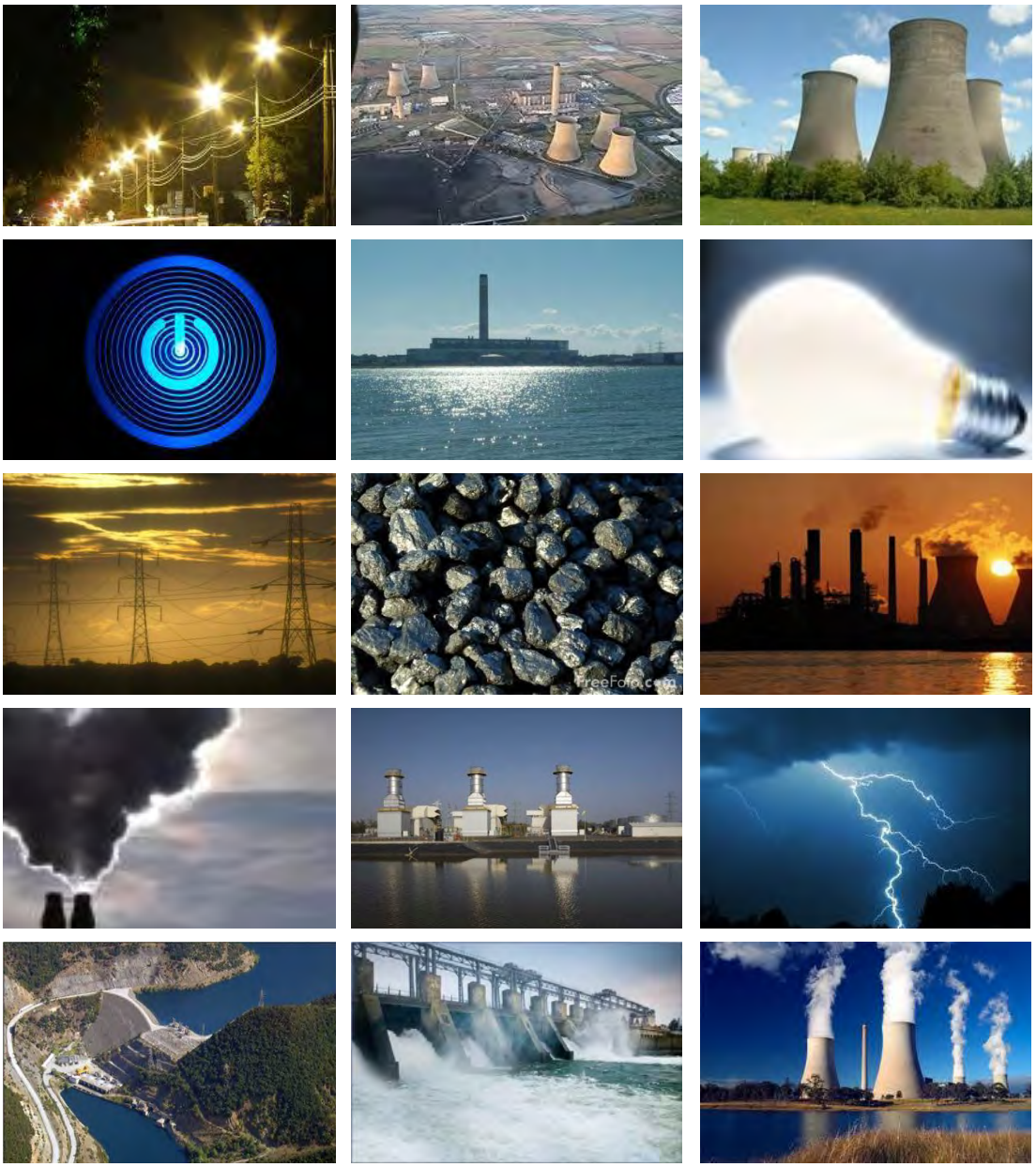
Macquarie Generation



COMMERCIAL IN CONFIDENCE

Macquarie Generation – Project Symphony

Bayswater Power Station

Preliminary Environmental Site Assessment

Ref: 0213879RP01_DRAFTRev02

October 2013

The world's leading sustainability consultancy

ERM

COMMERCIAL IN CONFIDENCE

Bayswater Power Station

Preliminary Environmental Site Assessment

Macquarie Generation - Project Symphony

October 2013

Approved by:	Joseph Ferring
Position:	*Project Manager*
Signed:	*DRAFT*
Date:	18 October 2013
Approved by:	Matthew Klein
Position:	*Managing Partner – Asia Pacific Transaction Services*
Signed:	*DRAFT*
Date:	18 October 2013

Environmental Resources Management Australia Pty Ltd Quality System

0213879RP01_DRAFT Rev02

www.erm.com

CONTENTS

CONTENTS

CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

ERM was engaged by Macquarie Generation 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 Macquarie Generation. The subject of this report is the Bayswater Power Station.

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

- *assess the nature and extent of potential soil and groundwater contamination issues which may be present at the Site;*
- *develop a preliminary Conceptual Site Model; and*
- *develop an abridged Sampling, Analysis and Quality Plan (SAQP) for the future intrusive investigations required to establish a baseline of soil and groundwater conditions present at the Site to support the potential sale of the Site.*

ERM has undertaken this Preliminary Environmental Site Assessment (ESA) which includes background research from a variety of sources as well as management and staff interviews and site visits.

The Preliminary ESA identified a number of potential contamination sources, of which several were determined as Areas of Environmental Concern (AECs) as follows in no particular order:

- *brine concentrator holding pond (potential seepage of brine);*
- *brine concentrator decant basin (historical seepage of brine);*
- *fuel oil installation (potential leaks);*
- *vehicle refuelling depot (potential leaks);*
- *coal storage area (historical and potential leaks);*
- *coal unloaders, rail infrastructure and coal transfer lines (potential and historic leaks);*
- *contaminated water treatment plant (potential leaks);*
- *cooling water treatment plants (historical and potential leaks, releases to ground);*
- *demineraliser plant (historical and potential leaks);*
- *former contractor staging area (potential spills, leaks and undocumented fill material);*
- *former large items assembly area ((potential spills, leaks and undocumented fill material);*

- *generator transformer areas (large volume of transformer oil used and stored);*
- *landfill (unknown waste disposal, potential for leaching to occur);*
- *lime softening plant (storage of chemicals, potential for leaks);*
- *lime softening plant sludge lagoons (disposal of spent softening plant sludge and potential for leaching);*
- *mobile plant maintenance and refuelling (historical leaks and spills of diesel fuel and lubricants, potential leak of waste oil);*
- *Pikes Gully Ash Dam (seepage to groundwater and surface water receptors);*
- *Ravensworth Rehabilitation Area (seepage to groundwater and surface water receptors);*
- *high pressure pumping station (potential leaks/spills of transformer oil);*
- *low pressure pumping station (potential leaks/spills of transformer oil);*
- *main store – dangerous goods storage area (potential leaks/spills and release through sump/dam);*
- *power block (historical and potential leaks of various chemicals); and*
- *Lake Liddell sediments (sediments may have accumulated contaminants from Liddell Power Station drainage and discharges over a lifetime of station operation and precipitation of calcium carbonate).*

Based on the results of the Preliminary ESA undertaken by ERM and consideration of Macquarie Generation'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 judgemental (targeted) sampling of soil, groundwater and sediments at the established AECs for the Site, which is also considered to provide suitable spatial coverage to act as a baseline assessment.

LIST OF ABBREVIATIONS

AEC	Area of Environmental Concern
ACM	Asbestos Containing Materials
AHD	Australian Height Datum
ANZECC	Australia and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASLP	Australian Standard Leaching Procedure
AST	Above-ground Storage Tank
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CEC	Cation Exchange Capacity
COPC	Contaminant of Potential Concern
DNAPL	Dense, Non-Aqueous Phase Liquid
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EDD	Environmental Due Diligence
EIL	Ecological Investigation Level
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environment Protection Authority
EP&A	Environmental Protection and Assessment
EPL	Environment Protection Licence
ERM	Environmental Resources Management
ESA	Environmental Site Assessment
ESL	Ecological Screening Level

HIL	Health Investigation Level
HSL	Health Screening Level
LDPE	Low-Density Polyethylene
LEP	Local Environmental Plan
LGA	Local Government Area
LNAPL	Light, Non-aqueous Phase Liquid
m bgl	metres below ground level
m btoc	metres below top of casing
MGA	Map Grid of Australia
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NSW	New South Wales
OEH	Office of Environment and Heritage
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PID	Photo-ionisation Detector
PRP	Pollution Reduction Plan
PSH	Phase Separated Hydrocarbon
QA/QC	Quality Assurance and Quality Control
RCU	Rail Coal Unloader
RFP	Request for Proposal
RIVM	Netherlands National Institute of Public Health and the Environment
RO	Reverse Osmosis

SAQP	Sampling, Analysis and Quality Plan
SOC	State-Owned Corporation
SOP	Standard Operating Procedure
SPR	Source-Pathway-Receptor
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRH	Total Recoverable Hydrocarbons
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VEDD	Vendor Environmental Due Diligence
VOC	Volatile Organic Compound

1 INTRODUCTION

1.1 BACKGROUND

On 24 November 2011, the New South Wales (NSW) State Government (Government) announced that it would divest certain State-owned electricity generation assets..

In order to support the sale of certain electricity generation assets owned and operated by Macquarie Generation (a State Owned Corporation – SOC), ERM were engaged 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. The subject of this report is Bayswater 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; and
- 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.

This Preliminary Environmental Site Assessment (ESA) comprises Stage 1 of the overall assessment, with Stage 2 comprising a detailed ESA in order to achieve the overall project objectives stated above.

1.3 SCOPE OF WORK

The scope of this Preliminary ESA was presented in the ERM proposal dated 3 July 2013 and included the following key elements:

- development of a site history via interviews with employees and review of information such as:
  - relevant documents identified by employees;
  - 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*;

- aerial photographs; and
- civil engineering works records.

- review of existing soil and groundwater reports;
- desktop assessment of the environment in which the Site is set such as site drainage, geology, hydrogeology and soil conditions at the Site and surrounding areas;
- inspection of the Site;
- identification of actual and/or potential soil and groundwater Areas of Concern (AECs) via:
  - identification of past and present potentially contaminating activities at, and adjacent to, the Site;
  - identification of potentially impacted areas;
  - identification and assessment of the chemicals of potential concern (COPCs) that may have been associated with historical and current use of the Site;
  - evaluation of the possible migration pathways of the COPCs;
  - assessment of the sensitivity of surrounding areas and/or property; and
  - compiling a preliminary Conceptual Site Model (CSM).
- Identifying where Stage 2 intrusive investigations are necessary on each site and, more specifically:
  - 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.

Spatially, the scope of ERM's assessment was limited to those areas shown within the Site boundary presented in *Figures 1* and *2* of *Annex A*.

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.

In other words, in identifying contamination sources, ERM sought to define actual or potential sources where costs of remediation or management of the sources as required by regulators would exceed $0.5M (+ GST if applicable). 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 presented in the following sections.

1.5.1 Project Initiation Meeting

In order to ensure that ERM and Macquarie Generation were fully aligned in terms of the scope and anticipated deliverables, the key members of the ERM project team attended a project initiation meeting with Macquarie Generation and NSW Treasury at the Site.

1.5.2 Review of Existing Data

Relevant environmental information on Bayswater Power Station was made available to ERM via an electronic dataroom.

In addition, ERM conducted background research using publicly available information on the Site. Background research included those items identified in *Section 3*, and *Annex D*. Following discussions with Macquarie Generation and given the timescale of this assessment, the large number of lots comprising the Site, the good level of information available on the history of the Site available from both knowledgeable Macquarie Generation personnel and a review of historic aerial photography (refer to *Section 3.2*) a search of historic land titles and S. 149 certificates has not been undertaken.

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*).

1.5.3 Site Visits and Management Interviews

ERM mobilised to site and completed site management interviews and a site visit to Bayswater Power Station on 15 and 16 August 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.

During the site visit, discussions and interviews were undertaken with the following staff:

- Environmental Manager – Mr. Howard Richards (environment team manager for both stations, based at Liddell Power Station);
- Environment Officer – Mr. Matthew Parkinson (environment specialist for Bayswater Power Station, based at Bayswater Power Station);
- Environment Officer – Ms. Elle Hutchinson (environment specialist for Bayswater Power Station, based at Bayswater Power Station);
- Electrical Engineer – Mr. Trevor Woolley (Bayswater Power Station); and
- Site Engineer – Mr. John Bennetts (Liddell and Bayswater Power Stations).

1.5.4 Preparation of Stage 1 ESA Reports

The Stage 1 ESA Reports were prepared in general accordance with the *Guidelines for Consultants Reporting on Contaminated Sites* (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) 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 Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1), the* Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 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 REPORT STRUCTURE

This report has been structured in order to align generally with the requirements for a Preliminary Environmental Site Assessment outlined in 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

Macquarie Generation owns and operates two large conventional coal-fired power stations in the Hunter Valley region of New South Wales. Liddell Power Station and Bayswater Power Station are located within three kilometres (km) of each other on either side of the New England Highway, approximately 25 km north-west of the township of Singleton and approximately 10 km to the south-east of the township of Muswellbrook. The two power stations share some infrastructure such as coal and water supply.

A site location plan is provided as *Figure 1* of *Annex A*. The approximate coordinates of Bayswater Power Station are 307 144 m E and 6 413 998 m S. The Lot and Deposited Plan (DP) information relevant to the Site is outlined in *Annex C*. ERM notes that this information is considered to be preliminary at the time of preparation of this report as the Macquarie Generation ownership boundaries are in the process of being clarified.

Based on the possible separation of assets between Bayswater and Liddell Power Stations as set out in *Proposed Liddell & Bayswater B Subdivision* (Chelace GIS, 2013), the shared infrastructure has been allocated as follows:

- the land associated with the water transfer lines and coal transfer lines between the power stations have been separated by assessing the portions located within the boundaries of the respective sites as indicated on *Figure 3* of *Annex A;*
- Antiene Rail Coal Unloader (RCU) and Ravensworth RCU have been assessed as part of Bayswater Power Station; and
- Lake Liddell has been assessed as part of Bayswater Power Station.

2.2 SITE DESCRIPTION

2.2.1 *Overview*

Bayswater Power Station received development approval from Muswellbrook Shire Council on 18 September 1980, with construction occurring between 1980 and 1986. The power station was commissioned in 1986.

Photographs of the Site are presented in *Annex B*.

2.2.2 *Site Layout*

According to information provided by Macquarie Generation, Bayswater Power Station is one of Australia's largest power stations. The total site area of Bayswater Power Station is approximately 8 300 hectares (ha), including the Ravensworth Rehabilitation Area, Lake Liddell and surrounds and buffer lands not currently in active use . The power station operational area itself occupies approximately 300 ha, which includes the Pikes Gully Ash Dam. A plan showing the layout of the operational area is provided as *Figure 2* of *Annex A*.

Bayswater Power Station comprises four coal-fired units (Units 1 to 4, each generating 660 MW) which have a combined generating capacity of 2,640 MW for the station. Further information on electricity generation and distribution processes is presented in *Section 4*.

The Site is composed of the following key features:

- Bayswater Power Station and associated infrastructure;
- Pikes Gully Ash Dam, located approximately 200m to the east and associated pipelines for ash slurry and return water;
- Ravensworth Rehabilitation Area (fly ash disposal), including the former Ravensworth No.2 and Ravensworth South final voids, located approximately 8 km east south-east of the power station and associated ash delivery and return water system;
- coal conveyors transporting from Antiene RCU and nearby mines and between Liddell Power Station and the Site; and
- buffer lands surrounding the infrastructure described above;
- A 330 kV and 500kV switching station located to the south-west of the power block. This station switchyard is owned and operated by the transmission SOC TransGrid (assessment of conditions within the switchyard boundary is outside the scope of this report) ;

In addition to Lake Liddell, water is supplied from off-site storage facilities detailed in *Section 4*. Review of environmental conditions at these off-site water storage facilities is outside the scope of this report.

2.3 *TOPOGRAPHY*

The Site lies within a broad river valley created by the Hunter River and its tributaries. Whilst the general slope in the area is towards the Hunter River in the south, the topography is characterized by undulating hills that leads to high variability in slope direction across the Site.

The Bayswater Power Station operational area was identified to gently slope to the north with the main power block cut into the slope of a hill. The power block lies at an elevation of approximately 200 m above sea level, dropping to an elevation of approximately 170 m above sea level at the northern edge of the coal storage facility. The Pikes Gully Ash Dam lies at an elevation of approximately 170m above sea level, with the down gradient Pikes Gully valley sloping towards the east. The Ravensworth Rehabilitation Site lies at an elevation of 120 m above sea level, with the local topography highly disturbed by former mining operations.

2.4 GEOLOGY

The Site is located on the northern section of the Sydney Geological Basin and the 1:100 000 Hunter Coalfield geological map (Department of Mineral Resources 1993) indicates that the Bayswater Power Station is underlain by Permian age conglomerate, sandstone, siltstone and claystone of the marine derived Maitland Group.

While the majority of the Pikes Gully Ash Dam (see *Section 4.9.1* for a description of the ash dam) is located on the Mulbring Siltstone of the Maitland Group, the eastern most extent of the Pikes Gully Ash Dam is located on the sandstone, siltstone and minor coal bands of the Saltwater Creek Formation of the Wittingham Coal Measures, Singleton Supergroup.

The 1:100 000 Hunter Coalfield geological map further indicates that Quaternary age alluvial sediments (consisting of silt, sand and gravel) are associated with the Bayswater Creek, Foy Creek and the Hunter River.

The Ravensworth Rehabilitation Site (in the location of the former Ravensworth No.2 Mine and a section of the Ravensworth South Mine, see *Section 4.9.2* for further details) is underlain by the Jerrys Plain Subgroup, Archfield Sandstone and the Foybrook Formation within the Wittingham Coal Measures. Together these sedimentary deposits consist of a sequence of sandstones, shales, mudstone, minor conglomerate and coal seams (Pacific Power, 1993).

The surface geology has been extensively disturbed by mining in the vicinity of the Ravensworth Rehabilitation Site. Much of the opencast mine workings at the Ravensworth Rehabilitation Site have been backfilled with mine spoil largely composed of course fragments (often boulders) of mudstone, siltstone and medium to fine grained lithic sandstone mixed together. In addition, the spoil contains coal from uneconomic seams which were included with the overburden material (Pacific Power, 1993).

This remnant coal is subject to spontaneous combustion which has been documented at the Site. Where mining has been completed at Ravensworth No.2 Mine, approximately 60 to 80 metres of disturbed overburden or mine spoil overlies the Archerfield Sandstone which forms the base of the opencast mine workings (Pacific Power, 1993). In addition, part of the Ravensworth No.2 Mine have been backfilled with fly ash (Voids 1 to 3) and coal preparation plant rejects (eastern ramp of Void 4) (Aurecon, 2012).

The Ravensworth Rehabilitation Site further occurs in a synclinal structure known as the Bayswater Syncline, with the axis of the syncline trending approximately north south along the centre of the mined area and plunging gently (1 to 2 degrees) to the south. The slopes on the flanks of the syncline dip gently (about 3 degrees) towards the centre. It is further noted that isolated basalt dykes or sills may occur within the stratigraphy in the general area (Pacific Power, 1993).

Bore logs for existing monitoring wells at the Site were not available for review at the time of preparation of this report; consequently local geology specific to various areas of the Site is not reviewed herein.

2.5 *HYDROGEOLOGY*

From a hydrogeology perspective, the sedimentary deposits can be categorised into the following units:

- Low permeability conglomerate, sandstone, siltstone and mudstone that comprise the majority of the Permian sediments.
- Low to moderately permeable coal seams, typically ranging in thickness from 2.5 m to 10 m, which are the prime water bearing strata within the Permian sequence.
- Medium to highly permeable Quaternary alluvial sediments associated with the Bayswater Creek, Foy Creek and the Hunter River.

