CITY OF HOBART

SUPPORTING INFORMATION
SUPPLEMENTARY ITEMS

CITY PLANNING COMMITTEE MEETING

OPEN PORTION OF THE MEETING

MONDAY, 17 FEBRUARY 2020
AT 5:00 PM
VENUE: LADY OSBORNE ROOM, TOWN HALL

TABLE OF CONTENTS

ENGINEERING
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199 Macquarie Street
Hobart 7000
Tasmania

100 Cameron Street
Launceston 7250
Tasmania

PROJECT COMMUNICATION

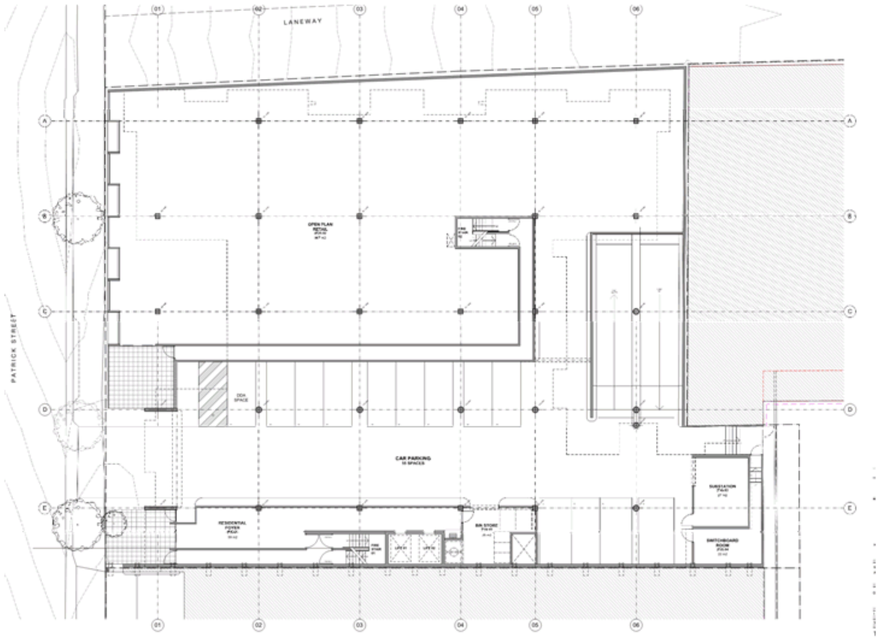
To:	Jacob Britten	PC No:	18275 PC01
Company:	HBV Architects	Date:	6 Aug 2019
From:	David Devenish	No. of Pages:	5
Project:	Patrick Street Apartments	Trade:	Sewer & Water

Sewer & Water Servicing Concept for 62-64 Patrick Street, Hobart

Introduction

'6 Failla Street Pty Ltd' is proposing to develop 6 levels of apartments (68 in total) plus carparking and commercial tenancies at the above address. The site is approximately 2100m^2 in area. This communication addresses the sewer and water servicing concept for the proposed development.

Proposed Development Site – Existing



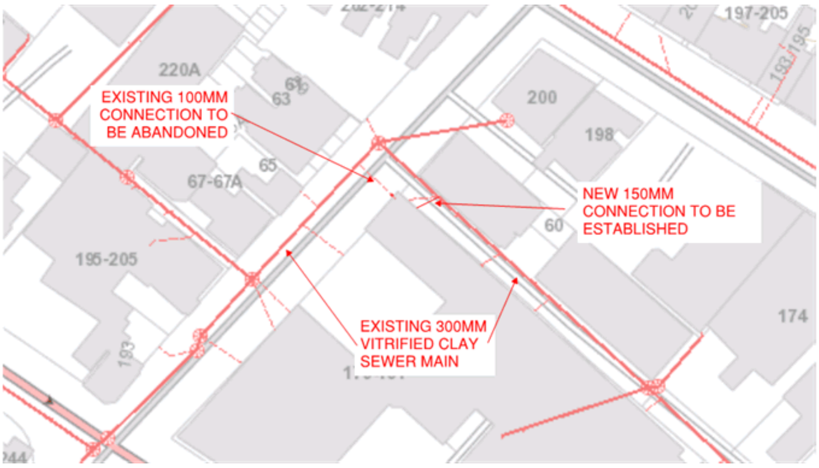
Proposed Development – Ground Level

Key points to note with the proposed development are:

- There will be commercial tenancies on the Ground Level only.
- In total there are 160 bedrooms:
  - 9 off 1 bedroom apartments
  - 31 off 2 bedroom apartments
  - 23 off 3 bedroom apartments
  - 5 off 4 bedroom apartments
- A basement drainage pit in the carpark is proposed to discharge to the stormwater system.
- The building will be fully fire sprinklered.

Proposed Sewer Servicing

There is an existing TasWater 300mm Vitrified Clay sewer main on the opposite of Patrick Street. There is already a 100mm connection from the site to this main. It is proposed that this connection be abandoned and that a new 150mm connection be made to the nearby main as indicated in the sketch below.



Sewer Servicing Concept

Sewer flow estimates are calculated in accordance with TasWater's WSA-02 Supplement Appendix B as:

- 1 Bedroom Apartments: 9 x 0.5 = 4.5
- 2 Bedroom Apartments: 31 x 0.75 = 23.25
- 3+ Bedroom Apartments: 28 x 1.0 = 28
- MP01: Commercial Area: 967m^2 floor area x 0.008 = 7.7

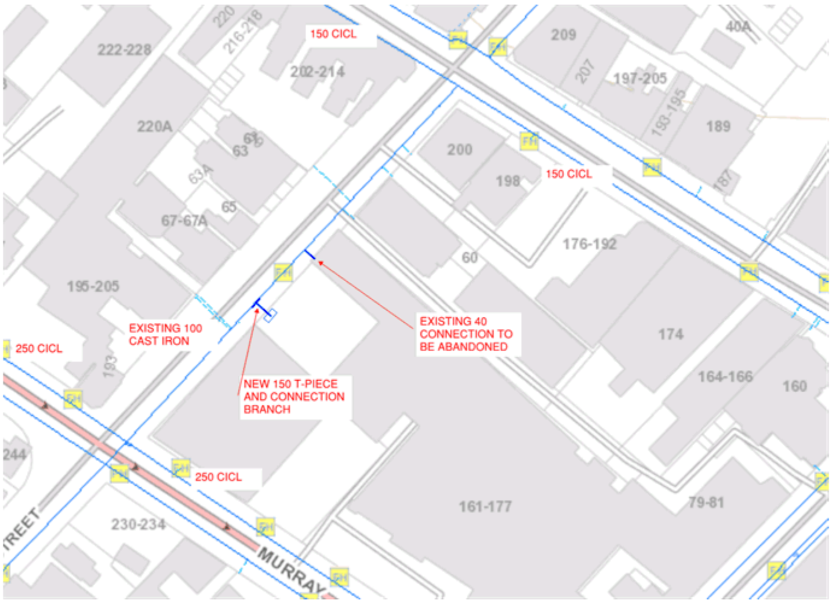
This is a Total Equivalent Tenements = **64 ETs**. (Sewer)

Using a loading rate of 450 L/ET/day, this is an **ADWF of 0.333 l/s**.
Using a peaking factor of 9, this is a **PDWF of 3.0 l/s**.

Proposed Water Servicing

There is only a 100mm CI main running along Patrick Street but it is fed from 2 directions which is likely to provide the flow requirements listed below. It is fed from an existing TasWater 250mm CICL water main on near side of Murray Street and an existing 150 CICL water main on Elizabeth Street.

There is already a 40mm connection from the site to the Patrick Street 100mm main. It is proposed that this connection be abandoned and that a new 150mm connection be established as indicated in the sketch below. The connection would involve a new 150mm T-piece inserted into the existing 100mm main. This arrangement would be subject to TasWater modelling confirming that the required flows are available.



Water Servicing Concept

The site is assessed as low hazard and it is proposed to establish an in-ground connection in the forecourt within 2m of the boundary. Access will be through pavement pit lids. The domestic water connection size will be **65mm diameter**. This connection size is based on 5.6 l/s as given by AS3500.1: 2018 Table 3.2.3 for 64 ETs.

Equivalent Tenements for the purposes of water calculated in accordance with TasWater's Supplement Appendix B are:

- 1 Bedroom Apartments: 9 x 0.33 = 3.0
- 2 Bedroom Apartments: 31 x 0.5 = 15.5
- 3+ Bedroom Apartments: 28 x 0.67 = 18.8
- MP01: Commercial Area: 967m^2 floor area x 0.005 = 4.8

This is a Total Equivalent Tenements = **42 ETs**. (Water)

The simultaneous water flow requirements for domestic water consumption and fire-fighting purposes are estimated as:

- Domestic Consumption 6 l/s
- Fire Hydrants 20 l/s
- Sprinklers 18 l/s (based on carpark sprinklers)

The total simultaneous flow requirement is: **44 l/s @ 380kPa** (measured at the upstream side of the backflow protection device of the water connection).

For the upper levels, less flow is required for the residential sprinklers, but more pressure is required. The simultaneous flow requirement is then: **36 l/s @ 550kPa** (measured at the upstream side of the backflow protection device of the water connection).

David Devenish BE(Mech), CPEng, FIEAust.
BP Accreditation No. CC5311T

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AllUrbanPlanning PTY LTD

Planning Report
62-64 Patrick Street
Hobart

Date 3 August 2019

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Table of contents

1. Introduction

All Urban Planning Pty Ltd has been engaged by the owner, 6 Failla Street Pty Ltd to provide an independent planning assessment of the proposed apartment use and development at 62-64 Patrick Street Hobart under the *Hobart Interim Planning Scheme 2015* (planning scheme).

1.1Site & Surrounds

The subject property is the 2152m^2 site of the RACT roadside service centre located on the southern side of Patrick Street between Elizabeth and Murray Streets. The site adjoins RACT house to the south west and Harvey Norman to the south east. There is an existing laneway along the north eastern side of the site. The proposal connects with an existing right of way over the RACT site (CT175729/1) owned by the Royal Automobile Club of Tasmania. No physical work is proposed on that title.

Address	***CT***
179-191 Murray Street (62-64 Patrick Street)	175729/2

Figure 1– Site Plan

2. The Proposal

The proposed development involves the construction of a 7-storey building with a total floor area of 13,291 m^2 containing 68 residential apartments and a ground floor retail area.

The proposal includes:

- demolition of the former RACT roadside service centre buildings
- on-site car parking for 126 spaces over three levels
- 9 x 1-bedroom apartments
- 31 x 2-bedroom apartments
- 23 x 3-bedroom apartments
- 5 x 4-bedroom apartments
- 972 m^2 ground floor open plan retail

The proposal will connect to the existing stormwater connection to the site.

Water and Sewer will connect to TasWater's existing infrastructure in Patrick Street.

Figure 2 – photo montage of the proposed development looking north east from near the corner of Patrick and Murray Streets (Source: HBV Architects)

Figure 3 - more distance photo montage of the proposed development looking north east from near the corner of Patrick and Murray Streets (Source: HBV Architects)

Figure 4 – The site as viewed along Patrick Street towards the south west (Source: HBV Architects)

Figure 5 - View from intersection of Elizabeth and Patrick Streets looking towards the site to the west (Source: HBV Architects)

Figure 6 - View looking north from Murray Street towards the rear of the site over the Harvey Norman and RACT sites. The proposal is the cream coloured building to the right of the RACT building. (Source: HBV Architects).

The proposal is accompanied by an Architectural Design Statement prepared by HBV that explains the rationale for the proposed building and response to the topography, townscape and surroundings. The following Figures illustrate the key considerations and responses.

In my opinion the proposal will provide an overwhelmingly positive contribution to the city with a fine-grained texture that will modulate between disparate neighbouring scales of the streetscape to link RACT House and 60 Patrick Street. The proposed stepped design will also minimise the apparent scale, massing and transition to the residential properties across Patrick Street.

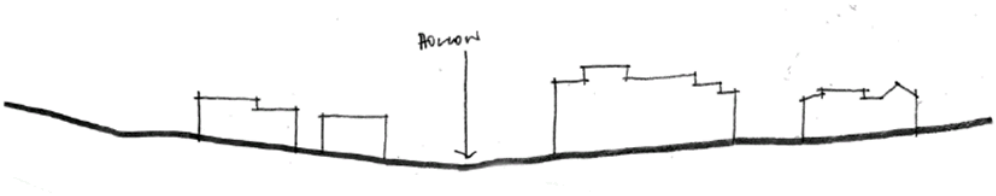


Figure 7 – the site is in a hollow between Murray and Elizabeth Streets (Source: HBV Design Statement)

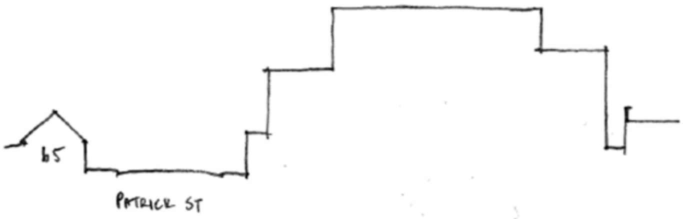


Figure 8- the proposal steps down in height and setback from the street to minimise the apparent scale, massing and overshadowing, particularly to lessen the impact of residential properties across Patrick Street (Source: HBV Design Statement)

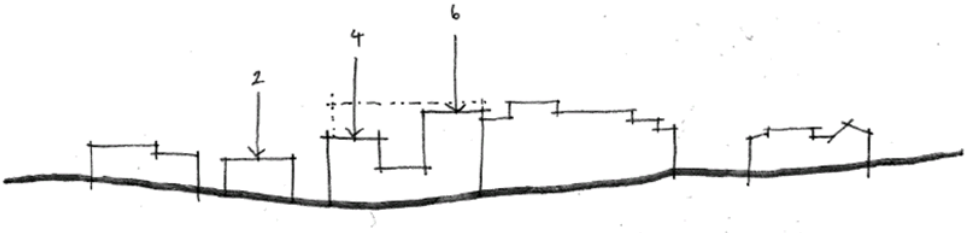


Figure 9 – The proposed building form modulates between disparate neighbouring scales of the streetscape to link RACT House and 60 Patrick Street (Source: HBV Design Statement)

Figure 10 – The proposal covers the blank RACT House with a fine-grained texture and positive intervention to the urban townscape, especially when viewed from Elizabeth Street and further up Patrick Street (Source: HBV Design Statement)

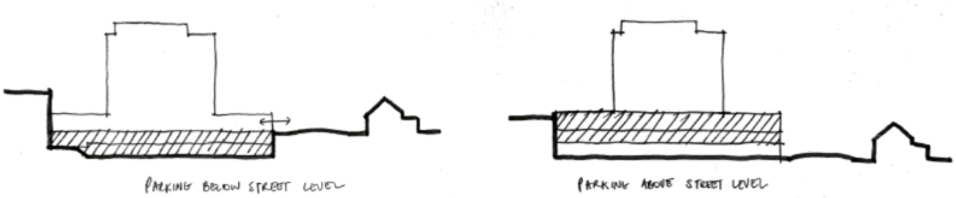


Figure 11 – The proposal activates the street by providing a retail tenancy at street level and reduce the overall height, and mass of the Patrick Street frontage by providing parking below ground level. (Source: HBV Design Statement)

3. The Planning Scheme

Under Clause 8.10.1 of the Planning Scheme the planning authority must, in addition to the matters required by s.51(2) of the Act, take into consideration:

> *(a) all applicable standards and requirements in this planning scheme; and*
>
> *(b) any representations received pursuant to and in conformity with s57(5) of the Act,*
>
> *but in the case of the exercise of discretion, only insofar as each such matter is relevant to the particular discretion being exercised.*

Relevantly, a standard is applicable if the site is within the relevant zone and the standard deals with a matter that could affect or be affected by the proposed development; cl.7.5.2.

A standard is defined to mean the objective for a particular planning issue and the means for satisfying that objective through either an acceptable solution or corresponding performance criterion.

Compliance with a standard is achieved by complying with either the acceptable solution or corresponding performance criterion; cl.7.5.3.

The objective of the standard may be considered to help determine whether the proposed use or development complies with the performance criterion of that standard; cl.7.5.4.

3.1 Zoning

The site is zoned Commercial under the Planning Scheme. Land further to the east along the Elizabeth Street 'spine' is zoned Central Business.

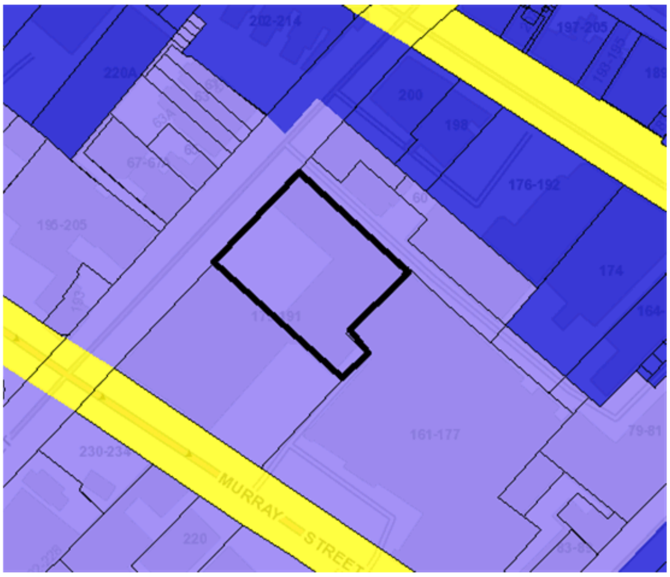


Figure 12 - Zoning plan (Source: iplan)

The Purpose of the Commercial Zone is:

- *To provide for large floor area retailing and service industries.*
- *To provide for development that requires high levels of vehicle access and car parking for customers.*
- *To provide for a diversity of generally non-residential uses reflecting the transition between the Central Business Zone and inner residential areas.*
- *To allow for uses such as car yards, warehouse and showrooms in the areas of high traffic volume and high passing visibility.*
- *To allow good quality building stock to be used for less land extensive central service uses such as offices and specialist wholesaling uses.*
- *To allow for service industry uses such as motor repairs which provide a valuable service to users of the central area.*
- *To provide for residential use primarily above ground floor level.*

There are no Local Area Objectives or Desired Future Character Statements under Clause 23.1.2 or 23.1.3.

3.2Use

The proposal involves 68 residential apartments located on the first- sixth floors with a roof top garden above. Access to the residential use is via a ground floor foyer and lifts. The residential use for multiple dwellings is Permitted under the Use Table 23.2.

The proposed ground floor retail tenancy of 972m^2 is discretionary as *General retail and hire* or *Bulky goods sales.*

The basement and ground floor carparking is directly associated with and subservient to the residential and retail uses. This parking is not located above ground level and although totally logical is technically discretionary in terms of use.

A discretionary use is to be determined with regard to the requirements of Clause 8.10.2 of the planning scheme including:

- the purpose of the applicable zone;
- the purpose of any applicable code;

In my opinion the proposed ground floor retail and car parking satisfies these criteria in that it includes:

- large floor area retailing consistent with Zone Purpose Statement 23.1.1.1. It will assit to activate the ground floor frontage;
- carparking required by the Parking and Access Code and consistent with Zone Purpose Statement 23.1.1.2 in a location that will not be visible from the street; and
- it provides for residential use primarily above ground floor level consistent with Zone Purpose Statement 23.1.1.7.

Use Standards

A number of the following Use Standards reference a 50m setback to the closest residential zone. In this case the closest residential zone is centred around Church Street, approximately 140m to the north east. The majority of the Use Standards therefore do not apply.

Hours of Operation (23.3.1)

Use Standard	***Assessment***
A1 *Hours of operation of a use within 50 m of a residential zone must be within:* *(a) 6.00 am to 10.00 pm Mondays to Saturdays inclusive;* *(b) 7.00 am to 9.00 pm Sundays and Public Holidays.* *except for office and administrative tasks.*	The site is approximately 140m from the closest residential zone and this Standard does not apply.

Noise (23.3.2)

Use Standard	***Assessment***
A1 *Noise emissions measured at the boundary of a residential zone must not exceed the following:* *(a) 55dB(A) (LAeq) between the hours of 7.00 am to 7.00 pm;* *(b) 5dB(A) above the background (LA90) level or 40dB(A) (LAeq), whichever is the lower, between the hours of 7.00 pm to 7.00 am;* *(c) 65dB(A) (LAmax) at any time.* *Measurement of noise levels must be in accordance with the methods in the Tasmanian Noise Measurement Procedures Manual, issued by the Director of Environmental Management, including adjustment of noise levels for tonality and impulsiveness.* *Noise levels are to be averaged over a 15 minute time interval.*	The proposal for retail and residential use will not involve any noise intensive activities. Assuming any mechanical plant is installed to accepted contemporary standards the proposal is likely to comfortably comply with the noise limits set out in A1.

External Lighting (23.3.3)

Use Standard	***Assessment***
A1 *External lighting within 50 m of a residential zone must comply with all of the following:* *(a) be turned off between 11:00 pm and 6:00 am, except for security lighting;* *(b) security lighting must be baffled to ensure they do not cause emission of light outside the zone.*	The site is approximately 140m from the closest residential zone and this Standard does not apply.

Commercial Vehicle Movements (23.3.4)

Use Standard	***Assessment***
A1 *Commercial vehicle movements, (including loading and unloading and garbage removal) to or from a site within 50 m of a residential zone must be within the hours of:*	The site is approximately 140m from the closest residential zone and this Standard does not apply.

(a) 6.00 am to 10.00 pm Mondays to Saturdays inclusive; *(b) 7.00 am to 9.00 pm Sundays and Public Holidays.*	

Outdoor Work Areas (23.3.5)

Use Standard	***Assessment***
A1 *Outdoor work areas and noise-emitting services such as air conditioning equipment, pumps and ventilations fans must not be located within 50 m of a residential zone.*	The site is approximately 140m from the closest residential zone and this Standard does not apply.

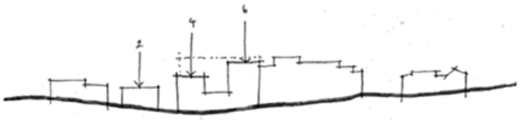
3.3Development Standards

Building Height (23.4.1)

Objective:

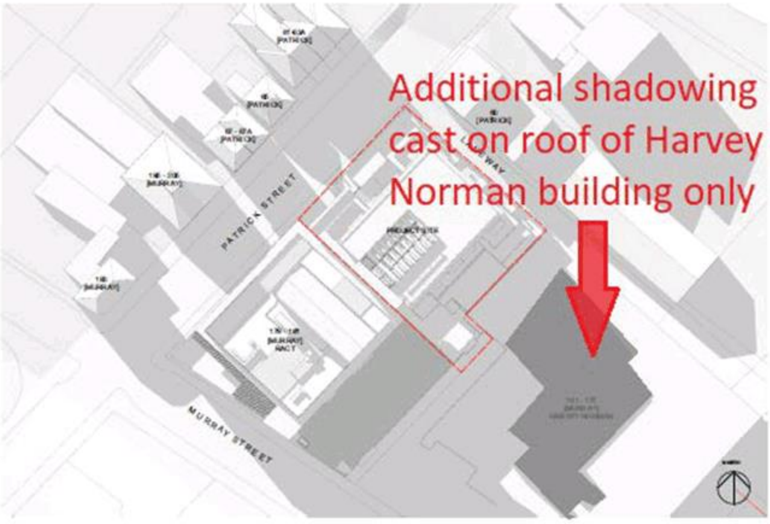
To ensure that building height contributes positively to the streetscape and does not result in unreasonable impact on residential amenity of land in a residential zone.

Development Standard	***Assessment***
A1 *Building height must be no more than:* *(a) 11.5m high and a maximum of 3 storeys; or* *(b) 15m high and a maximum of 4 storeys, if the development provides at least 50% of the floor space above ground level for residential use.*	The permitted height for this proposal involving exclusively residential use above ground floor is 15m and 4 storeys. The proposed building has a maximum height of 25.8m to the top of the lift over run (RL 47.8 AHD) and a parapet height of approximately 45.8m AHD. The proposed height is therefore discretionary and to be assessed under P1 below.
P1 *Building height must satisfy all of the following:* *(a) be consistent with any Desired Future Character Statements provided for the area;* *(b) be compatible with the scale of nearby buildings;* *(c) not unreasonably overshadow adjacent public space;*	The proposal is considered to satisfy all of the criteria in P1 in that: a) There is no applicable Desired Future Character Statement; b) The proposal abuts RACT house directly adjacent to the south west at 179-191 Murray Street and has a maximum height to the top of the lift overrun of RL 47.8 which matches the height of the lift overrun of RACT House. The primary parapet line of the new building (RL 45.6 is approximately 4m higher than the main parapet line of RACT House (RL 41.2) however this additional height is considered to be comfortably

(d) allow for a transition in height between adjoining buildings, where appropriate;	mitigated by the two projecting bays on the Patrick Street frontage that step down as shown in Figures 2, 3, 8 and 10 above. It is considered that the modulated and stepped form of the building as shown in the photo montages and discussed in the Design Statement will ensure that the height of the building will act as an intermediary between the scale of the blocked form of RACT House and nearby buildings including the residential cottages on the opposite side of Patrick Street and two storey building at 60 Patrick Street;  c) The accompanying shadow diagrams (Figures 13 & 14 below) confirm that the proposed building will not overshadow public spaces with the only noticeable shadowing impact occurring at 3pm on the winter solstice to the roof of eth Harvey Norman building; and d) Similar to the comments above in relation to criterion b) the proposed modulated and stepped form will provide a positive contribution to the townscape and act to transition from the dominant blank wall of RACT House adjoining to the south west. The nearby building to the north east on Patrick Street is separated by a laneway and does not technically adjoin the site. Nevertheless, it is considered that the proposed stepped form and in particular the 4 storey form on the northern most corner of the building will appropriately transition to the two storey building at 60 Patrick Street.
A2 *Building height within 10 m of a residential zone must be no more than 8.5 m.*	This Standard does not apply to this site that is remote to all residential zoned land.

22 JUNE 3PM - EXISTING
N.T.S. (WINTER SOLSTICE)

Figure 13 –Existing shadow diagram 3pm Winter Solstice (Source: HBV Architects)



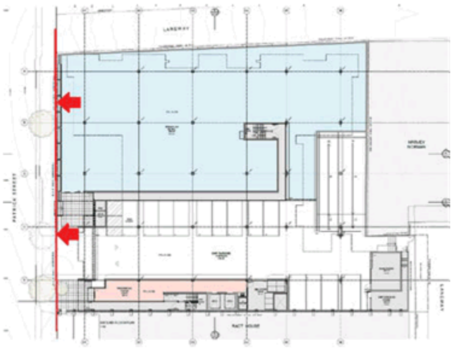
22 JUNE 3PM - PROPOSED
N.T.S. (WINTER SOLSTICE)

Figure 14 - Proposed shadow diagram 3pm Winter Solstice showing increased shadow cast to Harvey Norman building only (Source: annotated drawing from HBV Architects)

Setback (23.4.2)

Objective

To ensure that building setback contributes positively to the streetscape and does not result in unreasonable impact on residential amenity of land in a residential zone.

Development Standard	***Assessment***
A1 *Building setback from frontage must be parallel to the frontage and must be no less than:* *0 m.*	The proposal complies with A1 with the ground floor retail podium space aligning the front boundary on Patrick Street. 
A2 *Building setback from the General Residential or Inner Residential Zone must be no less than:* *(a) 5 m;* *(b) half the height of the wall,* *whichever is the greater.*	The proposal does not adjoin a residential zone. Not applicable.

Design (23.4.3)

Objective

To ensure that building design contributes positively to the streetscape, the amenity and safety of the public and adjoining land in a residential zone.

Development Standard	***Assessment***
A1 *Building design must comply with all of the following:* *(a) provide the main pedestrian entrance to the building so that it is clearly visible from the road or publicly accessible areas on the site;*	The proposal satisfies A1 in that the Patrick Street elevation: a) includes the main pedestrian entrance to the building; b) includes large areas of glazing, front door and garage door openings

(b) for new building or alterations to an existing facade provide windows and door openings at ground floor level in the front façade no less than 40% of the surface area of the ground floor level facade ; *(c) for new building or alterations to an existing facade ensure any single expanse of blank wall in the ground level front façade and facades facing other public spaces is not greater than 30% of the length of the facade;* *(d) screen mechanical plant and miscellaneous equipment such as heat pumps, air conditioning units, switchboards, hot water units or similar from view from the street and other public spaces;* *(e) incorporate roof-top service infrastructure, including service plants and lift structures, within the design of the roof;* *(f) provide awnings over the public footpath if existing on the site or on adjoining lots;* *(g) not include security shutters over windows or doors with a frontage to a street or public place.*	would exceed the 40% minimum requirement; c) includes articulation and avoids expanses of blank wall; d) Mechanical plant and equipment will be sited or screened from view from the street and other public spaces; e) The roof top lit overrun and plant will be incorporated into the design of the roof and pergola structure over the roof top terrace; f) There are no pedestrian awnings over the footpath existing at the site or on adjoining lots; and g) No security shutters are proposed.
A2 *Walls of a building on land adjoining a residential zone must comply with all of the following:* *(a) be coloured using colours with a light reflectance value not greater than 40 percent.;* *(b) if within 50 m of a residential zone, must not have openings in walls facing the residential zone, unless the line of sight to the building is blocked by another building.*	The proposal does not adjoin a residential zone. Not applicable.

Passive Surveillance (23.4.4)

Objective

To ensure that building design provides for the safety of the public.

Development Standard	***Assessment***
A1 *Building design must comply with all of the following:* *(a) provide the main pedestrian entrance to the building so that it is clearly visible from the road or publicly accessible areas on the site;* *(b) for new buildings or alterations to an existing facade provide windows and door openings at ground floor level in the front façade which amount to no less than 40% of the surface area of the ground floor level facade;* *(c) for new buildings or alterations to an existing facade provide windows and door openings at ground floor level in the façade of any wall which faces a public space or a car park which amount to no less than 30% of the surface area of the ground floor level facade;* *(d) avoid creating entrapment spaces around the building site, such as concealed alcoves near public spaces;* *(e) provide external lighting to illuminate car parking areas and pathways;* *(f) provide well-lit public access at the ground floor level from any external car park.*	The proposal satisfies A1 in that: a) The building design includes the main pedestrian entrance clearly visible from the main Patrick Street frontage; b) The proposal includes large areas of glazing, front door and garage door openings would exceed the 40% minimum requirement; c) The proposal incorporates windows and doors across significantly more than 30% of the ground floor level façade; d) The building does not include entrapment spaces; e) The proposal does not include external car parking spaces; and f) Includes a public access that will be well lit but there is no external carparking areas.

Landscaping (23.4.5)

Objective

To ensure that a safe and attractive landscaping treatment enhances the appearance of the site and if relevant provides a visual break from land in a residential zone.

Development Standard	***Assessment***
A1 *Landscaping along the frontage of a site is not required if all of the following apply:*	The proposal complies with A1 in that it extends across the width of the frontage other than for access.

(a) the building extends across the width of the frontage, (except for vehicular access ways); *(b) the building has a setback from the frontage of no more than 1m.*	A landscaped rooftop garden is proposed for residents.
A2 *Along a boundary with a residential zone landscaping must be provided for a depth no less than:* *2 m.*	The proposal does not adjoin a residential zone. Not applicable.

Outdoor Storage Areas (23.4.6)

Development Standard	***Assessment***
A1 *Outdoor storage areas for non-residential uses must comply with all of the following:* *(a) be located behind the building line;* *(b) all goods and materials stored must be screened from public view;* *(c) not encroach upon car parking areas, driveways or landscaped areas.*	The proposal does not involve any outdoor storage areas and A1 does not apply.

Fencing (23.4.7)

Development Standard	***Assessment***
A1 *Fencing must comply with all of the following:* *(a) fences, walls and gates of greater height than 1.5 m must not be erected within 10 m of the frontage;* *(b) fences along a frontage must be at least 50% transparent above a height of 1.2 m;* *(c) height of fences along a common boundary with land in a residential zone must be no more than 2.1 m and must not contain barbed wire.*	The proposal does not involve front fencing. This standard does not apply.

4. Planning Scheme Codes

There are no specific Code Overlays that affect the site. The remaining Codes that are relevant to the proposal are considered as follows:

4.1 Potentially Contaminated Land Code

As discussed in the accompanying Environmental Site Assessment (ESA) prepared by GEO Environmental Solutions, July 2019, the site is to be treated as potentially contaminated in accordance with this Code.

Subject to the findings and recommendations of the ESA the proposal is considered to satisfy the requirements of this Code and in particular demonstrates that:

- Subject to the mitigation measures discussed in Section 14.3 of the ESA, the land is suitable for the intended use and satisfies E2.5 P1(c); and
- Contamination at the site will not present a risk to human health and therefore satisfies the Standards for Evacuation under E.2.6

4.2 Road and Railway Assets Code

The accompanying Traffic Impact Assessment confirms that the proposal will provide for safe traffic and access consistent with the requirements of this Code.

Existing road accesses and junctions (E5.5)

Objective

To ensure that the safety and efficiency of roads is not reduced by increased use of existing accesses and junctions.

Use Standards	***Assessment***
A3 *The annual average daily traffic (AADT) of vehicle movements, to and from a site, using an existing access or junction, in an area subject to a speed limit of 60km/h or less, must not increase by more than 20% or 40 vehicle movements per day, whichever is the greater.*	The proposal would be exceed 40vpd and must therefore be assessed under P3.
P3 *Any increase in vehicle traffic at an existing access or junction in an area subject to a speed limit of 60km/h or less, must be safe and not unreasonably impact on the efficiency of the road, having regard to:*	The accompanying traffic impact assessment by Midson Traffic confirms that the traffic and access aspects of the proposal will be safe and no unreasonably impact on the efficiency of the road network.

(a) the increase in traffic caused by the use; *(b) the nature of the traffic generated by the use;* *(c) the nature and efficiency of the access or the junction;* *(d) the nature and category of the road;* *(e) the speed limit and traffic flow of the road;* *(f) any alternative access to a road;* *(g) the need for the use;* *(h) any traffic impact assessment; and* *(i) any written advice received from the road authority.*	

Road accesses and junctions (E5.6.2)

Development Standard	***Assessment***
A2 *No more than one access providing both entry and exit, or two accesses providing separate entry and exit, to roads in an area subject to a speed limit of 60km/h or less.*	The proposal includes a single access only and complies with A2.

Sight distance at accesses, junctions and level crossings (E5.6.4)

Development Standard	***Assessment***
A1 *Sight distances at:* *(a) an access or junction must comply with the Safe Intersection Sight Distance shown in Table E5.1; and* *(b) rail level crossings must comply with AS1742.7 Manual of uniform traffic control devices - Railway crossings, Standards Association of Australia.*	Section 4.4 of the TIA confirms that the sight distance of the proposed access complies with the Safe Intersection Sight Distance shown in Table E5.1 and therefore A1.

4.3 Parking and Access Code

The access and parking requirements of this Code are addressed in the accompanying TIA.

Number of Parking Spaces (E6.6.1)

Objective

To ensure that:

(a) there is enough car parking to meet the reasonable needs of all users of a use or development, taking into account the level of parking available on or outside of the land and the access afforded by other modes of transport.

(b) a use or development does not detract from the amenity of users or the locality by:

(i) preventing regular parking overspill;

(ii) minimising the impact of car parking on heritage and local character.

Use Standard	***Assessment***
A1 *The number of on-site car parking spaces must be:* *(a) no less than and no greater than the number specified in Table E6.1;* *except if:* *(i) the site is subject to a parking plan for the area adopted by Council, in which case parking provision (spaces or cash-in-lieu) must be in accordance with that plan;* *(ii) the site is subject to clauses E6.6.5, E6.6.6, E6.6.7, E6.6.8, E6.6.9 or E6.6.10 of this planning scheme.*	Under Table E6.1 the parking requirement for: the multiple dwellings is 1 space per 1 bedroom apartment and 2 spaces for each apartment for 2 or more bedrooms, plus 1 visitor space for every 4 dwellings; the requirement for the retail use is 1 space per 30m^2. Based on the following proposed uses the parking requirement is: • 9 x 1 bedroom apartments = 9 spaces • 59 x 2 -4 bedroom dwellings = 118 spaces • 1 visitor space for every 4 dwellings (68) = 17 spaces • 972m2 Gnd floor retail tenancy / 1 per 30m2 = 32.4 spaces Total = 177 spaces. The proposed parking provision of 126 spaces is therefore to be assessed under P1.
P1 *The number of on-site car parking spaces must be sufficient to meet the reasonable needs of users, having regard to all of the following:* *(a) car parking demand;* *(b) the availability of on-street and public car parking in the locality;*	Section 5.4 of the accompanying TIA confirms that the proposed carparking supply is sufficient to meet the reasonable needs of the users of the site.

(c) the availability and frequency of public transport within a 400m walking distance of the site; *(d) the availability and likely use of other modes of transport;* *(e) the availability and suitability of alternative arrangements for car parking provision;* *(f) any reduction in car parking demand due to the sharing of car parking spaces by multiple uses, either because of variation of car parking demand over time or because of efficiencies gained from the consolidation of shared car parking spaces;* *(g) any car parking deficiency or surplus associated with the existing use of the land;* *(h) any credit which should be allowed for a car parking demand deemed to have been provided in association with a use which existed before the change of parking requirement, except in the case of substantial redevelopment of a site;* *(i) the appropriateness of a financial contribution in lieu of parking towards the cost of parking facilities or other transport facilities, where such facilities exist or are planned in the vicinity;* *(j) any verified prior payment of a financial contribution in lieu of parking for the land;* *(k) any relevant parking plan for the area adopted by Council;* *(l) the impact on the historic cultural heritage significance of the site if subject to the Local Heritage Code;* *(m) whether the provision of the parking would result in the loss, directly or indirectly, of one or more significant trees listed in the Significant Trees Code.*	

The other requirements of this Code are addressed in the TIA and assessed to comply.

4.4 Stormwater Management Code

The requirements of this Code are addressed in the accompanying Stormwater Management Plan prepared by EST, 26 June 2019. This assessment confirms that the proposed stormwater system will manage both stormwater quantity and quality appropriately in accordance with the objectives of the State Stormwater Strategy.

4.5 Historic Heritage Code

The site is not a heritage place or in a heritage precinct. The proposed excavation however requires assessment under the archaeological provisions of the Code.

These matters are addressed in the accompanying heritage specialist's assessment from Praxis.

Building, Works and Demolition (E13.10.1)

Objective

To ensure that building, works and demolition at a place of archaeological potential is planned and implemented in a manner that seeks to understand, retain, protect, preserve and otherwise appropriately manage significant archaeological evidence.

Development Standard	***Assessment***
P1 *Buildings, works and demolition must not unnecessarily impact on archaeological resources at places of archaeological potential, having regard to:* *(a) the nature of the archaeological evidence, either known or predicted;* *(b) measures proposed to investigate the archaeological evidence to confirm predictive statements of potential;* *(c) strategies to avoid, minimise and/or control impacts arising from building, works and demolition;* *(d) where it is demonstrated there is no prudent and feasible alternative to impacts arising from building, works and demolition, measures proposed to realise both the research potential in the archaeological evidence and a meaningful public benefit from any archaeological investigation;* *(e) measures proposed to preserve significant archaeological evidence 'in situ'.*	These criteria are assessed in the accompanying Archaeological Impact Assessment.

4.6 Signs Code

Any signage will be the subject of a future application for signage

5. Conclusion

The proposal shows a high degree of compliance with the provisions of the Commercial Zone in that it will introduce 68 new residential apartments above ground floor, incorporates two levels of basement carparking and a total of 126 parking spaces and includes a large retail tenancy at ground level.

The proposal exceeds the permitted height of 15m with a proposed maximum height of approximately 25.8m to the top of the lift overrun. The proposed height however is considered to satisfy all of the relevant Performance Criteria of Clause 23.4.1 in that:

- The proposal is of a similar height to RACT house directly adjacent to the south west at 179-191 Murray Street;
- The height is considered to be comfortably mitigated by the two projecting bays on the Patrick Street frontage that step down as shown in the photo montages and Design Statement.
- The modulated and stepped form of the building as shown in the photo montages and Design Statement will ensure that the height of the building will act as an intermediary between the scale of the blocked form and blank wall of RACT House and nearby buildings. These include the residential cottages on the opposite side of Patrick Street and the two storey building at 60 Patrick Street; and
- The accompanying shadow diagrams confirm that the proposed building will not overshadow public spaces with the only noticeable shadowing impact occurring at 3pm on the winter solstice to the roof of the Harvey Norman building.

The accompanying servicing, Environmental Site Assessment, Traffic Impact Assessment and Archaeological Impact Assessment confirm that the requirements of the relevant codes are met.

The proposal is a well-considered, high quality development that will further strategic objectives for urban consolidation without conflict with heritage characteristics. The building is of an appropriate scale and assists the increase of density in the city without excessive height or impact on surrounding properties.

In my assessment it will provide an overwhelmingly positive contribution to the city and satisfies the relevant planning scheme provisions. I conclude that the proposal should be approved as a discretionary application pursuant to Section 57 of the Act.

Frazer Read

Principal

3 August 2019

HOBART 22 SALAMANCA SQUARE
HOBART TASMANIA 7004
TELEPHONE (03) 6224 9997

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52 - 54 BRISBANE STREET
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EMAIL hbv@hbvarchitects.com.au

HBV ARCHITECTS

Council Development Officer
City of Hobart
16 Elizabeth Street
Hobart TAS 7001

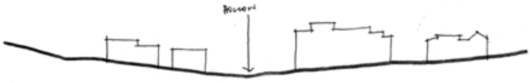
Dear Council Development Officer,

Re: Design Statement, Apartment Development, 62-64 Patrick Street

Please find enclosed development application that details our proposal for an apartment development located at 62-64 Patrick Street. This letter is intended to accompany the proposal and assist in outlining the priorities that have shaped the design.

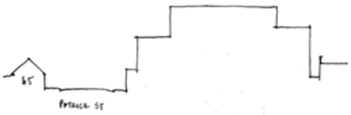
The proposal, as submitted, is the culmination of an exhaustive design process that has explored multiple iterations of scale, proportion and yield before developing the most appropriate solution for the site. The site itself has presented a number of design issues relating to the scale of adjacent buildings, natural topography and solar orientation. Upon studying the attached plans, you may note that each of the following principles has become integral to the final design.

1. Benefit from the site's natural topography by building in the hollow between Murray and Elizabeth Streets,



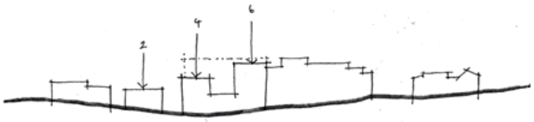
The proposed apartment building is generally shielded from view by buildings in the foreground along Murray and Elizabeth Streets as the site effectively sits in a hollow, approximately one storey below both. Where the view opens at the Patrick Street junctions, the building steps down to minimise its apparent scale, and mass.

2. Step down in height and setback from the street to minimise the apparent scale, massing and overshadowing, particularly to lessen the impact of residential properties across Patrick Street,



A building made up of multiple components, is presented with a greatly reduced scale and mass, and minimizes overshadowing that would otherwise be created by building up to the boundary. The design is made up of six separate components that resemble an 'H' in plan. Four are the legs of the 'H', the fifth is the central linking element, and the sixth the retail tenancy below. From the retail tenancy onwards, each component is set back from the street edge, with the central part of the H over 11M from Patrick Street. The remaining four legs of the H are set back from the street and set at different lengths to minimise the impact on the residential scale buildings across the street.

3. Modulate between disparate neighbouring scales of the streetscape to link RACT House and 60 Patrick Street,

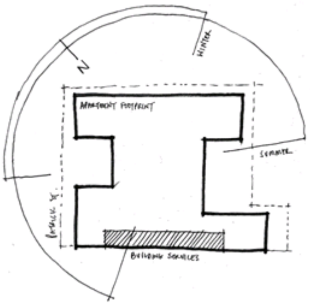


The two components that form the legs of the 'H' which faces Patrick Street, have been designed to step down the height from six to four to two storeys, as a gesture to connect RACT House to 60 Patrick Street. These elements sit in the foreground to the central linking element that references the overall height of RACT House, and helps to repair the streetscape.

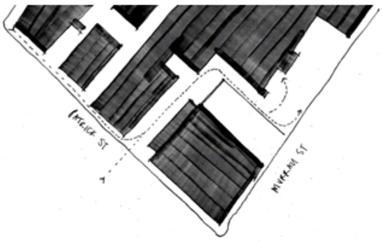
4. Cover the blank RACT House wall with a fine-grained texture to mimic the urban streetscape beyond, especially when viewed from Elizabeth Street and further up Patrick Street.

The building arrangement that emerged as the most suitable adopted a plan in the shape of an 'H,' with each apartment opening outwards and connected by an internal circulation spine. By simply alternating the combination of apartment types on each level, it was possible to create a fine-grained texture by stepping balconies in and out, alternating glazing and wall surfaces and varying different component heights.

5. Place all services and circulation to the South of the building to take advantage of the sites North facing solar orientation,

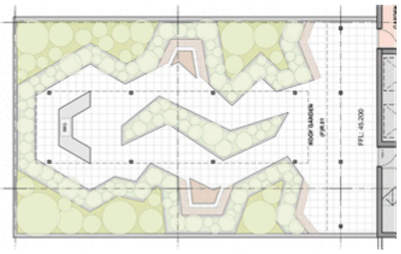


6. Create a pedestrian link to Murray Street, via the existing R.O.W. adjacent to Harvey Norman.

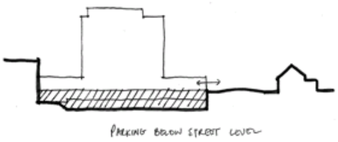


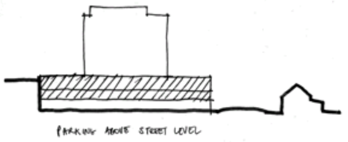
DIRECTORS
JOHN BUTTON
PAUL COCKBURN
HBV UNIT TRUST
A.B.N 44 861 614 012
EHWB P/L A.C.N 080 482 984

7. Provide communal and stepped gardens on roof tops for the amenity of building residents and to assist in the greening of the Hobart CBD fringe.



8. Activate the street by providing a retail tenancy at street level and reduce the overall height, and mass of the Patrick Street frontage by providing parking below ground level.





Basement car parking was deemed the most desirable outcome to service the proposed apartments, as it reduces the overall height, avoids ugly and imposing above ground car parking, and removes the need for on street car parking. Areas of high archeological potential are identified where bulk excavation is to occur for the basement levels. This is viewed as a necessity as it ensures that the street edge remains active and the overall height of the building is minimised. We will look to offset this by providing developer funded archeological research and installing publicly accessible site interpretation based on the research and findings.

Thank you for your consideration of the attached. It has been our focus to submit a considered and sympathetic proposal that is appropriate to the site. Please contact the undersigned directly to discuss in detail or for further information as required.

Yours sincerely,

JACOB BRITTEN
HBV ARCHITECTS

31 July 2019

DIRECTORS
JOHN BUTTON
PAUL COCKBURN
HBV UNIT TRUST
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From: Frazer Read
To: "ayersh@hobartcity.com.au"
Subject: Further Information- PLN-19-486 - 179-191 MURRAY STREET HOBART TAS 7000
Date: Thursday, 12 December 2019 7:09:00 AM
Attachments: PLN-19-486 - 179-191 MURRAY STREET HOBART TAS 7000 - Planning Letter Invalid Application (1).PDF
Amended footing details and stormwater protection works.pdf
62-64 Patrick St response to No3 RFI.pdf

Hi Helen, I refer to your letter 5 December and provide amended engineering details confirming that the stormwater protection works do not involve work outside the site.

Further details in relation to the construction methodology and construction management to protect the stormwater infrastructure will be provided prior to commencement of work and would sensibly be required as a condition on the planning permit.

I also attach Midson Traffic's response to the matter of swept paths.

I will lodge this information through the web portal also
Regards

Frazer Read
Principal

Call 0400 109 582 Email frazer@allurbanplanning.com.au
19 Mawhera Ave, Sandy Bay Tasmania 7005
allurbanplanning.com.au

AllUrbanPlanning

PIA Registered Planner
Planning Institute Australia

From: ayersh@hobartcity.com.au <ayersh@hobartcity.com.au>
Sent: Thursday, 5 December 2019 3:10 PM
To: Frazer Read <frazer@allurbanplanning.com.au>
Subject: Invalid Application - PLN-19-486 - 179-191 MURRAY STREET HOBART TAS 7000

Dear Frazer,

Your planning application is currently invalid.

Please find a link below to a letter detailing why your application is invalid, and what you can do to make your application valid.

https://HobartCityCouncil.sharefile.com/d/s3eea84cb75545758

Note: The above link will expire in 14 days. Please download and save the documents within this time frame.

The letter also foreshadows additional information that will be required to assess the planning application once it is valid.

Please submit the required documentation through the City of Hobart online services e-planning.

Kind regards

Helen Ayers
Development Appraisal Planner | City Planning

Telephone (03) 6238 2820
16 Elizabeth Street, Hobart, Tasmania, Australia, 7000 | hobartcity.com.au

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MIDSON
traffic
pty ltd

Keith Midson
Midson Traffic Pty Ltd
25 Hinman Drive
Kingston TAS 7050
0437 366 040

11 December 2019

Frazer Read
All Urban Planning
obo Failla Pty Ltd
19 Mawhere Ave
Sandy Bay TAS 7005

Dear Frazer,

179-191 Murray St & 62 Patrick St – Response to Council RFI

This letter has been prepared in response to Council's second request for information regarding the abovementioned development proposal dated 5th December 2019. Specifically this letter addresses Council's PA7 'Road and Railway Assets Code' section.

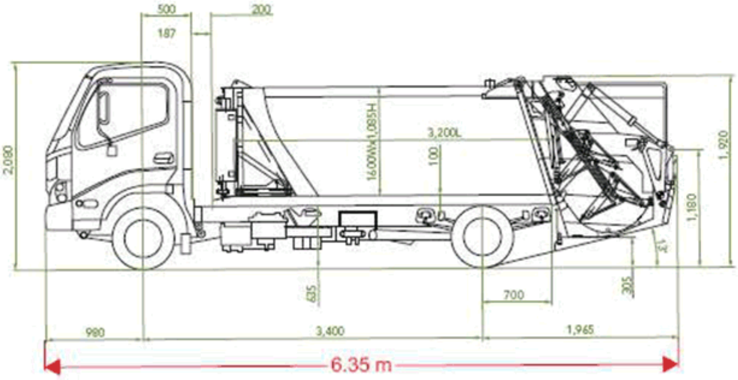
The response is outlined in the following sections.

1. Swept Path Diagrams

> *"An traffic impact statement (or addendum to the existing traffic impact statement) prepared by a suitably qualified traffic engineer, making particular reference to the following:*
>
> *The swept path diagrams provided show the entry and exit manoeuvres at the site access for a 6m vehicle and not a garbage truck vehicle which was what was requested in City of Hobart's Request for Information. It is expected that a garbage truck vehicle would have similar dimensions as an 8.8m service vehicle (refer to Austroads Design Vehicles and Turning Path Templates Guide)". Or the applicant can provide dimension information and swept paths for a specific garbage truck vehicle that would be expected to access the site".*

Swept paths were originally provided (in the previous response to Council RFI dated 14th October 2019) for a 6.0 metre service vehicle. It is common practice for developments to utilise a small truck for waste removal (hotels, high-density residential apartments and the like). An example of a Veolia garbage truck that is currently in use in Tasmania is shown in Figure 1.

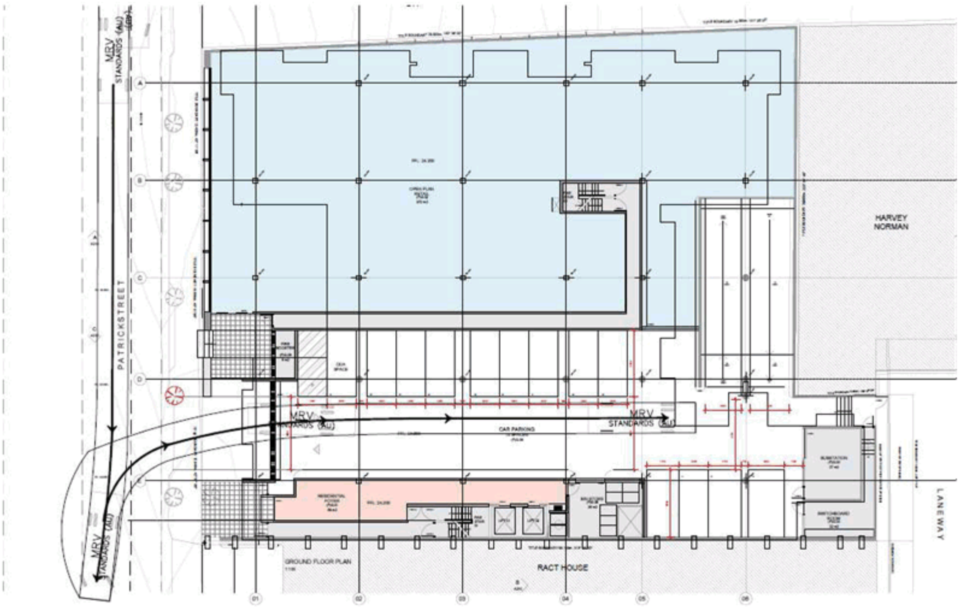
Figure 1 Veolia 6.35m Garbage Truck



The swept path for the 6.0m service vehicle that was provided in the previous response to Council's request for information has a very similar swept path (noting that the wheel base of the 6.0m truck tested in the swept path has a slightly longer wheel base and therefore the Veolia example would follow a very similar swept path).

A swept path assessment of an 8.8m service vehicle is provided in Figure 2. Note that a vehicle of this size cannot turn on-site. A reverse entry manoeuvre is therefore required. This would require a site traffic management plan that ensures that the reversing manoeuvre is safe and does not impact on the normal operation of the car park (such as manoeuvres undertaken prior to 7:00am or similar, etc). The requirements for waste removal are lower than other land uses (such as a hotel). Such reversing manoeuvres are also considered commonplace in city environments.

Figure 2 8.8m Service Vehicle Access



Please contact me on 0437 366 040 if you require any further information.

Yours sincerely,

Keith Midson BE MTraffic MTransport FIEAust CPEng EngExec NER

DIRECTOR
Midson Traffic Pty Ltd

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Keith Midson
Midson Traffic Pty Ltd
18 Earl Street
Sandy Bay TAS 7005
0437 366 040

14 October 2019

Frazer Read
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Sandy Bay TAS 7005

Dear Frazer,

179-191 Murray St & 62 Patrick St – Response to Council RFI

This letter has been prepared in response to Council's second request for information regarding the abovementioned development proposal dated 2nd October 2019. Specifically this letter addresses Council's PA7 'Road and Railway Assets Code' section.

The response is outlined in the following sections.

1. Swept Path Diagrams

> *"A traffic impact statement (or addendum to the existing traffic impact statement) prepared by a suitably qualified traffic engineer, making particular reference to the following:*
>
> - *Swept path diagrams that demonstrate that the design vehicle can turn into and out of the subject site to from the Patrick Street road reservation".*

The swept paths of entry and exit manoeuvres of the design vehicle (garbage truck) at the site's access is shown in Figure 1 and Figure 2. These swept paths clearly demonstrate that the design vehicle can turn into and out of the subject site from to Patrick Street.

Figure 1 Access Swept Path Entry Manoeuvre

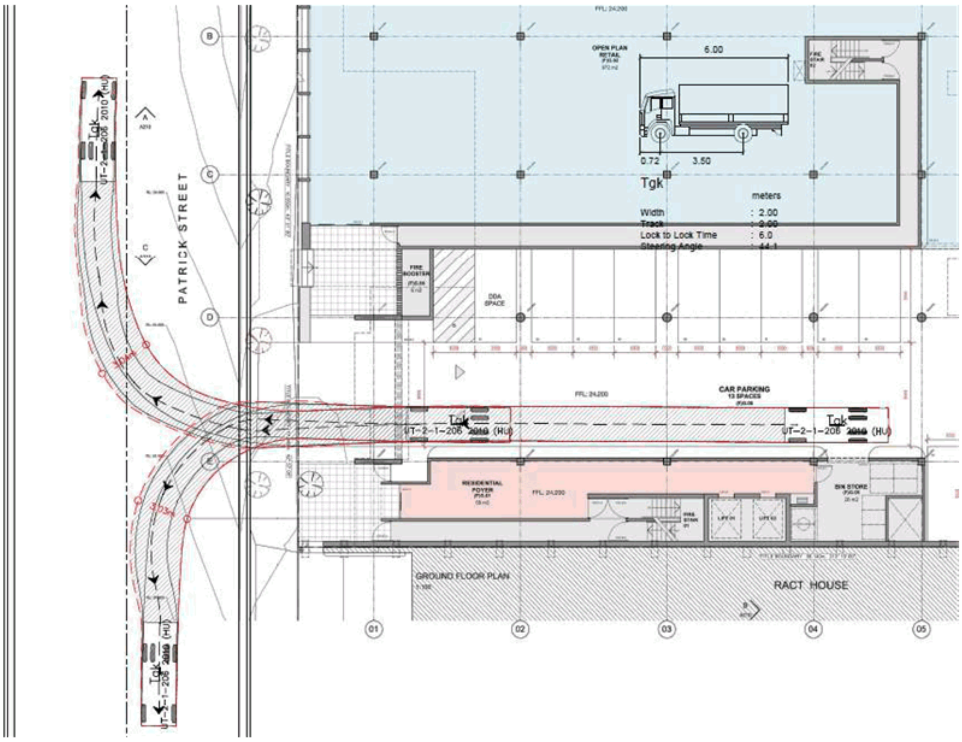
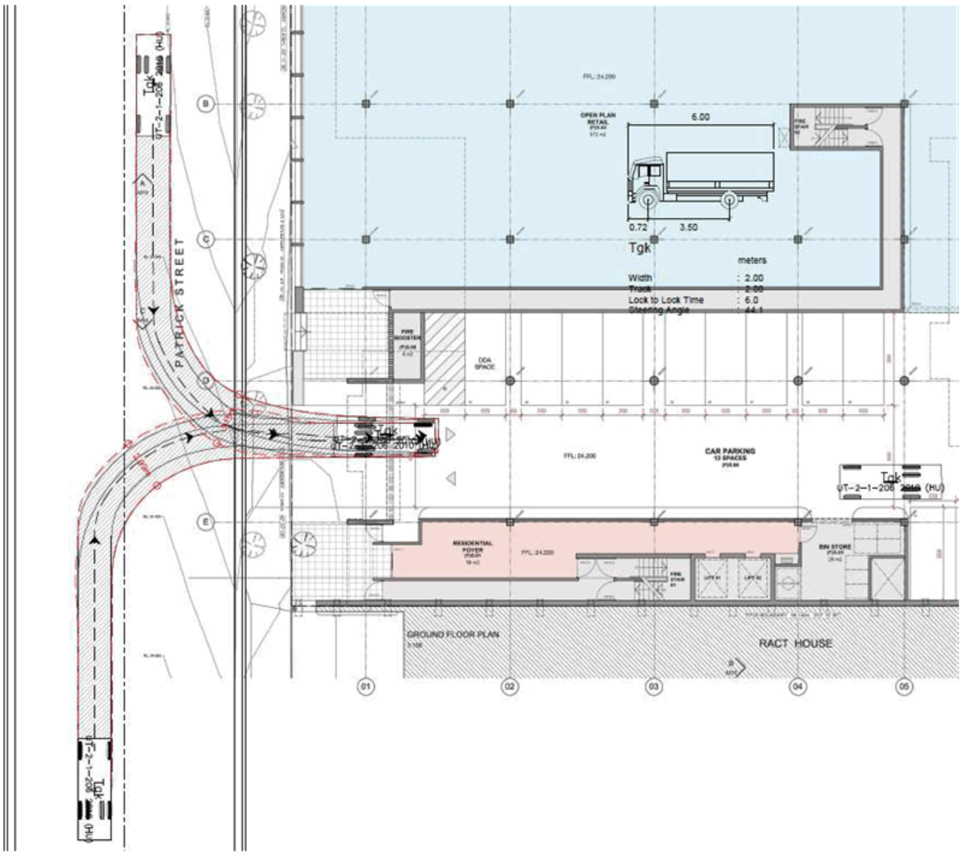


Figure 2 Access Swept Path Exit Manoeuvre



2. Traffic Impacts

> *"A traffic impact statement (or addendum to the existing traffic impact statement) prepared by a suitably qualified traffic engineer, making particular reference to the following:*
>
> - *A description of the expected impact that the vehicular traffic generated by the development would have on Patrick Street in the vicinity of the subject site, and at the immediately adjacent intersections".*

The TIA identified that the traffic generation of the development would be:

Residential component daily traffic generation	311 vehicles per day
Residential component AM peak generation	36 vehicles per hour
Residential component PM peak generation	22 vehicles per hour
Retail component daily traffic generation	650 vehicles per day
Retail component peak traffic generation	62 vehicles per hour
Total daily traffic generation	961 vehicles per day
Total peak traffic generation (PM)	98 vehicles per hour

It is noted that the retail component's traffic generation will be disbursed in the network, with parking occurring on-street in the surrounding network. Only a relatively small component of the traffic generation associated with the retail component will occur at the site's driveway access. This is due to the fact that only a small number of parking spaces are located on-site and therefore cannot cater for all traffic movements associated with this component of the development.

Based on the provision of 9 on-site car parking spaces for the commercial component of the development, it is likely that the traffic generation at the site's access will be in the order of 90 vehicles per day. The balance of traffic generation will be in the surrounding road network (assuming one-half will utilise Patrick Street and one-half will utilise Murray Street and Elizabeth Street). This equates to 480 vehicles per day using Patrick Street, 90 of which will utilise the access of Patrick street.

It is further noted that the existing site currently generates traffic that will be removed from the network. The net difference in traffic generation is therefore less than the calculations provided in the TIA (replicated above). Based on the size of the existing car park and the existing use of the site, the traffic generation of the site is likely to be in the order of 150 vehicles per day.

The net traffic generation at the site's access is therefore likely to be in the order of 401 vehicles per day. The net traffic generation within Patrick Street is likely to be 636 vehicles per day.

The existing traffic volumes on Patrick Street adjacent to the subject site are estimated to be 1,500 vehicles per day. The net increase of 636 vehicles per day can be readily absorbed in Patrick Street without any significant loss of efficiency. The net peak traffic increase in Patrick Street is likely to be in the order of 65 vehicles per hour.

The intersections at either end of Patrick Street consist of the following:

- Patrick Street   Murray Street   traffic signals.
- Patrick Street   Elizabeth Street   give-way control. Exit from Patrick Street is via left-turn only.

Assuming a relatively even distribution of traffic entering exiting the site to from Elizabeth and Murray Streets, this equates to a net increase of:

- 318 vehicles per day at each intersection.
- Peak of 33 vehicles per hour at each intersection

Based on the existing low volumes of traffic utilising Patrick Street at each intersection, the increased traffic generation will not have any significant adverse impacts on traffic efficiency.

Please contact me on 0437 366 040 if you require any further information.

Yours sincerely,

Keith Midson BE MTraffic MTransport FIEAust CPEng EngExec NER

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25 Hinman Drive
Kingston TAS 7050
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19 September 2019

Frazer Read
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19 Mawhere Ave
Sandy Bay TAS 7005

Dear Frazer,

179-191 Murray St & 62 Patrick St – Response to Council RFI

This letter has been prepared in response to Council's request for information regarding the abovementioned development proposal. Specifically this letter addresses Council's 'Parking and Access' section.

The response is outlined in the following sections.

1. PA – Scaled and Dimensioned Plans

Scaled and dimension plan(s) demonstrating on site turning for a B85 vehicle in accordance with the AS N S 2890.1:2004 Parking Facilities Part 1: Offstreet car parking or a design that ensures a safe and efficient turning.

To satisfy Hobart Interim Planning Scheme 2015 clauses E6.7.4 Acceptable Solution A1 the scaled and dimensioned design drawings must include:

- *Plan view demonstrating onsite turning for a garbage truck such that garbage trucks can enter and exit the property in a forward direction.*

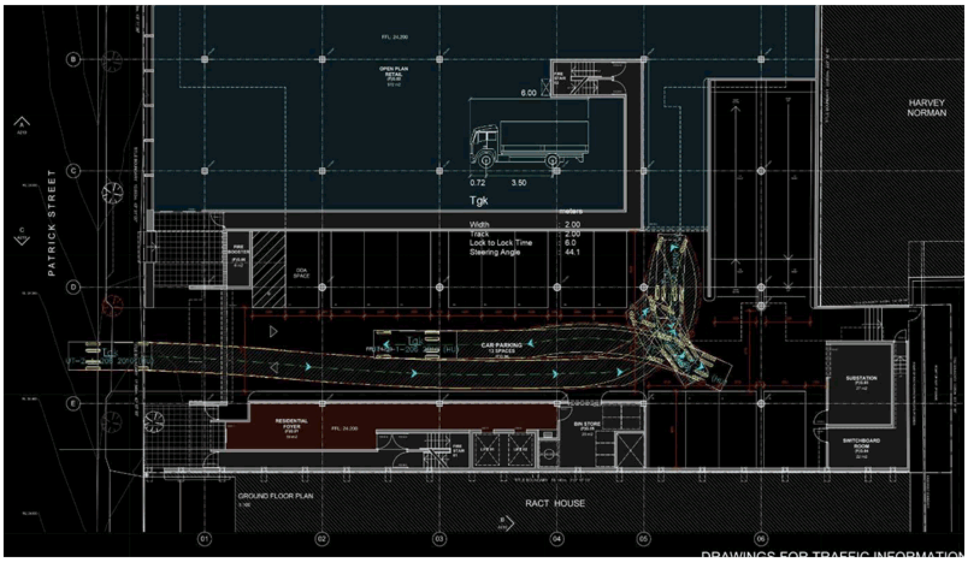
here the design drawing(s) do not comply with the above clauses, provide a certification by a suitably qualified engineer that the design provides for a safe, efficient and convenient access. This will then be assessed under performance criteria of the Hobart Interim Planning Scheme 2015.

Scaled and dimensioned plans have been prepared and are attached to this letter. These demonstrate that a B85 vehicle can access the car park and the spaces within the car park.

Figure 1 shows a garbage truck accessing the site, turning and exiting. The garbage truck proposed is a small 6m truck. Note that the truck can also reverse into the turning area and exit in a forwards direction (ie. turning is available by two methods).

Garbage removal would be once per week at a time that does not conflict with peak traffic generation associated with the residential or commercial components to the site.

Figure 1 Garbage Truck Service Vehicle Access Swept Path



2. PA5.1 Scaled and Dimensioned Plans

Scaled and dimensioned plan(s) showing the layout of car parking spaces, turning areas, driveway and access designed to comply with AS N S 2890.1:2004 or a design which ensures that parking areas enable safe, easy and efficient use.

To satisfy Hobart Interim Planning Scheme 2015 clauses E6.7.5 Acceptable Solution A1 the scaled and dimensioned design drawings must include:

- *A layout of car parking spaces, access aisles, circulation roadways and ramps, turning areas and driveway that is designed to comply with Section 2 of AS N S 2890.1:2004 and must have sufficient headroom to comply with Section 5.3 of AS N S 2890.1:2004.*

here the design drawing(s) do not comply with the above clauses, provide a certification by a suitably qualified engineer that the design is safe and ensures ease of access, egress and manoeuvring on site. This will then be assessed under performance criteria of the Hobart Interim Planning Scheme 2015.

To satisfy clauses E6.7.5 Acceptable Solution A1, AS N S 2890.1:2004 Section 2 and AS N S 2890.1:2004 Section 5.3, please state the following:

- *Confirm the classification of User Class for the offstreet car parking facility associated with the retail component and the location of any of these spaces*
- *Confirm all spaces where one side is confined by a wall or other high vertical obstruction closer than 300mm to the nominal edge of the car parking space have been increased by 300mm to provide manoeuvring clearances, measured to the vertical obstruction.*

> *here the design drawing(s) do not comply with the above clause and or AS N S 2890.1:2004 provide a certification by a suitably qualified engineer that the design provides for a safe and efficient access, this will then be assessed under Performance Criteria of the Hobart Interim Planning Scheme 2015.*

Scaled and dimensioned plans have been prepared and are attached to this letter. The key dimensions of the car park are outlined as follows:

- Space width 2.4 metres
- Space length 5.5 metres
- Aisle idth 6.0 metres

The required AS2890.1 dimensions are as follows:

Residential component

- User Class 1A residential, domestic and employee parking
- Space width 2.4 metres
- Space length 5.4 metres
- Aisle width 5.8 metres

Commercial component

- User Class 3 short term city town centre parking, parking stations, hospital medical centres
- Space width 2.6 metres
- Space length 5.4 metres
- Aisle width 5.8 metres

The residential spaces therefore comply with the dimension requirements of User Class 1A in Australian Standards, AS2890.1:2004 (Residential, domestic and employee parking).

The commercial component has a reduced width (2.4m provided, 2.6m required), but a larger aisle width (6.0m provided, 5.8m required). The increased aisle width improves car parking space accessibility. Note that these spaces comply with residential and employee parking requirements (again with an extended aisle width to improve accessibility) and therefore can be easily accessed by a B85 vehicle. To comply, it would be possible to reconfigure the commercial parking spaces (located on the main access aisle on the ground floor) to increase the widths. Alternatively, these spaces could be classified as staff parking and therefore comply with the requirements of User Class 1A.

The access aisle and ramps were assessed in the TIA:

- The ramps within the car park have a maximum grade of 20 , which is permitted under AS2890.1. Transitions are provided at 1:8 for 2 metres at the top and bottom of the ramps as required by AS2890.1.
- The access driveway has a width of 6.0 metres and a length of 27.1 metres. AS2890.1 requires a minimum access width of 6.0 metres, which is provided.

- Section 5.3 of AS2890.1 requires a minimum headroom of 2.2 metres (with 2.3 metres minimum required above a disabled space). The minimum height of the internal access driveway is 2.5 metres, thus complying with AS2890.1 requirements.

The car park has several blind aisles. The width of these spaces has been increased by 0.1 metres and a blind aisle extension of 1.0 metres has been provided in accordance with AS2890.1 requirements (Clause 2.4.2(c) of AS2890.1). Note that the requirement for extension of 0.3 metres only applies to spaces that are bounded by a wall or fence which is not the case for this development.

3. PA5.2 85 Swept Paths

Scaled and dimension drawing(s) showing vehicular swept paths (turning paths) into and out of all of the proposed car parking space(s) for a B85 vehicle in accordance with AS N S 2890.1:2004, or a design that ensures safe and efficient vehicular manoeuvring.

To satisfy Hobart Interim Planning Scheme 2015 clauses E6.7.5 Acceptable Solution A1 the scaled and dimensioned design drawings must include:

- *Standard single turn B85 swept paths (including 300mm manoeuvring clearance) into and out of all the circulation ramps, ensuring parking aisles are designed so that both the approach circulating ramps and the intersection areas are wide enough to accommodate turning vehicles and there is adequate intersection sight distance.*
- *Intersection areas designed for use by one vehicle at a time shall be designed for use by the B99 vehicle. Areas in which it is necessary for two vehicles to pass one another shall be designed for use by the B85 vehicle to pass a B99 vehicle. In both cases areas shall be checked using single turn swept path templates for B99 vehicle and B85 vehicle respectively. Swept paths must not conflict with structures or fixed objects.*

here the design drawing(s) do not comply with the above clauses, provide a certification by a suitably qualified engineer that the design is safe and ensures ease of access, egress and manoeuvring on site. This will then be assessed under performance criteria of the Hobart Interim Planning Scheme 2015.

Scaled and dimensioned plans have been prepared and are attached to this letter. These demonstrate that a B85 vehicle can access the car park, circulation ramps and the spaces within the car park. Note that the parking spaces comply with the dimensional requirements of AS2890.1 for User Class 1A (with an aisle width that exceeds the minimum dimensions). By default, B85 vehicles can access the parking spaces within the car park.

In terms of sight distance, the ramps will have good visibility for vehicles entering and exiting the ramps. Sight distance is only required in one direction only due to the physical location of the ramps at the eastern side of the car park.

There are no specific areas intersections within the car park that are designed for use by one vehicle at a time. The intersections within the car park are simply components of the circulation within the car park itself and the ramp accesses. There are no specific areas where it is necessary for two vehicles to pass in areas that are relatively tight (namely the ramp accesses), it is possible for a vehicle to stop and wait for a vehicle travelling in the opposing direction.

AS2890.1 states the following with respect to a B99 vehicle:

> *"design dimensions based on the B99 vehicle are required at all locations where failure of a vehicle to be able to physically fit into the facility would occasion intolerable congestion and possible hazard. Such locations shall include all access driveways, ramps and circulation roadways, unless there are special circumstances of severe space limitation coupled with relatively low traffic volumes in which case the B85 dimensions may be used".*

In this case the car park is accessible by a B99 vehicle. There is no area that would cause 'intolerable congestion and possible hazard', and the volumes are very low due to the nature of the majority of the car park being a domestic car park.

Please contact me on 0437 366 040 if you require any further information.

Yours sincerely,

Keith Midson BE MTraffic MTransport FIEAust CPEng EngExec NER

DIRECTOR
Midson Traffic Pty Ltd

MIDSON
traffic
pty ltd

effernan utton Voss Architects

62-6 Patrick Street Apartments
Traffic Impact Assessment

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Contents

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Figure Index

1. Introduction

1.1 Background

Midson Traffic were engaged by Heffernan Button Voss to prepare a traffic impact assessment for a proposed residential unit development at 62-64 Patrick Street, Hobart.

1.2 Traffic Impact Assessment TIA

A traffic impact assessment (TIA) is a process of compiling and analysing information on the impacts that a specific development proposal is likely to have on the operation of roads and transport networks. A TIA should not only include general impacts relating to traffic management, but should also consider specific impacts on all road users, including on-road public transport, pedestrians, cyclists and heavy vehicles.

This TIA has been prepared in accordance with the Department of State Growth (DSG) publication, *A Framework for Undertaking Traffic Impact Assessments*, September 2007. This TIA has also been prepared with reference to the Austroads publication, *Guide to Traffic Management,* Part 12: *Traffic Impacts of Developments*, 2009.

Land use developments generate traffic movements as people move to, from and within a development. Without a clear understanding of the type of traffic movements (including cars, pedestrians, trucks, etc), the scale of their movements, timing, duration and location, there is a risk that this traffic movement may contribute to safety issues, unforeseen congestion or other problems where the development connects to the road system or elsewhere on the road network. A TIA attempts to forecast these movements and their impact on the surrounding transport network.

A TIA is not a promotional exercise undertaken on behalf of a developer a TIA must provide an impartial and objective description of the impacts and traffic effects of a proposed development. A full and detailed assessment of how vehicle and person movements to and from a development site might affect existing road and pedestrian networks is required. An objective consideration of the traffic impact of a proposal is vital to enable planning decisions to be based upon the principles of sustainable development.

This TIA addresses E5.0, *Road and Railway Assets* Code, and E6.0, *Parking and Access Code,* of the Hobart Interim Planning Scheme, 2015.

1.3 Statement of Qualification and Experience

This TIA has been prepared by an experienced and qualified traffic engineer in accordance with the requirements of Council's Planning Scheme and The Department of State Growth's, *A Framework for Undertaking Traffic Impact Assessments*, September 2007, as well as Council's requirements.

The TIA was prepared by Keith Midson. Keith's experience and qualifications are briefly outlined as follows:

- 23 years professional experience in traffic engineering and transport planning.
- Master of Transport, Monash University, 2006
- Master of Traffic, Monash University, 2004

Bachelor of Civil Engineering, University of Tasmania, 1995

Engineers Australia: Fellow (FIEAust) Chartered Professional Engineer (CPEng) Engineering Executive (EngExec) National Engineers Register (NER)

1. Project Scope

The project scope of this TIA is outlined as follows:

Review of the existing road environment in the vicinity of the site and the traffic conditions on the road network.

Provision of information on the proposed development with regards to traffic movements and activity.

Identification of the traffic generation potential of the proposal with respect to the surrounding road network in terms of road network capacity.

Review of the parking requirements of the proposed development. Assessment of this parking supply with Planning Scheme requirements.

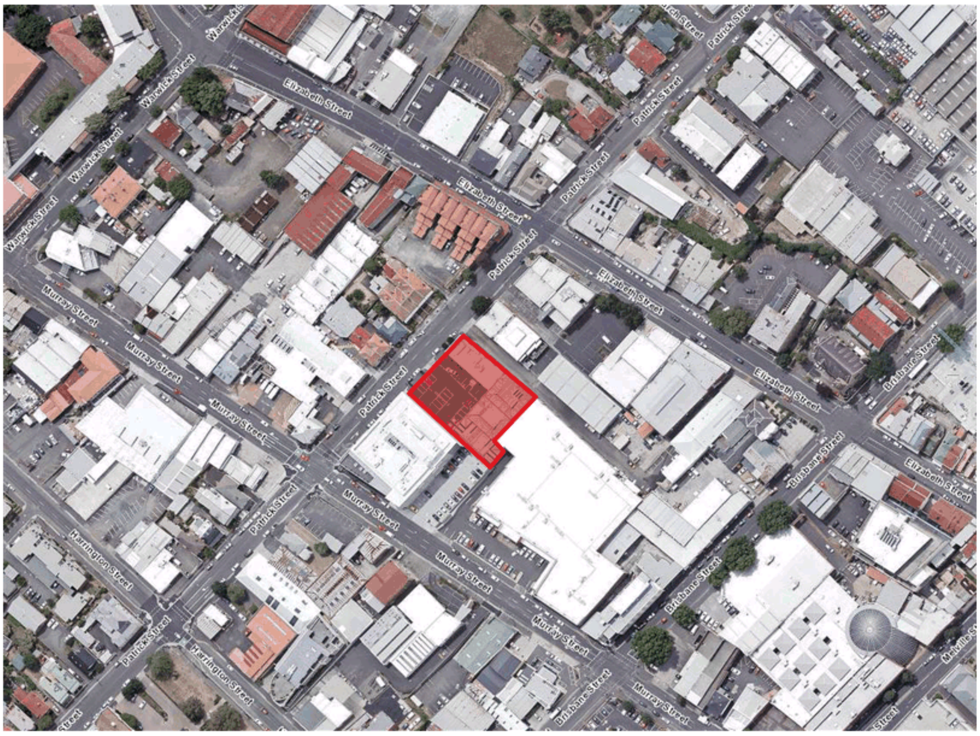
Traffic implications of the proposal with respect to the external road network in terms of traffic efficiency and road safety.

1.5 Subject Site

The subject site is located at 62-64 Patrick Street, Hobart. The site is currently a warehouse and an open car park.

The subject site and surrounding road network is shown in Figure 1.

Figure 1 Subject Site & Surrounding Road Network



<u>Image Source</u>: LIST Map, DPIPWE

1.6 Reference Resources

The following references were used in the preparation of this TIA:

- Hobart Interim Planning Scheme, 2015 (Planning Scheme)
- Austroads, *Guide to Traffic Management,* Part 12: *Traffic Impacts of Developments*, 2009
- Austroads, Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections, 2019
- Department of State Growth, *A Framework for Undertaking Traffic Impact Assessments*, 2007
- Roads and Maritime Services NSW, *Guide to Traffic Generating Developments*, 2002 (RMS Guide)
- Roads and Maritime Services NSW, *Updated Traffic Surveys,* 2013 (Updated RMS Guide)
- Australian Standards, AS2890.1, *Off-Street Parking*, 2004 (AS2890.1:2004)

2. Existing Conditions

2.1 Transport Network

For the purpose of this report, the transport network consists of Patrick Street, Murray Street and Elizabeth Street.

2.1.1 Patrick Street

Patrick Street connects between Campbell Street at its northern end and Hill Street at its southern end. Near the subject site is carries approximately 1,500 vehicles per day. Patrick Street adjacent to the subject site is shown in Figure 2.

It connects to Elizabeth Street at a give-way controlled intersection, with Elizabeth Street having priority (with left-turn only control from Patrick Street southern approach into Elizabeth Street). The Murray Street intersection is controlled by traffic signals (installed in 2015).

On street parking is provided on both sides of Patrick Street between Elizabeth Street and Murray Street in the form of 1/2P, 1/4P and 1P time restrictions. A short section of uncontrolled on-street parking is available on the eastern side of Patrick Street near the Murray Street intersection. Two loading zones are installed on the western side of Patrick Street.

Figure 2 Patrick Street

2.1.2 Elizabeth Street

Elizabeth Street is a major arterial corridor that connects Hobart CBD to North Hobart and areas to the north. It is a two-lane, two-way road that carries approximately 12,000 vehicles per day between Warwick Street and Patrick Street. Traffic volumes in Elizabeth Street steadily increase to approximately 20,000 vehicles per day further towards Augusta Road.

Elizabeth Street is an important transit corridor, with regular Metro bus services operating between Hobart and the northern suburbs.

2.1.3 Murray Street

Murray Street connects between Burnett Street in North Hobart and Morrison Street in Sullivans Cove. It has a one-way flow in an eastbound direction between Warwick Street and Morrison Street, with 2 or 3 lanes along its length.

2.2 Road Safety Performance

Crash data can provide valuable information on the road safety performance of a road network. Existing road safety deficiencies can be highlighted through the examination of crash data, which can assist in determining whether traffic generation from the proposed development may exacerbate any identified issues.

Crash data was obtained from the Department of State Growth for a 5 year period between 1st January 2014 and 31st March 2019 for Patrick Street between Elizabeth Street and Murray Street.

The findings of the crash data is summarised as follows:

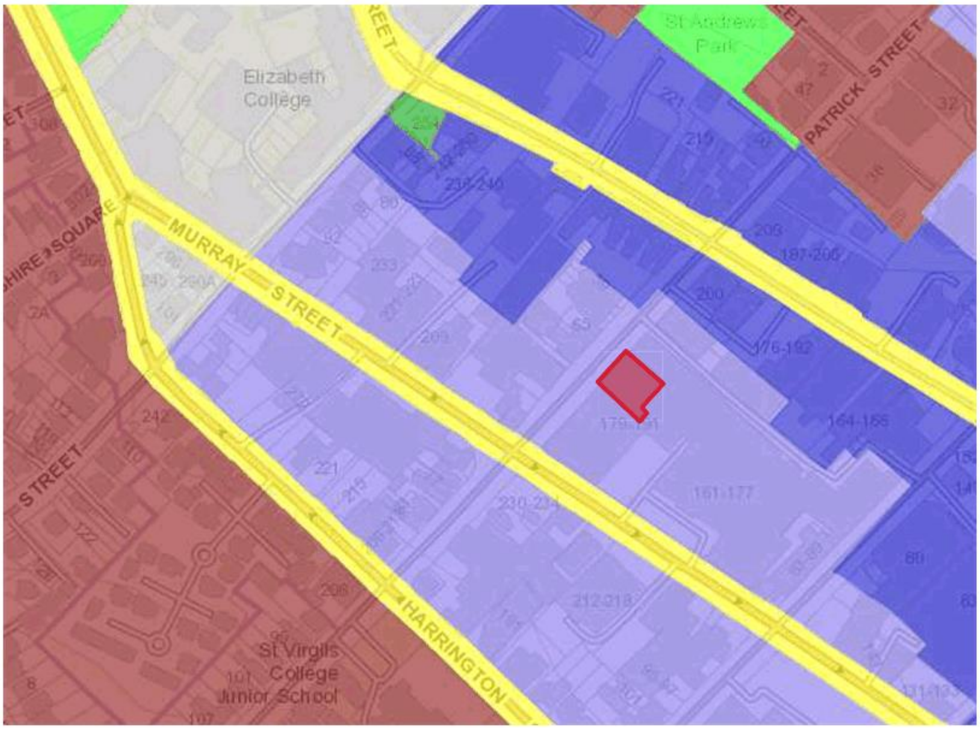
- A total of 12 crashes were reported during this time.
- Crash location. 5 crashes were reported at the Elizabeth Street junction and 7 crashes were reported at the Murray Street junction. No crashes were reported between the two junctions.
- Day of week. No clear trends were evident. 3 crashes were reported on Mondays and Tuesdays 2 crashes were reported on Thursdays and Fridays 1 crash was reported on a Wednesday and a Sunday no crashes were reported on Saturdays.
- Time of day. The majority of crashes were reported during typical working hours (10 crashes reported between 8:00am and 5:30pm). 1 crash was reported at 6:15am and one crash was reported at 9:09pm.
- Crash types. 6 crashes involved 'cross-traffic' collisions 2 crashes involved pedestrians 4 crashes of various types.
- Vulnerable road users. 2 crashes involved pedestrians 1 crash involved a bicycle.

The crash data is considered reasonably typical of busy city arterial roads (Murray Street and Elizabeth Street). The crash data for the Murray Street Patrick Street intersection includes a period of time prior to the installation of the traffic signals. The crash data does not provide an indication that there are any pre-existing road safety deficiencies that may be exacerbated by traffic generated by the proposed development. Importantly, no crashes were reported mid-block near the subject site, and no crashes involved vehicles emerging from property access or associated with parking manoeuvres.

2.3 Land Zoning

The subject site is zoned 'Commercial' under the Planning Scheme as shown in Figure 3.

Figure 3 Land Zoning



3. Proposed Development

3.1 Development Proposal

The proposed development involves the construction of a 7-storey building containing 68 residential apartments and a ground floor retail area. The development will include on-site car parking for 126 spaces over three levels.

The proposal includes the following:

9 x 1-bedroom apartments

31 x 2-bedroom apartments

23 x 3-bedroom apartments

5 x 4-bedroom apartments

972 m^2 ground floor open plan retail

The proposed development plans relating to access and car parking are shown in Figure 4, Figure 5 and Figure 6.

Figure **Proposed Development Plans – Ground Floor**

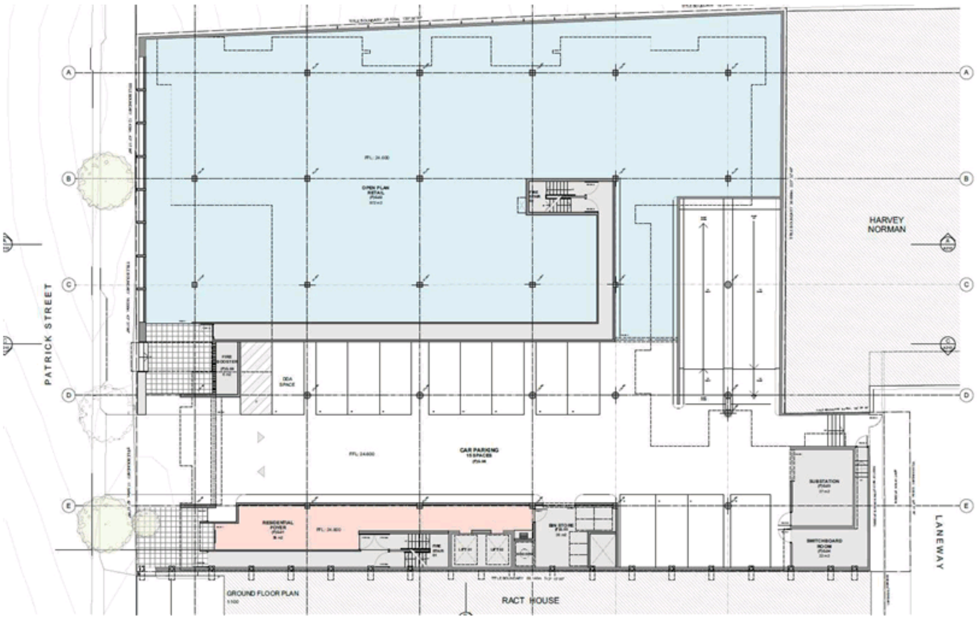


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Figure 5 Proposed Development Plans – asement Level

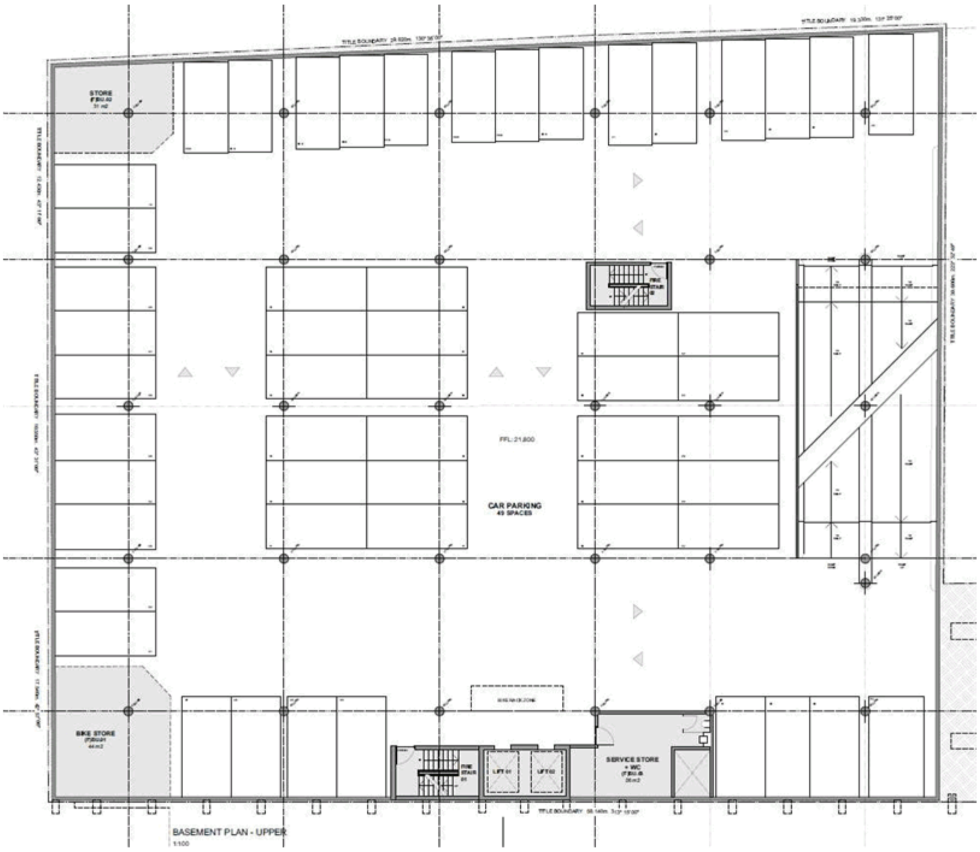
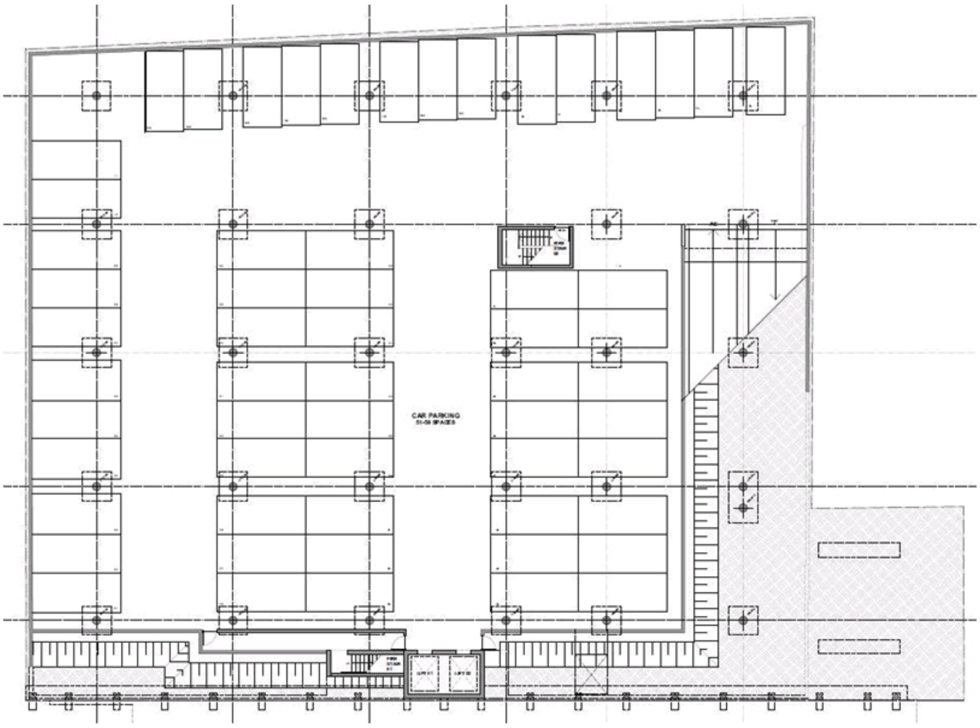


Figure 6 Proposed Development Plans – Lower asement Level



4. Traffic Impacts

.1 Traffic Generation

.1.1 Residential Component

For high density residential dwellings, the RMS Guide recommends a rate of 4.58 trips per day per dwelling, with a peak of 0.53 trips per dwelling per hour in the morning peak and 0.32 trips per hour in the evening peak.

This equates to the following residential traffic generation:

311 trips per day

36 trips per hour in the morning peak

22 trips per hour in the evening peak

.1.2 Retail Component

The retail component of the development is likely to generate 6.4 vehicles per hour per 100m^2 of floor area (based on RMS guide for bulky goods retail). This equates to a peak of 62 vehicles per hour. The daily generation is likely to be in the order of 650 vehicles per day.

It is noted that much of the retail traffic generation component will be in the surrounding road network, not at the access to the site. Only a small number of parking spaces are available for the retail component of the development (13 spaces located on the ground floor) and therefore the traffic generation of these spaces is likely to be relatively low at the access.

.1.3 Total Traffic Generation

The total traffic generation of the development is likely to be in the order of 961 vehicles per day, with a peak of 98 vehicles per hour.

.2 Trip Distribution

The trip distribution is likely to be relatively evenly split between Elizabeth Street and Murray Street approaches of Patrick Street.

.3 Access Impacts

Traffic generation at the site's access will be related to the activity associated with the on-site car parking spaces. The development provides a total of 126 spaces. The traffic generation associated with the on-site car parking is likely to be in accordance with the rates for parking spaces, which equate to:

412 trips per day

14 r r r r

45 trips per hour in the morning peak

33 trips per hour in the evening peak

The Acceptable Solution A2 of Clause E5.6.2 of the Planning Scheme states "*No more than one access providing both entry and exit, or two accesses providing separate entry and exit, to roads in an area subject to a speed limit of 60km h or less*".

The development provides one access providing both entry and exit movements, therefore satisfying the Acceptable Solution A2 of Clause E5.6.2 of the Planning Scheme.

. Sight Distance

The Acceptable Solution A1 of Clause E5.6.4 of the Planning Scheme states "*Sight distances at an access or junction must comply with the Safe Intersection Sight Distance shown in Table E5.1*".

The requirements of Table E5.1 for a vehicle speed of 50-km h in a speed limit of 60-km h or less (Patrick Street is 50-km h) is 80 metres. The available sight distance at the access's junction with Patrick Street exceeds this minimum requirement in both directions. It is further noted that the vehicle speeds are also lower than 50-km h due to relatively short length of the road and the narrow pavement width (thus resulting in a lower SISD).

The available sight distance therefore complies with the Acceptable Solution A1 of Clause E5.6.2 of the Planning Scheme.

.5 Pedestrian Impacts

A relatively high standard of pedestrian infrastructure is provided on all roads connecting to the site. Existing pedestrian infrastructure in the surrounding road network near the subject site consists of footpaths on both sides Patrick Street, as well as pedestrian activated crossings at all traffic signals in the surrounding network.

The nature of the development is likely to result in pedestrian movements to from the site to areas such as Hobart CBD and North Hobart.

Pedestrian access to the site is separated from the vehicular access.

.6 Road Safety Impacts

The proposed development was assessed against key road safety considerations. Road safety predominantly relates to the access conditions for all road users.

The following points are relevant for the proposed development:

Pedestrian access to the site is separated from the vehicular access.

Access conditions at Patrick Street is considered safe in terms of the speed environment and sight distance provision.

There is sufficient spare capacity in Patrick Street and the surrounding road network to absorb the predicted increase in peak hour traffic generated from the proposed development. No change to the level of service of the road network would be expected as a result of the development.

The crash history in the surrounding road network near the subject site does not indicate that there are any existing road safety issues that may be exacerbated by the increased traffic generated by the proposed development.

5. Parking Assessment

5.1 Parking Provision

The proposed development provides a total of 126 on-site car parking spaces as follows:

Ground floor	13 spaces
Basement B1	54 spaces (including 10 jockey style spaces)
Basement B2	59 spaces (including 16 jockey style spaces)

One parking space is provided for persons with a disability (located on the ground floor).

Bicycle parking is also provided on the Basement B2 level (44m^2).

5.2 On-Street Parking Provision

There is a relatively large pool of time-restricted on-street parking near the subject site. This parking is currently used for existing businesses. The site is effectively located between Hobart CBD and the North Hobart retail precinct, resulting in on-street parking being prioritised for customers of commercial land uses in the area.

The on-street parking management in Patrick Street, Murray Street and Elizabeth Street results in relatively good accessibility for short-term car parking supply.

5.3 Empirical Parking Demand

The RMS Guide recommends the following parking provision for high density residential dwellings:

Metropolitan sub-regional centres (non-CBD)
0.6 spaces per 1-bedroom unit
0.9 spaces per 2-bedroom unit
1.4 spaces per 3-bedroom unit
1 space per 5 units (visitor parking)

This equates to a residential parking provision of 87 spaces.

The retail component of the development is likely to require 1 space per 30m^2 of floor area, which equates to 33 spaces.

The total parking demands are therefore likely to be 120 spaces. The provision of 126 spaces caters for this demand.

5. Planning Scheme Requirements

The Acceptable Solution A1 of Clause E6.6.1 of the Planning Scheme states:

> *"The number of on-site car parking spaces must be no less than and no greater than the number specified in Table E6.1".*

Table E6.1 requires the following parking provision:

General retail and hire. 1 space per 30m² of floor area. 972m² floor area 33 spaces

Multiple dwelling containing 1 bedroom or studio. 1 for each dwelling and 1 dedicated visitor parking space per 4 dwellings 11.25 spaces (9 dwellings)

Multiple dwelling containing 2 or more bedrooms. 2 for each dwelling and 1 dedicated visitor parking space per 4 dwellings 118 spaces (dwellings) 14.75 spaces (visitor) 132.75 spaces

TOTAL Parking. 33 spaces 11.25 spaces 132.75 spaces 177 spaces

The development proposes 126 spaces, which is less than the requirements of Table E6.1. Therefore the requirements of Acceptable Solution A1 of Clause E6.6.1 of the Planning Scheme are not met.

The Performance Criteria P1 of Clause E6.6.1 of the Planning Scheme states:

> *"The number of on-site car parking spaces must be sufficient to meet the reasonable needs of users, having regard to all of the following:*
>
> *(a) car parking demand*
>
> *(b) the availability of on-street and public car parking in the locality*
>
> *(c) the availability and frequency of public transport within a 400m walking distance of the site*
>
> *(d) the availability and likely use of other modes of transport*
>
> *(e) the availability and suitability of alternative arrangements for car parking provision*
>
> *(f) any reduction in car parking demand due to the sharing of car parking spaces by multiple uses, either because of variation of car parking demand over time or because of efficiencies gained from the consolidation of shared car parking spaces*
>
> *(g) any car parking deficiency or surplus associated with the existing use of the land*
>
> *(h) any credit which should be allowed for a car parking demand deemed to have been provided in association with a use which existed before the change of parking requirement, except in the case of substantial redevelopment of a site*
>
> *(i) the appropriateness of a financial contribution in lieu of parking towards the cost of parking facilities or other transport facilities, where such facilities exist or are planned in the vicinity*
>
> *( ) any verified prior payment of a financial contribution in lieu of parking for the land*

> *(k) any relevant parking plan for the area adopted by Council*
>
> *(l) the impact on the historic cultural heritage significance of the site if subject to the Local Heritage Code*
>
> *(m) whether the provision of the parking would result in the loss, directly or indirectly, of one or more significant trees listed in the Significant Trees Code".*

The following is relevant with respect to the development proposal:

a. Car parking demand. The actual parking demands of the development are lower than the Planning Scheme Acceptable Solution. The likely parking demands are set out in Section 5.3. There is sufficient parking provision to cater for the likely parking demands of the development (further noting that residents living in these apartments would be aware of their parking allocation).

b. Availability of on-street and public car parking. On-street parking is available in the surrounding road network. Nearby public car parking stations include Hobart Central Car Park and Centrepoint Car Park.

c. Public transport. Metro Tasmania operates bus services along Elizabeth Street on a frequent basis.

d. Other modes of transport. The location of the site is likely to result in many customers of the retail component visiting as pedestrians.

e. Alternative parking arrangements. Alternative parking arrangements are not considered necessary as the development provides sufficient parking to cater for the likely needs of the site (as noted in a above).

f. Shared parking. Not applicable.

g. Parking deficiency or surplus. Not applicable.

h. Previous use parking credit. Not applicable.

i. Cash in lieu. Not applicable.

. Cash in lieu contribution. Not applicable.

k. Parking plan. Not applicable.

l. Cultural heritage significance. Not applicable.

m. Significant trees. Not applicable.

Based on the above assessment, the development meets the requirements of Performance Criteria P1 of Clause E6.6.1 of the Planning Scheme.

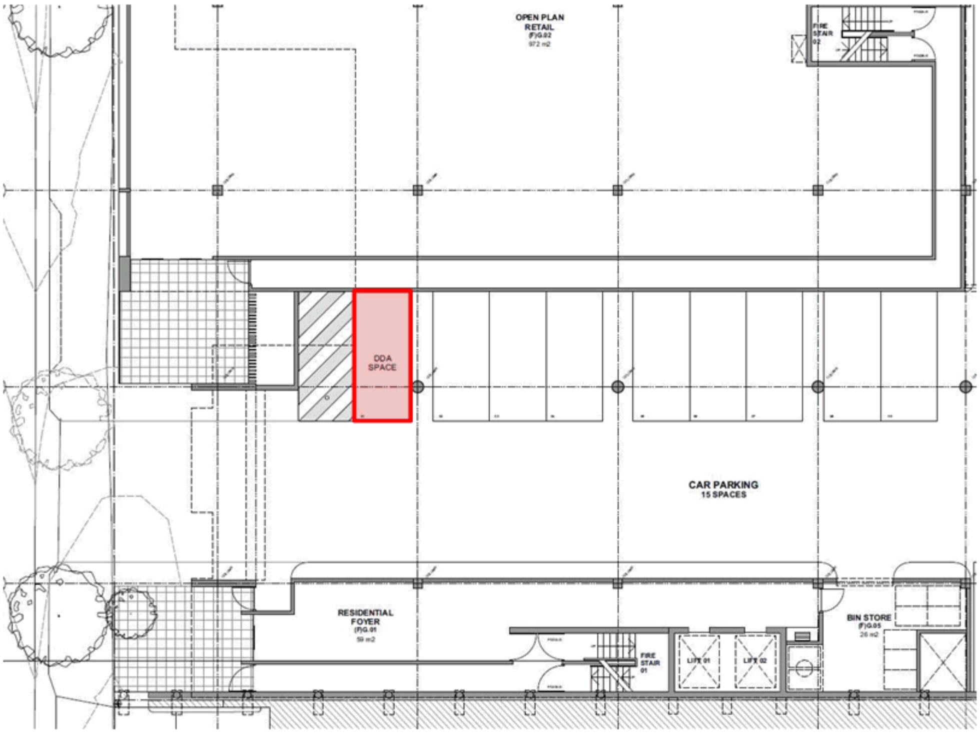
5.5 Accessible Parking

The Acceptable Solution A1 of Clause E6.6.2 of the Planning Scheme states that "*car parking spaces for people with a disability must: (a) satisfy the relevant requirements of the Building Code of Australia (b) be incorporated into the overall car parkin design and (c) be located as close as practicable to the building entrance*".

The National Construction Code (NCC) classifies the public area of the development as a Class 6 building. This includes the retail area and requires 1 space for every 50 car parking spaces or part thereof to be for persons with a disability.

If the parking supply associated with the retail component is considered, then the NCC requires a total of 1 disabled parking space. This space is provided on the ground level, as close as practicable to the building entrance, as shown in Figure 7.

Figure 7 Accessible Parking



5.6 icycle Parking

The Acceptable Solution A1 of Clause E6.6.4 of the Planning Scheme requires the number of on-site bicycle parking spaces to be provided to be no less than the number specified in Table E6.2 of the Planning Scheme.

Table E6.2 requires the following bicycle parking provision:

> Shop. Employee bicycle parking - 1 bicycle space for every 500m^2 floor area after the first 500m^2 of floor area customer bicycle parking 1 bicycle space for each 500m^2 floor area. This equates to a total bicycle provision of 1 staff and 2 customer spaces.
>
> Residential. No requirement.

The development proposes a bicycle parking area in the Upper Basement car parking level. This area is 44m^2 and therefore caters for the needs of Acceptable Solution A1 of Clause E6.6.4 of the Planning Scheme.

5.7 Car Parking Layout

The Acceptable Solution A1 of Clause E6.7.5 of the Planning Scheme states "*The layout of car parking spaces, access aisles, circulation roadways and ramps must be designed and constructed to comply with section 2 "Design of Parking Modules, Circulation Roadways and Ramps" of AS N S 2890.1:2004 Parking Facilities Part 1: Off-street car parking and must have sufficient headroom to comply with clause 5.3 "Headroom" of the same Standard*".

Typical car parking dimensions within the on-site car park are as follows:

Space width	2.4 metres
Space length	5.5 metres
Aisle idth	5.8 metres

These spaces therefore comply with the dimension requirements of User Class 1A in Australian Standards, AS2890.1:2004 (Residential, domestic and employee parking).

Ramps within the car park have a maximum grade of 20 , which is permitted under AS2890.1. Transitions are provided at 1:8 for 2 metres at the top and bottom of the ramps as required by AS2890.1.

The car parking design therefore complies with the requirements of Acceptable Solution A1 of Clause E6.7.5 of the Planning Scheme.

6. Conclusions

This traffic impact assessment (TIA) investigated the traffic and parking impacts of a proposed residential and retail development at 62-64 Patrick Street, Hobart.

The key findings of the TIA are summarised as follows:

The proposed development involves the construction of a 7-storey building containing 68 residential apartments and a ground floor retail area. The development will include on-site car parking for 126 spaces over three levels.

Access to the site is via a single driveway with a separated footpath.

The traffic generated by the development is likely to be 961 trips per day, with a peak of 98 trips per hour in the morning peak and 84 trips per hour in the evening peak.

The traffic generation will be concentrated at the site's access for the residential component of the development (412 vehicles per day, with a peak of 45 vehicles per hour). The retail component provides a small amount of on-site car parking and therefore some of the traffic generation associated with this component will be absorbed in the surrounding road network (as on-street car parking and parking in other sites near the development).

The development complies with Performance Criteria P1 of Clause E6.6.1 in terms of parking provision.

Based on the findings of this report above, the proposed development is supported on traffic grounds.

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Document Status

Revision	Author	Review	Date
0	Keith Midson	ara Kacic-Midson	1 uly 2019
1	Keith Midson	ara Kacic-Midson	3 uly 2019
2	Keith Midson	ara Kacic-Midson	19 uly 2019
3	Keith Midson	ara Kacic-Midson	26 uly 2019

GES

GEO-ENVIRONMENTAL

SOLUTIONS

SOIL AND WATER MANAGEMENT PLAN (SWMP)

62-64 PATRICK STREET, HOBART

For Heffeman Button Voss (HBV) Architects

November 2019

Geo-Environmental Solutions P/L 29 Kirksway Place, Battery Point 7004. Ph 6223 1839 Email: office@geosolutions.net.au

DOCUMENT CONTROL

Title	Version	Date	Author	Reviewed
Draft Soil & Water Plan, 62-64 Patrick Street, Hobart	Version 1	01/11/2019	Peri Lucas	JP Cumming
	Version 2	14/11/2019	Peri Lucas	JP Cumming

1 Introduction

Geo-Environmental Solutions Pty. Ltd. (GES) of 29 Kirksway Place, Battery Point, Tasmania were engaged by Heffeman Button Voss (HBV) (the 'Client') on behalf of their client to prepare a site Soil & Water Management Plan (SWMP) for 62 – 64 Patrick Street, Hobart - hereby referred to as 'The Site' for the proposed redevelopment of the site into a multilevel apartment building.

1.1 Assessment Framework

The proposed development flagged the Interim Planning Scheme (IPS) E2.0 Potentially Contaminated Land Code. As a result, GES completed a Contamination management Plan (CMP) report for the site in September 2019 in order to address potential contamination issues identified in the Environmental Site Assessment report (July 2019). The CMP report made a number of recommendations for site management to ensure environmental standards are maintained, including soil and water management. As a result, the permit authority has requested a formal soil and water management plan be prepared.

1.2 Conclusions From the CMP

The CMP made a number of recommendations to minimise the potential for contamination of stormwater and migration of contaminants including:

- Silt fencing is required around the perimeter of the site to reduce the extent of soil erosion from wind and rain (Fact Sheet 14 Appendix 1).
- Where possible overland flow should be diverted away from excavation workings to reduce the risk of surface waters becoming impacted as a result of mixing with contaminated soil (Fact Sheet 7 Appendix 1);
- The site will need to be regularly inspected for signs of scour including around all earthen drains (Fact Sheet 11 Appendix 4) and site slopes. Where scour is identified, erosion should be controlled with the use of erosion control matts and blankets (Fact Sheet 8 Appendix 1)
- Collect stormwater on-site and allow suspended solids to settle before disposal in accordance with EMPCA and/or local Water Authority requirements (Fact Sheet 17 Appendix 1).
- Control measures such as cut-off drains/mounds and or sand bags will be required to prevent soil and water from existing the site boundary at locations which are not identified as a legal point of discharge (LPOD).
- Silt traps will be required around all drainage pits to prevent soil from entering the stormwater system (Fact Sheet 15 Appendix 1). Soil collected around the pits will need to be excavated and placed into skip bins for disposal with other excavated soil. The silt traps will need to be regularly maintained and checked to ensure they are not discharging sediments into the stormwater.
- Install drainage and/or grade soil surfaces to minimise pooling of water on exposed soils. Pooling surface water may be contaminated and can be managed through placement of aggregate.

Given the contamination risks, as per the Hobart City Council Interim Planning Scheme (IPS), there is a requirement that this CMP document is implemented and followed to mitigate any adverse impact upon human health or the environment as a result of the proposed works.

1.3 Objectives

The objective of this SWMP is to comply with HCC IPS requirements. The purpose of this SWMP is to:

- Provide appropriate soil and water management advice to supplement the CMP;
- Minimise risks to the environment; and
- Provide advice on measures to be adopted during future excavation or construction works at the site.

1.4 Environmental Regulatory Requirements

Key regulations, legislation and policies considered most applicable to soil and groundwater management during any intrusive site works (excavation, construction or maintenance) include:

- Environmental Management and Pollution Control Act (1994).
- Environmental Management and Pollution Control (Waste Management) Regulations 2010.
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010
- Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (Version 3 2018), EPA Tasmania.
- NEPM (2013) National Environment Protection (Assessment of Site Contamination) Measure, 1999 as amended 2013.
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- ANZECC (2000) – Australian and New Zealand Environment & Conservation Council – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh Water Quality.
- DPIWE (1997) – State Policy on Water Quality Management, 1997.
- Australian Standard: AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds
- Australian Standard: AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances

1.5 Site Details

Site details are presented in Table 1 and the site investigation areas are presented in Figure 1.

Table 1 Site Details

Site Address 179-191 Murray Street, Hobart located at 62-64 Patrick Street.
Current Title identification details PID 2950042 Title Reference 175729/2
Investigation Area 2051m^2
Site Surfacing The surface of the investigation area is road base asphalt. Concrete in the warehouse.
Current land use Occupied by RACT.
Current Ownership (as per current certificates of title; the LIST) *6 Failla Avenue P/L*
Site Land Zoning and Land Use The site is *Commercial land use* under the Tasmanian Interim Planning Scheme, 2015.
Previous/ Historic Land use Hosted RACT and related business operations such as vehicle servicing and fuel storage.
Local Council Hobart City Council
Proposed Site Use Unknown
Requirement for current Investigation The site previously hosted underground fuel storage and there is a proposed change to a more sensitive land use.

1.6 Responsibility of Implementation

It will be the responsibility of the owner(s) of the site to implement this SWMP. The owner(s) of the site may at times expressly delegate responsibility for site management as appropriate. The site owner(s) retains overall responsibility for implementation of this SWMP and any modifications required to this SWMP should site conditions change.

The owner(s) of the site are responsible for the distribution of this SWMP to any contractors working on site associated with the site redevelopment and these contractors must comply with the requirements of this SWMP.

Figure 1 Aerial Photograph of Pre-Development Site for Construction (The LIST Map).

2 Soil and Water Management Plan

A high risk of stormwater pollution will occur from the site during the construction phase due to erosion and sediment transportation off site to the receiving environment. The majority of this risk results from construction activities disturbing the site and exposing areas of soil to the direct erosive influence of the environment. The following section outlines the procedures necessary to minimise erosion and control sediment during construction in accordance with the WSUD Manual and the International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*.

2.1 Key Pollutants

The following key pollutants have been identified for the construction phase of the development.

Key Pollutants, Construction Phase

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags, material off cuts.
Sediment	Exposed soils and stockpiles during earthworks and building works.
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary car park areas.
Toxic Materials	Cement slurry, asphalt primer, solvents, cleaning agents, and wash waters (e.g., from tile works).
Acids or Alkaline substances	Acid sulphate soils, cement slurry and wash waters.

2.2 Performance Criteria

The following site discharge pollutant criteria have been adopted for water quality monitoring during the construction phase of the development.

Construction Phase, Water Quality Performance Criteria

Pollutant	Criteria
Total Suspended Solids	90th %ile <50mg/L
pH	6.5 – 9.0
Dissolved Oxygen	90th %ile >80% saturation or 6mg/L
Hydrocarbons	No visible sheen on receiving waters
Litter	No visible litter washed from site.
Cations and Anions	As recommended by Acid Sulphate Soil Management Plan (If Applicable to Development).

2.3 Sediment and erosion controls

Sediment and Erosion Control devices (S&EC) employed on the site shall be designed and constructed in accordance with IECA, *Best Practice Erosion and Sediment Control* as shown on HBV, *Soil and Water Management Plan*, *Soil and Water Management Details* attached.

The following devices and management measures are proposed:

Pre-construction

- Stabilised site access/exit;
- Sediment fences to be located along the contour lines downstream of disturbed areas;
- Drainage structure protection;
- Dust fencing to be installed if required; and

- Educate site personnel to the requirements of the Soil and Water Management Plan;

Initial Construction – Bulk Earthworks

- Maintain construction access/exit, sediment fencing, dust fences and all other existing controls as required; and
- Confine construction activities to stages to minimise areas of disturbance at any given time.

Second Stage Construction

- Maintain construction access/exit, sediment fencing, dust fences, diversion drain and all other existing controls as required;
- Progressively revegetate finished areas where applicable; and
- Drainage structure protection around field inlets and gully pits.

During construction, all areas of exposed soils allowing dust generation are to be suitably treated. Treatments will include covering the soil and watering. Road accesses are to be regularly cleaned to prevent the transmission of soil on vehicle wheels and eliminate any build-up of typical road dirt and tyre dusts from delivery vehicles.

Adequate waste disposal facilities are to be provided and maintained on the site to cater for all waste materials such as litter, hydrocarbons, toxic materials, acids or alkaline substances.

2.4 Water quality and management and inspections

To ensure that the water quality objectives are being met during the construction phase of the development, water quality monitoring shall be conducted at one (1) monitoring stations. Water quality monitoring shall use a calibrated probe or sampling and testing at a NATA registered laboratory.

Location: Monitoring Station (MS1) shown on *Soil and Water Management Plan*.

Parameters: Site discharge criteria.

Frequency: Following at least 30 mm of rainfall in a 24 hour period.

The contractor shall be responsible for the inspection and maintenance of all sediment and erosion control devices. Additional controls and review of existing controls shall be undertaken in response to the results of the above-mentioned monitoring program.

2.5 Reporting

An inspection report shall be written by a suitably qualified and experienced scientist/engineer following each water quality monitoring episode. The report shall include at least the following information:

- Name, address and real property description for the development site;
- Council file reference number (if known);
- Monitoring locations;
- Performance criteria;
- Results for each monitoring location, identifying any breaches of performance criteria;
- Recommended corrective actions to be taken and additional sediment and erosion controls, if required; and
- Inspection reports shall be provided to the contractor for their action and compilation in an on-site register.

If the above mentioned performance criteria are exceeded and results from the downstream monitoring stations show significant deterioration from upstream results (if applicable), the contractor shall implement all recommendation of the inspection report within one (1) working day of receipt of the report

3 Concluding Statement

GES has been commissioned by HBV Architects to prepare a *Soil & Water Management Plan* (SWMP) for the Proposed works at 62-64 Patrick Street, Hobart. This SWMP details the planning, layout, and design of the stormwater management and erosion control infrastructure for the construction phase of the development.

REFERENCES

ANZECC (2000) Australian and New Zealand Environment & Conservation Council – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Australian Standard: AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds

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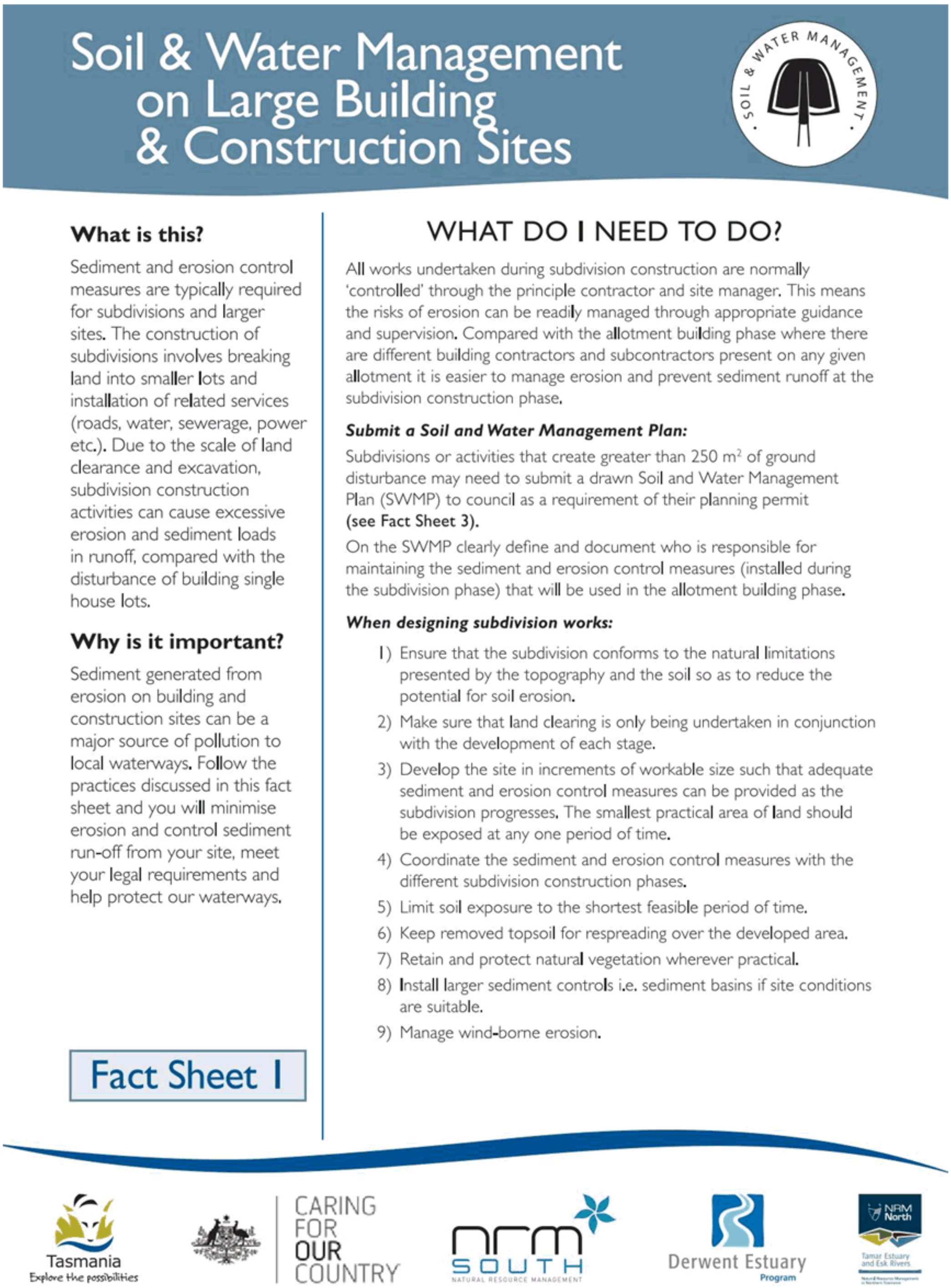
Appendix 1 Soil and Water Management Guideline Fact Sheets



Soil & Water Management on Large Building & Construction Sites

SOIL & WATER MANAGEMENT

What is this?

Sediment and erosion control measures are typically required for subdivisions and larger sites. The construction of subdivisions involves breaking land into smaller lots and installation of related services (roads, water, sewerage, power etc.). Due to the scale of land clearance and excavation, subdivision construction activities can cause excessive erosion and sediment loads in runoff, compared with the disturbance of building single house lots.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 1

WHAT DO I NEED TO DO?

All works undertaken during subdivision construction are normally 'controlled' through the principle contractor and site manager. This means the risks of erosion can be readily managed through appropriate guidance and supervision. Compared with the allotment building phase where there are different building contractors and subcontractors present on any given allotment it is easier to manage erosion and prevent sediment runoff at the subdivision construction phase.

Submit a Soil and Water Management Plan:

Subdivisions or activities that create greater than 250 m^2 of ground disturbance may need to submit a drawn Soil and Water Management Plan (SWMP) to council as a requirement of their planning permit **(see Fact Sheet 3).**

On the SWMP clearly define and document who is responsible for maintaining the sediment and erosion control measures (installed during the subdivision phase) that will be used in the allotment building phase.

When designing subdivision works:

1) Ensure that the subdivision conforms to the natural limitations presented by the topography and the soil so as to reduce the potential for soil erosion.
2) Make sure that land clearing is only being undertaken in conjunction with the development of each stage.
3) Develop the site in increments of workable size such that adequate sediment and erosion control measures can be provided as the subdivision progresses. The smallest practical area of land should be exposed at any one period of time.
4) Coordinate the sediment and erosion control measures with the different subdivision construction phases.
5) Limit soil exposure to the shortest feasible period of time.
6) Keep removed topsoil for respreading over the developed area.
7) Retain and protect natural vegetation wherever practical.
8) Install larger sediment controls i.e. sediment basins if site conditions are suitable.
9) Manage wind-borne erosion.

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Derwent Estuary Program

NRM North
Tamar Estuary and Esk Rivers

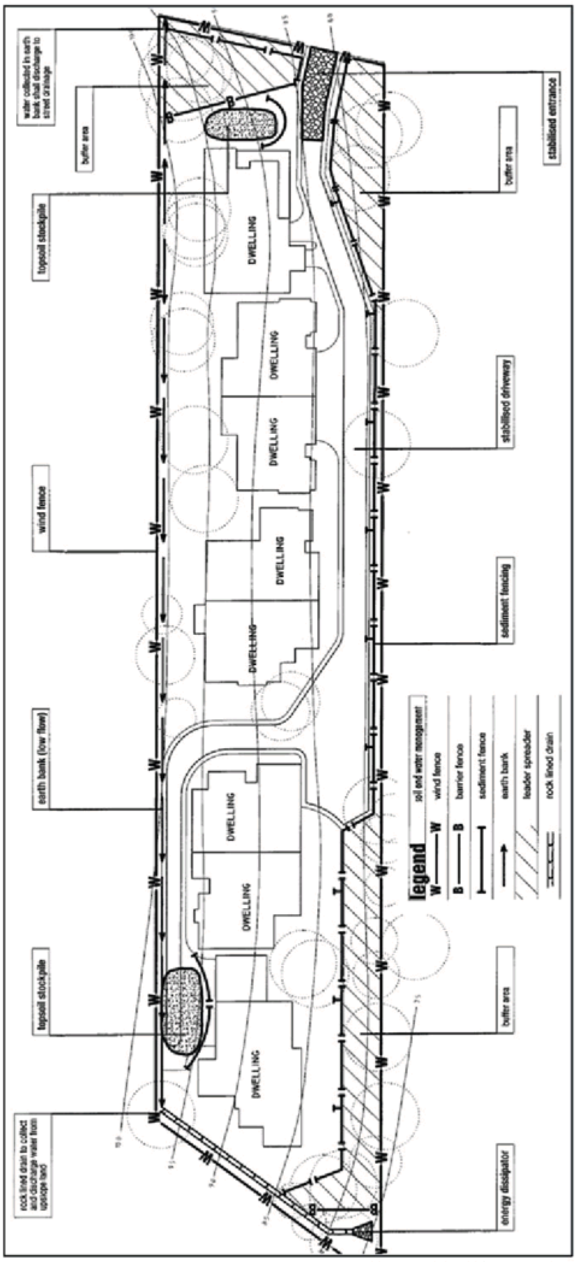


***Figure 1A:** SWMP for a subdivision.*

List of fact sheets

1. **Soil & Water Management on Large Building & Construction Sites**
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

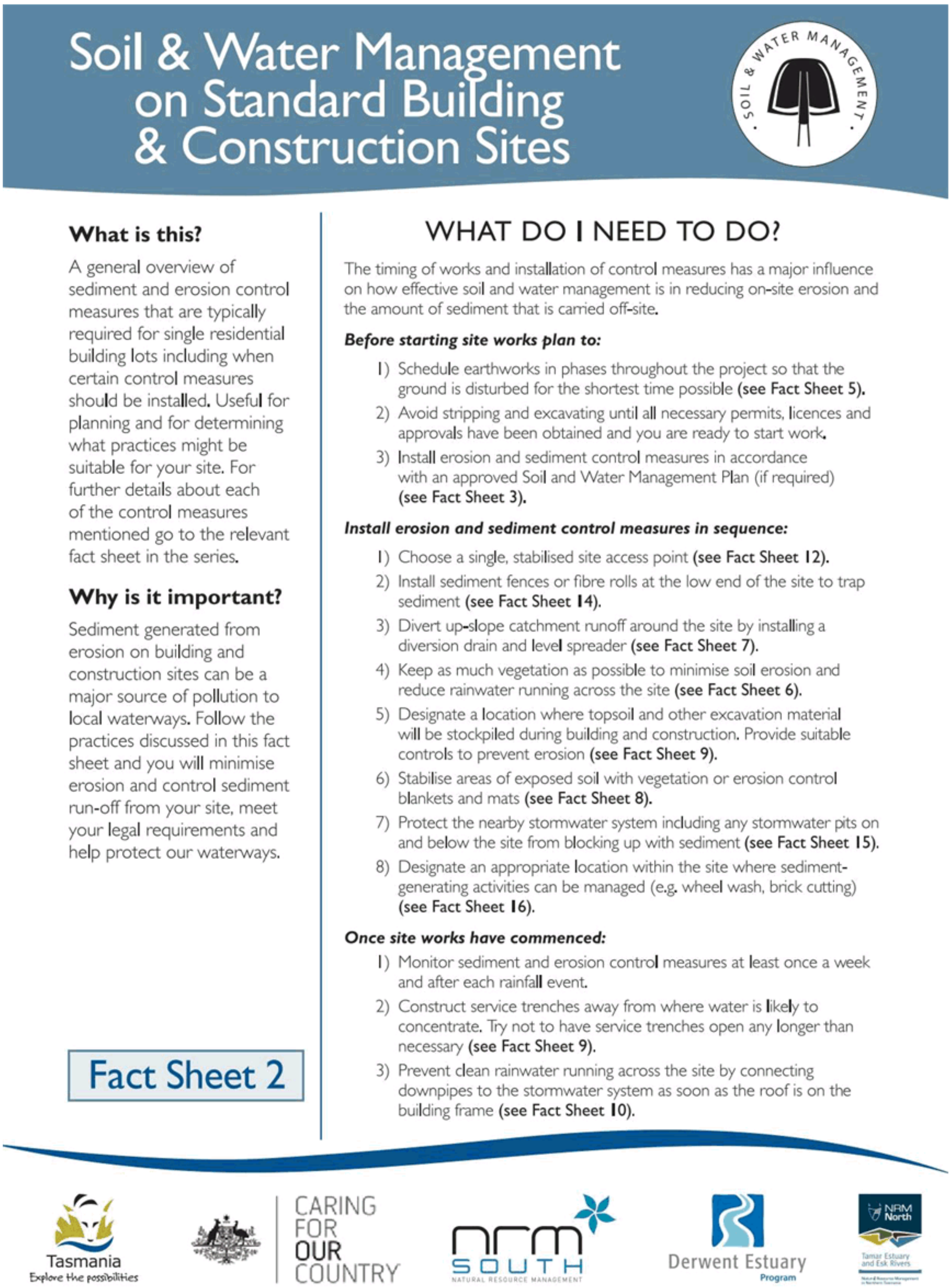
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 1A after Landcom 2004 *"Soils & Construction Volume 1 Managing Urban Stormwater (4th edition)"*. Some of the text in this brochure has been obtained and modified from the Brisbane City Council 2008 *"Subdivision and Development Guidelines"*.

Date of Issue: December 2008



Soil & Water Management on Standard Building & Construction Sites

What is this?

A general overview of sediment and erosion control measures that are typically required for single residential building lots including when certain control measures should be installed. Useful for planning and for determining what practices might be suitable for your site. For further details about each of the control measures mentioned go to the relevant fact sheet in the series.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 2

WHAT DO I NEED TO DO?

The timing of works and installation of control measures has a major influence on how effective soil and water management is in reducing on-site erosion and the amount of sediment that is carried off-site.

Before starting site works plan to:

1) Schedule earthworks in phases throughout the project so that the ground is disturbed for the shortest time possible **(see Fact Sheet 5).**
2) Avoid stripping and excavating until all necessary permits, licences and approvals have been obtained and you are ready to start work.
3) Install erosion and sediment control measures in accordance with an approved Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Install erosion and sediment control measures in sequence:

1) Choose a single, stabilised site access point **(see Fact Sheet 12).**
2) Install sediment fences or fibre rolls at the low end of the site to trap sediment **(see Fact Sheet 14).**
3) Divert up-slope catchment runoff around the site by installing a diversion drain and level spreader **(see Fact Sheet 7).**
4) Keep as much vegetation as possible to minimise soil erosion and reduce rainwater running across the site **(see Fact Sheet 6).**
5) Designate a location where topsoil and other excavation material will be stockpiled during building and construction. Provide suitable controls to prevent erosion **(see Fact Sheet 9).**
6) Stabilise areas of exposed soil with vegetation or erosion control blankets and mats **(see Fact Sheet 8).**
7) Protect the nearby stormwater system including any stormwater pits on and below the site from blocking up with sediment **(see Fact Sheet 15).**
8) Designate an appropriate location within the site where sediment-generating activities can be managed (e.g. wheel wash, brick cutting) **(see Fact Sheet 16).**

Once site works have commenced:

1) Monitor sediment and erosion control measures at least once a week and after each rainfall event.
2) Construct service trenches away from where water is likely to concentrate. Try not to have service trenches open any longer than necessary **(see Fact Sheet 9).**
3) Prevent clean rainwater running across the site by connecting downpipes to the stormwater system as soon as the roof is on the building frame **(see Fact Sheet 10).**

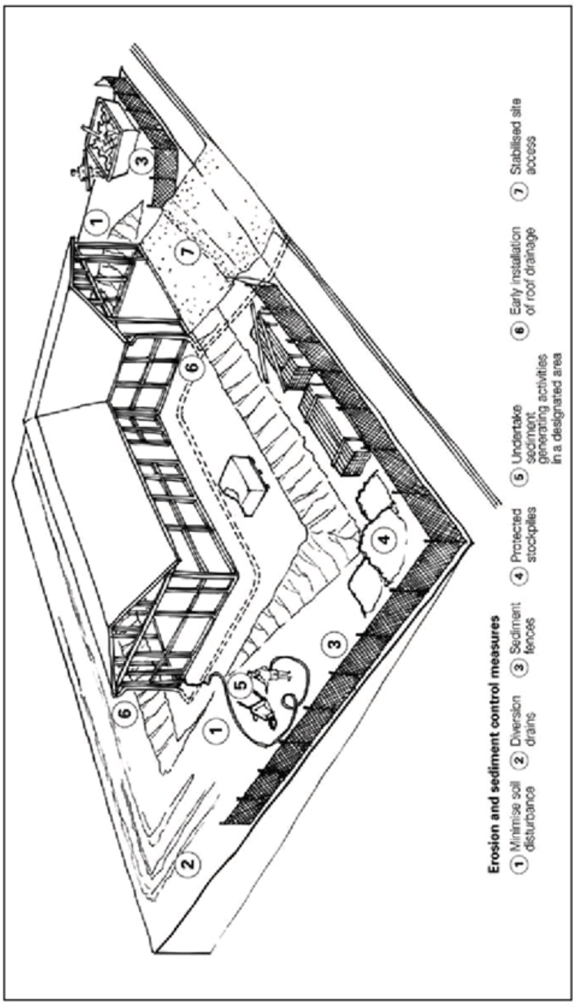


Figure 2A: *Appropriate sediment and erosion control measures for single residential building lots.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. **Soil & Water Management on Standard Building & Construction Sites**
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
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11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
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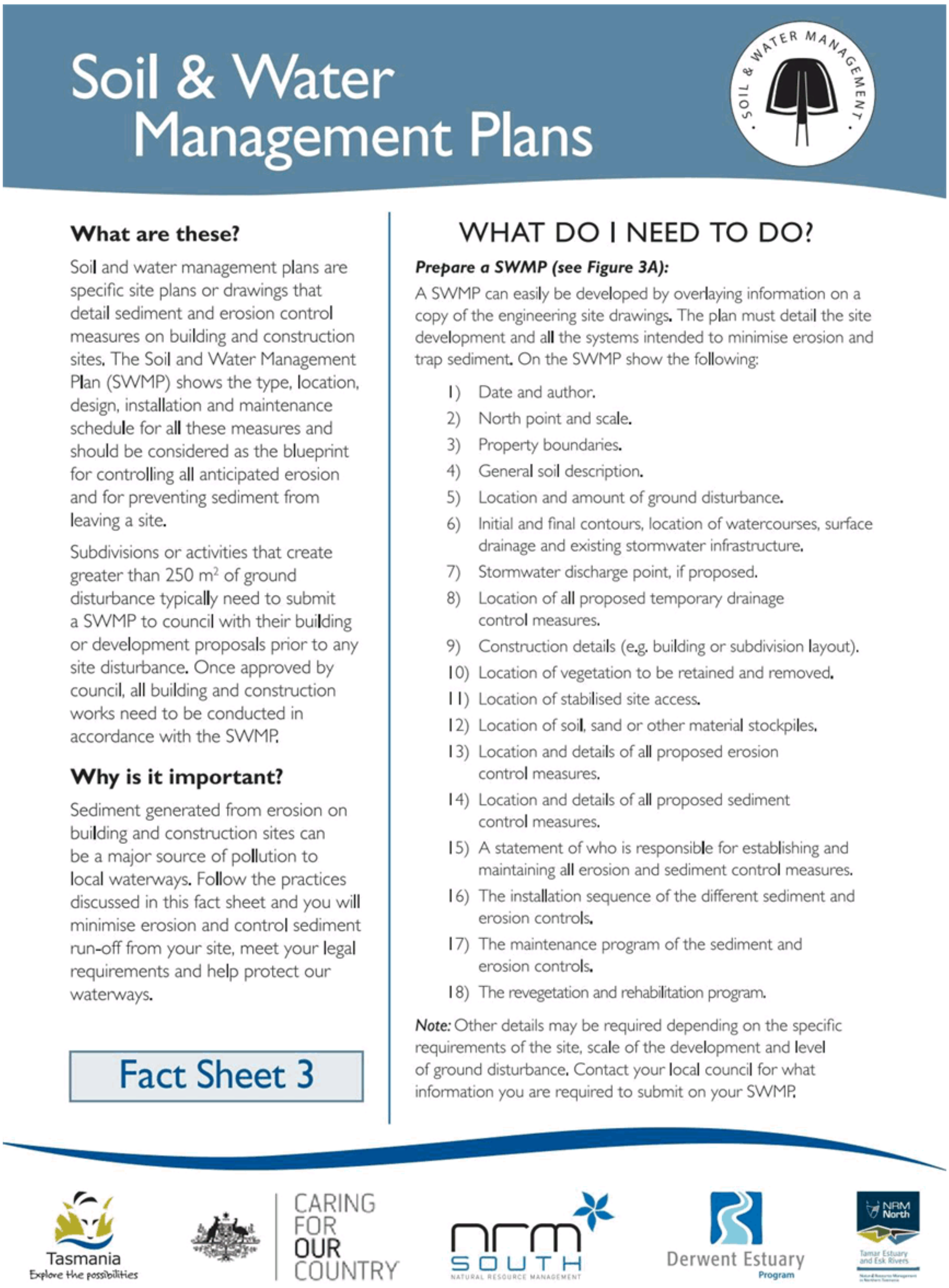
Acknowledgement:

Figure 2A was kindly provided by South East Queensland Healthy Waterways Partnership and Brisbane City Council. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Soil & Water Management Plans

What are these?

Soil and water management plans are specific site plans or drawings that detail sediment and erosion control measures on building and construction sites. The Soil and Water Management Plan (SWMP) shows the type, location, design, installation and maintenance schedule for all these measures and should be considered as the blueprint for controlling all anticipated erosion and for preventing sediment from leaving a site.

Subdivisions or activities that create greater than 250 m^2 of ground disturbance typically need to submit a SWMP to council with their building or development proposals prior to any site disturbance. Once approved by council, all building and construction works need to be conducted in accordance with the SWMP.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 3

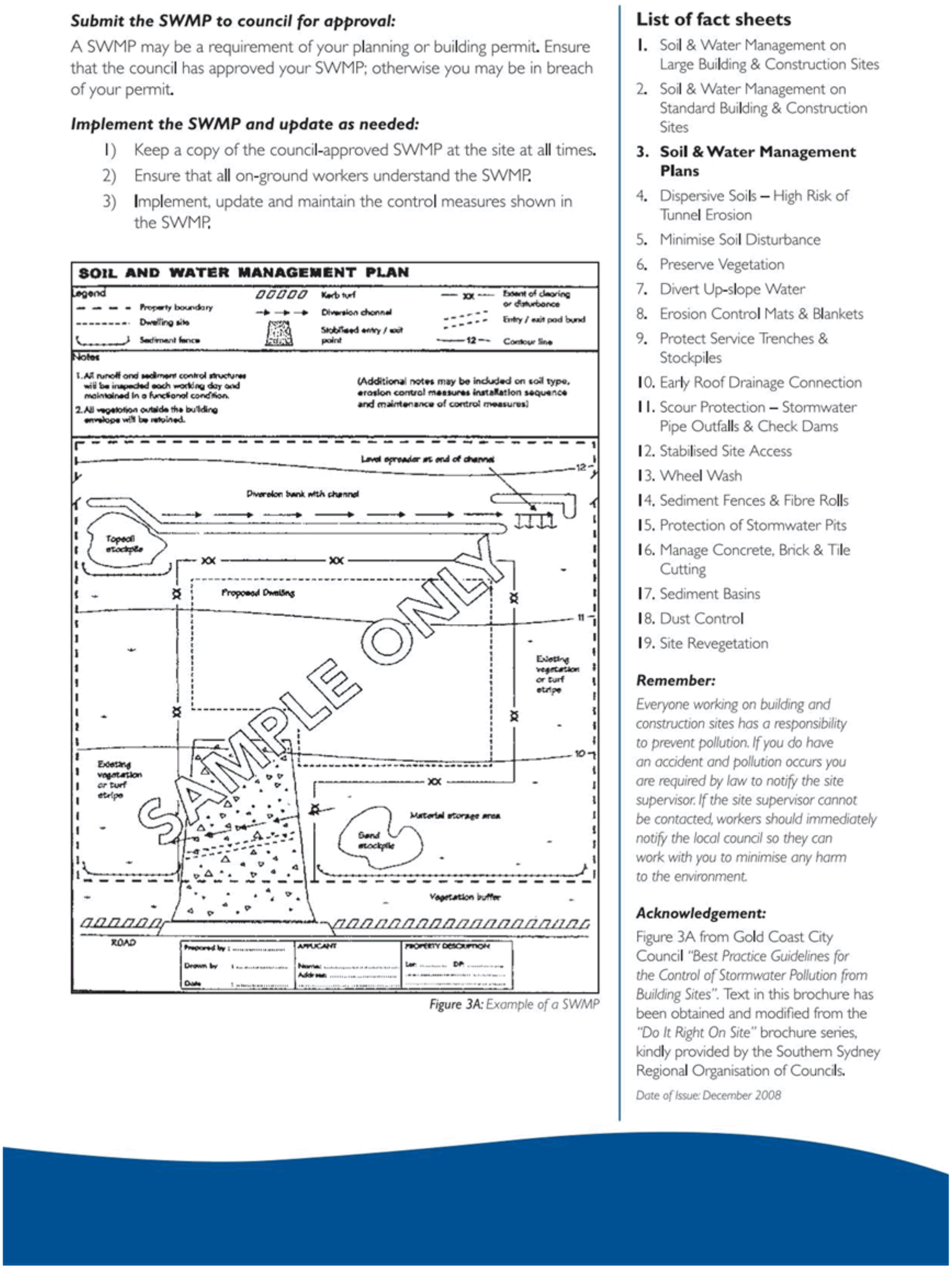
WHAT DO I NEED TO DO?

