: Origin considers it important for a proper Baseline Assessment that the consultant have adequate access to surrounding land and water. How will this be provided?]***
- Identification of actual and/or potential Receiving Environment areas of concern for the site and surrounding areas by:
  - Identification of past and present potentially contaminating activities at, and in the vicinity of, the site
  - Identification of potentially impacted areas
  - Identification and assessment of the chemicals of potential concern (**COPC**) that may have been associated with historical and current use of the site
  - Evaluation of the possible migration pathways of the COPC
  - Assessment of the sensitivity of surrounding areas and/or property
- Preliminary identification of potential cost implications of actual and/or potential Receiving Environment areas of concern, to assist in determining if those issues may be material. ***[Origin note: Please see our separate comment on the materiality threshold.]***
- The Stage 1 report should include identification of:
  - Where **Stage 2 intrusive investigations** are necessary on each site. (Where a complete history of the site and surrounding areas clearly demonstrates that activities on the site or surrounding areas have been non-contaminating, there may be no need for further investigation or site sampling. However, where contamination activities are suspected or known to have occurred, or if the history is incomplete, further investigation would be justified);
  - Where it may be necessary to undertake a preliminary sampling and analysis program at each site to assess the need for detailed investigation; and
  - A detailed scope-of-works for Stage 2 investigations at each site.

- The Stage 1 report should include comment on possible remediation options (**Stage 3**) for any clearly identified issues and their associated remediation cost estimates.

- **Preparation of a Stage 1 ESA report** in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites (NSW EPA, 2011)* and other relevant guidelines and standards as would reasonably be considered appropriate for a vendor environmental due diligence assessment of this nature. ***[Origin note: The relevant guidelines and standards should be more than just these EPA guidelines, and should be agreed before any report is finalised.]***

Annex F

Dataroom Documentation



No	CAPACITY	PRODUCT	TYPE
T1	58,900L	PETROL	UST
T2	33,500L	DIESEL	UST
T3	NOT KNOWN	LEADED PETROL	UST

T3 DECOMMISSIONED 1983. EXACT LOCATION NOT KNOWN

SCHEDULE OF TANKS

ISSUE	DATE	AMENDMENTS	DRAWN	CHECKED
01		ORIGINAL ISSUE		

NOTES

GEO-LOGIX PTY LTD
UNIT 2309, 4 DAYDREAM STREET, WARRIEWOOD NSW 22102
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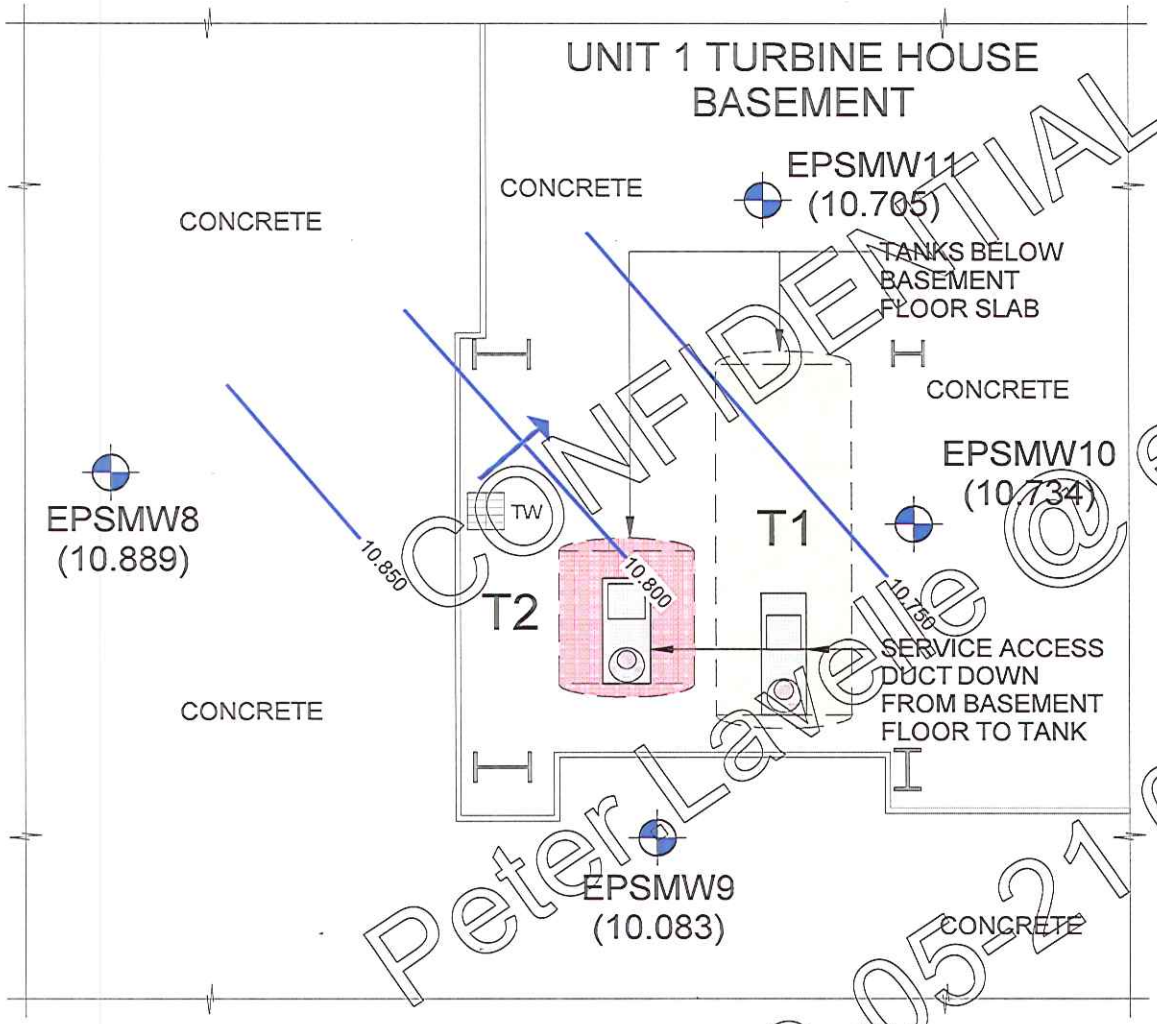
Fax: (02) 9979 1222

