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19 September 2025

s74
Eden Estates (Newcastle) Pty Ltd
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Suite 1.02, 3 Thomas Holt Drive
Macquarie Park NSW 2113

Dear s74

Site Auditor Advice on Sampling, Analysis and Quality Plan (SAQP) for Targeted Contamination Assessment, Lake Road, Wallsend

1.0 Background

s74 was engaged by Eden Estates (Newcastle) Pty Ltd (Eden Estates) as the Landuse Auditor (LUA), accredited by the NSW Environment Protection Authority (NSW EPA) under the Contaminated Land Management Act 1997, (Accreditation No. 9819), to provide an independent review of the Sampling, Analysis and Quality Plan (SAQP) for Targeted Contamination Testing for the proposed residential subdivision off Lake Road, Wallsend NSW.

2.0 Intrusive Investigation – Sampling, Analysis and Quality Plan (SAQP)

The LUA has reviewed the final version of the following key report:

- **Douglas Partners (2025)** 'Sampling, Analysis and Quality Plan for Targeted Contamination Testing, Proposed Residential Subdivision, off Lake Road, Wallsend, NSW', project reference 91610.10.R.001.Rev0 (Revision 0), dated 17 September 2025.

The Auditor's reviews of the SAQP followed the NSW EPA guidelines including the *NSWEPA's (2020) Consultant Reporting Guidelines*. All comments raised in relation to earlier drafts were closed out to the satisfaction of the LUA.

3.0 Auditor Opinion

It is the Auditor's opinion that the SAQP presented in **Douglas Partners (2025)** is consistent with NEW EPA Guidelines.

Subject to meeting the SAQP's data quality objectives (DQOs), the data gathered will be of adequate quality to feed directly into the further assessment, remediation (if required) and redevelopment of the proposed subdivision off Lake Road, Wallsend NSW.

4.0 EPA Requirements for LUA Information

Consistent with EPA requirements for provision of Auditor information and staged "sign-off" of sites that are the subject of progressive assessment, remediation and validation, I am required to advise that:

- This interim advice does not constitute a Site Audit Report (SAR) or Site Audit Statement (SAS).
- This information is considered by this Auditor to be consistent with EPA guidelines and policies.
- This interim advice does not derogate from any other approval matters that may relate to the Site.

I would be pleased to provide further explanation as to the basis of this Auditor's Interim Advice (AIA), at your request.

Yours sincerely,

s74

NSWEPA Accredited Site Auditor No. 9819
AECOM Chief Environmental Scientist (ANZ)

Enclosed:

- Douglas Partners (2025) 'Sampling, Analysis and Quality Plan for Targeted Contamination Testing for the proposed development, off Lake Road, Wallsend, NSW, 91610.10.R.001.Rev0 (Revision 0)' dated 17 September 2025 (85 pages).

Douglas PARTNERS

GROUNDED EXPERTISE

Sampling and Analysis Quality Plan for Targeted Contamination Testing

Proposed Residential Subdivision

off Link Road, Wallsend NSW

Prepared for Eden Estates (Newcastle) Pty Ltd

Project 91610.10

17 September 2025

Douglas PARTNERS | GROUNDED EXPERTISE

Document History

Details

Project No.	91610.10
Document Title	Sampling and Analysis Quality Plan for Targeted Contamination Testing
Site Address	off Link Road, Wallsend NSW
Report Prepared For	Eden Estates (Newcastle) Pty Ltd
Filename	91610.10.R.001.Rev0

Status and Review

Status	Prepared by	Reviewed by	Date issued
Draft A	s74	s74	25 July 2025
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Distribution of Copies

Status	Issued to	
Draft A	s74	– Eden Estates (Newcastle) Pty Ltd
Draft B		– Eden Estates (Newcastle) Pty Ltd
Revision 0		– Eden Estates (Newcastle) Pty Ltd

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

Signature		Date
Author	s74	17 September 2025
Reviewer	s74	17 September 2025

Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Table of Contents

Sampling and Analysis Quality Plan for Targeted Contamination Testing
Proposed Residential Subdivision off Link Road, Wallsend NSW

1. Introduction

Douglas Partners Pty Ltd (Douglas) has been engaged by Eden Estates (Newcastle) Pty Ltd to prepare this sampling and analysis quality plan (SAQP) for targeted contamination testing associated with the proposed residential subdivision located off Link Road, Wallsend NSW.

The general objective of the SAQP is to provide a targeted investigation program to broadly assess the areas of concern relating to site contamination for the proposed development. The assessment is focused on the areas of environmental concern as identified through previous investigations including the Preliminary Site investigation (PSI) undertaken by Ramboll (Ramboll, 2020) and aims to assess the site for proposed rezoning.

The SAQP for the targeted investigation will outline the general investigation scope to assist and inform the preparation of an updated planning proposal for rezoning to be submitted as part of a planning proposal.

Specifically, the objective of this SAQP for the targeted investigation program for the proposed residential subdivision is to present:

- A scope of work for site assessment, including sample locations, analytes for testing and quality assurance requirements;
- Methodology for soil, groundwater and surface water sampling;
- Site assessment criteria (SAC) for the assessment, based on the proposed land use; and
- Support for a planning proposal to allow the proposed development at the site.

It is noted that the assessment of the contaminants relating to the hazardous ground gases (HGG) have been addressed in a separate draft SAQP for HGG.

2. Site Description and Environmental Setting

The site covers a large area of land extending from Elermore Vale in the south-east, Fletcher in the north and Edgeworth in the south-west of approximated 592 hectares. The Newcastle Link Road bisects the site area and runs east-west as indicated on Figure 1 below. The majority of the site lies within the local government area of Newcastle City Council, with some areas in the southern and western parts of the site within Lake Macquarie City Council.

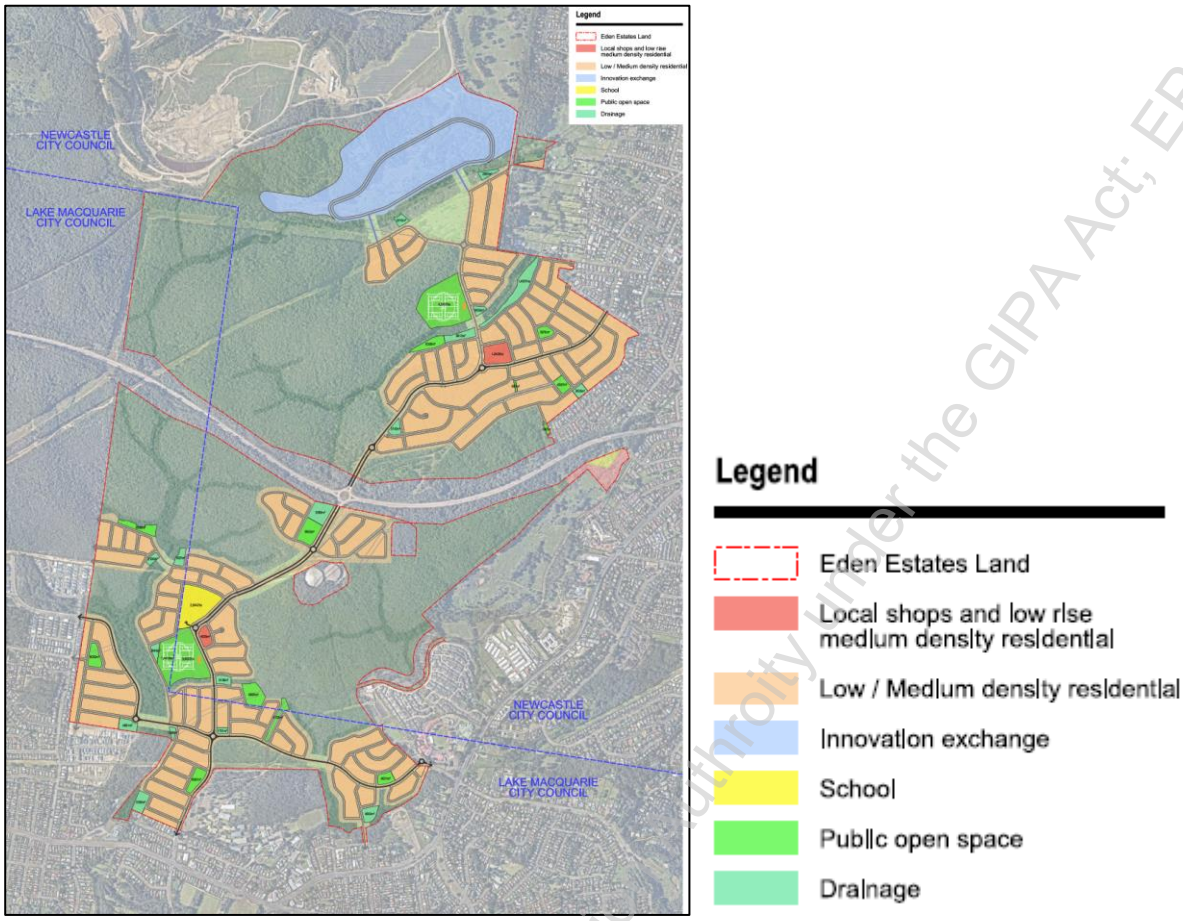

Figure 1: Proposed Layout of the Development (residential areas in yellow and public areas in bright green)

The proposal is to rezone land to accommodate 3,000 to 4,000 homes including two neighbourhood / local centres, land for public recreation and associated road network. Approximately 340 hectares of the site is also proposed to be conserved for environmental conservation. The proposed development areas consist of local shops, low rise medium density residential, innovation exchange, schools, public open space and drainage.

The site is primarily covered with vegetation, although some areas of the site have been previously cleared. The cleared areas are mostly associated with former coal mine pit top facilities.

The elevations for the site range from about RL 20 to above RL 90 AHD. The topography comprises lower lying areas (valleys) in the north east and southern portion. Two valleys fall towards the north-east and one towards the south-west. Steep terrain is mapped in the north western portion and within the north central and portions. The areas of higher elevation are typically within the north-west and west of the site and include a spur with an elevation of up to about RL 90 which projects into the site from the west.

The site, layout of the proposed development and labelling of divided areas which are used to reference specific development areas (R1 to R16, IE, PS1 and MD) in this SAQP are presented in Drawings 1-1 and 1-6 in Appendix B.

Site identification and summary of mapping review is presented in Table 1 below.

Table 1: Summary of site identification and environmental setting

Item	Comment
Site Address	Various - West of Bulkara Street, Wallsend, North and South of Newcastle Link Road, west of Elermore Vale, North of Main Road, Glendale.
Approximate Area	574 hectares.
Lot / DP	• Lot 1 in DP192650; • Lot 1 in DP822151; • Lot 2 in DP800035; • Lot 31 in DP35580; • Lots A and B in DP 36897; • Lot 130 in DP1155943; • Lot 3057 in DP1208470; • Lot 3051 in DP1202601; • Lot 3052 in DP1202601; • Lot 3053 in DP1202601; • Lot 350 in DP1167367.
Zoning	Predominantly zoned E4 Environmental Living, with zones E2 Environmental Conservation along the western boundary and southeastern portion, RU6 Transition in the southwestern portion and SP2 Infrastructure through the central portion of the site associated with the existing Newcastle Link Road.
Local council area	Approximately 70% of the site, or 406 Ha, is located within the City of Newcastle local government area (LGA). Approximately 30%, or 167 Ha, is within the City of Lake Macquarie LGA.
Topography	The ground surface at the site ranges in elevation from about RL 20 to about RL 90 relative to Australian Height Datum (AHD). The topography is complex and includes three valleys. Two of the valleys fall towards the north-east and one towards the south-west. The areas of higher elevation are typically within the north-west and west of the site, but include a spur with an elevation of up to about RL 90 m which projects into the site from the west.
Current Use	Vacant.
Surrounding Land Use	North – Summerhill Waste Management Centre is located to the north (approximately 500 m to 750 m from the northern extent of proposed residential development). South – Existing residential development. East – Existing residential development. West – Bushland.

Item	Comment
Geological Mapping	Reference to the 1:100,000 Geological Survey of New South Wales database indicates that the site is underlain by the Newcastle Coal Measures. Reference to the 1:13680 scale Surface Geology Map of the Newcastle Coalfields published by BHP indicates that the Warners Bay Formation subcrops to the west of the site and locally extends onto the site. The age of the strata increases to the east and the Waratah Sandstone, which forms the basal member of the Newcastle Coal Measures, subcrops near north-east of the site boundary. The site is toward the western margin of the outcrop of the Newcastle Coal Measures. In some areas the Nobbys Seam merges into the underlying upper split of the Dudley Seam and thereafter is called the "Young Wallsend Seam". Similarly, in some areas, the Dudley Seams merges into the Yard Seam and is called the Dudley Yard Seam. With further coalescence of the seams, the entire interval from the Nobbys Seam to the Borehole Seam merges into a single coal seam called the West Borehole Seam.
Acid Sulfate Soil	The site is located in an area mapped as having no known occurrence of acid sulfate soils. A small area in the north-eastern corner (Lots A and B in DP 36897) is mapped as 'no known occurrence' of acid sulfate soils but is at an elevation of less than 10 m AHD.
Soil Landscape Mapping	The mapping indicates that the site extends over soils belonging to several landscape groups, as follows: • Killingworth Group (erosional), with limitations associated with this soil group including a high water erosion hazard, mine subsidence district, localised foundation hazard, localised shallow soils, localised seasonal waterlogging, sodic/dispersible soils of low wet strength and very strongly acidic soils of low fertility; • Cedar Hill Group (colluvial). Soils within this group are described as being moderately deep to deep (0.6 m to 2 m). Limitations associated with this soil group include high mass movement hazard, high foundation hazard, steep slopes, mine subsidence district and acidic soil; • Warners Bay (residual). Soils within this ground are described as being moderately deep to deep (1 m to greater than 1.5 m). Limitations associated with this soil group include high water erosion hazard, foundation hazard, localised steep slopes, localised mass movement hazard, high run-on hazard, moderate to high shrink-swell; • Gateshead (erosional). Soils within this ground are described as being moderately deep(1 m to 2 m). Limitations associated with this soil group include water erosion hazard, mine subsidence district, localised steep slopes and shallow soils, high run-on and seasonal waterlogging on lower slopes and acid soil; and • Disturbed Terrain. These areas are highly variable and have been identified to have been largely disturbed in the past. The limitations depend on the nature of the site.

3. Background

3.1 Preliminary Site Investigation (Ramboll, 2020)

A PSI was conducted by Ramboll (Ramboll, 2020)

The scope of work comprised the following:

- A desktop review of published data available across the site;
- A review of available previous reports provided by the client;
- A detailed site inspection of the property by a qualified environmental practitioner.

The development of a preliminary conceptual site (CSM) assessing source, pathway, receptor linkages.