Regional groundwater flow is expected to be towards the Hunter River located to the south of the Site. Due to the undulating nature of the topography, variation in localised groundwater flow directions are however probable with groundwater flow expecting to follow topography. Inferring localised groundwater flow from topography would suggest a northerly groundwater flow component at the Bayswater Power Station towards Lake Liddell, predominantly easterly groundwater flow at the Pikes Gully Ash Dam, westerly flow at the Landfill, westerly to north westerly at the Brine Concentrator Decant Basin, and predominantly southerly flow at Lime Softening Sludge Lagoons (refer to *Section 3.4.3* for a description of the aforementioned operational areas).

Groundwater flow at the Ravensworth Rehabilitation Site is predominantly towards the Hunter River (along the southerly dip of the Bayswater Syncline) with a minor component of lateral discharge to the Bayswater Creek and Foy Brook (Pacific Power, 1993).

The sediments of marine origin are responsible for the naturally highly saline groundwater in the area. Groundwater in the Permian coal measures is reportedly moderately to highly saline with total dissolved solids (TDS) levels that can be higher than 6 000 mg/L (Pacific Power, 1993). Water quality monitoring conducted in Void 4 (used as a water management storage system receiving drainage water from the surrounding voids and mine spoils) further indicate that salinity levels in water from Void 4 averaged approximately 4 600 mg/L (based on an average electrical conductivity of 7 079 µS/cm and a conversation factor of 0.65) during monitoring conducted in 2012 (Macquarie Generation, 2012).

2.6 GROUNDWATER USE

The NSW Natural Resource Atlas online bore register (accessed 14 August 2013) identifies groundwater bores within a 5 km radius of the Bayswater Power Station registered for dewatering purposes, industrial use and groundwater monitoring. Thirteen licensed bores were identified within a 5 km radius of the Site and are listed in *Annex D*. These bores were registered for various uses, comprising industrial, dewatering and test/monitoring purposes.

The NSW Natural Resource Atlas was also accessed for registered bores in relation to the Ravensworth Rehabilitation Site. Due to the large number of registered bores within a 5 km radius of this area (>150), the search area was reduced to 1km. Forty-one licensed bores were identified within a 1 km radius of the Ravensworth Rehabilitation Area and are listed in *Annex D*.

Four of the identified bores for the Ravensworth Rehabilitation Site are registered for domestic water supply purposes. These bores (GW046786 to GW046789) are located within 300 m to the east of the Ravensworth Rehabilitation Site, and have been installed at relatively shallow depths (<7 metres below ground surface) in alluvial sediments likely associated with the nearby Foy Creek. Note that these bores have been identified in close proximity to a residential property located at 7 and 9 Hebden Road (see *Section 2.8* for further details). Information provided verbally by Macquarie Generation indicated that this residential property is currently owned by Glencore Xstrata and the bores are no longer used for the registered purposes.

A bore licensed for irrigation stock use (GW024385, with an installation depth of 4.6 metres below ground surface and unknown lithology) was identified within approximately 600 m of the Ravensworth Rehabilitation Site to the east.

In addition, a bore licensed for industrial use with intended use specified as domestic stock use in the database (GW078054, with an installation depth of 16.2 metres below ground surface installed in sandstone) was identified within approximately 100 m of the Ravensworth Rehabilitation Site to the east. The remaining bores within a 1km radius of Ravensworth presented in *Annex D* are licensed for test bore purposes, dewatering, unknown purposes or as monitoring bores Current uses of these bores were unknown at the time of assessment.

2.7 *HYDROLOGY*

The major hydrological feature in the Hunter Valley is the Hunter River, located approximately 10 km and 3 km to the south of the Bayswater Power Station and the Ravensworth Rehabilitation Site, respectively. In addition, several local waterways are found in the vicinity of the Site and the main hydrological features can be summarised as follows:

- Tinkers Creek, running along the western boundary of the Bayswater Power Station and draining into Lake Liddell in the north;
- Lake Liddell, located approximately 1.5 km to the north east of the Bayswater Power Station;
- Bayswater Creek, draining from Lake Liddell. Bayswater Creek runs along the western boundary of the Ravensworth Rehabilitation Site, ultimately draining into the Hunter River;
- Foy Creek, running along the eastern boundary of the Ravensworth Rehabilitation Site, ultimately draining into the Hunter River;
- Saltwater Creek and Wisemans Creek, draining to the south into the Plashett Dam;
- the Plashett Dam (also known as Plashett Reservoir), located approximately 4 km to the south west of the Bayswater Power Station;
- the Freshwater Dam, located adjacent and directly to the west of the Bayswater Power Station;
- the Bayswater Cooling Water Makeup Dam, located directly to the south of the Bayswater Power Station;
- the Pikes Gully Ash Dam (which holds a considerably amount of surface water) located to the east of the Bayswater Power Station;
- the Brine Concentrator Holding Pond, located approximately 740m to the south east of the Bayswater Power Station;

- the Brine Concentrator Decant Basin, located approximately 1.3 km to the south west of the Bayswater Power Station; and
- void 4 at the Ravensworth Rehabilitation Site, which acts as a water management storage system.

Operational use of the dams and ponds listed above are outlined in *Section 4.2*.

2.8 SURROUNDING ENVIRONMENT

The Site is surrounded by areas used mainly for mining purposes with some grazing, bushland, viticulture and thoroughbred horse stud farms in the region.

Key industrial uses in the area include:

- Macquarie Generation's Liddell Power Station located approximately 4 km to the north-east of the Bayswater Power Station; and
- existing and former coal mines surrounding the Site and within the Site footprint at the Ravensworth Rehabilitation Site.

The closest residential areas to the Site include:

- rural residencies that do not form part of residential centres. The closest identified residential property is located at 7 and 9 Hebden Road (in close proximity to the intersection with the New England Highway). The identified property is located approximately 130 m east of the Ravensworth Rehabilitation Site; however verbal information provided by Macquarie Generation indicates that this property is owned by Glencore Xstrata and is no longer occupied as a residence;
- Muswellbrook, located approximately 11 km to the north-west of the Bayswater Power Station;
- Jerrys Plains Village, located approximately 11 km to the south of the Bayswater Power Station; and
- Singleton, located approximately 25 km to the south-east of the Bayswater Power Station and 12 km south-east from the Ravensworth Rehabilitation Site.

2.9 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 and off-site users;

- intrusive maintenance workers both on and on-site;
- residential receptors and potential groundwater users;
- recreational users of Lake Liddell (the closest surface water body where recreational access is currently approved);
- aquifers beneath the Site and nearby potable water wells; and
- ecological receptors, including freshwater ecological receptors in the local creeks, Lake Liddell, the Plashett Dam and the Hunter River.

3 SITE HISTORY AND REGULATORY SETTING

3.1 SUMMARY OF SITE HISTORY

Information provided by Macquarie Generation management and a review of aerial photographs (refer below) indicates that prior to construction of the Bayswater Power Station, the Site and surrounds were primarily occupied by a mixture of farms, native vegetation and coal mines.

Construction of the power station commenced in 1980, with completion in 1986. Two large areas outside of the current power station operational area were used as staging areas during construction; a contractor staging area was located to the south of Freshwater Dam and the Large Items Assembly Area was located to the north-west of the current coal stockpile area. Both of these areas ceased being used upon completion of the power station in 1986. The layout of the power station and surrounding buffer lands owned by Macquarie Generation has stayed largely consistent since 1986.

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 Summary of Historical Aerial Photographs

Year	Site	Surrounding Area
1974	The Bayswater Site is undeveloped with the exception of Freshwater Dam. The area surrounding the dam is vegetated, and the remainder of the site is clear with unsealed tracks and roadways. East of the primary Bayswater Site, within the Ravensworth Rehabilitation Area, the Ravensworth open-cut mine is in operation. Site infrastructure including office buildings, roadways, and surface water bodies (located immediately north of the cutting, and on the eastern site boundary) are established. This area is sparsely vegetated.	The Liddell Power Station is located on the western foreshore of Lake Liddell, located north-east of the Site. The Liddell Ash Dam and Ash Skimmer Dam north of the Bayswater Site supports the Liddell Power Station. A coal conveyor runs south of the Lake, between the Liddell Power Station and Ravensworth Coal Unloader facility. Several apparent dams occupy an area along the south-eastern foreshore of Lake Liddell. The Howick open-cut mine is located immediately east of the Site, and the Swamp Pit mine is situated north-east of the Ravensworth mine. A third open cut mine is situated east of Lake Liddell and adjacent to Swamp Pit mine. Generally, the surrounding area is sparsely vegetated, and no other significant features noted in the area.

Year	Site	Surrounding Area
1982	The Bayswater Power Station appears to be under construction. The site footprint and roadways have been established adjacent to the Freshwater Dam. The Dry Surface Area, and Switch Yard area has been is cleared, construction has commenced on the power station, and one of the four cooling towers has been erected. The Pikes Gully Ash Dam has yet to be built, however the lime softening plant sludge lagoons have been constructed. Plashett Dam is also yet to be constructed. Construction of Plashett Dam has commenced to the south west of the sludge lagoons, and west of the apparent southern extent of the Howick open cut mine.	Where apparent dams were previously identified south-east of Lake Liddell, several of these dams appear to have been backfilled, with only the footprint now evident. A major coal stockpile is noted, and a rectangular clearing (inferred to be the Hunter Valley Load Point) has been established. The Howick open-cut mine has expanded towards the east, and older portions of the mine appear to have been rehabilitated. Swamp Pit mine appears to remain in operation.
1993	The Bayswater Power Station has been completed and is operational. In addition to the sludge lagoons identified in 1982 aerial photographs, key features on the Site in the vicinity of the power station include the cooling water reservoir, brine concentrator contaminated water ponds, waste water decanting basin, the Plashett Dam, and the Pikes Gully Ash Dam. Ash slurry occupies half of the area of the Ash Dam. Coal appears to be stockpiled in the Dry Surface Area. The Ravensworth Mine has expanded operations.	The surrounding mines appear to have expanded operations.
2003	The site layout and infrastructure appears to be the same as previously identified, and consistent with the current site layout. The northern portion of the Ravensworth Mine has been rehabilitated. Except two open cut areas filled with surface water, the Site is typically covered with grass. Open cut mining is still active south of this area, however outside the site boundaries.	Several large coal stockpiles, buildings, and other infrastructure are located where the apparent dams were present south-east of Lake Liddell. The dams appear to have been backfilled and re-vegetated. A small open cut mine has been established within this area, north of the Howick mine. A significant open-cut mine – Liddell Mine in in operation north of the area, immediately east of Lake Liddell. The Drayton Mine is evident north-west of the Bayswater Power Station. Howick Mine remains in operation, and the Hunter Valley Coal Preparation Plant has been established between Howick and Ravensworth mines.

Year	Site	Surrounding Area
2009 (reviewed via Google Earth)	No changes to site features within the Bayswater or Ravensworth rehabilitation areas are apparent.	A large area north east of the Hunter Valley Coal Preparation Plant has been cleared. Whilst it appears to be associated with mining operations the purpose of this area is not known. The Ashton open-cut mine is evident east of the Ravensworth mine.

3.3 *ZONING & LANDUSE*

The Macquarie Generation land holding covers approximately 10 074ha and encompasses the Liddell and Bayswater Power Stations, ash dams and ancillary operations. Land holdings occur within the Muswellbrook Shire and Singleton LGA.

A large portion of the Bayswater Power Station land is zoned SP2 Infrastructure Zone under *Muswellbrook Local Environmental Plan* (LEP) 2009 with smaller parcels of land in the north (near Antiene) and west (to the south of Bayswater Conveyor) zoned RU1 Rural 1 Primary Production.

The southern and easternmost extents of the land holdings occur within Singleton LGA and are zoned under the Singleton LEP 1996 as Zone 1(a) Rural and as RU1 Primary Production under the draft Singleton LEP 2012. This includes the Ravensworth Coal Unloading Facility, Ravensworth Mine Restoration Area, and the area south of Bayswater Power Station and Pikes Gully Ash Dam encompassing Plashett Dam and the land holding to the Hunter River.

3.4 *ENVIRONMENTAL APPROVALS, LICENSES AND MANAGEMENT*

Macquarie Generation operates under a range of State and Commonwealth Government 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 systems provide context for potential contamination sources (e.g. ash disposal) and hence a summary of salient points in relation to these issues has been presented in the following sections.

3.4.1 Planning Approvals

The original approval for the Bayswater Power Station was granted by Muswellbrook Shire Council on 18 September 1980 under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The approval relates to the construction and operation of the Bayswater Power Station as described in the environmental impact statement and supplementary information volume dated June 1979. The EIS describes the project as including storage sites for ash disposal and water supply and associated pipeline routes.

The approval document lists various approvals and licences required to be obtained from the State Pollution Control commission. Infrastructure associated with Bayswater Power Station has undergone a number of upgrades, alterations and additions since commission in 1985. Key planning approvals known to ERM are summarised in *Table 3.2*.

Table 3.2 Key Planning Approvals for Bayswater Power Station

Development	Description	Approval Authority and Number	Date
Bayswater Power Station	Original Development Consent for Bayswater Power Station (as per EIS June 1979).	Muswellbrook Shire Council DA 47209	18/9/1980
Barnard River Water Supply Project	Approval for Barnard River Water Supply Project (as per EIS July 1981).	Scone Shire Council DA 81/42	18/11/1981
Ravensworth South Coal Mine	Consent for open cut coal mine, including a requirement to rehabilitate upon closure, potentially by filling with power station rejects (subject to any approval).	Minister for Planning and Environment DA 86/51	15/12/1986
Ravensworth Ash Disposal (No. 2 Void)	Disposal of Bayswater Power Station ash to Ravensworth No. 2 Mine Void. Included ash pumping infrastructure, ash pipeline, a return water system and staged rehabilitation. Based on the Environmental Impact Statement (Pacific Power 1993).	Singleton Council (jointly with Muswellbrook Council) DA 144/1993	8/12/1993
Bayswater Ash Disposal	Covers ash transfer and water return infrastructure components of the Ravensworth Ash Disposal EIS that occur within the Muswellbrook Shire Council LGA.	Muswellbrook Shire Council DA 138/1993	16/12/1993
Ravensworth Ash Disposal (No. 2 Void) Modification	Approves noise generating activities on Saturdays.	DA 144193.2	17/3/1994

Development	Description	Approval Authority and Number	Date
Antiene Rail Coal Unloader	State Significant Development. Rail coal unloader and associated infrastructure (rail spurs, crossings etc.) at Antiene.	Minister for Planning DA 50-3-2005	7/11/2005
Antiene Rail Coal Unloader Modification	Modification for: relocation of ancillary buildings; construction of a small single--span bridge; diversion of Maidswater Creek; changes to construction hours.	Minister for Planning DA 50-3-2005 (1)	31/3/2006
Ravensworth Ash Disposal Modification	Modification of Development Consent No. 144/1993 based on Statement of Environmental Effects (2006) to allow additional parallel return water pipeline from Ravensworth ash emplacement to Bayswater Power Station.	Singleton Council DA 144/1993.3	20/7/2006
Ash Disposal s96 Amendment	As above as it relates to infrastructure within the Muswellbrook LGA.	Muswellbrook Shire Council DA 138/1993 Modification	1/2/2006
Water Treatment Plant Upgrade	Upgrade of Bayswater WWTP	Minister for Planning MP 06_0047	6/4/2006
Ravensworth Ash Disposal Void 4 Tailings Emplacement Operations Plan	Void 4 Tailings Emplacement Operation Plan (TEOP) Approval – expired 2012 and not audited.	Department of Primary Industries L 03/0154	21/5/2007
Water Pump Station Upgrade	Bayswater Water Pump Station upgrade to increase capacity. Out of scope and not audited	Minister for Planning MP 06_0259	23/5/2007
Water Pump Station Upgrade Modification	Modification to allow undergrounding of pipeline; two surge mitigation tanks; discharge to the dam at a location closer to the river; modification to the compliance reporting and platypus management practices.	Minister for Planning MP 06_0259 Mod 1	26/11/2007
Ravensworth Ash Disposal Void 3 Augmentation	Increase ash disposal capacity by 6.6M cubic metres over an additional approximate 5 year facility life. Modification of Ravensworth Rehabilitation Site EMP (1993) through Macquarie Generation's letter of 2 March 2009 and supporting Concept Design Report (Connell Wagner 13 February 2009). No Council consent was applied for or received and not audited.	Department of Primary Industries	17/3/2009

Development	Description	Approval Authority and Number	Date
Ravensworth Ash Disposal Modification	Extension of the existing ash delivery pipeline and installation of new pipelines to facilitate rehabilitation of Ravensworth South Mine Void 5 and deferment of filling and rehabilitation of existing Void 4 (as per Statement of Environmental Effects Aurecon 2012).	Singleton Council DA 144/1993.6	29/10/2012
Ravensworth South Final Void Rehabilitation Plan	Filling and final rehabilitation of Macquarie Generation's portion of Ravensworth South Void 5.	Department of Resources and Energy (DRE) Consistent with Planning Consent DA 86/51	20/12/2012
Bayswater B Power Station	Concept Plan approval	Minister for Planning S 09_0118 DoP	12/1/2012

3.4.2 Environmental Protection Licences

Bayswater Power Station holds Environmental Protection Licence (EPL) No. 779 (issued under *Section 55* of the *Protection of the Environment Operations Act 1997)* for the premises described as Bayswater Power Station, New England Highway, Muswellbrook, NSW, 2333.

The EPL authorises the generation of electrical power from coal (> 4,000 GWh generated), a scheduled activity under the *Protection of the Environment Operations Act 1997*.

The EPL applies to all activities conducted at the Site, including the listed ancillary activities:

- aircraft (helicopter) facilities (the plant has a landing area for helicopters);
- chemical storage facilities;
- crushing, grinding or separating works; and
- sewage treatment systems.

The EPL has recently been reviewed and amended through discussion between the EPA and Macquarie Generation. The latest variation to the EPL is dated 20 September 2013 and is next due for review in February 2018.

The EPL includes load-based licensing provisions, monitoring requirements and/or setting of concentration limits for emissions of pollutants discharged to air, water and land (for various locations), although dominantly relates to emissions to air. The EPL includes a range of conditions from the general requirement to operate in a "proper and efficient" manner to specific conditions such as methods for monitoring and analysis.

The EPL includes Pollution Reduction Programs (PRPs) relating to the following issues:

- management of water in relation to the ash dam;
- upgrades to water quality monitoring in Tinkers Creek; and
- spill containment at the alkalinity reduction plant.

ERM notes that this PRP requirement is considered to be an operational issue and is thus outside the scope of this investigation.

Non-compliances reported under EPL 779 identified in the 2013 Environmental Compliance Audit (ERM, 2013), and considered to represent potential contamination of soil and groundwater, are outlined in *Table 3.3* (below).

Table 3.3 Summary of Environmental Non-Compliances which are relevant to Potential Contamination Issues

EPL Report Reference	Requirement	Comment	Contamination Significance
L.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.	Annual Return 2011-2012 reported three non-compliances for discharge at Point 7 (Tinkers Creek) (high and low pH). Last 12 month scan of incidents - 30.1.2013 coal fines were washed into stormwater by contractor. Anecdotally, the conveyer to the coal station currently leaks and drops water which drains into stormwater. Normally all water in area drains to coal settling basins. Preliminary review of water quality results indicate elevated levels of some metals when compared against ANZECC (2000) freshwater criteria (90% protection level).	Contaminants may be exiting the Site from discharge points to Tinkers Creek.
L3.2	Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.	Review of data between Nov 2012 and April 2013 indicates parameters within range. Annual Return 2012-2013 indicates pH outside of limits three times over reporting period.	Contaminants may be exiting the Site from discharge points to Tinkers Creek.
L3.3	To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.	Refer EPL condition L.1	Refer EPL condition L.1
L3.6	Water and/or Land Concentration Limits	Refer EPL condition L.1	Refer EPL condition L.1
O1.1	Licensed activities must be carried out in a competent manner. This includes: a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.	Dangerous Goods Storage Observations during site inspection include: - anecdotally chemical deliveries are unsupervised. A risk assessment is underway to identify main risks and appropriate mitigation if any issues identified; - staining and corrosion from chemical deliveries noted around unloading facilities. - Audits on DGs have been completed with actions outstanding. Waste collected around site every couple of days - no waste noted around site during inspections	Potential contamination of soil and groundwater due to chemical spills/leaks.

