Douglas PARTNERS

GROUNDED EXPERTISE

Report on Supplementary Detailed Site Investigation

Proposed Visitor Information Centre

17 Denison Street, Gloucester NSW

Prepared for Department of Planning, Housing and Infrastructure

Project 228674.02

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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.

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Executive Summary

Douglas Partners Pty Ltd (Douglas) has undertaken a supplementary detailed site investigation (SDSI) for contamination for a proposed visitor information centre at 17 Denison Street, Gloucester (the site).

The current proposed development comprises a visitors information centre to be managed by National Parks and MidCoast Council. No development plans were available at the time of the investigation. The extent of cut/fill earthworks for the proposed development is unknown at this stage, however, it is understood that existing buildings and pavements will be demolished as part of site redevelopment.

The objective of the SDSI was to assess the suitability of the site for the proposed development and confirm site condition from a contamination perspective, additional investigation requirements (if any) and inform potential remediation options for the site.

The investigation included the drilling of six off-site boreholes, laboratory testing on soil, groundwater, surface water and sediment within the adjacent creek, and preparation of this report.

Previous investigations indicated the presence of a former service station with associated underground fuel storage tanks (USTs) and infrastructure. Hydrocarbon impacts in soil and groundwater were identified in the vicinity of existing USTs associated with the former service station within the central northern portion of the site.

The SDSI has identified on-site and off-site impacts associated with existing USTs and service station infrastructure. Field observations and laboratory testing suggest hydrocarbon impacts have migrated off-site via a preferential flow path (i.e. underlying natural sand/gravel materials). Hydrocarbon impacts were observed both immediately adjacent to the site and further north within Bores 304, 305 and 306 located 17 m from the site boundary near the bus shelter. It is noted that an amenities building is located further north of the bus shelter. The results of testing of groundwater suggests possible vapour intrusion risks when considering the sandy underlying strata (i.e. the preferential flow path for groundwater migration).

Based on the identified contamination, remediation will be required to render the site suitable for the proposed development. Remediation/management of off-site impact will also be required due to the migration of hydrocarbons via groundwater from the site. Remediation should include decommissioning of the service station, and remediation of the primary sources of contamination within the site (i.e. impacted soils and groundwater in the vicinity of UST's and service station infrastructure). Where practicable, remediation could also include removal of impacted soils and groundwater within the footpath / road reserve directly north of the site, subject to regulatory approval. Remediation will remove the primary source of contamination and also minimise the risk for further migration of contamination from the site. Off-site impacts could be managed via natural attenuation subject to appropriate design and monitoring, which is likely to require installation of additional monitoring wells downgradient of Bores 304, 305 and 306 and assessment of vapour intrusion risk associated with the amenities building.

The proposed remediation strategy, remediation action criteria and validation requirements will need to be outlined in a site-specific remediation action plan (RAP). The previous RAP should be amended to include the results of the current SDSI and provide procedures for the remediation/management of on-site and off-site impacts. Remediation will require further groundwater monitoring (both on-site and off-site) and assessment of off-site vapour intrusion risk and natural attenuation following removal of the primary source of contamination.

In summary, remediation will be required in accordance with a site-specific RAP to address the identified on-site and off-site impacts.

Based on the results of the SDSI and previous DSI, the site can be made suitable for the proposed development subject to appropriate remediation and validation of the site and the recommendations above.

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1. Introduction

Douglas Partners Pty Ltd (Douglas) was engaged by NSW Department of Planning, Housing and Infrastructure (DPHI) to prepare this Supplementary Detailed Site Investigation (SDSI) for a proposed visitor information centre at 17 Denison Street, Gloucester NSW (the site). The site is shown on Drawing 1, Appendix A.

The investigation was commissioned in an email dated 12 March 2025 by Kaitlin Withers of DPHI and was undertaken with reference to Douglas' proposal 228674.02.P.001.Rev0 dated 27 February 2025 and DPHI Contract No. PROC12334 executed 13 March 2025.

The objective of the SDSI was to further investigate the extent of contamination at the site and address the recommendations of the previous DSI by Douglas (Douglas, 2024). The supplementary DSI included:

- Further assessment of the presence and extent of possible migration of hydrocarbon impacts north of the site;
- Assessment of possible impacts to the neighbouring creek from historical site activities; and
- Assessment of possible off-site impacts and requirements (if any) for additional off-site remediation.

This report must be read in conjunction with all appendices including the notes provided in Appendix B.

The following key guidelines were consulted in the preparation of this report:

- NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]* (NEPC, 2013); and
- NSW EPA *Guidelines for Consultants Reporting on Contaminated Land* (NSW EPA, 2020).

2. Proposed Development

The current proposed development comprises a visitors information centre to be managed by National Parks and Mid Coast Council. No development plans were available at the time of the investigation. The extent of cut/fill earthworks for the proposed development is unknown at this stage. It is understood that existing structures and pavement will be demolished as part of site redevelopment.

3. Scope of Work

The scope of work for the SDSI comprised the following:

- Review of the previous DSI completed by Douglas;
- Preparation of relevant safety documentation and BYDA enquiries including completion of relevant permits / approvals required for the investigation;
- Underground services clearance at proposed test locations by a professional service locator;
- Drilling of a total of six boreholes (Bores 301 to 306) using a track-mounted Geoprobe drill rig to a depth of 4.0 m;
- Collection of soil samples from test locations at regular depth intervals changes in soil strata and upon signs of potential contamination (e.g. odours and staining);
- Logging of the subsurface profile and collection of soil samples from the boreholes at regular depth intervals for identification and testing purposes under contamination sampling protocols;
- Installation of six new groundwater monitoring wells within the bores to a maximum depth of 4 m. Class 18 PVC wells were installed and finished at the surface with a concrete flush mounted well cover. The wells were developed upon installation using a bailer;
- Field measurement of pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and temperature in groundwater using a hand-held calibrated meter;
- Measurement of groundwater depths and groundwater levels (AHD) in existing and new wells for estimation of groundwater flow direction;
- Groundwater purging and sampling using low flow micropurge or bailer techniques (as appropriate) for the six new wells and eight existing wells (14 wells in total);
- Collection of three sediment samples from the adjacent creek (upstream, midstream and downstream locations) using hand tools at accessible locations;
- Collection of three surface water samples (upstream, adjacent and downstream) using a long-handled swing sampler;
- Screening of soil, sediment and groundwater headspace with a photo-ionisation detector (PID) to assess the possible presence of volatile compounds;
- Laboratory analysis for contaminants of potential concern (CoPC) on selected samples retrieved from test locations;
- Collection of field quality control (QC) samples for data quality assurance and quality control (QA/QC) purposes;
- Measurement of surface levels and coordinates of test locations using a differential GPS, with an accuracy in the order of ±0.1 m;
- Preparation of this report presenting the findings of the investigation.

4. Site Information

Site Address	17 Denison Street, Gloucester
Legal Description	Lot 1 Deposited Plan 571352
Site Area	Approx. 3500 m^2
Land Zoning	Zone C3 Environmental Management
Local Council Area	Mid Coast Council
Current Use	Vacant, the site was formerly used as a fuel station / workshop.
Surrounding Uses	North – Denison Street, Bus shelter with associated public toilet block and Billabong Park (recreational land use) East – Billabong lane, parking spaces and commercial premises South – Industrial premises West – Unnamed unlined creek (tributary of Gloucester River), open space/sports grounds (recreational land use)

The site boundary is shown on Figure 1.

Figure 1: Overview of the site area in yellow (Source: SixMaps, image dated 24/06/2024)

5. Environmental Setting

Regional Topography (NSW 2m Contours)	The site is located within a region of moderately to steeply undulating terrain and is situated on a typically flat area of land to the west of the Gloucester CBD.
Site Topography (NSW 2m Contours)	Generally flat slightly sloping to the creek to the west of the site with surface elevations varying between RL92m and RL94m AHD. Drainage is anticipated to be via overland flow into the street drainage system (to the north), and creek located to the west of the site.
Soil Landscape (NSW Soil Landscapes Central Eastern NSW)	The site is located within the alluvial soils of the Gloucester River landscape, which is characterised by "broad level alluvial plains in the Stroud-Gloucester Basin region in the north-east of the area". Limitations include flood hazard, seasonal waterlogging and permanently high-water tables, low permeability soils of low wet bearing strength.
Geology (NSW Seamless Geology)	The site is underlain by Wards River Conglomerate which typically comprises of polymictic conglomerate, fine-grained siliceous volcanics, lithic sandstone and, thin coal beds.
Acid Sulfate Soils (ASS) (NSW ASS Risk Map)	The site is not mapped within an area of acid sulphate soil risk.
Surface Water	There are no mapped surface water bodies present on the site. The nearest off-site surface water ecological receptor would be the unnamed creek immediately adjacent the site (20m west of the site) which flows north into the Gloucester River. The creek is ephemeral in nature.
Groundwater	A total of 8 registered groundwater bores are located within 500 m of the site. A summary of registered groundwater bores has been provided in Table 1.

Table 1: Summary of available information from nearby registered groundwater bores

Bore ID Purpose	Installation Year	Location from site	Bore depth (m)	SWL (m)
GW024725 Groundwater Explore	1980	70 m W	5.0	NA
GW024724 Groundwater Explore	1980	150 SW	5.0	NA
GW203947 Monitoring Bore	2018	135 SSE	4.0	NA
GW203826 Monitoring Bore	2014	170 N	3.0	NA
GW203825 Monitoring Bore	2104	170 N	5.0	NA
GW203824 Monitoring Bore	2016	170 N	4.0	NA
GW030966 Groundwater Explore	1981	460 W	7.0	NA
GW057662 Groundwater Explore	1982	465 W	60.0	NA

Notes for Table 1:
SWL Standing water level

We note that a number of the registered wells above were installed for groundwater monitoring at a fuel service station (Shell) located about 170 m north (down hydraulic gradient) of the site. Due to the proximity and location to the subject site (i.e. down gradient), the risk of adverse impacts from the shell site to the subject site is considered to be low.

The site or immediately adjacent properties are not listed as contaminated sites by the NSW EPA. NSW EPA records show there is one contaminated property (Caltex Service Station) listed for the Gloucester area, however this is located approximately 600 m south of the subject site and is considered to not pose a significant risk to the subject site.

6. Summary of Previous Reports

The following previous reports are relevant to the current investigation:

- Regional Geotechnical Solutions (RGS, 2022)), Stage 1 & 2 Site Contamination Assessment, Proposed Visitor Centre – 17 Denison Street, Gloucester. Project RGS02423.1-AB; and
- Douglas. (Douglas, 2024)). Report on Detailed Site Investigation (Contamination), 17 Denison Street, Gloucester NSW. Document No. 228674.00.R.001.Rev0: Douglas Partners Pty Ltd.

