Information sheet for environmental audits and preliminary risk screen assessments (PRSAs)

Publication 2009 June 2021

Victoria's audit system

An environmental audit system has operated in Victoria since 1989. The *Environment Protection Act 2017* (the Act) provides for the appointment of environmental auditors. It also provides for Environment Protection Authority (EPA or the Authority) to have a system of preliminary risk screen assessments (PRSAs) and environmental audits. These are used in the planning, approval, regulation and management of activities, and in protection of human health and the environment.

Under the Act, the functions of an environmental auditor include to:

- conduct PRSAs and environmental audits
- prepare and issue PRSA statements and reports, and environmental audit statements and reports.

The purpose of a PRSA is to:

- assess the likelihood of the presence of contaminated land
- determine if an environmental audit is required
- recommend a scope for the environmental audit if an environmental audit is required.

The purpose of an environmental audit is to:

- assess the nature and extent of the risk of harm to human health or the environment from contaminated land, waste, pollution, or any activity
- recommend measures to manage the risk of harm to human health or the environment from contaminated land, waste, pollution, or any activity
- make recommendations to manage any contaminated land, waste, pollution or activity.

Upon completion, all PRSAs and environmental audits require preparation of either a PRSA statement, accompanied by a PRSA report, or an environmental audit statement, accompanied by an environmental audit report.

A person may engage an environmental auditor to conduct a PRSA or an environmental audit.

EPA administers the environmental audit system and ensures an acceptable quality of environmental auditing is maintained. This is achieved by assessing auditor applications and conducting a quality assurance program. These measures ensure that PRSAs and environmental audits that environmental auditors undertake are completed in accordance with the relevant sections of the Act or any other Act, and with the guidelines the Authority or other government agencies have published.

Environment Protection Authority Victoria
GPO BOX 4395 Melbourne VIC 3001
1300 372 842 (1300 EPA VIC) **epa.vic.gov.au**

File structures

EPA stores digital statements and reports from PRSAs and environmental audits in three parts:

- Part A, the PRSA or environmental audit report
- Part B, report appendices
- Part C, the PRSA statement and executive summary or environmental audit statement and executive summary.

Report executive summaries, findings and recommendations should be read and relied upon only in the context of the whole document, including any appendices and the PRSA statement or environmental audit statement.

Currency of PRSAs and environmental audits

PRSAs and environmental audits are based on the conditions encountered and information reviewed at the time of preparation. They don't represent any changes that may have occurred since the completion date. As it's not possible for the PRSA or audit report to present all data that could be of interest to all readers, consideration should be made to any appendices or referenced documentation for further information.

When information about the site changes from what was available at the time the PRSA or environmental audit was completed, or where an administrative error is identified, an environmental auditor may amend or withdraw PRSA or environmental audit statements and/or reports. Users are advised to check EPA's website to ensure documents' currency.

PDF searchability and printing

EPA can only provide PRSAs and environmental audit statements, reports and appendices that the environmental auditor provided to EPA via the EPA portal on the EPA website.

All statements and reports should be in a Portable Document Format (PDF) and searchable; however at times some appendices may be provided as image-only PDFs, which can affect searchability.

The PDF is compatible with Adobe Acrobat Reader, which is downloadable free from Adobe's Website (www.adobe.com).

Further information

For more information on Victoria's environmental audit system, visit EPA's website or contact EPA's Environmental Audit Unit.

Web: www.epa.vic.gov.au

Email: environmental.audit@epa.vic.gov.au

EPA VICTORIA

Preliminary risk screen assessment statement

Under Part 8.3 of the *Environment Protection Act 2017*

Publication F1031 published September 2021

This statement is a summary of the findings of a preliminary risk screen assessment conducted under Part 8.3 of the *Environment Protection Act 2017* for:

354 Hawthorn Road, Caulfield South, VIC

Further details are provided in the preliminary risk screen assessment report that accompanies this statement.

Section 1: Preliminary risk screen assessment overview

Environmental auditor details

Name:	Philip Mulvey
Company:	Environmental Earth Sciences VIC
Address:	98 Maribyrnong St Footscray
Phone:	9687 1666
Email:	pmulvey@eesigroup.com

Site owner/occupant

Name:	348-354 Hawthorn Road Pty Ltd
Company:	348-354 Hawthorn Road Pty Ltd

Environmental auditor engaged by

Name:	Elliot Verblun
Company:	Platinum Constructions (VIC) Pty Ltd
Relationship to site owner:	Builder

Reason for preliminary risk screen assessment

Planning scheme:	Glen Eira – Environmental audit overlay
Other:	

Section 2: Assessment scope

Site details

Address:	354 Hawthorn Road, Caulfield South, VIC
Title details:	Lots 8 and 9 TP700734M
Area (hectares):	0.05

☒ a plan of the site is attached

Use or proposed use assessed

☐ Sensitive use (including land used for residential use, a child care centre, pre-school, or primary school) or secondary school or children's playground
- ☒ high density
- ☐ other (lower density)

☐ Recreation/open space
☐ Parks and reserves
☐ Agricultural
☒ Commercial
☐ Industrial
☐ Other

Environmental elements assessed

☐ Ambient air
- ☐ all environmental values were considered **OR**
- ☐ all environmental values other than the following were considered:

☐ Ambient sound
- ☐ all environmental values were considered **OR**
- ☐ all environmental values other than the following were considered:

☒ Land
- ☐ all environmental values that apply to the land use category were considered **OR**
- ☒ all environmental values that apply to the land use category, other than the following, were considered:

Land dependent ecosystems and species; Aesthetics; Production of food, flora and fibre

☒ Water
- ☐ Surface water
  - ☐ all environmental values that apply to the applicable segment were considered **OR**
  - ☐ all environmental values that apply to the applicable segment, other than the following, were considered:
- ☒ Groundwater
  - ☐ all environmental values that apply to the applicable segment were considered **OR**
  - ☒ all environmental values that apply to the applicable segment, other than the following, were considered:

Potable mineral water supply, Potable water supply, Agriculture and irrigation (irrigation), Agriculture and irrigation (stock watering), Geothermal properties and Industrial and commercial water use

Preliminary risk screen assessment statement

Standards considered

Environment Reference Standard 2021
National Environment Protection (Assessment of Site Contamination) Measure 1999
National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013
National Health and Medical Research Council (NHMRC)/ Natural Resource Management Ministerial Council (NRMMC)(2011). Australian drinking water guidelines. National Water Quality Management Strategy.
NHMRC & NRMMC (2008). Guidelines for managing risks in recreational water. Australian Government, February 2008.

Assumptions made during the assessment or any limitations

The proposed development is to include removal of all fill material to construct a basement at the site.

Exclusions from the assessment and the rationale for these

N/A

This statement is accompanied by the following preliminary risk screen assessment report

Title:	Preliminary Risk Screen Assessment at 354 Hawthorn Rd, Caulfield South.
Report no:	221080_PRSA_V2
Date:	11/11/2021

Section 3: Assessment outcome

Based on my assessment, I am of the opinion that an environmental audit is **not required** for the following land uses, **including** the use or proposed use for which the site has been assessed:

(Tick as appropriate and strike out those uses not assessed and for which the need for an audit has not been determined)

- ☒ Sensitive use (including land used for residential use, a child care centre, pre-school, or primary school) or secondary school or children's playground
  - ☒ high density
  - ☐ other (lower density)
- ☐ Recreation/open space
- ☐ Parks and reserves
- ☐ Agricultural
- ☒ Commercial
- ☐ Industrial
- ☐ Other

Section 4: Environmental auditor's declaration

I state that:

- I am appointed as an environmental auditor by the Environment Protection Authority Victoria under the *Environment Protection Act 2017*.
- The findings contained in this statement represents a true and accurate summary of the findings of the preliminary risk screen assessment that I have completed.

Date: 11/11/2021

Signed:

Name: Philip James Mulvey

Environmental Auditor

EPA VICTORIA

TITLE PLAN		EDITION 2	TP 700734M

Location of Land

Parish: AT CAULFIELD PARISH OF PRAHRAN EAST OF ELSTERNWICK
Township:
Section:
Crown Allotment:
Crown Portion: 46(PT)

Last Plan Reference: LP13058
Derived From: VOL 5772 FOL 303
Depth Limitation: NIL

Notations

ANY REFERENCE TO MAP IN THE TEXT MEANS THE DIAGRAM SHOWN ON THIS TITLE PLAN

Description of Land / Easement Information

All that piece of Land delineated and coloured
Lots 1 to 9 (both inclusive) and part of a road on LP13058 and being
red, blue and green on the map in the margin being part of Crown Portion Forty-six--
at Caulfield Parish of Prahran East of Elsternwick County of Bourke - Together--
with a right of carriage way over the road colored brown on the said map and -------
Together with a right of drainage over the same - - - - - - - - - - - - - - - - - - -

THIS PLAN HAS BEEN PREPARED FOR THE LAND REGISTRY, LAND VICTORIA, FOR TITLE DIAGRAM PURPOSES AS PART OF THE LAND TITLES AUTOMATION PROJECT
COMPILED: 19/03/2004
VERIFIED: CL

ENCUMBRANCES REFERRED TO.