Prepare a SWMP (see Figure 3A):

A SWMP can easily be developed by overlaying information on a copy of the engineering site drawings. The plan must detail the site development and all the systems intended to minimise erosion and trap sediment. On the SWMP show the following:

1) Date and author.
2) North point and scale.
3) Property boundaries.
4) General soil description.
5) Location and amount of ground disturbance.
6) Initial and final contours, location of watercourses, surface drainage and existing stormwater infrastructure.
7) Stormwater discharge point, if proposed.
8) Location of all proposed temporary drainage control measures.
9) Construction details (e.g. building or subdivision layout).
10) Location of vegetation to be retained and removed.
11) Location of stabilised site access.
12) Location of soil, sand or other material stockpiles.
13) Location and details of all proposed erosion control measures.
14) Location and details of all proposed sediment control measures.
15) A statement of who is responsible for establishing and maintaining all erosion and sediment control measures.
16) The installation sequence of the different sediment and erosion controls.
17) The maintenance program of the sediment and erosion controls.
18) The revegetation and rehabilitation program.

Note: Other details may be required depending on the specific requirements of the site, scale of the development and level of ground disturbance. Contact your local council for what information you are required to submit on your SWMP.



Submit the SWMP to council for approval:

A SWMP may be a requirement of your planning or building permit. Ensure that the council has approved your SWMP; otherwise you may be in breach of your permit.

Implement the SWMP and update as needed:

1) Keep a copy of the council-approved SWMP at the site at all times.
2) Ensure that all on-ground workers understand the SWMP.
3) Implement, update and maintain the control measures shown in the SWMP.

Figure 3A: *Example of a SWMP*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. **Soil & Water Management Plans**
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
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11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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Acknowledgement:

Figure 3A from Gold Coast City Council *"Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Dispersive Soils – High Risk of Tunnel Erosion

SOIL & WATER MANAGEMENT

What is it?

Dispersive soils, or **sodic soils**, collapse or disperse to form dissolved slurry when in contact with fresh water (rain). These soils are highly prone to erosion often leading to **tunnel** and **gully erosion**. Unlike other forms of erosion, dispersion and tunnel erosion result from an imbalance in soil chemistry.

1) Tunnel erosion occurs in all municipalities in Southern Tasmania.
2) Tunnel erosion results from a combination of both chemical dispersion and physical transport of dispersed clay particles.
3) Soils with greater than 6% exchangeable sodium are prone to dispersion.

Dispersion and tunnel erosion usually occurs in subsoils making early detection difficult. Building activities such as excavation, topsoil removal and ponding of rainwater all increase the risk of initiating tunnel erosion. Whilst wind, rain and water runoff are the typical causes of soil erosion on construction sites, the soil chemistry can also determine how prone it is to erosion. Chemistry of the soil determines how well it stays bound together when fresh water is added. Dispersive soils can be caused by high sodium content (i.e. >6% exchangeable sodium); hence they are sometimes called sodic soils. Typically dispersive soils are found in the subsoil as the topsoil is usually non-dispersive. All southern municipalities have dispersive soil risks and tunnel erosion is not uncommon. Dispersive soil can be very patchy in distribution with soil types changing over a few metres in distance, thus it is **very important** to look and test for signs of dispersive soil!

Fact Sheet 4

Why is it important?

Building and construction activities may increase the risk of soil dispersion and can result in the formation of tunnel erosion. Tunnel erosion initially results from the dispersion of clay soils in rainwater, but once the tunnels have formed they can quickly enlarge to form underground drainage paths. When the tunnels collapse they create gullies. Development of tunnel erosion in residential areas has resulted in damage to buildings, roads and septic systems leading to increased public health risks and major impacts on the environment.

During building and construction the runoff from areas of disturbed dispersive soils will contain large amounts of clay and will appear very cloudy. It is very difficult to remove this clay from freshwater without the addition of chemicals (e.g. gypsum). If this runoff enters local waterways it will reduce light levels and decrease water quality. Follow the practices discussed in this fact sheet and you will prevent erosion of dispersive soils from your site, meet your legal requirements and help protect our waterways.

WHAT DO I NEED TO DO?

Before starting site works:

Always ask if there has been soil testing for dispersive or sodic soils, especially in the subsoils where they are more prevalent. An appropriate soil specialist can do this.

Installing the control measures:

1) Minimise disturbance to topsoil and vegetation.
2) Choose building and construction methods that minimise the need for excavation and subsoil exposure.
3) Avoid concentrating water flow over areas that have dispersive topsoil or subsoils. If possible divert water to areas where the soil is not dispersive (**Note:** dispersive soils can be very patchy in distribution).

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Tamar Estuary and Esk Rivers

4) When diverting water, create diversion berms/banks by pushing the soil to create banks up hill, this maintains grass in the channel and reduces infiltration directly to the subsoil and the potential for tunnel erosion.
5) **Do not** create soakage pits in dispersive soils.
6) Immediately infill any trenches or holes to prevent collection and ponding of water on subsoil surfaces.
7) **Always** compact dispersive subsoils that have been disturbed or excavated. Dispersive soils require above average compaction. Consider using a 'whacker packer' for small areas or a sheeps foot roller for large areas. Apply gypsum or lime according to soil test recommendations during infilling and cover with topsoil and revegetate.
8) **Always** bury any exposed subsoils with topsoil and revegetate.
9) Top dress the surface of potentially dispersive soils with gypsum (if soil pH > 6.5) or lime (if soil pH <5) or a mixture of both (if soil pH is within the range of 5 to 6.5) according to soil test recommendations to reduce dispersion.
10) Cover dispersive soils with a minimum 100 mm layer of non-dispersive soil prior to revegetation, or the placement of rock gabions, or concrete.

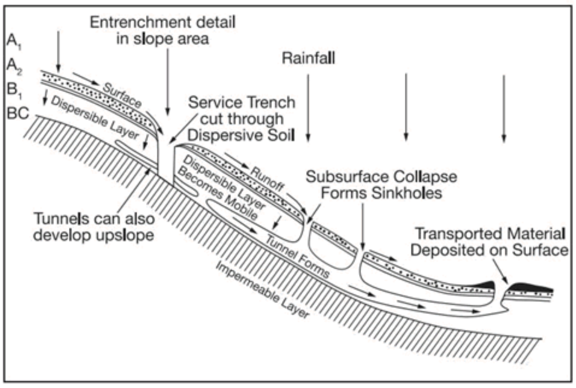

Figure 4A *Tunnel erosion development in dispersive soils*

Note: You can seek further information and advice on the issue of dispersive soils and tunnel erosion from several sources including: your local council, a soil surveyor, civil engineer or soil specialist, NRM South and the Land Conservation Branch of the Department of Primary Industries and Water (DPIW).

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. **Dispersive Soils – High Risk of Tunnel Erosion**
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
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15. Protection of Stormwater Pits
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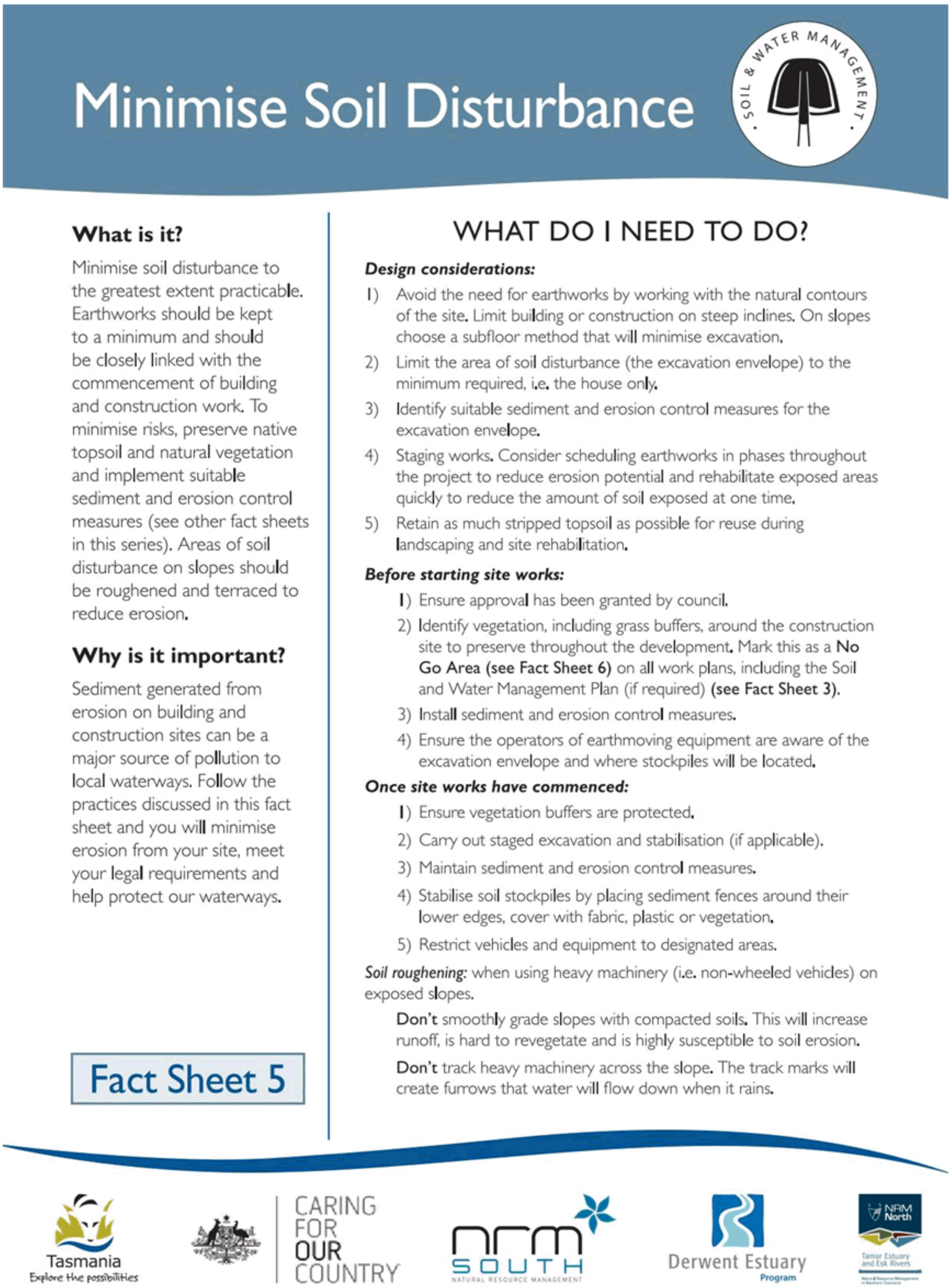
Acknowledgement:

Figure 4A after Department of Construction and Environment, Land Protection Division, Victoria *"Field Erosion its Characteristics and Amelioration".*

Date of Issue: December 2008



Minimise Soil Disturbance

SOIL & WATER MANAGEMENT

What is it?

Minimise soil disturbance to the greatest extent practicable. Earthworks should be kept to a minimum and should be closely linked with the commencement of building and construction work. To minimise risks, preserve native topsoil and natural vegetation and implement suitable sediment and erosion control measures (see other fact sheets in this series). Areas of soil disturbance on slopes should be roughened and terraced to reduce erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 5

WHAT DO I NEED TO DO?

Design considerations:

1) Avoid the need for earthworks by working with the natural contours of the site. Limit building or construction on steep inclines. On slopes choose a subfloor method that will minimise excavation.
2) Limit the area of soil disturbance (the excavation envelope) to the minimum required, i.e. the house only.
3) Identify suitable sediment and erosion control measures for the excavation envelope.
4) Staging works. Consider scheduling earthworks in phases throughout the project to reduce erosion potential and rehabilitate exposed areas quickly to reduce the amount of soil exposed at one time.
5) Retain as much stripped topsoil as possible for reuse during landscaping and site rehabilitation.

Before starting site works:

1) Ensure approval has been granted by council.
2) Identify vegetation, including grass buffers, around the construction site to preserve throughout the development. Mark this as a **No Go Area (see Fact Sheet 6)** on all work plans, including the Soil and Water Management Plan (if required) **(see Fact Sheet 3).**
3) Install sediment and erosion control measures.
4) Ensure the operators of earthmoving equipment are aware of the excavation envelope and where stockpiles will be located.

Once site works have commenced:

1) Ensure vegetation buffers are protected.
2) Carry out staged excavation and stabilisation (if applicable).
3) Maintain sediment and erosion control measures.
4) Stabilise soil stockpiles by placing sediment fences around their lower edges, cover with fabric, plastic or vegetation.
5) Restrict vehicles and equipment to designated areas.

Soil roughening: when using heavy machinery (i.e. non-wheeled vehicles) on exposed slopes.

Don't smoothly grade slopes with compacted soils. This will increase runoff, is hard to revegetate and is highly susceptible to soil erosion.

Don't track heavy machinery across the slope. The track marks will create furrows that water will flow down when it rains.

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Do track machinery (e.g. excavators) up and down the slope to create grooves from the wheels/or tracks that will catch seeds, fertilizer, and rainfall. The grooves will roughen the surface in a way that will slow runoff over the slope ***(see Figure 5A).***

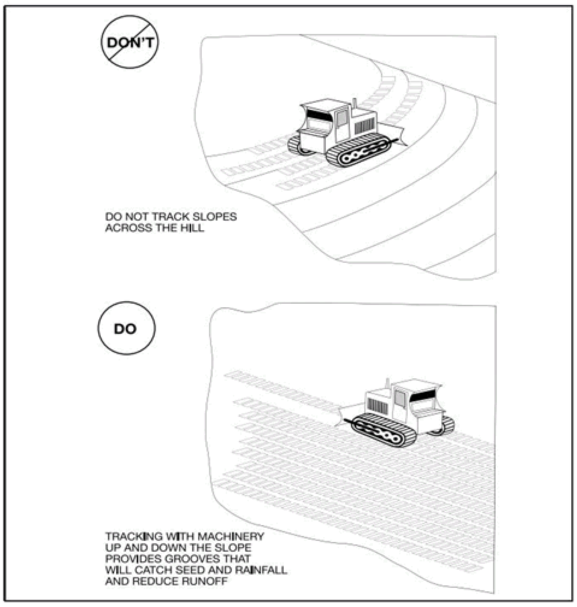

Figure 5A: *Avoid moving tracked vehicles across the slope, unless the final pass involves tracking up and down the slope.*

Maintaining control measures:

If topsoil has been removed it will need to be replaced ***(see Figure 5B).***

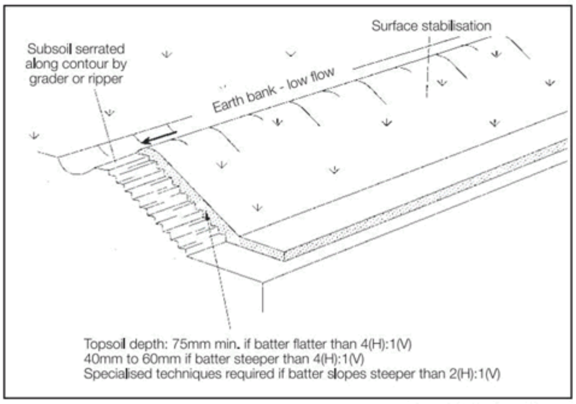

Figure 5B: *Replacing Topsoil.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. **Minimise Soil Disturbance**
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 5A after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*. Figure 5B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Preserve Vegetation

SOIL & WATER MANAGEMENT

What is it?

Keep as much of the original vegetation (grass, trees, etc.) on the site by establishing **No Go Areas** for the building and construction phase as well as vegetated filter strips down-slope of the work site. Preserving grassed areas, trees and shrubs protects the soil from erosion and provides an effective filter for sediment runoff.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 6

WHAT DO I NEED TO DO?

Before starting site works:

Identify vegetation (trees, shrubs and grassed areas) on site which can be kept throughout the entire building and construction phase and mark this as a **No Go Area**. Include this information on the Soil and Water Management Plan if required **(see Fact Sheet 3)**.

Vegetation is the most effective soil stabiliser available on building and construction sites. Keep groundcover along surface drainage areas and on steeper slopes. Retain significant areas of healthy grass down-slope of the worksite, these strips can be highly effective for filtering out coarse sediment. The flatter and wider the strips are, the more effective they become. Native vegetation along streams and waterways should be retained and protected from sediment by installing additional sediment control measures up-slope e.g. fibre rolls and sediment fences **(see Fact Sheet 14)**. On exposed sites a 400 mm wide planted turf strip between the kerb and the footpath is a good last resort sediment control, filtering the runoff before it enters the stormwater system **(see Figure 6A)**.

Where vegetation needs to be removed, leave it in place for as long as possible and stage earthworks to minimise the amount of site cleared at any time.

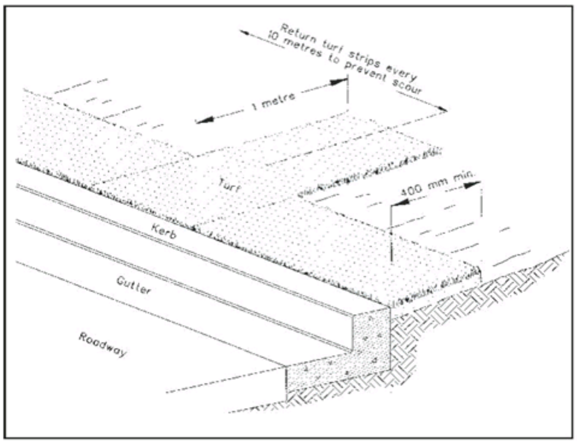

Figure 6A: *Planted turf strip.*

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Installing the control measures:

Fence off the **No Go Area**. Place red tape or other bright materials around the trees, shrubs and grassed areas to be kept. Ensure staff and subcontractors know not to enter these areas or damage marked trees. Where practicable, maintain the planted turf strip in a healthy state during the building and construction process and ensure it is fenced-off to prevent traffic-induced damage.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. **Preserve Vegetation**
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
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19. Site Revegetation

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Date of Issue: December 2008

Divert Up-slope Water

What is it?

Design surface drainage up-slope of building and construction sites to divert runoff away from the site. Where practical and particularly where stormwater runoff from more than 0.5 hectares feeds into the work site, divert up-slope water around the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 7

WHAT DO I NEED TO DO?

Before starting site works:

Look at the site plans to identify site areas where stormwater can be diverted around the disturbed or active work area. Stormwater can be diverted with the use of small diversion drains. Note that the stormwater must not be diverted onto adjacent properties; instead it must discharge the work site at a legal point of discharge. Diversion drains need to be properly designed to ensure that they can convey water without overflowing or accumulating sediment. Document the diversion drains on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).** Ensure workers on-site are aware of the need to maintain the diversion drains. Do not dig diversion drains on dispersive soils **(see Fact Sheet 4)**, instead build soil berms.

Installing the control measures:

Diversion drains: A diversion drain is a channel constructed on the high side of a site to divert surface runoff from rainwater that would otherwise flow down onto the disturbed or active work area.

1) The channel should be about 150 mm deep with a curved shape.
2) Place the excavated soil from the channel on the down-slope side to increase the diversion drain's capacity.

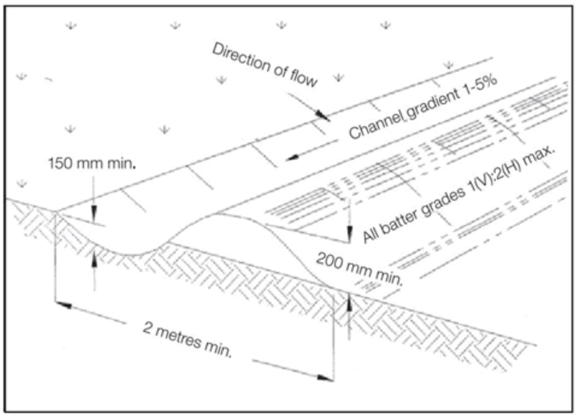

Figure 7A: *Example of a diversion drain.*

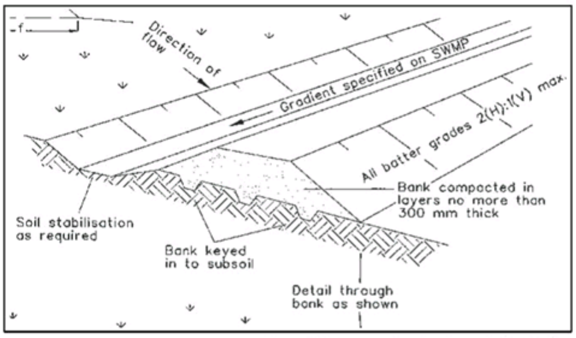

Figure 7B: *Example of a diversion drain for high flow.*

3) The diversion drain should divert flows to a stable drainage line to ensure that the channel does not itself cause erosion where it discharges.
4) The diversion drain should be kept clean and free of plantings and mulch as this will lead to the deposition of sediment that obstructs water flow and causes water to breach the channel and create unwanted erosion.

Level spreader: Level spreaders are generally used at the outlet of diversion channels. A level spreader is a wide, level overflow sill built across a slope. It allows even spread of water flow so velocities are reduced and soil erosion is avoided. This should only be constructed to release water to areas where the:

1) Water flow will not become concentrated.
2) Soil is stabilised and the site is not within the path of construction activities.
3) Ground remains well-vegetated.
4) Discharged water flow will be slow moving.

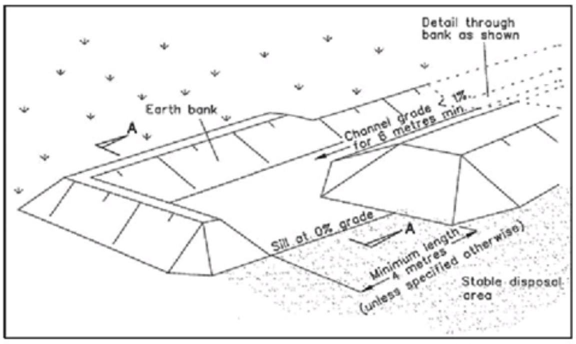

Figure 7C: *Example of a level spreader used to release minor concentrated flows as sheet flow.*

In some cases such as on steep slopes or where there are high flow velocities, a grass or geotextile fabric lined channel may be required to return the diverted flow to the stormwater system or a stable drainage line.

Maintaining the control measures:

Check diversion drains, level spreaders and discharge areas for signs of erosion.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. **Divert Up-slope Water**
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
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Acknowledgement:

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Date of Issue: December 2008

Erosion Control Mats & Blankets

What are these?

Erosion mats and blankets are used as a soil cover and a protective barrier for vegetation establishment. They are applied on soils with a high erosion risk, on steep sites or for site rehabilitation. When applied correctly, they are one of the most effective and practical means of controlling runoff and erosion on disturbed land prior to vegetation establishment.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 8

WHAT DO I NEED TO DO?

Before starting site works:

Identify where erosion is likely to occur i.e. areas of bare soil, especially on slopes steeper than 3:1 or when there is a delay in building and construction work or site rehabilitation. Select erosion control mats or erosion control blankets.

Erosion control mats: are heavier, synthetic and non-degradable, they are designed to add stability to soils and are often filled with topsoil, and vegetated when installed. Erosion control mats are suitable on slopes and in channel-lining applications.

Erosion control blankets: are light-weight and open-weave made from mulch, straw and wood fibre and held together by natural or synthetic netting. They are used for establishing and reinforcing vegetation. Their application depends on the blanket materials. Synthetic netting and wood fibre is stronger and can be used on steeper slopes compared to jute and straw blankets, which rapidly degrade and are more suitable for flatter areas. Check with suppliers of erosion control blankets about the applications of their different products.

Erosion control blankets can be used in conjunction with soil seeding, preventing the seed washing away and erosion of the prepared seedbed. Once established, the vegetation provides permanent erosion control.

Document erosion control mats and blankets on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Installing the control measures:

Erosion control mats should be installed immediately on exposed soils, while erosion control blankets should be fitted on newly seeded or landscaped areas. **See Figures 8A and 8B** for their installation guidelines.

Maintaining the control measures:

Close inspection after rainfall events and major runoff occurrences is essential. Check for damage due to water running under the mat or blanket or if it has been displaced by wind. Restabilise with anchor pins or wooden spikes. If significant erosion has occurred repair the fabric. Grading and reseeding may also be necessary. Continue inspections until vegetation is firmly established.

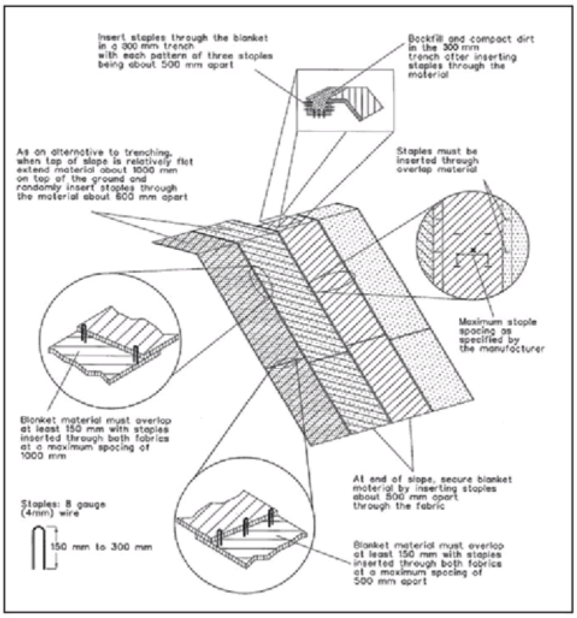

Figure 8A: *Installation of an erosion control blanket on a hillside.*

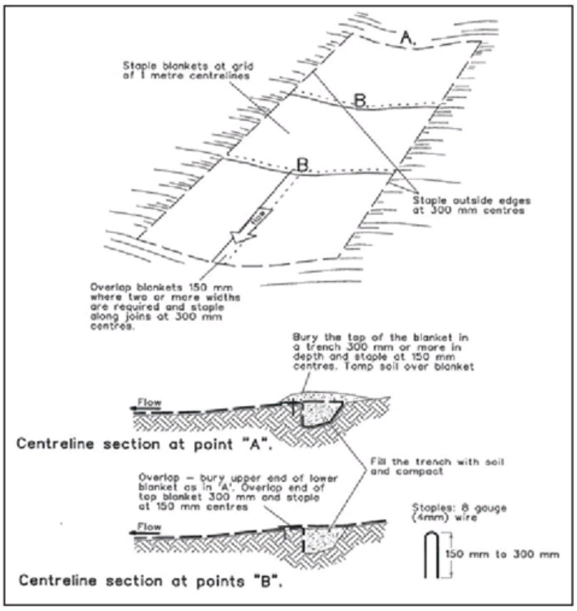

Figure 8B: *Erosion control mat used to line a channel.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. **Erosion Control Mats & Blankets**
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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Acknowledgement:

Figures 8A & 8B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)".*

Date of Issue: December 2008

Protect Service Trenches & Stockpiles

SOIL & WATER MANAGEMENT

What is it?

When excavated, service trenches can concentrate runoff and cause rapid soil erosion. This fact sheet discusses methods to install service trenches in a manner that does not cause soil erosion.

Temporary stockpiles are at risk of being washed or blown away. This fact sheet discusses proper on-site storage of materials such as sand, gravel, topsoil, mulch and woodchips.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 9

WHAT DO I NEED TO DO?

Before starting site works:

Service trenches: if your site has fine soil, protection measures may be needed. Decide where the service trenches will need to go and document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)**. Ideally they should be away from areas where water flow is likely to concentrate. Where possible coordinate the various service connections so a single trench can be used and quickly backfilled. Also try scheduling the work when rainfall is low. Be aware if you have dispersive soil **(see Fact Sheet 4)**.

Stockpiles: avoid stockpile loss and stormwater pollution by limiting the amount of material on-site and remove all materials when work is complete.

Identify a protected storage area for building material stockpiles away from on-site drainage or stormwater flow paths. Place control measures such as diversion drains up-slope or sediment fences down-slope. Cover the stockpiles with fabric, plastic or a temporary grass cover. Drivers delivering stockpile material should always use the protected storage area as the drop-off. Document your storage area on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: Don't stockpile sediment or building materials (sand, gravel, mulch) on roadways or within drainage areas.

Installing the control measures:

Service trenches:

1) Remove and store vegetated topsoil so it can be replaced after works to provide immediate erosion protection.
2) Place the soil on the uphill side of trenches to divert water flow away from the trench line. Temporary bunds can be used.
3) The trench should be open for the shortest time practicable and avoid opening them when the risk of rainfall is high.
4) Once completed, backfill trench with subsoil and compact.
5) Replace top soil, level and top up to account for soil settling.
6) If trenches are on steep slopes, install earthbanks along the backfill surface at 6 metre intervals to divert flows and prevent erosion.
7) Excess soil should be used or disposed of in such a way that it does not create a wind or water erosion hazard.

Stockpiles:

1) Locate stockpiles at least 5 metres from stormwater flow paths, roads and hazard areas.
2) Place on gently sloping ground (not level areas which tend to be overland low paths) as a low, flat, elongated mound.

3) Stockpiles should preferably be less than 1.5 metres high.
4) Construct an earth bank on the up-slope side to divert runoff around the stockpile and install a sediment fence 1–2 metres down-slope of the stockpile. The height of the sediment fence should be equal to the stockpile height and the length equal to the stockpile length at the base.
5) Stockpiled materials should be covered during windy conditions, rain or unattended periods. Topsoil stockpiles left for extended periods should be revegetated.

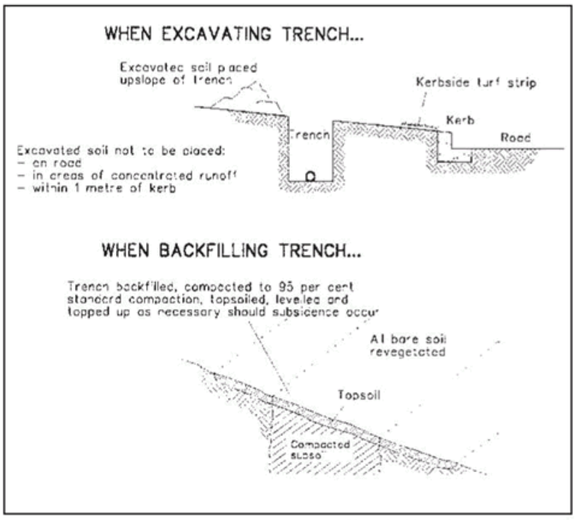

Figure 9A: *Example of a service trench.*

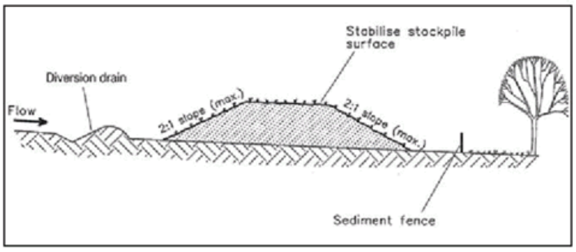

Figure 9B: *Keep building materials in protected stockpiles.*

Maintaining the control measures:

Service trenches: if they fill with water, pump water evenly over a stabilised vegetated area that will filter out the suspended clays. If this is not possible, add a small amount of gypsum to the water and allow the suspended clays to settle before pumping the water out.

Stockpiles: should be covered and checked regularly. Sediment and erosion controls (diversion drains and sediment fences) associated with stockpiles also need to be monitored and maintained.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. **Protect Service Trenches & Stockpiles**
10. Early Roof Drainage Connection
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12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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17. Sediment Basins
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Date of Issue: December 2008

Early Roof Drainage Connection

What is it?

Connect the downpipes to the stormwater system as soon as the roof is on the building frame. This control measure prevents 'clean' rainwater running through the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 10

WHAT DO I NEED TO DO?

Before starting site works:

Aim to have the roof and downpipes in place as soon as possible.

Document this on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure all on-ground staff are aware of its importance.

Installing the control measures:

Connect the permanent downpipe or temporary ones such as flexible tubing. If pipes to the road can not be installed, pipe the water to a turfed area, or infiltration trench, where it can soak into the ground.

Maintaining the control measures:

Check that the pipes are still connected whenever rain is forecast.

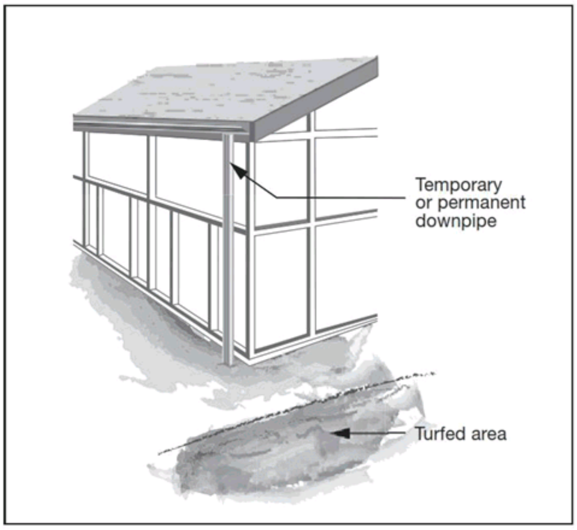

Figure 10A: Early installation of roof drainage.

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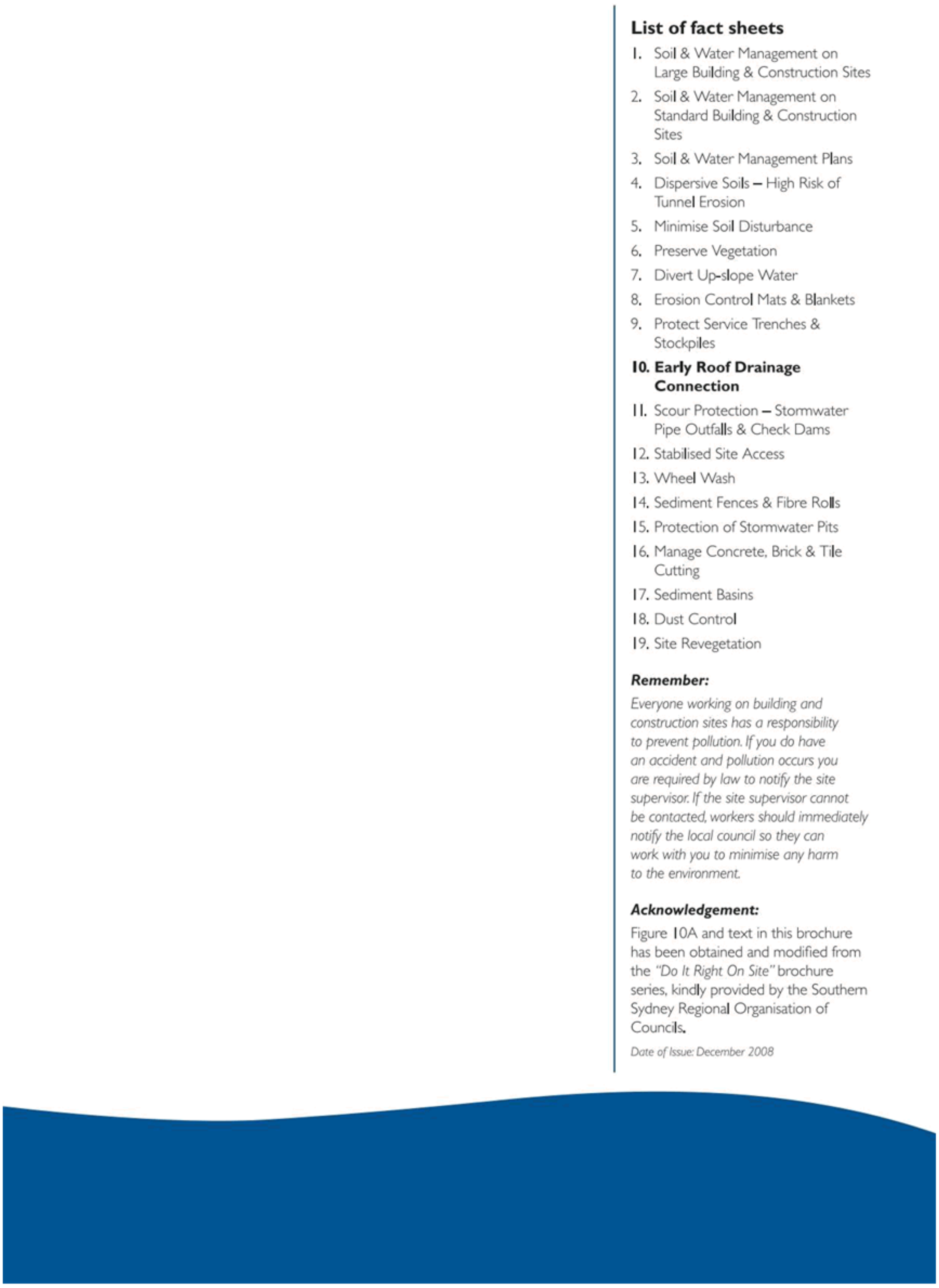

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. **Early Roof Drainage Connection**
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
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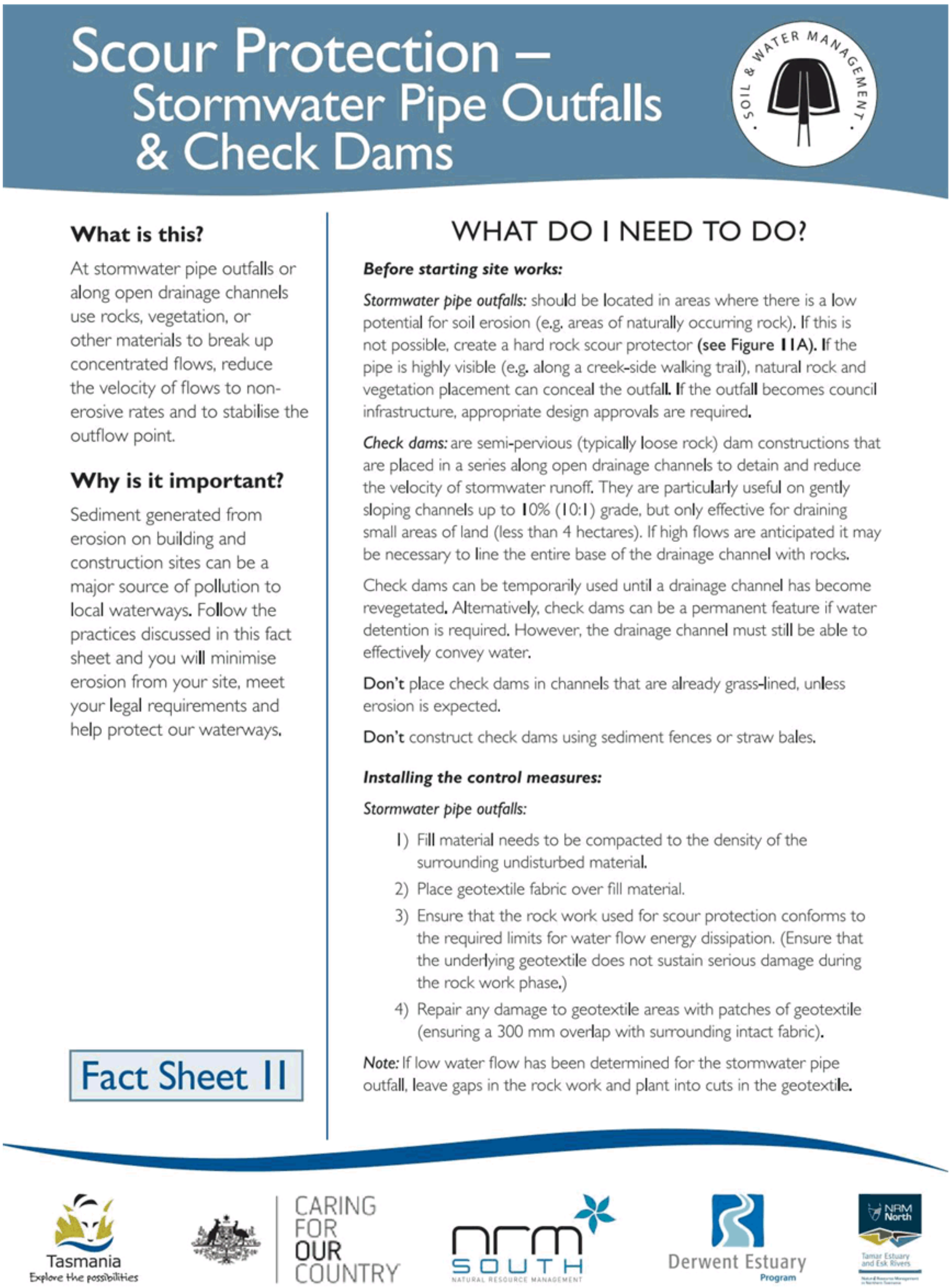

Scour Protection –
Stormwater Pipe Outfalls & Check Dams

What is this?

At stormwater pipe outfalls or along open drainage channels use rocks, vegetation, or other materials to break up concentrated flows, reduce the velocity of flows to non-erosive rates and to stabilise the outflow point.

Why is it important?

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Fact Sheet 11

WHAT DO I NEED TO DO?

Before starting site works:

Stormwater pipe outfalls: should be located in areas where there is a low potential for soil erosion (e.g. areas of naturally occurring rock). If this is not possible, create a hard rock scour protector **(see Figure 11A).** If the pipe is highly visible (e.g. along a creek-side walking trail), natural rock and vegetation placement can conceal the outfall. If the outfall becomes council infrastructure, appropriate design approvals are required.

Check dams: are semi-pervious (typically loose rock) dam constructions that are placed in a series along open drainage channels to detain and reduce the velocity of stormwater runoff. They are particularly useful on gently sloping channels up to 10% (10:1) grade, but only effective for draining small areas of land (less than 4 hectares). If high flows are anticipated it may be necessary to line the entire base of the drainage channel with rocks.

Check dams can be temporarily used until a drainage channel has become revegetated. Alternatively, check dams can be a permanent feature if water detention is required. However, the drainage channel must still be able to effectively convey water.

Don't place check dams in channels that are already grass-lined, unless erosion is expected.

Don't construct check dams using sediment fences or straw bales.

Installing the control measures:

Stormwater pipe outfalls:

1) Fill material needs to be compacted to the density of the surrounding undisturbed material.
2) Place geotextile fabric over fill material.
3) Ensure that the rock work used for scour protection conforms to the required limits for water flow energy dissipation. (Ensure that the underlying geotextile does not sustain serious damage during the rock work phase.)
4) Repair any damage to geotextile areas with patches of geotextile (ensuring a 300 mm overlap with surrounding intact fabric).

Note: If low water flow has been determined for the stormwater pipe outfall, leave gaps in the rock work and plant into cuts in the geotextile.

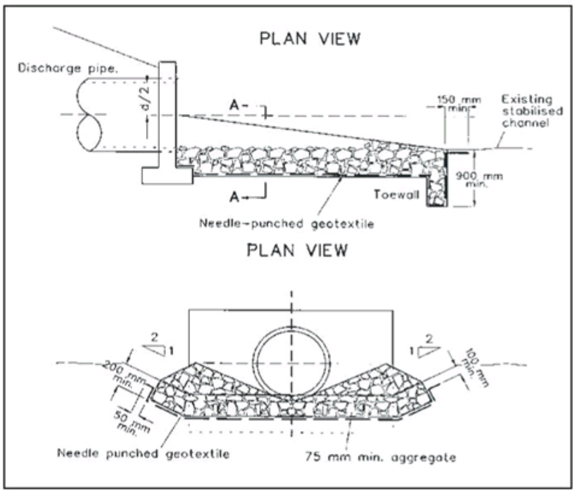

Figure 11A: *Hard rock scour protector.*

Check dams: these are appropriate for small channels with low flows that are susceptible to erosion (for larger channels or higher flows, specialist design may be required). A number of check dams will probably need to be built.

1) Excavate a shallow (200 mm) trench perpendicular to the drainage channel.
2) Construct the dam from aggregate (washed sand/gravel), placed in sandbags (for easy deconstruction). Place bags within the trench and build up the dam wall.
3) Ensure that the height of the dam spillway is less than 1 metre above the base of the drainage channel.
4) Ensure the dam height and spillway height does not dramatically impede water conveyance.
5) Space individual check dams so the toe of the upstream dam is level with the spillway of the next downstream dam. Otherwise extend downstream toe to provide erosion protection.
6) Check dams require regular maintenance as accumulated sediment needs to be removed, to prevent it becoming resuspended during subsequent storms.

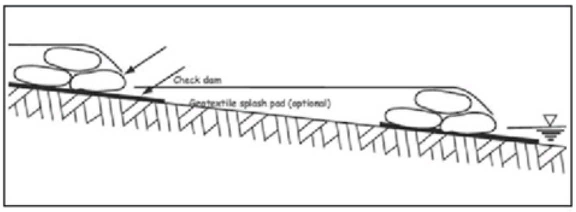

Figure 11B: *Example of a check dam.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. **Scour Protection – Stormwater Pipe Outfalls & Check Dams**
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 11A from Landcom 2004 *"Soils and Construction Volume I Managing Urban Stormwater (4th edition)"*. Figure 11B from South East Queensland Healthy Waterways partnership 2006 *"Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Stabilised Site Access

SOIL & WATER MANAGEMENT

What is it?

A stabilised site access is a single entry/exit point for building and construction sites that is designed to reduce the tracking of sediment off-site. It provides a clean, dry surface for vehicles to enter and unload during all weather conditions without destroying vegetation or carrying large amounts of sediment onto paved road surfaces.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 12

WHAT DO I NEED TO DO?

Before starting site works:

Identify the best location to place the stabilised site access – ideally it should be in an elevated position with little or no water flowing to it from up-slope and away from any down-slope stormwater pits. All deliveries should be able to be made through this point. Document it on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure on-site staff are aware of its importance.

Installing the control measures:

The recommended construction method for the stabilised site access is laying down 200 mm of aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable). Where the site access slopes toward the road, a diversion hump should be installed across the stabilised area to direct stormwater runoff to the side where it can be filtered by a sediment fence. If the construction process enables it, a permanent driveway can be laid and used as the access point.

Stabilised site access:

1) Strip at least 150 mm of topsoil, level area and stockpile in the space available.
2) Compact infill.
3) Cover the area with geotextile.
4) Construct a 200 mm thick pad over geotextile using aggregate at least 40 mm in size, ideally from kerb to building.
5) Construct a trafficable diversion hump immediately within the boundary to divert water to a sediment fence or other sediment control measure.

Note: On larger sites cattle grids or shaker grids can also be installed at the access point. These allow the wheels to turn a couple of times and shake off excess sediment. If sediment is still being tracked off-site then a wheel wash should be installed **(see Fact Sheet 13).**

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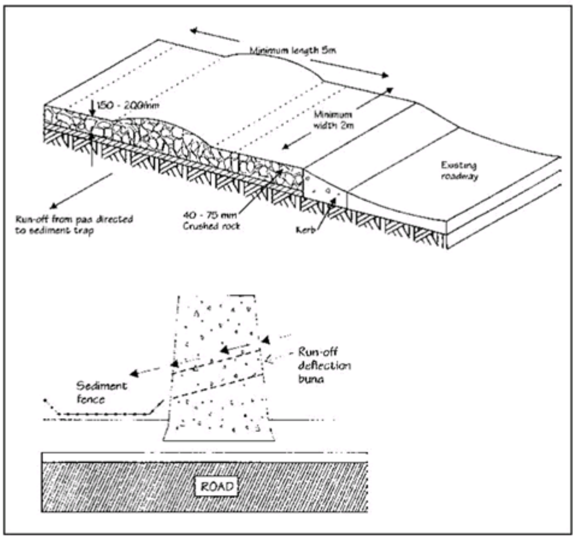

Figure 12A: *Stabilised site access for building sites only.*

Maintaining the control measures:

As vehicles use the stabilised site access they will slowly compact the gravel or rock. When it becomes too compacted the voids between the rock and gravel disappear and the stabilised site access will no longer trap mud and dirt.

Monitor the surface of the stabilised site access and ensure that it drains to the sediment fence or other sediment control measures. Add new gravel or rock as needed. Roads should be inspected for any sediment that has escaped the site at the end of each day and swept up if necessary. This should also be done whenever rain looks likely.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. **Stabilised Site Access**
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 12A and text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Wheel Wash

What is it?

A wheel wash reduces the amount of sediment transported onto paved roads by vehicles.

They should be installed on larger building and construction sites or when the stabilised site access is not preventing sediment from being tracked off the site.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 13

WHAT DO I NEED TO DO?

Installing the control measures:

1) Identify the best location to place the wheel wash. It should be incorporated with the stabilised site access **(see Fact Sheet 12).**
2) Construct a pad by evenly spreading a 200 mm layer of coarse aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable) at a minimum depth of 300 mm.
3) Install a wash rack that is suitable for the anticipated traffic and weight loads.
4) The water used to wash the wheels of the vehicles shall not be discharged into stormwater system at any time. Provide a drainage channel that will convey the runoff from the wash area to a suitable on-site sediment control measure i.e. sediment basin **(see Fact Sheet 17)**, sediment settling tank, or a flat vegetated area.
5) Ensure that the drainage channel used to transport the sediment to the sediment control measure is of adequate size and proper gradient to carry the wash runoff.
6) Make sure that the sediment control measure is also of adequate size.
7) Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
8) Require all employees, subcontractors and others that leave the site with mud or dirt caked tyres and undercarriages to use the wash facilities.
9) If weeds and plant disease are an issue for your site refer to *"Tasmanian Washdown Guidelines for Weed and Disease Control 2004"* from the Tasmanian Department of Primary Industries and Water, Forestry Tasmania and the Agricultural Contractors Association of Tasmania.

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Derwent Estuary Program

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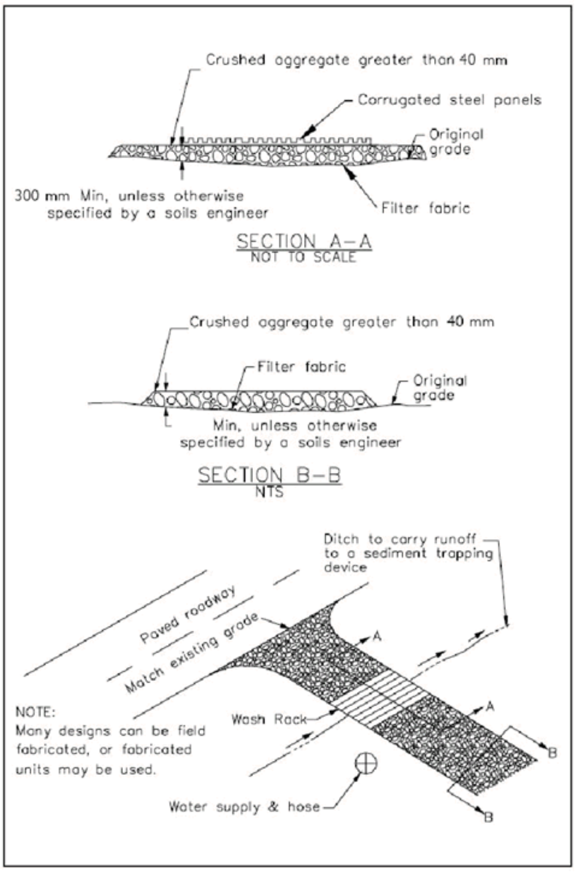

Figure 13 A: *Wheel wash design.*

Maintaining the control measures:

The wheel wash should be inspected weekly and after a major rainfall event. Remove accumulated sediment from the wash rack to maintain system performance. This sediment should be collected and may need to be disposed to landfill.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. **Wheel Wash**
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 13A after California Stormwater Quality Association 2003 *"California Stormwater BMP Handbook Construction".*

Date of Issue: December 2008

Sediment Fences & Fibre Rolls

SOIL & WATER MANAGEMENT

What are these?

Sediment fences and fibre rolls are sediment control measures installed across slopes or along the parameter of building and construction sites. Fibre rolls are a range of organic products (coconut fibre, straw, flax) that are rolled into large diameter logs. Sediment fences are vertical barriers made from woven geotextile that are held in place by star pickets and a backfilled trench.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 14

WHAT DO I NEED TO DO?

Fibre Rolls: are log-like products commonly consisting of biodegradable fibres. They vary from biodegradable rolled coir (coconut fibre) and hessian socks filled with straw or mulch, to non-biodegradable geotextile tubes filled with mulch or straw. Biodegradable fibre rolls can be left permanently onsite to assist stabilisation and will support vegetative growth if left in place.

Sediment fences: are a commonly used sediment control measure constructed from heavy-duty geotextile. Although a sediment fence looks like shade cloth it is very different (shade cloth is not appropriate because it cannot slow water flow enough to adequately pond water up-slope of the fence and allow sediment to settle under gravity).

Before starting site works:

Identify drainage flow pathways that will intercept runoff from the site. Decide whether to use fibre rolls or sediment fences. Use fibre rolls at the base of an embankment, on slopes that are exposed, or on vegetated slopes where vegetation is failing to control erosion. Sediment fences should be used on small drainage areas and placed down-slope of potential areas of erosion. Document these measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

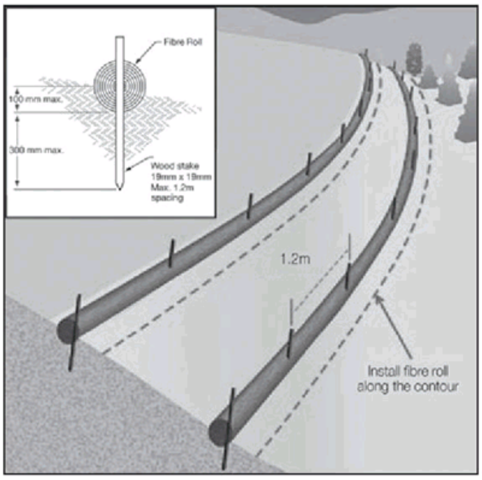

Figure 14A: *Installation of fibre rolls*

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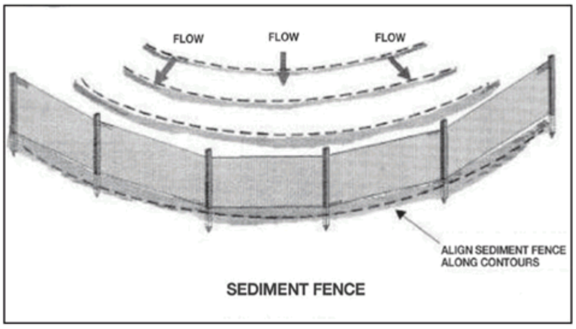
Installing the control measures:

Sediment control measures need to be in place prior to the start of site works. They can be altered after ground disturbance activities and if the site's drainage patterns change.

Installing fibre rolls:

1) Find a suitable installation site (if on a slope, place parallel to contours).
2) Remove large rocks and debris, and prepare a shallow concave trench (50–100 mm deep) to inset the fibre roll. (***Note:*** Place excavated material on the upside of the fibre roll to prevent undercutting.)
3) Place the fibre roll in a shallow trench and stake through the fibre roll every 30 cm.
4) Place further stakes on both sides of the fibre roll to within 2 m from the end of the roll.



SEDIMENT FENCE

Installing sediment fences:

1) Survey and mark out location of sediment fence, ensure it is parallel to the contours of the site.
2) Dig a 150 mm trench immediately above the proposed fence line.
3) Place the bottom of the fabric to the base of the trench and run fabric up the down-slope side of the trench.
4) Backfill the trench and compact to secure anchorage of the fabric.
5) Drive 1.5 m star pickets into ground, 2 m apart to support the sediment fence fabric. Tension and fasten fabric to pickets using UV stabilised zip ties or wire ties.
6) Join sections of fabric at a support post with a 2 m overlap.
7) Angle the ends of the sediment fence upslope to reduce scouring.

Don't place sediment fences across creeks or major drainage lines.

Maintaining the control measures:

Fibre rolls and sediment fences should be checked regularly, especially after every rain event and cleaned or repaired. For sediment fences check that all the pickets and the bottom of the fence are secure and that there are no tears in the fabric.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. **Sediment Fences & Fibre Rolls**
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figures 14A and 14B after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*.

Date of Issue: December 2008

Protection of Stormwater Pits

SOIL & WATER MANAGEMENT

What is it?

Protect the stormwater system from blocking with sediment and building materials by placing control measures around or inside any stormwater pits on and below the site. Stormwater pit protection is an important last resort sediment control measure that should be used in conjunction with other on-site practices.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 15

WHAT DO I NEED TO DO?

Before starting site works:

Identify any stormwater pits and drains on and below the site. Plan the layout of the work site so that any wash-down areas and tile or brick cutting areas are not near them. Clearly mark all the stormwater pits and drains on the site plan and choose appropriate methods that will protect them. Install these sediment control measures before site work commences. Document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: the placement of sediment control measures on road reserves (i.e. off the work site) will normally require approval from the owner of the road, i.e. council or the Department of Infrastructure, Energy and Resources (DIER).

Installing the control measures:

There are a range of sediment control measures to protect stormwater pits including, sediment fence traps, filter socks and stormwater pit traps. Those that collect sediment above the stormwater pit are easier to clean but have low storage capacity compared to controls that are installed inside the stormwater pits. Place cones around controls in the gutters or on roads to prevent vehicles damaging them.

Sediment fence trap: these are sediment fences staked around the stormwater pit to trap sediment. Fabric must be partially buried so that water and sediment does not just flow underneath. The more space between the fence and the pit, the more chance of sediment settling and the greater the capacity of the trap **(see Figure 15A).**

Filter socks: are woven tubes filled with compost or bioremediation media that separate sediment, hydrocarbons, nutrients and heavy metals from site runoff. Filter socks are more effective than sandbags or geotextile sausages filled with gravel. Filter socks are able to treat runoff at higher flow rates with significantly less ponding.

Filter socks can be installed in the kerb and gutter below the work site, while longer socks can be used as a barrier around the stormwater pit **(see Figure 15B).**

Stormwater pit traps: are baskets, trays, bags or screens placed just below the entrance of the stormwater pit. They prevent sediment from entering the stormwater system. Fine mesh or fabric filters should be used to capture sediment **(see Figure 15C).**

Maintaining the control measures:

All sediment control measures should be inspected, especially after rainfall events and cleaned regularly to maintain effectiveness and prevent bypass. The built up material can be re-stockpiled and used on-site (if it is not contaminated), or otherwise disposed to landfill.

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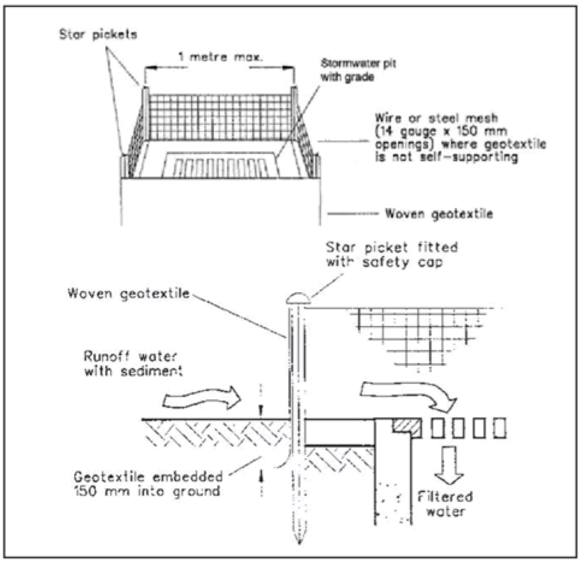

Figure 15A: A sediment fence trap.

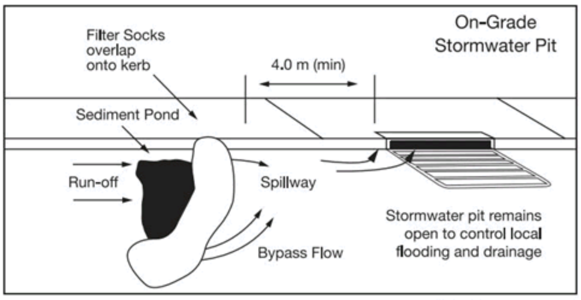

Figure 15B: A filter sock.

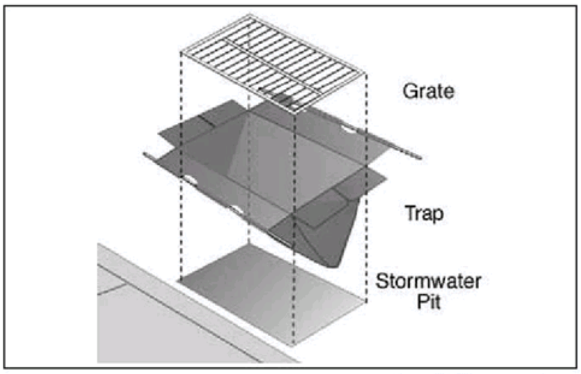

Figure 15C: Stormwater pit trap.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. **Protection of Stormwater Pits**
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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Acknowledgement:

Figure 15A from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Figure 15B after South East Queensland Healthy Waterways Partnership 2006 *"Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites"*. Figure 15C after California Regional Water Quality Board 1999 *"Erosion & Sediment Control Field Manual"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Protected Concrete, Brick & Tile Cutting

What is this?

Concreting, bricklaying, brick and tile cutting must be conducted in such a way that ensures no waste products enter the stormwater system. If washed into the stormwater system, brick and tile cutting, concrete and mortar slurries will harden and block stormwater pipes and potentially cause flooding. Cement also raises the pH of waterways making it alkaline which is deadly to aquatic animals.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 16

WHAT DO I NEED TO DO?

Before starting site works:

Find a location on the site away from stormwater pits and drains to undertake these activities, including mixing cement and mortar. This area should be large enough to contain all excess water, residues and waste.

Designate where associated building materials should be stockpiled, as this typically determines where this activity will occur. If the nature of the job requires cutting in a location close to stormwater pits or drains such as cutting a footpath then controls need to be put in place to ensure that no material enters the stormwater system. Identify site requirements and list them on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** before starting site works.

Installing the control measures:

The designated brick or tile cutting area should have a diversion channel up-slope and sediment collection devices such as a sediment fence below it. If cutting in an area near a stormwater pit, use temporary collection devices such as filter socks, bunding or skirts suitably installed to direct the slurry onto a land area where it can soak into the earth. If this is not possible and the slurry is likely to flow to the stormwater system, filtering will be required. There are filtration systems available that work in the brick cutting machine with built in slurry containment systems, while for the kerb and gutter there are filter socks and for stormwater pits insert traps can be used **(see Fact Sheet 15)**. The filtered water must not be cloudy when discharged to the stormwater system. Install a series of filtration systems for best results.

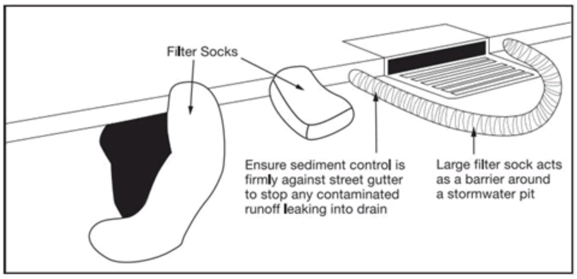

Figure 16A: *Installing a series of filtration systems.*

When equipment is washed down, use a designated wash-down area on-site e.g. wheel wash **(see Fact Sheet 13)**. Waste concrete slurry can be safely disposed of by tipping small amounts into plastic or geotextile-lined ditches **(see Figure 16C)**. This will enable the water to evaporate or soak in to the earth and the solids can then be disposed to landfill or reused as clean fill in construction or as road base.

Maintaining the control measures:

All sediment control measures will require regular cleaning to maintain effectiveness and over time may need to be replaced. Remove the built up sediment and check for holes, other breaks, clogging and blockages in the control measures.

Shovel or vacuum concrete, brick or tile cutting slurry to an area well away from the stormwater system. **Do not** hose down. If there is no designated disposal area, place slurry into a 40 gallon drum that is half full of water. Solid materials will settle to the bottom of the drum for later disposal and the water can be reused when concreting.

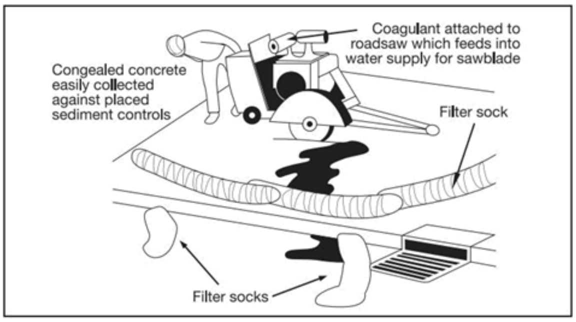

Figure 16B: *Acceptable concrete slurry disposal method.*

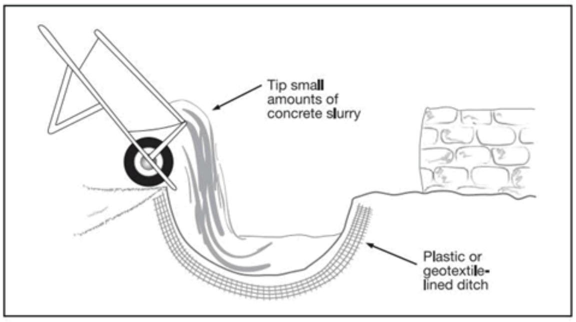

Figure 16C: *Disposing concrete slurry into a lined ditch.*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. **Manage Concrete, Brick & Tile Cutting**
17. Sediment Basins
18. Dust Control
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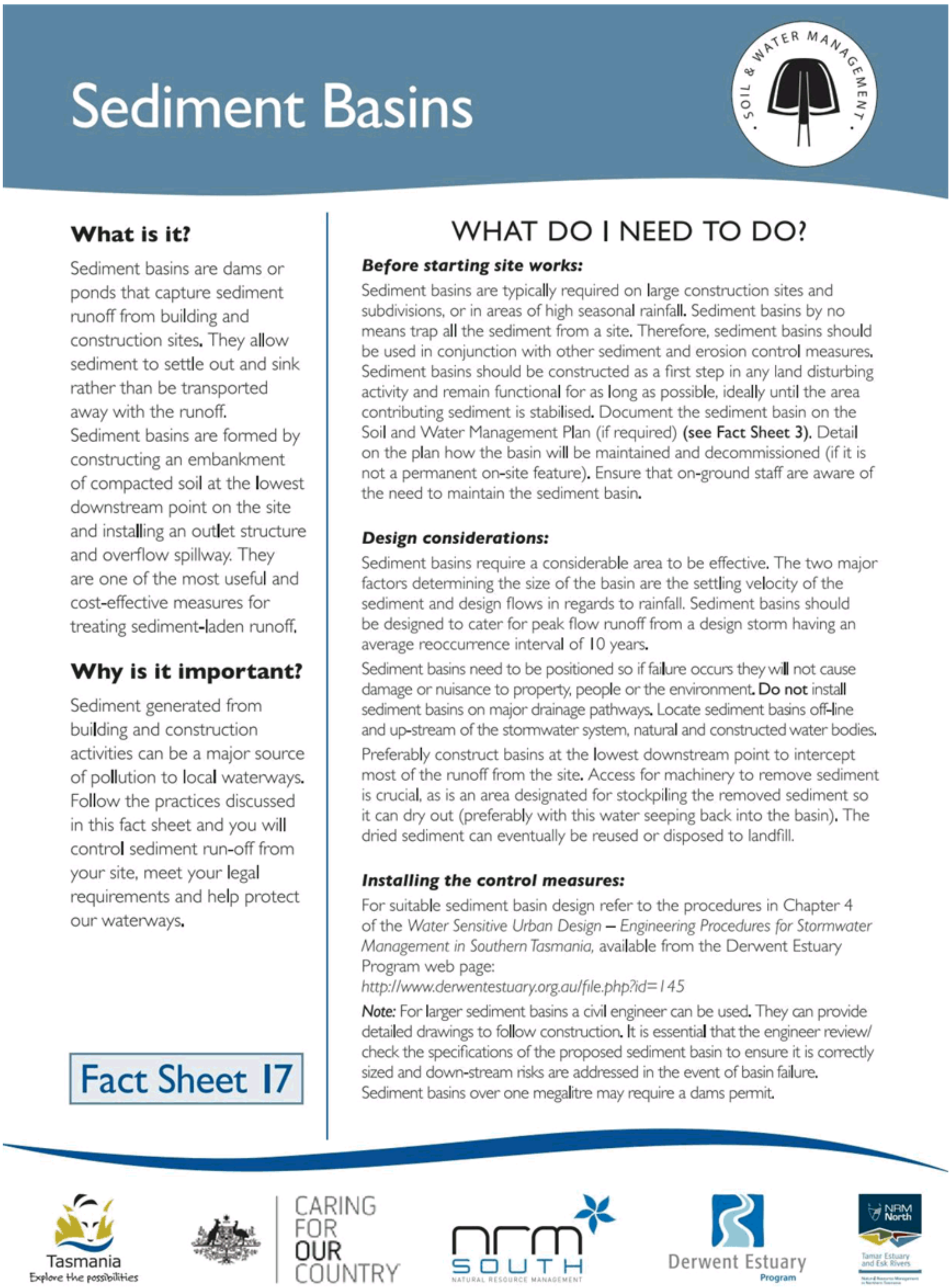
Acknowledgement:

Figures 16A, 16B and 16C after NSW Department of Conservation 2004 *"Environmental Best Management Practice Guideline for Concrete Contractors"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Sediment Basins

What is it?

Sediment basins are dams or ponds that capture sediment runoff from building and construction sites. They allow sediment to settle out and sink rather than be transported away with the runoff. Sediment basins are formed by constructing an embankment of compacted soil at the lowest downstream point on the site and installing an outlet structure and overflow spillway. They are one of the most useful and cost-effective measures for treating sediment-laden runoff.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 17

WHAT DO I NEED TO DO?

Before starting site works:

Sediment basins are typically required on large construction sites and subdivisions, or in areas of high seasonal rainfall. Sediment basins by no means trap all the sediment from a site. Therefore, sediment basins should be used in conjunction with other sediment and erosion control measures. Sediment basins should be constructed as a first step in any land disturbing activity and remain functional for as long as possible, ideally until the area contributing sediment is stabilised. Document the sediment basin on the Soil and Water Management Plan (if required) **(see Fact Sheet 3).** Detail on the plan how the basin will be maintained and decommissioned (if it is not a permanent on-site feature). Ensure that on-ground staff are aware of the need to maintain the sediment basin.

Design considerations:

Sediment basins require a considerable area to be effective. The two major factors determining the size of the basin are the settling velocity of the sediment and design flows in regards to rainfall. Sediment basins should be designed to cater for peak flow runoff from a design storm having an average reoccurrence interval of 10 years.

Sediment basins need to be positioned so if failure occurs they will not cause damage or nuisance to property, people or the environment. **Do not** install sediment basins on major drainage pathways. Locate sediment basins off-line and up-stream of the stormwater system, natural and constructed water bodies.

Preferably construct basins at the lowest downstream point to intercept most of the runoff from the site. Access for machinery to remove sediment is crucial, as is an area designated for stockpiling the removed sediment so it can dry out (preferably with this water seeping back into the basin). The dried sediment can eventually be reused or disposed to landfill.

Installing the control measures:

For suitable sediment basin design refer to the procedures in Chapter 4 of the *Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania,* available from the Derwent Estuary Program web page:
http://www.derwentestuary.org.au/file.php?id=145

Note: For larger sediment basins a civil engineer can be used. They can provide detailed drawings to follow construction. It is essential that the engineer review/check the specifications of the proposed sediment basin to ensure it is correctly sized and down-stream risks are addressed in the event of basin failure. Sediment basins over one megalitre may require a dams permit.

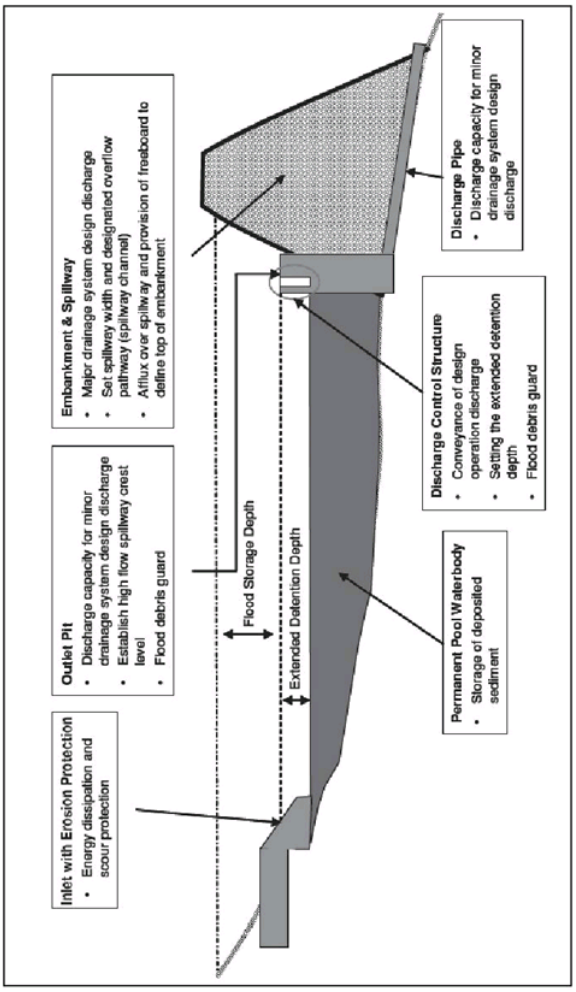


Figure 17A: Sediment basin.

Maintaining the control measures:

Sediment basins require regular inspection, especially after rain events and should be cleaned when more than half full of sediment. Litter and debris should be removed whenever observed in the sediment basin. If the water within the basin is cloudy and never clears, apply gypsum to allow the sediment to settle out.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. **Sediment Basins**
18. Dust Control
19. Site Revegetation

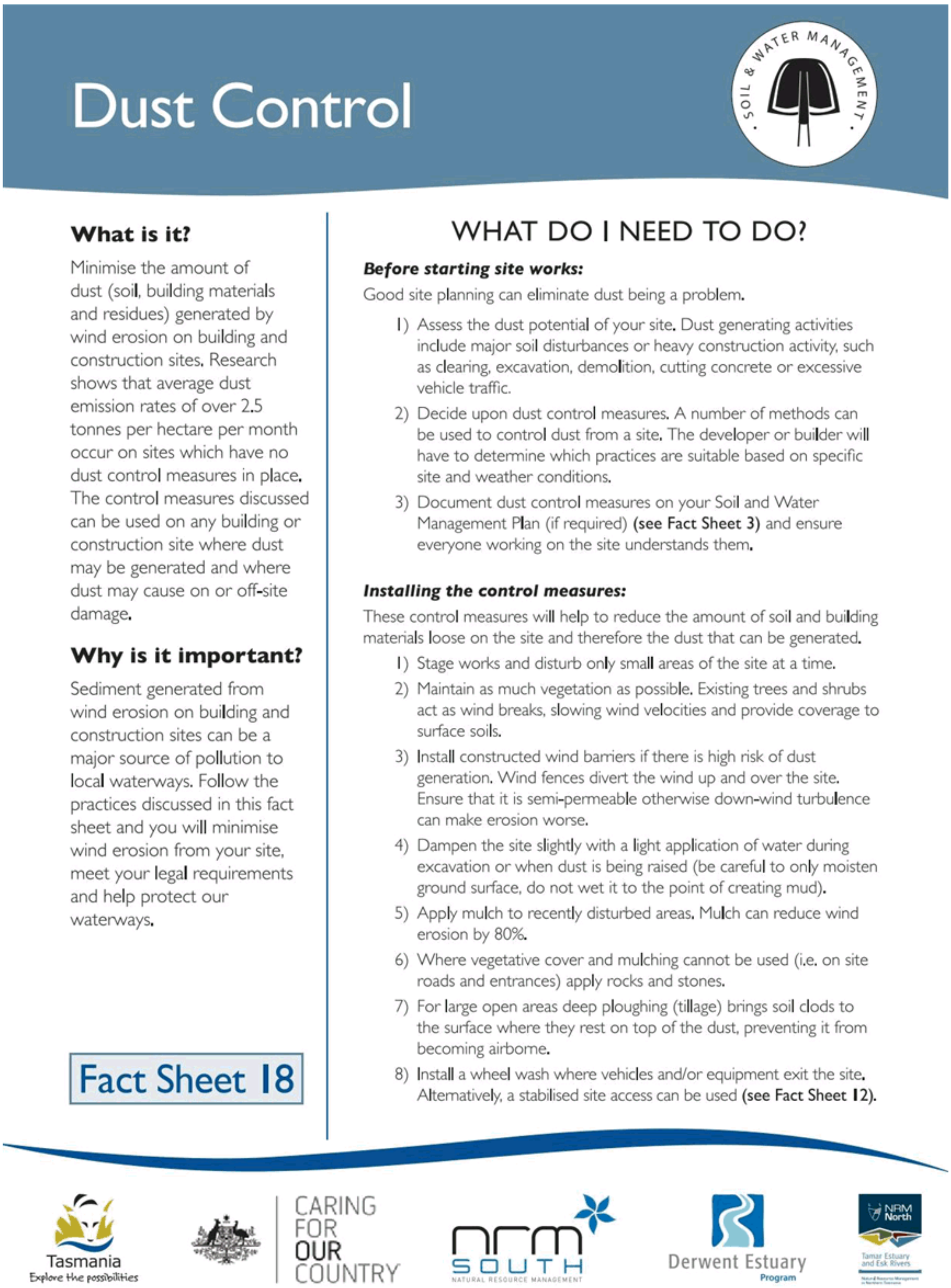
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 17A from Derwent Estuary Program 2006 *"Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania ".*

Date of Issue: December 2008



Dust Control

SOIL & WATER MANAGEMENT

What is it?

Minimise the amount of dust (soil, building materials and residues) generated by wind erosion on building and construction sites. Research shows that average dust emission rates of over 2.5 tonnes per hectare per month occur on sites which have no dust control measures in place. The control measures discussed can be used on any building or construction site where dust may be generated and where dust may cause on or off-site damage.

Why is it important?

Sediment generated from wind erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise wind erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 18

WHAT DO I NEED TO DO?

Before starting site works:

Good site planning can eliminate dust being a problem.

1) Assess the dust potential of your site. Dust generating activities include major soil disturbances or heavy construction activity, such as clearing, excavation, demolition, cutting concrete or excessive vehicle traffic.
2) Decide upon dust control measures. A number of methods can be used to control dust from a site. The developer or builder will have to determine which practices are suitable based on specific site and weather conditions.
3) Document dust control measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure everyone working on the site understands them.

Installing the control measures:

These control measures will help to reduce the amount of soil and building materials loose on the site and therefore the dust that can be generated.

1) Stage works and disturb only small areas of the site at a time.
2) Maintain as much vegetation as possible. Existing trees and shrubs act as wind breaks, slowing wind velocities and provide coverage to surface soils.
3) Install constructed wind barriers if there is high risk of dust generation. Wind fences divert the wind up and over the site. Ensure that it is semi-permeable otherwise down-wind turbulence can make erosion worse.
4) Dampen the site slightly with a light application of water during excavation or when dust is being raised (be careful to only moisten ground surface, do not wet it to the point of creating mud).
5) Apply mulch to recently disturbed areas. Mulch can reduce wind erosion by 80%.
6) Where vegetative cover and mulching cannot be used (i.e. on site roads and entrances) apply rocks and stones.
7) For large open areas deep ploughing (tillage) brings soil clods to the surface where they rest on top of the dust, preventing it from becoming airborne.
8) Install a wheel wash where vehicles and/or equipment exit the site. Alternatively, a stabilised site access can be used **(see Fact Sheet 12)**.

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Derwent Estuary Program

NRM North
Tamar Estuary and Esk Rivers

9) Cover sand and soil stockpiles with fabric, plastic or vegetation.
10) Ensure that relevant equipment and machinery have dust suppressors fitted.

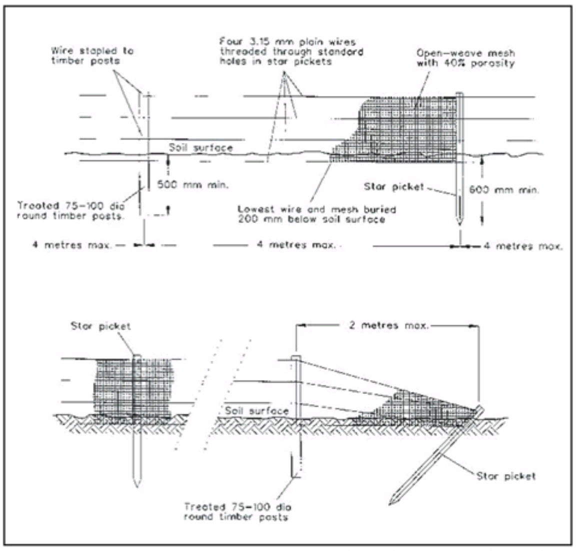

Figure 18A: Installation of a wind fence.

Maintaining the control measures:

Dust control measures involving the application of water require more monitoring than structural or vegetative controls to remain effective. If structural controls are used, they should be inspected for deterioration on a regular basis to ensure that they are still achieving their intended purpose.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
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15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. **Dust Control**
19. Site Revegetation

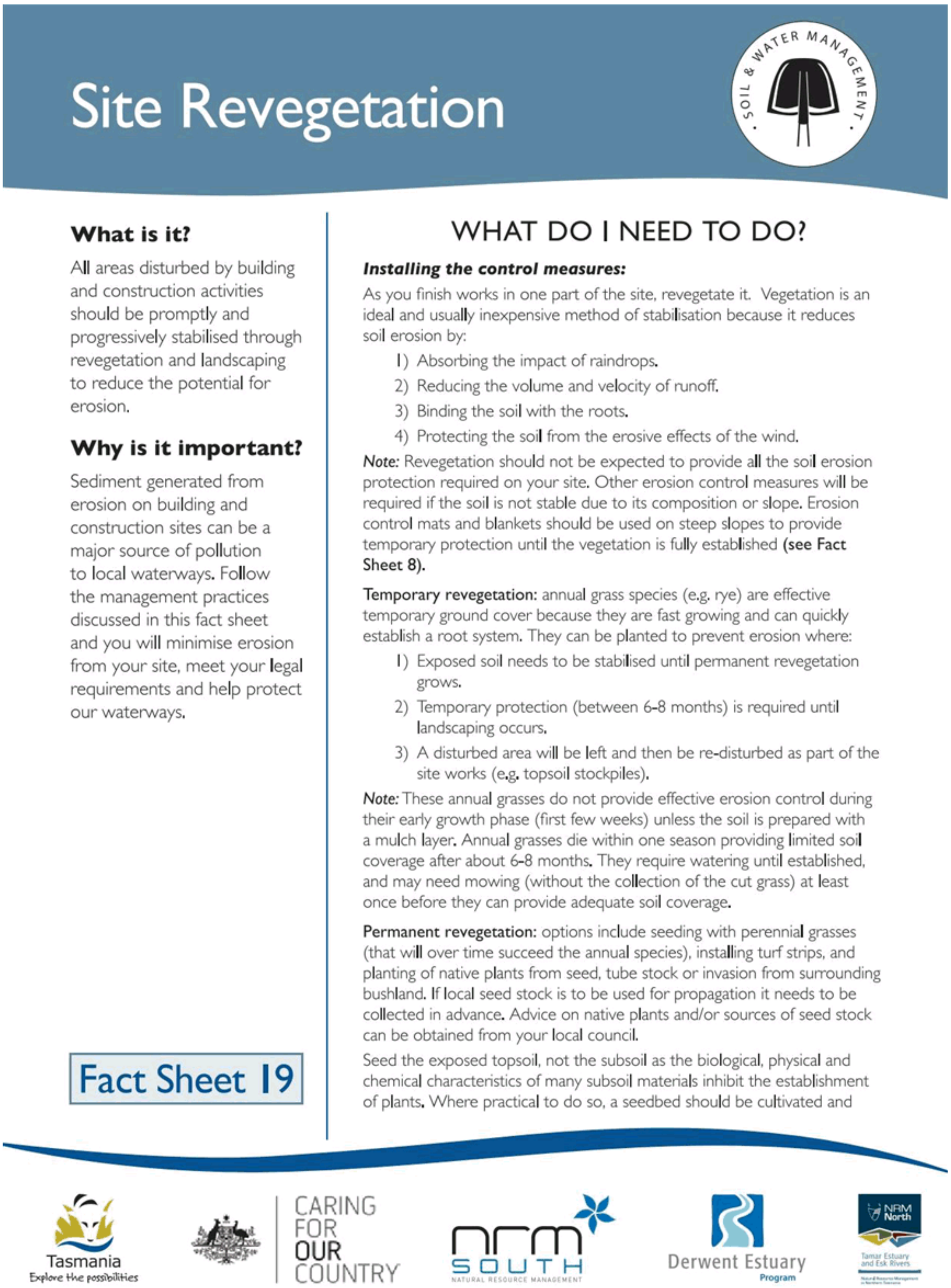
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 18A from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Site Revegetation

What is it?

All areas disturbed by building and construction activities should be promptly and progressively stabilised through revegetation and landscaping to reduce the potential for erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the management practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 19

WHAT DO I NEED TO DO?

Installing the control measures:

As you finish works in one part of the site, revegetate it. Vegetation is an ideal and usually inexpensive method of stabilisation because it reduces soil erosion by:

1) Absorbing the impact of raindrops.
2) Reducing the volume and velocity of runoff.
3) Binding the soil with the roots.
4) Protecting the soil from the erosive effects of the wind.

Note: Revegetation should not be expected to provide all the soil erosion protection required on your site. Other erosion control measures will be required if the soil is not stable due to its composition or slope. Erosion control mats and blankets should be used on steep slopes to provide temporary protection until the vegetation is fully established **(see Fact Sheet 8).**

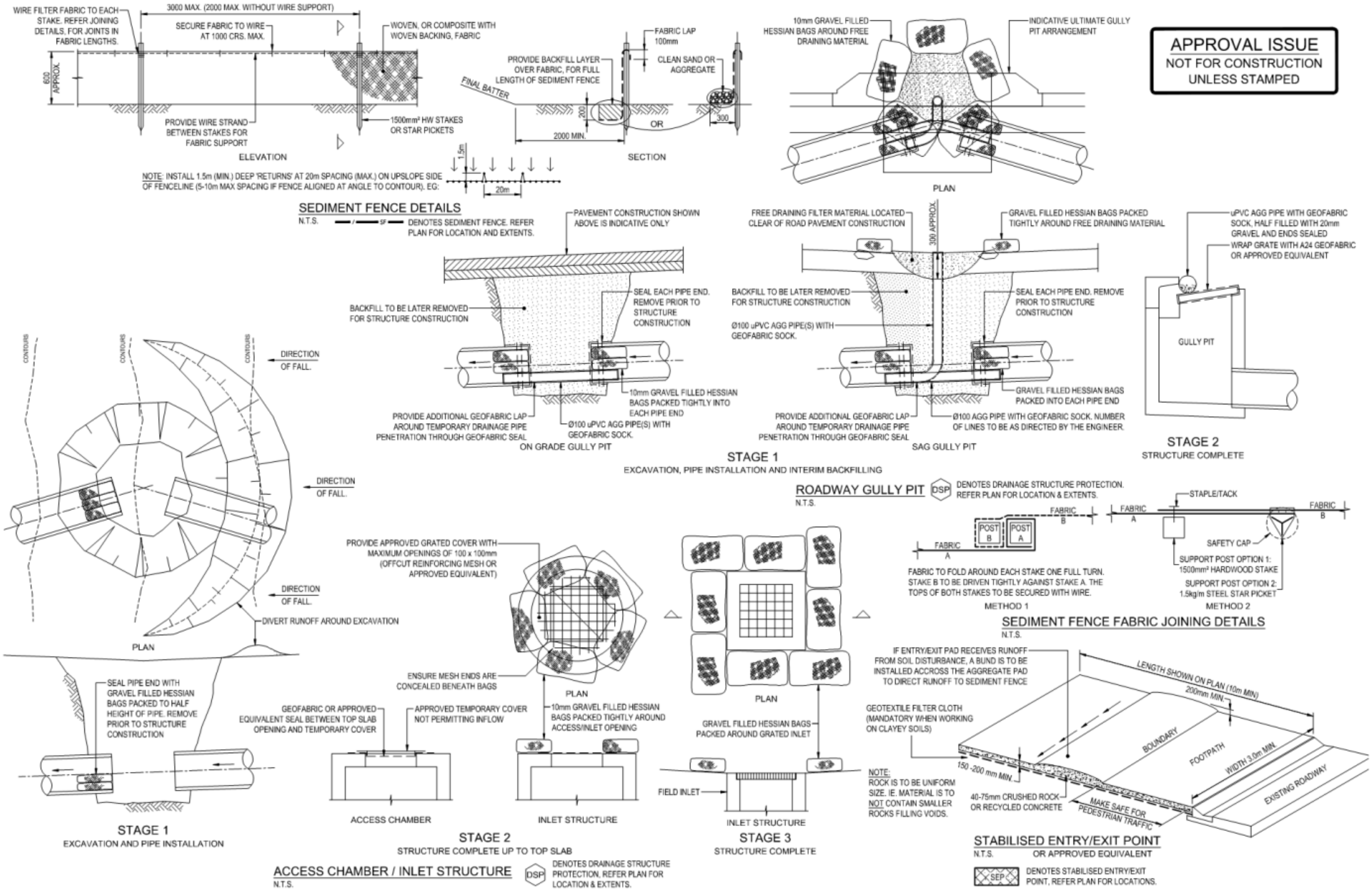
Temporary revegetation: annual grass species (e.g. rye) are effective temporary ground cover because they are fast growing and can quickly establish a root system. They can be planted to prevent erosion where:

1) Exposed soil needs to be stabilised until permanent revegetation grows.
2) Temporary protection (between 6-8 months) is required until landscaping occurs.
3) A disturbed area will be left and then be re-disturbed as part of the site works (e.g. topsoil stockpiles).

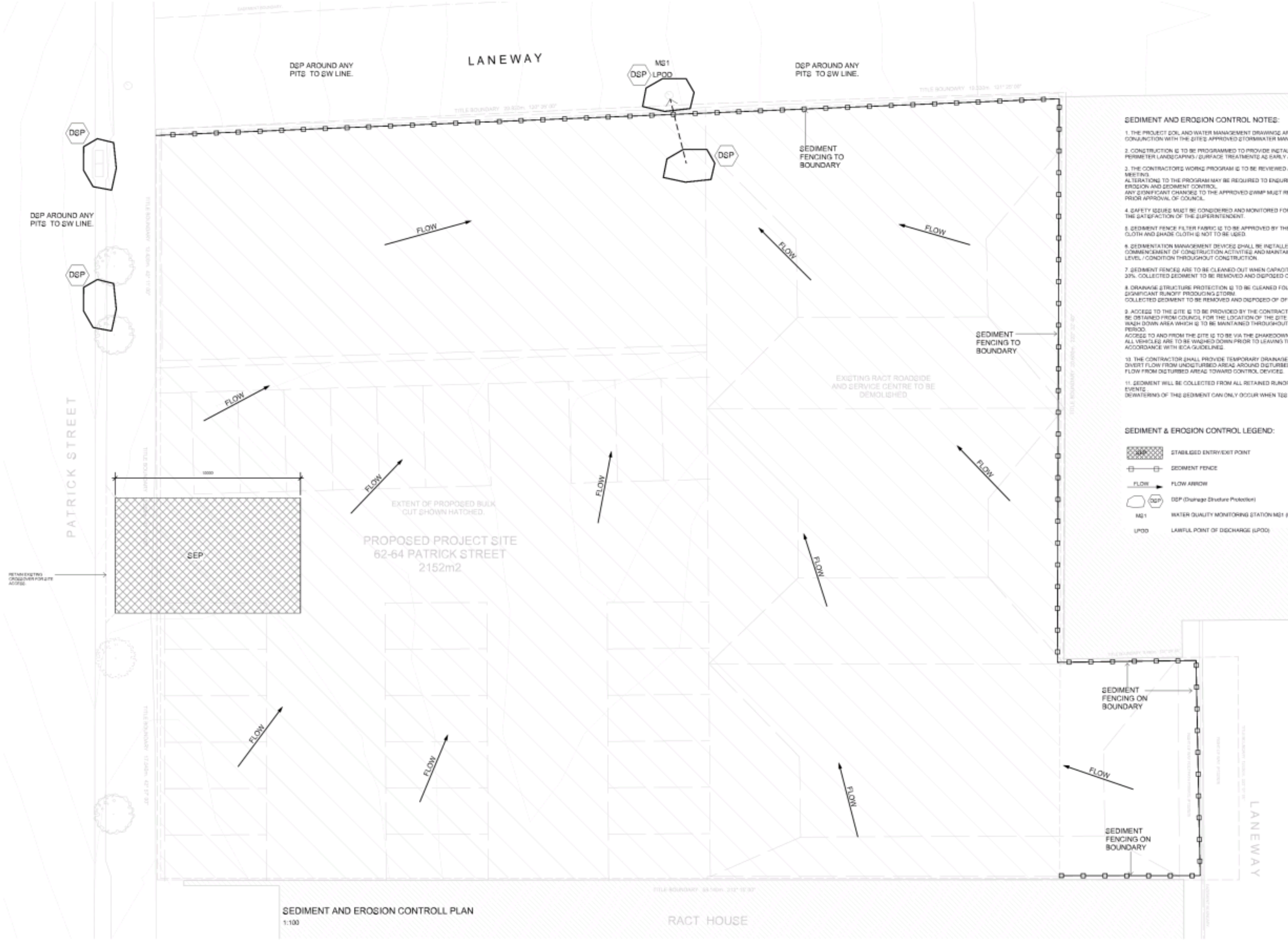
Note: These annual grasses do not provide effective erosion control during their early growth phase (first few weeks) unless the soil is prepared with a mulch layer. Annual grasses die within one season providing limited soil coverage after about 6-8 months. They require watering until established, and may need mowing (without the collection of the cut grass) at least once before they can provide adequate soil coverage.

Permanent revegetation: options include seeding with perennial grasses (that will over time succeed the annual species), installing turf strips, and planting of native plants from seed, tube stock or invasion from surrounding bushland. If local seed stock is to be used for propagation it needs to be collected in advance. Advice on native plants and/or sources of seed stock can be obtained from your local council.

Seed the exposed topsoil, not the subsoil as the biological, physical and chemical characteristics of many subsoil materials inhibit the establishment of plants. Where practical to do so, a seedbed should be cultivated and



APPROVAL ISSUE
NOT FOR CONSTRUCTION
UNLESS STAMPED



SEDIMENT AND EROSION CONTROLL PLAN
1:100

SEDIMENT AND EROSION CONTROL NOTES:

1. THE PROJECT SOIL AND WATER MANAGEMENT DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SITES APPROVED STORMWATER MANAGEMENT PLAN.

2. CONSTRUCTION IS TO BE PROGRAMMED TO PROVIDE INSTALLATION OF PERIMETER LANDSCAPING / SURFACE TREATMENTS AS EARLY AS PRACTICAL.

3. THE CONTRACTORS WORKS PROGRAM IS TO BE REVIEWED AT THE PRESTART MEETING.
ALTERATIONS TO THE PROGRAM MAY BE REQUIRED TO ENSURE SATISFACTORY EROSION AND SEDIMENT CONTROL.
ANY SIGNIFICANT CHANGES TO THE APPROVED SWMP MUST RECEIVE THE PRIOR APPROVAL OF COUNCIL.

4. SAFETY ISSUES MUST BE CONSIDERED AND MONITORED FOR EACH DEVICE TO THE SATISFACTION OF THE SUPERINTENDENT.

5. SEDIMENT FENCE FILTER FABRIC IS TO BE APPROVED BY THE ENGINEER. FILTER CLOTH AND SHADE CLOTH IS NOT TO BE USED.

6. SEDIMENTATION MANAGEMENT DEVICES SHALL BE INSTALLED PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES AND MAINTAINED AT A SUITABLE LEVEL / CONDITION THROUGHOUT CONSTRUCTION.

7. SEDIMENT FENCES ARE TO BE CLEANED OUT WHEN CAPACITY IS REDUCED BY 30%. COLLECTED SEDIMENT TO BE REMOVED AND DISPOSED OF OFF SITE.

8. DRAINAGE STRUCTURE PROTECTION IS TO BE CLEANED FOLLOWING EACH SIGNIFICANT RUNOFF PRODUCING STORM.
COLLECTED SEDIMENT TO BE REMOVED AND DISPOSED OF OFF SITE.

9. ACCESS TO THE SITE IS TO BE PROVIDED BY THE CONTRACTOR. APPROVAL IS TO BE OBTAINED FROM COUNCIL FOR THE LOCATION OF THE SITE ACCESS POINT AND WASH DOWN AREA WHICH IS TO BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
ACCESS TO AND FROM THE SITE IS TO BE VIA THE SHAKEDOWN FACILITY ONLY.
ALL VEHICLES ARE TO BE WASHED DOWN PRIOR TO LEAVING THE SITE IN ACCORDANCE WITH IECA GUIDELINES.

10. THE CONTRACTOR SHALL PROVIDE TEMPORARY DRAINAGE CONTROLS TO DIVERT FLOW FROM UNDISTURBED AREAS AROUND DISTURBED AREAS AND DIRECT FLOW FROM DISTURBED AREAS TOWARD CONTROL DEVICES.

11. SEDIMENT WILL BE COLLECTED FROM ALL RETAINED RUNOFF DURING RUN-OFF EVENTS .
DEWATERING OF THIS SEDIMENT CAN ONLY OCCUR WHEN TSS IS <50MG/L AND P

SEDIMENT & EROSION CONTROL LEGEND:

▨ SEP	STABILISED ENTRY/EXIT POINT
─□──□─	SEDIMENT FENCE
FLOW →	FLOW ARROW
⬡ DSP	DSP (Drainage Structure Protection)
MS1	WATER QUALITY MONITORING STATION MS1 (Monitoring Station)
LPOD	LAWFUL POINT OF DISCHARGE (LPOD)

GEO-ENVIRONMENTAL SOLUTIONS

REV NOTES DATE

DEVELOPMENT APPLICATION

PATRICK STREET APARTMENTS

62-64 PATRICK STREET

SEDIMENT AND EROSION CONTROLL PLAN

A101

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
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SOLUTIONS

CONTAMINATION MANAGEMENT PLAN (CMP)

62-64 PATRICK STREET, HOBART

For Heffeman Button Voss (HBV) Architects

September 2019

DOCUMENT CONTROL

Title	Version	Date	Author	Reviewed
Draft Contamination Management Plan, 62-64 Patrick Street, Hobart	Version 1	13/09/2019	Ellen Davis	JP Cumming
	Version 2	17/09/2019	Ellen Davis	JP Cumming

1 Introduction

Geo-Environmental Solutions Pty. Ltd. (GES) of 29 Kirksway Place, Battery Point, Tasmania were engaged by Heffeman Button Voss (HBV) (the 'Client') on behalf of their client to prepare a site Contamination Management Plan (CMP) for 62 – 64 Patrick Street, Hobart - hereby referred to as 'The Site' for the proposed redevelopment of the site into a multilevel apartment building.

1.1 Assessment Framework

GES completed an Environmental Site Assessment (ESA) report for the site in July 2019 in accordance with IPS E2.0 performance criteria. The ESA included a Tier 1 health risk assessment to determine potential soil contamination risks which may arise from the proposed commercial building development and associated works. The ESA report has been prepared by a suitably qualified person and 'defines the nature, extent and levels of existing contamination and the actual or potential risk to human health or the environment, on or off the site, resulting from that contamination, prepared in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 16 May 2013.'

The council contaminated site register confirms that the site is listed as a potential contaminated site due to the following past activities:

- White Houses Foundry iron / steel works 1822 – 1831
- Fuel storage in two underground fuel tanks removed in 2008, supervised by SEMF and reported in the Environmental Site Assessment (Including Tank Decommissioning) Report produced by SEMF Jan 2009 which concluded 'based on soil contamination, the site is considered suitable for continues commercial use and redevelopment.'
- Former vehicle servicing, car washing and maintenance

The proposed development has therefore flagged the Interim Planning Scheme (IPS) E2.0 Potentially Contaminated Land Code.

1.2 Conclusions From the ESA

GES considers that substantial data regarding the site contamination has been acquired during desktop investigation and the invasive site assessment and recommends the following to manage the soil on site during construction:

- The following contaminants of potential concern (COPC) associated with underground fuel storage, dispensing infrastructure, workshop and vehicle servicing activities plus iron and steel works have been identified on site:
    - Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
    - Mono Aromatic hydrocarbons: Benzene, Toluene, Ethylbenzene, Xylene (BTEX);
    - Polycyclic Aromatic Hydrocarbons (PAH) including Benzo(a)pyrene (B(a)p) and
    - Suite of 15 Heavy Metals
- There were elevated levels of Benzo(a)pyrene in BH04, BH05 and BH08 which exceeded ecological screening levels. There were elevated levels of zinc in BH02, BH04, BH05 and BH07. This means that despite the absence of close sensitive ecological receptors a Contamination Management Plan (CMP) will be required during the site redevelopment to manage the potential leaching of contaminates into the groundwater.
- The soil samples were compared against IB105 guidelines for soil disposal. The following heavy metals were detected at levels which classified the material as Level 2 Material; Barium, Beryllium, lead and zinc. The sum of PAH's was Level 2 as a result from the present of the B(a)p. Due to the concentrations B(a)p was classified as Level 3. Post leachate analysis the presence of B(a)p, the material could be reclassified as Level 2 Material. As half of the samples could have been classified as Level 1 Material – Clean fill; when future excavations take place at the site, all material should be stockpiled, samples collected by an environmental consultant and results compared against IB105 for appropriate soil disposal.
- If deemed necessary, it is to be transported to a Level 2 waste facility (Copping). A permit to transport the waste (obtained through the EPA) will be required.

- As some metals exceeded Level 1 Material classification; it is recommended that all excavated soil removed during the site redevelopment is stockpiled, sampled by a suitably qualified and experienced environmental consultant and results compared against *IB105* guideline limits for disposal purposes.
- Groundwater appears to be under pressure at the site because although it was encountered at 0.3m below the surface in RA4 it was not encountered in any of the soil bores or geotechnical bores (to be reported separately in GES, 2019); which end at 2.0, 8.4 or 9.5m bgs. Sloane 2009 installed slotted pipe to capture groundwater in RA4 between 14-17m bgs. It is likely that this is where groundwater is sitting.
- In the soil samples and the one groundwater sample tested it was confirmed that there were no volatile hydrocarbons or LNAPL detected. Therefore, no vapour risk to construction workers, trenchworks or future site uses has been identified.
- There were no guideline exceedances for soil direct contact for dermal contact, dust inhalation or soil ingestion for commercial/industrial land use, urban residential or trench workers. Combined with the fact that post site redevelopment the site will be completely sealed and there will be no opportunity to come in contact with soil there is no direct contact risk to future construction works or site users.
- If the site use changes to a more sensitive land use and or building designs change then the results will need to be compared against the applicable land use guidelines and / or further onsite soil, groundwater or soil vapour investigations may be required.
- Although the site has a proposed multilevel residential development there are three levels between the ground surface and Level 1 'First Floor Apartments'. 'Basement Plan – Lower', 'Basement Plan – Upper' and 'Ground floor Plan' - street level would act as a substantial vapour barrier if vapours had been detected.
- A Contamination Management Plan (CMP) will be required to manage soil/ water run off during construction to ensure contaminated soil or surface water does not enter the open drain/ waterway, to the east of the site.

Given the contamination risks, as per the Hobart City Council Interim Planning Scheme (IPS), there is a requirement that this CMP document is implemented and followed to mitigate any adverse impact upon human health or the environment as a result of the proposed works.

1.3 Objectives

The objective of this CMP is to comply with HCC IPS requirements. The purpose of this CMP is to:

- Identify the site hazards associated with contaminated soil exposure;
- Minimise risks to site workers and the environment; and
- Provide advice on and advise of safety measures to be adopted during future excavation or construction works at the site.

1.4 Scope of Works

The scope of work for the CMP is to produce a guidance document that includes information in relation to identifying measures and outlining procedures to minimise human health hazards and potential environmental impacts during all phases of site works including demolition, additional soil testing, excavation, construction and post construction future trench works at the site. This report is intended to:

- Minimise potential adverse environmental consequences associated with exposing contaminated soils. The most significant and direct pathway is through soil erosion into stormwater drains and into the River Derwent approximately 1km to the southeast
- Minimise potential health risks from the exposure of contaminated soil during demolition and excavation works. Contaminated soil may be spread onsite and offsite through various mechanisms including foot traffic, vehicle movements, dust erosion as well as stormwater erosion; and
- Provide guidance for management of soil for onsite reuse or off-site soil disposal in accordance with IB105 guidelines.

1.5 Environmental Regulatory Requirements

Key regulations, legislation and policies considered most applicable to soil and groundwater management during any intrusive site works (excavation, construction or maintenance) include:

- Environmental Management and Pollution Control Act (1994).
- Environmental Management and Pollution Control (Waste Management) Regulations 2010.
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010
- Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (Version 3 2018), EPA Tasmania.
- NEPM (2013) National Environment Protection (Assessment of Site Contamination) Measure, 1999 as amended 2013.
- CRC CARE (2011) – Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, September 2010. Friebel, E., Nadebaum, P. & GHD Pty Ltd.
- ANZECC (2000) – Australian and New Zealand Environment & Conservation Council – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh Water Quality.
- DPIWE (1997) – State Policy on Water Quality Management, 1997.
- Australian Standard: AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds
- Australian Standard: AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances

1.6 Site Details

Site details are presented in Table 1 and the site investigation areas are presented in Figure 1.

Table 1 Site Details

Site Address 179-191 Murray Street, Hobart located at 62-64 Patrick Street.
Current Title identification details PID 2950042 Title Reference 175729/2
Investigation Area 2051m^2
Site Surfacing The surface of the investigation area is road base asphalt. Concrete in the warehouse.
Current land use Occupied by RACT.
Current Ownership (as per current certificates of title; the LIST) *6 Failla Avenue P/L*
Site Land Zoning and Land Use The site is *Commercial land use* under the Tasmanian Interim Planning Scheme, 2015.
Previous/ Historic Land use Hosted RACT and related business operations such as vehicle servicing and fuel storage.
Local Council Hobart City Council
Proposed Site Use Unknown
Requirement for current Investigation The site previously hosted underground fuel storage and there is a proposed change to a more sensitive land use.

1.7 Responsibility of Implementation

It will be the responsibility of the owner(s) of the site to implement this CMP. The owner(s) of the site may at times expressly delegate responsibility for site management as appropriate. The site owner(s) retains overall responsibility for implementation of this CMP and any modifications required to this CMP should site conditions change.

The owner(s) of the site are responsible for the distribution of this CMP to any contractors working on site associated with the site redevelopment and these contractors must comply with the requirements of this CMP.

To manage potential health risks, the advice stipulated in this CMP should be followed by all persons involved in works or other activities at the site that may result in the disturbance and/or excavation of soil.

Figure 1 Aerial Photograph of Pre-Development Site for Construction (The LIST Map).

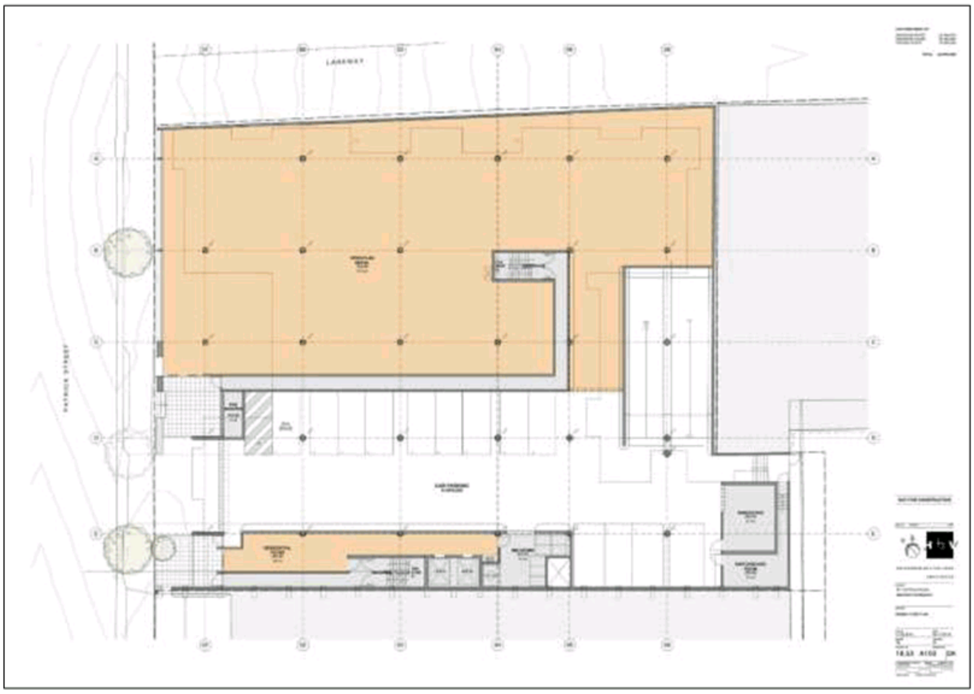

Figure 2 Elevations of the Proposed Ground Floor Building Footprint

2 Background Environmental Site Assessment Information

2.1 Assessment Criteria

2.1.1 Site Soil Assessment

The reported soil analytical results were compared against investigation guidelines presented in Table 2.

Table 2 Guideline on Investigation Levels for Soil.

Construction Phase	Location	Receptor	Pathway*	Land Use Class
During	Site	Commercial Contractors	PVI & DC	Commercial/Industrial (D)
	Offsite	Commercial Workers	PVI & DC	Commercial/Industrial (D)
		Hobart Rivulet & Derwent River	ECO	Urban Setting
Post	Site	Residents	DC	High Density Residential (B)
			PVI	Commercial/Industrial (D)
		Public - Open Space	DC & PVI	Recreational (C)
		Commercial Workers (Includes Office & Maintenance Workers)	DC & PVI	Commercial/Industrial (D)
	Offsite	Hobart Rivulet & Derwent River	ECO	Urban Setting

DC – Direct Contact:
  Dermal Contact - HSL's (CRC CARE 2013)
  Dust Inhalation - HIL's (NEPM ASC 2013)
  Soil Ingestion - HIL's (NEPM ASC 2013)
PVI – Petroleum Vapour Intrusion:
  Trenches & Excavations - HSL's (CRC CARE 2013)
  Indoor - HSL's (NEPM ASC 2013)
ECO – Ecological – EIL's & ESL's (NEPM ASC 2013)
ALL – All of above

2.1.2 Offsite Soil Disposal Assessment

Soil samples were compared against EPA Tasmania (2018) Information Bulletin 105 (IB105). Classification and Management of Contaminated Soil for Disposal, Version 3 (2018)

2.1.3 Groundwater

Groundwater samples were compared against the following guidelines:

- ANZECC 2000 ecosystem protection guidelines for 90% & 95% protection of Freshwater Ecosystems
- NEPM (2013) HSL's; and
- CRC CARE - Technical Report No. 10

2.1.4 Surface Water

Should surface water be encountered it will need to be disposed of and compared against the following:

- ANZECC 2000 ecosystem protection guidelines for 90% & 95% protection of fresh water ecosystems

2.2 Invasive Site Investigations

One site visit was conducted to complete the ESA. Site investigation works comprised of soil bore drilling and groundwater sampling which is summarised in Table 3 and Figure 3.

Table 3 Summary of Site Investigation Work Dates

Hole ID	SB$^{\#}$ Drill & Sample	MW$^{\#}$ Install	MW$^{\#}$ Development	MW$^{\#}$ Gauge MW$^{\#}$ Purge & Sample
BH01-BH08	28th June 2019	-	-	-
GW01(RA4 – Geotec)	-	16th Nov 2008	19th Nov 2008	28th June 2019

BH - Soil Bore; MW – Monitoring Well;

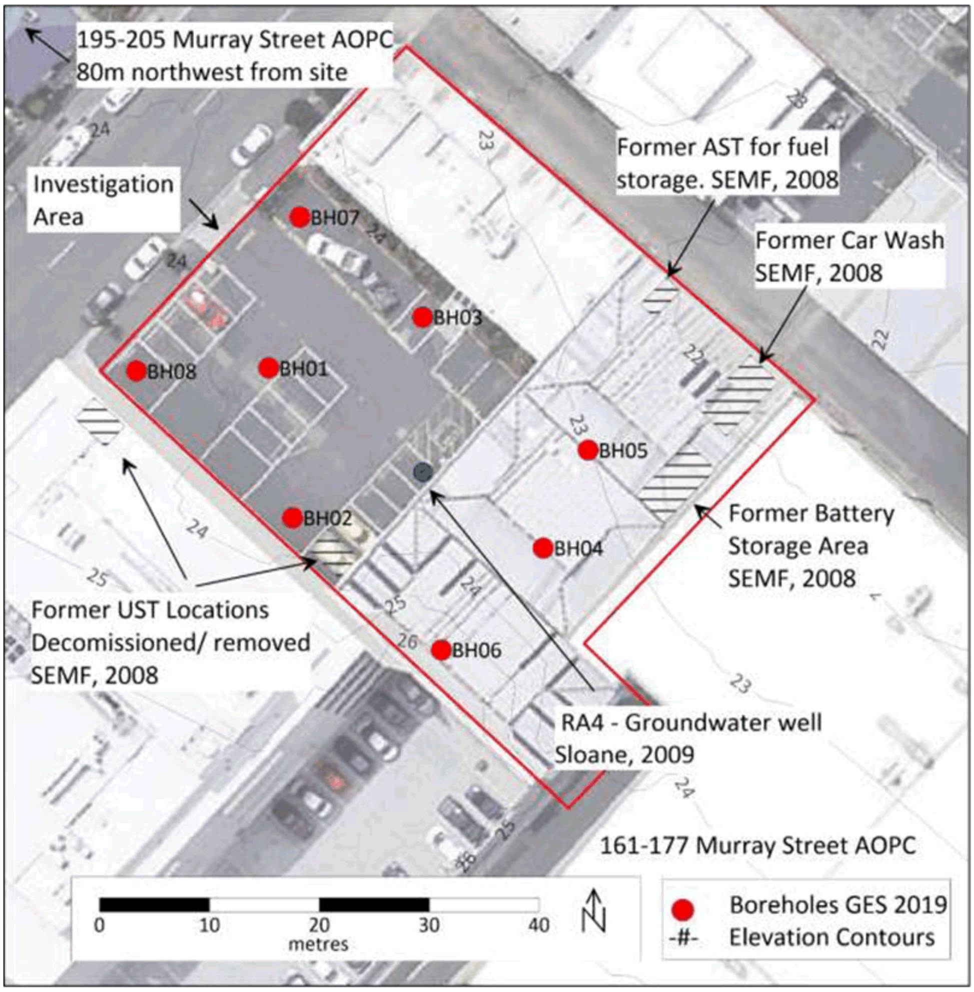

Figure 3 Borehole (BH) and Groundwater (GW) Sampling Locations

2.3 Soil Assessment Results

2.3.1 Environmental

Ecological Screening Level Guidelines

Benzo(a)pyrene was the only analyte which exceeded guidelines limits for ESL's. ESL exceedances were detected in three of the eight bores.

Ecological Investigation Level Guidelines

A number of soil samples collected on site exceeded HIL guideline limits for zinc from four bore holes.

Environmental Risks

As identified, the main contaminate of concern at the site is benzo(a)pyrene. Where excavation works are proposed, this soil will need to be managed carefully in accordance with measures identified within this document. The greatest risk is the mobilisation of sediments into the stormwater. Soil at the site will need to be managed in accordance with the soil and water management plan. The soil and water management plan will need to be designed in accordance with recommendations presented in within this CMP.

Although there is a low likelihood that surface waters will exceed ANZECC (2000) fresh water ecosystem guideline limits, given the whole site has not been tested, care must be taken to monitor surface water exiting the site.

2.3.2 Human Health

Health Screening Levels – Dermal Contact

There were no guideline exceedances for dermal contact.

Health Investigation Levels – Dust Inhalation and Soil Ingestion

There were no guideline exceedances for dust inhalation and soil ingestion.

Health Screening Levels – Vapour Intrusion/ Trench worker

There were no *HSL D* guideline exceedances for assessing petroleum vapour intrusion risks

Human Health Risks

No human health risks have been identified.

2.3.3 IB105

The soil samples were compared against IB105 guidelines for potential future soil disposal, see **Error! Reference source not found.**. The following heavy metals were detected at levels which classified the material as Level 2 Material; Zinc. The sum of PAH's was Level 2 as a result from the present of the B(a)p. Due to the concentrations B(a)p was classified as Level 3. Post leachate analysis the presence of B(a)p, the material could be reclassified as Level 2 Material.

As half of the samples could have been classified as Level 1 Material – Clean fill; when future excavations take place at the site, all material should be stockpiled, samples collected by an environmental consultant and results compared against IB105 for appropriate soil disposal.

All soil excavated at the site is to be sampled by a suitably qualified environmental consultant to determine the appropriate location to dispose of excavated material. The EPA amended *IB 105* in September 2018, to include PFAS, this analyte should also include in any sampling completed for future soil disposal.

2.4 Groundwater Assessment Results

One existing groundwater monitoring well was sampled. Results indicate that there were no guideline exceedances.

3 Potential Receptors

3.1 Ecological Receptors & Environmental Considerations

It is considered unlikely that groundwater impacts would extend to the nearest receiving waters of River Derwent which is 630m in a south easterly direction and the slightly closer Hobart Rivulet. As per the soil and water management plan (SWMP), stormwater runoff from the site is proposed to be diverted into the Legal Point of Discharge (LPOD) stormwater pits in the laneway adjacent to the site.

There is a responsibility that the water quality is assessed against guidelines for protection of the freshwater receiving environment being Hobart Rivulet (and effectively the Derwent River). ANZECC 2000 ecosystem protection guidelines for 90% & 95% protection of fresh water ecosystems should be applied. Percentage species protection values are based on various reports (Desmond 2002; DEP 2011).

3.2 Human Receptors and Exposure Routes

As a result, from the previous land use activities, there is localised contamination within and beneath fill material at the site. Potential health exposure risks may be associated with soil excavation and management activities as well as general movement of soil around the site caused by foot & vehicle traffic, mobile machinery, as well as natural elements including wind and rain. Onsite and offsite exposure pathways include dermal contact, ingestion of contaminated soil/water and inhalation of dust.

The SWMP developed for the site will need to reflect management measures identified within this document to minimise erosion of soil by surface water movement.

4 Minimising of Potential Environmental Impacts

Potential environmental impacts during any subsurface works or excavations may be associated with:

- Soil excavation and management
- Movement of soil
- Off-site disposal of soil
- Where relevant, groundwater and surface water extraction, removal and disposal
- Importation of fill to the site
- Dust and odour
- Stormwater management and sedimentation

To minimise potential environmental impacts, all work must be conducted in accordance with the:

- The Environmental Management and Pollution Control Act (EMPCA, 1994)
- Environmental Management and Pollution Control (Waste Management) Regulations (2010),
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010, and
- The guidance set out in this plan.

4.1 Soil

4.1.1 Soil Excavation and Management

The relevant sections of the CMP should be referred to during the following phases of site work: prior to commencement, demolition, additional soil testing, excavation, construction and ongoing future trenchwork at the site.

Prior to Commencement

Contractors and workers must be made aware of the potential soil and groundwater contamination and be familiar with the requirements of the CMP and they should also know that there may be environmental or human health consequences that result from noncompliance which may incur a fine from the EPA Tasmania.

Contractors must prepare one or more of the following: a site-specific Health and Safety Plan, a Job Safety Analysis (JSA) or a Safe Work Methods Statement (SWMS) covering their workers at the site for any reasonably anticipated risks.

Work procedures conducted on the site must be in accordance with relevant Occupational Health and Safety (OH&S) Regulations. It is the responsibility of the principal contractor that site workers are made aware of the OH&S issues at the site.

A Soil and Water Management Plan (SWMP) should be written and implemented prior to the commencement of any site demolition or excavation work. The SWMP should be closely aligned with recommendations identified in this CMP and Fact Sheets presented in Appendix 4.

Demolition

The time between site demolition and site resurfacing is a period where there is a heightened risk of offsite spread of contaminated soil. During this time there is expected to be the greatest chance of offsite spread of contaminates through soil leaching, dust generation, as well as soil erosion from vehicle and foot traffic, precipitation and stormwater runoff.

Limiting the exposure of paved surfaces through keeping pavement in place for as long as possible, this includes limiting the length of time the service trenches and footing pads remain open.

Demolition site work will involve removal of all site buildings and decommissioning redundant service infrastructure. Due to the contamination risk the impermeable surfaces should remain onsite and intact during this process for as long as practically possible even if this means concrete coring to obtain additional soil samples (the next phase).

It should be noted that asphalt surfaces often have hydrocarbon contamination, so any asphalt surface material should be managed separately to other materials.

Asbestos may be present in the site buildings, this is beyond the scope of the ESA or this CMP and will not be addressed again in this document. Demolition contractors should refer to their own JSA's or standard operating procedures regarding asbestos management.

Soil Excavation & Stockpiling

Soil exposed and excavated from the site must be managed so as not to cause environmental harm in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations (2010) and the Environmental Management and Pollution Control Act (EMPCA, 1994). Harm can be caused from contaminated soils leaching further underground, leaving the site through wind (as dust), carried off site with rain (as runoff stormwater), or released into the atmosphere as vapour.

Stockpiles should be sampled by a suitably experienced and qualified environmental assessor and analysed using a NATA registered laboratory to determine their contamination status, consistent with the procedures described in Section 4.1.3.

In order to prevent soil leaving the site the following erosion control measures must be followed:

- Develop a stabilized site access (Fact Sheet 12 Appendix 4);
- Clean up any soil spilt on roads adjoining the site.
- Ensure vehicles and equipment are free from excess soil when leaving the site, to avoid tracking soil off-site.
- Establish an equipment wash down area if necessary (Fact Sheet 13 Appendix 4);

Soil stockpiles must be managed in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations, 2010 and best practice guidelines. The following are recommended:

- It is recommended that separate stockpiles be constructed to separate varying levels of apparent soil contamination, if encountered. This will likely enable cost savings during disposal phases.
- The source area of stockpiled soil must be noted on a plan for reference to ensure the movement of potentially contaminated soil is tracked (see Section 4.1.2).
- Soil should be classified for disposal or reuse in accordance with EPA Tasmania (2018) Information Bulletin 105 (IB105) before being transported off site (see Section 4.1.3).
- Always keep stockpiles covered and sealed if possible (refer Section 4.1.5 Dust and Odour Control & Fact Sheet 9 Appendix 4).
- If stockpiled for greater than 12 hours, should be covered with an impermeable layer (eg. PVC plastic 2mm thick) to prevent the contents being affected by wind or rain;
- All soil stockpiles must have sediment control devices (silt fencing) around any temporary or longer-term stockpiles (Fact Sheet 14 Appendix 4)

Construction

If there are any changes to the plans during the construction phase and additional excavations are required, the CMP should be revisited. Additional soil and water testing may be required, or current results may need to be reassessed against different criteria.

SWMP measures must remain in place as long as soil is exposed at surface or in excavations including footing exposures and service trenches.

Following Completion of Excavation Works

Equipment used for excavation of potentially contaminated soil must be cleaned of loose soil prior to use in another area. The loose soil must be contained within the stockpiles at the site.

Future Trench Work

It is anticipated that over time, future trench workers or contractors will visit the site from time to time as services require repairs or new infrastructure is required.

The anticipated that the site layout will vary greatly to the current conditions; the site will be sealed by a ground floor concrete carpark. It is expected that some fill will remain on the northern two thirds of the site. Therefore, future trench workers and contractors should be made aware of the potential contamination that may be encountered at the site and should be provided with a copy of this document.

4.1.2 Movement of Soil

If soil is going to be removed from site is to be assessed and sampled by an Environmental Consultant and results compared against Information Bulletin 105 (IB105) for Classification and Management of Contaminated Soil for Disposal. It is not necessary for undisturbed soil that remains on site to be classified against IB 105.

Movement of soil at the site must be tracked to ensure its origin, contamination status and fate is documented. An example soil tracking form is provided in Appendix 5. Soil tracking forms are to be completed by the Site Foreman/supervisor of the site.

The source and destination of any soil moved around the site or off-site can be identified using references to development features, or a site grid. The appearance of soils encountered during excavation must be noted and checked to confirm they are consistent with those materials noted in the preliminary assessment. Soil appearance checks must be conducted by the Site Foreman or delegated to a suitably experienced and trained person.

4.1.3 Off-site Disposal of Soil

Waste soil generated at the site must be managed, transported and disposed in accordance with the Environmental Management and Pollution Control (Waste Management) Regulations 2010 and the Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010.

Aspects of these regulations related to classification and disposal of contaminated soils are summarised in Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (November 2018), published by EPA Tasmania.

See Appendix 2 for the comparison of soil analytical results from the ESA against IB105 plus IB105 in full. It is anticipated benzo(a)pyrene, and some heavy metals will be encountered across the site.

GES recommends that all soil excavated at the site is stockpiled systematically. Unclassified material will require systematic sampling for contamination levels. Soil flagged for landfill disposal is to be assessed by an Environmental Consultant and results compared against *Information Bulletin 105 (IB105) for Classification and Management of Contaminated Soil for Disposal.*

Soil samples would need to be obtained from the excavated soil and must comply with the sampling frequency in the EPA guidelines for off-site soil disposal.

Where excavated soil requires off-site disposal, the following is required:

- Communicate with the environmental consultant as early as possible. This will enable classification to be undertaken and relevant documentation prepared, prior to the proposed disposal date.
- Ensure that excavated soil volumes and origins are documented, to assist with classification for off-site disposal.
- Separate soils based on appearance and location of excavation. This will minimise the volume of higher category waste for dispose, and in turn minimise costs associated with disposal.
- Soils must be classified in accordance with Information Bulletin 105: Classification and Management of Contaminated Soil for Disposal (November 2018), published by EPA Tasmania or as updated.
- An application for disposal to an approved waste facility must be submitted to the Director, EPA Tasmania for review in accordance with Environmental Management and Pollution Control (Waste Management) Regulations, 2010 and the Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010.
- If approved, waste soils must be transported to the approved facility by a Controlled Waste Handler approved by EPA Tasmania.
- The Controlled Waste Handler must meet requirements for waste collection as well as disclosure of tracking information.

4.1.4 Importation of Fill Material

Fill imported to the site must meet Tasmanian EPA (IB105) "Fill Material" and NEPM HIL 'A' criteria (NEPM, 2013). Fill must be adequately sampled and analysed to demonstrate it meets Tasmanian EPA (IB105) "Fill Material" criteria prior to import to the site, as set out in this plan. A suitably qualified environmental consultant must conduct sampling and analysis.

A qualified environmental consultant must assess that the contamination status of the fill is suitable for use at the site. The environmental consultant shall inspect the source location of the fill. The material must be sampled and analysed at a minimum rate of one sample per 25 m^3 bulk soil volume and a minimum of 3 samples.

4.1.5 Dust and Odour Control

Generation of dust can spread contaminated soil and pose a risk to human health risk onsite and offsite and off-site ecological receptors. Fact Sheet 18 in Appendix 4 should be used as a guide for managing dust onsite. Measures that can be undertaken to assist in minimising the generation of dust and limit the amount of soil leaving the site include:

- Minimise movement of equipment on the site.
- Minimise excavation and movement of soils.

- Use a water spray sparingly to dampen work areas if excess dust is generated.
- Use a water spray sparingly to dampen soil prior to and during excavation if excess dust is generated.
- Avoid soil excavations that create dust on windy days.
- Always keep soil stockpiles covered where possible, with an impermeable membrane (eg. plastic sheeting) to minimise generation of dust, release of odours and to limit runoff of sediment.
- Avoid extended stockpiling of soil.
- Consider the use of dust barriers such as hessian or cloth screening.

4.2 Groundwater & Stormwater Management

To minimise potential migration of contaminants into the River Derwent, all work must be conducted in accordance with the State Policy on Water Quality Management 1997 and the guidance set out in this plan.

Although there were no ANZECC (2000) guideline exceedances in groundwater collected from the single groundwater well upgradient of much of the site, there remains a concern that during the site redevelopment, that potentially impacted surface and groundwater will drain either:

- Offsite as overland flow onto neighboring properties; or
- Into stormwater systems without appropriate silt traps being put in place; or
- Exceeds recommended ANZECC (2000) guidelines limits.

Based on post demolition conditions, it is expected that surface waters will drain to the EPOD to the south of the site. Advice should be sought on whether the EPOD can be used and if there are any risks that sediments may block the EPOD and cause a risk to offsite receptors. Otherwise, water is to be directed to the LPOD.

The following needs to be put in place to manage groundwater and surface water at the site:

- Depending on the depth of proposed building foundation pads, groundwater may need to be dewatered from excavations. Groundwater would need to be tested before it is pumped from excavations and disposed into the stormwater. Alternatively, groundwater may be transferred into soakage pits and allowed to diffuse back into the aquifer;
- Surface water at the site will need to bypass a main primary surface water sample collection point which will be used to test water before it enters the stormwater system;
- Sampled by an Environmental Consultant and compared against ANZECC 2000 guidelines for 90% & 95% protection of fresh water ecosystems and freshwater ecosystems and TasWater's disposal requirements.
- Sampling should occur when rainfall exceeds 5 mm within a 24 hours period for the Ellerslie Road gauging station (approximately 1.5 weather front passing per month based on 2018 Bureau of Meteorology records).
- In the event there is a trigger, management measures will need to be put in place to collect water existing the site to ensure compliance with identified ANZECC 2000 guidelines.

4.3 Surface Water and Sediment Control

Measures to minimise the potential for contamination of stormwater and migration of contaminants include:

- Silt fencing is required around the perimeter of the site to reduce the extent of soil erosion from wind and rain (Fact Sheet 14 Appendix 4).
- Where possible overland flow should be diverted away from excavation workings to reduce the risk of surface waters becoming impacted as a result of mixing with contaminated soil (Fact Sheet 7 Appendix 4);

- The site will need to be regularly inspected for signs of scour including around all earthen drains (Fact Sheet 11 Appendix 4) and site slopes. Where scour is identified, erosion should be controlled with the use of erosion control matts and blankets (Fact Sheet 8 Appendix 4)
- Collect stormwater on-site and allow suspended solids to settle before disposal in accordance with EMPCA and/or local Water Authority requirements (Fact Sheet 17 Appendix 4).
- Control measures such as cut-off drains/mounds and or sand bags will be required to prevent soil and water from existing the site boundary at locations which are not identified as a legal point of discharge (LPOD).
- Silt traps will be required around all drainage pits to prevent soil from entering the stormwater system (Fact Sheet 15 Appendix 4). Soil collected around the pits will need to be excavated and placed into skip bins for disposal with other excavated soil. The silt traps will need to be regularly maintained and checked to ensure they are not discharging sediments into the stormwater.
- Install drainage and/or grade soil surfaces to minimise pooling of water on exposed soils. Pooling surface water may be contaminated and can be managed through placement of aggregate.

4.4 Spill Avoidance

The following measures are recommended to manage preventable spills and contamination during site redevelopment works:

- Avoid conducting vehicle or machinery maintenance on-site.
- Ensure any fuel, oil or other chemicals are stored safely and securely in a temporary bunded area and that storage containers are absent from leaks and cracks.
- Repair or remove any leaking containers or machinery from the site immediately.
- Always have a complete spill kit onsite during site works.
- Clean up any spilt fuel, oil or other chemicals as soon as practically possible.
- Check sediment control measures regularly (at least daily) and clean and maintain as necessary.
- Inspect sediment control measures more frequently during rain periods, to check they are adequate for site conditions.

5 Minimisation of Risk to Health of Site Workers

Work procedures conducted on the site must be in accordance with relevant Occupational Health and Safety (OH&S) Regulations. It is the responsibility of the principal contractor that site workers are made aware of the OH&S issues at the site. An OH&S Specialist or an Occupational Hygienist must be engaged by the principal contractor to ensure OH&S measures are implemented on this site.

Engaged companies/contractors must prepare a site-specific Health and Safety Plan covering their workers at the site.

5.1 Exposure Routes

5.1.1 Soil

Potential hazards for site workers associated with the presence of contaminants at the site may be encountered during excavation or construction works must be considered as part of the overall Health and Safety Plan for the site, including:

- Ingestion of contaminated soil.
- Inhalation of dust.
- Dermal (skin) contact (low risk)
- Inhalation of petroleum hydrocarbon vapours (low risk)

5.1.2 Groundwater and Surface Water

Potential hazards for site workers associated with the presence of contaminants in groundwater that may be encountered during excavation works must be considered as part of the overall Health and Safety Plan for the site, including:

- Ingestion of contaminated water (low risk)
- Dermal (skin) contact (low risk)
- Inhalation of petroleum hydrocarbon vapours (low risk)

5.2 Control measures

Personnel working at or visiting the site during any construction (including demolition and excavation) works must be provided with an induction briefing, based on the example Site Induction Record provided in Appendix 6. This induction record may be incorporated into the general site induction procedure. The principal contractor may delegate responsibility for the induction briefing to their environmental consultant or occupational hygienist.

Measures that must be undertaken to manage exposure of site workers to contaminants include:

- Observations of unusual odours or discolouration of soil should be reported to an environmental consultant who can make an informed decision on the level of risk to workers.
- Avoid handling of potentially contaminated soil and/or water.
- Wash hands before eating, drinking or smoking.
- Avoid activities that may introduce soil and/or water to the mouth, such as nail biting.
- Store and consume food and drink in a designated clean area.
- Remove soiled clothing and footwear before entering a designated clean area and before leaving the site.
- Use personal protective equipment (PPE) as required. In addition to hard hats, safety boots, safety glasses and hearing protection, this equipment may include:

    - Impermeable (latex or nitrile) gloves, if handling potentially contaminated soil and/or water
    - Long sleeved shirt and long trousers
    - Dust masks
    - Vapour masks
- Store personal protective equipment in a clean place to avoid contamination.
- Replace gloves and masks regularly, and other equipment as required.
- The principal contractor must ensure that site workers and visitors are provided with:
    - Site safety induction briefing.
    - Adequate hand washing facilities.
    - A designated clean area for storage and consumption of food and drink.
    - Adequate personal protective equipment, as described above.

6 CMP review and reporting

6.1 Review

Following changes in the understanding of site contamination conditions, work requirements, legislation, or work scope (including excavation or construction), this CMP must be revised and reviewed by a competent person prior to use for the proposed works. If no changes to the above-mentioned conditions occur, the CMP should be reviewed every 2 years. The CMP must be revised to reflect any changes and provide adequate procedures for ensuring continued worker, public and environmental safety and compliance with legislation.

6.2 Reporting

It is recommended that Site Management maintain documentation demonstrating that the requirements of this CMP have been met. Such documentation is likely to include:

- Site survey levels.
- Soil tracking records.
- Repair details to vapour barrier or venting system (if required).
- Volumes of fill removed and imported to the site.
- Records of complaints, notices or breaches of the CMP requirements and an outline of actions taken.
- Signed induction records to the site which demonstrate workers commitment to following the CMP.
- Evidence that imported fill meets Tasmanian EPA (IB105) "Fill Material" and HIL A' criteria (NEPM, 2013).
- Evidence that excavated fill was disposed of in accordance with EMPCA (1994) requirements.

7 Concluding Statement

It is concluded that provided that specific remediation and protection measures identified in this document are implemented before any use and/or excavation commences:

- The land is suitable for the intended use;
- The proposed excavation works will not adversely impact on human health or the environment

8 SUMMARY OF ROLES AND RESPONSIBILITY

Site Owner	The owner(s) of the site are responsible for the distribution of this CMP to any building or development contractors working on site and these contractors must also comply with the requirements of this CMP. There is a responsibility to ensure the soil and water management plan (SWMP) is put in place prior to site demolition works, and the plan is active as soon as site coverings are removed. The SWMP should not be removed until all surfaces have been paved. Post the site redevelopment, the site owner(s), who may delegate to a site operator is responsible and must inform future site contractors and trench workers of the CMP and the requirements to follow its contents.
Site Manager during site redevelopment (including following phases of site work: prior to commencement, demolition, additional soil testing, excavation, construction and future trenchwork)	Responsible for the preliminary assessment of potential contamination discovered and assessing whether further action is required. The Site Manager is responsible for ensuring the induction of Site Operatives, assessing the adequacy of quarantine measures and contacting the relevant Consultant and/or Contractors where appropriate. Potential offsite migration of surface water and soil needs to be assessed. The site manager is to contact the Environmental Consultant to arrange for surface water to be tested in accordance with ANZECC (2000) and Stockpiled soil to be tested in accordance with IB105. The site manager is to become familiar with IB105 and determine the appropriate actions for soil transport and disposal following receiving final laboratory testing results. All soil must remain onsite until fate of the soil material is determined.
Site Operatives	During the works, the Site Operative will be vigilant for potential contamination. Where potential contamination is identified, Site Operatives will quarantine the area and inform the Site Manager. An Environmental Consultant may be required to assess the site. Potential offsite migration of surface water and soil needs to be assessed during and after rain events. The site operator is to notify the site manager when soil is ready for testing to discern the appropriate disposal actions.
Environmental Consultant	The services of an Environmental Consultant will be required for additional drilling and soil testing in accordance with IB105. The Environmental Consultant may also be required to sample temporarily stored groundwater. If unexpected or gross soil contamination is encountered (not identified in the ESA), an Environmental Consultant will need to be engaged to assess the potential contamination find, undertaking any necessary sampling and delineation, if required, developing a remedial scope and validating remediation. The Environmental Consultant must have appropriate qualifications and expertise in environmental assessment (e.g. an experienced environmental scientist, environmental soil scientist, environmental geologist or environmental engineer). All findings and conclusions will be reported, as appropriate, to the satisfaction of the Site Manager and the Site Owner

LIMITATIONS STATEMENT

This Contamination Management Plan has been prepared in accordance with the scope of services between Geo-Environmental Solutions Pty. Ltd. (GES) and Heffernan Button Voss (the 'Client') on behalf of their client. To the best of GES's knowledge, the information presented herein represents the Client's requirements at the time of printing of the Report. However, the passage of time, manifestation of latent conditions or impacts of future events may result in findings differing from that described in this Report. In preparing this Report, GES has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations referenced herein. Except as otherwise stated in this Report, GES has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

The conclusions described within this report are based the results of analysis from the Environmental Site Assessment by GES (2019) and an assessment of their contamination status. The scope of the ESA does not allow for the review of every possible soil and groundwater contaminant over the whole area of the site.

This report does not purport to provide legal advice. Readers of the report should engage professional legal practitioners for this purpose as required.

No responsibility is accepted for use of any part of this report in any other context or for any other purpose by third party.

REFERENCES

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Appendix 1 GES Staff

Geo-Environmental Solutions (GES) is a specialist geotechnical and environmental consultancy providing advice on all aspects of soils, geology, hydrology, and soil and groundwater contamination across a diverse range of industries.

Geo Environmental Solutions Pty Ltd:

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GES STAFF - ENGAGED IN SITE INVESTIGATION WORKS

Dr John Paul Cumming B.Agr.Sc (Hons) Phd CPSS GAICD

- Principle Environmental Consultant
- PhD in Environmental Soil Chemistry from the University of Tasmania in 2007
- 18 years' experience in environmental contamination assessment and site remediation.