DRAWN: J.E.D. | CHECKED: B.P.
APPROVED: D.G.
DATE: 31/08/2011

GROUNDWATER ELEVATION MAP
ERARING POWER STATION STORES BUILDING UPSS
ROCKY POINT ROAD, ERARING, NSW 2264

SHEET SIZE: A3 | PROJECT No. 1101018 | REV 01 | FIGURE 3



SITE LOCATION PLAN

N

No	CAPACITY	PRODUCT	TYPE
T1	50,000L	LUBE OIL	UST
T2	20,000L	WASTE OIL	UST

SCHEDULE OF TANKS

BUILDING AS NOTED
LUBE OIL UST
WASTE OIL UST
TW — TRADE WASTE DRAIN
EPSMW8 (10.889) — EPS GROUNDWATER MONITORING WELL
10.850 — GROUNDWATER ELEVATION (m) AHD
GROUNDWATER FLOW DIRECTION

LEGEND

0 5 10m

SCALE

ISSUE	DATE	AMENDMENTS	DRAWN	CHECKED
01		ORIGINAL ISSUE		

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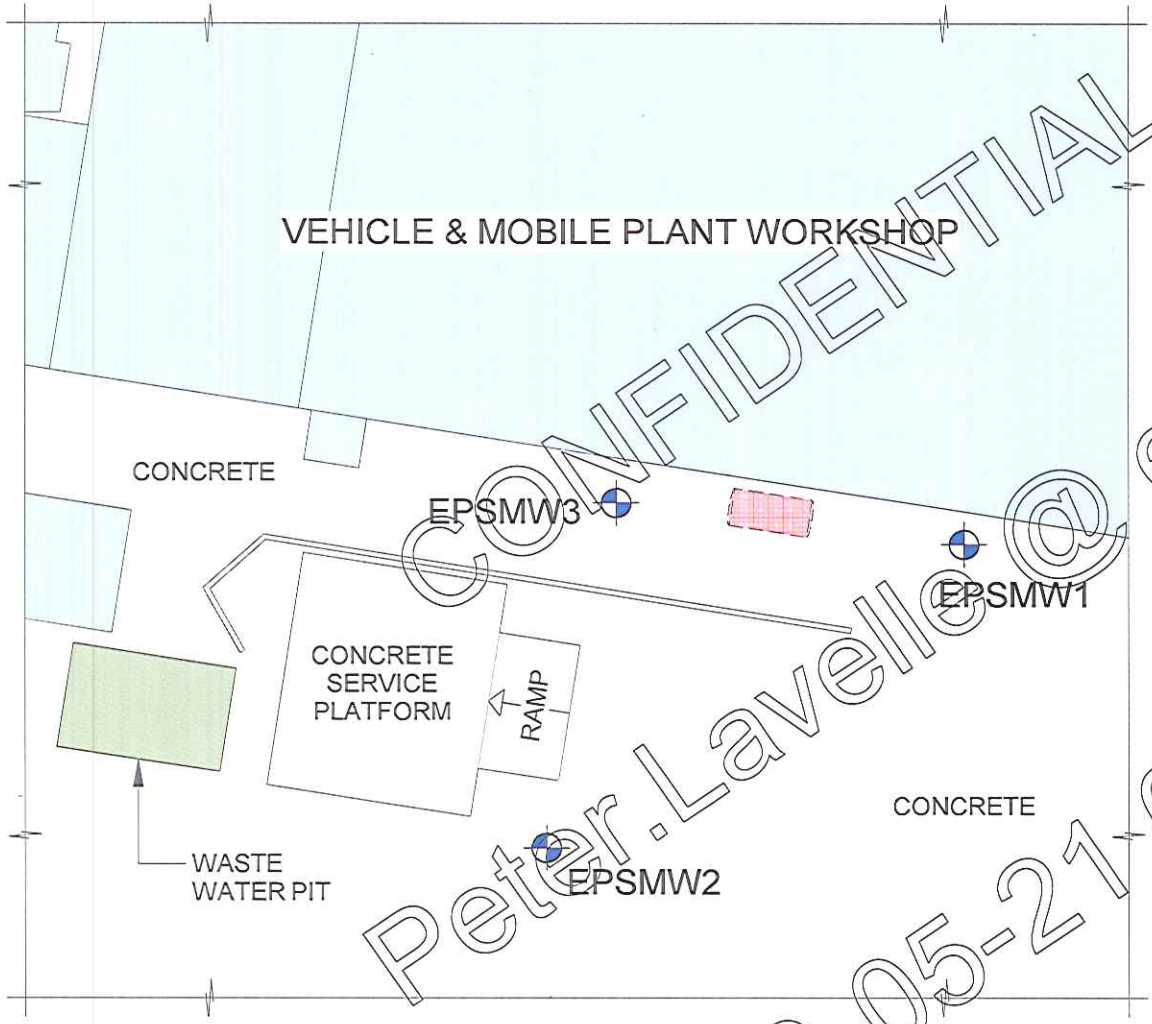
DRAWN:	CHECKED:
J.E.D.	B.P.
APPROVED:	B.P.
DATE:	31/08/2011

GROUNDWATER ELEVATION MAP
ERARING POWER STATION - TURBINE HOUSE BASEMENT
ROCKY POINT ROAD, ERARING, NSW 2264

SHEET SIZE:	PROJECT No.	REV:	
A4	1101018	01	FIGURE 3



SITE LOCATION PLAN

No	CAPACITY	PRODUCT	TYPE
T1	5,000L	WASTE OIL	UST

SCHEDULE OF TANKS

BUILDING AS NOTED

WASTE OIL UST

EPSMW1 EPS GROUNDWATER MONITORING WELL

LEGEND

0 5 10 15m

SCALE

ISSUE	DATE	AMENDMENTS	DRAWN	CHECKED