As to the land colored blue ---
ANY EASEMENTS affecting the same -------
As to the land colored green ---
ANY EASEMENTS implied under Section 212-
of Act No.3791- - - - - - - - - - - - - - -

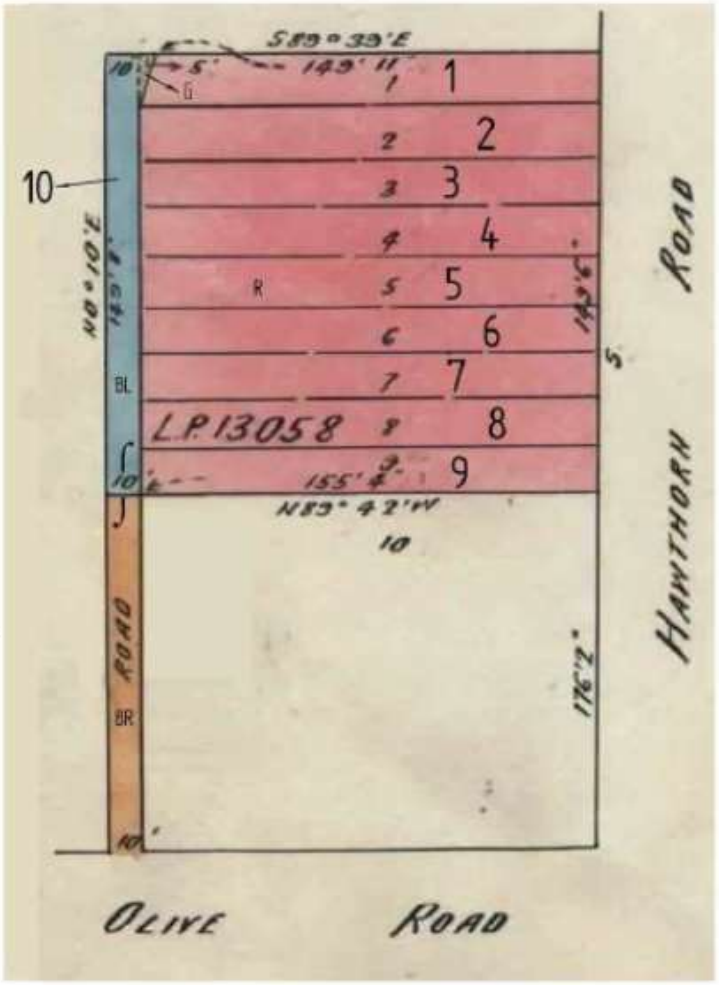
As to the land coloured blue .....
carriageway easement in favour of C/T V.6686 F.129
created vide AE734170Y

SEE SHEET 2 FOR DIAGRAM

TABLE OF PARCEL IDENTIFIERS
WARNING: Where multiple parcels are referred to or shown on this Title Plan this does not imply separately disposable parcels under Section 8A of the Sale of Land Act 1962
PARCEL 1 = LOT 1 ON LP13058
PARCEL 2 = LOT 2 ON LP13058
PARCEL 3 = LOT 3 ON LP13058
PARCEL 4 = LOT 4 ON LP13058
PARCEL 5 = LOT 5 ON LP13058
PARCEL 6 = LOT 6 ON LP13058
PARCEL 7 = LOT 7 ON LP13058
PARCEL 8 = LOT 8 ON LP13058
PARCEL 9 = LOT 9 ON LP13058
PARCEL 10 = ROAD (PT) ON LP13058

TITLE PLAN		TP 700734M

COLOUR CODE
R = RED BL = BLUE BR = BROWN G = GREEN



LENGTHS ARE IN FEET & INCHES	Metres × 0.3048 = Feet Metres × 0.201168 = Links		Sheet 2 of 2 sheets

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

PRELIMINARY RISK SCREEN ASSESSMENT AT 354 HAWTHORN RD, CAULFIELD SOUTH

PLATINUM CONSTRUCTIONS (VIC) PTY LTD

11 NOVEMBER 2021
221080
VERSION 2

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

11 November 2021

Platinum Constructions (Vic) Pty Ltd
105A Carpenter St
Brighton VIC 3186

Attention: **Elliot Verblun**
Director

Dear Elliot

Preliminary Risk Screen Assessment at 354 Hawthorn Rd, Caulfield South.

Please find enclosed a copy of our report titled as above. Thank you for the opportunity to undertake this work.

Should you have any queries, please do not hesitate to contact us on (03) 96871666.

For and on behalf of
Environmental Earth Sciences VIC

Author
Phil Mulvey
Auditor

221080_PRSA_V2

EXECUTIVE SUMMARY

Table 1: Summary of PRSA information

Item	Details
Auditor	Philip Mulvey
Auditor account number	EXT001092
Name of person requesting audit or PRSA	Elliot Verblun of Platinum Constructions (Vic) Pty Ltd
Relationship of person requesting audit or PRSA to site	Builder
Name of site owner	348-354 Hawthorn Road Pty Ltd
Date of auditor engagement	15 September 2021
Completion date of the audit or PRSA	11 November 2021
Reason for audit or PRSA	Redevelopment to more sensitive use and the presence of an audit overlay across a portion of the site
Elements of the environment assessed	Soil and groundwater
Planning permit number or requirement detail if applicable	n/a
EPA Region	Southern Metropolitan Region
Municipality	Glen Eira
Dominant — Lot on plan	Lot 8 TP700734M
Additional — Lot on plan(s)	Lot 9 TP700734M
Site/premises name	-
Street/Lot — Lower No.	354
Street/Lot — Upper No	354
Street Name	Hawthorn
Street type (For example, road, court)	Road
Street suffix (For example, North, South)	
Suburb	Caulfield South
Postcode	3162
Site area (in square metres)	Approx. 0.05 ha
Plan of site/premises/location showing the audit site boundary attached	Figure 1
Members and categories of support team utilised	Patrick Carroll – Environmental consultant – Environmental Earth Sciences Matthew Feehan – Environmental consultant – Environmental Earth Sciences
Further work or requirements	Waste classification for offsite disposal of soil.
Nature and extent of continuing risk of harm	-
Outcome of the PRSA report	No audit required

Table 2: Physical site information

Historical land use	Car Park for adjoining cinema and bowling alley
Current land use	Vacant
Proposed land use	Commercial and high density residential
Current land use zoning	Commercial 1 Zone
Proposed land use zoning	Commercial 1 Zone
Surrounding land use – north	Commercial properties and Caulfield south shopping precinct along Glen Huntly Rd.
Surrounding land use – south	Commercial premises including a clinic, auto service centre and a dry cleaner (corner of Olive St and Hawthorn Rd).
Surrounding land use – east	Bound by Hawthorn Rd. Former Service station (371 Hawthorn Rd) and tyre service centre (365 Hawthorn Road). Various Commercial and residential properties.
Surrounding land use – west	Unnamed laneway. Residential and commercial properties. Caulfield Primary School.
Has EPA been notified about the site under Section 40 of the Environment Protection Act 2017?	No
Nearest surface water receptor – name	Port Philip Bay
Nearest surface water receptor – direction	South west
Site aquifer formation	Sandringham Sandstone (formerly Brighton Group)
Groundwater segment	Segment A1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

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Appendices

1 INTRODUCTION

Platinum Constructions Pty Ltd, on behalf of the site owner, engaged Philip Mulvey of Environmental Earth Sciences to undertake a preliminary risk screen assessment (PRSA) of part of a property located at 354 Hawthorn Rd, Caulfield South ('the site').

The planning permit issued for the site does not include requirement for any environmental assessment works. However, a portion of the site has an environmental audit overlay (EAO) which requires, under the Victorian Planning Provisions (VPP) Clause 45.03, that either a PRSA or Environmental Audit of the site be completed before a sensitive use, or buildings and construction associated with a sensitive use commences.

The regional locational and site layout are shown in **Figure 1**, and the proposed development plans provided in **Appendix A**.

2 OBJECTIVES

The objective of the PRSA is to

- Assess the potential for contamination to be present at the site;
- Conclude whether an Audit of the site will be required to determine that the land is suitable for the proposed residential use; and
- If an Audit is considered by the Auditor to be required, an outline scope for Audit will be provided.

3 SCOPE OF WORK

The scope of work undertaken comprised the following:

- A desktop review of site history and environmental setting.
- A site inspection.
- Collection of one soil sample by hand auger from surface fill soils, with analysis for a selected suite of contaminants listed in Table 2 of EPA Publication 1828.2.
- Sampling of accessible groundwater bores using low flow sampling methods, with collection and analysis of samples (and quality control samples including split duplicate, field and rinsate blank) for a suite of contaminants including metals, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), volatile organic compounds (VOC) and major ions.

- Development of a conceptual site model (CSM) and assessment of the likelihood of the land being contaminated land and, if so, the need for an environmental audit considering the environmental values that apply to the site (taking into account the use or proposed use).
- Preparation of a PRSA report summarising the details and findings of the investigation and basis for conclusions as to whether or not an Audit is required.
- Preparation of a PRSA Statement in accordance with Section 206 of the Act including, if one is recommended, a scope for the Audit.

4 PHYSICAL SITE INFORMATION

4.1 Site location and identification

The site is located at 354 Hawthorn Rd, Caulfield South. The site is currently occupied by part of the car park of the now shut indoor bowling centre and picture theatre. The site identification details are summarised in **Table 3 below** and the site locality and layout are presented in **Figure 1** (in the Figures Appendix)

Table 3: Site Identification

Item	Details
Site Address	354 Hawthorn Rd, Caulfield South
Site Owner	348-354 Hawthorn Road Pty Ltd
Lot & Plan number	Lots 8 and 9 TP700734M
Area	Approx. 0.05 ha
Current Zoning	Commercial 1 Zone
Planning Overlays	Parking Overlay Environmental Audit Overlay – Lots 8 and 9
Current land use	Carpark
Local Government Authority	Glen Eira
Site locality and layout	See **Figure 1**

4.1.1 Surrounding land uses

The surrounding land uses to the site are presented below in Table 4.

Table 4: Surrounding land uses

Direction	Description
East	Bound by Hawthorn Rd. Former Service station (371 Hawthorn Rd) and tyre service centre (365 Hawthorn Road). Various commercial and residential properties.
West	Unnamed laneway. Residential and commercial properties. Caulfield Primary School.
North	Commercial properties and Caulfield south shopping precinct along Glen Huntly Rd.
South	Commercial premises including a clinic, auto service centre and a dry cleaner (corner of Olive St and Hawthorn Rd).

4.1.2 Sensitive receptors

The nearest sensitive receptors to the site include the following:

Table 5: Surrounding land uses

Receptor	Onsite	Offsite
Human	Site users (present and future) including residents, workers, and maintenance workers	Surrounding site users (present and future) including residents, pedestrians, workers, and maintenance workers.
Ecological	Flora and fauna with access to site soil	Flora and fauna at the location of groundwater discharge. The location of groundwater discharge is considered likely to be to be Port Philip Bay approximately 2km south west of site.

4.1.3 Proposed site use

The site currently has approved developments for the construction of a mixed-use commercial/residential development.

- The proposed development is to be seven floors in total with a three level basement.
- The proposed development is to have no access to soil.
- The ground floor is to be a retail trading premises with the remainder of floors residential.

Development plans are presented in Appendix A.

4.2 Regional geology

A review of Melbourne 1: 63,600 geological map (Geological Survey of Victoria, 1974) indicates the surface geology at the site is Tertiary aged Sandringham Sandstone (formerly Brighton Group / Red Bluff Sandstone) and Quaternary inland dune deposits aged. Surface geology is inferred to overlie Upper Silurian Melbourne Formation sandstone and siltstone.

The Sandringham Sandstone sediments are characterised as pale yellow and brown, fine to coarse grained, massive to well bedded, crossed and has localised ironstone layering.

Inland dune deposits are described as Sand, silt, clay: friable to consolidated; well sorted; inclusive of both lunette deposits and deposits of longitudinal dunes.