Mr Kris Taylor Bsc (Hons)

- Senior Environmental & Engineering Geologist
- Honours in Environmental Geology at the University of Tasmania in 1998
- 22 years professional work experience and 15 years contaminated site assessment & hydrogeology

GES STAFF – CONTAMINATED SITES EXPERIENCE

Ms Sarah Joyce BSc (Hons)

- Senior Environmental Scientist
- Honours in Geography and Environmental Science at the University of Tasmania in 2003;
- Undergraduate Degree Double Major in Geology and Geography & Environmental Science

15 years professional work experience and six years contaminated site assessment

Miss Ellen Davis *BAgSci (Hons)*

- Soil and Environmental Scientist
- 2 year experience in contamination assessment and reporting of soils and groundwater.

Mr Grant McDonald (Adv. cert. hort.)

- Soil Technician
- 6 years' experience in hydrocarbon and heavy metal contamination sampling of soils and groundwater.

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Mr Sam Rees B.Agr.Sc (Phd)

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- 6 years' experience in hydrocarbon and heavy metal contamination assessment and reporting of soils and groundwater.

Mr Mark Downie B.Agr.Sc (Hons)

- Soil Scientist
- 3 Year experience in contamination assessment and reporting of soils and groundwater.

Appendix 2 IB105

Table 4 Soil Analytical Results Compared Against IB105 Investigation Limits for soil Disposal – All Soil Samples

Information Bulletin 105 Classification and Management of Contaminated Soil For Disposal		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Sum of polycyclic aromatic hydrocarbons	Benzene	Toluene	Ethylbenzene	Total Xylenes
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		5	10	1	1	2	5	2	5	5	0.1	2	5	5	0.5	10	50	0.5	0.2	0.5	0.5	0.5
Investigation Level Selected																						
IB105 Level 1		<20	<300	<2	<3	<50	<100	<100	<300	<500	<1	<60	<10	<200	<0.08	<65	<1000	<20	<1	<1	<3	<14
IB105 Level 2		20	300	2	3	50	100	100	300	500	1	60	10	200	0.08	65	1000	20	1	1	3	14
IB105 Level 3		200	3000	40	40	500	2000	200	1200	5000	30	600	50	14000	2	650	5000	40	5	100	100	180
IB105 Level 4		750	30000	400	400	5000	7500	1000	3000	25000	110	3000	200	50000	20	1000	10000	200	50	1000	1080	1800
28/06/2019	BH01 0.5-0.6 X	<5	70	<1	<1	4	<5	2	8	211	<0.1	2	<5	8	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH01 1.5-1.6 X	<5	50	<1	<1	10	8	11	12	470	<0.1	10	<5	28	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH02 0.5-0.6 X	<5	80	<1	<1	13	12	3	12	15	<0.1	6	<5	24	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH02 1.5-1.6 X	<5	460	3	<1	15	23	19	10	223	<0.1	56	<5	221	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH03 0.5-0.6 X	<5	20	2	<1	6	<5	31	56	173	<0.1	12	<5	32	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH03 1.5-1.6 X	<5	70	<1	<1	9	35	71	311	345	0.7	15	<5	85	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH04 0.5-0.6 X	<5	150	1	<1	10	19	10	63	118	0.2	22	<5	182	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH04 1.5-1.6 X	<5	110	<1	<1	7	25	4	126	111	0.4	7	<5	249	1.2	<10	210	11.8	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH05 0.5-0.6 X	<5	140	<1	<1	9	22	7	283	216	0.3	8	<5	264	2.1	<10	<50	20	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH05 1.5-1.6 X	<5	110	<1	<1	11	24	5	112	162	0.5	9	<5	98	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH06 0.5-0.6 X	<5	120	<1	<1	20	22	9	8	63	<0.1	11	<5	16	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH06 1.5-1.6 X	<5	10	4	<1	7	8	63	6	229	<0.1	10	<5	15	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH07 0.50-0.60 X	<5	20	<1	<1	4	34	8	28	377	<0.1	7	<5	46	<0.5	<10	120	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH07 1.5-1.6 X	<5	120	<1	<1	9	21	6	89	184	0.2	7	<5	137	<0.5	<10	<50	1.2	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH08 0.50-0.60 X	<5	40	<1	<1	5	29	10	52	459	<0.1	12	<5	53	1	<10	130	11	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH08 1.5-1.6 X	<5	30	<1	<1	14	18	15	9	179	<0.1	23	<5	54	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5

Table 5 Soil Analytical Results Compared Against IB105 Investigation Limits for soil Disposal – All Soil Samples With PAH Leachate Analysis on Some Level 3+ Samples

Information Bulletin 105 **Classification and Management of Contaminated Soil For Disposal** **Leachable Fraction** *Italic/** - Based On Soil (Total) Limit **Bold** - Based On Leach Limit		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Benzene	Toluene	Ethylbenzene	Total Xylenes
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L			µg/L	µg/L	µg/L	µg/L
LOR		0.1	0.1	0.05	0.05	0.1	0.1		0.1	0.1	0.001	0.1	0.1	0.1	0.5			1	2	2	2
Investigation Level Selected																					
IB105 Level 1																					
IB105 Level 2		<0.5	<35	<1	<0.1	<0.5	<10		<0.5	<25	<0.01	<1	<0.1	<25	<0.5			<50	<1400	<3000	<5000
IB105 Level 3		0.5	35	1	0.1	0.5	10		0.5	25	0.01	1	0.1	25	0.5			50	1400	3000	5000
IB105 Level 4		5	350	4	0.5	5	100		5	250	0.1	8	1	250	5			500	14000	30000	50000
28/06/2019	BH01 0.5-0.6 X																				
28/06/2019	BH01 1.5-1.6 X																				
28/06/2019	BH02 0.5-0.6 X																				
28/06/2019	BH02 1.5-1.6 X		*	*										*							
28/06/2019	BH03 0.5-0.6 X			*																	
28/06/2019	BH03 1.5-1.6 X								*												
28/06/2019	BH04 0.5-0.6 X																				
28/06/2019	BH04 1.5-1.6 X													*	*						
28/06/2019	BH05 0.5-0.6 X													*	**<0.5**						
28/06/2019	BH05 1.5-1.6 X																				
28/06/2019	BH06 0.5-0.6 X																				
28/06/2019	BH06 1.5-1.6 X			*																	
28/06/2019	BH07 0.50-0.60 X																				
28/06/2019	BH07 1.5-1.6																				
28/06/2019	BH08 0.50-0.60 X														*						
28/06/2019	BH08 1.5-1.6 X																				

Note: BH05 0.5-0.6 was the only sample re-tested. Leachable fraction analysis will take precedence over soil analysis when calculating IB105 Limits. There are no leachable fraction investigation limits for certain compounds eg. Cobalt, and therefore the solids limit is applied. Where solid Level 2 or greater exceedances are present, these are represented with a * in the sheet. Leachable fraction limits are not available for Level 1 classification, and therefore a minimum leachable fraction Level 2 limit is applied if the solid results exceed Level 1 guideline limits for solids, alternatively Level 1 is applied

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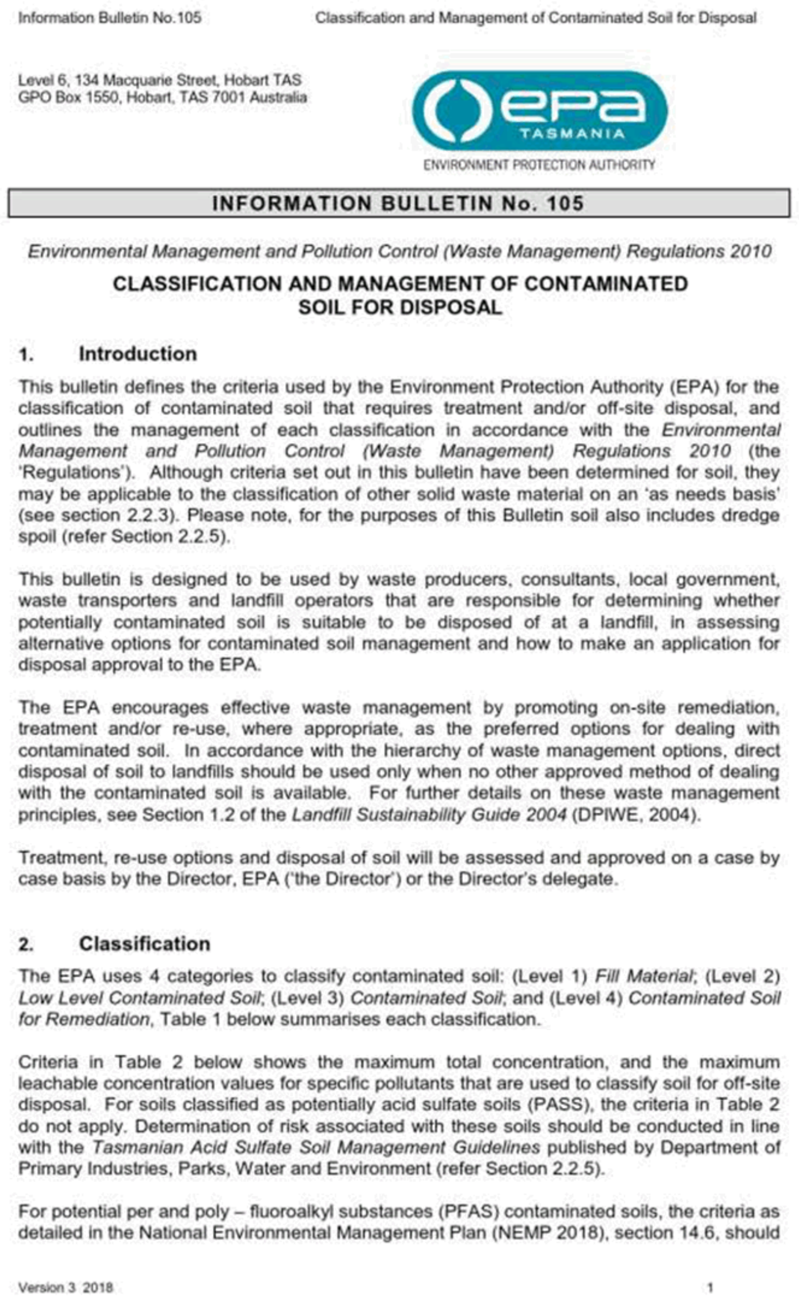

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ENVIRONMENT PROTECTION AUTHORITY

INFORMATION BULLETIN No. 105

Environmental Management and Pollution Control (Waste Management) Regulations 2010

CLASSIFICATION AND MANAGEMENT OF CONTAMINATED SOIL FOR DISPOSAL

1. Introduction

This bulletin defines the criteria used by the Environment Protection Authority (EPA) for the classification of contaminated soil that requires treatment and/or off-site disposal, and outlines the management of each classification in accordance with the *Environmental Management and Pollution Control (Waste Management) Regulations 2010* (the 'Regulations'). Although criteria set out in this bulletin have been determined for soil, they may be applicable to the classification of other solid waste material on an 'as needs basis' (see section 2.2.3). Please note, for the purposes of this Bulletin soil also includes dredge spoil (refer Section 2.2.5).

This bulletin is designed to be used by waste producers, consultants, local government, waste transporters and landfill operators that are responsible for determining whether potentially contaminated soil is suitable to be disposed of at a landfill, in assessing alternative options for contaminated soil management and how to make an application for disposal approval to the EPA.

The EPA encourages effective waste management by promoting on-site remediation, treatment and/or re-use, where appropriate, as the preferred options for dealing with contaminated soil. In accordance with the hierarchy of waste management options, direct disposal of soil to landfills should be used only when no other approved method of dealing with the contaminated soil is available. For further details on these waste management principles, see Section 1.2 of the *Landfill Sustainability Guide 2004* (DPIWE, 2004).

Treatment, re-use options and disposal of soil will be assessed and approved on a case by case basis by the Director, EPA ('the Director') or the Director's delegate.

2. Classification

The EPA uses 4 categories to classify contaminated soil: (Level 1) *Fill Material*; (Level 2) *Low Level Contaminated Soil*; (Level 3) *Contaminated Soil*; and (Level 4) *Contaminated Soil for Remediation*, Table 1 below summarises each classification.

Criteria in Table 2 below shows the maximum total concentration, and the maximum leachable concentration values for specific pollutants that are used to classify soil for off-site disposal. For soils classified as potentially acid sulfate soils (PASS), the criteria in Table 2 do not apply. Determination of risk associated with these soils should be conducted in line with the *Tasmanian Acid Sulfate Soil Management Guidelines* published by Department of Primary Industries, Parks, Water and Environment (refer Section 2.2.5).

For potential per and poly – fluoroalkyl substances (PFAS) contaminated soils, the criteria as detailed in the National Environmental Management Plan (NEMP 2018), section 14.6, should

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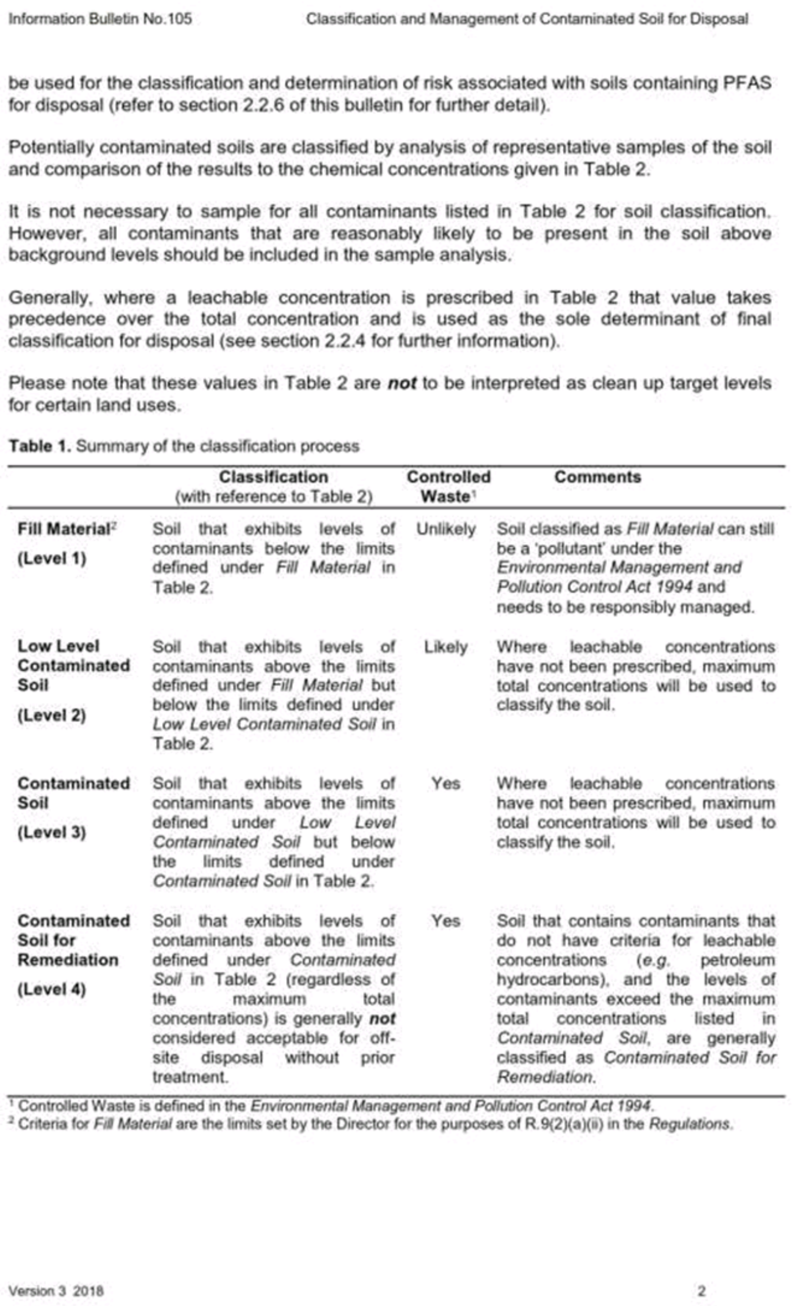

be used for the classification and determination of risk associated with soils containing PFAS for disposal (refer to section 2.2.6 of this bulletin for further detail).

Potentially contaminated soils are classified by analysis of representative samples of the soil and comparison of the results to the chemical concentrations given in Table 2.

It is not necessary to sample for all contaminants listed in Table 2 for soil classification. However, all contaminants that are reasonably likely to be present in the soil above background levels should be included in the sample analysis.

Generally, where a leachable concentration is prescribed in Table 2 that value takes precedence over the total concentration and is used as the sole determinant of final classification for disposal (see section 2.2.4 for further information).

Please note that these values in Table 2 are ***not*** to be interpreted as clean up target levels for certain land uses.

Table 1. Summary of the classification process

	Classification (with reference to Table 2)	**Controlled Waste**[1]	**Comments**
Fill Material[2] **(Level 1)**	Soil that exhibits levels of contaminants below the limits defined under *Fill Material* in Table 2.	Unlikely	Soil classified as *Fill Material* can still be a 'pollutant' under the *Environmental Management and Pollution Control Act 1994* and needs to be responsibly managed.
Low Level Contaminated Soil **(Level 2)**	Soil that exhibits levels of contaminants above the limits defined under *Fill Material* but below the limits defined under *Low Level Contaminated Soil* in Table 2.	Likely	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil **(Level 3)**	Soil that exhibits levels of contaminants above the limits defined under *Low Level Contaminated Soil* but below the limits defined under *Contaminated Soil* in Table 2.	Yes	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil for Remediation **(Level 4)**	Soil that exhibits levels of contaminants above the limits defined under *Contaminated Soil* in Table 2 (regardless of the maximum total concentrations) is generally ***not*** considered acceptable for off-site disposal without prior treatment.	Yes	Soil that contains contaminants that do not have criteria for leachable concentrations (*e.g.* petroleum hydrocarbons), and the levels of contaminants exceed the maximum total concentrations listed in *Contaminated Soil*, are generally classified as *Contaminated Soil for Remediation*.

[1] Controlled Waste is defined in the *Environmental Management and Pollution Control Act 1994*.

[2] Criteria for *Fill Material* are the limits set by the Director for the purposes of R.9(2)(a)(ii) in the *Regulations*.

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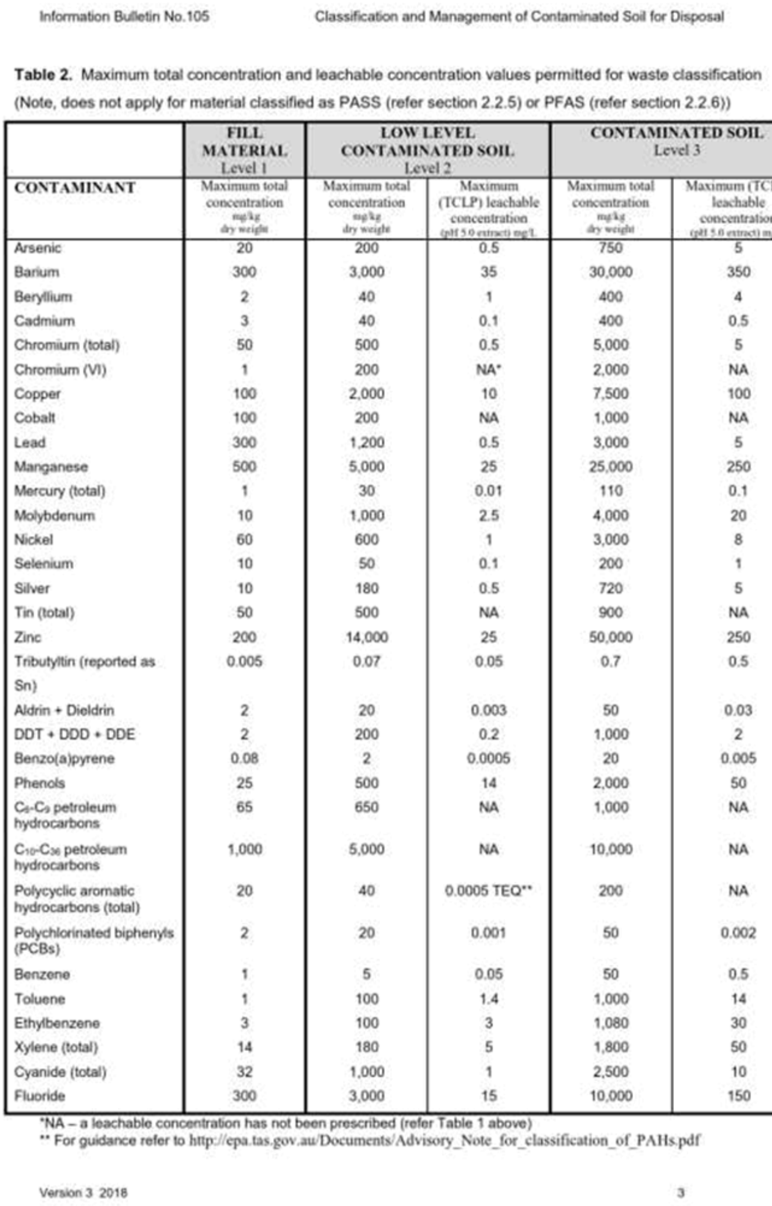

Table 2. Maximum total concentration and leachable concentration values permitted for waste classification (Note, does not apply for material classified as PASS (refer section 2.2.5) or PFAS (refer section 2.2.6))

	FILL MATERIAL Level 1	**LOW LEVEL CONTAMINATED SOIL** Level 2		**CONTAMINATED SOIL** Level 3	
CONTAMINANT	Maximum total concentration mg/kg dry weight	Maximum total concentration mg/kg dry weight	Maximum (TCLP) leachable concentration (pH 5.0 extract) mg/L	Maximum total concentration mg/kg dry weight	Maximum (TCLP) leachable concentration (pH 5.0 extract) mg/L
Arsenic	20	200	0.5	750	5
Barium	300	3,000	35	30,000	350
Beryllium	2	40	1	400	4
Cadmium	3	40	0.1	400	0.5
Chromium (total)	50	500	0.5	5,000	5
Chromium (VI)	1	200	NA*	2,000	NA
Copper	100	2,000	10	7,500	100
Cobalt	100	200	NA	1,000	NA
Lead	300	1,200	0.5	3,000	5
Manganese	500	5,000	25	25,000	250
Mercury (total)	1	30	0.01	110	0.1
Molybdenum	10	1,000	2.5	4,000	20
Nickel	60	600	1	3,000	8
Selenium	10	50	0.1	200	1
Silver	10	180	0.5	720	5
Tin (total)	50	500	NA	900	NA
Zinc	200	14,000	25	50,000	250
Tributyltin (reported as Sn)	0.005	0.07	0.05	0.7	0.5
Aldrin + Dieldrin	2	20	0.003	50	0.03
DDT + DDD + DDE	2	200	0.2	1,000	2
Benzo(a)pyrene	0.08	2	0.0005	20	0.005
Phenols	25	500	14	2,000	50
C_6-C_9 petroleum hydrocarbons	65	650	NA	1,000	NA
C_{10}-C_{36} petroleum hydrocarbons	1,000	5,000	NA	10,000	NA
Polycyclic aromatic hydrocarbons (total)	20	40	0.0005 TEQ**	200	NA
Polychlorinated biphenyls (PCBs)	2	20	0.001	50	0.002
Benzene	1	5	0.05	50	0.5
Toluene	1	100	1.4	1,000	14
Ethylbenzene	3	100	3	1,080	30
Xylene (total)	14	180	5	1,800	50
Cyanide (total)	32	1,000	1	2,500	10
Fluoride	300	3,000	15	10,000	150

*NA – a leachable concentration has not been prescribed (refer Table 1 above)

** For guidance refer to http://epa.tas.gov.au/Documents/Advisory_Note_for_classification_of_PAHs.pdf

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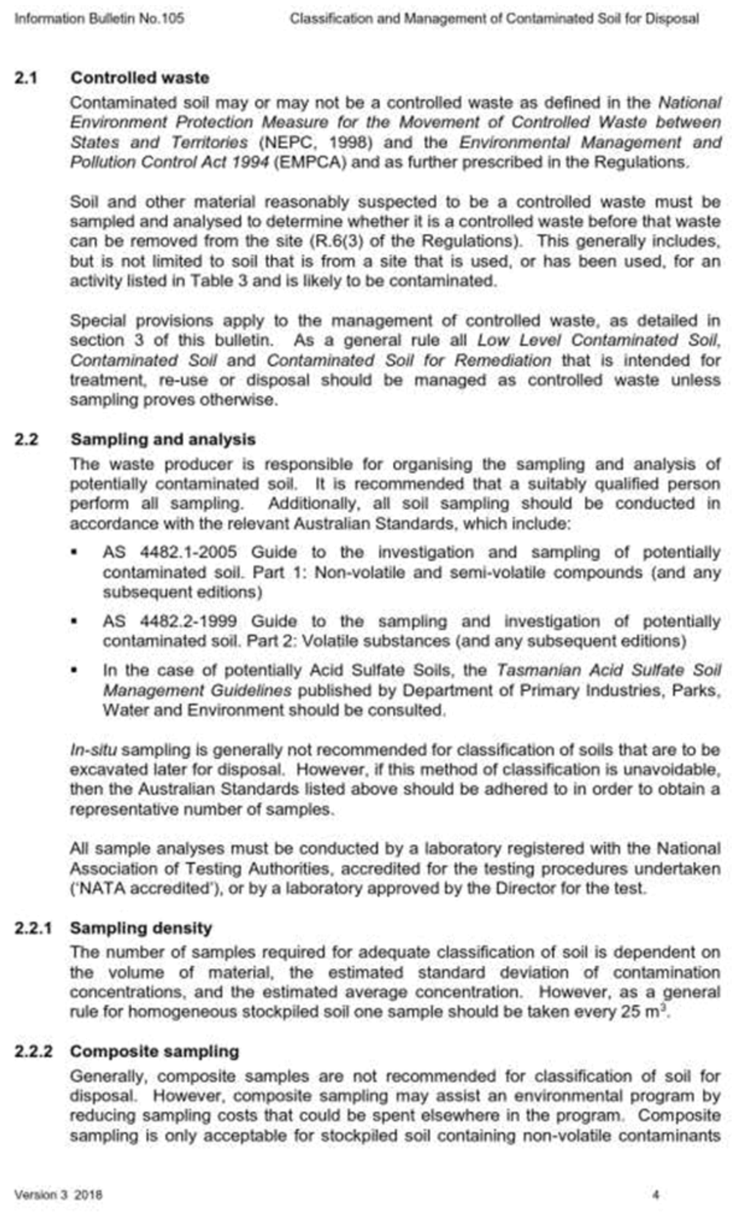

2.1 Controlled waste

Contaminated soil may or may not be a controlled waste as defined in the *National Environment Protection Measure for the Movement of Controlled Waste between States and Territories* (NEPC, 1998) and the *Environmental Management and Pollution Control Act 1994* (EMPCA) and as further prescribed in the Regulations.

Soil and other material reasonably suspected to be a controlled waste must be sampled and analysed to determine whether it is a controlled waste before that waste can be removed from the site (R.6(3) of the Regulations). This generally includes, but is not limited to soil that is from a site that is used, or has been used, for an activity listed in Table 3 and is likely to be contaminated.

Special provisions apply to the management of controlled waste, as detailed in section 3 of this bulletin. As a general rule all *Low Level Contaminated Soil*, *Contaminated Soil* and *Contaminated Soil for Remediation* that is intended for treatment, re-use or disposal should be managed as controlled waste unless sampling proves otherwise.

2.2 Sampling and analysis

The waste producer is responsible for organising the sampling and analysis of potentially contaminated soil. It is recommended that a suitably qualified person perform all sampling. Additionally, all soil sampling should be conducted in accordance with the relevant Australian Standards, which include:

- AS 4482.1-2005 Guide to the investigation and sampling of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds (and any subsequent editions)
- AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances (and any subsequent editions)
- In the case of potentially Acid Sulfate Soils, the *Tasmanian Acid Sulfate Soil Management Guidelines* published by Department of Primary Industries, Parks, Water and Environment should be consulted.

In-situ sampling is generally not recommended for classification of soils that are to be excavated later for disposal. However, if this method of classification is unavoidable, then the Australian Standards listed above should be adhered to in order to obtain a representative number of samples.

All sample analyses must be conducted by a laboratory registered with the National Association of Testing Authorities, accredited for the testing procedures undertaken ('NATA accredited'), or by a laboratory approved by the Director for the test.

2.2.1 Sampling density

The number of samples required for adequate classification of soil is dependent on the volume of material, the estimated standard deviation of contamination concentrations, and the estimated average concentration. However, as a general rule for homogeneous stockpiled soil one sample should be taken every 25 m^3.

2.2.2 Composite sampling

Generally, composite samples are not recommended for classification of soil for disposal. However, composite sampling may assist an environmental program by reducing sampling costs that could be spent elsewhere in the program. Composite sampling is only acceptable for stockpiled soil containing non-volatile contaminants

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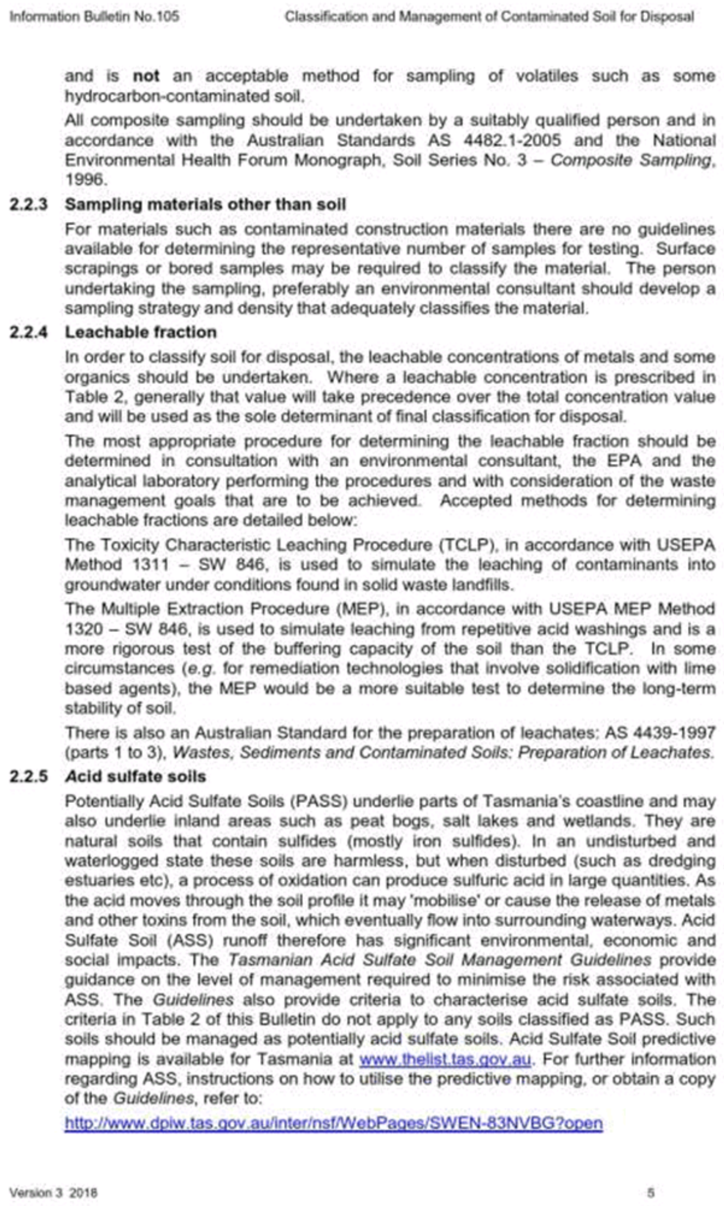

and is **not** an acceptable method for sampling of volatiles such as some hydrocarbon-contaminated soil.

All composite sampling should be undertaken by a suitably qualified person and in accordance with the Australian Standards AS 4482.1-2005 and the National Environmental Health Forum Monograph, Soil Series No. 3 – *Composite Sampling*, 1996.

2.2.3 Sampling materials other than soil

For materials such as contaminated construction materials there are no guidelines available for determining the representative number of samples for testing. Surface scrapings or bored samples may be required to classify the material. The person undertaking the sampling, preferably an environmental consultant should develop a sampling strategy and density that adequately classifies the material.

2.2.4 Leachable fraction

In order to classify soil for disposal, the leachable concentrations of metals and some organics should be undertaken. Where a leachable concentration is prescribed in Table 2, generally that value will take precedence over the total concentration value and will be used as the sole determinant of final classification for disposal.

The most appropriate procedure for determining the leachable fraction should be determined in consultation with an environmental consultant, the EPA and the analytical laboratory performing the procedures and with consideration of the waste management goals that are to be achieved. Accepted methods for determining leachable fractions are detailed below:

The Toxicity Characteristic Leaching Procedure (TCLP), in accordance with USEPA Method 1311 – SW 846, is used to simulate the leaching of contaminants into groundwater under conditions found in solid waste landfills.

The Multiple Extraction Procedure (MEP), in accordance with USEPA MEP Method 1320 – SW 846, is used to simulate leaching from repetitive acid washings and is a more rigorous test of the buffering capacity of the soil than the TCLP. In some circumstances (*e.g.* for remediation technologies that involve solidification with lime based agents), the MEP would be a more suitable test to determine the long-term stability of soil.

There is also an Australian Standard for the preparation of leachates: AS 4439-1997 (parts 1 to 3), *Wastes, Sediments and Contaminated Soils: Preparation of Leachates.*

2.2.5 *Acid sulfate soils*

Potentially Acid Sulfate Soils (PASS) underlie parts of Tasmania's coastline and may also underlie inland areas such as peat bogs, salt lakes and wetlands. They are natural soils that contain sulfides (mostly iron sulfides). In an undisturbed and waterlogged state these soils are harmless, but when disturbed (such as dredging estuaries etc), a process of oxidation can produce sulfuric acid in large quantities. As the acid moves through the soil profile it may 'mobilise' or cause the release of metals and other toxins from the soil, which eventually flow into surrounding waterways. Acid Sulfate Soil (ASS) runoff therefore has significant environmental, economic and social impacts. The *Tasmanian Acid Sulfate Soil Management Guidelines* provide guidance on the level of management required to minimise the risk associated with ASS. The *Guidelines* also provide criteria to characterise acid sulfate soils. The criteria in Table 2 of this Bulletin do not apply to any soils classified as PASS. Such soils should be managed as potentially acid sulfate soils. Acid Sulfate Soil predictive mapping is available for Tasmania at www.thelist.tas.gov.au. For further information regarding ASS, instructions on how to utilise the predictive mapping, or obtain a copy of the *Guidelines*, refer to:

http://www.dpiw.tas.gov.au/inter/nsf/WebPages/SWEN-83NVBG?open

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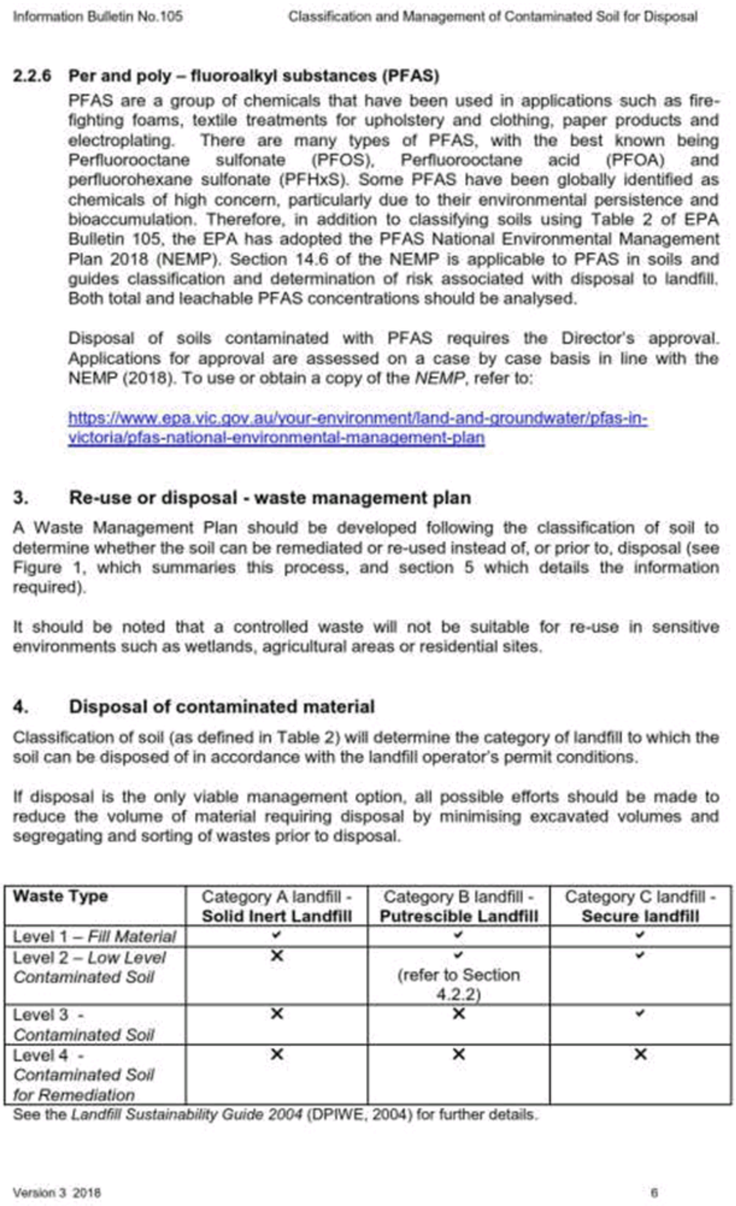

2.2.6 Per and poly – fluoroalkyl substances (PFAS)

PFAS are a group of chemicals that have been used in applications such as fire-fighting foams, textile treatments for upholstery and clothing, paper products and electroplating. There are many types of PFAS, with the best known being Perfluorooctane sulfonate (PFOS), Perfluorooctane acid (PFOA) and perfluorohexane sulfonate (PFHxS). Some PFAS have been globally identified as chemicals of high concern, particularly due to their environmental persistence and bioaccumulation. Therefore, in addition to classifying soils using Table 2 of EPA Bulletin 105, the EPA has adopted the PFAS National Environmental Management Plan 2018 (NEMP). Section 14.6 of the NEMP is applicable to PFAS in soils and guides classification and determination of risk associated with disposal to landfill. Both total and leachable PFAS concentrations should be analysed.

Disposal of soils contaminated with PFAS requires the Director's approval. Applications for approval are assessed on a case by case basis in line with the NEMP (2018). To use or obtain a copy of the *NEMP*, refer to:

https://www.epa.vic.gov.au/your-environment/land-and-groundwater/pfas-in-victoria/pfas-national-environmental-management-plan

3. Re-use or disposal - waste management plan

A Waste Management Plan should be developed following the classification of soil to determine whether the soil can be remediated or re-used instead of, or prior to, disposal (see Figure 1, which summaries this process, and section 5 which details the information required).

It should be noted that a controlled waste will not be suitable for re-use in sensitive environments such as wetlands, agricultural areas or residential sites.

4. Disposal of contaminated material

Classification of soil (as defined in Table 2) will determine the category of landfill to which the soil can be disposed of in accordance with the landfill operator's permit conditions.

If disposal is the only viable management option, all possible efforts should be made to reduce the volume of material requiring disposal by minimising excavated volumes and segregating and sorting of wastes prior to disposal.

Waste Type	Category A landfill - **Solid Inert Landfill**	Category B landfill - **Putrescible Landfill**	Category C landfill - **Secure landfill**
Level 1 – *Fill Material*	✓	✓	✓
Level 2 – *Low Level Contaminated Soil*	✗	✓ (refer to Section 4.2.2)	✓
Level 3 - *Contaminated Soil*	✗	✗	✓
Level 4 - *Contaminated Soil for Remediation*	✗	✗	✗

See the *Landfill Sustainability Guide 2004* (DPIWE, 2004) for further details.

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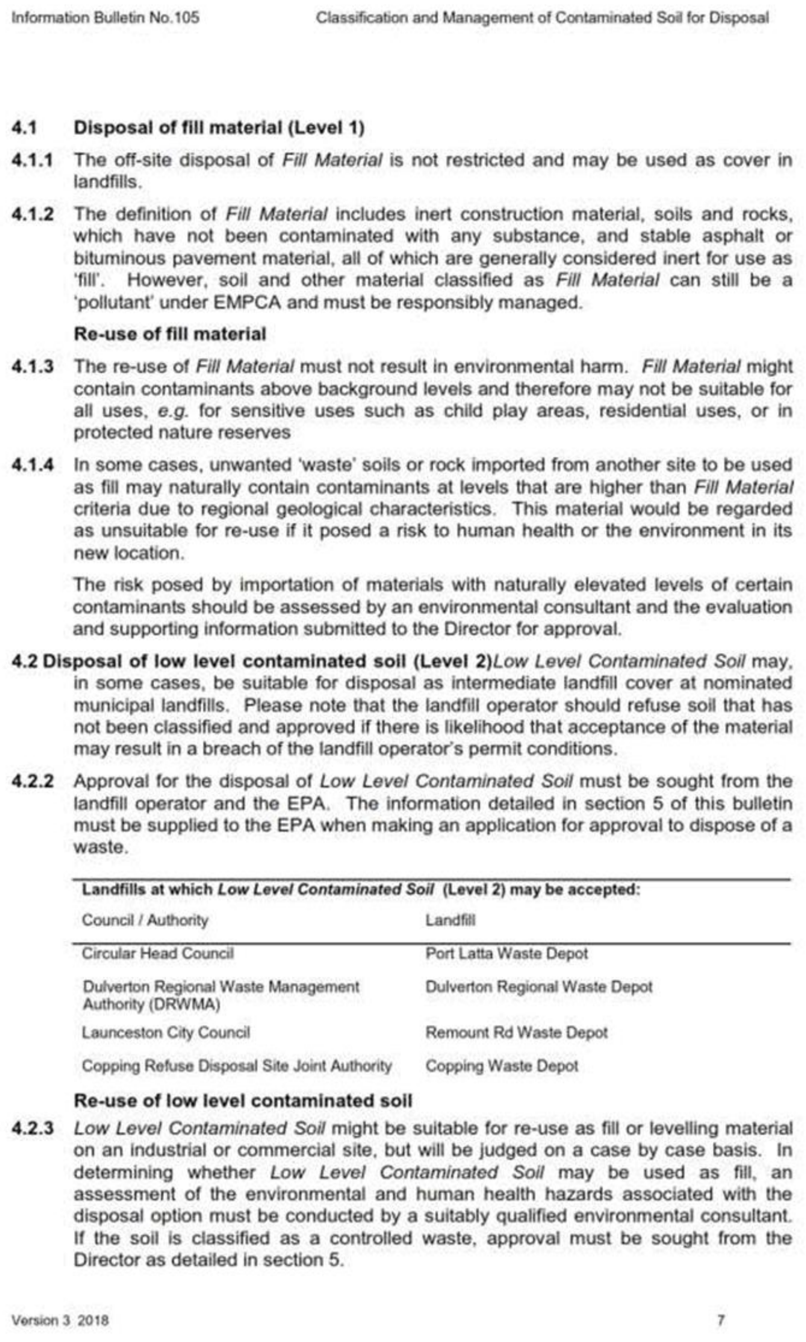

4.1 Disposal of fill material (Level 1)

4.1.1 The off-site disposal of *Fill Material* is not restricted and may be used as cover in landfills.

4.1.2 The definition of *Fill Material* includes inert construction material, soils and rocks, which have not been contaminated with any substance, and stable asphalt or bituminous pavement material, all of which are generally considered inert for use as 'fill'. However, soil and other material classified as *Fill Material* can still be a 'pollutant' under EMPCA and must be responsibly managed.

Re-use of fill material

4.1.3 The re-use of *Fill Material* must not result in environmental harm. *Fill Material* might contain contaminants above background levels and therefore may not be suitable for all uses, *e.g.* for sensitive uses such as child play areas, residential uses, or in protected nature reserves

4.1.4 In some cases, unwanted 'waste' soils or rock imported from another site to be used as fill may naturally contain contaminants at levels that are higher than *Fill Material* criteria due to regional geological characteristics. This material would be regarded as unsuitable for re-use if it posed a risk to human health or the environment in its new location.

The risk posed by importation of materials with naturally elevated levels of certain contaminants should be assessed by an environmental consultant and the evaluation and supporting information submitted to the Director for approval.

4.2 Disposal of low level contaminated soil (Level 2)*Low Level Contaminated Soil* may, in some cases, be suitable for disposal as intermediate landfill cover at nominated municipal landfills. Please note that the landfill operator should refuse soil that has not been classified and approved if there is likelihood that acceptance of the material may result in a breach of the landfill operator's permit conditions.

4.2.2 Approval for the disposal of *Low Level Contaminated Soil* must be sought from the landfill operator and the EPA. The information detailed in section 5 of this bulletin must be supplied to the EPA when making an application for approval to dispose of a waste.

Landfills at which *Low Level Contaminated Soil* (Level 2) may be accepted:

Council / Authority	Landfill
Circular Head Council	Port Latta Waste Depot
Dulverton Regional Waste Management Authority (DRWMA)	Dulverton Regional Waste Depot
Launceston City Council	Remount Rd Waste Depot
Copping Refuse Disposal Site Joint Authority	Copping Waste Depot

Re-use of low level contaminated soil

4.2.3 *Low Level Contaminated Soil* might be suitable for re-use as fill or levelling material on an industrial or commercial site, but will be judged on a case by case basis. In determining whether *Low Level Contaminated Soil* may be used as fill, an assessment of the environmental and human health hazards associated with the disposal option must be conducted by a suitably qualified environmental consultant. If the soil is classified as a controlled waste, approval must be sought from the Director as detailed in section 5.

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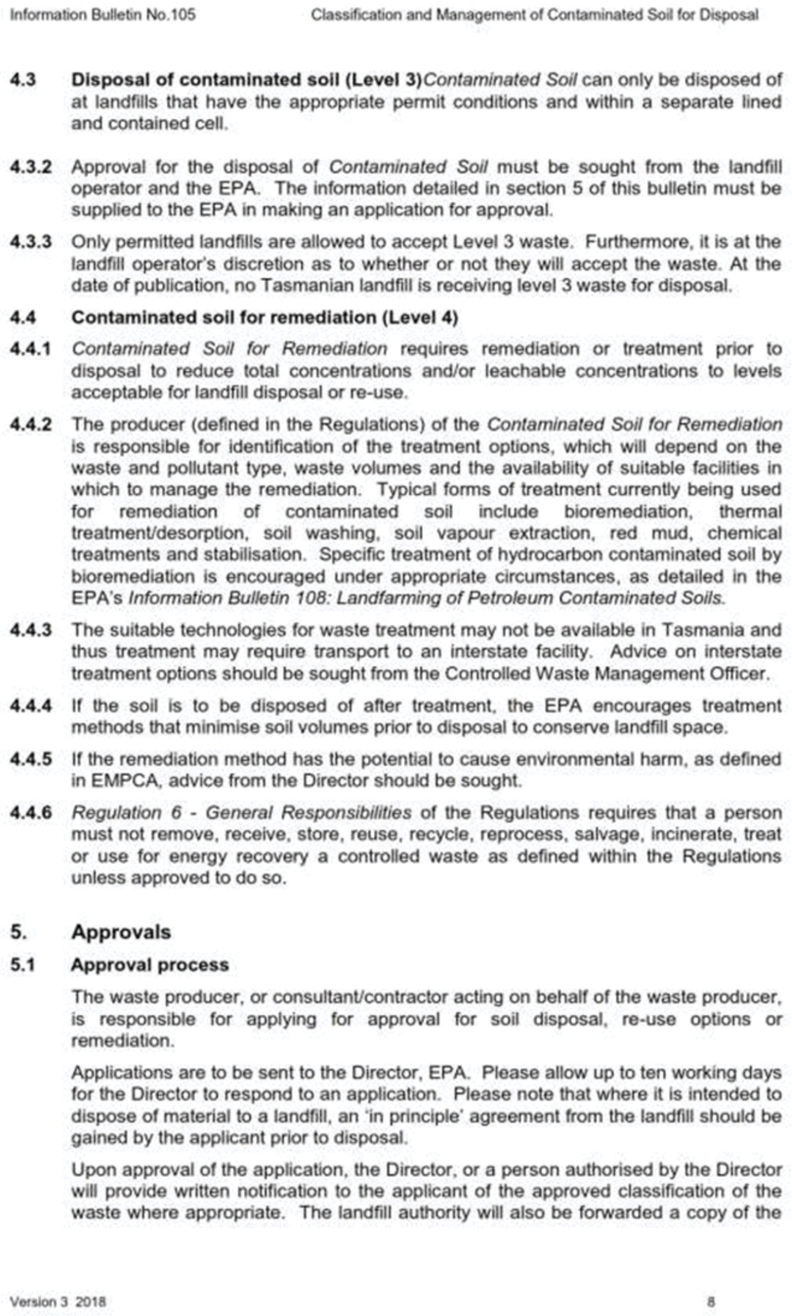


4.3 Disposal of contaminated soil (Level 3)*Contaminated Soil* can only be disposed of at landfills that have the appropriate permit conditions and within a separate lined and contained cell.

4.3.2 Approval for the disposal of *Contaminated Soil* must be sought from the landfill operator and the EPA. The information detailed in section 5 of this bulletin must be supplied to the EPA in making an application for approval.

4.3.3 Only permitted landfills are allowed to accept Level 3 waste. Furthermore, it is at the landfill operator's discretion as to whether or not they will accept the waste. At the date of publication, no Tasmanian landfill is receiving level 3 waste for disposal.

4.4 Contaminated soil for remediation (Level 4)

4.4.1 *Contaminated Soil for Remediation* requires remediation or treatment prior to disposal to reduce total concentrations and/or leachable concentrations to levels acceptable for landfill disposal or re-use.

4.4.2 The producer (defined in the Regulations) of the *Contaminated Soil for Remediation* is responsible for identification of the treatment options, which will depend on the waste and pollutant type, waste volumes and the availability of suitable facilities in which to manage the remediation. Typical forms of treatment currently being used for remediation of contaminated soil include bioremediation, thermal treatment/desorption, soil washing, soil vapour extraction, red mud, chemical treatments and stabilisation. Specific treatment of hydrocarbon contaminated soil by bioremediation is encouraged under appropriate circumstances, as detailed in the EPA's *Information Bulletin 108: Landfarming of Petroleum Contaminated Soils.*

4.4.3 The suitable technologies for waste treatment may not be available in Tasmania and thus treatment may require transport to an interstate facility. Advice on interstate treatment options should be sought from the Controlled Waste Management Officer.

4.4.4 If the soil is to be disposed of after treatment, the EPA encourages treatment methods that minimise soil volumes prior to disposal to conserve landfill space.

4.4.5 If the remediation method has the potential to cause environmental harm, as defined in EMPCA, advice from the Director should be sought.

4.4.6 *Regulation 6 - General Responsibilities* of the Regulations requires that a person must not remove, receive, store, reuse, recycle, reprocess, salvage, incinerate, treat or use for energy recovery a controlled waste as defined within the Regulations unless approved to do so.

5. Approvals

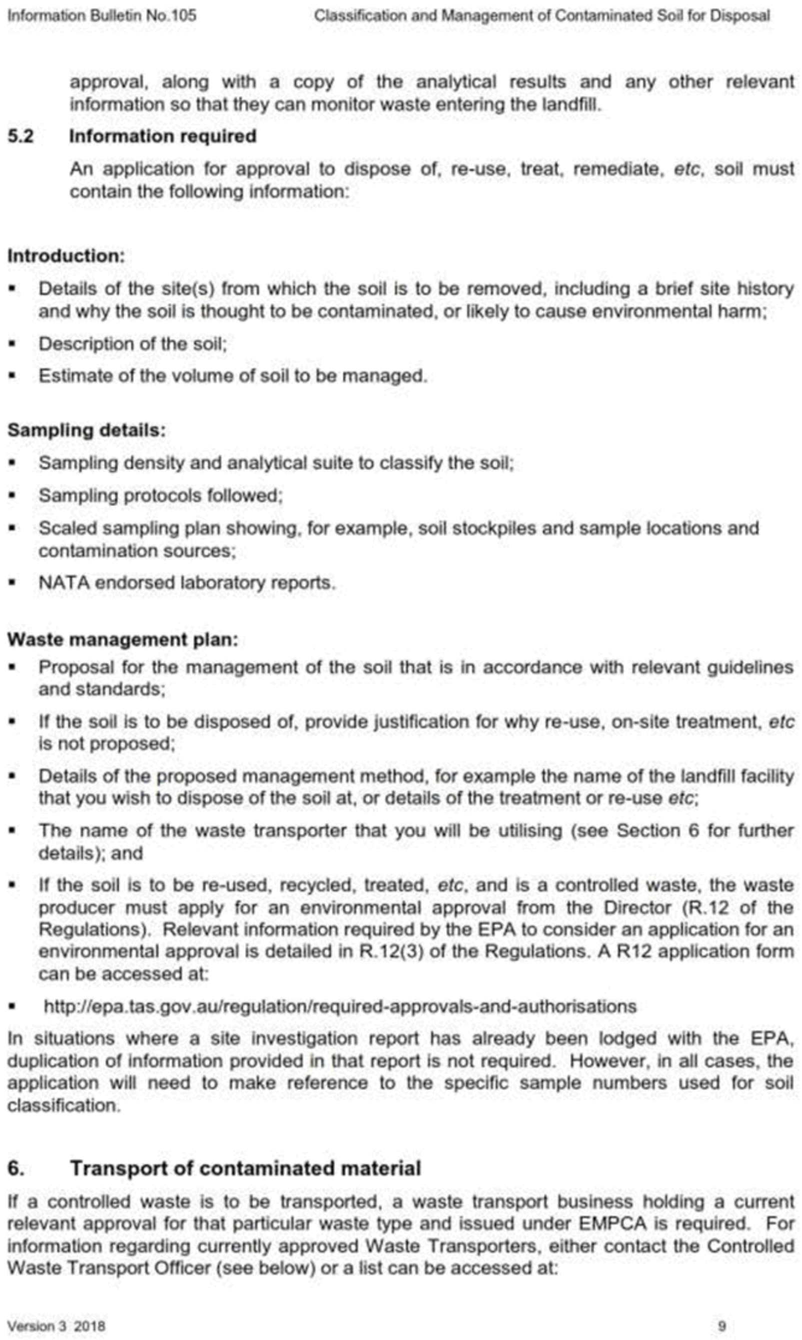
5.1 Approval process

The waste producer, or consultant/contractor acting on behalf of the waste producer, is responsible for applying for approval for soil disposal, re-use options or remediation.

Applications are to be sent to the Director, EPA. Please allow up to ten working days for the Director to respond to an application. Please note that where it is intended to dispose of material to a landfill, an 'in principle' agreement from the landfill should be gained by the applicant prior to disposal.

Upon approval of the application, the Director, or a person authorised by the Director will provide written notification to the applicant of the approved classification of the waste where appropriate. The landfill authority will also be forwarded a copy of the

IB105



approval, along with a copy of the analytical results and any other relevant information so that they can monitor waste entering the landfill.

5.2 Information required

An application for approval to dispose of, re-use, treat, remediate, *etc*, soil must contain the following information:

Introduction:

- Details of the site(s) from which the soil is to be removed, including a brief site history and why the soil is thought to be contaminated, or likely to cause environmental harm;
- Description of the soil;
- Estimate of the volume of soil to be managed.

Sampling details:

- Sampling density and analytical suite to classify the soil;
- Sampling protocols followed;
- Scaled sampling plan showing, for example, soil stockpiles and sample locations and contamination sources;
- NATA endorsed laboratory reports.

Waste management plan:

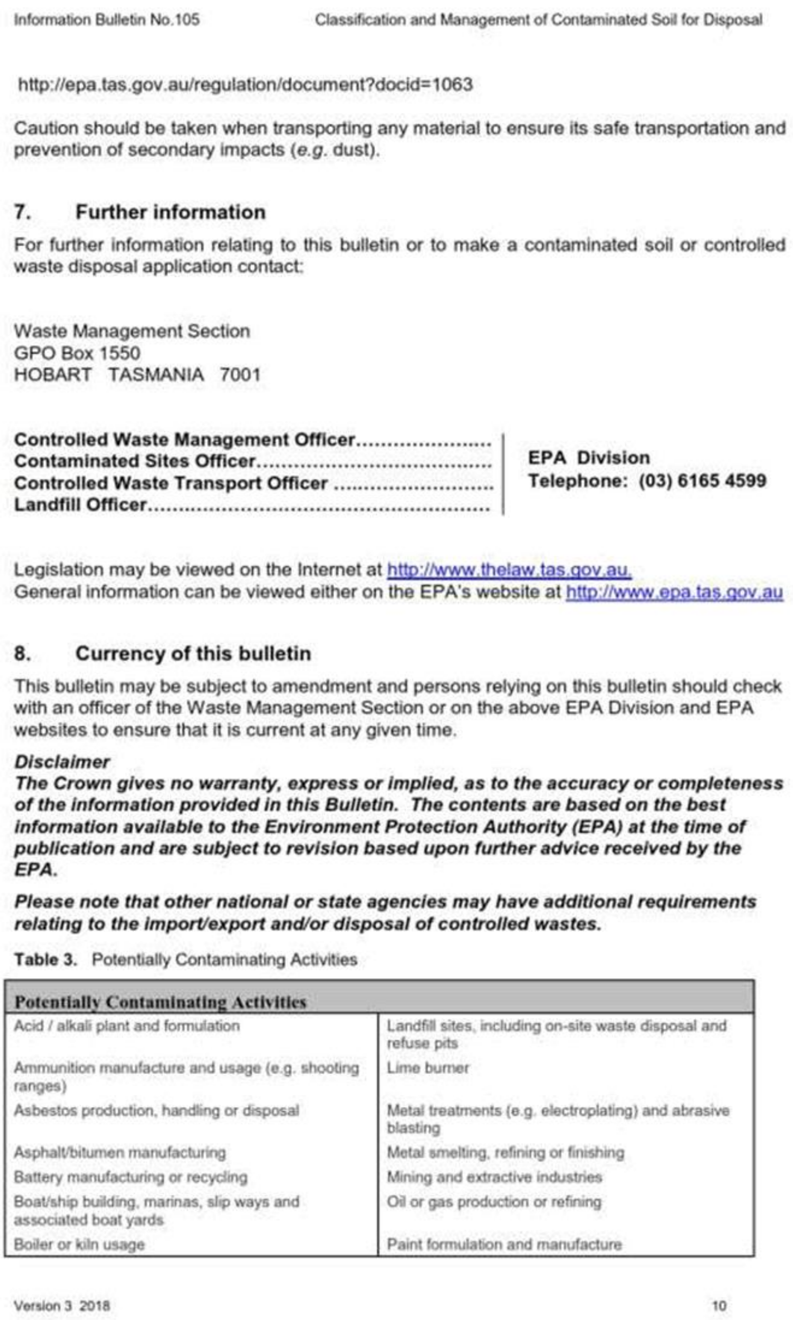
- Proposal for the management of the soil that is in accordance with relevant guidelines and standards;
- If the soil is to be disposed of, provide justification for why re-use, on-site treatment, *etc* is not proposed;
- Details of the proposed management method, for example the name of the landfill facility that you wish to dispose of the soil at, or details of the treatment or re-use *etc*;
- The name of the waste transporter that you will be utilising (see Section 6 for further details); and
- If the soil is to be re-used, recycled, treated, *etc*, and is a controlled waste, the waste producer must apply for an environmental approval from the Director (R.12 of the Regulations). Relevant information required by the EPA to consider an application for an environmental approval is detailed in R.12(3) of the Regulations. A R12 application form can be accessed at:
- http://epa.tas.gov.au/regulation/required-approvals-and-authorisations

In situations where a site investigation report has already been lodged with the EPA, duplication of information provided in that report is not required. However, in all cases, the application will need to make reference to the specific sample numbers used for soil classification.

6. Transport of contaminated material

If a controlled waste is to be transported, a waste transport business holding a current relevant approval for that particular waste type and issued under EMPCA is required. For information regarding currently approved Waste Transporters, either contact the Controlled Waste Transport Officer (see below) or a list can be accessed at:

IB105



http://epa.tas.gov.au/regulation/document?docid=1063

Caution should be taken when transporting any material to ensure its safe transportation and prevention of secondary impacts (*e.g.* dust).

7. Further information

For further information relating to this bulletin or to make a contaminated soil or controlled waste disposal application contact:

Waste Management Section
GPO Box 1550
HOBART TASMANIA 7001

Controlled Waste Management Officer……………………
Contaminated Sites Officer……………………………………
Controlled Waste Transport Officer ………………………
Landfill Officer………………………………………………………

EPA Division
Telephone: (03) 6165 4599

Legislation may be viewed on the Internet at http://www.thelaw.tas.gov.au.
General information can be viewed either on the EPA's website at http://www.epa.tas.gov.au

8. Currency of this bulletin

This bulletin may be subject to amendment and persons relying on this bulletin should check with an officer of the Waste Management Section or on the above EPA Division and EPA websites to ensure that it is current at any given time.

Disclaimer
The Crown gives no warranty, express or implied, as to the accuracy or completeness of the information provided in this Bulletin. The contents are based on the best information available to the Environment Protection Authority (EPA) at the time of publication and are subject to revision based upon further advice received by the EPA.

Please note that other national or state agencies may have additional requirements relating to the import/export and/or disposal of controlled wastes.

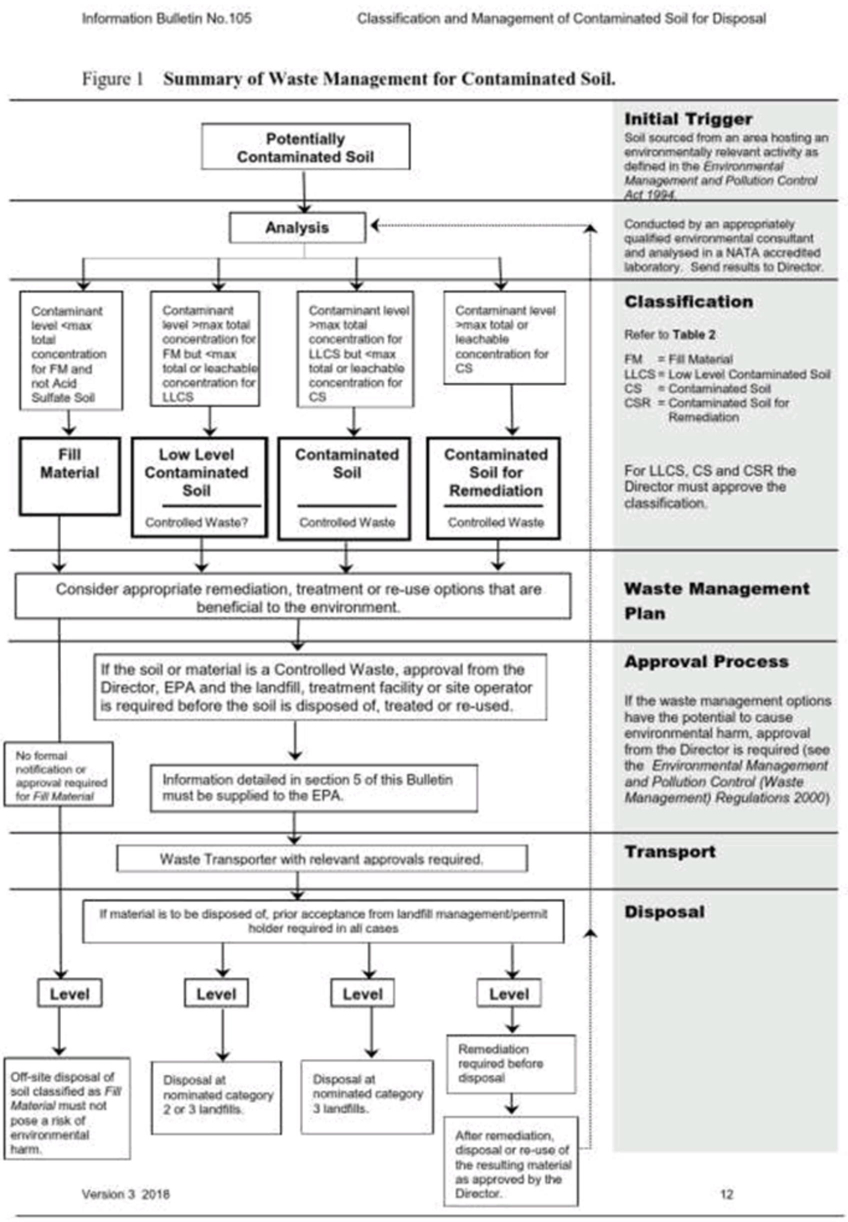
Table 3. Potentially Contaminating Activities

Potentially Contaminating Activities	
Acid / alkali plant and formulation	Landfill sites, including on-site waste disposal and refuse pits
Ammunition manufacture and usage (e.g. shooting ranges)	Lime burner
Asbestos production, handling or disposal	Metal treatments (e.g. electroplating) and abrasive blasting
Asphalt/bitumen manufacturing	Metal smelting, refining or finishing
Battery manufacturing or recycling	Mining and extractive industries
Boat/ship building, marinas, slip ways and associated boat yards	Oil or gas production or refining
Boiler or kiln usage	Paint formulation and manufacture

IB105

Chemical manufacture and formulation (e.g. fertilisers, paints, pesticides, photography, plastics, solvents)	Pesticide manufacture and formulation sites
Dewatering of sediments	Petroleum product or oil storage
Disturbance of potential acid sulfate soils	Pharmaceutical manufacture and formulation
Drum conditioning works	Power stations
Dry cleaning establishments	Printing
Electrical transformers	Radio-active material usage (e.g. hospitals)
Ethanol production plant	Railway yards
Engine works	Scrap yards and recycling facilities
Explosives industries and usage sites	Sewage treatment plant
Fertiliser manufacturing plants	Sheep and cattle dips
Fill material imported onto a site from a potentially contaminated source (includes dredge spoil)	Sites of fires involving hazardous materials, including fire fighting foam use
Foundry Operations	Spray mixing sites (e.g. for orchards)
Gas works	Spray painting industries
Herbicide manufacture	Tanning and associated trades
Hospitals	Textile operations
Sites of incidents involving release of hazardous materials	Tyre manufacturing and retreading works
Industrial activities involving chemicals that may have spilt	Wood preservation and storage or cutting of treated timber
Iron and steel works	Wool scouring
Laboratories	

IB105



Information Bulletin No.105 Classification and Management of Contaminated Soil for Disposal

Figure 1 **Summary of Waste Management for Contaminated Soil.**

Initial Trigger

Soil sourced from an area hosting an environmentally relevant activity as defined in the *Environmental Management and Pollution Control Act 1994*.

Potentially Contaminated Soil

Analysis

Conducted by an appropriately qualified environmental consultant and analysed in a NATA accredited laboratory. Send results to Director.

Classification

Refer to **Table 2**

FM = Fill Material
LLCS = Low Level Contaminated Soil
CS = Contaminated Soil
CSR = Contaminated Soil for Remediation

For LLCS, CS and CSR the Director must approve the classification.

Contaminant level <max total concentration for FM and not Acid Sulfate Soil → **Fill Material**

Contaminant level >max total concentration for FM but <max total or leachable concentration for LLCS → **Low Level Contaminated Soil** — Controlled Waste?

Contaminant level >max total concentration for LLCS but <max total or leachable concentration for CS → **Contaminated Soil** — Controlled Waste

Contaminant level >max total or leachable concentration for CS → **Contaminated Soil for Remediation** — Controlled Waste

Waste Management Plan

Consider appropriate remediation, treatment or re-use options that are beneficial to the environment.

Approval Process

If the waste management options have the potential to cause environmental harm, approval from the Director is required (see the *Environmental Management and Pollution Control (Waste Management) Regulations 2000*)

If the soil or material is a Controlled Waste, approval from the Director, EPA and the landfill, treatment facility or site operator is required before the soil is disposed of, treated or re-used.

Information detailed in section 5 of this Bulletin must be supplied to the EPA.

No formal notification or approval required for *Fill Material*

Transport

Waste Transporter with relevant approvals required.

Disposal

If material is to be disposed of, prior acceptance from landfill management/permit holder required in all cases

Level → Off-site disposal of soil classified as *Fill Material* must not pose a risk of environmental harm.

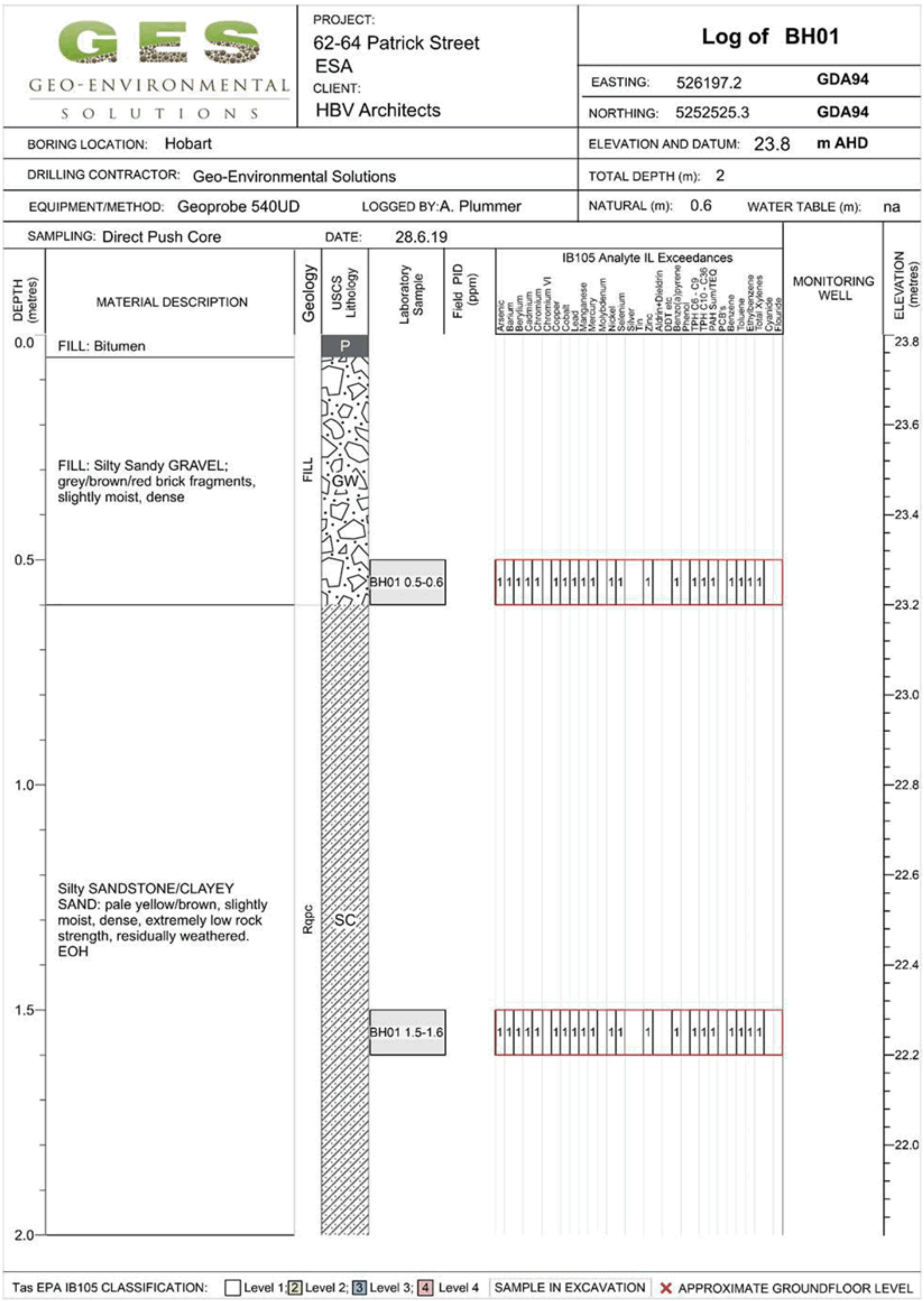
Level → Disposal at nominated category 2 or 3 landfills.

Level → Disposal at nominated category 3 landfills.

Level → Remediation required before disposal → After remediation, disposal or re-use of the resulting material as approved by the Director.

Version 3 2018 12

Appendix 3 Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

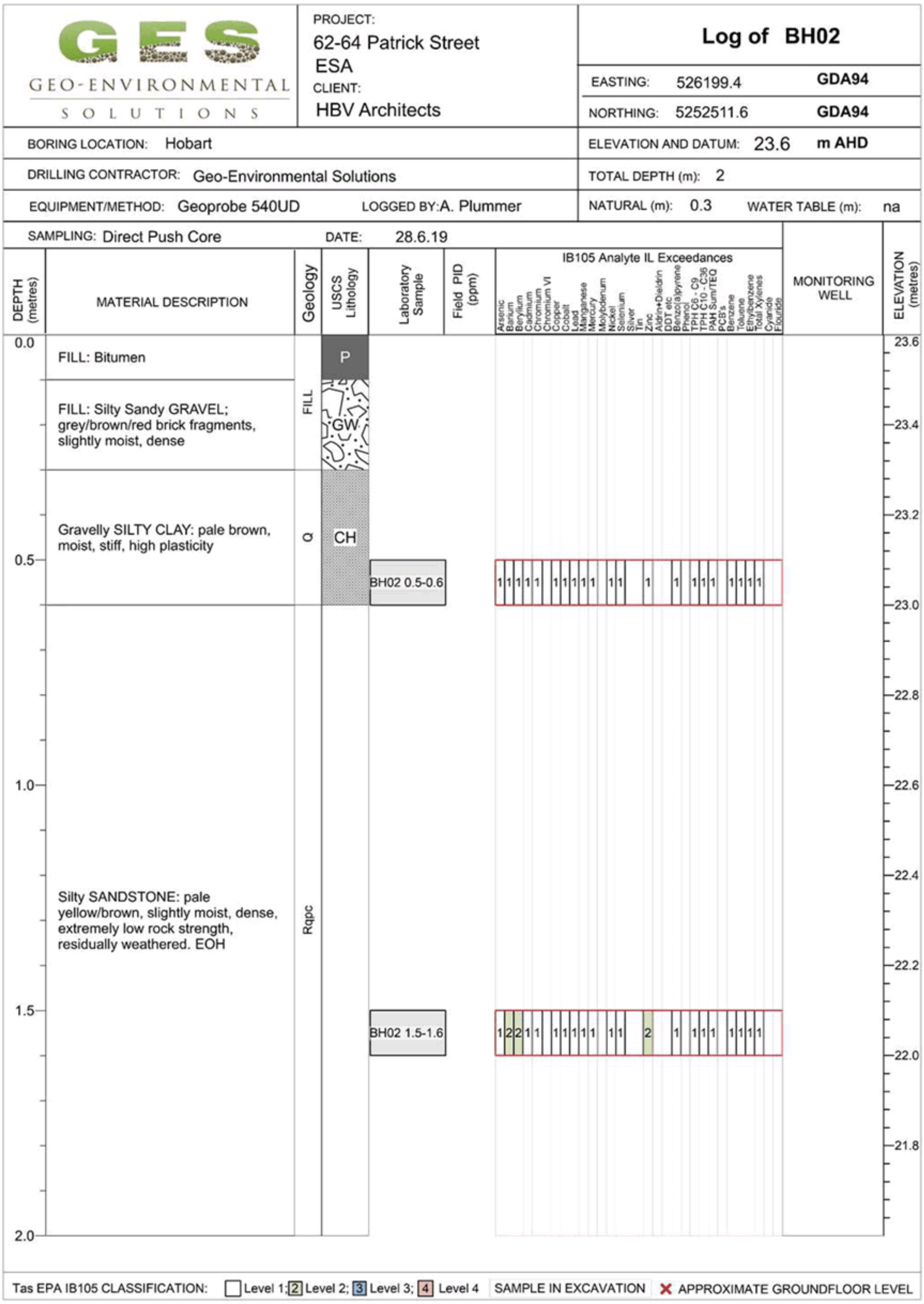
Log of BH01

EASTING: 526197.2 GDA94
NORTHING: 5252525.3 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.8 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.6
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Bitumen		P	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW	BH01 0.5-0.6
	Silty SANDSTONE/CLAYEY SAND: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc	SC	BH01 1.5-1.6

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 | SAMPLE IN EXCAVATION | ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH02

EASTING: 526199.4 **GDA94**
NORTHING: 5252511.6 **GDA94**
BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.6 **m AHD**
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.3
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)
0.0	FILL: Bitumen	FILL	P		
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW		
	Gravelly SILTY CLAY: pale brown, moist, stiff, high plasticity	Q	CH	BH02 0.5-0.6	
0.5 – 2.0	Silty SANDSTONE: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc		BH02 1.5-1.6	

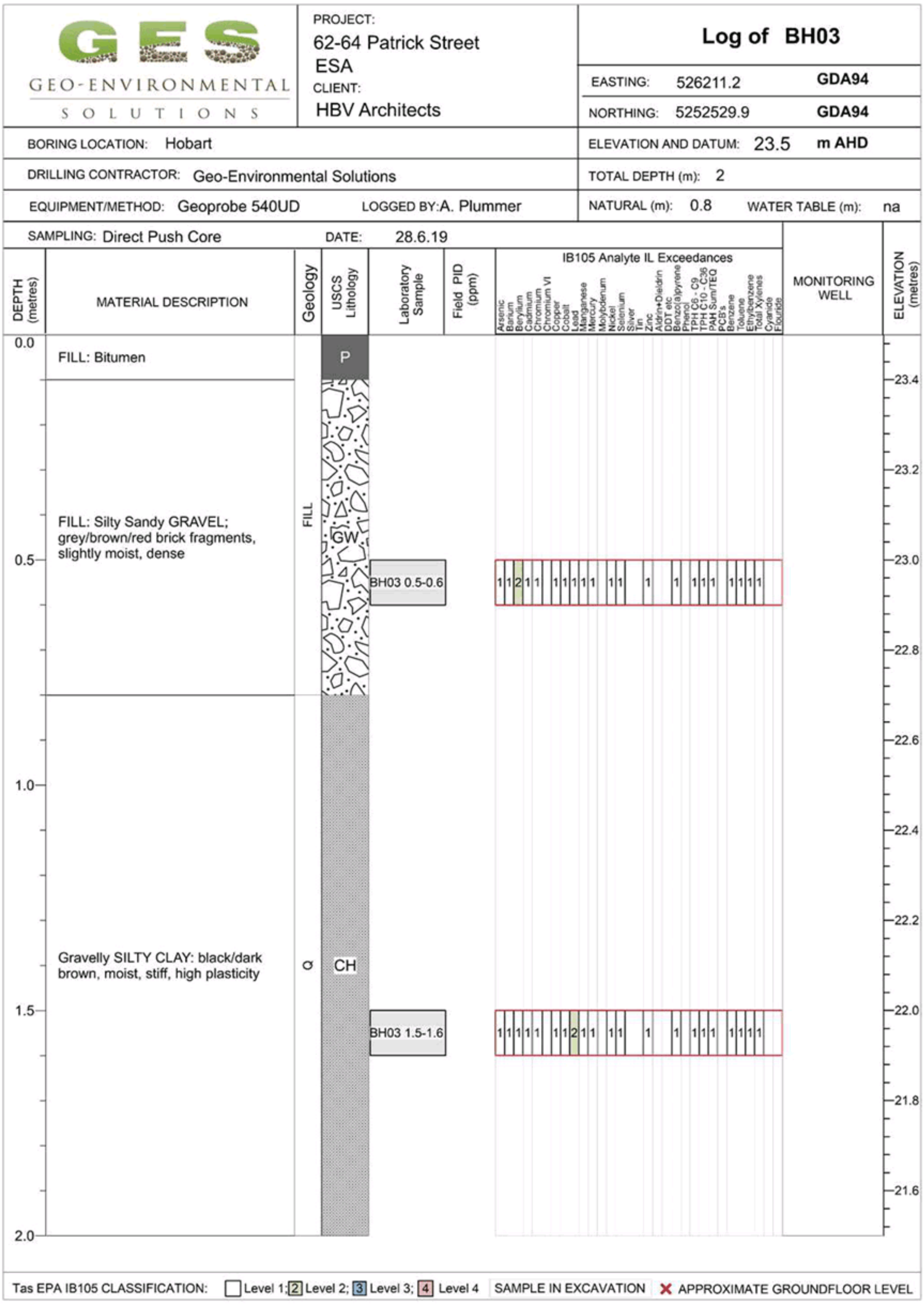
IB105 Analyte IL Exceedances

Laboratory Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium VI	Copper	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Tin	Zinc	Aldrin+Dieldrin	DDT etc	Benzo(a)pyrene	Phenol	TPH C6 - C9	TPH C10 - C36	PAH Sum/TEQ	PCB's	Benzene	Toluene	Ethylbenzene	Total Xylenes	Cyanide	Flouride
BH02 0.5-0.6	1	1	1	1	1		1	1	1	1	1		1	1			1			1		1	1	1		1	1	1	1		
BH02 1.5-1.6	1	2	2	1	1		1	1	1	1	1		1	1			2			1		1	1	1		1	1	1	1		

MONITORING WELL

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH03

EASTING:	526211.2	GDA94
NORTHING:	5252529.9	GDA94

BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.5 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.8
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)
0.0	FILL: Bitumen		P		
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW	BH03 0.5-0.6	
0.8	Gravelly SILTY CLAY: black/dark brown, moist, stiff, high plasticity	Q	CH	BH03 1.5-1.6	
2.0					

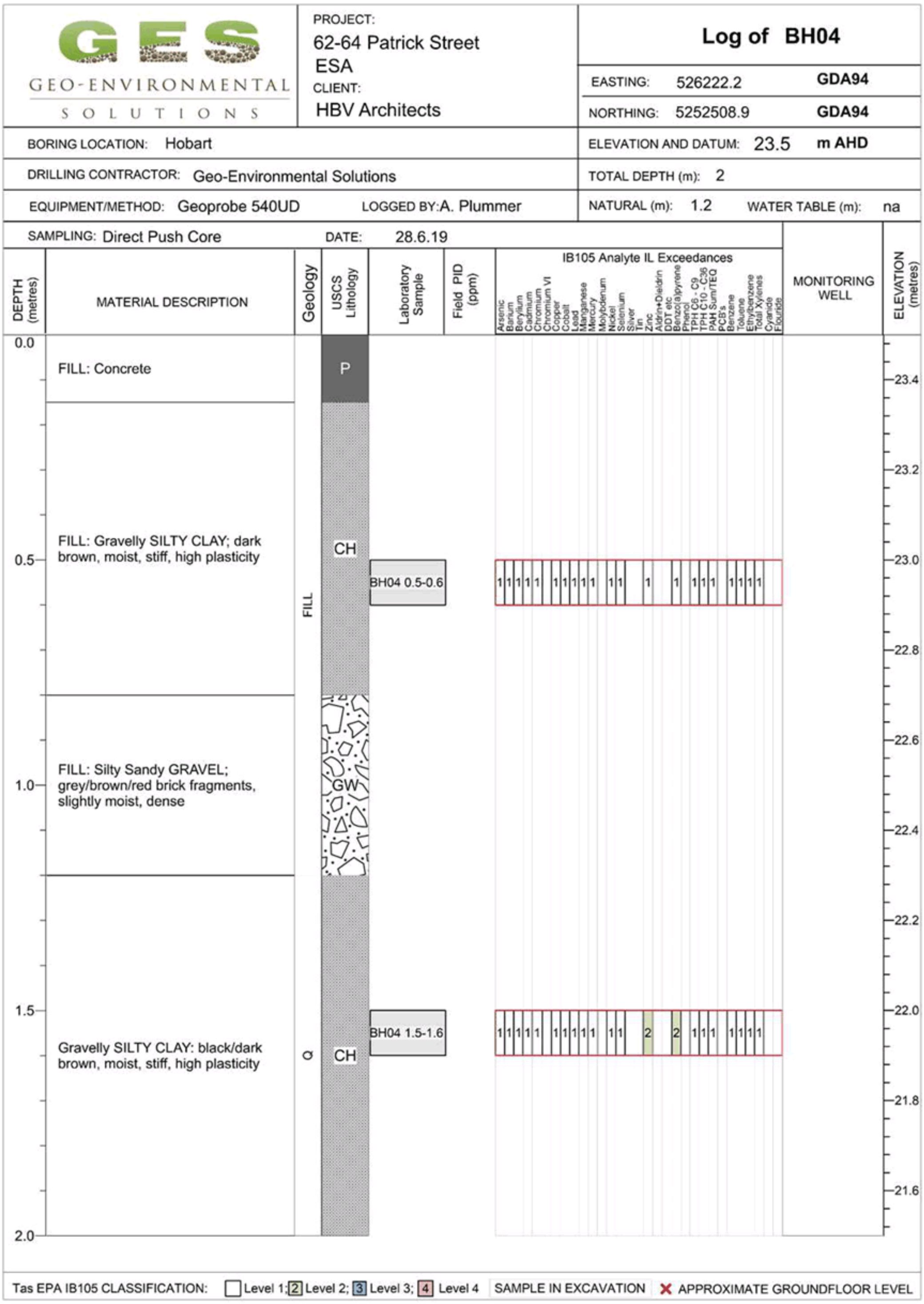
IB105 Analyte IL Exceedances

Laboratory Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium VI	Copper	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Tin	Zinc	Aldrin+Dieldrin	DDT etc	Benzo(a)pyrene	Phenol	TPH C6 - C9	TPH C10 - C36	PAH Sum/TEQ	PCB's	Benzene	Toluene	Ethylbenzene	Total Xylenes	Cyanide	Flouride
BH03 0.5-0.6	1	1	2	1	1		1	1	1	1	1		1	1			1			1		1	1	1		1	1	1	1		
BH03 1.5-1.6	1	1	1	1	1		1	1	2	1	1		1	1			1			1		1	1	1		1	1	1	1		

MONITORING WELL

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

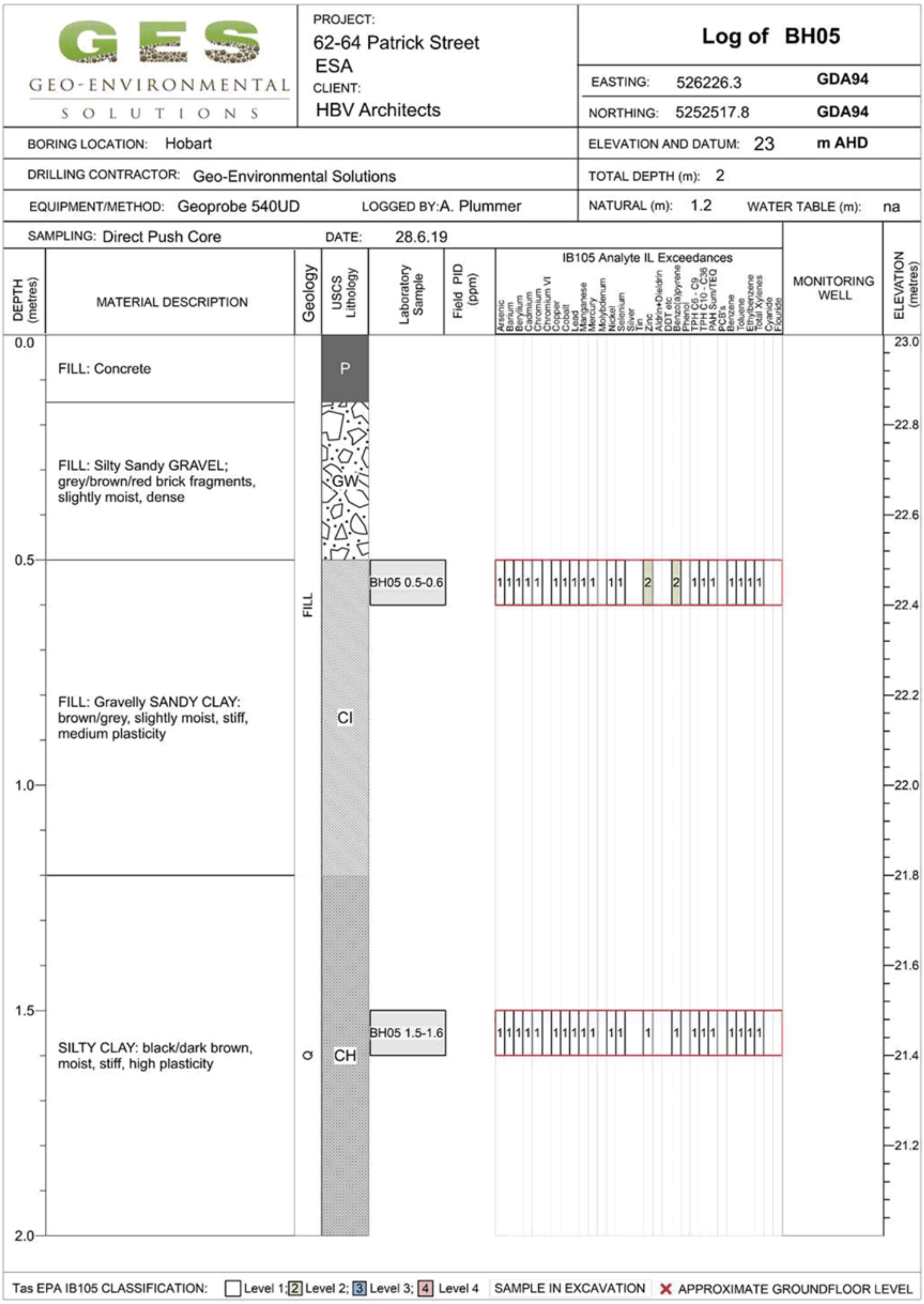
Log of BH04

EASTING: 526222.2 GDA94
NORTHING: 5252508.9 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.5 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 1.2
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)
0.0	FILL: Concrete	FILL	P		
	FILL: Gravelly SILTY CLAY; dark brown, moist, stiff, high plasticity		CH	BH04 0.5-0.6	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW		
	Gravelly SILTY CLAY: black/dark brown, moist, stiff, high plasticity	Q	CH	BH04 1.5-1.6	
2.0					

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GES
GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH05

EASTING:	526226.3	GDA94
NORTHING:	5252517.8	GDA94
ELEVATION AND DATUM:	23	m AHD

BORING LOCATION: Hobart
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 1.2
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
FILL: Concrete	FILL	P	
FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW	
FILL: Gravelly SANDY CLAY: brown/grey, slightly moist, stiff, medium plasticity	FILL	CI	BH05 0.5-0.6
SILTY CLAY: black/dark brown, moist, stiff, high plasticity	Q	CH	BH05 1.5-1.6

IB105 Analyte IL Exceedances

Analyte	BH05 0.5-0.6	BH05 1.5-1.6
Arsenic	1	1
Barium	1	1
Beryllium	1	1
Cadmium	1	1
Chromium	1	1
Chromium VI		
Copper	1	1
Cobalt	1	1
Lead	1	1
Manganese	1	1
Mercury	1	1
Molybdenum		
Nickel	1	1
Selenium	1	1
Silver		
Tin		
Zinc	2	1
Aldrin+Dieldrin		
DDT etc		
Benzo(a)pyrene	2	1
Phenol		
TPH C6 - C9	1	1
TPH C10 - C36	1	1
PAH Sum/TEQ	1	1
PCB's		
Benzene	1	1
Toluene	1	1
Ethylbenzene	1	1
Total Xylenes	1	1
Cyanide		
Flouride		

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs

GES
GEO-ENVIRONMENTAL
SOLUTIONS

PROJECT: 62-64 Patrick Street ESA

CLIENT: HBV Architects

Log of BH06

EASTING:	526213	GDA94
NORTHING:	5252499.6	GDA94
ELEVATION AND DATUM:	25.8	m AHD

BORING LOCATION: Hobart

DRILLING CONTRACTOR: Geo-Environmental Solutions

TOTAL DEPTH (m): 2

EQUIPMENT/METHOD: Geoprobe 540UD

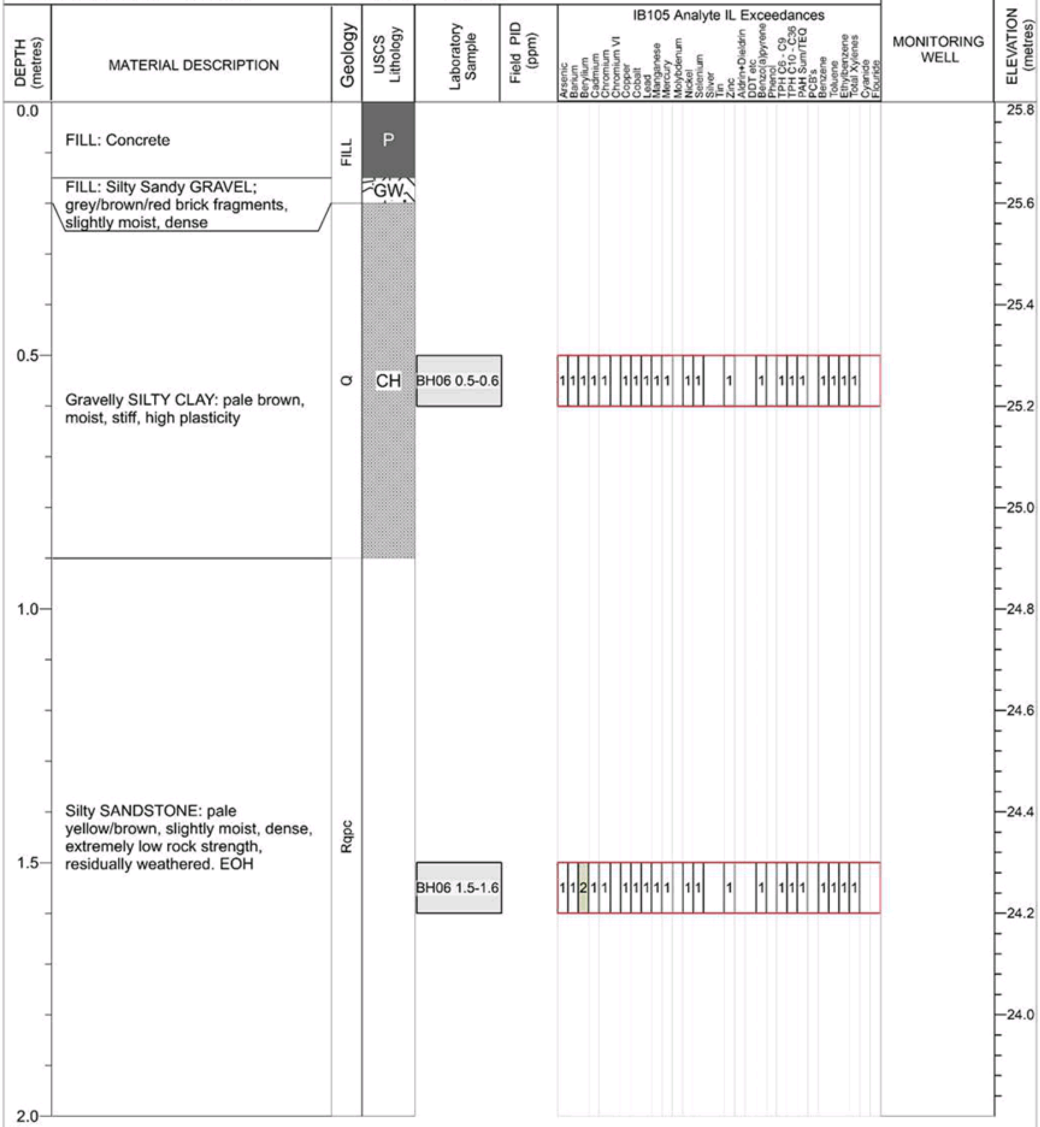
LOGGED BY: A. Plummer

NATURAL (m): 0.2

WATER TABLE (m): na

SAMPLING: Direct Push Core

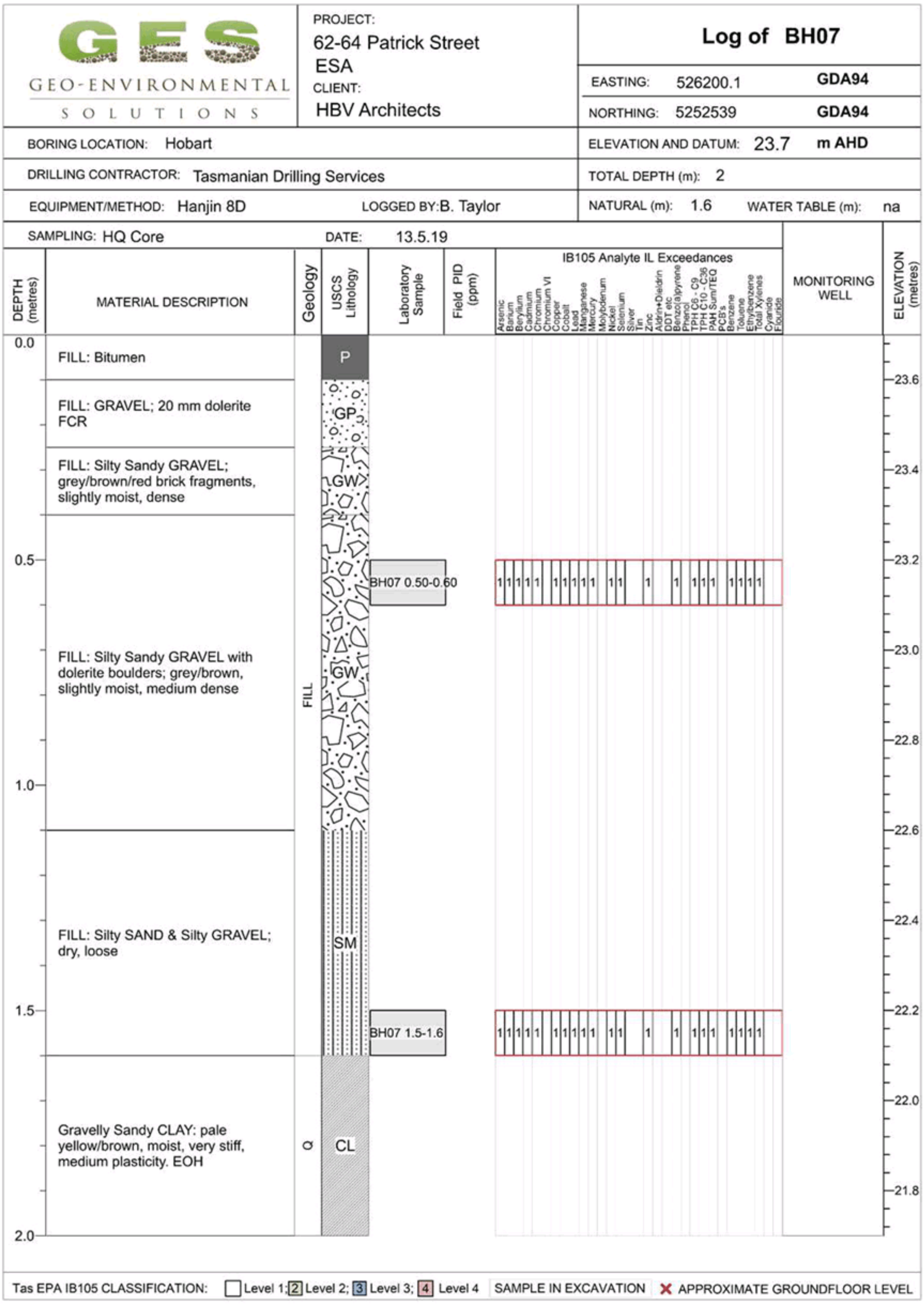
DATE: 28.6.19



MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
FILL: Concrete	FILL	P	
FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW	
Gravelly SILTY CLAY: pale brown, moist, stiff, high plasticity	Q	CH	BH06 0.5-0.6
Silty SANDSTONE: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc		BH06 1.5-1.6

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA

CLIENT: HBV Architects

Log of BH07

EASTING: 526200.1 **GDA94**

NORTHING: 5252539 **GDA94**

BORING LOCATION: Hobart

ELEVATION AND DATUM: 23.7 **m AHD**

DRILLING CONTRACTOR: Tasmanian Drilling Services

TOTAL DEPTH (m): 2

EQUIPMENT/METHOD: Hanjin 8D

LOGGED BY: B. Taylor

NATURAL (m): 1.6

WATER TABLE (m): na

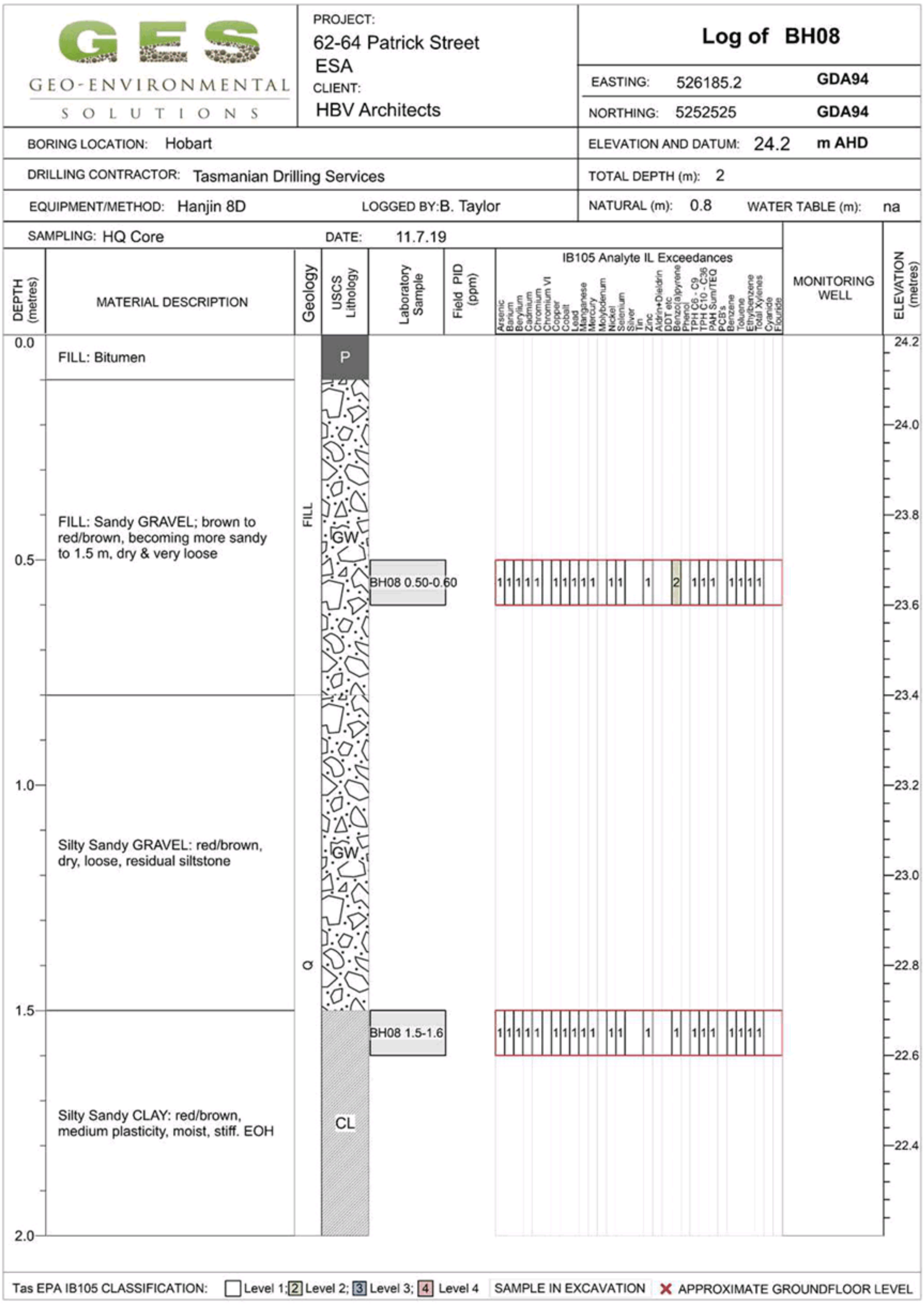
SAMPLING: HQ Core

DATE: 13.5.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Bitumen	FILL	P	
	FILL: GRAVEL; 20 mm dolerite FCR		GP	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW	
0.5	FILL: Silty Sandy GRAVEL with dolerite boulders; grey/brown, slightly moist, medium dense		GW	BH07 0.50-0.60
	FILL: Silty SAND & Silty GRAVEL; dry, loose		SM	BH07 1.5-1.6
1.6	Gravelly Sandy CLAY: pale yellow/brown, moist, very stiff, medium plasticity. EOH	Q	CL	

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✗ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH08

EASTING: 526185.2 GDA94
NORTHING: 5252525 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 24.2 m AHD
DRILLING CONTRACTOR: Tasmanian Drilling Services
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Hanjin 8D
LOGGED BY: B. Taylor
NATURAL (m): 0.8
WATER TABLE (m): na
SAMPLING: HQ Core
DATE: 11.7.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	MONITORING WELL	ELEVATION (metres)
0.0	FILL: Bitumen	FILL	P				24.2
	FILL: Sandy GRAVEL; brown to red/brown, becoming more sandy to 1.5 m, dry & very loose	FILL	GW	BH08 0.50-0.60			
	Silty Sandy GRAVEL: red/brown, dry, loose, residual siltstone	Q	GW				
1.5	Silty Sandy CLAY: red/brown, medium plasticity, moist, stiff. EOH	Q	CL	BH08 1.5-1.6			
2.0							

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0
Elevation scale: 24.2, 24.0, 23.8, 23.6, 23.4, 23.2, 23.0, 22.8, 22.6, 22.4

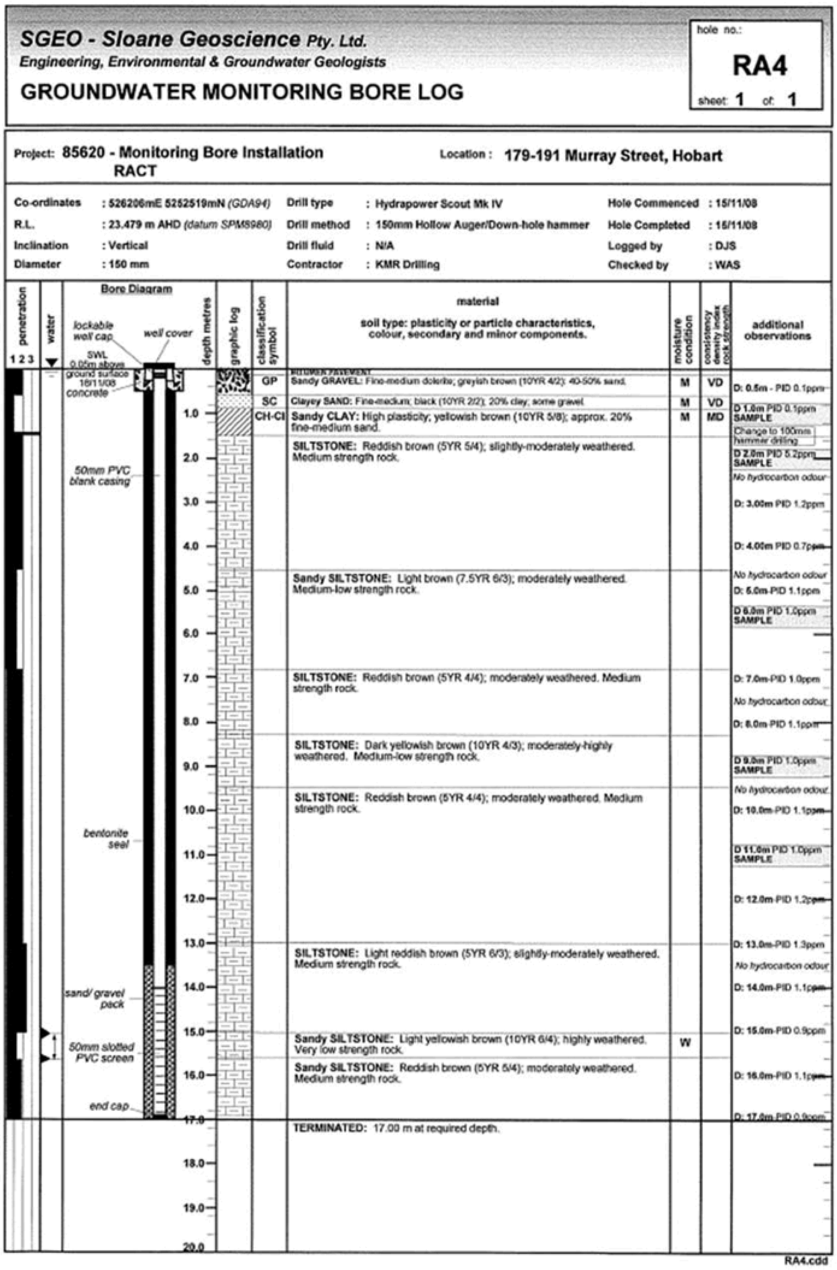
IB105 Analyte IL Exceedances

	BH08 0.50-0.60	BH08 1.5-1.6
Arsenic	1	1
Barium	1	1
Beryllium	1	1
Cadmium	1	1
Chromium	1	1
Chromium VI		
Copper	1	1
Cobalt	1	1
Lead	1	1
Manganese	1	1
Mercury	1	1
Molybdenum		
Nickel	1	1
Selenium	1	1
Silver		
Tin		
Zinc	1	1
Aldrin+Dieldrin		
DDT etc		
Benzo(a)pyrene	2	1
Phenol		
TPH C6 - C9	1	1
TPH C10 - C36	1	1
PAH Sum/TEQ	1	1
PCB's		
Benzene	1	1
Toluene	1	1
Ethylbenzene	1	1
Total Xylenes	1	1
Cyanide		
Flouride		

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Soil Bore Logs

Groundwater Bore Sloane 2009



SGEO - Sloane Geoscience Pty. Ltd.
Engineering, Environmental & Groundwater Geologists

GROUNDWATER MONITORING BORE LOG

hole no.: **RA4**
sheet: 1 of: 1

Project: 85620 - Monitoring Bore Installation RACT
Location: 179-191 Murray Street, Hobart

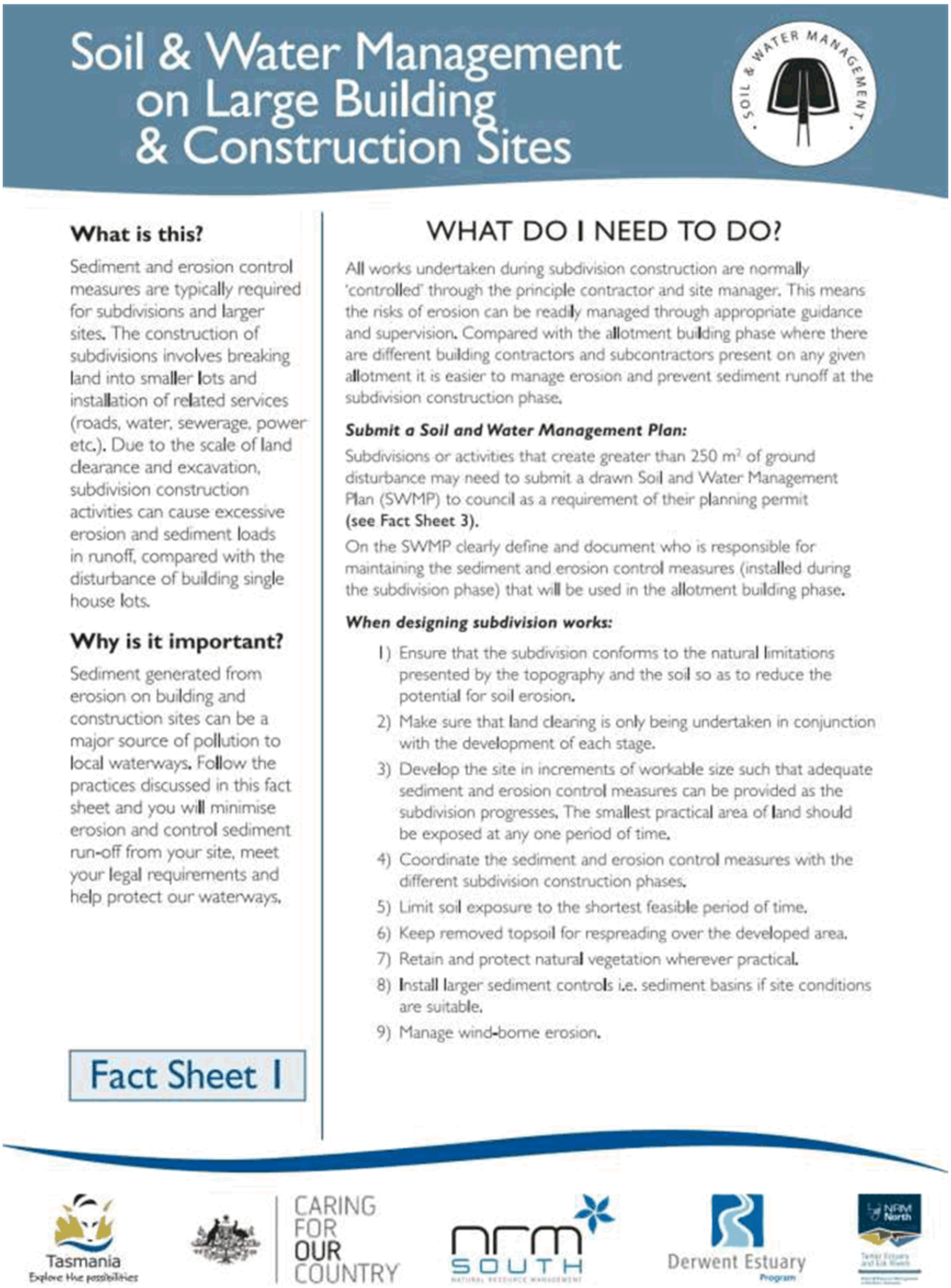
Co-ordinates	: 526206mE 5252519mN *(GDA94)*	Drill type	: Hydrapower Scout Mk IV	Hole Commenced	: 15/11/08
R.L.	: 23.479 m AHD *(datum SPM8980)*	Drill method	: 150mm Hollow Auger/Down-hole hammer	Hole Completed	: 15/11/08
Inclination	: Vertical	Drill fluid	: N/A	Logged by	: DJS
Diameter	: 150 mm	Contractor	: KMR Drilling	Checked by	: WAS

classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index rock strength
	BITUMEN PAVEMENT		
GP	**Sandy GRAVEL:** Fine-medium dolerite; greyish brown (10YR 4/2); 40-50% sand.	M	VD
SC	**Clayey SAND:** Fine-medium; black (10YR 2/2); 20% clay; some gravel.	M	VD
CH-CI	**Sandy CLAY:** High plasticity; yellowish brown (10YR 5/8); approx. 20% fine-medium sand.	M	MD
	SILTSTONE: Reddish brown (5YR 5/4); slightly-moderately weathered. Medium strength rock.		
	Sandy SILTSTONE: Light brown (7.5YR 6/3); moderately weathered. Medium-low strength rock.		
	SILTSTONE: Reddish brown (5YR 4/4); moderately weathered. Medium strength rock.		
	SILTSTONE: Dark yellowish brown (10YR 4/3); moderately-highly weathered. Medium-low strength rock.		
	SILTSTONE: Reddish brown (5YR 4/4); moderately weathered. Medium strength rock.		
	SILTSTONE: Light reddish brown (5YR 6/3); slightly-moderately weathered. Medium strength rock.		
	Sandy SILTSTONE: Light yellowish brown (10YR 6/4); highly weathered. Very low strength rock.	W	
	Sandy SILTSTONE: Reddish brown (5YR 5/4); moderately weathered. Medium strength rock.		
	TERMINATED: 17.00 m at required depth.		

additional observations
- D: 0.5m - PID 0.1ppm
- D 1.0m PID 0.1ppm SAMPLE
- Change to 100mm hammer drilling
- D 2.0m PID 5.2ppm SAMPLE
- No hydrocarbon odour
- D: 3.00m PID 1.2ppm
- D: 4.00m PID 0.7ppm
- No hydrocarbon odour
- D: 5.0m-PID 1.1ppm
- D 6.0m PID 1.0ppm SAMPLE
- D: 7.0m-PID 1.0ppm
- No hydrocarbon odour
- D: 8.0m-PID 1.1ppm
- D 9.0m PID 1.0ppm SAMPLE
- No hydrocarbon odour
- D: 10.0m-PID 1.1ppm
- D 11.0m PID 1.0ppm SAMPLE
- D: 12.0m PID 1.2ppm
- D: 13.0m-PID 1.3ppm
- No hydrocarbon odour
- D: 14.0m-PID 1.1ppm
- D: 15.0m-PID 0.9ppm
- D: 16.0m-PID 1.1ppm
- D: 17.0m PID 0.9ppm

RA4.cdd

Appendix 4 Soil and Water Management Guideline Fact Sheets



Soil & Water Management on Large Building & Construction Sites

What is this?

Sediment and erosion control measures are typically required for subdivisions and larger sites. The construction of subdivisions involves breaking land into smaller lots and installation of related services (roads, water, sewerage, power etc.). Due to the scale of land clearance and excavation, subdivision construction activities can cause excessive erosion and sediment loads in runoff, compared with the disturbance of building single house lots.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 1

WHAT DO I NEED TO DO?

All works undertaken during subdivision construction are normally 'controlled' through the principle contractor and site manager. This means the risks of erosion can be readily managed through appropriate guidance and supervision. Compared with the allotment building phase where there are different building contractors and subcontractors present on any given allotment it is easier to manage erosion and prevent sediment runoff at the subdivision construction phase.

Submit a Soil and Water Management Plan:

Subdivisions or activities that create greater than 250 m^2 of ground disturbance may need to submit a drawn Soil and Water Management Plan (SWMP) to council as a requirement of their planning permit **(see Fact Sheet 3).**

On the SWMP clearly define and document who is responsible for maintaining the sediment and erosion control measures (installed during the subdivision phase) that will be used in the allotment building phase.

When designing subdivision works:

1) Ensure that the subdivision conforms to the natural limitations presented by the topography and the soil so as to reduce the potential for soil erosion.
2) Make sure that land clearing is only being undertaken in conjunction with the development of each stage.
3) Develop the site in increments of workable size such that adequate sediment and erosion control measures can be provided as the subdivision progresses. The smallest practical area of land should be exposed at any one period of time.
4) Coordinate the sediment and erosion control measures with the different subdivision construction phases.
5) Limit soil exposure to the shortest feasible period of time.
6) Keep removed topsoil for respreading over the developed area.
7) Retain and protect natural vegetation wherever practical.
8) Install larger sediment controls i.e. sediment basins if site conditions are suitable.
9) Manage wind-borne erosion.

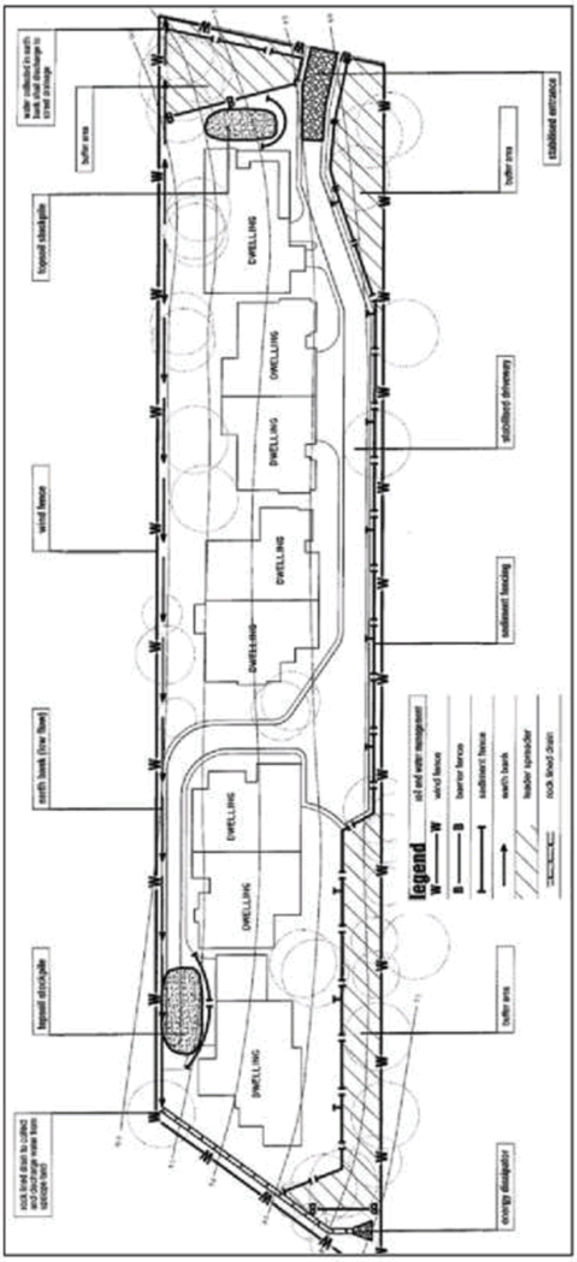


Figure 1A: SWMP for a subdivision.

List of fact sheets

1. **Soil & Water Management on Large Building & Construction Sites**
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

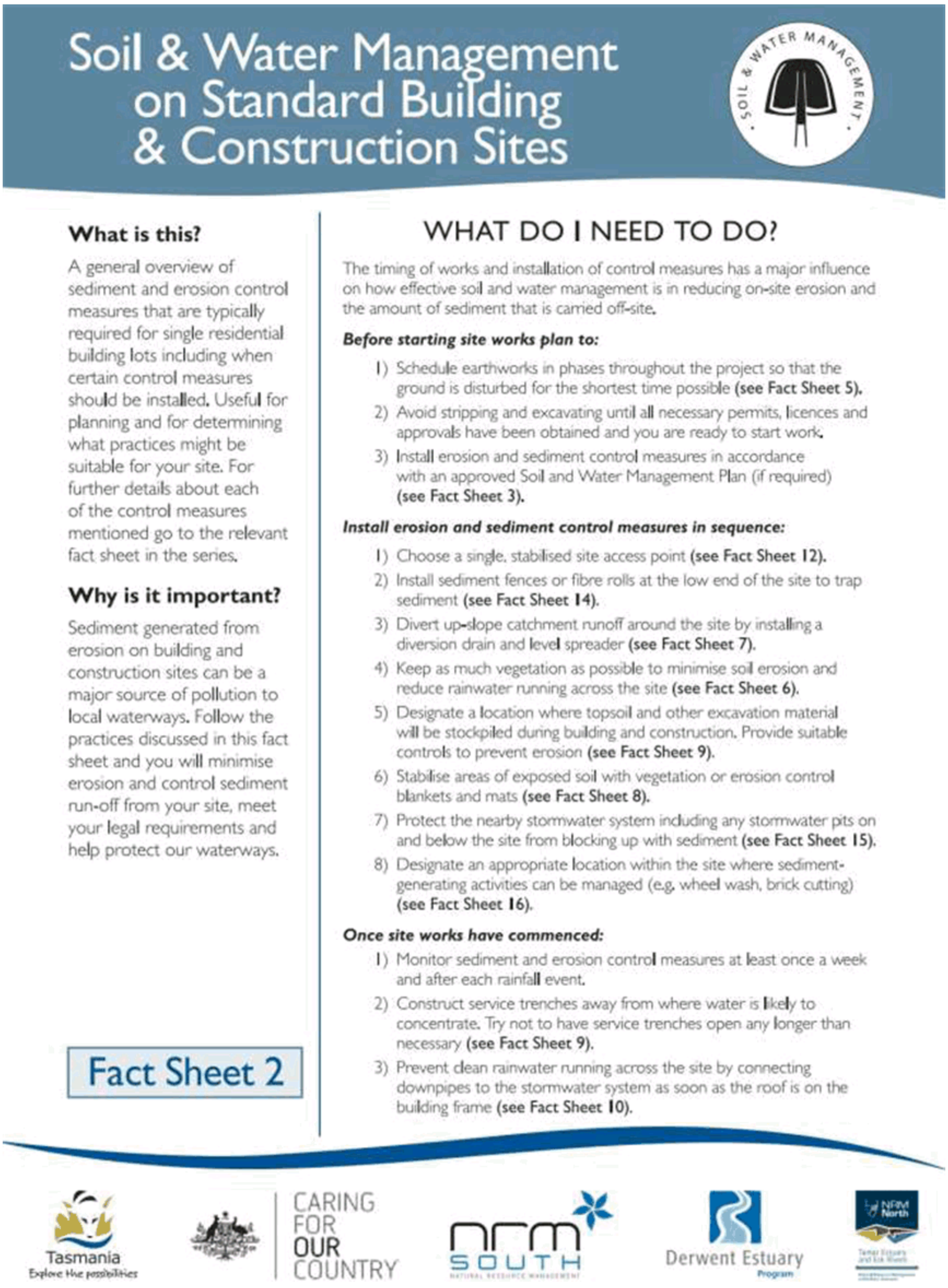
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 1A after Landcom 2004 *"Soils & Construction Volume 1 Managing Urban Stormwater (4th edition)"*. Some of the text in this brochure has been obtained and modified from the Brisbane City Council 2008 *"Subdivision and Development Guidelines"*.

Date of Issue: December 2008



Soil & Water Management on Standard Building & Construction Sites

What is this?

A general overview of sediment and erosion control measures that are typically required for single residential building lots including when certain control measures should be installed. Useful for planning and for determining what practices might be suitable for your site. For further details about each of the control measures mentioned go to the relevant fact sheet in the series.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 2

WHAT DO I NEED TO DO?

The timing of works and installation of control measures has a major influence on how effective soil and water management is in reducing on-site erosion and the amount of sediment that is carried off-site.

Before starting site works plan to:

1) Schedule earthworks in phases throughout the project so that the ground is disturbed for the shortest time possible **(see Fact Sheet 5).**
2) Avoid stripping and excavating until all necessary permits, licences and approvals have been obtained and you are ready to start work.
3) Install erosion and sediment control measures in accordance with an approved Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Install erosion and sediment control measures in sequence:

1) Choose a single, stabilised site access point **(see Fact Sheet 12).**
2) Install sediment fences or fibre rolls at the low end of the site to trap sediment **(see Fact Sheet 14).**
3) Divert up-slope catchment runoff around the site by installing a diversion drain and level spreader **(see Fact Sheet 7).**
4) Keep as much vegetation as possible to minimise soil erosion and reduce rainwater running across the site **(see Fact Sheet 6).**
5) Designate a location where topsoil and other excavation material will be stockpiled during building and construction. Provide suitable controls to prevent erosion **(see Fact Sheet 9).**
6) Stabilise areas of exposed soil with vegetation or erosion control blankets and mats **(see Fact Sheet 8).**
7) Protect the nearby stormwater system including any stormwater pits on and below the site from blocking up with sediment **(see Fact Sheet 15).**
8) Designate an appropriate location within the site where sediment-generating activities can be managed (e.g. wheel wash, brick cutting) **(see Fact Sheet 16).**

Once site works have commenced:

1) Monitor sediment and erosion control measures at least once a week and after each rainfall event.
2) Construct service trenches away from where water is likely to concentrate. Try not to have service trenches open any longer than necessary **(see Fact Sheet 9).**
3) Prevent clean rainwater running across the site by connecting downpipes to the stormwater system as soon as the roof is on the building frame **(see Fact Sheet 10).**

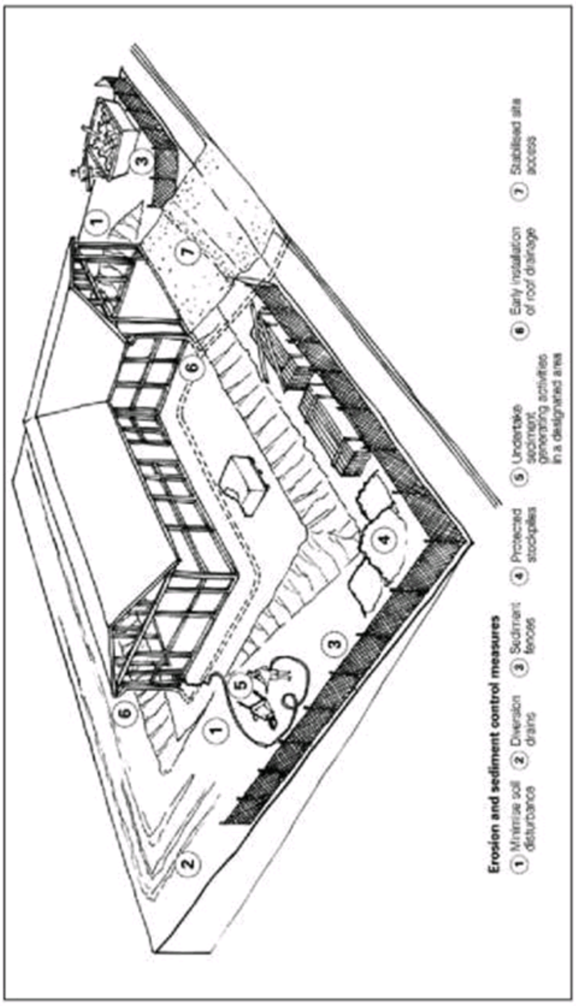


Figure 2A: Appropriate sediment and erosion control measures for single residential building lots.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. **Soil & Water Management on Standard Building & Construction Sites**
3. Soil & Water Management Plans
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5. Minimise Soil Disturbance
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12. Stabilised Site Access
13. Wheel Wash
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Acknowledgement:

Figure 2A was kindly provided by South East Queensland Healthy Waterways Partnership and Brisbane City Council. Text in this brochure has been obtained and modified from the "Do It Right On Site" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

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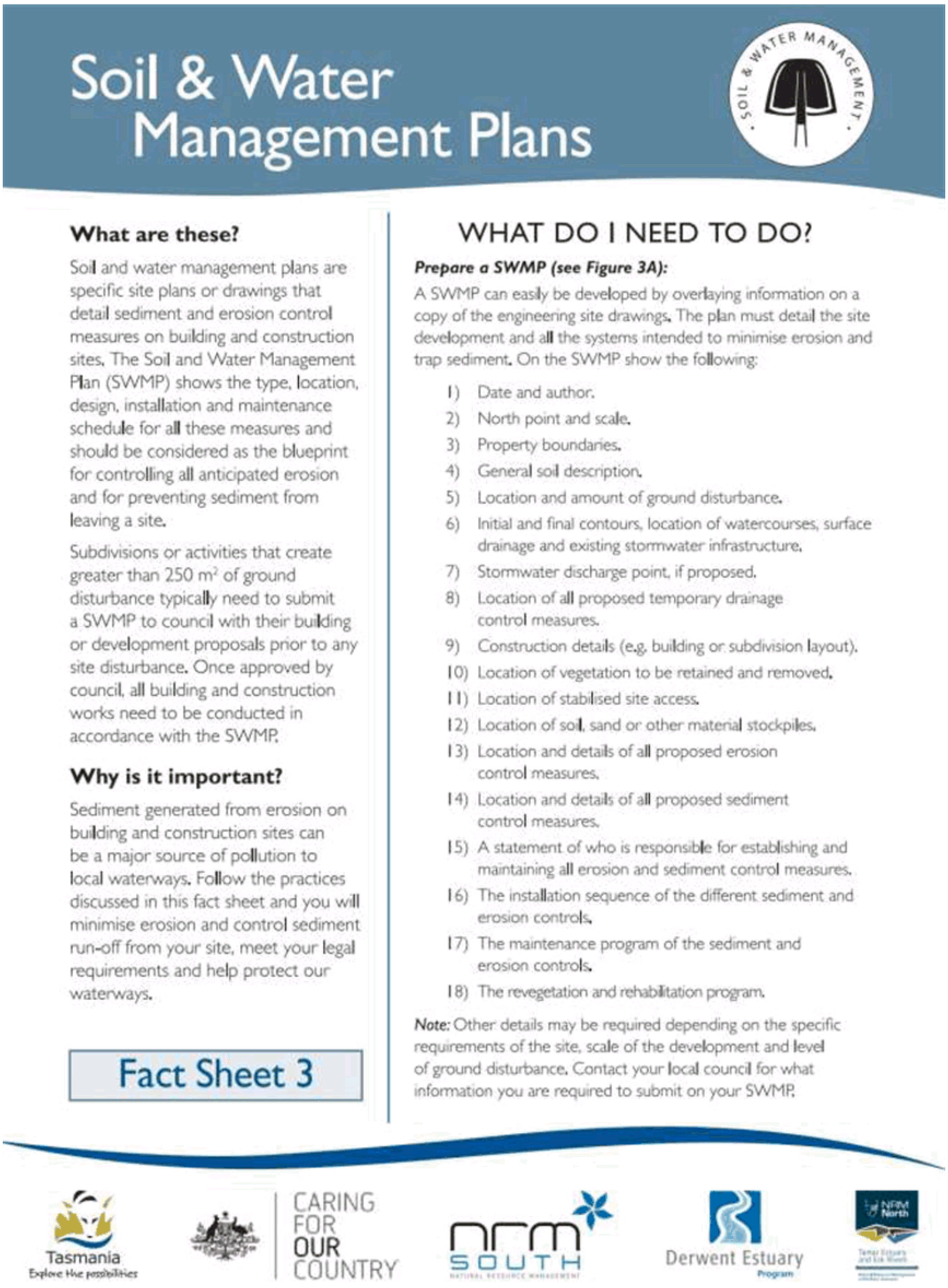

Soil & Water Management Plans

What are these?

Soil and water management plans are specific site plans or drawings that detail sediment and erosion control measures on building and construction sites. The Soil and Water Management Plan (SWMP) shows the type, location, design, installation and maintenance schedule for all these measures and should be considered as the blueprint for controlling all anticipated erosion and for preventing sediment from leaving a site.

Subdivisions or activities that create greater than 250 m^2 of ground disturbance typically need to submit a SWMP to council with their building or development proposals prior to any site disturbance. Once approved by council, all building and construction works need to be conducted in accordance with the SWMP.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion and control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 3

WHAT DO I NEED TO DO?

Prepare a SWMP (see Figure 3A):

A SWMP can easily be developed by overlaying information on a copy of the engineering site drawings. The plan must detail the site development and all the systems intended to minimise erosion and trap sediment. On the SWMP show the following:

1) Date and author.
2) North point and scale.
3) Property boundaries.
4) General soil description.
5) Location and amount of ground disturbance.
6) Initial and final contours, location of watercourses, surface drainage and existing stormwater infrastructure.
7) Stormwater discharge point, if proposed.
8) Location of all proposed temporary drainage control measures.
9) Construction details (e.g. building or subdivision layout).
10) Location of vegetation to be retained and removed.
11) Location of stabilised site access.
12) Location of soil, sand or other material stockpiles.
13) Location and details of all proposed erosion control measures.
14) Location and details of all proposed sediment control measures.
15) A statement of who is responsible for establishing and maintaining all erosion and sediment control measures.
16) The installation sequence of the different sediment and erosion controls.
17) The maintenance program of the sediment and erosion controls.
18) The revegetation and rehabilitation program.

Note: Other details may be required depending on the specific requirements of the site, scale of the development and level of ground disturbance. Contact your local council for what information you are required to submit on your SWMP.

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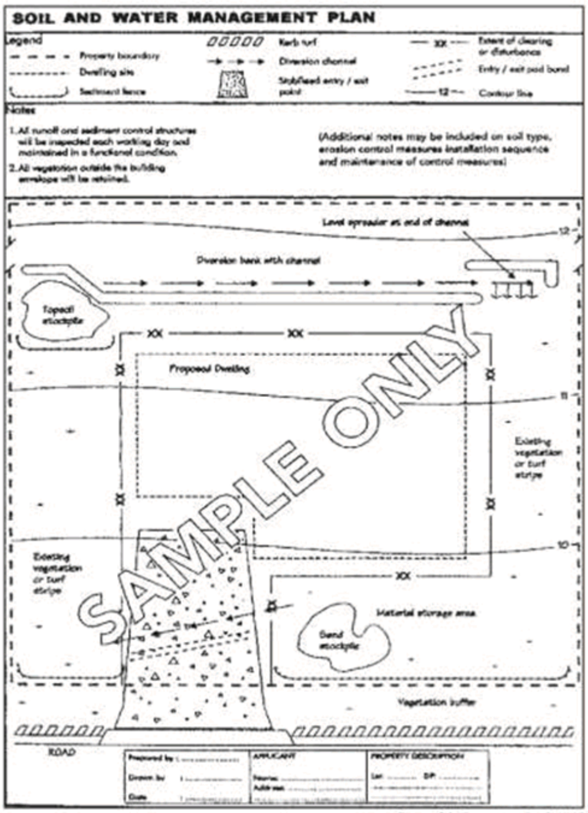
Submit the SWMP to council for approval:

A SWMP may be a requirement of your planning or building permit. Ensure that the council has approved your SWMP; otherwise you may be in breach of your permit.

Implement the SWMP and update as needed:

1) Keep a copy of the council-approved SWMP at the site at all times.
2) Ensure that all on-ground workers understand the SWMP.
3) Implement, update and maintain the control measures shown in the SWMP.



Notes

1. All runoff and sediment control structures will be inspected each working day and maintained in a functional condition.
2. All vegetation outside the building envelope will be retained.

(Additional notes may be included on soil type, erosion control measures installation sequence and maintenance of control measures)

Figure 3A: Example of a SWMP

List of fact sheets

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Remember:

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Acknowledgement:

Figure 3A from Gold Coast City Council "Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites". Text in this brochure has been obtained and modified from the "Do It Right On Site" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

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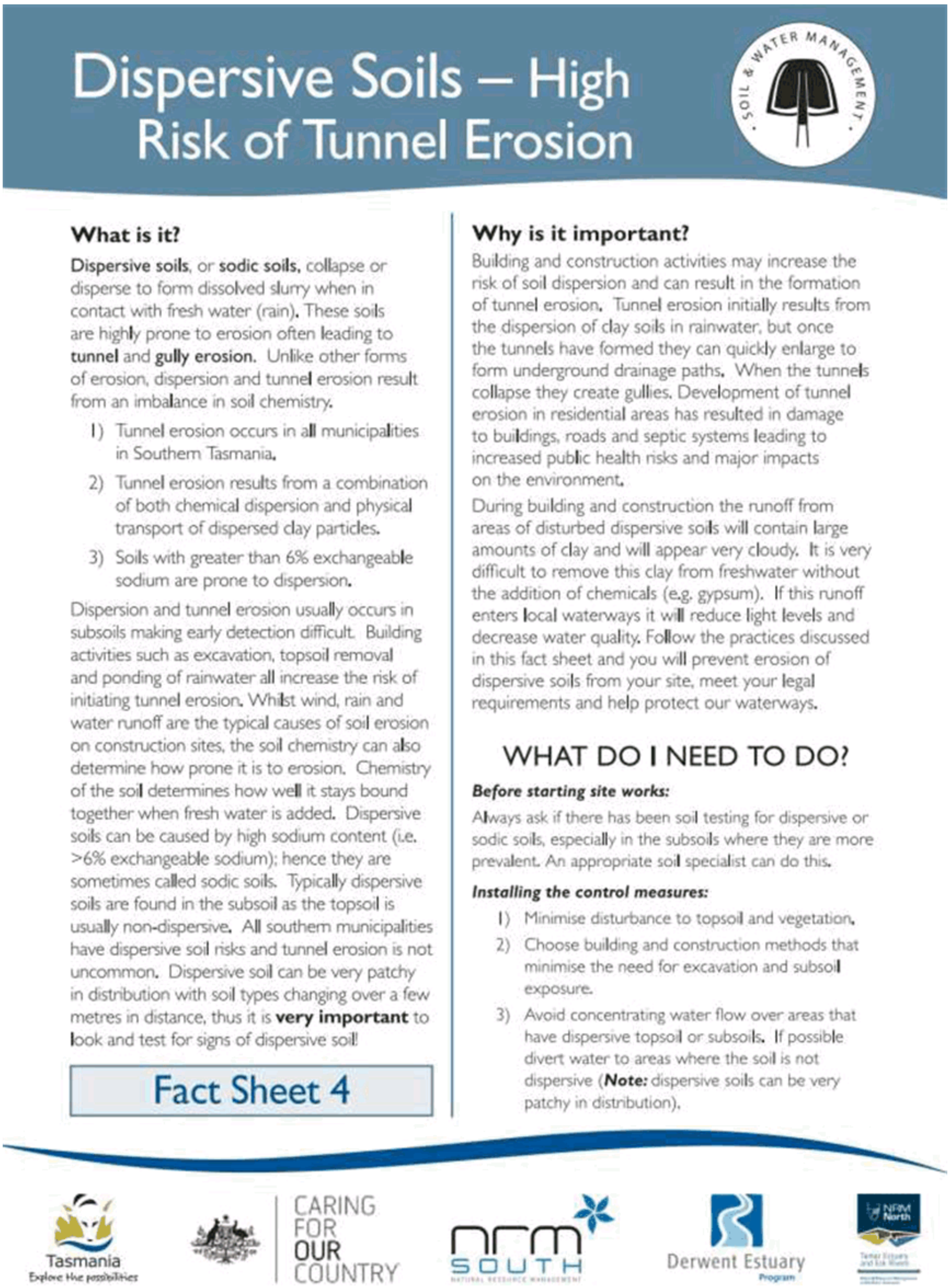

Dispersive Soils – High Risk of Tunnel Erosion

What is it?