EPL Report Reference	Requirement	Comment	Contamination Significance
O2.1	All plant and equipment installed at the premises or used in connection with the licensed activity: a) must be maintained in a proper and efficient condition; and b) must be operated in a proper and efficient manner.	Challenges in maintenance were noted during the site visit: - Significant corrosion of concrete was noted in the dangerous goods compound used primarily to house demineralisation chemicals. - Several bunds around bulk storage tanks were observed to be heavily stained on the external walls, suggesting that seal is not provided/maintained and bunds do not provide appropriate containment.	Potential contamination of soil and groundwater due to chemical spills/leaks.

3.4.3 Environmental Management

Macquarie Generation maintains an ISO14001 certified Environmental Management System (EMS) for Bayswater Power Station which is audited annually. The audit focuses on compliance with the aspects of ISO14001 and does not assess the implementation or effectiveness of the system.

A number of environmental plans for Bayswater Power Station have been developed under the EMS and/or in response to regulatory requirements, however the assessment of the implementation of these has not been completed as part of this assessment.

Environment specialists form a joint team that covers both the Liddell and Bayswater Power Stations, although some staff are specifically responsible for a site and are based at that location:

- Environmental Manager – Mr. Howard Richards (environment team manager for both stations, based at Liddell Power Station);
- Environment Officer – Mr. Stephen Fell (environment specialist for Liddell Power Station, based at Liddell Power Station);
- Environment Officer – Ms. Kathryn Yates (environment specialist for Liddell Power Station, based at Liddell Power Station);
- Environment Officer – Ms. Elle Hutchinson (environment specialist for Bayswater Power Station, based at Bayswater Power Station); and
- Environment Officer – Mr. Matthew Parkinson (environment specialist for Bayswater Power Station, based at Bayswater Power Station).

A recent Environmental Compliance Audit undertaken by ERM in July 2013 (ERM, 2013) generally found that Macquarie Generation has achieved a high level of compliance with the conditions of the Development Approvals and EPL. Primarily the main issues revolve around the storage of dangerous goods potentially resulting in releases, and also discharge to waters which may result in soil and/or groundwater contamination.

Water management challenges for Bayswater, which could result in soil and/or groundwater contamination, include potential overflows and seepage from the Pikes Gully Ash Dam to surface water courses which flow into Lake Liddell and seepage from Ravensworth Voids 4 and 5 into neighbouring land. It is understood Macquarie Generation is currently investigating options to manage these issues.

The audit found several non-compliances with the relevant approvals and licence that apply to the Site which had potential to be associated with soil and/or groundwater contamination. These include:

- exceedance of specific environmental performance criteria relating to historical water quality discharges (specifically pH). The primary root cause of these issues is failure of infrastructure and accidental releases of untreated water; and

- actions are outstanding from previous Dangerous Goods audits with the site inspections confirming challenges in this area.

ERM understands that Macquarie Generation are aware of the relevant issues identified in the July 2013 audit which relate to exceedances of the EPL performance criteria, and that these issues are being addressed in consultation with the EPA.

4 OPERATIONS

4.1 INTRODUCTION

The following sections present an overview of operations in order to provide context to the subsequent assessment of potential for contamination. A brief description of key activities is provided including, in particular, chemical and waste storage.

4.2 WATER SUPPLY

4.2.1 Water Sources and Storage

Water for the Liddell and Bayswater Power Stations is sourced primarily from the Hunter River. This can be supplemented by the Barnard River Scheme which takes water from the upper reaches of the Manning River and pumps it to the upper reaches of the Hunter River.

Approximately half of Macquarie Generation's water supply is held in Glenbawn Dam under a Major Utility Allocation Licence. The other half of the water supply is intended to be pumped periodically during high flow events in the Hunter River, which occur downstream of Glenbawn Dam (Macquarie Generation website 21 June 2013).

Water is dammed at the following locations:

- Glenbawn Dam (Hunter River), which holds the bulk of the storage capacity (72-76 ML);
- Barnard Weir (Barnard River) (62 ML);
- Orham Creek Dam (Barnard River); and
- Oakey Regulating Dam (Barnard River tributary).

Macquarie Generation holds various conditional water licences that permit the taking of water from various sources.

Water from these sources is pumped to various constructed dams near the Power Stations:

- Lake Liddell, adjacent to Liddell Power Station, holds the bulk of the cooling water storage capacity;
- Plashett Dam (also known as Plashett Reservoir), approximately 4.5 kilometres south-west of Bayswater Power Station;

- Freshwater Dam (also known as the Bayswater Domestic Water Dam or Bayswater Reservoir), adjacent to Bayswater Power Station and used for process and domestic water supply for both sites; and

- Bayswater Cooling Water Makeup Dam.

Water pumped from the Hunter River either pumps directly to the Bayswater Cooling Water Makeup Dam or passes through a Lime Softening Plant to remove hardness. The Softening Plant and associated Sludge Lagoons are located between Plashett Dam and the Bayswater Power Station. This treated water is then transferred to either Lake Liddell or the Freshwater Dam.

4.2.2 Lake Liddell

Lake Liddell was constructed as water storage for Bayswater and Liddell Power Stations and is located immediately adjacent to Liddell Power Station, approximately 500 m to the east/north-east of Bayswater Power Station at its nearest point. The Lake has a surface area of around 1100 hectares (ha), approximately 5km by 5km and is up to 32m deep (Lake Liddell Hydrodynamic Modelling, Worley Parsons, March 2009).

The Lake supplies cooling water to Liddell and make-up water for the Bayswater Cooling Water Makeup Dam. It also accepts a range of treated discharges as discussed elsewhere in this report.

The Lake is constructed in a natural valley at the confluence of Bayswater, Tinkers and Maidswater Creeks (Macquarie Generation, undated). The Lake is dammed on the eastern side and is equipped with a spillway leading to a large holding pond.

Water is periodically discharged from Lake Liddell to manage salinity and level. The discharge point is at the dam wall, and discharges flow via Bayswater Creek to the Hunter River, 12.8km downstream.

Discharges are under the Hunter River Salinity Trading Scheme (regulated under Bayswater's Environment Protection Licence (EPL) 779) and are made at times of high river flows and low background salinity levels.

Lake Liddell is also used by the public for recreation. The Lake Liddell Recreation Area is situated on a northern reach of the lake off Hebden Road. It caters for day visitors and campers, and the area is used for water-skiing, sailing, swimming and fishing (NSW Government Visit NSW website 21 June 2013). The area is managed by the Lake Liddell Recreation Area Reserve Trust appointed by the NSW Government to manage Crown Land (NSW Government LPMA website 21 June 2013).

Lake Liddell is surrounded by buffer land to the north. The eastern side is bordered by an open cut coal mine. The west and south are occupied by Liddell Power Station and Bayswater Power Station, respectively.

4.3 FUEL SUPPLY AND STORAGE

4.3.1 Sources and Receival

Bayswater Power Station receives black coal from local coal mines via overland conveyor, and from regional coal mines via rail. Rail receival facilities are located at Ravensworth and Antiene as detailed below. Facilities are available to receive coal by road; Station staff advised that this is not a significant transport mode at present.

Liddell and Bayswater Power Stations operate an integrated system of coal procurement and receival. While stockpiles are located at each plant, coal can be conveyed between the power stations and Bayswater holds the bulk of the coal stockpile.

Major sources of coal include Wilpinjong mine (Peabody, Ulan), Mount Arthur (BHP, Hunter Valley), Ravensworth (Xstrata, Hunter Valley) and Mangoola (Xstrata, Hunter Valley). Coal is generally unwashed.

4.3.2 Antiene Rail Coal Unloader

Antiene Rail Coal Unloader (RCU) is the main delivery point for coal for Bayswater Power Station. As discussed previously, Antiene RCU is assessed as part of the Preliminary ESA for Liddell Power Station and is included here for information purposes only. Antiene RCU is located approximately 4 km to the north of Bayswater Power Station and 2.5 km north of Liddell Power Station, adjacent to a northern branch of Lake Liddell and two creeks that feed into it (Maidswater Creek and an unnamed creek).

Antiene RCU was constructed in 2006 and consists of:

- a rail spur off the Main Northern Line and balloon loop for turning;
- a coal receival area including access roads, an in-ground coal hopper, conveyor systems and a control house; and
- conveyors leading to the Power Stations.

The facility is operated by Pacific National under an Operational Environmental Management Plan.

4.3.3 Ravensworth Rail Coal Unloader

Ravensworth Rail Coal Unloader, located approximately 250 meters to the north-east of the Ravensworth Rehabilitation Area, is not currently operational. It is understood that the coal loader can be placed into service if required. It has been used quarterly as a training facility for driver training.

4.3.4 Bayswater Coal Stockpiling and Delivery

Bayswater's coal stockpiles are located on the north side of the power block. Coal is delivered by conveyor which can either be fed directly to the power station bunkers or deposited in the storage area for later use. The storage area is capable of storing up to two million tonnes (Mt) of coal.

Perimeter drains collect run-off from rainfall on the storage area which drains to a settling basin to trap silt and coal particles. Discharge from the settling basin drains to Tinkers Creek and then to Lake Liddell.

Clean water run-off from areas around the coal storage area is intercepted before it reaches the coal stockpile by perimeter drains which discharge to Tinkers Creek and Lake Liddell.

The coal towers along the conveyors are also equipped with sedimentation ponds that discharge to Lake Liddell along drainage lines.

4.3.5 Mobile Plant Maintenance And Refuelling

A maintenance and refuelling area for mobile plant associated with coal stockpiling is located adjacent to the coal storage area. The refuelling/lubricating facilities include an area covered in concrete hardstand equipped with drainage sumps that discharge to the Site's contaminated water treatment system.

An underground waste oil storage tank is located to the north of the mobile plant maintenance workshop, which ERM understands is constructed of concrete and is 9 000L in volume. No information was available at the time of assessment regarding integrity testing. The *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008* (the 'UPSS Regulation') does address underground storage systems for used (waste) oil; however there is an exemption from the need to install and monitor groundwater monitoring wells and to develop an Environment Protection Policy for underground waste oil storage systems.

Diesel is stored in a steel aboveground storage tank (AST) of 68 000 L capacity located immediately to the north of the refuelling and lubrication facilities. ERM understands that the mobile plant maintenance and refuelling area was constructed during construction of the power station in 1980-1986.

4.4 AUXILIARY FUEL STORAGE

Bayswater Power Station uses diesel as auxiliary fuel for boiler ignition and so on. The Fuel Oil Installation is located on the south-east corner of the power block and consists of three 1.2ML tanks in a bunded area.

Refer to *Annex E* for a site layout and associated identifier numbers from the 2013 Dangerous Goods Notification – NDG023009.

4.5 WORKSHOPS, STORES AND COMPOUNDS

Various chemical and dangerous goods stores are located throughout the Site. Refer to *Annex E* for the list of registered chemicals from the 2013 Dangerous Goods Notification – NDG023009. Larger quantities of dangerous goods are stored at the water treatment plants, demineraliser, transformer areas, and fuel depots. Small quantities of dangerous goods are stored within workshop areas in the power block.

The Main Store and workshop is located to the east of the power block and includes the flammable gases and flammable liquids store. The Vehicle Refuelling Depot is located adjacent to the Main Store and consists of two Underground Storage Tanks which are used to store unleaded petrol and diesel. The Vehicle Refuelling Depot is discussed further in *Section 6.1.13*.

4.6 ELECTRICITY GENERATION UNITS

4.6.1 Main Generating Plant Area (Power Block)

The main generating plant area houses four units and associated infrastructure:

- coal hoppers, bowl mills and pulverised fuel feed systems;
- four coal-fired boilers;
- turbine house incorporating four steam turbines driving four hydrogen cooled generators;
- a centralised control room;
- four 660MW generator units;
- station service and auxiliary transformers;
- DC systems and associated internal battery banks;
- uninterrupted Power Supply; and
- pulsed bag filter houses and two chimney stacks (each serving two boilers).

4.6.2 *Hydrogen Supply*

Hydrogen for generator cooling is supplied via cylinders stored near the demineralisation plant. Cylinders are housed in a fixed roofed store (approximately 58 272L). Cylinders are refilled by road tanker from a separate location.

The former hydrogen manufacturing plant (located nearby) is not in service.

4.6.3 *Ammonia Supply*

Anhydrous ammonia is stored in a 50 000L AST at the demineralisation plant.

4.7 *TRANSMISSION*

The Bayswater 330 kiloVolt (kV) and 500 kV switchyard is located to the west of the power block and is operated by TransGrid. According to information provided by Macquarie Generation management, ERM understands that this area is also owned by TransGrid and that it was upgraded in 2009-2010. Overhead lines run from the generator transformers for units 1/2 and 3/4 located on the western portion of the power block approximately 300m to the TransGrid switchyard

4.8 *EMERGENCY GENERATOR*

The emergency generator building, located on the north side of the power block, houses two generators used to provide emergency electrical supplies to safely shut down plant in the event of a station shutdown and disconnection from the power grid. Both generators are understood to be currently operational and are run on diesel, supplied via two steel ASTs located within a concrete bunded area on the south side of the building. The ASTs are supplied with diesel via on aboveground pipeline from the fuel oil installation.

4.9 *ASH PLACEMENT*

Ash placement is divided into two areas. Pikes Gully Ash Dam, located in the Bayswater Power station area, is primarily used for bottom ash disposal but currently also receives some fly ash. Fly ash is currently piped in a slurry to for beneficial reuse to fill voids from the former Ravensworth Number 2 Colliery (Ravensworth void 1, 2, 3 and 4) and Ravensworth South (Ravensworth Void 5), collectively referred to as the Ravensworth Rehabilitation Site. Fly ash has been directed from the power station to the Ravensworth Rehabilitation Site since the mid-1990s.

4.9.1 Pikes Gully Ash Dam

The Pikes Gully Ash Dam covers an estimated 125 ha and at its nearest point is approximately 200m to the south-east of the Bayswater Power Station. The Dam has been formed by the construction of an earth dam across Pikes Gully in the east and a saddle dam on the dividing rise between Pikes Gully and Chilcotts Creek.

The dam is approved as part of the original Bayswater Power Station approval. No specific management requirements are established by the approval document. State Pollution Control Commission (SPCC) approval under the Clean Water Act was received 8 September 1982 based on information supplied however; this approval has now been superseded by the current Bayswater Power Station Environment Protection Licence (EPL 779).

Bottom ash is delivered to the dam via pipes and is discharged in the western corner. Water is then directed to the south west corner as the furthest point from the over boarding spill way located in the north east. A water return system is in place that returns water to the ash return water tank for reuse.

A seepage water return system is in place at the toe of the dam wall in Pikes Gully. This system was assessed in the original EIS. A second return water pumping station has been installed approximately 400m east of the first in Pikes Gully in response to complaints from the Ravensworth Underground Mine (RUM). It was reported during the Site visit and in follow up discussions that these complaints lead to Macquarie Generation purchasing land from the RUM operation. A large clean water catchment area drains to this water return pump location and may be contributing to excess water issues that exist following periods of extended rainfall.

No water is permitted to be discharged from the ash dam to Lake Liddell under the EPL. Pikes Gully Ash Dam is therefore part of a closed water system with the exception of evaporation and infiltration. Occasionally there are emergency discharges, following extended periods of wet weather, which are monitored and reported to the Environment Protection Authority (EPA). Macquarie Generation has indicated that a detailed site-wide water management strategy and water balance is being developed to manage the Pikes Gully Dam levels.

A significant Bottom Ash and Fly Ash reuse operation is undertaken from the Pikes Gully Ash Dam by third party contractors.

4.9.2 Ravensworth Rehabilitation Site

The Ravensworth Rehabilitation Site is located approximately eight kilometres east south-east of the Bayswater Power Station and is used for the disposal of fly ash.

Fly ash is transported 11km in a dense slurry form via two steel pipes. The ash disposal system occurs in two Local Government Areas (LGA); starting at the Bayswater Power Station in Muswellbrook LGA, with the Ravensworth Rehabilitation Site in Singleton LGA.

Current operations at the Ravensworth Rehabilitation Site were reported as:

- filling of subsidence cracks and ongoing vegetation and rehabilitation maintenance on Void 1;
- filling of subsidence cracks and ongoing vegetation and rehabilitation maintenance on Void 2;
- ash disposal to Void 3 nearing completion with capping recently commencing from the central area and progressing to the north as the southern portion filling is completed;
- Void 4 used as a water management storage system with relocation of pumping infrastructure in Void 4 from the originally approved location in the south west corner to the eastern bank, with associated upgrades to pumping infrastructure and transmission lines as a result of the Ravensworth North expansion;
- construction of Void 5 regulated dam wall recently commenced and extension of ash delivery and return water system pipelines underway; and
- ongoing Spontaneous Combustion Control measures (Xstrata responsibility), subsidence monitoring and rehabilitation works occurring generally across the Site.

Approximately 1.5 million tonnes per annum (Mtpa) of fly ash has been reused for rehabilitation of voids in the Ravensworth Rehabilitation Site in each of the previous two years.

4.10 WATER MANAGEMENT SYSTEMS

4.10.1 Cooling Water

Cooling water for Bayswater Power Station is sourced from the Cooling Water Make-Up Dam which is treated through the demineralisation plant before use. This dam normally consists of a 50/50 blend of unsoftened Hunter River water and Lake Liddell Return Water.

After passing through the plant condensers and other cooling systems, cooling water is treated through two Cooling Tower Water Treatment Plants (alkalinity reduction plant and reverse osmosis (RO) plant).

The waste products from the water treatment plants are transferred to the Lime Softening Plant sludge lagoons and Brine Concentrator Holding Pond for further water recovery and treatment. Three Brine Concentrators (vapour recompression evaporators) have been installed to reclaim some of this waste water which is then transferred to the station demineralisation plant for further treatment or transferred to the Cooling Water Make-Up Dam.

Overflows from the Brine Concentrator Holding Pond drain to the Pikes Gully Ash Dam. The highly saline wastewater from the treatment process goes to the Brine Concentrator Decant Basin.

4.10.2 Process Water

Process water is sourced from either the Bayswater Demin treated water or the Freshwater Dam. Water from the Freshwater Dam is pre-treated in a demineralisation plant located near the main stores area.

The demineralisation plant area includes:

- cation and anion resin bed vessels;
- storage tanks for flocculation (ferric chloride, two tanks of 18 000L);
- storage tanks for acid regeneration (sulphuric acid, two tanks of 68 000L);
- storage tanks for caustic regeneration (sodium hydroxide, two tanks of 93 000L); and
- four demineralised water storage tanks located above the plant.

Spent resin and regeneration wastewater is disposed to the effluent ponds, located to the south of the fuel oil installation.

4.10.3 Domestic Supply and Firewater

Water for domestic use and fire fighting is taken from the domestic dam and is treated at the chlorination plant prior to use. The chlorination plant is located adjacent to the demineralisation plant. Fire fighting water can also be derived from other sources when necessary.

4.10.4 Sewage

Sewage is pumped to effluent ponds where it evaporates. Any overflows would discharge to Pikes Gully Dam; however, the ponds were reportedly installed to cater for a population three times greater than currently on site.

4.10.5 Stormwater

Boiler and fly ash collection plant floor areas are periodically 'hosed down' and any ash, oil or other material that may be present in the wash down effluent is conveyed to the ash pits and pumped to the ash disposal areas.

Boiler blowdown goes to the stormwater system. Drainage from workshops, electrical service areas and induced draft fans area together with drainage from the turbine house floor area, cable tunnels, transformer areas and lift pits is directed to the wash-down water tank via an oil/solids/water separator and holding basin. Water will be drawn from the wash-down water tank for re-use in the station.

Oil removed from the oil/solids/water separator is collected by an oil reclamation contractor while solids collected are disposed in the Pikes Gully or Ravensworth Rehabilitation ash disposal areas.

Stormwater from the power block area and surrounds is assumed to be potentially contaminated with oil, ash or coal. Stormwater is directed to a large oil-grit trap adjacent to the sewage treatment plant (STP).

Rainwater draining from the switchyard, coal storage area clean water drains, roof drainage, and paved and open areas are directed to Tinkers Creek.