RGS (2022) - Stage 1 and 2 Site Contamination Assessment

The pertinent findings of the report are summarised below:

- The site contamination assessment was conducted in December 2021 and included a site history review, site inspection and subsurface investigation comprising drilling of eight bores, collection of six surface samples, installation of three groundwater wells and sampling of groundwater. Test locations are shown on Drawing 1 in Appendix A;
- The site history review indicated the site has been used for commercial / industrial purposes since at least the late 1950s which included the storage and dispensing of fuel from underground fuel storage tanks (USTs). The existing buildings have historically been used as a service station, machinery shop and tyre service centre and permanently closed in the 2010's;
- A review of the SafeWork NSW Hazardous Chemicals search indicated the site was used for storage of 2000 gallons of mineral spirit in the 1950s. A license dated 6 April 2001 was issued for four USTs within the tank farm area along the northern boundary of the site adjacent Denison Street. The tank farm comprised two 4,500 L unleaded petrol USTs, one 12,000 L diesel UST and one 27,000 L unleaded petrol UST. Location of USTs is shown on Drawing 1 in Appendix A;
- The site inspection indicated the former fuel bowsers across the northern portion of the site had been removed at some point, however the four existing USTs appear to have been left in-situ. It is unknown if the tanks have been decommissioned;
- Subsurface conditions generally comprised concrete / pavement seal and sandy gravelly clay fill materials overlying alluvial silty / sandy clay. Fill was identified in three of the eight bores (Bores 3, 6 and 8) to a maximum depth of 0.6 m. Moderate to strong hydrocarbon odours were observed in Bores 1, 2 and 7 during drilling;
- PID results indicated moderate to high hydrocarbon impact to underlying soils in the vicinity of the tank farm (i.e. PID readings 260 to 570 ppm);
- Groundwater was encountered within the three groundwater wells during gauging at depths between 1.75 m and 1.85 m below ground level. Slight / slight to moderate hydrocarbon odours and slight sheens were observed in purged groundwater from wells MW1 and MW2 (vicinity of the tank farm);
- Laboratory testing indicated TRH / BTEX concentrations in two samples (BH7/1.3-1.5 m and BH7/1.8-2.0 m) exceeded the adopted HSL for commercial/industrial land use. The samples were located at the front of the site to the west of the two former unleaded USTs. Two other surface samples (SS1 and SS2) exceeded the ecological assessment criteria for BaP;
- Concentrations of metals (cadmium, chromium, copper, lead, nickel and zinc), TRH and PAH exceeded the adopted criteria in groundwater samples from wells MW1 and MW2 (northern boundary of the site within tank farm). Metal concentrations (arsenic, cadmium, chromium, copper, lead, nickel and zinc) were also observed above the adopted criteria in well MW3 (located in the south western portion of the site adjacent former tyre centre). It is noted that total metals concentrations were reported for MW3 rather than dissolved metals (as reported in MW1 and MW2) which is likely to overestimate metal concentrations in groundwater at MW3;

- One surface sample (SS4) was collected from the existing fill Stockpile A in the western portion of the site. Laboratory testing indicated the presence of Chrysotile asbestos below the laboratory limit of reporting (LOR) of 0.1 g/kg (0.01%);
- RGS identified the following sources of contamination at the site:
  - USTs and former service station area;
  - Soils in the vicinity of existing structures;
  - Equipment and scrap materials storage area;
  - Existing fill Stockpile A;
  - Presence of fill of unknown origin;
- The results of the subsurface investigation indicated hydrocarbon impacts to soil and groundwater within the vicinity of USTs and former petrol station infrastructure;
- RGS recommended additional investigation to confirm the extent of hydrocarbon impact to soil and groundwater and possible risks to on-site and off-site receptors, provide waste classification for Stockpile A materials in the western portion of the site as well as a HAZMAT assessment of the existing buildings.

Douglas Partners (2024) – Detailed Site Investigation

The pertinent findings of the report are summarised below:

- Douglas conducted a detailed site investigation (DSI) at the site comprising subsurface investigation at 28 test locations (15 boreholes, 13 test pits and 6 additional groundwater wells), laboratory testing on soil and groundwater and preparation of a report;
- Hydrocarbon impacts were identified in soil and groundwater at four test locations (Bores 104 and 105 and previous RGS Bores MW1 and MW2);
- Localised asbestos impacts were identified at ground surface at one location (F1/JRK) and within soil at one location (Pit 207/0.2 m). Asbestos fines at Pit 207/0.2 m were identified in underlying soils at concentrations below the adopted SAC;
- Elevated concentrations of metals, BTEX, PAH, VOC and PFAS in groundwater were identified above the adopted SAC at some locations across the site. Elevated metals and PFAS were observed in upgradient well 106 during the previous investigation (including upgradient well 106);
- Elevated TRH concentrations were also identified in groundwater in Wells 104, 105 and MW1 in the vicinity of the existing USTs in the northern portion of the site;
- Douglas concluded that hydrocarbon impacted soil and groundwater within the northern portion of the site as well as localised asbestos impacts will require remediation to render the site suitable for the proposed development;
- The identified soil and groundwater impacts were likely associated with existing USTs and service station infrastructure near the site's northern boundary. It was considered likely that hydrocarbons may have migrated off-site via groundwater to Denison Street, although the extent of off-site impacts was not assessed;

- Off-site investigation was recommended to further assess the presence and extent of possible migration of impacts north of the site. Additional investigation was also recommended to assess possible impacts to the neighbouring creek from historical site activities (based on anecdotal evidence in the current assessment);
- Based on the identified contamination at the site, Douglas concluded that remediation will be required to render the site suitable for the proposed development. Remediation should include decommissioning of the service station, and remediation of the primary source of contamination within the site (ie impacted soils and groundwater in the vicinity of UST's and service station infrastructure). Based on experience with similar sites, residual contamination may also be present immediately beneath existing slabs within the workshop, refuelling areas, and within service pits/pipes within the site. Localised remediation of asbestos impacts may also be required subject to the proposed development. The proposed remediation strategy, remediation action criteria and validation requirements will need to be outlined in a site-specific remediation action plan (RAP).

7. 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 previous investigations, the following potential sources of contamination and associated contaminants of potential concern (CoPC) have been identified and summarised in Table 2 below. Additional investigation is also recommended to assess possible impacts to the neighbouring creek from historical site activities (based on anecdotal evidence in the current assessment).

Table 2: Summary of potential sources

Potential sources and associated CoPC
On site sources
S1: USTs and associated fuel infrastructure and former service station area: COPC include metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX) and polycyclic aromatic hydrocarbons (PAH); **S2**: Imported fill (unknown source): COPC include metals, TRH, BTEX, PAH, organochlorine/organophosphorus pesticides (OCP/OPP), polychlorinated biphenyls (PCB), per- and polyfluoroalkyl substances (PFAS) and asbestos (depending on the source). **S6**: Hazardous building materials from existing structures: COPC include lead, asbestos, synthetic mineral fibres (SMF), PCB **S8**: Existing Stockpile A: COPC include metals, TRH, BTEX, PAH, OCP/OPP, PCB, PFAS and asbestos.

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 [nearby residents / trespassers]; **HR2:** Construction and maintenance workers; **HR3:** End users [commercial land users]; and **HR4:** Adjacent site users [commercial land users].
Potential environmental receptors
ER1: Surface water [Unnamed Creek west of the site] **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 S4) and receptors are provided in Table 4 below.

Table 4: Summary of potentially complete exposure pathways

Source and COPC	Transport Pathway	Receptor	Risk Management Action
S1: USTs and associated infrastructure: metals, TRH, BTEX, PAH (central northern portion of the site)	P1: Ingestion and dermal contact P2: Inhalation of dust and/or vapours	R1: Current users [nearby residents / trespassers] R2: Construction and maintenance workers R3: End users [commercial land users]	Testing of soil and groundwater indicates the presence of hydrocarbon impacts near and downgradient of known USTs and service station infrastructure. USTs and service station infrastructure (ie pipes) should be appropriately removed and validated with reference to a site-specific remediation action plan (RAP) with reference to NSW EPA (2014c). Remediation is required for the identified hydrocarbon impacted soil and groundwater to render the site suitable for the proposed development from a contamination perspective. Additional investigation is required to further assess the presence and extent of hydrocarbon impacts from off-site migration north of the site.
	P3: Surface water run-off P4: Lateral migration of groundwater providing base flow to water bodies	R5: Surface water	
	P5: Leaching of contaminants and vertical migration into groundwater	R6: Groundwater	
	P6: Inhalation, ingestion and absorption	R7: Terrestrial ecosystems	
S2: Imported Fill: Asbestos (subject to source) **S6: Hazardous building materials:** lead, asbestos, SMF, PCB **S8: Existing Stockpile A**: Asbestos (subject to source)	P1: Ingestion and dermal contact P2: Inhalation of dust and/or vapours	R1: Current users [nearby residents / trespassers] R2: Construction and maintenance workers R3: End users [commercial land users]	Testing generally indicates the absence of gross chemical contamination to soils (excluding the UST and service station infrastructure area). Chemical contaminant concentrations were within commercial/industrial land use criteria. Chemical concentrations in groundwater were found above the adopted SAC (ANZG 2018 and NEMP 2020). ACM (bonded) impacts identified at the surface at one test location. Owing to the presence of fill at the site, history of building demolition and presence of building waste within fill across the site there is a risk of further ACM to be present within upper fill materials across the site. Remediation is required for the identified ACM impacted fill to render the site suitable for the proposed development from a contamination perspective.
	P3: Surface water run-off P4: Lateral migration of groundwater providing base flow to water bodies	R5: Surface water	
	P5: Leaching of contaminants and vertical migration into groundwater	R6: Groundwater	
	P6: Inhalation, ingestion and absorption	R7: Terrestrial ecosystems	

8. Sampling and Analysis Plan

8.1 Data Quality Objectives

The SDSI was devised with reference to the seven-step data quality objectives (DQO) process, which is provided in Appendix B Schedule B2, NEPC (2013). The data quality objective process is outlined in Appendix D.

8.2 Soil Sampling Rationale

A judgemental sampling strategy to determine test locations was adopted. Locations were based on site history information and the CSM with the rationale provided below. Test locations are shown on Drawing 1, in Appendix A.

Boreholes 301 to 306	Downgradient of existing UST's and the site (three within the footpath adjacent to the site on Denison Street, and three on the opposite side of Denison Street adjacent to the bus station) to further assess the possible extent of impact.

Soil samples were collected from each location at depths of approximately 0-0.1 m, 0.5 m and every 0.5 m thereafter, and changes in lithology or signs of contamination.

The general sampling methods are described in the field work methodology in Appendix E.

Soil samples were selected for analysis based upon field observations and PID screening results, and to provide lateral and vertical coverage of the site. The selected samples were analysed for the CoPC in the CSM and for physical parameters total organic carbon, cation exchange capacity (CEC) and pH.

8.3 Groundwater Sampling Rationale

Groundwater monitoring wells were installed in all six of the bores drilled in the current assessment. The groundwater wells were located in accessible areas to provide an assessment of potential off-site migration from USTs, with the rationale provided below. Test locations are shown on Drawing 1 in Appendix A.

The locations were selected based on the following rationale:

Wells 301 to 306	Located to assess possible migration of hydrocarbon impacts off-site from USTs across northern boundary of the site towards the adjacent park (i.e. down hydraulic gradient of the potential sources of contamination).

The six new groundwater wells as well as the existing eight wells (Wells 101 to 106, MW1, and MW2) were sampled in order to assess the current groundwater contamination conditions at the site and potential off-site migration into Denison Street to the north.

The general sampling methods are described in the field work methodology, included in Appendix B.

All samples were analysed for the CoPC in the CSM. One sample was also analysed for cations / anions and nutrients in addition to the CoPC.

8.4 Sediment and Surface Water Sampling Rationale

Sediment and surface water samples were collected from three locations within creek directly adjacent the site to assess potential off-site impacts from former commercial/industrial activities at the site. Sediment sampling was undertaken using hand tools to depths between 0.3 m and 0.4 m. Surface water sampling was undertaken using a long-handled swing sampler.

Locations were based on site history information and the CSM with the rationale provided below. Sampling locations are shown in Drawing 1 in Appendix A.