01		ORIGINAL ISSUE		

GEO-LOGIX PTY LTD
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J.E.D.	B.P.
APPROVED:	B.P.
DATE:	09/06/2011

SITE MAP
ERARING POWER STATION - VEHICLE & MOBILE PLANT WORKSHOP
ROCKY POINT ROAD, ERARING, NSW 2264

SHEET SIZE: A4 | PROJECT No. 1101018 | REV: 01 | FIGURE 2

Indicative Surface Water Flows Map—1 of 2

Truck Wash Down Area

Dense phase bottom ash slurry

Treated water from oil/water separator (2 pipes). One pipe option to divert to Ash Dam.

Oil Retention Lagoon

Holding Pond overflow

From Boomerarng Pond

Transfer Pond

From o/w separator

Old bottom ash sluiceway to ash dam

From Sewerage Plant, o/w separator and runoff

Fuel Oil Loading Area—2x Oil/ Water Separators

To Ash Dam from Demin Plant Effluent Pits (not actual route)

2x Coal Collection Ponds

Boomerang pond pumping pit to ash dam

70ML Reclaimed water storage tanks

Rising main to effluent disposal area

Boomerang Pond — Final point for Coal Stockpile area drainage.

Sausage Pond

Creek Diversion

Silt Trap

Conveyor M1 Silt Trap

Return Water Dam

Seepage

Seepage

Oil Containment Pond—1ML

Return Water

Boomerang Pond overflow to outlet canal.