4.11 WASTE DISPOSAL

4.11.1 Landfills

The landfill is located to the south of the Site. Macquarie Generation management has indicated that the operation of this landfill is not licensed by the EPL (779). A number of materials are licensed to be disposed on site by the EPL (unspecified location), but these aren't currently disposed in the landfill.

Waste currently placed in the landfill comprises primarily domestic wastes (e.g. general rubbish) and minor construction waste resulting from recent renovation of the administration building. Waste historically placed in the landfill include various wastes associated with the construction of the power station in the early 1980s; however detailed records were not available for review at the time of assessment. It is considered possible that hazardous wastes have been placed in the landfill.

This landfill is scheduled for closure in late 2013, with wastes after this period to be collected by waste contractors. A Waste Management Plan for Bayswater Power Station is currently under development to further manage waste management and disposal.

4.12 *FIRE SUPPRESSION SYSTEM*

The fire suppression system uses a combination of water (obtained from the Freshwater Dam) and gas suppression. A water sprinkler and deluge system is located throughout the power block, with hydrants and hose reels present in the administration area and throughout the remainder of the power station.

Carbon dioxide (CO_2) gas is supplied to portions of the turbine generators and the coal mill from large CO2 storage vessels and via wheeled extinguishers. Inergen gas, comprised of nitrogen, argon and carbon dioxide, is used in the Simulator building and some IT server rooms.

A manually-operated, fixed foam injection system is present in the fuel oil storage tank area. Information on the type of foam used in this system was not available at the time of assessment.

4.13 *INVENTORY OF CHEMICALS AND WASTES*

An inventory of significant storage facilities is provided in *Annex E*, based on the Site's most recent Dangerous Goods Notification (May 2013). Minor stores are also kept in the maintenance workshops and other operational areas.

The Site holds a variety of bulk (>1,000 L) chemical storage:

- Petrol
- Diesel
- Waste oil
- Transformer oils
- Anhydrous ammonia
- Hydrogen
- Chlorine
- Coagulants (e.g. Ferric chloride)
- Sodium hydroxide
- Sulfuric acid
- Nitrogen
- Hydrogen peroxide

The storage and contamination potential of these chemicals are discussed in detail in *Section 6*.

A number of large transformers contain significant quantities of insulating oil. Due to the age of the facility, polychlorinated biphenyl additives would have historically been used in insulating oils in transformers, capacitors and light fittings. The Bayswater Power Station Environmental Manual (Macquarie Generation, 2010) states, "Currently there are no known PCB's at Bayswater with the exception of some older capacitors at the River Pumping Stations. However it remains possible for PCB's to be introduced to the Station via contaminated transformer oils." The Manual also contains a requirement for monitoring PCBs during regular transformer maintenance works to assess whether transformer oil has been contaminated as a result of the works. All transformer oils externally supplied to Bayswater are required to be certified as being free of PCBs with appropriate documentation provided on supply.

5 SITE CONTAMINATION HISTORY

5.1 OVERVIEW

The provision of a detailed account of the contamination history at Bayswater 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 at the Site have generally not changed significantly since operation of the Site commenced in 1986. As such, potential and actual areas of contamination can be assessed based upon current operations, in conjunction with a review of chemical and waste inventories (*Section 4.2*), spill and incident information, a review of the limited soil and groundwater investigations completed to date (*Section 5.4*) and discussions with Macquarie Generation staff. Potential and actual AECs are presented in *Section 6*.

5.2 NSW EPA CONTAMINATED SITE RECORDS

The *Contaminated Land Management Record of Notices* is a public database of information regarding significantly contaminated land in NSW and is managed by the NSW EPA under the *Contaminated Land Management Act 1997*. At the time of this assessment (August 2013), the Bayswater Power Station was not listed on the record and no sites within a 5 km radius of the Site were listed on the record.

NSW landowners and occupiers who believe that their sites may be contaminated above certain levels specified in the *Contaminated Land Management Act 1997* must notify the NSW EPA of the suspected contamination. The contamination may or may not be significant enough to warrant regulation by the EPA. Following notification, the EPA conducts an assessment process to determine whether regulation is required. The *NSW EPA List of Contaminated Lands Notified to the EPA* describes these sites.

At the time of this assessment, Bayswater Power Station has not been notified to the NSW EPA as being potentially contaminated; however Liddell Power Station has been notified to the EPA as being potentially contaminated. The EPA initial assessment is listed as 'in progress' with the contamination of this Site being assessed by the EPA. Sites which have yet to be determined as significant enough to warrant regulation may result in no further regulation under the *Contaminated Land Management Act 1997*.

5.3 *PRODUCT SPILL AND LOSS HISTORY & OTHER DISCHARGES*

The history of the Site as a power station encompasses over 30 years; as such, a comprehensive listing of spills and inadvertent discharges is not feasible as part of this assessment. ERM reviewed available information on spills, leaks and unplanned discharges in the dataroom and through discussions with Macquarie Generation management. Specific information relevant to identifying AECs is presented in *Section 6.1*.

5.4 *PREVIOUS ENVIRONMENTAL INVESTIGATIONS*

The Site has undergone a limited amount of intrusive soil and groundwater assessments to date as set out below. Works were generally completed to achieve compliance with water licence requirements and underground petroleum storage system (UPSS) regulations. No comprehensive or systematic assessment of Site conditions has been undertaken..

The following section summarises the relevant reports reviewed by ERM.

Water Management Licence Package Annual Monitoring and Compliance Reports with water quality data from July 2006 to June 2010 (Macquarie Generation, 2010).

The monitoring and compliance reports provide the results from monitoring associated with activities carried out under water licenses issued to Macquarie Generation. Areas monitored for groundwater quality from a limited number of monitoring wells (three in total monitored on a regular basis) that apply directly to the Bayswater Site included the Pikes Gulley Ash Dam, the Lime Softening Sludge Lagoons and the Brine Concentrator Decant Basin. Parameters monitored included electrical conductivity (EC), pH, hardness, arsenic and metals (including aluminium, copper, iron, lead, manganese, nickel, and selenium. Data were assessed against guidelines for irrigation and livestock water quality - Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000. The results of the monitoring area discussed in the relevant area of environmental concern (AEC) in *Section 6* (specifically, *Sections 0, 6.1.19* and *6.1.20*).

Ravensworth Rehabilitation Site. Environmental Management Plan Report 2012 (Macquarie Generation, 2012).

The Environmental Management Plan Report includes the results of monitoring conducted at the Ravensworth Rehabilitation Site, including water quality results obtained from Void 4 that is used as a water management storage system receiving drainage water from the surrounding voids and mine spoils. Water quality results reported for Void 4 are outlined in in *Section 6.1.21*.

Saline Groundwater Plume Determination Downstream of Bayswater Power Station Brine Concentrator Decant Basin Letter Report (HLA, 2003).

The letter report makes reference to the identification of an increasing trend in groundwater salinity downgradient of the Brine Concentrator Decant Basin and reports the results of a geophysical survey (utilising electrical resistivity imaging) in the affected area.

Pikes Gully Ash Dam – Geophysical Survey Letter Report (HLA, 2004).

The letter report outlines the results of a geophysical survey conducted to the south of the Pikes Gully Ash Dam. The survey identified shallow conductive zones consistent with groundwater with elevated salinity that may have presented preferential pathways of saline groundwater extending towards the south of the ash dam.

UPSS Report

The investigation completed by DLA Environmental in 2010 in relation to the UPSS located at the vehicle refuelling depot was not available for review at the time of this assessment. However, based on information provided by Macquarie Generation management, ERM understands that four groundwater monitoring wells were installed for the purpose of monitoring the UPSS in accordance with regulatory requirements. Laboratory analytical results for samples collected from these wells indicated that the contaminants of concern (i.e. petroleum hydrocarbons) were all below the detection limits from the most recent sampling event in 2012.

6 PRELIMINARY CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representation of the sources of contamination, potential receptors and pathways which the receptors may be exposed to the contaminants. The development of a CSM is an iterative process, staring with a preliminary CSM based on a review of background data for the Site and any available data from previous intrusive investigations. The CSM is refined by identifying data gaps and undertaking additional investigation to address these gaps, often in a staged approach. Typically the CSM is based on a 'lines-of evidence' approach where multiple data sources are used in the assessment of actual and potential risks to human health and the environment.

The preliminary CSM for the Site is derived from an assessment of the information reviewed to date and presented in the preceding sections of this report. The sources, pathways and receptors (SPR) are specifically addressed in the following sections and a graphical representation of the preliminary CSM is presented in *Annex G*.

In order to generate what the SPR linkages are, the first step is to identify the Areas of Environmental Concern (AECs) which may give rise to potential contamination issues. Following a review of site data and site visits, a number of AECs were identified that limit ERM's ability to assess risk currently (environmental, financial or regulatory) and require further investigation. The following sections describe AECs that are considered to represent data gaps in the CSM that warrant further assessment. The location of the AECs is shown on *Figure 3* of *Annex A*.

6.1 AREAS OF ENVIRONMENTAL CONCERN

6.1.1 Main Generating Plant Area (Power Block)

Power Block

The main building of the power station contains the four power generating units previously described. The primary source of potential contamination results from lubricating oil leaks at various points around the plant due to continuous vibration. Observations during the site visit confirmed this oil loss in various areas. Within the power block, leaks and spills are generally captured in internal contaminated water drains and transferred to the contaminated water treatment system; however larger spills which pool on the ground surface below various infrastructure and from the drainage system have the potential to directly impact underlying soil and groundwater by migration through cracks in concrete or via damaged drains.

No investigation has previously been completed within the immediate area of the power generating units due to access and safety limitations and a lack of a specific requirement to do so. Targeted investigation of these units is not considered possible at this time due to the operational nature of the facility.

Workshops and Minor Dangerous Goods Storage Areas

Various small workshops are present throughout the power block which service specific areas. Many of these workshops hold small quantities of lubricating oils, cleaners and similar chemicals. During the site visit, dangerous goods were generally observed to be appropriately stored within bunded or contained areas. However, staining of the concrete surface in various areas in relation to the workshops was observed, which indicates the potential for pooled spills and leaks to penetrate the concrete through cracks and joints into the subsurface. No investigations are known to have been undertaken to date which specifically target the small workshops within the power block. Targeted investigation of these areas is not considered possible at this time due to the operational nature of the facility.

Power Block Drainage Network

The network of drains which runs beneath the power block represent a potential contamination source to soil and groundwater due to the subsurface nature of this network and the various contaminants of potential concern (including corrosive chemicals) likely to be currently present or having been historically present as a result of the collection and conveyance of spills and leaks in various areas. In addition to the dedicated stormwater and contaminated water drainage systems, a sluiceway which transports ash and coal fines collected in various surface drains in the power block runs through the power block from west to east, eventually discharging into Pikes Gully Ash Dam.

No investigations are known to have been undertaken to date which specifically target the drainage network within the power block. Outside of the eastern end of the sluiceway, targeted investigation of these areas is not considered possible at this time due to the operational nature of the facility.

Power Block Investigation Approach

Targeted investigation of the power block, including the workshops and minor dangerous goods storage areas and the drainage network, is not considered safe or possible due to the operational nature of this area. To address this AEC, it is considered data collected from around the perimeter of the power block, and supplemented with investigation data from other AECs outside of the power block, will be sufficient in terms of spatial coverage and to assess the potential for migration of COPCs (of a material nature), if any, that may have migrated from the power block.

6.1.2 Main Store - Dangerous Goods Storage Area

The Main Store compound is located on the eastern edge of the operational area of the power station and comprises a covered section and an open lay-down area and storage yard covered in concrete hardstand. This area is used for storage of various spare parts and materials used throughout the power station, including dangerous goods. There are two dangerous goods storage areas located the Main Store; one is located within a bunded area on the southern portion of the Main Store and the other is located on the south-western portion. Both storage areas hold smaller quantities (<200L) of various solvents such as acetone, turpentine and kerosene and other liquid chemicals such as sodium hydroxide, sodium hypochlorite, formaldehyde and ammonia. ERM understands that flammable gases were previously stored in this area also, but are not currently stored here. Both dangerous goods storage areas within the Main Store are covered.

Surface water drainage from the Main Store compound is collected into a concrete sump located to the east of the compound. Whilst this sump is normally pumped out by a contractor, it can also discharge to the adjacent dam, which in turn has the potential to overflow into Pikes Gully Ash Dam. Any spills from inside the dangerous goods areas that end up in the sump have some potential to be discharged to the dam, although there is no record of this having occurred. No previous investigations are known to have been undertaken in this area.

Given the lack of investigation data in this AEC and the potential sources of contamination, further investigation is considered to be required to provide a baseline for this area and to assess potential material issues associated with soil and groundwater contamination.

6.1.3 Landfill

The landfill is located approximately 1.3 km to the south of the power block and has a largely undefined footprint due to the long-term use of the Site coupled with overgrowth in areas no longer actively used for waste disposal. The unlined landfill is understood to have become operational during the construction phase of the Bayswater Power Station and has received both construction waste and waste generated during operations following commissioning of the power station. The level of waste management during the circa 30 year life of the landfill is largely unknown and the potential exists that hazardous wastes have been disposed in the landfill.

Two groundwater wells have been installed down gradient from the landfill to monitor potential groundwater impacts. ERM understands that limited monitoring has been conducted to date, and the results are not reported in the *Water Management Licence Package Annual Monitoring and Compliance Reports* outlined in *Section 5.4.*

ERM did not identify groundwater results for the monitoring well located at the landfill site within the dataroom and a review of data for this monitoring well is outstanding.

However, given the paucity of groundwater characterization data, the lack of records on the extent of waste disposal, the lack of knowledge on extent and the potential that hazardous wastes have been disposed in the landfill, further investigation would be required to confirm soil and groundwater conditions.

6.1.4 Low Pressure Pumping Station

The Low Pressure Pumping Station is located approximately 9.6 km to the south-west of the operational area. The station pumps water from the Hunter River and transfers the water to the high pressure pumping station via an open channel. The low pressure pumping station include a series of five pumps within the Hunter River, a pump house building and power supply with a (brick) bunded external transformer.

As outlined previously, low concentrations of PCBs are expected to be present in the transformers at the Low Pressure Pumping Station, although no spills or leaks in this area have been previously reported. No investigations are known to have been completed to date in this area.

Given the lack of groundwater characterization data coupled with the potential for impact presented by the PCB-containing transformers, further investigation would be required to soil and groundwater conditions.

6.1.5 High Pressure Pumping Station

The High Pressure Pumping Station is located approximately 8.6 km to the south-west of the operational area of the power station. The pump receives water from the low pressure pumping station and pumps the water via above ground pipelines to Plashett Dam or storage facilities at Bayswater or Liddell Power Stations. The high pressure pump house contains pumps and associated lubrication facilities, and power supply with a (brick) bunded external transformer forms part of the station.

Hydrocarbon staining on the concrete floor of the pump house was observed during a facilities and process audit conducted in 2007 (Parsons Brinckerhoff, 2007). As noted previously, low concentrations of PCBs further expected to be present in the transformer at the High Pressure Pumping Station.

Groundwater quality is not being monitoring in the immediate vicinity of the pumping station. Given the lack of groundwater characterization data coupled with the potential for impact as indicated by the noted oil staining and PCB containing transformers, further investigation would be required to confirm soil and groundwater conditions.

6.1.6 Lime Softening Plant

At its nearest point, the Lime Softening Plant is located approximately 1.2 km (at its nearest point) to the south of the Bayswater Power Station. The plant includes the gypsum and lime storage area, acid storage area, ferric chloride storage area, the mechanical plant room shed and two large clarifiers.

Oil stains were observed beneath the hydro-pneumatic tank and unbunded 205 litre oil drums in the mechanical plant room during the facilities and process audit conducted in 2007 (Parsons Brinckerhoff, 2007). Ferric chloride staining on the ferric chloride pump room inside the mechanical plant room and on the ferric chloride storage tanks is however considered to be of limited environmental significance. Groundwater quality is not being monitoring in the immediate vicinity of the Lime Softening Plant.

Given the lack of groundwater characterization data coupled with the potential for impact as indicated by the oil staining in the mechanical plant room, limited further investigation would be required to confirm soil and groundwater conditions.

6.1.7 Contaminated Water Treatment System

The Contaminated Water Treatment System is an oil-water separation facility providing treatment for water captured by the contaminated water drain system at the Bayswater Power Station. Water entering the facility could contain a range of potential contaminants including fuels, chemicals, coal and ash.

All the elements of the Contaminated Water Treatment System facility are located in the north-eastern section of the operational area. The facility comprises a sediment basin (with a surface area of approximately 0.3 Ha) with an oil skimmer and a separate secondary oil water separation section. After passing through the secondary oil water separation section, water discharges to a downstream storage pond (with a surface area of approximately 0.5 ha) before ultimately discharging to Tinkers Creek via a weir.

Visual inspection during ERM's site visit in August 2013 identified a layer of oily residue in the sediment on the edges of the sediment basin, and an oily layer of light non-aqueous phase liquid (LNAPL) on the water within the sediment basin. While oily residue was not observed in the holding pond, dissolved phase impact may still be present in water held within the pond. Groundwater quality is not being monitored in the immediate vicinity of the Contaminated Water Treatment System.

Given the lack of groundwater characterization data coupled with the potential for impact from the oily residues and contaminated water, further investigation would be required to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.8 Coal Storage Area

The coal storage area is approximately 35 ha in size and is used for stockpiling of coal prior to being transferred via conveyor to the coal mill and boilers. Potential contamination sources include contaminated stormwater runoff from this area, which is captured in the retention ponds located in the northern portion of the stockpile area, and leaching of contaminants from the coal stockpiled on open ground to groundwater. The retention ponds are understood to be cleaned out on a regular basis and any fines collected are deposited in the Pikes Gully Ash Dam.

No soil and groundwater investigations are known to have been completed within the Coal Storage Area. EPL discharge monitoring point #1 is located at the outlet from the Treated Contaminated Water Pond, which is directly to the south of the Coal Storage Area, prior to discharge into Tinkers Creek, Although previous surface water analytical data collected from EPL discharge monitoring point #1 indicates that the conditions of the EPL are consistently complied with, there is some potential for contaminants from the coal stockpile area to impact surface water and groundwater between the EPL monitoring point and the discharge into Tinker's Creek.

Based on the potential sources of contamination and the relatively low likelihood of receptor exposure, and that this area will continue to be used for coal storage, the coal stockpile is considered to be relatively low risk in the context of the Site-wide assessment. However, based on the lack of investigation data for this AEC, further investigation is considered to be required to provide a baseline and to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.9 Coal Unloaders, Rail Infrastructure And Coal Transfer Lines

Antiene RCU

The Antiene facility is considered an AEC due to its current and historical bulk fuel storage and operations associated with rail infrastructure and locomotive refuelling and maintenance. The Site currently has bulk storage tanks containing diesel and oil which appear to be recently installed and in good condition. There is no evidence to suggest any issues with the current fuel storage infrastructure, however limited information was available on the historic fuel storage at the facility. Leakage of oil and diesel from trains is also a potential risk and it is anticipated this has occurred historically. There is potential for this along the entire rail corridor, however greatest risk is at the unloader where trains may be parked or idle for long periods.

Ravensworth RCU

The Ravensworth RCU is considerably smaller than Antiene and only used occasionally. It has no bulk fuel or chemical storage as part of current operations, but is expected to have similar potential contamination issues as those presented for Antiene. The Ravensworth unloader has had reported diesel releases from locomotives as recent as 2003.

Given the absence of previous environmental characterisation work at both coal unlading facilities, further investigation would be required to provide a baseline for this area and to assess potential material issues associated with soil and groundwater contamination.

Coal Transfer Lines

Overland coal transfer lines are present in several areas of the Site:

- the northern portion of the Site, extending from the north-west site boundary to the coal stockpiling area (inbound);
- the north-eastern portion of the Site extending from Antiene Rail Coal Unloader to the coal stockpiling area (inbound);
- the south-eastern portion of the Site extending from the adjoining mine to the coal stockpiling area (inbound); and
- the eastern portion of the Site extending from the coal stockpiling area to Liddell Power Station (primarily outbound).