The desktop site history review indicated the following:

- The northern portion of the site has a history of coal mining from at least the late 1800s until the early 2000s when the collieries were decommissioned;
- Majority of the site has been predominantly vacant bushland;
- The reports reviewed as relating to the former mining activities in the northern portion are briefly summarised below.

The results of the observations during the site walkover undertaken for the PSI are outlined as follows:

- The topography of the site was observed to be variable with a high ridge on the northern boundary and generally undulating land from less than 10 mAHD in the south and east to almost 100 mAHD in the north;
- Surface slopes were greater towards the water courses which included Brush Creek in the south and Maryland Creek in the north of the site;
- Landscaped and filled land was assumed to be present in the former colliery infrastructure areas in the north of the site. It was noted that dense vegetation cover over the site hampered identification of such features during the Ramboll site inspection;

  The site boundaries were generally fenced along either side of the Newcastle Link Road with locked gates at major access points. Informal entry points were noted however, where access by four-wheel drive vehicle would still be possible. All parts of the site remain accessible by foot;
- The northern boundary is formed by a topographically high area (ridge) which separates the site from the Summerhill Waste Management facility;
- The area of the former New Wallsend No. 2 Colliery was accessible by vehicle using the existing tracks on the site and also by foot. Thorough inspection of the area was not possible due to the vegetation covering this portion of the site at the time of the Ramboll inspection. No indications of the former pit top infrastructure were observed;
- During the site inspection no significant visible signs of contamination (such as staining or odours) were noted with the exception of the sporadic dumped waste material across the site;

- During the site inspection, a total of 79 locations of illegally dumped wastes were observed and logged. Observed dumped waste materials were located on or near tracks with the most waste generally positioned nearest to site boundaries and access points to the site;
- The wastes generally comprised:
  - automobile parts including car bodies, often burnt, wheels/tyres etc;
  - household wastes including broken furniture/mattresses, wood, plastics, metals, some electronic items (TVs), broken household appliances (ovens/washers/dryers etc);
  - Suspected ACM were noted at nine locations.

The following reports prepared for the site and/or portions of the site were reviewed as part of the Ramboll PSI (Ramboll, 2020):

- Environmental Site Assessment and Remediation, New Wallsend No. 2 Colliery, Bulkara Street, Wallsend' dated 14 September 2005 by RCA Australia (RCA):
  - The scope of work included:
    - Investigation around the operational areas of the site, which comprises the north eastern portion of the current site area;
    - Supervision of remediation of areas as required;
    - Validation of remediation and preparation of a report.
  - The results of investigation indicated the presence of soil contamination in various areas of the site;
  - Remediation and validation works were conducted in selected areas of the former colliery;
  - RCA concluded that minor contamination remains:
    - Within the area of the hydrocarbon excavation;
    - At depth in the trial box cut;
    - At depth in the borrow pit;
    - Within the area of the former noise bund.
  - A preliminary qualitative risk assessment concluded that the remnant contamination posed no ecological or human health risk with control/management measures in place;
  - RCA commented that further investigation of the site area would be required for redevelopment.
- Final Report, Phase 2 Decommissioning and Rehabilitation of New Wallsend No. 2, Colliery' dated February 2006 by Umwelt (Australia) Pty Ltd (Umwelt);
  - The objective of the report was to demonstrate that the decommissioning works had been completed in compliance with the relevant Department of Primary Industries-approved mining operations plans for the site;
  - In regard to site contamination Umwelt indicated the following potential ongoing issues:
    - Asbestos-containing materials (ACM) was present in site infrastructure and had been removed by a licenced contractor. However there existed a potential for some to have remained onsite including insitu material capped in the operations area;

  - Carbonaceous tailings material was partially disposed of offsite with the remainder buried on site;
  - Coal rejects were buried in "emplacement areas" which are understood to occupy part of the former Wallsend Borehole Colliery. There is a low probability of spontaneous combustion and landslips;
  - A number of dams, such as the former Goat Hill Dam, had been dewatered, filled, reshaped and revegetated. A series of contour drains eventually direct surface water runoff into Maryland Creek.

- Australand Holdings Limited, Report for New Wallsend Due Diligence Assessment and Concept Design' dated June 2006 by GHD Pty Ltd (GHD):
  - GHD prepared a report to outline a due diligence assessment and provide engineering input to a feasibility study for a potential residential development for the former New Wallsend No. 2 land;
  - A brief summary of the findings indicated the following:
    - The minor hydrocarbon contamination remaining on site as reported in RCA (2005) was noted;
    - Potential for the presence of fine asbestos in soil following removal of infrastructure, as well as data gaps for PCBs and lead in former buildings in the former operational areas;
    - The presence of a former site tramway/railway was noted and was considered a potential contamination source (metals/hydrocarbons/asbestos) (however it is noted that GHD did not observe evidence of former tram lines and railways during their site inspection in 2006);
    - Spraying of weeds and pests may also have occurred at the site and as such contaminants associated with herbicides and pesticide spraying may be present in soil;
    - The main potential for site contamination was considered to be illegal dumping of waste through the many public-accessible areas of the site and which were noted by GHD during the site inspection.
- Preliminary Contamination Review of Supplied Documents, The Newcastle Wallsend Coal Company Holdings, Link Road, Wallsend' dated 7 November 2019 by Douglas Partners Pty Ltd (DP) (DP 2019):
  - The objective of the 'high level' preliminary review was to provide comment on the identified areas of contamination within the reports and the suitability of the remediation works undertaken to date (as outlined in the reports) for future proposed residential development of the site and identify other possible areas of environmental concern or potentially contaminating activities which may typically be associated with the former use of the site as a coal mine;
  - Douglas considered that as the previous site remediation was conducted for mine closure purposes and that additional remediation is likely to be required to facilitate future residential site development. It was also noted that additional investigation will be needed to confirm the extent of remediation/management required.
- Additional Assessment for Asbestos, Former New Wallsend No 2 Colliery Pit Top Facility off Bulkara Street, Wallsend' dated 11 December 2019 by Douglas (DP 2019a):

- The scope of the additional investigation comprised:
  - Site inspection and limited surface sampling;
  - Excavation of 11 test pits at former building locations of interest, to depths up to 4.0 m below ground level (mbgl);
  - Collection of representative soil samples for identification and laboratory analysis where signs of potential ACM were observed. Analysis of two soil samples for the presence of asbestos;
  - Collection of 10L soil samples for on-site sieving through a < 7 mm sieve where signs of potential ACM were observed;
  - Preparation of a factual report.
- A brief summary of the findings indicated the following:
  - Fill was observed in all test pits to a maximum depth of investigation of 4.0 mbgl. Building materials were observed in six of the 11 test pits, and indicators of potential hydrocarbon staining and odours were observed in two pits. Fragments of potential ACM fibre sheeting were observed on the ground surface over an asphalt pavement;
  - Field screening did not identify visually evident ACM during test pitting. Douglas recommended laboratory testing would be required to confirm the presence/absence of asbestos. Two soil samples were analysed with results indicating the absence of asbestos;
  - It was noted that the investigation did not constitute a detailed asbestos investigation with reference to NEPM (2013) and further investigation would be required to confirm site conditions and facilitate future residential development.

- Report on Geotechnical Investigation of Filled Areas, dated September 2020 by DP (DP 2020):
  - The objective of the assessment was to:
    - Identify the depth of fill at the test locations;
    - Inform the condition of the fill (fill materials, compaction, constituent characteristics);
    - Identify possible site improvement options for residential development within these areas;
    - Assess the risk of generation of acid leachate, treatment and mitigation of leachate generation;
    - Assess the propensity for spontaneous combustion and bushfire ignited combustion; and
    - Detail methods to reduce combustion and acid generation risk.
  - Fill was identified to depths of 28 mbgl. Fill predominantly comprised coal rejects and coal fines and to a lesser extent non-carbonaceous materials comprising gravelly sandy clays and alluvial clays. Drilling logs did not include commentary on olfactory or visual evidence of contamination;
  - Laboratory analysis found that tested carbonaceous material have a low propensity for spontaneous combustion but that combustion in the presence of an external ignition source was possible. Capping measures were recommended to reduce this risk;

- Groundwater was encountered in some drill locations, with piezometers installed in seven drill holes. Groundwater was found in five piezometers (two were dry) between 3.1 and 11.9 mbgl following a period of stabilisation, with groundwater elevations around 17 mAHD to 27 mAHD, with the exception of one location where groundwater was at 70 mAHD. Analysis of pH of water samples found groundwater to be acidic to neutral. Analysis of pH was also conducted in Dam 3 (northern portion) was also completed and found generally neutral (pH 6.6) pH;
- An assessment of acid generating potential was completed on selected soil/rock/fill samples. The analysis suggested the potential for acid generation upon oxidation of the tested soils. Recommendations to control acid leachate were provided;
- DP identified that the assessment completed was preliminary in nature and included a series of recommendations for additional further work including:
  - Identification of the former high wall;
  - Investigation in areas that are currently inaccessible;
  - Further investigation to define the extent and depth of fill;
  - Further monitoring of groundwater to assess acid generation;
  - Water quality monitoring of the surface water body to assess impacts to surface water from water shedding off the filled areas;
  - Trials to assess acid generating potential and provide options for mitigation.

Assessment of acidity and contamination investigations. Based on the findings of the PSI and previous reports listed above, the following areas of environmental concern (AEC) are noted:

- Historical Mining Operations:
  - Sites: New Wallsend No. 2 Colliery and Wallsend Borehole Colliery.
    Concerns:
    - Leaks/spills from former fuel and oil storage and machinery (ie. hydrocarbon spill area);
    - Hazardous materials from demolished buildings (e.g. asbestos, lead, PCBs);
    - Potential ground gas generation, acid generation, and combustibility from buried carbonaceous materials;
    - Discharge of mine water into on-site creeks and water bodies;
    - Residual contamination from previous site activities.
- Illegal Dumping:
  - Widespread dumping of:
    - Burnt car bodies, household items, building materials, and possible asbestos-containing material (ACM);
    - Over 80 locations identified during the 2020 site inspection.
- Imported Fill Material:
  - Potential for contamination from:

  - Hydrocarbons, heavy metals, organochlorine and organophosphate pesticides, solvents, and asbestos.

- Demolition Waste and Buried Infrastructure:
  - Presence of building foundations and buried waste including potential asbestos pipe remnants and former industrial plant/machinery.
- Use of Chemicals for Pest Control:
  - Historical use of herbicides and pesticides across the site, especially in easements and operational areas.

The PSI (Ramboll 2020) indicated that the majority of the site could be suitable for rezoning for any future land use subject to removal of illegally dumped wastes. Ramboll indicated that further investigation of the former collieries and areas associated with former mining activities was required to assess the suitability of these areas for certain land uses with or without remediation.

Based on the available information and the results of the PSI, a SAQP for further targeted investigation for contamination was recommended as follows:

- Soil, ground gas, and groundwater sampling at key former mining operational areas (Wallsend Borehole Colliery and New Wallsend No. 2, Colliery):
  - Residual areas comprising hydrocarbon impact;
  - Locations of buried noise bunds, trial box cut and borrow pits;
  - Former building locations (for hazardous building materials);
  - Emplacement areas of coal reject and carbonaceous material.
- Asbestos assessment - further asbestos investigation in soils to detect residual ACM, especially in:
  - Former building sites;
  - Tailings pipe areas;
  - Locations of observed dumped ACM (based on visual inspection).
- Wallsend Borehole Colliery:
  - Additional assessment or review of closure of the colliery, including sampling of soil, groundwater, and ground gas.
- Water quality investigations:
  - Surface water and sediment sampling from onsite creeks and dams to assess possible contamination from mine water discharge or runoff.
- Characterisation of fill:
  - Define extent and depth of deep fill (up to 28 m);
  - Assess combustibility and acid leachate potential of fill materials;
  - Conduct groundwater monitoring for acidity and contaminant migration risks.
- Review of historical closure and monitoring records regarding the following:

  - Closure documentation and monitoring reports for both New Wallsend No. 2 and Wallsend Borehole Collieries;
  - Details regarding burial of equipment or plant, especially within shafts.
- Assessment of areas relating to former tram lines in the southern portion.

Ramboll indicated that while the majority of the site appears suitable for future rezoning including potential sensitive residential use. This is conditional upon:

- The removal of illegal waste;
- Completion of targeted site investigations; and
- Potential remediation based on the outcomes.

Douglas is generally in agreement with the above findings and advice. Further investigation will provide data to demonstrate site suitability or identify areas requiring remedial action or possible land use restrictions.

Areas of potential contamination as identified in the PSI (Ramboll, 2020) are summarised on the Drawings in Appendix B.

It is noted that no further reports where available for review regarding the closure and the Wallsend Borehole Colliery or information regarding the possible burial of equipment or plant within shafts.

4. Site Walkover

A brief site walkover was conducted on 15 July 2025 within the northern and far southern portions of the site. The intent of the site walkover was to provide a general assessment of current site condition (i.e. compared to the previously prepared and more detailed site description in the PSI) and to inform the general access conditions across the site for future intrusive investigations. with.

At the time of the site walkover the site was covered with a medium dense to dense cover of trees and undergrowth, with no obvious indicators of previous infrastructure evident other than remnant access tracks. Given the relative inaccessibility of large portions of the site, the walkover was focussed within the more open areas of the site, including the former colliery areas.

Where surface soils were exposed, soils generally comprised a mixture of siltstone (gravel to boulders) and silty clay or coal reject material, with some coal gravel and cobbles observed in some areas. It is noted that large portions of the site were not accessible to visual observation due to thick vegetation cover.

Localised opportunistic dumping (including general household waste), were observed at numerous locations across the site, although predominantly along access tracks.. The general site conditions were generally consistent with the site conditions described in the PSI (Ramboll 2020).

Photos showing the current general site condition are presented in Appendix A.

Additional pertinent observations during the brief walkover comprised the following:

- Sporadic suspected ACM fragments encountered along the access in tracks in the proposed development areas R6 and R7 (Photo 4);
- Abundant coal reject materials within access tracks in the far southern portion of the site (area R15) up to 0.4 m thick) (Photo 5); and
- Black slag within the adjacent road reserve connecting the southern boundary of area R15 (Photo 6).

5. Preliminary Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

Based on the PSI (Ramboll, 2020), the following potential sources of contamination and associated contaminants of potential concern (CoPC) have been identified and summarised in Table 2.