SED1 / SW1	Upstream location to assess contaminant concentrations entering the site
SED2 / SW2	Located mid-stream along the creek in the approximate area of the drainage pipe outlet running from the site
SED3 / SW3	Downstream location to assess potential contamination to sediments and surface water from the site

It is noted that the exact location of the drainage pipe outlet could not be located during service locating. The possible outlet was obscured by dense vegetation and has likely been buried over time. As such, approximate mid-stream sediment and surface water samples (SED2/SW2) were collected within the adjacent creek. Refer to Drawing 1 in Appendix A for sample locations.

The general sampling methods are described in the field work methodology, included in Appendix E.

9. Site Assessment Criteria

The site assessment criteria (SAC) applied in the current investigation are informed by the CSM (Section 7) which identified human and environmental receptors to potential contamination on 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).

The investigation and screening levels applied in the current investigation comprise levels adopted for a generic commercial/industrial land use scenario. The derivation of the SAC is in Appendix F, and the adopted SAC are listed on the summary analytical results tables in Appendix G.

10. Results

10.1 Subsurface Conditions

Photographs from field work are shown in Appendix C.

The borehole logs for this assessment are provided in Appendix E. The logs recorded the following general sub-surface profile:

ASPHALT:	Found in all bores to depths of between 0.02 m and 0.03 m below ground level (bgl).
FILL:	Found in all test locations and generally comprised pale brown clayey sandy gravel / clayey gravel to depths between 0.18 m and 0.4 m bgl (refer to logs for details).
ALLUVIAL / COLLUVIUM:	Found in all test locations and generally comprised brown / grey clay, clayey gravel, sandy clay and gravelly clay. Test locations terminated in this material at 4 m bgl.

It is noted that a natural sand/gravel layer was generally observed at depths between 1.9 m to 3.6 m below ground level. This layer would be more permeable than the surrounding clayey soils and may be acting as a preferential migration pathway for the migration of groundwater.

10.2 Groundwater Conditions

Free groundwater was observed in Bores 301 to 306 at depths between 1.8 m and 2.1 m bgl during drilling. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

Groundwater levels were gauged on 29 April 2025 prior to sampling using an electronic oil/water interface meter. The measured water levels prior to sampling are shown in Table 5.

Table 5: Summary of groundwater level measurements on 29 April 2025

Well ID	Ground RL (AHD)	RL TOC (AHD)	Approx. Well Stickup (m)	Depth to GW (m TOC)	RL Groundwater (AHD)
MW1*	92.01	91.91	-0.10	1.12	90.79
MW2*	92.13	92.05	-0.09	0.98	91.07
101**	91.67	91.57	-0.10	0.50	91.07
102**	91.95	91.81	-0.14	0.90	90.91
103**	92.14	92.06	-0.08	0.80	91.26
104**	92.22	92.13	-0.08	1.18	90.96
105**	91.94	91.86	-0.08	1.01	90.85
106**	91.93	91.85	-0.08	0.60	91.25
301	92.00	91.72	-0.29	1.12	90.59
302	92.04	91.93	-0.115	1.30	90.62
303	91.95	91.83	-0.12	1.15	90.68
304	91.84	91.76	-0.08	1.36	90.40
305	92.06	91.94	-0.12	1.26	90.68
306	92.16	92.09	-0.07	1.38	90.72

Notes to table:
TOC – Top of Casing
* Denotes well installed during previous RGS investigation
** Denotes well installed during previous Douglas investigation

Groundwater levels were measured at depths ranging from 0.5 m and 1.38 m below ground level during gauging (RL 90.40 and 91.26 AHD). Inferred contours of piezometric head are shown on Drawing 2 in Appendix A and indicate the groundwater flow direction is to the north-north east from the central portion of the site.

Groundwater parameters measured during purging and sampling on 28 and 29 April 2025 are presented in Table 6.

Table 6: Results of Groundwater Field Parameters (28-29 April 2025)

Sample ID	Date Sampled	Floating Product (mm)	PID Well Headspace (ppm)	PID GW Headspace (ppm)	RL TOC (AHD)	Water Level below TOC (m)	Water Level RL (AHD)	Volume Purged (L)	pH	EC (µS/cm)	DO (mg/L)	Turbidity (NTU)	ORP (mV)	Temp. (°C)	Comments
MW1*	28/04/2025	<1	1884	1554	91.91	1.742	90.168	10	6.4	758	0.4	>1000	-40	25.5	Grey/brown, very turbid, hydrocarbon odour
MW2*	28/04/2025	<1	-	<1	92.05	1.860	90.185	10	6.3	389	1.5	>1000	68	24.5	Brown, very turbid, hydrocarbon odour
101**	28/04/2025	<1	<1	<1	91.57	1.345	90.23	10	5.9	361	0.3	>1000	117	22.4	Brown, very turbid
102**	28/04/2025	<1	<1	<1	91.81	1.688	90.13	12	6.4	451	1.6	452	147	23.2	Brown, moderately turbid
103**	28/04/2025	<1	<1	<1	92.06	1.906	90.15	8	5.8	323	5.6	216	136	22.3	Pale brown, slightly turbid
104**	28/04/2025	<1	<1	270	92.13	1.998	90.14	10	6.4	527	0.2	>1000	-53	25.4	Grey/brown, very turbid, hydrocarbon odour
105**	28/04/2025	<1	145	399	91.86	1.626	90.23	8	6.3	594	0.2	>1000	-49	24.9	Brown, very turbid, hydrocarbon odour
106**	28/04/2025	<1	<1	<1	91.85	1.595	90.256	14	6.3	877	0.4	>1000	24	23.7	Brown, very turbid
301	29/04/2025	<1	<1	1763	91.72	1.345	90.37	10	6.6	867	6.2	>1000	36	25.6	Brown, very turbid, hydrocarbon odour
302	29/04/2025	<1	3264	1026	91.93	1.688	90.24	10	6.3	714	6.5	>1000	-31	24.5	Brown, very turbid, slight hydrocarbon odour
303	29/04/2025	<1	2009	2267	91.83	1.906	89.92	12	6.4	846	7.0	>1000	-57	23.3	Brown, very turbid, slight hydrocarbon odour
304	29/04/2025	<1	68.5	632	91.76	1.998	89.76	12	6.2	633	5.3	>1000	21	25.5	Brown, very turbid, slight hydrocarbon odour
305	29/04/2025	<1	1446	1435	91.94	1.626	90.32	14	6.3	738	5.9	>1000	-26	25.0	Brown, very turbid, hydrocarbon odour
306	29/04/2025	<1	1398	774	92.09	1.595	90.498	10	6.4	1040	5.9	>1000	-47	25.8	Brown, very turbid, hydrocarbon odour

Notes to table:
EC – Electrical Conductivity
DO – Dissolved Oxygen
ORP – Oxidation Reduction Potential
PID – Photo-ionisation Detector
* Denotes well installed during previous RGS investigation
** Denotes well installed during previous Douglas investigation

Results of groundwater field parameters measured during sampling indicated the following:

- Dissolved oxygen levels indicated generally aerobic conditions;
- pH was generally slightly acidic;
- Electrical conductivity values are typical of fresh water;
- Redox potential (Eh) indicates oxidising conditions in Wells MW2, 101, 102, 103, 106, 301 and 304 and reducing conditions in Wells MW1, 104, 105, 302, 303, 305 and 306; and
- Groundwater within wells was generally very turbid with the exception of monitoring wells 102 and 103.

10.3 Contaminant Observations

Observations of potential contamination within test locations are summarised in Table 7 below.

Table 7: Potential Contamination Observations at Current Test Locations

Potential Contamination Observation	Locations and Depths (m)
Soil (Bores)	
Fill[1]	Found in all borehole - refer to logs in Appendix B for details
Hydrocarbon Staining	Hydrocarbon staining in Bore 303 (1.7 m to 3.6 m)
Hydrocarbon Odour	Slight to moderate hydrocarbon odours noted in all bores (301 to 306) during drilling.
Groundwater	
Hydrocarbon Odour	Wells MW1, MW2, 104, 105, 301, 302, 303, 304, 305, and 306.

Notes to table:
1 - Potential presence of a range of contaminants due to unknown source of imported fill
2 - Potential presence of hazardous building materials (HBM) including asbestos

Elevated PID measurements in soil were recorded at Bores 302 (up to 2047 ppm), 303 (up to 760 ppm), 305 (up to 266 ppm), and 306 (up to 1200 ppm) suggesting possible volatile hydrocarbon impact at these test locations. These bores are all located downgradient of the existing USTs. The elevated PID results generally corresponded to the more permeable sandy/gravelly strata suggesting a possible migration pathway for impacted groundwater from the site.

The PID screening indicated the general absence of gross volatile impacts in soil at the remaining test locations and to the depths investigated, with most values being recorded less than 20 ppm.

Elevated PID concentrations were identified in well and groundwater headspace during sampling suggesting the possible presence of volatile impacts as outlined in Table 8 below.

Table 8: PID Concentrations in Groundwater (28-29 April 2025)

Well ID	Well Headspace (ppm)	Groundwater Headspace (ppm)
MW1	1884	1554
104	<1	270
105	145	399
301	<1	1763
302	3264	1026
303	2009	2267
304	68.5	632
305	1446	1435
306	1398	774

LNAPL and DNAPL were not detected by the oil-water interface probe based on level gauging of the groundwater table interface and full depth of the well respectively. It is noted that the interface probe accuracy is 1 mm. Free product, slicks or emulsions were not observed in groundwater during sampling.

11. Laboratory Testing

11.1 Program

Laboratory testing for selected soil samples was undertaken by Envirolab Services Pty Ltd for the main potential contaminants of concern outlined in the CSM in Section 7 and the sampling and analysis plan in Section 8. Analytical methods used are shown in the laboratory certificates in Appendix G.

The analytical program for the assessment is summarised in Table 9.

Table 9: Summary of Analytical Program

Media	Analytes Tested	No. Primary Samples Tested	No. Replicate Samples Tested	No. Trip Spikes / Blanks (TRH/BTEX)	No. Rinsate Samples Tested
Soil	Metals (16), TRH, BTEX, PAH, OCP/OPP, PCB	9	1	-	-
	PFAS	6	-	-	-
	VOC	5	-	-	-
	pH, EC	10	1	-	-
	CEC	2	-	-	-
Sediment	Metals (16), TRH, BTEX, PAH, OCP/OPP, PCB, PFAS, VOC	3	-	-	-
	pH, EC, Total Organic Carbon	3	-	-	-
	CEC	1	-	-	-
	TCLP PFAS	1			
	TRH Silica Gel Clean-up	2	-	-	-
Water	Metals (17), TRH, BTEX, PAH, VOC, PFAS	14	2*	1	1
	Ionic Balance	1	-	-	-
	TRH Silica Gel Clean-up	7	-	-	-

Notes to table:
Metals (17) – aluminium (Al), arsenic (As), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), zinc (Zn)
BTEX - benzene, toluene, ethylbenzene, xylene
CEC - cation exchange capacity
EC - electrical conductivity
OCP - organochlorine pesticides
OPP - organophosphorus pesticides
PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyls
PFAS - Per-and polyfluoroalkyl substances
TCLP - toxicity characteristics leaching procedure
TRH - total recoverable hydrocarbons
VOC – volatile organic compounds
*Replicate and triplicate

11.2 **Analytical Results**

The results of laboratory analysis are summarised in the following tables in Appendix G:

- Table G1: Summary of Soil and Sediment Laboratory Results (Land Use Comparison);
- Table G2: Summary of Soil and Sediment Laboratory Results (Preliminary Waste Classification);
- Table G3: Summary of Groundwater Laboratory Results;
- Table G4: Summary of Surface Water Laboratory Results; and

- Table G5: Summary of Sediment Laboratory Results (Sediment Guideline Comparison).