Dispersive soils, or **sodic soils**, collapse or disperse to form dissolved slurry when in contact with fresh water (rain). These soils are highly prone to erosion often leading to **tunnel** and **gully erosion**. Unlike other forms of erosion, dispersion and tunnel erosion result from an imbalance in soil chemistry.

1) Tunnel erosion occurs in all municipalities in Southern Tasmania.
2) Tunnel erosion results from a combination of both chemical dispersion and physical transport of dispersed clay particles.
3) Soils with greater than 6% exchangeable sodium are prone to dispersion.

Dispersion and tunnel erosion usually occurs in subsoils making early detection difficult. Building activities such as excavation, topsoil removal and ponding of rainwater all increase the risk of initiating tunnel erosion. Whilst wind, rain and water runoff are the typical causes of soil erosion on construction sites, the soil chemistry can also determine how prone it is to erosion. Chemistry of the soil determines how well it stays bound together when fresh water is added. Dispersive soils can be caused by high sodium content (i.e. >6% exchangeable sodium); hence they are sometimes called sodic soils. Typically dispersive soils are found in the subsoil as the topsoil is usually non-dispersive. All southern municipalities have dispersive soil risks and tunnel erosion is not uncommon. Dispersive soil can be very patchy in distribution with soil types changing over a few metres in distance, thus it is **very important** to look and test for signs of dispersive soil!

Fact Sheet 4

Why is it important?

Building and construction activities may increase the risk of soil dispersion and can result in the formation of tunnel erosion. Tunnel erosion initially results from the dispersion of clay soils in rainwater, but once the tunnels have formed they can quickly enlarge to form underground drainage paths. When the tunnels collapse they create gullies. Development of tunnel erosion in residential areas has resulted in damage to buildings, roads and septic systems leading to increased public health risks and major impacts on the environment.

During building and construction the runoff from areas of disturbed dispersive soils will contain large amounts of clay and will appear very cloudy. It is very difficult to remove this clay from freshwater without the addition of chemicals (e.g. gypsum). If this runoff enters local waterways it will reduce light levels and decrease water quality. Follow the practices discussed in this fact sheet and you will prevent erosion of dispersive soils from your site, meet your legal requirements and help protect our waterways.

WHAT DO I NEED TO DO?

Before starting site works:

Always ask if there has been soil testing for dispersive or sodic soils, especially in the subsoils where they are more prevalent. An appropriate soil specialist can do this.

Installing the control measures:

1) Minimise disturbance to topsoil and vegetation.
2) Choose building and construction methods that minimise the need for excavation and subsoil exposure.
3) Avoid concentrating water flow over areas that have dispersive topsoil or subsoils. If possible divert water to areas where the soil is not dispersive (***Note:*** dispersive soils can be very patchy in distribution).

4) When diverting water, create diversion berms/banks by pushing the soil to create banks up hill, this maintains grass in the channel and reduces infiltration directly to the subsoil and the potential for tunnel erosion.
5) **Do not** create soakage pits in dispersive soils.
6) Immediately infill any trenches or holes to prevent collection and ponding of water on subsoil surfaces.
7) **Always** compact dispersive subsoils that have been disturbed or excavated. Dispersive soils require above average compaction. Consider using a 'whacker packer' for small areas or a sheeps foot roller for large areas. Apply gypsum or lime according to soil test recommendations during infilling and cover with topsoil and revegetate.
8) **Always** bury any exposed subsoils with topsoil and revegetate.
9) Top dress the surface of potentially dispersive soils with gypsum (if soil pH > 6.5) or lime (if soil pH <5) or a mixture of both (if soil pH is within the range of 5 to 6.5) according to soil test recommendations to reduce dispersion.
10) Cover dispersive soils with a minimum 100 mm layer of non-dispersive soil prior to revegetation, or the placement of rock gabions, or concrete.

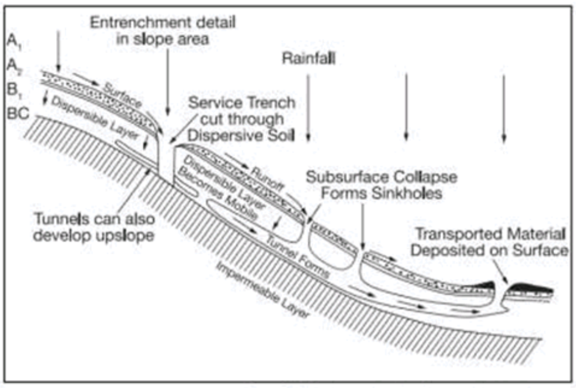

Figure 4A *Tunnel erosion development in dispersive soils*

Note: You can seek further information and advice on the issue of dispersive soils and tunnel erosion from several sources including: your local council, a soil surveyor, civil engineer or soil specialist, NRM South and the Land Conservation Branch of the Department of Primary Industries and Water (DPIW).

List of fact sheets

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7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
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11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
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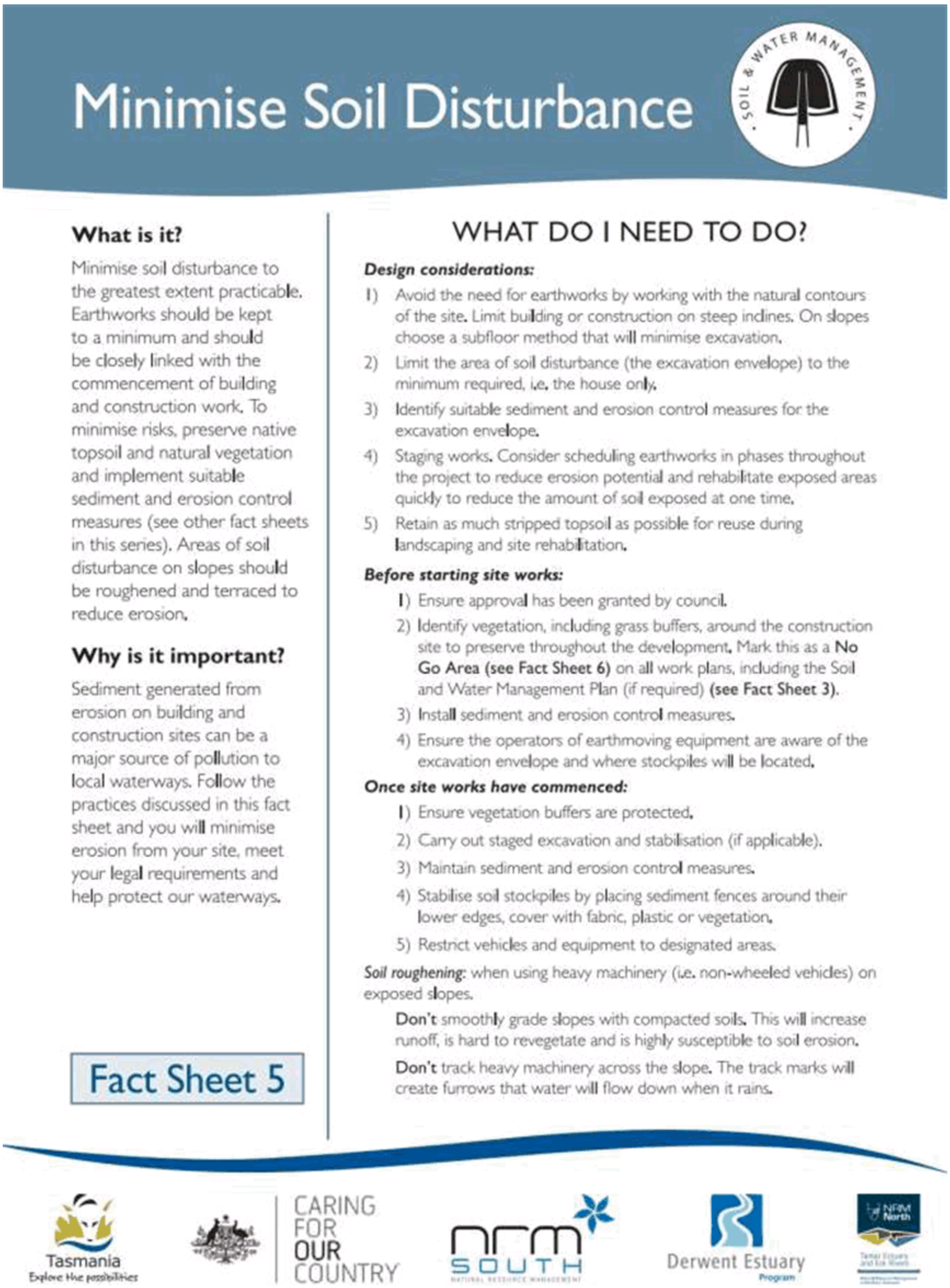
Acknowledgement:

Figure 4A after Department of Construction and Environment, Land Protection Division, Victoria *"Field Erosion its Characteristics and Amelioration"*.

Date of Issue: December 2008



Minimise Soil Disturbance

What is it?

Minimise soil disturbance to the greatest extent practicable. Earthworks should be kept to a minimum and should be closely linked with the commencement of building and construction work. To minimise risks, preserve native topsoil and natural vegetation and implement suitable sediment and erosion control measures (see other fact sheets in this series). Areas of soil disturbance on slopes should be roughened and terraced to reduce erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 5

WHAT DO I NEED TO DO?

Design considerations:

1) Avoid the need for earthworks by working with the natural contours of the site. Limit building or construction on steep inclines. On slopes choose a subfloor method that will minimise excavation.
2) Limit the area of soil disturbance (the excavation envelope) to the minimum required, i.e. the house only.
3) Identify suitable sediment and erosion control measures for the excavation envelope.
4) Staging works. Consider scheduling earthworks in phases throughout the project to reduce erosion potential and rehabilitate exposed areas quickly to reduce the amount of soil exposed at one time.
5) Retain as much stripped topsoil as possible for reuse during landscaping and site rehabilitation.

Before starting site works:

1) Ensure approval has been granted by council.
2) Identify vegetation, including grass buffers, around the construction site to preserve throughout the development. Mark this as a **No Go Area (see Fact Sheet 6)** on all work plans, including the Soil and Water Management Plan (if required) **(see Fact Sheet 3).**
3) Install sediment and erosion control measures.
4) Ensure the operators of earthmoving equipment are aware of the excavation envelope and where stockpiles will be located.

Once site works have commenced:

1) Ensure vegetation buffers are protected.
2) Carry out staged excavation and stabilisation (if applicable).
3) Maintain sediment and erosion control measures.
4) Stabilise soil stockpiles by placing sediment fences around their lower edges, cover with fabric, plastic or vegetation.
5) Restrict vehicles and equipment to designated areas.

Soil roughening: when using heavy machinery (i.e. non-wheeled vehicles) on exposed slopes.

Don't smoothly grade slopes with compacted soils. This will increase runoff, is hard to revegetate and is highly susceptible to soil erosion.

Don't track heavy machinery across the slope. The track marks will create furrows that water will flow down when it rains.

Do track machinery (e.g. excavators) up and down the slope to create grooves from the wheels/or tracks that will catch seeds, fertilizer, and rainfall. The grooves will roughen the surface in a way that will slow runoff over the slope ***(see Figure 5A).***

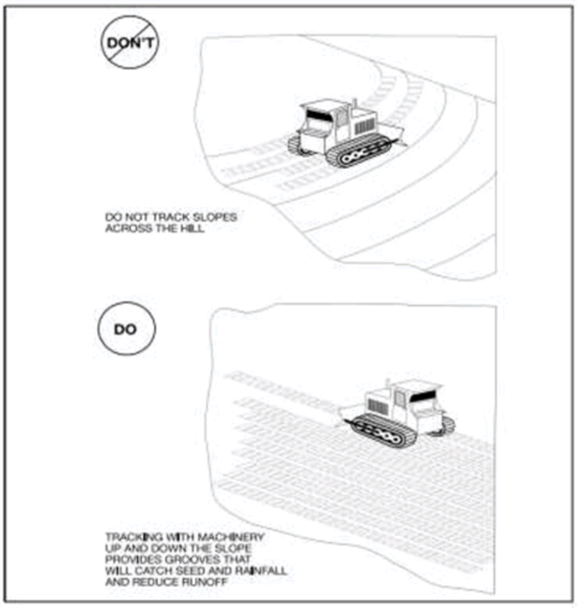


Figure 5A: *Avoid moving tracked vehicles across the slope, unless the final pass involves tracking up and down the slope.*

Maintaining control measures:

If topsoil has been removed it will need to be replaced ***(see Figure 5B).***

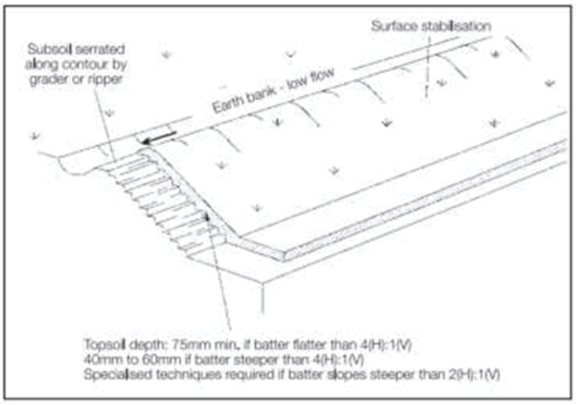


Figure 5B: *Replacing Topsoil.*

List of fact sheets

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7. Divert Up-slope Water
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9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 5A after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*. Figure 5B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Preserve Vegetation

What is it?

Keep as much of the original vegetation (grass, trees, etc.) on the site by establishing **No Go Areas** for the building and construction phase as well as vegetated filter strips down-slope of the work site. Preserving grassed areas, trees and shrubs protects the soil from erosion and provides an effective filter for sediment runoff.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 6

WHAT DO I NEED TO DO?

Before starting site works:

Identify vegetation (trees, shrubs and grassed areas) on site which can be kept throughout the entire building and construction phase and mark this as a **No Go Area**. Include this information on the Soil and Water Management Plan if required **(see Fact Sheet 3).**

Vegetation is the most effective soil stabiliser available on building and construction sites. Keep groundcover along surface drainage areas and on steeper slopes. Retain significant areas of healthy grass down-slope of the worksite, these strips can be highly effective for filtering out coarse sediment. The flatter and wider the strips are, the more effective they become. Native vegetation along streams and waterways should be retained and protected from sediment by installing additional sediment control measures up-slope e.g. fibre rolls and sediment fences **(see Fact Sheet 14).** On exposed sites a 400 mm wide planted turf strip between the kerb and the footpath is a good last resort sediment control, filtering the runoff before it enters the stormwater system **(see Figure 6A).**

Where vegetation needs to be removed, leave it in place for as long as possible and stage earthworks to minimise the amount of site cleared at any time.

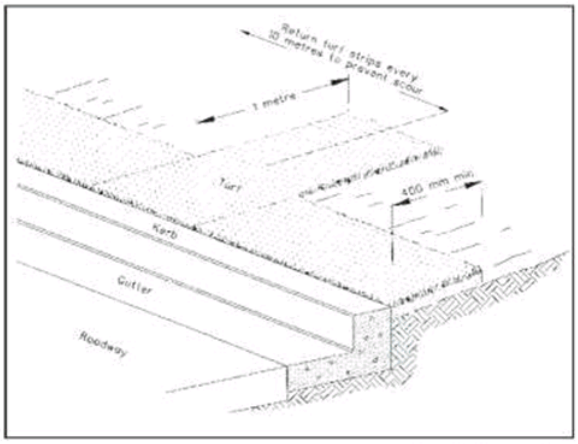

Figure 6A: *Planted turf strip.*

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Installing the control measures:

Fence off the **No Go Area.** Place red tape or other bright materials around the trees, shrubs and grassed areas to be kept. Ensure staff and subcontractors know not to enter these areas or damage marked trees. Where practicable, maintain the planted turf strip in a healthy state during the building and construction process and ensure it is fenced-off to prevent traffic-induced damage.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
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3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. **Preserve Vegetation**
7. Divert Up-slope Water
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9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
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Acknowledgement:

Text in this brochure has been obtained and modified from the "Do *It* Right On Site" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils. Figure 6A from Landcom 2004 "Soils *& Construction Volume I Managing Urban Stormwater (4th edition)*".

Date of Issue: December 2008

Divert Up-slope Water

SOIL & WATER MANAGEMENT

What is it?

Design surface drainage up-slope of building and construction sites to divert runoff away from the site. Where practical and particularly where stormwater runoff from more than 0.5 hectares feeds into the work site, divert up-slope water around the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 7

WHAT DO I NEED TO DO?

Before starting site works:

Look at the site plans to identify site areas where stormwater can be diverted around the disturbed or active work area. Stormwater can be diverted with the use of small diversion drains. Note that the stormwater must not be diverted onto adjacent properties; instead it must discharge the work site at a legal point of discharge. Diversion drains need to be properly designed to ensure that they can convey water without overflowing or accumulating sediment. Document the diversion drains on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).** Ensure workers on-site are aware of the need to maintain the diversion drains. Do not dig diversion drains on dispersive soils **(see Fact Sheet 4)**, instead build soil berms.

Installing the control measures:

Diversion drains: A diversion drain is a channel constructed on the high side of a site to divert surface runoff from rainwater that would otherwise flow down onto the disturbed or active work area.

1) The channel should be about 150 mm deep with a curved shape.
2) Place the excavated soil from the channel on the down-slope side to increase the diversion drain's capacity.

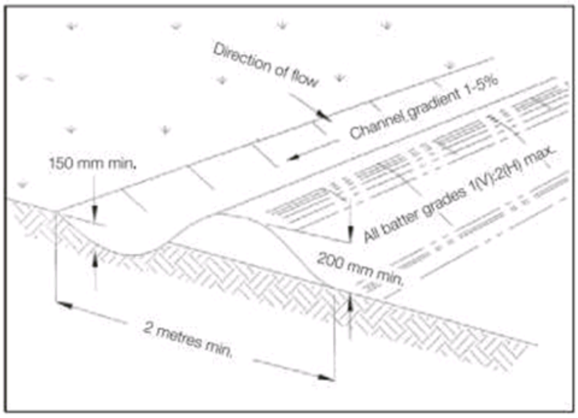

Figure 7A: *Example of a diversion drain.*

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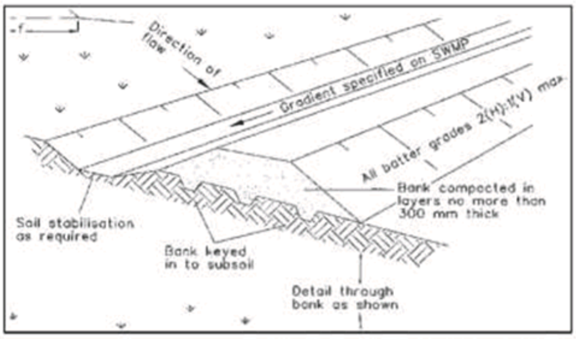

Figure 7B: Example of a diversion drain for high flow.

3) The diversion drain should divert flows to a stable drainage line to ensure that the channel does not itself cause erosion where it discharges.
4) The diversion drain should be kept clean and free of plantings and mulch as this will lead to the deposition of sediment that obstructs water flow and causes water to breach the channel and create unwanted erosion.

Level spreader: Level spreaders are generally used at the outlet of diversion channels. A level spreader is a wide, level overflow sill built across a slope. It allows even spread of water flow so velocities are reduced and soil erosion is avoided. This should only be constructed to release water to areas where the:

1) Water flow will not become concentrated.
2) Soil is stabilised and the site is not within the path of construction activities.
3) Ground remains well-vegetated.
4) Discharged water flow will be slow moving.

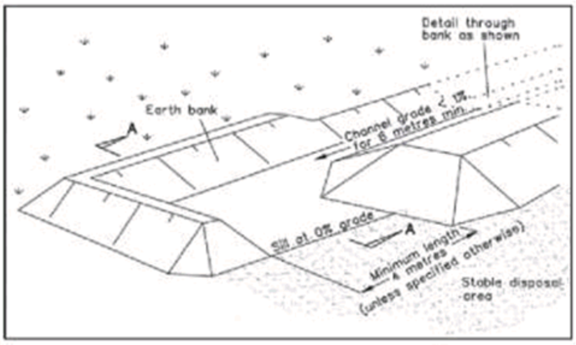

Figure 7C: Example of a level spreader used to release minor concentrated flows as sheet flow.

In some cases such as on steep slopes or where there are high flow velocities, a grass or geotextile fabric lined channel may be required to return the diverted flow to the stormwater system or a stable drainage line.

Maintaining the control measures:

Check diversion drains, level spreaders and discharge areas for signs of erosion.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. **Divert Up-slope Water**
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11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
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Acknowledgement:

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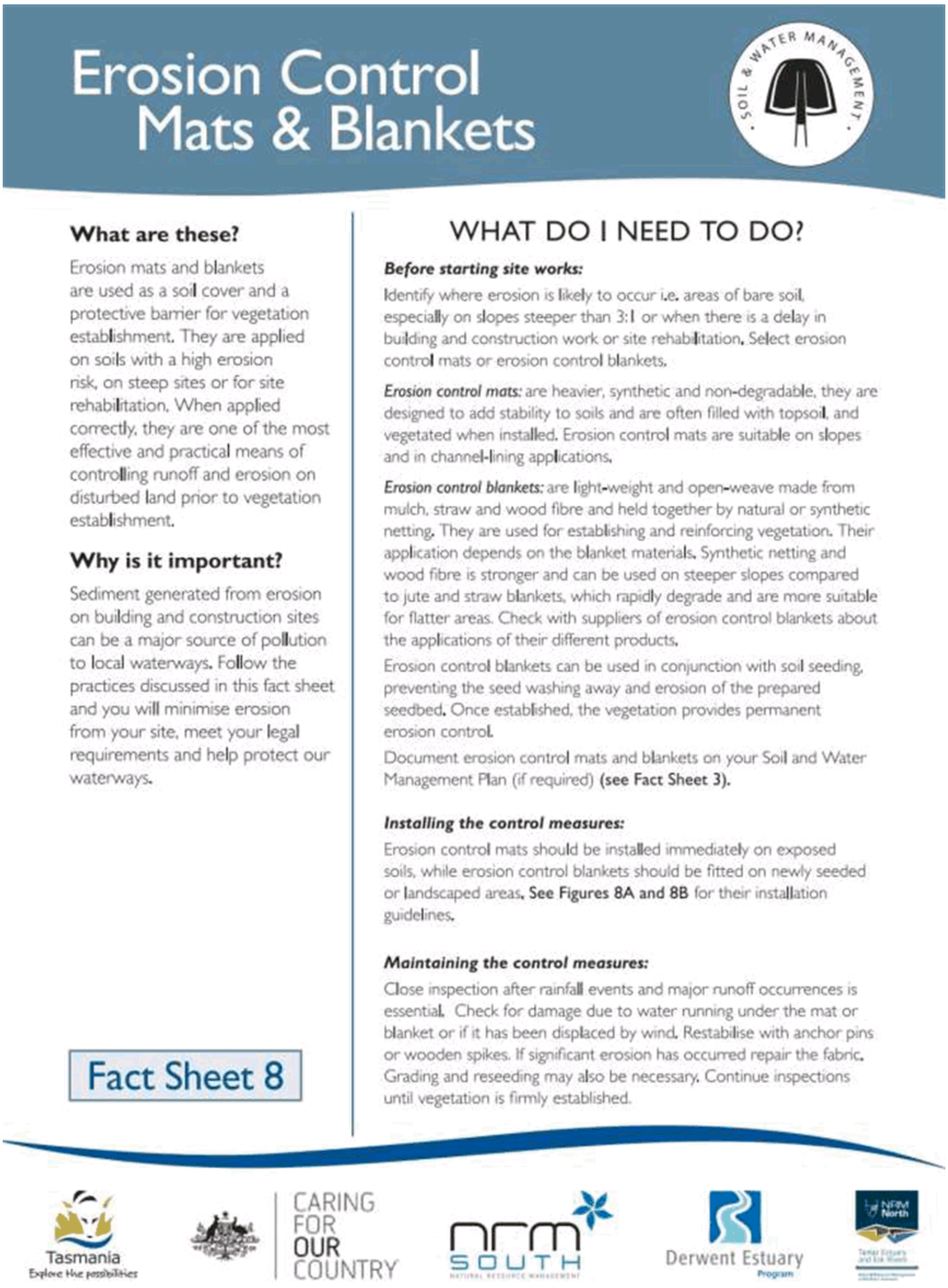

Erosion Control Mats & Blankets

What are these?

Erosion mats and blankets are used as a soil cover and a protective barrier for vegetation establishment. They are applied on soils with a high erosion risk, on steep sites or for site rehabilitation. When applied correctly, they are one of the most effective and practical means of controlling runoff and erosion on disturbed land prior to vegetation establishment.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 8

WHAT DO I NEED TO DO?

Before starting site works:

Identify where erosion is likely to occur i.e. areas of bare soil, especially on slopes steeper than 3:1 or when there is a delay in building and construction work or site rehabilitation. Select erosion control mats or erosion control blankets.

Erosion control mats: are heavier, synthetic and non-degradable, they are designed to add stability to soils and are often filled with topsoil, and vegetated when installed. Erosion control mats are suitable on slopes and in channel-lining applications.

Erosion control blankets: are light-weight and open-weave made from mulch, straw and wood fibre and held together by natural or synthetic netting. They are used for establishing and reinforcing vegetation. Their application depends on the blanket materials. Synthetic netting and wood fibre is stronger and can be used on steeper slopes compared to jute and straw blankets, which rapidly degrade and are more suitable for flatter areas. Check with suppliers of erosion control blankets about the applications of their different products.

Erosion control blankets can be used in conjunction with soil seeding, preventing the seed washing away and erosion of the prepared seedbed. Once established, the vegetation provides permanent erosion control.

Document erosion control mats and blankets on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

Installing the control measures:

Erosion control mats should be installed immediately on exposed soils, while erosion control blankets should be fitted on newly seeded or landscaped areas. **See Figures 8A and 8B** for their installation guidelines.

Maintaining the control measures:

Close inspection after rainfall events and major runoff occurrences is essential. Check for damage due to water running under the mat or blanket or if it has been displaced by wind. Restabilise with anchor pins or wooden spikes. If significant erosion has occurred repair the fabric. Grading and reseeding may also be necessary. Continue inspections until vegetation is firmly established.

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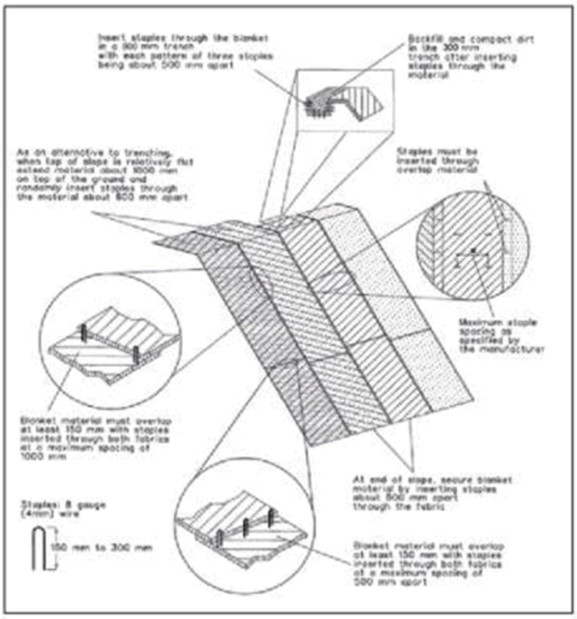

Figure 8A: Installation of an erosion control blanket on a hillside.

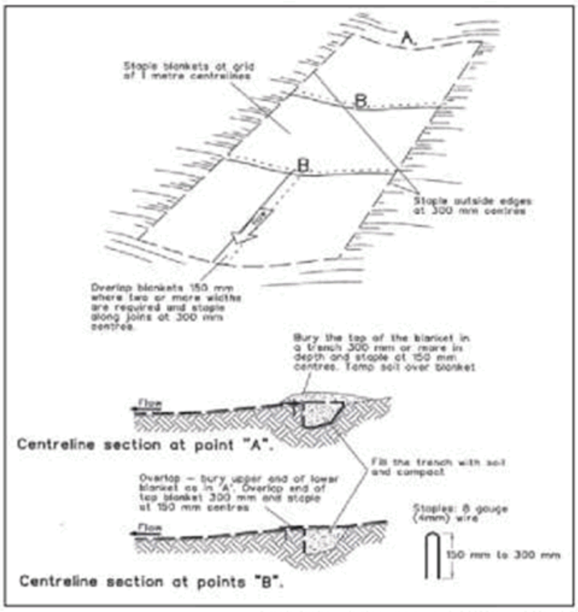

Figure 8B: Erosion control mat used to line a channel.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. **Erosion Control Mats & Blankets**
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
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Acknowledgement:

Figures 8A & 8B from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)".*

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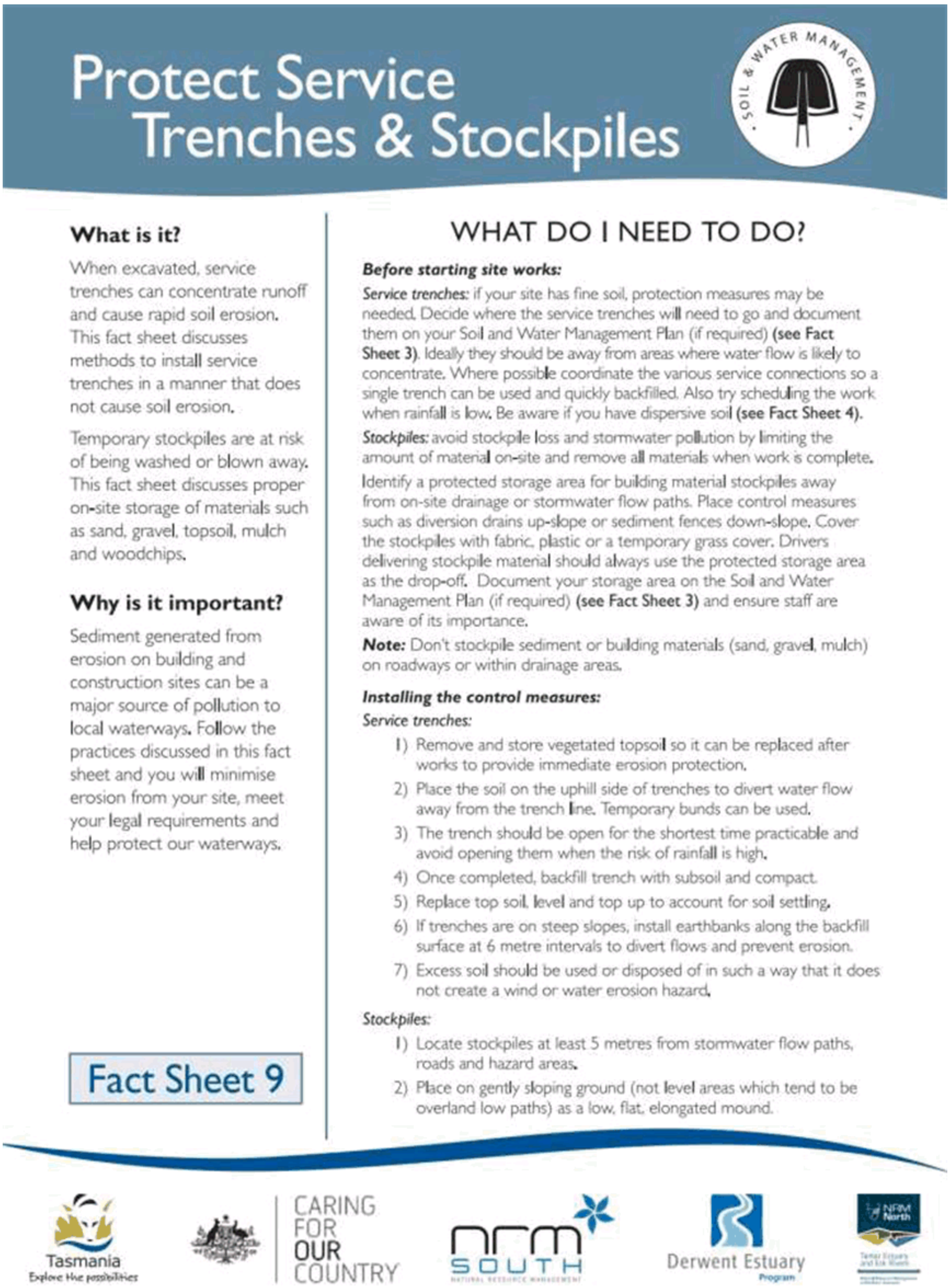

Protect Service Trenches & Stockpiles

What is it?

When excavated, service trenches can concentrate runoff and cause rapid soil erosion. This fact sheet discusses methods to install service trenches in a manner that does not cause soil erosion.

Temporary stockpiles are at risk of being washed or blown away. This fact sheet discusses proper on-site storage of materials such as sand, gravel, topsoil, mulch and woodchips.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 9

WHAT DO I NEED TO DO?

Before starting site works:

Service trenches: if your site has fine soil, protection measures may be needed. Decide where the service trenches will need to go and document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)**. Ideally they should be away from areas where water flow is likely to concentrate. Where possible coordinate the various service connections so a single trench can be used and quickly backfilled. Also try scheduling the work when rainfall is low. Be aware if you have dispersive soil **(see Fact Sheet 4)**.

Stockpiles: avoid stockpile loss and stormwater pollution by limiting the amount of material on-site and remove all materials when work is complete.

Identify a protected storage area for building material stockpiles away from on-site drainage or stormwater flow paths. Place control measures such as diversion drains up-slope or sediment fences down-slope. Cover the stockpiles with fabric, plastic or a temporary grass cover. Drivers delivering stockpile material should always use the protected storage area as the drop-off. Document your storage area on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: Don't stockpile sediment or building materials (sand, gravel, mulch) on roadways or within drainage areas.

Installing the control measures:

Service trenches:

1) Remove and store vegetated topsoil so it can be replaced after works to provide immediate erosion protection.
2) Place the soil on the uphill side of trenches to divert water flow away from the trench line. Temporary bunds can be used.
3) The trench should be open for the shortest time practicable and avoid opening them when the risk of rainfall is high.
4) Once completed, backfill trench with subsoil and compact.
5) Replace top soil, level and top up to account for soil settling.
6) If trenches are on steep slopes, install earthbanks along the backfill surface at 6 metre intervals to divert flows and prevent erosion.
7) Excess soil should be used or disposed of in such a way that it does not create a wind or water erosion hazard.

Stockpiles:

1) Locate stockpiles at least 5 metres from stormwater flow paths, roads and hazard areas.
2) Place on gently sloping ground (not level areas which tend to be overland low paths) as a low, flat, elongated mound.

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3) Stockpiles should preferably be less than 1.5 metres high.
4) Construct an earth bank on the up-slope side to divert runoff around the stockpile and install a sediment fence 1–2 metres down-slope of the stockpile. The height of the sediment fence should be equal to the stockpile height and the length equal to the stockpile length at the base.
5) Stockpiled materials should be covered during windy conditions, rain or unattended periods. Topsoil stockpiles left for extended periods should be revegetated.

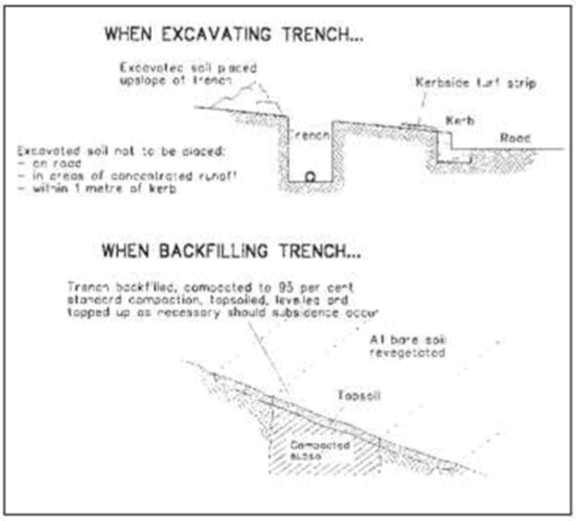

Figure 9A: *Example of a service trench.*

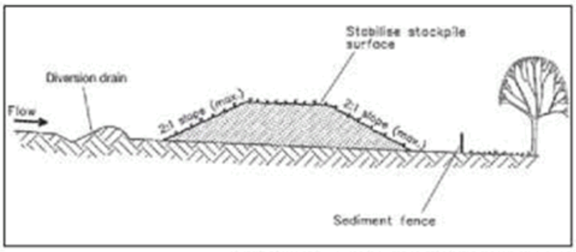

Figure 9B: *Keep building materials in protected stockpiles.*

Maintaining the control measures:

Service trenches: if they fill with water, pump water evenly over a stabilised vegetated area that will filter out the suspended clays. If this is not possible, add a small amount of gypsum to the water and allow the suspended clays to settle before pumping the water out.

Stockpiles: should be covered and checked regularly. Sediment and erosion controls (diversion drains and sediment fences) associated with stockpiles also need to be monitored and maintained.

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Date of Issue: December 2008

Early Roof Drainage Connection

What is it?

Connect the downpipes to the stormwater system as soon as the roof is on the building frame. This control measure prevents 'clean' rainwater running through the disturbed or active work area.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 10

WHAT DO I NEED TO DO?

Before starting site works:

Aim to have the roof and downpipes in place as soon as possible.

Document this on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure all on-ground staff are aware of its importance.

Installing the control measures:

Connect the permanent downpipe or temporary ones such as flexible tubing. If pipes to the road can not be installed, pipe the water to a turfed area, or infiltration trench, where it can soak into the ground.

Maintaining the control measures:

Check that the pipes are still connected whenever rain is forecast.

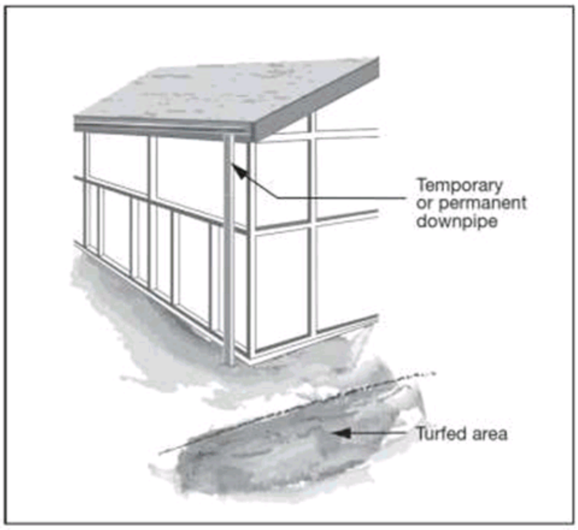
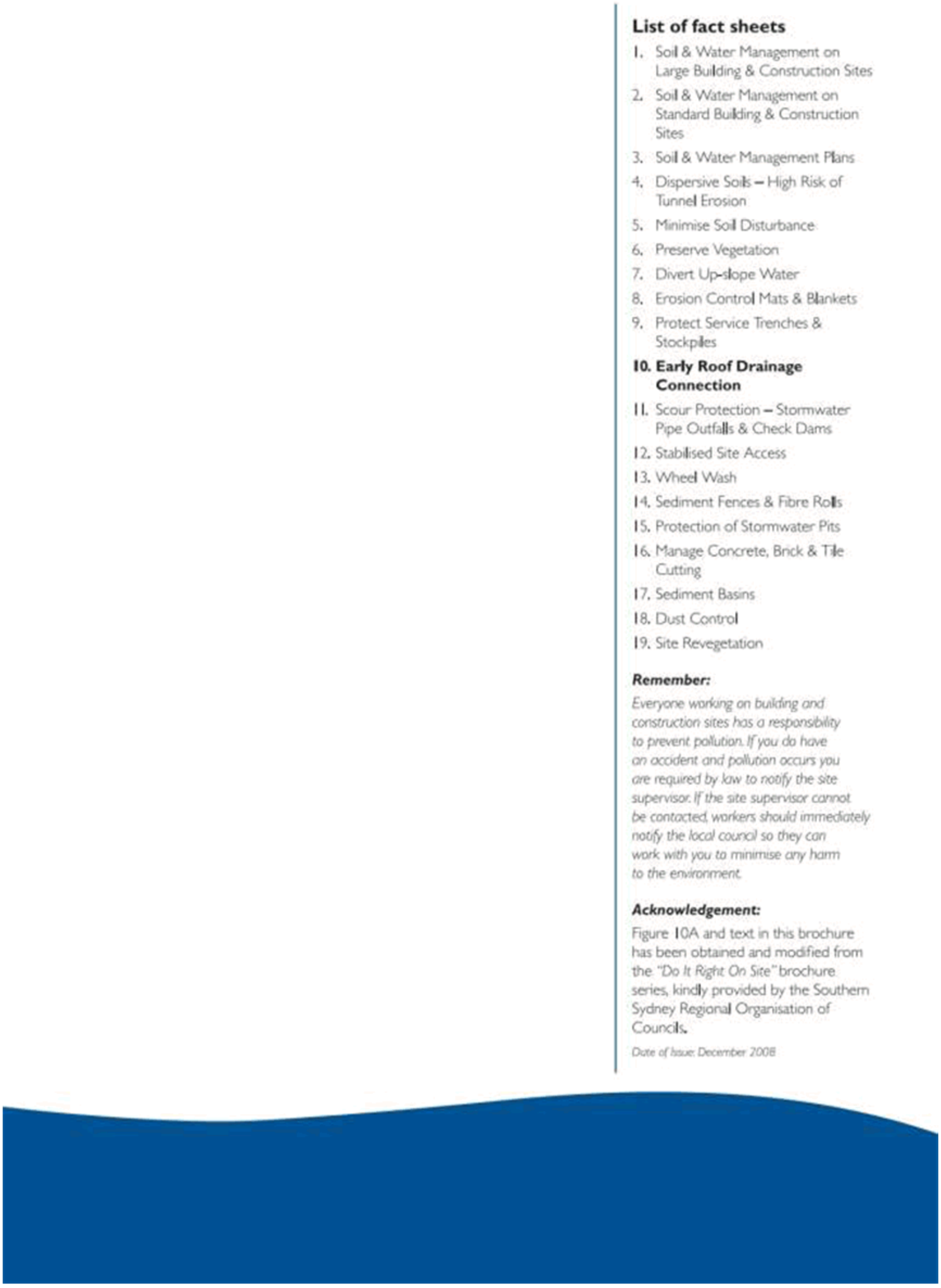


Figure 10A: Early installation of roof drainage



List of fact sheets

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5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. **Early Roof Drainage Connection**
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
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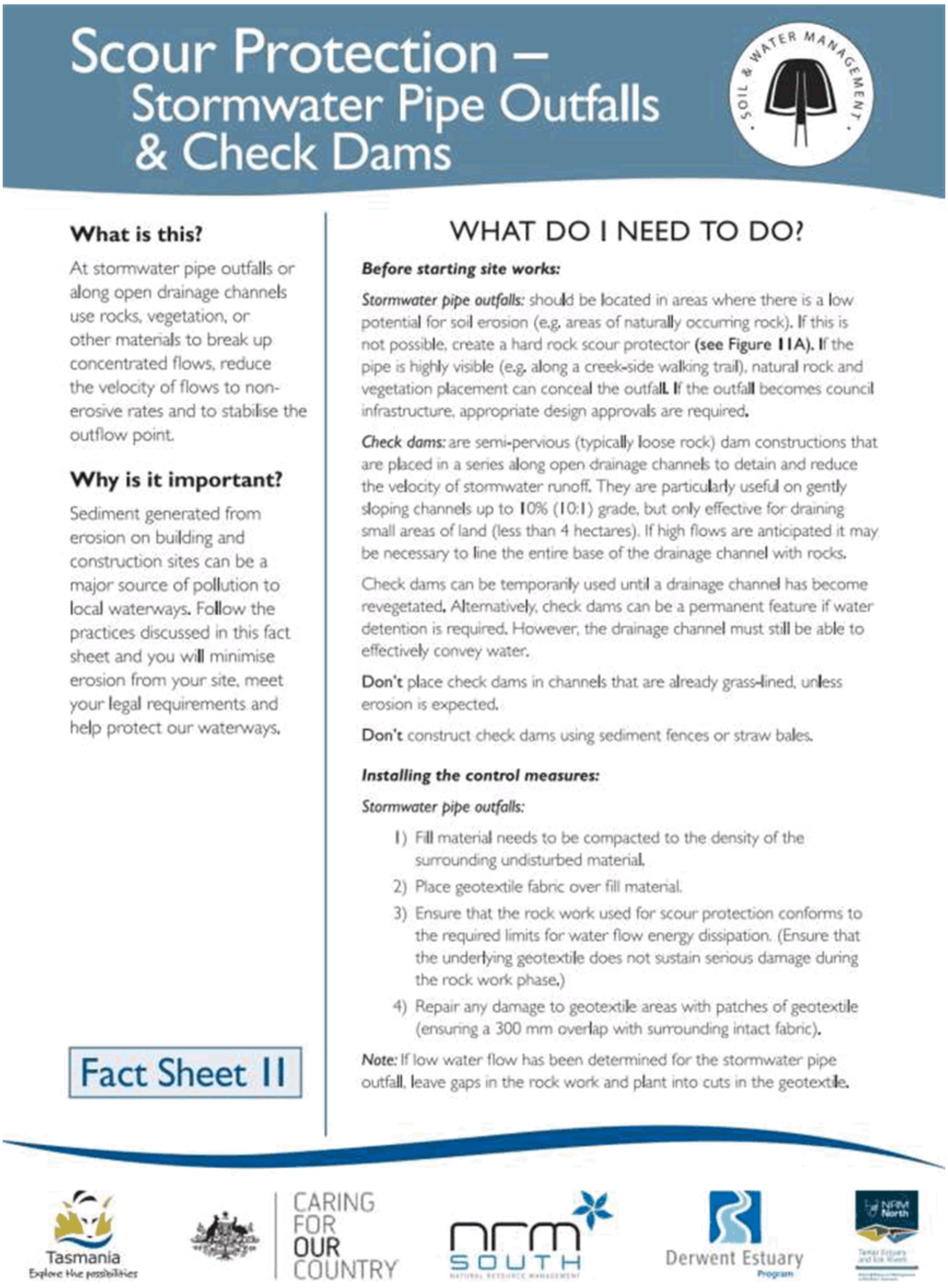
Date of Issue: December 2008



Scour Protection – Stormwater Pipe Outfalls & Check Dams

What is this?

At stormwater pipe outfalls or along open drainage channels use rocks, vegetation, or other materials to break up concentrated flows, reduce the velocity of flows to non-erosive rates and to stabilise the outflow point.

Why is it important?

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Fact Sheet 11

WHAT DO I NEED TO DO?

Before starting site works:

Stormwater pipe outfalls: should be located in areas where there is a low potential for soil erosion (e.g. areas of naturally occurring rock). If this is not possible, create a hard rock scour protector **(see Figure 11A).** If the pipe is highly visible (e.g. along a creek-side walking trail), natural rock and vegetation placement can conceal the outfall. If the outfall becomes council infrastructure, appropriate design approvals are required.

Check dams: are semi-pervious (typically loose rock) dam constructions that are placed in a series along open drainage channels to detain and reduce the velocity of stormwater runoff. They are particularly useful on gently sloping channels up to 10% (10:1) grade, but only effective for draining small areas of land (less than 4 hectares). If high flows are anticipated it may be necessary to line the entire base of the drainage channel with rocks.

Check dams can be temporarily used until a drainage channel has become revegetated. Alternatively, check dams can be a permanent feature if water detention is required. However, the drainage channel must still be able to effectively convey water.

Don't place check dams in channels that are already grass-lined, unless erosion is expected.

Don't construct check dams using sediment fences or straw bales.

Installing the control measures:

Stormwater pipe outfalls:

1) Fill material needs to be compacted to the density of the surrounding undisturbed material.
2) Place geotextile fabric over fill material.
3) Ensure that the rock work used for scour protection conforms to the required limits for water flow energy dissipation. (Ensure that the underlying geotextile does not sustain serious damage during the rock work phase.)
4) Repair any damage to geotextile areas with patches of geotextile (ensuring a 300 mm overlap with surrounding intact fabric).

Note: If low water flow has been determined for the stormwater pipe outfall, leave gaps in the rock work and plant into cuts in the geotextile.

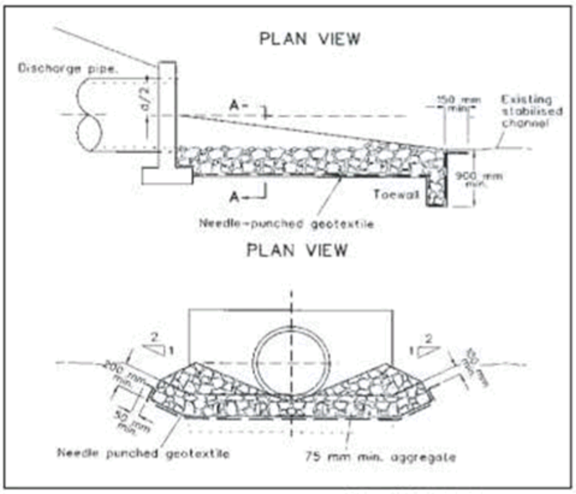

Figure 11A: Hard rock scour protector.

Check dams: these are appropriate for small channels with low flows that are susceptible to erosion (for larger channels or higher flows, specialist design may be required). A number of check dams will probably need to be built.

1) Excavate a shallow (200 mm) trench perpendicular to the drainage channel.
2) Construct the dam from aggregate (washed sand/gravel), placed in sandbags (for easy deconstruction). Place bags within the trench and build up the dam wall.
3) Ensure that the height of the dam spillway is less than 1 metre above the base of the drainage channel.
4) Ensure the dam height and spillway height does not dramatically impede water conveyance.
5) Space individual check dams so the toe of the upstream dam is level with the spillway of the next downstream dam. Otherwise extend downstream toe to provide erosion protection.
6) Check dams require regular maintenance as accumulated sediment needs to be removed, to prevent it becoming resuspended during subsequent storms.

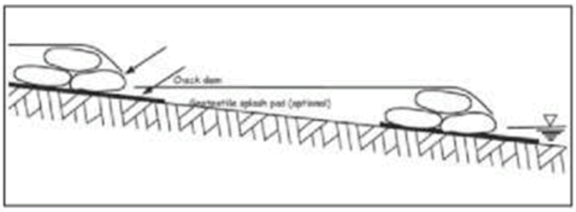

Figure 11B: Example of a check dam.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
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5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
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Acknowledgement:

Figure 11A from Landcom 2004 *"Soils and Construction Volume I Managing Urban Stormwater (4th edition)"*. Figure 11B from South East Queensland Healthy Waterways partnership 2006 *"Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

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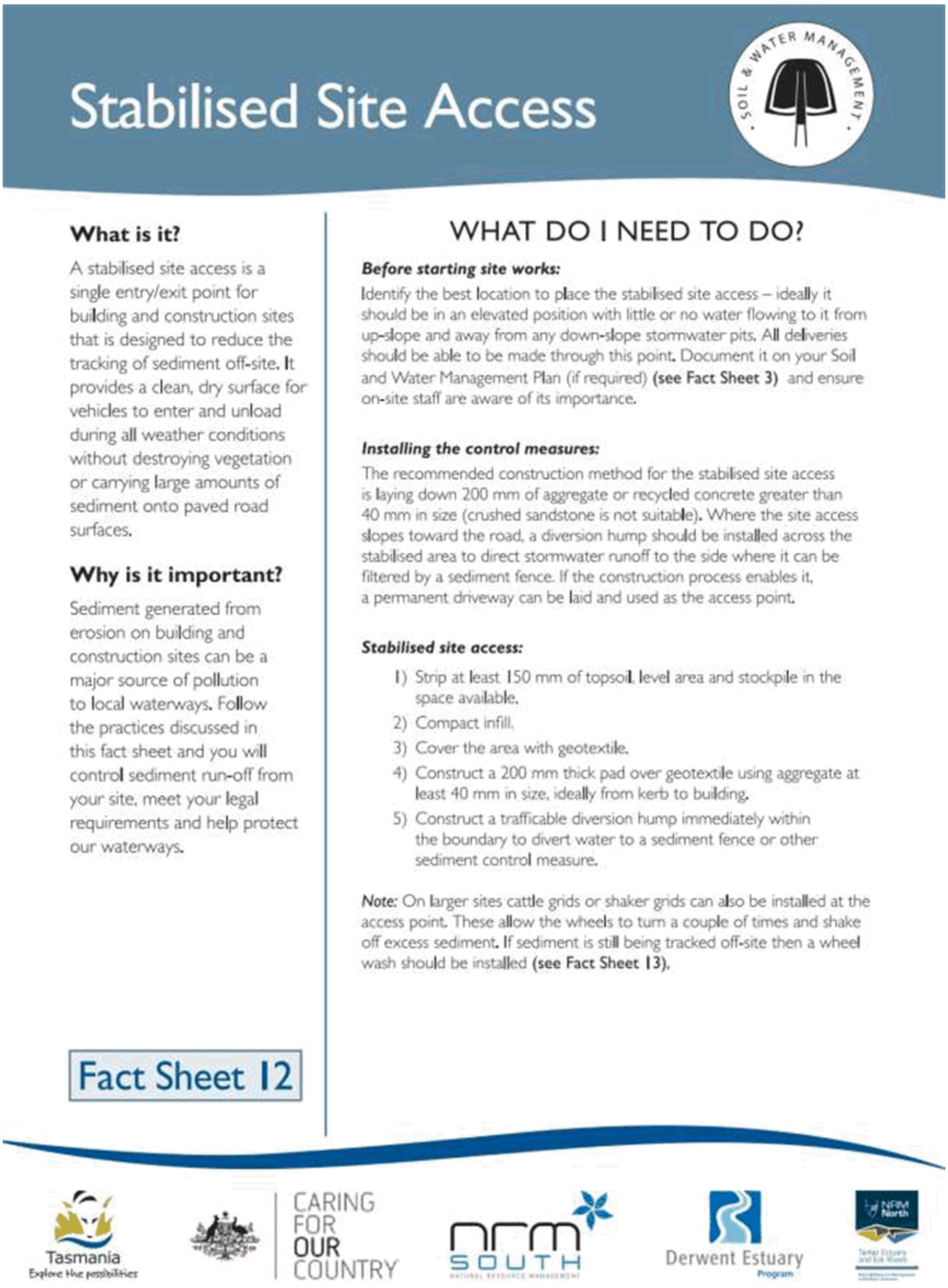


Stabilised Site Access

What is it?

A stabilised site access is a single entry/exit point for building and construction sites that is designed to reduce the tracking of sediment off-site. It provides a clean, dry surface for vehicles to enter and unload during all weather conditions without destroying vegetation or carrying large amounts of sediment onto paved road surfaces.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

WHAT DO I NEED TO DO?

Before starting site works:

Identify the best location to place the stabilised site access – ideally it should be in an elevated position with little or no water flowing to it from up-slope and away from any down-slope stormwater pits. All deliveries should be able to be made through this point. Document it on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure on-site staff are aware of its importance.

Installing the control measures:

The recommended construction method for the stabilised site access is laying down 200 mm of aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable). Where the site access slopes toward the road, a diversion hump should be installed across the stabilised area to direct stormwater runoff to the side where it can be filtered by a sediment fence. If the construction process enables it, a permanent driveway can be laid and used as the access point.

Stabilised site access:

1) Strip at least 150 mm of topsoil, level area and stockpile in the space available.
2) Compact infill.
3) Cover the area with geotextile.
4) Construct a 200 mm thick pad over geotextile using aggregate at least 40 mm in size, ideally from kerb to building.
5) Construct a trafficable diversion hump immediately within the boundary to divert water to a sediment fence or other sediment control measure.

Note: On larger sites cattle grids or shaker grids can also be installed at the access point. These allow the wheels to turn a couple of times and shake off excess sediment. If sediment is still being tracked off-site then a wheel wash should be installed **(see Fact Sheet 13).**

Fact Sheet 12

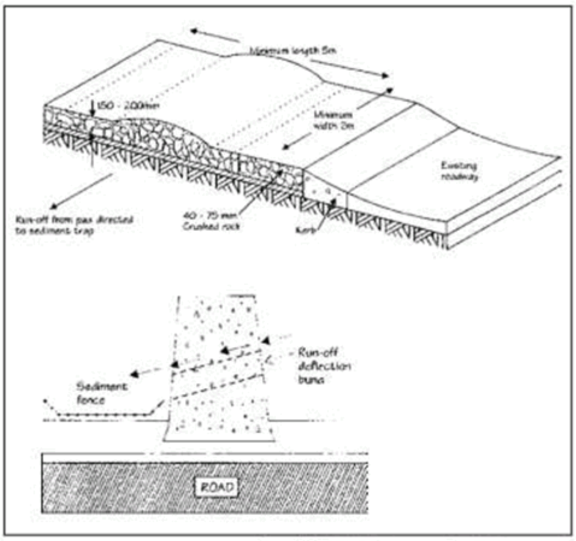


Figure 12A: *Stabilised site access for building sites only.*

Maintaining the control measures:

As vehicles use the stabilised site access they will slowly compact the gravel or rock. When it becomes too compacted the voids between the rock and gravel disappear and the stabilised site access will no longer trap mud and dirt.

Monitor the surface of the stabilised site access and ensure that it drains to the sediment fence or other sediment control measures. Add new gravel or rock as needed. Roads should be inspected for any sediment that has escaped the site at the end of each day and swept up if necessary. This should also be done whenever rain looks likely.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. **Stabilised Site Access**
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

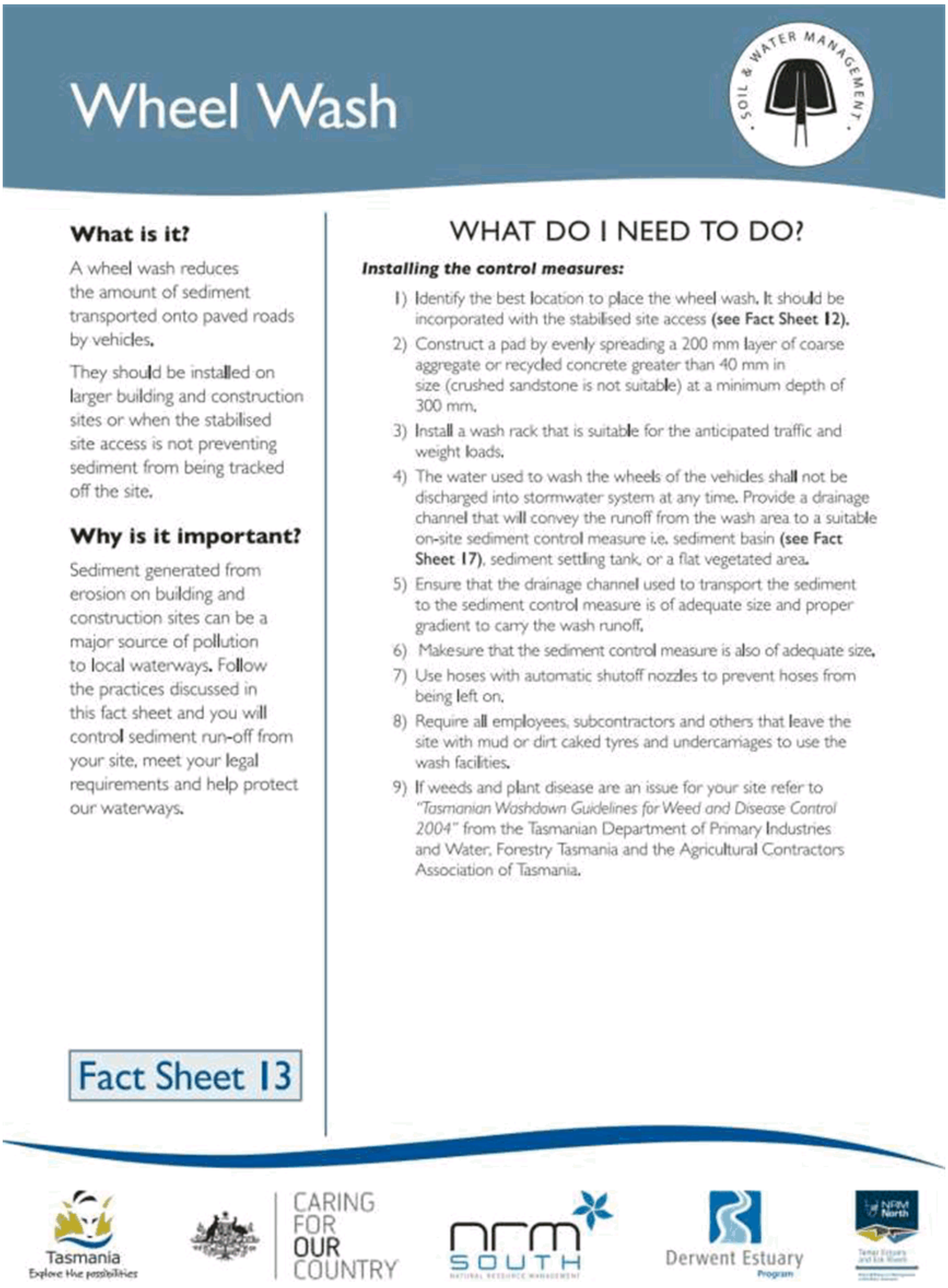
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 12A and text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Wheel Wash

SOIL & WATER MANAGEMENT

What is it?

A wheel wash reduces the amount of sediment transported onto paved roads by vehicles.

They should be installed on larger building and construction sites or when the stabilised site access is not preventing sediment from being tracked off the site.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 13

WHAT DO I NEED TO DO?

Installing the control measures:

1) Identify the best location to place the wheel wash. It should be incorporated with the stabilised site access **(see Fact Sheet 12).**
2) Construct a pad by evenly spreading a 200 mm layer of coarse aggregate or recycled concrete greater than 40 mm in size (crushed sandstone is not suitable) at a minimum depth of 300 mm.
3) Install a wash rack that is suitable for the anticipated traffic and weight loads.
4) The water used to wash the wheels of the vehicles shall not be discharged into stormwater system at any time. Provide a drainage channel that will convey the runoff from the wash area to a suitable on-site sediment control measure i.e. sediment basin **(see Fact Sheet 17)**, sediment settling tank, or a flat vegetated area.
5) Ensure that the drainage channel used to transport the sediment to the sediment control measure is of adequate size and proper gradient to carry the wash runoff.
6) Makesure that the sediment control measure is also of adequate size.
7) Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
8) Require all employees, subcontractors and others that leave the site with mud or dirt caked tyres and undercarriages to use the wash facilities.
9) If weeds and plant disease are an issue for your site refer to *"Tasmanian Washdown Guidelines for Weed and Disease Control 2004"* from the Tasmanian Department of Primary Industries and Water, Forestry Tasmania and the Agricultural Contractors Association of Tasmania.

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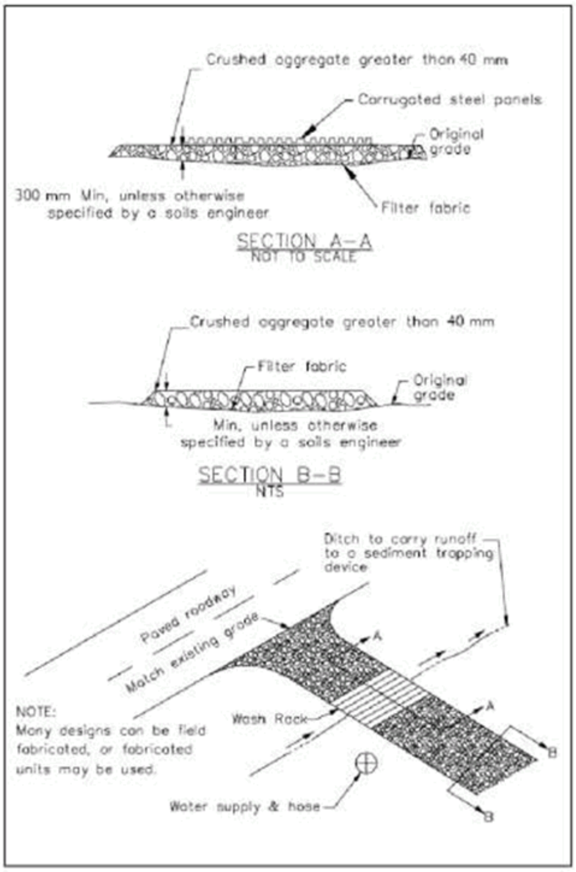

Figure 13 A: Wheel wash design.

Maintaining the control measures:

The wheel wash should be inspected weekly and after a major rainfall event. Remove accumulated sediment from the wash rack to maintain system performance. This sediment should be collected and may need to be disposed to landfill.

List of fact sheets

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Acknowledgement:

Figure 13A after California Stormwater Quality Association 2003 *"California Stormwater BMP Handbook Construction".*

Date of Issue: December 2008

Sediment Fences & Fibre Rolls

What are these?

Sediment fences and fibre rolls are sediment control measures installed across slopes or along the parameter of building and construction sites. Fibre rolls are a range of organic products (coconut fibre, straw, flax) that are rolled into large diameter logs. Sediment fences are vertical barriers made from woven geotextile that are held in place by star pickets and a backfilled trench.

Why is it important?

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Fact Sheet 14

WHAT DO I NEED TO DO?

Fibre Rolls: are log-like products commonly consisting of biodegradable fibres. They vary from biodegradable rolled coir (coconut fibre) and hessian socks filled with straw or mulch, to non-biodegradable geotextile tubes filled with mulch or straw. Biodegradable fibre rolls can be left permanently onsite to assist stabilisation and will support vegetative growth if left in place.

Sediment fences: are a commonly used sediment control measure constructed from heavy-duty geotextile. Although a sediment fence looks like shade cloth it is very different (shade cloth is not appropriate because it cannot slow water flow enough to adequately pond water up-slope of the fence and allow sediment to settle under gravity).

Before starting site works:

Identify drainage flow pathways that will intercept runoff from the site. Decide whether to use fibre rolls or sediment fences. Use fibre rolls at the base of an embankment, on slopes that are exposed, or on vegetated slopes where vegetation is failing to control erosion. Sediment fences should be used on small drainage areas and placed down-slope of potential areas of erosion. Document these measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3).**

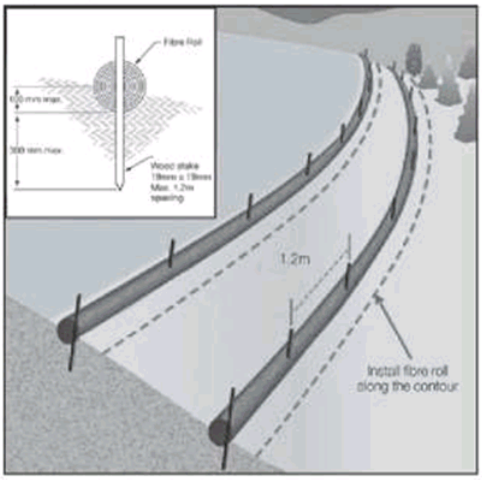

Figure 14A: *Installation of fibre rolls*

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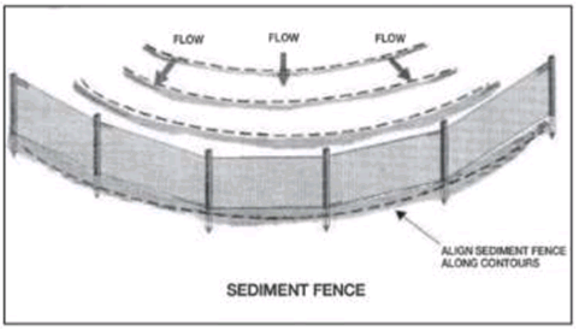
Installing the control measures:

Sediment control measures need to be in place prior to the start of site works. They can be altered after ground disturbance activities and if the site's drainage patterns change.

Installing fibre rolls:

1) Find a suitable installation site (if on a slope, place parallel to contours).
2) Remove large rocks and debris, and prepare a shallow concave trench (50–100 mm deep) to inset the fibre roll. (**Note:** Place excavated material on the upside of the fibre roll to prevent undercutting.)
3) Place the fibre roll in a shallow trench and stake through the fibre roll every 30 cm.
4) Place further stakes on both sides of the fibre roll to within 2 m from the end of the roll.



Installing sediment fences:

1) Survey and mark out location of sediment fence, ensure it is parallel to the contours of the site.
2) Dig a 150 mm trench immediately above the proposed fence line.
3) Place the bottom of the fabric to the base of the trench and run fabric up the down-slope side of the trench.
4) Backfill the trench and compact to secure anchorage of the fabric.
5) Drive 1.5 m star pickets into ground, 2 m apart to support the sediment fence fabric. Tension and fasten fabric to pickets using UV stabilised zip ties or wire ties.
6) Join sections of fabric at a support post with a 2 m overlap.
7) Angle the ends of the sediment fence upslope to reduce scouring.

Don't place sediment fences across creeks or major drainage lines.

Maintaining the control measures:

Fibre rolls and sediment fences should be checked regularly, especially after every rain event and cleaned or repaired. For sediment fences check that all the pickets and the bottom of the fence are secure and that there are no tears in the fabric.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. **Sediment Fences & Fibre Rolls**
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

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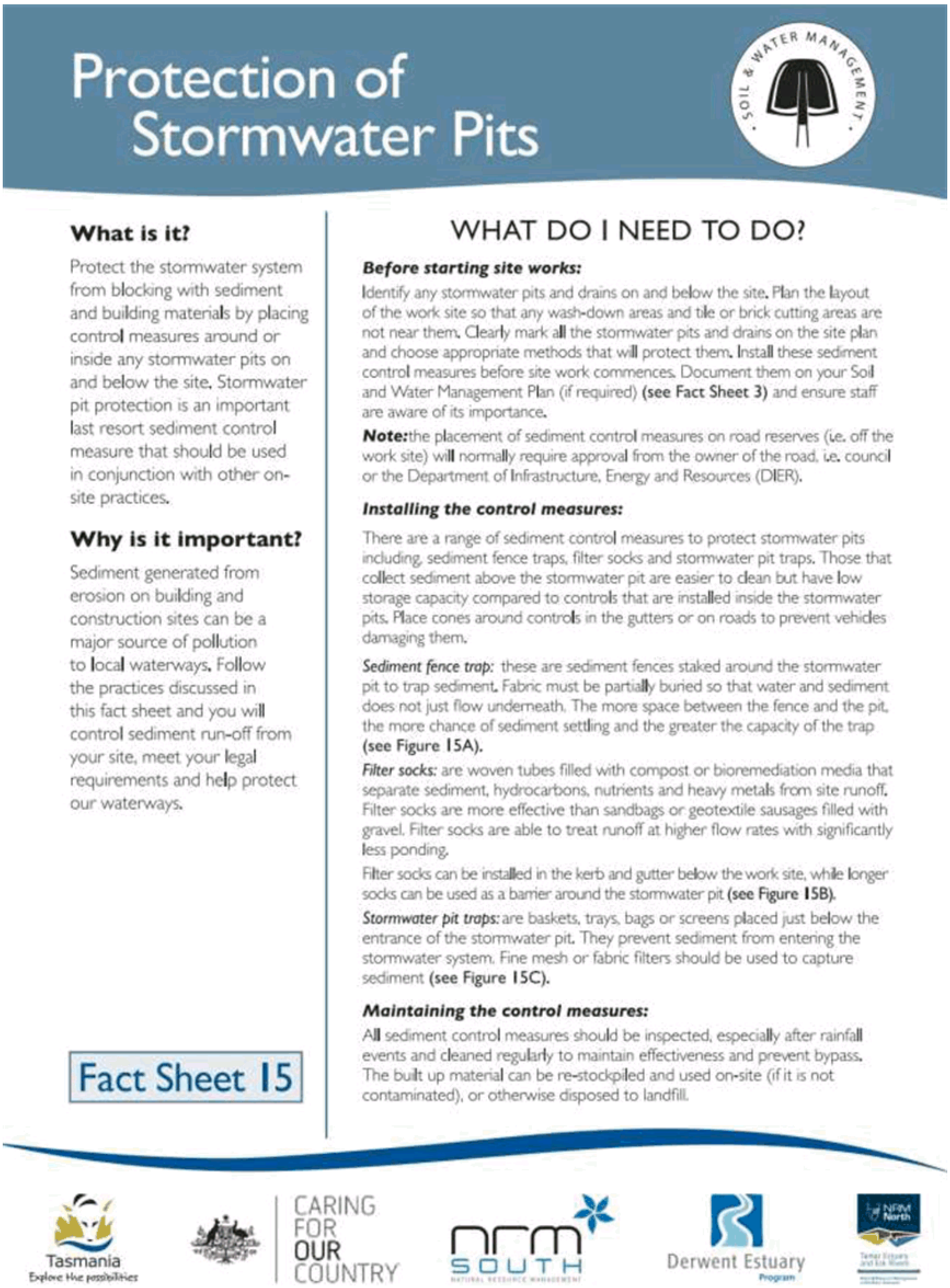
Acknowledgement:

Figures 14A and 14B after California Regional Water Quality Control Board 1999 *"Erosion & Sediment Control Field Manual"*.

Date of Issue: December 2008



Protection of Stormwater Pits

SOIL & WATER MANAGEMENT

What is it?

Protect the stormwater system from blocking with sediment and building materials by placing control measures around or inside any stormwater pits on and below the site. Stormwater pit protection is an important last resort sediment control measure that should be used in conjunction with other on-site practices.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 15

WHAT DO I NEED TO DO?

Before starting site works:

Identify any stormwater pits and drains on and below the site. Plan the layout of the work site so that any wash-down areas and tile or brick cutting areas are not near them. Clearly mark all the stormwater pits and drains on the site plan and choose appropriate methods that will protect them. Install these sediment control measures before site work commences. Document them on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure staff are aware of its importance.

Note: the placement of sediment control measures on road reserves (i.e. off the work site) will normally require approval from the owner of the road, i.e. council or the Department of Infrastructure, Energy and Resources (DIER).

Installing the control measures:

There are a range of sediment control measures to protect stormwater pits including, sediment fence traps, filter socks and stormwater pit traps. Those that collect sediment above the stormwater pit are easier to clean but have low storage capacity compared to controls that are installed inside the stormwater pits. Place cones around controls in the gutters or on roads to prevent vehicles damaging them.

Sediment fence trap: these are sediment fences staked around the stormwater pit to trap sediment. Fabric must be partially buried so that water and sediment does not just flow underneath. The more space between the fence and the pit, the more chance of sediment settling and the greater the capacity of the trap **(see Figure 15A).**

Filter socks: are woven tubes filled with compost or bioremediation media that separate sediment, hydrocarbons, nutrients and heavy metals from site runoff. Filter socks are more effective than sandbags or geotextile sausages filled with gravel. Filter socks are able to treat runoff at higher flow rates with significantly less ponding.

Filter socks can be installed in the kerb and gutter below the work site, while longer socks can be used as a barrier around the stormwater pit **(see Figure 15B).**

Stormwater pit traps: are baskets, trays, bags or screens placed just below the entrance of the stormwater pit. They prevent sediment from entering the stormwater system. Fine mesh or fabric filters should be used to capture sediment **(see Figure 15C).**

Maintaining the control measures:

All sediment control measures should be inspected, especially after rainfall events and cleaned regularly to maintain effectiveness and prevent bypass. The built up material can be re-stockpiled and used on-site (if it is not contaminated), or otherwise disposed to landfill.

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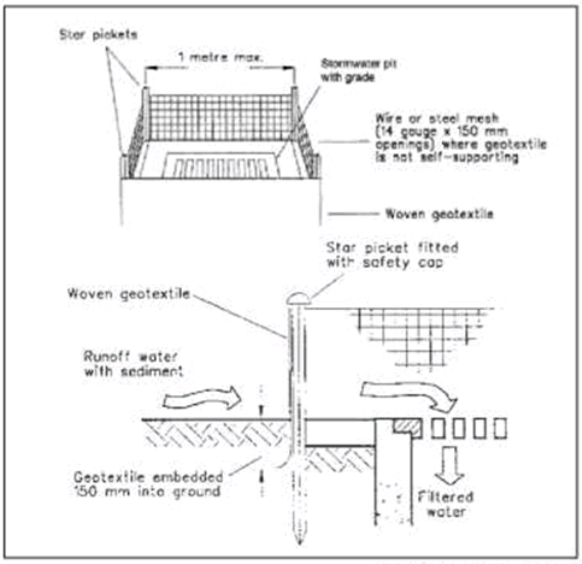

Figure 15A: A sediment fence trap.

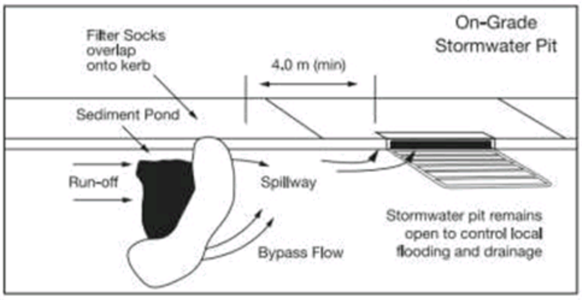

Figure 15B: A filter sock.

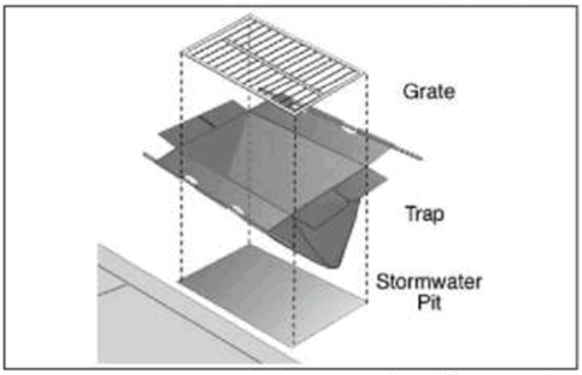

Figure 15C: Stormwater pit trap.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. **Protection of Stormwater Pits**
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. Dust Control
19. Site Revegetation

Remember:

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Acknowledgement:

Figure 15A from Landcom 2004 "*Soils & Construction Volume I Managing Urban Stormwater (4th edition)*". Figure 15B after South East Queensland Healthy Waterways Partnership 2006 "*Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites*". Figure 15C after California Regional Water Quality Board 1999 "*Erosion & Sediment Control Field Manual*". Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008

Protected Concrete, Brick & Tile Cutting

What is this?

Concreting, bricklaying, brick and tile cutting must be conducted in such a way that ensures no waste products enter the stormwater system. If washed into the stormwater system, brick and tile cutting, concrete and mortar slurries will harden and block stormwater pipes and potentially cause flooding. Cement also raises the pH of waterways making it alkaline which is deadly to aquatic animals.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 16

WHAT DO I NEED TO DO?

Before starting site works:

Find a location on the site away from stormwater pits and drains to undertake these activities, including mixing cement and mortar. This area should be large enough to contain all excess water, residues and waste.

Designate where associated building materials should be stockpiled, as this typically determines where this activity will occur. If the nature of the job requires cutting in a location close to stormwater pits or drains such as cutting a footpath then controls need to be put in place to ensure that no material enters the stormwater system. Identify site requirements and list them on the Soil and Water Management Plan (if required) **(see Fact Sheet 3)** before starting site works.

Installing the control measures:

The designated brick or tile cutting area should have a diversion channel up-slope and sediment collection devices such as a sediment fence below it. If cutting in an area near a stormwater pit, use temporary collection devices such as filter socks, bunding or skirts suitably installed to direct the slurry onto a land area where it can soak into the earth. If this is not possible and the slurry is likely to flow to the stormwater system, filtering will be required. There are filtration systems available that work in the brick cutting machine with built in slurry containment systems, while for the kerb and gutter there are filter socks and for stormwater pits insert traps can be used **(see Fact Sheet 15)**. The filtered water must not be cloudy when discharged to the stormwater system. Install a series of filtration systems for best results.

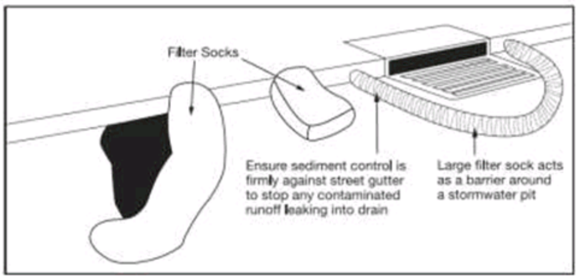

Figure 16A: Installing a series of filtration systems.

When equipment is washed down, use a designated wash-down area on-site e.g. wheel wash **(see Fact Sheet 13)**. Waste concrete slurry can be safely disposed of by tipping small amounts into plastic or geotextile-lined ditches **(see Figure 16C)**. This will enable the water to evaporate or soak in to the earth and the solids can then be disposed to landfill or reused as clean fill in construction or as road base.

Maintaining the control measures:

All sediment control measures will require regular cleaning to maintain effectiveness and over time may need to be replaced. Remove the built up sediment and check for holes, other breaks, clogging and blockages in the control measures.

Shovel or vacuum concrete, brick or tile cutting slurry to an area well away from the stormwater system. **Do not** hose down. If there is no designated disposal area, place slurry into a 40 gallon drum that is half full of water. Solid materials will settle to the bottom of the drum for later disposal and the water can be reused when concreting.

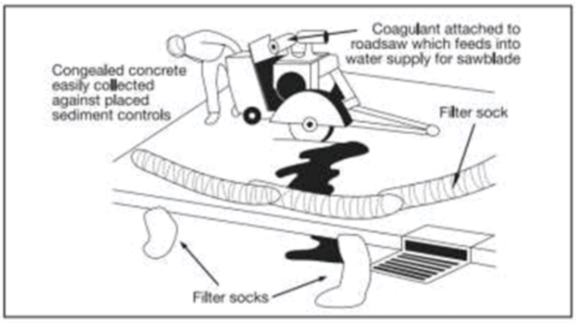

***Figure 16B:** Acceptable concrete slurry disposal method*

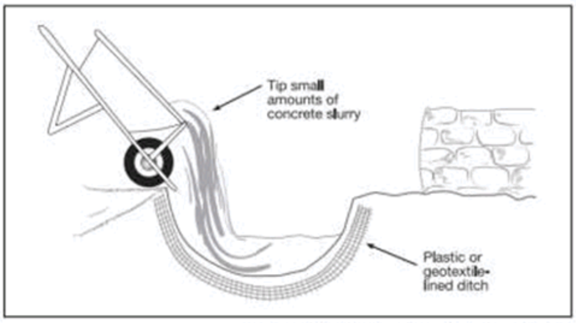

***Figure 16C:** Disposing concrete slurry into a lined ditch*

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. **Manage Concrete, Brick & Tile Cutting**
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18. Dust Control
19. Site Revegetation

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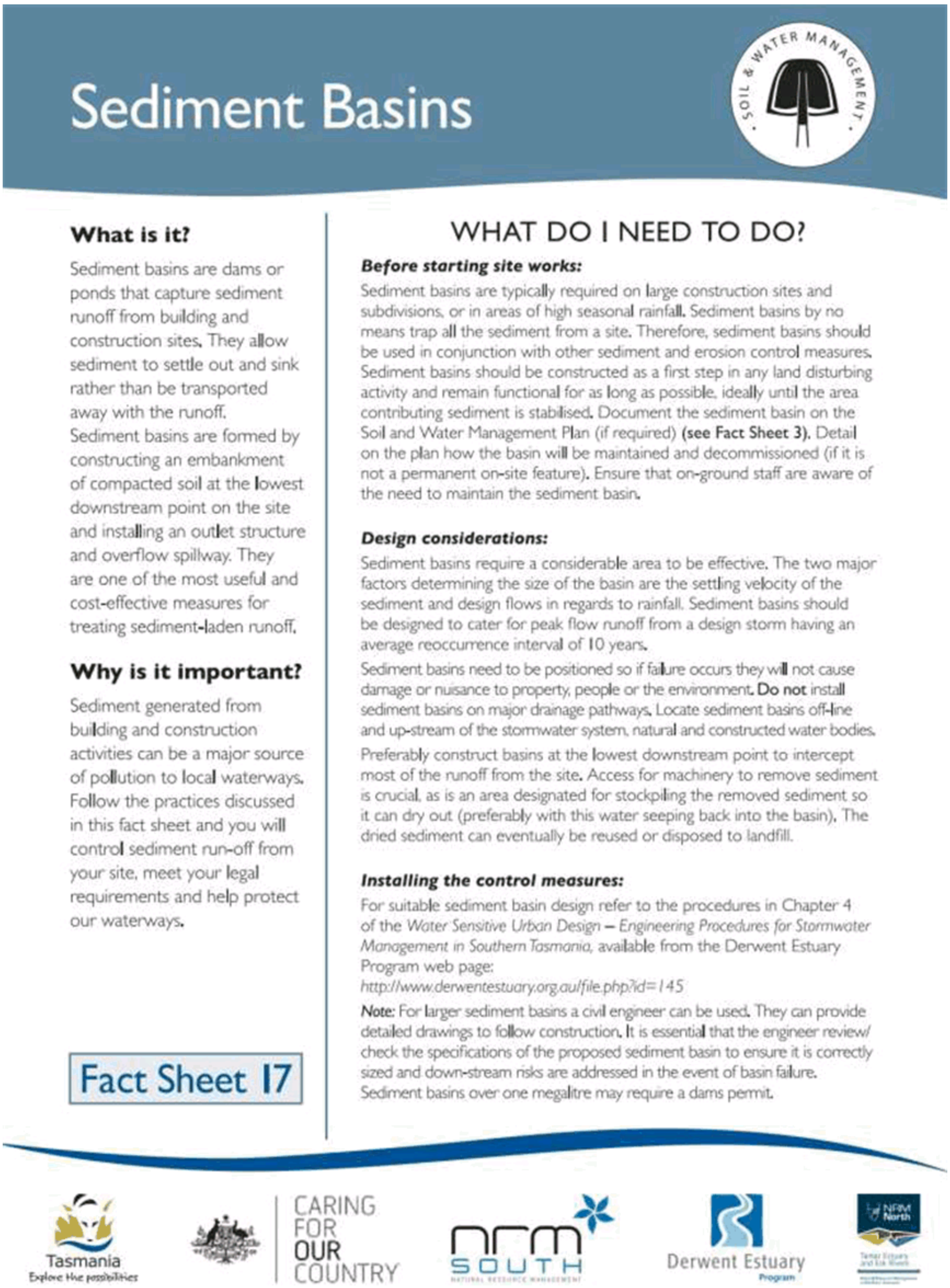
Acknowledgement:

Figures 16A, 16B and 16C after NSW Department of Conservation 2004 *"Environmental Best Management Practice Guideline for Concrete Contractors"*. Text in this brochure has been obtained and modified from the "Do It Right On Site" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Sediment Basins

What is it?

Sediment basins are dams or ponds that capture sediment runoff from building and construction sites. They allow sediment to settle out and sink rather than be transported away with the runoff. Sediment basins are formed by constructing an embankment of compacted soil at the lowest downstream point on the site and installing an outlet structure and overflow spillway. They are one of the most useful and cost-effective measures for treating sediment-laden runoff.

Why is it important?

Sediment generated from building and construction activities can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will control sediment run-off from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 17

WHAT DO I NEED TO DO?

Before starting site works:

Sediment basins are typically required on large construction sites and subdivisions, or in areas of high seasonal rainfall. Sediment basins by no means trap all the sediment from a site. Therefore, sediment basins should be used in conjunction with other sediment and erosion control measures. Sediment basins should be constructed as a first step in any land disturbing activity and remain functional for as long as possible, ideally until the area contributing sediment is stabilised. Document the sediment basin on the Soil and Water Management Plan (if required) **(see Fact Sheet 3).** Detail on the plan how the basin will be maintained and decommissioned (if it is not a permanent on-site feature). Ensure that on-ground staff are aware of the need to maintain the sediment basin.

Design considerations:

Sediment basins require a considerable area to be effective. The two major factors determining the size of the basin are the settling velocity of the sediment and design flows in regards to rainfall. Sediment basins should be designed to cater for peak flow runoff from a design storm having an average reoccurrence interval of 10 years.

Sediment basins need to be positioned so if failure occurs they will not cause damage or nuisance to property, people or the environment. **Do not** install sediment basins on major drainage pathways. Locate sediment basins off-line and up-stream of the stormwater system, natural and constructed water bodies.

Preferably construct basins at the lowest downstream point to intercept most of the runoff from the site. Access for machinery to remove sediment is crucial, as is an area designated for stockpiling the removed sediment so it can dry out (preferably with this water seeping back into the basin). The dried sediment can eventually be reused or disposed to landfill.

Installing the control measures:

For suitable sediment basin design refer to the procedures in Chapter 4 of the *Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania,* available from the Derwent Estuary Program web page:
http://www.derwentestuary.org.au/file.php?id=145

Note: For larger sediment basins a civil engineer can be used. They can provide detailed drawings to follow construction. It is essential that the engineer review/check the specifications of the proposed sediment basin to ensure it is correctly sized and down-stream risks are addressed in the event of basin failure. Sediment basins over one megalitre may require a dams permit.

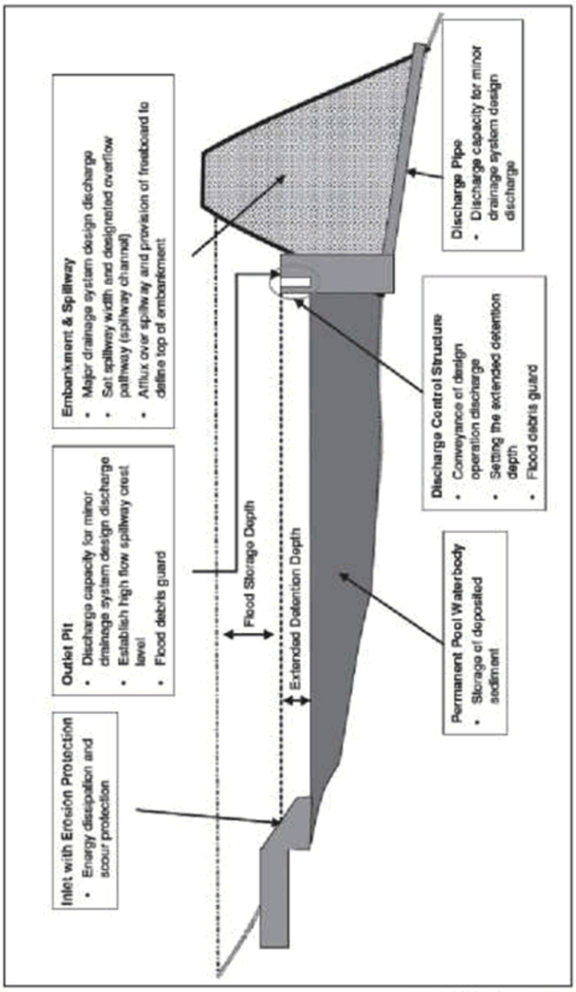


Figure 17A: Sediment basin.

Maintaining the control measures:

Sediment basins require regular inspection, especially after rain events and should be cleaned when more than half full of sediment. Litter and debris should be removed whenever observed in the sediment basin. If the water within the basin is cloudy and never clears, apply gypsum to allow the sediment to settle out.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
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18. Dust Control
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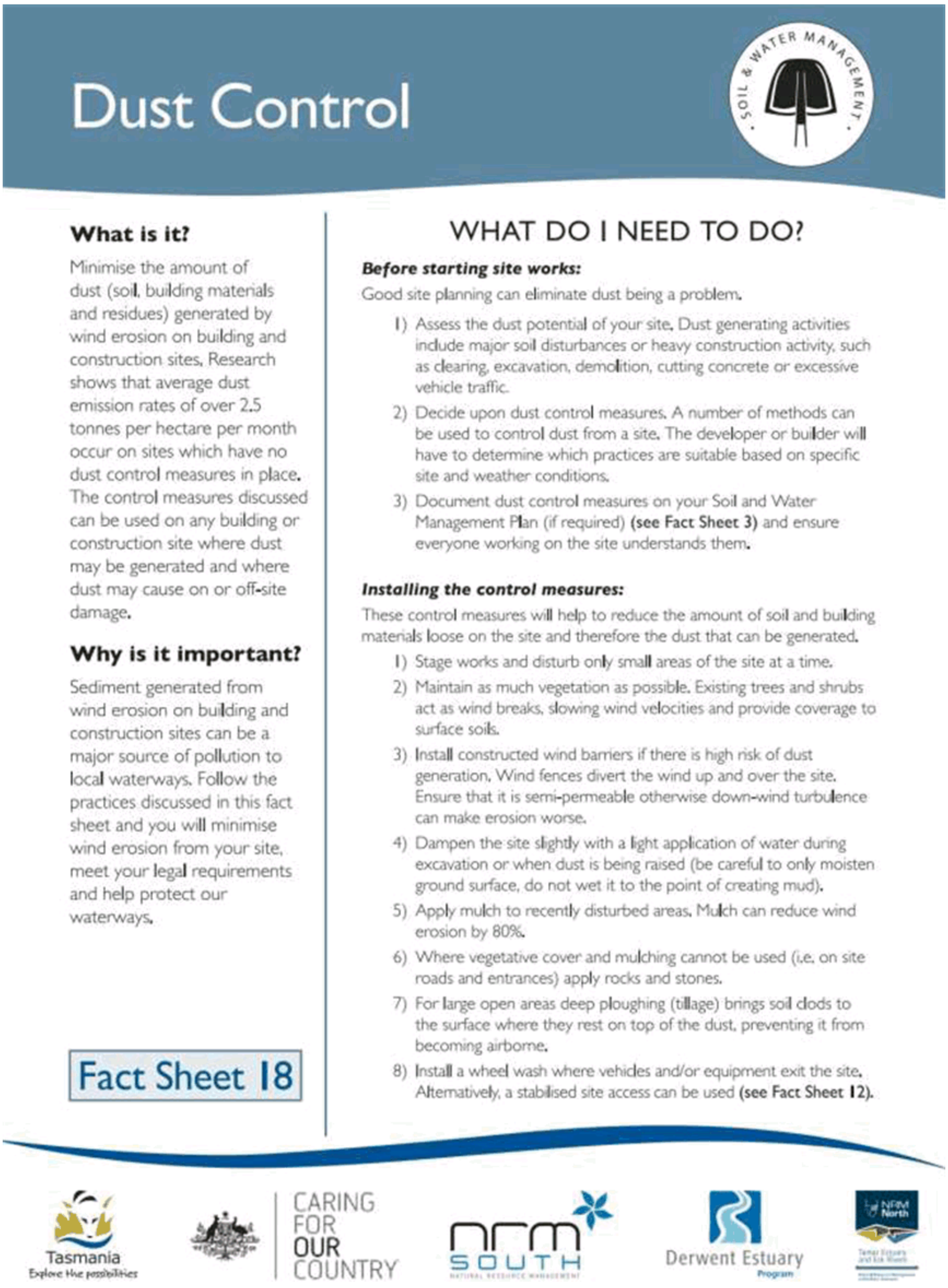
Acknowledgement:

Figure 17A from Derwent Estuary Program 2006 *"Water Sensitive Urban Design – Engineering Procedures for Stormwater Management in Southern Tasmania".*

Date of Issue: December 2008



Dust Control

What is it?

Minimise the amount of dust (soil, building materials and residues) generated by wind erosion on building and construction sites. Research shows that average dust emission rates of over 2.5 tonnes per hectare per month occur on sites which have no dust control measures in place. The control measures discussed can be used on any building or construction site where dust may be generated and where dust may cause on or off-site damage.

Why is it important?

Sediment generated from wind erosion on building and construction sites can be a major source of pollution to local waterways. Follow the practices discussed in this fact sheet and you will minimise wind erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 18

WHAT DO I NEED TO DO?

Before starting site works:

Good site planning can eliminate dust being a problem.

1) Assess the dust potential of your site. Dust generating activities include major soil disturbances or heavy construction activity, such as clearing, excavation, demolition, cutting concrete or excessive vehicle traffic.
2) Decide upon dust control measures. A number of methods can be used to control dust from a site. The developer or builder will have to determine which practices are suitable based on specific site and weather conditions.
3) Document dust control measures on your Soil and Water Management Plan (if required) **(see Fact Sheet 3)** and ensure everyone working on the site understands them.

Installing the control measures:

These control measures will help to reduce the amount of soil and building materials loose on the site and therefore the dust that can be generated.

1) Stage works and disturb only small areas of the site at a time.
2) Maintain as much vegetation as possible. Existing trees and shrubs act as wind breaks, slowing wind velocities and provide coverage to surface soils.
3) Install constructed wind barriers if there is high risk of dust generation. Wind fences divert the wind up and over the site. Ensure that it is semi-permeable otherwise down-wind turbulence can make erosion worse.
4) Dampen the site slightly with a light application of water during excavation or when dust is being raised (be careful to only moisten ground surface, do not wet it to the point of creating mud).
5) Apply mulch to recently disturbed areas. Mulch can reduce wind erosion by 80%.
6) Where vegetative cover and mulching cannot be used (i.e. on site roads and entrances) apply rocks and stones.
7) For large open areas deep ploughing (tillage) brings soil clods to the surface where they rest on top of the dust, preventing it from becoming airborne.
8) Install a wheel wash where vehicles and/or equipment exit the site. Alternatively, a stabilised site access can be used **(see Fact Sheet 12)**.

9) Cover sand and soil stockpiles with fabric, plastic or vegetation.
10) Ensure that relevant equipment and machinery have dust suppressors fitted.

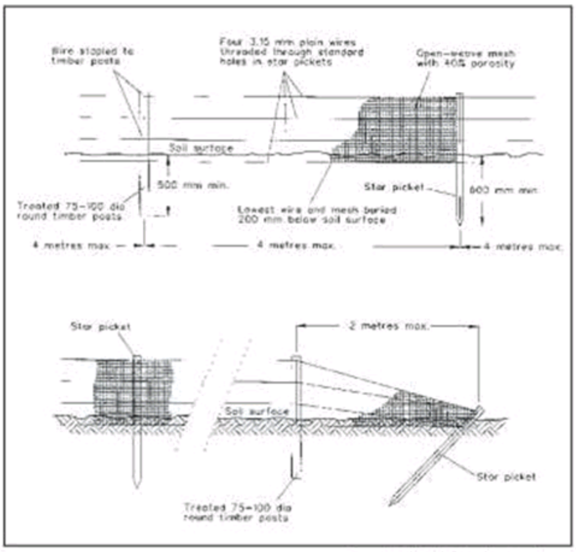


Figure 18A: Installation of a wind fence.

Maintaining the control measures:

Dust control measures involving the application of water require more monitoring than structural or vegetative controls to remain effective. If structural controls are used, they should be inspected for deterioration on a regular basis to ensure that they are still achieving their intended purpose.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
5. Minimise Soil Disturbance
6. Preserve Vegetation
7. Divert Up-slope Water
8. Erosion Control Mats & Blankets
9. Protect Service Trenches & Stockpiles
10. Early Roof Drainage Connection
11. Scour Protection – Stormwater Pipe Outfalls & Check Dams
12. Stabilised Site Access
13. Wheel Wash
14. Sediment Fences & Fibre Rolls
15. Protection of Stormwater Pits
16. Manage Concrete, Brick & Tile Cutting
17. Sediment Basins
18. **Dust Control**
19. Site Revegetation

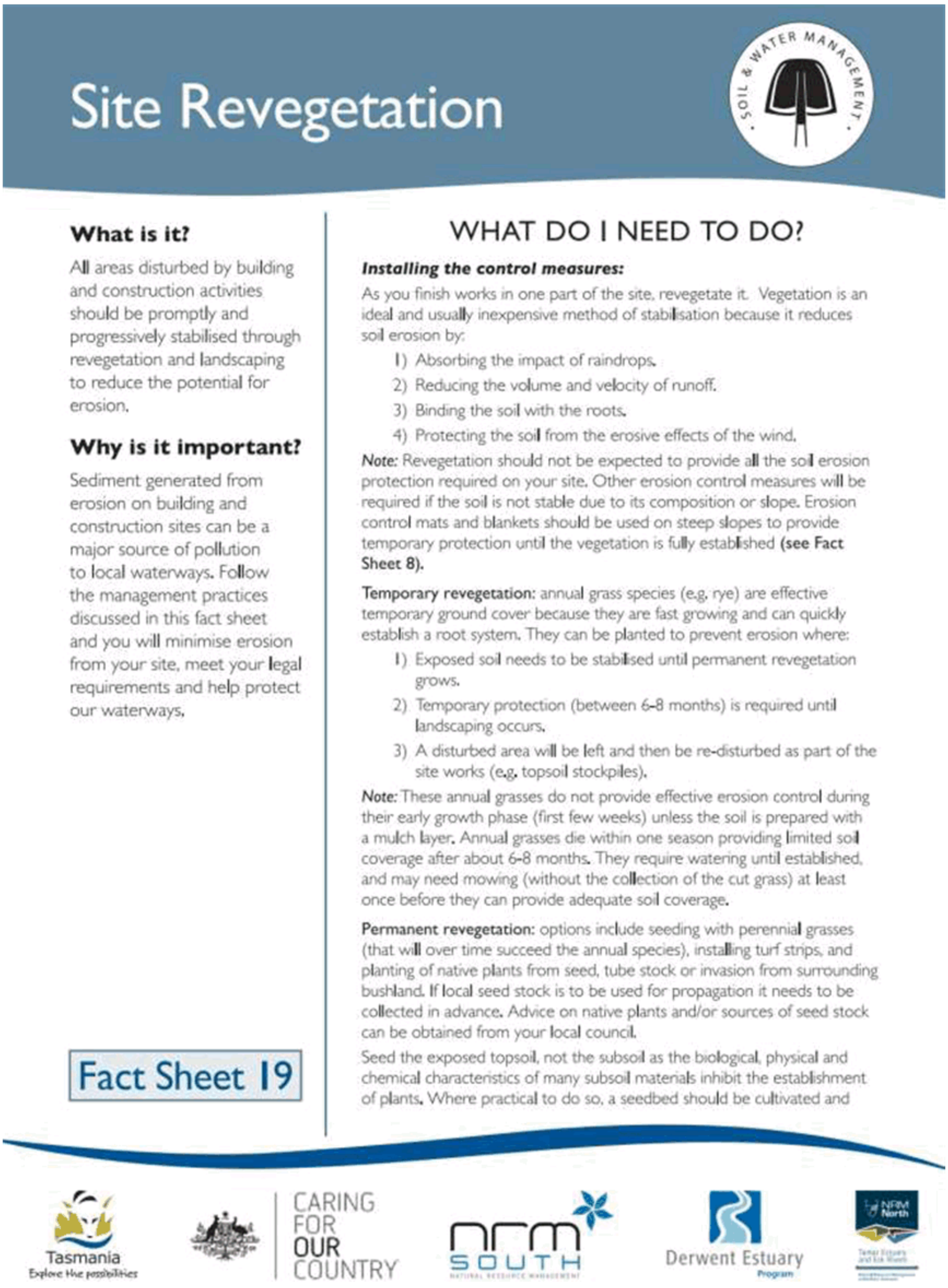
Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 18A from Landcom 2004 "*Soils & Construction Volume 1 Managing Urban Stormwater (4th edition)*". Text in this brochure has been obtained and modified from the "*Do It Right On Site*" brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of Issue: December 2008



Site Revegetation

SOIL & WATER MANAGEMENT

What is it?

All areas disturbed by building and construction activities should be promptly and progressively stabilised through revegetation and landscaping to reduce the potential for erosion.

Why is it important?

Sediment generated from erosion on building and construction sites can be a major source of pollution to local waterways. Follow the management practices discussed in this fact sheet and you will minimise erosion from your site, meet your legal requirements and help protect our waterways.

Fact Sheet 19

WHAT DO I NEED TO DO?

Installing the control measures:

As you finish works in one part of the site, revegetate it. Vegetation is an ideal and usually inexpensive method of stabilisation because it reduces soil erosion by:

1) Absorbing the impact of raindrops.
2) Reducing the volume and velocity of runoff.
3) Binding the soil with the roots.
4) Protecting the soil from the erosive effects of the wind.

Note: Revegetation should not be expected to provide all the soil erosion protection required on your site. Other erosion control measures will be required if the soil is not stable due to its composition or slope. Erosion control mats and blankets should be used on steep slopes to provide temporary protection until the vegetation is fully established **(see Fact Sheet 8).**

Temporary revegetation: annual grass species (e.g. rye) are effective temporary ground cover because they are fast growing and can quickly establish a root system. They can be planted to prevent erosion where:

1) Exposed soil needs to be stabilised until permanent revegetation grows.
2) Temporary protection (between 6-8 months) is required until landscaping occurs.
3) A disturbed area will be left and then be re-disturbed as part of the site works (e.g. topsoil stockpiles).

Note: These annual grasses do not provide effective erosion control during their early growth phase (first few weeks) unless the soil is prepared with a mulch layer. Annual grasses die within one season providing limited soil coverage after about 6-8 months. They require watering until established, and may need mowing (without the collection of the cut grass) at least once before they can provide adequate soil coverage.

Permanent revegetation: options include seeding with perennial grasses (that will over time succeed the annual species), installing turf strips, and planting of native plants from seed, tube stock or invasion from surrounding bushland. If local seed stock is to be used for propagation it needs to be collected in advance. Advice on native plants and/or sources of seed stock can be obtained from your local council.

Seed the exposed topsoil, not the subsoil as the biological, physical and chemical characteristics of many subsoil materials inhibit the establishment of plants. Where practical to do so, a seedbed should be cultivated and

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moistened before sowing seed **(see Figure 19A).** This may require deep ripping to 300 mm where there is a compacted layer.

Include native species endemic to the region to enhance the ecological values and create an aesthetically pleasing environment. Native species have evolved to local environment and can establish themselves more quickly and vigorously than exotic species.

Some revegetation options may require mulching. Planting trees and shrubs tends to be more successful if combined with weed suppressing mulching and installation of tree guards and stakes. Apply mulch at a depth between 75-100 mm.

Note: Seeding, turf strips and native plants require sufficient irrigation for germination and to sustain plant growth if rainfall is poor. If the plants are slow growing other erosion control measures may be required until the vegetation is established and is able to prevent erosion.

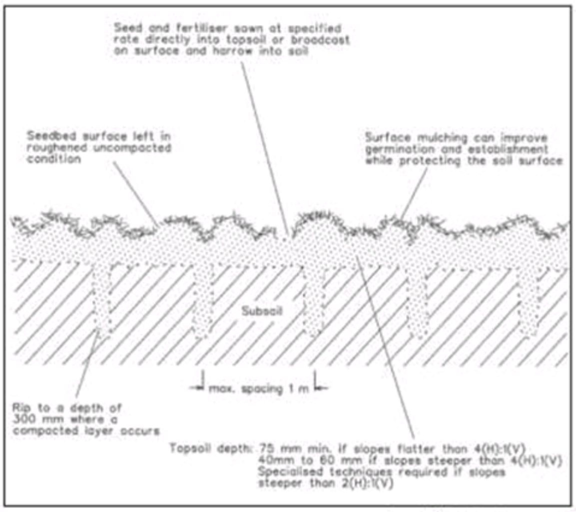

Figure 19A: *Seedbed preparation.*

Maintaining the control measures:

A monitoring and maintenance program for site revegetation should be developed and implemented. It needs to include irrigation, mowing, weeding and appropriate remedial action such as replacing any lost topsoil and re-sowing the site. Once the site has been revegetated and is established to the satisfaction of the council it can be handed over to the new homeowner.

List of fact sheets

1. Soil & Water Management on Large Building & Construction Sites
2. Soil & Water Management on Standard Building & Construction Sites
3. Soil & Water Management Plans
4. Dispersive Soils – High Risk of Tunnel Erosion
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Remember:

Everyone working on building and construction sites has a responsibility to prevent pollution. If you do have an accident and pollution occurs you are required by law to notify the site supervisor. If the site supervisor cannot be contacted, workers should immediately notify the local council so they can work with you to minimise any harm to the environment.

Acknowledgement:

Figure 19A from Landcom 2004 *"Soils & Construction Volume I Managing Urban Stormwater (4th edition)"*. Text in this brochure has been obtained and modified from the *"Do It Right On Site"* brochure series, kindly provided by the Southern Sydney Regional Organisation of Councils.

Date of issue: December 2008

SOIL TRACKING FORM

Appendix 5 Soil Tracking From

62-64 Patrick Street, Hobart, Tasmania

Date excavated	Soil origin (grid block)	Stockpile ID	Stockpile location (grid block)	Soil description (colour, texture, moisture, odour, staining)	Samples collected	Laboratory analysis (list lab tests)	Final soil classification Fill, Level 1, Level 2, Level 3, Level 4	Final destination	Notes	Logged by

Appendix 6 Site Induction Form

62-64 Patrick Street, Hobart, Tasmania

I ………………………………………………….. of ………………………………………..….. have been inducted to 62-64 Patrick Street, Hobart, Tasmania and have been informed of the CMP and its contents on …………………………………..(date)

I have been informed of the contents of the CMP and the responsibilities I have in ensuring that the CMP is adhered to relating to the following issues:

- Understanding the site contamination status
- Understanding the potential health impacts for site workers associated with site contamination
- Understanding the potential environmental impacts associated with site contamination
- Understanding how to reduce the risks to human health and the environment
- Maintaining documentation related to upholding the CMP

SOIL MANAGEMENT

- Excavation and stockpiling of soil at the site
- Movement of soil around the site
- Off-site disposal of soil
- Import of fill to the site
- Dust and sediment control

WATER MANAGEMENT

- Stormwater management and sediment control as outlined in the SWMP

I HEREBY ACCEPT THESE RESPONSIBILITIES.

NAME: ……………………………………………COMPANY:……………..………….…..

SIGNED ……………………………..…………DATE …………………….……

INDUCTED BY: …………………………………DATE …………………………

GES

GEO-ENVIRONMENTAL SOLUTIONS

62-64 Patrick Street, Hobart

DRAFT ENVIRONMENTAL SITE ASSESSMENT

62-64 Patrick Street, Hobart

July 2019

Report for Heffernan Button Voss (HBV) Architects

Geo-Environmental Solutions P/L 29 Kirksway Place, Battery Point, 7004. Ph 6223 1839 E: Office@geosolutions.net.au

DOCUMENT CONTROL

Title	**Version**	**Date**	**Author**	**Reviewed By**
Draft Environmental Site Assessment. *62-64 Patrick Street, Hobart.*	Version 1	18 July 2019	Sarah Joyce	-

EXECUTIVE SUMMARY

This report presents the findings from Environmental Site Assessment (ESA) undertaken by Geo-Environmental Solutions Pty. Ltd. (GES) at 62-64 Patrick Street, Hobart hereby referred to as 'The Site'. GES was engaged by Heffernan Button Voss (HBV) Architects P/L on behalf of their client to conduct this investigation for a potential site redevelopment into a multilevel apartment building. This report has been prepared by a suitably qualified and experience practitioner in accordance with procedures and practices detailed in NEPM ASC (2013) guidelines and key regulations and policies

The objectives of the ESA was to assess the likelihood of contamination at the site; address the Potentially Contaminated Land Code; E2.5 P1 (change of use) and E2.6.2 P1 (excavation) performance criteria under the Interim Planning scheme and determine:

- Whether the site is suitable for the proposed use
- Whether any site contamination presents an occupational health and safety risk to workers involved in redevelopment of the site or future site users (Human Health)
- Whether any site contamination is likely to present an environmental risk from excavation conducted during development at the site (Environment), and
- Whether any specific remediation and/or protection measures are required to be implemented before use or excavation commences to mitigate risks
- Provide preliminary classification for soil management and disposal.
- Provide a statement of suitability for future use.

The following conclusions were made from the desktop assessment following a review of the historical aerial photographs, WorkSafe Tasmanian Dangerous Goods records, EPA Tasmania, and previous site investigations plus consultation with the Hobart City Council has confirmed the following:

- The site is zoned *Commercial land use* under the Tasmanian Interim Planning Scheme (2015).
- The site is underlain by a mix of quaternary aged sediments alluvium, tertiary boulder deposits and underlying Triassic sandstone and silt stone.
- The site is approximately 24 m above sea level and situated in a shallow dipping area which is prone to receiving flood waters during high rainfall events. The entire site is sealed with either asphalt or concrete in the workshop. All surface waters will be diverted into stormwater drains. Groundwater is inferred to be directed towards the southeast with the same aspect as the surface topography, towards the River Derwent which is 1 km away
- The Hobart City Council confirmed that the site is listed as a potentially contaminated site; as it hosted the activity of an iron /steel works – White Houses Foundry – 1822-1831.
- The site hosted fuel storage in two underground fuel tanks which were removed in 2008, supervised by SEMF and reported in the *Environmental Site Assessment (Including Tank Decommissioning) Report* produced by SEMF Jan 2009 which concluded *'based on soil contamination, the site is considered suitable for continued commercial use and redevelopment'*.
- The Hobart City Council also confirmed, as noted in the historical aerial photographs that 195-205 Murray Street is a potentially contaminated site as it formally hosted a BP Service Station, from 1964 to around the mid 1990's, the exact year of change of use is unknown. It is situated 80m northwest of the site and now hosts Tasmanian Bakeries retail outlet, office spaces and a warehouse.
- The site at 215-217 Harrington Street, has been identified as a potentially contaminated site but no contamination from Harrington Street was confirmed onsite in the ESA (SEMF, 2009) or the current investigation.
- The following contaminants of potential concern (COPC) associated with underground fuel storage, dispensing infrastructure, workshop and vehicle servicing activities plus iron and steel works have been identified on site:
  - Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
  - Mono Aromatic hydrocarbons: Benzene, Toluene, Ethylbenzene, Xylene (BTEX);
  - Polycyclic Aromatic Hydrocarbons (PAH) including Benzo(a)pyrene (B(a)p) and
  - Suite of 15 Heavy Metals

The following conclusions have been made from the soil and groundwater investigation:

<u>Environment</u>

There were elevated levels of Benzo(a)pyrene in BH04, BH05 and BH08 which exceeded ecological screening levels. There were elevated levels of zinc in BH02, BH04, BH05 and BH07. This means that despite the absence of close sensitive ecological receptors a Contamination Management Plan (CMP) will be required during the site redevelopment to manage the potential leaching of contaminates into the groundwater.

Human Health

- There were no guideline exceedances for soil direct contact for dermal contact, dust inhalation or soil ingestion for commercial/industrial land use, urban residential or trench workers. Combined with the fact that post site redevelopment the site will be completely sealed and there will be no opportunity to come in contact with soil there is no direct contact risk to future construction works or site users.
- In the soil samples and the one groundwater sample tested it was confirmed that there were no volatile hydrocarbons or LNAPL detected. Therefore, no vapour risk to construction workers, trenchworks or future site uses has been identified.
- Although the site has a proposed multilevel residential development there are three levels between the ground surface and Level 1 'First Floor Apartments'. 'Basement Plan – Lower', 'Basement Plan – Upper' and 'Ground floor Plan' - street level would act as a substantial vapour barrier if vapours had been detected.

Excavated Soil Management:

The soil samples were compared against IB105 guidelines for soil disposal. The following heavy metals were detected at levels which classified the material as Level 2 Material; Barium, Beryllium, lead and zinc. The sum of PAH's was Level 2 as a result from the present of the B(a)p. Due to the concentrations B(a)p was classified as Level 3. Post leachate analysis the presence of B(a)p, the material could be reclassified as Level 2 Material. As half of the samples could have been classified as Level 1 Material – Clean fill; when future excavations take place at the site, all material should be stockpiled, samples collected by an environmental consultant and results compared against IB105 for appropriate soil disposal.

Groundwater Observation: Groundwater appears to be under pressure at the site because although it was encountered at 0.3m below the surface in RA4 it was not encountered in any of the soil bores or geotechnical bores (to be reported separately in GES, 2019); which end at 2.0, 8.4 or 9.5m bgs. Sloane 2009 installed slotted pipe to capture groundwater in RA4 between 14-17m bgs. It is likely that this is where groundwater is sitting.

GES considers that substantial data regarding the site contamination has been acquired during desktop investigation and the invasive site assessment and recommends the following to manage the soil on site during construction:

- A Contamination Management Plan (CMP) will be required to manage soil/ water run off during construction to ensure contaminated soil or surface water does not enter the open drain/ waterway, to the east of the site.
- As some metals exceeded Level 1 Material classification; it is recommended that all excavated soil removed during the site redevelopment is stockpiled, sampled by a suitably qualified and experienced environmental consultant and results compared against *IB105* guideline limits for disposal purposes.
- If deemed necessary, it is to be transported to a Level 2 waste facility (Copping). A permit to transport the waste (obtained through the EPA) will be required.
- If the site use changes to a more sensitive land use and or building designs change then the results will need to be compared against the applicable land use guidelines and / or further onsite soil, groundwater or soil vapour investigations may be required.

Statement of Suitability

The findings from the invasive soil and limited groundwater investigation can confirm that contamination at the site will not present a risk to Human Health. Low level contamination may pose a risk to the Environment (ecological receptors).

Therefore, providing the above recommendations are followed in relation to the environment, GES can confirm that the planned excavation works and proposed future site use will not adversely impact on human health or the environment.

No additional contamination remediation or management measures will be required during the site redevelopment works.

Table of Contents

Plates

Figures

Tables

ABREVIATIONS

AEC	Areas of Environmental Concern
AHD	Australian Height Datum
ALS	Analytical Laboratory Services
ANZECC	Australia and New Zealand Environment and Conservation Council
BGS	Below Ground Surface
BH	Borehole
BTEX	Benzene Toluene Ethylbenzene Xylene
CMP	Contamination Management Plan
COA	Certificate of Analysis
COC	Chain of Custody
COPC	Contaminant of Potential Concern
CRC CARE	Corporative Research Centre for Contamination Assessment and Remediation of the Environment
CSM	Conceptual Site Model
DQO	Data Quality Objectives
EOH	End Of Hole
EIL	Ecological Investigation Levels
ESL	Ecological Screening Levels
EPA	Environmental Protection Authority
ESA	Environmental Site Assessment
GDA94	Geocentric Datum of Australia 1994
GES	Geo-Environmental Solutions Pty. Ltd.
HIL	Health Investigation Levels
HSL	Health Screening Levels
IL	Investigation Levels
LiDAR	Light Detection And Ranging
LOR	Limits of Reporting
MCRWBA	Minimum Construction Requirements for Water Bores in Australia
MDL	Mean Detection Limit
NATA	National Association of Testing Authorities
NEPM ASC	National Environmental Protection (Assessment of Site Contamination) Measure
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NL	Non Limiting
NRMMC	Natural Resource Management Ministerial Council
PAH	Polynuclear Aromatic Hydrocarbons
PCP	Physico-Chemical Parameters
PEV	Protected Environmental Values
PHC	Petroleum Hydrocarbons
PID	Photo-Ionisation Detector
PPA	Preferential (PVI) Pathways Assessment

PSH	Phase Separated Hydrocarbons
PVI	Petroleum Vapour Intrusion
Redox	Reduction / Oxidation Potential
SCA	Site Contamination Assessment
SCM	Site Contamination Model
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
USCS	Unified Soil Classification System
WRG	Water Resource Group

1 INTRODUCTION

1.1 General

This report presents the findings from Environmental Site Assessment (ESA) undertaken by Geo-Environmental Solutions Pty. Ltd. (GES) at 62-64 Patrick Street, Hobart hereby referred to as 'The Site'. GES was engaged by Heffernan Button Voss (HBV) Architects P/L on behalf of their client to conduct this investigation for a potential site redevelopment into a multilevel apartment building.

The Site is location on Patrick Street is shown in Figure 1, an image of current site conditions is presented in Plate 1 and the current site aerial photograph is presented in Figure 2.

This report has been prepared by a suitably qualified and experience practitioner in accordance with procedures and practices detailed in NEPM ASC (2013) guidelines and key regulations and policies identified in the References section of this document. Personnel engaged in preparing this ESA are listed in Appendix 1 along with their relevant qualifications and years of experience.

Figure 1 Site Location (image sourced from the LIST)

Plate 1 Street View of current site conditions (Google Earth Image) – entrance from Patrick Street

Figure 2 Current Site Layout

1.2 Investigation Objectives

The objectives of the ESA was to assess the likelihood of contamination at the site; address the Potentially Contaminated Land Code; E2.5 P1 (change of use) and E2.6.2 P1 (excavation) performance criteria under the Interim Planning scheme and determine:

- Whether the site is suitable for the proposed use
- Whether any site contamination presents an occupational health and safety risk to workers involved in redevelopment of the site or future site users (Human Health)
- Whether any site contamination is likely to present an environmental risk from excavation conducted during development at the site (Environment), and
- Whether any specific remediation and/or protection measures are required to be implemented before use or excavation commences to mitigate risks
- Provide preliminary classification for soil management and disposal.
- Provide a statement of suitability for future use.

1.3 Scope of Works

The scope of works of this ESA was to:

- Conduct a desktop assessment, review of relevant document.
- Soil investigation including; drill a total of 8 bore holes and collect 16 primary soil samples to analyse for Total Recoverable Hydrocarbons (TRH), Benzene Toluene Ethylbenzene Xylene Naphthalene (BTEXN), Polynuclear Aromatic Hydrocarbons (PAHs) plus a suite of 15 Metals. All soil samples were sent to a National Association of Testing Authorities (NATA) accredited laboratory to determine the presence/ absence of contamination and at what level;
- A single groundwater sample was collected from a well (RA4) on site installed by KMR Drilling in 2008, supervised by Sloane Geoscience for SEMF; plus a duplicate QA/QC sample.
- All samples were sent with quality assurance/quality control samples for analysis;
- All Soil analytical results against were compared against NEPM ASC (2013) guidelines as well as other relevant guidelines for assessing hydrocarbon vapour and soil dermal contact risks; and
- The groundwater sample was compared against relevant water quality guidelines, ANZECC 2000.
- Present risks in a conceptual site model (CSM) for the site and offsite if applicable to assess specific potential ecosystem and human health receptors. GES considered the following:
    - Detail specific onsite human health risk and environmental impacts which may source from any contaminated soil and groundwater;
    - Assess all risks with respect to proposed future land use which includes site demolition, soil excavation and commercial/ residential building development; and
    - Assess potential impact to surrounding offsite receptors.
- Present the findings in an ESA document.

1.4 Site Details

Site details are presented in Table 1.

Table 1 Site Details

Site Address 179-191 Murray Street, Hobart located at 62-64 Patrick Street.
Current Title identification details PID 2950042 Title Reference 175729/2
Investigation Area 2051m^2
Site Surfacing The surface of the investigation area is road base asphalt. Concrete in the warehouse.
Current land use Occupied by RACT.
Current Ownership (as per current certificates of title; the LIST) *6 Failla Avenue P/L*
Site Land Zoning and Land Use The site is *Commercial land use* under the Tasmanian Interim Planning Scheme, 2015.
Previous/ Historic Land use Hosted RACT and related business operations such as vehicle servicing and fuel storage.
Local Council Hobart City Council
Proposed Site Use Unknown
Requirement for current Investigation The site previously hosted underground fuel storage and there is a proposed change to a more sensitive land use.

2 PLANNING

2.1 Proposed Site Redevelopment Works

The Client is proposing a multilevel apartment building, see Appendix 2, which will include the following:

- Demolition of existing building (62 Patrick Street) and the workshop at the rear of the property.
- To excavate to 19 m above sea level (street level elevation is current 24.6m ASL) to construct a 7-story apartment building with two additional below ground levels for carparking.
- The building will house up to 123 car parking spaces, 68 apartments ranging from 1-4 bedrooms with terraces.
- There will be a rooftop garden and gravel roofed area.

A development application will be submitted to HCC by HBV Architects and this report will addresses the Change of Use clause E2.5 P1 and Excavation clause E2.6.2 P1 of the Potentially Contaminated Land Code of the Interim Planning Scheme.

2.2 Planning Scheme Overview

An environmental site assessment (ESA) is the principal requirement within the IPS E2.0 performance criteria. According to the IPS, the ESA report must be prepared by an suitably qualified person and define the nature, extent and levels of existing contamination and the actual or potential risk to human health or the environment, on or off the site, resulting from that contamination, prepared in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 16 May 2013.

There is a proposed change of use from commercial to high density residential, and excavation works are also preposed as part of the site redevelopment.

2.3 Change of Use (E2.5 P1)

As there is proposed change of use of the site (from commercial to residential), and there are no acceptable solutions to change of use, E2.5 P1 performance criteria are to be addressed. The performance criteria identify that for there to be a change of use, the objective is that it must be suitable for the intended use, having regard to:

(a) an environmental site assessment that demonstrates there is no evidence the land is contaminated; or
(b) an environmental site assessment that demonstrates that the level of contamination does not present a risk to human health or the environment; or
(c) a plan to manage contamination and associated risk to human health or the environment that includes:
  i. an environmental site assessment;
  ii. (any specific remediation and protection measures required to be implemented before any use commences; and
  iii. a statement that the land is suitable for the intended use.

2.4 Excavation Works E2.6.2 P1

As there is proposed excavation works at the site, there are no acceptable solutions to proposed works, E2.6.2 P1 performance criteria are to be addressed. The performance criteria identify that the excavation works must not adversely impact on health and the environment, having regard to:

(a) an environmental site assessment that demonstrates there is no evidence the land is contaminated; or
(b) a plan to manage contamination and associated risk to human health and the environment that includes:
  i. an environmental site assessment;
  ii. any specific remediation and protection measures required to be implemented before excavation commences; and

iii. a statement that the excavation does not adversely impact on human health or the environment.

2.5 Zoning

The site is zoned *Commercial land use* under the Tasmanian Interim Planning Scheme of 2015 (Figure 3) and is surrounded by *Central Business, Utilities* and *Inner Residential.*

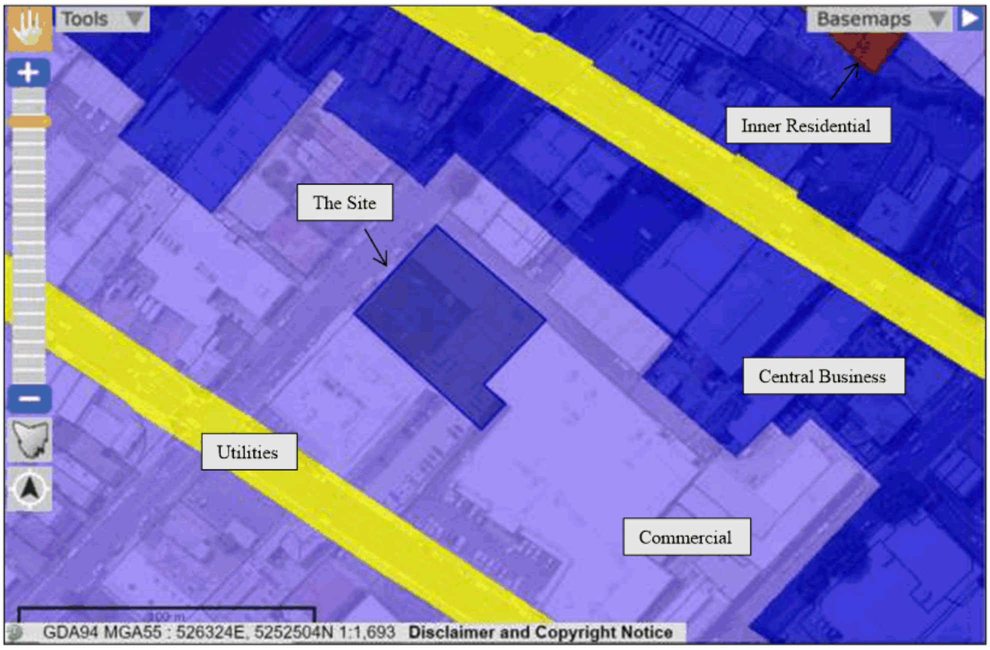


Figure 3 Council planning zones (2015) under the Tasmanian Interim Planning Scheme

3 PRELIMINARY INVESTIGATION - DESKTOP

3.1 MRT Geology Mapping

The geology of the site has been mapped by Mineral Resources Tasmania, see Figure 4. The site is inferred to be underlain by a mix of quaternary aged sediments alluvium, tertiary boulder deposits and underlying Triassic sandstone and silt stone. The surrounding geology comprises of similar Triassic and quaternary sediments.

Qa *– undifferentiated Quaternary sediments – alluvial gravel, sand and clay.* ***Tcbd*** *- Undifferentiated Paleogene - Neogene sequences Poorly sorted boulder to pebble grade deposits with boulders up to 3 m length, clasts generally dominantly of dolerite with traces to rarely dominant amounts of Upper Parmeener mudstone and other rocks and less commonly Lower Parmeener rocks.* ***Rqpc*** *- Upper Parmeener Supergroup. Upper Fluviolacustrine Sequence - Quartz Sandstone Sequence (Rq). Predominantly interbedded siltstone shale and mudstone and planar-bedded, ripple cross-laminated or cross-bedded sandstone, red-purple, green or carbonaceous siltstone at places (part of Knocklofty Formation where in Hobart area).* ***Rqph*** *- Late Carboniferous to Triassic sedimentary sequences. Knocklofty Formation*

Figure 4 Mineral Resources Tasmania 1:25000 Scale Mapping (The LIST).

3.2 Site Topography, Drainage & Hydrogeology

Based 5m contours on the LIST, the site elevation is approximately 18m above sea level (ASL) and is it situated in a shallow dipping area which is prone to receiving flood waters during high rainfall events. The entire site is sealed with either asphalt or concrete in the workshop. All surface waters will be diverted into stormwater drains. Groundwater is inferred to be directed towards the southeast with the same aspect as the surface topography, towards the River Derwent which is 1 km away, see Figure 5.

3.2.1 Potential Up-Gradient Contamination Sources

The site is situated in a Groundwater is likely to drain directly towards the site from the southwest to northeast. No upgradient pollutant sources have been identified. The EPA (SEMF 2008) identified that the adjacent property to the south east (down gradient) had a localised contamination plume, this was not likely to be impacting the site; at for full letter see Appendix 3.

3.2.2 Downgradient Ecological Receptors

The closest ecological receptor is the River Derwent which is 1 km to the southeast. Given the urban setting impact to this receptor is minimal providing run off to stormwater drains are managed during construction phase of the site redevelopment works.

3.2.3 Water Bore Users

Given the urban setting groundwater bores have not been considered relevant to this investigation.

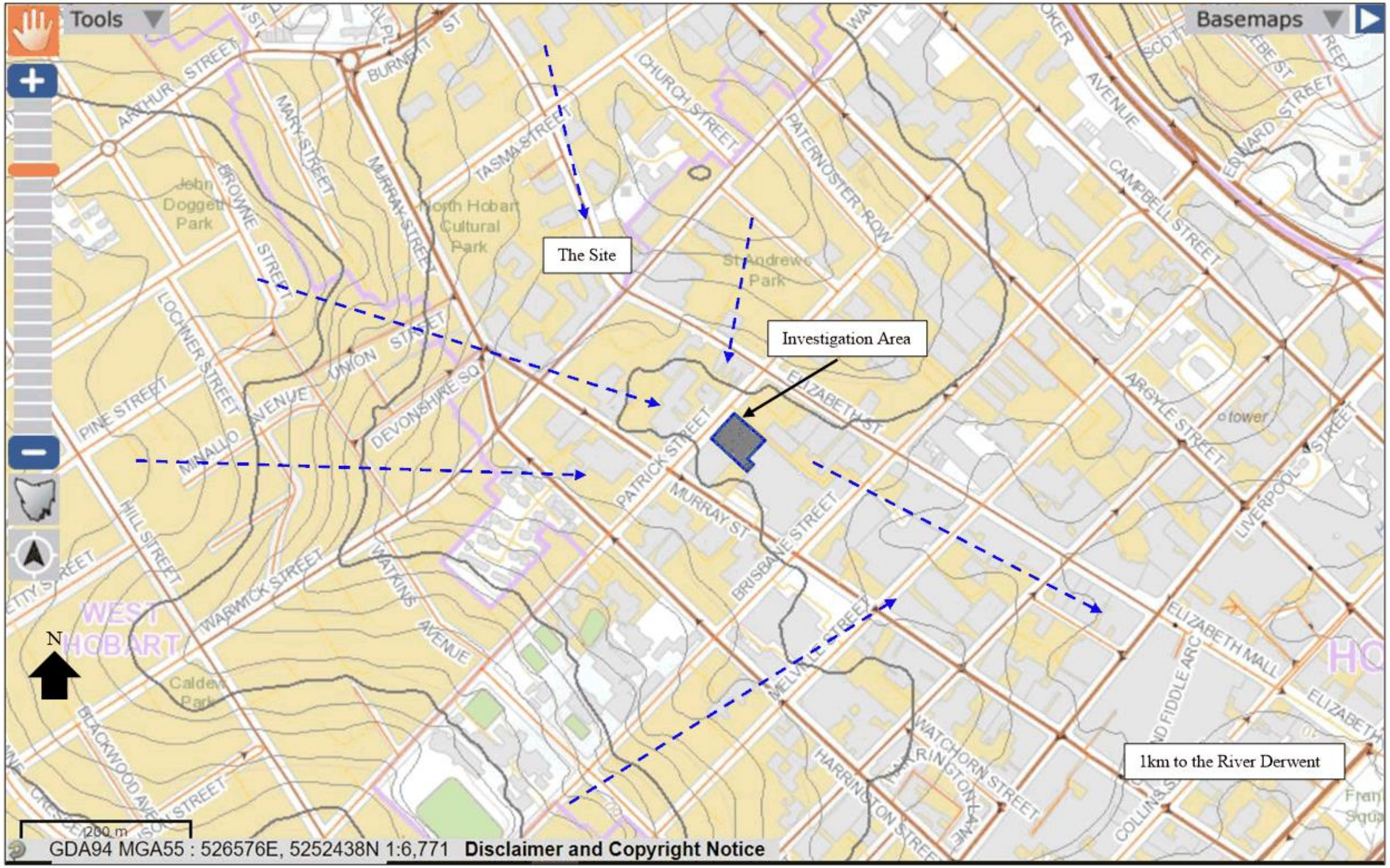


Figure 5 Surface Topography and Inferred Groundwater Flow (C/O the LIST)

3.3 Historical Aerial Photography Interpretation

Historical aerial photographs of the site and surrounding areas were provided by the Department of Primary Industries, Parks, Water and Environment (DPIPWE) and Google Earth. The individual aerial photographs are presented in Plate 2 (2017) to Plate 9 (1958). Table 2 list the corresponding plate number for each historical aerial photograph.

The site hosted residential properties until mid-1960's. The original commercial buildings were present onsite by1969. Part of the rear building was demolished in 2009 for the construction of the existing building facing onto Murray Street.

A site, 80m to the northwest of the site at 195-205 Murray Street which formally hosted a BP Service Station from 1964 to around the mid 1990's, the exact year of change of use is unknown. The site now hosts Tasmanian Bakeries retail outlet, office spaces and a warehouse.

To the southeast of the property at 161-177 Murray Street, there was a workshop/shed potentially for vehicle maintenance. By 1989 this building was demolished and there appears to be car sales at this property. By 2003 the site was redeveloped into a large commercial building which currently houses Harvey Norman.

Table 2 Historical Aerial Photograph References

Photo	Observations
2017	• Historical Aerial Photograph Plate 2
2009	• Historical Aerial Photograph Plate 4
2008	• Historical Aerial Photograph Plate 3
1989	• Historical Aerial Photographs Plate 5
1977	• Historical Aerial Photographs Plate 6
1973	• Historical Aerial Photographs Plate 7
1969	• Historical Aerial Photographs Plate 8
1958	• Historical Aerial Photographs Plate 9

Plate 2 2017 Historical Aerial Photograph the Site (13 November 2017)

Plate 3 2009 Historical Aerial Photograph the Site (28 September 2009) – Site redevelopment works

Plate 4 2008 Historical Aerial Photograph the Site (1 March 2008)

Plate 5 1989 Historical Aerial Photograph

Plate 6 1977 Historical Aerial Photograph

Plate 7 1973 Historical Aerial Photograph

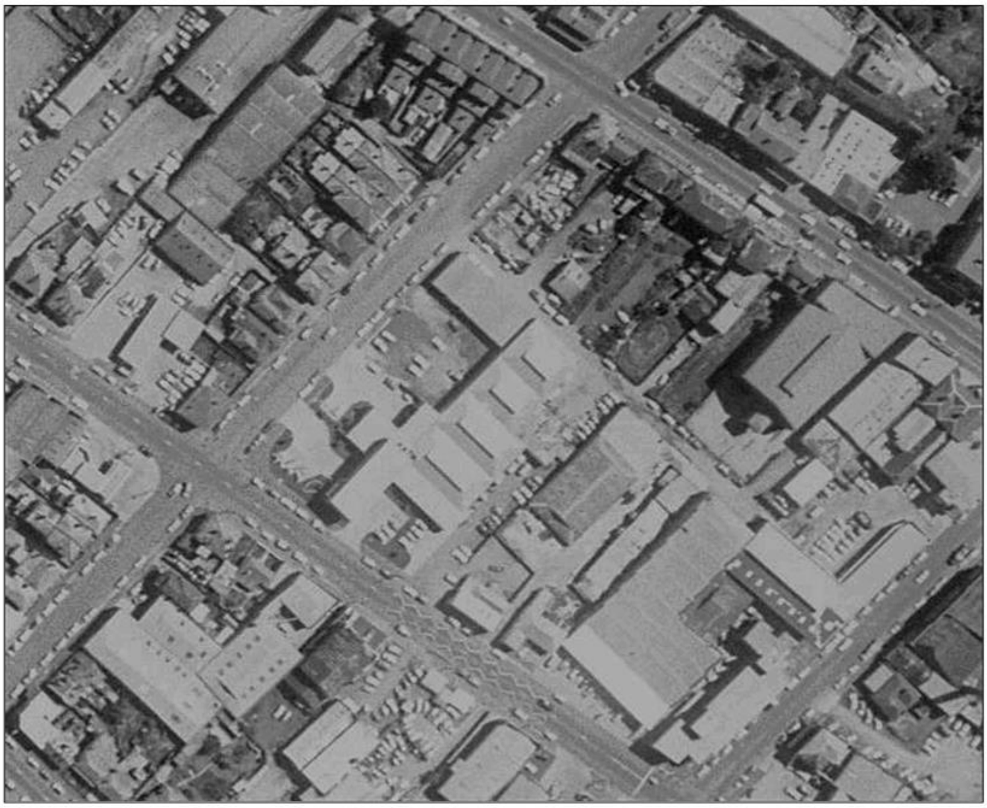


Plate 8 1969 Historical Aerial Photograph

Plate 9 1958 Historical Aerial Photograph

3.4 Dangerous Goods Records (WorkSafe Tasmania) not for 2914 Huon Highway

A dangerous goods search was conducted by SEMF in 2008, see Section 3.7.1 Site History Report SEMF 2008; of this report for details. The WST closed the file for the site, once the known UST on site was decommissioned in situ in 1995. The site has been occupied by the same owner, RACT since then and a dangerous goods search was not deemed necessary.

3.5 Council Environmental Records

Yvette Wierenga an Environmental Health Officer with the Hobart City Council confirmed the following information for the site, on the 15th July 2019:

- The site is listed as a potentially contaminated site;
- Activity iron /steel works – White Houses Foundry – 1822-1831;
- The council hold a copy of an Environmental Site Assessment (ESA) by SEMF Jan 2009. GES were advised if copy were to be provided then an RTI must be submitted.

Simone Salter, Senior Environmental Health Officer with the Hobart City Council confirmed the following information for 195-205 Murray Street, 80m northwest of the site:

- That site hosted a BP Service Station from 1964 and is listed as a potentially contaminated site.

3.6 Environmental Protection Authority - Property Information Request

It was not deemed necessary to conduct a property information request at Environmental Protection Authority (EPA) Tasmania for the following reasons; 1) the site has had one owner for the past 47 years since 1972 and 2) SEMF conducted a search in 2008, see Section 3.7.1 Site History Report SEMF 2008; of this report for details.