Oil Water Separator

Return Water Tank

Weir

Crooked Creek

Seepage collection

CCP Plant

From Return Water Dam

Effluent Holding Tank (able to act as reserve return water tank)

Weir

Weir

C2 Pit

C4 Pit (Emergency pump out) to oil/water separator or truck)

Switchyard management by Transgrid

C3 Pit (Emergency pump -out)

Wastewater Pump Station

C1 Pit

Demin Plant Effluent Pits pumped to Ash Dam

Muddy Lake Settling Basin

Treated effluent to Outlet Canal

Over/under weir

Both drains exit via spillways

Oil Retention Weir + Platform with Oil on Water detector

Return Water emergency discharge to Glory Hole

Low Level Outlet Canal Discharge via Glory Hole

Tail out drain

To Receiving Waters: Muddy Lake

High Level Intake Canal

Outfall Tunnel from Glory Hole to Myuna Bay

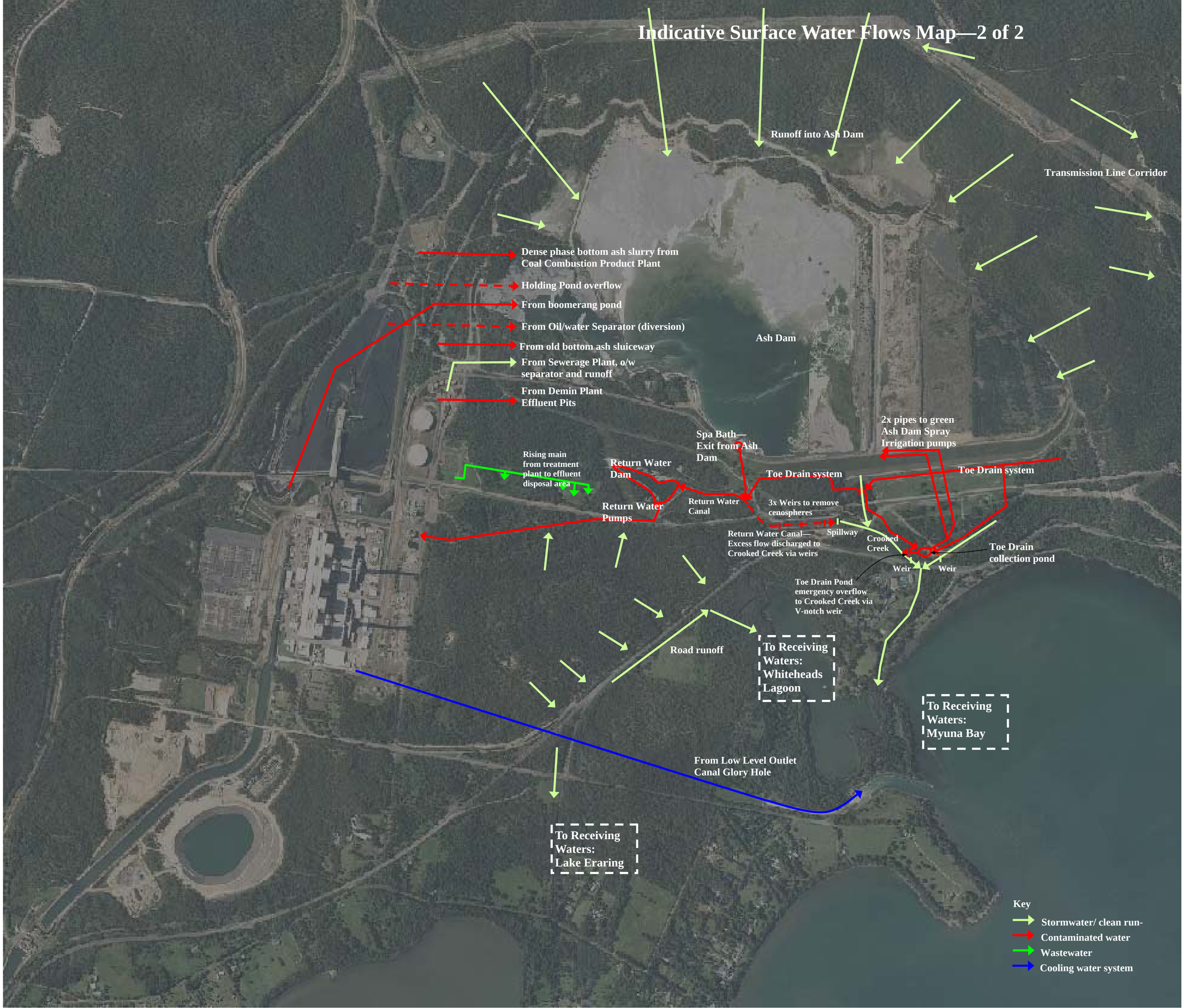
To Receiving Waters: Lake Eraring

Attemperation Reservoir

Key

- Stormwater/ clean runoff water
- Contaminated water
- Wastewater/ Treated water
- Cooling water system