The laboratory certificates of analysis together with the chain of custody and sample receipt information are provided in Appendix H.

11.3 Chromatograph Review

11.3.1 Soil and Sediment

Douglas requested chromatogram review and interpretation by the laboratory for selected soil and sediment samples with elevated TRH / PAH to assist with data interpretation. The laboratory reviewed chromatograms against known standards and provided comment on the material as shown in Table 10. It is noted that the interpretation has not been formally reported in laboratory sheets and is therefore not NATA accredited. Copies of chromatograms are included in Appendix G.

Table 10: Chromatograph Review for TRH in Soil and Sediment

Sample ID	Media	Identified Contaminant	Inferred Material Based on TRH Chromatograph
302/2.0	Soil	TRH, BTEX, PAH	Petrol
303/2.0	Soil	TRH, BTEX, PAH	Petrol
306/2.5	Soil	TRH, BTEX, PAH	Petrol
SED2	Sediment	TRH, PAH	Not a close match to anything in the reference library. Sample has inclusions of organic matter
SED3	Sediment	TRH, PAH	Not a close match to anything in the reference library, response is too low to make an accurate determination. Sample has inclusions of organic matter

11.3.2 Groundwater

The chromatographs of groundwater samples with detected TRH were interpreted by the laboratory against known standards. Chromatographs are included in Appendix G The results are summarised in Table 11.

Table 11: Chromatograph Review for TRH in Groundwater

Well ID	Identified Contaminant	Inferred Material Based on TRH Chromatograph
104	TRH, BTEX, PAH, VOC	Response is too low to accurately determine a source
105	TRH, BTEX, PAH, VOC	Response is too low to accurately determine a source
302	TRH, BTEX, PAH, VOC	Weathered petrol
303	TRH, BTEX, PAH, VOC	Weathered petrol
304	TRH, BTEX, PAH, VOC	Weathered petrol
305	TRH, BTEX, PAH, VOC	Weathered petrol
306	TRH, BTEX, PAH, VOC	Weathered petrol
MW1	TRH, BTEX, PAH, VOC	Weathered petrol

It is noted that silica gel clean up testing was undertaken on seven of the eight groundwater samples above (Samples MW1, 105, 302, 303, 304, 303, 304, 305, and 306) to further assess the TRH detected. Total petroleum hydrocarbons (TPH) were detected above the LOR for each of the seven samples which indicates the presence of petroleum hydrocarbon impacts.

12. Discussion

12.1 Soils

The results of the laboratory testing on soils from the current investigation (i.e. off-site Bores 301 to 306) indicated the following for the samples tested:

- OCP, OPP, PCB and PFAS were below the laboratory LOR;
- Heavy metal concentrations were within the adopted SAC;
- TRH (>C10-C40) was generally not detected above the LOR with the exception of TRH detections in three soil samples (302/2.0 m, 303/2.0 m, and 306/2.5 m). TRH concentrations for samples 302/2.0 m and 306/2.5 m exceeded the adopted human health and ecological investigation limits;
- BTEX was detected above the LOR for three samples (302/2.0 m, 303/2.0 m, and 306/2.6 m), however the concentrations were well below the adopted SAC;
- PAHs were detected above the LOR in three samples tested (302/2.0 m, 303/2.0 m, and 306/2.5 m), however concentrations were within the adopted human health and ecological criteria (SAC) for all soil samples tested;
- VOCs were detected above the LOR in three samples (302/2.0 m, 303/2.0 m, and 306/2.5 m), comprising 1,2,4- trimethyl benzene, 1,3,5-trimethyl benzene, 4-isopropyl toluene, Isopropylbenzene (cumene) and n-propyl benzene. No criteria were available for these analytes in the adopted SAC;
- Based on the comparison of the chromatographs to know standards, the laboratory indicated samples 302/2 m, 303/2 m and 306/2.5 m with TRH above the LOR were associated with petrol;

- The majority of tested soils were within the adopted human health and ecological guidelines for standard commercial/industrial land use (SAC) with the exception of those listed in Table 12:

Table 12: Summary of Soils Results that Exceeded the Site Assessment Criteria (Current Investigation)

Analyte	SAC	No. primary samples	No. Test Locations	No. exceedances	No. exceedances >2.5 SAC
TRH C6-C10	Management Limits	9	6	1	0
TRH >C10-C16	EIL D	9	6	2	0
F1 ((C6-C10)-BTEX)	HSL D	9	6	1	0
	EIL D	9	6	2	1

Notes to table:
Where exceedances are > 2.5 times the SAC, the impacted soil represent a hotspot (NEPC, 2013)
EIL – Ecological investigation level
HSL – Health screening level

The results indicate the presence of hydrocarbon impacts to off-site soils as a result of the migration of impacted groundwater from the site as follows:

- Within Bores 302 and 303 (located on the southern edge of Denison Street – approximately 6 m downgradient of the site boundary);
- Within Bore 306 (located on the northern edge of Denison Street – approximately 17 m downgradient of the site boundary).

Based on the hydrogeology of the site and surrounds, together with the observations made during fieldwork and the results of testing, the permeable sandy/gravelly strata located at depths between 1.9 m to 3.6 m below ground level presents a preferential pathway for the migration of impacted groundwater from the site.

12.2 Preliminary Waste Classification

Based on the total and leachable (TCLP) analytical testing conducted for this preliminary assessment, the in-situ soils tested would generally be classified as 'General Solid Waste (non-putrescible)' (both CT1 and SCC1/TCLP1).

It is noted that the testing conducted for this assessment is preliminary only and a specific waste classification with reference to NSW EPA (2014) and NSW EPA (2022) would be required for any in-situ materials proposed to be disposed off-site.

12.3 Groundwater

The results of the laboratory testing on groundwater from the current investigation (i.e. on-site and off-site wells) indicated the following for the samples tested:

- Most metals were detected above the laboratory LOR with elevated concentrations of arsenic, cobalt, copper, manganese, nickel and zinc above the adopted ANZG freshwater DGVs in all wells (including the upgradient well in location 106);
- Detectable concentrations of TRH were found in Wells 104, 105, MW1, 302, 303, 304, 305 and 306. Additional silica gel clean-up testing was undertaken on seven of the eight samples (excluding Well 104) which indicated the presence of petroleum hydrocarbons within all seven samples tested. It is noted that HSL criteria for the elevated TRH fractions are 'non-limiting' or have no criteria for the predominant clay strata;
- Chromatograph review for the eight samples with elevated TRH indicated the hydrocarbon profile resembled "weathered petrol" for the majority of wells except for Wells 104 and 105, which had concentrations too low to accurately determine a source. The wells with detectable TRH are located in the northern portion of the former service station in the vicinity of the existing USTs, as well as within Denison Street to the north;
- BTEX was detected above the LOR in eight of the fourteen primary samples tested (Wells 104, 105, MW1, 302, 303, 304, 305 and 306) with concentrations in MW1, 302, 303, 304, 305 and 306 being above the adopted ANZG freshwater DGVs. It is noted that the results were below the HSL criteria for the predominant clay strata;
- PAH was detected in Wells 104, 105, MW1, 302, 303, 304, 305 and 306 with exceedances of the ANZG freshwater DGVs in MW1, 302, 303, 305 and 306. The elevated PAHs above the adopted SAC comprised Naphthalene;
- VOCs were detected above the laboratory LOR in Wells 104, 105, MW1, MW2, 301, 302, 303, 304, 305 and 306. Isopropylbenzene was found to be above the adopted SAC in Well MW1, 303, 305 and 306;
- PFAS was detected in at all locations with concentrations of PFOS (constituent of PFAS) exceeding the 99% level of protection criteria for fresh water systems. The guideline value is lower than the LOR for PFOS, therefore any detection results in an exceedance. Eleven locations (Wells 101, 102, 103, 104, 105, 301, 302, 303, 304, 305 and 306) also exceeded the 95% level of protection criteria;
- Total nitrogen, TON and total phosphorus were detected above the adopted ANZECC criteria in the one sample tested (Well 301);

Table 13 provides a summary of the number of samples which exceeded the SAC which are also shown on Drawing 4 in Appendix A. The remainder of analytes not listed in the Table 13 were all below the SAC.

Table 13: Summary of Groundwater Results that Exceeded the Site Assessment Criteria

Analyte	SAC	Monitoring Well	No. Test Locations	No. Exceedances [1]
Nitrogen (Total Oxidised)	ANZECC 2000 (Lowland River)	301	1	1
Nitrogen (Total)	ANZECC 2000 (Lowland River)	301	1	1
Total Phosphorus	ANZECC 2000 (Lowland River)	301	1	1
Arsenic	ANZG (2018) Freshwater	MW1, 302, 303, 305	14	4
Cobalt	ANZG (2018) Freshwater	306	14	1
Copper	ANZG (2018) Freshwater	102	14	1
Manganese	ANZG (2018) Freshwater	MW1, 302, 303, 305, 306	14	5
Nickel	ANZG (2018) Freshwater	105, 305	14	2
Zinc	ANZG (2018) Freshwater	103, 106, 305	14	3
Naphthalene	ANZG (2018) Freshwater	MW1, 302, 303, 304, 305, 306	14	5
Benzene	ANZG (2018) Freshwater	MW1, 302, 303, 305	14	4
Toluene	ANZG (2018) Freshwater	MW1, 302, 303	14	3
Ethylbenzene	ANZG (2018) Freshwater	MW1, 302, 303, 305, 306	14	5
Xylene (m & p)	ANZG (2018) Freshwater	MW1, 302, 303, 305, 306	14	5
Xylene (o)	ANZG (2018) Freshwater	MW1, 302, 303, 305	14	4
Isopropylbenzene	ANZG (2018) Freshwater	MW1, 303, 305, 306	14	4
Perfluorooctanesulfonic acid (PFOS)	PFAS NEMP 2020 Freshwater 99%	101, 102, 103, 104, 105, 106, MW1, MW2, 301, 302, 303, 304, 305, 306	14	14

Based on the results, it noted that the predominant soil type at the site is clay, however, there is a gravelly/sandy layer located between 1.9m to 3.6m below ground level. The vapour intrusion risks from groundwater migration are generally considered to be low considering a clay strata. However, comparison of groundwater results to the HSL guidelines for sandy strata suggests a possible vapour risk due to slightly elevated F1 TRH concentrations at locations 302, 303 and 305 (refer to Table G3 in Appendix G).

Based on the results of groundwater testing, groundwater impacts from the USTs and petrol station infrastructure have migrated off-site via groundwater to the north – north east to adjacent Denison Street. The more permeable sandy/gravelly strata located at depths between 1.9 m to 3.6 m below ground level appears to be providing a preferential migration pathway for impacted groundwater from the site. Hydrocarbon impacts were observed in wells directly adjacent the site boundary (Wells 302 and 303) as well as on the opposite side of Denison Street further north (Wells 304 to 306). The concentration of hydrocarbons has generally decreased with distance from the primary source of impacts (ie UST's and petrol station infrastructure). The extent of impacts has not been determined and is present within off-site Wells 304 to 306 located 17 m downgradient of the site on the norther side of Denison Street.