3.7 Historical Site Investigations

GES has been provided with the following reports written for the site:

- Site History Report 179-191 Murray Street, Hobart by SEMF September 2008.
- Geotechnical Investigation for RACT Redevelopment for SEMF; RACT Redevelopment. By Coffey Mining P/L, 12 November 2008.
- Groundwater Monitoring Bore Installation: Hobart RACT 179-191 Murray Street, Hobart for RACT. By Sloane Geoscience. 1 January 2009.
- Environmental Site Assessment, 179-191 Murray Street, Hobart. By SEMF January 2009.

The following investigation has been reviewed as part of this investigation *Environmental Site Assessment, 209-215 Harrington Street*, Hobart. GES, November 2017.

The following sections summarise the information from the reports that is relevant to the current investigation.

3.7.1 Site History Report SEMF 2008

The Site History Report for 179-191 Murray Street confirmed the following information:

- RACT occupied the site for 36 years, since around 1972.
- Previously owned by Dunlop, as a distribution and warehousing centre.
- Potentially contaminating activities identified during the site history included presence of underground storage tanks; mechanical workshop and garage – vehicle inspection activities and potential hydrocarbon contamination from neighbouring properties.
- Discussions with HCC confirmed foundry plus a motor car dealer (engineers & garages).
- WorkSafe Tasmania (Workplace Standards Tasmania) records confirmed petrol was stored in Underground Storage Tanks (UST) which was decommissioned in situ in 1995 following a rupture of the tank. The USTs were onsite from 1979 to 1995. There was a bowser. File close once tanks decommissioned.
- EPA records indicated that dangerous goods have been stored in drums on site. EPA is aware of adjacent properties that have had localised groundwater plumes associated with activities on those sites.
- Title search in 2008 related to RACT ownership only.
- During site inspection the following were noted: carwash in workshop, AST for fuel storage in workshop, 3 interceptor traps in workshop, vehicle inspections may have led to contamination at the site.
- There was a potential for soil and groundwater contamination on the site.
- Fuel storage ceased at the site from 1995.
- Further investigations were recommended in order to confirm the extent of contamination at the site. It is understood that the findings of additional work would be presented in the ESA written by SEMF January 2009; which has not been reviewed at this time.

3.7.2 Coffey Mining 2008

Coffey Mining produced this Geotechnical report for SEMF 12 November 2008. The follow information was confirmed:

- A total of 3 boreholes were drilled to a maximum depth of 10 m bgs and a minimum depth of 7.8m bgs to confirm ground conditions.
- Geology at the site; on the eastern half is mapped on the Hobart 1:25,000 geological map as Triassic cross-bedded quartzose to feldpathic sandstone. The western half is underlain by Tertiary aged poorly sorted large boulder to pebble grade deposits. Also directly north and east of the design footprint (the western building that was constructed in 2009-2010); there are Quaternary alluvial grave, sand and clay deposits.
- See Table 3 for subsurface profiles.
- Groundwater inflowed into BH2 only at 5.5m bgs; see Figure 6.
- From the Borehole log images included by Coffey Mining, there does not appear to be visible contamination on the western side of the site.

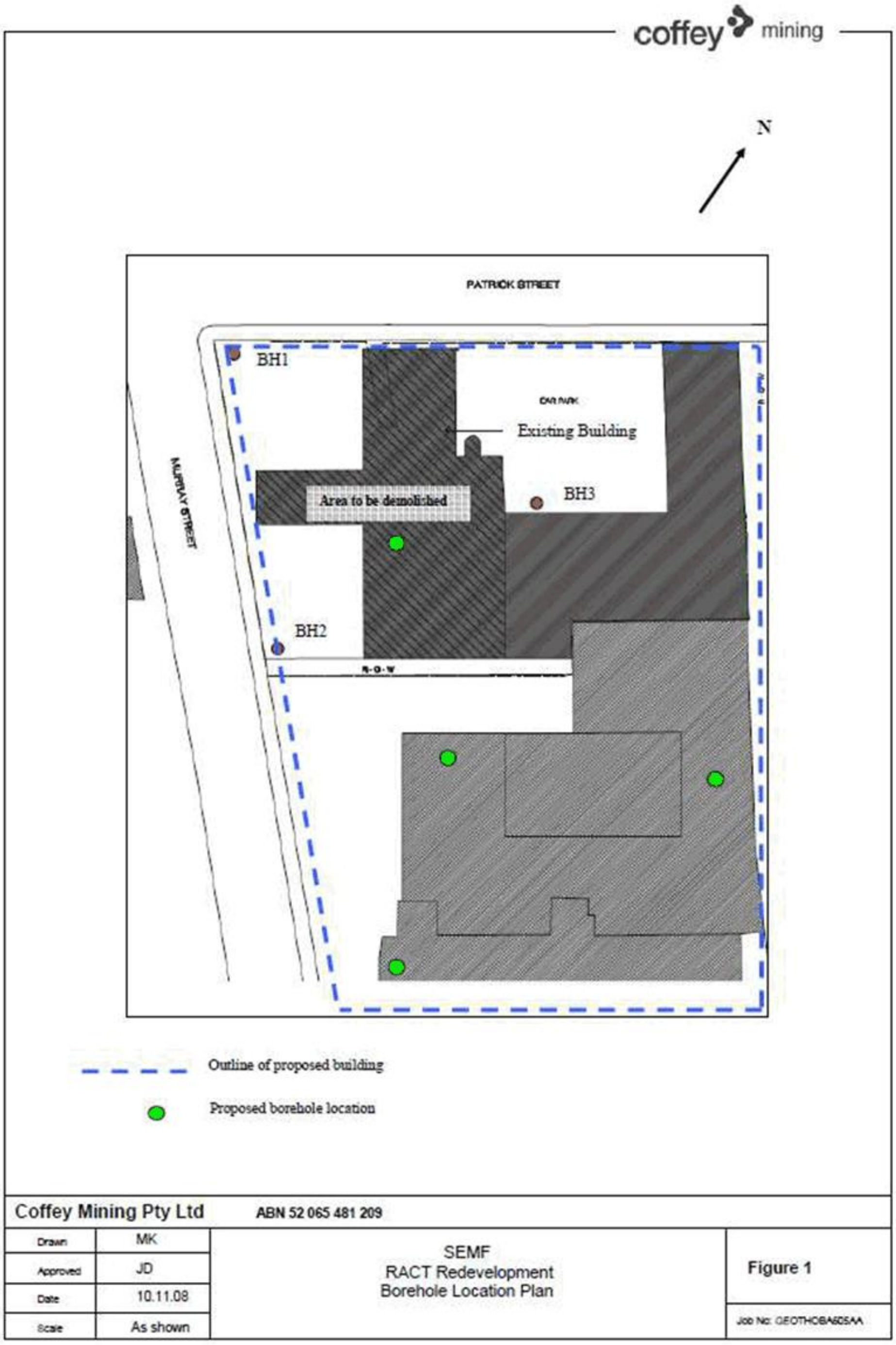
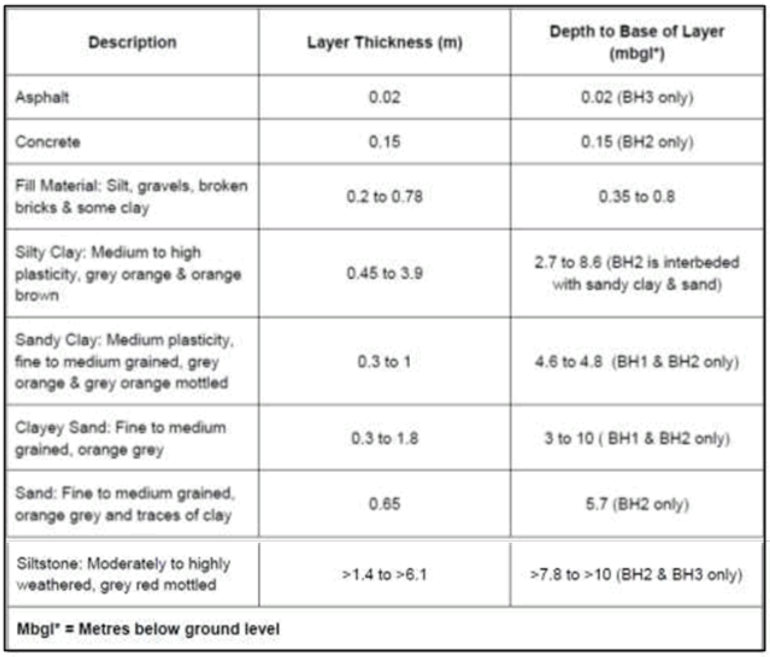


Figure 6 Coffey Mining 2008, Borehole plan

Table 3 Coffey Mining 2008 Subsurface Profiles.



Description	Layer Thickness (m)	Depth to Base of Layer (mbgl*)
Asphalt	0.02	0.02 (BH3 only)
Concrete	0.15	0.15 (BH2 only)
Fill Material: Silt, gravels, broken bricks & some clay	0.2 to 0.78	0.35 to 0.8
Silty Clay: Medium to high plasticity, grey orange & orange brown	0.45 to 3.9	2.7 to 8.6 (BH2 is interbeded with sandy clay & sand)
Sandy Clay: Medium plasticity, fine to medium grained, grey orange & grey orange mottled	0.3 to 1	4.6 to 4.8 (BH1 & BH2 only)
Clayey Sand: Fine to medium grained, orange grey	0.3 to 1.8	3 to 10 (BH1 & BH2 only)
Sand: Fine to medium grained, orange grey and traces of clay	0.65	5.7 (BH2 only)
Siltstone: Moderately to highly weathered, grey red mottled	>1.4 to >6.1	>7.8 to >10 (BH2 & BH3 only)
Mbgl* = Metres below ground level		

3.7.3 Sloane 2009

Sloane produced a groundwater monitoring bore installation report for SEMF January 2009. The follow information was confirmed:

- Slone acknowledged that SEMF previously supervised the removal of two USTs at the site. The two tank locations are presented in Figure 7.
- Groundwater in all bores is shallow, 3m bgs in borehole RA1 to 0.25m bgs in RA3.
- Groundwater in RA4 (sampled in this investigation) was very shallow at 0.32 m bgs; suggesting that it is a perched aquifer that is under pressure. Data from this well is questionable. Borehole log for RA4 is presented in Appendix 9.

3.7.4 ESA SEMF 2009

With RACT's permission, COVA (formally SEMF) provided GES with a copy of the ESA report. The follow information was confirmed:

- Gilbarco was engaged to decommission the two USTs.
- Soil sampling in T1's (adjacent to Patrick Street) pit was conducted by SEMF on the 22 October 2008, it was concluded that this tank had been was used for heating oil.
- Soil sampling in T2's pit was conducted by SEMF on the 5 & 6 November 2008. A slight hydrocarbon odour was noted during removal.
- Analytical results from both tank pits confirmed all contaminated soil had been removed and that no contamination was present.
- It was noted that a single bowser had already been removed. Both tanks were slurry filled and difficult to remove.
- SEMF confirmed that the site was suitable for continued use as a commercial site.

3.7.5 ESA GES 2017

The property at 215-217 Harrington Street was formally owned by City Cabs Co-Operative Society and hosted vehicle parking and re-fuelling. The following conclusions were made from the investigation:

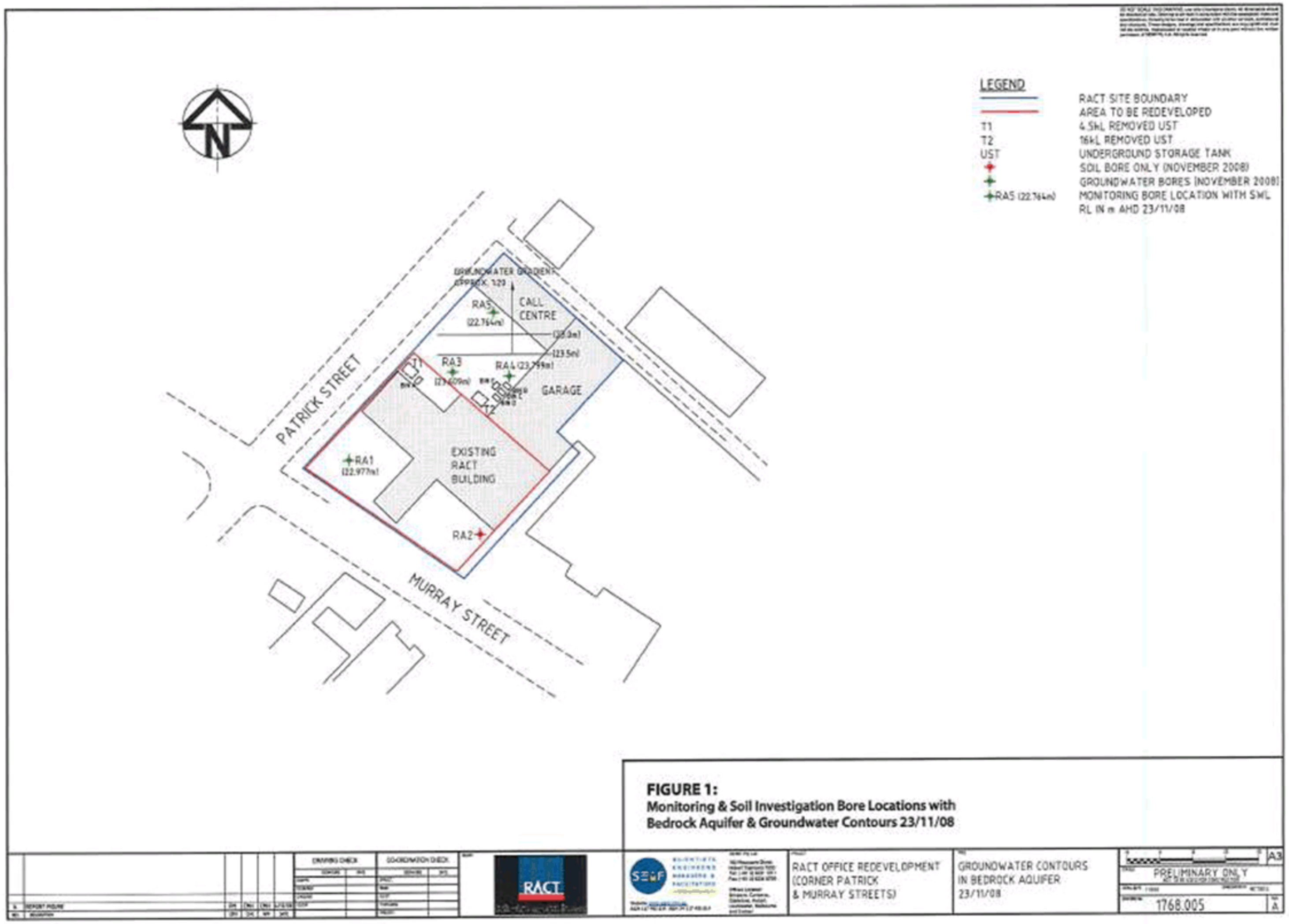


Figure 7 Borehole plan; Sloane 2009; former tank locations mapped.

Provided the recommendations herein are implemented, the following conclusions can be made:

- A risk to potential receptors has not been identified during and after development.
- All samples collected at the site are below threshold concentrations for assessing risk to human health;
- No particular health and safety issues are identified which may originate from onsite contamination activities;
- Other than advice provided within the recommendations section of this report, there are no specific remediation and protection measures required to be implemented before excavation commences;
- As a result of proposed site excavation, there is a very low human health risk to future users of the site; and
- GES advise that during site excavation works for site redevelopment, there is a low risk that site contamination will present an environmental risk.

Level 2 and 3 materials proposed to be excavated will require management where identified in fill and natural soils in the western corner of the site and near the former interceptor trap.

An excavation management plan is recommended to minimize the risk of contaminating clean Level 1 soil at the site which is proposed to be excavated. Additional soil sampling prior to excavation works is optional to further classify proposed material for disposal at a licensed landfill.

In summary, if recommendations herein are implemented, based on the adopted land used class, there is a low risk that residual contamination at the site will present a risk to human health or the environment.

3.8 Potential Contamination Issues

3.8.1 Areas of Potential Concern

As determined in this desktop assessment, the site has been identified as a potentially contaminated site from recent and historical site activities and the following areas of potential concern (AOPC) have been identified, see Figure 8:

- The entire site may be impacted from activities relating to iron /steel works – White Houses Foundry – 1822-1831.
- Former Fuel storage USTs.
- Former vehicle servicing, car washing and maintenance.

3.8.2 Contaminants of Potential Concern

The following contaminants of potential concern (COPC) associated previous site activities have been identified on site:

- Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
- Mono Aromatic hydrocarbons: Benzene, Toluene, Ethylbenzene, Xylene (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAH); and
- Suite of 15 Heavy Metals.

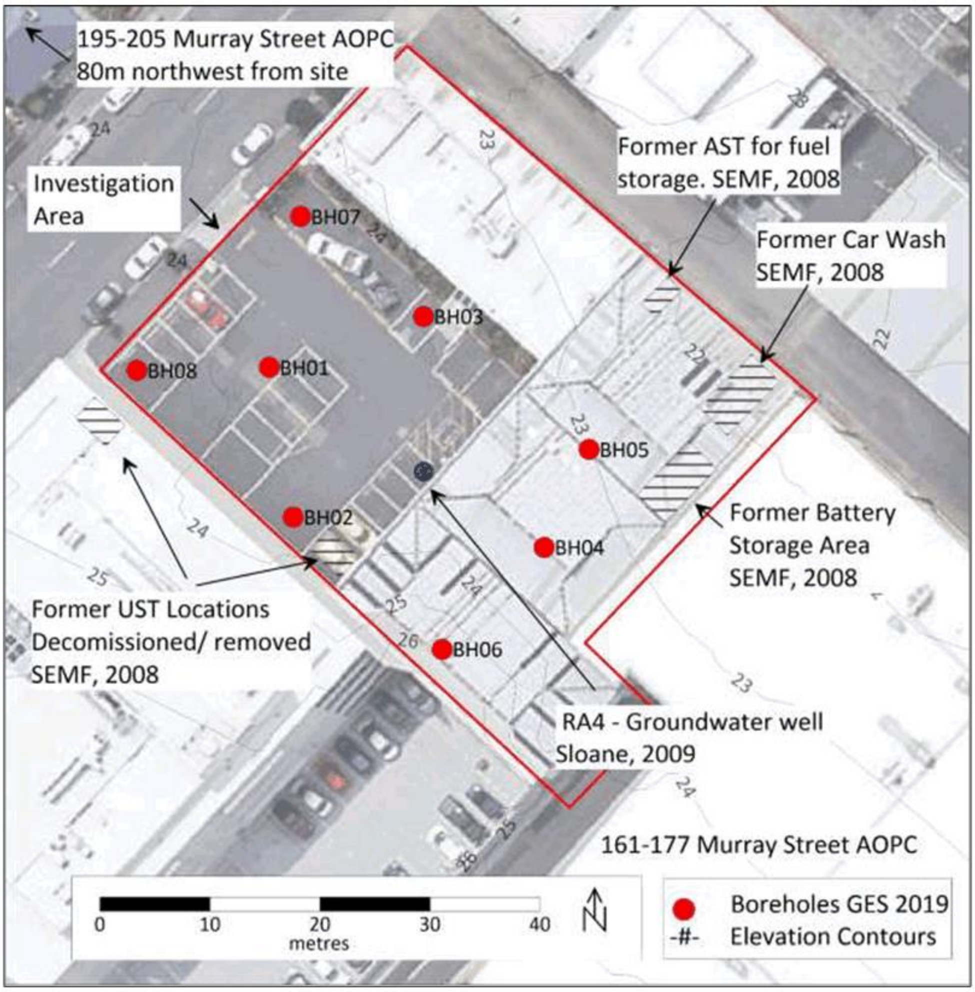


Figure 8 Areas Of Potential Concern

4 FIELD INVESTIGATION PROCEDURES

4.1 Works Summary

A total of 1 site visit was conducted to complete the environmental site assessment, see details in Table 4; borehole locations are presented in Figure 9. Site photographs and core samples are presented in Appendix 4.

A total of 16 primary soil samples were collected for analysis. QA/QC samples included 1 'duplicate', 1 'Intra-lab duplicate split', 1 'Soil Rinsate blank' and two 'soil trip blanks'.

A total of 1 groundwater sample was collected from *RA4*; a well onsite previously installed by Slone Geoscience. QA/QC samples included a 'duplicate' sample and a 'water trip blank'. A full groundwater monitoring program could not be conducted at the time as the majority of the previously installed wells (Slone, 2009) have been destroyed.

Table 4 Summary of Site Investigation Work Dates

Scope	Data	Lab Report	Details
Drilling/ Sample collection	28th June 2019	EM1910349 Primary Lab	Sampled BH01 – BH08; 16 Primary Soil Samples plus one water sample from RA4. Secondary Laboratory samples (ES1920828): *Intra-lab duplicate split'*

4.2 Site Walkover

A site walkover was completed by GES staff on the 28th June 2019. Images if the current site conditions are presented in Plate 10 and Plate 11; additional photographs are presented in Appendix 4. The surface of across the site is asphalt in the outside parking area and concrete inside the workshop both of which are in good condition.

Plate 10 Current Site conditions, view to the east and building at 62 Patrick Street.

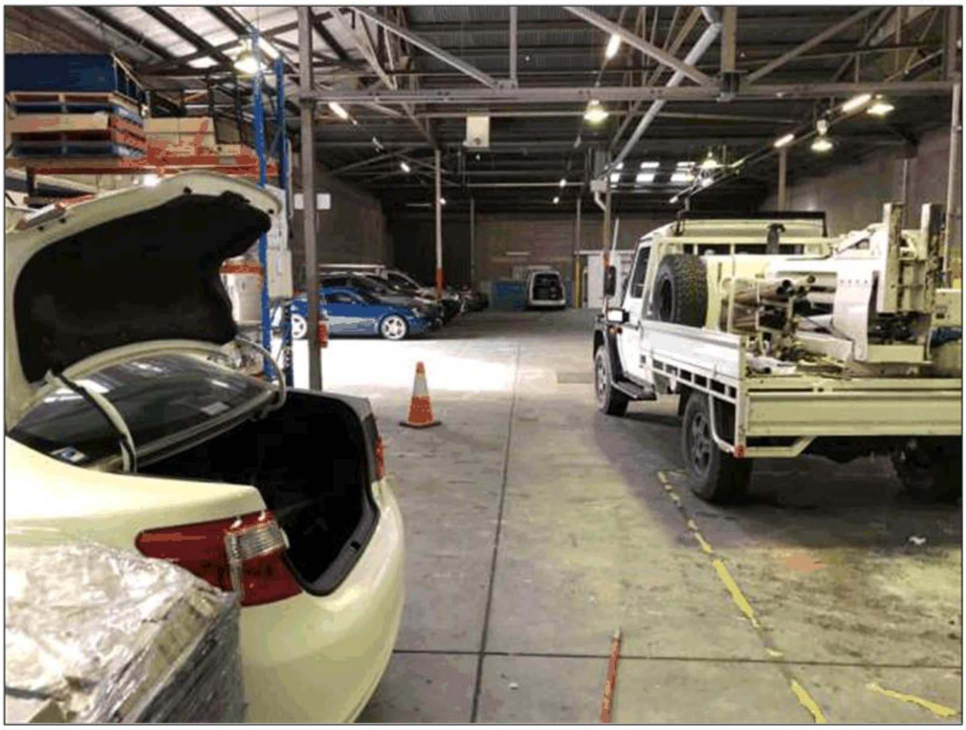


Plate 11 Current Site conditions, view to the east inside the workshop building.

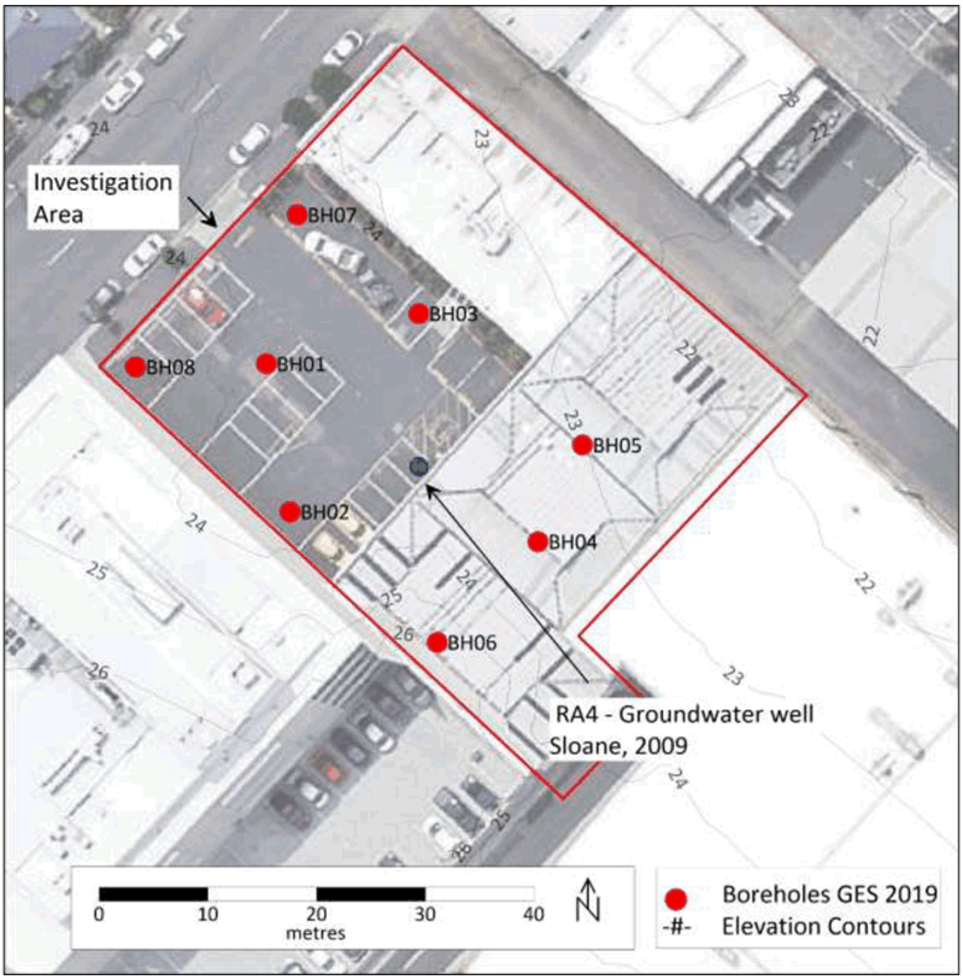


Figure 9 Borehole Plan

4.2.1 Signs of Contamination

The site appears clean and free from oily stains or spills on the surface of the site.

4.3 Soil Investigation

4.3.1 Borehole Drilling

At each of the bore locations, the following precautions were put in place to avoid disrupting underground service assets:

- Dial Before You Dig plans were obtained; and
- The first meter of the bore was cleared with a hand auger.

A total of eight (8) 65 mm diameter soil bores were drilled for assessing site geology and sampling for contamination impact. The bores were drilled by GES using the industry recognized Geoprobe direct push drilling system. The selected drilling method involved using a Geoprobe dual tube to retain wall integrity and eliminates risk of profile collapse whilst allowing extraction of 1.0 m length sample cores and allows for deployment of pre-packed well systems. Soil samples were collected from the cores in accordance with procedures set out in Table 5.

4.3.2 Soil Sampling

Soil bore soil sampling was conducted per the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM ASC 2013) and AS4482 sampling guidelines. Table 5 presents a summary of the soil assessment methodology adopted at the site.

Table 5 Summary of Soil Sampling Methods

Activity	Details / Comments
Underground Service Clearance	At each testing location, the following precautions were put in place to avoid disrupting underground service assets: • Dial Before You Dig plans were obtained; and • Where practical, the first meter of the bore was cleared with a hand auger.
Drilling Method	Soil bores were drilled: • Hand auger over the first meter to clear for services; • Industry recognized Geoprobe direct push drilling system
Soil Logging	Logging the soil was conducted in accordance with the unified soil classification system (USCS) as detailed in AS1726 (1993).
Decontamination of Sampling Equipment	Decon 90 was used to decontaminate reusable sampling equipment (hand auger and core trays) which was triple rinsed, the final rinse with deionised water.
Soil Sample Collection	In accordance with AS4482.2. Individual soil samples were collected using disposable nitrile gloves from approximately at 0.5 intervals below ground surface (bgs) and/or change in geology. Sampling was either grab sampling taken directly from the hand auger or from the push tube core.
Soil Screening	In accordance with AS4482.2. Collected samples were screened for volatile fractions using a Photoionisation Detector (PID). This was done by placing the samples within snap lock bags and analysing the headspace with a PID probe. A service record for GES's PID is included in Appendix 5 for the second round of sampling.
Sample Selection	A minimum number of samples were carefully selected which would provide enough information to identify hydrocarbon contamination in soils.
Sample preservation	Samples were placed into a jar for laboratory analysis. Soil jars were placed in a pre-chilled cool box with ice bricks.
Sample holding times	Sample holding times were within acceptable range (based on NEPM B3-2013) from collection to extraction.

4.3.3 Soil Analysis

Primary and QC samples were submitted to Analytical Laboratory Services (ALS) Environmental, Springvale Avenue in Melbourne for analysis. Inter lab split samples was sent to ALS Environmental, located in Smithfield, NSW. The samples were analysed for TPH/TRH, BTEX, PAHs and 15 Metals. One duplicate and 1 intra laboratory split duplicate sample was selected for analysis. Chain of Custody (COC) documentation was completed and is provided in Appendix 6 plus the Sample Receipt Notification (SRN) in Appendix 7. Table 6 presents a summary of the laboratory analyses undertaken for the soil samples.

Table 6 Overview of Soil Analysis and Quality Control

Analytes	Primary Soil Samples	Duplicates[a]	ILSS[b]	Rinate Blank[c]	Trip blanks
TPH/TRH	16	1	1	1	2
BTEX	16	1	1	1	-
PAH	16	1	1	1	-
Suite of 15 Metals	16	1	1	1	-

Sampling Quality Control Standards (AS4482):
a – One (1) in twenty (20) primary laboratory duplicate sample
b - Inter Laboratory Split Sample - One (1) in twenty (20) inter laboratory split samples
c - Single Rinsate Blank sample per piece of equipment per day

As all 15 metals were analysed, there was requirement to assess the following soil physical properties to determine soil threshold investigation levels:

- Soil grain class (sand/silt or clay)
- % Clay content;
- Cation exchange capacity; and
- Soil pH

The soil physical properties were assessed through site assessment and chemical properties were based on knowledge of similar soil types encountered around Hobart area.

5 QUALITY CONTROL

All Field and laboratory Quality Assurance and Quality Control (QA/QC) details, outputs and reports are presented in Appendix 8.

5.1 Field

It is standard to expect up to 10% error in field duplication and up to 10% laboratory error. Therefore, in theory up to 20% error can be assumed on duplicate analysis. Some variation may exist in soil and groundwater because even though all efforts are made to split samples homogeneously of materials may bias samples in certain elements.

Relative Percentage Differences (RPDs) for the duplicate and triplicate samples where applicable are calculated using the method outlined below.

The acceptance criteria used for the RPDs depend on the levels of contaminants detected and the laboratory's Method Detection Limits (MDL). The closer the levels detected are to the MDL the greater the acceptable RPD. RPDs are calculated as follows:

- RPD <50% for low level results (<20 * MDL)
- RPD <30% for medium level results (20-100 * MDL)
- RPD <15% for high level results (>100 * MDL)
- No limit applies at <2 * MDL (Method Detection Limit)

Field QA/QC procedures and compliance are summarised in Table 7.

Table 7 Field QA/QC procedures and Compliance

QA/QC Requirement	Compliance	Comments
Appropriate sampling strategy used, and representative samples collected	Yes	Sampling program was undertaken in accordance with AS4482.1-2005
Appropriate and well documented sample collection, handling, logging and transportation procedures.	Yes	Appropriate and well documented
Decontamination	Yes	Appropriate decontamination such as cleaning tools before sampling and between sample locations was undertaken
Chain-of-custody documentation completed	Yes	COC were completed in accordance with NEPM Schedule B2, Section 5.4.5 and transported under strict COC procedures. The signed COC documents are included in this report, which includes the condition report on arrival of samples to the Laboratory, cross checking of sample identification and paperwork and preservation method.
Required number of splits: Duplicate & inter-lab splits: 1 per 20 primary samples	Yes	A total of 16 Primary samples were selected for analysis; 1 soil duplicate and 1 soil inter lab split samples were required. The groundwater was a grab sample and a duplicate was collected but no inter lab split.
QA/QC samples reported method detection limits within indicated guidelines.	No	For BH04 1.5-1.6 and Duplicate 2 pairs, 96% of analytes complied. For BH04 1.5-1.6 and Inter-Lab Split 2 pairs, 80% of analytes complied. No RPDs exceeding method detection limit for duplicate pairs for the groundwater duplicate
Trip blanks collected with no laboratory detections?	NA	According to AS4482.2-1999 not required unless there is concern with cross contamination risks. As there may have been hydrocarbons present trip blanks were used. There were no detections of hydrocarbons which indicates that sampling jar were not compromised.
Required numbers of rinse blank samples collected with no laboratory detections?	Yes	One soil rinse blank was collected as per AS4482.1-2005. There were not detections.
Samples delivered to the laboratory within sample holding times and with correct preservative	Yes	All samples were sent to the laboratory within holding times and correct preservative.

5.2 Laboratory

Laboratory QA/QC procedures and compliance are summarised in Table 8.

Table 8 Laboratory QA/QC Procedures and Compliance

QA/QC Requirement	Compliance	Comments
All analyses NATA accredited	Yes	ALS Laboratories is NATA Accredited. Appropriate analytical methods used, in accordance with Schedule B(3) of the NEPM ASC 2013. Acceptable laboratory limits of reporting (LORs) adopted.
Method Blanks: zero to <Practical Quantitation Limit (PQL)	Yes	There were no method blank value outliers in the QC1 report.
Laboratory Control Samples: 70% to 130% recovery for soil.	Yes	There were no laboratory control outliers in the QC1 report.
Matrix spikes: 70% to 130% recovery for organics or 80%-120% recovery for inorganics	No	EM1910349 (primary samples/ lab): MS recovery not determined, background level greater than or equal to 4x spike level for Manganese in sample BH07 0.5-0.6. Plus recovery was less than lower data quality objective for C^6-C^9 and C^6-C^{10} in an anonymous sample.
Duplicate Samples: 0% to <20% RPD.	No	ES1920828 (inter laboratory) The following duplicate RPD samples exceeded LOR based limits of 0-20%: The sum of PAHs
Surrogates: 70% to 130% recovery	Yes	There were no surrogate recovery outliers in the QC1 report
Analysis holding time outliers	Yes	No hold-time outliners exist for the QCI report.
Quality Control Sample Frequency Outliers	No	EM1910889 (Rebatch) The following duplicate frequency outliers was identified as they did not meet the NEPM 2013 B3 & ALS QC Standard: PAH/Phenols (GC/MS - SIM) with 0% and 10% expected The following matrix spike frequency outliers were identified: PAH/Phenols (GC/MS - SIM) with 0% and 5% expected

6 FIELD INVESTIGATION FINDINGS

6.1 Soil Bores

Borehole logs are presented in Appendix 9.

6.1.1 Geological Interpretation

In general, the Mineral Resources Tasmania (MRT) geological mapping was consistent with the ground conditions encountered during the investigation. The soil profile comprised 0.1 to 0.2 m of FILL consisting of either bitumen (outside carpark) or concrete (in workshop samples). Then 0.2 -0.5 and up to 1.6 FILL silty sandy GRAVEL, then underlying natural was a mix of silty sandy GRAVEL, silty sandy CLAY and or Silty SANDSTONE.

6.1.2 Grain Class Interpretation

Grain size classifications are applied to all soils at the site to determine threshold screening level concentrations for hydrocarbons to assess soil ecological and human health risks.

Grain class threshold values are determined based on either the:

- sample grain size (in the case of ecological screening levels or chromium limits); or
- average grain class overlying the sample point (when assessing petroleum vapour screening levels).

When assessing petroleum vapour intrusion screening levels, where soil is proposed to be excavated from the site, the excavated material is excluded from the grain class averaging. The corresponding depth class from which the sample is collected is also shallowed based on the renewed basement depth.

Table 9 provides a summary of the grain class averages for material overlying the sample.

Table 9 Summary of Grain Class Based on USCS Classification – BH01 – BH08

Sample	Footing Excavation Depth^ - Red Fill Thickness^ - Green	Sample PVI Depth (m) Relative to Slab/Cut Depth	Soil Grain Size Class Averaging Above Soil Sample																		Attenuation			Petroleum Vapour Intrusion HSL Grain Class*	SAMPLE USCS
			GW	GP	GM	GC	SW	SP	SM	SC	ML	CL	OL	MH	CH	OH	CI	Rock (R)	Existing Pavement (P)	Crawl Space Thickness (m)	Proposed CONCRETE (CH)	Crawl Space	Biodegradation		
BH01 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	GW
BH01 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	SC
BH02 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH02 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	R
BH03 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	GW
BH03 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH04 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH04 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH05 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CI
BH05 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH06 0.5-0.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CH
BH06 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	R
BH07 0.50-0.60	6.6	<																		NA	0.2	1.0	1.0	CLAY	GW
BH07 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	SM
BH08 0.50-0.60	6.6	<																		NA	0.2	1.0	1.0	CLAY	GW
BH08 1.5-1.6	6.6	<																		NA	0.2	1.0	1.0	CLAY	CL

7 SOIL ECOLOGICAL IMPACT ASSESSMENT

7.1 Protected Environmental Values

The requirement for protecting soil from contaminated activities in Tasmania is managed under the Environmental Management and Pollution Control Act 1994 (EMPCA) which states in Part 5A:

(2) An area of land is a contaminated site if –

> (a) there is in, on or under that area of land a pollutant in a concentration that –
>
> > (i) is above the background concentration; and
> >
> > (ii) is causing or is likely to be causing serious or material environmental harm or environmental nuisance, or is likely to cause serious or material environmental harm or environmental nuisance in the future if not appropriately managed;

Potential soil impact at the site is assessed through application of the following environmental investigation guidelines.

7.2 NEPM ASC (2013) Guidelines

The following ecological investigation guidelines are to be addressed to assess acceptable levels of risk to terrestrial ecosystems:

- NEPM ASC (2013) Ecological Investigation Levels (EIL's) – have been developed for selected metal and organic substances. EIL's depend on specific soil and physicochemical properties and land use scenarios and generally apply to the top two (2) metres of the soil profile (NEPM 2013);
- NEPM ASC (2013) Ecological Screening Levels (ESL's) – have been developed for selected petroleum hydrocarbon compounds and total petroleum hydrocarbon fractions. ESL's broadly apply to coarse- and fine-grained soils and various land use scenarios within the top two (2) metres of the soil profile (NEPM ASC 2013).

Soil analytical results are compared against Ecological Screening Levels (ESL's) and Ecological Investigation Levels (EIL's) limits presented in Table 10.

Table 10 Summary of Soil Investigation Limits Considered at the Site based in NEPM ASC (2013)

Investigation Levels (IL)	**Analytes Investigated**						
	Hydrocarbons				**Metals**		**DDT**
	BTEX	**TRH (F1 to F4)**	**Benzo(a) pyrene (PAH)**	**Naphthalene (PAH)**	**Zn, Cu, Cr(III), Ni & As**	**Lead**	
ESL's	Analysed	Analysed	Analysed				
EIL's				Analysed	Analysed	Analysed	Not Analysed

7.3 Guidelines

7.3.1 Ecological Screening Levels

The following compounds were compared against NEPM (2013) Ecological Screening Levels (ESL's):

- BTEX;
- F1 to F4 TRH; and
- Benzo(a)pyrene

Selection of ESL threshold investigation limits are set out in the NEPM (2013) guidelines and require classification of the soil according to:

- Land use sensitivity:
  - Areas of ecological significance
  - Urban residential and public open space; and
- Dominant particle size passing through a 2 mm sieve into:
  - Coarse – sand sizes and greater; and
  - Fine – clay and silt sizes.

Adopted NEPM (2013) soil and land use classifications are presented below.

7.3.2 Ecological Investigation Levels

The following compounds were compared against Environmental Investigation Levels:

- Lead;
- Nickel;
- Chromium;
- Zinc;
- Copper;
- Arsenic; and
- Naphthalene.

There was a requirement to classify the soil according to physicochemical properties given that the above listed compounds. Adopted physicochemical parameters are presented in the results tables.

Selection of EIL threshold investigation limits are set out in the NEPM ASC (2013) guidelines and require classification of the soil per specific soil and physicochemical properties which are presented in the results tables. The adopted land use scenario applied was commercial and industrial plus urban residential guidelines because it was the best fit for current and future land use.

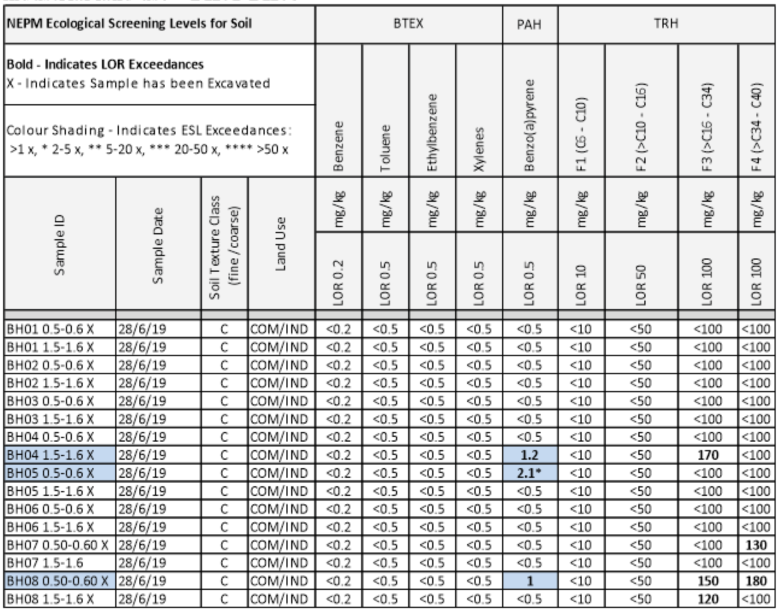
7.4 Findings

7.4.1 Ecological Screening Levels

Laboratory analytical results for soil are presented in Appendix 10. Table 11 summaries all soil analytical results against relevant ESLs guideline limits for commercial/ industrial land use. Table 12 summaries all soil analytical results against relevant ESLs guideline limits for urban residential land use. Concentrations which exceed laboratory limits of reporting (LOR) are highlighted in bold. ESL exceedances are highlighted with a coloured cell. Samples within the proposed excavation zone are marked with an X; Note a minimum of 6.6m excavation is proposed, not including service trenches and building footings.

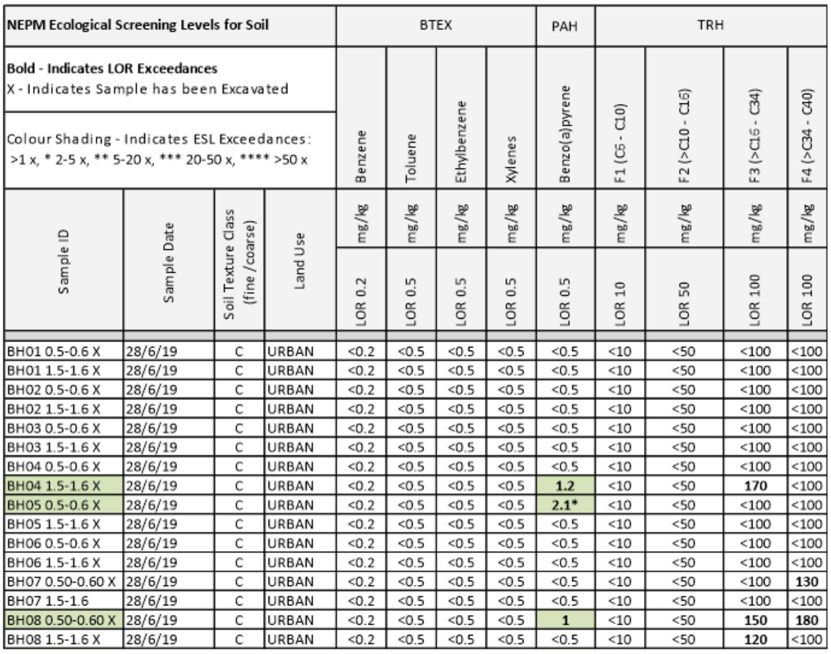
Hydrocarbon detections exceeded ESL guidelines for Benzo(a)pyrene in BH04, BH05 and BH08. No ecological receptors have been identified but excavations are planned therefore a contamination management plan (CMP) will be required to manage soil and water at the site.

Table 11 Summary of Soil Analytical Results Compared with Ecological Screening Level's for commercial / industrial land use – BH01-BH08



NEPM Ecological Screening Levels for Soil				BTEX				PAH	TRH			
Bold - Indicates LOR Exceedances X - Indicates Sample has been Excavated Colour Shading - Indicates ESL Exceedances: >1 x, * 2-5 x, ** 5-20 x, *** 20-50 x, **** >50 x				Benzene	Toluene	Ethylbenzene	Xylenes	Benzo(a)pyrene	F1 (C6 - C10)	F2 (>C10 - C16)	F3 (>C16 - C34)	F4 (>C34 - C40)
Sample ID	Sample Date	Soil Texture Class (fine / coarse)	Land Use	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				LOR 0.2	LOR 0.5	LOR 0.5	LOR 0.5	LOR 0.5	LOR 10	LOR 50	LOR 100	LOR 100
BH01 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH01 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH02 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH02 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH03 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH03 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH04 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH04 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	**1.2**	<10	<50	**170**	<100
BH05 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	**2.1***	<10	<50	<100	<100
BH05 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH06 0.5-0.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH06 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH07 0.50-0.60 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	**130**
BH07 1.5-1.6	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH08 0.50-0.60 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	**1**	<10	<50	**150**	**180**
BH08 1.5-1.6 X	28/6/19	C	COM/IND	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	**120**	<100

Table 12 Summary of Soil Analytical Results Compared with Ecological Screening Level's for residential land use – BH01-BH08



NEPM Ecological Screening Levels for Soil				BTEX				PAH	TRH			
Bold - Indicates LOR Exceedances X - Indicates Sample has been Excavated Colour Shading - Indicates ESL Exceedances: >1 x, * 2-5 x, ** 5-20 x, *** 20-50 x, **** >50 x				Benzene	Toluene	Ethylbenzene	Xylenes	Benzo(a)pyrene	F1 (C5 - C10)	F2 (>C10 - C16)	F3 (>C16 - C34)	F4 (>C34 - C40)
Sample ID	Sample Date	Soil Texture Class (fine /coarse)	Land Use	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				LOR 0.2	LOR 0.5	LOR 0.5	LOR 0.5	LOR 0.5	LOR 10	LOR 50	LOR 100	LOR 100
BH01 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH01 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH02 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH02 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH03 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH03 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH04 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH04 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	**1.2**	<10	<50	**170**	<100
BH05 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	**2.1***	<10	<50	<100	<100
BH05 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH06 0.5-0.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH06 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH07 0.50-0.60 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	**130**
BH07 1.5-1.6	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	<100	<100
BH08 0.50-0.60 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	**1**	<10	<50	**150**	**180**
BH08 1.5-1.6 X	28/6/19	C	URBAN	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50	**120**	<100

7.4.2 Ecological Investigation Levels

Laboratory analytical results are presented in Appendix 10. Table 14 compares all soil analytical results against relevant ecological investigation limits (EIL's) for commercial/ industrial land use. Table 14 compares all soil analytical results against relevant ecological investigation limits (EIL's) for urban residential land use. Concentrations which exceeded laboratory LOR are detailed in the table. EIL exceedances are highlighted with a coloured cell and samples within a proposed excavation zone are marked with an X; note a minimum of 6.6m excavation is proposed, not including service trenches and building footings.

There were elevated levels of zinc in BH02, BH04, BH05 and BH07 above EIL guideline limits. No ecological receptors have been identified but excavations are planned therefore a contamination management plan (CMP) will be required to manage soil and water at the site.

Table 13 Soil Analytical Results Compared Against Ecological Investigation Levels for commercial/ industrial land use – BH01-BH08

NEPM Ecological Investigation Levels for Soil													
Bold - Indicates LOR Exceedances X - Indicates Sample Withiin Inferred Excavation													
Colour Shading - Indicates ESL Exceedances: >1 x, * 2-5 x, ** 5-20 x, *** 20-50 x, **** >50 x													
Sample ID	Sample Date	EIL Land Use Sensitivity Class	Soil CEC (cmolc/kg)	Soil pH	Soil Texture Class (fine /coarse)	Copper (CEC)	Copper (pH)	Nickel	Zinc	Chromium III	Lead	Arsenic	Naphthalene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BH01 0.5-0.6 X	28/6/19	COM/IND	10	4.5 (3)	C	<5	<5	2	8	4	8	<5	<1
BH01 1.5-1.6 X	28/6/19	COM/IND	20	4.5 (3)	C	8	8	10	28	10	12	<5	<1
BH02 0.5-0.6 X	28/6/19	COM/IND	45	4.5 (3)	F	12	12	6	24	13	12	<5	<1
BH02 1.5-1.6 X	28/6/19	COM/IND	10	4.5 (3)	C	23	23	56	221	15	10	<5	<1
BH03 0.5-0.6 X	28/6/19	COM/IND	10	4.5 (3)	C	<5	<5	12	32	6	56	<5	<1
BH03 1.5-1.6 X	28/6/19	COM/IND	45	4.5 (3)	F	35	35	15	85	9	311	<5	<1
BH04 0.5-0.6 X	28/6/19	COM/IND	45	4.5 (3)	F	19	19	22	182	10	63	<5	<1
BH04 1.5-1.6 X	28/6/19	COM/IND	45	4.5 (3)	F	25	25	7	249	7	126	<5	<1
BH05 0.5-0.6 X	28/6/19	COM/IND	35	4.5 (3)	F	22	22	8	264	9	283	<5	<1
BH05 1.5-1.6 X	28/6/19	COM/IND	45	4.5 (3)	F	24	24	9	98	11	112	<5	<1
BH06 0.5-0.6 X	28/6/19	COM/IND	45	4.5 (3)	F	22	22	11	16	20	8	<5	<1
BH06 1.5-1.6 X	28/6/19	COM/IND	10	4.5 (3)	C	8	8	10	15	7	6	<5	<1
BH07 0.50-0.60 X	28/6/19	COM/IND	10	4.5 (3)	C	34	34	7	46	4	28	<5	<1
BH07 1.5-1.6 X	28/6/19	COM/IND	15	4.5 (3)	C	21	21	7	137	9	89	<5	<1
BH08 0.50-0.60 X	28/6/19	COM/IND	10	4.5 (3)	C	29	29	12	53	5	52	<5	<1
BH08 1.5-1.6 X	28/6/19	COM/IND	35	4.5 (3)	F	18	18	23	54	14	9	<5	<1

pH Designation:

1) Using 0.01M CaCl2 extract. Rayment, G.E. and Lyons, D.J. (2011). "Soil Chemical Methods – Australasia". 495+20 pp. CSIRO Publishing, Melbourne.

2) pHF (1:5). Adjusted by subtracting 0.75 with +/- 0.25 error to calibrate to the CaCl2 method (per comm. ALS Brisbane Acid Sulphate Soils Laboratory). Methods in accordance with Ahern, C.R., Stone Y., and Blunden B. (1998b). 'Acid Sulphate Soils Assessment Guidelines'. Acid Sulphate Soils Management Advisory Committee, Wollongbar, NSW, Australia.

3) Classified in accordance with parent material typical soil pH as per the Tasmanian soils database / or on-site testing

Table 14 Soil Analytical Results Compared Against Ecological Investigation Levels for urban residential/ public open spaces – BH01-BH08

NEPM Ecological Investigation Levels for Soil

Bold - Indicates LOR Exceedances
X - Indicates Sample Withiin Inferred Excavation

Colour Shading - Indicates ESL Exceedances:
>1 x, * 2-5 x, ** 5-20 x, *** 20-50 x, **** >50 x

Sample ID	Sample Date	EIL Land Use Sensitivity Class	Soil CEC (cmolc/kg)	Soil pH	Soil Texture Class (fine /coarse)	Copper (CEC)	Copper (pH)	Nickel	Zinc	Chromium III	Lead	Arsenic	Naphthalene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BH01 0.5-0.6 X	28/6/19	URBAN	10	4.5 (3)	C	<5	<5	2	8	4	8	<5	<1
BH01 1.5-1.6 X	28/6/19	URBAN	20	4.5 (3)	C	8	8	10	28	10	12	<5	<1
BH02 0.5-0.6 X	28/6/19	URBAN	45	4.5 (3)	F	12	12	6	24	13	12	<5	<1
BH02 1.5-1.6 X	28/6/19	URBAN	10	4.5 (3)	C	23	23	56	221	15	10	<5	<1
BH03 0.5-0.6 X	28/6/19	URBAN	10	4.5 (3)	C	<5	<5	12	32	6	56	<5	<1
BH03 1.5-1.6 X	28/6/19	URBAN	45	4.5 (3)	F	35	35	15	85	9	311	<5	<1
BH04 0.5-0.6 X	28/6/19	URBAN	45	4.5 (3)	F	19	19	22	182	10	63	<5	<1
BH04 1.5-1.6 X	28/6/19	URBAN	45	4.5 (3)	F	25	25	7	249*	7	126	<5	<1
BH05 0.5-0.6 X	28/6/19	URBAN	35	4.5 (3)	F	22	22	8	264*	9	283	<5	<1
BH05 1.5-1.6 X	28/6/19	URBAN	45	4.5 (3)	F	24	24	9	98	11	112	<5	<1
BH06 0.5-0.6 X	28/6/19	URBAN	45	4.5 (3)	F	22	22	11	16	20	8	<5	<1
BH06 1.5-1.6 X	28/6/19	URBAN	10	4.5 (3)	C	8	8	10	15	7	6	<5	<1
BH07 0.50-0.60 X	28/6/19	URBAN	10	4.5 (3)	C	34	34	7	46	4	28	<5	<1
BH07 1.5-1.6 X	28/6/19	URBAN	15	4.5 (3)	C	21	21	7	137	9	89	<5	<1
BH08 0.50-0.60 X	28/6/19	URBAN	10	4.5 (3)	C	29	29	12	53	5	52	<5	<1
BH08 1.5-1.6 X	28/6/19	URBAN	35	4.5 (3)	F	18	18	23	54	14	9	<5	<1

pH Designation:

1) Using 0.01M CaCl2 extract. Rayment, G.E. and Lyons, D.J. (2011). "Soil Chemical Methods – Australasia". 495+20 pp. CSIRO Publishing, Melbourne.

2) pHF (1:5). Adjusted by subtracting 0.75 with +/- 0.25 error to calibrate to the CaCl2 method (per comm. ALS Brisbane Acid Sulphate Soils Laboratory). Methods in accordance with Ahern, C.R., Stone Y., and Blunden B. (1998b). 'Acid Sulphate Soils Assessment Guidelines'. Acid Sulphate Soils Management Advisory Committee, Wollongbar, NSW, Australia.

3) Classified in accordance with parent material typical soil pH as per the Tasmanian soils database / or on-site testing

8 GROUNDWATER PROTECTED VALUES

8.1 Guidelines

The State Policy on Water Quality Management 1997 defines a range of PEV's on the basis of groundwater salinity. Groundwater electrical conductivity (EC) is used as a basis in which to assess total dissolved solid (TDS) concentrations at the site through a conservative ratio of 1 mg/L TDS to 0.75 µS/cm EC.

Groundwater PEV's were explored to assess potential receptors at risk. EC was not collected during the site visit inferred average values of 2600 µS/cm from a GME at 209-215 Harrington Street (SEMF 2017) have been applied which approximately translates to an average TDS concentration 3099 mg/L.

Therefore groundwater beneath the site is anticipated to fall within Category B when classified according to the State Policy. The environmental values requiring protection are presented in Table 15.

Table 15 Environmental Values and Uses of Groundwater Requiring Protection (State Policy on Water Quality Management 1997).

Protected Environmental Value	PEV Based on TDS Concentrations (mg/L)			
	A	B	C	D
	Less than 1000	1000 – 3500	3500 – 13000	Greater than 13000
Drinking Water	*	╳	╳	╳
Irrigation	*	*	╳	╳
Industry	*	*	*	╳
Stock Watering	*	*	*	╳
Ecosystem Protection	*	*	*	*

Note: Blue Shading Indicates Protected Environmental Value Requirement

8.1.1 *Drinking Water*

The aquifer is not considered of drinking water quality given the typically high salinity. The groundwater is therefore not considered a PEV which needs to compared against Tier 1 screening criteria.

8.1.2 *Irrigation*

Given the urban setting and the development of an extensive reticulated water supply network the potential for groundwater extraction for crop irrigation and groundwater drawdown within the possible extent of groundwater impacts is considered highly unlikely. The PEV for crop irrigation has not been considered in this instance.

8.1.3 *Industrial Water Use*

As the applicable criteria for industrial water use are highly specific to the type of process, criteria for possible future industrial water use at the site have not been included.

8.1.4 *Stock Watering*

The potential for groundwater extraction for stock watering within the nearby area is considered low. The PEV for stock irrigation has therefore not been considered in this instance.

8.1.5 *Ecosystem Protection*

It is considered unlikely that groundwater impacts would extend to the nearest receiving waters of River Derwent which is 1km in a south easterly direction and the slightly closer Hobart Rivulet.

There is therefore a responsibility that the water quality is assessed against guidelines for protection of freshwater waterways receiving environment being Hobart Rivulet. ANZECC 2000 ecosystem protection guidelines for 90% protection of Fresh Water Ecosystems should be applied. Percentage species protection values are based on various reports (Desmond 2002; DEP 2011).

8.2 Findings

8.2.1 Ecosystem Protection

The groundwater analytical results report is presented in Appendix 10. Groundwater results compared against the ANZECC (2000) freshwater guidelines 90% trigger for hydrocarbons are presented in Table 16; for PAHs in Table 17 and for Metals in Table 18.

There were no detections of hydrocarbons including total recoverable hydrocarbons, BTEXN compounds or polynuclear Aromatic Hydrocarbons in the groundwater. Most metals were non-detect except for barium and manganese; there are no guideline limits for barium and the manganese detections were below guideline limits.

Table 16 Groundwater Results compared against the ANZECC (2000) for Freshwater - 90% Trigger HYDROCARBONS

Fresh Water (90% Trigger) ANZECC (2000)		Benzene	Toluene	Ethyl-benzene	Xylene			BTEX	Napthalene	TRH Carbon Chain Fractions							Dilsolved Lead
					M,P	O	Total	Total		6 - 10	F1	>10 - 16	>16 - 34	>34 - 40	>10 - 40	F2	
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
LOR		1	2	2	2	2	2	1	5	20	20	100	100	100	100	100	0.001
Investigation Limit		1300				470			37								0.0056
Date Collected	**Water Sample ID**																
28/06/2019	Water 1	<1	<2	<2	<2	<2	<2	<1	<5	<20	<20	<100	<100	<100	<100	<100	<0.001
28/06/2019	Water Duplicate	<1	<2	<2	<2	<2	<2	<1	<5	<20	<20	<100	<100	<100	<100	<100	<0.001

Table 17 Groundwater Results compared against the ANZECC (2000) for Freshwater - 90% Trigger PAHs

Fresh Water (90% Trigger) ANZECC (2000)		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	PAH Sum	Benzo(a)pyrene TEQ (WHO)
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	0.5	0.5
Investigation Limit		37																	
Date Collected	**Water Sample ID**																		
28/06/2019	Water 1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5
28/06/2019	Water Duplicate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5

Table 18 Groundwater Results compared against the ANZECC (2000) for Freshwater - 90% Trigger Metals

Fresh Water (90% Trigger) ANZECC (2000)		Disolvd Metals														
		Arsenic	Beryllium	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Vanadium	Zinc	Boron	Mercury
	UNITS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	LOR	0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.01	0.005	0.05	0.0001
Investigation Limit		0.094			0.0004			0.0018	0.0056	2.5	0.013	0.018		0.015	0.68	0.0019
Date Collected	**Water Sample ID**															
28/06/2019	Water 1	<0.001	<0.001	0.029	<0.0001	<0.001	<0.001	<0.001	<0.001	0.421	<0.001	<0.01	<0.01	<0.005	<0.05	<0.0001
28/06/2019	Water Duplicate	<0.001	<0.001	0.03	<0.0001	<0.001	<0.001	<0.001	<0.001	0.439	<0.001	<0.01	<0.01	<0.005	<0.05	<0.0001

8.2.2 LNAPL Classification

Determining the presence of LNAPL at the site is important for understanding petroleum vapour intrusion risk and refining the conceptual site model. The presence of LNAPL is based on CRC CARE (2013 page 8) guidelines for defining LNAPL based on 20% effective solubility of hydrocarbon concentrations in groundwater (Table 19). Table 19 shows the absence of hydrocarbons in both the primary and duplicate water sample from well RA4. The lack of hydrocarbons confirmed that there was no contamination identified at this location.

Table 19 Summary of Groundwater Concentrations Compared Against CRC CARE (Friebel & Nadebaum, 2011) Guidelines for Assessing for the Presence of LNAPL

Investigation Levels		Benzene	Toluene	Ethyl-benzene	Xylene			BTEX	Napthalene	TPH Carbon Chain Fractions		TRH Carbon Chain Fractions							
Indicates >Laboratory LOR Indicates Likely LNAPL (CRC CARE Tech. Report 23; p8)					M, P Xylene	O Xylene	Total Xylene			C6 - C14	C10 - C14	C6 - C10	C6 - C16	F1	>C10 - C16	>C16 - C34	>C34 - C40	>C10 - C40	F2
UNITS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		1	2	2	2	2	2	1	5	20	50	20	20	20	100	100	100	100	100
Date Collected	**Water Sample**																		
28/06/2019	Water 1	<1	<2	<2	<2	<2	<2	<1	<5	<20	<50	<20	<20	<20	<100	<100	<100	<100	<100
28/06/2019	Water Duplicate	<1	<2	<2	<2	<2	<2	<1	<5	<20	<50	<20	<20	<20	<100	<100	<100	<100	<100

9 SOIL HUMAN HEALTH DIRECT CONTACT ASSESSMENT

9.1 Guidelines

Guidelines presented herein are based on potential exposure of human receptors to soil impact which may include:

- Onsite excavation works which may include basement carpark and deep foundations. Receptors include onsite commercial contractors, offsite residential receptors as well as sensitive land use and recreational receptors;
- Proposed future onsite residential land users which may be exposed to potential shallow soil impact in non-paved areas of the site – not likely given the entire site will be sealed by a concrete carpark;
- Trench workers repairing or building services (typically to 1 m bgs) as assessed against commercial worker guidelines for dermal contact and HIL's.

9.1.1 Land Use Classification

The NEPM (2013) guidelines have been referenced to ensure that the correct land use and density category has been adopted for the site and the surrounding properties (where applicable). As per NEPM (2013) guidelines, the adopted land use class is dependent on the building density and the opportunity for soil access by site occupants (exposure to potentially impacted soil). Aspects needing to be considered include:

- Whether the site is of sensitive land use such as a childcare centre, preschool, primary school or aged care facility in which case land use Class A is applicable;
- The proportion of paved area to determine direct contact exposure risk and therefore classification as low or high density; and
- Classification based on residential, recreational or commercial/industrial setting.

9.1.2 Adopted Land Use Classification

The adopted land use class is presented in Table 20.

Table 20 Summary of Land Use Spatial and Temporal Setting for Determining Exposure Risk

Soil Bores	Construction Phase	Location	Land Use	Pathway	Land Use Class
All soil	Pre	Onsite	Commercial workers	ALL	D
			Trench Workers	ALL	D & Standard
		Offsite - adjacent	High density residential	ALL	B
	During	Site	Commercial workers	ALL	D
			Trench Workers	ALL	D & Standard
		Offsite	High density residential	DI	B
	Post	Site	High density residential	ALL	B
			Commercial workers	ALL	D
			Trench Workers	ALL	D & Standard

* ALL Pathways: including
DC– Dermal Contact – HSL Trench Worker Guidelines (CRC CARE 2013)
DI – Dust Inhalation - HIL Guidelines (NEPM ASC 2013)
SI – Soil Ingestion - HIL Guidelines (NEPM ASC 2013)

9.2 Findings

9.2.1 Dermal Contact - Petroleum Hydrocarbons

Laboratory analytical results are presented in Appendix 10. Table 21 presents soil hydrocarbon analytical results compared against CRC CARE (Friebel & Nadebaum, 2011) Health Screening Levels (HSL) guidelines for assessing dermal contact risk HSL D HSL B and Trench workers. Concentrations which exceeded laboratory LOR are highlighted in bold. HSL exceedances would be highlighted with a coloured cell indicating the highest HSL land used class which is exceeded. Samples in a proposed excavation zone are marked with an X. Note a minimum of 6.6m excavation is proposed, not including service trenches and building footings.

All detections of hydrocarbons were below HSL guidelines. As there is a concrete slab across the sites and the fact that there were no Dermal Contact exceedances, there is no dermal contact risk at the site.

Table 21 Soil Analytical Results Compared Against CRC CARE Guidelines for Dermal Contact – BH01-BH08

CRC CARE Health Screening Level **Dermal Contact Hazard from Soil Hydrocarbons'**		EP080: BTEXN					EP080/071: TRH			
		Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	C6 - C10 Fraction	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		0.2	0.5	0.5	0.5	1	10	50	100	100
HSL B High Density Residential		140	21000	5900	17000	2200	5600	4200	5800	8100
HSL D Commercial/Industrial		430	99000	27000	81000	11000	26000	20000	27000	38000
Intrusive Maintenance Worker		1100	120000	85000	130000	29000	82000	62000	85000	120000
Date	Sample									
28/06/2019	BH01 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH01 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH02 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH02 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH03 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH03 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH04 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH04 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	**170**	<100
28/06/2019	BH05 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH05 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH06 0.5-0.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH06 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH07 0.50-0.60 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	**130**
28/06/2019	BH07 1.5-1.6	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
28/06/2019	BH08 0.50-0.60 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	**150**	**180**
28/06/2019	BH08 1.5-1.6 X	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	**120**	<100

9.2.2 Dust Inhalation & Soil Ingestion

Laboratory analytical results are presented in Appendix 10. Table 22 presents the soil analytical results compared against combined dust inhalation and soil ingestion risk is assessed through the application of NEPM (2013) Health Investigation Levels (HILs) for exposure to soil contaminants. Concentrations which exceeded laboratory LOR would be highlighted in bold, metals are simply reported. HIL exceedances would be highlighted with a coloured cell indicating the highest HIL land used class which is exceeded. Samples within the proposed excavation zone are marked with an X; Note a minimum of 6.6m excavation is proposed, not including service trenches and building footings.

There were no HIL D commercial land use or HIL B high density residential land use, exceedances at the site. A dust inhalation and soil ingestion risk has not been identified at the site.

Table 22 Soil Analytical Results Compared Against NEPM (2013) Health Investigation Limit Guidelines – BH01-BH08

Bold - Indicates LOR Exceedance in Non Metalic Compounds			EA055: Moisture Content	EG005T: Total Metals by ICP-AES														EG035T: Total Recoverable Mercury by FIMS	EP075(SIM)B: Polynuclear Aromatic Hydrocarbons																	
NEPM Health Investigation Levels (HIL's) **Dust Inhalation and Soil Ingestion Assessment** X - Indicates Sample Within Proposed Excavation Zone			Moisture Content	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium Total	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Vanadium	Zinc	Mercury	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	PAHs	Benzo(a)pyrene TEQ (WHO)
Units			%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR			1	5	10	1	50	1	2	2	5	5	5	2	5	5	5	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
HIL B Medium/High Density Residen		☑ HIL B		500		90	40000	150		600	30000	1200	14000	1200	1400		60000	120																	400	4
HIL D Commerial/Industrial		☑ HIL D		3000		500	300000	900		4000	240000	1500	60000	6000	10000		400000	730																	4000	40
Sample date:	Sample ID																																			
28/06/2019	BH01 0.5-0.6 X		12.8	<5	70	<1	<50	<1	4	2	<5	8	211	2	<5	13	8	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH01 1.5-1.6 X		12.8	<5	50	<1	<50	<1	10	11	8	12	470	10	<5	14	28	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH02 0.5-0.6 X		17.6	<5	80	<1	<50	<1	13	3	12	12	15	6	<5	32	24	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH02 1.5-1.6 X		6.9	<5	460	3	<50	<1	15	19	23	10	223	56	<5	33	221	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH03 0.5-0.6 X		7.7	<5	20	2	<50	<1	6	31	<5	56	173	12	<5	9	32	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH03 1.5-1.6 X		16.8	<5	70	<1	<50	<1	9	71	35	311	345	15	<5	34	85	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH04 0.5-0.6 X		20	<5	150	1	<50	<1	10	10	19	63	118	22	<5	20	182	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH04 1.5-1.6 X		20.7	<5	110	<1	<50	<1	7	4	25	126	111	7	<5	16	249	0.4	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	2.0	2.1	1.0	1.0	1.4	0.6	1.2	0.7	<0.5	1.0	**12**	**1.6**
28/06/2019	BH05 0.5-0.6 X		17.5	<5	140	<1	<50	<1	9	7	22	283	216	8	<5	24	264	0.3	<0.5	<0.5	<0.5	<0.5	1.6	0.6	3.0	3.6	2.1	1.7	2.4	0.9	2.1	0.9	<0.5	1.1	**20**	**2.8**
28/06/2019	BH05 1.5-1.6 X		18.7	<5	110	<1	<50	<1	11	5	24	112	162	9	<5	32	98	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH06 0.5-0.6 X		21.9	<5	120	<1	<50	<1	20	9	22	8	63	11	<5	52	16	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH06 1.5-1.6 X		7.6	<5	10	4	<50	<1	7	63	8	6	229	10	<5	6	15	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH07 0.50-0.60 X		2.2	<5	20	<1	<50	<1	4	8	34	28	377	7	<5	19	46	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
28/06/2019	BH07 1.5-1.6		2	<5	120	<1	<50	<1	9	6	21	89	184	7	<5	23	137	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1**	<0.5
28/06/2019	BH08 0.50-0.60 X		2.4	<5	40	<1	<50	<1	5	10	29	52	459	12	<5	14	53	<0.1	<0.5	<0.5	<0.5	<0.5	1.9	<0.5	2.4	2.3	1.0	0.7	1.1	<0.5	1.0	<0.5	<0.5	0.6	**11**	**1.2**
28/06/2019	BH08 1.5-1.6 X		3.9	<5	30	<1	<50	<1	14	15	18	9	179	23	<5	30	54	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

10 INDOOR INHABITANT PVI ASSESSMENT – HSL's

The indoor vapour risk could not be assessed from the soil samples collected because they were not taken from below the proposed buildings footing. Despite this, a limited groundwater assessment could be conducted.

10.1 Guidelines

This PVI assessment has been conducted in accordance with relevant CRC CARE Technical Documentation and NEPM 2013 guidelines presented in references section of this report. The HSL assessment approach is generally the first (Tier 1) investigation phase adopted for assessing PVI risk at petroleum hydrocarbon (PHC) impacted sites. HSL guidelines have been applied for samples collected from the site to account for risks that may be associated with volatile hydrocarbon vapour intrusion into confined spaces where there may be an inhalation risk through longer term exposure. This does not constitute a full vapour risk assessment but provides additional information from which to further quantify any risk.

A detailed investigation (Tier 2 to 3) is recommended over an HSL assessment where an acute risk has been identified at the site (CRC CARE 2013) because of:

- Migrating product on surface soils beneath buildings;
- Strong PHC odours;
- Flammable risk in confined spaces; and/or
- Health complaints from occupants.

Based on the site visits, none of the above conditions have been identified at the site. If the outcome of this Tier 1 assessment reveals HSL exceedances for hydrocarbon vapour intrusion, a more detailed (Tier 2) assessment will be required to further evaluate the human health risk.

PVI risk is initially interpreted through the development of HSL threshold limits from the following classifications:

- The geology and or hydrogeology of the investigation point; and
- Land use sensitivity:

The resulting HSL threshold limits are compared with laboratory analytical results.

10.2 Selected Media for Assessing PVI Risk

Table 23 presents a summary of the preferred HSL approach to assessing PVI risk. In this case, all soil investigated was within the excavation zone and within the water table.

Table 23 Preferred Methods for Determining Site PVI Risk

Media Analysed	Method	Limitations	Order of Preference
Soil Gas	Concentrations of a soil gas through a soil vapor probe	This approach provides the most reliable data in interpreting PVI risk, although direct modelling should be applied if concentrations exceed HSL threshold limits.	Primary
Groundwater	Concentrations of PHC in groundwater through deployment of monitoring wells	More robust and reliable that soil in determining onsite and in particular, offsite risks. Determining PVI risk based on groundwater is inherently conservative when interpreting vapour risk to account for not readily discernible preferential pathways. Reference may be drawn to alternative assessment approaches: 1) Application of site-specific conditions to the CRC CARE model for assessing PVI risk 2) Soil gas interpretation for areas where a PVI risk is identified from groundwater analysis.	Secondary
Soil	Concentrations of PHC in soil	Concentrations in soil may be subject variability due to soil moisture, organic content and oxygen ingress all which create significant bias in threshold values. Reliance is place on utilizing groundwater analysis over soil. Soil results provide localised information.	Tertiary

10.3 Groundwater

Groundwater sampling results, Certificate of Analysis is presented in Appendix 10. Groundwater has been assessed against the elected NEPM ASC health screening levels (HSL) to determine potential hydrocarbon vapour risks to site users. Specific grain, depth and land use classes as well as nominated guideline limits are presented in Table 24.

Due to the shallow nature of groundwater there are no guideline limits and it is not be possible to conduct an accurate assessment using the current approach however result did proved that there were no volatile hydrocarbons present in the groundwater; which concludes that no vapour risk has been identified.

Table 24 Summary of Groundwater Samples That Exceeded Threshold HSL Limits

NEPM (ASC) 2013 Schedule B1 **Groundwater HSL's for Assessing Vapour Intrusion Risk**						Benzene	Toluene	Ethylbenzene	Xylene	Naphthalene	F1	F2
Units						µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR						1	2	2	2	5	20	100
Water Sample ID	Date	Groundwater Depth Class (m)	Grain Class	HSL								
Water 1	28/6/19	<2	CLAY	D	Limit	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					Result	<1	<2	<2	<2	<5	<20	<100
Water Duplicate	28/6/19	<2	CLAY	D	Limit	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					Result	<1	<2	<2	<2	<5	<20	<100

#N/A - Requires alternative assessment approach if PHC identified ie. soil vapour assessment
NL – Non Limiting applicable as any derived HSL will exceed analyte solubility limit

11 TRENCH WORKER PVI ASSESSMENT – HSL's

11.1 Classification

The following Health Screening Assessment is based on hydrocarbon vapour intrusion risk to subsurface excavation workers within excavations. This is assessed through analysis of vapours from soil and soil vapours. Groundwater is generally not used to assess risk as threshold limits for all depth and grain classes are non-limiting. Land use classes are not applicable when assessing vapour intrusion into trenches.

Soil and soil vapour HSL's for assessing hydrocarbon risk to maintenance workers are based on CRC CARE Technical Report 10 guidelines (Friebel & Nadebaum 2011) and the following variables:

- Dominant grain size class of material at the soil sample depth or based on the dominant grain class of the backfill material based on US Agriculture Soil Classification System (SCS) and partitioning into either sand, silt or clay; and
- Classifying soil according to depth ranges: 0 to 2 m; 2 to 4 m; 4 to 8 m; and greater than 8 m;

11.2 Findings

Laboratory analytical results are presented in Appendix 10. Summary of Soil Analytical Results Compared against HSL's for Assessing PVI Risk to Trench Workers are presented in Table 25. Concentrations that exceeded laboratory LOR would be highlighted in bold, and if there were any HSL exceedances they would be highlighted with a coloured cell. There were no exceedances of the CRC CARE HSL guidelines for Assessing PVI Risk to Trench Workers and no risk identified.

Table 25 Summary of Soil Analytical Results Compared against HSL's for Assessing PVI Risk to Trench Workers – BH01-BH08

CRC CARE Health Screening Level Assessment for PHC Inhalation Risk To Trench Workers From Soil Sample Analysis				EP080: BTEXN					EP080/071: TRH	
Bold - Indicates LOR Exceedances **Dark Grey Shading - Indicates HSL Exceedances: >1 x, * 2-5 x, ** 5-20 x, *** 20-50 x, **** >50 x**				Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	C6 - C10 Fraction	>C10 - C16 Fraction
Sample ID	Sample Date	Depth Class	Grain Class	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				LOR 0.2	LOR 0.5	LOR 0.5	LOR 0.5	LOR 1	LOR 10	LOR 50
BH01 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH01 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH02 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH02 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH03 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH03 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH04 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH04 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH05 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH05 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH06 0.5-0.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH06 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH07 0.50-0.60	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH07 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH08 0.50-0.60	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50
BH08 1.5-1.6	28/06/2019	4 to 8m	CLAY	<0.2	<0.5	<0.5	<0.5	<1	<10	<50

12 SOIL DISPOSAL ASSESSSMENT

12.1 Guidelines

Soil which is excavated from the site for landfill disposal is to be assessed against Information Bulletin 105 (IB105) for Classification and Management of Contaminated Soil for Disposal, Version 3 2018. The Environmental Protection Authority (EPA) uses 4 categories to classify contaminated soil as per Table 26:

- (Level 1) Fill Material;
- (Level 2) Low Level Contaminated Soil;
- (Level 3) Contaminated Soil; and
- (Level 4) Contaminated Soil.

Fixed numerical values are presented for soil concentrations and leachable fraction concentrations.

Table 26 Summary of IB105 Classification Guidelines

	Classification (with reference to Table 2)	**Controlled Waste**[1]	**Comments**
Fill Material[2] **(Level 1)**	Soil that exhibits levels of contaminants below the limits defined under *Fill Material* in Table 2.	Unlikely	Soil classified as *Fill Material* can still be a 'pollutant' under the *Environmental Management and Pollution Control Act 1994* and needs to be responsibly managed.
Low Level Contaminated Soil **(Level 2)**	Soil that exhibits levels of contaminants above the limits defined under *Fill Material* but below the limits defined under *Low Level Contaminated Soil* in Table 2.	Likely	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil **(Level 3)**	Soil that exhibits levels of contaminants above the limits defined under *Low Level Contaminated Soil* but below the limits defined under *Contaminated Soil* in Table 2.	Yes	Where leachable concentrations have not been prescribed, maximum total concentrations will be used to classify the soil.
Contaminated Soil for Remediation **(Level 4)**	Soil that exhibits levels of contaminants above the limits defined under *Contaminated Soil* in Table 2 (regardless of the maximum total concentrations) is generally ***not*** considered acceptable for off-site disposal without prior treatment.	Yes	Soil that contains contaminants that do not have criteria for leachable concentrations (*e.g.* petroleum hydrocarbons), and the levels of contaminants exceed the maximum total concentrations listed in *Contaminated Soil*, are generally classified as *Contaminated Soil for Remediation*.

[1] Controlled Waste is defined in the *Environmental Management and Pollution Control Act 1994*.
[2] Criteria for *Fill Material* are the limits set by the Director for the purposes of R.9(2)(a)(ii) in the *Regulations*.

12.2 Findings

The soil samples were compared against IB105 guidelines for potential future soil disposal, see Table 27. The following heavy metals were detected at levels which classified the material as Level 2 Material; Barium, Beryllium, lead and zinc. The sum of PAH's was Level 2 as a result from the present of the B(a)p. Due to the concentrations B(a)p was classified as Level 3. Post leachate analysis the presence of B(a)p, the material could be reclassified as Level 2 Material.

As half of the samples could have been classified as Level 1 Material – Clean fill; when future excavations take place at the site, all material should be stockpiled, samples collected by an environmental consultant and results compared against IB105 for appropriate soil disposal.

Table 27 Soil Analytical Results Compared Against IB105 Dry Weight Concentration Investigation Limits for soil Disposal – BH01-BH08

Information Bulletin 105 **Classification and Management of Contaminated Soil For Disposal**		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Sum of polycyclic aromatic hydrocarbons	Benzene	Toluene	Ethylbenzene	Total Xylenes
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		5	10	1	1	2	5	2	5	5	0.1	2	5	5	0.5	10	50	0.5	0.2	0.5	0.5	0.5
Investigation Level Selected																						
IB105 Level 1		<20	<300	<2	<3	<50	<100	<100	<300	<500	<1	<60	<10	<200	<0.08	<65	<1000	<20	<1	<1	<3	<14
IB105 Level 2		20	300	2	3	50	100	100	300	500	1	60	10	200	0.08	65	1000	20	1	1	3	14
IB105 Level 3		200	3000	40	40	500	2000	200	1200	5000	30	600	50	14000	2	650	5000	40	5	100	100	180
IB105 Level 4		750	30000	400	400	5000	7500	1000	3000	25000	110	3000	200	50000	20	1000	10000	200	50	1000	1080	1800
28/06/2019	BH01 0.5-0.6 X	<5	70	<1	<1	4	<5	2	8	211	<0.1	2	<5	8	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH01 1.5-1.6 X	<5	50	<1	<1	10	8	11	12	470	<0.1	10	<5	28	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH02 0.5-0.6 X	<5	80	<1	<1	13	12	3	12	15	<0.1	6	<5	24	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH02 1.5-1.6 X	<5	460	3	<1	15	23	19	10	223	<0.1	56	<5	221	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH03 0.5-0.6 X	<5	20	2	<1	6	<5	31	56	173	<0.1	12	<5	32	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH03 1.5-1.6 X	<5	70	<1	<1	9	35	71	311	345	0.7	15	<5	85	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH04 0.5-0.6 X	<5	150	1	<1	10	19	10	63	118	0.2	22	<5	182	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH04 1.5-1.6 X	<5	110	<1	<1	7	25	4	126	111	0.4	7	<5	249	1.2	<10	210	11.8	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH05 0.5-0.6 X	<5	140	<1	<1	9	22	7	283	216	0.3	8	<5	264	2.1	<10	<50	20	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH05 1.5-1.6 X	<5	110	<1	<1	11	24	5	112	162	0.5	9	<5	98	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH06 0.5-0.6 X	<5	120	<1	<1	20	22	9	8	63	<0.1	11	<5	16	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH06 1.5-1.6 X	<5	10	4	<1	7	8	63	6	229	<0.1	10	<5	15	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH07 0.50-0.60 X	<5	20	<1	<1	4	34	8	28	377	<0.1	7	<5	46	<0.5	<10	120	<0.5	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH07 1.5-1.6 X	<5	120	<1	<1	9	21	6	89	184	0.2	7	<5	137	<0.5	<10	<50	1.2	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH08 0.50-0.60 X	<5	40	<1	<1	5	29	10	52	459	<0.1	12	<5	53	1	<10	130	11	<0.2	<0.5	<0.5	<0.5
28/06/2019	BH08 1.5-1.6 X	<5	30	<1	<1	14	18	15	9	179	<0.1	23	<5	54	<0.5	<10	<50	<0.5	<0.2	<0.5	<0.5	<0.5

Table 28 Soil Analytical Results Compared Against IB105 Leachable Fractions Investigation Limits for soil Disposal – BH01-BH08

Information Bulletin 105 **Classification and Management of Contaminated Soil For Disposal** **Leachable Fraction** *Italic*/* - Based On Soil (Total) Limit **Bold** - Based On Leach Limit		Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Copper	Cobalt	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzo(a)pyrene	C6 - C9 Fraction	C10 - C36 Fraction (sum)	Benzene	Toluene	Ethylbenzene	Total Xylenes
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L			µg/L	µg/L	µg/L	µg/L
LOR		0.1	0.1	0.05	0.05	0.1	0.1		0.1	0.1	0.001	0.1	0.1	0.1	0.5			1	2	2	2
Investigation Level Selected																					
IB105 Level 1																					
IB105 Level 2		<0.5	<35	<1	<0.1	<0.5	<10		<0.5	<25	<0.01	<1	<0.1	<25	<0.5			<50	<1400	<3000	<5000
IB105 Level 3		0.5	35	1	0.1	0.5	10		0.5	25	0.01	1	0.1	25	0.5			50	1400	3000	5000
IB105 Level 4		5	350	4	0.5	5	100		5	250	0.1	8	1	250	5			500	14000	30000	50000
28/06/2019	BH01 0.5-0.6 X																				
28/06/2019	BH01 1.5-1.6 X																				
28/06/2019	BH02 0.5-0.6 X																				
28/06/2019	BH02 1.5-1.6 X		*	*										*							
28/06/2019	BH03 0.5-0.6 X			*																	
28/06/2019	BH03 1.5-1.6 X								*												
28/06/2019	BH04 0.5-0.6 X																				
28/06/2019	BH04 1.5-1.6 X													*	*						
28/06/2019	BH05 0.5-0.6 X													*	**<0.5**						
28/06/2019	BH05 1.5-1.6 X																				
28/06/2019	BH06 0.5-0.6 X																				
28/06/2019	BH06 1.5-1.6 X			*																	
28/06/2019	BH07 0.50-0.60 X																				
28/06/2019	BH07 1.5-1.6																				
28/06/2019	BH08 0.50-0.60 X														*						
28/06/2019	BH08 1.5-1.6 X																				

Note: BH05 0.5-0.6 was the only sample re-tested. Leachable fraction analysis will take precedence over soil analysis when calculating IB105 Limits. There are no leachable fraction investigation limits for certain compounds eg. Cobalt, and therefore the solids limit is applied. Where solid Level 2 or greater exceedances are present, these are represented with a * in the sheet. Leachable fraction limits are not available for Level 1 classification, and therefore a minimum leachable fraction Level 2 limit is applied if the solid results exceed Level 1 guideline limits for solids, alternatively Level 1 is applied

13 CONCEPTUAL SITE MODEL

13.1 Primary Sources of Contamination

13.1.1 Confirmed Primary Source

Primary sources of contamination have not been confirmed onsite.

13.1.2 Potential Primary Sources

The following onsite potential primary source contaminating activities have been identified;

- Metal Works - iron /steel works – White Houses Foundry – 1822-1831;
- A total of two former USTs associated with RACTs refuelling infrastructure.

The following offsite and upgradient potential primary source contaminating activities have been identified;

- Former BP service station at 195-205 Murray Street, 80m upgradient of the site;
- Former City Cabs Co-Operative Society at 215-217 Harrington Street, 160m upgradient from the site.

Both invasive soil and groundwater investigations; SEMF 2009 and the current investigation have not identified concerning levels of contamination in soil or groundwater from either onsite or offsite potential up gradient primary sources.

13.1.3 Contaminates of Potential Concern

Contaminants of potential concern associated with these potential sources have already been identified in a previous section.

13.2 Secondary Sources of Contamination

Secondary source contamination includes impacted soil, groundwater, surface water and vapour which may originate from a primary source. Secondary sources may have a direct pathway linkage to receptors of interest.

13.2.1 Confirmed Secondary Source

The following confirmed secondary sources of contamination has been identified on site:

- Slightly elevated metals in soil likely to be from the former iron and steel works.
- Traces of hydrocarbons in the soil derived from former fuel storage at the site.

Both sources (metal works and underground infrastructure) have been removed and therefore ongoing contamination is unlikely.

13.2.2 Potential Secondary Source

Since 2008, the site investigations have been thorough, and no other potential secondary sources of contamination is anticipated at the site.

13.3 Potential Receptors

For this assessment, 'receptors' include persons, structures, utilities, ecological receptors, shallow groundwater and water supply wells that are, or may be, adversely affected by the contaminants of concern. ALL onsite potential receptors have been considered here.

13.3.1 Potential Onsite Receptors

Potential onsite receptors include:

- Commercial workers and trench workers developing the site;
- Proposed future commercial users on the ground floor level of the site;
- Residential receptors inhabiting all levels from level 1 and up;
- All people using the basement carpark (visitors, residences, commercial workers)
- Terrestrial ecosystems at the site under the proposed building footprint, groundwater.

13.3.2 Potential Offsite Receptors

Potential offsite receptors include:

- Commercial workers in the neighbouring commercial buildings, during and post construction;
- Trenchworkers working immediately adjacent to the site.
- Residential receptors on the adjacent properties directly to the north;
- The River Derwent is the closest ecological receptor which is 1km to the southeast.

13.4 Transport Mechanisms and Exposure Pathways

Transport Mechanisms considered as part of the CSM are presented in Figure 10 and include:

- Wind erosion/ dispersion
- Stormwater/ surface runoff
- Leaching of heavy metals from the soil
- Volatile hydrocarbon vapours sourcing from contaminated groundwater.

Exposure Pathways considered at the site are presented in Figure 10 and include:

- Dermal contact
- Dust Inhalation and Soil Ingestion
- Vapour intrusion; and
- Stormwater drains.

13.5 Identified Receptors

The following presents a summary of all potential receptors considered in the assessment.

13.5.1 Potential Ecological Receptors

Groundwater is the only onsite ecological receptor, given the urban setting. The following offsite ecological receptors have been identified:

- Hobart Rivulet – 600m from the site
- River Derwent – 1 km from the site

There were no groundwater guideline exceedances but as there were soil ESL/ EIL exceedances identified at the site. This means that there is a low risk of impacted soil entering waterways through uncontrolled/unmanaged release of soil into the stormwater system, during high rainfall events. This will need to be managed through a dedicated CMP.

13.5.2 Potential Human Receptors

Potential current and future onsite and offsite human receptors are depictured in **Error! Reference source n ot found.** and discussed in Table 29.

13.5.3 Potential Pathways

A potential pathway is a pathway that may be present and has not been ruled out as yet.

The following potential pathways have been identified:

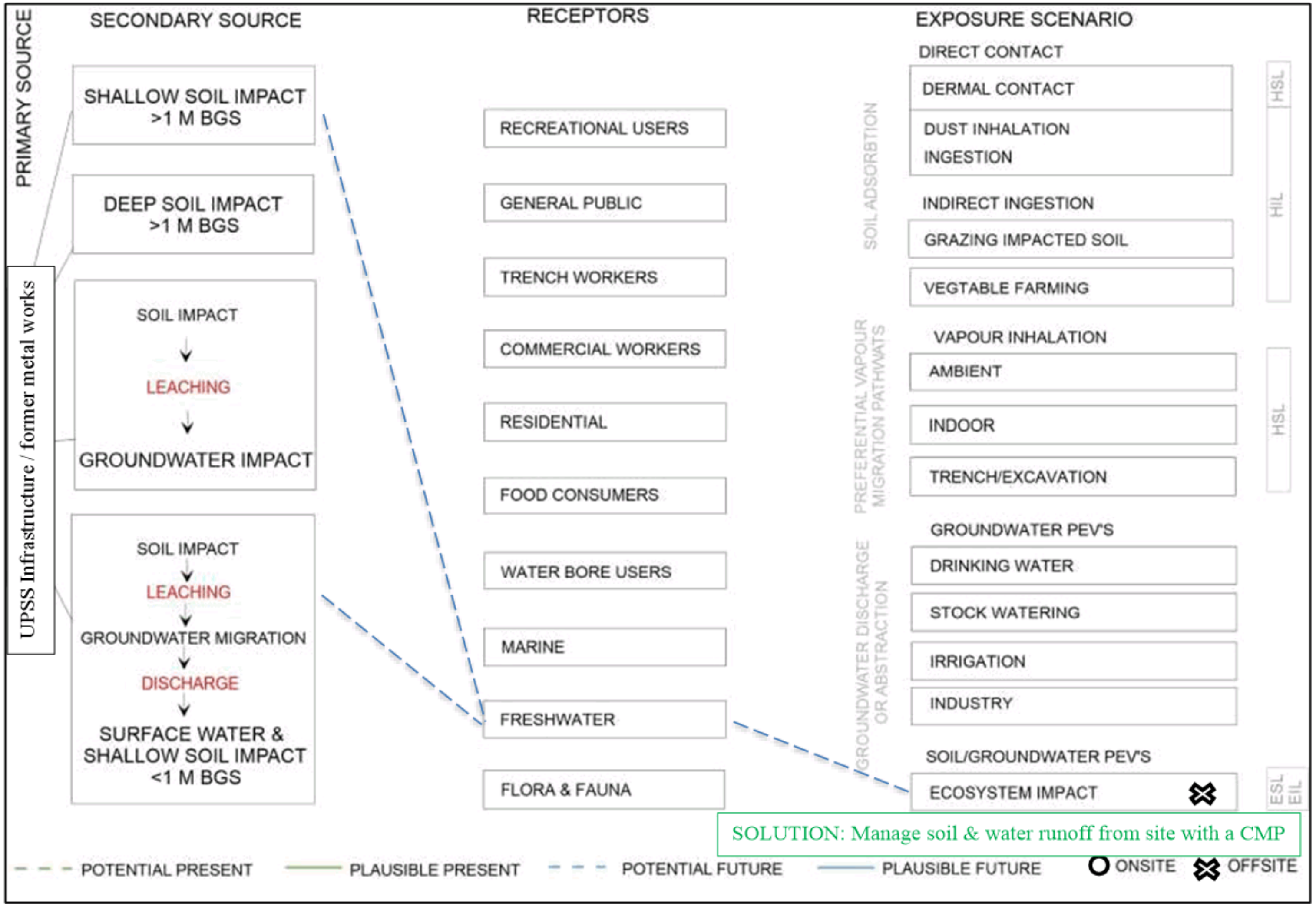
- There is a potential pathway for shallow impacted soil (exceeding ESL's & EIL's) to erode/discharge offsite. Provided that a soil and water management guidelines in the CMP is put in place and followed it is unlikely to present a risk and become a plausible contaminant exposure pathway.

13.5.4 Plausible Contaminant Exposure Pathway Details

A plausible pathway is an exposure pathway that has been identified and there is a risk to the receptor. Plausible contaminant exposure pathway has not been identified.

Table 29 Explanatory Notes Regarding Potential Receptors

Medium	**Specific Receptor**	**Exposure risk/ Management Strategies**
Soil Impact (shallow 0-1m)	Current Commercial Workers on and off site	No HSL or HIL exceedances identified plus no risk to current commercial workers in surrounding buildings as under regular circumstances have no opportunity to come in contact with soil as the site is a sealed carpark.
	Future construction workers and trench workers	Limited contamination has been identified in the soil with no HSL or HIL exceedances. As a precautionary measure a Contamination Management Plan (CMP) should be developed to manage soil and water on the site during the site redevelopment as there were ESL and EIL exceedances.
	Future onsite inhabitants - commercial workers and residence	With no HSL or HIL exceedances and the assumption that once the site redevelopment has been completed the concrete lower level basement carpark will act as a barrier to any potential vapours or direct contact from the soil.
	Off-site Human Receptors during the construction phase	There were no HIL exceedances for dust inhalation and soil ingestion risk, however as a precaution soil will be managed with the CMP.
Soil Impact (deep >1m)	Future construction workers and trench workers	Limited contamination has been identified in the soil and no risk to construction workers or trench workers has been identified. Shallow rock should limit spread of heavy metal contamination.
	Future onsite inhabitants - commercial workers	With no HSL or HIL exceedances and the assumption that once the site redevelopment has been completed the contaminated material will be removed and sealed by a concrete lower level basement carpark, thus eliminating the soil contact risk to future site users. A vapour risk to onsite users was not identified.
Groundwater Impact	Vapour risk to future residence and commercial workers	Although the groundwater investigation was limited to one monitoring well, there was no contaminated groundwater identified and there were no groundwater guideline exceedances.



SOLUTION: Manage soil & water runoff from site with a CMP

Figure 10 Conceptual Site Model Identifying Contamination Source, Receptors and Transport Mechanisms/Exposure Routes

14 CONCLUSIONS

14.1 Desktop Assessment

The following conclusions were made from the desktop assessment following a review of the historical aerial photographs, the WorkSafe Tasmanian Dangerous Goods records, and previous site investigations plus consultation with the Hobart City Council has confirmed the following:

- The site is zoned *Commercial land use* under the Tasmanian Interim Planning Scheme (2015).
- The site is underlain by a mix of quaternary aged sediments alluvium, tertiary boulder deposits and underlying Triassic sandstone and siltstone.
- The site is approximately 24 m above sea level and situated in a shallow dipping area which is prone to receiving flood waters during high rainfall events. The entire site is sealed with either asphalt or concrete in the workshop. All surface waters will be diverted into stormwater drains. Groundwater is inferred to be directed towards the southeast with the same aspect as the surface topography, towards the River Derwent which is 1 km away
- The Hobart City Council confirmed that the site is listed as a potentially contaminated site; as it hosted the activity of an iron /steel works – White Houses Foundry – 1822-1831.
- The site hosted fuel storage in two underground fuel tanks which were removed in 2008, supervised by SEMF and reported in the *Environmental Site Assessment (Including Tank Decommissioning) Report* produced by SEMF Jan 2009 which concluded *'based on soil contamination, the site is considered suitable for continued commercial use and redevelopment'*.
- The Hobart City Council also confirmed as noted in the historical aerial photographs that 195-205 Murray Street is a potentially contaminated site as it formally hosted a BP Service Station, from 1964 to around the mid 1990's, the exact year of change of use is unknown. It is situated 80m northwest of the site and now hosts Tasmanian Bakeries retail outlet, office spaces and a warehouse.
- The site at 215-217 Harrington Street, has been identified as a potentially contaminated site but no contamination from Harrington Street was confirmed onsite in the ESA (SEMF, 2009) or the current investigation.
- The following contaminants of potential concern (COPC) associated with underground fuel storage, dispensing infrastructure, workshop and vehicle servicing activities plus iron and steel works have been identified on site:
  - Total Petroleum/Recoverable Hydrocarbons (TPH/TRH);
  - Mono Aromatic hydrocarbons: Benzene, Toluene, Ethylbenzene, Xylene (BTEX);
  - Polycyclic Aromatic Hydrocarbons (PAH) including Benzo(a)pyrene (B(a)p) and
  - Suite of 15 Heavy Metals

14.2 Adopted Land Use Settings

The following investigation limits/guidelines were adopted for the site for the proposed development:

- Ecosystem – although no ecological receptors have been identified near the site, as a conservative measure, the following guidelines were adopted:
  - Soil – Commercial/Industrial and urban/residential land uses - EILs and ESLs
- Human health risks during site redevelopment:
  - Trench worker guidelines for assessing dermal contact risk;
  - HSL D for vapour intrusion risk to onsite commercial workers and offsite commercial workers;
  - HSL A for vapour intrusion risk to offsite residence;
  - HSL B CRC CARE) for assessing dermal contact risk to offsite receptors;
  - HSL D (CRC CARE) for assessing dermal contact risk to onsite commercial workers and offsite receptors; and
  - HIL D for assessing dust inhalation and soil ingestion risk to onsite commercial worker.
- Human health risks for ongoing site use; noting that there will be no opportunity for site users to come in contact with soil and that the two basement carpark levels plus the ground floor level for commercial purposes will act as a vapour barrier:

  - HSL D for vapour intrusion risk to onsite commercial workers – Ground floor Level.Note that although there are residential apartments proposed; there is sufficient space between Level 1 which is the first floor that will house residential users and the lower basement level where potential vapours would be most likely.

14.3 Assessment Findings

The following conclusions have been made from the soil and groundwater investigation:

Environment

- There were elevated levels of Benzo(a)pyrene in BH04, BH05 and BH08 which exceeded ecological screening levels. There were elevated levels of zinc in BH02, BH04, BH05 and BH07. This means that despite the absence of close sensitive ecological receptors a Contamination Management Plan (CMP) will be required during the site redevelopment to manage the potential leaching of contaminates into the groundwater.

Human Health

- There were no guideline exceedances for soil direct contact for dermal contact, dust inhalation or soil ingestion for commercial/industrial land use, urban residential or trench workers. Combined with the fact that post site redevelopment the site will be completely sealed and there will be no opportunity to come in contact with soil there is no direct contact risk to future construction works or site users.
- In the soil samples and the one groundwater sample tested it was confirmed that there were no volatile hydrocarbons or LNAPL detected. Therefore, no vapour risk to construction workers, trenchworks or future site uses has been identified.
- Although the site has a proposed multilevel residential development there are three levels between the ground surface and Level 1 'First Floor Apartments'. 'Basement Plan – Lower', 'Basement Plan – Upper' and 'Ground floor Plan' - street level would act as a substantial vapour barrier if vapours had been detected.

Excavated Soil Management

- The soil samples were compared against IB105 guidelines for soil disposal. The following heavy metals were detected at levels which classified the material as Level 2 Material; Barium, Beryllium, lead and zinc. The sum of PAH's was Level 2 as a result from the present of the B(a)p. Due to the concentrations B(a)p was classified as Level 3. Post leachate analysis the presence of B(a)p, the material could be reclassified as Level 2 Material. As half of the samples could have been classified as Level 1 Material – Clean fill; when future excavations take place at the site, all material should be stockpiled, samples collected by an environmental consultant and results compared against IB105 for appropriate soil disposal.

Groundwater Observation

- Groundwater appears to be under pressure at the site because although it was encountered at 0.3m below the surface in RA4 it was not encountered in any of the soil bores or geotechnical bores (to be reported separately in GES, 2019); which end at 2.0, 8.4 or 9.5m bgs. Sloane 2009 installed slotted pipe to capture groundwater in RA4 between 14-17m bgs. It is likely that this is where groundwater is encountered under pressure.

15 RECOMMENDATIONS

GES considers that substantial data regarding the site contamination has been acquired during desktop investigation and the invasive site assessment and recommends the following to manage the soil on site during construction:

- A Contamination Management Plan (CMP) will be required to manage soil/ water run off during construction to ensure contaminated soil or surface water does not enter the open drain/ waterway, to the east of the site.
- As some metals exceeded Level 1 Material classification; it is recommended that all excavated soil removed during the site redevelopment is stockpiled, sampled by a suitably qualified and experienced environmental consultant and results compared against *IB105* guideline limits for disposal purposes.
- If deemed necessary, it is to be transported to a Level 2 waste facility (Copping). A permit to transport the waste (obtained through the EPA) will be required.
- If the site use changes to a more sensitive land use and or building designs change then the results will need to be compared against the applicable land use guidelines and / or further onsite soil, groundwater or soil vapour investigations may be required.

15.1 Statement of Suitability

The findings from the invasive soil and limited groundwater investigation can confirm that contamination at the site will not present a risk to Human Health. Low level contamination may pose a risk to the Environment (ecological receptors) if not managed.

Therefore, providing the above recommendations are followed in relation to the environment GES can confirm that the planned excavation works and proposed future site use will not adversely impact on human health or the environment.

No additional contamination remediation or management measures will be required during the site redevelopment works.

Yours faithfully,

Sarah Joyce

Sarah Joyce BSc (Hons)
Environmental Scientist

REFERENCES

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LIMITATIONS STATEMENT

This ESA Report has been prepared in accordance with the scope of services between Geo-Environmental Solutions Pty. Ltd. (GES) and HBV Architects P/L on behalf of their client. To the best of GES's knowledge, the information presented herein represents the Client's requirements at the time of printing of the Report. However, the passage of time, manifestation of latent conditions or impacts of future events may result in findings differing from that described in this Report. In preparing this Report, GES has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations referenced herein. Except as otherwise stated in this Report, GES has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

The scope of this study does not allow for the review of every possible soil and groundwater contaminant over the whole area of the site. Samples collected from the investigation area are assumed to be representative of the areas from where they were collected and indicative of the contamination status of the site at that point in time. The conclusions described within this report are based on these samples, the results of their analysis and an assessment of their contamination status.

This report does not purport to provide legal advice. Readers of the report should engage professional legal practitioners for this purpose as required.

No responsibility is accepted for use of any part of this report in any other context or for any other purpose by third party.

Note If the land use changes to a more sensitive land use then soil results will need to be compared against alternative guidelines or further site investigations maybe required.

Appendix 1 GES Staff

GES is a specialist geotechnical and environmental consultancy providing advice on all aspects of soils, geology, hydrology, and soil and groundwater contamination across a diverse range of industries.

Geo Environmental Solutions Pty Ltd:

- ACN – 115 004 834
- ABN – 24 115 004 834

GES STAFF - ENGAGED IN SITE INVESTIGATION WORKS

Dr John Paul Cumming B.Agr.Sc (Hons) Phd CPSS GAICD

- Principle Author and Principle Environmental Consultant
- PhD in Environmental Soil Chemistry from the University of Tasmania in 2007
- 18 years' experience in environmental contamination assessment and site remediation.

Ms Sarah Joyce BSc (Hons)

- Environmental Geologist
- Honours in Geography and Environmental Science at the University of Tasmania in 2003;
- Undergraduate Degree Double Major in Geology and Geography & Environmental Science
- 15 years professional work experience and 7 years contaminated site assessment

Mr Grant McDonald (Adv. cert. hort.)

- Soil Technician
- 10 years' experience in hydrocarbon and heavy metal contamination sampling of soils and groundwater.

Ms Peri Lucas B.Agr.Sc (Hons)

- Agricultural Soil Scientist
- 1 Year experience in contamination assessment of soils.

GES STAFF – WITH CONTAMINATED SITES EXPERIENCE

Mr Kris Taylor Bsc (Hons)

- Senior Environmental & Engineering Geologist
- Honours in Environmental Geology at the University of Tasmania in 1998
- 20 years' experience in environmental contamination assessments and hydrogeology (including honours in mine site tailing pollution assessment). Including 15 years' experience in asbestos assessment.

Mr Aaron Plummer (Cert. IV)

- Soil Technician
- 5 years' experience in hydrocarbon and heavy metal contamination sampling of soils and groundwater.

Mr Mark Downie B.Agr.Sc (Hons)

- Soil Scientist
- 8 Year experience in contamination assessment and reporting of soils and groundwater.

Ms Peri Lucas B.Agr.Sc (Hons)

- Soil Scientist
- 2 Year experience in contamination assessment and reporting of soils and groundwater.

Appendix 2 Architects Design

SITE CONTECT PLAN
1:1000

PATRICK STREET ELEVATION
1:400

NOT FOR CONSTRUCTION

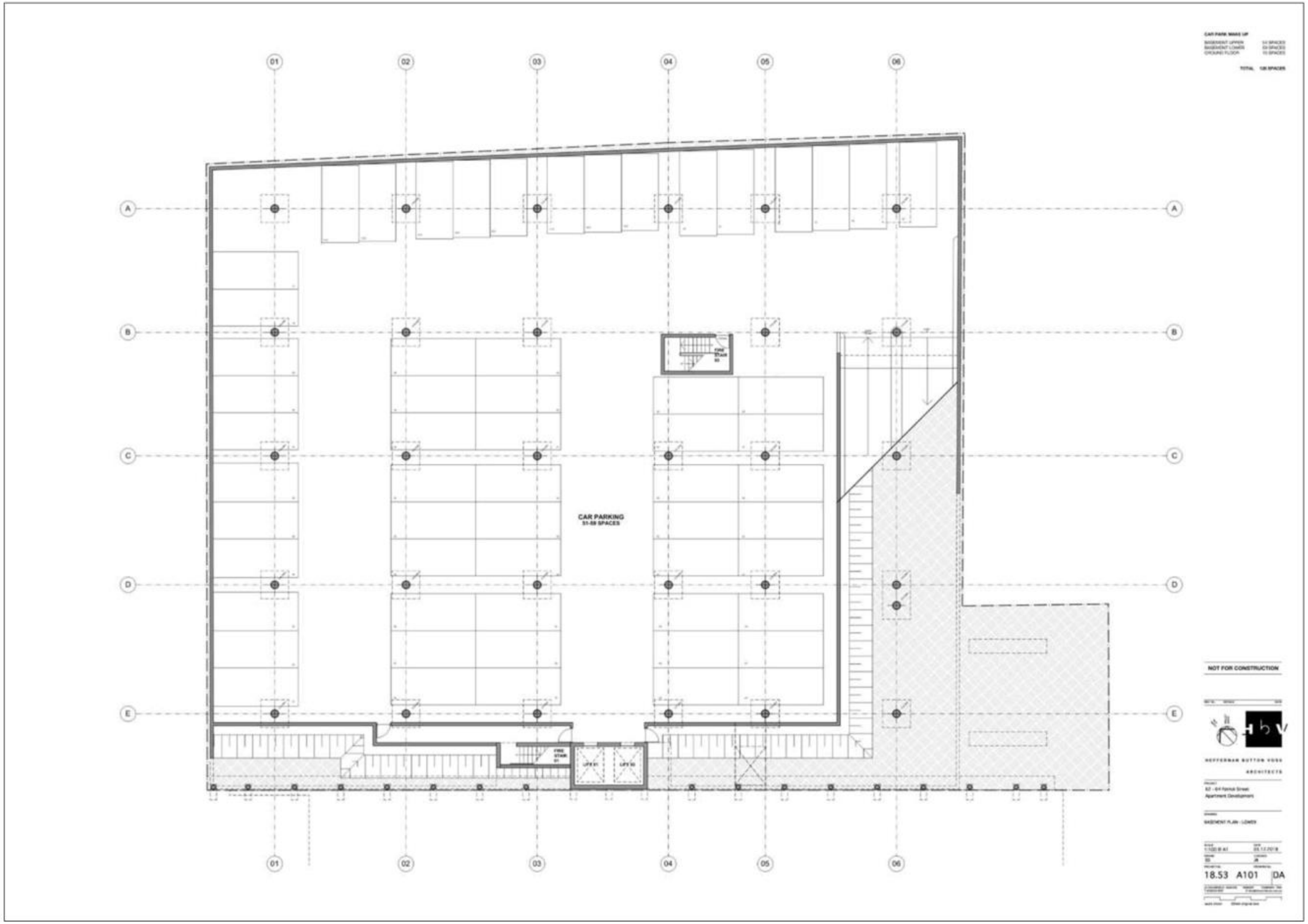
HEFFERNAN BUTTON VOSS
ARCHITECTS

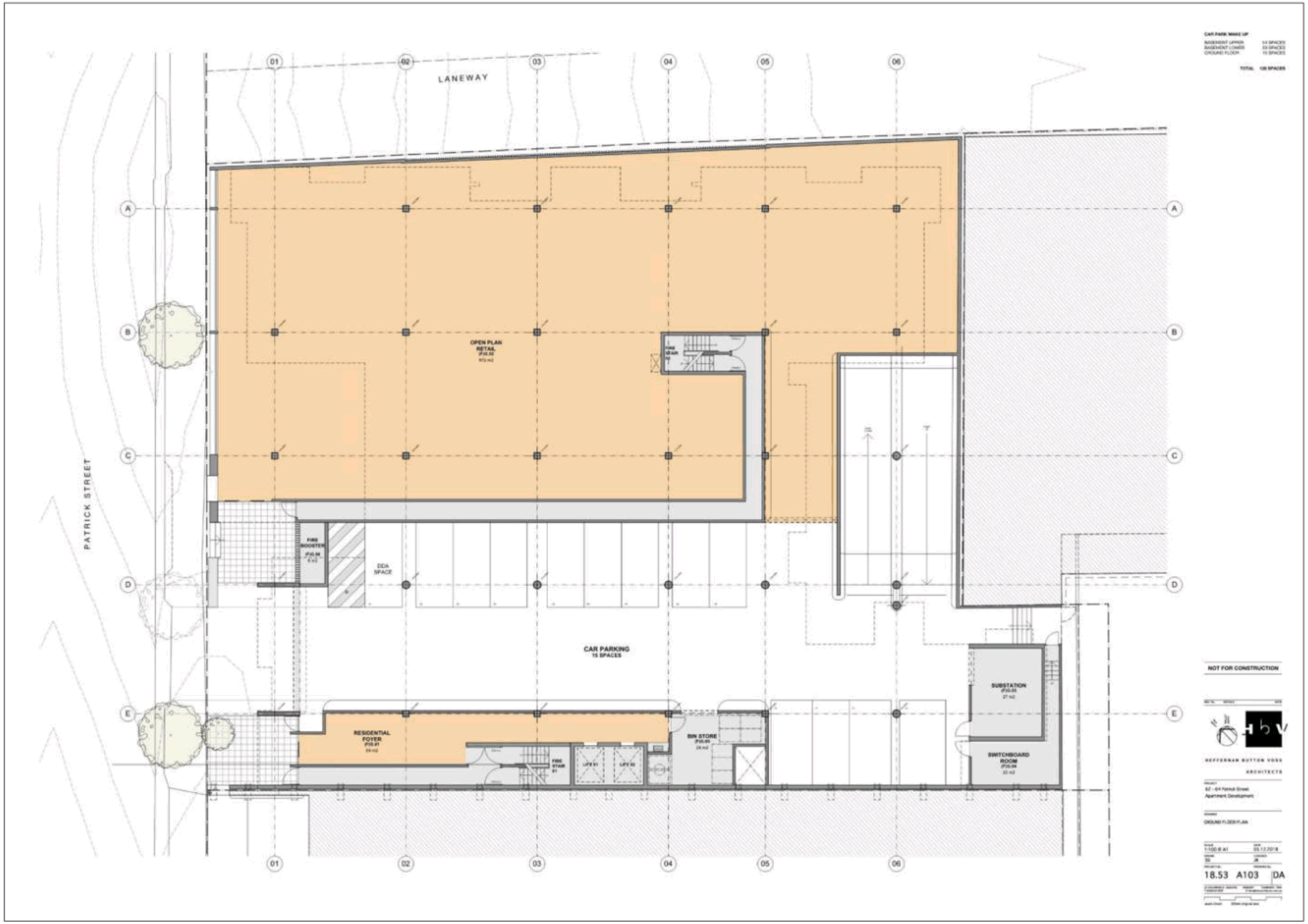
67 - 69 Patrick Street
Apartment Development

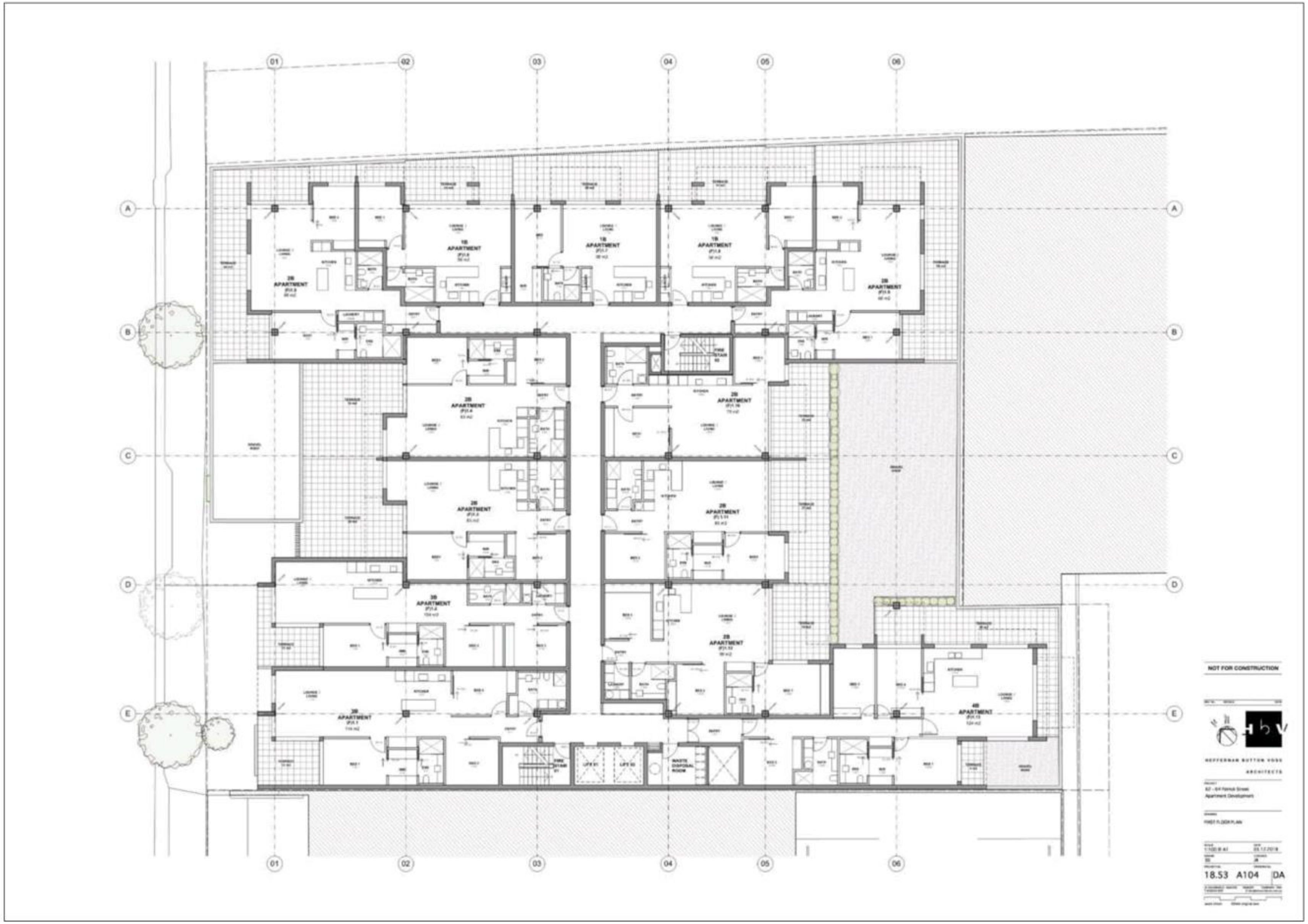
SITE CONTEXT PLAN AND
STREET ELEVATION

1:100 @ A1
03.12.2019

18.53 A100 DA


CAR PARK MAKE UP
BASEMENT UPPER
BASEMENT LOWER
GROUND FLOOR
TOTAL
01
02
03
04
05
06
A
B
C
D
E
FIRE STAIR
CAR PARKING
51-58 SPACES
LIFT 01
LIFT 02
NOT FOR CONSTRUCTION
HEFFERNAN BUTTON VOSS
ARCHITECTS
BASEMENT PLAN - LOWER
18.53 A101 DA


CAR PARK MAKE UP
BASEMENT UPPER
BASEMENT LOWER
GROUND FLOOR
TOTAL
LANEWAY
PATRICK STREET
01
02
03
04
05
06
A
B
C
D
E
OPEN PLAN RETAIL
FIRE BOOSTER
DDA SPACE
CAR PARKING
15 SPACES
RESIDENTIAL FOYER
FIRE STAIR 01
LIFT 01
LIFT 02
BIN STORE
SUBSTATION
SWITCHBOARD ROOM
NOT FOR CONSTRUCTION
HEFFERNAN BUTTON VOSS
ARCHITECTS
62 - 64 Patrick Street
Apartment Development
GROUND FLOOR PLAN
1:100 @ A1
03.12.2018
18.53
A103
DA


01
02
03
04
05
06
A
B
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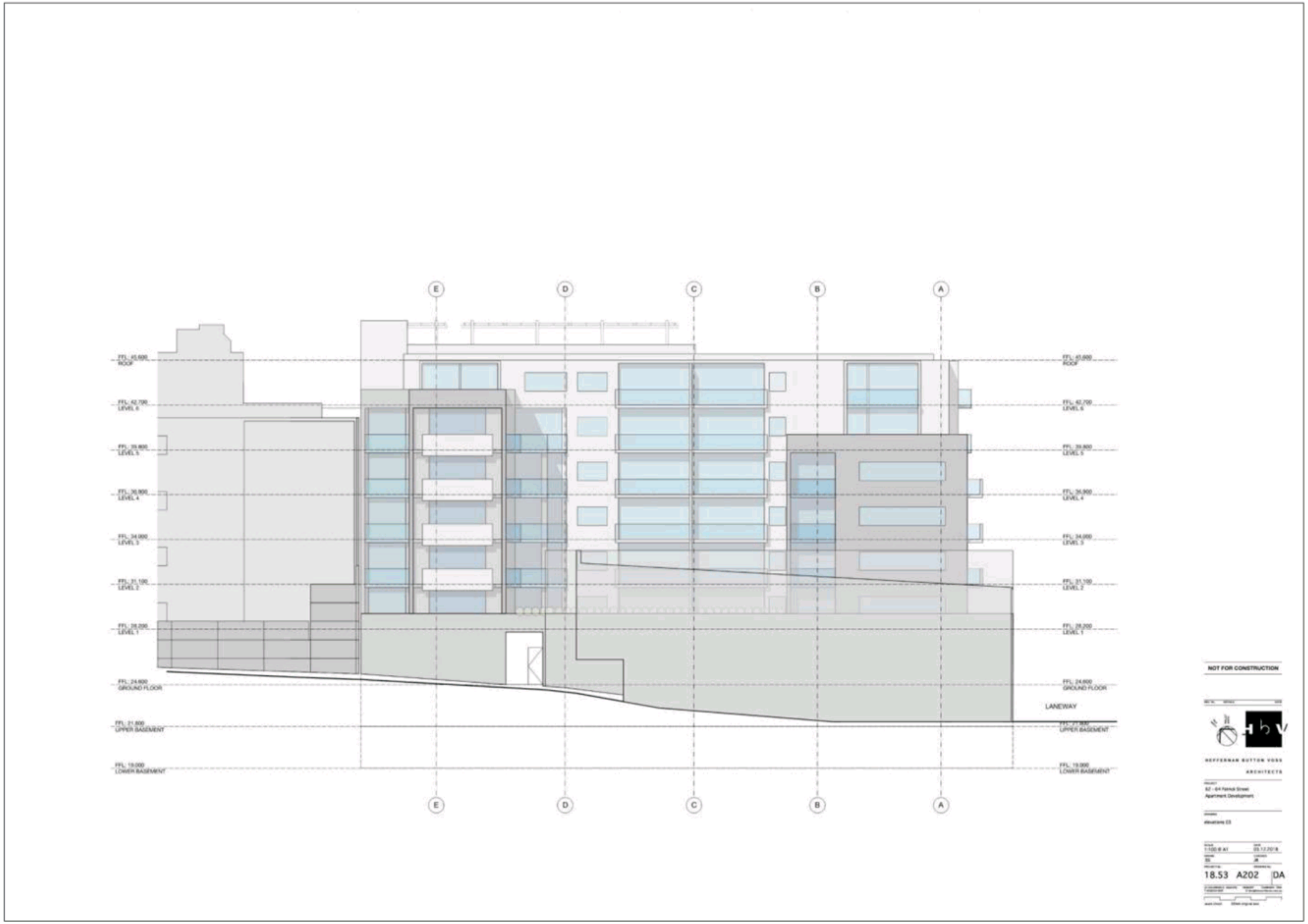
D
E
1B APARTMENT
2B APARTMENT
3B APARTMENT
4B APARTMENT
FIRE STAIR
LIFT 01
LIFT 02
WASTE DISPOSAL ROOM
NOT FOR CONSTRUCTION
HEFFERNAN BUTTON VOSS
ARCHITECTS
62 - 64 Patrick Street
Apartment Development
FIRST FLOOR PLAN
18.53 A104 DA


E
D
C
B
A
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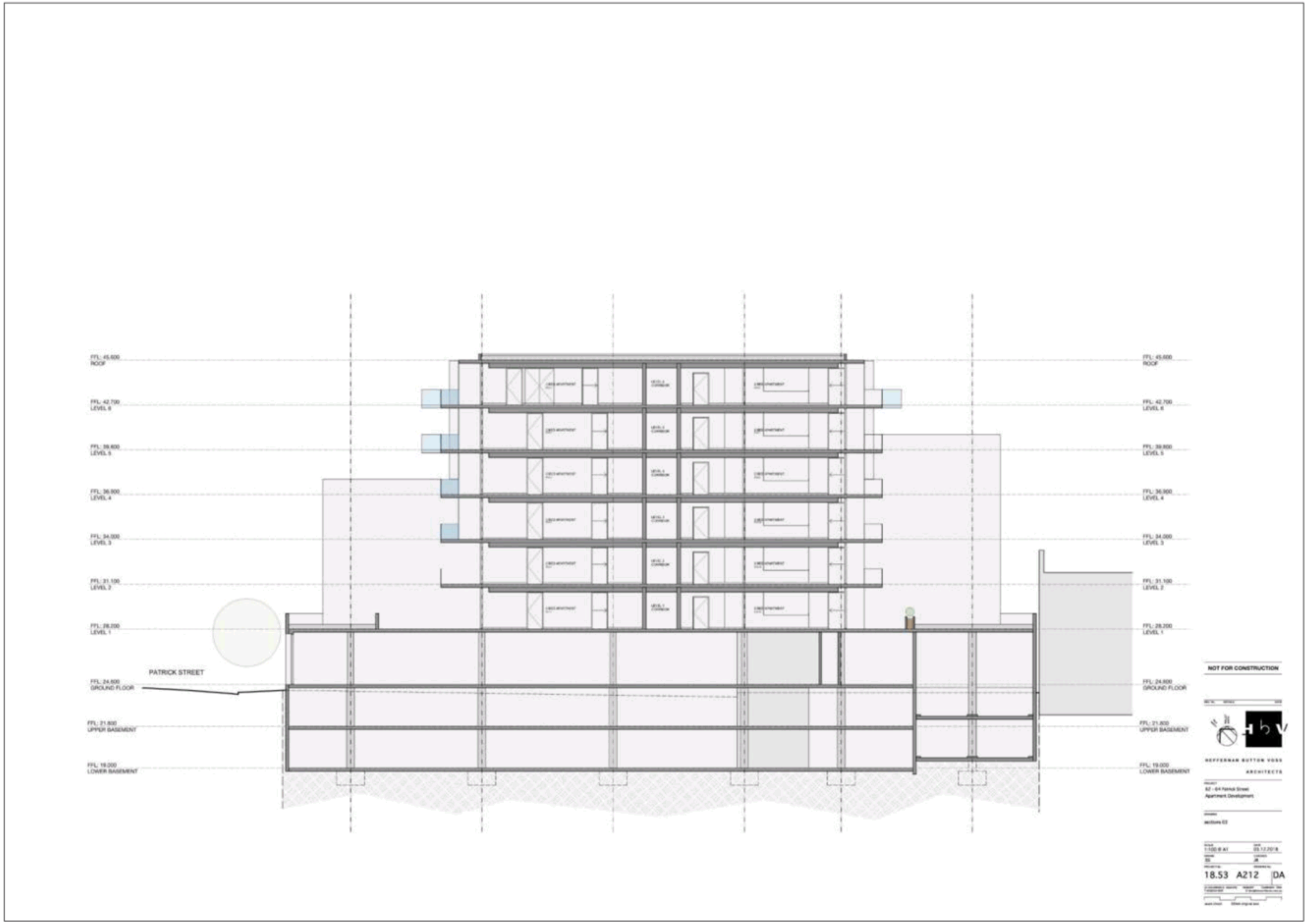
FFL: 42.700 LEVEL 6
FFL: 39.800 LEVEL 5
FFL: 36.900 LEVEL 4
FFL: 34.000 LEVEL 3
FFL: 31.100 LEVEL 2
FFL: 28.200 LEVEL 1
FFL: 24.600 GROUND FLOOR
FFL: 21.800 UPPER BASEMENT
FFL: 19.000 LOWER BASEMENT
LANEWAY
NOT FOR CONSTRUCTION
HEFFERNAN BUTTON VOSS
ARCHITECTS
62 - 64 Patrick Street
Apartment Development
elevations 03
1:100 @ A1
03.12.2018
18.53
A202
DA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FFL: 42.700 LEVEL 6
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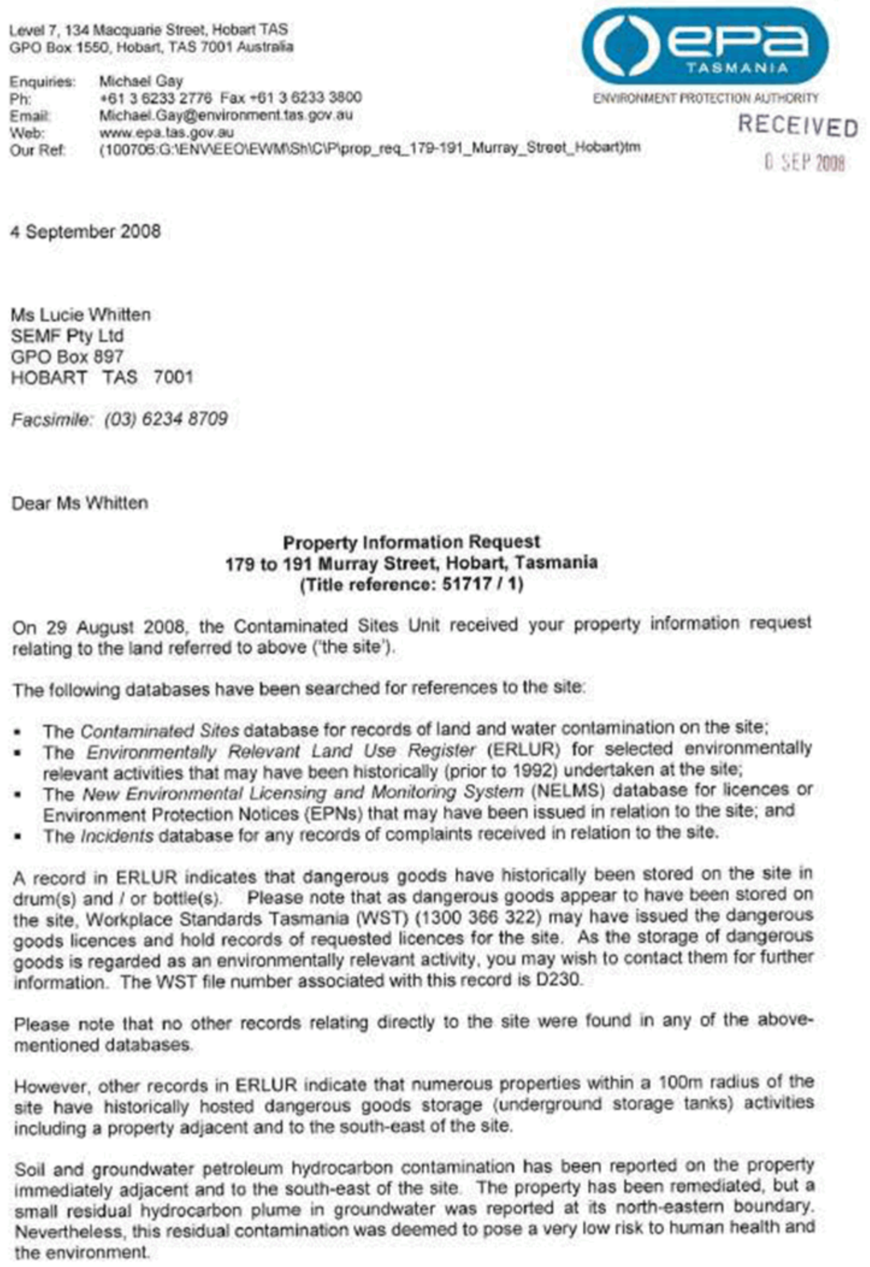
FFL: 34.000 LEVEL 3
FFL: 31.100 LEVEL 2
FFL: 28.200 LEVEL 1
PATRICK STREET
FFL: 24.600 GROUND FLOOR
FFL: 21.800 UPPER BASEMENT
FFL: 19.000 LOWER BASEMENT
NOT FOR CONSTRUCTION
HEFFERNAN BUTTON VOSS
ARCHITECTS
62 - 64 Patrick Street
Apartment Development
sections 03
1:100 @ A1
03.12.2018
18.53
A212
DA

Appendix 3 EPA PIR – SEMF 2008



Level 7, 134 Macquarie Street, Hobart TAS
GPO Box 1550, Hobart, TAS 7001 Australia

Enquiries: Michael Gay
Ph: +61 3 6233 2776 Fax +61 3 6233 3800
Email: Michael.Gay@environment.tas.gov.au
Web: www.epa.tas.gov.au
Our Ref: (100706:G:\ENV\EEO\EWM\Sh\C\P\prop_req_179-191_Murray_Street_Hobart)tm

EPA TASMANIA
ENVIRONMENT PROTECTION AUTHORITY

RECEIVED
0 SEP 2008

4 September 2008

Ms Lucie Whitten
SEMF Pty Ltd
GPO Box 897
HOBART TAS 7001

Facsimile: (03) 6234 8709

Dear Ms Whitten

Property Information Request
179 to 191 Murray Street, Hobart, Tasmania
(Title reference: 51717 / 1)

On 29 August 2008, the Contaminated Sites Unit received your property information request relating to the land referred to above ('the site').

The following databases have been searched for references to the site:

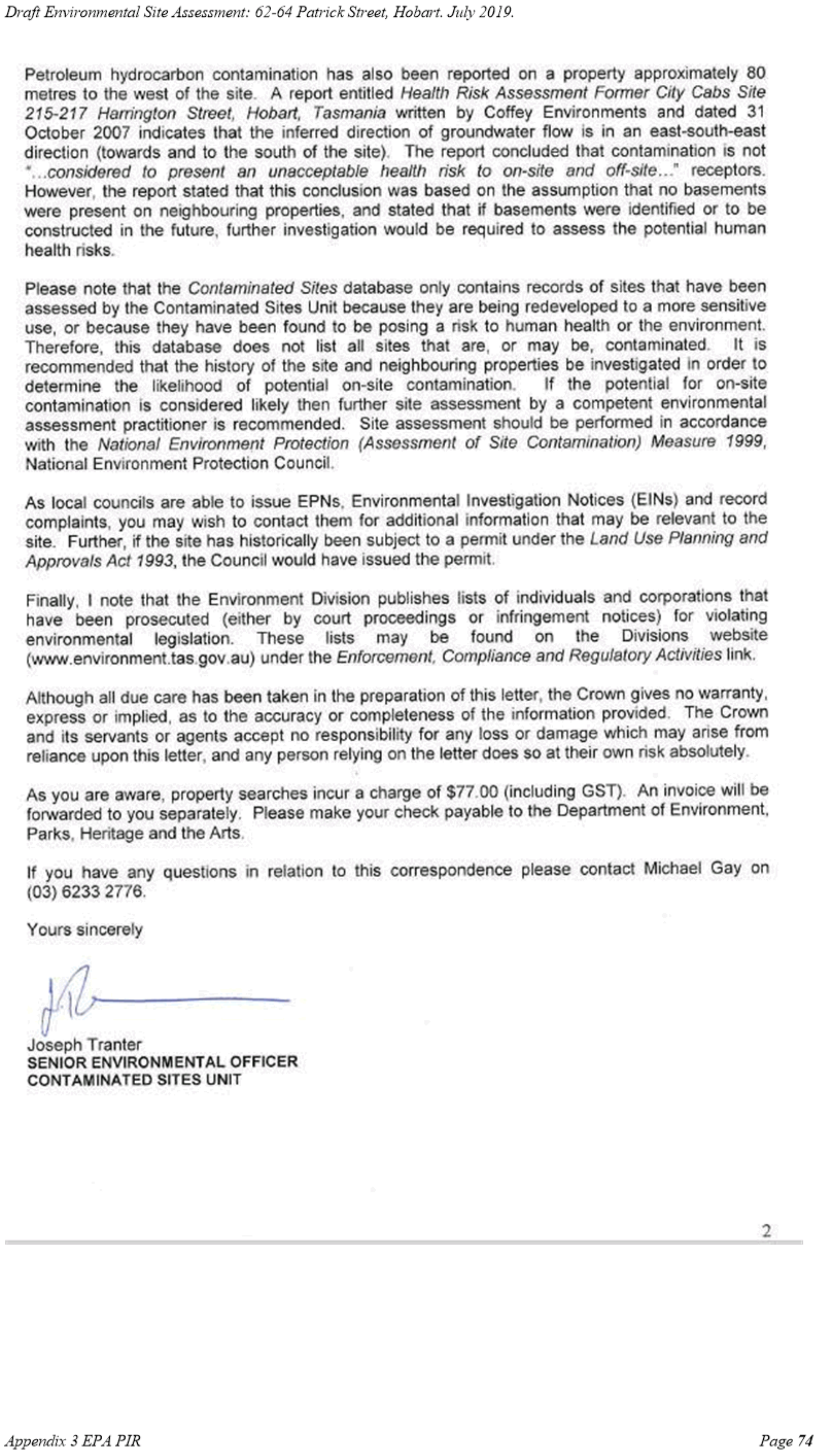
- The *Contaminated Sites* database for records of land and water contamination on the site;
- The *Environmentally Relevant Land Use Register* (ERLUR) for selected environmentally relevant activities that may have been historically (prior to 1992) undertaken at the site;
- The *New Environmental Licensing and Monitoring System* (NELMS) database for licences or Environment Protection Notices (EPNs) that may have been issued in relation to the site; and
- The *Incidents* database for any records of complaints received in relation to the site.

A record in ERLUR indicates that dangerous goods have historically been stored on the site in drum(s) and / or bottle(s). Please note that as dangerous goods appear to have been stored on the site, Workplace Standards Tasmania (WST) (1300 366 322) may have issued the dangerous goods licences and hold records of requested licences for the site. As the storage of dangerous goods is regarded as an environmentally relevant activity, you may wish to contact them for further information. The WST file number associated with this record is D230.

Please note that no other records relating directly to the site were found in any of the above-mentioned databases.

However, other records in ERLUR indicate that numerous properties within a 100m radius of the site have historically hosted dangerous goods storage (underground storage tanks) activities including a property adjacent and to the south-east of the site.

Soil and groundwater petroleum hydrocarbon contamination has been reported on the property immediately adjacent and to the south-east of the site. The property has been remediated, but a small residual hydrocarbon plume in groundwater was reported at its north-eastern boundary. Nevertheless, this residual contamination was deemed to pose a very low risk to human health and the environment.



Petroleum hydrocarbon contamination has also been reported on a property approximately 80 metres to the west of the site. A report entitled *Health Risk Assessment Former City Cabs Site 215-217 Harrington Street, Hobart, Tasmania* written by Coffey Environments and dated 31 October 2007 indicates that the inferred direction of groundwater flow is in an east-south-east direction (towards and to the south of the site). The report concluded that contamination is not "*...considered to present an unacceptable health risk to on-site and off-site...*" receptors. However, the report stated that this conclusion was based on the assumption that no basements were present on neighbouring properties, and stated that if basements were identified or to be constructed in the future, further investigation would be required to assess the potential human health risks.

Please note that the *Contaminated Sites* database only contains records of sites that have been assessed by the Contaminated Sites Unit because they are being redeveloped to a more sensitive use, or because they have been found to be posing a risk to human health or the environment. Therefore, this database does not list all sites that are, or may be, contaminated. It is recommended that the history of the site and neighbouring properties be investigated in order to determine the likelihood of potential on-site contamination. If the potential for on-site contamination is considered likely then further site assessment by a competent environmental assessment practitioner is recommended. Site assessment should be performed in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999*, National Environment Protection Council.

As local councils are able to issue EPNs, Environmental Investigation Notices (EINs) and record complaints, you may wish to contact them for additional information that may be relevant to the site. Further, if the site has historically been subject to a permit under the *Land Use Planning and Approvals Act 1993*, the Council would have issued the permit.

Finally, I note that the Environment Division publishes lists of individuals and corporations that have been prosecuted (either by court proceedings or infringement notices) for violating environmental legislation. These lists may be found on the Divisions website (www.environment.tas.gov.au) under the *Enforcement, Compliance and Regulatory Activities* link.

Although all due care has been taken in the preparation of this letter, the Crown gives no warranty, express or implied, as to the accuracy or completeness of the information provided. The Crown and its servants or agents accept no responsibility for any loss or damage which may arise from reliance upon this letter, and any person relying on the letter does so at their own risk absolutely.

As you are aware, property searches incur a charge of $77.00 (including GST). An invoice will be forwarded to you separately. Please make your check payable to the Department of Environment, Parks, Heritage and the Arts.

If you have any questions in relation to this correspondence please contact Michael Gay on (03) 6233 2776.