The Melbourne Formation comprises sandstone, siltstone, and minor shaley siltstone thinly and regularly bedded.

The surface geology noted from sample collection in the historical report (Alliance EPM 2019) was recorded as slightly clayey sand from 2.2 – 7.5 m below ground level (bgl) and is consistent with Sandringham Sandstone sediments.

4.3 Soil and acid sulfate soils

A review of Australian Soil Resource Information System (ASRIS) indicates the soils at the site are classified as Podosols which are described as plains of leached sands and other soils in association with sandy acidic yellow mottled soils.

A review of the Atlas of Australian Acid Sulfate Soils Map indicates there is an extremely low probability for acid sulfate soils to occur at the site.

4.4 Topography and hydrology

The approximate surface elevation of the site is 30 – 32 mAHD (DELWP 2021). The site is observed to be predominantly flat and surface drainage is likely to be dominated by surface water drainage infrastructure and localised falls.

4.5 Hydrogeology

Groundwater was encountered at approximately 6.0 – 6.2 m bgl (as confirmed by Alliance 2019). The water bearing aquifer at the site is inferred to be Sandringham Sandstone sediments based on the stratigraphic information provided in Alliance (2019). The standing water level at the time of sampling was 4.07 – 4.88 m bgl (14 August 2019)

Groundwater flow direction is inferred to be south westerly, in the direction of Port Phillip Bay. Groundwater flow direction has not been confirmed by onsite investigations as the installed groundwater bore network (GW1 and GW2) is less than the minimum required to determine flow direction (three bores).

Groundwater salinity from data presented in Alliance (2019) is 500 – 550 mg/L.

4.6 Registered groundwater bores

A search of registered groundwater users was undertaken. 157 bores were identified within a 2 km radius of the site. Below is summary of surrounding groundwater uses and aquifer details:

- One bore is registered for domestic and stock purposes 71 m to the east of the site. The bore was drilled to a depth of 60 m bgl, however, is noted as being screened from 14 to 20 m bgl.

- The second closest registered bore for extractive purposes (domestic) is listed as being approx. 700 m from the site to the north east. The screened depth is not noted however, the total depth is listed as 67 m bgl.

- A total of 46 bores are currently registered for domestic, stock or irrigation and listed as active. Total bore depths of active bores ranges from 15 to 100 m bgl.
- The remainder of registered bores are listed as investigation/observation (43), disposal/observation (1), commercial (1) and not known (53).

4.7 Groundwater dependent ecosystems

A review of the Department of Environment, Land, Water and Planning (DELWP) Groundwater dependent ecosystems (GDE) atlas map (2021) suggests the site in not situated within an area identified as being reliant upon the surface expression of groundwater (terrestrial GDE).

5 HISTORICAL REVIEW

The site historical review included a review of the following documents and information sources:

- Previous investigations - Alliance EPM (2019);
- Historical aerial imagery dating from 1931 – 2009;
- Royal Historical society of Victoria (RHSV);
- Sands and McDougall directories;
- EPA completed audits;
- EPA priority register;
- EPA Groundwater Quality Restricted Use Zones Map;
- EPA Victoria List of former landfill sites;
- Cathodic protections systems register

5.1 Previous investigations – Alliance EPM (2019)

Alliance EPM were engaged by Platinum construction to undertake a preliminary site investigation (PSI). The PSI includes the following components:

- Site history summary (Sands and McDougall, aerial imagery, historical databases);
- An intrusive soil and groundwater sampling program including:
    - Advancement of four soil bores;
    - Installation of two groundwater monitoring bores; and

- Completion of one groundwater monitoring event.

5.1.1 Soil investigation

Four soil investigation bores were advanced across the carpark area of the site, a summary is as follows:

- Fill material was observed ranging approximately 0.1 to 0.4 m in thickness. Fill material was described as grey brown sandy gravel, gravelly sand and silty sand with trace brick fragments and metal. No indicators of contamination such as odour or staining were noted.
- Natural soil material was described as grey – orange silty sand – silty clay until 2.2 m bgl and as slightly clayey sand from 2.2 to 7.5 m bgl.
- Laboratory analysis was undertaken on the collected soil samples and returned elevated levels (greater than EPA Victoria IWRG 621 Fill Material Upper Limits) of nickel, lead, copper, tin, benzo(a)pyrene and polycyclic aromatic hydrocarbons (PAHS) in the fill material. Publication IWRG621 has been replaced by Publication 1828.2, however the Fill Material Upper Limits have remained the same.
- Soil sample analytical results were not compared with investigation levels or other relevant guidance relative to site land use settings. However, follow up review of results by Environmental Earth Sciences has determined that the concentrations reported did not exceed Health Investigation/Screening Levels (HIL/HSL) or Ecological Investigation/screening levels (EIL/ESLs) for land use setting B (high density residential) as provided in the *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended (NEPC, 2013) (“NEPM”). One sample did exceed HIL A (low density residential) for lead.
- No elevated contaminant concentrations were reported for samples collected within natural site soil.

5.1.2 Groundwater investigation

Two groundwater bores were installed in the carpark area of the site. Details of the installation are as follows:

- Groundwater was noted as being encountered between 6.0 to 6.2 m bgl within fine grained clayey sand during drilling.
- Groundwater bores were screened from 3.0 to 7.5 m bgl.
- Groundwater bores were not developed prior to sampling.
- Groundwater was sampled using low flow (micropurge techniques).
- Groundwater was observed to be moderately acidic (5.16 to 5.55) and light brown/orange in colour with high turbidity.

- Standing water levels were 4.07 to 4.88 m below top of casing (m bTOC) at bores GW1 and GW2 respectively on 14 August 2019.
- Laboratory analysis was undertaken on the collected groundwater samples and returned the following results:
    - Inorganic analytes (sodium, chloride, TKN and sulfate) exceeded the adopted values for specified water quality objectives.
    - Dissolved metals (nickel and zinc) exceeded the adopted values for maintenance of ecosystems and drinking water (nickel only).
    - No detections of volatile or petroleum sourced contaminants were identified.
    - Exceedances of adopted criteria were attributed to the occurrence of regional groundwater conditions and not of concern.

5.1.3 Recommendations and conclusions

The report concluded the following:

- There is low potential for the past uses on the site to have adversely impacted/ contaminated the site.
- The is no evidence to suggest that the site will be subject to an EPA determined CUTEP or require active groundwater remediation.
- There is no evidence that groundwater beneath the site is significantly contaminated with hydrocarbons or volatile organics which would require an engineered vapour mitigation system.

A copy of the Alliance EPM (2019) report is presented in Appendix B.

5.2 Royal Historical Society of Victoria

The Royal Historical Society of Victoria (RHSV) were contracted by Alliance EPM to summarise historical information relevant to the site using predominantly Sands and McDougall archives. RHSV state that:

- The surrounding area was utilised for agricultural purposes between the 1850s and the 1920s.
- The site was historical utilised for cement/masonry work prior to 1936.
- The site was developed into a picture theatre in 1936 and later converted into the present day indoor bowling alley in 1964. The site was formerly the carpark of the picture theatre.
- Two business operated from the front of the theatre, a confectioner, and a bicycle shop.
- Surrounding land uses included a timber merchant at 368 Hawthorn Rd, South Caulfield Garage at 370 Hawthorn Rd and a motor body works at 372 – 376 Hawthorn Rd.

Environmental Earth Sciences undertook an independent review of the Sands and McDougall archives and noted:

- The presence of the Larch service station at 371 Caulfield Rd is confirmed in multiple directories.

The RHSV search is presented in Appendix B (an appendix of the Alliance EPM (2019) report).

5.3 Aerial photographs

Presented below in Table 6 is a review of available historical aerial imagery.

The aerial photographs reviewed are presented in Appendix B (an appendix of the Alliance EPM (2019) report).

Table 6: Aerial photograph summary

Year	Onsite	Offsite
1931	No buildings appear to be present onsite and ground coverage appears consistent.	Development on the periphery of the site appears to consist predominantly of single block dwellings or small commercial buildings. Immediately south of the site is a block which comprises of one large central building.
1945	The site appears in the present day configuration with the picture theatre building present in the north of the site and a parking area to the south. Variation in surface cover of the carpark is apparent suggesting an unsealed surface.	As above
1951	As per 1945	As above
1956	As per 1945	The site on the eastern side of Hawthorn road (371 Hawthorn Rd) appears to be occupied by a shed in the south eastern corner and concrete surfacing elsewhere. This is likely associated with the operation of the service station.
1963	As per 1945	As above
1968	As per 1945	A large commercial sized building is present over the western adjacent boundary.
1978	As per 1945	As per 1968
1981	As per 1945	As per 1968
1984	As per 1945	As per 1968
1987	As per 1945	As per 1968
2002	As per 1945	Excavation appears to be occurring on the service station site on the eastern side of Hawthorn Rd.
2009	As per 1945	The service station site appears vacant with limited infrastructure present.

5.4 EPA Victoria records

5.4.1 Completed audit reports

A search of completed EPA audits within 500m identified the below listed sites in Table 7 below

Table 7: Nearby completed audit reports

CARMS	Address	Distance and direction	Date completed	Former land use	Soil	Groundwater
71760-1	365 Hawthorn Road	60m north east	3/06/2013	Residential and commercial (non manufacturing)	Lead, zinc, TRH, B(a)P, sulphur, OCP	**Contaminants** - Not found to be contaminated **Aquifer** -Brighton group aquifer **Depth to groundwater** - 3.7m bgl **Flow direction** - west to south west **Groundwater segment -** A2 (100 – 2,300 mg/L TDS)
73668-1	383 Hawthorn Road	100m south	8/09/2016	Soap manufacture, photographic printer clothing manufacturer, residential and other retail uses	Heavy metals (copper, lead, zinc), PAHs	N/A
62457-1	818-840 Glen Huntly Rd, Caulfield South	170 north east	20/11/2018	Service station	TRH, BTEX, PAHs, Heavy metals (copper, manganese, nickel, and zinc)	**Contaminants** - Hydrocarbons (TRH, BTEX, MTBE), sulphate, ammonia, and total nitrogen in groundwater on and offsite. **Aquifer** - Brighton group aquifer **Depth to groundwater** - 1 – 3 m bgl **Flow direction** – south easterly **Groundwater segment –** B (591 – 3,470 mg/L TDS)
41563-1	719-721 Glenhuntly Rd	190 m north west	29/05/2000	Commercial including printing, brush manufacturer, other retail uses.	Zinc, PAHs	N/A

CARMS	Address	Distance and direction	Date completed	Former land use	Soil	Groundwater
31702-1	848-854 Glen Huntly Rd	240m east	30/06/1997	Commercial including sewing machine repair, wholesale clothing, film supplies, car sales and other retail uses	Arsenic, PAHs	N/A
75574-1	670-672 Glen Huntly Rd, Caulfield South	350m north west	13/10/2018	Audit report not available on EPA Victoria website	Audit report not available on EPA Victoria website	Audit report not available on EPA Victoria website
52709-1	874 Glen Huntly Rd	400m east	8/12/2003	Commercial including school requisitions manufacturer, furniture manufacturer and other retail uses	Heavy metals (arsenic, zinc), TRH, PAHs	**Contaminants** - Not found to be contaminated **Aquifer** - Brighton group aquifer **Depth to groundwater** - 2 m bgl **Flow direction** – south west (inferred) **Groundwater segment** – (A2 – 492 - 570 TDS)
70704-1	876 Glen Huntly Rd	420m east	27/02/2013	Residential and commercial (nursery)	Heavy metals (Barium, vanadium, zinc), PAHs sulphur	**Contaminants -** Heavy metals (Al, Cu, Zn), nitrate, sodium **Aquifer** - Brighton group aquifer **Depth to groundwater** - 3.6 – 5.2 m bgl **Flow direction** – west to north west **Groundwater segment** –B (1,300 – 1,900 mg/L TDS)

The audit for the 371 Hawthorn Rd Caulfield South is not currently available for viewing on the EPA Victoria website, however, as development has commenced it is assumed that remediation and the audit have been completed.