12.4 **Surface Water**

The results of the laboratory testing on surface water from the adjacent creek indicated the following for the samples tested:

- TRH, BTEX, PAH and VOC were below the laboratory LOR;
- Most metals were detected above the laboratory LOR with elevated concentrations of chromium, copper, lead and zinc above the adopted SAC;
- PFAS was detected at all locations with concentrations of PFOS (constituent of PFAS) exceeding the 99% level of protection criteria for fresh water systems. The guideline value is lower than the LOR for PFOS, therefore any detection results in an exceedance. Concentrations in all samples tested were below the 95% level of protection criteria;

Table 14 provides a summary of the number of samples which exceeded the SAC.

Table 14: Summary of Surface Water Results that Exceeded the Site Assessment Criteria

Analyte	SAC	Surface Water Location	No. Test Locations	No. Exceedances [1]
Chromium (III +VI)	ANZG (2018) Freshwater	SW1, SW3	2	2
Copper	ANZG (2018) Freshwater	SW1, SW2, SW3	3	3
Lead	ANZG (2018) Freshwater	SW1, SW2, SW3	3	3
Zinc	ANZG (2018) Freshwater	SW1, SW2, SW3	3	3
Perfluorooctanesulfonic acid (PFOS)	PFAS NEMP 2025 Freshwater 99%	SW1, SW2, SW3	3	3

It is noted that detected concentrations of metals and PFAS were generally higher or commensurate in the upstream sample (SW1) than the downstream sample (SW3). Results from the midstream sample (SW2) in the approximate location of the drainage pipe outlet were also commensurate with the upstream and downstream samples and had detectable hydrocarbons.

The results of testing generally suggest the absence of significant impacts to surface waters within the adjacent creek from the subject site.

12.5 **Sediment**

The results of the laboratory testing on sediments from the adjacent creek indicated the following for the samples tested:

- BTEX, OCP, OPP, PCB and VOC were below the laboratory LOR;
- Heavy metal concentrations were generally within the adopted sediment DGVs, with the exception of Lead (SED3/0-0.1 m) and Zinc (SED2/0-0.1 m);
- TRH was detected above the LOR in two sediment samples (SED2/0-0.1 m, and SED3/0-0.1 m), however concentrations were below the adopted sediment DGVs. Additional silica gel clean-up testing was undertaken on each sample which indicated the absence of petroleum hydrocarbons;
- PAHs were detected above the LOR in two samples tested (SED2/0-0.1 m, and SED3/0-0.1 m), however concentrations were well within the adopted sediment DGVs;
- PFAS was detected above the LOR in all samples tested from the adjacent creek; Additional leachability testing (TCLP) was undertaken for one sample for PFAS (SED2/0-0.1 m) and indicated the sediments had a low propensity to leach in acidic conditions;
- Review of chromatographs for the two samples with detectable TRH concentrations (SED2/0-0.1 m) and SED3/0-0.1 m) indicated TRH were associated with organic / plant material;
- Sediment results were also compared to the adopted NEPM human health (HIL/HSL) and ecological (EIL/ESL) criteria for a generic commercial / industrial land use scenario. Concentrations were generally within the adopted criteria except for the following:
    - PFOS concentrations in two samples (SED1/0-0.1 m and SED2/0-0.1 m) were found to exceed the NEMP ecological criteria for indirect exposure;
- Contaminant concentrations were generally within the adopted SAC for the samples tested with the exception of the analytes shown below in Table 15.

Table 15: Summary of Sediment Results that Exceeded the Site Assessment Criteria

Analyte	SAC	No. primary samples	No. Test Locations	No. exceedances	No. exceedances >2.5 SAC
Lead	ANZG Sediment DGV	3	3	1	0
Zinc	ANZG Sediment DGV	3	3	1	0
PFOS	ECV -Indirect	3	3	2	2

Notes to table:
Where exceedances are > 2.5 times the SAC, the impacted soil represent a hotspot (NEPC, 2013)

The results of laboratory testing indicate contaminant concentrations were generally commensurate between upstream, midstream and downstream samples. While concentrations of zinc in the midstream sample (SED2/0-0.1 m) and lead in the downstream sample (SED3/0-0.1 m) were found to exceed ANZG sediment DGVs, the concentrations were of a similar order of magnitude suggesting the general absence of significant impacts from the subject site. Detectable TRH were identified in the midstream (SED2/0-0.1 m) and downstream (SED3/0-0.1 m) samples but were below the adopted SAC. Additional silica-gel testing, chromatograph review and field work observations indicate the minor TRH concentrations associated with organic materials (ie not petroleum hydrocarbons).

PFOS was identified above the adopted SAC at the midstream location (approximate location of the drainage pipe outlet), however, concentrations were commensurate with the upstream location.

The results of testing suggest the site is not significantly impacting sediment quality or resulting in significant impacts to the adjacent creek from a contamination perspective.

12.6 Data Quality Assurance and Quality Control

The data quality assurance and quality control (QA/QC) results are provided in Appendix H. Based on the results of the field QA and field and laboratory QC, and evaluation against the data quality indicators (DQI) it is concluded that the field and laboratory test data obtained are reliable and useable for this assessment.

13. Revised Conceptual Site Model

The data collected for the SDSI has generally confirmed that certain potential contaminant sources outlined in the CSM outlined in Section 8 pose a potentially complete pathway to the identified receptor(s) whilst others do not. No other sources of contamination have been identified as a result of the testing results. This is summarised in

Table 16.

Table 16: Updated summary of potentially complete exposure pathways (proposed land use)

Source and COPC	Transport Pathway	Receptor	Risk Management Action
S1: USTs and associated infrastructure: metals, TRH, BTEX, PAH (central northern portion of the site)	HP1: Ingestion and dermal contact HP2: Inhalation of dust and/or vapours	HR1: Current users [nearby residents / trespassers] HR2: Construction and maintenance workers HR3: End users [commercial land users]	Testing of soil and groundwater during the previous DSI indicated the presence of hydrocarbon impacts near and downgradient of known USTs and service station infrastructure within the site. Additional testing of soil and groundwater during the current SDSI indicated the presence of hydrocarbon impacts off-site to the north into Denison Street. Hydrocarbon impacts were observed directly adjacent the site as well as within Bores 304, 305 and 306 located approximately 17 m north on the opposite side of Denison Street. USTs and service station infrastructure (i.e. pipes) should be appropriately removed and validated with reference to a site-specific remediation action plan (RAP) with reference to NSW EPA (2014c). Remediation is required for the identified hydrocarbon impacted soil and groundwater to render the site suitable for the proposed development from a contamination perspective.
	EP1: Surface water run-off EP2: Lateral migration of groundwater providing base flow to water bodies	ER1: Surface water	
	EP3: Leaching of contaminants and vertical migration into groundwater	ER2: Groundwater	
	EP4: Inhalation, ingestion and absorption	ER3: Terrestrial ecosystems	
S2: Imported Fill: asbestos (subject to source) **S6: Hazardous building materials:** lead, asbestos, SMF, PCB **S8: Existing Stockpile A:** asbestos (subject to source)	HP1: Ingestion and dermal contact HP2: Inhalation of dust and/or vapours	ER1: Current users [nearby residents / trespassers] ER2: Construction and maintenance workers ER3: End users [commercial land users]	Testing generally indicates the absence of gross chemical contamination to soils (excluding the UST and service station infrastructure area). Chemical contaminant concentrations were within commercial/industrial land use criteria. Chemical concentrations in groundwater were found above the adopted SAC (ANZG 2018 and NEMP 2020). ACM (bonded) impacts identified at the surface at one test location. Owing to the presence of fill at the site, history of building demolition and presence of building waste within fill across the site there is a risk of further ACM to be present within upper fill materials across the site. Remediation is required for the identified ACM impacted fill to render the site suitable for the proposed development from a contamination perspective.

14. Conclusions and Recommendations

The SDSI was undertaken to further investigate the extent of contamination at the site, possible migration of hydrocarbon impacts north of the site, possible impacts to the adjacent creek and inform additional remediation requirements / requirements for further investigation at the site.

The results of the assessment indicated the following:

- The subsurface investigation and laboratory testing program indicated the presence of hydrocarbon impacts north (downgradient) of the existing USTs and associated service station infrastructure into Denison Street;
- Soils tested were generally within the adopted human health and ecological guidelines for standard commercial / industrial land use scenario for chemical contaminants with the exception of elevated TRH concentrations in two samples (302/2 m and 306/2.5 m);
- Elevated concentrations of metals, BTEX, PAH, VOC and PFAS in groundwater were identified above the adopted SAC at most locations (including upgradient well in location 106);
- Elevated TRH concentrations were also identified in groundwater in three wells in the vicinity of the existing USTs and service station infrastructure (Wells 104, 105 and MW1) as well as five newly installed off-site wells along Denison Street downgradient of the site (Wells 302, 303 located 6 m downgradient of the site boundary, and 304, 305 and 306 located 17 m downgradient of the site boundary);
- LNAPL (free phase impacts or slicks/emulsion) was not observed in groundwater at on-site or off-site wells during field work;
- The results of the investigation confirm that hydrocarbon impacts from existing USTs have migrated north (downgradient) of the site into Denison Street. Impacts were identified within the outer downgradient wells located 17 m from the site boundary. The more permeable sandy/gravelly strata located at depths between 1.9 m to 3.6 m appears to be providing a preferential migration pathway for impacted groundwater from the site. The extent of off-site groundwater impact has not been confirmed during the current investigation;
- The results of testing on surface water and sediments within the adjacent creek suggest the general absence of significant adverse impacts from site activities;
- Remediation will be required to address on-site and off-site impacts.

The SDSI has identified on-site and off-site impacts associated with existing USTs and service station infrastructure. Field observations and laboratory testing suggest hydrocarbon impacts have migrated off-site via a preferential flow path (i.e. underlying natural sand/gravel materials). Hydrocarbon impacts were observed both immediately adjacent to the site and further north within Bores 304, 305 and 306 located 17 m from the site boundary near the bus shelter. It is noted that an amenities building is located further north of the bus shelter. The results of testing of groundwater suggests possible vapour intrusion risks when considering the sandy underlying strata (i.e. the preferential flow path for groundwater migration).

Based on the identified contamination, remediation will be required to render the site suitable for the proposed development. Remediation/management of off-site impact will also be required due to the migration of hydrocarbons via groundwater from the site. Remediation should include decommissioning of the service station, and remediation of the primary sources of contamination within the site (i.e. impacted soils and groundwater in the vicinity of UST's and service station

infrastructure). Where practicable, remediation could also include removal of impacted soils and groundwater within the footpath / road reserve directly north of the site, subject to regulatory approval. Remediation will remove the primary source of contamination and also minimise the risk for further migration of contamination from the site. Off-site impacts could be managed via natural attenuation subject to appropriate design and monitoring, which is likely to require installation of additional monitoring wells downgradient of Bores 304, 305 and 306 and assessment of vapour intrusion risk associated with the amenities building.

As discussed in the previous DSI, residual contamination may also be present immediately beneath existing slabs within the workshop, refuelling areas, and within service pits/pipes within the site, based on experience with similar sites. Localised remediation of asbestos impacts may also be required subject to the proposed development. The proposed remediation strategy, remediation action criteria and validation requirements will need to be outlined in a site-specific remediation action plan (RAP).

The previous RAP should be amended to include the results of the current SDSI and provide procedures for the remediation/management of on-site and off-site impacts. Remediation will require further groundwater monitoring (both on-site and off-site) and assessment of off-site vapour intrusion risk and natural attenuation following removal of the primary source of contamination.