Indicative Surface Water Flows Map—2 of 2



Annex G

Asbestos Register

Eraring Power Station Asbestos Containment Register

Description / Location	Exposure Evaluation*	Risk Ranking	Inspection methods**	Control Method***	Date of Follow up inspection	Condition of asbestos at inspection	Management Strategy	Responsible Person
Turbine & Associated Plant								
High Pressure Cylinder Inspection Gaskets Unit 1: removed 03/2004 Unit 2: removed 1993 outage Unit 3: removed 09/2002 Unit 4: Scheduled for removal 2005 outage	Risk - Negligible Asbestos bonded into gasket, gasket under compression.	6	• Maintenance history • Documented Design specifications	Removal	Not required Inaccessible		Removal of remaining gaskets will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual.	Turbine Plant Owner
High pressure cylinder inspection flange gaskets – unit 4	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression	6	• Documented Design specifications	Defer	Not required inaccessible		No proposal for disposal	Turbine Plant Owner
High pressure cylinder casing key cover flange gaskets - unit 4	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression	6	• Documented Design specifications	Defer	Not Required inaccessible		No proposal for disposal	Turbine Plant Owner
Main Steam Pipework Pipe support clamps for the pressure transmitter lines leading from the main steam pipework upstream of the main turbine stop valves – units 1,2,3,& 4.	Risk Ranking – Negligible. Asbestos bonded to pipe support clamp & covered by lagging.	6	• Documented Design specifications	Defer	Not required inaccessible		No proposal for disposal	Turbine Plant Owner
Gland steam regulator high pressure steam valve seat – units 1,3 & 4	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression	6	• Documented Design specifications	Defer	Not required inaccessible		No proposal for disposal	Turbine Plant Owner
Air Compressor Plant HP & LP outlet connections contain gaskets comprised of asbestos material (Klingerite AAA)	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression.	6	• Documented Design specifications • Maintenance history	Defer	Not Required inaccessible		Gaskets to be replaced during routine plant maintenance. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Turbine Plant Owner
Condensate Extraction pumps main bearing are lubricated by Ferrobestos grease which is impregnated with asbestos	Risk Ranking: negligible Bearing and grease sealed inside of condensation pumps	6	• Documented design specifications	Removal	Not Required inaccessible		Alternative materials are now available. Existing Ferrobestos material will be removed as per routine maintenance requirements. Removal will be undertaken in accordance with	Turbine Plant Owner

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Information on removal of Asbestos – Code of Practice for the Safe Removal of Asbestos 2nd Addition.
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							"Asbestos Removal" Guidelines in Section 2 of Safety Manual	
Hydrogen Plant Cell diaphragms separating the electrolyte are made of asbestos materials.	Risk Ranking - Negligible Diaphragms immersed in electrolyte	6	• Documented design specifications	Removal	Not required inaccessible		Diaphragms will be disposed of when the plant is decommissioned. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual.	Turbine Plant Owner
ACW waste water drains from the CW Air Removal Pumps to the CW Outfall Canal	The asbestos drain pipes previously protruded above the concrete floor	Low	• Safety walk down of the area asked for the pipe material to be confirmed. Material later confirmed to be asbestos	Engage and approved asbestos removal contractor to cut off the exposed pipes and permanently seal the pipe ends	1/10/2011	Pipe ends confirmed to be effectively sealed	CW Plant Owner perform 6 monthly inspections	CW Plant Owner
Boiler								
Blow Down Lines – all Units Gaskets contain bonded asbestos material	Risk Ranking – Negligible Asbestos bonded into gaskets – gaskets under compression	6	Gaskets cannot be inspected when in service	Removal	Not required inaccessible		Gaskets will be replaced as required by routine maintenance procedures. Removal will be undertaken as per "Asbestos Removal" Guideline in Section 2 of the Safety Manual	Boiler Plant Owner
Burner Scroll Gaskets – Unit 1 and 3 Gaskets contain bonded asbestos material	Risk Ranking – Negligible Asbestos bonded into gaskets – gaskets under compression	6	Gaskets cannot be inspected when in service	Removal	Not requires inaccessible		Gaskets will be replaced as required by routine maintenance procedures. Removal will be undertaken as per "Asbestos Removal" Guideline in Section 2 of the Safety Manual	
ID Fans (A + B) – Units 1 to 4 Gaskets in sight glasses on Bearing Lube oil in system contain bonded asbestos material	Risk Ranking – Negligible Asbestos bonded into gaskets – gaskets under compression	6	Gaskets cannot be inspected when in service	Removal	Not requires inaccessible		Gaskets will be replaced as required by routine maintenance procedures. Removal will be undertaken as per "Asbestos Removal" Guideline in Section 2 of the Safety Manual	