5.4.2 EPA priority site register

A search of completed EPA priority site register (dated 31 July 2021) identified one site within 500m of the site (approximately 150m north east):

- 818 Glen Huntly Rd, Caulfield South - Former Service Station. Requires ongoing management – Notice no. 90009502

The former service station located at 371 Hawthorn Rd (east of the site) was previously listed on the EPA Victoria priority site register as a former service station requiring clean up.

5.4.3 Former landfill register

A search of the EPA Victoria landfill register did not identify any former or current landfill within 1km of the site.

5.4.4 Groundwater restricted use zones (GQRUZ)

One GQRUZ was identified within 1km of the site, the details are presented below in Table 8.

Table 8: GQRUZ details

CARMs No	EPA ID	Site history	Address	Distance and direction	Restricted use
62457-1	7001796	Service station/fuel storage	818 - 840 Glen Huntly Rd Caulfield South VIC 3162	120m east	Drinking water, Livestock water supply. Irrigation of crops (including domestic gardens) and parks, Water used for recreational purposes (e.g., swimming)

5.4.5 Cathodic protections systems

A search of the cathodic protection systems database dated 15 May 2017 (provided within the Appendix B) did not identify the presence of a cathodic protection system at the site.

5.5 Site history summary

Based on the historical documents reviewed, the site history is as understood to be as follows:

- The surrounding area was utilised for agricultural purposes between the 1850s and the 1920s.
- The site was historical utilised for cement/masonry work prior to 1936.
- The site was developed into a carpark for a picture theatre in 1936 which was later converted into the indoor bowling alley in 1964 which remained until recently being demolished. Two business operated from the front of the theatre, a confectioner, and a bicycle shop.

- Surrounding land uses included a timber merchant at 368 Hawthorn Rd, South Caulfield Garage at 370 Hawthorn Rd and a motor body works at 372 – 376 Hawthorn Rd (RHSV).
- A service station operated at 371 Hawthorn Rd from the 1950s and was formerly present on the EPA priority sites register as a former service station requiring clean up. The site was remediated from 2019 to present. The audit for the site was not available at the time of writing, however, development has commenced on the site.

6 CONCEPTUAL SITE MODEL DEVELOPMENT

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play at the site, the contaminant source, potential receptors, and the pathways to the receptors. The development of a CSM is an iterative process, constantly being updated during the investigation process as more information becomes available.

6.1 Source to receptor pathway analysis

6.1.1 Sources

Sources of potential contamination are considered to be limited to the following:

- Imported fill material containing waste material; and
- Offsite sourced groundwater contamination from the historical service station.

The imported fill material will be removed from the site during the construction proposed development and thus eliminating any risk associated with the presence of imported fill material.

The occurrence of offsite groundwater contamination at 371 Hawthorn Rd, Caulfield South is considered likely.

6.1.2 Pathways

The potential pathways between the sources and receptors include:

- Soil: direct contact, inhalation, and ingestion (soil) during excavation of the carpark; and
- Groundwater: extraction and ingestion; and inhalation of volatile contamination.

Following the likely removal of fill material, pathways associated with soil material are unable to be realised.

The potential for groundwater contamination to migrate from 371 Hawthorn Rd is to be considered, however, the inferred is groundwater direction is towards the southwest, placing the site up gradient of 371 Hawthorn Rd and as such, contamination from the service station is not expected.

6.1.3 Receptors

The potential human receptors include the future users of the site (resident, workers, and visitors) and workers and visitors at the surroundings sites from consumption of groundwater and inhalation of vapours. The potential environmental receptors include flora and fauna at the point of groundwater discharge (taken to be Port Philip Bay)

6.1.4 Contaminants of potential concern

Based on the site history and sampling undertaken to date, contaminants of potential concern (soil) are considered to be associated with the presence of imported fill material at the site which will be removed. Contaminants commonly present within pre-1950's fill material and as previously identified (Alliance EPM 2019) include:

- Heavy metals;
- Polycyclic aromatic hydrocarbons (PAHs); and

In addition to soil contaminants, groundwater contamination arising from the offsite operation of a service station include:

- Benzene, toluene, ethylbenzene, xylene, and naphthalene (BTEXN); and
- Hydrocarbons (TPH/TRH).

7 FIELD PROGRAM

7.1 Site inspections

A site inspection was conducted on the 22 September by the Auditor. Photographs were taken and are presented in **Appendix C**. The following observations were made during the site inspection:

The site was flat sloping slightly upwards from Hawthorn Road entrance. Demolition of the Cinema was occurring on the adjoining lots at the time of the inspection. The site was fully covered by bitumen with building rubble, cars, and an excavator on the site. There was no exposed soil and no evidence of polluting structures or evidence of USTs.

7.2 Soil investigation

7.2.1 Rationale for sampling locations

One targeted soil sample was taken from the audit overlay area to compare with the outcomes of the previous investigation (Alliance EPM 2019).

The borehole location is shown in **Figure 2**.

7.2.2 Soil sampling methodology

One soil borehole was advanced using a hand auger to a depth of 0.6 m bgl.

Soil profiles were logged by a suitably qualified environmental scientist, with information including soil classification, moisture, texture, pH (Raupach method), visual/ olfactory indicators of contamination and water ingress.

The soil samples were collected from the upper fill material layer. The samples were collected and retrieved using a clean spatula. All samples were placed in laboratory prepared containers, labelled with the location number, depth of discrete sample collection, site reference and date before being placed into a chilled container. The container was dispatched to the laboratory on the same day of sampling with a chain of custody form.

Geological bore logs are included in **Appendix D**.

7.2.3 Soil sampling observations

Fill material was encountered until the depth of termination predominantly consisting of black/brown clay with minor sand and gravels.

No odour or staining was observed at any bore location. Nor was any potential asbestos containing material (ACM) observed during the soil assessment.

7.3 Groundwater Investigation

One of the groundwater monitoring bores previously installed by Alliance EPM in 2019 (GW1) was gauged and sampled as part of the groundwater investigation on 20 September 2021. Due to demolition activities, GW2 was not accessible.

7.3.1 Groundwater gauging and sampling methodology

The bore was gauged using an interface meter for the presence of non-aqueous phase liquids (NAPL) prior to sampling.

Sampling was conducted using low flow micro-purge bladder pump with static water level (SWL), field parameters, and aquifer recovery rate recorded.

Groundwater field parameters were recorded during purging using a water quality meter (field sheets and calibration certificates provided in **Appendix E**) and allowed to stabilise prior to sampling. Groundwater samples were collected in the appropriate laboratory prepared containers. All samples were placed in a dark cooler, on ice, prior to being dispatched to the laboratories under full chain of custody documentation.

7.3.2 Groundwater field chemistry and observations

Groundwater field chemistry and observations from the groundwater monitoring event (GME) are presented in **Table 8** below. Groundwater field records are provided in **Appendix E**.

The following groundwater field observations were noted:

- Purged water was observed to be opaque brown in appearance (moderate turbidity).
- No odours or NAPL were observed during the GME
- The groundwater recharge rate was low.

Table 9: Field water quality parameters

Bore	SWL mbTOC	Temp °C*	pH	EC* µs/cm	ORP* mV	DO* ppm
GW1	3.977	14.2	5.28	566.6	303.6	2.72

* Temp – temperature; EC - Electrical conductivity; ORP - oxidation reduction potential; DO - dissolved oxygen

Static water level, pH and electrical conductivity are consistent with the previous investigation, though the groundwater collected appears to be slightly less brackish.

8 LABORATORY ANALYSIS

Samples were analysed by ALS Environmental (ALS) and Eurofins. Both laboratories are accredited with the National Association of Testing Authorities (NATA) for the methods used. Inter- and intra-laboratory duplicates, rinsate and trip blanks were analysed as part of our Quality Assurance and Quality Control (QA/QC) procedures.

8.1 Soil

Analysis was undertaken for the following chemicals which are listed EPA Publication 1828.2 - Table 2 (a broad ranging contaminant suite):

- Metals (arsenic, beryllium, boron, cadmium, chromium (hexavalent), copper, lead, mercury, molybdenum, nickel, selenium, silver, tin, zinc, barium, and antimony)
- Petroleum hydrocarbons (TRH/TPH),
- Mono and polycyclic aromatic hydrocarbons (MAHs, PAH)
- Volatile organic compounds (VOCs)
- Pesticides, Polychlorinated biphenyls (PCBs) and
- Other miscellaneous chemicals.

8.2 Groundwater

Analysis was undertaken for the following chemicals: Dissolved metals, Nutrients, Major ions and cations, VOCs, and TRH/TPH.

Laboratory transcripts are provided in **Appendix F**.

8.3 Procedures for quality control and quality assurance

Quality control (QC) is achieved by using NATA registered laboratories using ASTM standard methods supported by internal duplicates, the checking of high, abnormal, or otherwise anomalous results against background and other chemical results for the sample concerned.

Quality assurance (QA) is achieved by confirming that field results, or anticipated results based upon comparison with field observations, are consistent with laboratory results. Also, that sampling methods are uniform, and that decontamination of sampling equipment is thorough. In addition to their internal QA/QC, the laboratory undertakes additional duplicate analysis as part of their internal quality assurance program on the basis of one duplicate analysis for every 20 samples analysed.