In summary, remediation will be required in accordance with a site-specific RAP to address the identified on-site and off-site impacts.

Based on the results of the SDSI and previous DSI, the site can be made suitable for the proposed development subject to appropriate remediation and validation of the site and the recommendations above.

15. References

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

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NSW EPA. (2022). *Contaminated Sites, Sampling Design Guidelines*. NSW Environment Protection Authority.

RGS. (2022). *Stage1 & 2 Site Contamination Assessment, Proposed Visitor Information Centre, 17 Denison Street, Gloucester.* Document No. RGS02423.1-AB: Regional Geotechnical Solutions.

16. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at 17 Denison Street, Gloucester NSW in line with Douglas' proposal 228674.02.P.001.Rev0 dated 27 February 2025 and Contract No. PROC12334 executed 13 March 2025. The work was carried out under Contract No. PROC12334. This report is provided for the exclusive use of Department of Planning, Housing and Infrastructure 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 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 this investigation. 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.

Asbestos has previously been detected by observation and by laboratory analysis, both on the surface of the site, and in fill materials at the test locations sampled and analysed. Building demolition materials, such as brick, ceramic tile, metal wire, concrete, plastic, timber, glass, pipe, rubber, were also observed in the fill and above-ground stockpile present on site, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to parts of the site being inaccessible and not available for inspection/sampling. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

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

Drawing 1 – Test Location Plan

Drawing 2 – Groundwater Contour – 29 April 2025

Drawing 3 – Soil and Sediment Exceedances Above the Adopted Site Assessment Criteria

Drawing 4 – Groundwater and Surface Water Exceedances Above the Adopted Site Assessment Criteria

Site Location

Legend

- Approximate Borehole Locations (Current Investigation)
- Approximate Surface Water & Sediment Locations (Current Investigation)
- Approximate Drainage Line
- Installed Groundwater Wells (Current and Previous Investigations)
- Approximate Bore Locations (Douglas, 2024)
- Approximate Test Pit Locations (Douglas, 2024)
- Approximate Stockpile A Extent
- Approximate Borehole Location (RGS, 2022)
- Approximate Surface Sample Location (RGS, 2022)
- Approximate UST Locations
- Site Boundary
- Lot Boundary

0 10 20 m

NOTE:
1. Drawing adapted from aerial imagery from Sixmaps dated 05.05.2018
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage (handheld GPS, measured off site features)

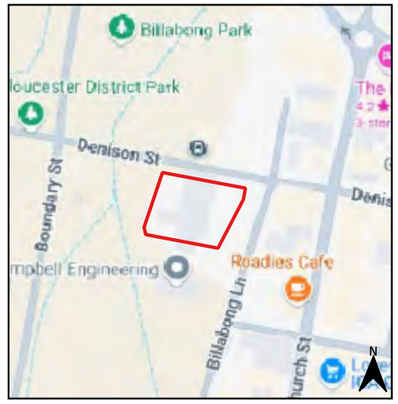
Douglas PARTNERS

CLIENT:	NSW Department of Planning, House and Infrastructure	
OFFICE:	Newcastle	DRAWN BY: JRK
SCALE:	1:500 @A3	DATE: 20 June 2025

TITLE: **Test Location Plan**
Detailed Site Investigation (Contamination)
17 Denison Street, Gloucester, NSW

N

Project:	228674.02
DRAWING No:	1
REVISION:	0



Site Location

Legend

- Inferred Groundwater Flow Direction
- Inferred Groundwater Contour (AHD) - April 2025
- Approximate Borehole Locations (Current Investigation)
- Approximate Surface Water & Sediment Locations (Current Investigation)
- Approximate Drainage Line
- Installed Groundwater Wells (Current and Previous Investigations)
- Approximate Bore Locations (Douglas, 2024)
- Approximate Test Pit Locations (Douglas, 2024)
- Approximate Stockpile A Extent
- Approximate Borehole Location (RGS, 2022)
- Approximate Surface Sample Location (RGS, 2022)
- Approximate UST Locations
- Site Boundary
- Lot Boundary

0 10 20 m

NOTE:
1. Drawing adapted from aerial imagery from Sixmaps dated 05.05.2018
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage (handheld GPS, measured off site features)

Douglas PARTNERS

CLIENT:	NSW Department of Planning, House and Infrastructure		
OFFICE:	Newcastle	DRAWN BY:	JRK
SCALE:	1:500 @A3	DATE:	20 June 2025

TITLE: **Groundwater Contour - 29 April 2025**
Detailed Site Investigation (Contamination)
17 Denison Street, Gloucester, NSW

N

Project:	228674.02
DRAWING No:	2
REVISION:	0

Site Location

Legend

- Approximate Borehole Locations (Current Investigation)
- Observed Hydrocarbon Impacts (Soil and Groundwater)
- Approximate Surface Water & Sediment Locations (Current Investigation)
- Approximate Drainage Line
- Installed Groundwater Wells (Current and Previous Investigations)
- Approximate Bore Locations (Douglas, 2024)
- Approximate Test Pit Locations (Douglas, 2024)
- Approximate Stockpile A Extent
- Approximate Borehole Location (RGS, 2022)
- Approximate Surface Sample Location (RGS, 2022)
- Approximate UST Locations
- Site Boundary
- Lot Boundary

0 10 20 m

NOTE:
1. Drawing adapted from aerial imagery from Sixmaps dated 05.05.2018
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage (handheld GPS, measured off site features)

Douglas PARTNERS

CLIENT:	NSW Department of Planning, House and Infrastructure	
OFFICE:	Newcastle	DRAWN BY: JRK
SCALE:	1:500 @A3	DATE: 20 June 2025

TITLE: **Soil and Sediment Exceedances Above the Adopted Site Assessment Criteria**
Detailed Site Investigation (Contamination)
17 Denison Street, Gloucester, NSW

N

Project:	228674.02
DRAWING No:	3
REVISION:	0

306: Co, Mn, Naphthalene, Ethylbenzene, Xylene, Isopropylbenzene (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

302: As, Mn, Naphthalene, BTEX (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

Amenities Building

Bus Shelter

301: Nitrogen, TON, Phosphorus (ANZECC 2000) PFOS (NEMP Freshwater 95% & 99% DGVs)

305: As, Mn, Ni, Zn, Naphthalene, Benzene, Ethylbenzene, Xylene, Isopropylbenzene (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

102: Cu (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

306 305 304

DENISON STREET

304: Naphthalene (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

SW3: Cr, Cu, Pb, Zn (ANZG Freshwater DGVS) PFOS (NEMP Freshwater 99% DGVs)

SW3 / SED3

301 302 303

27,000L Unleaded UST

102 211 BH2 / MW2 104

303: As, Mn, Naphthalene, BTEX Isopropylbenzene (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

SW2: Cu, Pb, Zn (ANZG Freshwater DGVS) PFOS (NEMP Freshwater 99% DGVs)

SW2 / SED2

?

BH5 113 BH4 BH1 / MW1 105

101: PFOS (NEMP Freshwater 95% & 99%)

101 115 207

12,000L Diesel UST

4,500L Unleaded UST x 2

105: Ni (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

MW2: PFOS (NEMP Freshwater 99%)

208 210

104: PFOS (NEMP Freshwater 95% & 99%)

BH7

201 205 203 SS3

103: Zn (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

202 SS4 103 107 212 111

209

204

BH3 / MW3

MW1: As, Mn, Naphthalene, BTEX, Isopropylbenzene (ANZG Freshwater DGVs) PFOS (NEMP Freshwater 99%)

108 SS1 114

213

110 112

SW1: Cr, Cu, Pb, Zn (ANZG Freshwater DGVS) PFOS (NEMP Freshwater 99% DGVs)

206

BH6

SW1 / SED1

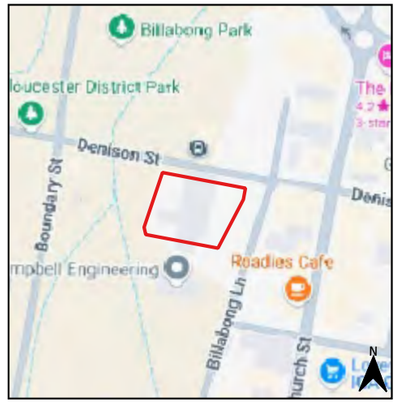
106 BH8

SS5 SS6 SS2

109

106: Zn (ANZg Freshwater DGVs) PFOS (NEMP Freshwater 95% & 99%)

BILLABONG LANE



Site Location

Legend

- Approximate Borehole Locations (Current Investigation)
- Observed Hydrocarbon Impacts (Soil and Groundwater)
- Approximate Surface Water & Sediment Locations (Current Investigation)
- Approximate Drainage Line
- Installed Groundwater Wells (Current and Previous Investigations)
- Approximate Bore Locations (Douglas, 2024)
- Approximate Test Pit Locations (Douglas, 2024)
- Approximate Stockpile A Extent
- Approximate Borehole Location (RGS, 2022)
- Approximate Surface Sample Location (RGS, 2022)
- Approximate UST Locations
- Site Boundary
- Lot Boundary

0 10 20 m

NOTE:
1. Drawing adapted from aerial imagery from Sixmaps dated 05.05.2018
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage (handheld GPS, measured off site features)

Douglas PARTNERS

CLIENT:	NSW Department of Planning, House and Infrastructure	
OFFICE:	Newcastle	DRAWN BY: JRK
SCALE:	1:500 @A3	DATE: 20 June 2025

TITLE: **Groundwater and Surface Water Exceedances Above the Adopted Site Assessment Criteria**
Detailed Site Investigation (Contamination)
17 Denison Street, Gloucester, NSW

Project:	228674.02
DRAWING No:	4
REVISION:	0

Appendix B

About this Report

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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Appendix C

Photoplates (Photos 1 to 12)

Photo 1: Looking south towards the site and UST area (31 March 2025)

Photo 2: Looking north at the amenities building and bus stop north of Denison Street (31 March 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	1
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Photo 3: Looking east along the road shoulder. Directly adjacent existing USTs (31 Mach 2025)

Photo 4: Car parking and bus stop on northern side of Denison Street. Bore 304 in foreground (31 March 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	2
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Photo 5: Former sump located adjacent workshop building at the site (31 March 2025)

Photo 6: Drainage pipe within sump leading towards the creek adjacent the site (31 March 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	3
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Photo 7: Drilling Bore 301 in the road along Denison Street (14 April 2025)

Photo 8: Drilling Bore 305 on northern side of Denison Street (14 April 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	4
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Photo 9: Vegetation observed at sediment/surface water location 3 – looking north west (15 April 2025)

Photo 10: Looking south along the adjacent creek (15 April 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	5
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Photo 11: Looking east towards the approximate area of pipe outlet (31 March 2025)

Photo 12: Waste metal and fill materials observed in area of pipe outlet in embankment (31 March 2025)

Douglas PARTNERS GROUNDED EXPERTISE	**Site Photographs**	PROJECT:	228674.02
	Proposed Visitor Information Centre	PLATE No:	6
	17 Denison Street, Gloucester	REV:	0
	CLIENT: NSW Department of Planning, Housing and Infrastructure	DATE	17/06/2025

Appendix D

Data Quality Objectives

1. Data Quality Objectives

The supplementary assessment 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 1: Data quality objectives

Step	Summary
1: State the problem	The objective of the investigation is to assess potential off-site impacts associated with the former service station at the subject site. The site is to be redeveloped into a visitor information centre. The requirements of the regulator, Mid Coast Council, will also be considered by consulting their Development Control Plan (DCP), Local Environment Plan (LEP) and any other requirements based on our recent experience with Council on similar sites. A conceptual site model (CSM) has been prepared (Section 7) for the proposed development. The project team consisted of experienced environmental engineers and scientists working in the roles of Project Principal, Project Reviewer, Project Manager and field staff.
2: Identify the decisions / goal of the study	The site history has identified possible contaminating previous uses which are identified in the CSM (Section 7). The CSM identifies the associated contaminants of potential concern (CoPC) and the likely impacted media. The site assessment criteria (SAC) for each of the CoPC are detailed in Appendix F. The decision is to establish whether or not the results fall below the SAC. On this basis, an assessment of the site's suitability from a contamination perspective will be derived and a decision made on whether (or not) further assessment and / or remediation will be required.
3: Identify the information inputs	Inputs will be the analytical results for the CoPC (identified in the CSM, Section 7) from NATA accredited laboratories and methods, where possible. The SAC for each of the CoPC are detailed in Appendix E. A photoionisation detector (PID) will be used on-site to screen soils for VOC. PID readings 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, Appendix A. The vertical boundaries are to the extent of contamination impact as determined from the site history assessment and site observations. The assessment is limited to the timeframe over which the field works were undertaken. Constraints to the assessment are identified and discussed in the conclusions of the report, Section 14.