Table 2: Summary of potential sources

Potential sources and associated CoPC
On site sources
S1: Former mining operations in the northern portion – the New Wallsend No. 2 Colliery and Wallsend Borehole Colliery, including: • Leaks and spills from fuel storage and machinery/plant; • Demolition of former buildings containing hazardous building materials such as asbestos, lead and PCBs; • Spills and leaks associated with former tram lines and railways; • Hazardous ground gases, acid generation and combustibility associated with carbonaceous materials; • Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas. CoPC: Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAHs), heavy metals, solvents, asbestos, PCBs, pH and ASS and PFAS. **S2:** Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery. CoPC: TRH, BTEXN, PAHs, heavy metals and solvents. **S3:** Importation of fill material within the former collieries, access tracks and easements and surrounding areas encroaching the site boundary (ie. black slag encroaching southern boundary). CoPC include TRH, BTEXN, PAHs, heavy metals, PCBs, organochlorine pesticides and organphosphosphorus pesticides (OCP/OPPs) and asbestos and PFAS. **S4:** Illegal dumping of waste, including rubbish, building materials, potential ACM and soil. CoPC: TRH, BTEXN, PAHs, heavy metals, PCBs, OCP/OPPs and asbestos and PFAS. **S5:** Use of herbicides and pesticides for weed and pest control. CoPC: OCP/OPP and herbicides.
Off-site sources
S6: Summerhill Waste Management Facility to the north of the site (ie. migration of hazardous ground gases and impact to groundwater from burial and management of wastes). CoPC: Ammonia, TRH, BTEXN, heavy metals, PFAS, and landfill gases (methane, carbon monoxide, carbon dioxide and hydrogen sulfide).

The following potential human and environmental receptors, along with relevant potential pathways, have been identified and summarised in Table 3.

Table 3: Summary of potential receptors and pathways

Potential human receptors
HR1: Current users [trespassers and workers]. **HR2:** Construction and maintenance workers. **HR3:** End users [Onsite occupants (residential, recreational, schools and commercial), visitors and workers]. **HR4**: Adjacent site users [Residential].
Potential environmental receptors
ER1: Surface water [Brush Creek and Maryland Creek]. **ER2:** Groundwater **ER3:** Terrestrial ecosystems.
Potential pathways to human receptors
HP1: Ingestion and dermal contact. **HP2:** Inhalation of dust and/or vapours.
Potential pathways to environmental receptors
EP1: Surface water run-off. **EP2:** Leaching of contaminants and vertical migration into groundwater. **EP3:** Lateral migration of groundwater providing base flow to water bodies. **EP4:** Inhalation, ingestion and absorption.

Summary of potentially complete exposure pathways

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways (potential complete pathways). The possible pathways between the above sources (S1 to S6) and receptors are provided in below Table 4.

Table 4: Summary of potentially complete exposure pathways

Source and CoPC	Exposure pathway	Receptor	Risk management action
S1: Former mining operations: TRH, BTEX, PAH, PCB, PCBs, pH and ASS. **S2:** Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery: TRH, BTEXN, PAHs, heavy metals and solvents. **S3:** Importation of fill material: TRH, BTEXN, PAHs, heavy metals, PCBs, OCP/OPPs and asbestos. **S4:** Illegal dumping: TRH, BTEXN, PAHs, heavy metals, PCBs, OCP/OPPs and asbestos. **S5:** Use of herbicides and pesticides for weed and pest control: OCP/OPP and herbicides. **S6:** Summerhill Waste Management Facility to the north of the site: Ammonia, TRH, BTEXN, heavy metals, PFAS, and landfill gases (methane, carbon monoxide, carbon dioxide and hydrogen sulfide).	**HP1:** Ingestion and dermal contact. **HP2:** Inhalation of dust and/or vapours.	**HR1:** Current users [Onsite occupants, visitors and workers]. **HR2:** Construction and maintenance workers. **HR3:** End users [Onsite occupants (residential), visitors and workers].	An intrusive investigation is recommended to assess possible contamination including testing of the soils, surface water and groundwater.
	HP2: Inhalation of dust and/or vapours.	**HR4:** Adjacent site users [Residential].	
	EP1: Surface water run-off. **EP3:** Lateral migration of groundwater providing base flow to water bodies.	**ER1:** Surface water.	
	EP2: Leaching of contaminants and vertical migration into groundwater.	**ER2:** Groundwater.	
	EP4: Inhalation, ingestion and absorption.	**ER3:** Terrestrial ecosystems.	

6. Data Quality Objectives

The SAQP has been devised broadly in accordance with the seven-step data quality objectives (DQO) process which is provided in Appendix B, Schedule B2 of NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013). **Table 5** below provides the data quality objectives for the SAQP.

Table 5: Data Quality Objectives

Step	Summary
1: State the problem	The broad objective of the SAQP is to provide a targeted investigation program to assess the areas of concern relating to site contamination for the proposed development, as identified through previous investigations. The report is being undertaken as the land is to be redeveloped as residential subdivision. A list of potential contaminant sources has been presented for the site (Section 5 above). The proposed receptors include the future site users, adjacent site users, surface water, groundwater and terrestrial ecosystems. The project team will consist of experienced environmental engineers and scientists working in the roles of Project Principal, Project Reviewer, Project Manager, field staff. It is noted that the site area is considered to be too large to categorise from a site suitability perspective. The problem to be addressed, as captured in the above broad objective, is to provide an assessment program to investigate the potential contaminant sources/areas to a level suitable to facilitate preliminary decision making with regards to future development, and to inform future more detailed assessment.
2: Identify the decisions / goal of the study	Previous assessment and site history has identified possible contaminating previous uses which are identified in the CSM in Section 5 above along with the associated contaminants of potential concern (COPC) and potential affected media. The site assessment criteria (SAC) for each of the COPC are detailed in Appendix E. The decision is to establish whether or not the results fall below the SAC or whether or not the 95% upper confidence limit of the sample population falls below the SAC, with the goal of informing future sampling and testing rationale as part of more detailed assessment. On this basis, staged assessment (of which this assessment is the first stage) will provide an iterative assessment of the site's suitability from a contamination perspective will be derived, decisions made on whether (or not) further assessment and / or remediation will be required.
3: Identify the information inputs	Inputs to the investigation will include the results of site history review and site walkover and the results of analysis of samples to measure the concentrations of COPC identified in Section 5 above using NATA accredited laboratories and methods, where possible. The SAC that will be adopted is discussed in Appendix E. Results of previous assessment by Douglas will also be input into the proposed targeted assessment, subject to an evaluation of data quality with current industry standard as outlined in this SAQP. A photoionisation detector (PID) will be used on-site to screen soils for VOC. PID readings in conjunction with contaminant observations and asbestos sieve results will be used to inform sample selection for laboratory analysis.
4: Define the study boundaries	The lateral boundaries of the investigation area are shown on Drawing 1, which is presented in Appendix B. The vertical boundaries are to the extent of contamination impact as determined from the site history assessment and site observations. Given the likely staged assessment of site suitability from a contamination perspective, and the potential for site conditions to change with time due to human or other influences, the temporal boundary of the current targeted assessment is limited to the timeframe over which the field work is undertaken. Observed changes to site condition following the field work would need to be captured in subsequent assessments.

Step	Summary
5: Develop the analytical approach (or decision rule)	The decision rule is to assess the data quality of the gathered data and analytical results. Analytical data deemed to be of adequate quality will be compared with SAC, based on NEPC (2013)). Where guideline values are absent, other sources of guideline values accepted by NEPC (2013) shall be adopted where possible. Should the assessment of data against the data quality indicators suggest data quality gaps, the data will still be used, but the results will be qualified, with recommendations for future data collection provided to minimise data quality impacts. Where a sample result exceeds the adopted criterion, a further site-specific assessment will be made as to the risk posed by the presence of that contaminant(s). Initial comparisons will be with individual results then, where required and suitable, summary statistics (including mean, standard deviation and 95% upper confidence limit (UCL) of the arithmetic mean (95% UCL)) to assess potential risks posed by the site contamination. Quality control results are to be assessed according to their relative percent difference (RPD) values. For field duplicates and laboratory results, RPD values should generally be below 30%; for field blanks, results should be at or less than the limits of reporting (NEPC, 2013). Should individual representative results (or 95% UCL results) of acceptable data quality be within the adopted SAC, the sample or assessed area will be considered to have a low risk of contamination. Should results be above the SAC, not be representative of the media or area sampled or do not adequately characterise the area of concern, the sample or area may be considered to be impacted by the contaminant(s) of concern or require additional assessment to further characterise for assessment of site suitability.
6: Specify the performance or acceptance criteria	Baseline condition: Contaminants at the site and/or statistical analysis of data (in line with NEPC (2013)) exceed human health and environmental SAC and pose a potentially unacceptable risk to receptors (null hypothesis). Alternative condition: Contaminants at the site and statistical analysis of data (in line with NEPC (2013)) and existing remediation measures (ie capping measures) comply with human health and environmental SAC and relevant remediation guidelines and as such, do not pose a potentially unacceptable risk to receptors (alternative hypothesis). Unless conclusive information from the collected data is sufficient to reject the null hypothesis, it is assumed that the baseline condition is true. Uncertainty that may exist due to the above potential decision errors shall be mitigated as follows: • As well as a primary screening exercise, the use of the 95% UCL as per NEPC (2013) may be applied, i.e: 95% is the defined confidence level associated with the UCL on the geometric mean for relevant contaminant data. The resultant 95%UCL shall subsequently be screened against the corresponding SAC; • The statistical assessment will only be able to be applied to certain data-sets, such as those obtained via systematic sampling. Identification of areas for targeted sampling will be via professional judgement and errors will not be able to have a probability assigned to them; • Interpreting results with reference to the CSM, field observations and known data gaps; • Use of interpretation of results with reference to the data quality indicators/QAQC protocols

Step	Summary
7: Optimise the design for obtaining data	As the purpose of the sampling program is to provide a targeted investigation program to assess the areas of concern relating to site contamination for the proposed development, as identified through previous investigations, the sampling program is reliant on professional judgement to identify and sample the potentially affected areas. Further details regarding the proposed sampling plan are presented in Section 7.

7. Proposed Sampling and Analysis Strategy

7.1 General

A targeted sampling strategy via test pits and boreholes is proposed within each proposed development area across the site in order to achieve the above data quality objectives. The targeted locations are within identified areas of potential environmental concern as identified in the CSM, with targeted locations considering the current site conditions, site history and former infrastructure locations (ie mine site infrastructure), previous investigations (ie targeting areas of fill), and for general site coverage where access permits.

Following discussion with the NSW EPA-accredited auditor for the project, consideration of an Incremental Sampling Methodology (ISM) has been made for the site. This methodology, defined in The Interstate Technology & Regulatory Council (ITRC) document *Technical/Regulatory Guidance Incremental Sampling Methodology (ISM) Update* (ITRC, 2020).

In assessing the use of ISM for the site, we have considered the following:

- Areas of the site that would be amenable to ISM characterisation (i.e. in terms of nature, type and possible distribution of contamination;
- Access constraints that may inhibit ISM; and
- Overall assessment objectives, given that an assessment of chemical contamination, potential asbestos contamination, combustibility assessment and general geotechnical conditions are also to be assessed as part of this investigation.

On the basis of the above, ISM is proposed to be implemented in the following areas of the site:

- Former pit-top facilities in the north-western portion of the site within investigation area ‘IE’;
- Former open cut area in in the northern portion of the site within investigation area ‘R2’;
- Former Hydrocarbon excavation area in the central portion of the site, within investigation areas ‘R3’ and ‘R4’;
- Nosie bund in the eastern portion of the site, within investigation area ‘R3’;
- Investigation area ‘R6’.

The areas that will be subject to ISM are shown on Drawings 1 to 3 in Appendix A.

7.2 Sampling Density

Table 6 below outlines the density of testing proposed within each development area.

As part of the targeted investigation, an additional site walkover of each development area is proposed to identify possible further areas of concern (ie. additional opportunistic dumping, possible fill areas, etc).

The density of testing as outlined in Table 6 below, is considered appropriate for this initial targeted assessment as outlined below:

- The purpose of the investigation is to provide broad, high-level assessment of identified potential contamination sources and areas of concern for future resource allocation and planning, including to inform further more detailed assessment;;
- The density of testing in the identified areas of concern are considered to be appropriate to assess large-scale potential contamination sources such as potential bulk fill placement which is likely to be encountered at this site (e.g. mine overburden/spoil and coal reject). Test location density in the northern and central potions of the site (i.e. in those areas of previous commercial land use) equate to approximately 11% to 22% of the systematic sampling quantity as provided in the NSW Sampling Design Guidelines (NSW EPA, 2022);
- Access restrictions within the site, generally associated with mature tree coverage, are providing a limitation to further site coverage for contamination assessment. Invasive assessment via test pits is the preferred methodology for broad-acre assessment in potential fill materials. On the basis of the initial broad assessment, a decision will be made as to whether less-invasive assessment or controlled clearing is conducted to further assess areas of limited access;
- Lower sampling density is proposed in the southern portion of the site. This area of the site, as shown in Drawings 4, 5 and 6 in Appendix A, has historically been bushland, with the identified potential contaminant sources being localised (ie. superficial fill in access tracks and minor opportunistic dumping). As outlined above an additional walkover across each precinct area is proposed to further assess these areas and identify possible further potential contaminant sources which require further detailed investigation or localised remediation (e.g. opportunistic dumping).

Table 6: Summary of Proposed Test Locations in Each Investigation Area

Investigation Sub-Areas	Total Development Sub-Area (ha)	Sampling Density as per EPA sampling design guidelines based on area	Proposed Discrete Test Locations for Targeted Investigation	Proposed Incremental Sampling Method / Decision Units	Potential Sources
IE	40.3	440	41	1	Former borehole colliery, pit top facilities, deep fill, Imported fill in easements and access tracks and opportunistic
IE-A	-	-	ISM	-	Pit top
PS1 (playing field)	4.9	55	8	-	Vicinity of former colliery, deep fill (trial box cut), Imported fill in easements and access tracks and opportunistic dumping
MD/S	2.7	40	9	-	Adjacent developments and opportunistic dumping, imported fill in easements, previous mining structures and former
R1	6.4	70	6	-	Adjacent to former emplacement Area B, easements and access tracks and opportunistic dumping
R2	13.6	150	20	1	Vicinity of former colliery, deep fill (borrow pit), former coal stockpiling area
R2-A	-	-	ISM	-	Former open cut area
R3	10.1	125	17	2	Former colliery, former site structures, residual hydrocarbon area and opportunistic dumping
R3-A	-	-	ISM	-	Eastern portion of hydrocarbon area
R3-B	-	-	ISM	-	Former noise bund
R4	12.6	147	29	1	Former colliery, former site structures, residual hydrocarbon area, deep fill (borrow pit) and opportunistic dumping
R4-A		-	ISM	-	Western portion of hydrocarbon area
R5	9.2	122	19	-	Vicinity of former colliery, former coal stockpiling area and opportunistic dumping
R6	8.3	92	-	1	Vicinity of former colliery, Imported fill in easements and access tracks and opportunistic dumping
R7	10.8	119	10	-	Imported fill in easements and access tracks and opportunistic dumping
R8	9.8	123	6	-	Imported fill in easements and access tracks
R9	16.7	184	12	-	Imported fill in easements and access tracks
R10	7.3	80	5	-	Adjacent developments and opportunistic dumping, imported fill in easements
R11/R12	29.5	324	12	-	Imported fill in easements and possible deeper fill
R13	14	154	14	-	Adjacent developments and opportunistic dumping, imported fill in easements
R14	17.4	192	5	-	Imported fill in easements, former tramline
R15	16	176	25	-	Adjacent developments and opportunistic dumping, imported fill in easements and previous mining structures
R16	12.1	133	10	-	Adjacent developments and opportunistic dumping, imported fill in easements and former tramline

Given the vegetation coverage across the majority of the site, the gathered site history information and the subsequent CSM formulation, a judgemental sampling rationale has been proposed to provide assessment of accessible site areas that have been subject to previous use and potential impact. Preliminary systematic assessment of the identified areas will be conducted via walkover to identify further areas of potential impact, where access allows.