Yours sincerely

Joseph Tranter
SENIOR ENVIRONMENTAL OFFICER
CONTAMINATED SITES UNIT

Appendix 4 Site Photographs

BH01 Location

BH01 Full core

BH01 Close up

BH01 Close up

BH02 full core

Location of BH02

BH02 Close up

BH02 Close up

BH02 Close up

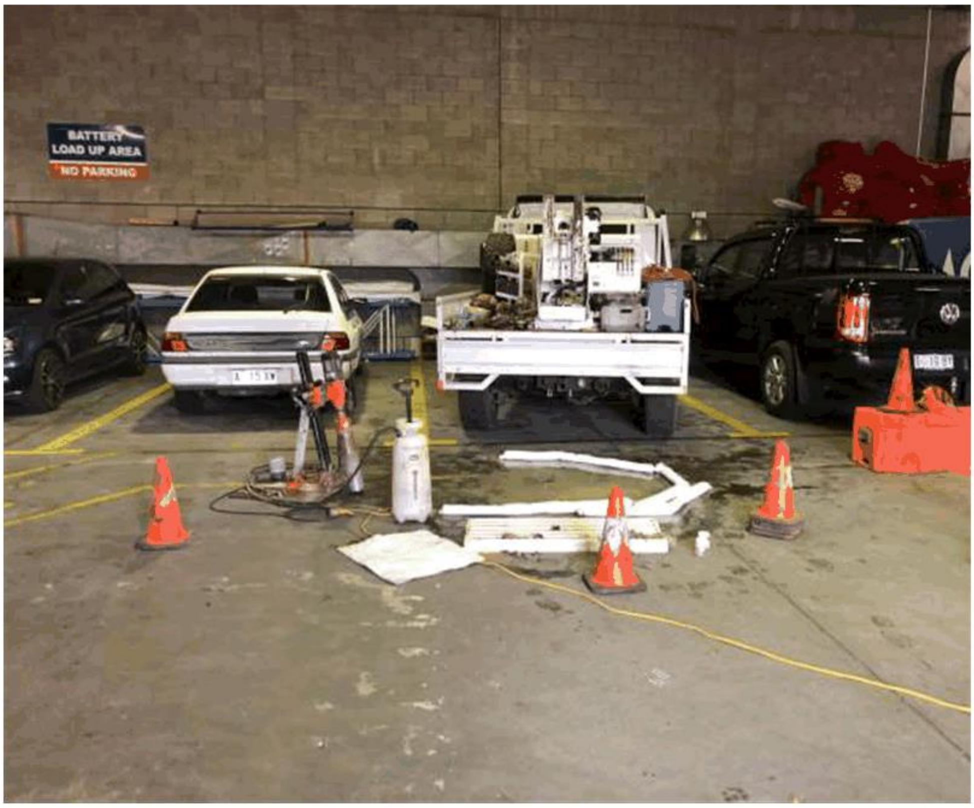
Fill core BH03

Close up BH03

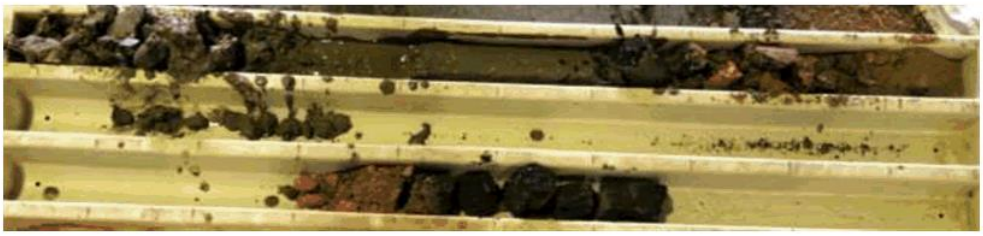
Close up BH03

BH03 Location

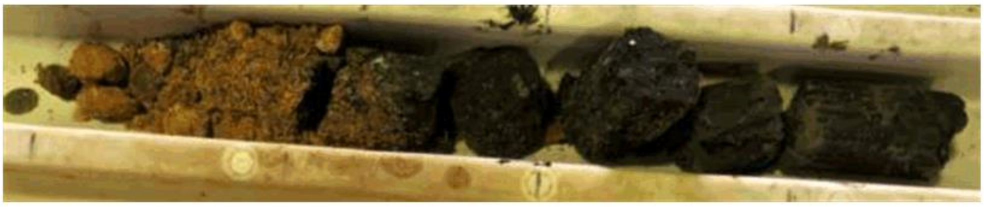
\

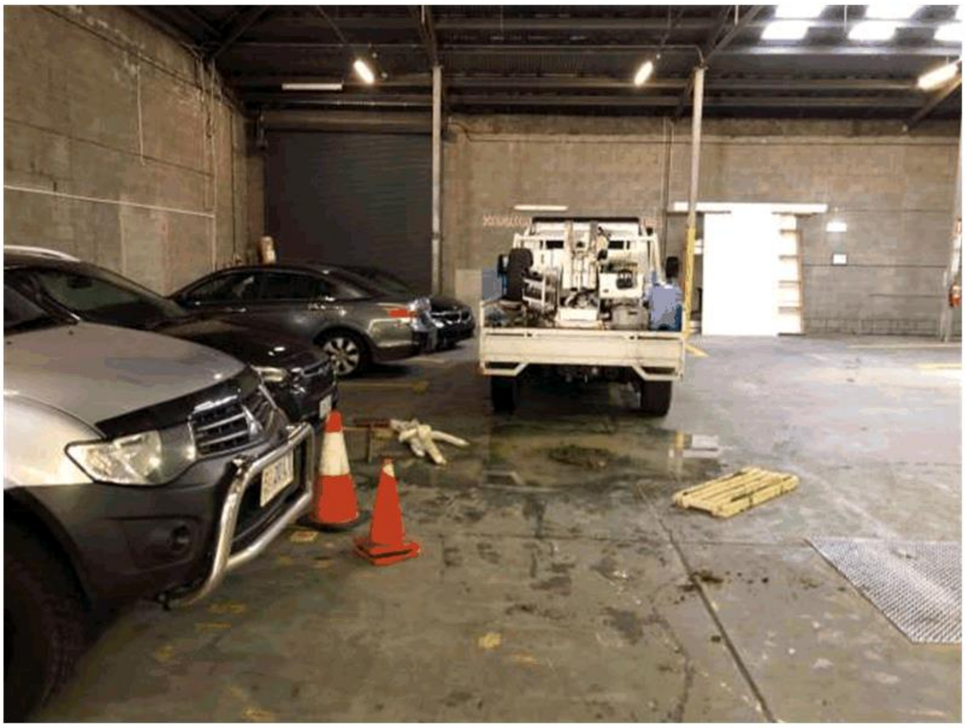


Location of BH04



BH04 full core

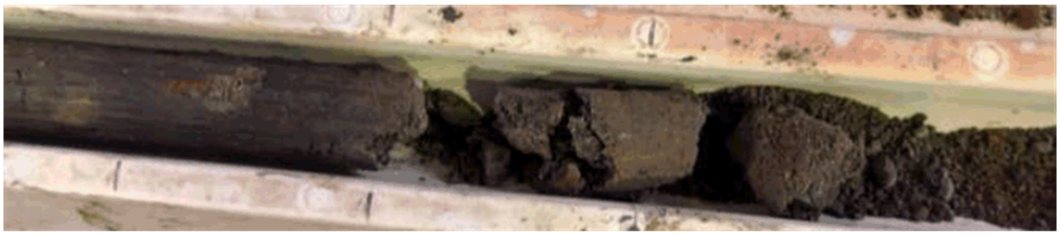




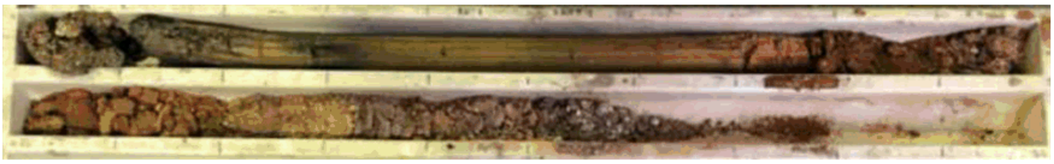
BH05 Location

BH05 core

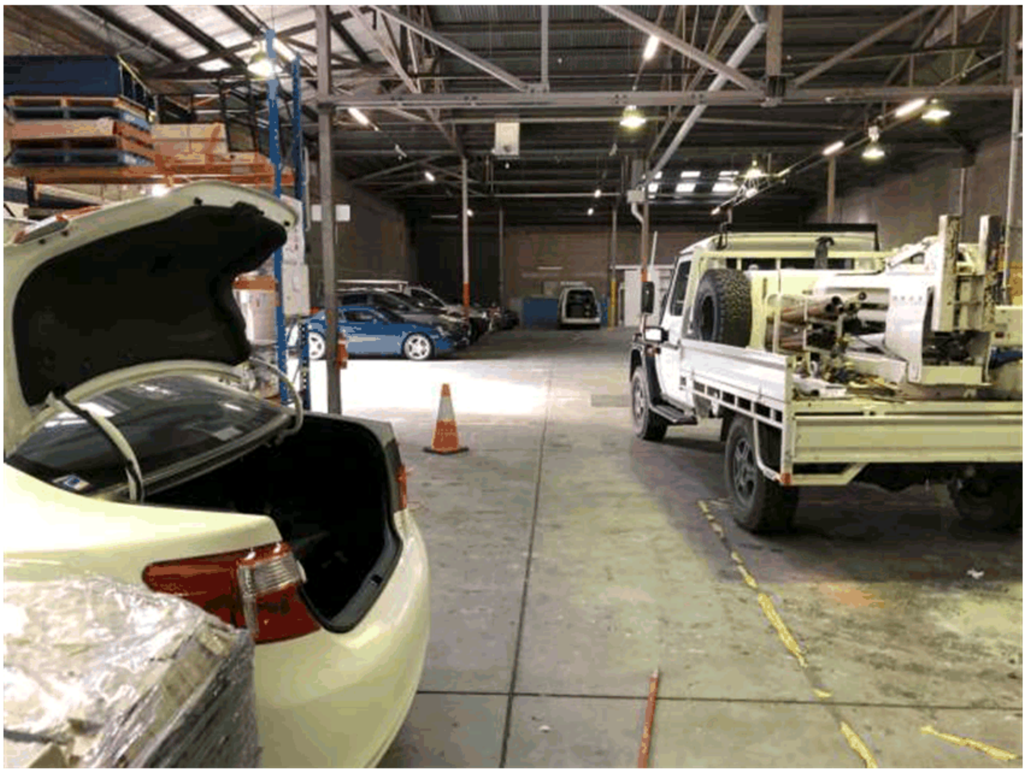
BH05 Close up



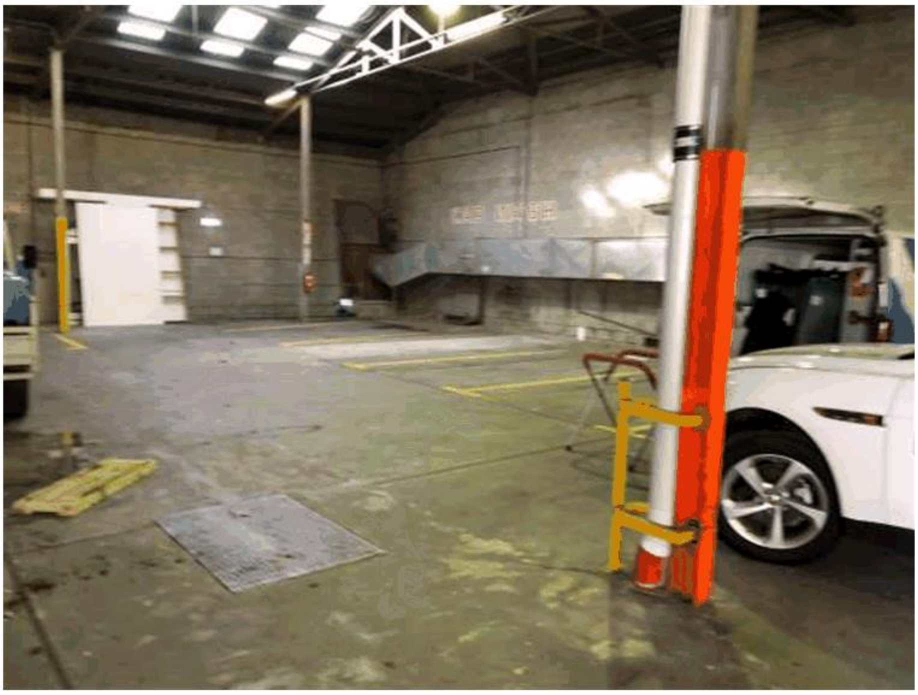
BH05 Close up



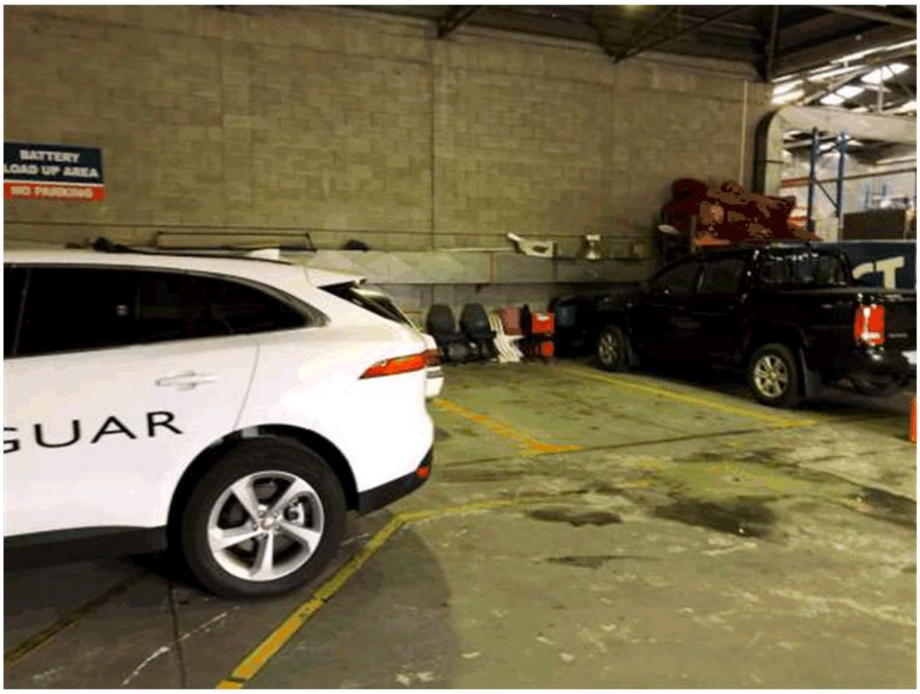
BH06 full core



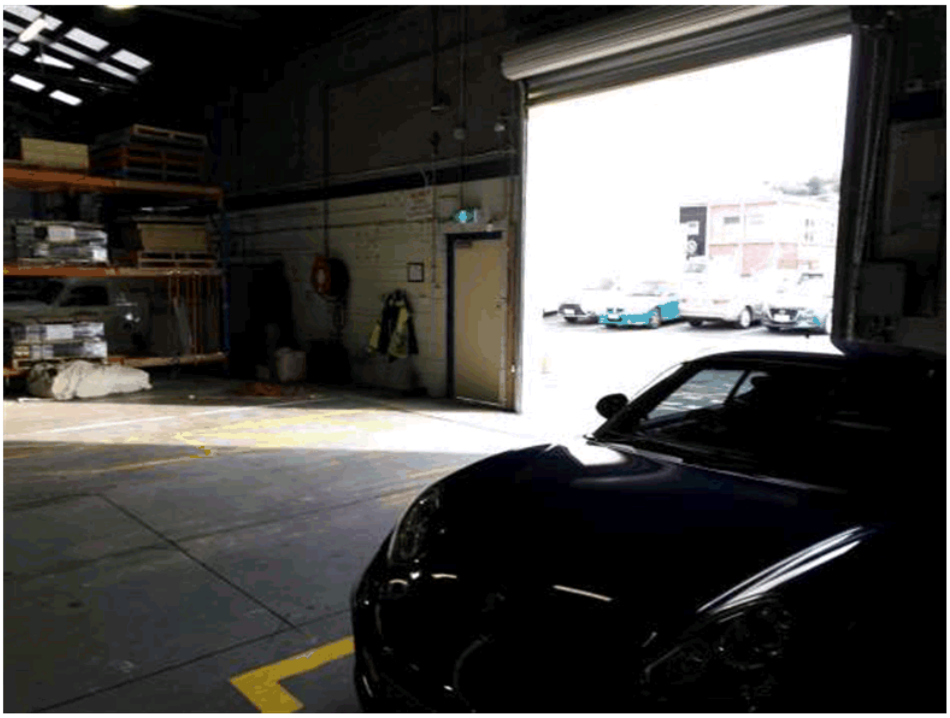
BH06 location



Inside workshop



Inside workshop



Inside workshop

Appendix 5 PID Calibration Record

Imbros Pty Ltd
ABN 29 009 525 053
1059 Cambridge Road, Cambridge
Tasmania Australia 7170

Phone (03) 6216 1500
Fax (03) 6216 1555
info@imbros.com.au

Calibration Test Certificate
29/01/2019 16:05:00 PM

Device
Serial Number: **590-902123**
Device Type: **MiniRAE Lite**
Manufacturer: **RAE Systems**
Next Cal Due: **28/07/2019**

Test Result **Pass**

Sensors
Type: **ISO**
Result: **Pass**
Final Reading: **50%**
Next Calibration Due: **28/07/2019**

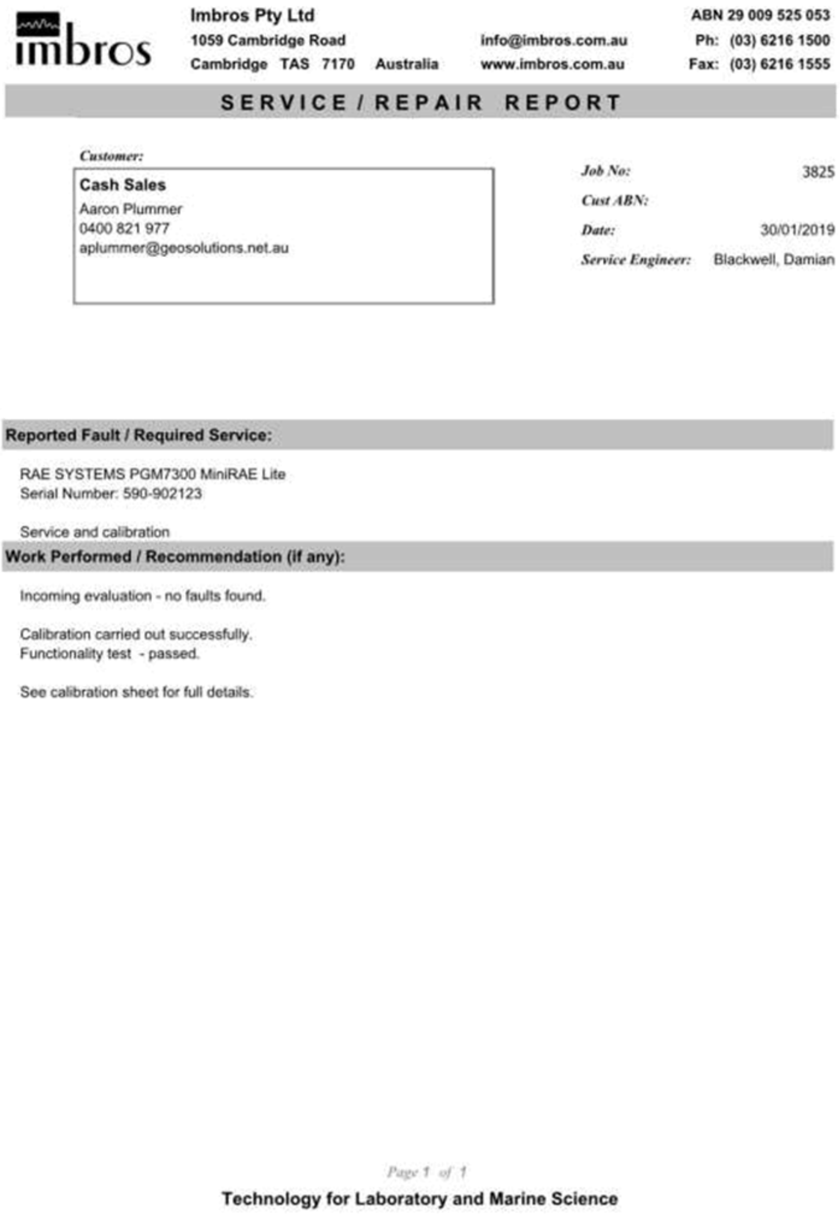
Set Points
Type: **ISO**
High Alarm: **10.00%**
Low Alarm: **5.00%**
TWA Alarm:
STEL Alarm:

Options
Datalog Interval: **15 seconds**
Unit Programmed: **N/A**
H2S STEL Period: **15 minutes**
CO STEL Period: **15 minutes**

Test Station
Dock Serial Number: **Z309-002181**
Dock Location: **Imbros Cal Lab**

	Inlet 1:	Inlet 2:	Inlet 3:	Inlet 4:	Inlet 5:
Used:	**Yes**	**Yes**	**No**	**No**	**No**
Concentration:	**20.9%**	**100ppm**			
Type:	**Purge**	**ISO 100ppm by volume**			
Notes:	**NOTE: Calibration all Ok.**				

Technology for Laboratory and Marine Science



Imbros Pty Ltd
1059 Cambridge Road
Cambridge TAS 7170 Australia
info@imbros.com.au
www.imbros.com.au
ABN 29 009 525 053
Ph: (03) 6216 1500
Fax: (03) 6216 1555

SERVICE / REPAIR REPORT

Customer:

Cash Sales
Aaron Plummer
0400 821 977
aplummer@geosolutions.net.au

Job No: 3825
Cust ABN:
Date: 30/01/2019
Service Engineer: Blackwell, Damian

Reported Fault / Required Service:

RAE SYSTEMS PGM7300 MiniRAE Lite
Serial Number: 590-902123

Service and calibration

Work Performed / Recommendation (if any):

Incoming evaluation - no faults found.

Calibration carried out successfully.
Functionality test - passed.

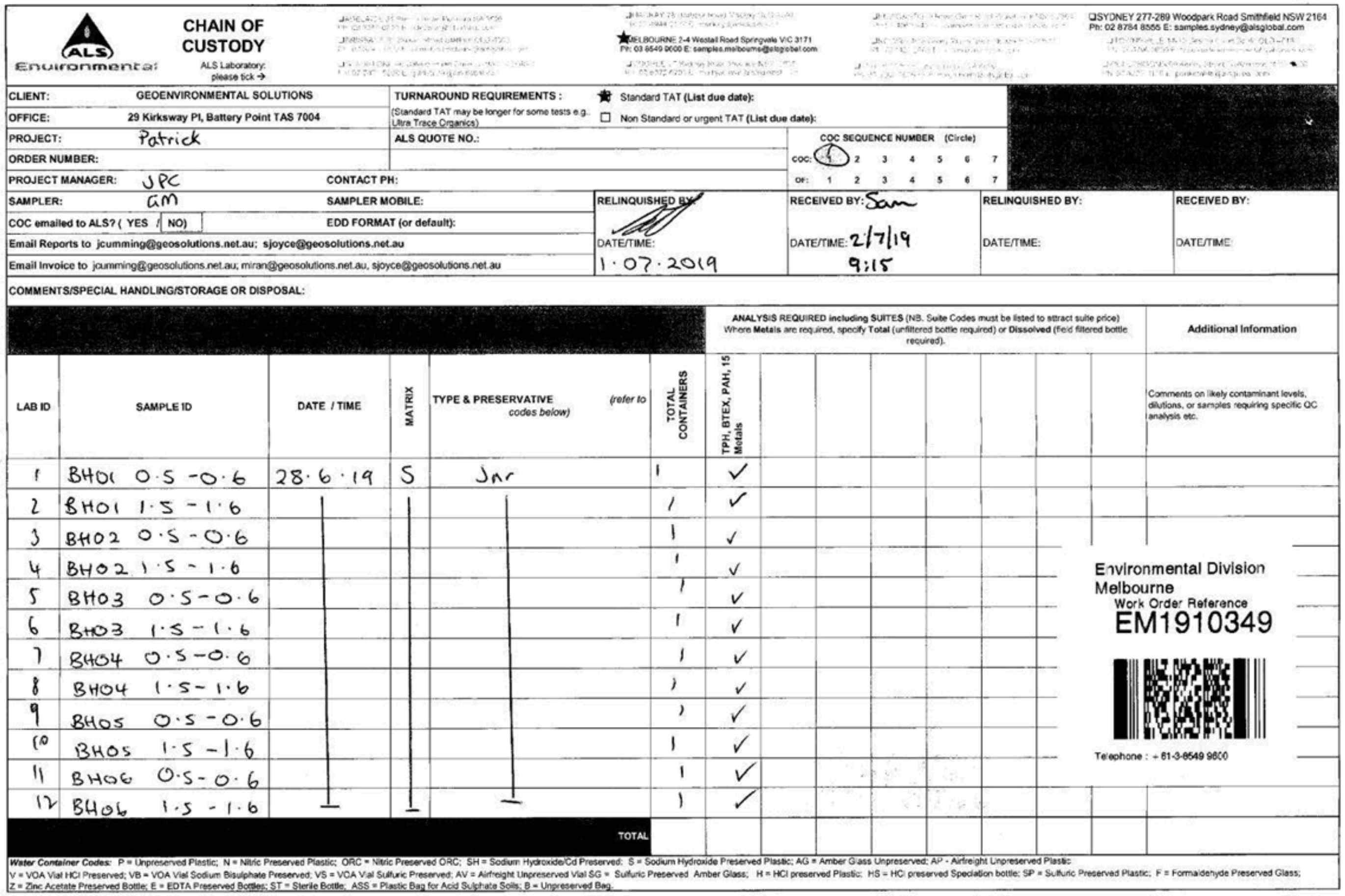
See calibration sheet for full details.

Page 1 of 1

Technology for Laboratory and Marine Science

Draft Environmental Site Assessment: 62-64 Patrick Street, Hobart. July 2019.

Appendix 6 Laboratory Chain of Custody



ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

★MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

CLIENT: GEOENVIRONMENTAL SOLUTIONS
OFFICE: 29 Kirksway Pl, Battery Point TAS 7004
PROJECT: Patrick
ORDER NUMBER:
PROJECT MANAGER: JPC
CONTACT PH:
SAMPLER: GM
SAMPLER MOBILE:
COC emailed to ALS? (YES / [✓ NO])
EDD FORMAT (or default):
Email Reports to jcumming@geosolutions.net.au; sjoyce@geosolutions.net.au
Email Invoice to jcumming@geosolutions.net.au; miran@geosolutions.net.au; sjoyce@geosolutions.net.au
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)
★ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)
COC: [✓ 1] 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

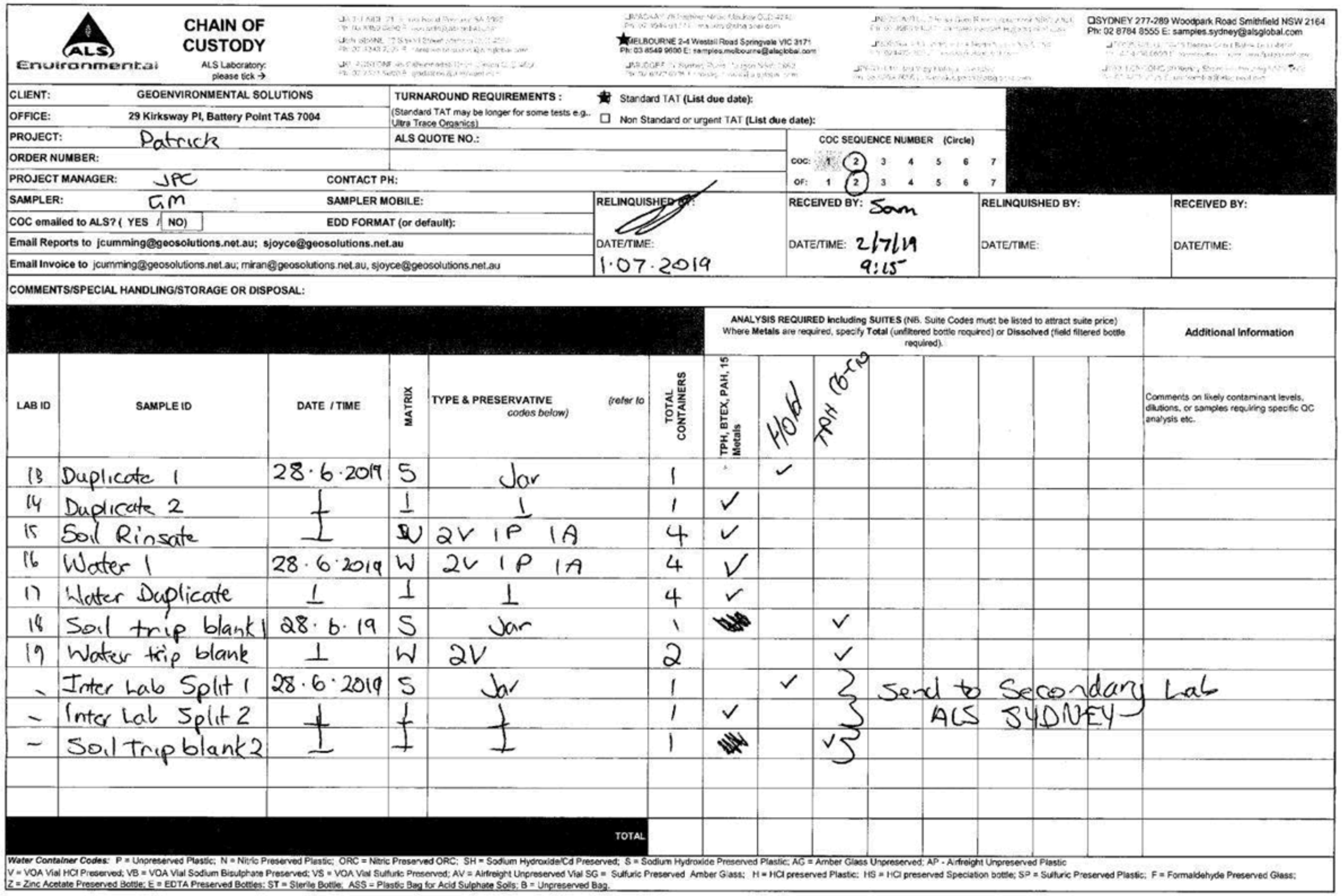
RELINQUISHED BY:	RECEIVED BY: Sam	RELINQUISHED BY:	RECEIVED BY:
DATE/TIME: 1·07·2019	DATE/TIME: 2/7/19 9:15	DATE/TIME:	DATE/TIME:

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	TPH, BTEX, PAH, 15 Metals	Additional Information Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	BH01 0.5-0.6	28·6·19	S	Jar	1	✓	
2	BH01 1.5-1.6				1	✓	
3	BH02 0.5-0.6				1	✓	
4	BH02 1.5-1.6				1	✓	
5	BH03 0.5-0.6				1	✓	
6	BH03 1.5-1.6				1	✓	
7	BH04 0.5-0.6				1	✓	
8	BH04 1.5-1.6				1	✓	
9	BH05 0.5-0.6				1	✓	
10	BH05 1.5-1.6				1	✓	
11	BH06 0.5-0.6				1	✓	
12	BH06 1.5-1.6				1	✓	
				TOTAL			

Environmental Division
Melbourne
Work Order Reference
EM1910349
Telephone : + 61-3-8549 9600

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.



ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

★ MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐ SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

CLIENT: GEOENVIRONMENTAL SOLUTIONS
OFFICE: 29 Kirksway Pl, Battery Point TAS 7004
PROJECT: Patrick
ORDER NUMBER:
PROJECT MANAGER: JPC **CONTACT PH:**
SAMPLER: GM **SAMPLER MOBILE:**
COC emailed to ALS? (YES / [✓ NO]) **EDD FORMAT (or default):**
Email Reports to jcumming@geosolutions.net.au; sjoyce@geosolutions.net.au
Email Invoice to jcumming@geosolutions.net.au; miran@geosolutions.net.au, sjoyce@geosolutions.net.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
★ Standard TAT **(List due date):**
☐ Non Standard or urgent TAT **(List due date):**
ALS QUOTE NO.:

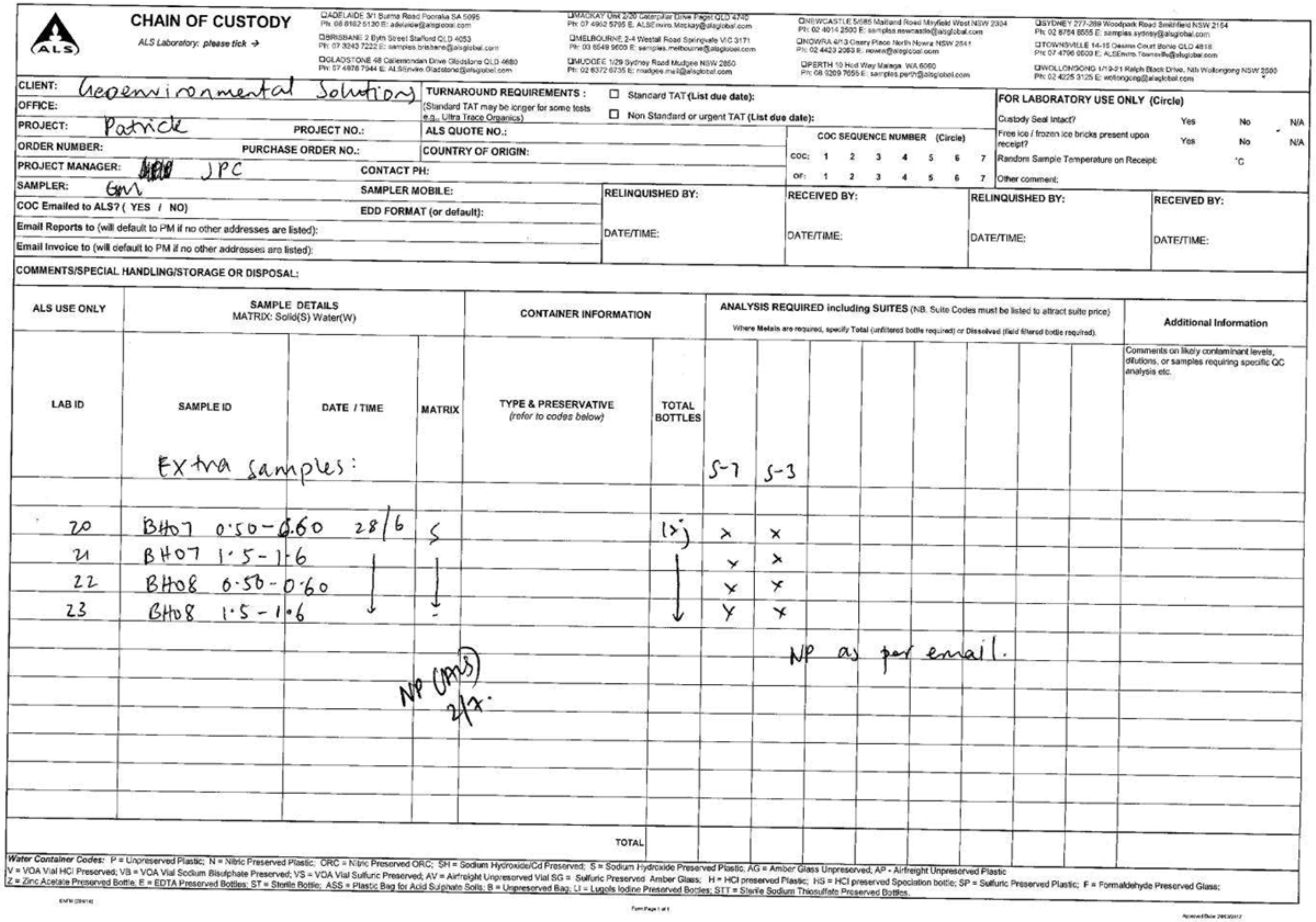
COC SEQUENCE NUMBER (Circle)
COC: 1 [✓ 2] 3 4 5 6 7
OF: 1 [✓ 2] 3 4 5 6 7

RELINQUISHED BY:	RECEIVED BY: Sam	RELINQUISHED BY:	RECEIVED BY:
DATE/TIME: 1·07·2019	DATE/TIME: 2/7/19 9:15	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	**ANALYSIS REQUIRED including SUITES** (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required). TPH, BTEX, PAH, 15 Metals	 Hold	 TPH (C6-C10)						**Additional Information** Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
13	Duplicate 1	28·6·2019	S	Jar	1		✓							
14	Duplicate 2	|	|	|	1	✓								
15	Soil Rinsate	|	W	2V 1P 1A	4	✓								
16	Water 1	28·6·2019	W	2V 1P 1A	4	✓								
17	Water Duplicate	|	|	|	4	✓								
18	Soil trip blank 1	28·6·19	S	Jar	1			✓						
19	Water trip blank	|	W	2V	2			✓						
-	Inter Lab Split 1	28·6·2019	S	Jar	1		✓		Send to Secondary Lab ALS SYDNEY					
-	Inter Lab Split 2	|	|	|	1	✓								
-	Soil Trip blank 2	|	|	|	1			✓						
					TOTAL									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095
Ph: 08 8162 5130 E: adelaide@alsglobal.com

☐BRISBANE 2 Byth Street Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

☐GLADSTONE 48 Callemondah Drive Gladstone QLD 4680
Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com

☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740
Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com

☐MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304
Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

☐NOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 02 4423 2063 E: nowra@alsglobal.com

☐PERTH 10 Hod Way Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818
Ph: 07 4796 0600 E: ALSEnviro.Townsville@alsglobal.com

☐WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: Geoenvironmental Solutions
OFFICE:
PROJECT: Patrick **PROJECT NO.:**
ORDER NUMBER: **PURCHASE ORDER NO.:**
PROJECT MANAGER: [redacted] JPC **CONTACT PH:**
SAMPLER: GM **SAMPLER MOBILE:**
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**
Email Reports to (will default to PM if no other addresses are listed):
Email Invoice to (will default to PM if no other addresses are listed):
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS :
(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:
COUNTRY OF ORIGIN:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

RELINQUISHED BY:	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
DATE/TIME:	DATE/TIME:	DATE/TIME:	DATE/TIME:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	**SAMPLE ID**	**DATE / TIME**	**MATRIX**	**TYPE & PRESERVATIVE** *(refer to codes below)*	**TOTAL BOTTLES**									Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	Extra samples:					S-7	S-3							
20	BH07 0·50-0.60	28/6	S		1xj	x	x							
21	BH07 1·5-1·6	↓	↓		↓	x	x							
22	BH08 0·50-0·60					x	x							
23	BH08 1·5-1·6					x	x							
					TOTAL									

NP (PMS) 2/7.

NP as per email.

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Niki Papastergiou

To: Shirley LeCornu
Cc: Samples Melbourne
Subject: RE: [EXTERNAL] - RE: EM1910349 - GEOENVSOL - Patrick

From: JP Cumming [mailto:jcumming@geosolutions.net.au]
Sent: Tuesday, 2 July 2019 5:19 PM
To: Shirley LeCornu <shirley.lecornu@alsglobal.com>
Subject: [EXTERNAL] - RE: EM1910349 - GEOENVSOL - Patrick

CAUTION: This email originated from outside of ALS. Do not click links or open attachments unless you recognize the sender and are sure content is relevant to you.

Yes please can you analyse all. Same suites.

From: Shirley LeCornu <shirley.lecornu@alsglobal.com>
Sent: Tuesday, 2 July 2019 5:12 PM
To: JP Cumming <jcumming@geosolutions.net.au>
Subject: FW: EM1910349 - GEOENVSOL - Patrick

Hi JP

A few extra samples received today. See email below.

Please let me know if analysis is required.

Kind regards

Shirley

Shirley LeCornu
Client Services Coordinator – Springvale
Environmental

T +61 3 8549 9600 D +61 3 8549 9630
F +61 3 8549 9626
Shirley.lecornu@alsglobal.com
2-4 Westall Rd
Springvale Vic 3171
Australia

EnviroMail™ 122 – TEG in Air and Vapour
EnviroMail™ 123 – Leaching Environmental Assessment Framework
EnviroMail™ 124 – PFOS Analysis to Freshwater Species Protection Lvl 99%
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From: Niki Papastergiou
Sent: Tuesday, 2 July 2019 5:01 PM
To: Shirley LeCornu <shirley.lecornu@alsglobal.com>
Cc: Samples Melbourne <Samples.Melbourne@alsglobal.com>
Subject: EM1910349 - GEOENVSOL - Patrick

Hi Shirley,

We received 4 x extra soil samples:

#020 BH07 0.50-0.60 (28/6) - 1 x jar
#021 BH07 1.5-1.6 (28/6) - 1 x jar
#022 BH08 0.50-0.60 (28/6) - 1 x jar
#023 BH08 1.5-1.6 (28/6) - 1 x jar

Samples are on hold.

Kind regards,

Niki Papastergiou
Work Order Committal Officer – Springvale Environmental

T +61 3 8549 9633
F +61 3 8549 9601
niki.papastergiou@alsglobal.com
2-4 Westall Rd
Springvale VIC 3171
Australia

EnviroMail™ 122 – TEG in Air and Vapour
EnviroMail™ 123 – Leaching Environmental Assessment Framework

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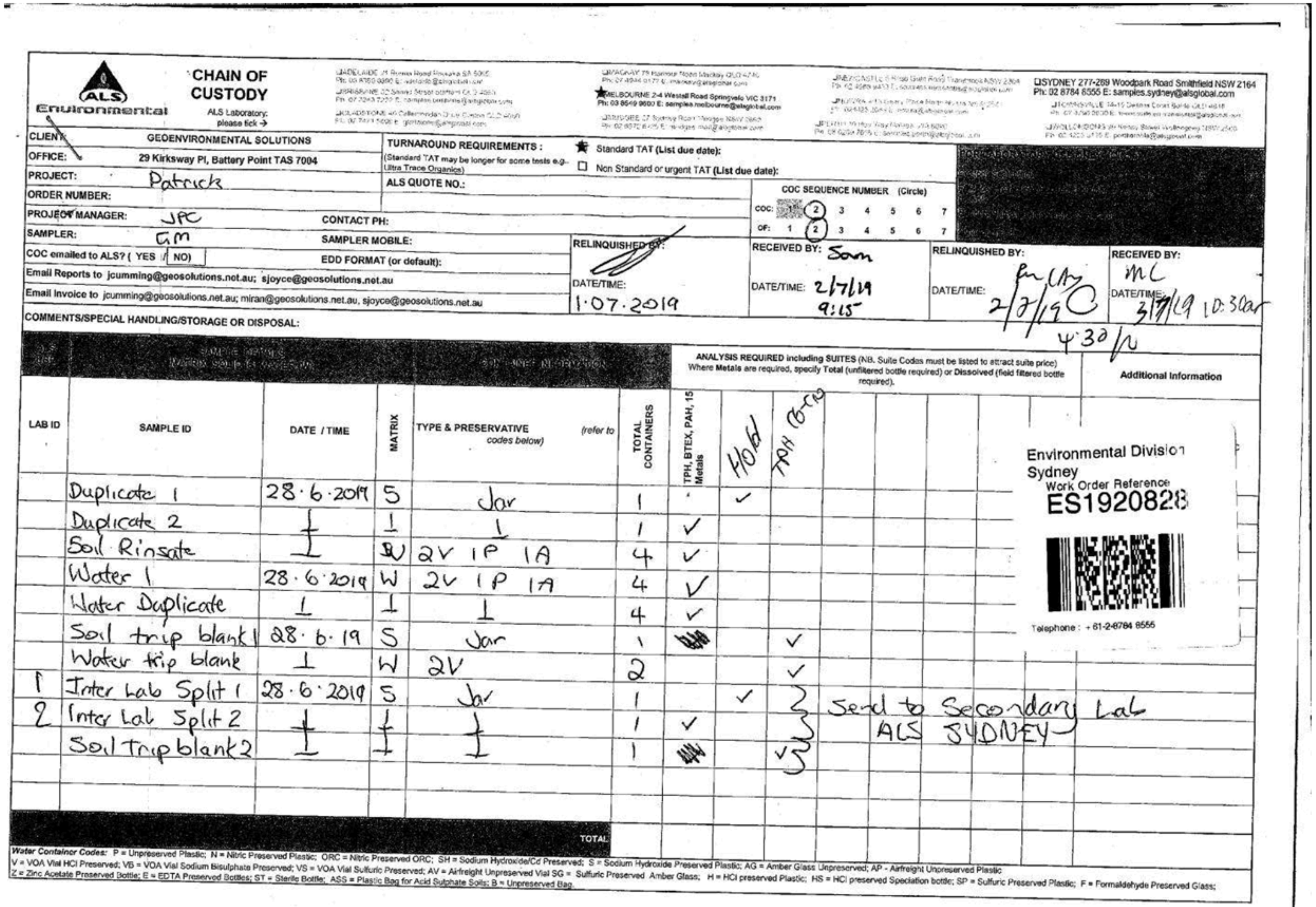


ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

★ MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐ SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

CLIENT: GEOENVIRONMENTAL SOLUTIONS
OFFICE: 29 Kirksway Pl, Battery Point TAS 7004
PROJECT: Patrick
ORDER NUMBER:
PROJECT MANAGER: JPC
CONTACT PH:
SAMPLER: GM
SAMPLER MOBILE:
COC emailed to ALS? (YES / [✓ NO])
EDD FORMAT (or default):
Email Reports to jcumming@geosolutions.net.au; sjoyce@geosolutions.net.au
Email Invoice to jcumming@geosolutions.net.au; miran@geosolutions.net.au, sjoyce@geosolutions.net.au
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
★ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)
COC: 1 (2) 3 4 5 6 7
OF: 1 (2) 3 4 5 6 7

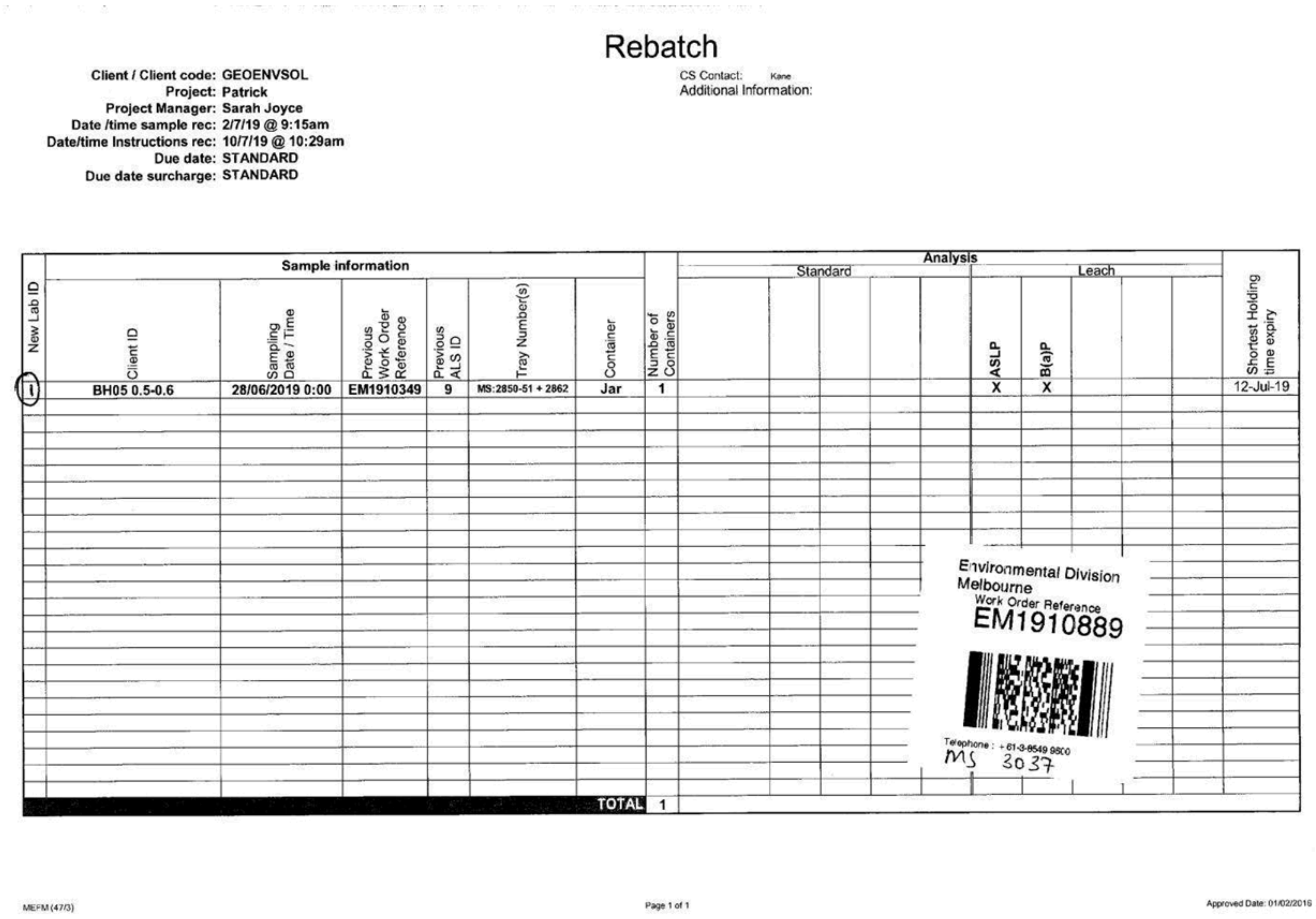
RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
	Sam		MC
DATE/TIME: 1·07·2019	DATE/TIME: 2/7/19 9:15	DATE/TIME: 2/7/19 4:30 pm	DATE/TIME: 3/7/19 10:30am

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	TPH, BTEX, PAH, 15 Metals	Hold	TPH C6-C9						Additional Information
	Duplicate 1	28·6·2019	S	Jar	1		✓							
	Duplicate 2	|	|	|	1	✓								
	Soil Rinsate	|	W	2V 1P 1A	4	✓								
	Water 1	28·6·2019	W	2V 1P 1A	4	✓								
	Water Duplicate	|	|	|	4	✓								
	Soil trip blank 1	28·6·19	S	Jar	1			✓						
	Water trip blank	|	W	2V	2			✓						
1	Inter Lab Split 1	28·6·2019	S	Jar	1		✓		Send to Secondary Lab					
2	Inter Lab Split 2	|	|	|	1	✓			ALS SYDNEY					
	Soil Trip blank2	|	|	|	1			✓						
					TOTAL									

Environmental Division
Sydney
Work Order Reference
ES1920828
Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.



Rebatch

CS Contact: Kane
Additional Information:

Client / Client code: GEOENVSOL
Project: Patrick
Project Manager: Sarah Joyce
Date /time sample rec: 2/7/19 @ 9:15am
Date/time Instructions rec: 10/7/19 @ 10:29am
Due date: STANDARD
Due date surcharge: STANDARD

	Sample information							Analysis										
								Standard					Leach					
New Lab ID	Client ID	Sampling Date / Time	Previous Work Order Reference	Previous ALS ID	Tray Number(s)	Container	Number of Containers						ASLP	B(a)P				Shortest Holding time expiry
1	BH05 0.5-0.6	28/06/2019 0:00	EM1910349	9	MS:2850-51 + 2862	Jar	1						X	X				12-Jul-19
						TOTAL	1											

Environmental Division
Melbourne
Work Order Reference
EM1910889

Telephone : + 61-3-8549 9600
MS 3037

MEFM (47/3)
Page 1 of 1
Approved Date: 01/02/2016

Kane Vorwerk

From:	Sarah Joyce <sjoyce@geosolutions.net.au>
Sent:	Wednesday, 10 July 2019 10:29 AM
To:	Kane Vorwerk
Cc:	ALS Enviro Melbourne
Subject:	[EXTERNAL] - Rebatch EM1910349
Categories:	Rebatch

CAUTION: This email originated from outside of ALS. Do not click links or open attachments unless you recognize the sender and are sure content is relevant to you.

Hi Kane,

Rebatch please Sample : EM1910349-009 (BH05 0.5-0.6) soil

Leachate testing on B(a)p.

That's all thanks.

Kind Regards,

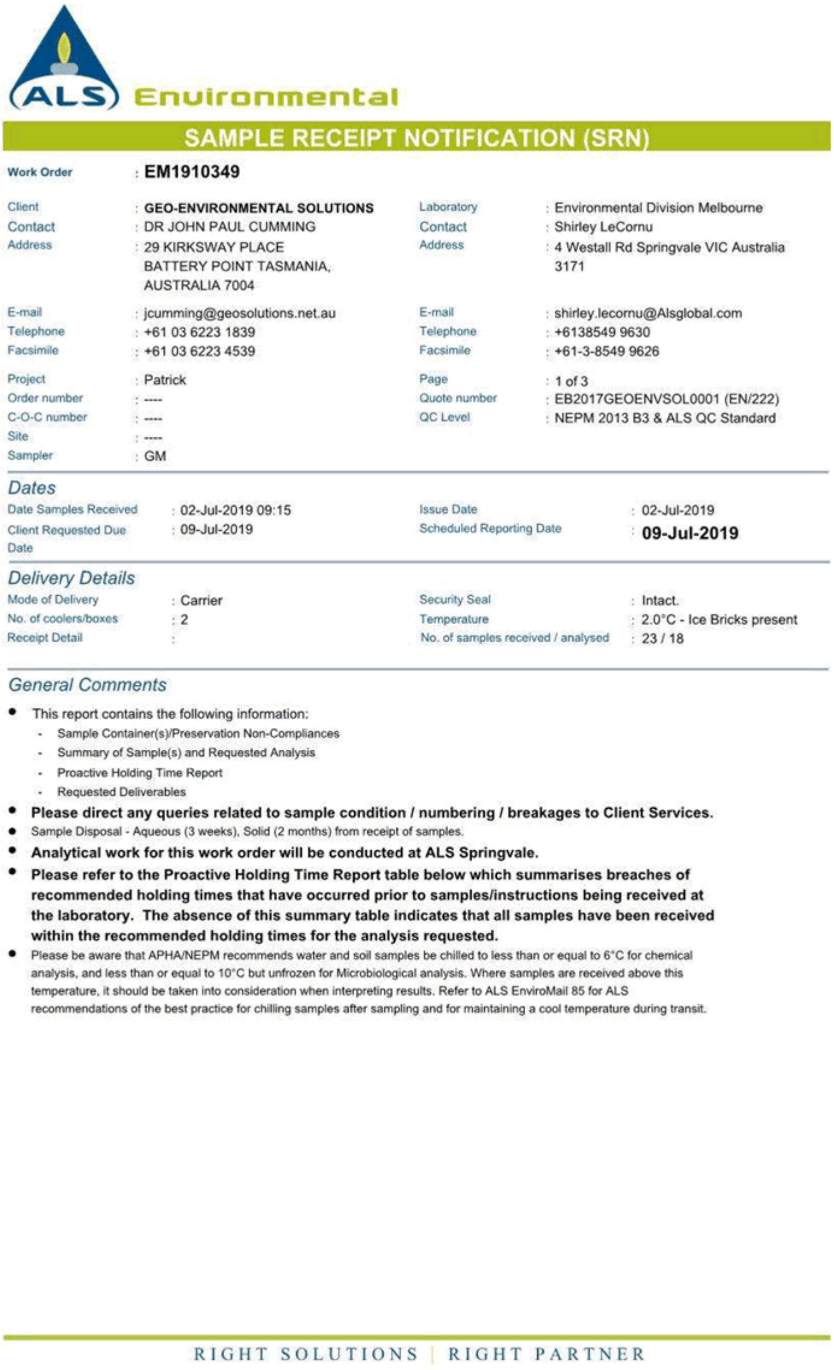
Sarah Joyce
Environmental Scientist

Please note my working days are Monday to Thursday.

GEO-ENVIRONMENTAL SOLUTIONS P/L
29 Kirksway Place, Battery Point, 7004
P: 0362231839
E: sjoyce@geosolutions.net.au

GES

Appendix 7 Laboratory Sample Receipt Notification



ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM1910349**

Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Melbourne
Contact	: DR JOHN PAUL CUMMING	Contact	: Shirley LeCornu
Address	: 29 KIRKSWAY PLACE BATTERY POINT TASMANIA, AUSTRALIA 7004	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: jcumming@geosolutions.net.au	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: +61 03 6223 1839	Telephone	: +6138549 9630
Facsimile	: +61 03 6223 4539	Facsimile	: +61-3-8549 9626
Project	: Patrick	Page	: 1 of 3
Order number	: ----	Quote number	: EB2017GEOENVSOL0001 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: GM		

Dates

Date Samples Received	: 02-Jul-2019 09:15	Issue Date	: 02-Jul-2019
Client Requested Due Date	: 09-Jul-2019	Scheduled Reporting Date	: **09-Jul-2019**

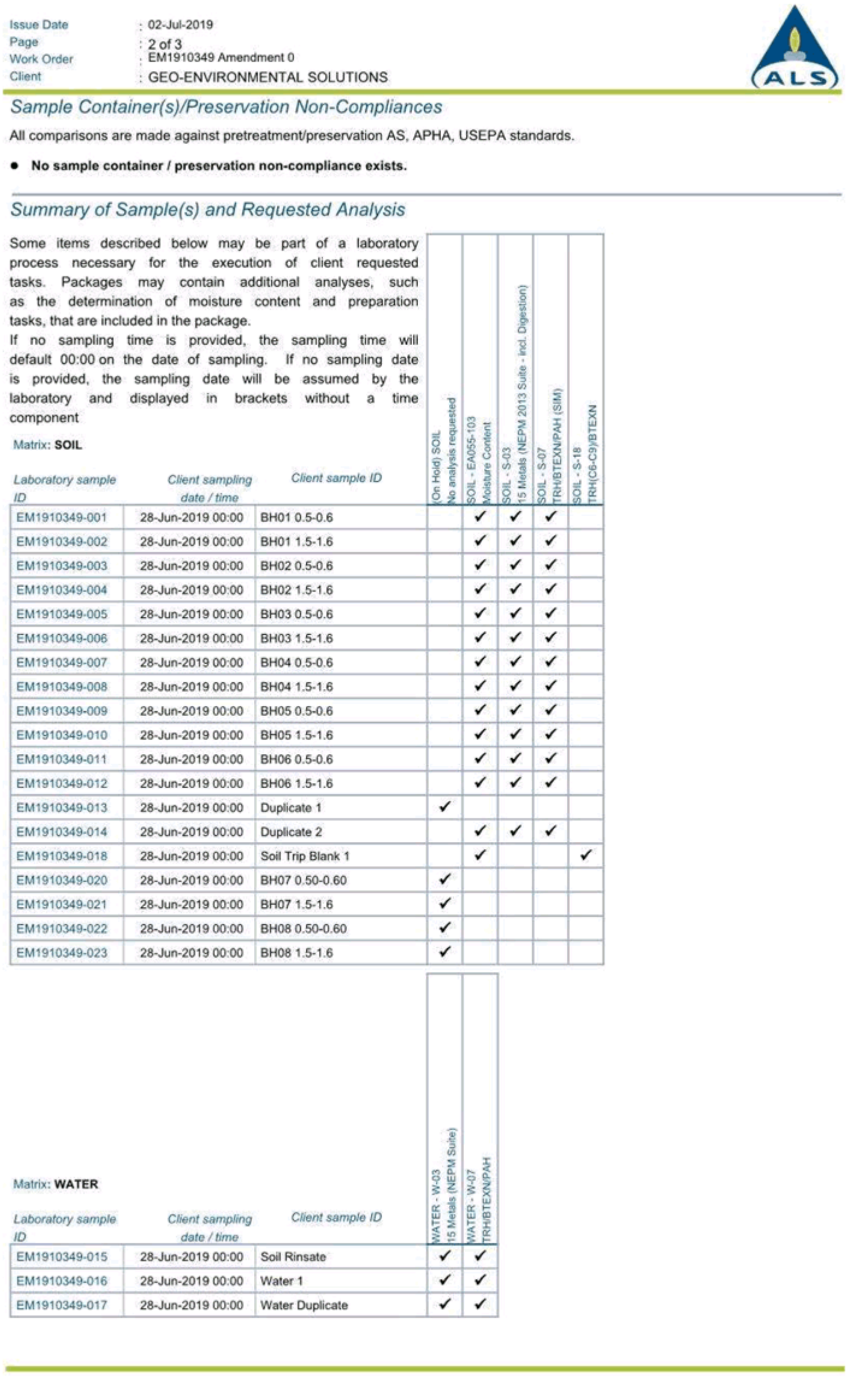
Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 2	Temperature	: 2.0°C - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 23 / 18

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

RIGHT SOLUTIONS | RIGHT PARTNER



Issue Date : 02-Jul-2019
Page : 2 of 3
Work Order : EM1910349 Amendment 0
Client : GEO-ENVIRONMENTAL SOLUTIONS

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

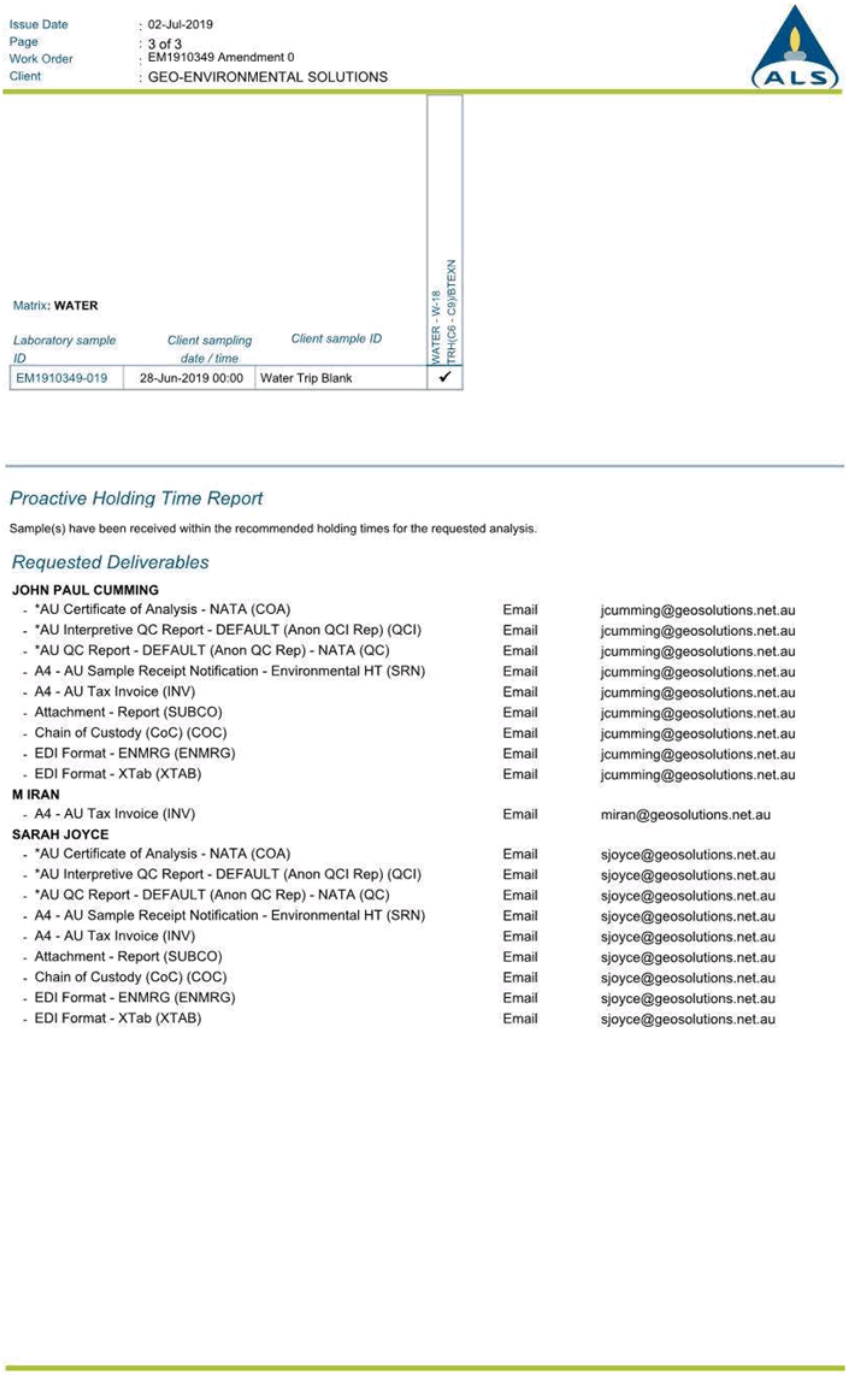
Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA055-103 Moisture Content	SOIL - S-03 15 Metals (NEPM 2013 Suite - incl. Digestion)	SOIL - S-07 TRH/BTEXN/PAH (SIM)	SOIL - S-18 TRH(C6-C9)/BTEXN
EM1910349-001	28-Jun-2019 00:00	BH01 0.5-0.6		✓	✓	✓	
EM1910349-002	28-Jun-2019 00:00	BH01 1.5-1.6		✓	✓	✓	
EM1910349-003	28-Jun-2019 00:00	BH02 0.5-0.6		✓	✓	✓	
EM1910349-004	28-Jun-2019 00:00	BH02 1.5-1.6		✓	✓	✓	
EM1910349-005	28-Jun-2019 00:00	BH03 0.5-0.6		✓	✓	✓	
EM1910349-006	28-Jun-2019 00:00	BH03 1.5-1.6		✓	✓	✓	
EM1910349-007	28-Jun-2019 00:00	BH04 0.5-0.6		✓	✓	✓	
EM1910349-008	28-Jun-2019 00:00	BH04 1.5-1.6		✓	✓	✓	
EM1910349-009	28-Jun-2019 00:00	BH05 0.5-0.6		✓	✓	✓	
EM1910349-010	28-Jun-2019 00:00	BH05 1.5-1.6		✓	✓	✓	
EM1910349-011	28-Jun-2019 00:00	BH06 0.5-0.6		✓	✓	✓	
EM1910349-012	28-Jun-2019 00:00	BH06 1.5-1.6		✓	✓	✓	
EM1910349-013	28-Jun-2019 00:00	Duplicate 1	✓				
EM1910349-014	28-Jun-2019 00:00	Duplicate 2		✓	✓	✓	
EM1910349-018	28-Jun-2019 00:00	Soil Trip Blank 1		✓			✓
EM1910349-020	28-Jun-2019 00:00	BH07 0.50-0.60	✓				
EM1910349-021	28-Jun-2019 00:00	BH07 1.5-1.6	✓				
EM1910349-022	28-Jun-2019 00:00	BH08 0.50-0.60	✓				
EM1910349-023	28-Jun-2019 00:00	BH08 1.5-1.6	✓				

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - W-03 15 Metals (NEPM Suite)	WATER - W-07 TRH/BTEXN/PAH
EM1910349-015	28-Jun-2019 00:00	Soil Rinsate	✓	✓
EM1910349-016	28-Jun-2019 00:00	Water 1	✓	✓
EM1910349-017	28-Jun-2019 00:00	Water Duplicate	✓	✓



Issue Date : 02-Jul-2019
Page : 3 of 3
Work Order : EM1910349 Amendment 0
Client : GEO-ENVIRONMENTAL SOLUTIONS

Matrix: **WATER**

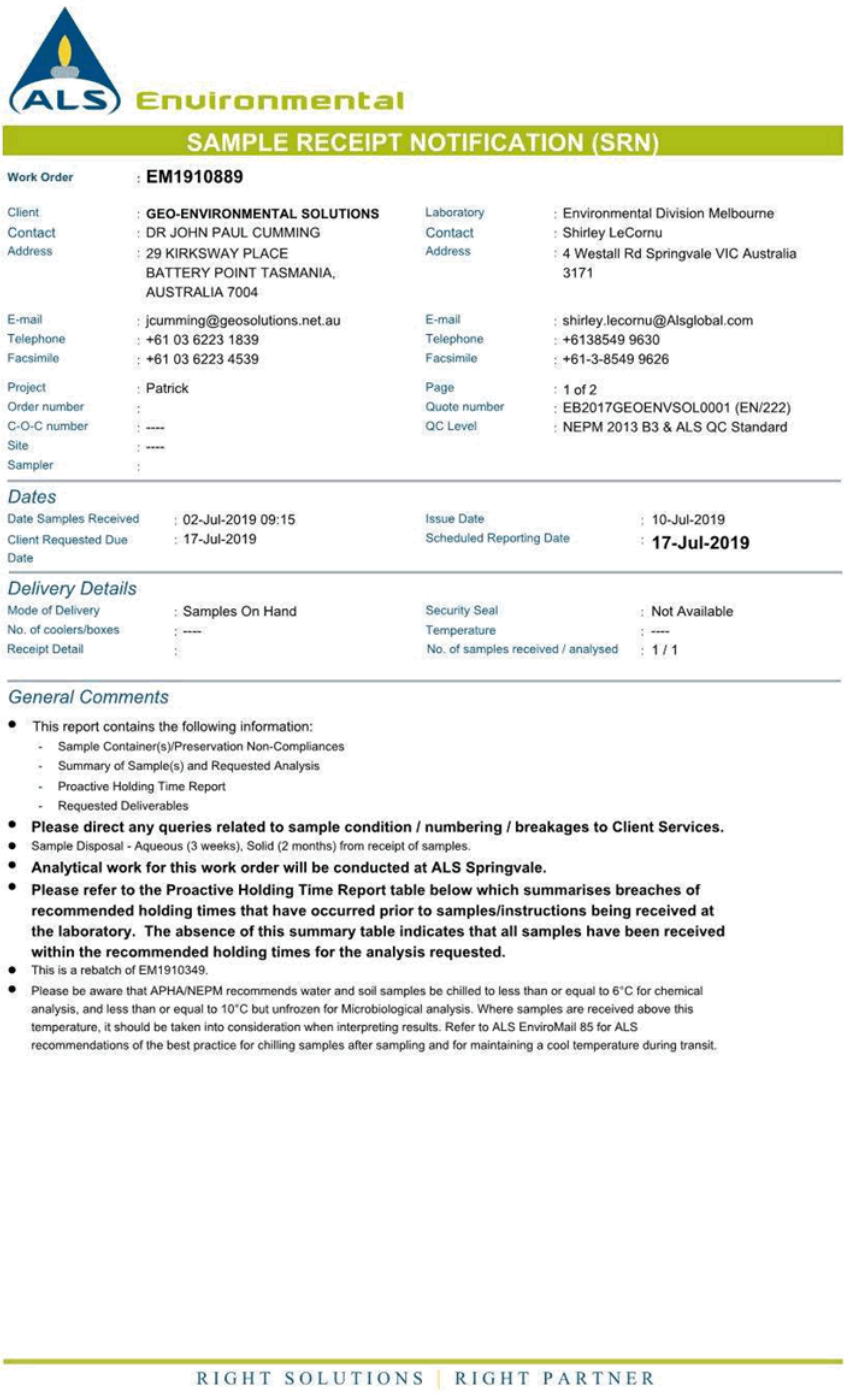
Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - W-18 TRH(C6 - C9)/BTEXN
EM1910349-019	28-Jun-2019 00:00	Water Trip Blank	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

JOHN PAUL CUMMING		
- *AU Certificate of Analysis - NATA (COA)	Email	jcumming@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	jcumming@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	jcumming@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	jcumming@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	jcumming@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	jcumming@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	jcumming@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	jcumming@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	jcumming@geosolutions.net.au
M IRAN		
- A4 - AU Tax Invoice (INV)	Email	miran@geosolutions.net.au
SARAH JOYCE		
- *AU Certificate of Analysis - NATA (COA)	Email	sjoyce@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	sjoyce@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	sjoyce@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	sjoyce@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	sjoyce@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	sjoyce@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	sjoyce@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	sjoyce@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	sjoyce@geosolutions.net.au



ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	**EM1910889**		
Client	**GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	Environmental Division Melbourne
Contact	DR JOHN PAUL CUMMING	Contact	Shirley LeCornu
Address	29 KIRKSWAY PLACE BATTERY POINT TASMANIA, AUSTRALIA 7004	Address	4 Westall Rd Springvale VIC Australia 3171
E-mail	jcumming@geosolutions.net.au	E-mail	shirley.lecornu@Alsglobal.com
Telephone	+61 03 6223 1839	Telephone	+6138549 9630
Facsimile	+61 03 6223 4539	Facsimile	+61-3-8549 9626
Project	Patrick	Page	1 of 2
Order number		Quote number	EB2017GEOENVSOL0001 (EN/222)
C-O-C number	----	QC Level	NEPM 2013 B3 & ALS QC Standard
Site	----		
Sampler			

Dates

Date Samples Received	02-Jul-2019 09:15	Issue Date	10-Jul-2019
Client Requested Due Date	17-Jul-2019	Scheduled Reporting Date	**17-Jul-2019**

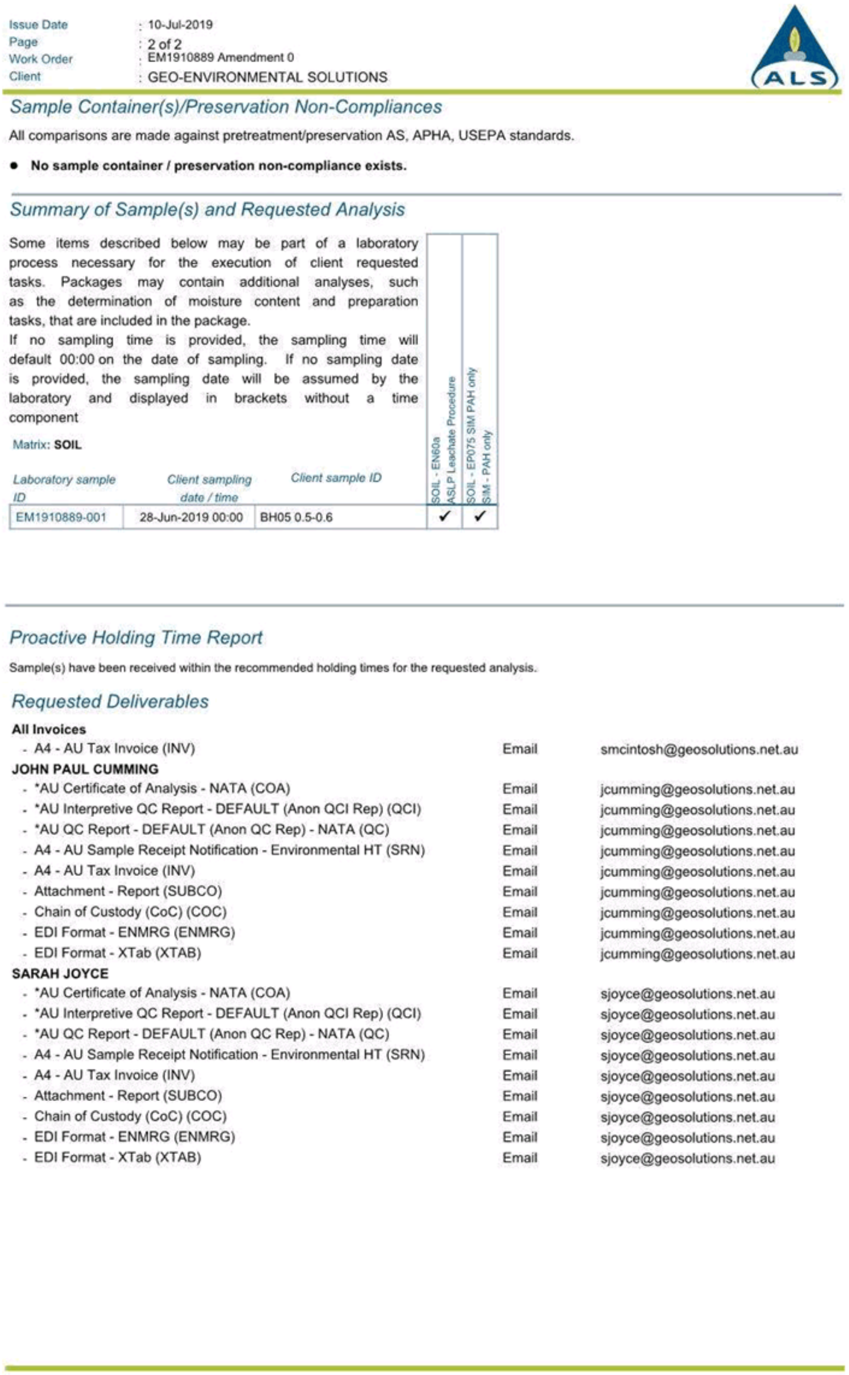
Delivery Details

Mode of Delivery	Samples On Hand	Security Seal	Not Available
No. of coolers/boxes	----	Temperature	----
Receipt Detail		No. of samples received / analysed	1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- This is a rebatch of EM1910349.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

RIGHT SOLUTIONS | RIGHT PARTNER



Issue Date : 10-Jul-2019
Page : 2 of 2
Work Order : EM1910889 Amendment 0
Client : GEO-ENVIRONMENTAL SOLUTIONS

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

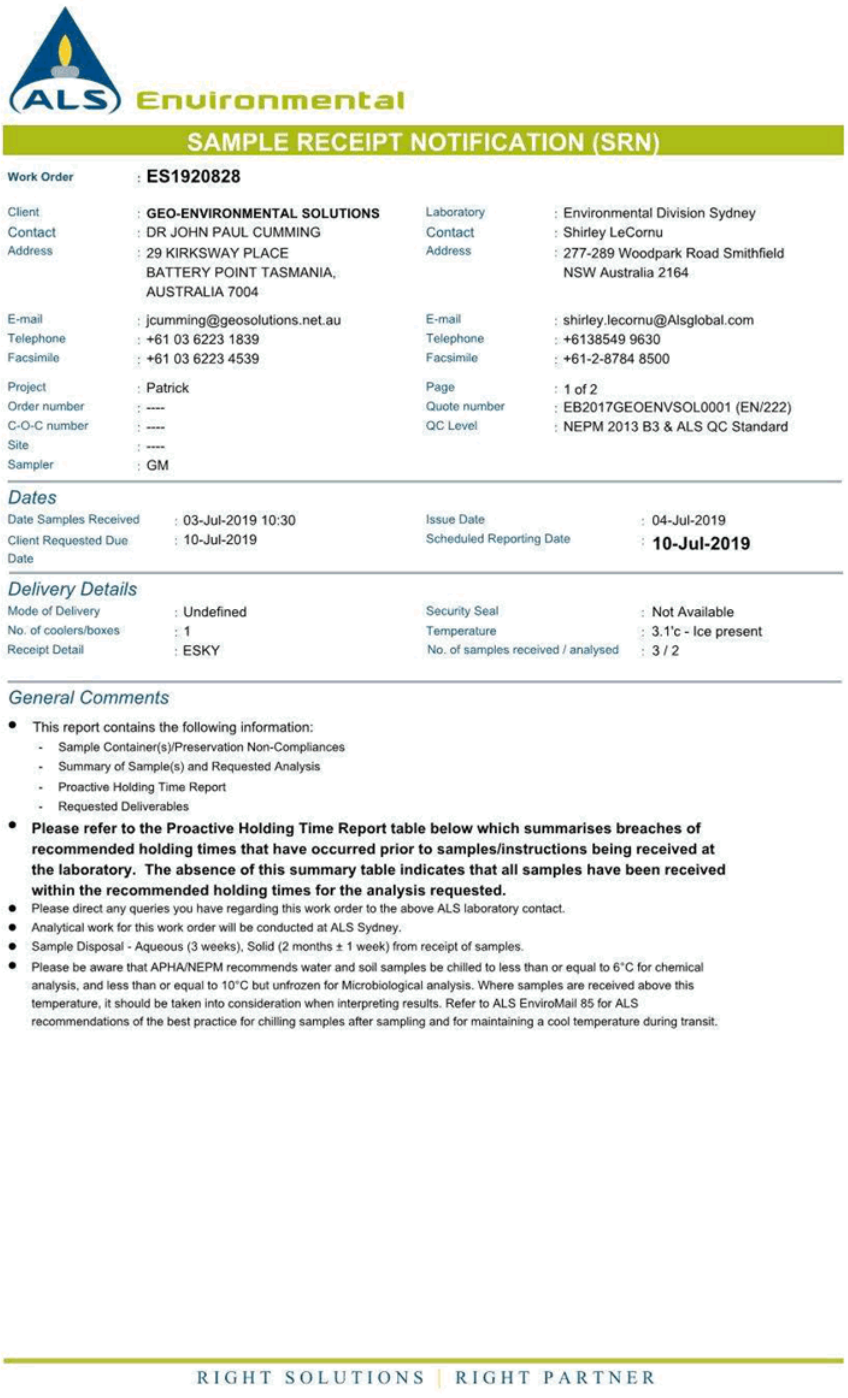
Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EN60a ASLP Leachate Procedure	SOIL - EP075 SIM PAH only SIM - PAH only
EM1910889-001	28-Jun-2019 00:00	BH05 0.5-0.6	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

All Invoices		
- A4 - AU Tax Invoice (INV)	Email	smcintosh@geosolutions.net.au
JOHN PAUL CUMMING		
- *AU Certificate of Analysis - NATA (COA)	Email	jcumming@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	jcumming@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	jcumming@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	jcumming@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	jcumming@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	jcumming@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	jcumming@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	jcumming@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	jcumming@geosolutions.net.au
SARAH JOYCE		
- *AU Certificate of Analysis - NATA (COA)	Email	sjoyce@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	sjoyce@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	sjoyce@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	sjoyce@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	sjoyce@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	sjoyce@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	sjoyce@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	sjoyce@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	sjoyce@geosolutions.net.au



ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES1920828**

Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Sydney
Contact	: DR JOHN PAUL CUMMING	Contact	: Shirley LeCornu
Address	: 29 KIRKSWAY PLACE BATTERY POINT TASMANIA, AUSTRALIA 7004	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jcumming@geosolutions.net.au	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: +61 03 6223 1839	Telephone	: +6138549 9630
Facsimile	: +61 03 6223 4539	Facsimile	: +61-2-8784 8500
Project	: Patrick	Page	: 1 of 2
Order number	: ----	Quote number	: EB2017GEOENVSOL0001 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: GM		

Dates

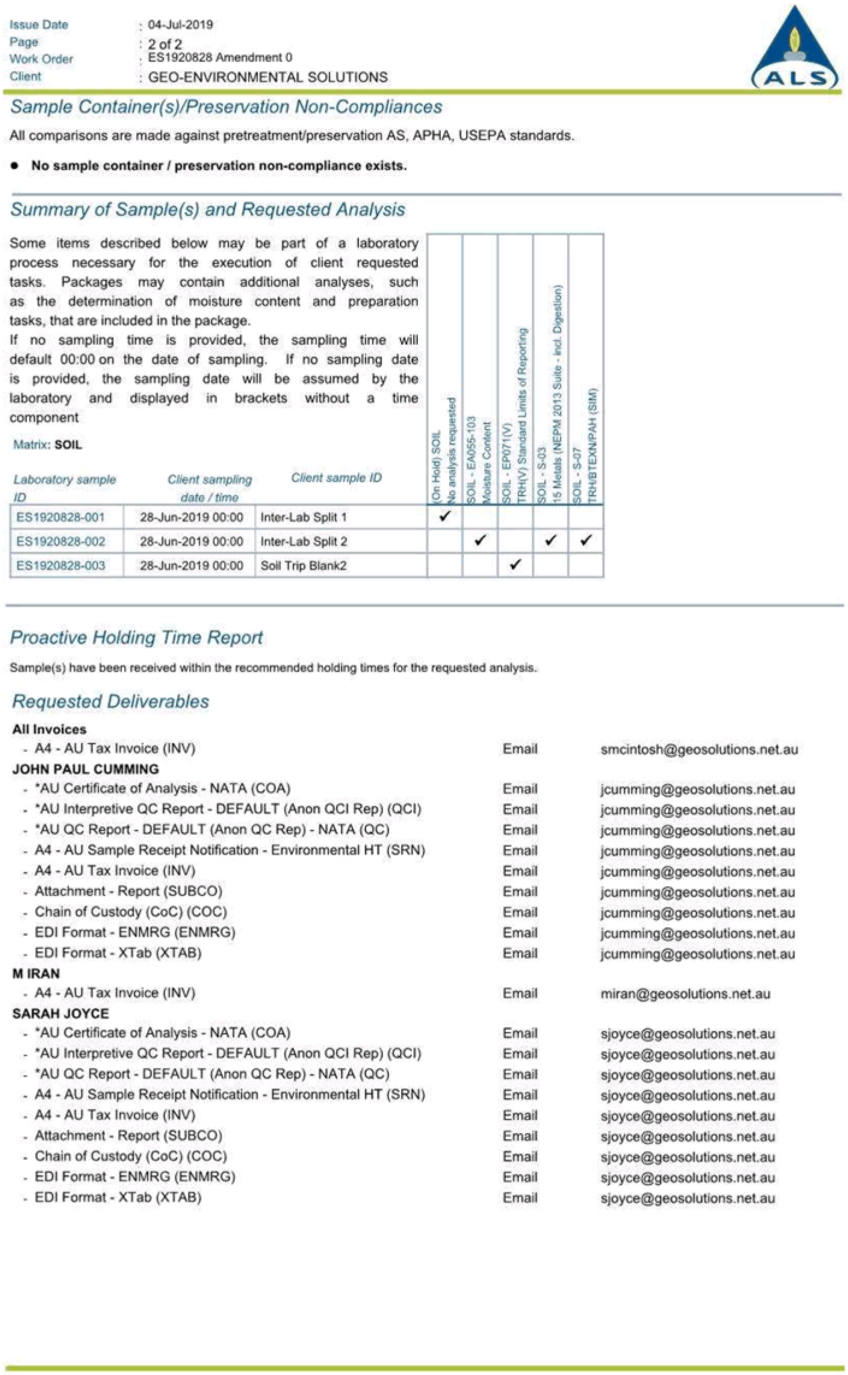
Date Samples Received	: 03-Jul-2019 10:30	Issue Date	: 04-Jul-2019
Client Requested Due Date	: 10-Jul-2019	Scheduled Reporting Date	: **10-Jul-2019**

Delivery Details

Mode of Delivery	: Undefined	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: 3.1'c - Ice present
Receipt Detail	: ESKY	No. of samples received / analysed	: 3 / 2

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.



Issue Date : 04-Jul-2019
Page : 2 of 2
Work Order : ES1920828 Amendment 0
Client : GEO-ENVIRONMENTAL SOLUTIONS

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA055-103 Moisture Content	SOIL - EP071(V) TRH(V) Standard Limits of Reporting	SOIL - S-03 15 Metals (NEPM 2013 Suite - incl. Digestion)	SOIL - S-07 TRH/BTEXN/PAH (SIM)
ES1920828-001	28-Jun-2019 00:00	Inter-Lab Split 1	✓				
ES1920828-002	28-Jun-2019 00:00	Inter-Lab Split 2		✓		✓	✓
ES1920828-003	28-Jun-2019 00:00	Soil Trip Blank2			✓		

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

All Invoices		
- A4 - AU Tax Invoice (INV)	Email	smcintosh@geosolutions.net.au
JOHN PAUL CUMMING		
- *AU Certificate of Analysis - NATA (COA)	Email	jcumming@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	jcumming@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	jcumming@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	jcumming@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	jcumming@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	jcumming@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	jcumming@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	jcumming@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	jcumming@geosolutions.net.au
M IRAN		
- A4 - AU Tax Invoice (INV)	Email	miran@geosolutions.net.au
SARAH JOYCE		
- *AU Certificate of Analysis - NATA (COA)	Email	sjoyce@geosolutions.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	sjoyce@geosolutions.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	sjoyce@geosolutions.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	sjoyce@geosolutions.net.au
- A4 - AU Tax Invoice (INV)	Email	sjoyce@geosolutions.net.au
- Attachment - Report (SUBCO)	Email	sjoyce@geosolutions.net.au
- Chain of Custody (CoC) (COC)	Email	sjoyce@geosolutions.net.au
- EDI Format - ENMRG (ENMRG)	Email	sjoyce@geosolutions.net.au
- EDI Format - XTab (XTAB)	Email	sjoyce@geosolutions.net.au

Appendix 8 Quality Assurance and Quality Control Documentation

Soil Duplicate and Interlab split

Duplicate Comparrison	Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium Total	Cobalt	Copper	Lead	Manganese	Nickel	Vanadium	Zinc	Mercury	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	Sum of polycyclic aromatic hyd	Benzo(a)pyrene TEQ (WHO)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Sum of BTEX	Total Xylenes	Naphthalene	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	F1	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	F2	Benzo(a)pyrene TEQ (half LOR)	Benzo(a)pyrene TEQ (LOR)
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR		5	10	1	1	2	2	5	5	5	2	5	5	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.2	0.5	1	10	50	100	100	50	10	10	50	100	100	50	50	0.5	0.5
28/06/2019	BH04 1.5-1.6	<5	110	<1	<1	7	4	25	126	111	7	16	249	0.4	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	2	2.1	1	1	1.4	0.6	1.2	0.7	<0.5	1	11.8	1.6	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<1	<10	<50	100	110	210	<10	<10	<50	170	<100	170	<50	1.8	2.1
28/06/2019	Duplicate 2	<5	150	<1	<1	10	7	35	145	159	9	23	295	0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	1.8	2	0.9	0.9	1.4	0.6	1.2	0.7	<0.5	0.9	11.1	1.6	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<1	<10	<50	<100	<100	<50	<10	<10	<50	160	<100	160	<50	1.8	2.1
Relative Percentage Difference (RPD) %		NA	30.8	NA	NA	35.3	54.5	33.3	12.6	22.4	25.0	35.9	16.9	22.2	NA	NA	NA	NA	13.3	NA	10.5	4.9	10.5	10.5	0.0	0.0	0.0	0.0	NA	10.5	6.1	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.1	NA	6.1	NA	0.0	0.0
RPD Compliance Limit %		NA	50	NA	NA	50	50	50	30	30	50	50	30	50	NA	NA	NA	NA	NA	NA	50	50	NA	NA	50	NA	50	NA	NA	NA	30	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50	NA	NA	NA	NA	NA	50	NA	50	50
Method Detection Limit (MDL)		NA	200	NA	NA	40	40	100	500	500	40	100	500	2	NA	NA	NA	NA	NA	NA	10	10	NA	NA	10	NA	10	NA	NA	NA	50	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1000	NA	NA	NA	NA	NA	1000	NA	10	10
MDL Class		NONE	LOW	NONE	NONE	LOW	LOW	LOW	MED	MED	LOW	LOW	MED	LOW	NONE	NONE	NONE	NONE	NONE	NONE	LOW	LOW	NONE	NONE	LOW	NONE	LOW	NONE	NONE	NONE	MED	LOW	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	LOW	NONE	NONE	NONE	NONE	NONE	LOW	NONE	LOW	LOW
RPD Compliance With MDL?	54/56 (96%)	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
28/06/2019	BH04 1.5-1.6	<5	110	<1	<1	7	4	25	126	111	7	16	249	0.4	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	2	2.1	1	1	1.4	0.6	1.2	0.7	<0.5	1	11.8	1.6	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<1	<10	<50	100	110	210	<10	<10	<50	170	<100	170	<50	1.8	2.1
28/06/2019	Inter-Lab Split 2	<5	220	<1	<1	12	8	48	473	207	12	31	588	0.7	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	1.9	2.2	0.9	0.9	1.5	0.6	1.2	0.7	<0.5	1	11.5	1.6	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<1	<10	<50	<100	<100	<50	<10	<10	<50	140	100	240	<50	1.8	2.1
Relative Percentage Difference (RPD) %		NA	66.7	NA	NA	52.6	66.7	63.0	115.9	60.4	52.6	63.8	81.0	54.5	NA	NA	NA	NA	0.0	NA	5.1	4.7	10.5	10.5	7.4	0.0	0.0	0.0	NA	0.0	2.6	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19.4	NA	34.1	NA	0.0	0.0
RPD Compliance Limit %		NA	50	NA	NA	50	50	50	30	30	50	50	30	50	NA	NA	NA	NA	NA	NA	50	50	NA	NA	50	NA	50	NA	NA	50	30	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50	NA	NA	NA	NA	NA	50	NA	50	50
Method Detection Limit (MDL)		NA	200	NA	NA	40	40	100	500	500	40	100	500	2	NA	NA	NA	NA	NA	NA	10	10	NA	NA	10	NA	10	NA	NA	10	50	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1000	NA	NA	NA	NA	NA	1000	NA	10	10
MDL Class		NONE	LOW	NONE	NONE	LOW	LOW	LOW	MED	MED	LOW	LOW	MED	LOW	NONE	NONE	NONE	NONE	NONE	NONE	LOW	LOW	NONE	NONE	LOW	NONE	LOW	NONE	NONE	LOW	MED	LOW	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	LOW	NONE	NONE	NONE	NONE	NONE	LOW	NONE	LOW	LOW
RPD Compliance With MDL?	45/56 (80%)	YES	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES

Rinsate Blank and soil trip blanks

		EG020F: Dissolved Metals by ICP-MS														EP080						EP080/071				EP080/071																										
Quality Control Blanks		Arsenic	Beryllium	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Vanadium	Zinc	Boron	Mercury	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sum of BTEX	Naphthalene	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	>C10 - C16 Fraction minus Naphthalene (F2)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	Sum of polycyclic aromatic hydrocarbons	Benzo(a)pyrene TEQ (zero)
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR		0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.01	0.005	0.05	0.0001	1	2	2	2	2	2	1	5	20	50	100	50	50	20	20	100	100	100	100	100	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	0.5	0.5
Date	Sample																																																					
28/06/2019	Soil Rinsate	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.005	<0.05	<0.0001	<1	<2	<2	<2	<2	<2	<1	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5
28/06/2019	Soil Trip Blank 1	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	<10	----	----	----	----	<10	<10	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
28/06/2019	Soil Trip Blank2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	<10	----	----	----	----	<10	<10	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Groundwater Duplicate

Sample Date	Client sample ID (Primary):	EG020F: Dissolved Metals by ICP-MS														EG035F
		Arsenic	Beryllium	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Vanadium	Zinc	Boron	Mercury
	LOR	0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0	0.01	0.01	0.005	0.05	0.0001
Duplicate / Triplicate																
Groundwater Splits - Fixed RPD Method (20%)																
28/06/2019	Water Duplicate	<0.001	<0.001	0.03	<0.0001	<0.001	<0.001	<0.001	<0.001	0.439	<0.001	<0.01	<0.01	<0.005	<0.05	<0.0001
28/06/2019	Water 1	<0.001	<0.001	0.029	<0.0001	<0.001	<0.001	<0.001	<0.001	0.421	<0.001	<0.01	<0.01	<0.005	<0.05	<0.0001
RPD %		**NA**	**NA**	3	**NA**	**NA**	**NA**	**NA**	**NA**	4	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Duplicate																
Level Calculation		NONE	NONE	MED	NONE	NONE	NONE	NONE	NONE	HIGH	NONE	NONE	NONE	NONE	NONE	NONE
Compliance?		**NA**	**NA**	YES	**NA**	**NA**	**NA**	**NA**	**NA**	YES	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Sample Date	Client sample ID (Primary):	EP075(SIM)B: Polynuclear Aromatic Hydrocarbons																	
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	Sum of polycyclic aromatic hydrocarbons	Benzo(a)pyrene TEQ (WHO)
	LOR	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	0.5	0.5
Duplicate / Triplicate																			
Groundwater Splits - Fixed RPD Method (20%)																			
28/06/2019	Water Duplicate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5
28/06/2019	Water 1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5
RPD %		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Duplicate																			
Level Calculation		NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Compliance?		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Sample Date	Client sample ID (Primary):	EP080: BTEXN								EP080/071:TPH					EP080/071: TRH - NEPM 2013						
		Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sum of BTEX	Naphthalene	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	F1	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	F2
	LOR	1	2	2	2	2	2	1	5	20	50	100	50	50	20	20	100	100	100	100	100
Duplicate / Triplicate																					
Groundwater Splits - Fixed RPD Method (20%)																					
28/06/2019	Water Duplicate	<1	<2	<2	<2	<2	<2	<1	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100
28/06/2019	Water 1	<1	<2	<2	<2	<2	<2	<1	<5	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100
RPD %		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Duplicate																					
Level Calculation		NA	NONE	NONE	NONE	NONE	NONE	NA	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Compliance?		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

No RPDs exceeding method detection limit for duplicate pairs

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1910349**	Page	: 1 of 15
Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Melbourne
Contact	: DR JOHN PAUL CUMMING	Contact	: Shirley LeCornu
Address	: 29 KIRKSWAY PLACE BATTERY POINT TASMANIA, AUSTRALIA 7004	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 6223 1839	Telephone	: +6138549 9630
Project	: Patrick	Date Samples Received	: 02-Jul-2019
Order number	: ----	Date Analysis Commenced	: 03-Jul-2019
C-O-C number	: ----	Issue Date	: 09-Jul-2019
Sampler	: GM		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 23		
No. of samples analysed	: 22		

ilac-MRA

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

RIGHT SOLUTIONS | RIGHT PARTNER

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

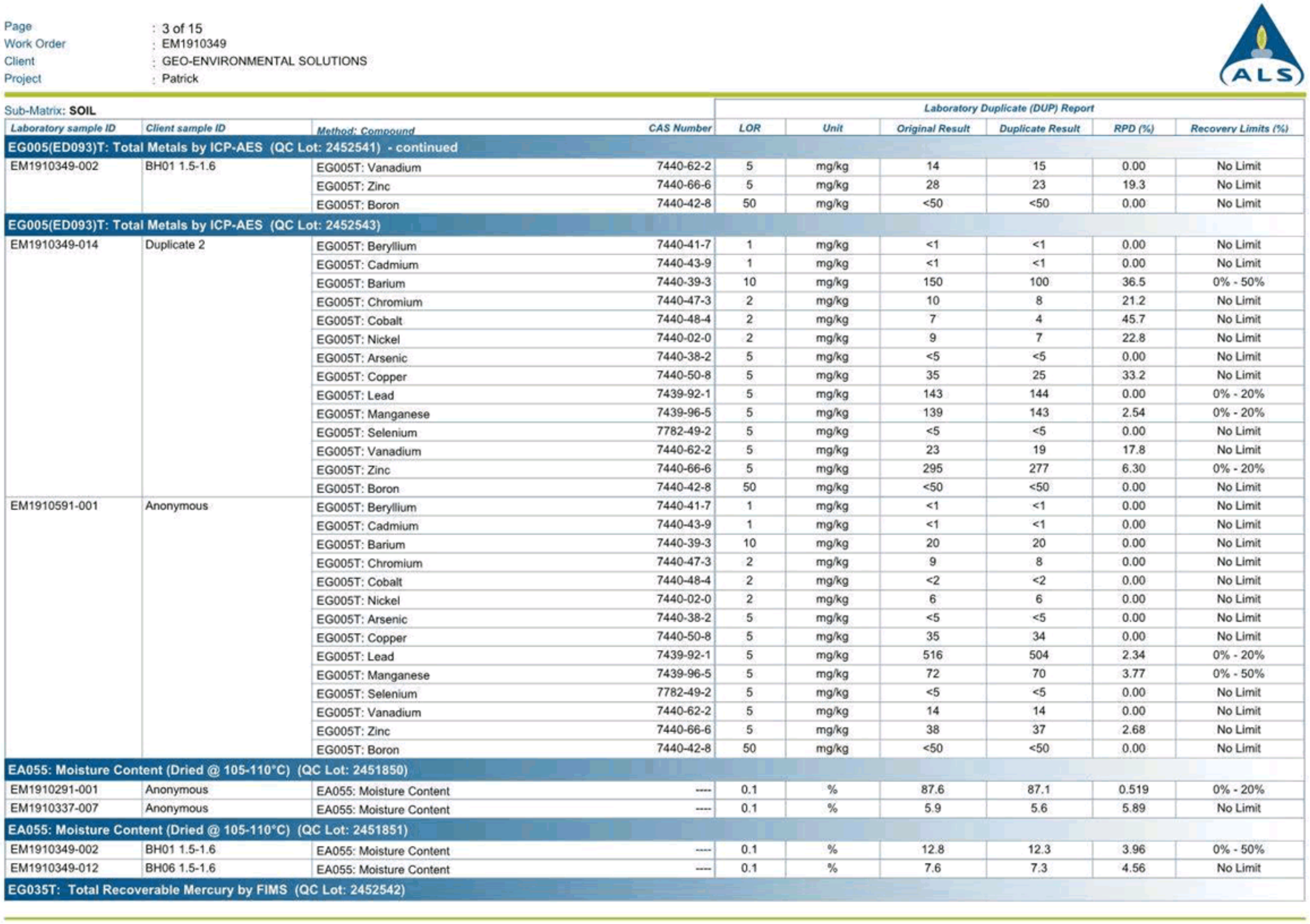
Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2452541)									
EM1910329-011	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	1	1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	160	120	28.0	0% - 50%
		EG005T: Chromium	7440-47-3	2	mg/kg	50	48	4.73	0% - 20%
		EG005T: Cobalt	7440-48-4	2	mg/kg	10	9	15.8	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	40	39	4.20	0% - 20%
		EG005T: Arsenic	7440-38-2	5	mg/kg	6	6	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	12	12	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	6	<5	19.7	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	209	202	3.42	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	50	47	6.08	0% - 50%
		EG005T: Zinc	7440-66-6	5	mg/kg	18	17	6.10	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	80	70	0.00	No Limit
EM1910349-002	BH01 1.5-1.6	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	50	60	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	10	8	11.4	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	11	10	12.4	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	10	10	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	8	8	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	12	16	33.4	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	470	457	2.79	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit



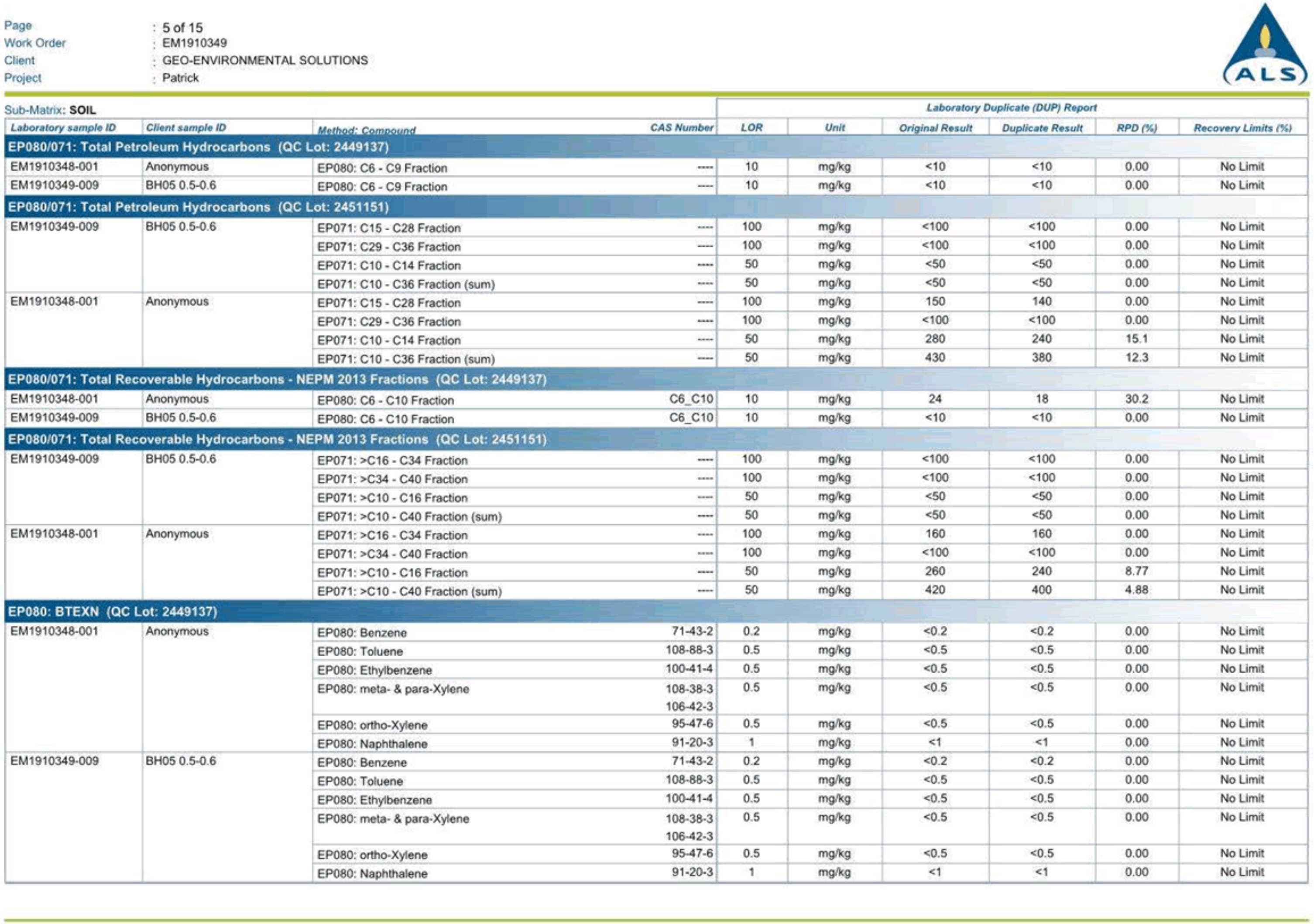
Page : 3 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2452541) - continued									
EM1910349-002	BH01 1.5-1.6	EG005T: Vanadium	7440-62-2	5	mg/kg	14	15	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	28	23	19.3	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.00	No Limit
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2452543)									
EM1910349-014	Duplicate 2	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	150	100	36.5	0% - 50%
		EG005T: Chromium	7440-47-3	2	mg/kg	10	8	21.2	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	7	4	45.7	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	9	7	22.8	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	35	25	33.2	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	143	144	0.00	0% - 20%
		EG005T: Manganese	7439-96-5	5	mg/kg	139	143	2.54	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	23	19	17.8	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	295	277	6.30	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.00	No Limit
EM1910591-001	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	20	20	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	9	8	0.00	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	6	6	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	35	34	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	516	504	2.34	0% - 20%
		EG005T: Manganese	7439-96-5	5	mg/kg	72	70	3.77	0% - 50%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	14	14	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	38	37	2.68	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.00	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2451850)									
EM1910291-001	Anonymous	EA055: Moisture Content	----	0.1	%	87.6	87.1	0.519	0% - 20%
EM1910337-007	Anonymous	EA055: Moisture Content	----	0.1	%	5.9	5.6	5.89	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2451851)									
EM1910349-002	BH01 1.5-1.6	EA055: Moisture Content	----	0.1	%	12.8	12.3	3.96	0% - 50%
EM1910349-012	BH06 1.5-1.6	EA055: Moisture Content	----	0.1	%	7.6	7.3	4.56	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2452542)									

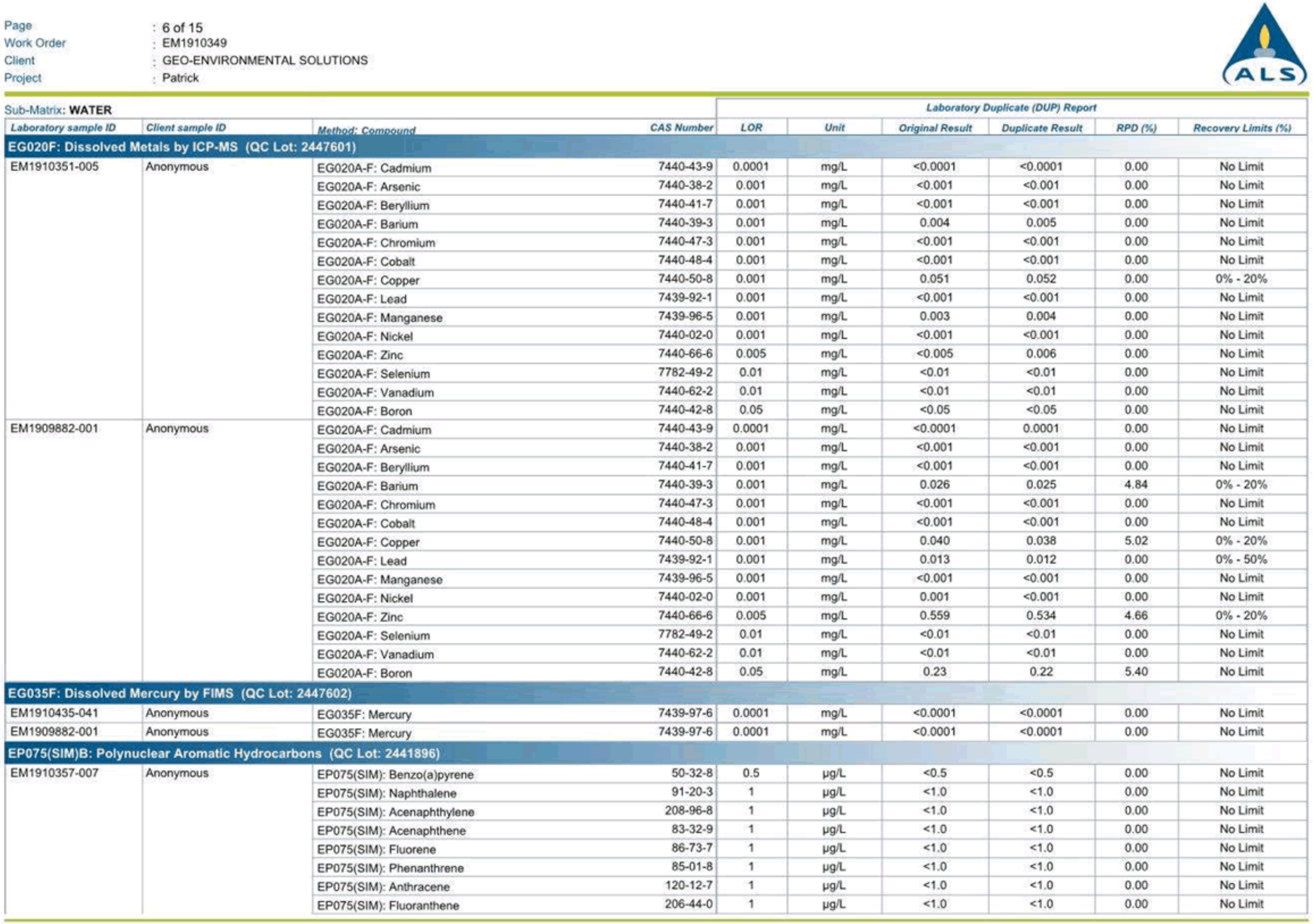
Page : 4 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2452542) - continued									
EM1910329-011	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1910349-002	BH01 1.5-1.6	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2452544)									
EM1910349-014	Duplicate 2	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.5	0.4	0.00	No Limit
EM1910591-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2451152)									
EM1910349-009	BH05 0.5-0.6	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	1.6	0.8	69.2	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	0.6	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	3.0	1.6	59.8	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	3.6	1.8	64.8	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	2.1	1.0	68.9	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	1.7	0.8	70.7	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	2.4	1.3	60.7	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	0.9	<0.5	53.6	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	2.1	1.1	62.1	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	0.9	<0.5	54.3	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	1.1	0.6	64.8	No Limit
EM1910348-001	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit



Page	: 5 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

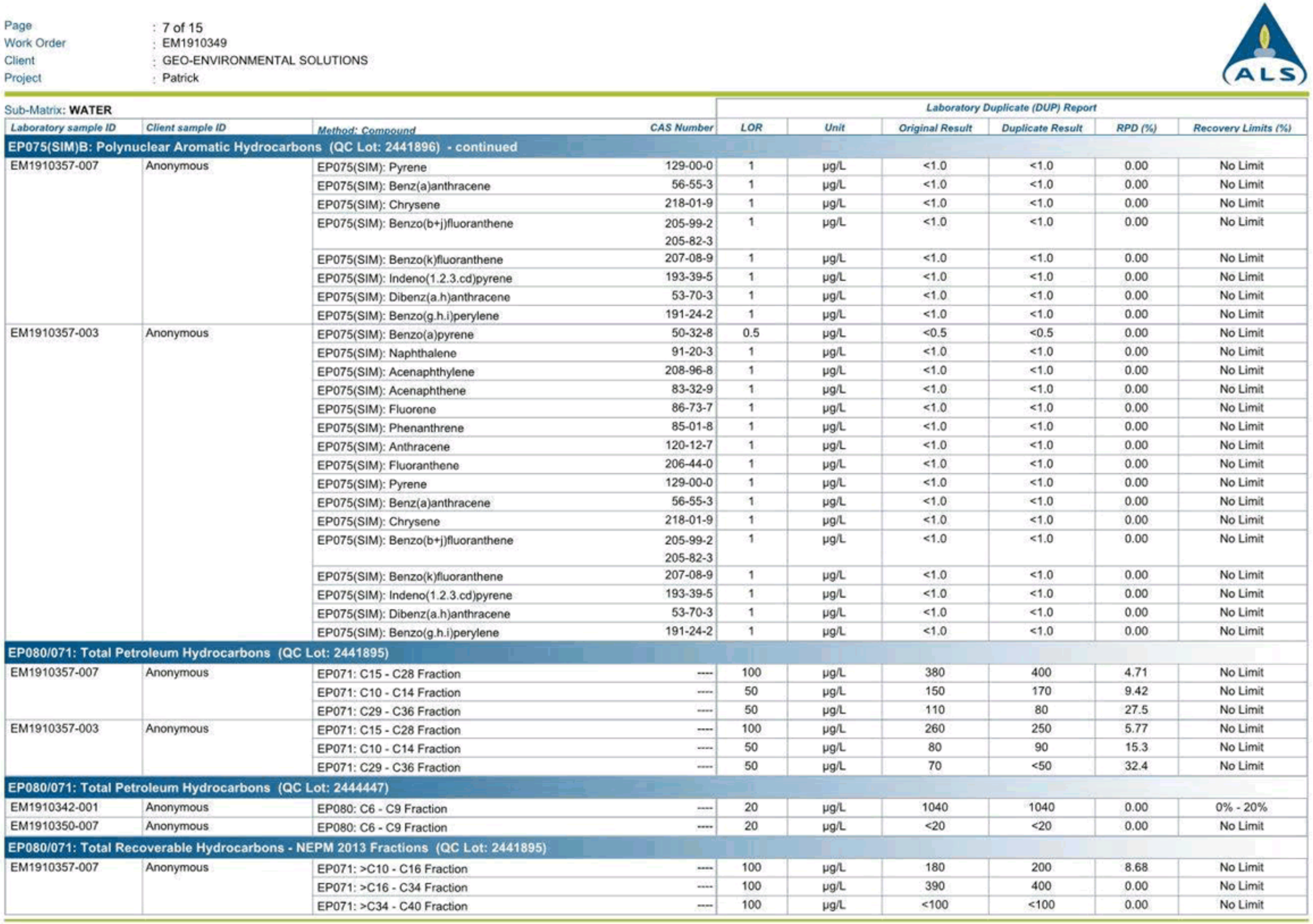
Sub-Matrix: **SOIL**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2449137)									
EM1910348-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EM1910349-009	BH05 0.5-0.6	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2451151)									
EM1910349-009	BH05 0.5-0.6	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1910348-001	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	150	140	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	280	240	15.1	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	430	380	12.3	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2449137)									
EM1910348-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	24	18	30.2	No Limit
EM1910349-009	BH05 0.5-0.6	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2451151)									
EM1910349-009	BH05 0.5-0.6	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1910348-001	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	160	160	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	260	240	8.77	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	420	400	4.88	No Limit
EP080: BTEXN (QC Lot: 2449137)									
EM1910348-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EM1910349-009	BH05 0.5-0.6	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit



Page : 6 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

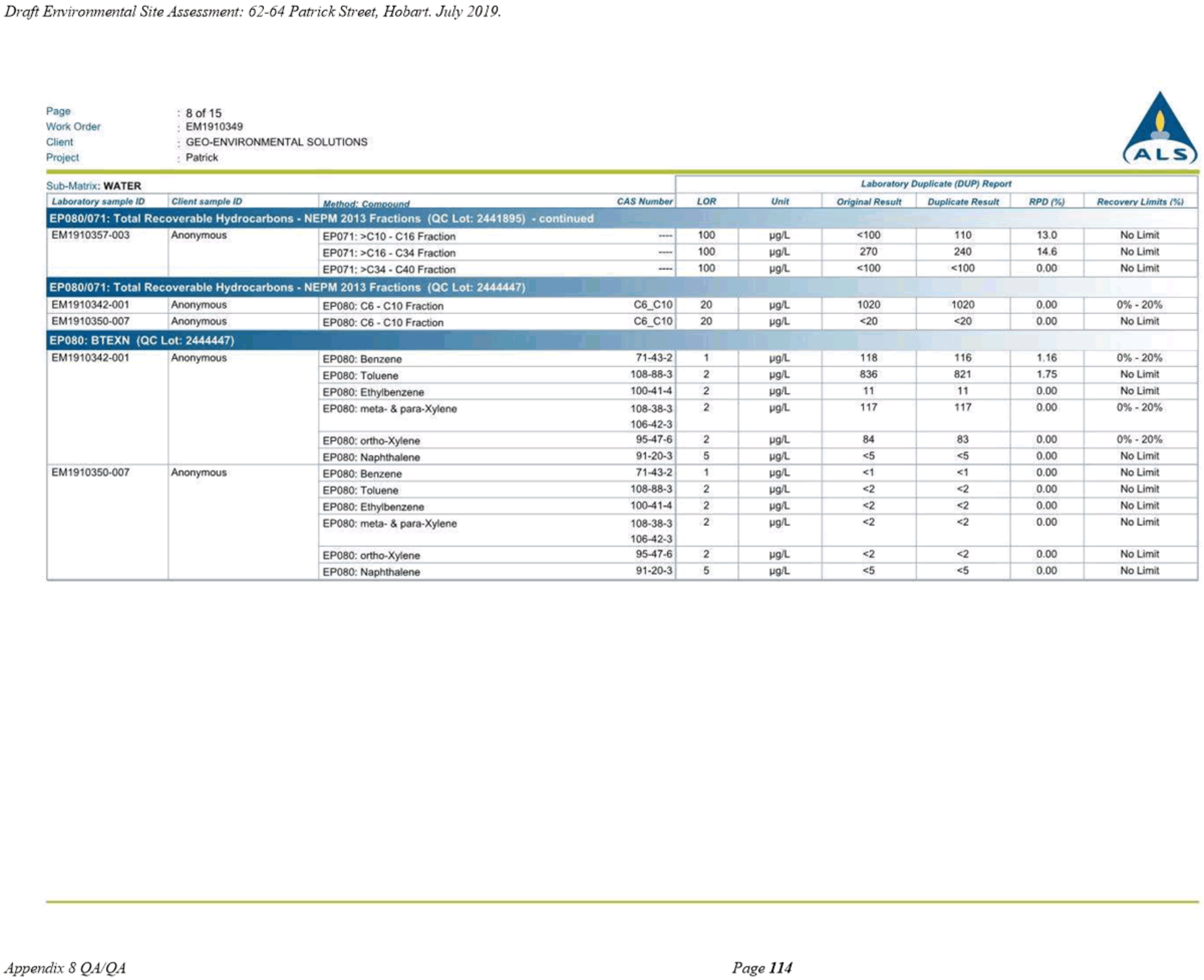
Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2447601)									
EM1910351-005	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.004	0.005	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.051	0.052	0.00	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.003	0.004	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.006	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EM1909882-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.026	0.025	4.84	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.040	0.038	5.02	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.013	0.012	0.00	0% - 50%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.559	0.534	4.66	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.23	0.22	5.40	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2447602)									
EM1910435-041	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1909882-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2441896)									
EM1910357-007	Anonymous	EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	0.00	No Limit



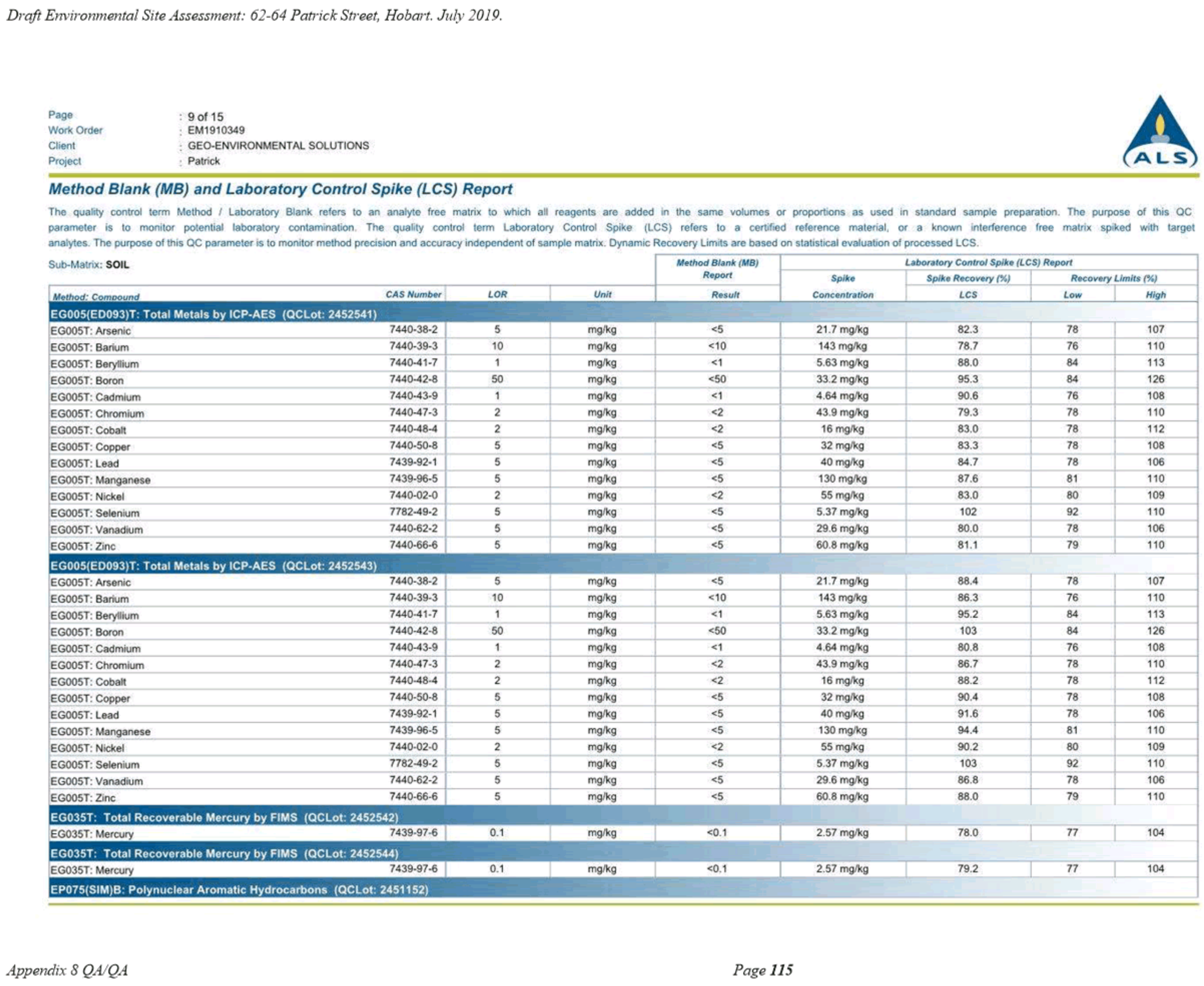
Page	: 7 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2441896) - continued									
EM1910357-007	Anonymous	EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	<1.0	0.00	No Limit
EM1910357-003	Anonymous	EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	<1.0	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2441895)									
EM1910357-007	Anonymous	EP071: C15 - C28 Fraction	----	100	µg/L	380	400	4.71	No Limit
		EP071: C10 - C14 Fraction	----	50	µg/L	150	170	9.42	No Limit
		EP071: C29 - C36 Fraction	----	50	µg/L	110	80	27.5	No Limit
EM1910357-003	Anonymous	EP071: C15 - C28 Fraction	----	100	µg/L	260	250	5.77	No Limit
		EP071: C10 - C14 Fraction	----	50	µg/L	80	90	15.3	No Limit
		EP071: C29 - C36 Fraction	----	50	µg/L	70	<50	32.4	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2444447)									
EM1910342-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	1040	1040	0.00	0% - 20%
EM1910350-007	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2441895)									
EM1910357-007	Anonymous	EP071: >C10 - C16 Fraction	----	100	µg/L	180	200	8.68	No Limit
		EP071: >C16 - C34 Fraction	----	100	µg/L	390	400	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	µg/L	<100	<100	0.00	No Limit



Page	: 8 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2441895) - continued									
EM1910357-003	Anonymous	EP071: >C10 - C16 Fraction	----	100	µg/L	<100	110	13.0	No Limit
		EP071: >C16 - C34 Fraction	----	100	µg/L	270	240	14.6	No Limit
		EP071: >C34 - C40 Fraction	----	100	µg/L	<100	<100	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2444447)									
EM1910342-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	1020	1020	0.00	0% - 20%
EM1910350-007	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 2444447)									
EM1910342-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	118	116	1.16	0% - 20%
		EP080: Toluene	108-88-3	2	µg/L	836	821	1.75	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	11	11	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	117	117	0.00	0% - 20%
		EP080: ortho-Xylene	95-47-6	2	µg/L	84	83	0.00	0% - 20%
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EM1910350-007	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit



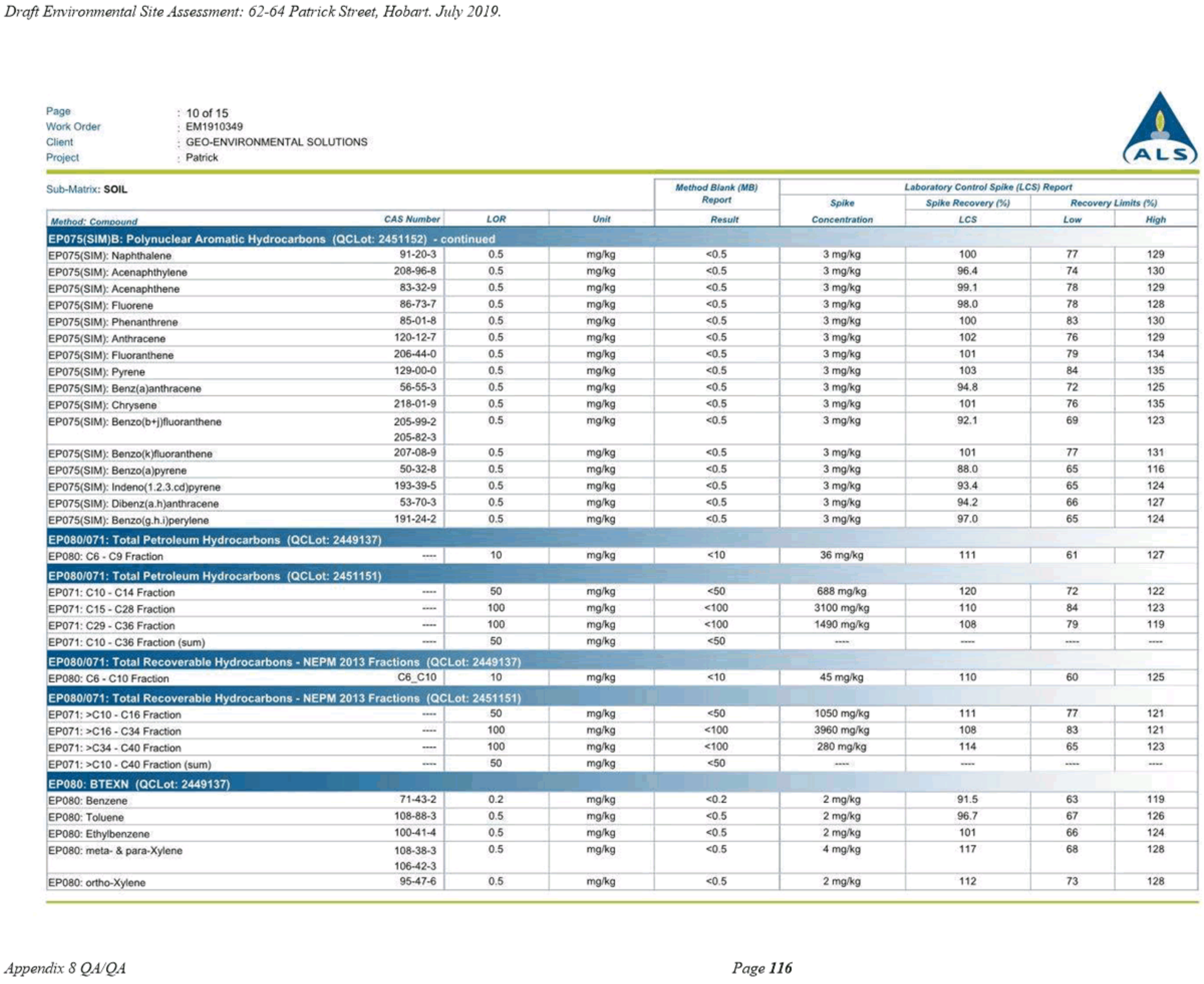
Page	: 9 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

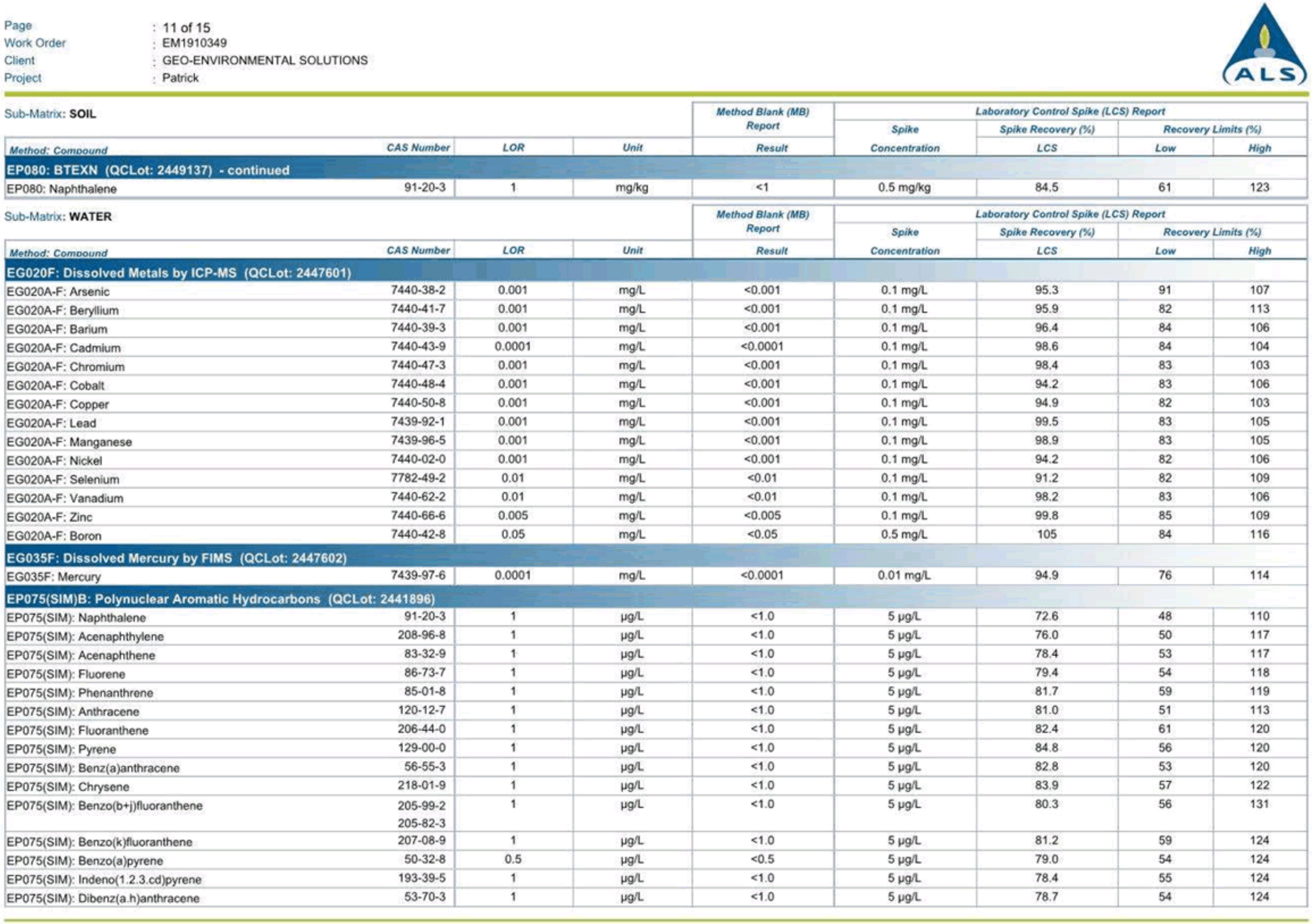
				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2452541)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	82.3	78	107
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	78.7	76	110
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	88.0	84	113
EG005T: Boron	7440-42-8	50	mg/kg	<50	33.2 mg/kg	95.3	84	126
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	90.6	76	108
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	79.3	78	110
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	83.0	78	112
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	83.3	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	84.7	78	106
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	87.6	81	110
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	83.0	80	109
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	102	92	110
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	29.6 mg/kg	80.0	78	106
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	81.1	79	110
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2452543)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	88.4	78	107
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	86.3	76	110
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	95.2	84	113
EG005T: Boron	7440-42-8	50	mg/kg	<50	33.2 mg/kg	103	84	126
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	80.8	76	108
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	86.7	78	110
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	88.2	78	112
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	90.4	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	91.6	78	106
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	94.4	81	110
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	90.2	80	109
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	103	92	110
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	29.6 mg/kg	86.8	78	106
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	88.0	79	110
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2452542)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	78.0	77	104
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2452544)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	79.2	77	104
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451152)								



Page	: 10 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451152) - continued								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	3 mg/kg	100	77	129
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	3 mg/kg	96.4	74	130
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	3 mg/kg	99.1	78	129
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	3 mg/kg	98.0	78	128
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	3 mg/kg	100	83	130
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	3 mg/kg	102	76	129
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	3 mg/kg	101	79	134
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	3 mg/kg	103	84	135
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	3 mg/kg	94.8	72	125
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	3 mg/kg	101	76	135
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	3 mg/kg	92.1	69	123
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	3 mg/kg	101	77	131
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	3 mg/kg	88.0	65	116
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	3 mg/kg	93.4	65	124
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	3 mg/kg	94.2	66	127
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	3 mg/kg	97.0	65	124
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2449137)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	111	61	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2451151)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	688 mg/kg	120	72	122
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	3100 mg/kg	110	84	123
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	1490 mg/kg	108	79	119
EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2449137)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	45 mg/kg	110	60	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2451151)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1050 mg/kg	111	77	121
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	3960 mg/kg	108	83	121
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	280 mg/kg	114	65	123
EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080: BTEXN (QCLot: 2449137)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	91.5	63	119
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	96.7	67	126
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	101	66	124
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	117	68	128
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	112	73	128



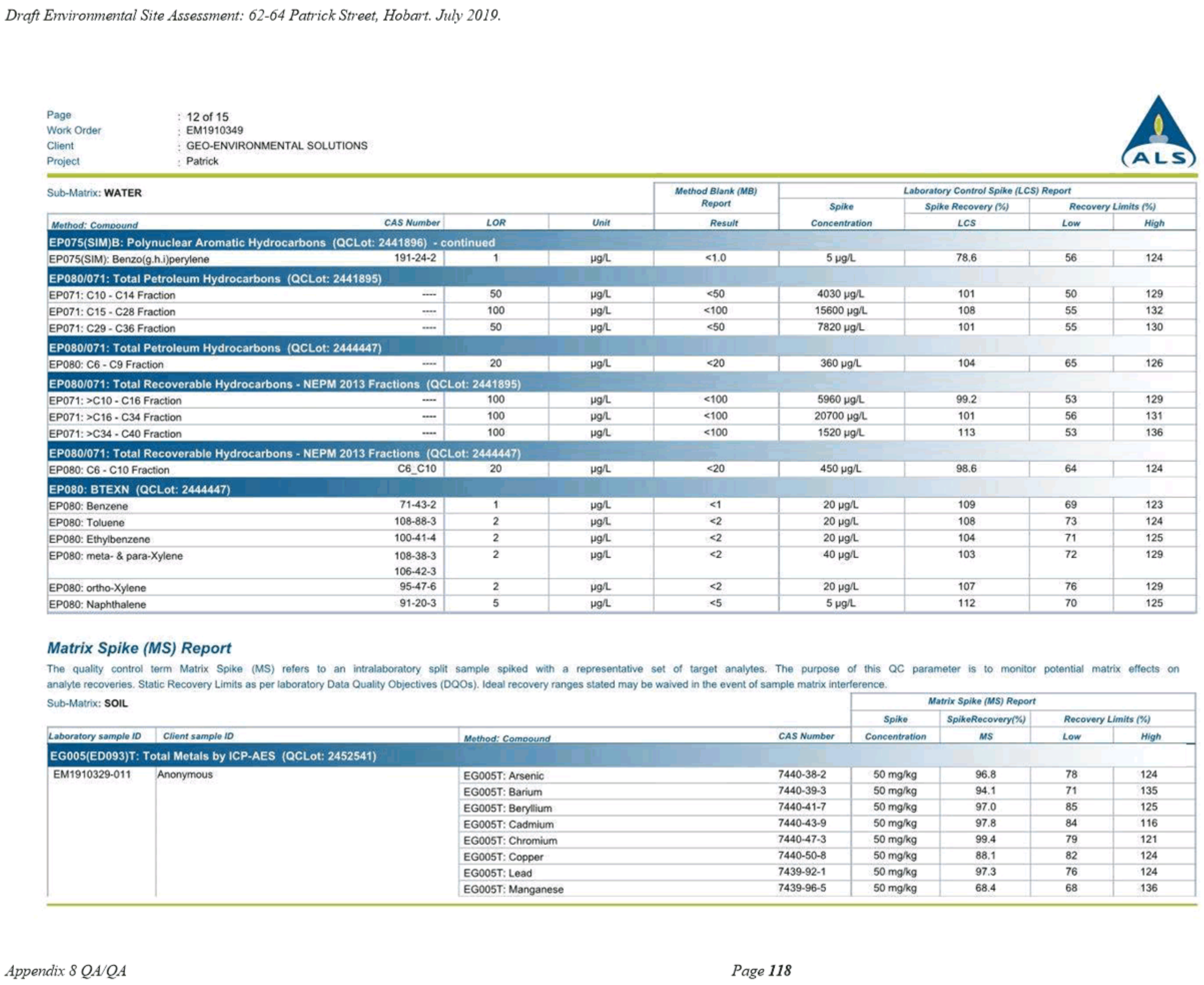
Page	: 11 of 15
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080: BTEXN (QCLot: 2449137) - continued								
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	84.5	61	123

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2447601)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	95.3	91	107
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.9	82	113
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	96.4	84	106
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.6	84	104
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.4	83	103
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	94.2	83	106
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	94.9	82	103
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	99.5	83	105
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	98.9	83	105
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.2	82	106
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	91.2	82	109
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	98.2	83	106
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	99.8	85	109
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	105	84	116
EG035F: Dissolved Mercury by FIMS (QCLot: 2447602)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.9	76	114
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2441896)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	72.6	48	110
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	76.0	50	117
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	78.4	53	117
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	79.4	54	118
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	81.7	59	119
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	81.0	51	113
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	82.4	61	120
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	84.8	56	120
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	82.8	53	120
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	83.9	57	122
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	80.3	56	131
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	81.2	59	124
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	79.0	54	124
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	78.4	55	124
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	78.7	54	124



Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2441896) - continued								
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	78.6	56	124
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2441895)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	4030 µg/L	101	50	129
EP071: C15 - C28 Fraction	----	100	µg/L	<100	15600 µg/L	108	55	132
EP071: C29 - C36 Fraction	----	50	µg/L	<50	7820 µg/L	101	55	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2444447)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	104	65	126
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2441895)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	5960 µg/L	99.2	53	129
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	20700 µg/L	101	56	131
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1520 µg/L	113	53	136
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2444447)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	98.6	64	124
EP080: BTEXN (QCLot: 2444447)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	109	69	123
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	108	73	124
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	104	71	125
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	103	72	129
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	107	76	129
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	112	70	125