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PA Fans (A + B) – Unit 1 to 4 Gaskets in sight glasses on bearing lube oil systems contain bonded asbestos material	Risk Ranking – Negligible Asbestos bonded into gaskets – gaskets under compression	6	Gaskets cannot be inspected when in service	Removal	Not requires inaccessible		Gaskets will be replaced as required by routine maintenance procedures. Removal will be undertaken as per "Asbestos Removal" Guideline in Section 2 of the Safety Manual	
Electrical								
240V DC Motor Starters and Switchboards CFS Units contain bonded asbestos cement insulating barriers	Risk Ranking - Negligible Asbestos bonded into insulation components. All components sealed within CFS unit.	6	• Documented records, • visual inspection • analysis of material sample	Removal	Not required inaccessible	Complete all asbestos removed	Removal and replacement of all CFS units containing asbestos as practicable during unit outages. Removal will be undertaken as per "Asbestos Removal Guidelines in Section 2 of the Safety Manual	Electrical Plant Owner
DC Motor Starters and Switchboards DC contactor arc chutes	Risk Ranking: 3 Components not easily accessible	3	• Documented records • visual inspection • analysis of material sample February 2005 (I & C Electrical Group maintain records of material analysis)	Removal	Not required inaccessible	Complete all asbestos removed	Removal and replacement of all CFS units containing asbestos as practicable during unit outages. Removal will be undertaken as per "Asbestos Removal Guidelines in Section 2 of the Safety Manual	Electrical Plant Owner
Generator Transformer (Tyree) 500kV/23kV & 330kV/23kV Generator Transformers - John's wedge gate valves have graphited asbestos cord packing & bonded asbestos gaskets Transformer Boggie wheel assembly . Bearing contains ferobestos (asbestos reinforced plastic)	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression. Packing enclosed in stuffing box. Risk ranking negligible, asbestos bonded into plastic and contained in bearings.	6	• Documented Design specifications	Defer	Not required inaccessible		Gaskets and packing to be replaced when valves overhauled, Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual Bearings to be replaced upon failure. Removal will be undertaken in accordance as per 'Asbestos removal guidelines in section L of the safety manual'.	Electrical Plant Owner
Auxiliary Transformer 23kV/11kV Auxiliary Transformer –John's wedge gate valves have graphited asbestos chord packing & bonded asbestos gaskets	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression. Packing enclosed in stuffing box.	6	• Documented Design specifications	Defer	Not required Inaccessible		Gaskets and packing to be replaced when valves overhauled. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Electrical Plant Owner

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Station Transformer 33kV/11kV Station Transformer – John's wedge gate valves have graphited asbestos cord packing & bonded asbestos gaskets	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression. Packing enclosed in stuffing box.	6	• Documented Design specifications	Defer	Not required Inaccessible		Gaskets and packing to be replaced when valves overhauled. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Electrical Plant Owner

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Unit Transformers 11kV/3.3KV Unit Transformers – John's wedge gate valves have graphited asbestos cord packing & bonded asbestos gaskets	Risk Ranking - Negligible Asbestos bonded into gasket – gasket under compression. Packing enclosed in stuffing box.	6	• Documented Design specifications	Defer	Not required Inaccessible		Gaskets and packing to be replaced when valves overhauled. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Electrical Plant Owner
Transformers Gas filled transformers – asbestos rope gaskets used within transformer	Risk Ranking: Negligible Asbestos bonded into gasket – gasket under compression. Packing enclosed in stuffing box.	6	• Documented Design specifications	Defer	Not required Inaccessible		Gaskets and packing to be replaced when valves fail. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Electrical Plant Owner
T1 and T2 Crane Brakes	Risk Ranking: 3 Components not easily accessible.	3	• Documented Design specifications	Removal	Not required inaccessible		Brake linings to be replaced under new crane contract schedule 2013	Electrical Plant Owner