A number of contamination laboratory testing suites have been identified as presented in Section 5 and below. The particulars of each of these suites are outlined below:

- **General Contamination Suite** (within areas of residual mining operations and general fill areas):
  - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, B, Co, Mn, Se)(HM);
  - Total recoverable hydrocarbons (TRH);
  - Monocyclic aromatic hydrocarbons (BTEX);
  - Polycyclic aromatic hydrocarbons (PAH).
- **Extended Contamination Suite** (within areas of residual mining operations and general fill areas and areas of possible pesticide use and former suite structures):
  - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, B, Co, Mn, Se)(HM);
  - TRH;
  - BTEX;
  - PAH;
  - Organochlorine pesticides (OCP);
  - Organophosphorus pesticides (OPP);
  - Polychlorinated biphenyls (PCB).
- **Asbestos in soil** (~500g samples and 10 L bulk samples for sieving/screening) (within general fill areas and former site structures and where observations of potential hazardous building material are made);
- **Asbestos identification** in fibro fragments (within general fill areas and former site structures);
- **PFAS** - Perfluoroalkyl and polyfluoroalkyl substances (PFAS) potentially associated with imported fill (within areas of residual mining operations and general fill areas and imported from potentially impacted groundwater from burial and management of wastes form landfill to the north);
- **pH and cation exchange capacity (CEC)** for site-specific ecological investigation criteria derivation;
- **Combustibility** - moisture, ash, volatile matter, fixed carbon (with materials comprising coal reject and carbonaceous materials);
- **Acid mine drainage -** AMD Phase 1 Suite - (pH, electrical conductivity, net acid generation, net acid producing potential, acid neutralising capacity and total sulfur) (with materials comprising coal reject and carbonaceous materials);

- **Groundwater**
  - Dissolved Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, B, Co, Mn, Se)(HM);
  - TRH;
  - BTEX;
  - PAH;
  - pH and EC;
  - Total dissolved soils (TDS);
  - Alkalinity;
  - Cyanide;
  - Ammonia
  - PFAS.
- **Surface water screening**
  - pH, EC.
- **Surface water**
  - Dissolved Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, B, Co, Mn, Se)(HM);
  - TRH;
  - BTEX;
  - PAH.
- **Sediment**
  - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, B, Co, Mn, Se)(HM);
  - TRH;
  - BTEX;
  - PAH.

The number of proposed contamination suites and analytes to be tested within each investigation area is detailed in Appendix C. The tables provide information on the number of tests, contamination suites and justification of testing based on identified contaminants of concern within each proposed development area.

8. Sampling Methodology

Soil, groundwater and surface water sampling will be conducted in accordance with Douglas' standard operating procedures. The general sampling and sample management procedures are outlined in Appendix D

9. Quality Assurance/Quality Control

Field quality assurance and quality control (QA/QC) testing will include the following:

- 5% (10% for PFAS analysis) sample inter-laboratory analysis, analysed for the same suite as primary sample;
- 5% (10% for PFAS analysis) sample intra-laboratory analysis, analysed for the same suite as primary sample;
- Rinsate samples (one per groundwater sampling event (ie. one) where re-useable sampling equipment is used), analysed for metals, TRH and PFAS;
- Trip spike and trip blank samples (analysed for BTEX) (approximately one per batch of samples where volatile contaminants are CoPC); and
- Trip blank samples (approximately one per batch of samples).

The reliability of field procedures and analytical results will be assessed against the following data quality indicators (DQIs) as outlined in NEPC National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM] (NEPC, 2013):

- Completeness: a measure of the amount of usable data from a data collection activity;
- Comparability: the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness: the confidence (qualitative) of data representativeness of media present on-site;
- Precision: a measure of variability or reproducibility of data; and
- Accuracy: a measure of closeness of the data to the 'true' value.

Assessment of the DQIs will utilise the target evaluation criteria presented in Table 7 for field and laboratory quality control.

Table 7: Evaluation criteria for assessment of DQI

Item	Evaluation / acceptance criteria
Analytical laboratories used	NATA accreditation
Holding times	Various based on type of analysis
Intra-laboratory replicates	5% (10% for PFAS analysis) of primary samples; <30% RPD
Inter-laboratory replicates	5% (10% for PFAS analysis) of primary samples; <30% RPD
Trip spikes	1 per sampling event; 60-140% recovery
Trip blanks	1 per sampling event; <PQL
Rinsates	1 per sampling event; <PQL
Laboratory / reagent blanks	1 per batch; <PQL
Laboratory duplicate	1 per lab batch; as laboratory certificate
Matrix spikes	1 per lab batch; 70-130% recovery (inorganics); 60-140% recovery (organics)
Surrogate spikes	All organics analysis; 70-130% recovery (inorganics); 60-140% recovery (organics)
Control samples	1 per lab batch; 70-130% recovery (inorganics); 60-140% recovery (organics)
Standard operating procedures (SOP)	Adopting SOP for all aspects of the sampling field work

10. Assessment of Contamination – Site Assessment Criteria

10.1 Soil

The site assessment criteria (SAC) for soil to be applied in the investigation are informed by the CSM (Section 5) which identified human and environmental receptors to potential contamination on the site. Analytical results will be assessed (as a Tier 1 assessment) against the SAC comprising primarily the investigation and screening levels of Schedule B1 of NEPC (2013).

The investigation and screening levels to be applied in the investigation comprise levels adopted for a generic low density residential land use scenario. It is noted that an area in the northern portion is proposed for commercial along with localised areas across the site proposed for recreational / open space. In the absence of a final development layout, residential land use scenario will be adopted for the targeted assessment.

Table 8: Proposed Land use of each area

Investigation Area / Sub-Areas	Proposed Landuse
IE	Commercial
PS1	Recreational / Open Space
MD	Residential/ Open Space
R1	Residential/ Open Space
R2	Residential and Recreational / Open Space
R3	Residential and Recreational / Open Space
R4	Residential / Open Space and Commercial
R5	Residential and Recreational / Open Space
R6	Residential and Recreational / Open Space
R7	Residential and Recreational / Open Space
R8	Residential and Recreational / Open Space
R9	Residential and Recreational / Open Space
R10	Residential and Recreational / Open Space
R11/R12	Residential and Recreational / Open Space
R13	Residential and Recreational / Open Space
R14	Residential and Recreational / Open Space / Commercial
R15	Residential and Recreational / Open Space
R16	Residential and Recreational / Open Space

10.2 **Groundwater and surface water**

Groundwater and surface water samples will be assessed against the following:

- HEPA *PFAS National Environmental Management Plan (NEMP)* (HEPA, 2025);
- ANZG *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018);
- ANZECC *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).

11. Reporting

The results will be reported with reference to the NSWEPA Guidelines for Consultants Reporting on Contaminated Land (NSW EPA 2020)The report will present the following:

- Brief summary of adopted sampling and testing strategy;

- Details of the investigations undertaken, including subsurface conditions, observations of contamination and results of soil and groundwater laboratory testing;
- Updated CSM;
- Comments on the presence of potential contamination at the site based on site history, previous and current site investigations and site conditions;
- Comments on the suitability of the site for the proposed future land use with respect to site contamination;
- Comments on requirements for further investigation and remediation.

12. References

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Subsidence Advisory. (2023a). *Development Application - Merit Assessment Policy (Version 2)*. NSW Department of Customer Service.

13. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this SAQP for this project located off Link Road, Wallsend NSW in line with Douglas' proposal dated 5 August 2024 and acceptance received from Tim Goldacre of Eden Estates (Newcastle) Pty Ltd in purchase order No LR-DP-04 dated 13 August 2024. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of Eden Estates (Newcastle) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions from previous subsurface investigations on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during previous investigations. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental / groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

Appendix A

About This Report

Photoplates

About this Report

October 2024

Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, Douglas cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Douglas requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Douglas would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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Photo 1: Far northern portion of the site in the vicinity of former Wallsend Borehole Colliery Pit top facilities, Area E1 (15 July 2025)

Photo 2: North eastern portion of the site within vicinity of former New Wallsend No.2 Colliery Pit top facilities, Area R3 (15 July 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Photoplates**	PROJECT:	91610.10
	Proposed Residential Subdivision	PLATE No:	1
	Off Link Road, Wallsend NSW	REV:	0
	CLIENT: Eden Estates (Newcastle) Pty Ltd	DATE:	15-Jul-25

Photo 3: North eastern portion of the site within the hydrocarbon spill areas in the vicinity of former New Wallsend No.2 Colliery Pit top facilities, Area R4 (15 July 2025).

Photo 4: Sporadic suspected ACM fragments encountered along the access in tracks in the proposed development, Areas R6 and R7 (15 July 2025).

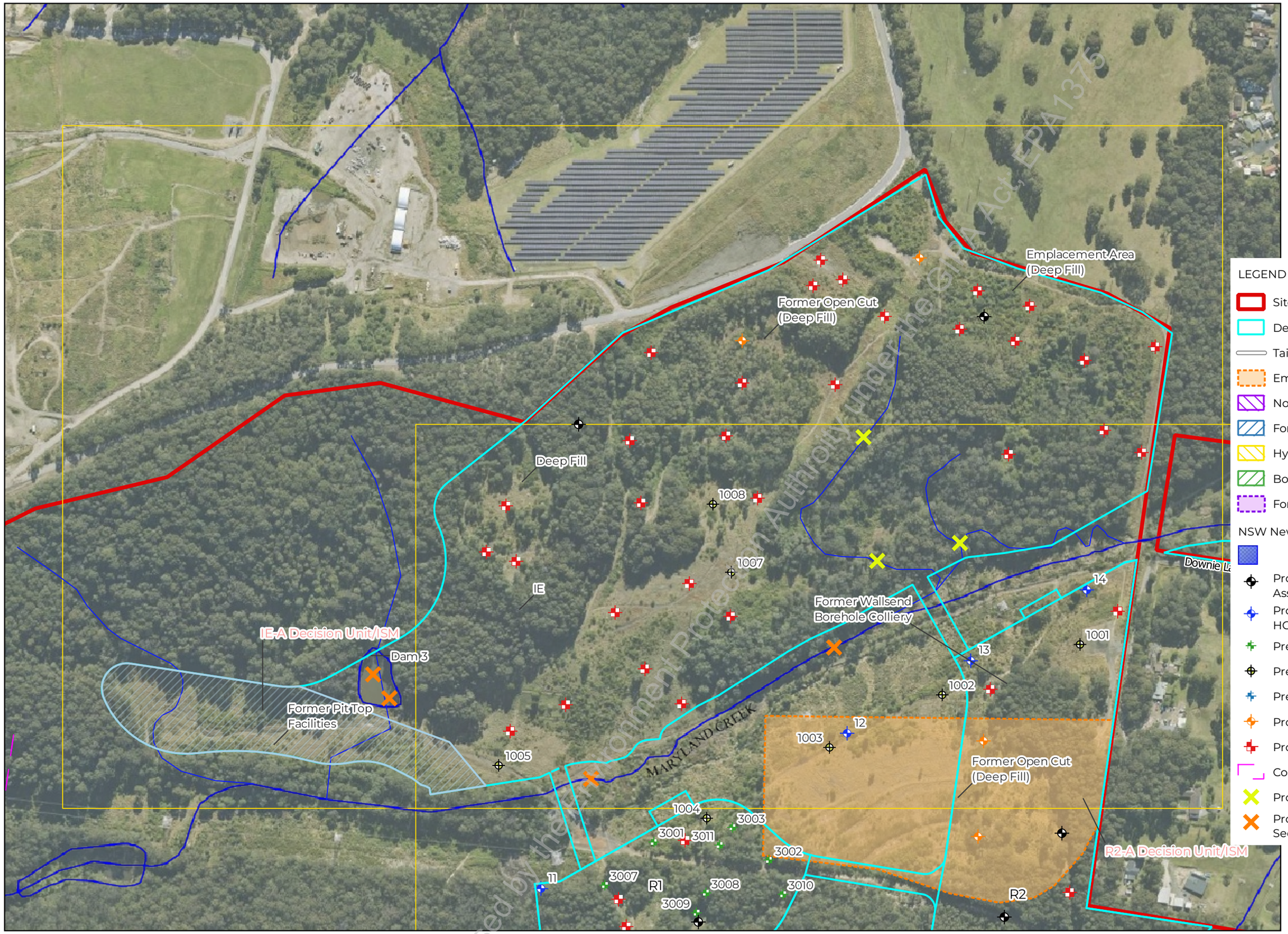
Photo 5: Abundant coal reject materials within access tracks in the far southern portion of the site (area R15) up to 0.4 m thick) (15 July 2025).

Photo 6: Black slag within the adjacent road reserve connecting the southern boundary of area R15 (15 July 2025).