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

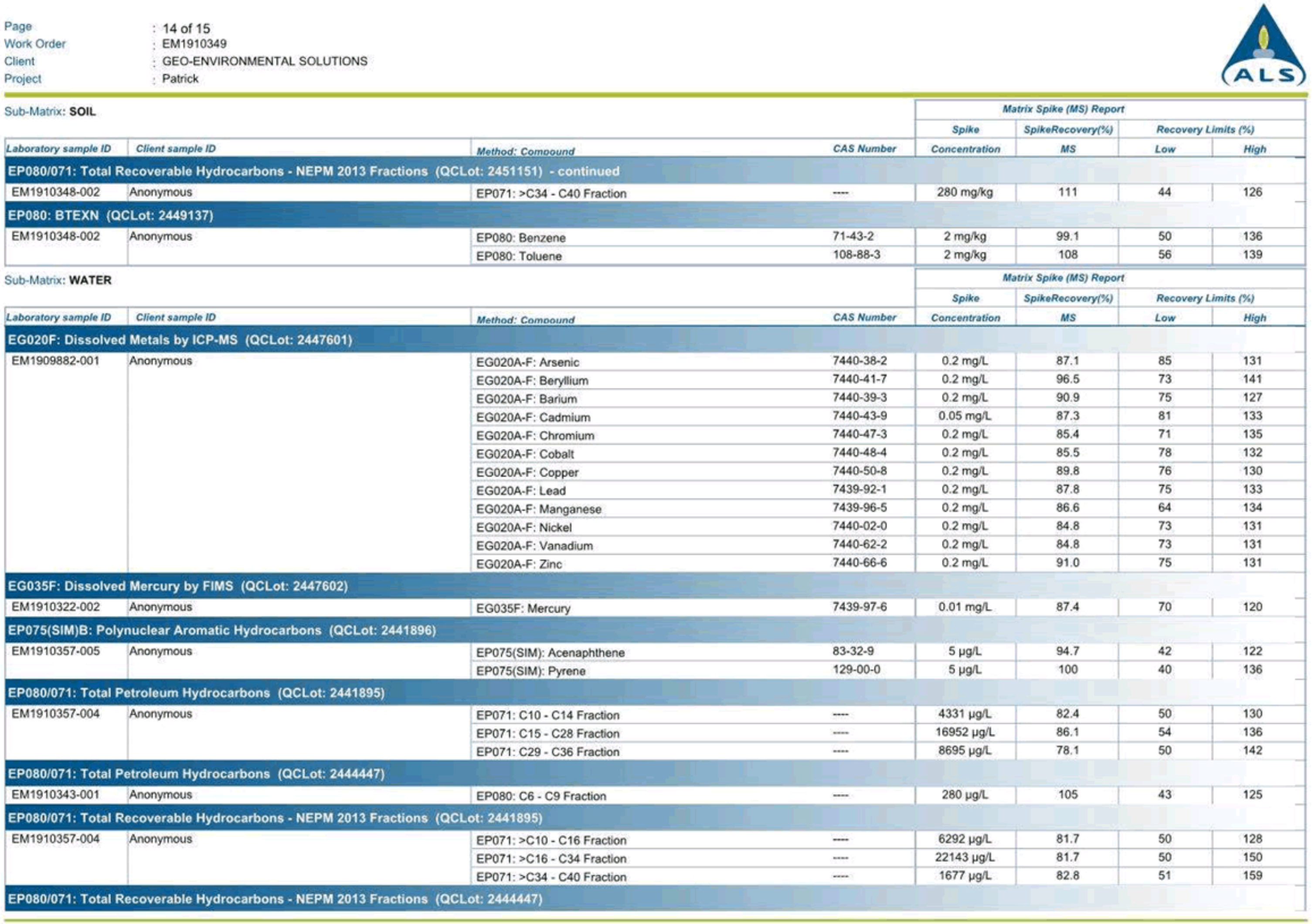
Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2452541)							
EM1910329-011	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	96.8	78	124
		EG005T: Barium	7440-39-3	50 mg/kg	94.1	71	135
		EG005T: Beryllium	7440-41-7	50 mg/kg	97.0	85	125
		EG005T: Cadmium	7440-43-9	50 mg/kg	97.8	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	99.4	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	88.1	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	97.3	76	124
		EG005T: Manganese	7439-96-5	50 mg/kg	68.4	68	136

Page : 13 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2452541) - continued							
EM1910329-011	Anonymous	EG005T: Nickel	7440-02-0	50 mg/kg	98.8	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	98.2	71	125
		EG005T: Vanadium	7440-62-2	50 mg/kg	99.0	76	124
		EG005T: Zinc	7440-66-6	50 mg/kg	100	74	128
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2452543)							
EM1910349-020	BH07 0.50-0.60	EG005T: Arsenic	7440-38-2	50 mg/kg	86.7	78	124
		EG005T: Barium	7440-39-3	50 mg/kg	81.8	71	135
		EG005T: Beryllium	7440-41-7	50 mg/kg	92.8	85	125
		EG005T: Cadmium	7440-43-9	50 mg/kg	84.0	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	82.9	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	95.3	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	101	76	124
		EG005T: Manganese	7439-96-5	50 mg/kg	# Not Determined	68	136
		EG005T: Nickel	7440-02-0	50 mg/kg	85.2	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	75.5	71	125
		EG005T: Vanadium	7440-62-2	50 mg/kg	83.5	76	124
		EG005T: Zinc	7440-66-6	50 mg/kg	96.8	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2452542)							
EM1910329-011	Anonymous	EG035T: Mercury	7439-97-6	0.5 mg/kg	78.8	76	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2452544)							
EM1910349-020	BH07 0.50-0.60	EG035T: Mercury	7439-97-6	0.5 mg/kg	87.0	76	116
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2451152)							
EM1910349-001	BH01 0.5-0.6	EP075(SIM): Acenaphthene	83-32-9	3 mg/kg	94.8	67	117
		EP075(SIM): Pyrene	129-00-0	3 mg/kg	99.1	52	148
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2449137)							
EM1910348-002	Anonymous	EP080: C6 - C9 Fraction	----	28 mg/kg	# 22.3	42	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2451151)							
EM1910348-002	Anonymous	EP071: C10 - C14 Fraction	----	688 mg/kg	120	53	123
		EP071: C15 - C28 Fraction	----	3100 mg/kg	112	70	124
		EP071: C29 - C36 Fraction	----	1490 mg/kg	108	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2449137)							
EM1910348-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	33 mg/kg	# 10.2	39	129
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2451151)							
EM1910348-002	Anonymous	EP071: >C10 - C16 Fraction	----	1050 mg/kg	112	65	123
		EP071: >C16 - C34 Fraction	----	3960 mg/kg	109	67	121



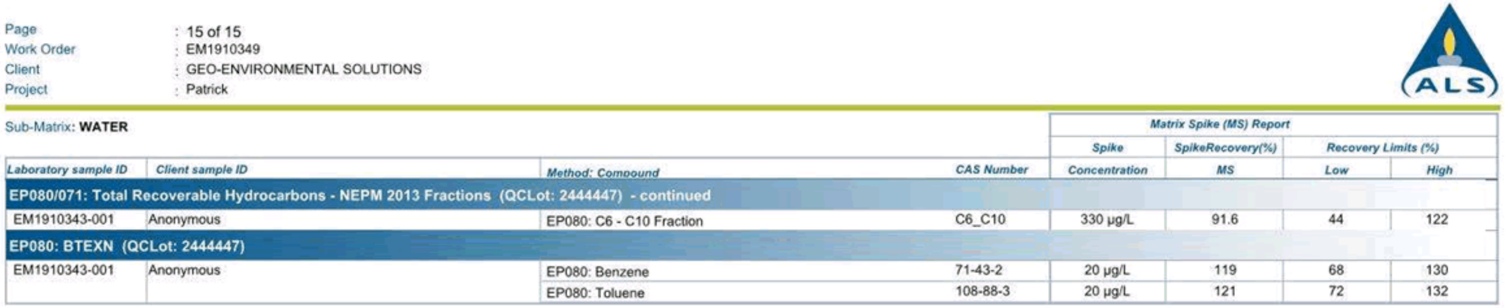
Page : 14 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2451151) - continued							
EM1910348-002	Anonymous	EP071: >C34 - C40 Fraction	----	280 mg/kg	111	44	126
EP080: BTEXN (QCLot: 2449137)							
EM1910348-002	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	99.1	50	136
		EP080: Toluene	108-88-3	2 mg/kg	108	56	139

Sub-Matrix: **WATER**

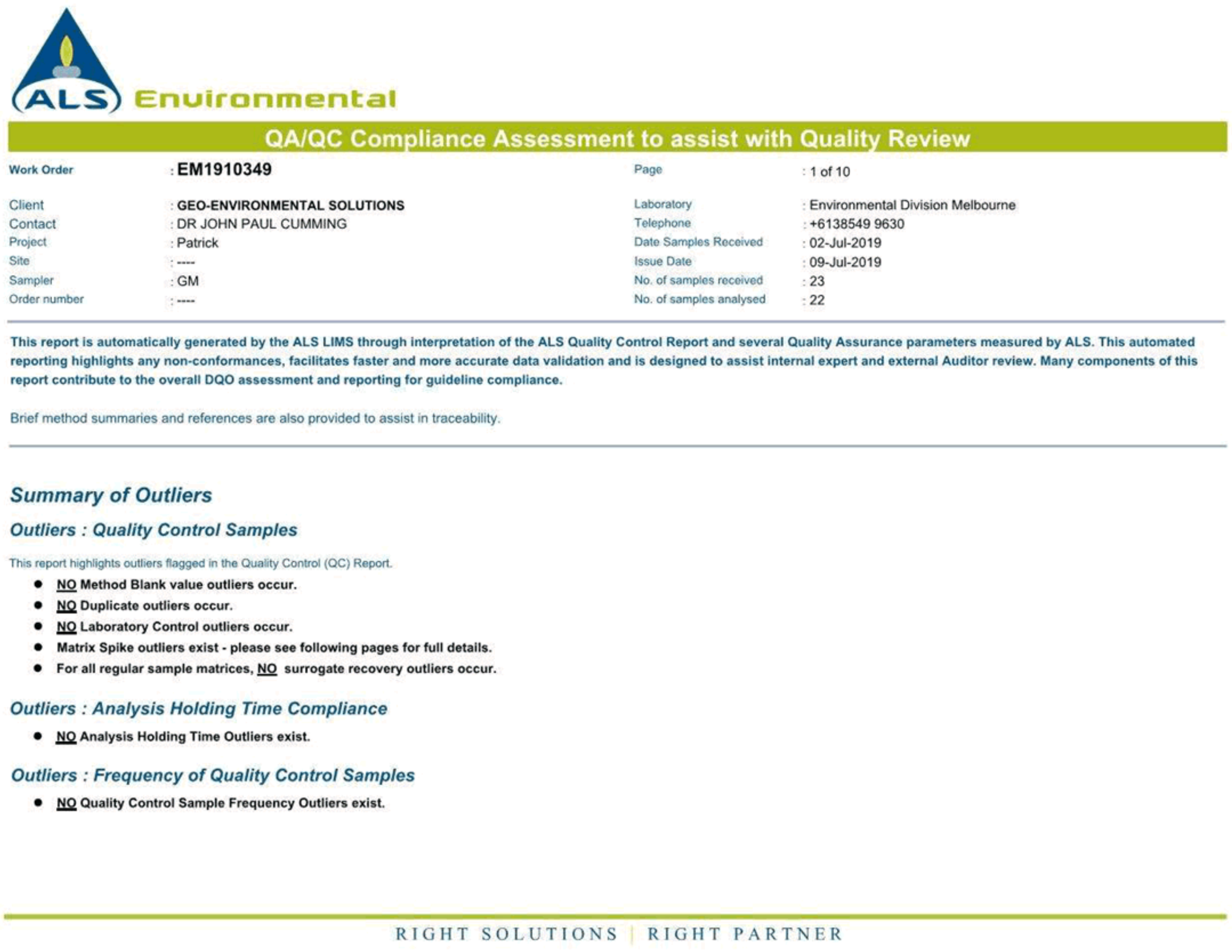
				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2447601)							
EM1909882-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	87.1	85	131
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	96.5	73	141
		EG020A-F: Barium	7440-39-3	0.2 mg/L	90.9	75	127
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	87.3	81	133
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	85.4	71	135
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	85.5	78	132
		EG020A-F: Copper	7440-50-8	0.2 mg/L	89.8	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	87.8	75	133
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	86.6	64	134
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	84.8	73	131
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	84.8	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	91.0	75	131
EG035F: Dissolved Mercury by FIMS (QCLot: 2447602)							
EM1910322-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	87.4	70	120
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2441896)							
EM1910357-005	Anonymous	EP075(SIM): Acenaphthene	83-32-9	5 µg/L	94.7	42	122
		EP075(SIM): Pyrene	129-00-0	5 µg/L	100	40	136
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2441895)							
EM1910357-004	Anonymous	EP071: C10 - C14 Fraction	----	4331 µg/L	82.4	50	130
		EP071: C15 - C28 Fraction	----	16952 µg/L	86.1	54	136
		EP071: C29 - C36 Fraction	----	8695 µg/L	78.1	50	142
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2444447)							
EM1910343-001	Anonymous	EP080: C6 - C9 Fraction	----	280 µg/L	105	43	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2441895)							
EM1910357-004	Anonymous	EP071: >C10 - C16 Fraction	----	6292 µg/L	81.7	50	128
		EP071: >C16 - C34 Fraction	----	22143 µg/L	81.7	50	150
		EP071: >C34 - C40 Fraction	----	1677 µg/L	82.8	51	159
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2444447)							



Page : 15 of 15
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	*SpikeRecovery(%)*	*Recovery Limits (%)*	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2444447) - continued							
EM1910343-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	330 µg/L	91.6	44	122
EP080: BTEXN (QCLot: 2444447)							
EM1910343-001	Anonymous	EP080: Benzene	71-43-2	20 µg/L	119	68	130
		EP080: Toluene	108-88-3	20 µg/L	121	72	132



ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order : **EM1910349**
Client : **GEO-ENVIRONMENTAL SOLUTIONS**
Contact : DR JOHN PAUL CUMMING
Project : Patrick
Site : ----
Sampler : GM
Order number : ----

Page : 1 of 10
Laboratory : Environmental Division Melbourne
Telephone : +6138549 9630
Date Samples Received : 02-Jul-2019
Issue Date : 09-Jul-2019
No. of samples received : 23
No. of samples analysed : 22

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

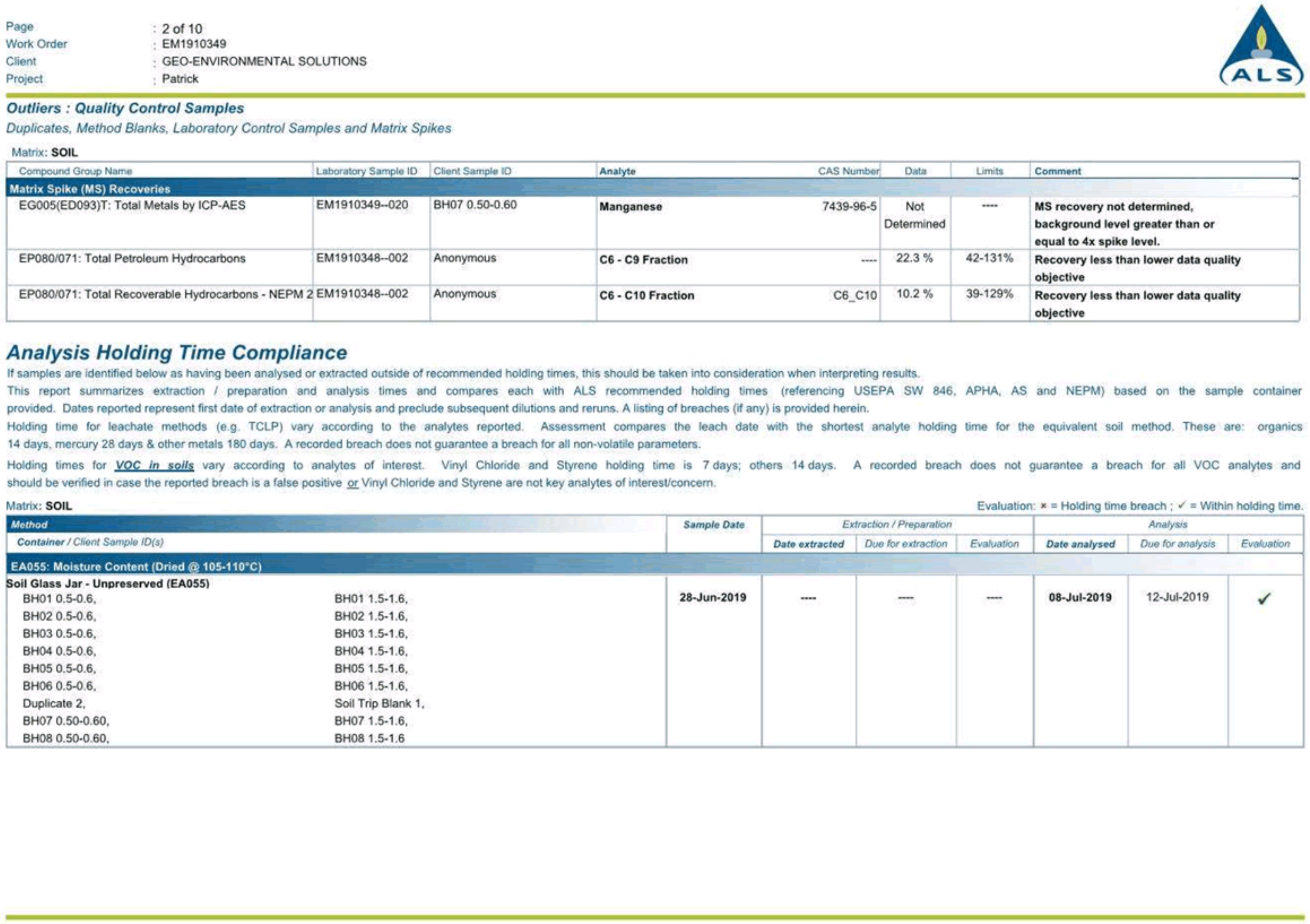
Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

RIGHT SOLUTIONS | RIGHT PARTNER



Page : 2 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005(ED093)T: Total Metals by ICP-AES	EM1910349--020	BH07 0.50-0.60	**Manganese**	7439-96-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EP080/071: Total Petroleum Hydrocarbons	EM1910348--002	Anonymous	**C6 - C9 Fraction**	----	22.3 %	42-131%	**Recovery less than lower data quality objective**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2	EM1910348--002	Anonymous	**C6 - C10 Fraction**	C6_C10	10.2 %	39-129%	**Recovery less than lower data quality objective**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method		*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)			*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
BH01 0.5-0.6, BH02 0.5-0.6, BH03 0.5-0.6, BH04 0.5-0.6, BH05 0.5-0.6, BH06 0.5-0.6, Duplicate 2, BH07 0.50-0.60, BH08 0.50-0.60,	BH01 1.5-1.6, BH02 1.5-1.6, BH03 1.5-1.6, BH04 1.5-1.6, BH05 1.5-1.6, BH06 1.5-1.6, Soil Trip Blank 1, BH07 1.5-1.6, BH08 1.5-1.6	**28-Jun-2019**	----	----	----	**08-Jul-2019**	12-Jul-2019	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

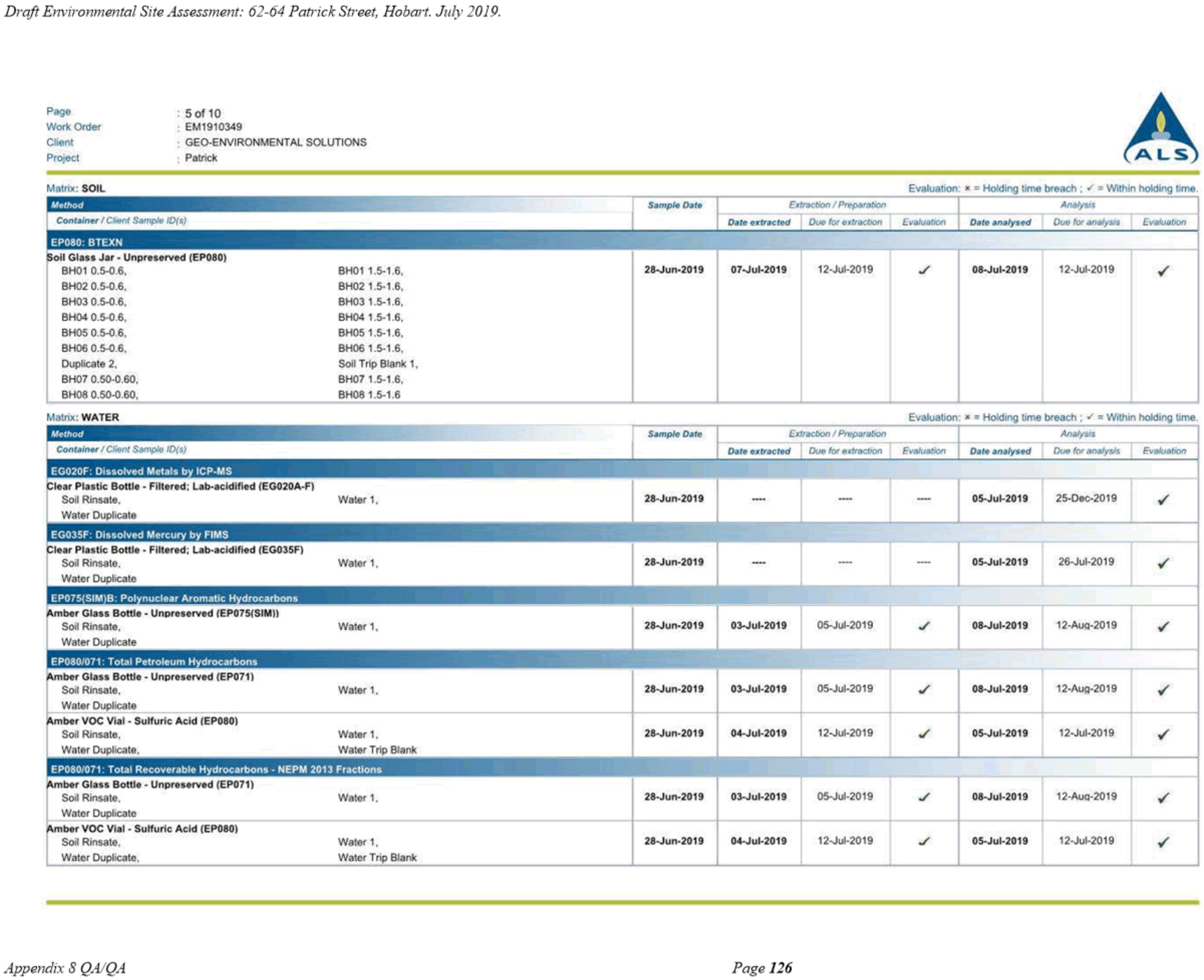
Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation* *Date extracted*	 *Due for extraction*	 *Evaluation*	*Analysis* *Date analysed*	 *Due for analysis*	 *Evaluation*
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**08-Jul-2019**	25-Dec-2019	✓	**08-Jul-2019**	25-Dec-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**08-Jul-2019**	26-Jul-2019	✓	**09-Jul-2019**	26-Jul-2019	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM))							
BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	17-Aug-2019	✓

Page : 4 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, Soil Trip Blank 1, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**07-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	12-Jul-2019	✓
Soil Glass Jar - Unpreserved (EP071) BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	17-Aug-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, Soil Trip Blank 1, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**07-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	12-Jul-2019	✓
Soil Glass Jar - Unpreserved (EP071) BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	17-Aug-2019	✓



Page : 5 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Matrix: **SOIL**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080)							
BH01 0.5-0.6, BH01 1.5-1.6, BH02 0.5-0.6, BH02 1.5-1.6, BH03 0.5-0.6, BH03 1.5-1.6, BH04 0.5-0.6, BH04 1.5-1.6, BH05 0.5-0.6, BH05 1.5-1.6, BH06 0.5-0.6, BH06 1.5-1.6, Duplicate 2, Soil Trip Blank 1, BH07 0.50-0.60, BH07 1.5-1.6, BH08 0.50-0.60, BH08 1.5-1.6	**28-Jun-2019**	**07-Jul-2019**	12-Jul-2019	✓	**08-Jul-2019**	12-Jul-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

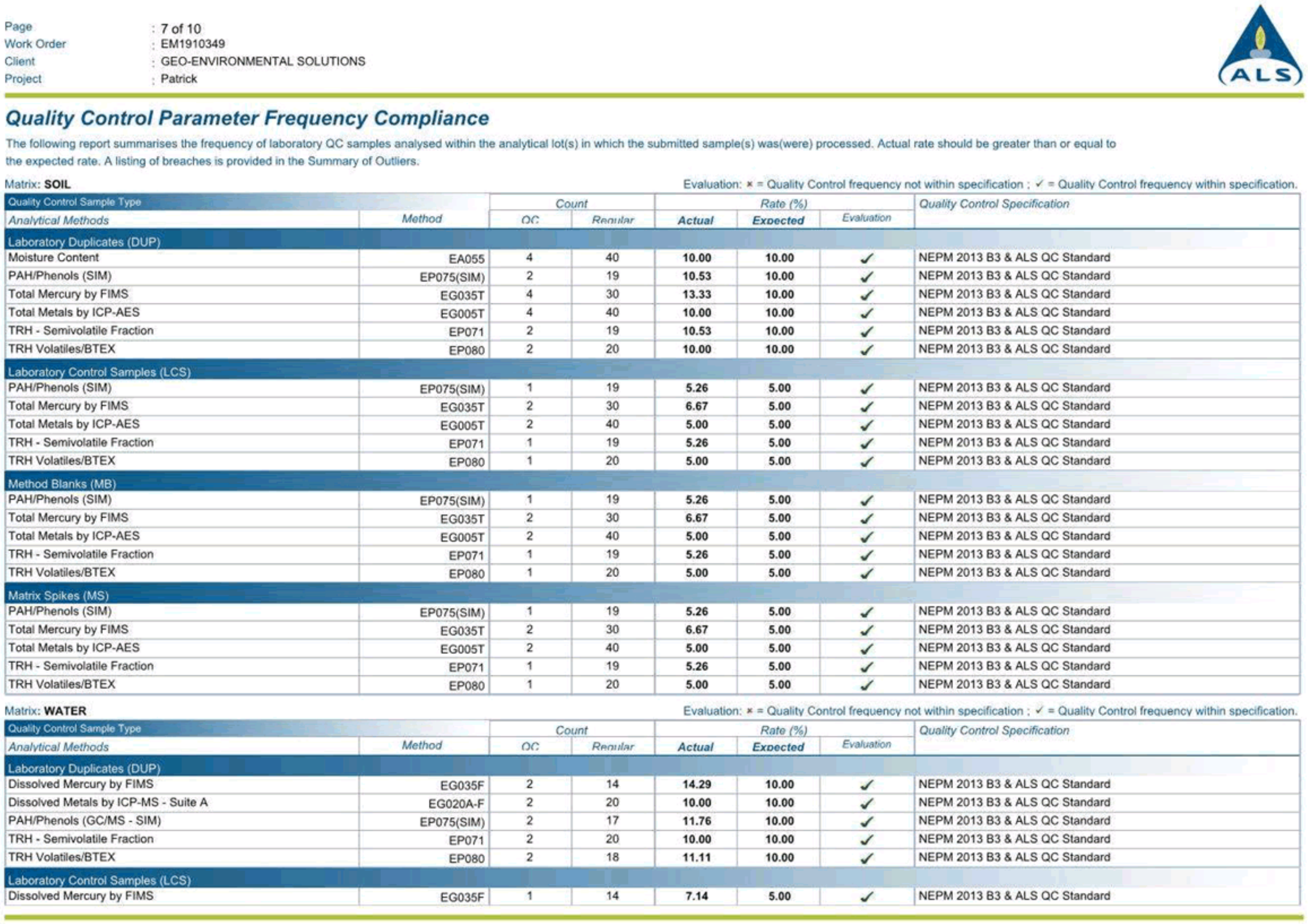
Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F)							
Soil Rinsate, Water 1, Water Duplicate	**28-Jun-2019**	----	----	----	**05-Jul-2019**	25-Dec-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F)							
Soil Rinsate, Water 1, Water Duplicate	**28-Jun-2019**	----	----	----	**05-Jul-2019**	26-Jul-2019	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
Soil Rinsate, Water 1, Water Duplicate	**28-Jun-2019**	**03-Jul-2019**	05-Jul-2019	✓	**08-Jul-2019**	12-Aug-2019	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
Soil Rinsate, Water 1, Water Duplicate	**28-Jun-2019**	**03-Jul-2019**	05-Jul-2019	✓	**08-Jul-2019**	12-Aug-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
Soil Rinsate, Water 1, Water Duplicate, Water Trip Blank	**28-Jun-2019**	**04-Jul-2019**	12-Jul-2019	✓	**05-Jul-2019**	12-Jul-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
Soil Rinsate, Water 1, Water Duplicate	**28-Jun-2019**	**03-Jul-2019**	05-Jul-2019	✓	**08-Jul-2019**	12-Aug-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
Soil Rinsate, Water 1, Water Duplicate, Water Trip Blank	**28-Jun-2019**	**04-Jul-2019**	12-Jul-2019	✓	**05-Jul-2019**	12-Jul-2019	✓

Page : 6 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method		*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)			*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080)								
Soil Rinsate,	Water 1,	**28-Jun-2019**	**04-Jul-2019**	12-Jul-2019	✓	**05-Jul-2019**	12-Jul-2019	✓
Water Duplicate,	Water Trip Blank							



Page : 7 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

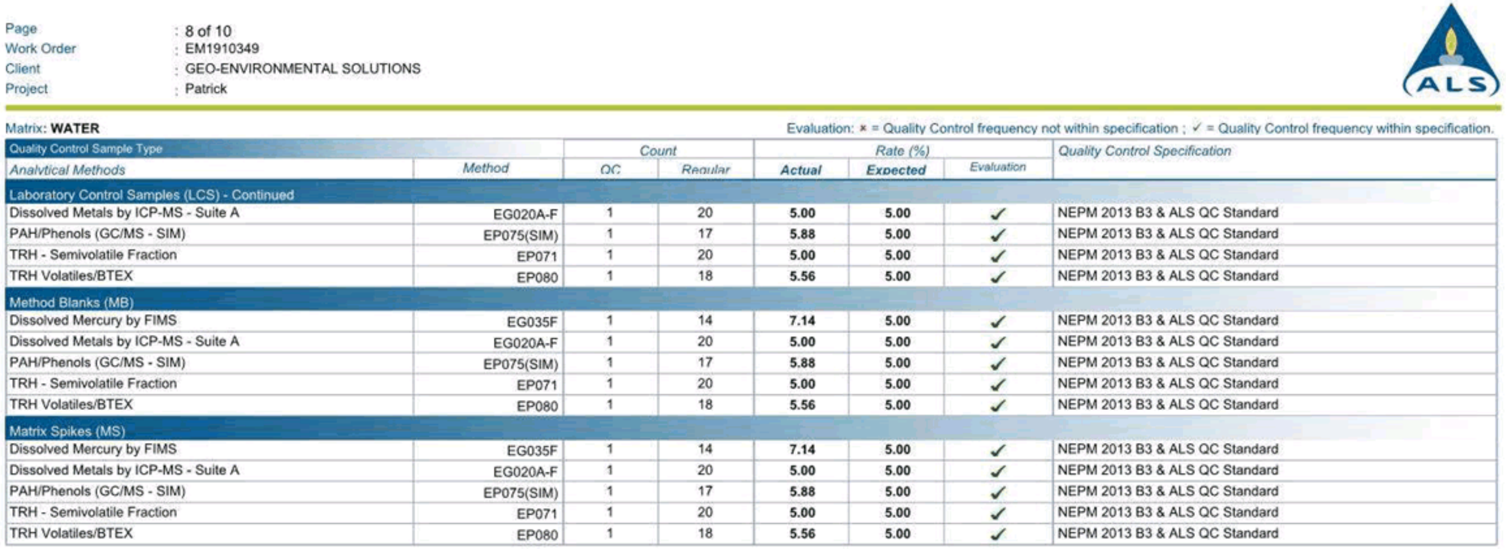
Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	**Actual**	**Expected**	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	4	30	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	**Actual**	**Expected**	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

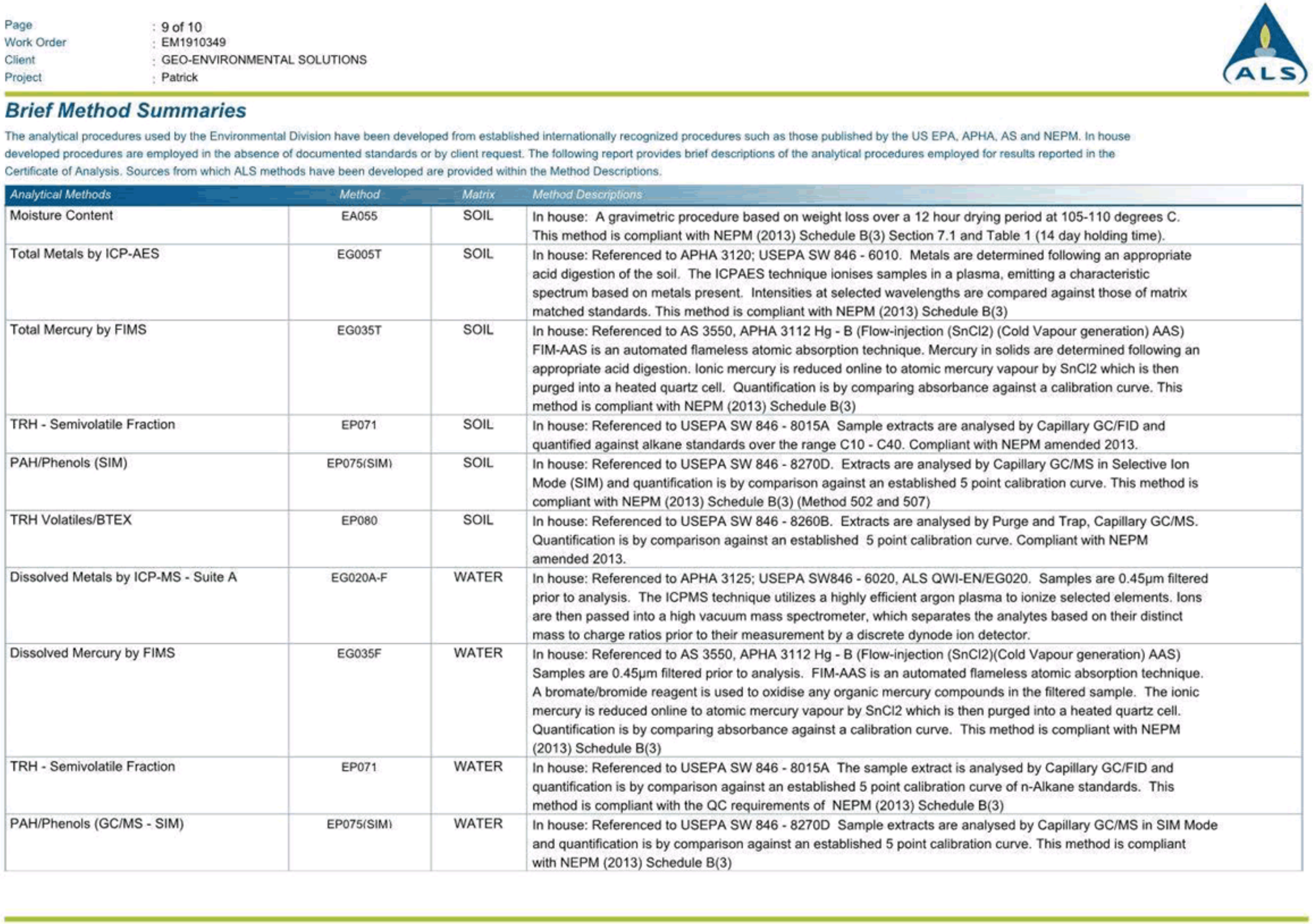


Page : 8 of 10
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard



Page	: 9 of 10
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM amended 2013.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM amended 2013.
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

ALS Environmental

QUALITY CONTROL REPORT

Work Order : **ES1920828**
Client : **GEO-ENVIRONMENTAL SOLUTIONS**
Contact : DR JOHN PAUL CUMMING
Address : 29 KIRKSWAY PLACE
BATTERY POINT TASMANIA, AUSTRALIA 7004
Telephone : +61 03 6223 1839
Project : Patrick
Order number : ----
C-O-C number : ----
Sampler : GM
Site : ----
Quote number : EN/222
No. of samples received : 3
No. of samples analysed : 2

Page : 1 of 8
Laboratory : Environmental Division Sydney
Contact : Shirley LeCornu
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +6138549 9630
Date Samples Received : 03-Jul-2019
Date Analysis Commenced : 05-Jul-2019
Issue Date : 10-Jul-2019

ilac-MRA

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Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

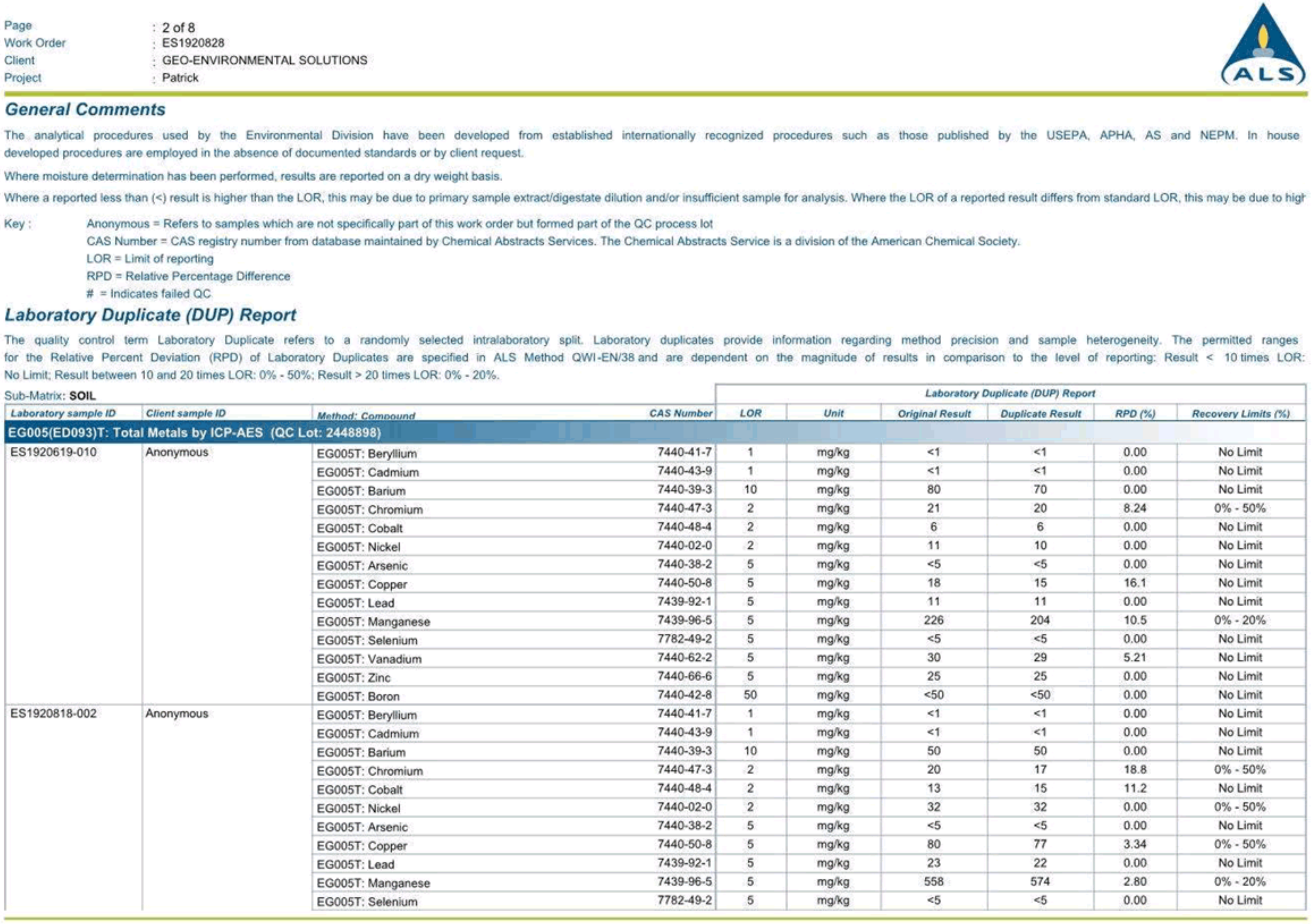
- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Peter Wu		Sydney Inorganics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, NSW

RIGHT SOLUTIONS | RIGHT PARTNER



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

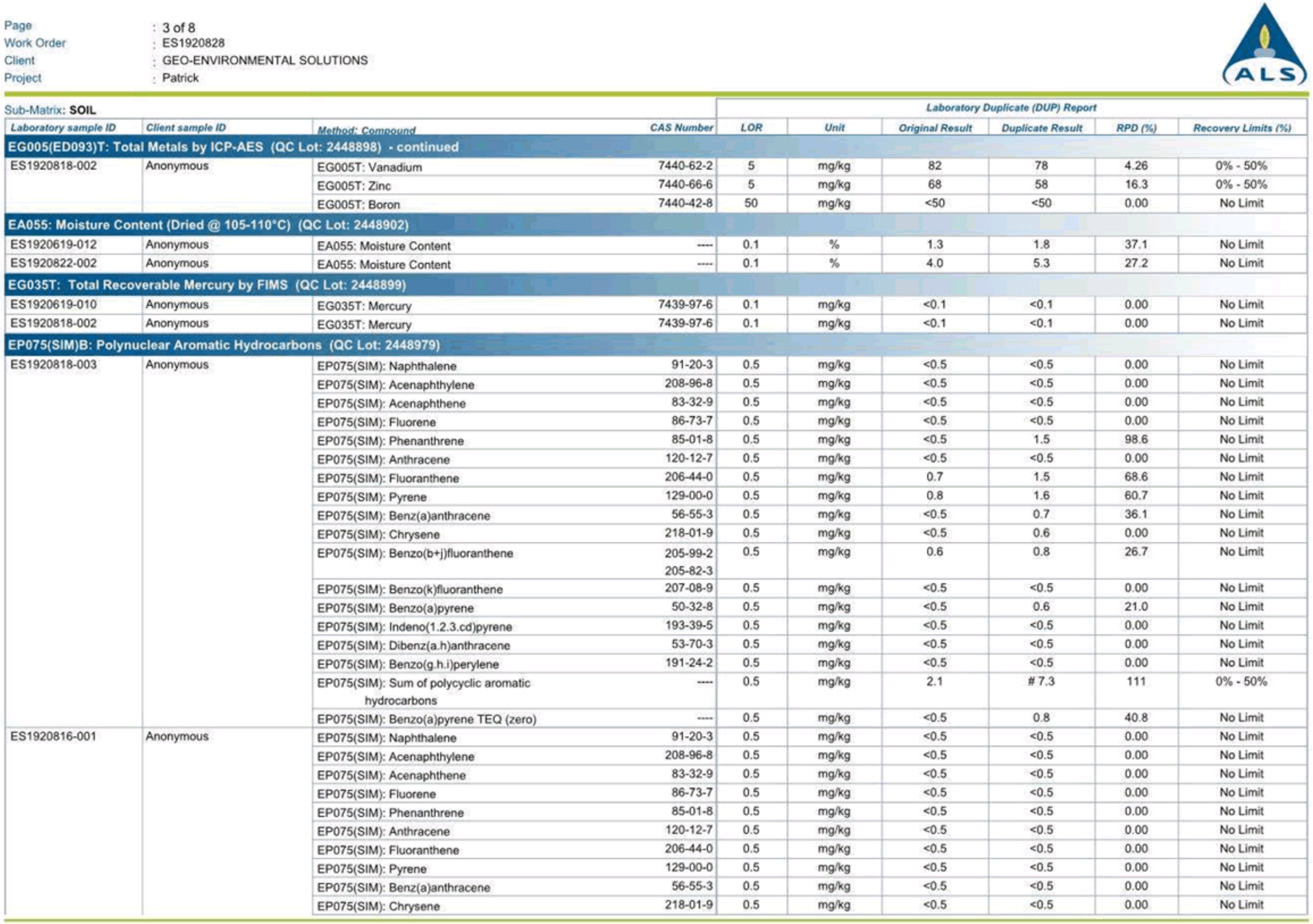
Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
\# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2448898)									
ES1920619-010	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	80	70	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	21	20	8.24	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	6	6	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	11	10	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	18	15	16.1	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	11	11	0.00	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	226	204	10.5	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	30	29	5.21	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	25	25	0.00	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.00	No Limit
ES1920818-002	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	50	50	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	20	17	18.8	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	13	15	11.2	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	32	32	0.00	0% - 50%
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	80	77	3.34	0% - 50%
		EG005T: Lead	7439-92-1	5	mg/kg	23	22	0.00	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	558	574	2.80	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit



Page : 3 of 8
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

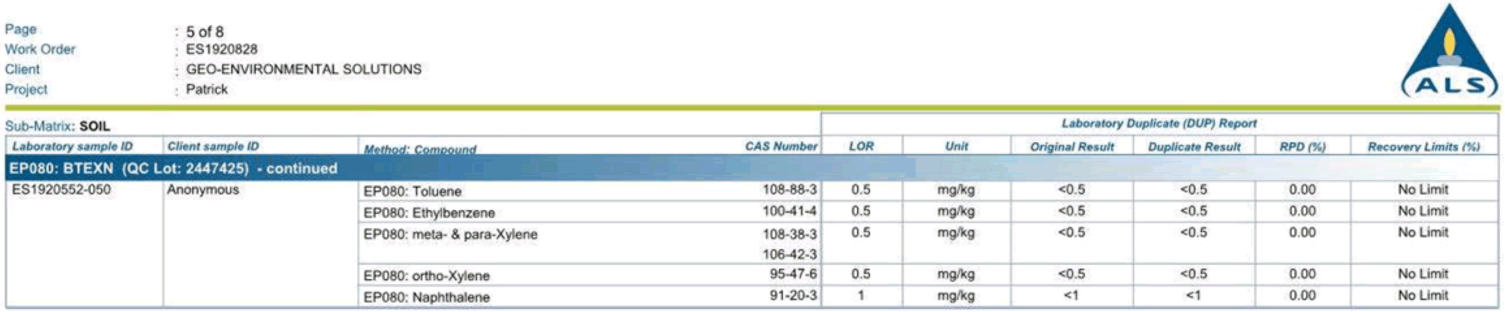
Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2448898) - continued									
ES1920818-002	Anonymous	EG005T: Vanadium	7440-62-2	5	mg/kg	82	78	4.26	0% - 50%
		EG005T: Zinc	7440-66-6	5	mg/kg	68	58	16.3	0% - 50%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.00	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2448902)									
ES1920619-012	Anonymous	EA055: Moisture Content	----	0.1	%	1.3	1.8	37.1	No Limit
ES1920822-002	Anonymous	EA055: Moisture Content	----	0.1	%	4.0	5.3	27.2	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2448899)									
ES1920619-010	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
ES1920818-002	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2448979)									
ES1920818-003	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	1.5	98.6	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	0.7	1.5	68.6	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	0.8	1.6	60.7	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	0.7	36.1	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	0.6	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	0.6	0.8	26.7	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	0.6	21.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	2.1	# 7.3	111	0% - 50%
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	0.8	40.8	No Limit
ES1920816-001	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Page	: 4 of 8
Work Order	: ES1920828
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Sub-Matrix: **SOIL**

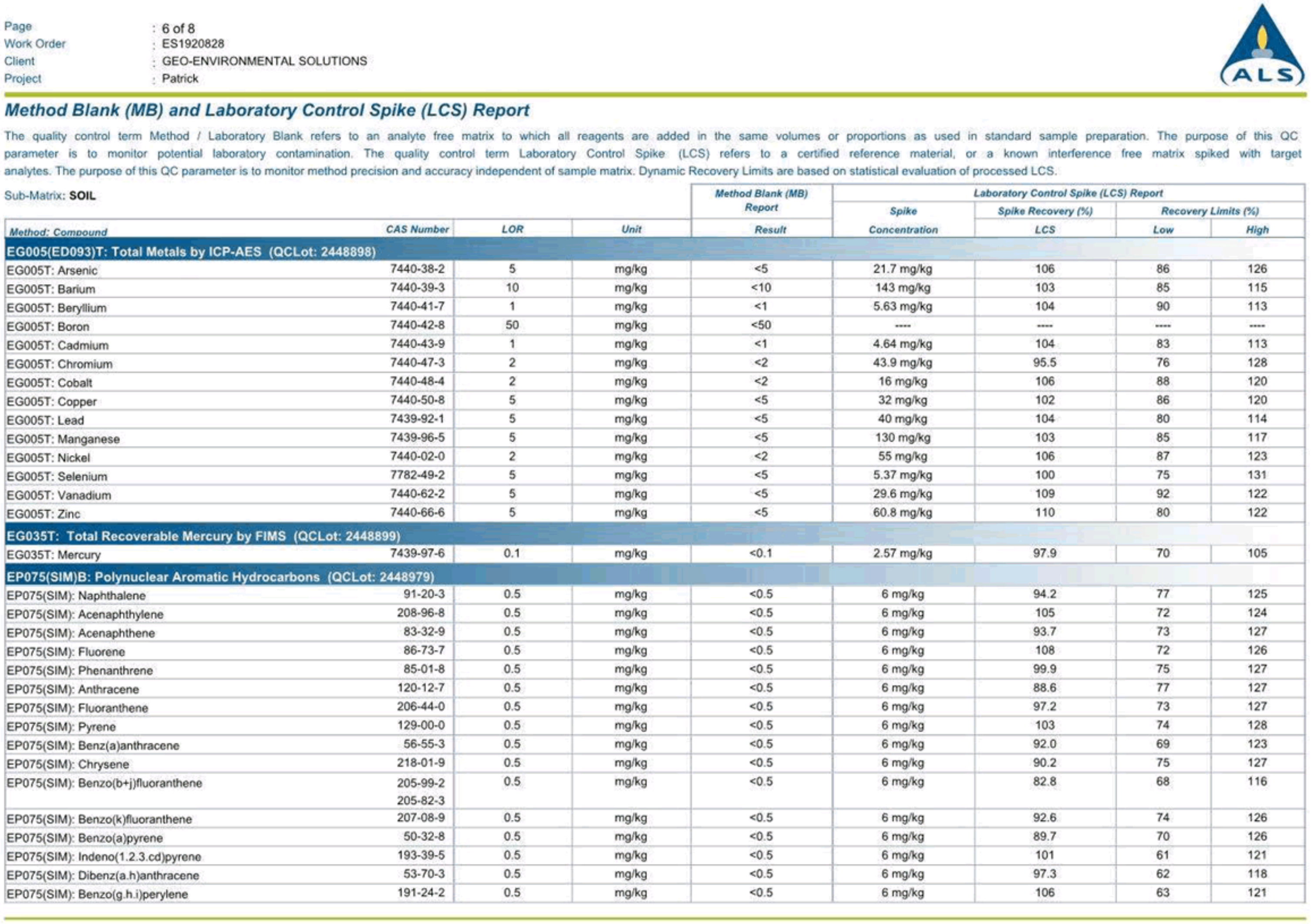
				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2448979) - continued									
ES1920816-001	Anonymous	EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2447425)									
ES1920552-033	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
ES1920552-050	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2448978)									
ES1920818-003	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
ES1920816-001	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2447425)									
ES1920552-033	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
ES1920552-050	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2448978)									
ES1920818-003	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	120	110	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
ES1920816-001	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080: BTEXN (QC Lot: 2447425)									
ES1920552-033	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
ES1920552-050	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit



Page : 5 of 8
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 2447425) - continued									
ES1920552-050	Anonymous	EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit



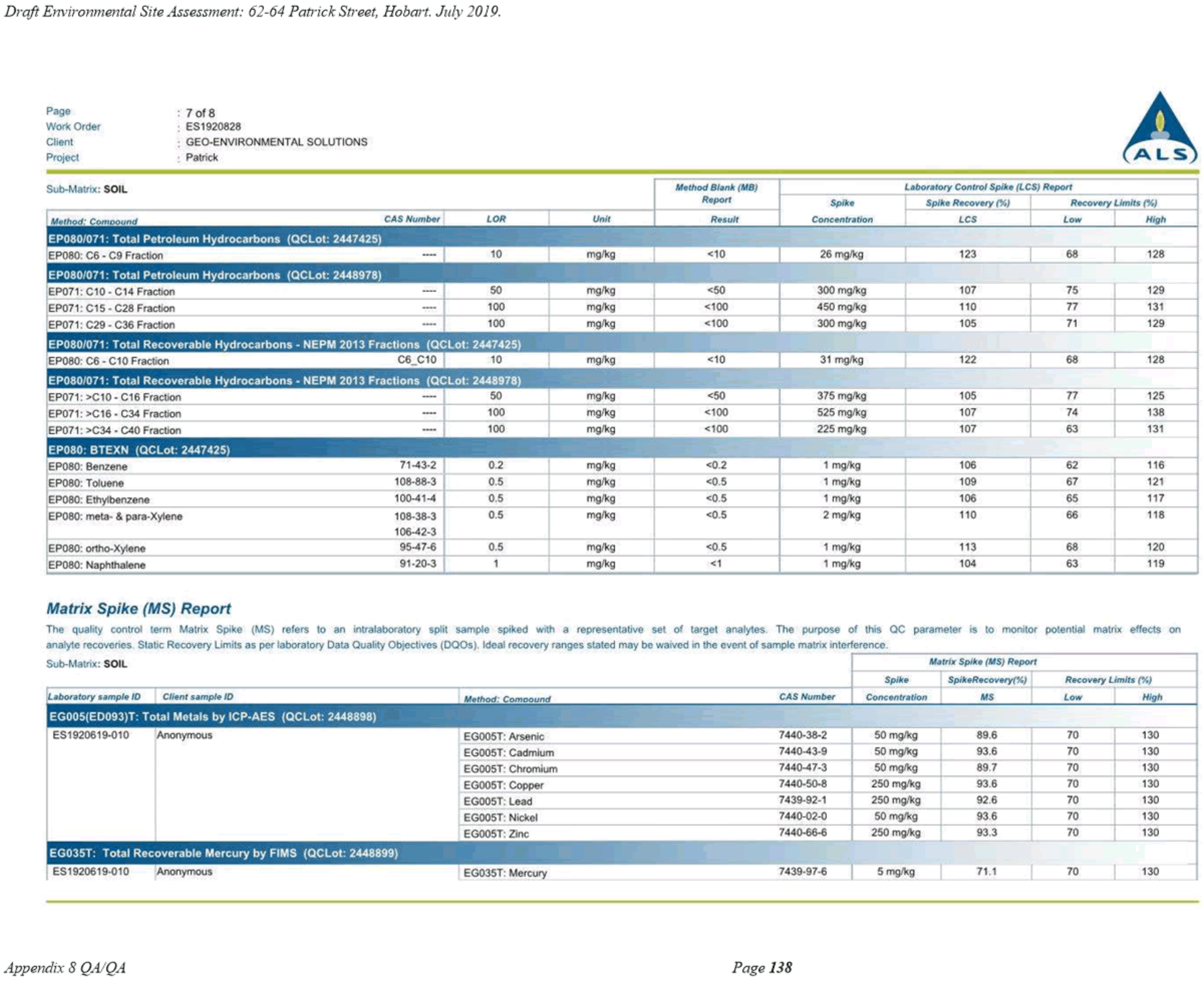
Page : 6 of 8
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2448898)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	106	86	126
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	103	85	115
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	104	90	113
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	104	83	113
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	95.5	76	128
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	106	88	120
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	102	86	120
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	104	80	114
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	103	85	117
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	106	87	123
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	100	75	131
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	29.6 mg/kg	109	92	122
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	110	80	122
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2448899)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	97.9	70	105
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2448979)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	6 mg/kg	94.2	77	125
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	6 mg/kg	105	72	124
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	6 mg/kg	93.7	73	127
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	6 mg/kg	108	72	126
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	6 mg/kg	99.9	75	127
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	6 mg/kg	88.6	77	127
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	6 mg/kg	97.2	73	127
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	6 mg/kg	103	74	128
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	6 mg/kg	92.0	69	123
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	6 mg/kg	90.2	75	127
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	6 mg/kg	82.8	68	116
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	6 mg/kg	92.6	74	126
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	6 mg/kg	89.7	70	126
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	6 mg/kg	101	61	121
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	6 mg/kg	97.3	62	118
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	6 mg/kg	106	63	121



Page : 7 of 8
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2447425)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	26 mg/kg	123	68	128
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2448978)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	300 mg/kg	107	75	129
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	450 mg/kg	110	77	131
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	300 mg/kg	105	71	129
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2447425)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	31 mg/kg	122	68	128
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2448978)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	375 mg/kg	105	77	125
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	525 mg/kg	107	74	138
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	225 mg/kg	107	63	131
EP080: BTEXN (QCLot: 2447425)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	106	62	116
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	109	67	121
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	106	65	117
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	110	66	118
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	113	68	120
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	104	63	119

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2448898)							
ES1920619-010	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	89.6	70	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	93.6	70	130
		EG005T: Chromium	7440-47-3	50 mg/kg	89.7	70	130
		EG005T: Copper	7440-50-8	250 mg/kg	93.6	70	130
		EG005T: Lead	7439-92-1	250 mg/kg	92.6	70	130
		EG005T: Nickel	7440-02-0	50 mg/kg	93.6	70	130
		EG005T: Zinc	7440-66-6	250 mg/kg	93.3	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2448899)							
ES1920619-010	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	71.1	70	130

Page : 8 of 8
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	*SpikeRecovery(%)*	*Recovery Limits (%)*	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2448979)							
ES1920816-001	Anonymous	EP075(SIM): Acenaphthene	83-32-9	10 mg/kg	82.7	70	130
		EP075(SIM): Pyrene	129-00-0	10 mg/kg	95.3	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2447425)							
ES1920552-033	Anonymous	EP080: C6 - C9 Fraction	----	32.5 mg/kg	125	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2448978)							
ES1920816-001	Anonymous	EP071: C10 - C14 Fraction	----	523 mg/kg	81.5	73	137
		EP071: C15 - C28 Fraction	----	2319 mg/kg	105	53	131
		EP071: C29 - C36 Fraction	----	1714 mg/kg	114	52	132
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2447425)							
ES1920552-033	Anonymous	EP080: C6 - C10 Fraction	C6_C10	37.5 mg/kg	124	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2448978)							
ES1920816-001	Anonymous	EP071: >C10 - C16 Fraction	----	860 mg/kg	88.3	73	137
		EP071: >C16 - C34 Fraction	----	3223 mg/kg	110	53	131
		EP071: >C34 - C40 Fraction	----	1058 mg/kg	101	52	132
EP080: BTEXN (QCLot: 2447425)							
ES1920552-033	Anonymous	EP080: Benzene	71-43-2	2.5 mg/kg	102	70	130
		EP080: Toluene	108-88-3	2.5 mg/kg	104	70	130
		EP080: Ethylbenzene	100-41-4	2.5 mg/kg	103	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2.5 mg/kg	104	70	130
		EP080: ortho-Xylene	95-47-6	2.5 mg/kg	106	70	130
		EP080: Naphthalene	91-20-3	2.5 mg/kg	96.8	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1920828**	Page	: 1 of 5
Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Sydney
Contact	: DR JOHN PAUL CUMMING	Telephone	: +6138549 9630
Project	: Patrick	Date Samples Received	: 03-Jul-2019
Site	: ----	Issue Date	: 10-Jul-2019
Sampler	: GM	No. of samples received	: 3
Order number	: ----	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

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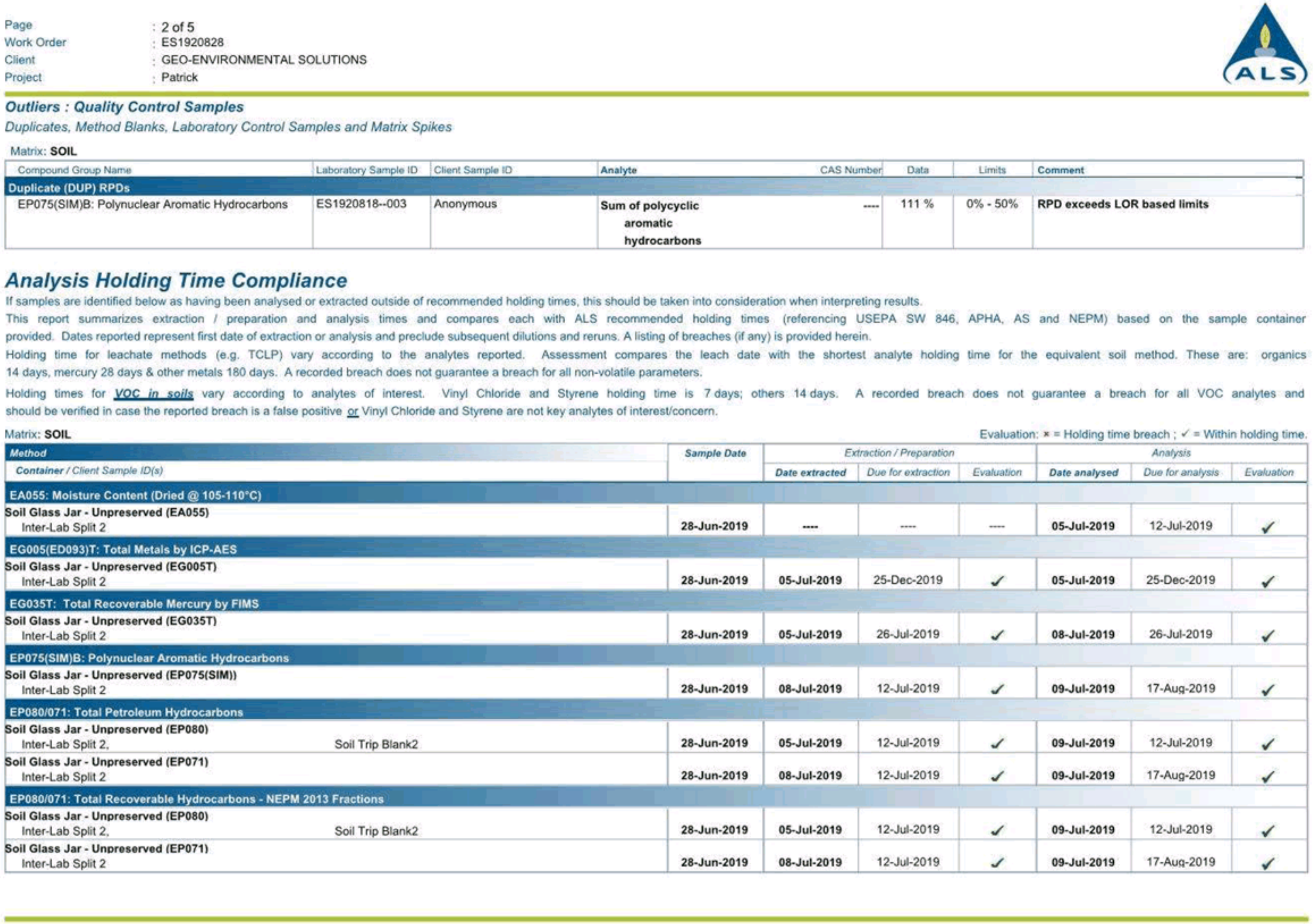


Page : 2 of 5
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	ES1920818--003	Anonymous	**Sum of polycyclic aromatic hydrocarbons**	----	111 %	0% - 50%	**RPD exceeds LOR based limits**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

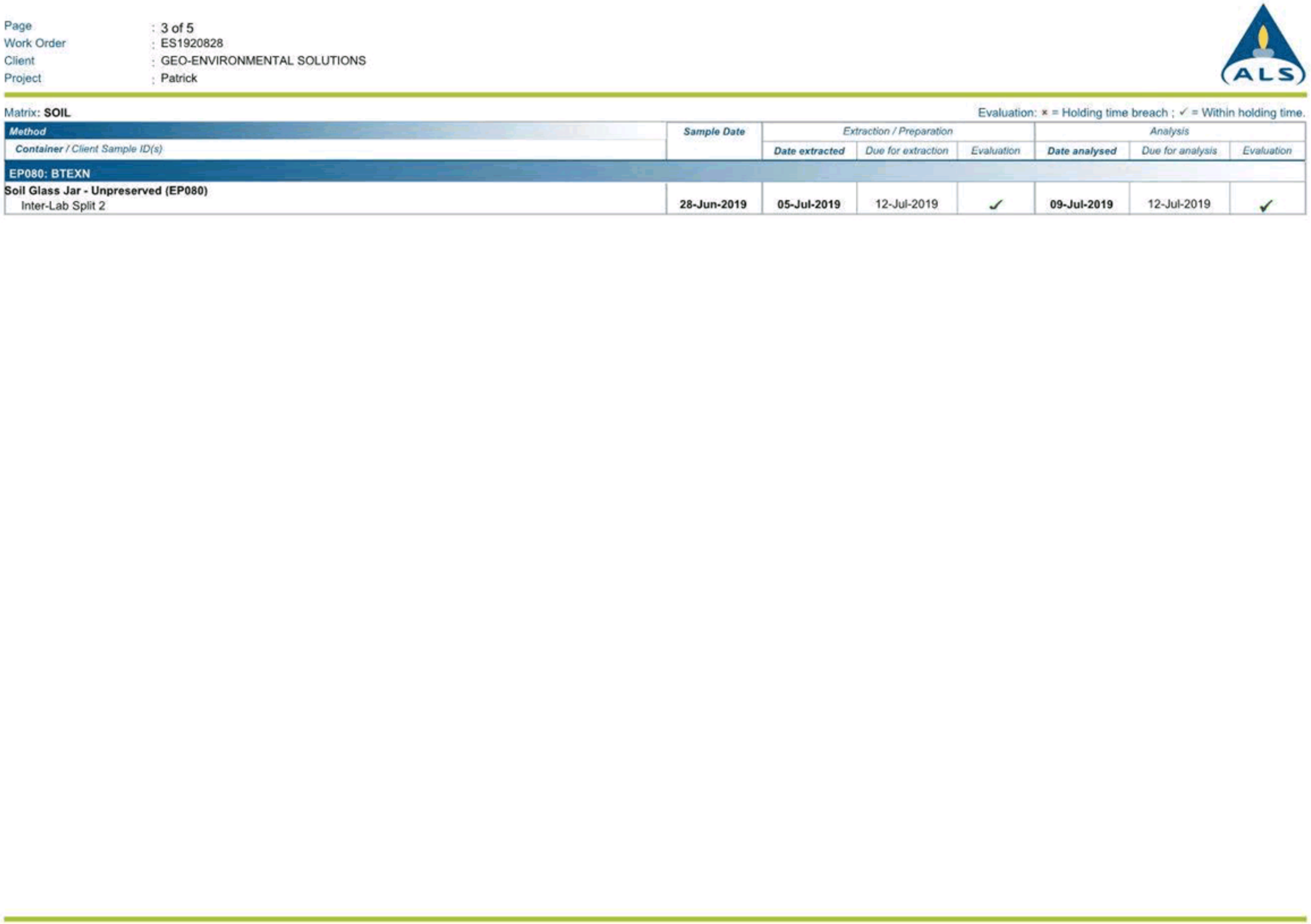
Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container** / Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) Inter-Lab Split 2	**28-Jun-2019**	**----**	----	----	**05-Jul-2019**	12-Jul-2019	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) Inter-Lab Split 2	**28-Jun-2019**	**05-Jul-2019**	25-Dec-2019	✓	**05-Jul-2019**	25-Dec-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) Inter-Lab Split 2	**28-Jun-2019**	**05-Jul-2019**	26-Jul-2019	✓	**08-Jul-2019**	26-Jul-2019	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM)) Inter-Lab Split 2	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	17-Aug-2019	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) Inter-Lab Split 2, Soil Trip Blank2	**28-Jun-2019**	**05-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	12-Jul-2019	✓
Soil Glass Jar - Unpreserved (EP071) Inter-Lab Split 2	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	17-Aug-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) Inter-Lab Split 2, Soil Trip Blank2	**28-Jun-2019**	**05-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	12-Jul-2019	✓
Soil Glass Jar - Unpreserved (EP071) Inter-Lab Split 2	**28-Jun-2019**	**08-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	17-Aug-2019	✓

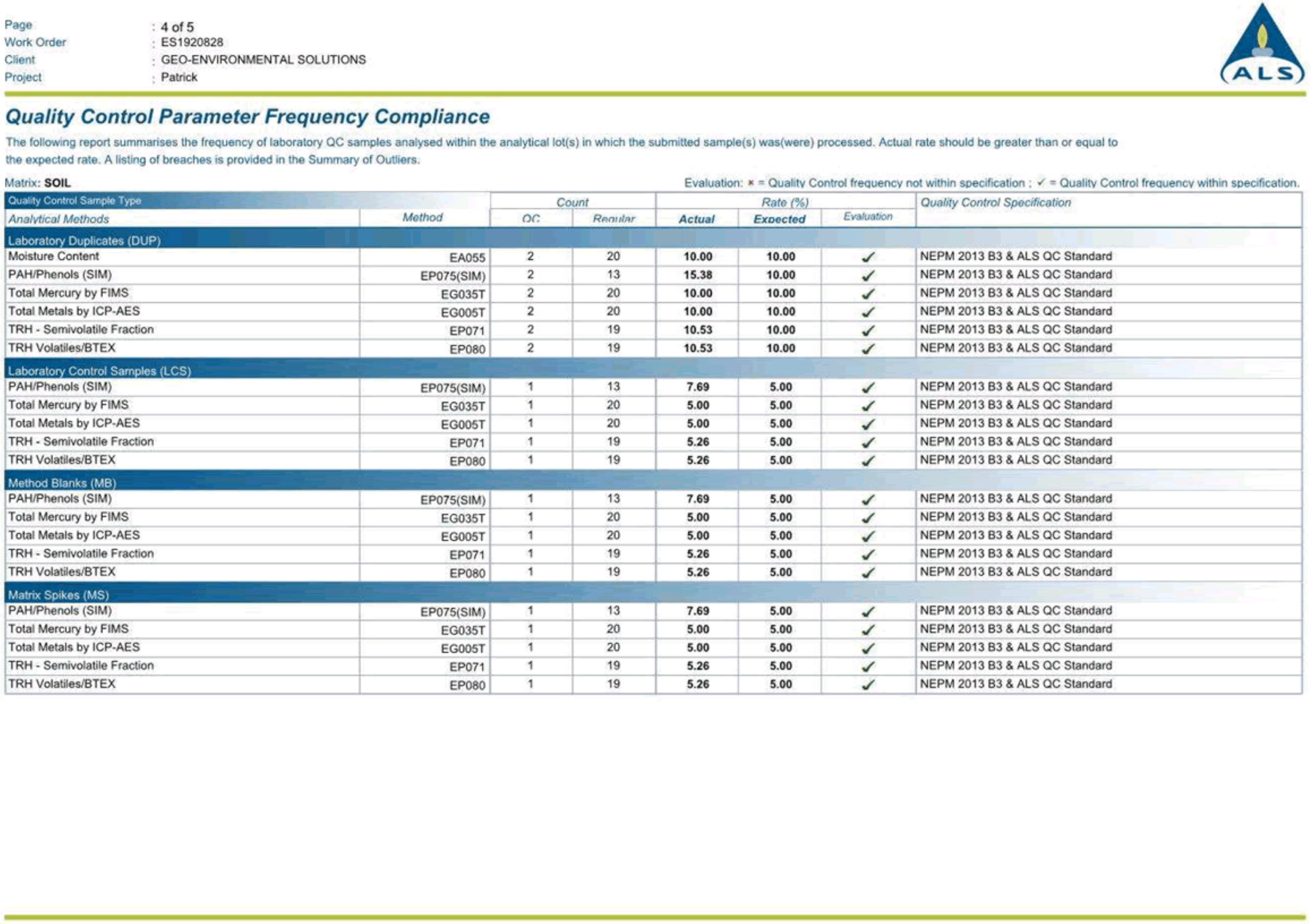


Page : 3 of 5
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Matrix: **SOIL**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) Inter-Lab Split 2	**28-Jun-2019**	**05-Jul-2019**	12-Jul-2019	✓	**09-Jul-2019**	12-Jul-2019	✓



Page : 4 of 5
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type Analytical Methods	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Page	: 5 of 5
Work Order	: ES1920828
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM amended 2013.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM amended 2013.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

ALS Environmental

QUALITY CONTROL REPORT

Work Order : **EM1910889**
Client : **GEO-ENVIRONMENTAL SOLUTIONS**
Contact : DR JOHN PAUL CUMMING
Address : 29 KIRKSWAY PLACE
BATTERY POINT TASMANIA, AUSTRALIA 7004
Telephone : +61 03 6223 1839
Project : Patrick
Order number :
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : EN/222
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 3
Laboratory : Environmental Division Melbourne
Contact : Shirley LeCornu
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +6138549 9630
Date Samples Received : 02-Jul-2019
Date Analysis Commenced : 11-Jul-2019
Issue Date : 15-Jul-2019

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

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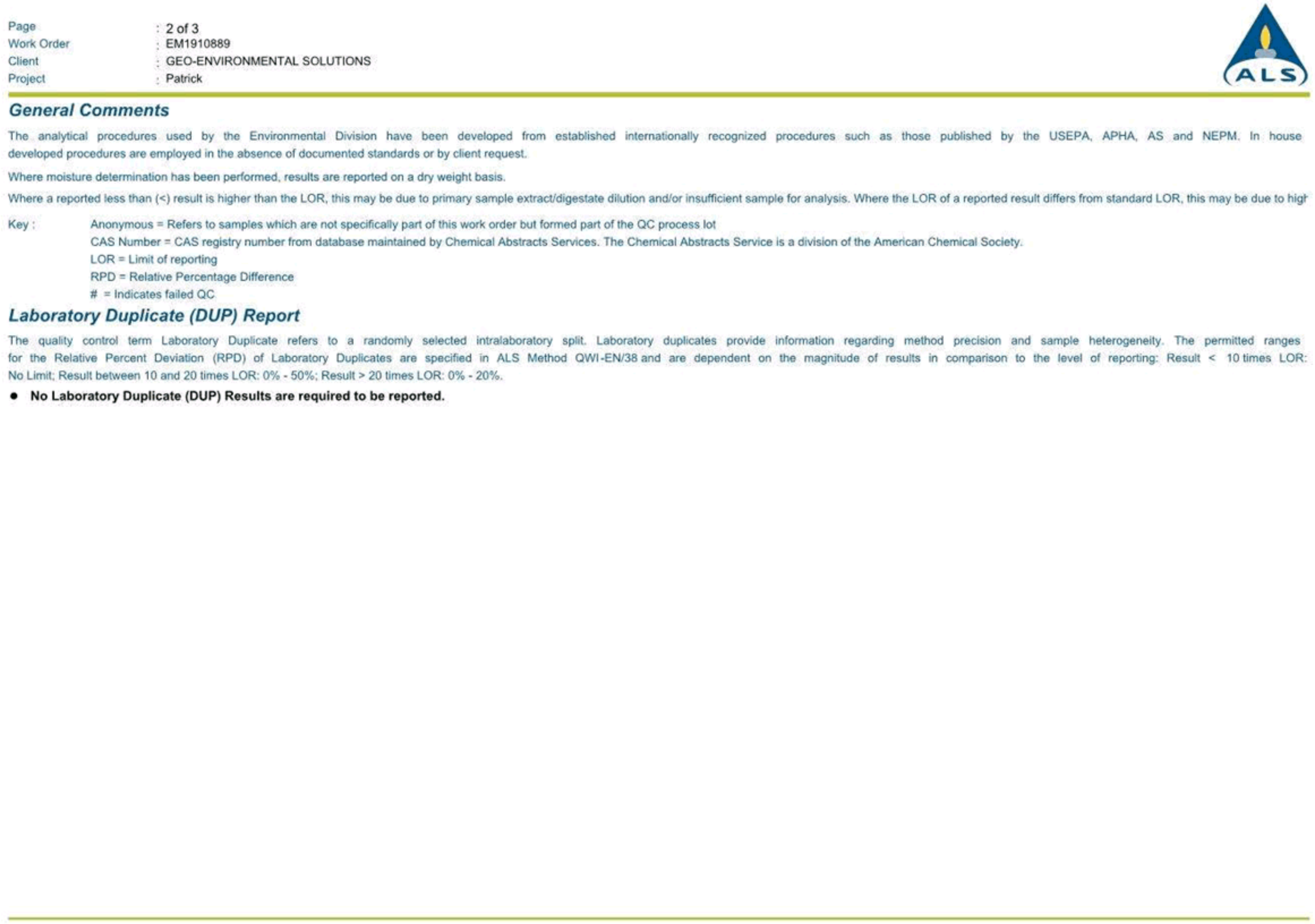


General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

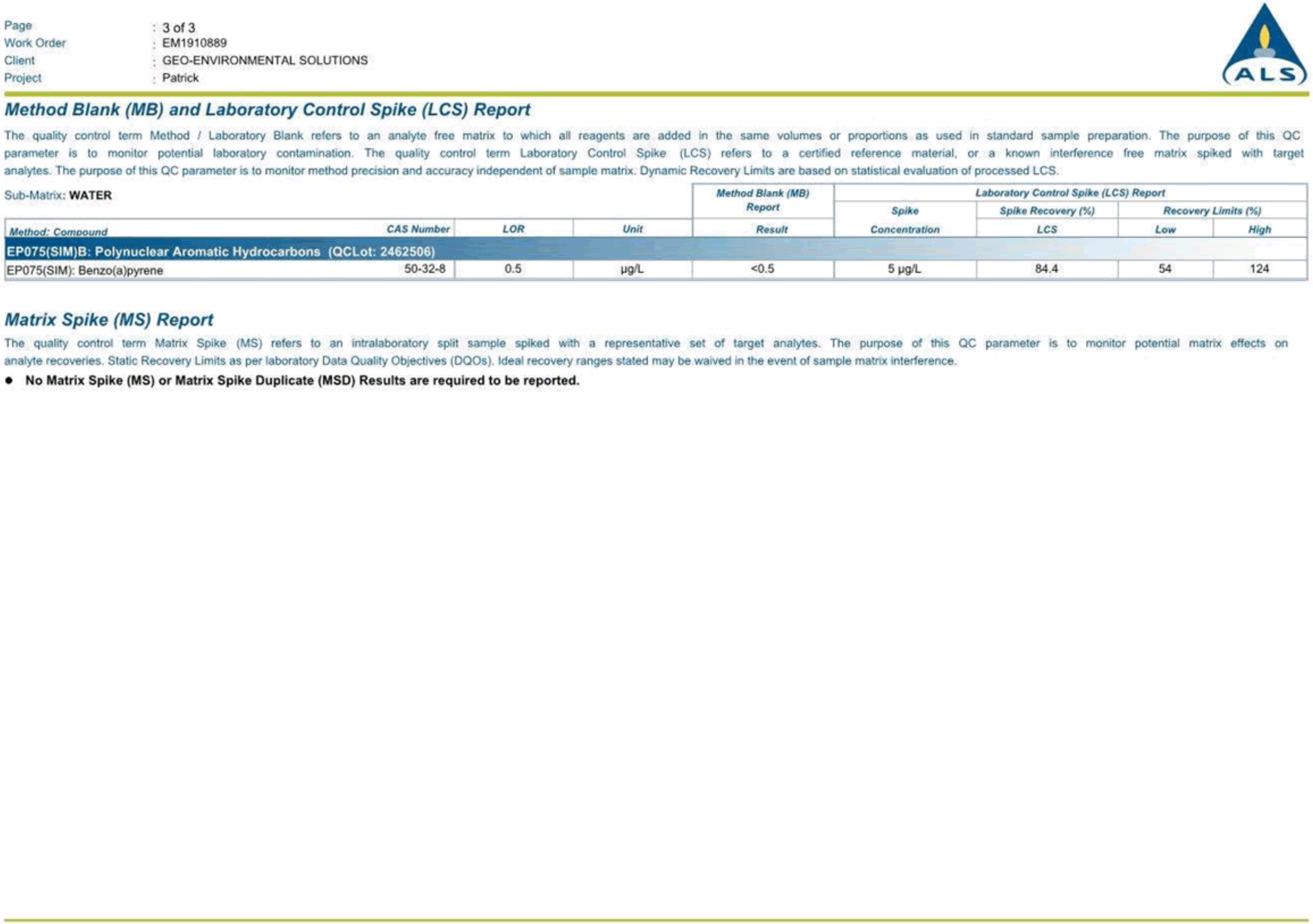
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to hig

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

- **No Laboratory Duplicate (DUP) Results are required to be reported.**



Page : 3 of 3
Work Order : EM1910889
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2462506)								
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	84.4	54	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1910889**	Page	: 1 of 4
Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Melbourne
Contact	: DR JOHN PAUL CUMMING	Telephone	: +6138549 9630
Project	: Patrick	Date Samples Received	: 02-Jul-2019
Site	: ----	Issue Date	: 15-Jul-2019
Sampler	: ----	No. of samples received	: 1
Order number	:	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

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Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	13	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	13	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for **VOC in soils** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

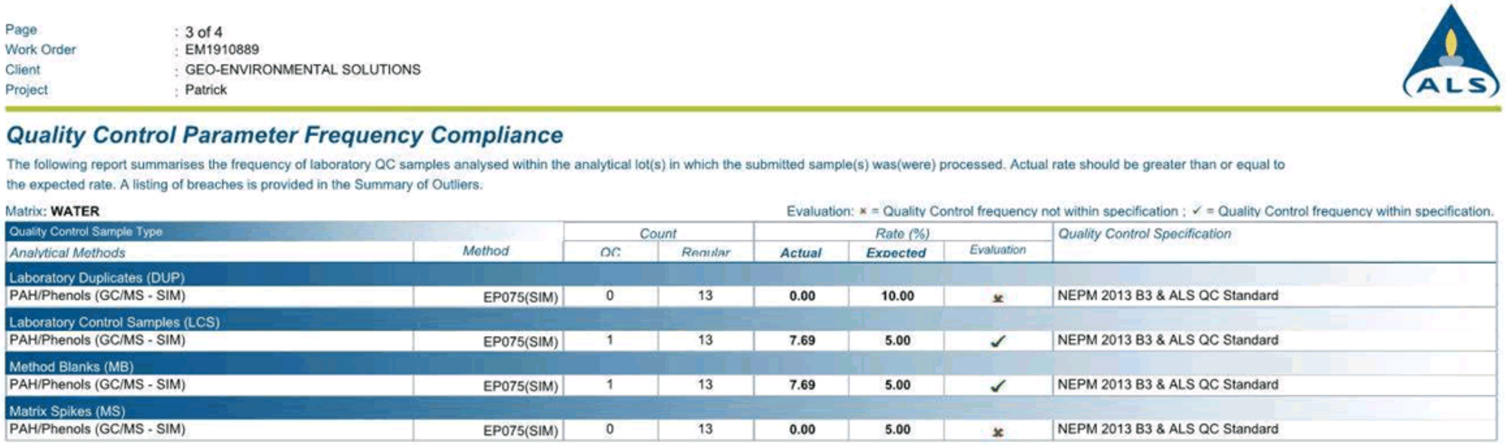
Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EN60: ASLP Leaching Procedure							
Non-Volatile Leach: 14 day HT(e.g. SV organics) (EN60a) BH05 0.5-0.6	**28-Jun-2019**	**11-Jul-2019**	12-Jul-2019	✓	----	----	----

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) BH05 0.5-0.6	**11-Jul-2019**	**12-Jul-2019**	18-Jul-2019	✓	**12-Jul-2019**	21-Aug-2019	✓



Page : 3 of 4
Work Order : EM1910889
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

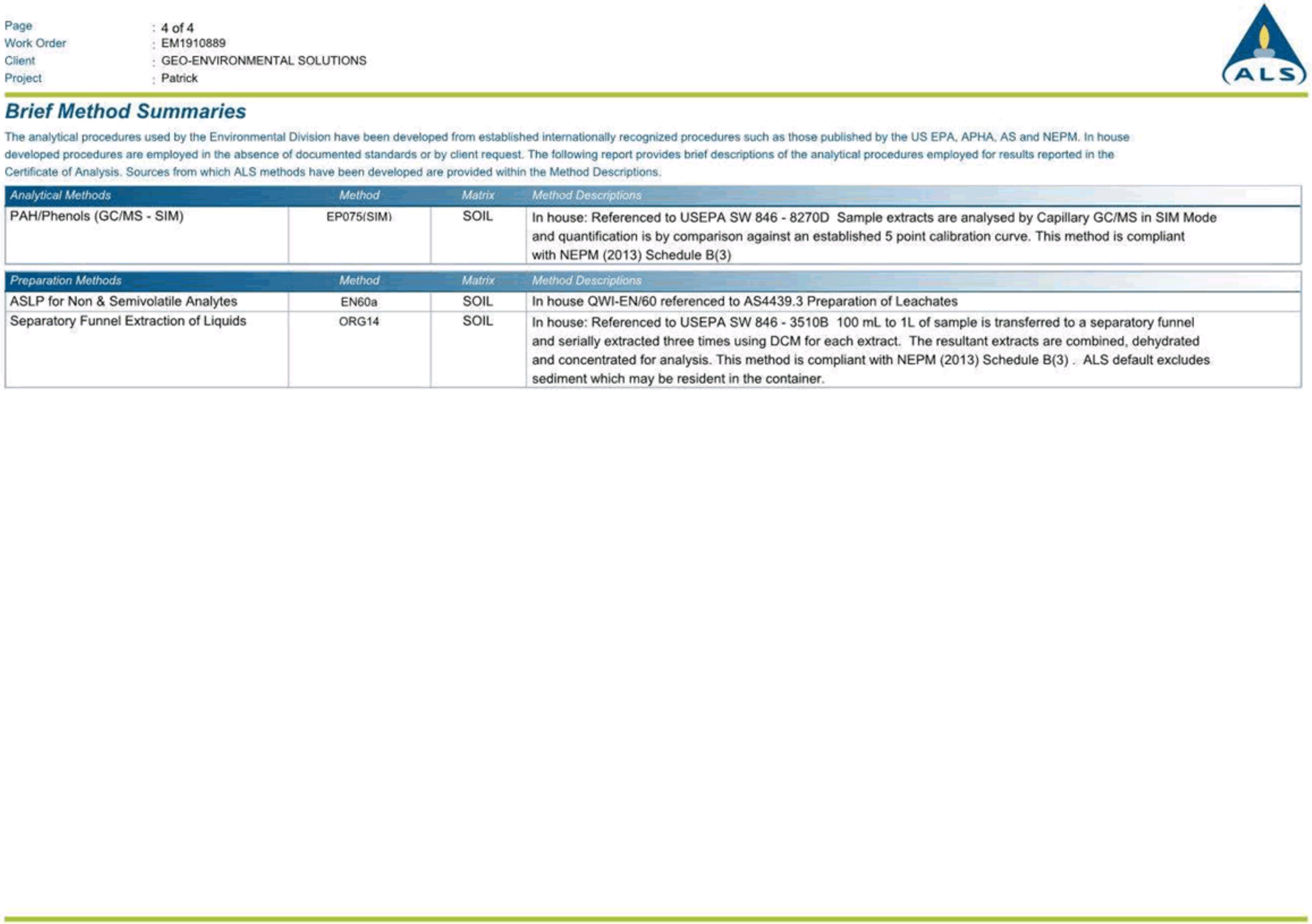
Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	**Actual**	**Expected**	*Evaluation*	
Laboratory Duplicates (DUP)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	13	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	13	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard



Page	: 4 of 4
Work Order	: EM1910889
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

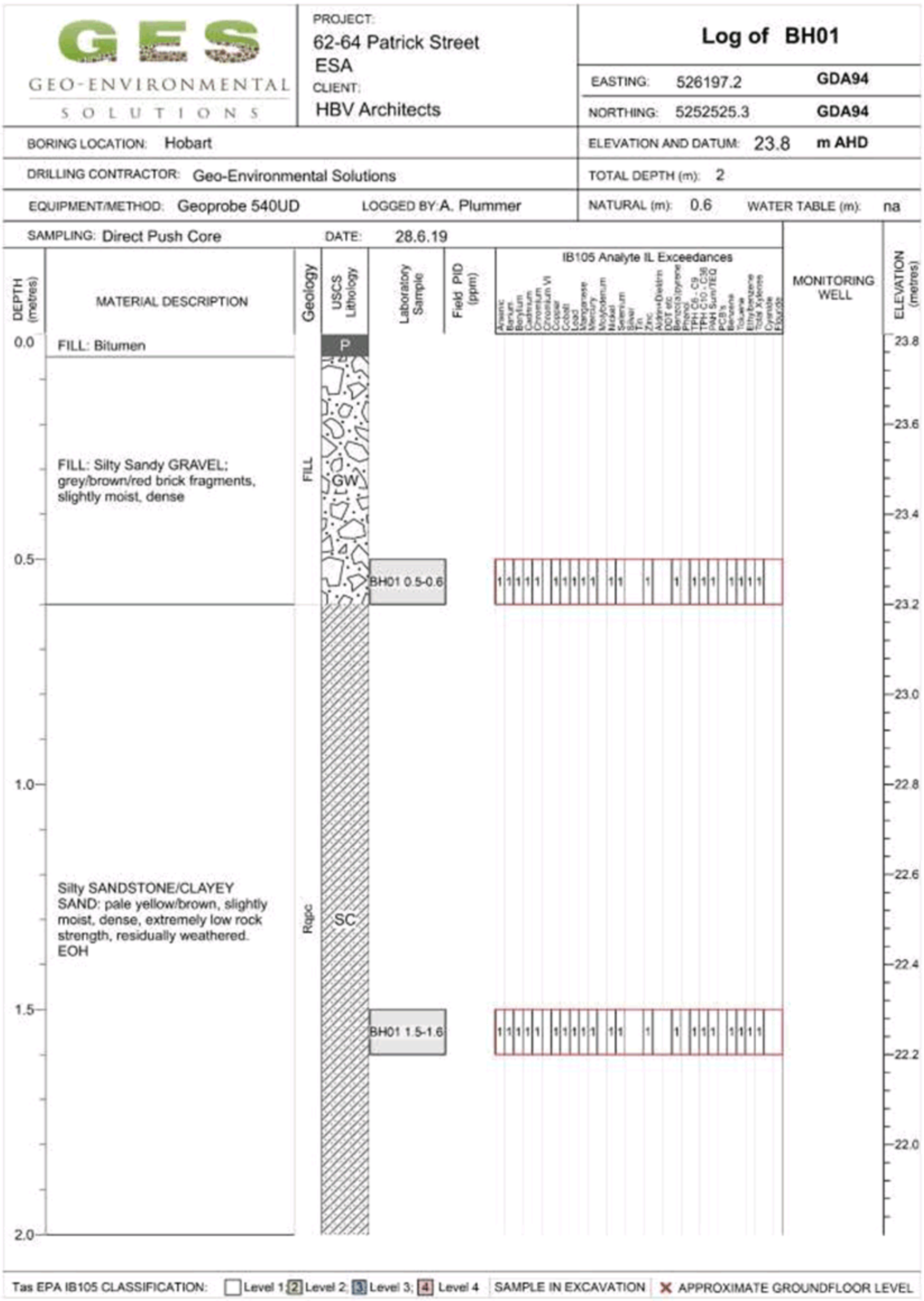
Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
ASLP for Non & Semivolatile Analytes	EN60a	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
Separatory Funnel Extraction of Liquids	ORG14	SOIL	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

Appendix 9 Borehole Logs



GES GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA

CLIENT: HBV Architects

Log of BH01

EASTING: 526197.2 **GDA94**

NORTHING: 5252525.3 **GDA94**

BORING LOCATION: Hobart

ELEVATION AND DATUM: 23.8 **m AHD**

DRILLING CONTRACTOR: Geo-Environmental Solutions

TOTAL DEPTH (m): 2

EQUIPMENT/METHOD: Geoprobe 540UD

LOGGED BY: A. Plummer

NATURAL (m): 0.6

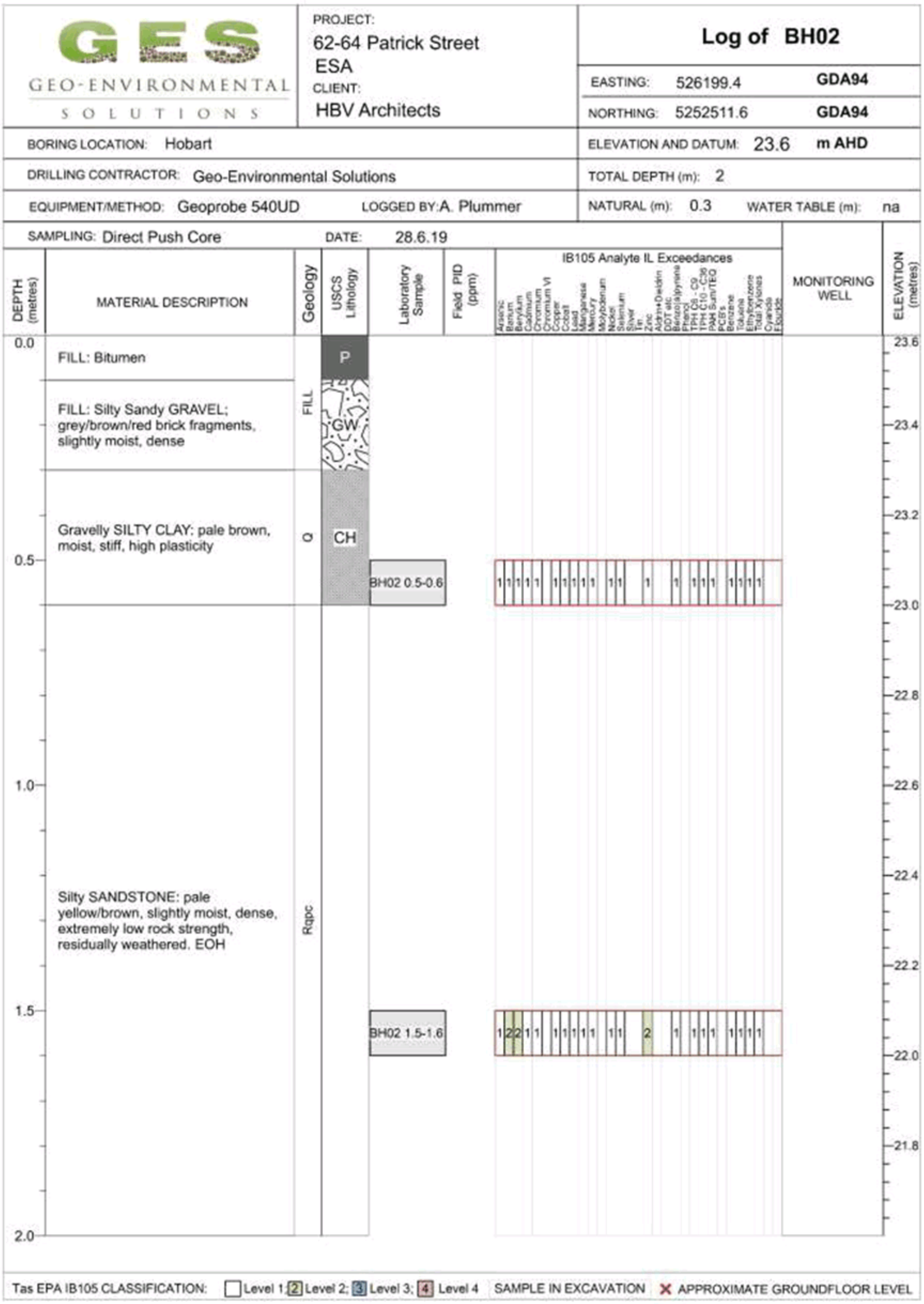
WATER TABLE (m): na

SAMPLING: Direct Push Core

DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Bitumen		P	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW	BH01 0.5-0.6
	Silty SANDSTONE/CLAYEY SAND: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc	SC	BH01 1.5-1.6

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 | SAMPLE IN EXCAVATION | ✕ APPROXIMATE GROUNDFLOOR LEVEL



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH02

EASTING:	526199.4	GDA94
NORTHING:	5252511.6	GDA94

BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.6 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.3
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	MONITORING WELL	ELEVATION (metres)
0.0	FILL: Bitumen	FILL	P				23.6
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW				23.4
	Gravelly SILTY CLAY: pale brown, moist, stiff, high plasticity	Q	CH				23.2
0.5				BH02 0.5-0.6			23.0
1.0	Silty SANDSTONE: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc					22.8 22.6 22.4 22.2
1.5				BH02 1.5-1.6			22.0 21.8
2.0							

IB105 Analyte IL Exceedances

Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium VI	Copper	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Tin	Zinc	Aldrin+Dieldrin	DDT etc	Benzo(a)pyrene	Phenol	TPH C6 - C9	TPH C10 - C36	PAH Sum/TEQ	PCBs	Benzene	Toluene	Ethylbenzene	Total Xylenes	Cyanide	Flouride
BH02 0.5-0.6	1	1	1	1	1		1	1	1	1	1		1	1			1			1		1	1	1		1	1	1	1		
BH02 1.5-1.6	1	2	2	1	1		1	1	1	1	1		1	1			2			1		1	1	1		1	1	1	1		

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

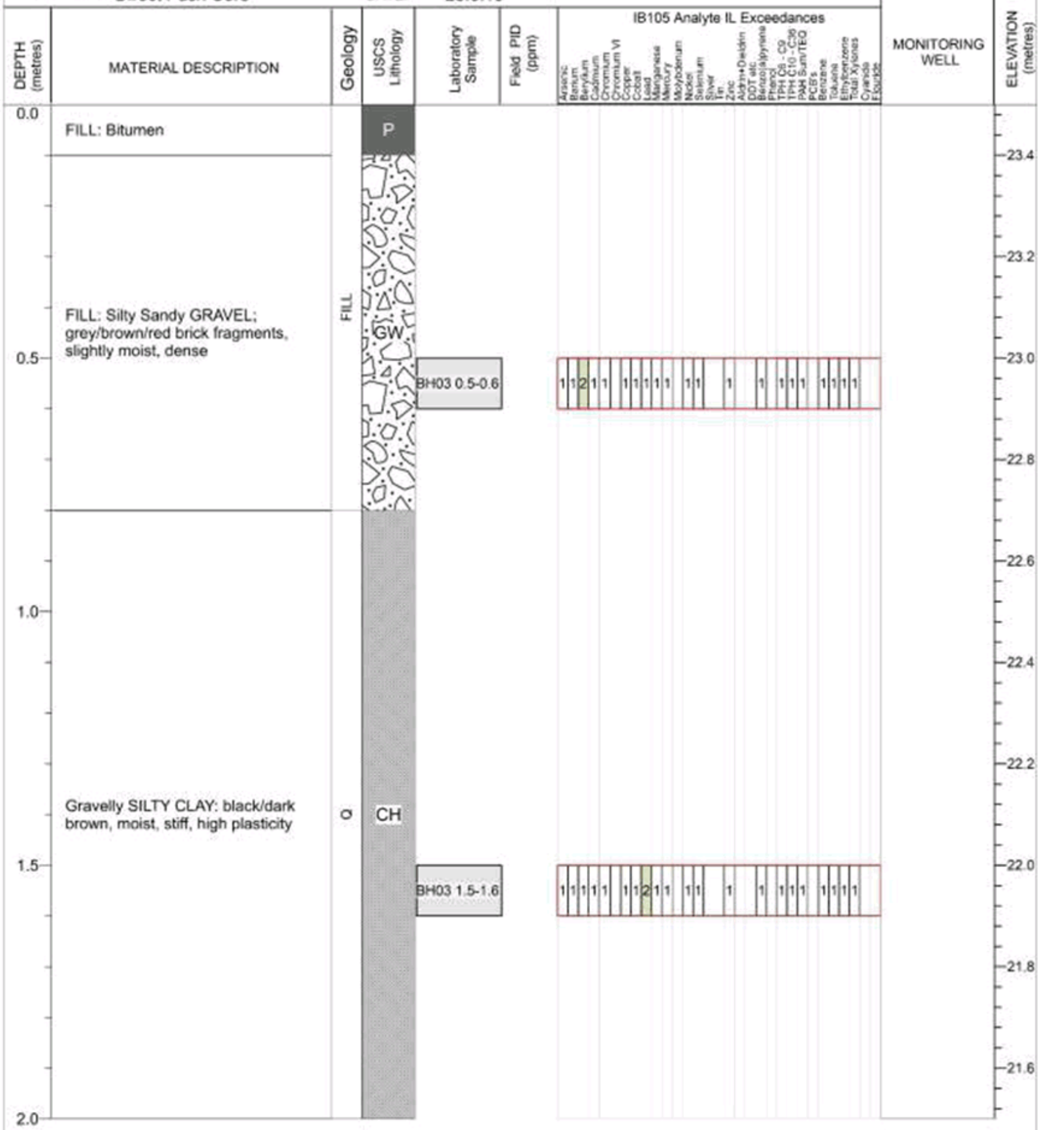
GES GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH03

EASTING:	526211.2	GDA94
NORTHING:	5252529.9	GDA94
ELEVATION AND DATUM:	23.5	m AHD

BORING LOCATION: Hobart
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.8
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19



Depth (m)	Material description	Geology	USCS Lithology	Laboratory Sample	IB105 Analyte IL Exceedances
0.0	FILL: Bitumen		P		
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW	BH03 0.5-0.6	1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	Gravelly SILTY CLAY: black/dark brown, moist, stiff, high plasticity	G	CH	BH03 1.5-1.6	1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

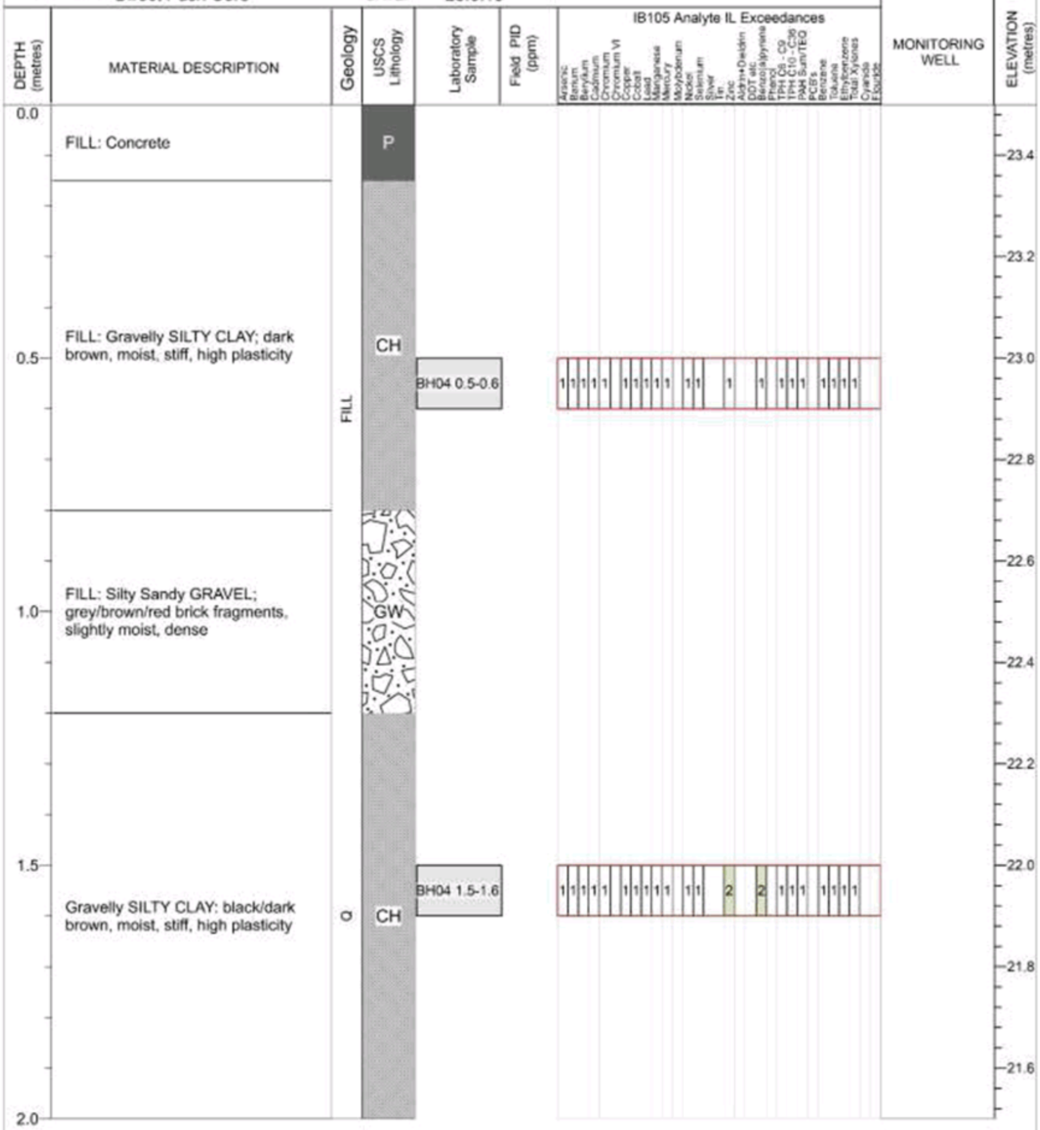
Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

GES
GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

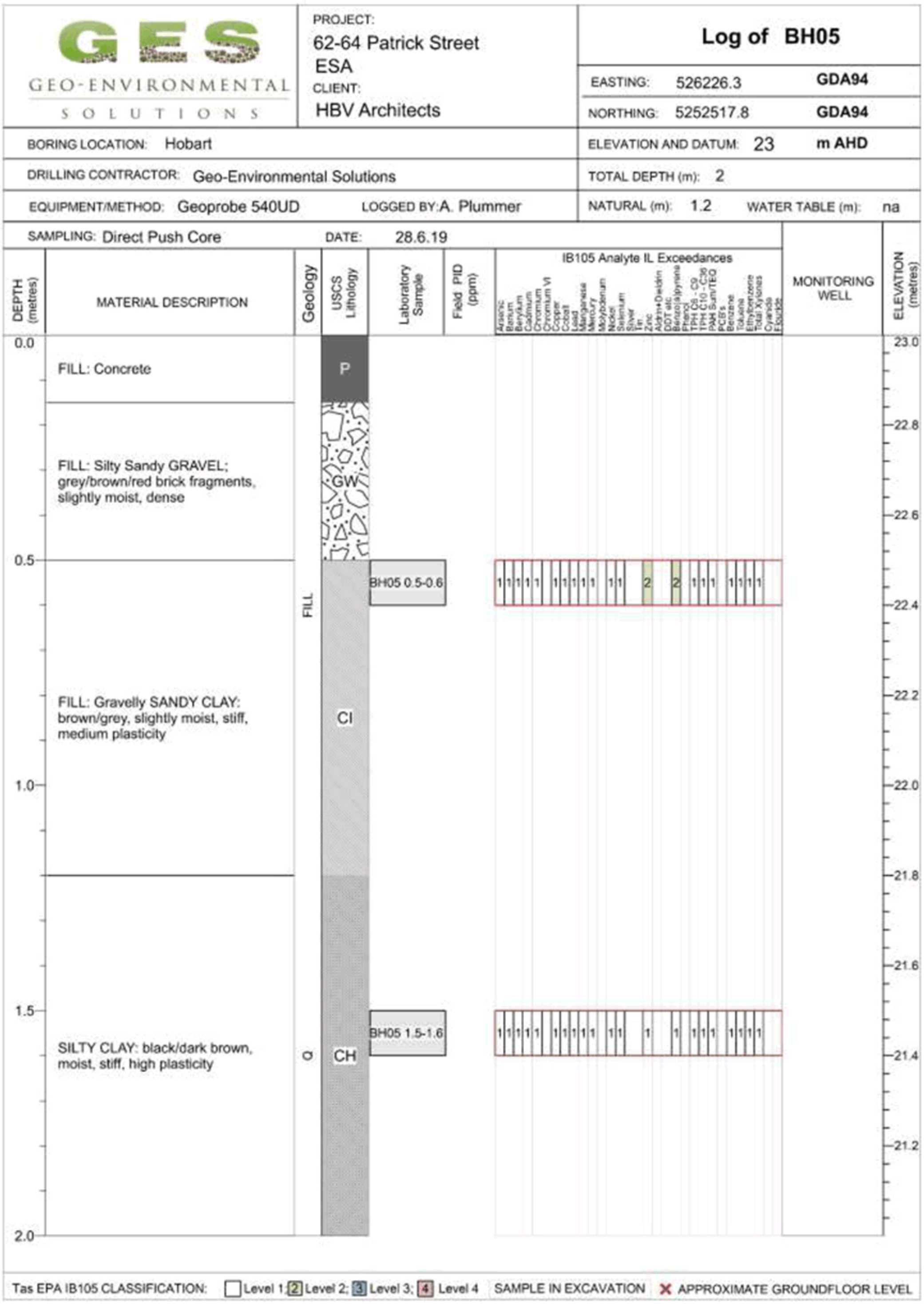
Log of BH04

EASTING: 526222.2 **GDA94**
NORTHING: 5252508.9 **GDA94**
BORING LOCATION: Hobart
ELEVATION AND DATUM: 23.5 **m AHD**
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 1.2
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19



DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Concrete		P	
	FILL: Gravelly SILTY CLAY; dark brown, moist, stiff, high plasticity	FILL	CH	BH04 0.5-0.6
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW	
	Gravelly SILTY CLAY: black/dark brown, moist, stiff, high plasticity	G	CH	BH04 1.5-1.6
2.0				

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL



GEO-ENVIRONMENTAL SOLUTIONS

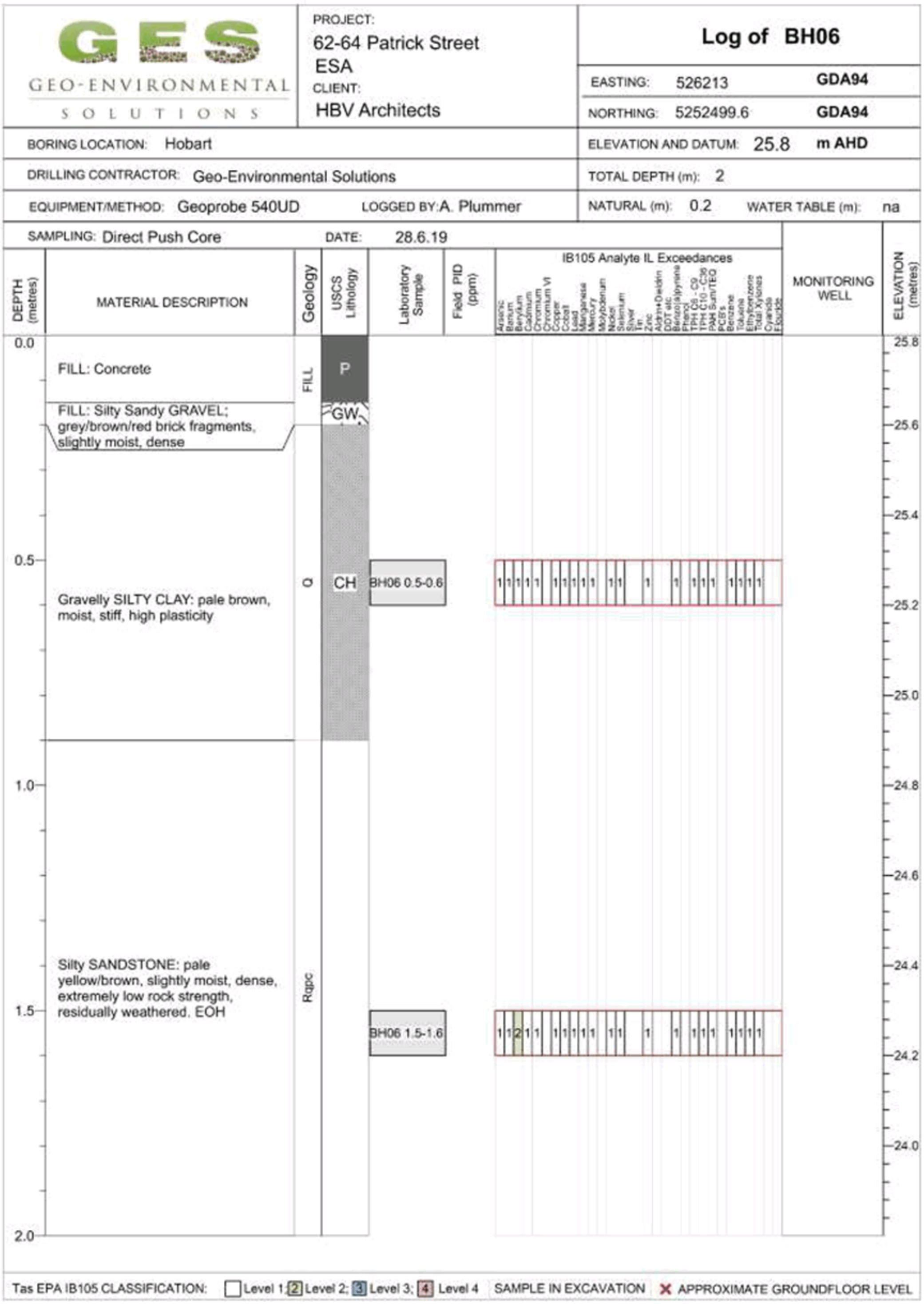
PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH05

EASTING: 526226.3 GDA94
NORTHING: 5252517.8 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 23 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 1.2
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Concrete	FILL	P	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW	
0.5	FILL: Gravelly SANDY CLAY: brown/grey, slightly moist, stiff, medium plasticity		CI	BH05 0.5-0.6
1.2	SILTY CLAY: black/dark brown, moist, stiff, high plasticity	C	CH	BH05 1.5-1.6
2.0				

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

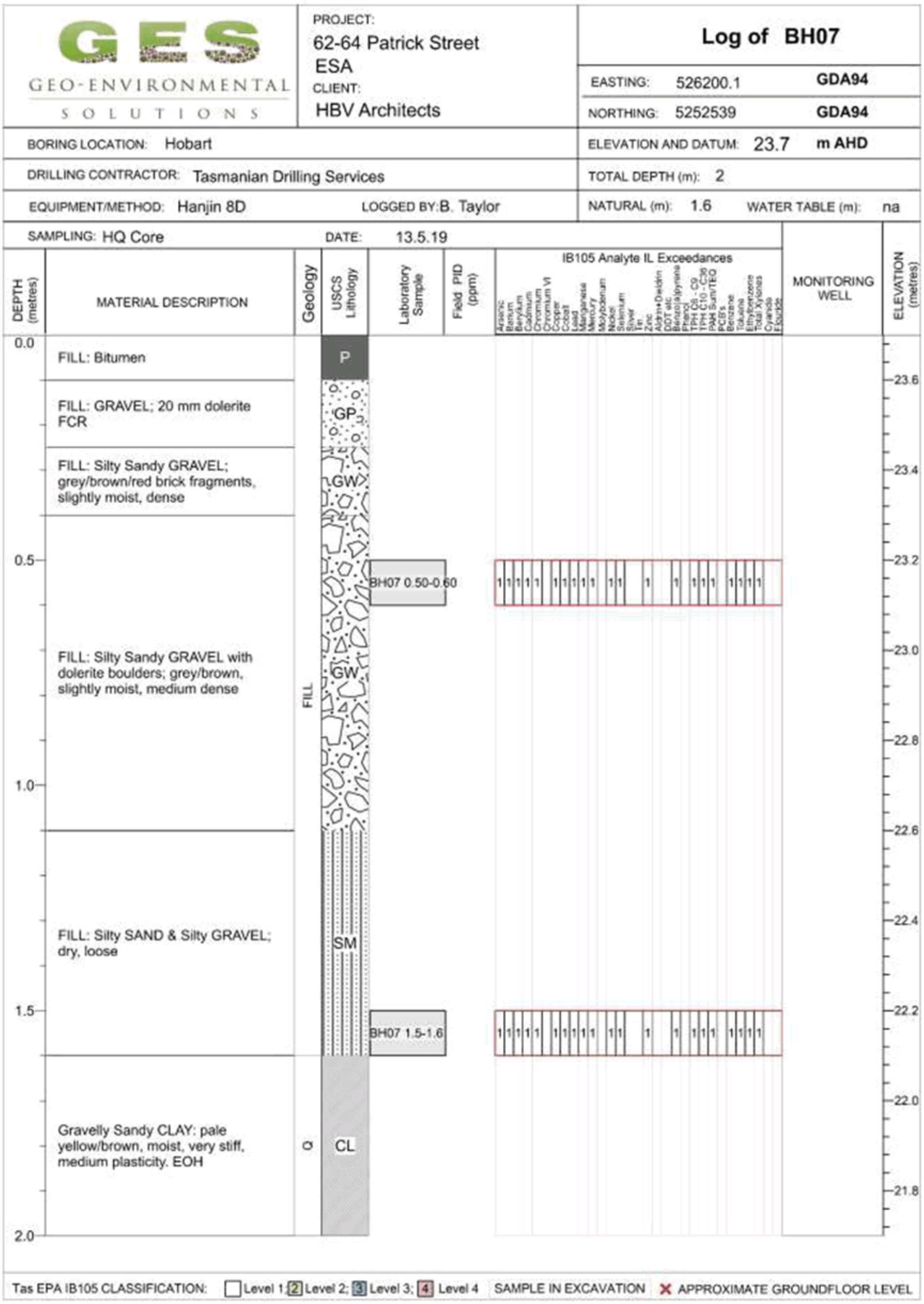


Log of BH06

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects
EASTING: 526213 GDA94
NORTHING: 5252499.6 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 25.8 m AHD
DRILLING CONTRACTOR: Geo-Environmental Solutions
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Geoprobe 540UD
LOGGED BY: A. Plummer
NATURAL (m): 0.2
WATER TABLE (m): na
SAMPLING: Direct Push Core
DATE: 28.6.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample
0.0	FILL: Concrete	FILL	P	
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense		GW	
0.5	Gravelly SILTY CLAY: pale brown, moist, stiff, high plasticity	Q	CH	BH06 0.5-0.6
1.5	Silty SANDSTONE: pale yellow/brown, slightly moist, dense, extremely low rock strength, residually weathered. EOH	Rqpc		BH06 1.5-1.6

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

Log of BH07

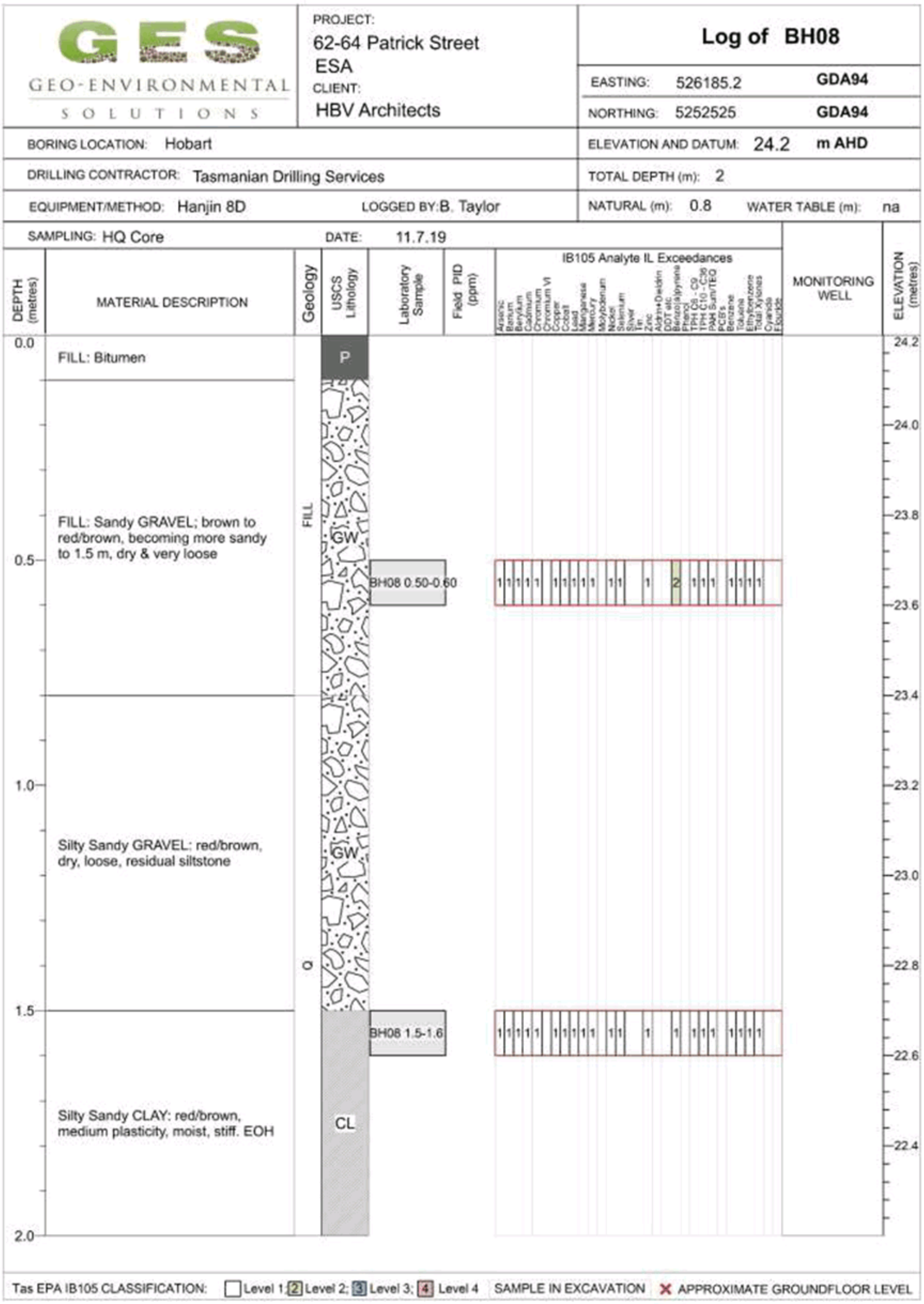
EASTING:	526200.1	GDA94
NORTHING:	5252539	GDA94
ELEVATION AND DATUM:	23.7	m AHD

BORING LOCATION: Hobart
DRILLING CONTRACTOR: Tasmanian Drilling Services
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Hanjin 8D
LOGGED BY: B. Taylor
NATURAL (m): 1.6
WATER TABLE (m): na
SAMPLING: HQ Core
DATE: 13.5.19

IB105 Analyte IL Exceedances: Arsenic, Barium, Beryllium, Cadmium, Chromium, Chromium VI, Copper, Cobalt, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Tin, Zinc, Aldrin+Dieldrin, DDT etc, Benzo(a)pyrene, Phenol, TPH C6 - C9, TPH C10 - C36, PAH Sum/TEQ, PCBs, Benzene, Toluene, Ethylbenzene, Total Xylenes, Cyanide, Flouride

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL
0.0	FILL: Bitumen	FILL	P				
	FILL: GRAVEL; 20 mm dolerite FCR	FILL	GP				
	FILL: Silty Sandy GRAVEL; grey/brown/red brick fragments, slightly moist, dense	FILL	GW				
0.5	FILL: Silty Sandy GRAVEL with dolerite boulders; grey/brown, slightly moist, medium dense	FILL	GW	BH07 0.50-0.60		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
1.0	FILL: Silty SAND & Silty GRAVEL; dry, loose	FILL	SM	BH07 1.5-1.6		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
1.6	Gravelly Sandy CLAY: pale yellow/brown, moist, very stiff, medium plasticity. EOH	Q	CL				
2.0							

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street ESA
CLIENT: HBV Architects

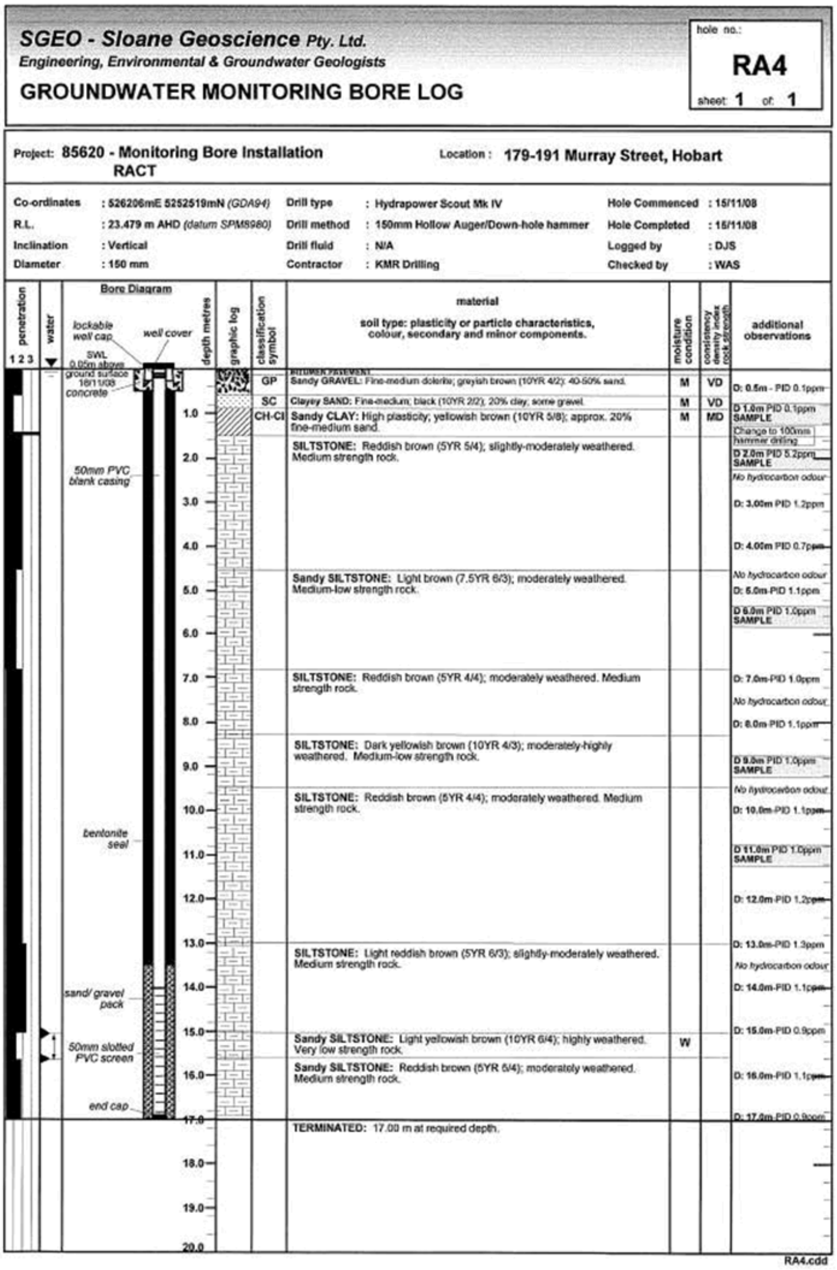
Log of BH08

EASTING: 526185.2 GDA94
NORTHING: 5252525 GDA94
BORING LOCATION: Hobart
ELEVATION AND DATUM: 24.2 m AHD
DRILLING CONTRACTOR: Tasmanian Drilling Services
TOTAL DEPTH (m): 2
EQUIPMENT/METHOD: Hanjin 8D
LOGGED BY: B. Taylor
NATURAL (m): 0.8
WATER TABLE (m): na
SAMPLING: HQ Core
DATE: 11.7.19

DEPTH (metres)	MATERIAL DESCRIPTION	Geology	USCS Lithology	Laboratory Sample	Field PID (ppm)	IB105 Analyte IL Exceedances	MONITORING WELL	ELEVATION (metres)
0.0	FILL: Bitumen		P					24.2
	FILL: Sandy GRAVEL; brown to red/brown, becoming more sandy to 1.5 m, dry & very loose	FILL	GW	BH08 0.50-0.60		1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1		
	Silty Sandy GRAVEL: red/brown, dry, loose, residual siltstone	Q	GW					
1.5	Silty Sandy CLAY: red/brown, medium plasticity, moist, stiff. EOH		CL	BH08 1.5-1.6		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
2.0								

Tas EPA IB105 CLASSIFICATION: ☐ Level 1; 2 Level 2; 3 Level 3; 4 Level 4 SAMPLE IN EXCAVATION ✕ APPROXIMATE GROUNDFLOOR LEVEL

Groundwater Bore Sloane 2009



SGEO - Sloane Geoscience Pty. Ltd.
Engineering, Environmental & Groundwater Geologists
GROUNDWATER MONITORING BORE LOG

hole no.: **RA4**
sheet: 1 of: 1

Project: 85620 - Monitoring Bore Installation RACT
Location : 179-191 Murray Street, Hobart

Co-ordinates	: 526206mE 5252519mN *(GDA94)*	Drill type	: Hydrapower Scout Mk IV	Hole Commenced	: 15/11/08
R.L.	: 23.479 m AHD *(datum SPM8980)*	Drill method	: 150mm Hollow Auger/Down-hole hammer	Hole Completed	: 15/11/08
Inclination	: Vertical	Drill fluid	: N/A	Logged by	: DJS
Diameter	: 150 mm	Contractor	: KMR Drilling	Checked by	: WAS

classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index rock strength
	BITUMEN PAVEMENT		
GP	Sandy GRAVEL: Fine-medium dolerite; greyish brown (10YR 4/2): 40-50% sand.	M	VD
SC	Clayey SAND: Fine-medium; black (10YR 2/2); 20% clay; some gravel.	M	VD
CH-CI	Sandy CLAY: High plasticity; yellowish brown (10YR 5/8); approx. 20% fine-medium sand.	M	MD
	SILTSTONE: Reddish brown (5YR 5/4); slightly-moderately weathered. Medium strength rock.		
	Sandy SILTSTONE: Light brown (7.5YR 6/3); moderately weathered. Medium-low strength rock.		
	SILTSTONE: Reddish brown (5YR 4/4); moderately weathered. Medium strength rock.		
	SILTSTONE: Dark yellowish brown (10YR 4/3); moderately-highly weathered. Medium-low strength rock.		
	SILTSTONE: Reddish brown (5YR 4/4); moderately weathered. Medium strength rock.		
	SILTSTONE: Light reddish brown (5YR 6/3); slightly-moderately weathered. Medium strength rock.		
	Sandy SILTSTONE: Light yellowish brown (10YR 6/4); highly weathered. Very low strength rock.	W	
	Sandy SILTSTONE: Reddish brown (5YR 5/4); moderately weathered. Medium strength rock.		
	TERMINATED: 17.00 m at required depth.		

additional observations

D: 0.5m - PID 0.1ppm
D 1.0m PID 0.1ppm SAMPLE
Change to 100mm hammer drilling
D 2.0m PID 5.2ppm SAMPLE
No hydrocarbon odour
D: 3.00m PID 1.2ppm
D: 4.00m PID 0.7ppm
No hydrocarbon odour
D: 5.0m-PID 1.1ppm
D 6.0m PID 1.0ppm SAMPLE
D: 7.0m-PID 1.0ppm
No hydrocarbon odour
D: 8.0m-PID 1.1ppm
D 9.0m PID 1.0ppm SAMPLE
No hydrocarbon odour
D: 10.0m-PID 1.1ppm
D 11.0m PID 1.0ppm SAMPLE
D: 12.0m-PID 1.2ppm
D: 13.0m-PID 1.3ppm
No hydrocarbon odour
D: 14.0m-PID 1.1ppm
D: 15.0m-PID 0.9ppm
D: 16.0m-PID 1.1ppm
D: 17.0m-PID 0.9ppm

RA4.cdd

Appendix 10 Certificate of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EM1910349**
Client : **GEO-ENVIRONMENTAL SOLUTIONS**
Contact : DR JOHN PAUL CUMMING
Address : 29 KIRKSWAY PLACE
BATTERY POINT TASMANIA, AUSTRALIA 7004
Telephone : +61 03 6223 1839
Project : Patrick
Order number : ----
C-O-C number : ----
Sampler : GM
Site : ----
Quote number : EN/222
No. of samples received : 23
No. of samples analysed : 22

Page : 1 of 18
Laboratory : Environmental Division Melbourne
Contact : Shirley LeCornu
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +6138549 9630
Date Samples Received : 02-Jul-2019 09:15
Date Analysis Commenced : 03-Jul-2019
Issue Date : 09-Jul-2019 17:04

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

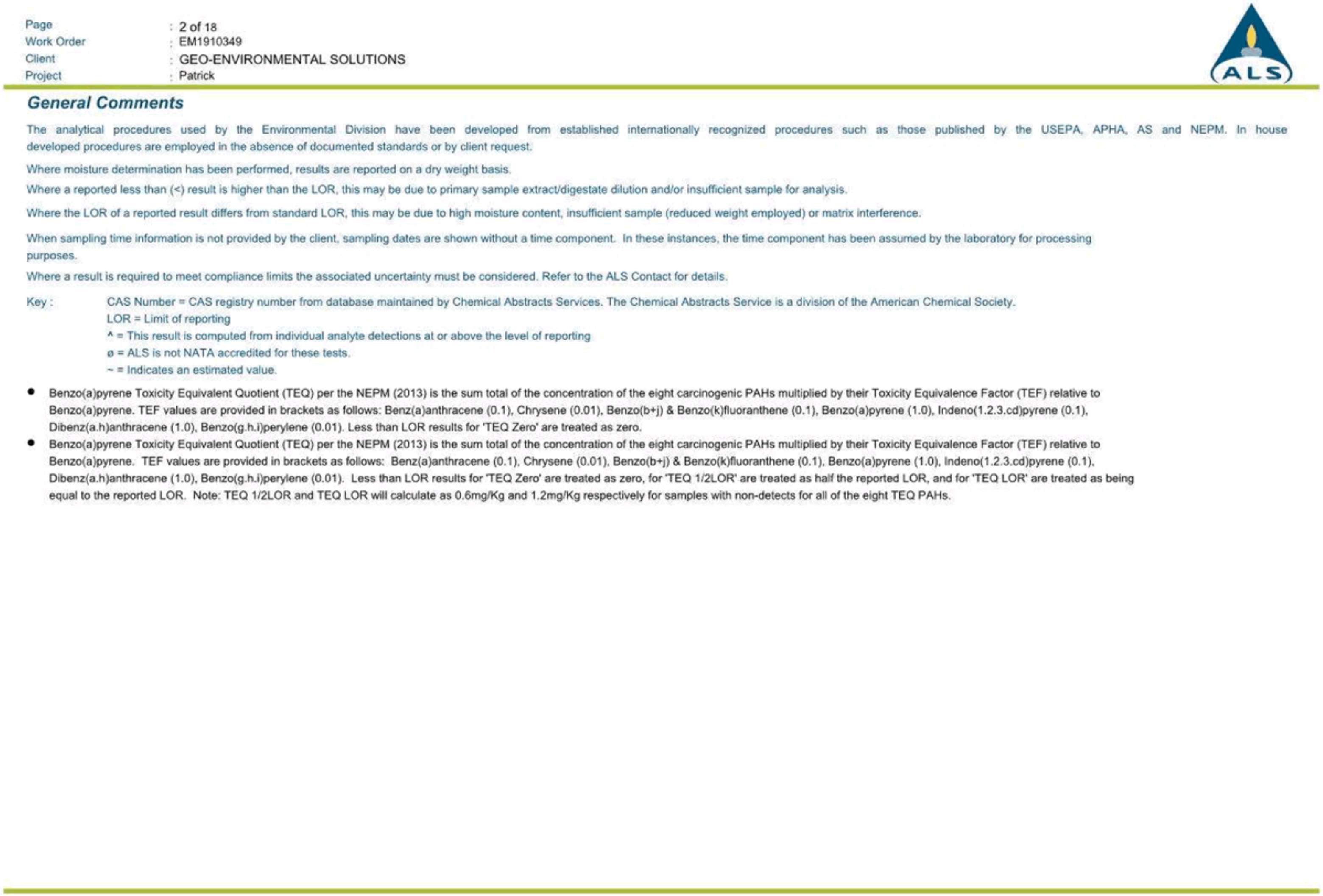
Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

RIGHT SOLUTIONS | RIGHT PARTNER



Page	: 2 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key :
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

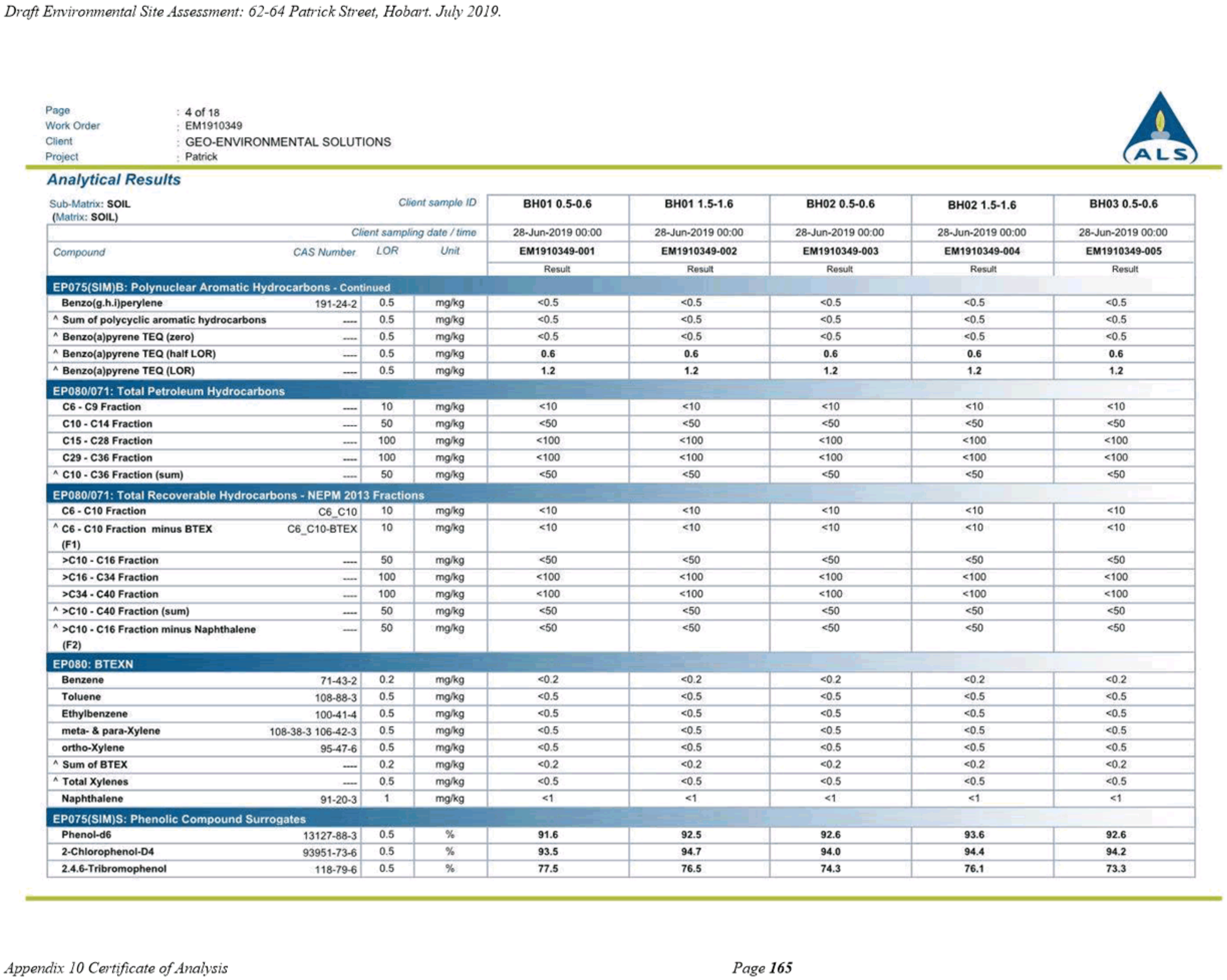
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Page : 3 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	BH01 0.5-0.6	BH01 1.5-1.6	BH02 0.5-0.6	BH02 1.5-1.6	BH03 0.5-0.6
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
				EM1910349-001	EM1910349-002	EM1910349-003	EM1910349-004	EM1910349-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	12.8	12.8	17.6	6.9	7.7
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	70	50	80	460	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	3	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	4	10	13	15	6
Cobalt	7440-48-4	2	mg/kg	2	11	3	19	31
Copper	7440-50-8	5	mg/kg	<5	8	12	23	<5
Lead	7439-92-1	5	mg/kg	8	12	12	10	56
Manganese	7439-96-5	5	mg/kg	211	470	15	223	173
Nickel	7440-02-0	2	mg/kg	2	10	6	56	12
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	13	14	32	33	9
Zinc	7440-66-6	5	mg/kg	8	28	24	221	32
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