These conveyors are located above the ground surface and are generally unsealed. According to information supplied by Macquarie Generation management, there is likely to have been historical oil leaks in the older coal conveyors due to a design fault with the initial gearboxes, which likely resulted in lubricating oil leaks to open ground. Further documentation of these leaks (e.g. volume, recurrence, precise locations, etc.) was not available at the time of this assessment and no previous investigations along the coal transfer lines are known to have been undertaken.

Despite the lack of detailed information for review in relation to these leaks, it is considered unlikely that potential receptors would be exposed to contaminants on a widespread basis. However, based on the lack of investigation data for this AEC, further investigation is considered to be required to provide a baseline and to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.10 Lime Softening Plant Sludge Lagoons

The Lime Softening Plant Sludge Lagoons are located approximately 1.8km (at the nearest point) to the south of the Bayswater Power Station. Five individual lagoons cover a total area of approximately 10 ha. Sludge contained within the lime softening sludge lagoons includes residue from the water softening process, constituting calcium oxides, magnesium hydroxide and other precipitates from the water treatment process.

Groundwater monitoring at the lime softening sludge lagoons is limited to the sampling of one groundwater bore (BWGM1/D7) located approximately 100 m downgradient of the sludge lagoons. Parameters monitored included electrical conductivity (EC), pH, hardness, arsenic and metals (including aluminium, copper, iron, lead, manganese, nickel, and selenium). Sampling frequency has varied from twice per year to more than seven times per year.

Monitoring has indicated that conductivity in groundwater monitoring bore BWGM1/D7 has been above typical groundwater background values for the region with EC as high as 14 180 µS/cm measured in September 2009 (Macquarie Generation, 2010).

Analytes that have exceeded one or more of the guidance criteria (for irrigation and livestock water quality - Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000) for BWGM1/D7 during one or more sampling events include nickel and manganese (Macquarie Generation, 2010).

Given the elevated salinity measured in groundwater bore BWGM1/D7 and the other exceedences of screening levels noted above coupled with the potential for impact to downgradient receptors which includes the downgradient creek, further investigation would be required to assess potentially significant soil and groundwater contamination issues associated with the Lime Softening Plant Sludge Lagoons.

6.1.11 Transformer Area

The Transformer Area houses the main transformers for the Site and is located immediately west of the power block and is separated into two portions, with the administration buildings located in between. In addition to the potentially contaminating activity of transformer operation, also located within this area are five ASTs used for the storage of transformer oil. Based on verbal information supplied by Macquarie Generation management during the site visit, ERM understands that a PCB removal program was undertaken during the 1990s, which consisted primarily of changing transformer oil containing PCBs with oil that did not contain PCBs during regular maintenance activities.

Due to the construction of the oil tanks within the transformers, not all PCB-containing oil could be drained at once and low concentrations of PCBs are expected to be present currently in the transformers in this area. As presented previously, current levels of PCBs in transformer oil in these transformers are expected to be low.

While the transformers are now contained within new bund systems that drain to the contaminated 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 2A Generator Transformer and associated fire in 1986 resulted in a rupture of the transformer oil tank and is likely to have released transformer oil to the surrounding area. The use of fire fighting foam during this fire indicates that perfluorooctane sulfonate (PFOS) and/or perflurooctanoic acid (PFOA) are also contaminants of potential concern for this area. No investigations are known to have been completed within this AEC to date.

Given the absence of previous environmental investigations, historic release events and the volume and content of transformer oils contained within the area, further investigation would be required to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.12 Fuel Oil Installation and Associated Pipeworks/ASTs

The Fuel Oil Installation comprises four 1.2 ML steel ASTs, three of which are used for the storage of diesel. One of the ASTs is not used for any purpose currently. Integrity testing was completed during 2011 on the three tanks currently in use, with no failures reported. These ASTs supply diesel via an above ground pipeline to the operational area, servicing several diesel ASTs located throughout the facility. The volume of fuel being stored and transferred across the Site represents a significant source of potential contamination.

Each of the four ASTs are individually bunded with drainage from the bund discharging to a local oil/water separator. This containment system is understood to be separate from the contaminated water containment and treatment system servicing the operational area. Anecdotal evidence provided by Macquarie Generation management and the results of previous environmental audits in this area indicated that the local separator may have been bypassed, with drainage from the tank bunds discharging directly to a dam located approximately 35 meters to the south-east of the fuel oil installation. Although this could not be confirmed, this scenario represents a significant risk to the area to the south-east of the fuel oil installation (upgradient of the Pikes Gully Ash Dam) should a spill occur within the bund.

No information was available at the time of assessment regarding procedures for reconciling delivery and usage volumes. Regardless, given the limitations of wet stock reconciliation when dealing with such large volumes, 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 to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.13 Vehicle Refuelling Depot

The vehicle refuelling area comprises an area of approximately 250 m^2 in the north-east portion of the operational area near the Main Store. There is one unleaded petrol UST (21 000L) and one diesel UST (37 000L) and associated fuel dispensing infrastructure. For reference, the mobile plant maintenance and refuelling area associated with the coal storage area is a separate facility. The USTs are understood to have been installed at the time of the construction of the power station. Tank integrity test results reported in 2009 (Hodge Industrial Installations Pty Ltd, 2009) indicate that the petrol UST passed, but the diesel UST failed the wet pressure test. According to this report, the diesel tank failure may have been due to a fault in the non-return valve at the top of the tank or could be indicative of the commencement of tank shell failure.

Dataroom documents indicate that one UST (30 000 L), which previously held petrol, was decommissioned in 2007 in this area by pumping out the residual fuel, excavating the overlying soil above the tank, cutting the top off the tank and backfilling the tank with compacted fly ash (Hodge Industrial Installations Pty Ltd, 2007). No further information relating to validation of the decommissioning of this UST was available at the time of assessment.

Soil and groundwater investigations have been completed in the areas of underground tank infrastructure to ensure compliance with relevant underground petroleum storage system (UPSS) legislation, and ensure protection of soil and groundwater receptors. Four groundwater monitoring wells were installed during a previous investigation (DLA Environmental, 2010), three wells were installed downgradient of the USTs and fuel dispensers (to the north) and one well was installed up hydraulic gradient from the USTs (to the south). The wells were initially sampled following installation and are sampled every six months for laboratory analysis. Results in November 2012 indicated that no contaminants related to petroleum hydrocarbons were detected.

Based on the previous investigation results, it is considered that contamination related to the presence of the USTs and aboveground fuel dispensing infrastructure does not appear to be present. However, it is recommended that these existing groundwater wells are sampled to provide up-to-date baseline data in this area. The existing monitoring well network is considered to be sufficient to provide data on baseline conditions in this area.

6.1.14 Mobile Plant Maintenance and Refuelling

Mobile plant associated primarily with the coal storage area are serviced and refuelled in this area, located directly to the south of the coal storage area and comprising an area of approximately 2 500 m^2. Significant surface staining of the concrete in the refuelling and lubrication area indicates that spills and leaks of diesel from the AST and lubrication dispensers in this area have potential to have impacted the subsurface. A concrete subsurface sump (9 000L) used for storage of waste oil prior to pump-out by a contractor is located to the north of the workshop. This sump is understood to have been installed during construction of the power station and no integrity testing is known to have been completed on this sump to date. Whilst no spills or leaks of waste oil have been documented from this sump, it is possible that damage to the sump would result in releases of oil to the subsurface. No investigations are known to have been completed in this area.

Surface water from this area discharges to the coal storage area retention ponds, which in turn discharge to Tinkers Creek via a weir. Given the lack of investigation data available and the evidence of leaks and spills of hydrocarbons, further investigation would be required to assess potentially significant soil and groundwater contamination issues associated with this AEC.

6.1.15 Cooling Water Treatment Plants

The cooling water treatment system comprises separate plants for generation units 1/2 and units 3/4, both located on opposite sides of the power block and covering an area of approximately 3 ha in total. There are a number of ASTs located in these areas, which hold the following chemicals used in the treatment process:

- Anhydrous ammonia;
- Sulphuric acid;
- Sodium hydroxide;
- Chlorine; and
- Ferric chloride.

The results of several previous environmental compliance audits indicated that various areas of these systems had leaks via corroded valves and unlined, damaged concrete sumps. These leaks at the ground surface could have resulted in releases of contaminants to the environment in these areas. No investigations are known to have been completed in this area to date.

Whilst it is considered that the risk from potential releases in these areas to the surrounding areas is relatively low in the context of the Site-wide assessment, no previous investigations have been undertaken in these areas to date and no baseline has been established. It is recommended that further investigation is completed to establish a baseline at this AEC and to assess the potential for material issues to be present in relation to soil and groundwater contamination.

6.1.16 Demineraliser Plant

The demineraliser plant comprises an area of approximately 3 500 m^2 and is located on the north-eastern corner of the power block, approximately 40 meters west/north-west of the vehicle refuelling depot. Significant quantities of sulphuric acid, sodium hydroxide and ferric chloride are stored in ASTs in this area for use in the demineralising process water. Previous compliance audits have noted damage to the bunds or bund linings surrounding some of the ASTs and corrosion to associated pipework. These conditions have the potential to lead to uncontrolled releases of chemicals to stormwater or directly to the subsurface via cracks or other preferential pathways.

Impacted stormwater originating from this area has some potential to impact aquatic ecology in discharges to surface water bodies surrounding the Site.

Overall, the likelihood of receptors being exposed to contaminants originating from the demineralisation area is considered to be low. However, given the lack of investigation in this area to date and the potential for subsurface impact to be present due to damage to the containment system, further investigation is considered to be required to establish a baseline for this area and to assess the potential for material issues to be present related to soil and groundwater contamination.

6.1.17 Former Large Items Assembly Area and Former Contractor Staging Area

The Large Items Assembly Area and Contractor Staging Area are two large portions of the Site used during construction of the power station which have been largely unused since the power station was commissioned in 1986. Negligible formal documentation was available on these areas, but Macquarie Generation management supplied verbal information during site interviews in relation to historical activities.

Large Items Assembly Area

The Large Items Assembly Area is located to the north-west of the coal storage area and adjacent to Tinkers Creek and comprises an area of approximately 8 hectares. This area was previously used for assembly of large pieces of infrastructure such as boiler components, the electrical supply system, and the fire water system for the Site. The area was cut out of the hillside, with the natural excavated material being used to fill the Site to level. It is unknown whether imported fill materials were used in this area. The area is predominantly flat and is understood to have been unsealed since it was levelled. A sedimentation pond was constructed on the north-eastern side of this area and is currently present.

Site activities included primarily welding, with the only buildings present being portable toilets. Information on electricity supply to this area was not provided during site interviews, but it considered likely that generators were used during assembly works. No chemical stores were confirmed to have been present, but it is likely that various fuels were used or stored temporarily in this area. No significant spills or other environmental incidents were known to have occurred in this area; however detailed information on incidents in this area was not available for review at the time of this assessment. No investigations are known to have been completed to date in this area.

Potential contaminants include liquid fuels (e.g. petrol and diesel) and heavy metals from welding activities and associated waste products such as slag.

Given the lack of detailed information for this area and the large spatial area, it is difficult to assess potential risks currently. Further investigation is considered to be required to assess the potential for material contamination issues related to soil and groundwater contamination to be present in this area.

Contractor Staging Area

The Contractor Staging Area is located approximately 250 m south/south-west of Freshwater Dam and comprises an area of approximately 30 hectares. The north-western portion of this area (approximately 2.5 ha) is currently used by the local civil contractor on the Site for temporary storage of equipment and materials. Roads and lots constructed in a grid across this area were evident during the site walkover and during review of historical aerial photos. The area slopes gently from the north to the south and two retention ponds are constructed in the southern portion of the Site and are currently present.

Macquarie Generation management indicated that various activities occurred in this area during construction of the power station; however, more detailed information on any specific activities was not available.

It is understood that various contractors associated with the construction of the power station may have had site offices and/or accommodation here, and that plant and equipment were likely to have been stored in the area also, with associated maintenance activities likely having been conducted. It is unclear whether electricity, water, sewer and other utilities were supplied to this area. No previous investigations are known to have been undertaken in this area.

Potential contaminants include fuels, solvents and other cleaners associated with workshops/maintenance and various contaminants associated with potential undocumented fill materials used or stored in this area (potentially including asbestos).

Given the lack of detailed information for this area and the large spatial area, it is difficult to assess potential risks currently. It is therefore recommended that further investigation be undertaken at this AEC to assess the potential for material issues related to soil and groundwater contamination to be present.

6.1.18 Brine Concentrator Holding Pond

The Brine Concentrator Holding Pond is located approximately 700m to the south of the eastern section of the Bayswater Power Station and has a surface area of approximately 6 ha. As outlined previously, waste products from the Cooling Water Treatment Plants are transferred to the Brine Concentrator Holding Pond for further water recovery and treatment by the Brine Concentrators. ERM understands that, in addition to receiving treated water from the Cooling Water Treatment Plants, the holding pond can also receive return water from the Pikes Gully Ash Dam.

Water stored in the holding pond has the potential to be impacted by high levels of salinity, heavy metals and biocides. Overflows from the Brine Concentrator Holding Pond can drain to the Pikes Gully Ash Dam, although there is no evidence to indicate that this happened to date. Groundwater monitoring of the holding pond has not been conducted to date.

Based on the low likelihood of receptor exposure (with the Pikes Gully Ash Dam located directly downgradient) this area is considered to represent a relatively low risk in the context of the site-wide assessment. However, given the lack of investigation in this area to date, further investigation is recommended to confirm soil and groundwater contamination.

6.1.19 Brine Concentrator Decant Basin

The Brine Concentrator Decant Basin is located approximately 1.4 km to the south-west of the Bayswater Power Station and covers an area of approximately 14 ha. The decant basin receives highly saline wastewater from the Brine Concentrator treatment process.

Groundwater monitoring conducted at the decant basin has been limited to monitoring one groundwater monitoring well (BWGM1/D10) located approximately 300 m downgradient of the decant basin dam wall. Parameters tested included EC, pH, hardness, arsenic and metals (including aluminium, copper, iron, lead, manganese, nickel, and selenium). EC levels in BWGM1/D10 showed a steady increase from 10 000 µS/cm in 1989 to 45 000 µS/cm in 2003. With an expected background EC level in the region of 3 000 µS/cm in the area the increase in EC was attributed to leakage of saline water from the decant basin (HLA, 2003).

Following the identification of the increasing trend in groundwater salinity levels, a geophysical survey utilising electrical resistivity imaging was conducted downgradient of the decant basin dam wall. The survey identified a region of very low resistivity interpreted to represent saline groundwater, with the saline plume constrained to a narrow zone following the surface drainage path down the centre of the valley to the north west (HLA, 2003).

An interception curtain was subsequently installed to intercept seepage from the decant basin, creating a new pondage (referred to as 'Seepage Pond 2') downgradient from the decant basin dam wall. The return water pumps and associated control systems for Seepage Pond 2 and the pre-existing Seepage Pond 1 were completed on 11 April 2008 (Macquarie Generation, 2008).

Groundwater monitoring of BWGM1/D10 following the installation of the interception curtain has shown varying levels of EC over time, with elevated levels recorded from time to time (with EC as high as 38 060 µS/cm in February 2010 - Macquarie Generation, 2010).

Analytes that have exceeded one or more of the guidance criteria (for irrigation and livestock water quality - Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000) for BWGM1/D10 during one or more sampling events include nickel, manganese and iron (Macquarie Generation, 2010).

Given the continued measurement of high levels of salinity in groundwater bore BWGM1/D10, along with the other exceedences of screening levels noted above, and the potential for impact to the downgradient creek, further investigation would be required to assess potentially significant soil and groundwater contamination issues associated with the Brine Concentrator Decant Basin.

6.1.20 Pikes Gully Ash Dam

The Pikes Gully Ash Dam is located approximately 200 m (at its nearest point) to the east/south-east of the Bayswater Power Station and covers an area of approximately 150 ha.

The ash dam receives runoff received from the sluiceways draining from the Bayswater Power Station. In addition, sections of fly ash slurry pipes and return water pipes with asbestos containing material (ACM) are reportedly buried in the ash within the dam once a section is decommissioned. The fly ash slurry pipeline and water return water pipeline (with ACM) runs along the northern side of the ash dam.

The EPL (779) licenses several materials for disposal on site, but does not specify disposal locations. Macquarie Generation management indicated that the following items from the EPL may have been disposed of in the ash dam:

- acid solutions or acids in solid form;
- asbestos;
- fly ash and bottom ash;
- waste mineral oils unfit for their original use;
- waste oil / water hydrocarbon / water mixtures or emulsions;
- boiler cleaning residues;
- spent fly ash filter bags; and
- water treatment residues.

As outlined previously, seepage has been noted at the toe of the dam wall in Pikes Gully. In addition, a report by HLA (HLA, 2004) makes reference to the presence of saline groundwater seepage at and below a small dam located approximately 250 m from the south of the Pikes Gully Ash Dam. A geophysical survey conducted by HLA identified shallow conductive zones consistent with groundwater with elevated salinity that may have presented preferential pathways of saline groundwater extending towards the south of the ash dam (HLA, 2004). During ERM's site visit conducted in August 2013, seepage was also observed on the saddle dam wall on the northern section of the dam.

Seepage from the ash repository has the potential to be saline and contain arsenic and heavy metals (specifically barium, beryllium, boron, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, nickel, thallium, selenium and zinc).

Parameters assessed during groundwater monitoring conducted at the ash dam included EC, pH, hardness, arsenic and metals (including aluminium, copper, iron, lead, manganese, nickel, and selenium) in up to six monitoring wells located downgradient of the ash dam wall.

Available results indicate that analytes exceeding one or more of the guidance criteria (for irrigation and livestock water quality - Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000) for one or more sampling events include nickel, manganese and iron (Macquarie Generation, 2010).

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 to confirm soil and groundwater conditions.

6.1.21 Ravensworth Rehabilitation Site

The Ravensworth Rehabilitation Site is located approximately 8 km east/south-east of the Bayswater Power Station and is currently used for the disposal of fly ash. The Site is located in the former Ravensworth No.2 Mine (the location of Void 1 to 4) and a section of the Ravensworth South Mine (the location of Void 5). The surface geology has been extensively disturbed by mining.

Much of the former opencast mine workings at the Site have been backfilled with mine spoil that includes coal from uneconomic seams, and the remnant coal is subject to spontaneous combustion. Part of the Ravensworth No.2 Mine have been backfilled with fly ash (Voids 1 to 3) and coal preparation plant rejects (eastern ramp of Void 4) (Aurecon, 2012). ERM understands that Void 5 is currently being prepared for future fly ash disposal.

The base of the voids is expected to be in contact with regional groundwater flow. Seepage from the ash filled voids has the potential to be saline and contain heavy metals.

The available groundwater sampling reports state that samples have not been obtained from the Ravensworth Rehabilitation Site during sampling events covering the monitoring period from 2006 to 2010 as underground heat generated from spontaneous combustion does not permit samples to be taken from the available monitoring wells (Macquarie Generation, 2010). Six wells were reportedly installed in this area, but Macquarie Generation has advised that none of the wells are currently useable due to subsidence, being covered by fill material, or being affected by high temperatures from spontaneous combustion.

Water quality monitoring has however been conducted in Void 4, which is currently used as a water management storage system receiving drainage water from the surrounding voids and mine spoils. Surface water samples collected from Void 4 were analysed for EC, pH, boron, chromium, fluoride, lithium, molybdenum, selenium and vanadium.

Monitoring has indicated that salinity levels are relatively saline with an average electrical conductivity of 7 079 µS/cm for monitoring conducted in 2012 (Macquarie Generation, 2012). Relatively alkaline conditions were further observed with pH levels generally ranging between pH 8 and pH 9. While the report with the Void 4 monitoring data did not compare the results against guidance criteria, a comparison of data collected prior to the ash disposal commencing indicate that boron and molybdenum have increased by approximately a factor of six and an order of magnitude respectively between 1992/1995 and 2012 (Macquarie Generation, 2012).

Given the lack of groundwater characterization data coupled with the potential for impact considering the nature of the mine spoils and the ash disposed of at the Ravensworth Rehabilitation Site, further investigation would be required to assess potential material environmental issues associated with soil and groundwater conditions.

6.1.22 Lake Liddell Sediments

Lake Liddell was constructed adjacent to Liddell Power Station in order to provide cooling water storage. Liddell Power Station is designed to operate without cooling towers and instead uses the capacity of Lake Liddell to manage waste heat.