Field observations were compared with laboratory results when they are not as expected. Confirmation, re-sampling and re-analysis of a sample are undertaken if the results are not consistent with field observations and/or measurements. In addition, field duplicate sample results have to be within the acceptable range of reproducibility. A discussion of the quality of internal laboratory results and field duplicate relative percentage difference (RPD) calculations are presented in Appendix G.

Laboratory QA/QC calculations are presented in Table G1 – G2 (QA/QC appendix).

The overall assessment of the data quality is as follows:

- No analysis holding time breaches were present;
- Elevated RPDs between primary and secondary examples exist, however, are considered acceptable as per the stated data quality objectives (MDQIS, Appendix G);
- Field observations and measurements were generally comparable to laboratory data;
- Internal laboratory quality data is considered acceptable;
- The use of field instruments was acceptable;
- Concentrations of toluene and TRH C6 – C10 were identified in the rinsate water however are not considered to represent either poor decontamination procedure (as no toluene was identified during sampling) or the potential for cross contamination (as only one well was sampled). As such, the collected rinsate was not considered to compromise analytical results.
- The dataset as a whole is considered reliable.

9 ENVIRONMENTAL QUALITY OBJECTIVES AND CRITERIA

The Victorian Government has prepared an *Environmental Reference Standard* (ERS) in accordance with Clause 93 of the *Environment Protection Act* 2017. The ERS provides the framework for the assessment and reporting on environmental conditions in Victoria. It sets out the environmental values (EVs) of the ambient air, ambient sound, land, and water environments that are sought to be achieved or maintained in Victoria and standards to support those values.

Standards for the environmental values are comprised of objectives for supporting different uses of the environment and indicators that can be measured to determine whether those objectives are being met. The ERS is not a compliance standard, but the indicators and objectives provide a basis for assessment and reporting on environmental conditions in Victoria and the ERS is required to be considered by Auditors when carrying out their functions under the Act, including conducting Audits.

The PRSA process requires that the levels of contamination reported be assessed in the context of the future land use. The applicable sections of the environment which need to be considered, such as soil, groundwater, surface water and air, are discussed in more detail below.

9.1 Land environmental values

Part 4 of the ERS sets out EVs applicable to various land use categories. These are summarised in **Table 10**.

Table 10: Land Environmental Values

Environmental Values		Land use						
		Parks and reserves	Agricultural	Sensitive use		Recreation/ open space	Commercial	Industrial
				High Density	Other (lower density)			
Land dependant ecosystems and species	Natural ecosystems	✓						
	Modified ecosystems	✓	✓		✓	✓		
	Highly modified ecosystems	✓	✓	✓	✓	✓	✓	✓
Human Health		✓	✓	✓	✓	✓	✓	✓
Building and structures		✓	✓	✓	✓	✓	✓	✓
Aesthetics		✓		✓	✓	✓	✓	
Production of food, flora, and fibre		✓	✓		✓			

The site is proposed for high density residential and commercial use, for which EVs are:

- Highly modified ecosystems
- Human Health
- Buildings and Structures
- Aesthetics.

The land EVs considered to be applicable to the site are defined by the proposed use, mixed commercial and residential. In considering the approved development (Appendix A) it is noted that:

- Removal of imported fill material is required to facilitate development at the site (enabling the construction of basement structures). As such, the contamination status of the fill material is not considered relevant to the future usage of the site.
- The proposed development is to have no access to soil and as such the EV land dependent ecosystems and species is not considered to be relevant to natural underlying soil at the site (at depth, following basement construction).
- The proposed development is to have no access to soil and as such the EV Aesthetics is not considered to be relevant.
- The Human health EV is considered relevant to the site with regards to underlying natural soil material. Fill material will be removed prior to development during the excavation of the carpark.
- The Buildings and structures EV is considered to be relevant to the site given that development will occur at the site in the future.

9.2 Soil assessment criteria

The environmental quality indicators and objectives applicable to the assessment of the relevant EVs for the proposed land uses are detailed in **Table 11**.

Table 11: Indicators and objectives for relevant land environmental values

Beneficial use	Indicators	Objectives
Human health	Contaminants specified in Appendix A of Schedule B2 of the NEPM or other contaminants, as identified from current or historical site use.	Health investigation or screening levels (HIL/HSL) specified in the NEPM or other such levels (where no guidelines are available) or where more appropriate, levels derived in accordance with risk based methodologies specific in the NEPM or background levels established in accordance with the Act.

Beneficial use	Indicators	Objectives
Buildings and structures	pH; sulfate; ORP; salinity; other substance or waste that may have a detrimental impact on the structural integrity of buildings and other structures.	Contamination must not cause the land to be corrosive to or adversely affect the integrity of structures or building materials.

The following section discusses the specific assessment criteria adopted for the protection of relevant land EVs at site.

9.2.1 Human health

Schedule B(1) of the NEPM provides a range of investigation levels for the protection of human health, referred to as health investigation levels (HILs), and provides health screening levels (HSLs) for BTEXN and petroleum hydrocarbons. HILs and HSLs are provided for four generic land use settings:

- HIL A: residential with garden / accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children's day care centres, preschools and primary schools;
- HIL B: residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats;
- HIL C: public open space such as parks, playgrounds, playing fields (e.g., ovals), secondary schools and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves) which should be subject to a site-specific assessment where appropriate; and
- HIL D: commercial/ industrial such as shops, offices, factories, and industrial sites.

The adopted HIL level for the site is HIL B (high density residential) based on the most sensitive use undertaken as per the provided development plans for the site.

9.2.2 Buildings and structures

The ERS states that the contamination must not cause the land to be corrosive to or adversely affect the integrity of structures or building materials. The relevant indicators include pH, sulfate, redox potential, salinity or any chemical substance or waste that may have detrimental impact on the structural integrity of buildings and other structures.

Objectives for these key indicators have primarily been sourced from AS 2159 (2009), *Piling Design and Installation*, in which levels of pH, chloride and sulfate which are considered to represent mild and/or non-aggressive conditions for concrete or steel piles are specified. The values adopted for initial screening (<5,000 mg/kg sulfate, pH >5 and <5,000 mg/kg chloride) are the most conservative of those reported in AS 2159 for concrete and steel piles and are considered to be associated with mild or non-aggressive conditions only where all objectives are met.

9.2.3 Considerations

For a contaminant in soil to be considered acceptable for the respective land-use, the data set should conform to the following requirements, as outlined in the NEPM:

- The 95% upper confidence limit (UCL) of the arithmetic mean of analytical results is below the site criteria;
- The arithmetic (or geometric in cases where the data is log normally distributed) mean is below the site criteria;
- The standard deviation is less than 50% of the site criteria; and
- No single sample analytical result is greater than 250% of the site criteria.

9.3 Groundwater Environmental Values

Part 5, Division 2 of the ERS sets out the EVs for groundwater for various Groundwater Segments, which are based on water quality represented by measured total dissolved solids (TDS) concentrations. TDS ranges defining each segment are summarised in Table 12.

Table 12: Groundwater segments

Segment	A1	A2	B	C	D	E	F
TDS range (mg/L)	0–600	601– 1,200	1,201– 3,100	3,101– 5,400	5,401– 7,100	7,101– 10,000	>10,001

According to site specific laboratory TDS values, groundwater is classified as **Segment A1.** Applicable environmental values for this Segment as specified in the ERS are:

- Water Dependent ecosystems and species
- Potable mineral water supply;
- Potable water supply;
- Agriculture and irrigation (irrigation);
- Agricultural and irrigation (Stock watering);
- Industrial and commercial water use;
- Water-based recreation (primary contact recreation);
- Traditional Owner cultural values;
- Cultural and spiritual values;
- Buildings and structures; and
- Geothermal properties

9.3.1 Relevance of beneficial uses

The following beneficial uses are not considered to be relevant to the site:

- Potable mineral water supply;
- Potable water supply;
- Agriculture and irrigation (irrigation);
- Agricultural and irrigation (stock watering);
- Industrial and commercial water use.
- Geothermal properties.

The beneficial uses listed above are not considered to be relevant due to the following:

- The site is not within a recognised mineral water supply area.
- Groundwater yield from the upper tertiary aquifer being unsuitable for supply for large scale extractive purposes. Though no formal slug testing has been undertaken to determine aquifer hydraulic conductivity, drawdown of groundwater potentiometric head was noted during the extraction of groundwater at the site during low flow sampling (loss of head during the extraction of 4L over 16 minutes) suggesting low recharge rates.
- The availability of reticulated water supply in the area suggests that groundwater is unlikely to be utilised for commercial/industrial, potable water supply, irrigation, or stock watering. Land zoning on site and surrounding (commercial, general residential) also indicates that water would not be extracted for a number of these purposes (agriculture and irrigation, and industrial use are not applicable under zoning).
- The temperature of the water collected precludes the groundwater from the being used for its geothermal properties.

9.4 Groundwater assessment criteria

The environmental quality indicators and objectives applicable to the assessment of the relevant EVs for the identified groundwater segment are detailed in Table 13.

Table 13: Indicators and objectives for relevant groundwater environmental values

Environmental Values	Indicators	Objectives
Water Dependent ecosystems and species	For groundwater that discharges to surface water, the indicators are the indicators applicable to the relevant surface water as specified in Division 3 of Part 5 of the ERS	The level that ensures the groundwater does not affect receiving waters to the extent that the level of any indicator in the receiving waters is exceeded for the relevant surface water division. Port Philip Bay is identified as the likely surface water division and is a *slightly to moderately modified* system. Where the ERS does not specify indicator levels, the levels provided in ANZG (2018) for 95% species protection (marine) have been applied.
Water-based recreation (primary contact recreation)	E. Coli Chemical Hazards and aesthetics	1o E. Coli100 mL where human faecal contamination sources not present. Those specified in NHMRC/ NRMMC (2008) including adjusting criteria for non-volatile chemicals to account for lower exposure rates (100-200 mL/day for recreation compared to 2 L/day for drinking).
Traditional Owner cultural values	Not specified in the ERS for groundwater	Criteria adopted for protection of WDE have also been applied as a preliminary assessment of this EV.
Cultural and spiritual values	Not specified in the ERS for groundwater	Criteria adopted for protection of WDE have also been applied as a preliminary assessment of this EV.
Buildings and structures	pH, sulphate, chloride, redox potential, salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures	Groundwater that is not corrosive to or otherwise adversely affecting structures or building.