Douglas PARTNERS GROUNDED EXPERTISE	**Photoplates**	PROJECT:	91610.10
	Proposed Residential Subdivision	PLATE No:	4
	Off Link Road, Wallsend NSW	REV:	0
	CLIENT: Eden Estates (Newcastle) Pty Ltd	DATE:	15-Jul-25

Appendix B

Drawings 1 to 6 – Proposed Test Locations



SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features

NSW Newcastle Tramways

- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

0 100 200 m

Douglas PARTNERS

CLIENT: Eden Estates (Newcastle) Pty Ltd		TITLE: **Proposed Test Location Plan**	PROJECT: 91610.10
OFFICE: Newcastle	DRAWN BY: s74	**Proposed Residential Subdivision**	DRAWING No: 1
SCALE: 1:4638 @A3	DATE: 05.September.2025	**Off Link Road, Wallsend, NSW**	REVISION: 0

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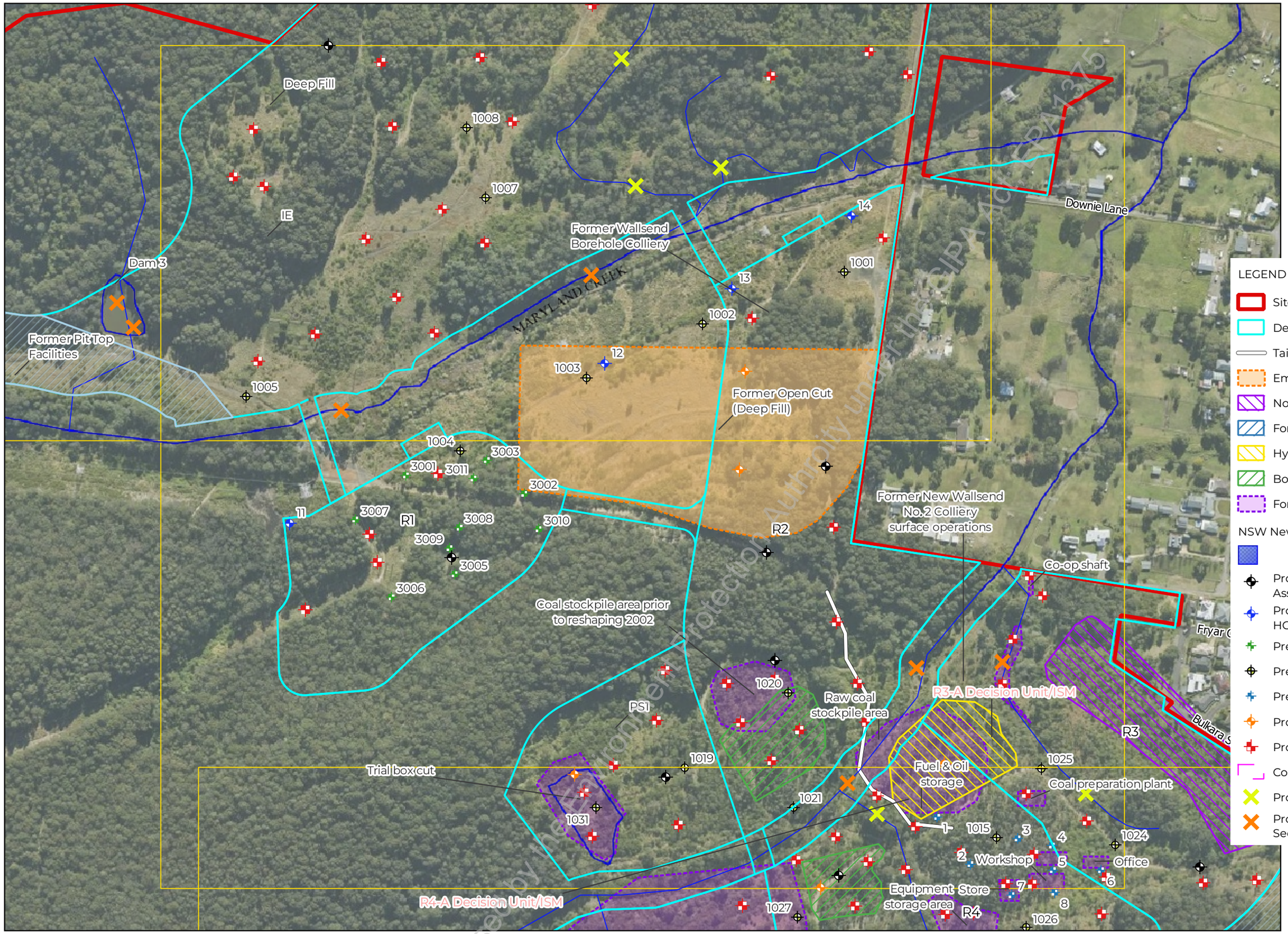


SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features

NSW Newcastle Tramways

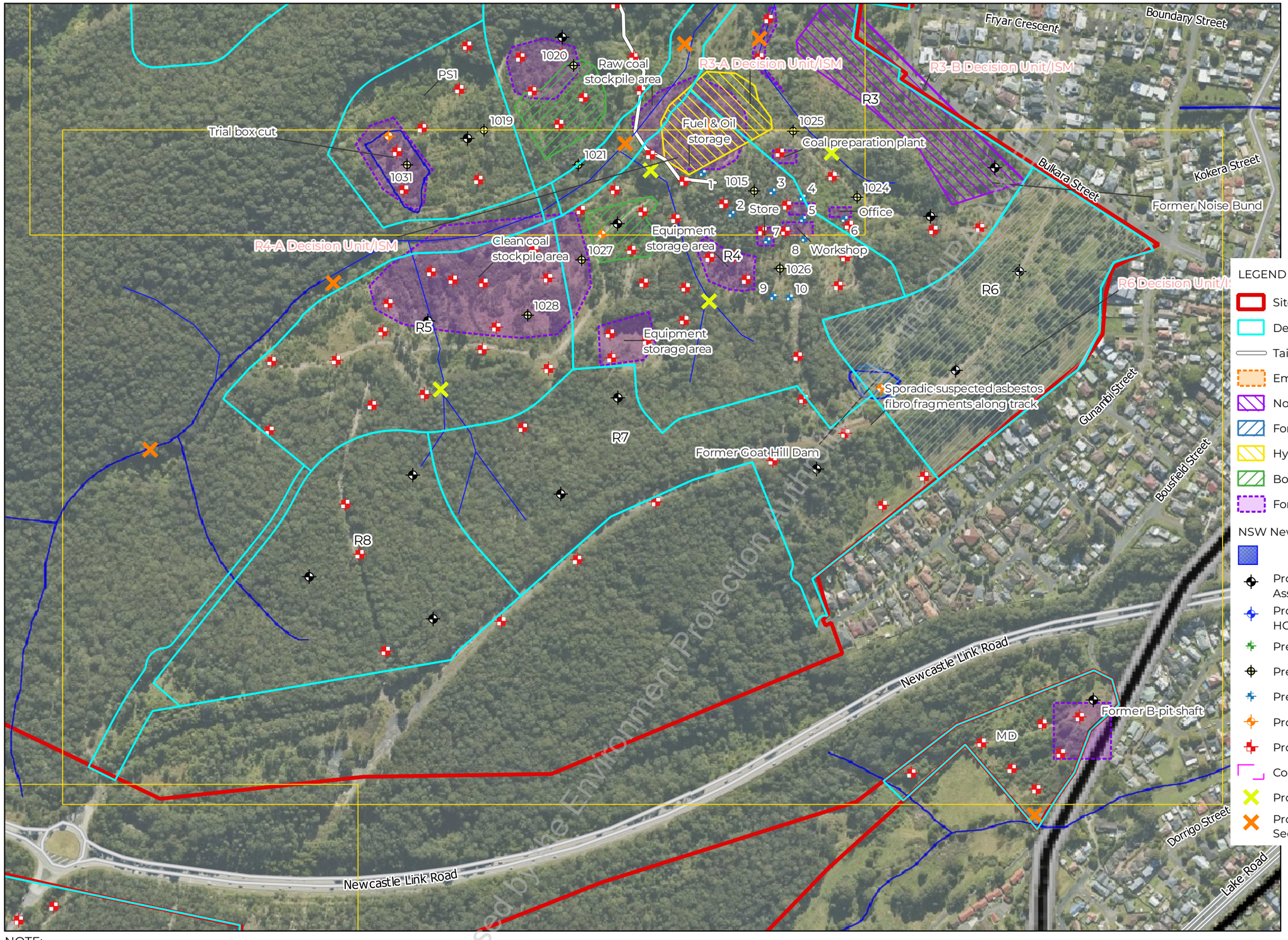
- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

0 100 200 m

Douglas PARTNERS

CLIENT: Eden Estates (Newcastle) Pty Ltd		TITLE: **Proposed Test Location Plan**	PROJECT: 91610.10
OFFICE: Newcastle	DRAWN BY: s74	**Proposed Residential Subdivision**	DRAWING No: 2
SCALE: 1:4507 @A3	DATE: 05.September.2025	**Off Link Road, Wallsend, NSW**	REVISION: 0



SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features

NSW Newcastle Tramways

- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

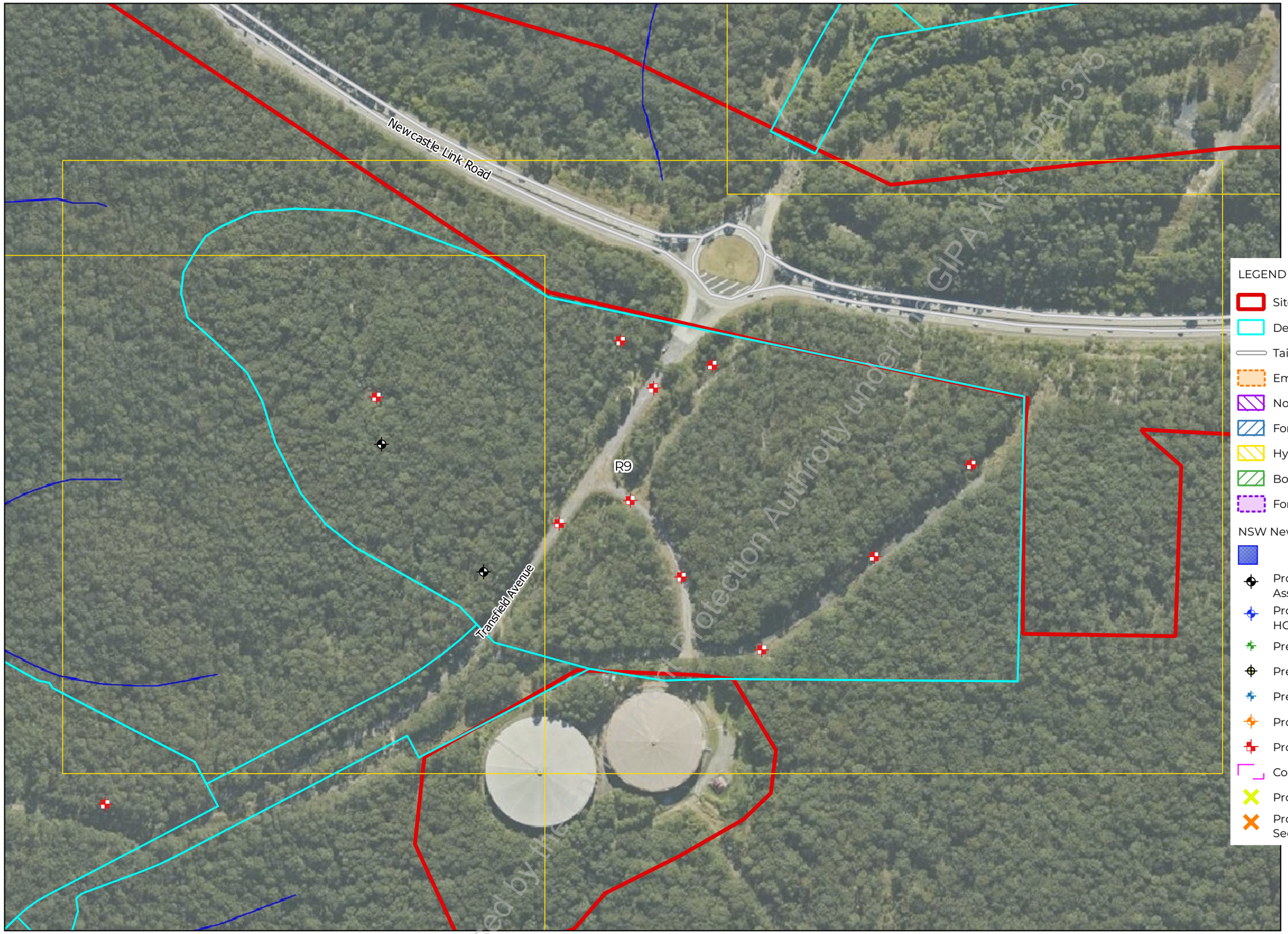
0 100 200 m

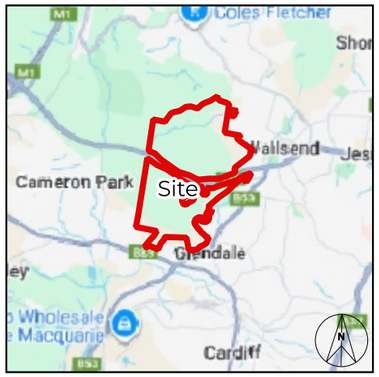
NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

Douglas PARTNERS

CLIENT: Eden Estates (Newcastle) Pty Ltd		TITLE: **Proposed Test Location Plan**	PROJECT: 91610.10
OFFICE: Newcastle	DRAWN BY: s74	**Proposed Residential Subdivision**	DRAWING No: 3
SCALE: 1:5200 @A3	DATE: 05.September.2025	**Off Link Road, Wallsend, NSW**	REVISION: 0

N





SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features

NSW Newcastle Tramways

- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

0 100 200 m

Douglas PARTNERS

CLIENT: Eden Estates (Newcastle) Pty Ltd		TITLE: **Proposed Test Location Plan**	PROJECT: 91610.10
OFFICE: Newcastle	DRAWN BY: s74	**Proposed Residential Subdivision**	DRAWING No: 4
SCALE: 1:3101 @A3	DATE: 05.September.2025	**Off Link Road, Wallsend, NSW**	REVISION: 0

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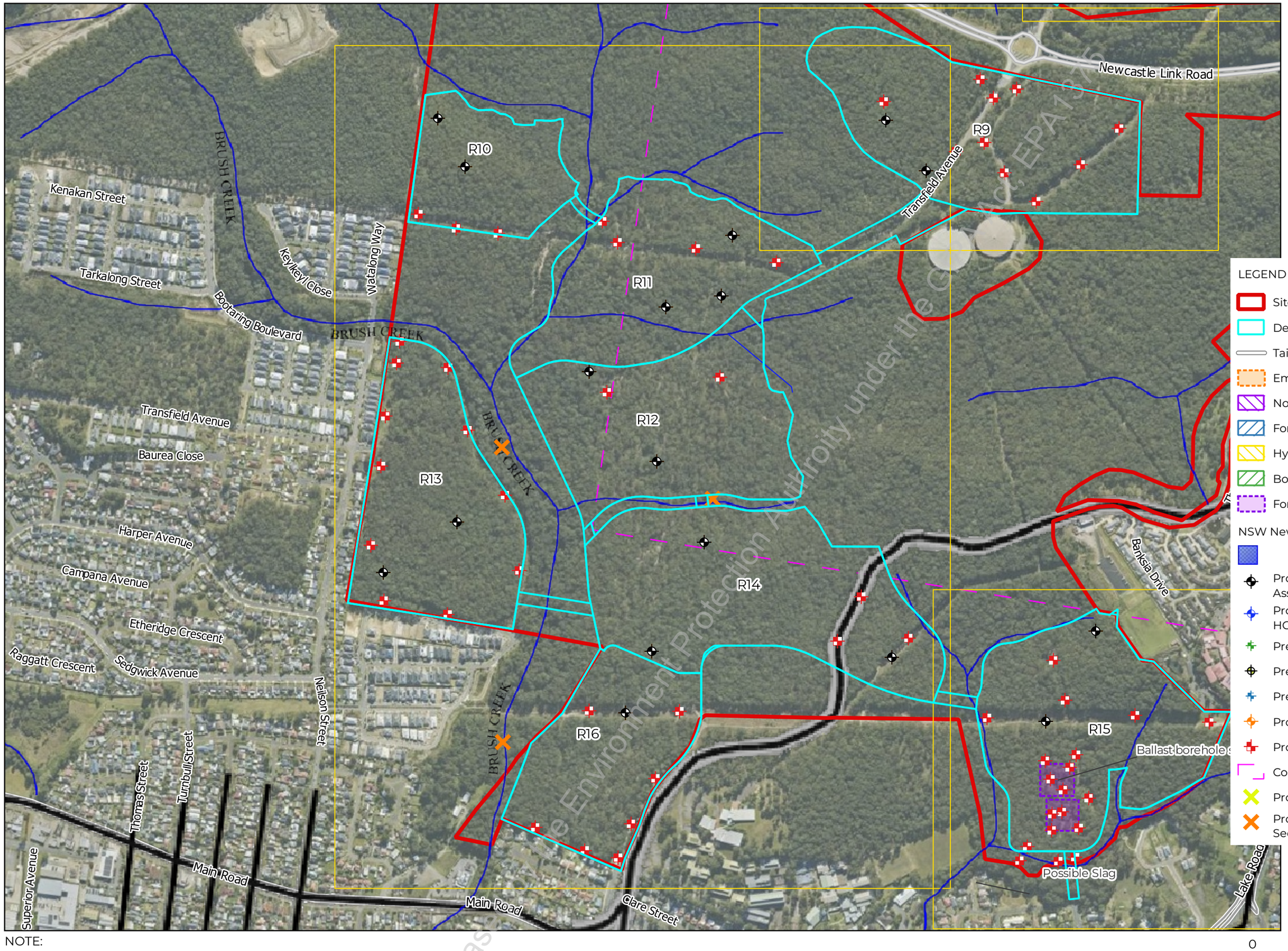

SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features

NSW Newcastle Tramways

- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

0 100 200 m

Douglas PARTNERS

CLIENT:	Eden Estates (Newcastle) Pty Ltd	TITLE:	**Proposed Test Location Plan**
OFFICE:	Newcastle	DRAWN BY:	s74	**Proposed Residential Subdivision**
SCALE:	1:7841 @A3	DATE:	05.September.2025	**Off Link Road, Wallsend, NSW**

N

PROJECT:	91610.10
DRAWING No:	5
REVISION:	0

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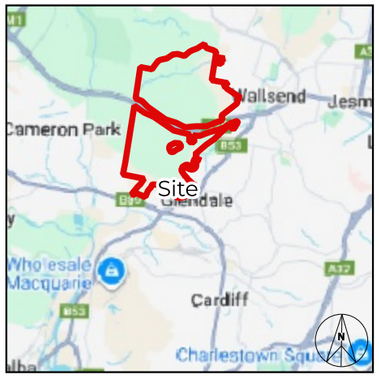

SITE LOCATION

LEGEND

- Site Boundary
- Development Boundary
- Tailings Line
- Emplacement Area B
- Noise Bund
- Former Goat Hill Dam
- Hydrocarbon Excavation Area
- Borrow Pit
- Former Site Features
- NSW Newcastle Tramways
- Proposed Bores for Geotechnical Assessment (91610.09)
- Proposed Groundwater Wells for HGG Assessment (91610.08)
- Previous Geotechnical Test Pits (91610.06)
- Previous Test Locations (91610.05)
- Previous Test Pits (91610.01)
- Proposed Contamination Bores
- Proposed Contamination Pits
- Council Boundary
- Proposed Surface Water Screening
- Proposed Surface Water and Sediment Sampling

NOTE:
1. Drawing projection in GDA2020 / MGA zone 56, adapted from aerial imagery from Metromap Image dated 22 July 2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage

0 100 200 m

Douglas PARTNERS

CLIENT: Eden Estates (Newcastle) Pty Ltd		TITLE: **Proposed Test Location Plan**	PROJECT: 91610.10
OFFICE: Newcastle	DRAWN BY: s74	**Proposed Residential Subdivision**	DRAWING No: 6
SCALE: 1:3155 @A3	DATE: 05.September.2025	**Off Link Road, Wallsend, NSW**	REVISION: 0

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Appendix C

Proposed Sampling Plan -Tables C1 to C18

Table C1: Sampling Rationale for Area PS1

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	6	6	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	6	2*	1	8	-	-	6	-	6	2	6	2	-	-	1	-	-	√	-	-	Testing for residual contamination due to former colliery and deep fill (i.e.. Trial box cut)
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	2**	2**	2**	-	-	-	-	-	-	-	√	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	-	-	-	
Importation of fill material														-	-	-	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**6**	**2**	**1**	**8**	**-**	**-**	**6**	**2**	**6**	**4**	**6**	**2**	**-**	**-**	**1**	**6**	**6**	√	√	√	-

Notes

* Geotechnical bores (1), Deeper contamination bores/well (1)

** Nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C2: Sampling Rationale for Area IE

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	15		√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	7***	-	-	7	-	-	-	-	-	-	-	-	4	4	-	15	15	√	-	-	Onsite dams and Maryland Creek adjacent to area
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	30	4*	4	34	1	3	22	12	40	15	22	2	-	-	2	-	-	-	-	-	Testing for residual contamination due to former colliery and deep fill areas along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	4**	10**	10**	-	-	-	-	-	-	-	√	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																	-	-	-	-	-	
Importation of fill material																	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**37**	**4**	**4**	**41**	**1**	**3**	**25**	**19**	**35**	**25**	**24**	**2**	**4**	**4**	**2**	**15**	**15**	√	√	√	-

Notes

* Geotechnical bores (2), Deeper contam bores/well (2)

** Nominal allowance for testing of indiscriminate dumping

*** Includes sediment samples to the south and in Dam 3

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM) - Decision Unit IE-A within the former pit top facility area

Table C3: Sampling Rationale for Area R1

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	4	4	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	4	2*	1*	6	-	-	4	2	4	2	4	1	-	-	-	-	-	-	-	-	Testing for residual contamination due to former colliery and deep fill areas along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	2**	4**	4**	-	-	-	-	-	-	-	√	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	√	-	-	
Importation of fill material														-	-	-	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	
Total		**4**	**2**	**-**	**6**	**-**	**-**	**4**	**4**	**8**	**6**	**4**	**1**	**-**	**-**	**2**	**4**	**4**	√	√	√	

Notes

* Geotechnical bores (1), Groundwater wells for LFG assessment (1)
** Nominal allowance for testing of indiscriminate dumping
Bores - Contamination bores drilled to natural or up to 10 m deep
Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant
Incremental Sampling Method (ISM)

Table C4: Sampling Rationale for Area R2 and area to the west

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-			-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-			-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-			-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-			-	-	-	-	-		-	-	-	8	8	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding landuse	2***	-	-	2			-	-	-	-	-		2	2	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	10	8*	5	18	1	3	18	6	12	10	13	2	-	-	5	-	-	√	-	-	Testing for residual contamination due to former colliery (ie. ACM tailing pipe, borrow pit (deep fill), former coal pile areas, open cut) along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	3**	3**	3**	-	-	-	-	-	-	-	√	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	√	-	-	
Importation of fill material														-	-	-	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total		**12**	**8**	**5**	**20**	**1**	**3**	**18**	**9**	**15**	**13**	**13**	**2**	**2**	**2**	**5**	**8**	**8**	√	√	√	

Notes

* Geotechnical bores (3), Groundwater wells for LFG assessment (3), Deeper contam bores/well (2)

** Nominal allowance for testing of indiscriminate dumping

*** Includes sediment samples to the south

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM) - Decision Unit R2-A within the former open cut area

Douglas PARTNERS

Table C5: Sampling Rationale for Area R3

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / ISM Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	1	1	2	1	3	-	-	-	-	-		-	-	1	-	-	√	-	-	-
	Demolition of former buildings containing hazardous building materials	2	-	-	2	-	-	-	4	4	4	3		-	-	-		-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-		8	8	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding landuse	2***	-	-	2	-	-	-	-	-	-	-		1	1		-	-	√	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	7	2*	-	9	1	3	7	-	7	4	7	2	-	-		-	-	√	-	-	Testing for residual contamination due to former colliery (ie. noise bund, hydrocarbon spill area, former site structures and former coal pile areas) along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	4**	4**	4**	-	-	-	-	-	-	-	-	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	-	-	-	
Importation of fill material														-	-	-	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-
Total		**13**	**3**	**1**	**17**	**2**	**6**	**7**	**8**	**15**	**12**	**10**	**2**	**1**	**1**	**1**	**8**	**8**	√	√	√	-

Notes

* Geotechnical bores (2), Deeper contam bores/well (1)

** Nominal allowance for testing of indiscriminate dumping

*** Includes sediment samples to the north

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM) - Decision Units R3-A and R3-B within the eastern portion of hydrocarbon area and former noise bund area

Table C6: Sampling Rationale for Area R4

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-
	Demolition of former buildings containing hazardous building materials	9	-	-	9	-	-	-	9	9	8	6	-	-	-	-	-	-	-	-	-	Testing for residual contamination due to former site structures
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	12	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	14	4*	-	18	-	-	18	-	18	3	18	2	-	-	-	-	-	√	-	-	Testing for residual contamination due to former colliery (i.e.. hydrocarbon spill area, borrow pit (deep fill), former site structures and former coal pile areas) along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	4**	4**	4**	-	-	-	-	-	-	-	-	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	-	-		
Importation of fill material														-	-	-		-	-	-		
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Total		**25**	**4**	**-**	**29**	**-**	**3**	**18**	**13**	**31**	**15**	**24**	**2**	**-**	**-**	**-**	**12**	**12**	√	√	√	-

Notes

* Geotechnical bores (3), Deeper contam bores/well (1)

** Nominal allowance for testing of indiscriminate dumping

*** Includes sediment samples

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM) - Decision Unit R4-A within the western portion of hydrocarbon area

Douglas PARTNERS

Table C7: Sampling Rationale for Area R5

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	10	10	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining	3***	-	-	3	-	-	-	-	-	-	-		2	2	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	15	1*	-	16	-	-	14	-	16	6	16	2	-	-	-	-	-	√	√	√	Testing for residual contamination due to former colliery (i.e.. former coal pile areas) along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	3**	3**	3**	-	-	-	-	-	-	-	-	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																			-	-	-	
Importation of fill material																			-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**18**	**1**	**-**	**19**	**-**	**-**	**14**	**3**	**19**	**9**	**16**	**2**	2	2	-	**10**	**10**	√	√	√	-

Notes

* Geotechnical bores (1)
** Nominal allowance for testing of indiscriminate dumping
*** Includes sediment sample to the north
Bores - Contamination bores drilled to natural or up to 10 m deep
Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant
Incremental Sampling Method (ISM)

Table C8: Sampling Rationale for Area R6

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery		3	1	3	1	3	-	-	-	-	-	2	-	-	1	3	3	√	√	√	Testing for residual contamination due to former colliery (i.e.. goal hill dam) along with imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		-	-	-	-	-	-	-	4**	4**	4**	-	-	-	-	-	-	-	√	-	-	Nominal allowance for testing of indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																		-	-			
Importation of fill material																		-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-
Total		**-**	**3**	**1**	**3**	**-**	**3**	**-**	**4**	**4**	**4**	**-**	**2**	**-**	**-**	**1**	**3**	**3**	√	√	√	-

Notes

* Geotechnical bores (2), Deeper contam bores/well (1)

** Nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM) - Decision Unit R6 - entire precinct area R6

Table C9: Sampling Rationale for Area R7

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		8	2*	-	10	-	-	5**	5	12**	10**	9	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	√			
Importation of fill material														-	-	-	-	-	-	-	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-
Total		**8**	**2***	**-**	**10**	**-**	**-**	**5**	**5**	**12**	**10**	**9**	**2**	**-**	**-**	**-**	**5**	**5**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Douglas PARTNERS

Table C10: Sampling Rationale for Area MD

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	1***	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		7	1*	-	8	-	-	6	4**	10**	6**	6	2						√	-	-	Testing along imported fill from access tracks and indiscriminate dumping and possible shaft location
Use of herbicides and pesticides for weed and pest control																			√			
Importation of fill material																	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Total		**8**	**1***	**-**	**9**	**-**	**-**	**6**	**4**	**10**	**6**	**6**	**2**	**-**	**-**	**-**	**4**	**4**	√	√	√	-

Notes

* Geotechnical bores (1)

** Includes nominal allowance for testing of indiscriminate dumping

*** Includes sediment samples

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C11: Sampling Rationale for Area R8

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Boreshole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding landuse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		4	2*	-	6	-	-	4	4**	8**	6	4	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Total		**4**	**2***	**-**	**6**	**-**	**-**	**4**	**4**	**8**	**6**	**4**	**2**	**-**	**-**	**-**	**4**	**4**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C12: Sampling Rationale for Area R9

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding landuse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		10	2*	-	12	-	-	8	6**	14**	4**	6	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**10**	**2***	**-**	**12**	**-**	**-**	**8**	**6**	**14**	**4**	**6**	**2**	**-**	**-**	**-**	**4**	**4**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C13: Sampling Rationale for Area R10

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-			-						-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	√	√	Fill areas likely comprising carbonaceous materials
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		3	2*	-	5	-	-	5	5**	8**	5**	3	2	-	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	-	-	-	-	-	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**3**	**2***	**-**	**5**	**-**	**-**	**5**	**5**	**8**	**5**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C14: Sampling Rationale for Area R11-12

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-			-						-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	1***	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	Testing of surface water and sediment of Brush Creek form possible impact from adjacent land use
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		6	5*	-	11	-	-	8	4**	8**	4**	8	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping, nominal allowance for carbonaceous materials in access tracks
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	3	3	-	√	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**7**	**5**	**-**	**12**	**-**	**-**	**8**	**4**	**8**	**4**	**8**	**2**	**-**	**-**	**-**	**3**	**3**	√	√	√	-

Notes
* Geotechnical bores (5)
** Includes nominal allowance for testing of indiscriminate dumping
*** Incudes sediment sample to the south
Bores - Contamination bores drilled to natural or up to 10 m deep
Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant
Incremental Sampling Method (ISM)

Table C15: Sampling Rationale for Area R13

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding land use	1***	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	Testing of surface water and sediment of Brush Creek form possible impact from adjacent land use
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		11	2*	-	13	-	-	7	4**	11**	5**	11	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping, nominal allowance for carbonaceous materials in access tracks
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	3	3	-	√	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**12**	**2**	**-**	**14**	**-**	**-**	**7**	**4**	**11**	**5**	**11**	**2**	**1**	**1**	**-**	**3**	**3**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

*** Incudes sediment sample to the east

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C16: Sampling Rationale for Area R14