Lake Liddell sediments have been identified as a potential AEC due to the discharges it receives from the Liddell Power Station, which include:

- cooling water that has passed through the plant and therefore:
  - has been treated with biocides and anti-scale chemicals;
  - is heated;
  - may contain traces of oil;
  - has potentially elevated salts and metals due to concentration created by evaporation.
- backwash from the process water pre-treatment plant (sand filter, clarifier and demineralisation plant) including lime enriched water (potentially resulting in the precipitation of calcium carbonate within Lake Liddell) from the from the water softening plant;
- treated effluent from the oil-water separator associated with the operational site drainage network and oil and grit trap (noting that the oil water separator was only installed in 1976, five years after commencement of site operation);

- overflow and potential seepage from the ash dam and associated tributary streams;
- stormwater from the sediment traps around the coal stockpiles and conveyor systems; and
- stormwater from other areas including the HVGT.

The recirculation of water through the Lake has the potential to concentrate impurities within the system.

Given the absence of available previous detailed environmental characterisation work, the numerous discharge points and sources of potential contaminants, and the presence of recreational users of the Lake, further investigation of selected depositional areas would be required to provide a baseline for this area and to assess potential material issues associated with soil and groundwater contamination.

6.1.23 TransGrid Switchyard

The TransGrid Switchyard, although not owned by Macquarie Generation, is a potential AEC due to the storage/use of transformer oil which may have historically contained PCBs. The surrounding topography slopes gently to the south and west, indicating that there is some potential for impacts at the switchyard to migrate onto land owned by Macquarie Generation.

Given the absence of previous environmental characterisation work, further investigation would be required to confirm soil and groundwater conditions surrounding the switchyard (investigation is not proposed within TransGrid owned land).

6.2 EXPOSURE PATHWAYS

There are several potential exposure pathways in which contaminants may impact sensitive receptors:

- transport via the site drainage system into surface waters;
- leakage from the site drainage system into groundwater;
- seepages of spilt chemicals/fuels direct to ground;
- leaching of metals from soil into groundwater;
- dermal contact with contaminated soils;
- ingestion of contaminated soils/sediments;

- inhalation of vapours related to impacted soils/groundwater (e.g. in presence of high concentrations of volatile contaminants or NAPL);
- seepage from the Ash Dam, and overflow/skimmer ponds into local creeks;
- inhalation of asbestos fibres; and
- groundwater flow into surface water bodies (e.g. Freshwater Dam and Lake Liddell).

6.3 SENSITIVE RECEPTORS

The sensitive receptors identified are as follows:

- indoor and outdoor human health receptors in the form of industrial on-site and off-site users;
- intrusive maintenance workers both on and on-site;
- residential receptors and potential groundwater users, the closest of which are located at 7 and 9 Hebden Road, approximately 130 m east of the Ravensworth Rehabilitation Site;
- recreational users of Lake Liddell (the closest surface water body where recreational access is currently approved);
- aquifers beneath the Site and nearby potable water wells; and
- ecological receptors, including freshwater ecological receptors in the local creeks, Lake Liddell, the Plashett Dam and the Hunter River.

7 RECOMMENDATIONS FOR STAGE 2 ASSESSMENT

Based on the results of the Preliminary ESA undertaken by ERM and consideration of Macquarie Generation's intended approach to the assignment of liability relating to soil and groundwater contamination issues, a programme of intrusive (Stage 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 Stage 2 works in general accordance with the requirements set out in NSW EPA (2011).

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

The primary objective for the Stage 2 ESA is to gather data from applicable environmental media in order to develop a baseline assessment of environmental conditions at the Site and immediate surrounding receiving environments (including water, land and sediments), at the time of the transaction. Data obtained during completion of the Stage 2 ESA will also be used to assess whether there are contamination issues present which will exceed the material threshold and may also be used to inform future management of contamination issues both at the Site and in relation to the relevant receiving environments.

7.1 DATA QUALITY OBJECTIVES

Prior to commencement of the Stage 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), ANZECC and the 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 H.*

7.2 *SAMPLING RATIONALE*

Based on a review of the available data, and the establishment of AECs, the most appropriate sampling design to achieve the stated project objectives is considered to be primarily based on a judgemental (targeted) sampling program, with additional sampling undertaken to provide spatial coverage for low risk areas of the Site (e.g. buffer lands) or to fill material data gaps within the CSM. 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. The sampling plan will be discussed with site management prior to the commencement of works to assess this risk. As such, the sampling design currently proposed is considered indicative, and subject to minor alteration.

Given the scale of the Site, different sampling densities are proposed to be adopted relative to the contamination risk and logistical constraints in different areas of the Site. The sampling approach is generally in accordance with the NSW EPA (1995) *Sampling Design Guidelines*. The NSW EPA (1995) guidelines do not recommend a minimum number of sampling points for sites larger than 5.0 hectares. The Site has been divided into smaller areas of concern based on a review of historical activities and identified potentially contaminating activities as recommended in the NSW EPA (1995) guidelines.

The proposed sampling locations are provided in *Figures 4a* to *4j* of *Annex A*, with information on rationale, constituents of potential concern and number of investigation locations provided in *Table 7.1* (over).

Table 7.1 Proposed Sampling Approach

Area of Environmental Concern	AEC ID	Issue	Analytes	Proposed Boreholes & Monitoring Wells
Brine Concentrator Holding Pond	BA	Leaching of brine to surrounding areas	Standard Suite* plus 13 metals and boron, molybdenum, thallium and selenium, pH, major cations/anions	• 3 monitoring wells
Brine Concentrator Decant Basin	BB	Leaching of brine to surrounding areas	Standard Suite* plus 13 metals and boron, molybdenum, thallium and selenium, pH, major cations/anions	• 5 monitoring wells
Fuel Oil Installation	BC	Contamination of soil and groundwater from loss of fuel and oil	Standard Suite*	• 4 soil bores • 5 monitoring wells • Supplemented with additional investigation locations from other surrounding AECs
Vehicle Refuelling Depot	BD	Contamination of soil and groundwater from loss of fuel and oil (UPSS)	Standard Suite*	• 4 existing monitoring wells
Coal Storage Area	BE	Potential leaching of contaminants from stockpiled coal and retention ponds	Standard Suite*	• 9 monitoring wells
Coal Unloaders, Rail Infrastructure and Coal Transfer Lines	BF	Contamination of soil and groundwater from transfer line gearbox oil leaks, fugitive coal fines, current and historic fuel storage, locomotive maintenance, and rail infrastructure activity.	Standard Suite*	• 7 soil bores • 7 monitoring wells • Visual inspection of coal transfer lines to assess the need for further investigation
Contaminated Water Treatment Plant	BG	Contamination of soil and groundwater from contaminated water from operational areas	Standard Suite* plus VOCs and PCBs	• 7 monitoring wells
Cooling Water Treatment Plants	BH	Contamination of soil and groundwater use of chemicals in water treatment (sulphuric acid)	Standard Suite* plus pH, major cations/anions,	• 8 soil bores • 8 monitoring wells

Area of Environmental Concern	AEC ID	Issue	Analytes	Proposed Boreholes & Monitoring Wells
Demineraliser Plant	BI	Contamination of soil and groundwater from spills and leaks of chemicals used in demineraliser process	Standard Suite* plus pH, major cations/anions	• 3 monitoring wells
Former Contractor Staging Area	BJ	Contamination of soil and groundwater from spills and leaks of fuels and chemicals used during facility construction	Standard Suite* plus VOCs	• 19 soil bores • 5 monitoring wells
Former Large Items Assembly Area	BK	Contamination of soil and groundwater from spills and leaks of fuels and chemicals used during facility construction	Standard Suite* plus VOCs	• 7 soil bores • 4 monitoring wells
Generator Transformer Areas	BL	Contamination of soil and groundwater from transformer oil	Standard Suite*plus PCBs & PFOS/PFOA	• 7 soil bores • 6 monitoring wells
Landfill	BM	Contamination of soil and groundwater from current and historical waste burial	Standard Suite* plus VOCs and PCBs	• 9 soil bores • 6 monitoring wells
Lime Softening Plant	BN	Contamination of soil and groundwater from chemicals used in softening (ferric chloride, sulphuric acid, lime)	Standard Suite* plus 13 metals, pH, major cations/anions	• 3 monitoring wells
Lime Softening Plant Sludge Lagoons	BO	Contamination of soil and groundwater from spent softening plant sludge	Standard Suite* plus 13 metals, pH, major cations/anions	• 5 monitoring wells
Mobile Plant Workshop and Refuelling	BP	Contamination of soil and groundwater from fuel storage/dispensing and waste oil sump	Standard Suite*plus VOCs	• 6 monitoring wells
Pikes Gully Ash Dam	BQ	Contamination of soil and groundwater from ash dam leachate, waste disposal and ash slurry/return water lines with ACM.	Standard Suite* plus 13 metals and boron, molybdenum, thallium and selenium, pH, major cations/anions	• 14 monitoring wells • 21 surface soil samples for asbestos only (beneath ACM pipeline)
Ravensworth Rehabilitation Area	BR	Contamination of soil and groundwater from CCP leachate.	Standard Suite* plus 13 metals and boron, molybdenum, thallium and selenium, pH, major cations/anions	• 11 monitoring wells • Visual inspection of fly ash transfer lines to assess the need for further investigation

Area of Environmental Concern	AEC ID	Issue	Analytes	Proposed Boreholes & Monitoring Wells
Low Pressure Pumping Station	BS	Contamination of soil and groundwater from transformer oil	Standard Suite*plus PCBs	• 2 soil bores • 1 monitoring wells
High Pressure Pumping Station	BT	Contamination of soil and groundwater from transformer oil	Standard Suite*plus PCBs	• 2 soil bores • 1 monitoring wells
Main Store - Dangerous Goods Storage Area	BU	Contamination of soil and groundwater from spills and leaks of chemicals	Standard Suite* plus VOCs	• 2 soil bores • 3 monitoring wells
Power Block	BV	Contamination of soil and groundwater from spills and leaks of various chemicals	Standard Suite* plus VOCs and PCBs	• 9 soil bores • 13 monitoring wells • Supplemented with additional investigation locations from other surrounding AECs
Sediments in Surrounding Waterways and Lake Liddel	BW	Contamination of sediments in Cullens Gully and Tinkers Creek from discharges (drainage lines and groundwater seepage) related to Bayswater site operations. Contamination of sediments in Lake Liddell from discharges (drainage lines and groundwater seepage) related to Liddell Power Station operations.	Standard Suite* plus PCBs and PSD and TOC for ecological risk.	• 6 sediment samples from Tinkers Creek • 4 sediment samples from unnamed creek (tributary of Cullens Gully) • 44 sediment samples from Lake Liddell • Surface water samples at each sediment sampling location (10)
TransGrid Switchyard	BX	Contamination of soil and groundwater from surface water and groundwater migrating from the TransGrid switchyard onto land owned by Macquarie Generation	Standard Suite*plus VOCs and PCBs	• 4 monitoring wells
Site Boundary Monitoring Wells	BY	Assessing migration of potential contamination across the Site boundaries where there are no investigations locations as part of other AECs	Standard Suite*	• 36 monitoring wells • Supplemented with additional investigation locations from other surrounding AECs

Notes:

* - Standard Suite includes TRH (C_6 – C_{40}), BTEX, suite of 8 metals, PAHs, phenols. Asbestos will be analysed in one shallow fill sample at each borehole in operational areas.

One soil sample from each AEC will be analysed for cation exchange capacity and pH for use in determining the appropriate ecological screening levels to apply.

All sediment samples and selected soil samples will be analysed for particle size distribution and total organic carbon to allow for adoption of appropriate health screening levels for vapour inhalation risk.

7.2.1 Waterways

Bayswater Power Station Operational Area

Sediment sampling is proposed to target potential contamination from cooling water discharges or other potential instances of off-site migration of contaminants from the Site and includes sampling in two areas:

- within Tinkers Creek (a potential depositional zone from cooling water discharges and discharges from the coal storage area retention basin); and
- Cullens Gully, a creek to the north of the spillway from Pikes Gully Ash dam, which has been reported to have received unplanned overflow from the ash dam.

The proposed sediment sampling design for these areas is targeted at the source and limited downgradient areas. A transect approach to sampling is not considered to be required initially, but may be considered upon receipt of laboratory results from the initial sediment samples.

Lake Liddell and associated waterways

Sediment sampling is proposed to target potential contamination from cooling water discharges or other potential instances of off-site migration of contaminants from Liddell Power Station and includes sampling in areas including an unnamed tributary of Lake Liddell that flows north east from the Hunter Valley Gas Turbine (HVGT), which has been reported to have received contaminant flow, including petroleum hydrocarbons, for the HVGT operations.

The proposed sediment sampling design for these areas is targeted at the source and limited downgradient areas. A transect approach to sampling is not considered to be required initially, but may be considered upon receipt of laboratory results from the initial sediment samples.

7.2.2 Existing Groundwater Wells

Where existing groundwater monitoring wells have been identified, the locations of these wells are presented on *Figure 4a to 4j* of *Annex A*.

It is proposed that existing groundwater monitoring wells will be sampled during Stage 2 investigation works. 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;
- where bore logs are not available, wells will be assessed for suitability on a case-by-case basis; 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.

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

7.3 PROPOSED SAMPLING METHODOLOGIES

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

- underground service location and mark-out (this may influence currently proposed investigation design);
- proposed borehole location mark-out;
- coring of hard standing surfaces where present;
- drilling and soil sampling of subsurface material using a combination of hand auger, 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;
- test pitting/trenching using excavator or backhoe in selected locations outside of the operational area where access permits;
- reinstatement of hardstanding surfaces;
- surveying the location of boreholes and monitoring wells; and
- development, measurement of standing water levels and sampling of the groundwater monitoring wells.

7.3.1 Proposed Field Screening Protocols

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

Soil and Sediment

Soils 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.

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 (24 hours as a minimum) 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 where conditions allow. During this process, a calibrated water quality parameter meter will be used to record field measurements of pH, conductivity, redox potential, temperature and dissolved oxygen.

7.3.2 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 the primary contaminants of potential concern listed below along with additional contaminants of potential concern associated with activities undertaken in that area.

- metals and metalloids (arsenic, boron, cadmium, chromium, copper, molybdenum, nickel, lead, mercury, selenium, thallium and zinc);
- Major cations and anions (including sulfate and chloride);
- Total Recoverable Hydrocarbons (TRH);
- BTEX - benzene, toluene, ethylbenzene and xylenes -BTEX);
- Polycyclic Aromatic Hydrocarbons (PAHs) and Phenols;
- Polychlorinated biphenyls (PCBs)
- Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA)
- asbestos (presence / absence).

Additional contaminants of potential concern may also be analysed if required based on observations made in the field. Leachate analysis will be undertaken on soil samples based on observations made in the field and preliminary laboratory results. The Australian Standard Leachate Procedure (ASLP) is the preferred analytical method and is considered to be more representative of site conditions than the Toxicity Characteristic Leaching Procedure (TCLP).

8 CONCLUSIONS

The Preliminary ESA undertaken by ERM has identified that limited previous intrusive ESAs appear to have been completed on the Site and a number of potential areas of environmental concern have been identified based on the understanding of current and historic operations undertaken. These include:

- brine concentrator holding pond (potential seepage of brine);
- brine concentrator decant basin (historical seepage of brine);
- fuel oil installation (potential leaks);
- vehicle refuelling depot (potential leaks);
- coal storage area (historical and potential leaks);
- coal unloaders, rail infrastructure and coal transfer lines (potential and historic leaks);
- contaminated water treatment plant (potential leaks);
- cooling water treatment plants (historical and potential leaks, releases to ground);
- demineraliser plant (historical and potential leaks);
- former contractor staging area (potential spills, leaks and undocumented fill material);
- former large items assembly area ((potential spills, leaks and undocumented fill material);
- generator transformer areas (large volume of transformer oil used and stored);
- landfill (unknown waste disposal, potential for leaching to occur);
- lime softening plant (storage of chemicals, potential for leaks);
- lime softening plant sludge lagoons (disposal of spent softening plant sludge and potential for leaching);
- mobile plant maintenance and refuelling (historical leaks and spills of diesel fuel and lubricants, potential leak of waste oil);
- Pikes Gully Ash Dam (seepage to groundwater and surface water receptors);

- Ravensworth Rehabilitation Area (seepage to groundwater and surface water receptors);
- high pressure pumping station (potential leaks/spills of transformer oil);
- low pressure pumping station (potential leaks/spills of transformer oil);
- main store – dangerous goods storage area (potential leaks/spills and release through sump/dam);
- power block (historical and potential leaks of various chemicals); and
- Lake Liddell Sediments (sediments may have accumulated contaminants from site drainage and discharges over lifetime of station operation and precipitation of calcium carbonate).

Based on the results of the Preliminary ESA and consideration of the 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 judgemental (targeted) sampling of soil, groundwater and sediments at the established AECs for the Site, which is also considered to provide suitable spatial coverage to act as a baseline assessment.

Based on the information available at the time of preparation of this report ERM has not identified any contamination issues which are currently undergoing or likely to require material remediation, assuming ongoing industrial land use as a coal fired power plant. A number of potential material issues were identified, which will be assessed during Stage 2 investigation works.

9 *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 Macquarie Generation ("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 August 2013 and 18 October 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.

10 REFERENCES

Aurecon (2012). *Ravensworth South Final Void Rehabilitation Plan*. Final report dated 1 May 2012.

Australia and New Zealand Environmental and Conservation Council (2000). *Australia and New Zealand Guidelines for Fresh and Marine Water Quality.*

Chelace GIS (2013). *Proposed Liddell & Bayswater B Subdivision*. Figure dated 29 August 2013.

CRC CARE (2011). *Technical Report No. 10, Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater.*

Department of Mineral Resources (1993). *Hunter Coalfield Regional Geology, 1:100 000 Geology Map*. Geological Series Sheet 9033 and part of 9133, 9032 and 9132. Second Edition.

Environmental Resources Management Australia Pty Ltd (2013). *Bayswater Power Station Environmental Compliance Audit and Consistency Review*. Final report dated 25 July 2013.

HLA Envirosciences Pty Ltd (2003). *Saline Groundwater Plume Determination Downstream of Bayswater Power Station Brine Concentrator Decant Basin*. Letter report dated 11 August 2003.

HLA Envirosciences Pty Ltd (2004). *Pikes Gully Ash Dam – Geophysical Survey*. Letter report dated 26 August 2004.

Hodge Industrial Installations Pty Ltd (2007). [Integrity Testing Letter]

Hodge Industrial Installations Pty Ltd (2009). *Reference: Underground Diesel Storage Tank*. Letter dated 2 June 2009.

Macquarie Generation (2008). *Saline Seepage Containment from Brine Concentrators Decant Basin*. Letter dated 26 November 2008.

Macquarie Generation (2010). *Macquarie Generation Water Management Licence Package*. Annual Monitoring and Compliance Report for year ending 30th June 2010.

Macquarie Generation (2012). *Ravensworth Rehabilitation Site, Environmental Management Plan Report 2012*.

National Environment Protection Council (2013). *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)*.

National Health and Medical Research Council and National Resource Management Ministerial Council (2011). *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy.*

NSW DEC (2006). *Guidelines for the NSW Site Auditor Scheme (2nd edition).*

NSW Department of Mineral Resources *Muswellbrook 1:25,000 Geological Sheet 9033-II-N.*

NSW Department of Mineral Resources *Jerry Plains Geological Series Sheet 9033-11-S (Edition 1) 1987.*

NSW OEH (2011). *Guidelines for Consultants Reporting on Contaminated Sites.*

New South Wales Government *Natural Resource Atlas:* online database accessed 29 August 2013.

Pacific Power (1993). *Environmental Impact Statement for the transport to and disposal of fly ash on the Ravensworth No.2 mine site, restoration of affected lands and completion of mine rehabilitation*.

Parsons Brinckerhoff (2007). *Bayswater Power Station 2007 – Facilities and Process Audit*.