10 DISCUSSION OF CHEMICAL RESULTS

The analytical results for soil and groundwater have been summarised and presented in the Tables section of this report and the chain of custody documentation and complete laboratory transcripts are provided in **Appendix F**.

10.1 Soil

No exceedances of adopted site criteria (HIL/HSL B) were identified within the soil sample collected (BH01_0.4).

Elevated levels of specific analytes (greater than natural background concentrations for the Tertiary sediments) were identified including the following:

- Zinc (126 mg/kg);
- Lead (52 mg/kg)
- Benzo(a)pyrene (2.6 mg/kg) and total PAH (13.4 mg/kg in total); and
- TRH >C16-C34 Fraction and TPH C10 - C36 (Sum of total) (170 mg/kg and 100 mg/kg respectively).

The collected data is consistent with the historical data collected for the site (Alliance EPM 2019) and is consistent with the presence of imported fill material.

Reported concentrations in the fill material (inclusive of Alliance EPM 2019 data) are not considered to present a potential risk to future site receptors under a high density residential site use scenario or pose a potential secondary contamination risk (through vertical leaching) to underlying natural soil.

Though the site soils are not considered to present a risk to future site or offsite users under the proposed site use (high density residential/commercial), the presence of imported fill material containing elevated metals (lead greater than HIL A), PAHs and general waste (brick and glass) may be considered to present potential risks to site receptors under more sensitive land use scenarios, constituting the land to be defined as 'contaminated land' in accordance with Section 35 of the *Environment Protection Act* 2017. However, to excavate a three level underground carpark, all fill will be excavated and disposed offsite.

Soil conditions do not indicate that an Environmental Audit in accordance with Section 208 of the *Environment Protection Act* 2017 should be undertaken to further assess risk to site receptors as the site is considered to be of low risk under a commercial/residential mixed use land use scenario. However, prior to development of the site, soil material to be excavated should be assessed as per relevant EPA Victoria guidance (IWRG 702 and 1828.2).

10.2 Groundwater

Exceedances of adopted site criteria were identified in the groundwater samples collected at location GW1 and are presented in Table 14 below.

Table 14: Groundwater adopted criteria exceedances

Analyte	Criteria	Result
Aluminium	Ecosystem (marine) = 0.0005 mg/L	0.02 mg/L
Zinc	Ecosystem (marine) = 0.015 mg/L	0.057 mg/L (SPLIT01)
Copper	Ecosystem (marine) = 0.0013 mg/L	0.003 mg/L

- Exceedances of adopted ecosystem criteria (dissolved metals) are consistent with previously reported results (Alliance EPM 2019) and are considered to be indicative of diffuse regional concentrations or attributable to increased metallic dissolution due to acidic groundwater conditions (pH = 5.26).

- Elevated dissolved aluminium is considered likely to be resultant from sediment solids being present within the laboratory sample prior to acidification. Aluminium is sparingly soluble within pH range 5 – 8, the presence of dissolved aluminium within the collected sample (pH = 5.26) is not considered representative of site conditions. Suspended solid breakthrough during field filtration is one potential cause of the reported concentrations.

- TRH >C16 - C34 Fraction was reported at concentrations less than the adopted site criteria (600 µg/L). The presence of TRH is potentially linked with historical contamination from surrounding sites, oil from stormwater ingress or is indicative of diffuse regional concentrations.

Reported chemical concentrations in the groundwater (inclusive of Alliance EPM 2019 data) and historical data suggests that:

- The potential risk to future onsite receptors is low as no volatile contamination has been identified.

- The site is not considered to be a source site of groundwater contamination (dissolved metals).

- The presence of elevated dissolved metals (above adopted water dependent ecosystem values) indicates that groundwater is impacted, however, is likely to be the result of regional, diffuse heavy metal contamination or is naturally occurring within the Sandringham Sandstone formation.

- The occurrence of dissolved metal concentrations does not preclude onsite environmental values of land and are relevant at the point of groundwater discharge (offsite).

On the basis of the above, an Environmental Audit in accordance with Section 208 of the *Environment Protection Act* 2017 is not considered to be required to further assess the potential of groundwater contamination at the site.

11 CONCLUSION AND OUTCOME

The historical investigation, soil sampling and groundwater sampling undertaken to date at the site suggests the following:

- There is a low risk to future onsite or offsite receptors as a result of the site's soil and groundwater condition.

- Potential groundwater impact at the site (dissolved metals) and TRH >C_{16} - C_{34} below criteria is not considered to be site sourced and will not impact on the environmental values of land at the site (human health).

- Elevated contaminant concentrations associated with imported fill material are not considered to present a risk to site users under a high density residential/commercial

land use scenario and will be removed during the excavation of a three level basement at the site.

- The presence of elevated contaminant concentrations in both the soil and groundwater constitute the land being defined as 'contaminated land', however, do not suggest that an Environmental Audit in accordance with Section 208 of the *Environment Protection Act* 2017 is required to determine suitability for the proposed high density residential/commercial land use.

11.1 PRSA outcome

One the basis of the information presented within this report, the outcome of the PRSA is Outcome 2 as per EPA (2021b):

- Likely that contaminated land is present, but no environmental audit is required.

12 LIMITATIONS

This report has been prepared by Environmental Earth Sciences VIC ACN 109 404 024 in response to and subject to the following limitations:

1. The specific instructions received from Platinum Constructions (VIC) Pty Ltd;
2. The specific scope of works set out in PO221178V1 issued by Environmental Earth Sciences VIC for and on behalf of Platinum Constructions (VIC) Pty Ltd, is included in Section 3 (Scope of Work) of this report;
3. May not be relied upon by any third party not named in this report (with the exception of regulatory authorities) for any purpose except with the prior written consent of Environmental Earth Sciences VIC (which consent may or may not be given at the discretion of Environmental Earth Sciences VIC);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at 348 – 354 Hawthorn Rd, Caulfield South, VIC ("the site");
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;
8. Fill, soil, groundwater, and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site;

9. This report is not a geotechnical report; and

10. Our General Limitations set out at the back of the body of this report.

13 REFERENCES

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ENVIRONMENTAL EARTH SCIENCES
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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences VIC. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
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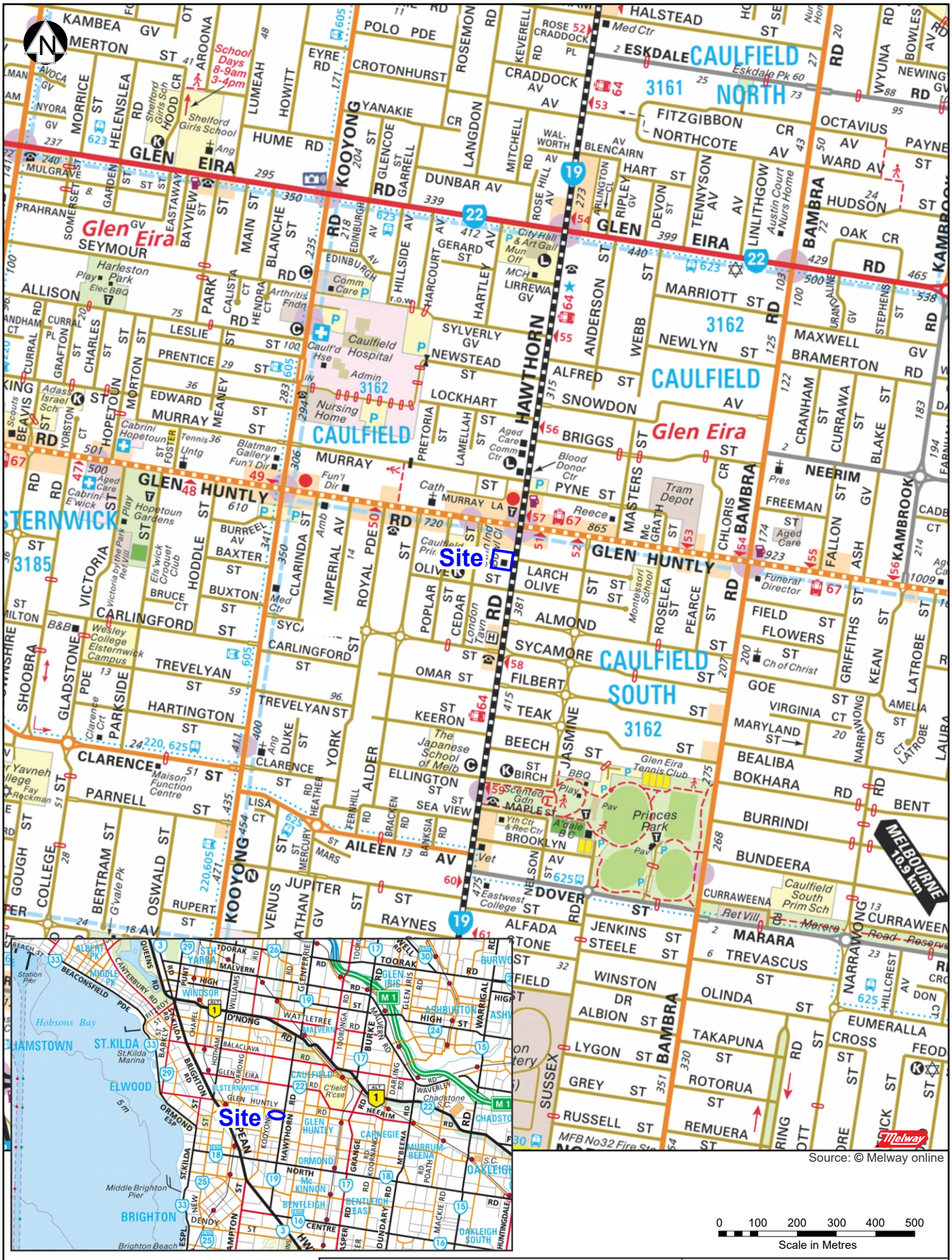
FIGURES



ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Title:	**Regional Locality and Location Map**		
Location:	**348-354 Hawthorn Rd, Caulfield South, VIC**		
Client:	**Platinum Constructions (VIC) Pty Ltd**	Job No:	**221080**
PM:	**PC**	Scale:	**As Shown**
Drawn:	**LB**	Date:	**September 2021**
			Figure 1

Source: © Nearmap

LEGEND:

- Site boundary
- Groundwater Well (GW) and Soil Bore (BH) (Alliance EPM 2019)
- Soil Bore (BH) (Alliance EPM 2019)
- Soil sample (EES 2021)
- Audit overlay
- Property boundary