Step	Summary
5: Develop the analytical approach (or decision rule)	The decision rule is to compare all analytical results with the SAC (Appendix F, based on NEPC (2013)). Where guideline values are absent, other sources of guideline values accepted by NEPC (2013) shall be adopted where possible. 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, 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, triplicates and laboratory results, RPD values should generally be below 30%; for field blanks and rinsates, results should be at or less than the limits of reporting (NEPC, 2013). The field and laboratory quality assurance assessment is included in Appendix H.
6: Specify the performance or acceptance criteria	Baseline condition: Contaminants at the site exceed the human health and environmental SAC and pose a potentially unacceptable risk to receptors (null hypothesis). Alternative condition: Contaminants at the site comply with the human health and environmental SAC 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.
7: Optimise the design for obtaining data	As the purpose of the investigation is to assess the contamination status of the site, the sampling program is reliant on professional judgement to identify and sample the potentially affected areas. Further details regarding the sampling plan are in Section 8.

2. Reference

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

Terminology, Symbols and Abbreviations

Soil Descriptions

Sampling, Testing and Excavation Methodology

Borehole Logs (Bores 301 to 306 and SED1 to SED3)

Field Work Methodology

Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style XW. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	KL
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	UK
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	ND
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	NA

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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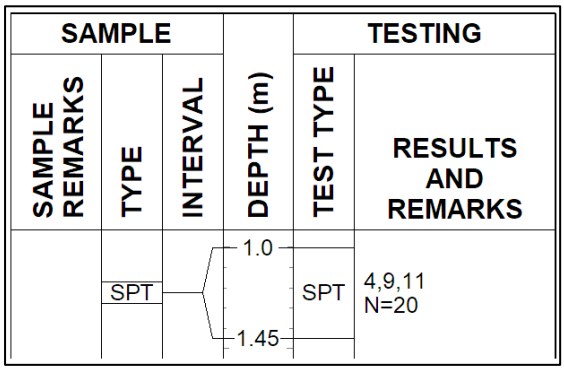
Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150
Dynamic probe super heavy, followed by blow count penetration increment in mm	DPSH/100

Groundwater Observations

	water seepage/inflow
	water seepage/outflow
	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 92.2 AHD
COORDINATE: E:401514.8, N:6458322.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 301
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*)	DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS	BACKFILL	WELL PIPE
	92	0.03	FILL / BITUMINOUS CHIP SEAL: black.							D		0.03	PID	2.2ppm	Concrete	
		0.25	FILL / Clayey Sandy GRAVEL (GP): pale brown; fine to medium, sub-angular to sub-rounded; fine to medium sand; gravels (natural).		FILL	NA		M		D/ES		0.20	PID	3.2ppm	Bentonite	
			CLAY (CL): brown; low plasticity.							D/ES		0.50	PID	3.7ppm		50mm Class 18 PVC Casing
	91	1								D/ES		1.00	PID	1.9ppm		
					ALV	H		w<PL		D/ES		1.50	PID	1.5ppm		
▼ Free groundwater observed 14/04/25	90	2								D/ES		2.00	PID	1.3ppm	Sand - 2 mm	
										D/ES		2.50	PID	2.7ppm		50mm Class 18 Machine-Slotted PVC Screen
		2.70	Clayey GRAVEL (GP): mottled grey brown; fine to medium, sub-angular to sub-rounded; gravels (natural).		ALV	NA		W								
		2.90	CLAY (CL): brown; low plasticity.							D/ES		3.00	PID	2.4ppm		
	89	3	From 3.40m-3.80m: slight hydrocarbon odour		ALV	S to F		w<PL		D/ES		3.50	PID	<1ppm		
		4								D/ES		4.00	PID	<1ppm		
	88		Borehole discontinued at 4.00m depth. Limit of investigation.													

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil Log

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 92.3 AHD
COORDINATE: E:401526.0, N:6458320.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 302
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*)	DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	SAMPLE DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS
		0.03	FILL / BITUMINOUS CHIP SEAL: black.							D		0.01	PID	29.7ppm
			FILL / Clayey GRAVEL (GP) with sand: pale brown; fine to medium, sub-angular to sub-rounded; gravels comprised of crushed natural rock.		FILL	NA		M		ES		0.10	PID	12.3ppm
		0.18	CLAY (CL): mottled grey brown; low plasticity.											
	92				ALV	H		w<PL		D/ES		0.50	PID	20.3ppm
		1								D/ES		1.00	PID	61.5ppm
		1.20	CLAY (CL): brown; low plasticity.											
	91				ALV	VSt		w<PL		D/ES		1.50	PID	109ppm
▼ 14/04/25 Free groundwater observed		1.90	Clayey SAND (SP) with gravel: grey; fine to medium; fine to medium, sub-angular to sub-rounded gravel; gravels (natural); strong hydrocarbon odour.							D/ES		2.00	PID	2047ppm
	90	2	1.90m: slight hydrocarbon odour											
					ALV	WC		W		D/ES		2.50	PID	208.4ppm
		3								D/ES		3.00	PID	289.3ppm
	89													
										D/ES		3.50	PID	25.8ppm
		3.70	Sandy CLAY (CL) trace gravel: brown; fine to medium sand; fine to medium, sub-angular to sub-rounded gravel; gravels (natural); strong hydrocarbon odour.		ALV	St		w<PL						
		4								D/ES		4.00	PID	17.9ppm
	88		Borehole discontinued at 4.00m depth. Limit of investigation.											

BACKFILL: Concrete; Bentonite; Sand - 2 mm
WELL PIPE: 50mm Class 18 PVC Casing; 50mm Class 18 Machine-Slotted PVC Screen

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.
D1/SBK @ 1.0m.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil Log

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 92.1 AHD
COORDINATE: E:401536.9, N:6458318.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 303
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	SAMPLE DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS	BACKFILL	WELL PIPE
	92	0.03	FILL / BITUMINOUS CHIP SEAL: black.												
			FILL / Clayey GRAVEL (GP) with sand: pale brown; fine to medium, sub-angular to sub-rounded; fine to medium sand; gravels comprised of crushed natural rock.		FILL	NA	M		D/ES		0.10	PID	106ppm	Concrete	
		0.25	FILL / Sandy CLAY (CL): brown; low plasticity; fine to medium sand.						D/ES		0.30	PID	72.4ppm	Bentonite	50mm Class 18 PVC Casing
			0.50m: slight odour observed, potentially hydrocarbon?						D		0.80	PID	58.1ppm		
		1			FILL possibly COL	H	w<PL				1				
	91								D/ES		1.50	PID	66.4ppm		
Free groundwater observed 14/04/25			1.70m-3.60m: strong hydrocarbon odour, staining present												
		2							D/ES		2.00	PID	474.2ppm		
	90	2.10	Gravelly CLAY (CL): grey; low plasticity; fine to medium, sub-angular to sub-rounded gravel; (natural).						D/ES		2.50	PID	510.3ppm	Sand - 2 mm	50mm Class 18 Machine-Slotted PVC Screen
		3			COL	ND	w<PL		D/ES		3.00	PID	759.8ppm		
	89								D/ES		3.50	PID	42ppm		
		3.80	CLAY (CL) with gravel trace sand: brown; low plasticity; fine to medium, sub-angular to sub-rounded, (natural) gravel; fine to medium sand.		COL	F	w<PL								
		4							D/ES		4.00	PID	<1ppm		
	88		Borehole discontinued at 4.00m depth. Limit of investigation.												

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Hand auger to 1.0m, push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

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BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 92.2 AHD
COORDINATE: E:401522.8, N:6458333.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 304
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS
	92	0.02	FILL / BITUMINOUS CHIP SEAL: black.						D/ES		0.10	PID	3.4ppm
		0.20	FILL / Clayey GRAVEL (GP) with sand: brown; fine to medium, sub-angular to sub-rounded; gravels comprised of crushed natural rock.		FILL	NA	W						
			CLAY (CL): grey brown; low plasticity.						D/ES		0.50	PID	1.8ppm
		1			possibly ALV	H	w<PL		D/ES		1.00	PID	<1ppm
	91								D/ES		1.50	PID	<1ppm
		1.70	CLAY (CL): brown; low plasticity.										
		2							D/ES		2.00	PID	<1ppm
▼ 14/04/25 Free groundwater observed	90								D/ES		2.50	PID	<1ppm
					ALV	VSt	w<PL						
		3							D/ES		3.00	PID	1.6ppm
	89								D/ES		3.50	PID	17.9ppm
		3.60	Clayey GRAVEL (GP) with sand: grey; fine to medium, sub-angular to sub-rounded; gravels (natural); slight hydrocarbon odour.		ALV	NA	W						
		4							ES		4.00	PID	<1ppm
	88		Borehole discontinued at 4.00m depth. Limit of investigation.										

BACKFILL: Concrete; Bentonite
WELL PIPE: 50mm Class 18 PVC Casing; Sand - 2 mm; 50mm Class 18 Machine-Slotted PVC Screen

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.
D3/SBK @ 4.0m.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 92.1 AHD
COORDINATE: E:401531.9, N:6458332.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 305
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS	BACKFILL	WELL PIPE
	92	0.02	FILL / BITUMINOUS CHIP SEAL: black.												
			FILL / Clayey GRAVEL (GP) with sand: brown; fine to medium, sub-angular to sub-rounded; fine to medium sand; gravels comprised of crushed natural rock.		FILL	NA	M		D/ES		0.25	PID	5.0ppm	Concrete	
		0.35	CLAY (CL): brown; low plasticity.											Bentonite	50mm Class 18 PVC Casing
			From 0.50m: slight hydrocarbon odour						D/ES		0.50	PID	4.5ppm		
	91	1			ALV	H	w<PL		D/ES		1.00	PID	4.1ppm		
									D/ES		1.50	PID	5.2ppm		
▼ Free groundwater observed 14/04/25		1.90													
	90	2	Gravelly CLAY (CL) with sand: mottled grey brown; low plasticity; fine to medium, sub-angular to sub-rounded gravel; fine to medium sand; gravels (natural); slight hydrocarbon odour.		ALV	St to VSt	w<PL		D/ES		2.00	PID	3.1ppm		
		2.50	Clayey GRAVEL (GP) with sand: grey; fine to medium, sub-angular to sub-rounded; fine to medium sand; gravels (natural); slight hydrocarbon odour.		ALV	NA	W		D/ES		2.50	PID	23.5ppm	Sand - 2 mm	50mm Class 18 Machine-Slotted PVC Screen
		3							D/ES		3.00	PID	266.1ppm		
	89	3.10	Sandy CLAY (CL) with gravel: brown; fine to medium sand; fine to medium, sub-angular to sub-rounded gravel; gravels (natural); slight hydrocarbon odour.		ALV	S	w<PL		D/ES		3.50	PID	27.5ppm		
		4							D/ES		4.00	PID	22.9ppm		
	88		Borehole discontinued at 4.00m depth. Limit of investigation.												