Annex A

Figures

Legend

Site Boundary

DRAFT

0 5 10km

N

Client:	Macquarie Generation	
Drawing No:	0213879s_B_PESA_G001_R1.mxd	
Date:	27/09/2013	Drawing Size: A4
Drawn By:	KB	Reviewed By: JF

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 1 - Site Locality

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

LEGEND:

= BOILER
= ELECTRICAL SERVICES CENTRE
= CHECK WIEGH BIN
= SAFETY SHOWER

REFERENCE DRAWINGS:

BW636711 – STATION ARRANGEMENT PLAN 1:1000
BW636713 – GENERAL STATION LAYOUT 1:4000

A B C D

BAYSWATER POWER STATION ASH DAM
DRY FLY ASH COLLECTION AREA
EFFLUENT PONDS
TANK FARM
330kV TRANSMISSION LINE
RIVER ROAD
1/2 WATER TREATMENT PLANT
'OLD' WATER PLANT CARPARK
MAIN STORE SECURITY GATE
WATER PLANT CONTROL ROOM
MAIN STORE COMPOUND
MAIN STORE
COOLING TOWER No. 1
COOLING TOWER No. 2
ASH & DUST PLANT RETURN WATER MAKE-UP PUMPING STATION
BRINE CONCENTRATOR PLANT
WASHDOWN WATER PUMPS
1/2 CW CLORINE & ACID DOSING PLANT
1/2 CW PUMPS
AMMONIA PLANT
BEVERAGE TREATMENT PLANT
CONTAMINATED WATER TREATMENT PLANT
DEMIN WATER TREATMENT PLANT
HYDROGEN PLANT
BAYSWATER 33/11 KV STATION SWITCHYARD
Demin Plant
1 FABRIC FILTERS
1 BLR
MILLS A B C D E F G
1/2 CHIMNEY
1/2 ESC
1/2 Lift
1 TRANSFORMER
MOBILE PLANT WORKSHOP
STATION FIRE SERVICE PUMPS BUILDING
CONTAMINATED WATER HOLDING POND
2 FABRIC FILTERS
2 BLR
Diesel Generator
1/2 Fabric Filter Lift
MAIN CARPARK SECURITY GATE
2 TRANSFORMER
EASTERN MAIN CARPARK
EAST RECLAIM HOPPER
EAST COMPACTED COAL STOCKPILE
EAST RILL TOWER
E 1 WORKSHOP
ASH & DUST CONTROL ROOM
G 2 WORKSHOP
BUNKER BAY
Bunker Bay Lift
COAL PLANT AREA SECURITY GATE
GSS
E 2 WORKSHOP
G 1 WORKSHOP
ADMIN BUILDING
TRANSGRID SWITCHYARD ROAD
3/4 Fabric Filter Lift
EMERGENCY SUPPLIES & EQUIPMENT STORE
3 FABRIC FILTERS
3 BLR
HEALTH CENTRE
Simulator Training Building
WESTERN MAIN CARPARK
EVACUATION POINT
COAL PLANT
DRY STORAGE BIN
CONTROL ROOM
Southern DSB Lift
Northern DSB Lift
STACKER / RECLAIMER
EAST NON-COMPACTED COAL STOCKPILE
WEST NON-COMPACTED COAL STOCKPILE
WEST RILL TOWER
WEST COMPACTED COAL STOCKPILE
3/4 CHIMNEY
3/4 ESC
3/4 Lift
4 FABRIC FILTERS
4 BLR
3 TRANSFORMER
4 TRANSFORMER
TRANSGRID SWITCHYARD
EVACUATION POINT
CONTRACTORS CAR PARK
CONTRACTORS OFFICE AREA
"CHINA TOWN"
WEST RECLAIM HOPPER
3/4 CW CLORINE & ACID DOSING PLANT
EMERGENCY HELECOPTER LANDING PAD
3/4 CW PUMPS
COOLING TOWER No. 4
COOLING TOWER No. 3
VISITOR CENTRE CAR PARK
VISITOR CENTRE
'OLD' CONSTRUCTION SITE ROAD
TIP ROAD
ENVIRONMENTAL WALK
COOLING WATER MAKE-UP RESERVOIR
R ROAD
MAIN SECURITY GATE HOUSE
MT ARTHUR COAL CONVEYOR ROAD
ANTIENE CWB
3/4 WATER TREATMENT PLANT
DOMESTIC

Source:
© 2013 Macquarie Generation,
Drawing No. BW816608, 27/05/2008.

0 50 100 150m

N

Client:	Macquarie Generation		
Drawing No:	0213879h_B_PESA_C001_R1.cdr		
Date:	26/09/2013	Drawing size: A3	
Drawn by:	JD	Reviewed by: MB	

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 2 - Site Layout Plan (Operational Area)

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Areas of Environmental Concern:

1. BA - Brine Concentrator Holding Pond
2. BB - Brine Concentrator Decant Basin
3. BC - Fuel Oil Installation
4. BD - Vehicle Refueling Depot
5. BE - Coal Storage Area
6. BF - Coal Unloaders, Rail Infrastructure and Coal Transfer Lines
7. BG - Contaminated Water Treatment Plant
8. BH - Cooling Water Treatment Plants
9. BI - Demineraliser Plant
10. BJ - Former Contractor Staging Area
11. BK - Former Large Items Assembly Area
12. BL - Generator Transformer Areas
13. BM - Landfill
14. BN - Lime Softening Plant
15. BO - Lime Softening Plant Sludge Lagoons
16. BP - Vehicle and Mobile Plant Workshop
17. BQ - Pikes Gully Ash Dam
18. BR - Ravensworth Rehabilitation Area
19. BS - Low Pressure Pumping Station
20. BT - High Pressure Pumping Station
21. BU - Dangerous Goods Storage
22. BV - Power Block
23. BW - Sediments
24. BX - Transgrid Switchyard
25. BY - Buffer Lands

Legend

- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample
- Site Boundary

Bayswater_AECs

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrastructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 0.5 1 1.5km

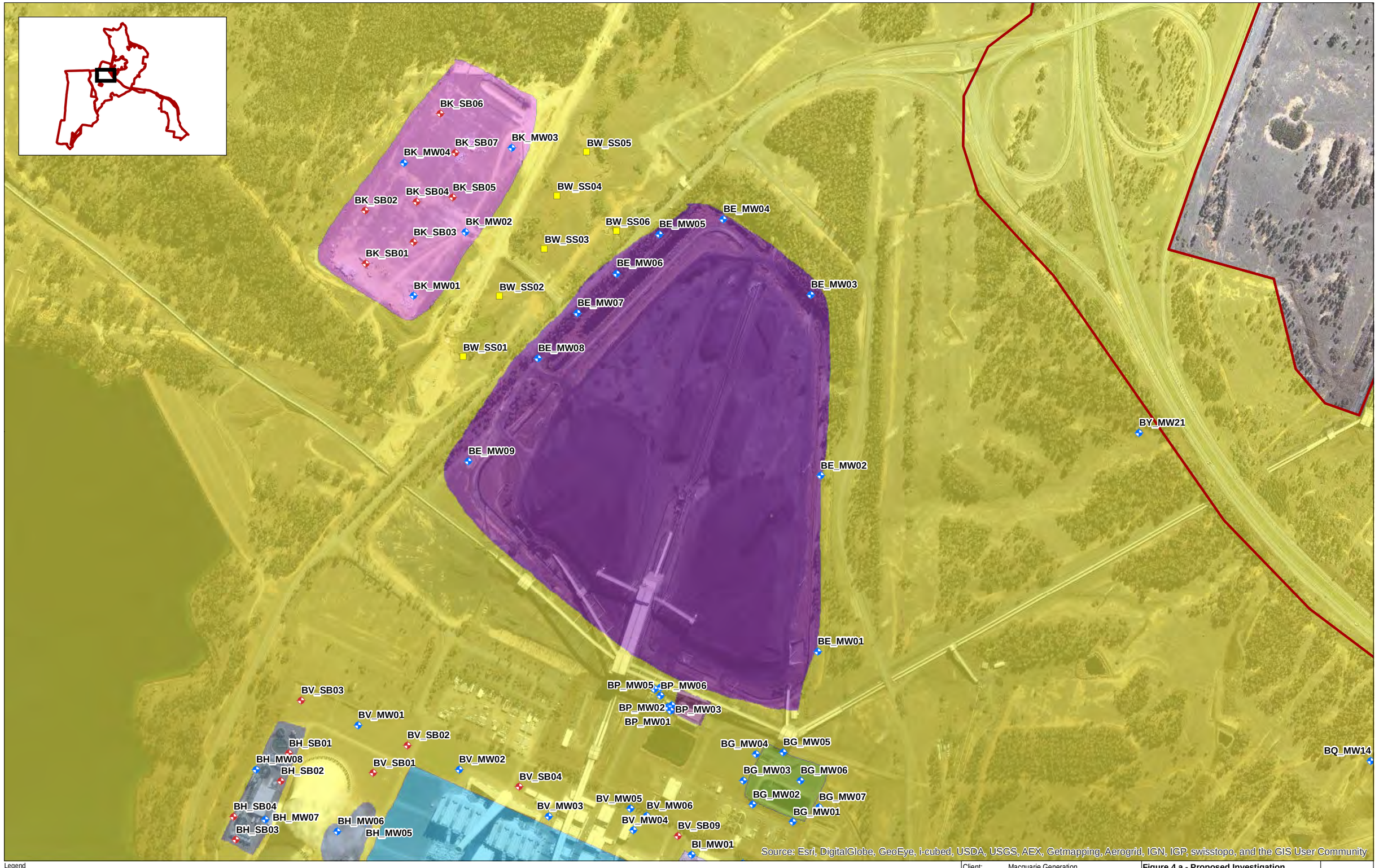
N

Client:	Macquarie Generation		**Figure 3 - Areas of Environmental Concern**
Drawing No:	0213879s_B_PESA_G002_R3.mxd		
Date:	01/10/2013	Drawing Size: A3	Project Symphony - Bayswater
Drawn By:	KB	Reviewed By: JF	Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

Site Boundary
Monitoring Well
Soil Bore
Existing Well
Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 50 100 150m

N

Client:	Macquarie Generation	
Drawing No:	0213879s_B_PESA_G004_R3.mxd	
Date:	27/09/2013	Drawing Size: A3
Drawn By:	KB	Reviewed By: JF

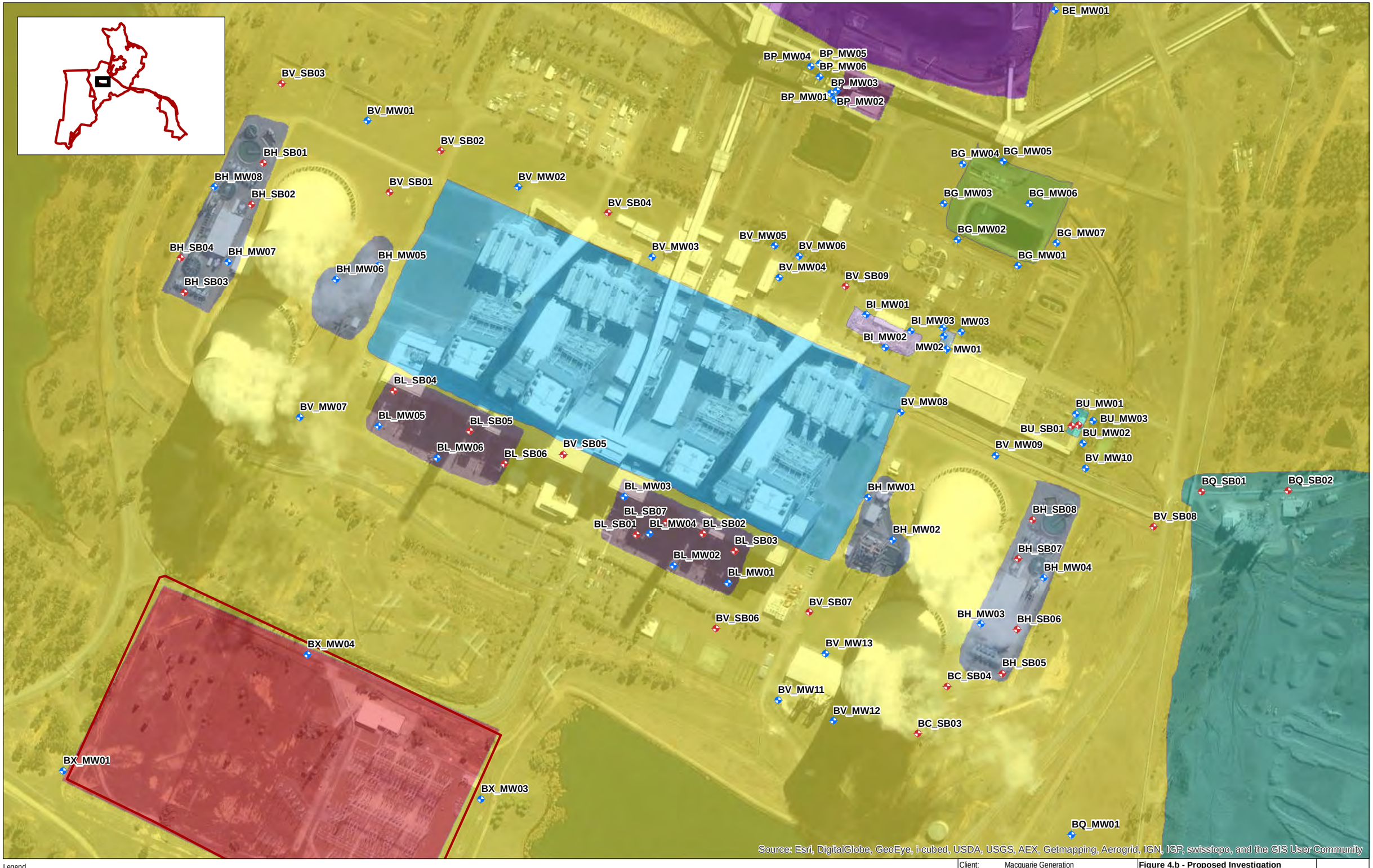
Figure 4.a - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

N

0 50 100 150m

Client:	Macquarie Generation		
Drawing No:	0213879s_B_PESA_G005_R3.mxd		
Date:	27/09/2013	Drawing Size: A3	
Drawn By:	KB	Reviewed By: JF	

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.

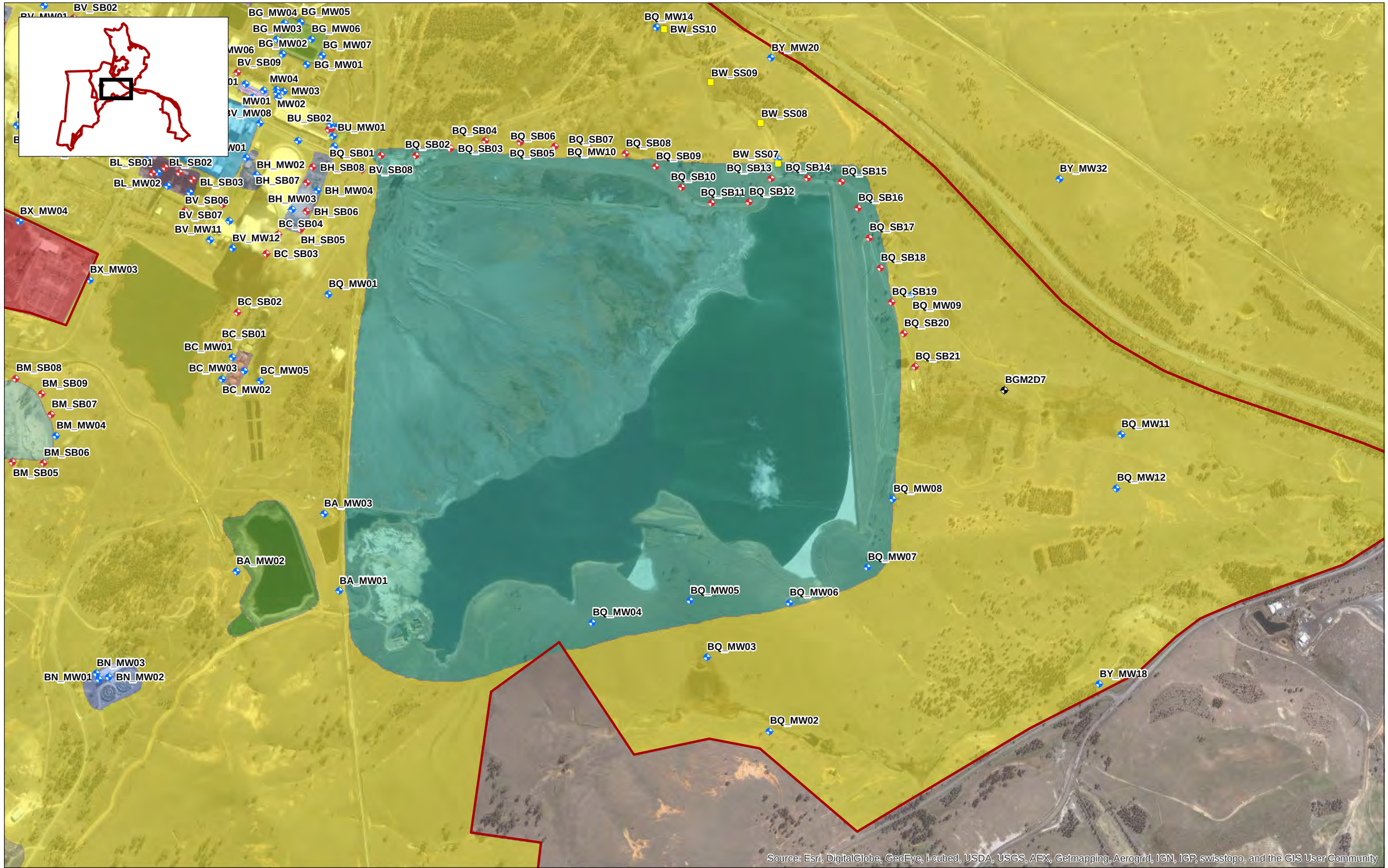
Figure 4.b - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 100 200 300m

N

Client:	Macquarie Generation		
Drawing No:	0213879s_B_PESA_G006_R3.mxd		
Date:	27/09/2013	Drawing Size: A3	
Drawn By:	KB	Reviewed By: JF	

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.