0 5 10 15 20 25
Scale in Metres

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Title:	Site Features and Sample Locations
Location:	348-354 Hawthorn Rd, Caulfield South, VIC
Client:	Platinum Constructions (VIC) Pty Ltd
Job No:	221080
PM:	PC
Scale:	As Shown
Drawn:	LB
Date:	September 2021
Figure	2

TABLES

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 15 - Soil results

Chemical Group	Chemical Name	Units	LOR	NEPM 2013 Table 1A(1) HILs Res B Soil	NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour	BH01_0.4
					0-1m	20/09/2021
	3/4-Methylphenol (m/p-cresol)	mg/kg	1			<1
	Formaldehyde	mg/kg	2			<2
Halogenated Ali Compounds	1,1,2-trichloroethane	mg/kg	0.04			<0.04
	Dichloromethane	mg/kg	0.4			<0.4
	Tetrachloroethene	mg/kg	0.02			<0.02
	1,2-dichloroethane	mg/kg	0.02			<0.02
	Carbon tetrachloride	mg/kg	0.01			<0.01
	Hexachlorobutadiene	mg/kg	0.02			<0.02
	1,1-dichloroethene	mg/kg	0.01			<0.01
	1,1,1-trichloroethane	mg/kg	0.01			<0.01
	1,1,2,2-tetrachloroethane	mg/kg	0.02			<0.02
	cis-1,2-dichloroethene	mg/kg	0.01			<0.01
	trans-1,2-dichloroethene	mg/kg	0.02			<0.02
	1,1,1,2-tetrachloroethane	mg/kg	0.01			<0.01
	Vinyl chloride	mg/kg	0.02			<0.02
	Trichloroethene	mg/kg	0.02			<0.02
Halogenated Aromatic Compounds	1,2,3-trichlorobenzene	mg/kg	0.01			<0.01
	Chlorobenzene	mg/kg	0.02			<0.02
	1,4-dichlorobenzene	mg/kg	0.02			<0.02
	1,2,4-trichlorobenzene	mg/kg	0.01			<0.01
	1,2-dichlorobenzene	mg/kg	0.02			<0.02
OCP	Other organochlorine pesticides EPAVic	mg/kg	0.03			<0.06
Oxygenated Compounds	Methyl Ethyl Ketone	mg/kg	1			<1
Phenolic Compounds	4,6-Dinitro-2-methylphenol	mg/kg	5			<5
	4-nitrophenol	mg/kg	5			<5
	2,4-dichlorophenol	mg/kg	0.03			<0.06
	Phenols (non-halogenated) EPAVic	mg/kg	1			<1
	Phenol	mg/kg	1	45000		<1
	2-nitrophenol	mg/kg	1			<1
	2,4-dinitrophenol	mg/kg	5			<5
	2-methylphenol	mg/kg	1			<1
	2,4-dimethylphenol	mg/kg	1			<1
	2,4,5-trichlorophenol	mg/kg	0.05			<0.06
	Dinoseb	mg/kg	5			<5
	2-chlorophenol	mg/kg	0.03			<0.06
	4,6-Dinitro-o-cyclohexyl phenol	mg/kg	5			<5
	2,4,6-trichlorophenol	mg/kg	0.05			<0.06
TPH (NEPM, 1999)	TPH C6-C9 Fraciton	mg/kg	10			<10
	TPH C10 - C14 Fraction	mg/kg	50			<50
	TPH C15-C28 Fraction	mg/kg	100			100
	TPH C29-C36 Fraction	mg/kg	100			<100
	TPH C10 - C36 (Sum of total)	mg/kg	50			100
TRH (NEPM, 2013)	TRH C6-C10 Fraction	mg/kg	10			<10
	TRH C6-C10 less BTEX (F1)	mg/kg	10		45	<10
	TRH >C10-C16 Fraction	mg/kg	50			<50
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	50		110	<50
	TRH >C16-C34 Fraction	mg/kg	100			170
	TRH >C34-C40 Fraction	mg/kg	100			<100
	TRH C10 - C40 (Sum of total)	mg/kg	50			170
Trihalomethanes	Chloroform	mg/kg	0.02			<0.02
BTEX	Benzene	mg/kg	0.2		0.5	<0.2
	Ethylbenzene	mg/kg	0.5		55	<0.5
	Toluene	mg/kg	0.5		160	<0.5
	Xylene (m & p)	mg/kg	0.5			<0.5
	Xylene (o)	mg/kg	0.5			<0.5
	Xylene Total	mg/kg	0.5		40	<0.5
	Naphthalene	mg/kg	0.5		3	<0.5
Chlorinated Hydrocarbons	Chlorinated hydrocarbons EPAVic	mg/kg	0.01			<0.01
Explosives	2,4-Dinitrotoluene	mg/kg	1			<1
	Nitrobenzene	mg/kg	0.5			<0.5
Halogenated Benzenes	Trichlorobenzene (total)	mg/kg	0.01			<0.01
	1,3,5-Trichlorobenzene	mg/kg	0.01			<0.01
Herbicides	Hedonal	mg/kg	0.001	1600		<0.001
Inorganics	Cyanide (amenable)	mg/kg	1			<1
	Fluoride	mg/kg	40			40
	Moisture	%	0.1			8.3
	pH (CaCl2)	pH Unit	0.1			7.5
	Cyanide Total	mg/kg	1			<1
MAH	Monocylic aromatic hydrocarbons EPAVic	mg/kg	0.2			<0.2
	Styrene	mg/kg	0.5			<0.5
Metals	Arsenic	mg/kg	5	500		11
	Beryllium	mg/kg	1	90		<1
	Boron	mg/kg	50	40000		<50
	Cadmium	mg/kg	1	150		<1
	Chromium (hexavalent)	mg/kg	0.5	500		<0.5
	Copper	mg/kg	5	30000		14
	Lead	mg/kg	5	1200		52
	Mercury	mg/kg	0.1	120		<0.1
	Molybdenum	mg/kg	2			<2
	Nickel	mg/kg	2	1200		11
	Selenium	mg/kg	5	1400		<5
	Silver	mg/kg	2			<2

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 14 - Soil results

Chemical Group	Chemical Name	Units	LOR	NEPM 2013 Table 1A(1) HILs Res B Soil	NEPM 2013 Table 1A(3) Res A/B Soil HSL for Vapour	BH01_0.4
					0-1m	20/09/2021
	Tin	mg/kg	5			9
	Zinc	mg/kg	5	60000		126
	Barium	mg/kg	10			40
	Antimony	mg/kg	5			<5
Organo Metals	Tributyltin oxide (TBTO)	mg/kg	0.01			<0.01
Organochlorine Pesticides	4,4-DDE	mg/kg	0.05			<0.06
	a-BHC	mg/kg	0.03			<0.06
	Aldrin	mg/kg	0.03			<0.06
	Aldrin + Dieldrin	mg/kg	0.03	10		<0.06
	b-BHC	mg/kg	0.03			<0.06
	chlordane	mg/kg	0.03	90		<0.06
	Chlordane (cis)	mg/kg	0.03			<0.06
	Chlordane (trans)	mg/kg	0.03			<0.06
	d-BHC	mg/kg	0.03			<0.06
	DDD	mg/kg	0.05			<0.06
	DDT	mg/kg	0.05			<0.06
	DDT+DDE+DDD	mg/kg	0.05	600		<0.06
	Dieldrin	mg/kg	0.03			<0.06
	Endosulfan I	mg/kg	0.03			<0.06
	Endosulfan II	mg/kg	0.03			<0.06
	Endosulfan sulphate	mg/kg	0.03			<0.06
	Endrin	mg/kg	0.03	20		<0.06
	Endrin aldehyde	mg/kg	0.03			<0.06
	g-BHC (Lindane)	mg/kg	0.03			<0.06
	Heptachlor	mg/kg	0.03	10		<0.06
	Heptachlor epoxide	mg/kg	0.03			<0.06
	Methoxychlor	mg/kg	0.03	500		<0.06
	Hexachlorobenzene	mg/kg	0.03	15		<0.06
PAH	Acenaphthylene	mg/kg	0.5			<0.5
	Acenaphthene	mg/kg	0.5			<0.5
	Fluorene	mg/kg	0.5			<0.5
	Anthracene	mg/kg	0.5			<0.5
	Phenanthrene	mg/kg	0.5			<0.5
	Fluoranthene	mg/kg	0.5			1.1
	Benz(a)anthracene	mg/kg	0.5			0.8
	Pyrene	mg/kg	0.5			1.3
	Chrysene	mg/kg	0.5			0.9
	Benzo(b+j+k)fluoranthene	mg/kg	1			3.4
	Benzo(a) pyrene	mg/kg	0.5			2.6
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5			1.5
	Dibenz(a,h)anthracene	mg/kg	0.5			<0.5
	Benzo(g,h,i)perylene	mg/kg	0.5			1.8
	Benzo(a)pyrene TEQ calc (Zero)	mg/kg	0.5			3.2
	Benzo(a)pyrene TEQ calc (Half)	mg/kg	0.5			3.4
	Benzo(a)pyrene TEQ (LOR)	mg/kg	0.5		4	3.7
	Cresol Total	mg/kg	1	4700		<1
	Polycylic aromatic hydrocarbons EPAVic	mg/kg	0.5		400	13.4
Phthalates	Bis(2-ethylhexyl) phthalate	mg/kg	0.5			<0.5
Polychlorinated Biphenyls	PCBs (Sum of total)	mg/kg	0.1	1		<0.2