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	2	-	-	2	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	Former tram line
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding landuse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		1	2*	-	3	-	-	3	2**	5**	5**	6	2	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping, nominal allowance for carbonaceous materials in access tracks
Use of herbicides and pesticides for weed and pest control																	-	-	√	-	-	
Importation of fill material																	2	2	-	√	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**3**	**2***	**-**	**5**	**-**	**-**	**3**	**2**	**7**	**5**	**6**	**2**	**-**	**-**	**-**	**2**	**2**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

Table C17: Sampling Rationale for Area R15

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	8	-	-	8	-	-	-	8	8	6	-	2	-	-	-	-	-	-	-	-	Testing for residual contamination due to former mining structures (i.e.. compressor house) and along imported fill from access tracks and indiscriminate dumping
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		11	2*	-	12	-	-	12**	-	15**	6**	6	-	-	-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping, nominal allowance for carbonaceous materials in access tracks
Use of herbicides and pesticides for weed and pest control														-	-	-	-	-	√	-	-	
Importation of fill material														-	-	-	4	4	-	√	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Total		**22**	**2**	**-**	**25**	**-**	**-**	**12**	**13**	**28**	**12**	**8**	**2**	**-**	**-**	**-**	**4**	**4**	√	√	√	-

Notes

* Geotechnical bores (2)

** Includes nominal allowance for testing of indiscriminate dumping

Bores - Contamination bores drilled to natural or up to 10 m deep

Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant

Incremental Sampling Method (ISM)

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Table C18: Sampling Rationale for Area R16

Identified contamination sources from CSM		Number of Pits	Number of Bores	Wells	Total Locations	Decision Units / Incremental Sampling Method Areas	Sampling Units / ISM Suite	Contam Suite - General	Extended Contam Suite - General	Asbestos (500 mL)	Asbestos ID	PFAS	pH / CEC	Sediment Suite	Surface Water	Groundwater	Geo Lab - Combustible Suite	Geo Lab - Acid Drainage Suite	Purpose / Sampling Requirements			Contamination Sampling Rationale
																			Contamination	Acid Mine Drainage	Combustibility	
Former mining operations – the New Wallsend No. 2 Colliery and Borehole Colliery	Hydrocarbon Excavation area / Leaks and spills from fuel storage and machinery/plant.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Demolition of former buildings containing hazardous building materials	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Spills and leaks associated with former tram lines and railways.	3	-	-	3	-	-	-	3	3	-	-		-	-	-	-	-	√	-	-	Former tram line
	Acid generation and combustibility associated with carbonaceous materials.	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
	Discharge of water into onsite creeks and surface water bodies from former mine water discharges or run off from mining areas or surrounding	1***	-	-	1	-	-	-	-	-	-	-		1	1	-	-	-	-	-	-	Testing of surface water and sediment of Brush Creek form possible impact from adjacent land use
	Residual contamination remaining after remediation of the New Wallsend No. 2 Colliery and Borehole Colliery	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Illegal dumping of waste, including rubbish, building materials, potential ACM and soil		4	2*	-	6	-	-	5	5**	10**	6**	4	2		-	-	-	-	√	-	-	Testing along imported fill from access tracks and indiscriminate dumping, nominal allowance for carbonaceous materials in access tracks
Use of herbicides and pesticides for weed and pest control																	-	-	√			
Importation of fill material																	2	2	-	√	√	
Summerhill Waste Management Facility to the north of the site		-	-	-	-	-	-	-	-	-	-	-		-	-	-			-	-	-	-
Total		**8**	**2**	**-**	**10**	**-**	**-**	**5**	**8**	**13**	**6**	4	**2**	**1**	**1**	**-**	**2**	**2**	√	√	√	-

Notes

* Geotechnical bores (2)
** Includes nominal allowance for testing of indiscriminate dumping
*** Incudes sediment sample to the east
Bores - Contamination bores drilled to natural or up to 10 m deep
Pits - Excavated to natural or up to 4 m with excavator or hand tools if not accessible with plant
Incremental Sampling Method (ISM)

Appendix D

Field Work Methodology

1. Guidelines

The following key guidelines were consulted for the field work methodology:

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013);
- HEPA *PFAS National Environmental Management Plan (NEMP)* (HEPA, 2020).

2. Soil sampling

2.1 Discrete Sampling

Soil sampling is carried out in accordance with Douglas' standard operating procedures. The general sampling and sample management procedures comprise:

- Collect soil samples directly from the excavator bucket at the nominated sample depth / split sample tube from each 1.5 m length of push tube at the nominated sample depth / SPT sample tube / solid flight auger;
- Collect soil samples from the stockpile(s) from a depth of at least 0.3 m below the stockpile surface;
- Collect near surface samples using hand tools;
- Place samples into laboratory-prepared glass jars with Teflon lined lids, capping immediately and minimising headspace within the sample jar;
- Place samples into laboratory-prepared containers (specific for PFAS), capping immediately and minimising headspace within the sample jar;
- Collect replicate samples in zip-lock bags for photoionisation detector (PID) screening;
- Collect ~500 ml samples in zip-lock bags for fibrous asbestos and asbestos fines (FA and AF) analysis;
- Collect bulk (~10 L) soil samples for asbestos-containing material (ACM) field sieve test;
- Collect ~40 g to 50 g samples in zip-lock bags for asbestos (presence / absence) analysis;
- Wear a new disposable nitrile glove for each sample point thereby minimising potential for cross-contamination;
- Collect 10% replicate samples for quality control (QC) purposes;
- Label sample containers with individual and unique identification details, including project number, sample location and sample depth (where applicable);
- Place samples into a cooled, insulated and sealed container for transport to the laboratory;
- Use chain of custody documentation.

Reference was made to HEPA (2020) for requirements specific to PFAS.

2.2 Incremental Sampling Methodology (ISM)

Incremental soil sampling is carried out with reference to *Technical/Regulatory Guidance Incremental Sampling Methodology Update* (ITRC, 2020). The general sampling and sample management procedures comprise:

- Allocate preliminary Decision Units (DU) based on the results of site history, previous investigation and access;
- Allocate preliminary sampling units (SU) based on the initial field work findings (i.e. observations of contamination, subsurface units, fill profile, etc.);
- Determine the final mass of the ISM sample required (e.g. minimum 1 kg);
- Incremental soil sub-samples must be collected for each decision unit (DU) or sub-soil sampling unit (SU) via the following:
    - Collect an entire core interval (most preferred but results in large ISM sample mass);
    - Collect a core wedge or core slice or plug sub-sample that reduces the mass of the total ISM sample;
- Each sub-sample must be of equal mass;
- The method of sampling will depend on the drilling or excavation technique utilised (ie. hand tools, test pits, geo probe, etc);
- Collect soil sub-samples directly from the excavator bucket at the nominated sample depth / split sample tube from each 1.5 m length of push tube at the nominated sample depth / SPT sample tube / solid flight auger;
- Place sample into an approximate 4 L resealable plastic bag (for non volatile analysis) or multiple 1-liter glass containers or high density polyethylene (HDPE);
- If volatile analysis is required, methanol preservation in a separate additional container may be required;
- Collect replicate samples in zip-lock bags for photoionisation detector (PID) screening;
- Wear a new disposable nitrile glove for each sample point thereby minimising potential for cross-contamination;
- Label sample containers with individual and unique identification details, including project number, sample location and sample depth (where applicable);
- Place samples into a cooled, insulated and sealed container for further processing;
- Further homogenisation as per (ITRC, 2020) of SU sample to be undertaken prior to analysis (i.e. drying, crushing, disaggregation, sub-sampling);
- Use chain of custody documentation.

Use of ISM is proposed for some areas of the site for the proposed targeted investigation. The use and suitability of an ISM will be reviewed during and following field work. Should the results of field work suggest that conditions for a given decision unit are unsuitable/impractical for ISM (e.g. heterogeneity leading to excessive sampling units), the investigation methodology and ISM DUs/SUs will be reviewed. Discrete sampling will be conducted in areas where ISM is deemed to be impractical.

2.3 Field testing

Field testing is carried out in accordance with Douglas' standard operating procedures. The general sampling and sample management procedures comprise:

PID field test

- Calibrate the PID with isobutylene gas at 100 ppm and with fresh air prior to commencement of each successive day's field work;
- Allow the headspace in the PID zip-lock bag samples to equilibrate; and
- Screen using the PID.

Assessment of subsurface ACM

- Collect at least one bulk (~10 L) soil sample per metre of fill from each test pit / borehole;
- Weigh each bulk sample;
- Screen each bulk sample through a ≤7 mm aperture sieve;
- Weigh all retrieved potential ACM fragments; and
- Calculate the asbestos concentration (% w/w) in soil as per the procedure described in NEPC (2013).

3. Groundwater sampling

3.1 Monitoring well installation

Monitoring wells are constructed using class 18 uPVC machine slotted screen and blank sections with screw threaded joints. The screened section of each well is backfilled with a washed sand filter pack to approximately 0.5 m above the screened interval. Each well is completed with a hydrated bentonite plug and then bentonite / cement grout OR compacted drill cuttings to the surface, finished as a stick-up (no monument) OR with cast iron road-box OR with lockable steel monument set in a concrete plinth.

3.2 Monitoring well development

Groundwater monitoring wells are developed as soon as practicable following well installation. The purpose of well development is to remove sediments and/or drilling fluid introduced to the well during drilling and to facilitate connection of the monitoring well to the aquifer. The wells are developed by pumping / bailing to remove a minimum of five well volumes, or until dry.

3.3 Groundwater sampling

Bladder pump

Groundwater sampling is carried out in accordance with Douglas' standard operating procedures. Groundwater samples are collected using a positive displacement low flow bladder pump via the micro-purge (minimal drawdown) method. The method minimises aeration of the sample and disturbance to the water column thereby enhancing the quality of results for oxygen sensitive analytes. The sampling method is described as follows:

- Measure the static water level using an electronic interface probe and record the thickness of LNAPL (if encountered);
- Decontaminate the interface probe and cable between monitoring wells by rinsing in a diluted Liquinox solution and then rinsing in demineralised water;
- Fit the pump with a well-dedicated bladder and tubing. Lower the pump into the well then clamp at a level estimated to be 1 m below the top of the water column (provided the depth of the pump is within the screened section) or to the approximate mid-point of the well screen;
- Set the pump at the lowest rate possible that could produce laminar flow to minimise drawdown of the water column;
- Measure physical parameters by continuously passing the purged water through a flow cell; and
- Following stabilisation of the field parameters, collect samples in laboratory-prepared bottles minimising headspace within the sample bottle and cap immediately.

Bailer

Groundwater sampling is carried out in accordance with Douglas' standard operating procedures. Groundwater samples are collected using a well-dedicated bailer via the well stress / well-purge method. The sampling method is described as follows:

- Measure the static water level using an electronic interface probe and record the thickness of LNAPL (if encountered);
- Decontaminate the interface probe and cable between monitoring wells by rinsing in a diluted Liquinox solution and then rinsing in demineralised water;
- Estimate the volume of groundwater in the well, including the annulus and purge at least three well volumes from the well (or purge until dry);
- Measure physical parameters by continuously passing the purged water through a flow cell and record a stabilised reading (if possible) after stagnant water has been removed from the well; and
- Collect samples in laboratory-prepared bottles minimising headspace within the sample bottle and cap immediately.

Sample handling, all methods

The general groundwater sample handling and management procedures comprise:

- Collect 10% replicate samples for QC purposes;
- Label sample containers with individual and unique identification details, including project number and sample location;
- Place the sample jars into a cooled, insulated and sealed container for transport to the laboratory; and
- Use chain of custody documentation.

4. Surface water sampling

Surface water sampling is carried out in accordance with Douglas' standard operating procedures. Sample collection is completed using a telescopic pole and decontaminated sample container. A new pair of disposable nitrile gloves are worn at each sample site to minimise potential for cross-contamination. The sampling method is described as follows:

- Where possible, select a sampling point that is a reasonable distance from the edge;
- Immerse the sample container below the surface, with the opening pointing directly down to maintain a volume of air in the container, thereby avoiding the collection of any surface films;
- Once under the surface of the water, point the mouth of the sample container up stream so that gloved hands, sample container and/or sample collection device are downstream of the sample being collected;
- If the water is still, move the sample container forward away from the sampler and any equipment to collect a continuous uncontaminated sample;
- Use a sample location specific laboratory-prepared glass bottle without preservatives;
- Decant the water sample into laboratory-prepared bottles, minimising headspace within the sample bottle and cap immediately. The sample location specific laboratory-prepared glass bottle can be used as the sample container for the last sample from that location;
- Dispose of any excess water downstream of the sampling point or at a reasonable distance from sample site;
- Collect 10% replicate samples for QC purposes;
- Label sample containers with individual and unique identification details, including project number and sample location;
- Place the sample jars into a cooled, insulated and sealed container for transport to the laboratory; and
- Use chain of custody documentation.

5. References

HEPA. (2020). *PFAS National Environmental Management Plan (NEMP)*. Version 2.0: Heads of EPAs Australia and New Zealand and Australian Government Department of the Environment.

ITRC. (2020). *Incremental Sampling Methodolgy (ISM) Update*. The Interstate Technology & Regulatory Council .

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]*. Australian Government Publishing Services Canberra: National Environment Protection Council.

Appendix E

Site Assessment Criteria

1. Introduction

1.1 Guidelines

The following key guidelines were consulted for deriving the site assessment criteria (SAC):

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013);
- CRC CARE *Health screening levels for petroleum hydrocarbons in soil and groundwater* (CRC CARE, 2011);
- HEPA *PFAS National Environmental Management Plan (NEMP)* (HEPA, 2025);
- ANZG *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018);
- ANZECC *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).

1.2 General

The SAC applied in the current investigation are informed by the CSM which identified human and environmental receptors to potential contamination at the site. Analytical results are assessed (as a Tier 1 assessment) against the SAC comprising primarily the investigation and screening levels of Schedule B1 of NEPC (2013).

For the purpose of the targeted assessment the adopted criteria will be for generic low density residential land use scenario, this SAC however presents a range of land use scenarios (ie. commercial and recreational / open space) for localised areas of the proposed development.

The following inputs are relevant to the selection and/or derivation of the SAC:

- Land use: residential / recreational / commercial / industrial:
  - Corresponding to land use category 'A', residential with garden / accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry)), also includes children's day care centres, preschools and primary schools;
  - Corresponding to land use category 'C', public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves) which should be subject to a site-specific assessment where appropriate;
  - Corresponding to land use category 'D', commercial / industrial such as shops, offices, factories and industrial sites.
- Soil type: sand / silt / clay.

2. Soils

2.1 Health investigation and screening levels

The generic health investigation levels (HIL) and health screening levels (HSL) are considered to be appropriate for the assessment of human health risk via all relevant pathways of exposure associated with contamination at the site. The adopted soil HIL and HSL for the contaminants of concern are in Table 1 and Table 2.