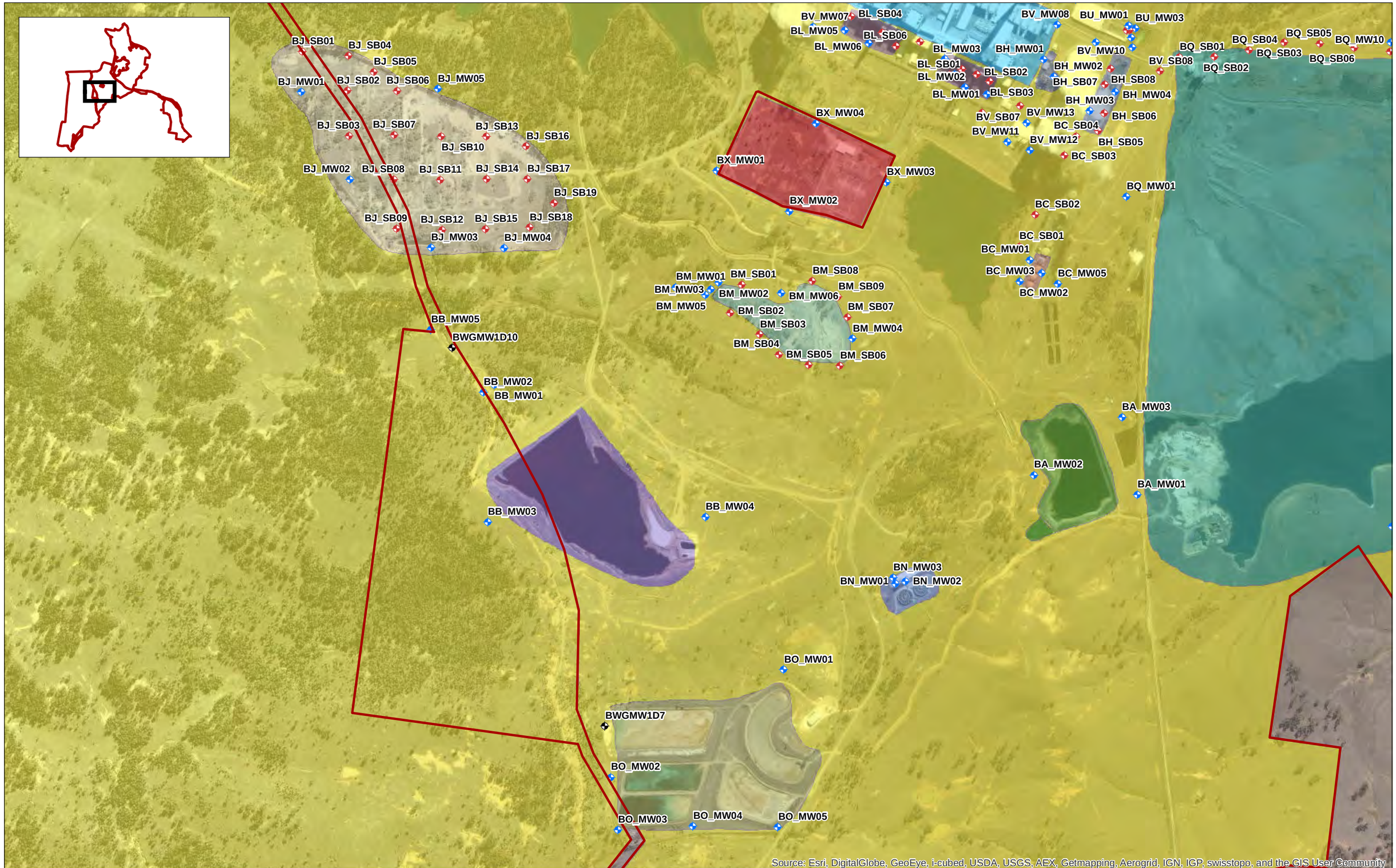
Figure 4.c - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 100 200 300m

N

Client:	Macquarie Generation		
Drawing No:	0213879s_B_PESA_G007_R3.mxd		
Date:	27/09/2013	Drawing Size: A3	
Drawn By:	KB	Reviewed By: JF	

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.

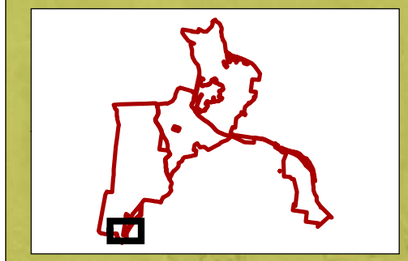
Figure 4.d - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



BT_SB02
BT_MW01
BT_SB01
BS_MW01
BS_SB02
BS_SB01
bing™
© 2012 DigitalGlobe © 2012 GeoEye State of Michigan

Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 50 100 150m

N

Client:	Macquarie Generation		
Drawing No:	0213879s_B_PESA_G008_R3.mxd		
Date:	27/09/2013	Drawing Size: A3	
Drawn By:	KB	Reviewed By: JF	

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.

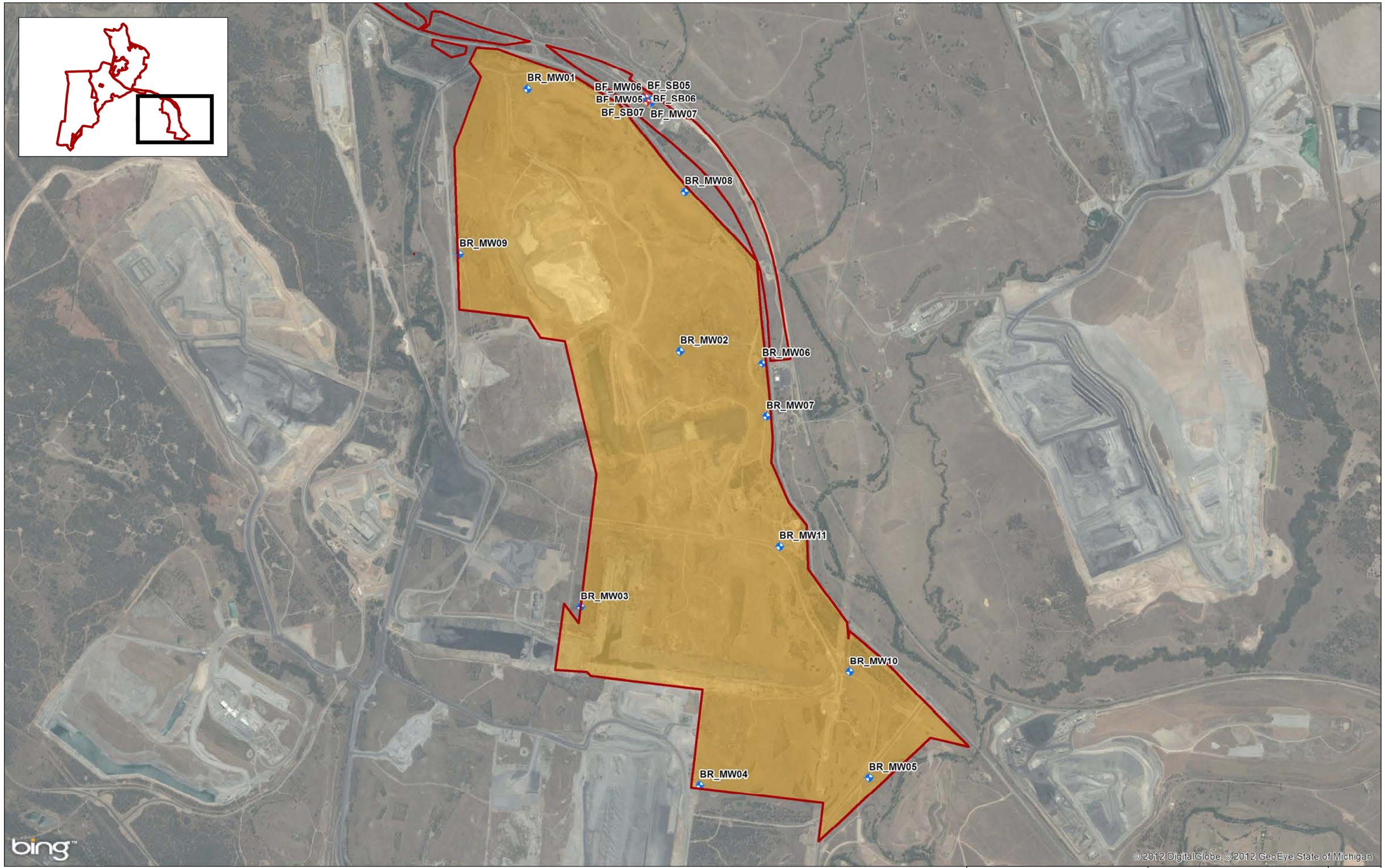
Figure 4.e - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 200 400 600m

N

Client:	Macquarie Generation		**Figure 4.f - Proposed Investigation Locations**
Drawing No:	0213879s_B_PESA_G009_R3.mxd		Project Symphony - Bayswater
Date:	27/09/2013	Drawing Size: A3	Stage 1 - Preliminary Environmental Site Assessment
Drawn By:	KB	Reviewed By: JF	Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

BF_SB01

BF_MW01

BF_SB03

BF_SB02

BF_MW02

BF_SB04

BF_MW04

BF_MW03

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage Area
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash Dam
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 10 20 30m

N

Client:	Macquarie Generation	
Drawing No:	0213879s_B_PESA_G011_R3.mxd	
Date:	27/09/2013	Drawing Size: A3
Drawn By:	KB	Reviewed By: JF

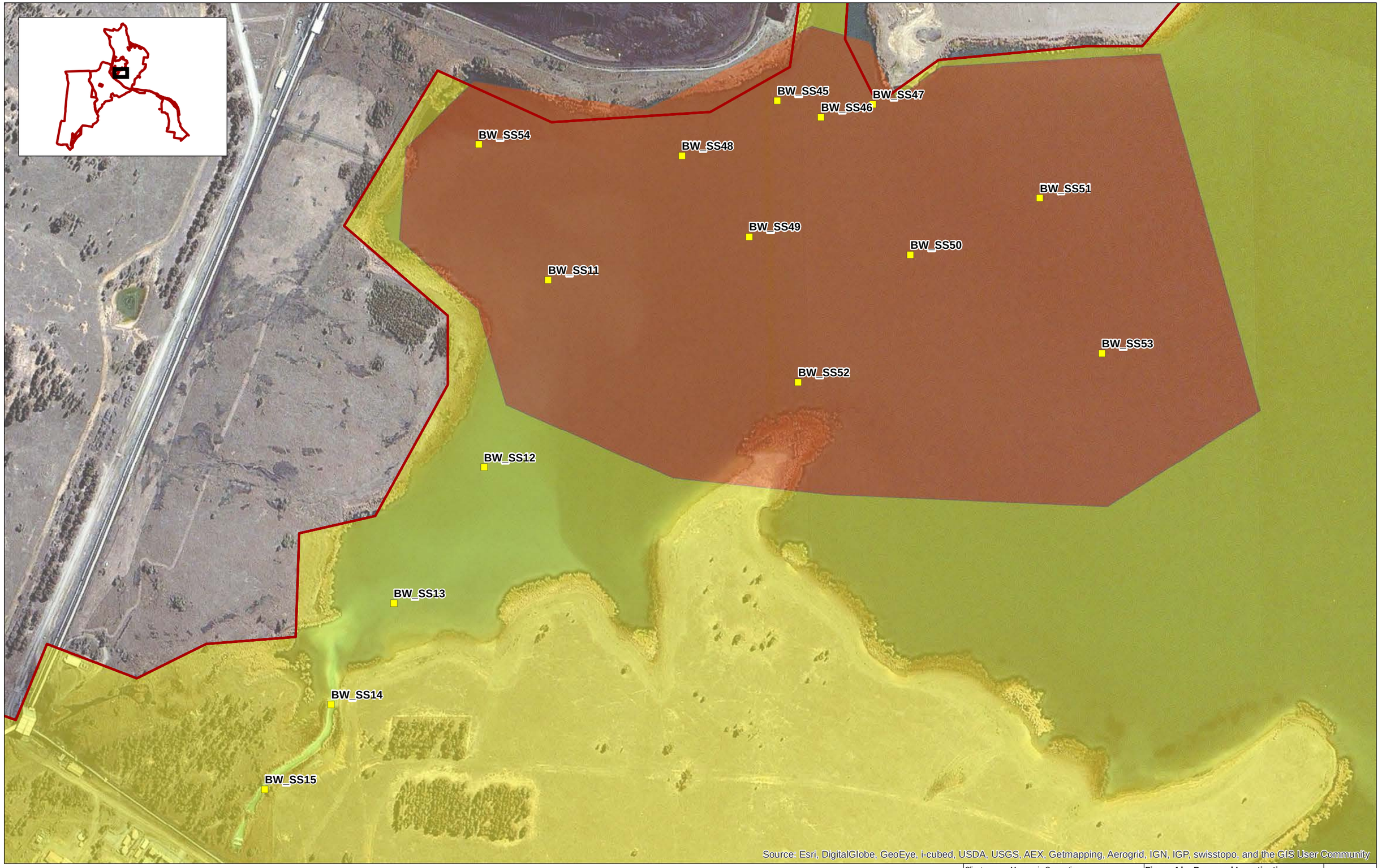
Figure 4.g - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

DRAFT

0 50 100 150m

N

Client:	Macquarie Generation	
Drawing No:	0213879s_B_PESA_G012_R1.mxd	
Date:	01/10/2013	Drawing Size: A3
Drawn By:	KB	Reviewed By: JF

Figure 4.h - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

0 50 100 150m

N

DRAFT

Client:	Macquarie Generation	
Drawing No:	0213879s_B_PESA_G013_R1.mxd	
Date:	01/10/2013	Drawing Size: A3
Drawn By:	KB	Reviewed By: JF

Figure 4.i - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Site Boundary
- Monitoring Well
- Soil Bore
- Existing Well
- Sediment Sample

AECs:

- BA - Brine Concentrator Holding Pond
- BB - Brine Concentrator Decant Basin
- BC - Fuel Oil Installation
- BD - Vehicle Refueling Depot
- BE - Coal Storage
- BF- Coal Unloaders, Rail Infrustructure & Coal Transfer Lines
- BG - Contaminated Water Treatment Plant
- BH - Cooling Water Treatment Plants
- BI - Demineraliser Plant
- BJ - Former Contractor Staging Area
- BK - Former Large Items Assembly Area
- BL - Generator Transformer Area (North & South)
- BM - Landfill
- BN - Lime Softening Plant
- BO - Lime Softening Plant Sludge Lagoons
- BP - Vehicle and Mobile Plant Workshop
- BQ - Pikes Gully Ash
- BR - Ravensworth Rehabilitation Area
- BS - Low Pressure Pumping Station
- BT - High Pressure Pumping Station
- BU - Dangerous Goods Storage
- BV - Power Block
- BW - Sediments in Surrounding Waterways and Lake Liddel
- BX - Transgrid Switchyard
- BY - Buffer Land

0 50 100 150m

N

DRAFT

Client:	Macquarie Generation		
Drawing No:	0213879s_B_PESA_G014_R1.mxd		
Date:	01/10/2013	Drawing Size: A3	
Drawn By:	KB	Reviewed By: JF	

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 4.j - Proposed Investigation Locations

Project Symphony - Bayswater
Stage 1 - Preliminary Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Annex B

Photographs

Photograph 1

Power block - near dust collection system

Photograph 2

Power block – Generator Transformer

Photograph 3

Power block – Turbine House

Photograph 4

Cooling Water Make-up Dam (at right) and Brine Concentrator Contaminated Water Holding Pond (background)

Photograph 5

Contaminated Water Treatment Plant

Photograph 6

Drum storage near Contaminated Water Treatment Plant

Photograph 7

Power Block - sluiceway

Photograph 8

High pressure pumping station - transformers

Photograph 9

Low pressure pumping station - transformers

Photograph 10

Power block – transformer oil ASTs near Generator Transformers

Photograph 11

Demineraliser plant

Photograph 12

Softening Plant Sludge Lagoon

Photograph 13

Lime Softening Plant – Iron Chloride ASTs

Photograph 14

Brine Concentrator Decant Basin

Photograph 15

Brine Concentrator Decant Basin – salinity impacts to vegetation in downgradient areas

Photograph 16

Brine Concentrator Decan Basin – Seepage Pond No. 2

Photograph 17

Pikes Gully Ash Dam – spillway in north-east portion

Photograph 18

Landfill – current disposal area

Photograph 19

Landfill – historical disposal areas

Photograph 20

Landfill – drum disposal

Photograph 21

Ravensworth Rehabilitation Area – void 3

Photograph 22

Ravensworth Rehabilitation Area – void 3

Photograph 23

Ravensworth Rehabilitation Area – void 4 water return system

Photograph 24

Ravensworth Rehabilitation Area – revegetated area

Annex C

Registered Titles

Lot	DP	Registered Owner	Local Govt. Area
1	113655	Macquarie Generation	SINGLETON
1	234545	Macquarie Generation	SINGLETON
1	252530	Macquarie Generation	MUSWELLBROOK
1	369326	Macquarie Generation	SINGLETON / MUSWELLBROOK
1	574168	Macquarie Generation	SINGLETON / MUSWELLBROOK
1	616024	Macquarie Generation	SINGLETON / MUSWELLBROOK
1	616025	Macquarie Generation	SINGLETON / MUSWELLBROOK
1	658099	Macquarie Generation	MUSWELLBROOK
1	738417	Macquarie Generation	SINGLETON
1	774679	Macquarie Generation	SINGLETON
1	774706	Macquarie Generation	SINGLETON
1	986496	Macquarie Generation	SINGLETON
1	1135603	Macquarie Generation	MUSWELLBROOK
1	1142103	Macquarie Generation	SINGLETON
1	1155775	Macquarie Generation	SINGLETON
1	1158697	Macquarie Generation	MUSWELLBROOK
1	1158700	Macquarie Generation	MUSWELLBROOK
1	1175303	Macquarie Generation	SINGLETON
2	113655	Macquarie Generation	SINGLETON
2	247943	The Electricity Commission of NSW	MUSWELLBROOK
2	327372	Macquarie Generation	MUSWELLBROOK
2	574168	Macquarie Generation	SINGLETON / MUSWELLBROOK
2	628645	Macquarie Generation	SINGLETON
2	774679	Macquarie Generation	SINGLETON
2	774706	Macquarie Generation	SINGLETON
2	986496	Macquarie Generation	SINGLETON
2	1095515	Macquarie Generation	MUSWELLBROOK
2	1167986	Macquarie Generation	SINGLETON
2	1175303	Macquarie Generation	SINGLETON
3	113655	Macquarie Generation	SINGLETON
3	247943	Macquarie Generation	MUSWELLBROOK
3	774681	Macquarie Generation	MUSWELLBROOK
3	774706	Macquarie Generation	SINGLETON
3	1171724	Macquarie Generation	SINGLETON
4	113655	Macquarie Generation	SINGLETON
4	247943	Macquarie Generation	MUSWELLBROOK
4	774706	Macquarie Generation	SINGLETON
4	1175271	Macquarie Generation	SINGLETON
5	966589	Macquarie Generation	MUSWELLBROOK
5	1175271	Macquarie Generation	SINGLETON
6	247943	Macquarie Generation	MUSWELLBROOK
6	966589	Macquarie Generation	MUSWELLBROOK
9	247943	Macquarie Generation	MUSWELLBROOK
10	700554	Macquarie Generation	SINGLETON / MUSWELLBROOK
11	247943	Macquarie Generation	MUSWELLBROOK
13	247945	Macquarie Generation	SINGLETON
15	247945	Macquarie Generation	SINGLETON
15	848095	Macquarie Generation	SINGLETON
17	752468	Macquarie Generation	SINGLETON
18	752468	Macquarie Generation	SINGLETON
19	752486	Macquarie Generation	MUSWELLBROOK
23	225426	Macquarie Generation	MUSWELLBROOK
25	225426	Macquarie Generation	SINGLETON

Lot	DP	Registered Owner	Local Govt. Area
30	752468	Macquarie Generation	SINGLETON
31	752468	Macquarie Generation	SINGLETON
62	752468	Macquarie Generation	SINGLETON
73	752468	Macquarie Generation	SINGLETON
74	752486	Macquarie Generation	MUSWELLBROOK
75	752468	Macquarie Generation	SINGLETON
76	752468	Macquarie Generation	SINGLETON
86	752468	Macquarie Generation	SINGLETON
88	752468	Macquarie Generation	SINGLETON
89	752468	Macquarie Generation	SINGLETON
91	752468	Macquarie Generation	SINGLETON
103	752468	Macquarie Generation	SINGLETON
105	752468	Macquarie Generation	SINGLETON
107	547864	Macquarie Generation	SINGLETON
110	625973	Macquarie Generation	SINGLETON
112	1059007	Macquarie Generation	SINGLETON
120	1174907	Macquarie Generation	SINGLETON
125	752468	Macquarie Generation	SINGLETON
150	752468	Macquarie Generation	SINGLETON
151	752468	Macquarie Generation	SINGLETON
152	752468	Macquarie Generation	SINGLETON
322	625513	Macquarie Generation	SINGLETON / MUSWELLBROOK
331	752486	Macquarie Generation	MUSWELLBROOK
910	1123501	Macquarie Generation	SINGLETON
1000	1132937	Macquarie Generation	SINGLETON
2012	1151790	Macquarie Generation	SINGLETON

Source:
Baker & McKenzie (23 August 2013).

ERM has over 100 offices across the following countries worldwide

Australia
Argentina
Belgium
Brazil
China
France
Germany
Hong Kong
Hungary
India
Indonesia
Ireland
Italy
Japan
Korea
Malaysia
Mexico
Netherlands
Peru
Poland
Portugal
Puerto Rico
Singapore
Spain
Sri Lanka
Sweden
Taiwan
Thailand
UK
USA
Venezuela
Vietnam

Environmental Resources Management

Building C, 33 Saunders Street
Pyrmont NSW 2009
Locked Bag 24,
Broadway NSW 2007

T: 61 2 8584 8888
F: 61 2 8584 8800
www.erm.com

ERM