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil Log

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL: 91.9 AHD
COORDINATE: E:401542.8, N:6458330.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 306
PROJECT No: 228674.02
DATE: 14/04/25
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING AND REMARKS: TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
		0.03	FILL / BITUMINOUS CHIP SEAL: black.												
			FILL / Clayey GRAVEL (GP) with sand: brown; fine to medium, sub-angular to sub-rounded; fine to medium sand; gravels comprised of crushed natural rock.		FILL	NA	M		ES		0.25	PID	2.0ppm		
		0.40	CLAY (CL): grey; low plasticity.												
			0.50m-3.60m: hydrocarbon odour						D/ES		0.50	PID	2.5ppm		
	91	1							D/ES		1.00	PID	4.9ppm		
					ALV	H	w<PL								
									D/ES		1.50	PID	3.6ppm		
	90	1.90													
		2	Clayey GRAVEL (GP) with sand: grey; fine to medium, sub-angular to sub-rounded; gravels (natural).						D/ES		2.00	PID	51.8ppm		
▼ Free groundwater observed 14/04/25									D/ES		2.50	PID	1200ppm		
	89				ALV	NA	M								
		3							D/ES		3.00	PID	36.2ppm		
									D/ES		3.50	PID	21.4ppm		
		3.60	Gravelly CLAY (CL) with sand: brown; fine to medium, sub-angular to sub-rounded gravel; fine to medium sand; gravels (natural).												
	88				ALV	F	w<PL								
		4							D/ES		4.00	PID	17.0ppm		
			Borehole discontinued at 4.00m depth. Limit of investigation.												
	87														

Concrete; Bentonite; 50mm Class 18 PVC Casing; Sand - 2 mm; 50mm Class 18 Machine-Slotted PVC Screen

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe 7822DT
METHOD: Push tube to 4.0m
REMARKS: Well finished with gatic cover at surface.
D2/SBK @ 0.5m.

OPERATOR: Tuck Environmental

LOGGED: Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil Log

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL:
COORDINATE:
DATUM/GRID:
DIP/AZIMUTH: 90°/---°

LOCATION ID: SED1
PROJECT No: 228674.02
DATE: 15/04/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(^) DENSITY.(^)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
15/04/25 No free groundwater observed		Clayey SILT: brown; abundant organic matter; roots; rootlets.			VS	w<PL		D/ES		0.10	PID	<1ppm
		Borehole discontinued at 0.30m depth. Limit of investigation.										

1
2
3
4

NOTES: (#)Soil origin is "probable" unless otherwise stated. (^)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD:
REMARKS: SW 0.15 above sediment.

OPERATOR: Krebs

LOGGED:
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL:
COORDINATE:
DATUM/GRID:
DIP/AZIMUTH: 90°/---°

LOCATION ID: SED2
PROJECT No: 228674.02
DATE: 15/04/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(^) / DENSITY.(^)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
15/04/25 No free groundwater observed		Clayey SILT: brown; abundant organic matter; roots; rootlets.			S	w<PL		D/ES		0.10	PID	<1ppm
		Borehole discontinued at 0.40m depth. Limit of investigation.										

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NOTES: (#)Soil origin is "probable" unless otherwise stated. (^)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD:
REMARKS: SW 0.2 above sediment.

OPERATOR: Krebs

LOGGED:
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: NSW Department of Planning Housing and Infrastructure
PROJECT: Supplementary Detailed Site Investigation
LOCATION: 17 Denison Street, Gloucester, NSW

SURFACE LEVEL:
COORDINATE:
DATUM/GRID:
DIP/AZIMUTH: 90°/---°

LOCATION ID: SED3
PROJECT No: 228674.02
DATE: 15/04/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(^) DENSITY.(^)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
15/04/25 No free groundwater observed		Clayey SILT: brown; abundant organic matter; roots; rootlets.			VS	w<PL		D/ES		0.10	PID	<1ppm
		Borehole discontinued at 0.30m depth. Limit of investigation.										

1
2
3
4

NOTES: (#)Soil origin is "probable" unless otherwise stated. (^)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD:
REMARKS: SW 0.35 above sediment.

OPERATOR: Krebs

LOGGED:
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

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

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 each 1.5 m length of push tube at the nominated sample depth;
- 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;
- 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; and
- Use chain of custody documentation.

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

2.1 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.

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 of at least 0.5 m thick and then bentonite / compacted drill cuttings to the surface, finished with cast iron road-box.

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.

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 to at least 1 m below the surface or as low as practical, 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. Sediment Sampling

Sediment sampling is carried out with reference to Douglas standard operating procedures. The sampling method is described as follows:

- Collect sediment samples using hand tools at the nominated sample depth;

- Transfer samples in laboratory-prepared glass jars with Teflon lined lids by hand, capping immediately and minimising headspace within the sample jar;
- Transfer samples in laboratory-prepared container (specific for PFAS) by hand, capping immediately and minimising headspace within the sample jar;
- Collect replicate samples in zip-lock bags for PID screening;
- Wear a new disposable nitrile glove for each sample point thereby minimising potential for cross-contamination;
- Collect 10% replicate samples for 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; and
- Use chain of custody documentation.

6. 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.

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 F

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).

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

- Land use: commercial / industrial.
    - Corresponding to land use category 'D', commercial / industrial such as shops, offices, factories and industrial sites.
- Soil type: 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-D
Metals	
Arsenic	3000
Beryllium	500
Boron	300 000
Cadmium	900
Chromium (VI)	3600
Cobalt	4000
Copper	240 000
Lead	1500
Manganese	60 000
Mercury (inorganic)	730
Methyl mercury	180
Nickel	6000
Selenium	10 000
Zinc	400 000
PAH	
B(a)P TEQ	40
Total PAH	4000
OCP	
DDT+DDE+DDD	3600
Aldrin and dieldrin	45
Chlordane	530
Endosulfan	2000
Endrin	100
Heptachlor	50
HCB	80
Methoxychlor	2500
Mirex	100
OPP	
Chlorpyrifos	2000
PCB	
PCB	7
VOC (various analytes)	-

Table 2: Health screening levels (mg/kg)

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 3.

Table 3: Health screening levels for direct contact (mg/kg)

Contaminant	DC HSL-D	DC HSL-IMW
Benzene	430	1100
Toluene	99 000	120 000
Ethylbenzene	27 000	85 000
Xylenes	81 000	130 000
Naphthalene	11 000	29 000
TRH F1	26 000	82 000
TRH F2	20 000	62 000
TRH F3	27 000	85 000
TRH F4	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 4.

Table 4: Health investigation levels (mg/kg)

Contaminant	HIL-D
PFOS and PFHxS *	20
PFOA	50

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

2.3 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 6, with inputs into their derivation shown in Table 5.

Table 5: Inputs to the derivation of the ecological investigation levels

Variable	Input	Rationale
Age of contaminants	"Aged" (>2 years)	Historic use as service station / workshop
pH	8.1	Conservative value based on previous and current site testing.
CEC	11.1 $cmol_c/kg$	Conservative value based on previous and current site testing.
Clay content	10%	Conservative value, site soils observed to be clay.
Traffic volumes	High	Historic site contamination
State / Territory	NSW	Gloucester, NSW

Table 6: Ecological investigation levels (mg/kg)

Contaminant	EIL-D
Metals	
Arsenic	160
Copper	310
Nickel	310
Chromium III	680
Lead	1800
Zinc	800
PAH	
Naphthalene	370
OCP	
DDT	640

Notes:
EIL-D commercial / industrial

2.4 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 7.

Table 7: Ecological screening levels (mg/kg)

Contaminant	Soil type	ESL-D
Benzene	Coarse	75
Toluene	Coarse	135
Ethylbenzene	Coarse	165
Xylenes	Coarse	180
TRH F1	Coarse/ Fine	215*
TRH F2	Coarse/ Fine	170*
TRH F3	Coarse	1700
TRH F4	Coarse	3300
B(a)P	Coarse	1.4
Benzene	Fine	95
Toluene	Fine	135
Ethylbenzene	Fine	185
Xylenes	Fine	95
TRH F1	Coarse/ Fine	215*
TRH F2	Coarse/ Fine	170*
TRH F3	Fine	2500
TRH F4	Fine	6600
B(a)P	Fine	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

2.5 Ecological Soil Guideline Values

The interim ecological soil guideline values (EGV) derived from Table 6 of HEPA (2025) are in Table 8.

Table 8: Ecological soil guideline values (mg/kg) – all land uses

Contaminant	Direct exposure	Indirect exposure
PFOS	1	0.003
PFOA	10	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.

2.6 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 9.

Table 9: Management limits (mg/kg)

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

Table 10: 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 (existing or 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 11.

Table 11: 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 12.

Table 12: 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.
Vanadium	6	Unknown reliability and LOP.
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.

Contaminant	Freshwater DGV 95% LOP	Notes
Phenanthrene	0.6	99% LOP adopted as recommended due to potential for bioaccumulation. Unknown reliability.
Phenols		
Phenol	320	Moderate reliability.
Pentachlorophenol	3.6	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
2,4,6-Trichlorophenol	3	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
OCP		
Aldrin	0.001	Unknown reliability and LOP.
Chlordane	0.03	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
DDT	0.006	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Dieldrin	0.01	Unknown reliability and LOP.
Endosulfan	0.03	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Endrin	0.01	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Heptachlor	0.01	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.
Methoxychlor	0.005	Unknown reliability and LOP.
OPP		
Chlorpyrifos	0.01	Moderate reliability.
Diazinon	0.01	Moderate reliability.
Dimethoate	0.15	Low reliability.
Fenitrothion	0.2	Moderate reliability.
Malathion	0.05	Moderate reliability.
Parathion	0.004	Moderate reliability.
PCB		
Aroclor 1242	0.3	99% LOP adopted as recommended due to potential for bioaccumulation. Low reliability.
Aroclor 1254	0.01	99% LOP adopted as recommended due to potential for bioaccumulation. Moderate reliability.

Contaminant	Freshwater DGV 95% LOP	Notes
VOC		
Tetrachloroethene (PCE)	70	Unknown reliability.
Trichloroethene (TCE)	330	Unknown reliability.
cis-1,2-dichloroethene (DCE)	700	Unknown reliability.
Chloroethene (vinyl chloride / VC)	100	Unknown reliability.
Tetrachloromethane (carbon tetrachloride / CT)	240	Unknown reliability.
Trichloromethane (chloroform / TCM)	370	99% LOP adopted as recommended to protect key species from chronic toxicity. 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 13.

Table 13: 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 14. There are no generic HSL for groundwater within 2 m of the ground (or basement) level.

Table 14: Groundwater health screening levels for vapour intrusion (µg/L)

Contaminant	HSL-D	HSL-D	HSL-D	Solubility limit
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 directly adjacent 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 12.

5. References

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