Table 1: Health investigation levels (mg/kg)

Contaminant	HIL-A	HIL-C	HIL-D
Metals			
Arsenic	100	300	3000
Beryllium	60	90	500
Boron	4500	20 000	300 000
Cadmium	20	90	900
Chromium (VI)	100	300	3600
Cobalt	100	300	4000
Copper	6000	17 000	240 000
Lead	300	600	1500
Manganese	3800	19 000	60 000
Mercury (inorganic)	40	80	730
Nickel	400	1200	6000
Selenium	200	700	10 000
Zinc	7400	30 000	400 000
PAH			
B(a)P TEQ	3	3	40
Total PAH	300	300	4000
OCP			
DDT+DDE+DDD	240	400	3600
Aldrin and dieldrin	6	10	45
Chlordane	50	70	530
Endosulfan	270	340	2000
Endrin	10	20	100
Heptachlor	6	10	50
HCB	10	10	80
Methoxychlor	300	400	2500
OPP			
Chlorpyrifos	160	250	2000
PCB			
PCB	1	1	7

Table 2: Health screening levels (mg/kg) - Residential

Contaminant	HSL-A&B	HSL-A&B	HSL-A&B	HSL-A&B
SAND	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	0.5	0.5	0.5	0.5
Toluene	160	220	310	540
Ethylbenzene	55	NL	NL	NL
Xylenes	40	60	95	170
Naphthalene	3	NL	NL	NL
TRH F1	45	70	110	200
TRH F2	110	240	440	NL
SILT	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	0.6	0.7	1	2
Toluene	390	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	95	210	NL	NL
Naphthalene	4	NL	NL	NL
TRH F1	40	65	100	190
TRH F2	230	NL	NL	NL
CLAY	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	0.7	1	2	3
Toluene	480	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	110	310	NL	NL
Naphthalene	5	NL	NL	NL
TRH F1	50	90	150	290
TRH F2	280	NL	NL	NL

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'

Table 3: Health screening levels (mg/kg) - Recreational

Contaminant	HSL-C	HSL-C	HSL-C	HSL-C
SAND	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	NL	NL	NL	NL
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	NL	NL	NL	NL
TRH F2	NL	NL	NL	NL
SILT	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	NL	NL	NL	NL
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	NL	NL	NL	NL
TRH F2	NL	NL	NL	NL
CLAY	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	NL	NL	NL	NL
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	NL	NL	NL	NL
TRH F2	NL	NL	NL	NL

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'

Table 4: Health screening levels (mg/kg) – Commercial/Industrial

Contaminant	HSL-D	HSL-D	HSL-D	HSL-D
SAND	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	3	3	3	3
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	230	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	260	370	630	NL
TRH F2	NL	NL	NL	NL
SILT	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	4	4	6	10
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	250	360	590	NL
TRH F2	NL	NL	NL	NL
CLAY	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**
Benzene	4	6	9	20
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	NL	NL	NL	NL
Naphthalene	NL	NL	NL	NL
TRH F1	310	480	NL	NL
TRH F2	NL	NL	NL	NL

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'

The HSL for direct contact derived from CRC CARE (2011) are in Table 5.

Table 5: Health screening levels for direct contact (mg/kg)

Contaminant	DC HSL-A	DC HSL-C	DC HSL-D	DC HSL-IMW
Benzene	100	120	430	1100
Toluene	14 000	18 000	99 000	120 000
Ethylbenzene	4500	5300	27 000	85 000
Xylenes	12 000	15 000	81 000	130 000
Naphthalene	1400	1900	11 000	29 000
TRH F1	4400	5100	26 000	82 000
TRH F2	3300	3800	20 000	62 000
TRH F3	4500	5300	27 000	85 000
TRH F4	6300	7400	38 000	120 000

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
IMW intrusive maintenance worker

2.2 Health investigation levels for per- and poly-fluoroalkyl substances in soil

The laboratory analytical results for per- and poly-fluoroalkyl substances (PFAS) in soil have been assessed against HIL published in HEPA (2025). The HIL represent a nationally-agreed suite that should be used to inform site investigations. The HIL are intentionally conservative, and an exceedance of these criteria may not constitute a risk if other exposure pathways are controlled. An exceedance of the HIL should trigger further investigations, such as a site-specific risk assessment. At the time of this investigation, screening values were available only for perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS).

The HIL derived from Table 5 of HEPA (2025) are in Table 6.

Table 6: Health investigation levels (mg/kg)

Contaminant	HIL-A	HIL-C	HIL-D
PFOS and PFHxS *	0.003	1	20
PFOA	0.06	10	50

Notes:
* Includes PFOS only, PFHxS only and the sum of the two.

2.3 Asbestos in soil

The HSL for asbestos in soil are based on likely exposure levels for different scenarios published in NEPC (2013) for the following forms of asbestos:

- Bonded asbestos containing material (ACM); and
- Fibrous asbestos and asbestos fines (FA and AF).

The HSL are in Table 7.

Table 7: Health screening levels for asbestos

Form of asbestos	HSL-A	HSL-C	HSL-D
ACM	0.01%	0.02%	0.05%
FA and AF	0.001%	0.001%	0.001%
FA and AF and ACM	No visible asbestos for surface soil *	No visible asbestos for surface soil *	No visible asbestos for surface soil *

Notes:
Surface soils defined as top 10 cm.
* Based on site observations at the sampling points and the analytical results of surface samples.

Where insufficient sample recovery is possible for FA and AF analysis the presence or absence of asbestos at a limit of reporting of 0.1 g/kg (AS:4964) will be adopted for the assessment as an initial screen.

2.4 Ecological investigation levels

Ecological investigation levels (EIL) and added contaminant limits (ACL), where appropriate, have been derived in NEPC (2013) for arsenic, copper, chromium (III), nickel, lead, zinc, DDT and naphthalene. The adopted EIL, derived using the interactive (excel) calculation spreadsheet on the NEPM toolbox website are shown in Table 9, with inputs into their derivation shown in Table 8.

Table 8: Inputs to the derivation of the ecological investigation levels

Variable	Input	Rationale
Age of contaminants	"Aged" (>2 years)	
pH	5	Conservative value, to be confirmed after results of laboratory testing
CEC	2 $cmol_c/kg$	Conservative value, to be confirmed after results of laboratory testing
Clay content	10%	Conservative value, to be confirmed after results of laboratory testing
Traffic volumes	high	
State / Territory	NSW	

Table 9: Ecological investigation levels (mg/kg)

Contaminant	EIL-A-B-C	EIL-D
Metals		
Arsenic	100	160
Copper	65*	80*
Nickel	9*	10*
Chromium III	410*	680*
Lead	1100	1800
Zinc	190*	230*
PAH		
Naphthalene	170	370
OCP		
DDT	180	640

Notes:
EIL-A-B-C urban residential and public open space
*Assumed initial EIL values based on conservative pH and CEC, criteria to be amended based on pH and CEC testing.

2.5 Ecological screening levels

Ecological screening levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. The adopted ESL are shown in Table 10.

Table 10: Ecological screening levels (mg/kg)

Contaminant	Soil type	ESL-A-B-C	ESL-D
Benzene	Coarse	50	75
Toluene	Coarse	85	135
Ethylbenzene	Coarse	70	165
Xylenes	Coarse	105	180
TRH F1	Coarse/ Fine	180*	215*
TRH F2	Coarse/ Fine	120*	170*
TRH F3	Coarse	300	1700
TRH F4	Coarse	2800	3300
B(a)P	Coarse	0.7	1.4
Benzene	Fine	65	95
Toluene	Fine	105	135
Ethylbenzene	Fine	125	185
Xylenes	Fine	45	95
TRH F1	Coarse/ Fine	180*	215*
TRH F2	Coarse/ Fine	120*	170*
TRH F3	Fine	1300	2500
TRH F4	Fine	5600	6600
B(a)P	Fine	0.7	1.4

Notes:
ESL are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} including naphthalene
ESL-A-B-C urban residential and public open space

2.6 Ecological soil guideline values

The interim ecological soil guideline values (EGV) derived from Table 6 of HEPA (2025) are in Table 11.

Table 11: Ecological soil guideline values (mg/kg) – all land uses

Contaminant	Direct exposure	Indirect exposure
PFOS	1	0.003
PFOA	10 / 0.005	0.003
PFHxS	NC	NC

Notes:
NC no criterion
*For intensely developed sites with no secondary consumers and minimal potential for indirect ecological exposure, a higher criterion of up to 0.14 mg/kg PFOS may be appropriate.

2.7 Management limits

In addition to appropriate consideration and application of the HSL and ESL, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards;
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

The adopted management limits are in Table 12.

Table 12: Management limits (mg/kg)

Contaminant	Soil type	ML-A-B-C	ML-D
TRH F1	Coarse	700	700
TRH F2	Coarse	1000	1000
TRH F3	Coarse	2500	3500
TRH F4	Coarse	10 000	10 000
TRH F1	Fine	800	800
TRH F2	Fine	1000	1000
TRH F3	Fine	3500	5000
TRH F4	Fine	10 000	10 000

Notes:
TRH F1 is TRH C_6-C_{10} including BTEX
TRH F2 is TRH >C_{10}-C_{16} including naphthalene
ML-A-B-C residential, parkland and public open space

3. Groundwater

3.1 Introduction

The groundwater investigation levels (GIL) used for interpretation of the groundwater data (as a Tier 1 assessment) have been selected based on the potential risks posed from contamination sourced from the site to receptors at or down-gradient of the site, as identified by the conceptual site model (CSM). The receptors, exposure points and pathways are summarised in Table 13.

Table 13: Summary of potential receptors and potential risks

Receptor	Location	Exposure point	Exposure pathway
Surface water aquatic ecosystem	Down-gradient from site.	Receiving surface water body at the groundwater discharge point.	Exposure to contaminants.
Occupants of buildings	On site and down-gradient from site.	Enclosed buildings (proposed).	Inhalation of VOC (including TRH and BTEX) overlying VOC impacted groundwater via the vapour intrusion pathway.

The rationale for the selection of GIL is in Table 14.

Table 14: Groundwater investigation level rationale

Receptor / beneficial use	GIL	Source	Comments / rationale
Aquatic ecosystem	DGV	ANZG (2018)	Freshwater 99% LOP for bioaccumulative contaminants 95% LOP for non-bioaccumulative contaminants
Aquatic ecosystem	DGV	HEPA (2025)	Freshwater 99% LOP as recommended for potential bioaccumulation Screening values were only available for PFOS and PFOA at the time of this investigation.
Building occupants (vapour intrusion)	HSL	NEPC (2013)	2 m to <4 m / 4 m to <8 m / 8 m+

Notes:
DGV default guideline value
% LOP percentage level of protection of species
HSL health screening level
GV guideline value
LTV long term value (up to 100 years)
STV short term value (up to 20 years)

3.2 Groundwater investigation levels for aquatic ecosystems

The DGV for the protection of aquatic ecosystems derived from ANZG (2018) are in Table 15.

Table 15: Groundwater investigation levels for protection of aquatic ecosystems (µg/L)

Contaminant	Freshwater DGV 95% LOP	Notes
Metals / metalloids		
Arsenic	24 / 13	Levels provided for As III / As IV respectively. Moderate reliability.
Boron	940	Very high reliability.
Cadmium	0.2	Very high reliability.
Chromium (VI)	1	Chromium VI levels adopted as initial screen for total chromium. Very high reliability.
Cobalt	1.4	Unknown reliability and LOP.
Copper	1.4	Very high reliability.
Cyanide	7	Moderate reliability.
Lead	3.4	Moderate reliability.
Manganese	1900	Moderate reliability.
Mercury (inorganic)	0.06	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Nickel	11	Low reliability.
Selenium	5	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Zinc	8	Very high reliability.
BTEX		
Benzene	950	Moderate reliability.
Ethylbenzene	80	Unknown reliability.
m-Xylene	75	Unknown reliability.
o-xylene	350	Low reliability.
p-Xylene	200	Low reliability.
Toluene	180	Unknown reliability.
PAH		
Anthracene	0.01	99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability.
Benzo(a)pyrene	0.1	99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability.
Fluoranthene	1	99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability.
Naphthalene	16	Low reliability.
Phenanthrene	0.6	99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability.
Inorganics		
Ammonia	900	Very high reliability.

Notes:
95% LOP for non-bioaccumulative contaminants
99% LOP for bioaccumulative contaminants

The DGV for the protection of aquatic ecosystems derived from HEPA (2025) are in Table 16.

Table 16: Groundwater investigation levels for protection of aquatic ecosystems (µg/L)

Contaminant / LOP	Freshwater DGV
PFOS 99% LOP	0.00023
PFOA 99% LOP	19
PFOS 95% LOP	0.13
PFOA 95% LOP	220
PFOS 90% LOP	2
PFOA 90% LOP	632
PFOS 80% LOP	31
PFOA 80% LOP	1824

3.3 Health screening levels for vapour intrusion

The HSL to evaluate potential vapour intrusion risks derived from NEPC (2013) are in Table 17 to Table 19. There are no generic HSL for groundwater within 2 m of the ground (or basement) level.

Table 17: Groundwater health screening levels for vapour intrusion (µg/L) - Residential

Contaminant	HSL-A&B	HSL-A&B	HSL-A&B	Solubility limit
SAND	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	800	800	900	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	1000	1000	1000	9000
TRH F2	1000	1000	1000	3000
SILT	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	4000	5000	5000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	6000	6000	6000	9000
TRH F2	NL	NL	NL	3000
CLAY	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	5000	5000	5000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

Table 18: Groundwater health screening levels for vapour intrusion (µg/L) - Recreational

Contaminant	HSL-C	HSL-C	HSL-C	Solubility limit
SAND	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	NL	NL	NL	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000
SILT	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	NL	NL	NL	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000
CLAY	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	NL	NL	NL	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

Table 19: Groundwater health screening levels for vapour intrusion (µg/L) – Commercial/ Industrial

Contaminant	HSL-D	HSL-D	HSL-D	Solubility limit
SAND	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	5000	5000	5000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	6000	6000	7000	9000
TRH F2	NL	NL	NL	3000
SILT	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	30 000	30 000	30 000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000
CLAY	**2 m to <4 m**	**4 m to <8 m**	**8 m+**	**-**
Benzene	30 000	30 000	35 000	59 000
Toluene	NL	NL	NL	61 000
Ethylbenzene	NL	NL	NL	3900
Xylenes	NL	NL	NL	21 000
Naphthalene	NL	NL	NL	170
TRH F1	NL	NL	NL	9000
TRH F2	NL	NL	NL	3000

Notes:
TRH F1 is TRH C_6-C_{10} minus BTEX
TRH F2 is TRH >C_{10}-C_{16} minus naphthalene
The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

4. Surface Water

A creek which sustains a freshwater ecosystem is located within and downgradient of the site. The surface water investigation levels used for interpretation of the surface water data (as a Tier 1 assessment) have been selected based on the potential risks posed to this receptor.

The DGV for the protection of aquatic ecosystems derived from ANZG (2018) are in Table 15, HEPA (2025) are in Table 16.

5. References

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