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Generator phase isolated busbar asbestos sheet in the internal segregation panels	Risk Ranking - Negligible Enclosed in welded panel.	6	• Documented Design specifications	Defer	Not required inaccessible		No proposal for removal	Electrical Plant Owner
Siemens Controls & Instrumentation asbestos packing used in all instrument valves	Risk Ranking: 3 Packing enclosed in stuffing box.	3	• Documented Design specifications	Defer	Not required inaccessible		Packing to be replaced when valves overhauled. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Electrical Plant Owner
Small Communication Electrical Pits Pits installed during construction of Power Station may contain asbestos cement	Risk Ranking: 3 Asbestos bonded into cement.	3	• Documented Design specifications	Defer	Not required inaccessible		The pits accessed infrequently. A visual inspection of their condition should be made before accessing.	Electrical Plant Owner
Generator rotors Unit 2 & 4 may contain asbestos in end winding blocking and other components.	Risk Ranking - Negligible Sealed inside generator enclosure	6	• Documented Design specifications • Maintenance history	Defer	Not required inaccessible		No proposal for removal	Electrical Plant Owner
Generator stators Generator stators may contain asbestos in :- a) Connection between top and bottom coils b) Coil ends c) Coil in stator slot: Asbestos tape (one layer) is used between layers of paint d) Within the terminal box: A compound containing asbestos where there are fasteners for smoothing.	Risk Ranking - Negligible Sealed inside generator enclosure	6	• Documented Design specifications • Maintenance history • Visual on removal	Defer	Not required inaccessible		No proposal for removal	Electrical Plant Owner
110VDC Unit Auxiliaries Switch board Basement adjacent to LP bypass hydraulic pump station	Risk Ranking - Negligible Sealed inside metal switch gear	6	• Visual on removal	Remove	Not required inaccessible	Asbestos is contained within metal clad switch gear. Cabinets will be signposted.	Remove and replace with composite products Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual.	Electrical Plant Owner

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Eraring Power Station Asbestos Containment Register

Chemical Section								
Bulk Caustic & Acid Tanks Asbestos Sealing Gaskets used inside tanks	Asbestos bonded into gasket – gasket under compression.	6	• Documented Design specifications	Defer	Not required inaccessible		No proposal for disposal	Chemical Plant Owner
Contaminated Water System (asbestos cement) all subterranean pipe work including rising mains no 2, 3 and 4 and the disused No 1 main (approx 10 metres of No 1 is exposed and approximately 10 metres of No 4 is exposed)	Asbestos is bonded into cement and is mostly buried.	6	• Documented design specifications • Visual inspection of exposed pipework.	Defer	14/ 3 /2008	Cement was in good condition at last inspection	Exposed pipe work to be inspected and sealed if necessary. Subterranean pipework to be replaced when maintenance required. Inspections will be conducted 3 yearly as asbestos cement work is not in a normal access area and is submerged or wet.	Chemical Plant Owner
Condensate Polishing Plant Unit 1 – 4 Vessel air release drains/sumps asbestos cement pipework	Aurecon Report 201663 27/7/11 stated "very unlikely airborne asbestos would be detected during normal operation	4 will be 6 once repairs complete	• Aurecon occupational hygienist conducted full survey July 2011 • Yearly inspections by plant owner after repairs complete	• Repair drain pipes • Seal edges • Erect warnin g signs	December 2011	• Drains 2C, 4A, 4B, 4C the worst • Refer report from Aurecon Trim DOC11/25 1478	• Repair drain pipes • Seal edges • Erect warning signs • Yearly inspections by plant owner after repairs complete	Chemical Plant Owner
Polishing Vessels (all polishers, all Units) • Access door gasket for the lower section of the polishing vessels contains asbestos. • Base gaskets for the strainers inside the polishing vessel contain chrysotile asbestos	Asbestos bonded into gasket – gasket under compression.	3	• Documented Design specifications	Defer	Not required inaccessible		Gaskets to be replaced when maintenance work is carried out. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of	Chemical Plant Owner

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Eraring Power Station Asbestos Containment Register