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 16 - Groundwater results

				Water dependent ecosystems and species (marine)	Water-based recreation	GW1	DUP01	SPLIT01
Chem Group	**Chemical Name**	**Units**	**LOR**			20/09/2021	20/09/2021	20/09/2021
Halogenated Aliphatic Compounds	cis-1,4-Dichloro-2-butene	mg/L	0.005			<0.005	<0.005	-
	Pentachloroethane	mg/L	0.005			<0.005	<0.005	-
	1,1,2-trichloroethane	mg/L	0.001	1.9		<0.005	<0.005	<0.001
	Dichloromethane	mg/L		20	0.004	-	-	<0.001
	Tetrachloroethene	mg/L	0.001	0.07	0.05	<0.005	<0.005	<0.001
	1,3-dichloropropane	mg/L	0.001	1.1	0.73	<0.005	<0.005	<0.001
	Dichlorodifluoromethane	mg/L	0.001		0.2	<0.05	<0.05	<0.001
	1,2-dichloroethane	mg/L	0.001	0.005|1.9	0.003|0.005	<0.005	<0.005	<0.001
	Dibromomethane	mg/L	0.001		0.0082	<0.005	<0.005	<0.001
	Carbon tetrachloride	mg/L	0.001	0.24	0.003	<0.005	<0.005	<0.001
	Hexachlorobutadiene	mg/L	0.005		14	<0.005	<0.005	-
	1,1-dichloroethene	mg/L	0.001	0.7	0.03	<0.005	<0.005	<0.001
	1,1-dichloroethane	mg/L	0.001	0.25	0.9	<0.005	<0.005	<0.001
	Bromomethane	mg/L	0.001	0.12	0.0087	<0.05	<0.05	<0.001
	1,1,1-trichloroethane	mg/L	0.001	0.27	2	<0.005	<0.005	<0.001
	1,1,2,2-tetrachloroethane	mg/L	0.001			<0.005	<0.005	<0.001
	cis-1,2-dichloroethene	mg/L	0.001	0.7	0.07	<0.005	<0.005	<0.001
	Iodomethane	mg/L	0.001			<0.005	<0.005	<0.001
	1,1-dichloropropene	mg/L	0.005			<0.005	<0.005	-
	1,2-dibromo-3-chloropropane	mg/L	0.005			<0.005	<0.005	-
	trans-1,4-Dichloro-2-butene	mg/L	0.005			<0.005	<0.005	-
	trans-1,2-dichloroethene	mg/L	0.001	0.7	0.01	<0.005	<0.005	<0.001
	1,1,1,2-tetrachloroethane	mg/L	0.001		0.00052	<0.005	<0.005	<0.001
	Vinyl chloride	mg/L	0.001	0.84	0.0003	<0.05	<0.05	<0.001
	Chloromethane	mg/L	0.001	2.7	0.19	<0.05	<0.05	<0.001
	Trichloroethene	mg/L	0.001	0.33	0.02	<0.005	<0.005	<0.001
	Trichlorofluoromethane	mg/L	0.001		1.3	<0.05	<0.05	<0.001
	Chloroethane	mg/L	0.001		21	<0.05	<0.05	<0.001
Halogenated Aromatic Compounds	1,2,3-trichlorobenzene	mg/L	0.005	0.003	0.029	<0.005	<0.005	-
	1,2,3-trichloropropane	mg/L	0.001			<0.005	<0.005	<0.001
	Chlorobenzene	mg/L	0.001	0.055	0.3	<0.005	<0.005	<0.001
	1,4-dichlorobenzene	mg/L	0.001	0.06	0.04	<0.005	<0.005	<0.001
	1,3-dichlorobenzene	mg/L	0.001			<0.005	<0.005	<0.001
	1,2,4-trichlorobenzene	mg/L	0.005		0.0023	<0.005	<0.005	-
	1,2-dichlorobenzene	mg/L	0.001	0.16	1.5	<0.005	<0.005	<0.001
	4-chlorotoluene	mg/L	0.001		0.73	<0.005	<0.005	<0.001
	2-chlorotoluene	mg/L	0.005		0.73	<0.005	<0.005	-
	Bromobenzene	mg/L	0.001		0.088	<0.005	<0.005	<0.001
Ionic Balance	Ionic Balance	%	0.01			10.5	6.83	-
	Anions Total	meq/L	0.01			5.69	5.24	-
	Cations Total	meq/L	0.01			4.61	4.57	-
Oxygenated compounds	Vinyl acetate	mg/L	0.05		0.41	<0.05	<0.05	-
	2-hexanone (MBK)	mg/L	0.05		0.038	<0.05	<0.05	-
	Methyl Ethyl Ketone	mg/L	0.001			<0.05	<0.05	<0.001
	4-Methyl-2-pentanone	mg/L	0.001			<0.05	<0.05	<0.001
Sulfonated	Carbon disulfide	mg/L	0.001			<0.005	<0.005	<0.001
TRH (NEPM, 2013)	TRH C6-C10 Fraction	µg/L	20	150	150	<20	<20	<20
	TRH C6-C10 less BTEX (F1)	µg/L	20			<20	<20	<20
	TRH >C10-C16 Fraction	µg/L	50			<100	<100	<50
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	µg/L	50			<100	<100	<50
	TRH >C16-C34 Fraction	µg/L	100			120	110	100
	TRH >C34-C40 Fraction	µg/L	100			<100	<100	<100
	TRH C10 - C40 (Sum of total)	µg/L	100	600	600	120	110	100
Trihalo methanes	Chloroform	mg/L	0.005	0.37	0.3	<0.005	<0.005	<0.005
BTEX	Benzene	µg/L	1	700	1	<1	<1	<1
	Ethylbenzene	µg/L	1	5	300	<2	<2	<1
	Toluene	µg/L	1	180	800	<2	<2	<1
	Xylene (m & p)	µg/L	2			<2	<2	<2
	Xylene (o)	µg/L	1			<2	<2	<1
	Xylene Total	µg/L	2	625	600	<2	<2	<3
	Total BTEX	µg/L	1			<1	<1	-
	Naphthalene	µg/L	1	70		<1	<1	<10
Chlorinated Hydrocarbons	1,2-dibromoethane	mg/L	0.001			<0.005	<0.005	<0.001
	1,2-dichloropropane	mg/L	0.001			<0.005	<0.005	<0.001
	2,2-dichloropropane	mg/L	0.005			<0.005	<0.005	-
	Bromochloromethane	mg/L				-	-	<0.001
	Bromodichloromethane	mg/L	0.001		0.06	<0.005	<0.005	<0.001

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Table 15 - Groundwater results

Chem Group	Chemical Name	Units	LOR	Water dependent ecosystems and species (marine)	Water-based recreation	GW1	DUP01	SPLIT01
						20/09/2021	20/09/2021	20/09/2021
	Bromoform	mg/L	0.001	0.64	0.0085	<0.005	<0.005	<0.001
	Chlorinated hydrocarbons EPAVic	mg/L				-	-	<0.005
	Chlorodibromomethane	mg/L	0.001		0.1	<0.005	<0.005	<0.001
	cis-1,3-dichloropropene	mg/L	0.001			<0.005	<0.005	<0.001
	Other chlorinated hydrocarbons EPAVic	mg/L				-	-	<0.005
	trans-1,3-dichloropropene	mg/L	0.001			<0.005	<0.005	<0.001
Inorganics	pH (Lab)	pH_Units	0.01			5.38	5.26	-
	TDS	mg/L	10			419	398	-
	Calcium (Filtered)	mg/L	1			<1	<1	-
	Sodium (Filtered)	mg/L	1			106	105	-
	Magnesium (Filtered)	mg/L	1			<1	<1	-
	Ammonia as N	mg/L	0.01	0.91		<0.01	0.02	-
	Potassium (Filtered)	mg/L	1			<1	<1	-
	Chloride	mg/L	1			27	30	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	1			53	52	-
	Sulfate as SO4 (Filtered)	mg/L	1		5000	186	161	-
	Alkalinity (total) as CaCO3	mg/L	1			53	52	-
	Nitrate (as N)	mg/L	0.01	2.39277652370203	112.866817155756	0.03	0.03	-
	Nitrite (as N)	mg/L	0.01		9.14634146341463	<0.01	<0.01	-
	Fluoride	mg/L	0.1		15	0.7	<0.1	-
	Phosphate (as P)	mg/L	0.01			<0.01	<0.01	-
MAH	1,2,4-trimethylbenzene	mg/L	0.001	0.019	0.015	<0.005	<0.005	<0.001
	1,3,5-trimethylbenzene	mg/L	0.001		0.12	<0.005	<0.005	<0.001
	Isopropylbenzene	mg/L	0.001	0.03	0.68	<0.005	<0.005	<0.001
	n-butylbenzene	mg/L	0.005			<0.005	<0.005	-
	n-propylbenzene	mg/L	0.005		0.66	<0.005	<0.005	-
	p-isopropyltoluene	mg/L	0.005			<0.005	<0.005	-
	sec-butylbenzene	mg/L	0.005			<0.005	<0.005	-
	Styrene	mg/L	0.001	0.57	0.03	<0.005	<0.005	<0.001
	tert-butylbenzene	mg/L	0.005			<0.005	<0.005	-
	Total MAH	mg/L				-	-	<0.003
Metals	Arsenic (Filtered)	mg/L	0.001	0.0023	0.1	<0.001	<0.001	0.001
	Cadmium (Filtered)	mg/L	0.0001	0.0007	0.02	<0.0001	<0.0001	<0.0002
	Chromium (III+VI) (Filtered)	mg/L	0.001			<0.001	<0.001	<0.001
	Copper (Filtered)	mg/L	0.001	0.0013	20	0.003	0.003	0.003
	Aluminium (Filtered)	mg/L	0.01	0.0005		0.02	0.02	-
	Lead (Filtered)	mg/L	0.001	0.0044	0.1	<0.001	<0.001	<0.001
	Mercury (Filtered)	mg/L	0.0001	0.0004	0.01	<0.0001	<0.0001	<0.0001
	Nickel (Filtered)	mg/L	0.001	0.07	0.2	0.01	0.009	0.011
	Zinc (Filtered)	mg/L	0.005	0.015	30	0.051	0.05	0.057
	Iron (Filtered)	mg/L	0.05	0.3		<0.05	<0.05	-
	Manganese (Filtered)	mg/L	0.001	0.08	5	0.001	0.001	-
PAH	Acenaphthylene	µg/L	1			<1	<1	-
	Acenaphthene	µg/L	1	6.6		<1	<1	-
	Fluorene	µg/L	1			<1	<1	-
	Anthracene	µg/L	1			<1	<1	-
	Phenanthrene	µg/L	1	2		<1	<1	-
	Fluoranthene	µg/L	1			<1	<1	-
	Benz(a)anthracene	µg/L	1			<1	<1	-
	Pyrene	µg/L	1			<1	<1	-
	Chrysene	µg/L	1			<1	<1	-
	Benzo(b+j)fluoranthene	µg/L	1			<1	<1	-
	Benzo(k)fluoranthene	µg/L	1			<1	<1	-
	Benzo(a) pyrene	µg/L	0.5	0.2		<0.5	<0.5	-
	Indeno(1,2,3-c,d)pyrene	µg/L	1			<1	<1	-
	Dibenz(a,h)anthracene	µg/L	1			<1	<1	-
	Benzo(g,h,i)perylene	µg/L	1			<1	<1	-
	Benzo(a)pyrene TEQ calc (Zero)	µg/L	0.5			<0.5	<0.5	-
	PAHs (Sum of total)	µg/L	0.5			<0.5	<0.5	-
Solvents	Allyl chloride	mg/L				-	-	<0.001
	Acetone	mg/L				-	-	<0.001