Coal Plant								
Stacker Reclaimer cable reel brakes are asbestos lined	Risk Ranking: 3	3	• Documented Design specifications	Remove	Not required inaccessible		Scheduled for removal in 2005. Removal will be undertaken as per "Asbestos Removal" Guidelines in Section 2 of Safety Manual	Coal Plant Owner
M1 & C1 auto coal samplers M1 & C1 auto coal samplers elevator motor brakes – brakes incorporated in motor assembly may contain asbestos	Risk Ranking: 3 Motor assembly has only ever been replaced as a complete unit.	3	• Documented Design specifications • maintenance history	Defer	Not required inaccessible		To be removed when plant maintenance is required. Motor maintenance contractor to be advised of the possibility of asbestos in motor assembly.	Coal Plant Owner
Ash & Dust								
Fly ash slurry disposal pipelines are asbestos concrete	Risk Ranking: 3 Asbestos is bonded into concrete.	3	• Visual Inspection • Documented Design specifications	Defer	14 / 3 / 2006	Outer skin (tapping) of bonding agent has started to deteriorate in some places, inner is in good condition.	Pipelines have been encapsulated by Gardner Perrot in 1998 and then sealed by Astra Roof Maintenance in May 1998. Annual inspection to confirm the integrity of the encapsulation	Ash and Dust Plant Owner
Return water pipelines Are asbestos cement	Risk Ranking: 3 Asbestos is bonded into concrete and mostly buried.	3	• Visual Inspection at pit locations • Documented Design specifications	Defer	14 / 3 / 2008	Concrete is in good condition	3 yearly visual inspection to be conducted at pit locations	Ash and Dust Plant Owner
Make up water pipelines Are asbestos cement	Risk Ranking: 3 Asbestos is bonded into cement and buried.	3	• Visual Inspection • Documented Design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Ash and Dust Plant Owner
Return water mains Return water mains from the return water dam to the return water tank is asbestos concrete.	Risk Ranking: 3 Asbestos is bonded into concrete and mostly buried.	3	• Visual Inspection • Documented Design specifications	Defer	14 / 3 / 2007	Concrete is in good condition	Pipelines to be inspected and if necessary encapsulated. Annual inspection to confirm the integrity of pipeline or the encapsulation	Ash and Dust Plant Owner
Return water make up Return water make up mains from the Glory Hole to the return water tank (asbestos Cement)	Risk Ranking: 3 Asbestos is bonded into concrete and mostly buried.	3	• Visual Inspection • Documented Design specifications	Defer	14 / 3 / 2007	Concrete is in good condition	Pipelines to be inspected and if necessary encapsulated. Annual inspection to confirm the integrity of pipeline or the encapsulation	Ash and Dust Plant Owner

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Eraring Power Station Asbestos Containment Register

Fire Services								
Fire doors all fire doors installed during construction possibly contain asbestos cores	Risk Ranking: 6 Encapsulated in door frame	6	• Documented Design specifications • Visual inspection	Defer	Doors inspected as part of routine inspections	Doors replace as required	Fire doors to be replaced if damaged.	Fire Services Plant Owner
Civil								
Ash Dam Embankment All Toe Drain foundation drainage systems apart from the obvious plastic pipes are asbestos cement.	Risk Ranking: Negligible Asbestos is bonded into cement and buried.	6	• Documented design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Civil Group
Waste Water System All waste water systems with the exception of workshops and the administration buildings are made from asbestos cement.	Risk Ranking: Negligible Asbestos is bonded into cement and buried.	6	• Documented design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Civil Group
Residential Housing Asbestos sheeting in residential houses	Risk: minimal providing inspections are carried out.	3	• Documented design specifications • Visual Inspection	Defer	Not required inaccessible		Refer to Asbestos Survey and Management Plan Rental Properties Final Report dated 5 August 2006	Civil Group
Stormwater Drainage Any stormwater drains under 600mm diameter are asbestos cement.	Risk Ranking: negligible Asbestos is bonded into cement and buried.	6	• Documented design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Civil Group
Fresh water system / fire water system All 100mm water main that supplies Cooranbong mine is asbestos Cement.	Risk Ranking: negligible Asbestos is bonded into cement and buried.	6	• Documented design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Civil Group
Valve Key risers that form access to operate valves appear to be asbestos cement in some areas	Risk Ranking: negligible Asbestos bonded into cement and mostly buried.	6	• Documented design specifications • Visual Inspection	Defer	14/3/2008	Visible cement work in good condition	Keyrisers to be inspected 3 yearly to confirm their integrity	Civil Group
CW Screens Area the 600mm Spray water supply from the H.L.I.C is asbestos cement	Risk Ranking: negligible Asbestos bonded into cement and buried.	6	• Documented design specifications	Defer	Not required inaccessible		Pipelines are all buried underground	Civil Group

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Northern & Southern Asbestos Disposal Sites	Risk Ranking – Negligible as Asbestos buried in allocated disposal sites	6	• Refer to DOC06/152358 and drawings ER749609 and Er569955	Defer	Not required as asbestos inaccessible. Annual inspection of site in June of each year	Asbestos is buried at two locations with barrier fences and signage	Maintain signage and barrier fencing	Civil Plant Owner

Note: names of all contractors that have worked on asbestos containing materials can be identified through induction and work activity records.

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