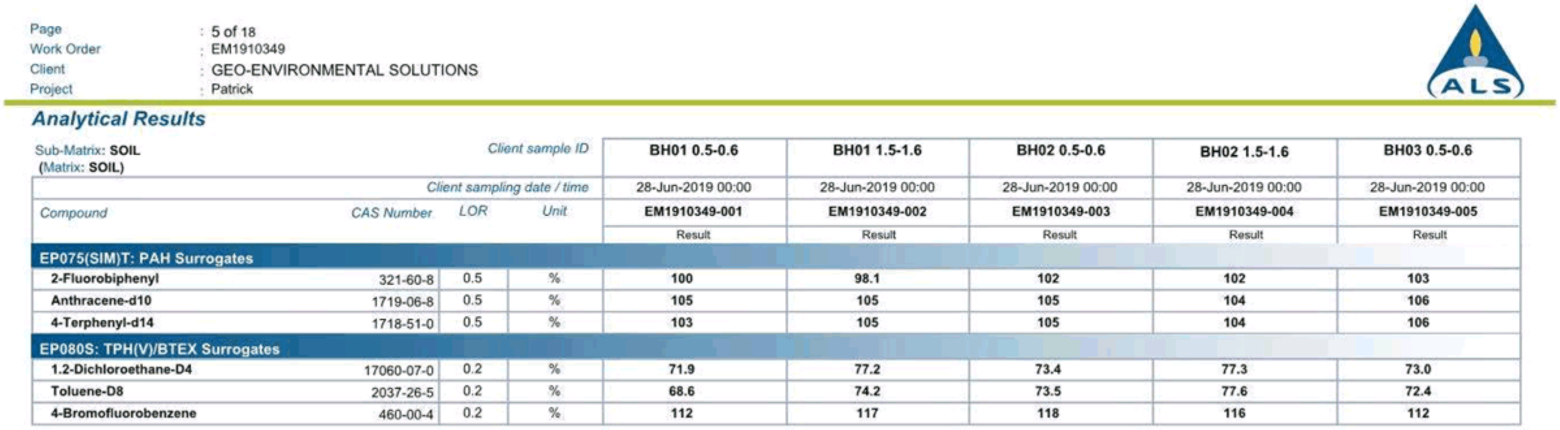


Page : 4 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	BH01 0.5-0.6	BH01 1.5-1.6	BH02 0.5-0.6	BH02 1.5-1.6	BH03 0.5-0.6
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	EM1910349-001	EM1910349-002	EM1910349-003	EM1910349-004	EM1910349-005
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	0.6	0.6	0.6	0.6	0.6
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	1.2	1.2	1.2	1.2	1.2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	91.6	92.5	92.6	93.6	92.6
2-Chlorophenol-D4	93951-73-6	0.5	%	93.5	94.7	94.0	94.4	94.2
2.4.6-Tribromophenol	118-79-6	0.5	%	77.5	76.5	74.3	76.1	73.3

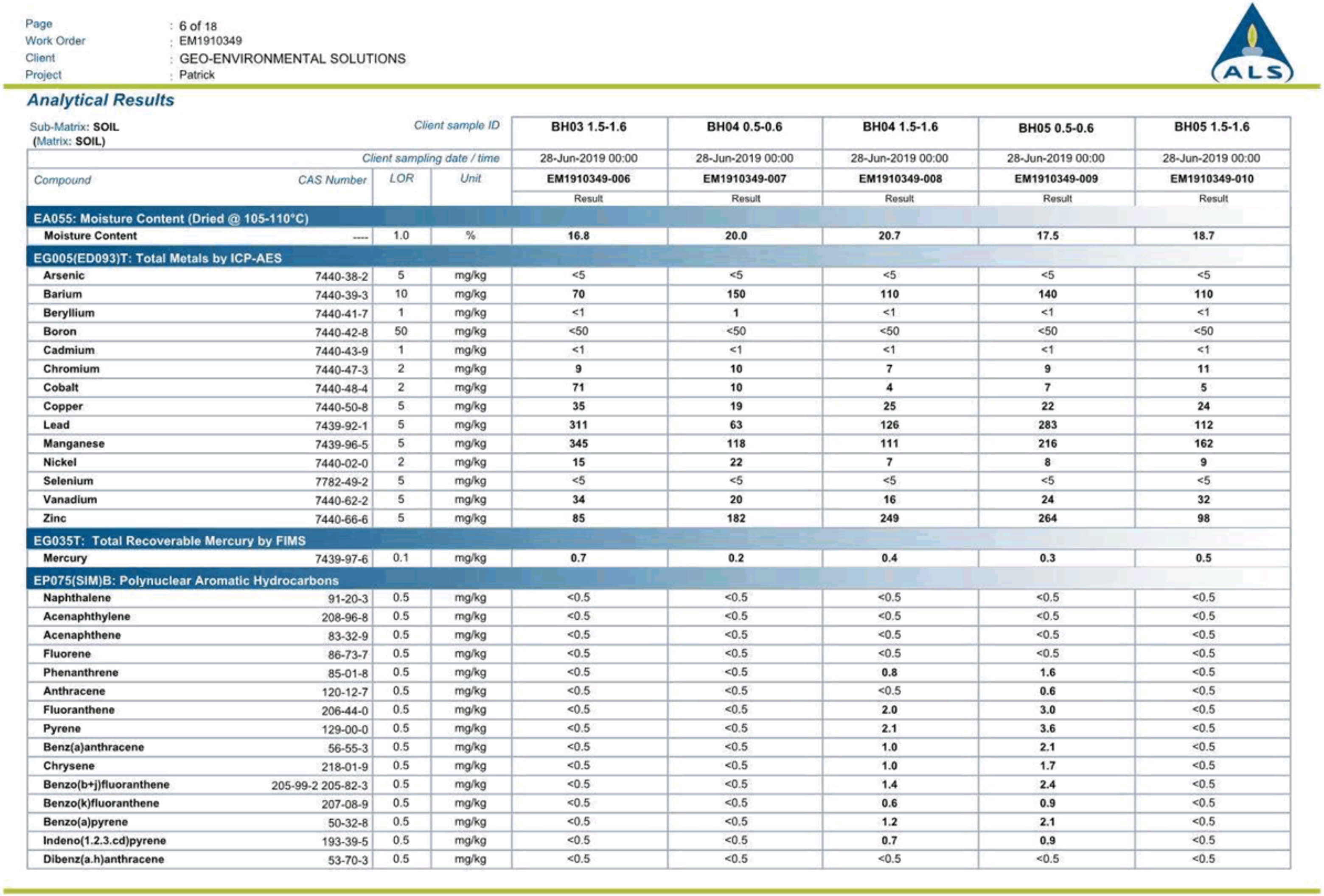


Page : 5 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**BH01 0.5-0.6**	**BH01 1.5-1.6**	**BH02 0.5-0.6**	**BH02 1.5-1.6**	**BH03 0.5-0.6**
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	**EM1910349-001**	**EM1910349-002**	**EM1910349-003**	**EM1910349-004**	**EM1910349-005**
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**100**	**98.1**	**102**	**102**	**103**
Anthracene-d10	1719-06-8	0.5	%	**105**	**105**	**105**	**104**	**106**
4-Terphenyl-d14	1718-51-0	0.5	%	**103**	**105**	**105**	**104**	**106**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**71.9**	**77.2**	**73.4**	**77.3**	**73.0**
Toluene-D8	2037-26-5	0.2	%	**68.6**	**74.2**	**73.5**	**77.6**	**72.4**
4-Bromofluorobenzene	460-00-4	0.2	%	**112**	**117**	**118**	**116**	**112**



Page	: 6 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

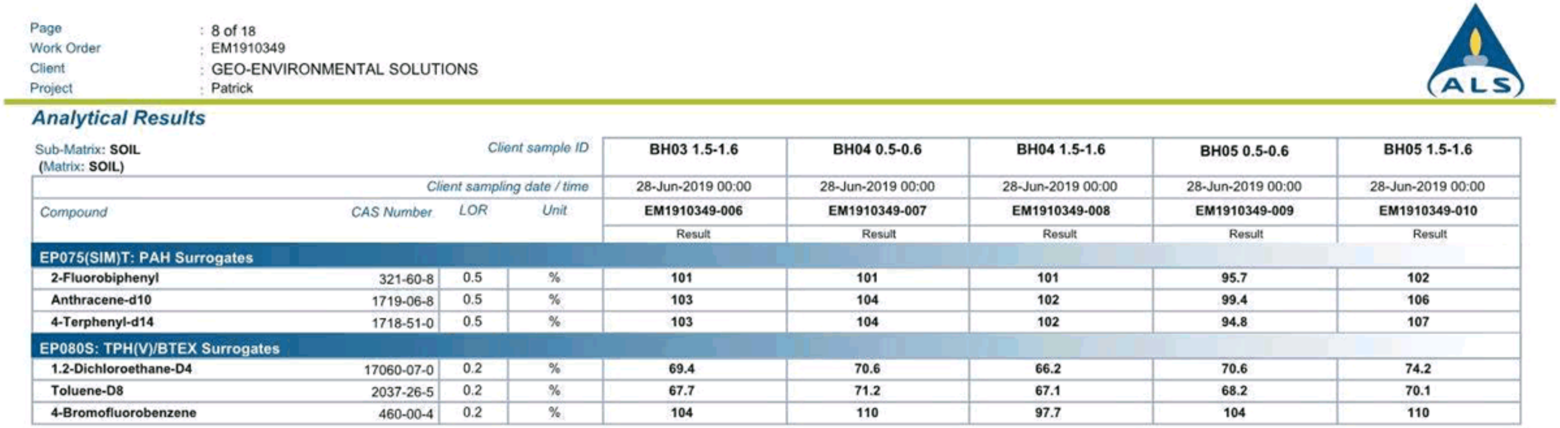
Compound	CAS Number	LOR	Unit	BH03 1.5-1.6	BH04 0.5-0.6	BH04 1.5-1.6	BH05 0.5-0.6	BH05 1.5-1.6
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
				EM1910349-006	EM1910349-007	EM1910349-008	EM1910349-009	EM1910349-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	16.8	20.0	20.7	17.5	18.7
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	70	150	110	140	110
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	9	10	7	9	11
Cobalt	7440-48-4	2	mg/kg	71	10	4	7	5
Copper	7440-50-8	5	mg/kg	35	19	25	22	24
Lead	7439-92-1	5	mg/kg	311	63	126	283	112
Manganese	7439-96-5	5	mg/kg	345	118	111	216	162
Nickel	7440-02-0	2	mg/kg	15	22	7	8	9
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	34	20	16	24	32
Zinc	7440-66-6	5	mg/kg	85	182	249	264	98
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.7	0.2	0.4	0.3	0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.8	1.6	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	2.0	3.0	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	2.1	3.6	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	1.0	2.1	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	1.0	1.7	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	1.4	2.4	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.6	0.9	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	1.2	2.1	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.7	0.9	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Page : 7 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

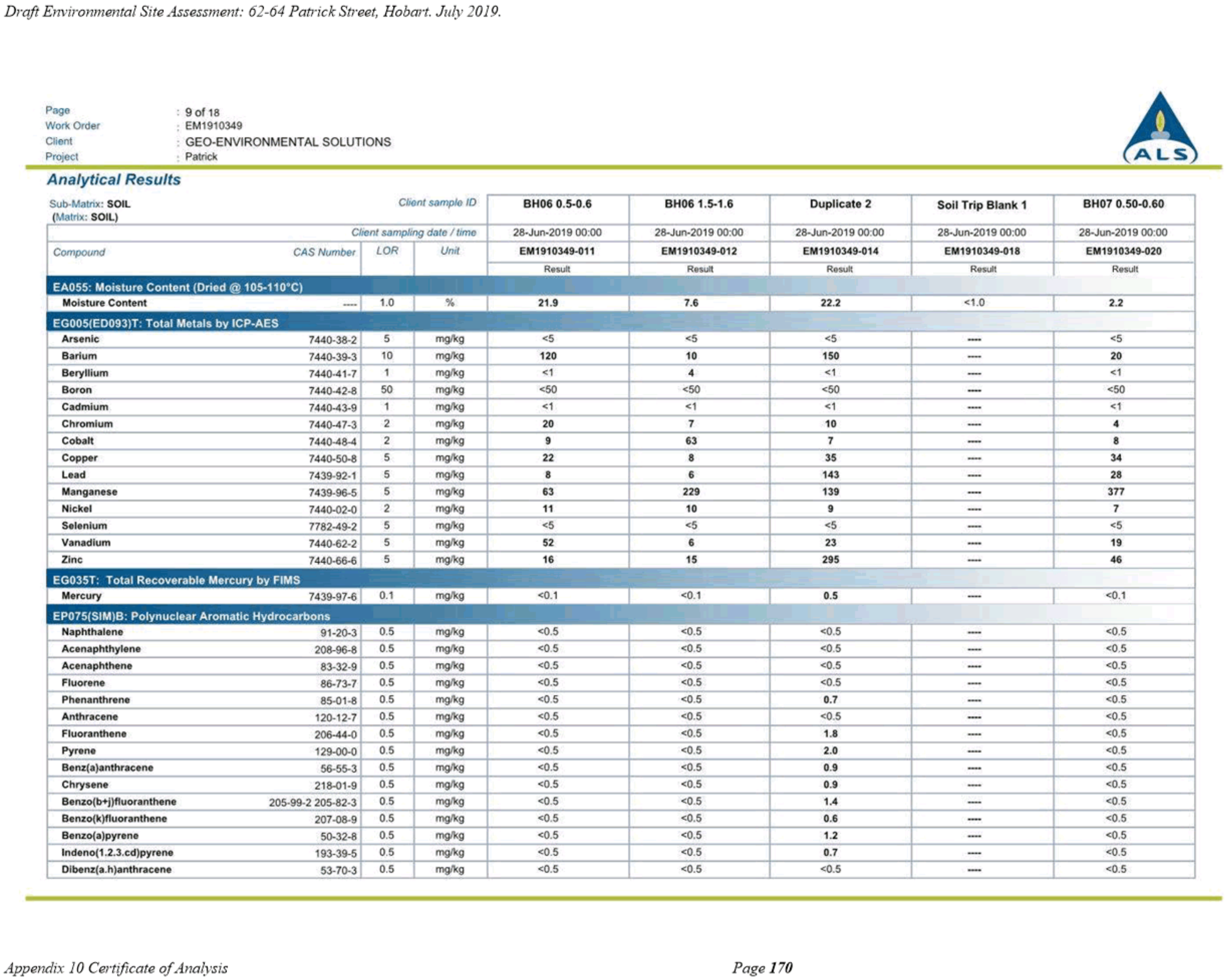
			Client sample ID	**BH03 1.5-1.6**	**BH04 0.5-0.6**	**BH04 1.5-1.6**	**BH05 0.5-0.6**	**BH05 1.5-1.6**
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**EM1910349-006**	**EM1910349-007**	**EM1910349-008**	**EM1910349-009**	**EM1910349-010**
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	**1.0**	**1.1**	<0.5
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	<0.5	<0.5	**11.8**	**20.0**	<0.5
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	<0.5	<0.5	**1.6**	**2.8**	<0.5
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**0.6**	**0.6**	**1.8**	**3.0**	**0.6**
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**1.2**	**1.2**	**2.1**	**3.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	**100**	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	**110**	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	**210**	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	**170**	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	**170**	<50	<50
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**90.5**	**93.4**	**90.3**	**97.5**	**94.0**
2-Chlorophenol-D4	93951-73-6	0.5	%	**92.2**	**95.0**	**91.9**	**97.8**	**96.0**
2.4.6-Tribromophenol	118-79-6	0.5	%	**73.2**	**77.6**	**81.6**	**77.0**	**84.6**



Page : 8 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**BH03 1.5-1.6**	**BH04 0.5-0.6**	**BH04 1.5-1.6**	**BH05 0.5-0.6**	**BH05 1.5-1.6**
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	**EM1910349-006**	**EM1910349-007**	**EM1910349-008**	**EM1910349-009**	**EM1910349-010**
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**101**	**101**	**101**	**95.7**	**102**
Anthracene-d10	1719-06-8	0.5	%	**103**	**104**	**102**	**99.4**	**106**
4-Terphenyl-d14	1718-51-0	0.5	%	**103**	**104**	**102**	**94.8**	**107**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**69.4**	**70.6**	**66.2**	**70.6**	**74.2**
Toluene-D8	2037-26-5	0.2	%	**67.7**	**71.2**	**67.1**	**68.2**	**70.1**
4-Bromofluorobenzene	460-00-4	0.2	%	**104**	**110**	**97.7**	**104**	**110**

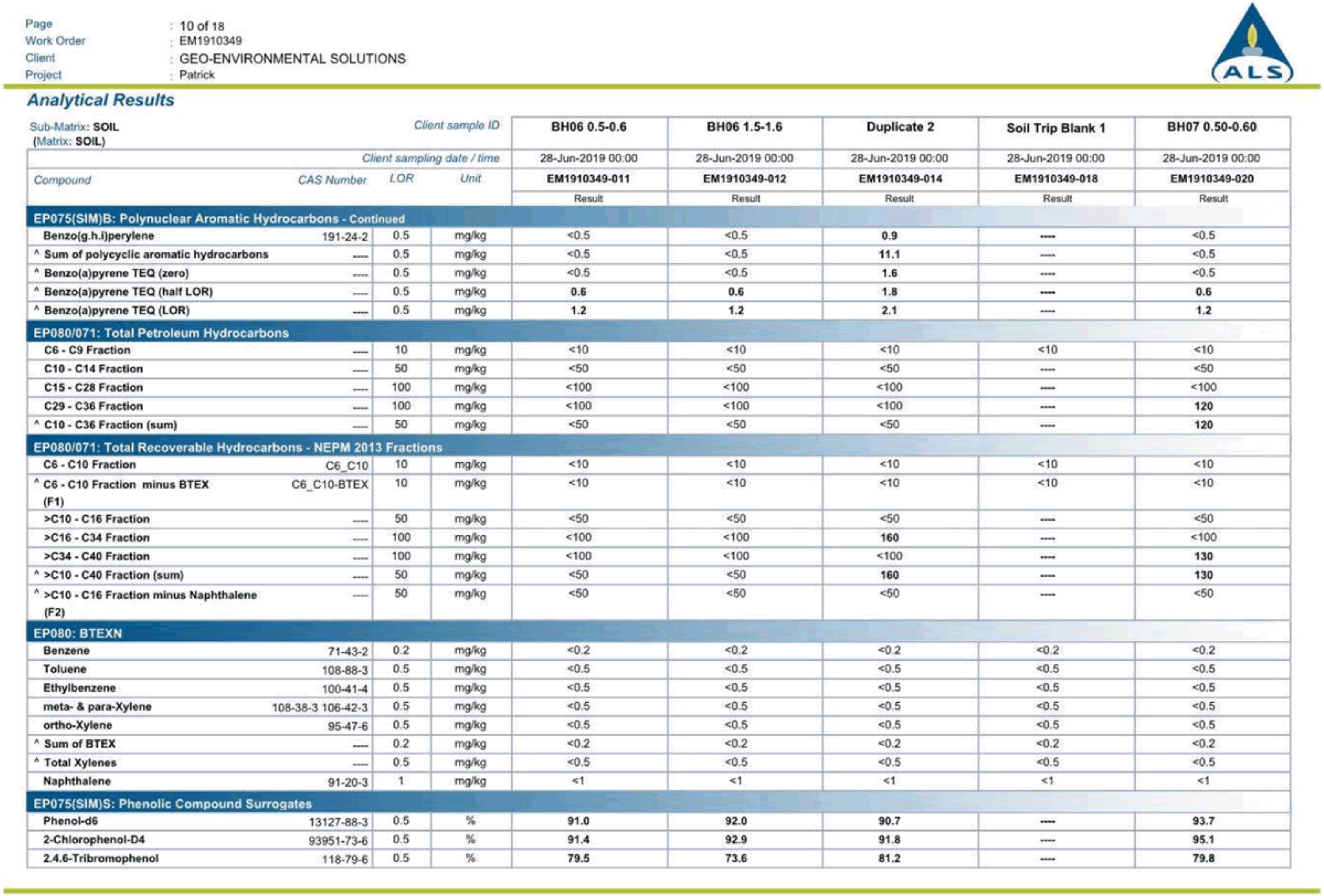


Page	: 9 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	BH06 0.5-0.6	BH06 1.5-1.6	Duplicate 2	Soil Trip Blank 1	BH07 0.50-0.60
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	EM1910349-011	EM1910349-012	EM1910349-014	EM1910349-018	EM1910349-020
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	21.9	7.6	22.2	<1.0	2.2
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	----	<5
Barium	7440-39-3	10	mg/kg	120	10	150	----	20
Beryllium	7440-41-7	1	mg/kg	<1	4	<1	----	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	----	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	<1
Chromium	7440-47-3	2	mg/kg	20	7	10	----	4
Cobalt	7440-48-4	2	mg/kg	9	63	7	----	8
Copper	7440-50-8	5	mg/kg	22	8	35	----	34
Lead	7439-92-1	5	mg/kg	8	6	143	----	28
Manganese	7439-96-5	5	mg/kg	63	229	139	----	377
Nickel	7440-02-0	2	mg/kg	11	10	9	----	7
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	----	<5
Vanadium	7440-62-2	5	mg/kg	52	6	23	----	19
Zinc	7440-66-6	5	mg/kg	16	15	295	----	46
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.5	----	<0.1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.7	----	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	1.8	----	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	2.0	----	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.9	----	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.9	----	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	1.4	----	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.6	----	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	1.2	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.7	----	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5



Page	: 10 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

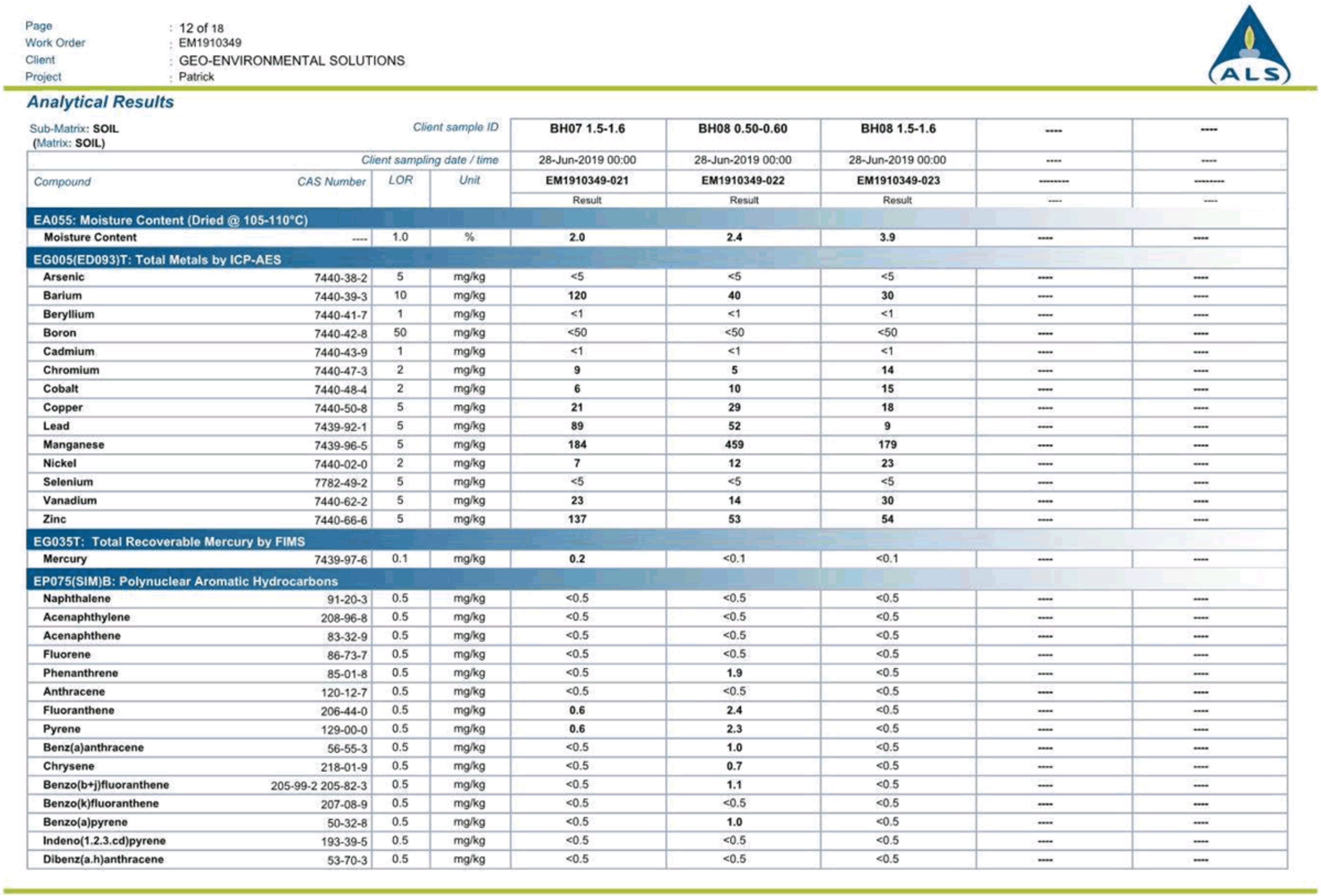
Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	BH06 0.5-0.6	BH06 1.5-1.6	Duplicate 2	Soil Trip Blank 1	BH07 0.50-0.60
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	EM1910349-011	EM1910349-012	EM1910349-014	EM1910349-018	EM1910349-020
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	**0.9**	----	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	**11.1**	----	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	**1.6**	----	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**1.8**	----	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**2.1**	----	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	----	**120**
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	----	**120**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	**160**	----	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	----	**130**
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	**160**	----	**130**
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	----	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**91.0**	**92.0**	**90.7**	----	**93.7**
2-Chlorophenol-D4	93951-73-6	0.5	%	**91.4**	**92.9**	**91.8**	----	**95.1**
2.4.6-Tribromophenol	118-79-6	0.5	%	**79.5**	**73.6**	**81.2**	----	**79.8**

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**BH06 0.5-0.6**	**BH06 1.5-1.6**	**Duplicate 2**	**Soil Trip Blank 1**	**BH07 0.50-0.60**
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00
Compound	CAS Number	LOR	Unit	**EM1910349-011**	**EM1910349-012**	**EM1910349-014**	**EM1910349-018**	**EM1910349-020**
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**98.4**	**101**	**101**	----	**103**
Anthracene-d10	1719-06-8	0.5	%	**102**	**103**	**102**	----	**105**
4-Terphenyl-d14	1718-51-0	0.5	%	**102**	**104**	**102**	----	**105**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**73.9**	**72.9**	**69.9**	**81.0**	**77.1**
Toluene-D8	2037-26-5	0.2	%	**74.8**	**71.5**	**66.3**	**79.1**	**75.9**
4-Bromofluorobenzene	460-00-4	0.2	%	**110**	**110**	**102**	**118**	**114**

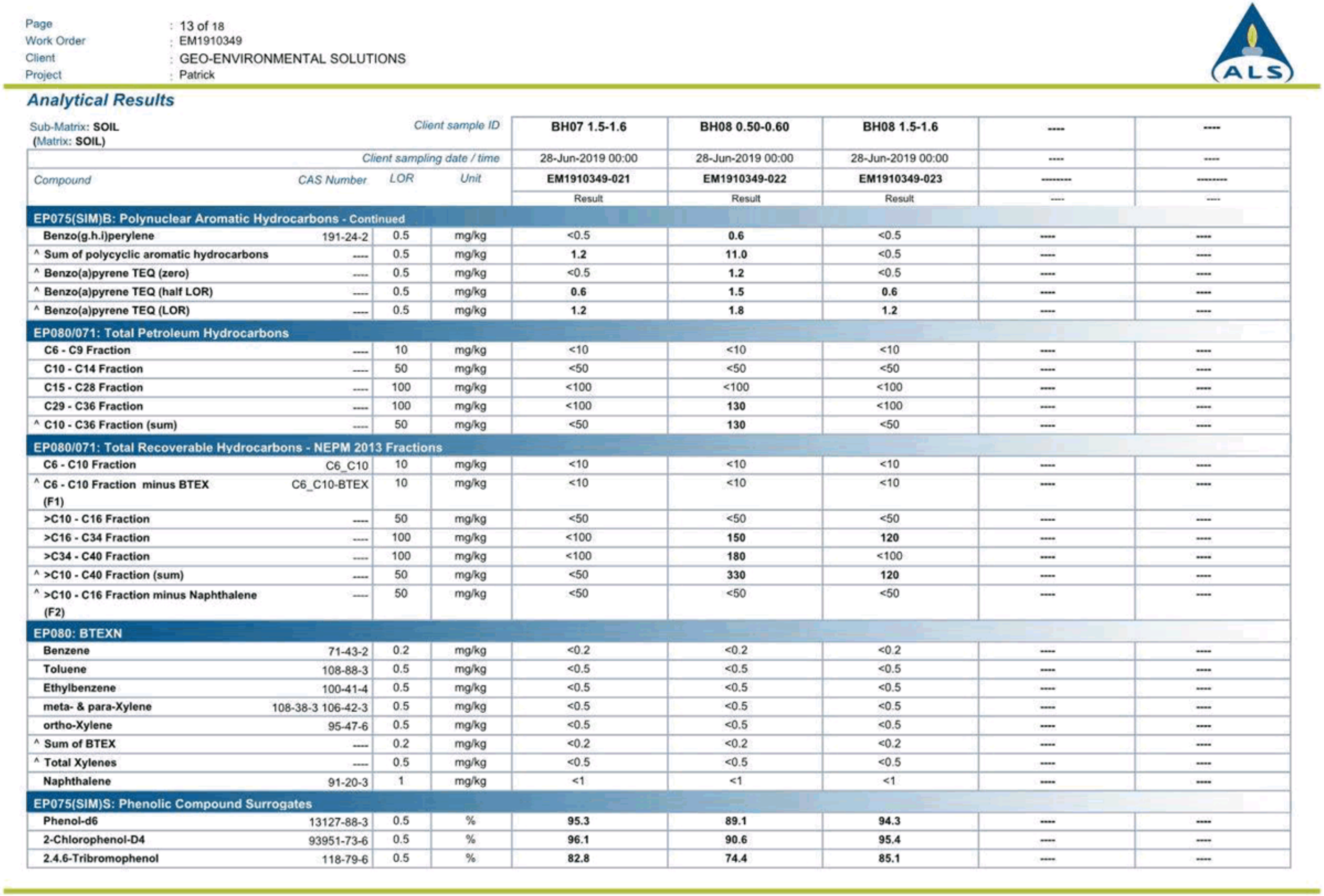


Page : 12 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

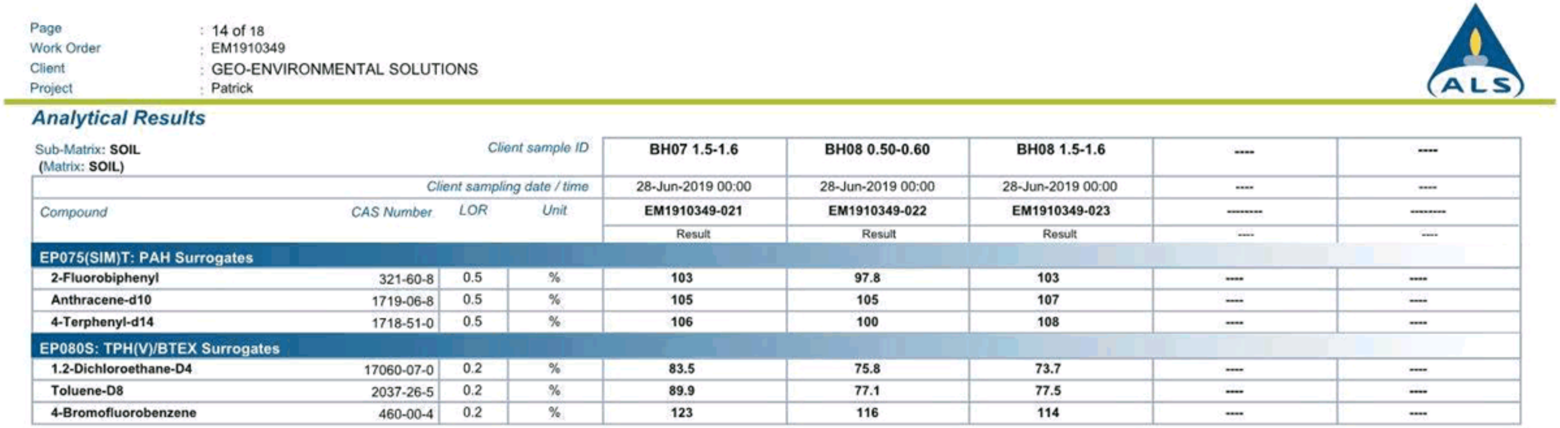
			Client sample ID	**BH07 1.5-1.6**	**BH08 0.50-0.60**	**BH08 1.5-1.6**	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1910349-021	EM1910349-022	EM1910349-023	--------	--------
				Result	Result	Result	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.0	2.4	3.9	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	----	----
Barium	7440-39-3	10	mg/kg	120	40	30	----	----
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	----	----
Boron	7440-42-8	50	mg/kg	<50	<50	<50	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	9	5	14	----	----
Cobalt	7440-48-4	2	mg/kg	6	10	15	----	----
Copper	7440-50-8	5	mg/kg	21	29	18	----	----
Lead	7439-92-1	5	mg/kg	89	52	9	----	----
Manganese	7439-96-5	5	mg/kg	184	459	179	----	----
Nickel	7440-02-0	2	mg/kg	7	12	23	----	----
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	----	----
Vanadium	7440-62-2	5	mg/kg	23	14	30	----	----
Zinc	7440-66-6	5	mg/kg	137	53	54	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.2	<0.1	<0.1	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	1.9	<0.5	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Fluoranthene	206-44-0	0.5	mg/kg	0.6	2.4	<0.5	----	----
Pyrene	129-00-0	0.5	mg/kg	0.6	2.3	<0.5	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	1.0	<0.5	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	0.7	<0.5	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	1.1	<0.5	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	1.0	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----



Page : 13 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**BH07 1.5-1.6**	**BH08 0.50-0.60**	**BH08 1.5-1.6**	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	**EM1910349-021**	**EM1910349-022**	**EM1910349-023**	--------	--------
				Result	Result	Result	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	**0.6**	<0.5	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	**1.2**	**11.0**	<0.5	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	<0.5	**1.2**	<0.5	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**0.6**	**1.5**	**0.6**	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**1.2**	**1.8**	**1.2**	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	**130**	<100	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	**130**	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	<10	<10	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	**150**	**120**	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	**180**	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	**330**	**120**	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	<50	<50	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
^ **Total Xylenes**	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**95.3**	**89.1**	**94.3**	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**96.1**	**90.6**	**95.4**	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**82.8**	**74.4**	**85.1**	----	----

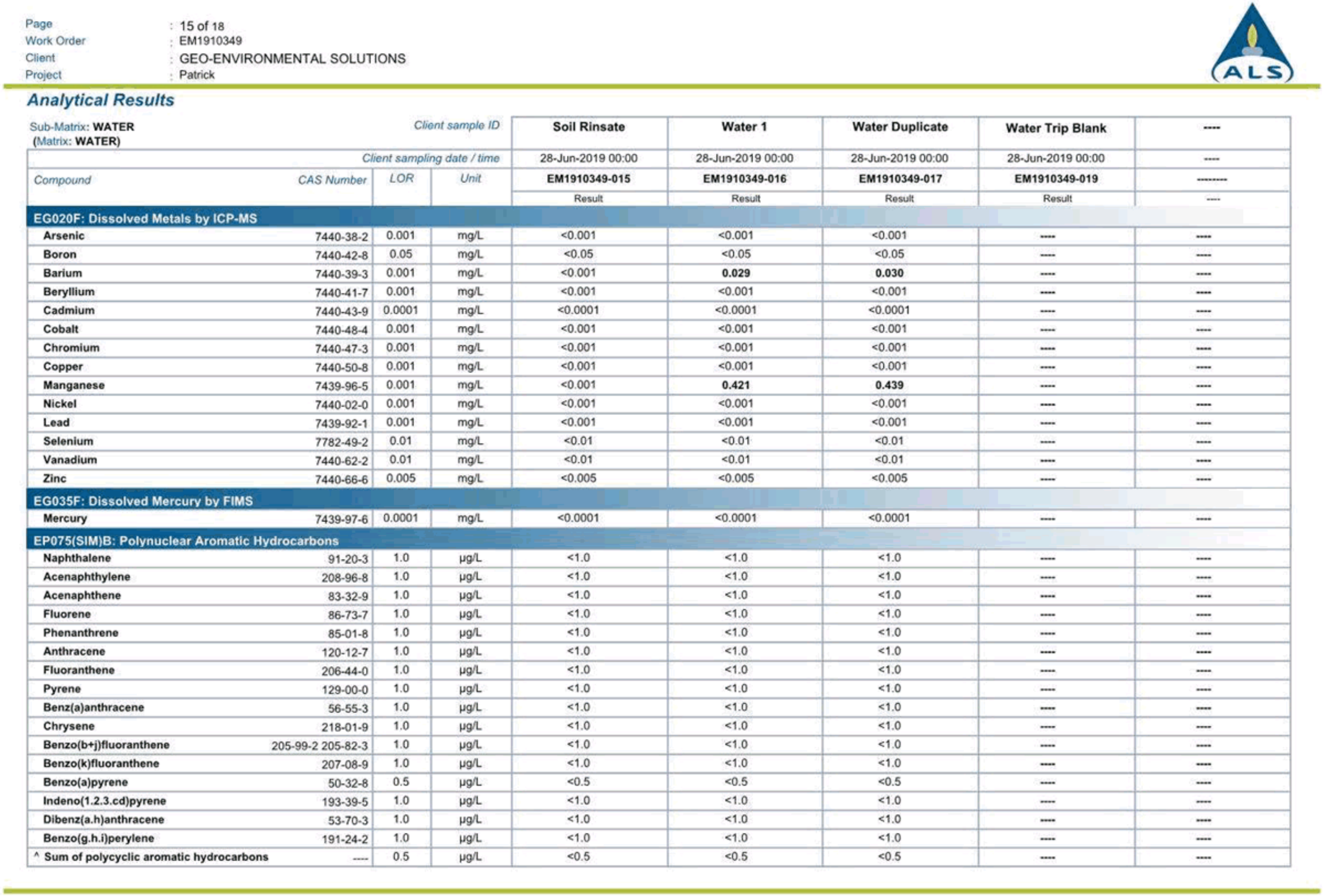


Page : 14 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL)**

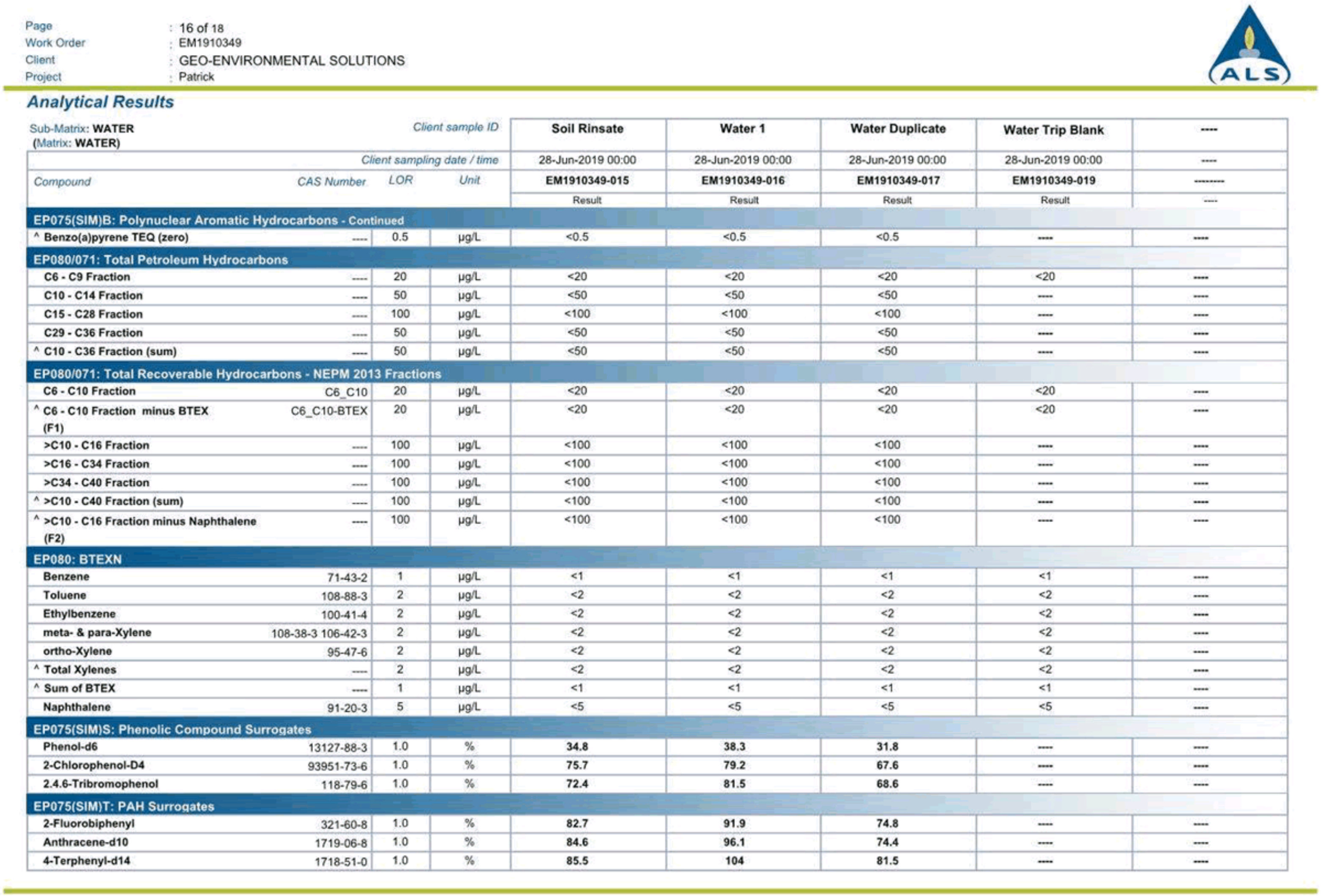
			Client sample ID	**BH07 1.5-1.6**	**BH08 0.50-0.60**	**BH08 1.5-1.6**	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	**EM1910349-021**	**EM1910349-022**	**EM1910349-023**	--------	--------
				Result	Result	Result	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**103**	**97.8**	**103**	----	----
Anthracene-d10	1719-06-8	0.5	%	**105**	**105**	**107**	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	**106**	**100**	**108**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**83.5**	**75.8**	**73.7**	----	----
Toluene-D8	2037-26-5	0.2	%	**89.9**	**77.1**	**77.5**	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	**123**	**116**	**114**	----	----



Page : 15 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

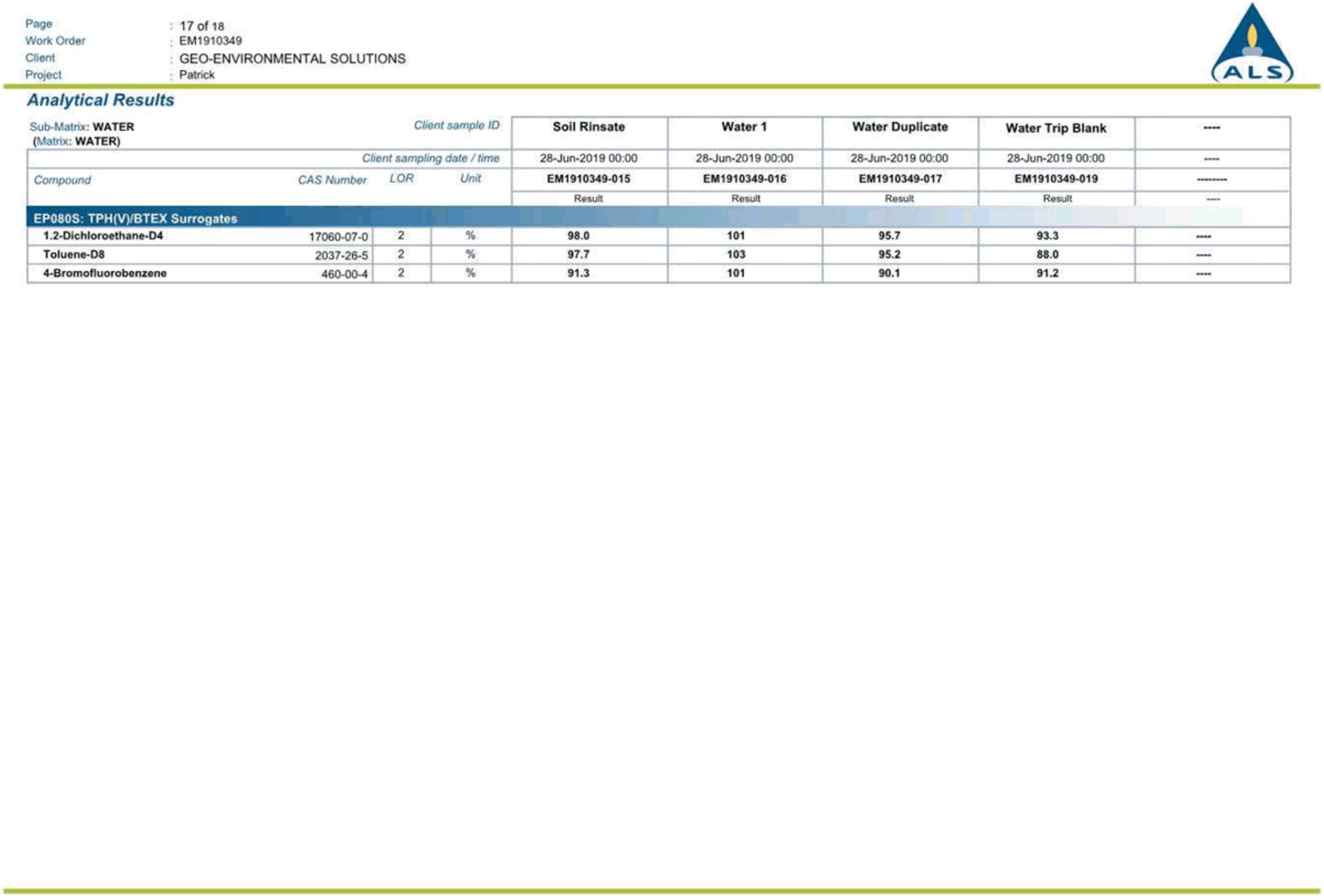
Sub-Matrix: WATER (Matrix: WATER)			*Client sample ID*	**Soil Rinsate**	**Water 1**	**Water Duplicate**	**Water Trip Blank**	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1910349-015**	**EM1910349-016**	**EM1910349-017**	**EM1910349-019**	--------
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	----	----
Barium	7440-39-3	0.001	mg/L	<0.001	**0.029**	**0.030**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.421**	**0.439**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----



Page	: 16 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**Soil Rinsate**	**Water 1**	**Water Duplicate**	**Water Trip Blank**	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1910349-015**	**EM1910349-016**	**EM1910349-017**	**EM1910349-019**	--------
				Result	Result	Result	Result	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	<2	<2	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**34.8**	**38.3**	**31.8**	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**75.7**	**79.2**	**67.6**	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**72.4**	**81.5**	**68.6**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**82.7**	**91.9**	**74.8**	----	----
Anthracene-d10	1719-06-8	1.0	%	**84.6**	**96.1**	**74.4**	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**85.5**	**104**	**81.5**	----	----

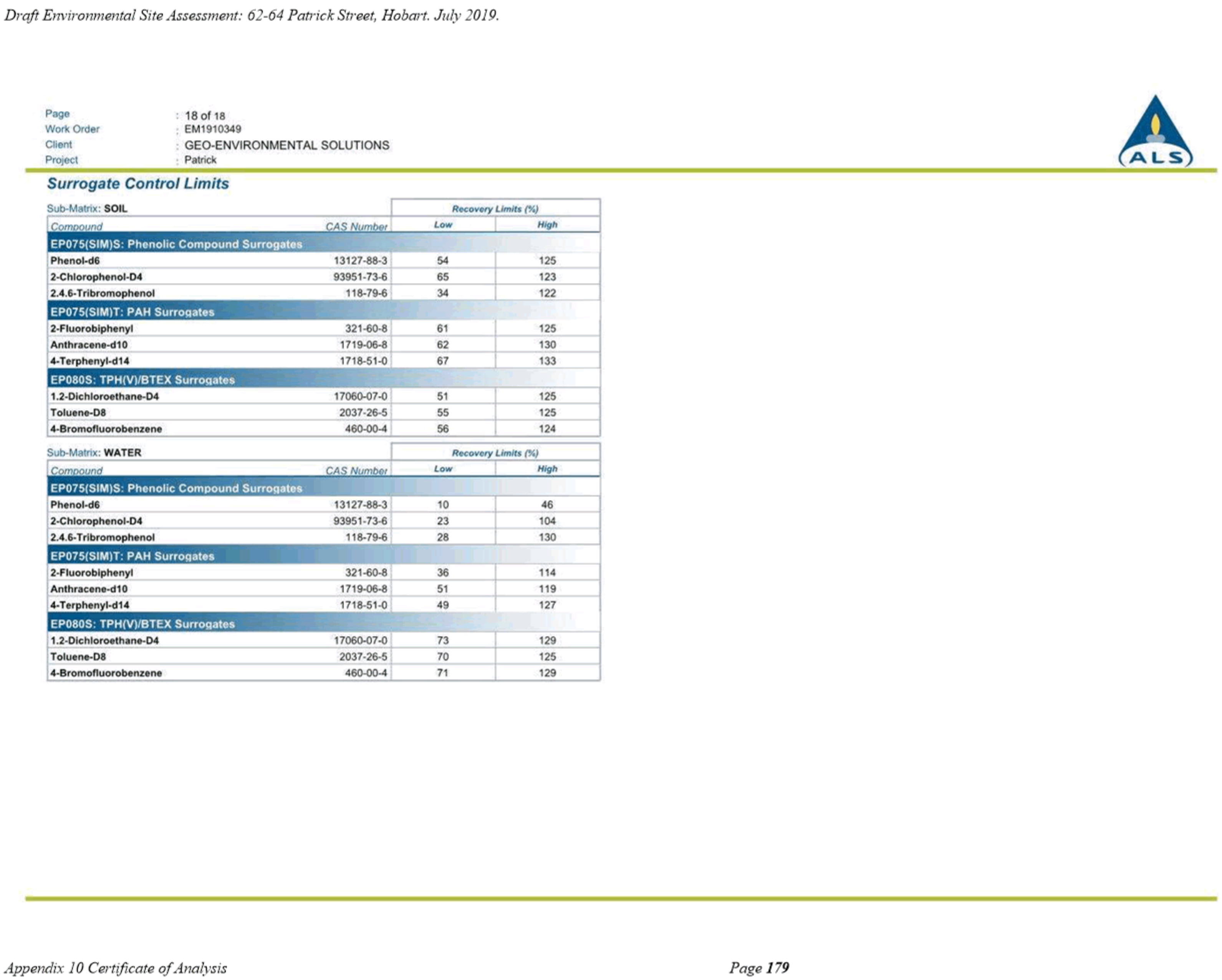


Page : 17 of 18
Work Order : EM1910349
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**Soil Rinsate**	**Water 1**	**Water Duplicate**	**Water Trip Blank**	**----**
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	28-Jun-2019 00:00	----
Compound	CAS Number	LOR	Unit	**EM1910349-015**	**EM1910349-016**	**EM1910349-017**	**EM1910349-019**	--------
				Result	Result	Result	Result	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**98.0**	**101**	**95.7**	**93.3**	----
Toluene-D8	2037-26-5	2	%	**97.7**	**103**	**95.2**	**88.0**	----
4-Bromofluorobenzene	460-00-4	2	%	**91.3**	**101**	**90.1**	**91.2**	----



Page	: 18 of 18
Work Order	: EM1910349
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%)	
		Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	54	125
2-Chlorophenol-D4	93951-73-6	65	123
2.4.6-Tribromophenol	118-79-6	34	122
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	61	125
Anthracene-d10	1719-06-8	62	130
4-Terphenyl-d14	1718-51-0	67	133
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	51	125
Toluene-D8	2037-26-5	55	125
4-Bromofluorobenzene	460-00-4	56	124

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%)	
		Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	46
2-Chlorophenol-D4	93951-73-6	23	104
2.4.6-Tribromophenol	118-79-6	28	130
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	36	114
Anthracene-d10	1719-06-8	51	119
4-Terphenyl-d14	1718-51-0	49	127
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	129
Toluene-D8	2037-26-5	70	125
4-Bromofluorobenzene	460-00-4	71	129

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EM1910889**
Client : **GEO-ENVIRONMENTAL SOLUTIONS**
Contact : DR JOHN PAUL CUMMING
Address : 29 KIRKSWAY PLACE
BATTERY POINT TASMANIA, AUSTRALIA 7004
Telephone : +61 03 6223 1839
Project : Patrick
Order number :
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : EN/222
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 5
Laboratory : Environmental Division Melbourne
Contact : Shirley LeCornu
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +6138549 9630
Date Samples Received : 02-Jul-2019 09:15
Date Analysis Commenced : 11-Jul-2019
Issue Date : 15-Jul-2019 13:51

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

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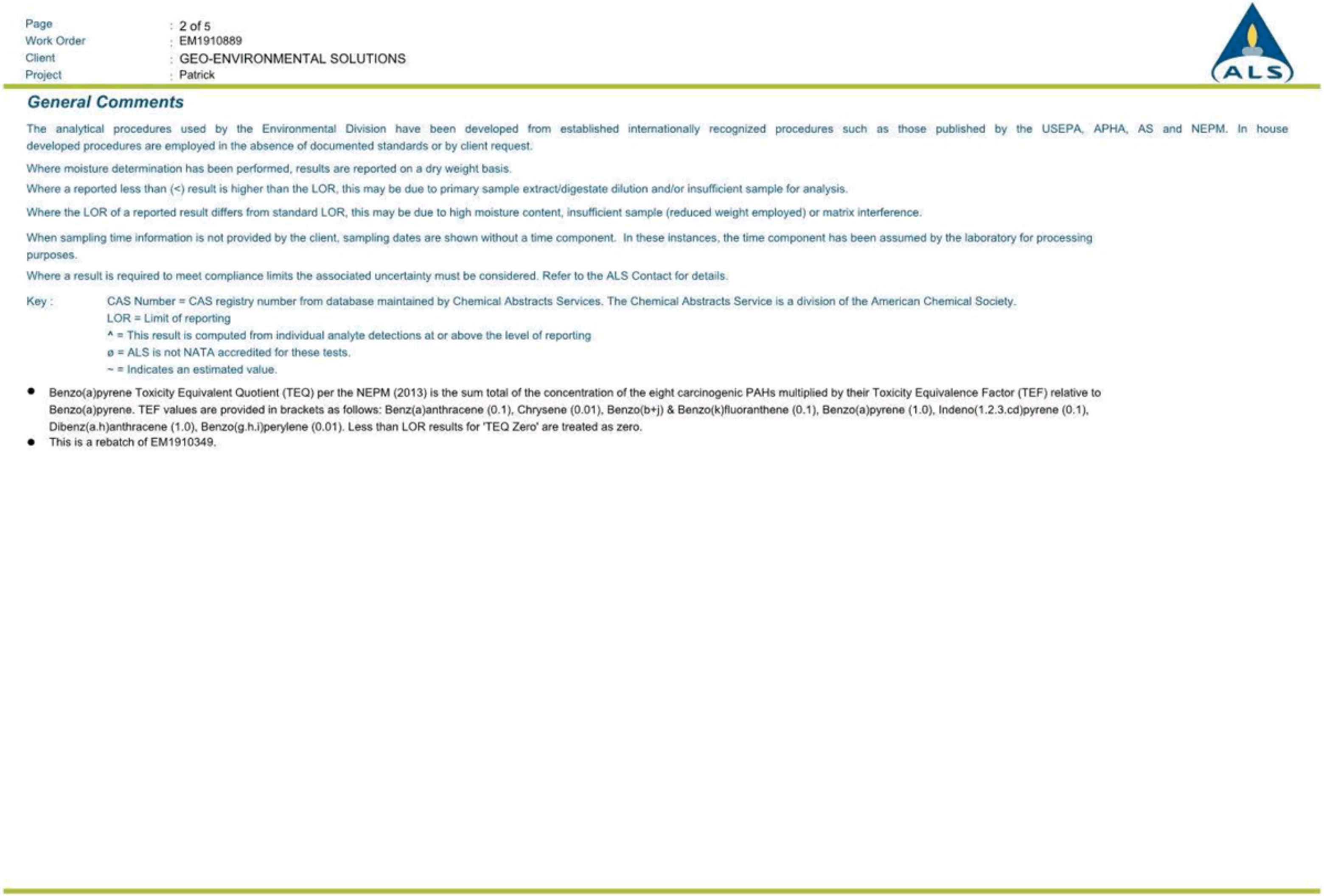

Page	: 2 of 5
Work Order	: EM1910889
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

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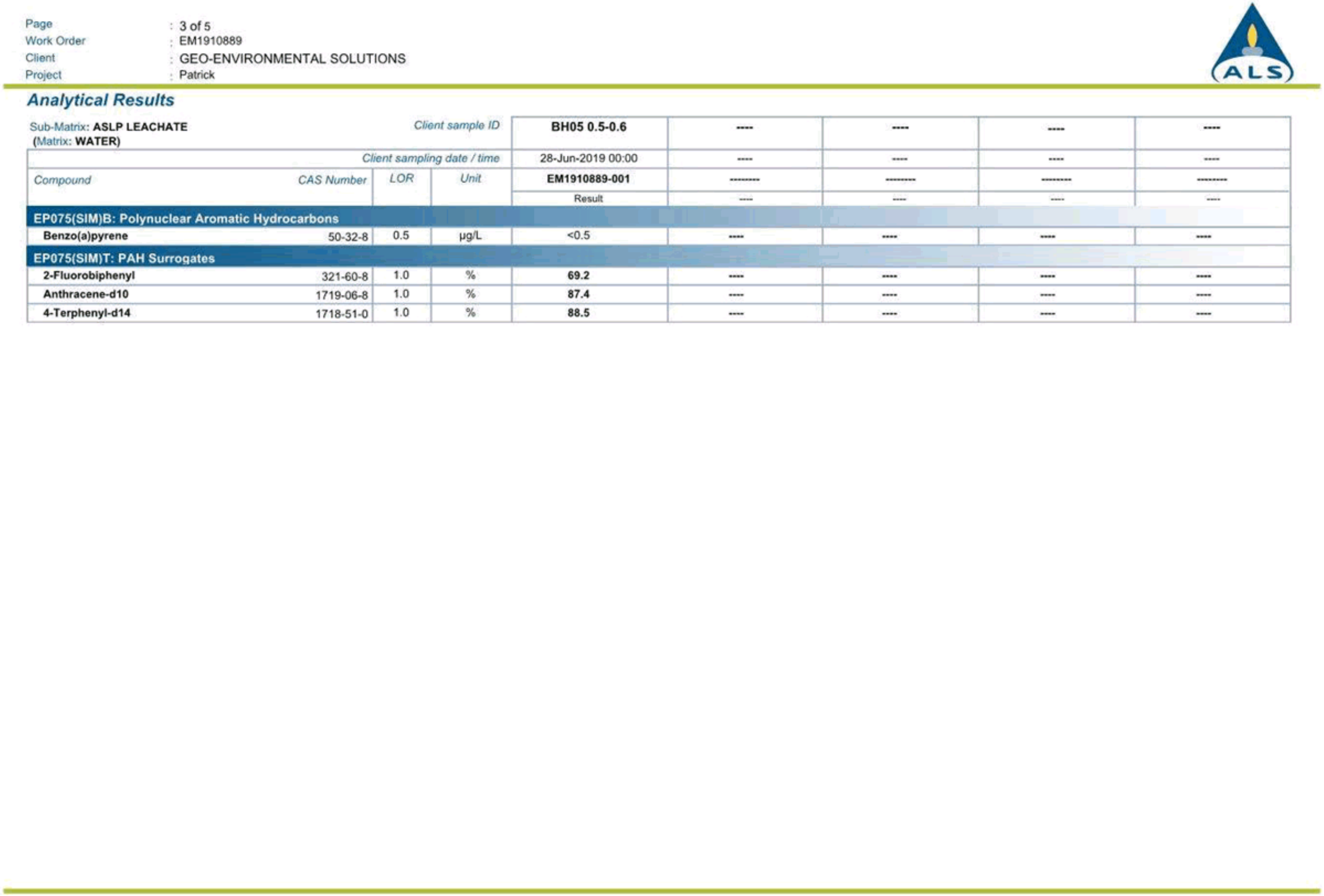
When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

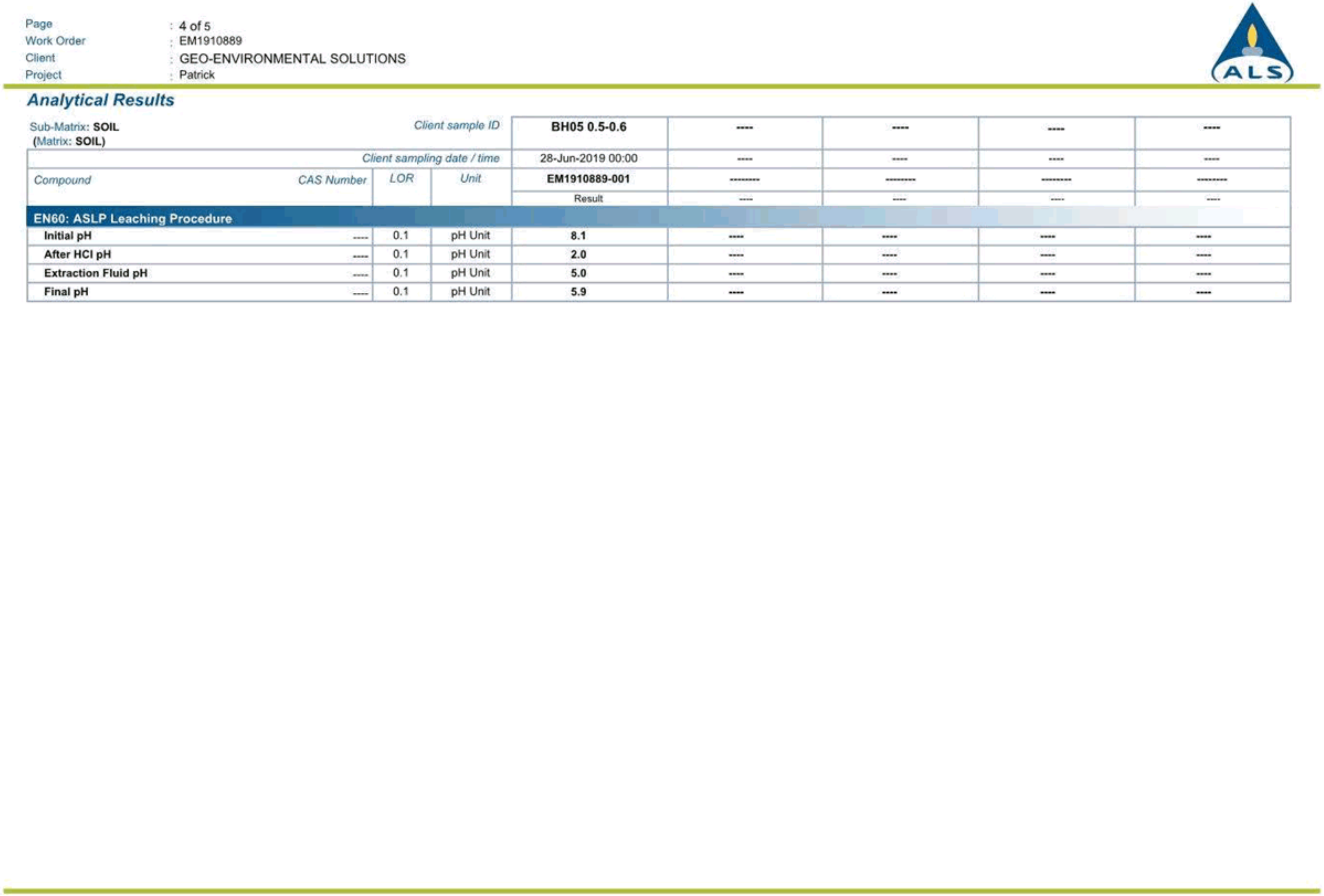
Key :
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- This is a rebatch of EM1910349.



Analytical Results

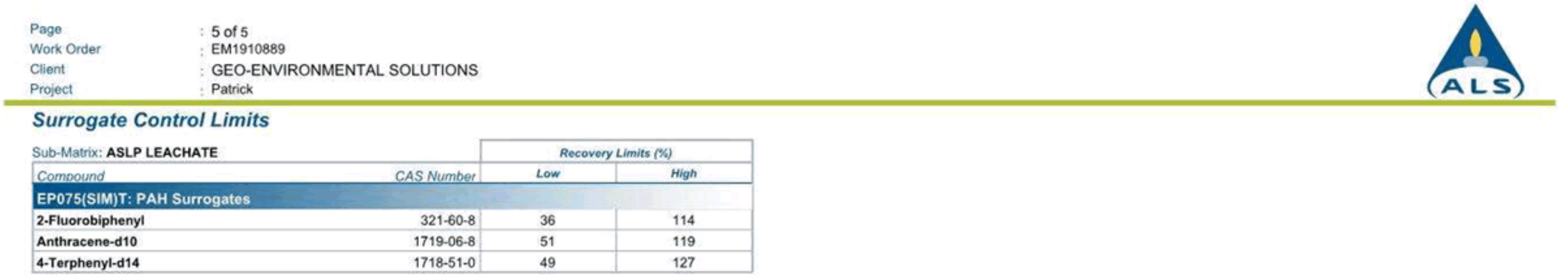
Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			*Client sample ID*	**BH05 0.5-0.6**	-----	-----	-----	-----
			Client sampling date / time	28-Jun-2019 00:00	-----	-----	-----	-----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1910889-001**	---------	---------	---------	---------
				Result	-----	-----	-----	-----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	-----	-----	-----	-----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**69.2**	-----	-----	-----	-----
Anthracene-d10	1719-06-8	1.0	%	**87.4**	-----	-----	-----	-----
4-Terphenyl-d14	1718-51-0	1.0	%	**88.5**	-----	-----	-----	-----



Page : 4 of 5
Work Order : EM1910889
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL)**			Client sample ID	**BH05 0.5-0.6**	----	----	----	----
			Client sampling date / time	28-Jun-2019 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	**EM1910889-001**	---------	---------	---------	---------
				Result	----	----	----	----
EN60: ASLP Leaching Procedure								
Initial pH	----	0.1	pH Unit	**8.1**	----	----	----	----
After HCl pH	----	0.1	pH Unit	**2.0**	----	----	----	----
Extraction Fluid pH	----	0.1	pH Unit	**5.0**	----	----	----	----
Final pH	----	0.1	pH Unit	**5.9**	----	----	----	----



Page : 5 of 5
Work Order : EM1910889
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Surrogate Control Limits

Sub-Matrix: **ASLP LEACHATE**

Compound	CAS Number	Recovery Limits (%)	
		Low	High
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	36	114
Anthracene-d10	1719-06-8	51	119
4-Terphenyl-d14	1718-51-0	49	127

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1920828**	Page	: 1 of 6
Client	: **GEO-ENVIRONMENTAL SOLUTIONS**	Laboratory	: Environmental Division Sydney
Contact	: DR JOHN PAUL CUMMING	Contact	: Shirley LeCornu
Address	: 29 KIRKSWAY PLACE BATTERY POINT TASMANIA, AUSTRALIA 7004	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 03 6223 1839	Telephone	: +6138549 9630
Project	: Patrick	Date Samples Received	: 03-Jul-2019 10:30
Order number	: ----	Date Analysis Commenced	: 05-Jul-2019
C-O-C number	: ----	Issue Date	: 10-Jul-2019 18:16
Sampler	: GM		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 3		
No. of samples analysed	: 2		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

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- Analytical Results
- Surrogate Control Limits

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Peter Wu		Sydney Inorganics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, NSW

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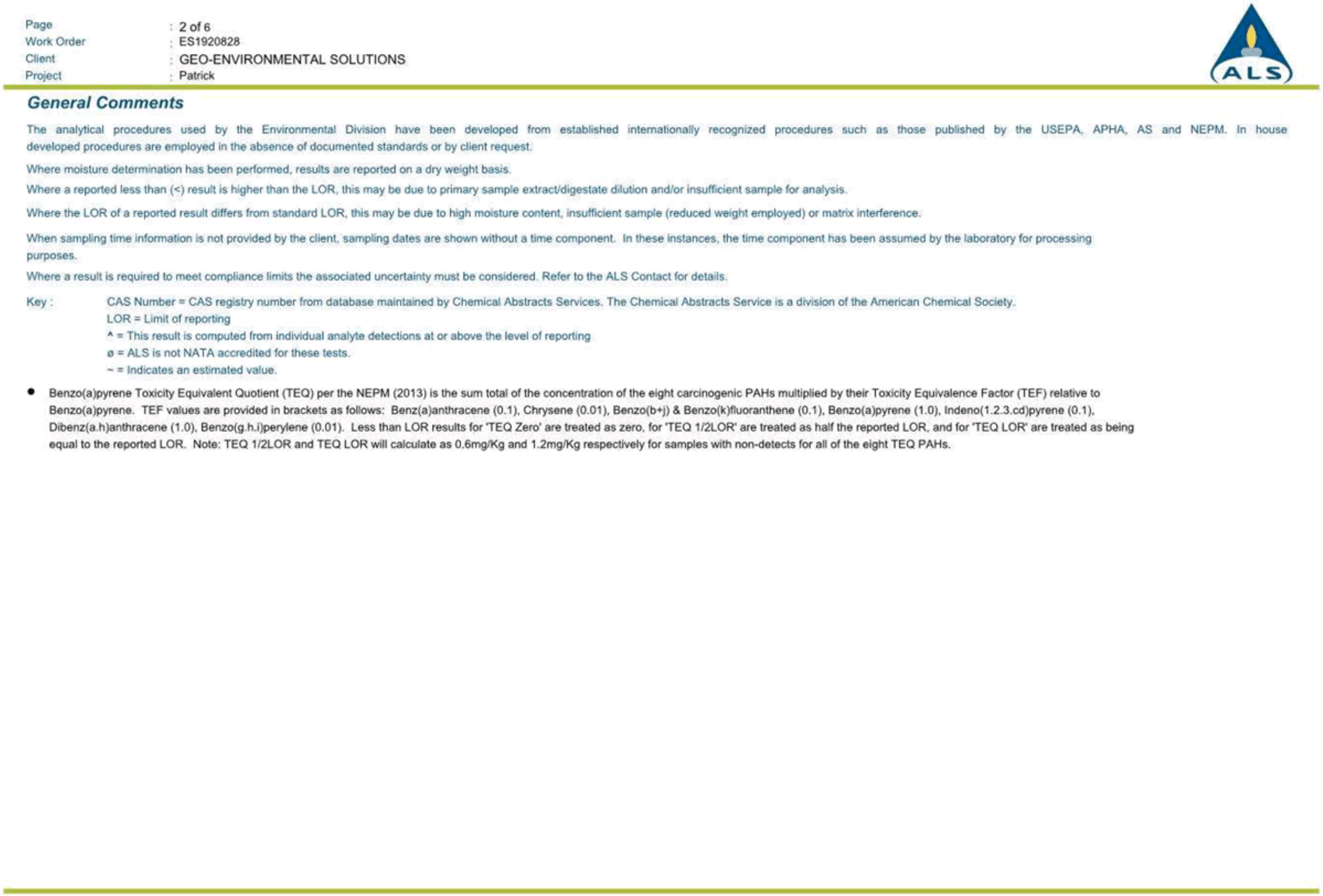

Page	: 2 of 6
Work Order	: ES1920828
Client	: GEO-ENVIRONMENTAL SOLUTIONS
Project	: Patrick

General Comments

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

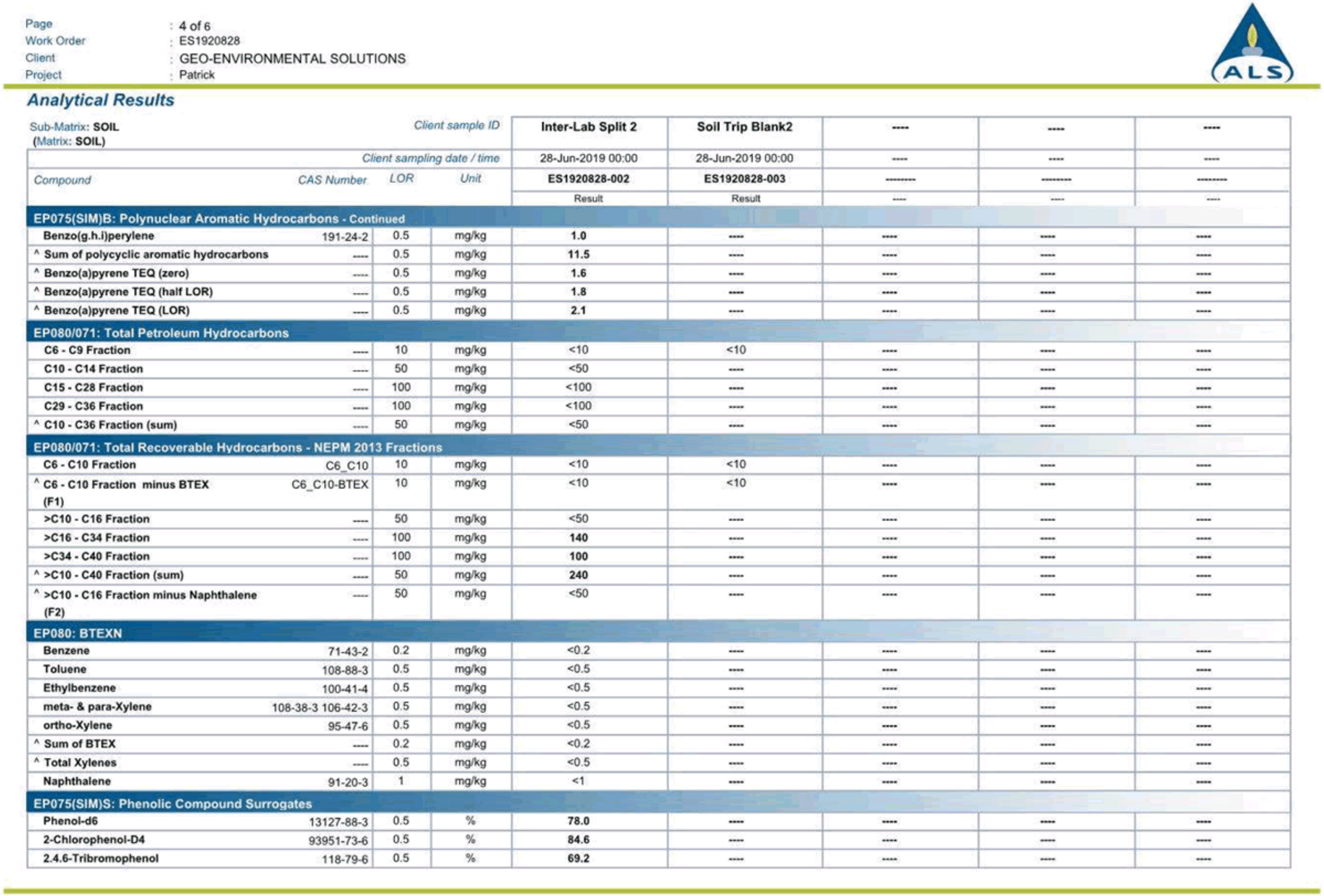
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Page : 3 of 6
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

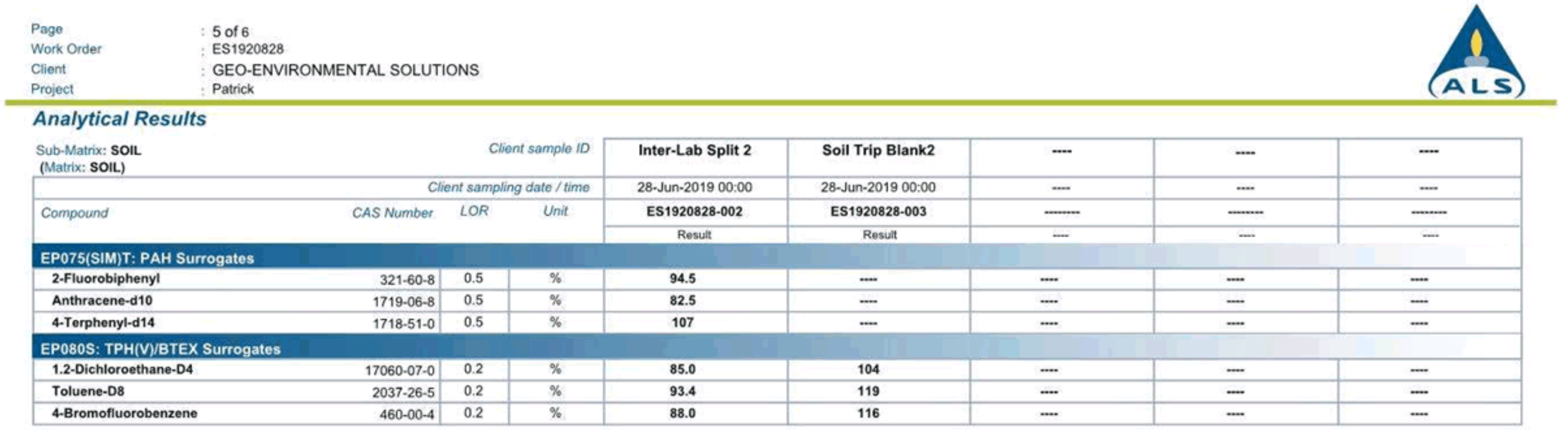
			Client sample ID	**Inter-Lab Split 2**	**Soil Trip Blank2**	----	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	**ES1920828-002**	**ES1920828-003**	--------	--------	--------
				Result	Result	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**24.2**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Barium	7440-39-3	10	mg/kg	**220**	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	**12**	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	**8**	----	----	----	----
Copper	7440-50-8	5	mg/kg	**48**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**473**	----	----	----	----
Manganese	7439-96-5	5	mg/kg	**207**	----	----	----	----
Nickel	7440-02-0	2	mg/kg	**12**	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg	**31**	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**588**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.7**	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	**0.8**	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	**1.9**	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	**2.2**	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	**0.9**	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	**0.9**	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	**1.3**	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	**0.6**	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	**1.2**	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	**0.7**	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	----	----



Page : 4 of 6
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**Inter-Lab Split 2**	**Soil Trip Blank2**	----	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	**ES1920828-002**	**ES1920828-003**	--------	--------	--------
				Result	Result	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	**1.0**	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	**11.5**	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	**1.6**	----	----	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**1.8**	----	----	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**2.1**	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	<10	----	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	**140**	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	**100**	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	**240**	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	----	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg	<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**78.0**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**84.6**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**69.2**	----	----	----	----



Page : 5 of 6
Work Order : ES1920828
Client : GEO-ENVIRONMENTAL SOLUTIONS
Project : Patrick

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**Inter-Lab Split 2**	**Soil Trip Blank2**	----	----	----
			Client sampling date / time	28-Jun-2019 00:00	28-Jun-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1920828-002**	**ES1920828-003**	--------	--------	--------
				Result	Result	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**94.5**	----	----	----	----
Anthracene-d10	1719-06-8	0.5	%	**82.5**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	**107**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**85.0**	**104**	----	----	----
Toluene-D8	2037-26-5	0.2	%	**93.4**	**119**	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	**88.0**	**116**	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	133
Toluene-D8	2037-26-5	74	132
4-Bromofluorobenzene	460-00-4	72	130

GES
GEO-ENVIRONMENTAL
SOLUTIONS

GEOTECHNICAL ASSESSMENT

62-64 Patrick Street, HOBART

CLIENT
Heffernan Button Voss Architects

August 2019

Geo-Environmental Solutions P/L 29 Kirksway Place 7004. Ph 6223 1839 Fax 6223 4539

1 INTRODUCTION

Geo-Environmental Solutions Pty Ltd (GES) were engaged by Heffernan Button Voss Architects, to carry out a geotechnical investigation of a proposed mixed residential and commercial development including car park facilities at 62-64 Patrick Street, Hobart – hereby referred to as 'The Site'.

The site is the site of the RACT driver training school which has single storey offices, a car park and large shed for parking and RACT roadside assist battery and vehicle storage.

The site is located is presented in Figure 1 and Figure 2.

This report outlines the key findings of the geotechnical investigation, which comprised 3 no. boreholes drilled using 150 mm diameter auger within soil. These boreholes were then rotary cored on encountering rock, to facilitate the collection of rock samples. This report also incorporates findings from the previous investigations carried out by GES, which comprised an *Environmental Site Assessment* (ESA: GES, July 2019). This report should be read in conjunction with the ESA report.

1.1 Proposed Development

It is understood that the proposed new development is a mixed residential/commercial building comprising the following (Figure 3):

- Car Park Basement Lower @ 19.0 m AHD – car park, lifts & ~4 m retained earth/rock setback from SE boundary
- Car Park Basement Upper @ 21.8 m AHD – car park, lifts, substation
- Ground Floor – @ 24.6 m AHD retail space & car parking
- Level 1 – Level 6 – apartments
- Level 7: rooftop garden

2 OBJECTIVES AND SCOPE OF WORK

2.1 Project Objectives

Based on our understanding of the project and the information provided by the client, the following outlines the main objectives of the preliminary geotechnical investigation:

- Assess the subsurface conditions at the site relevant to the proposed development;
- Provide preliminary advice on suitable footing systems to support the proposed structures;
- Assess soil/rock allowable bearing capacity at the basement level (m AHD);
- Provide information on likely depth to rock and assess likely excavatibility;
- Comment on expected depth of groundwater;
- Assessing safe batter angles and provide retention design parameters; and
- Provide any necessary geotechnical recommendations and construction considerations.

2.2 Scope of Work

The scope of work for the geotechnical investigation is as follows:

- Carry out geotechnical drilling at three (3) locations across the site to a depth of up to 10 m below the ground surface (bgs). Fill material and surficial soil is to be augered to bedrock and rotary core the underlying bedrock;
- Collect disturbed and undisturbed soil samples from cohesive soil materials for laboratory testing (if required); and
- Provide a suitably qualify engineer to log photograph and sample core and direct *in-situ* testing onsite.

3 INFORMATION PROVIDED

3.1 Client Supplied Information

GES has been provided with the following information in relation to the project:

- Concept plan drawings by HBV Architects, dated December 2018
- Coffey Mining.; Geotechnical Investigation for RACT Redevelopment. SEMF. RACT Redevelopment. GEOTHOBA00605AA
- SEMF 2008. RACT Office Redevelopment.

3.2 Previous Investigations

Previous investigation holes drilled near the site are illustrated in Figure 4. Site investigation activities have been summarised below in Table 1.

Table 1 Summary of Site Investigations

Hole ID	Company	Titles*	Purpose	Date
RA1 to RA5	Sloane Geosciences	175729/1 175729/2	Environmental Site Assessment	15th to 16th November 2008
C_BH1 to C_BH3	Coffey Mining	175729/1 175729/2	Geotechnical	30th September to 2nd October 2008
BH01 to BH08	Geo-Environmental Solutions	175729/2	Environmental Site Assessment	28th June 2019
PSBH01 to PSBH03	Geo-Environmental Solutions	175729/2	Geotechnical	13th May to 11th July 2019

* 175729/2 – 62 Patrick Street (The Site)
175729/1 – 179 to 191 Murray Street (RACT site to the south-west)

3.2.1 179 to 191 Murray Street Geotechnical Assessment

Coffey Mining conducted a ground investigation for the neighbouring RACT building to the south-west and drilled a total of three geotechnical (3) boreholes of which one (C_BH3) was drilled on the site. Siltstone bedrock was encountered at 1.7 m depth (~22 m AHD) in C_BH3 and at 8.6 m depth (~17.8 m AHD) in C_BH2, 50 m to the SSW of C_BH3 indicating a gradient of at least 8% over the underlying bedrock to the south and west. The primary material encountered beneath 179 to 191 Murray Street comprised of very stiff sandy and silty CLAY which is part of the mapped highly weathered Tertiary boulder deposits.

An allowable bearing capacity of 400 kPa has been assigned for the Tertiary deposits and 2000 kPa for the Triassic bedrock.

3.2.2 Groundwater Assessment (Sloane Geosciences 2008)

A groundwater investigation was conducted at the site and on the neighbouring RACT title to the south-west by Sloane Geoscience in November 2018. A total of five (5) boreholes wells were drilled to depths of between 6 and 24.5 m for the purpose of installing groundwater monitoring wells.

Fill is common across the site to depths of up to 1.8 m in RA5. Underlying the fill, borehole RA5 was drilled into an alluvial sandy CLAY valley infill (paleochannel) deposit to a depth of 4 m (20 m AHD) where Triassic siltstone and sandstone bedrock was encountered. As with C_BH3, borehole RA3, located on the south-western boundary encountered Triassic bedrock at a relatively shallow depth of 1.5 m (22.4 m AHD) indicating consistency along the south western boundary.

Wells were screened deep into the underlying Triassic fractured rock aquifer where water was struck between 12 to 24 m depths, groundwater has risen to within 1.2 m of the surface indicating the aquifer is pressurised from beneath. Groundwater is therefore expected to be encountered in workings given the excavations are proposed to be below 1.2 m depth.

3.2.3 Environmental Site Assessment (GES 2019)

Prior to carrying out the recent geotechnical investigation, GES carried out an ESA soil investigation July 2019 to identify if the environmental condition of the site complies with planning requirements for the redevelopment of the site from the commercial land use to residential apartments.

Environmental boreholes were limited to 2 m depth and were primarily focused on the shallow fill material. The Triassic deposits shallow to the south-west of the site where GES's ESA bores BH02 & BH06 intersected sandstone bedrock at 0.6 (~23 m AHD) and 0.9 m (~22.5 m AHD) depth respectively.

The following conclusions and recommendations were made:

- There were elevated levels of benzo(a)pyrene exceeding ecological guideline limits in samples collected from the site. This indicates that a Contamination Management Plan (CMP) will be required during the site redevelopment to manage the potential leaching of contaminants from the groundwater;
- There were no guideline exceedances for soil direct contact for dermal contact, dust inhalation or soil ingestion for commercial/industrial land use, urban residential or trench workers. This indicates that during and after construction works, there is a low risk to human health;
- Based on the soil samples and the single groundwater sample collected from the site, there is a low risk that petroleum vapours will impact on future users of the site;
- Half of the material encountered at the site is classified as Level 1 (clean fill) and half is classified as Level 2 (requires disposal at a licensed facility). It is recommended that the fill material is stockpiled and analysed separately from the natural material, as there may be cost savings in disposal, with the natural material possibly yielding positive results from leachate testing (indicating Level 1), whilst Level 2 fill material containing benzo(a)pyrene cannot be improved through leach testing and will need to be disposed of in licenced facility.

4 GEOLOGICAL CONTEXT

4.1 Site Details and Setting

The proposed development covers an area of approximately 2150 m^2 and is bound to the northwest by Patrick Street and a commercial building to the southwest (RACT), to the southeast (Harvey Norman) and an unnamed service laneway to the northeast. The site has an elevation ranging between 21.5 m AHD to the west and 24.3 m AHD to the east. The site is concrete, and bitumen paved.

4.2 Geological Setting

4.2.1 Geological Mapping

Based on a review of the published geology map of Hobart (1:25,000 Digital Geological Atlas, sheet no. 5225) indicates the following surficial geological units underlie the site:

- **Rqpc** – Triassic Aged Predominantly interbedded siltstone shale and mudstone and planar-bedded, ripple cross-laminated or cross-bedded sandstone, red-purple, green or carbonaceous siltstone at places (part of Knocklofty Formation where in Hobart area); and
- **Tcbd** – Tertiary Aged Poorly sorted boulder to pebble grade deposits with boulders up to 3 m length, clasts generally dominantly of dolerite with traces to rarely dominant amounts of Upper Parmeener mudstone and other rocks and less commonly Lower Parmeener rocks, clayey;
- **Qa** – Quaternary Aged Alluvial gravel, sand and clay.

The geology map has been presented in Figure 5.

4.3 Groundwater

During proposed excavation works, groundwater discharge from below 1.2 m is expected to be highly localised around fractured sandstone bedrock. The siltstone units are generally tight and low yielding. Although there is no indication that the groundwater is contaminated, testing would be required before it can be pumped into stormwater drains.

The groundwater is not expected to create a significant construction to proposed works but will require the presence of a sump and continual operating pump to collected discharging groundwater. This is perhaps best managed through creating a slight grade across the site to one corner and excavating a shallow pump well for groundwater extraction.

5 GEOTECHNICAL INVESTIGATION

5.1 Field Investigations

The fieldwork was performed in the presence of an engineering geologist from GES who located the boreholes, nominated sampling and testing, recovered samples, photographed the core and prepared engineering logs.

The fieldwork was performed between the 13th May 2019 and the 11th July 2019 and involved the drilling of three (3) boreholes, designated PSBH01 to PSBH03 at locations shown on Figure 4. The investigation locations were designed to be in general accordance with the locations as per the scope of works.

The following activities were carried out during the investigation:

- All boreholes were drilled using a truck mounted Drillmac Explorer 500 drilling rig operated by Tasmanian Drilling Services Pty Ltd;
- The drilling was performed using hollow flight augers to advance through fill material and cohesive soils and HQ diamond coring in rock. The boreholes were all initiated from the current surface level and were drilled to between 8 and 9 m depth below ground surface level (bgsl);
- Boreholes were terminated on reaching their target depth based on achieving adequate rock quality;
- All fieldwork was carried out in accordance with AS1726 – 2017 'Geotechnical Site Investigation';

- Dial Before You Dig (DBYD) plans were obtained;
- Archers Underground Services were engaged to clear borehole locations of existing underground services;
- All boreholes were logged by visual assessment and in general accordance with AS1726-2017. The photographs were taken for each borehole; and
- On completion of the boreholes, each location was surveyed using a Garmin hand-held GPS (horizontal accuracy ± 3 m).

Borehole logs and core photographs have been presented in Appendix 1 and 2 of this report, respectively.

Table 2 below presents a summary of the fieldwork carried out (includes contamination assessment holes), including coordinates, borehole locations, termination depths and estimated ground surface level.

Table 2 Summary of Fieldwork

Borehole Location ID	***Approximate Coordinates ****		***Estimated Ground Surface Level (m AHD)^***	***Termination Depth below ground surface level (m)***
	Easting (m)	***Northing (m)***		
PSBH01	526,200	5,252,539	23.8	9.05
PSBH02	526,239	5,252,524	23.5	8.3
PSBH03	526,185	5,252,525	24.3	8.8
BH01	526,197	5,252,525	23.8	2.0
BH02	526,199	5,252,512	23.6	2.0
BH03	526,211	5,252,530	23.5	2.0
BH04	526,222	5,252,509	23.5	2.0
BH05	526,226	5,252,518	23	2.0
BH06	526,213	5,252,500	25.8	2.0
BH07	526,200	5,252,539	23.7	2.0
BH08	526,185	5,252,525	24.2	2.0

Notes:

*Coordinates are provided in GDA94 MGA Zone 55 coordinate system.

^Australian Height Datum (m AHD) has been estimated based on survey data provided due to the low reliability of the GOS elevation data and has been estimate using surface contouring.

5.2 Field Geotechnical Testing

5.3 Point Load Index Testing

PLSI testing conducted on the HQ3 core was converted to IS(50). Bad breaks through healed defects were not included in the results. A summary of the results of the tests can be found in the engineering logs in Appendix 1.

5.3.1 Standard Penetration Test

Standard Penetration Test (SPT) testing was carried out on soil and soft rock where allowable. Testing was not conducted on fill or in higher strength rock material, with some testing conducted on cemented gravels, sands, clay etc. Testing was carried out in accordance with AS 1289.6.3.1—2004.

SPT values are less reliable for the cemented materials encountered at the site.

5.1 Laboratory Geotechnical Testing

No laboratory testing has been carried out on the rock. The Triassic rock material is consistent with pervious investigation site from which an IS(50) to UCS correlation (of 1:20) has been developed.

An undisturbed soil sample was collected during auguring/split spoon sampling and sent to Civil Geotechnical Services, a Melbourne-based NATA Accredited laboratory to perform Consolidated-Undrained (CU) Triaxial testing in accordance with AS1289.6.4.2 (2000).

6 RESULTS

6.1 Sub-surface Conditions

In general, the Mineral Resources Tasmania (MRT) geological mapping was consistent with the ground conditions encountered during the investigation.

Table 3 provides a summary of ground conditions encountered during the investigation. Below is a summary of each sub-surface layer encountered:

- **FILL** – All investigation locations encoutered a 120 to 150 mm cover of concrete or bitumen. Fill material thickness and composition under the concrete varied from 0.2 m thickness to the south (BH06), increasing to 2.8 m thick (PSBH02) to the east. The fill varied in description from 'Silty Sandy GRAVEL', 'Silty SAND & Silty GRAVEL', 'Gravelly SILTY CLAY', and 'Gravelly CLAY' which were generally dark brown, to grey brown, very soft to stiff and very loose to dense with medium to high plasticity fines. Fill material contained occaional fragments of brick, dolerite, siltstone and sandstone. The fill material was moist indicating a lack of perched groundwater within the fill material overlying the impermeable mudstone bedrock.
- **CLAY - EXTREMELY WEATHERED TRIASSIC SILTSTONE & SANDSTONE (Map Unit: Rvpc)** – A typically narrow band of extremely weathered siltstone and sandstone (ranging from 0 to 2.3 m thick) was encountered on the surface of the slightly weathered bedrock, which was recovered as a red/brown to yellow/brown, stiff to very stiff, medium plasticity, moist 'silty or gravelly Sandy CLAY'.
- **SLIGHTLY WEATHERED TRIASSIC SILTSTONE & SANDSTONE (Map Unit: Rvpc)** – siltstone and sandstone bedrock was encountered at varying depths across the site. The bedrock generally comprised a pink, to yellow and pale grey, medium strength, slightly weathered MUDSTONE interbedded with a pale yellow brown, medium strength, slightly weathered SANDSTONE to refusal depth.

Table 3 Summary of Subsurface Borehole Geology (depths in metres)

Material / Unit	*PSDH01*	*PSDH02*	*PSDH03*
FILL: Sandy/silty GRAVEL & Silty/Gravelly CLAY: dark brown, to grey brown, very soft to stiff and very loose to dense with medium to high plasticity fines. Occasional brick, dolerite and sandstone fragments.	0 - 1.6	0.1 - 2.8	0 - 0.8
Silty Sandy GRAVEL: red/brown, dry, loose, residual siltstone	-	-	0.8 - 1.5
CLAY - EXTREMELY WEATHERED TRIASSIC SILTSTONE & SANDSTONE (Rvpc) –red/brown to yellow/brown, stiff to very stiff, medium plasticity, moist 'silty or gravelly Sandy CLAY'	1.6 - 3.9	-	1.5 - 2.2
SLIGHTLY WEATHERED TRIASSIC SILTSTONE & SANDSTONE (Rvpc) –pink, to yellow and pale grey, medium strength, slightly weathered MUDSTONE interbedded with a pale yellow brown, medium strength, slightly weathered SANDSTONE	3.9 – 9*	2.8 - 8.3*	2.2 - 8.8*

Note : * Boreholes were terminated on reaching target depth.

6.2 Geotechnical Testing Summary

6.2.1 Point Load Strength Index

PLSI testing conducted on the HQ3 core was converted to IS(50). Bad breaks through healed defects were not included in the results. Fourth one (41) axial and diametral PLSI tests were carried out on the core, with the results summarised in Table 4. Preliminary findings indicate that:

- there was very little difference in strength between the different rock units (sandstone and siltstone) encountered at the site.
- The diametral to axial strength anisotropy ratio averaged at 1 : 1.65. As the bedding is primarily sub horizontal, the axial values have been used as opposed to the diametral values where bias is removed due to breaks on the bedding plane
- On average, the material is classified as medium strength

Table 4 Summary of Point Load Strength Index Test Results

Strength Classification IS(50) (Mpa)	Class	Number of test results within this strength classification
0 to 0.03	Extremely Low	-
0.03 to 0.1	Very Low	2
0.1 to 0.3	Low	3

0.3 to 1	Medium	29
1 to 3	High	7
3 to 10	Very High	-
>10	Extremely High	-

The results of the PLSI are presented on the engineering logs in Appendix 1.

It should be noted the PLSI results provide an indication of the strength of the rock that was encountered during the investigation and that rock with higher or lower strengths than tested may be present at the site.

6.2.2 Triaxial testing

Triaxial testing was undertaken on core (sandy clay material) by CGS laboratories in Melbourne and the results can be found in appendix 3. The results indicate the material tested has a cohesion value of 10kPa and an friction angle of friction 25 degrees.

7 DISCUSSION AND RECOMMENDATIONS

7.1 Geotechnical Design Parameters

The following design parameters have been assigned based on laboratory test results, available published literature and engineering judgement and are summarised below in Table 5.

Table 5 Geotechnical Design Parameters

Layers/Units	*Consistency / Density / Strength*	*Unit Weight (kN/m3)*	*Effective Friction Angle (°)*	*Cohesion (kPa)*	*Uniaxial Compressive Strength (MPa)*	*Elastic Modulus (MPa)*	*Deformation Modulus (GPa)*	*Poisson's Ratio*
FILL: Sandy/silty GRAVEL & Silty/Gravelly CLAY	Variable	16	20	2	-	10	-	0.3
Silty Sandy GRAVEL	Lose	18	25	0	-	40	-	0.3
Silty or gravelly Sandy CLAY (Extremely Weathered Residual Rock)	Stiff to very stiff	17.5	25	10	-	65	-	0.25
Slightly Weathered Triassic Sandstone & Siltstone (Rvpc)	Medium Strength	24	38	500	13	4000	2.5	0.3

Note : Rock strength parameters have been estimated based on rock mass properties using RocScience RocLab 1.0 software

7.2 Building Foundations

It is understood the proposed development comprises a six-level residential/commercial building, with car parking access from Commercial Road, indicating a basement finished floor level of approximately 19 m AHD. In order to achieve the proposed design level, the ground level will need to be cut to a depth of approximately 5 m below current surface along the south-eastern boundary, 4 m along the northern boundary & 2 to 3 m along the eastern boundary. Based on the ground conditions encountered during the investigations, cross-sections have been developed and presented in Figure 7, which run northeast to southwest across the site.

The cross-section indicates all the existing fill and natural soil material will be removed along with a significant volume of Triassic sedimentary rock on excavating to the proposed design level. The excavation will extend into the underlying bedrock by between 1.8 m to the east and 3.3 m to the west of the site where bedrock was encountered close to ground surface level.

Figure 6 presents the expected rock surface level (m AHD) based on borehole refusal depths during the ESA and rock depths encountered during the geotechnical investigation. The contour plot indicates the rock is present at between 19.2 to 23.2 m AHD.

Based on the presence of the shallow bedrock, GES recommend to place the foundations for the proposed development on slightly weathered mudstone/sandstone. It should be noted that due to the spacing of the deeper investigation boreholes, lateral and vertical variability in ground conditions may be expected.

7.2.1 Pad Footings

Table 6 presents the estimated allowable bearing capacities for pad footings, assuming a 1 m by 1 m wide pad. GES are not recommending founding the pads on the extremely weathered material, which should be removed during excavation works. The bearing capacities have been estimated based on point load (PLSI) results and a Factor of Safety (FOS) of 2.5 has been applied.

Table 6 Estimated Bearing Capacities for Pad Footings

Material	***Allowable Bearing Capacity (kPa)****
SANDSTONE/SILTSTONE : Slightly weathered	2,500

Note: Allowable bearing capacities have been calculated using rock mass characteristics & point load index strength test results using a IS50 to UCS conversion factor of 20 and an allowable safety factor of 2.5

Based on the allowable bearing capacities and pad founding depths outlined in Table 6, for 1 m square pad footings, settlement of less than 5 mm is expected provided all footings a clear of any excavation material. However, settlements of pads depend on the actual pad type and pad layout (pad diameter, founding depths, etc.) and rock mass condition encountered. At this stage, no detailed settlement analysis has been carried out.

7.3 Construction Considerations and Recommendations

7.3.1 Earthworks Recommendations

During construction, the following earthworks recommendations should be adhered to:

- Uncontrolled, contaminated fill and organic materials at footing and subgrade locations should be stripped and removed appropriately from site. This may require multiple stockpiles to separate contaminated and non-contaminated fill materials; and
- Earthworks are to be carried out in accordance with methods outlined in AS 3798-2007.
- Clay or low strength rock encountered below the proposed basement levels should be stripped prior to construction;

7.3.2 Site Excavation Considerations

- Care should be taken to ensure that the base of the pad excavation is clear of any loose material, water or clay smear prior to pouring concrete;
- Consideration should be made for encountering shallow groundwater, as per the ground conditions encountered during the geotechnical investigation with initial groundwater strikes recorded at 6 m depth (confined aquifer, rising to 1.2 m depth);
- All surface water should be diverted away from the excavations;
- Excavation of fill materials and natural soils to required depths at all locations is likely to be achieved with relative ease with conventional hydraulic excavation machinery;

- Care should also be taken due to the underground services which are likely to be present below the surface fill on site;
- Although not encountered, during the investigation boulder and cobbles may be expected to be encountered within the fill materials, which was found to be highly variable. On encountering oversized materials, these should be removed from site;
- Construction contractors should be made aware of the fill that covers much of the site. Soil dermal contact, ingestion and dust inhalation risks have not been identified at the site. However, there remains the possibility that residual secondary hydrocarbons are present in soil and groundwater at the site. Excavation spoil may contain contaminates including hydrocarbons and heavy metals, such that any excavated material must be tested and classified according to EPA IB105 prior to removal from site. When considering such earthworks activities, refer to GES's ESA report; and
- It is recommended that excavations be observed by a Geotechnical Engineer/Geologist during construction to ensure that founding conditions are consistent with those on which the design recommendations are based. Allowance need to be made for footing and in particular, cut inspections there is proposal to exceed the recommended batter angles.

7.3.3 Unsupported Batters and Earth Retaining Systems

Based on the drawings provided, it is estimated the proposed retaining wall structure will be constructed around the boundaries of the site including adjacent to the RACT building. It is proposed that the base level of the car park will be constructed ~3.6 m from the RACT building on the south-western boundary resulting in an angle of 40 to 50 degrees between the toe of the cut and the top of the bedrock. 3.6 m of bedrock is proposed to be retained in the lower basement level except where the lift shaft and stairwell is proposed where a vertical cut is proposed. The upper basement cut along the southwestern boundary is proposed to be cut vertically and bedrock and soil will need to be retained. Subject to further analysis of neighbouring building footing loads and design, preliminary analysis has identified 55 to 80° clay filled defects which should not pose a problem with the proposed 40 to 50-degree batters along the south-western boundary. However, the steep defects may pose complications in the lift shaft and stairwell area, and this can not be determined without an understanding of the orientation of the defects and the placement of the neighbouring building footings.

Geotechnical rock mass properties (estimated bedrock friction and cohesion parameters) should not be used in solidarity to determine neighbouring footing integrity. Nail bolting may be required to stabilise structural elements within the bedrock around the building pads.

The following preliminary safe slope batter angles can be recommended within each subsurface unit (assuming batter slope for less than 1 month):

- Fill – 1V:3H;
- Extremely Weathered Siltstone/Sandstone – 1V:1.5H; and
- Slightly Weathered Siltstone/Sandstone – 3V:2.5H

Batters may be steepened possibly to near vertical pending individual geotechnical reports and cutting inspections as identified in the recommendations.

7.3.4 Pad Footing Construction Considerations

Water inflows may also be encountered during excavation which may cause softening of the founding material. Therefore, it is recommended that all clayey, loose or water affected material be removed from the base of all excavations prior to construction (as much as practically possible). Pads should be socketed into the mudstone/sandstone with an equal embedment depth to width ratio.

It is also recommended that the foundation/pavement excavations be inspected by a suitably qualified professional in order confirm the foundations conditions are consistent with engineering design parameters and foundation embedment depths outlined above are suitable.

It is recommended that:

- Levelling and compaction of footprints with either natural rock fill or imported Class 1 fill should follow AS 1289 5.1.1;
- All earthworks onsite be compliant with AS3798-2007 "Guidelines for Earthworks on commercial and residential subdivision";
- Stormwater be connected as soon as any roofing is sealed; and
- Drainage of the ground surface and pavements be designed to flow away from footing areas and towards stormwater discharge points.

7.3.5 Foundation Maintenance

Optimal foundation maintenance is concerned with keeping soils in the founding zone at low and constant moisture contents to limit ground surface movement. Ground surface movement associated with endemic soils on site have long term implications for footing maintenance and it is recommended that:

- Adequate consideration be given to drainage around the building as well as the entire site to prevent surface and subsurface moisture accumulation around footings;
- Stormwater be connected as soon as the roof is sealed; and
- Drainage of the ground surface and pavements be designed to flow away from footing areas and towards stormwater discharge points.

7.3.6 Site Seismic Factor

Based on the subsurface conditions encountered and the location of the site, it is considered that a site subsoil classification of Class Be – Rock site and a Site Hazard Factor (Z) of 0.03 is applicable in accordance with Section 4 of AS1170.4-2007 "Structural Design Actions Part:4 Earthquake actions in Australia".

8 RECOMMENDATIONS

The following recommendations have been made by GES for further geotechnical investigation and analysis:

- The groundwater is not expected to create a significant obstruction to the proposed works but will require the presence of a sump and continual operating pump to collect discharging groundwater. This is perhaps best managed through creating a slight grade across the site to one corner and excavating a shallow pump well for groundwater extraction.
- GES does not recommend placing footings within the shallow clay-rich material due to the likely significant settlement that will be encountered;
- It is recommended footings be placed into the slightly weathered sandstone/siltstone materials at depth;
- Cutting inspections will need to be conducted on a case by case basis to maximise the unsupported batter angles within safe working limits;
- GES recommend an Engineering Geologist should observe foundation excavations during construction to ensure that founding conditions are consistent with those on which the design recommendations are based.
- A separate analysis will need to be conducted on the integrity of the retaining wall adjacent to the RACT building as well as the integrity of the neighbouring building footings. Around the lift shaft, a geotechnical analysis involving oriented diamond coring should be undertaken to determine the likely influence of joint orientation on the stability of the neighbouring RACT building foundations. Alternatively, the 3.6 m setback cut may be inspected in the lower basement excavation prior to lift shaft excavation to determine the likely need for rock bolting in the proposed lift shaft area.
- It is recommended that that the 3V:2.5 setback in bedrock is determined prior to excavation works, and the preliminary excavation may be made vertically (provided people not approach the works area). The vertical cut should be inspected by an engineering geologist or geotechnical engineer to determine rock bolting pattern if required or unsupported batter angles prior to advancing the cut to the proposed boundary position.

9 LIMITATIONS STATEMENT

This Assessment Report has been prepared in accordance with the scope of services between Geo-Environmental Solutions Pty. Ltd. (GES) and Heffernan Button Voss Architects (‘the Client’). To the best of GES's knowledge, the information presented herein represents the Client's requirements at the time of printing of the Report. However, the passage of time, manifestation of latent conditions or impacts of future events may result in findings differing from that discussed in this Report. In preparing this Report, GES has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations referenced herein. Except as otherwise stated in this Report, GES has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

The scope of this study does not allow for the review of every possible geotechnical parameter or soil contaminant over the whole area of the site. Soil and rock samples collected from the investigation area are assumed to be representative of the areas from where they were collected and not indicative of the entire site. The conclusions discussed within this report are based on observations and/or testing at these investigation points.

This report does not purport to provide legal advice. Readers of the report should engage professional legal practitioners for this purpose as required.

No responsibility is accepted for use of any part of this report in any other context or for any other purpose by third party.

10 REFERENCES

AS1170.4 (2007). Australian Standard. Structural design actions. Part 4: Earthquake actions in Australia. prepared by Committee BD-006, General Design Requirements and Loading on Structures. It was approved on behalf of the Council of Standards Australia on 22 May 2007. This Standard was published on 9 October 2007.

AS1289 (2000). Australian Standard. Various methods as Prepared by Committee CE/9, Testing of Soils for Engineering Purposes. Approved on behalf of the Council of Standards Australia on 3 December 1999 and published on 28 February 2000. Includes:

1289.6.3.1 Method 6.3.1: Soil strength and consolidation tests—Determination of the penetration resistance of a soil—Standard penetration test (SPT)

1289.6.4.2 Method 6.4.2: Soil strength and consolidation tests—Determination of the compressive strength of a soil—Compressive strength of a saturated specimen tested in undrained triaxial compression with measurement of pore water pressure

AS1726 (2017). Australian Standard. Geotechnical site investigations. Prepared by Committee CE-015, Site Investigations. Approved on behalf of the Council of Standards Australia on 7 April 2017 and published on 2 May 2017.

AS4133.4.1 (1993). Australian Standard. Geotechnical site investigations. Prepared by Committee CE-015, Testing of Rocks for Engineering Purposes. It was approved on behalf of the Council of Standards Australia on 1 September 2005. This Standard was published on 13 December 2005. Includes:

4133.4.1 Method 4.1: Rock strength tests—Determination of the point load strength index

4133.4.2 2005 Method 4.2: Rock strength tests—Determination of the uniaxial compressive strength

4133.4.3 2005 Method 4.3: Rock strength tests—Determination of deformability of rock materials in uniaxial compression

Coffey Mining.; Specialists from boardroom to mine face. Geotechnical Investigation for RACT Redevelopment. SEMF. RACT Redevelopment. GEOTHOBA00605AA

FORSYTH, S.M. and CLARKE, M.J. (compilers) 1999. Digital Geological Atlas 1:25 000 Scale Series. Sheet 5225 Hobart. Mineral Resources Tasmania.

Geo-Environmental Solutions (2019). DRAFT ENVIRONMENTAL SITE ASSESSMENT. 62-64 Patrick Street, Hobart. July 2019. Report for Heffernan Button Voss (HBV) Architects

SEMF 2008. RACT Office Redevelopment.

FIGURES

Figure 1 Site Location, 1:7000 scale, image sourced from the LIST. Site outlined in red

Figure 2 Site Location, 1:700 scale, image sourced from the LIST

Figure 3 Lower Basement Level Plan

(Coordinate System: GDA94 MGA Zone 55)

Figure 4 Borehole Layout Plan

(Coordinate System: GDA94 MGA Zone 55)

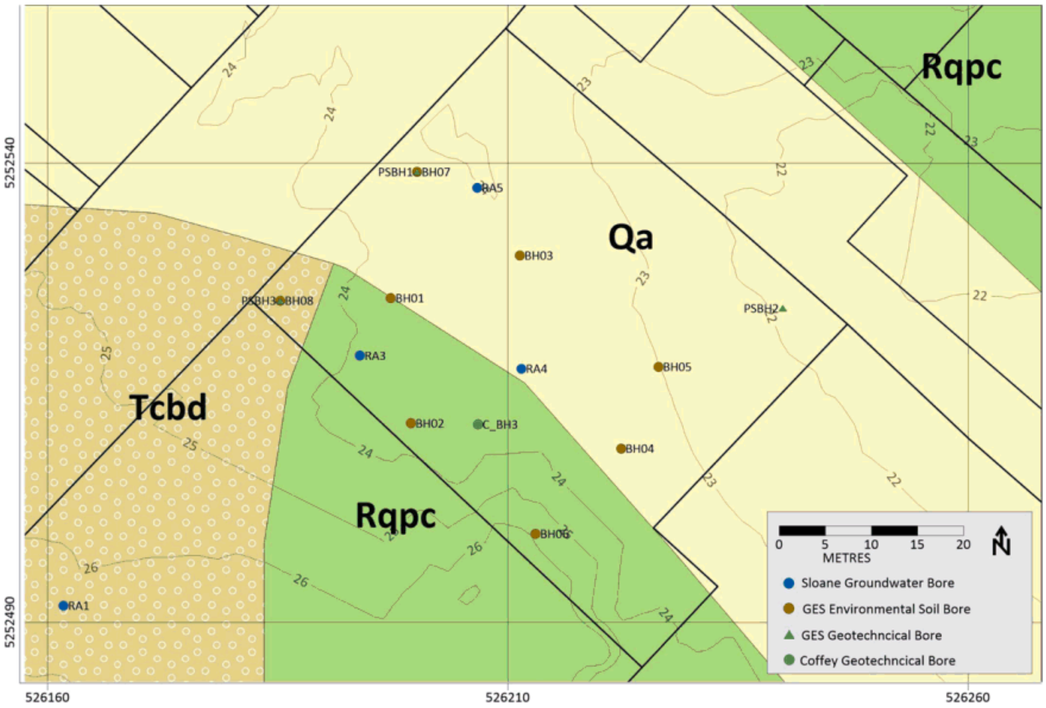


Figure 5 Site Geology

(Coordinate System: GDA94 MGA Zone 55)

Note : **Rqpc** – Triassic Aged *Predominantly interbedded siltstone shale and mudstone and planar-bedded, ripple cross-laminated or cross-bedded sandstone, red-purple, green or carbonaceous siltstone at places (part of Knocklofty Formation where in Hobart area)*; and **Tcbd** – Tertiary Aged *Poorly sorted boulder to pebble grade deposits with boulders up to 3 m length, clasts generally dominantly of dolerite with traces to rarely dominant amounts of Upper Parmeener mudstone and other rocks and less commonly Lower Parmeener rocks, clayey*; **Qa** – *Quaternary Aged Alluvial gravel, sand and clay.*

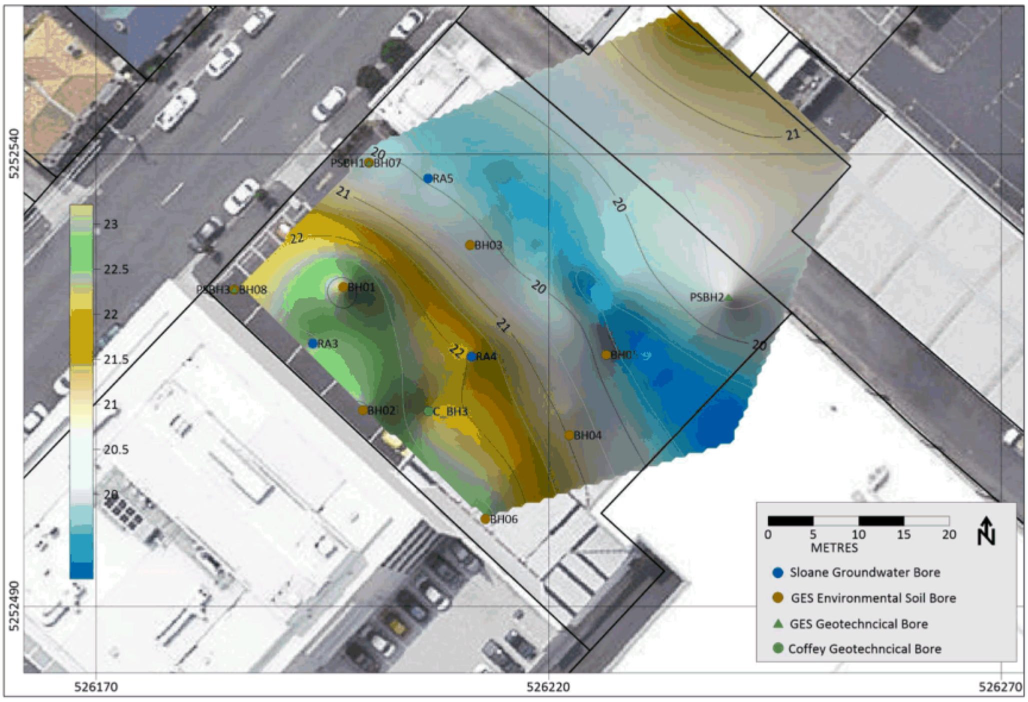


Figure 6 Contoured Surface Plot of the Bedrock Elevation & Cross Sections

(Coordinate System: GDA94 MGA Zone 55) Note: bedrock mounding near BH01 attributed to the presence of weathered siltstone gravels

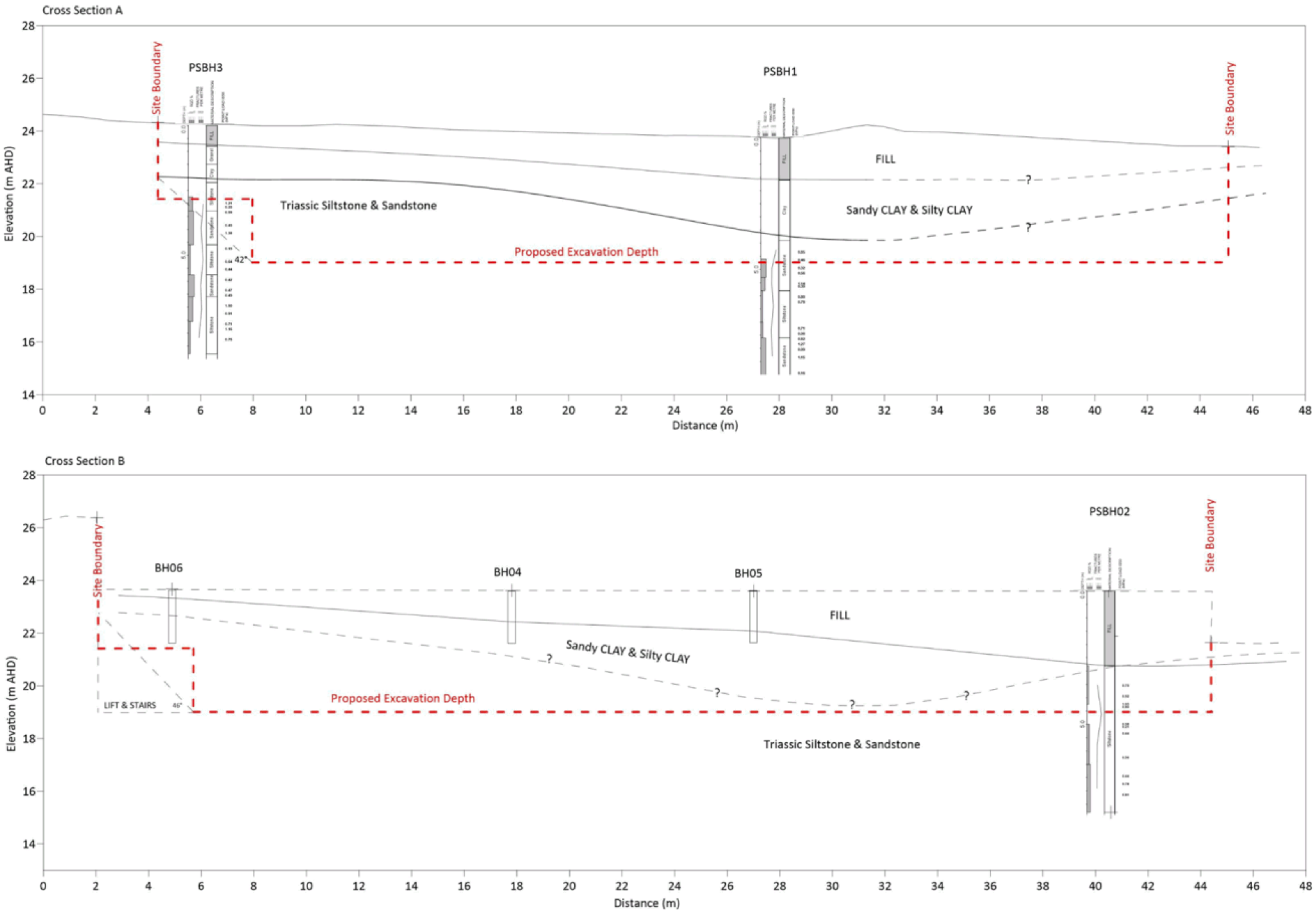
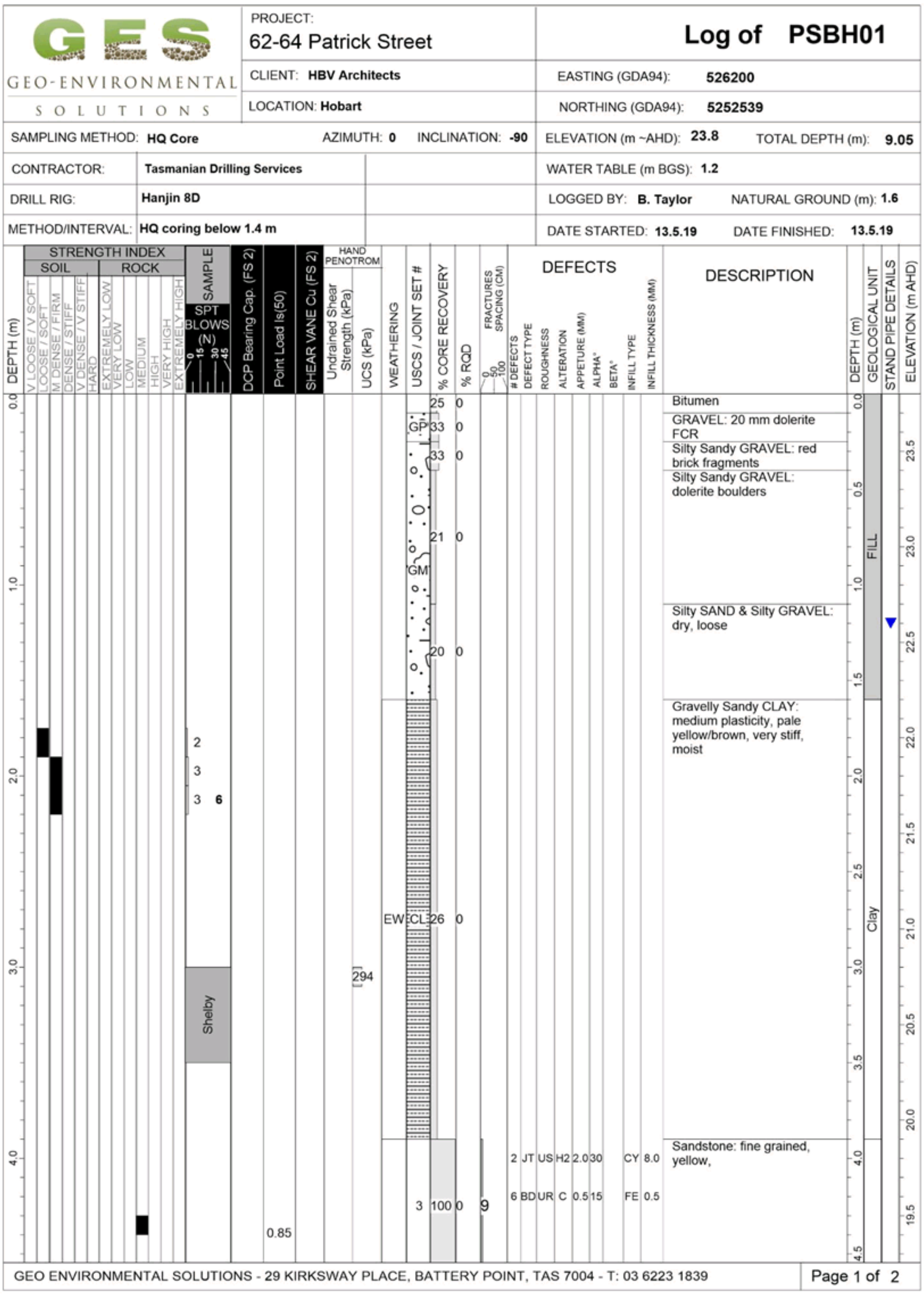


Figure 7 Cross Sections

APPENDIX 1 – ENGINEERING LOGS & GES EXPLANATORY NOTES



GES GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH01

CLIENT: **HBV Architects**
LOCATION: **Hobart**
EASTING (GDA94): **526200**
NORTHING (GDA94): **5252539**
SAMPLING METHOD: **HQ Core**
AZIMUTH: **0**
INCLINATION: **-90**
ELEVATION (m ~AHD): **23.8**
TOTAL DEPTH (m): **9.05**
CONTRACTOR: **Tasmanian Drilling Services**
WATER TABLE (m BGS): **1.2**
DRILL RIG: **Hanjin 8D**
LOGGED BY: **B. Taylor**
NATURAL GROUND (m): **1.6**
METHOD/INTERVAL: **HQ coring below 1.4 m**
DATE STARTED: **13.5.19**
DATE FINISHED: **13.5.19**

DESCRIPTION

Bitumen

GRAVEL: 20 mm dolerite FCR

Silty Sandy GRAVEL: red brick fragments

Silty Sandy GRAVEL: dolerite boulders

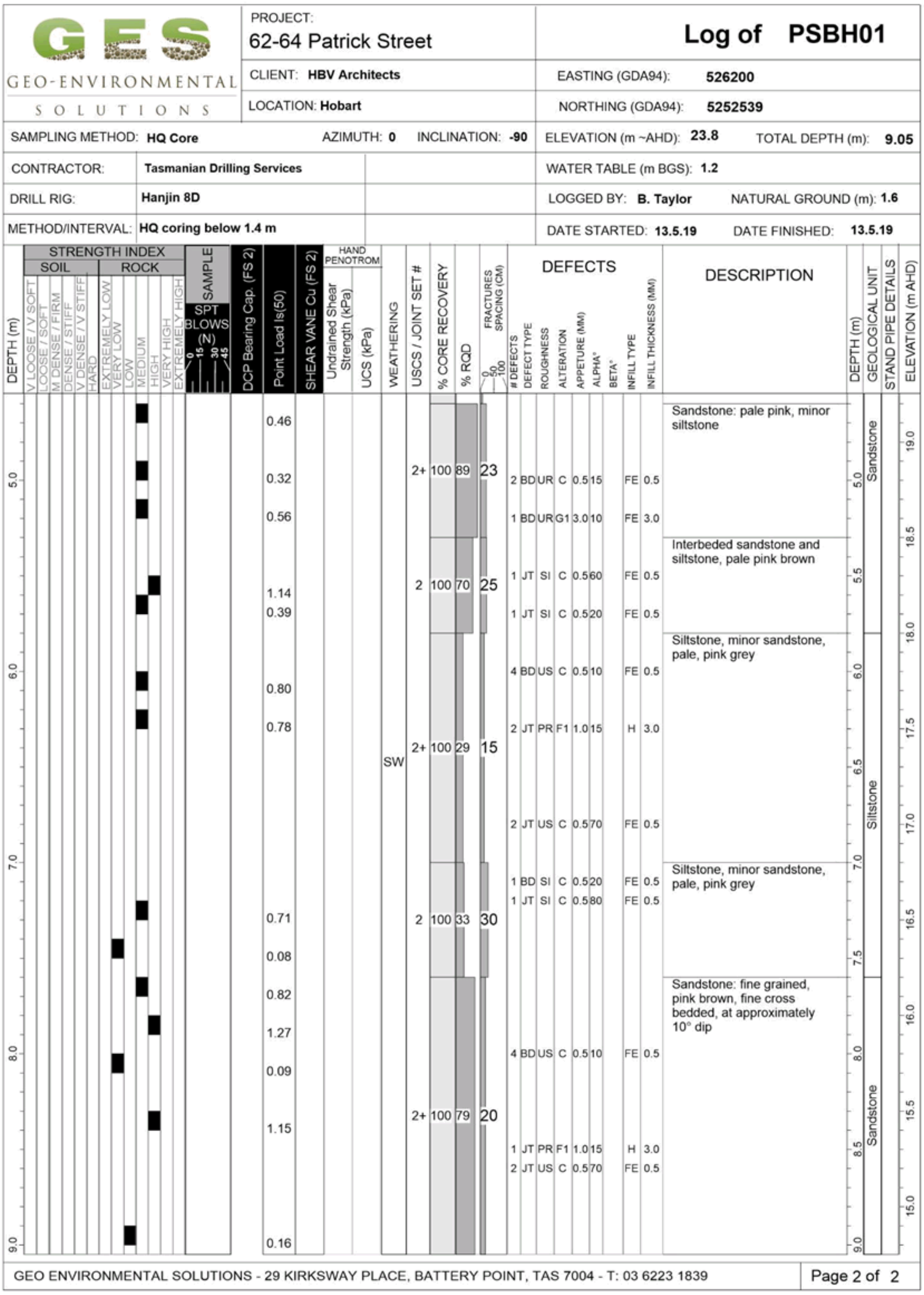
Silty SAND & Silty GRAVEL: dry, loose

Gravelly Sandy CLAY: medium plasticity, pale yellow/brown, very stiff, moist

Sandstone: fine grained, yellow,

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT, TAS 7004 - T: 03 6223 1839

Page 1 of 2



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH01

CLIENT: **HBV Architects**
LOCATION: **Hobart**
EASTING (GDA94): **526200**
NORTHING (GDA94): **5252539**
SAMPLING METHOD: **HQ Core**
AZIMUTH: **0**
INCLINATION: **-90**
ELEVATION (m ~AHD): **23.8**
TOTAL DEPTH (m): **9.05**
CONTRACTOR: **Tasmanian Drilling Services**
WATER TABLE (m BGS): **1.2**
DRILL RIG: **Hanjin 8D**
LOGGED BY: **B. Taylor**
NATURAL GROUND (m): **1.6**
METHOD/INTERVAL: **HQ coring below 1.4 m**
DATE STARTED: **13.5.19**
DATE FINISHED: **13.5.19**

Point Load Is(50)
0.46
0.32
0.56
1.14
0.39
0.80
0.78
0.71
0.08
0.82
1.27
0.09
1.15
0.16

WEATHERING	USCS / JOINT SET #	% CORE RECOVERY	% RQD	FRACTURES SPACING (CM)
	2+	100	89	23
	2	100	70	25
SW	2+	100	29	15
	2	100	33	30
	2+	100	79	20

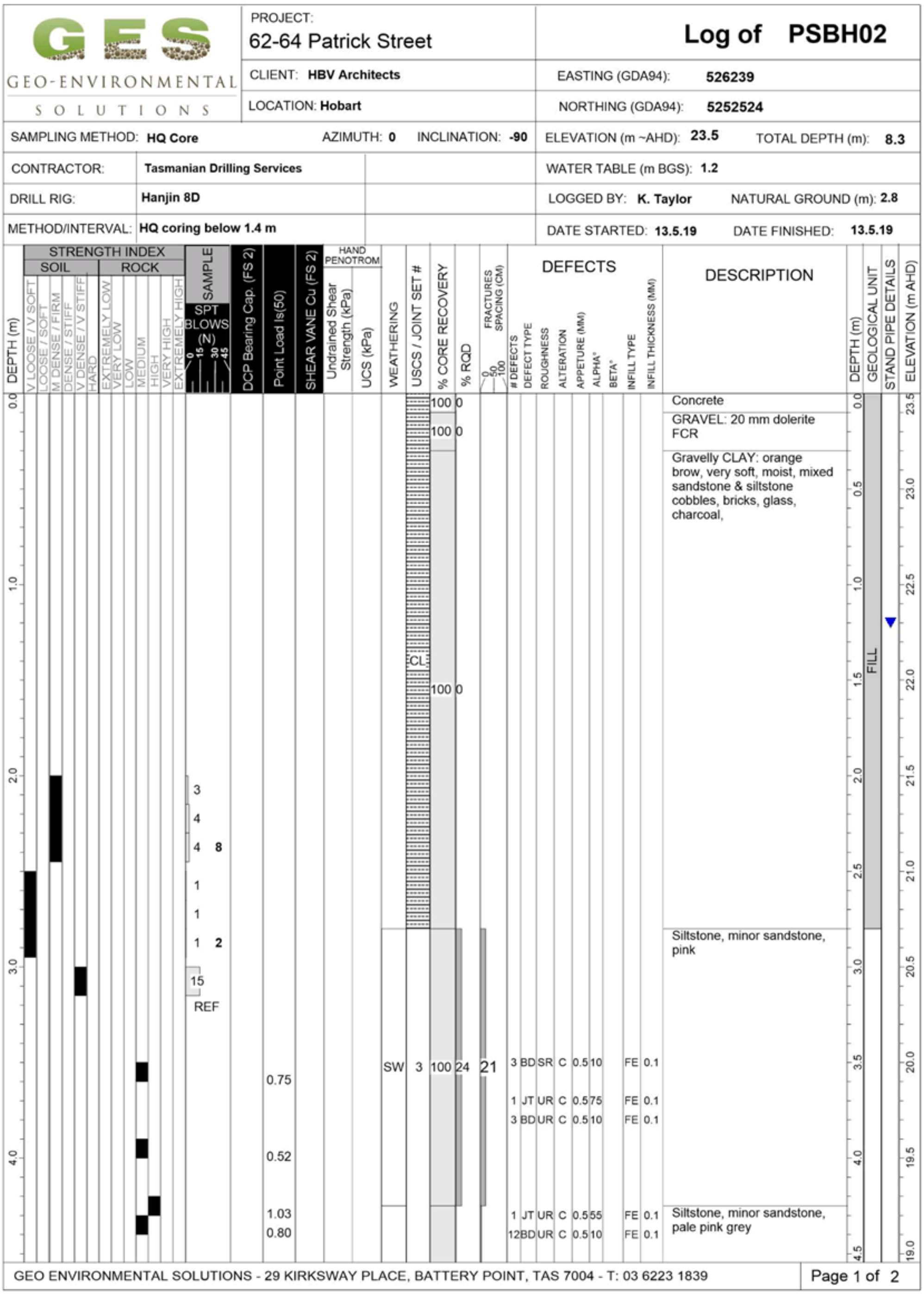
DEFECTS

# DEFECTS	DEFECT TYPE	ROUGHNESS	ALTERATION	APPETURE (MM)	ALPHA°	BETA°	INFILL TYPE	INFILL THICKNESS (MM)
2	BD	UR	C	0.5	15		FE	0.5
1	BD	UR	G1	3.0	10		FE	3.0
1	JT	SI	C	0.5	60		FE	0.5
1	JT	SI	C	0.5	20		FE	0.5
4	BD	US	C	0.5	10		FE	0.5
2	JT	PR	F1	1.0	15		H	3.0
2	JT	US	C	0.5	70		FE	0.5
1	BD	SI	C	0.5	20		FE	0.5
1	JT	SI	C	0.5	80		FE	0.5
4	BD	US	C	0.5	10		FE	0.5
1	JT	PR	F1	1.0	15		H	3.0
2	JT	US	C	0.5	70		FE	0.5

DESCRIPTION	GEOLOGICAL UNIT
Sandstone: pale pink, minor siltstone	Sandstone
Interbeded sandstone and siltstone, pale pink brown	
Siltstone, minor sandstone, pale, pink grey	Siltstone
Siltstone, minor sandstone, pale, pink grey	
Sandstone: fine grained, pink brown, fine cross bedded, at approximately 10° dip	Sandstone

DEPTH (m)	ELEVATION (m AHD)
	19.0
5.0	
	18.5
5.5	
	18.0
6.0	
	17.5
6.5	
	17.0
7.0	
	16.5
7.5	
	16.0
8.0	
	15.5
8.5	
	15.0
9.0	

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT, TAS 7004 - T: 03 6223 1839
Page 2 of 2



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH02

CLIENT:	HBV Architects
LOCATION:	Hobart
EASTING (GDA94):	526239
NORTHING (GDA94):	5252524
SAMPLING METHOD:	HQ Core
AZIMUTH:	0
INCLINATION:	-90
ELEVATION (m ~AHD):	23.5
TOTAL DEPTH (m):	8.3
CONTRACTOR:	Tasmanian Drilling Services
WATER TABLE (m BGS):	1.2
DRILL RIG:	Hanjin 8D
LOGGED BY:	K. Taylor
NATURAL GROUND (m):	2.8
METHOD/INTERVAL:	HQ coring below 1.4 m
DATE STARTED:	13.5.19
DATE FINISHED:	13.5.19

SPT BLOWS (N)	Point Load Is(50)	WEATHERING	USCS / JOINT SET #	% CORE RECOVERY	% RQD	FRACTURES SPACING (CM)	DESCRIPTION	GEOLOGICAL UNIT
				100	0		Concrete	FILL
				100	0		GRAVEL: 20 mm dolerite FCR	
3 4 4 8 1 1 1 2 15 REF			CL	100	0		Gravelly CLAY: orange brow, very soft, moist, mixed sandstone & siltstone cobbles, bricks, glass, charcoal,	
	0.75 0.52	SW	3	100	24	21	Siltstone, minor sandstone, pink	
	1.03 0.80						Siltstone, minor sandstone, pale pink grey	

DEFECTS

# DEFECTS	DEFECT TYPE	ROUGHNESS	ALTERATION	APPETURE (MM)	ALPHA°	BETA°	INFILL TYPE	INFILL THICKNESS (MM)
3	BD	SR	C	0.5	10		FE	0.1
1	JT	UR	C	0.5	75		FE	0.1
3	BD	UR	C	0.5	10		FE	0.1
1	JT	UR	C	0.5	55		FE	0.1
12	BD	UR	C	0.5	10		FE	0.1

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT, TAS 7004 - T: 03 6223 1839

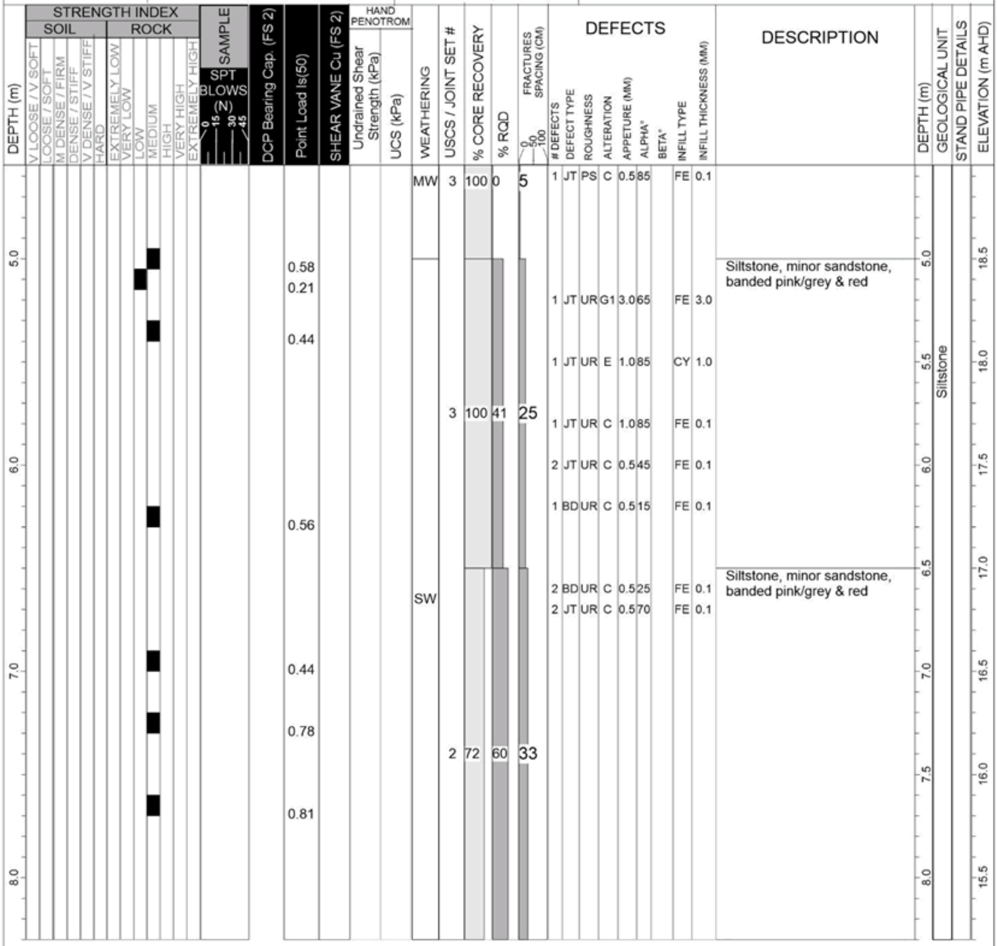
Page 1 of 2

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH02

CLIENT: **HBV Architects**
EASTING (GDA94): **526239**
LOCATION: **Hobart**
NORTHING (GDA94): **5252524**
SAMPLING METHOD: **HQ Core**
AZIMUTH: **0**
INCLINATION: **-90**
ELEVATION (m ~AHD): **23.5**
TOTAL DEPTH (m): **8.3**
CONTRACTOR: **Tasmanian Drilling Services**
WATER TABLE (m BGS): **1.2**
DRILL RIG: **Hanjin 8D**
LOGGED BY: **K. Taylor**
NATURAL GROUND (m): **2.8**
METHOD/INTERVAL: **HQ coring below 1.4 m**
DATE STARTED: **13.5.19**
DATE FINISHED: **13.5.19**



Point Load Is(50): 0.58, 0.21, 0.44, 0.56, 0.44, 0.78, 0.81

WEATHERING	USCS / JOINT SET #	% CORE RECOVERY	% RQD	FRACTURES SPACING (CM)
MW	3	100	0	5
	3	100	41	25
SW	2	72	60	33

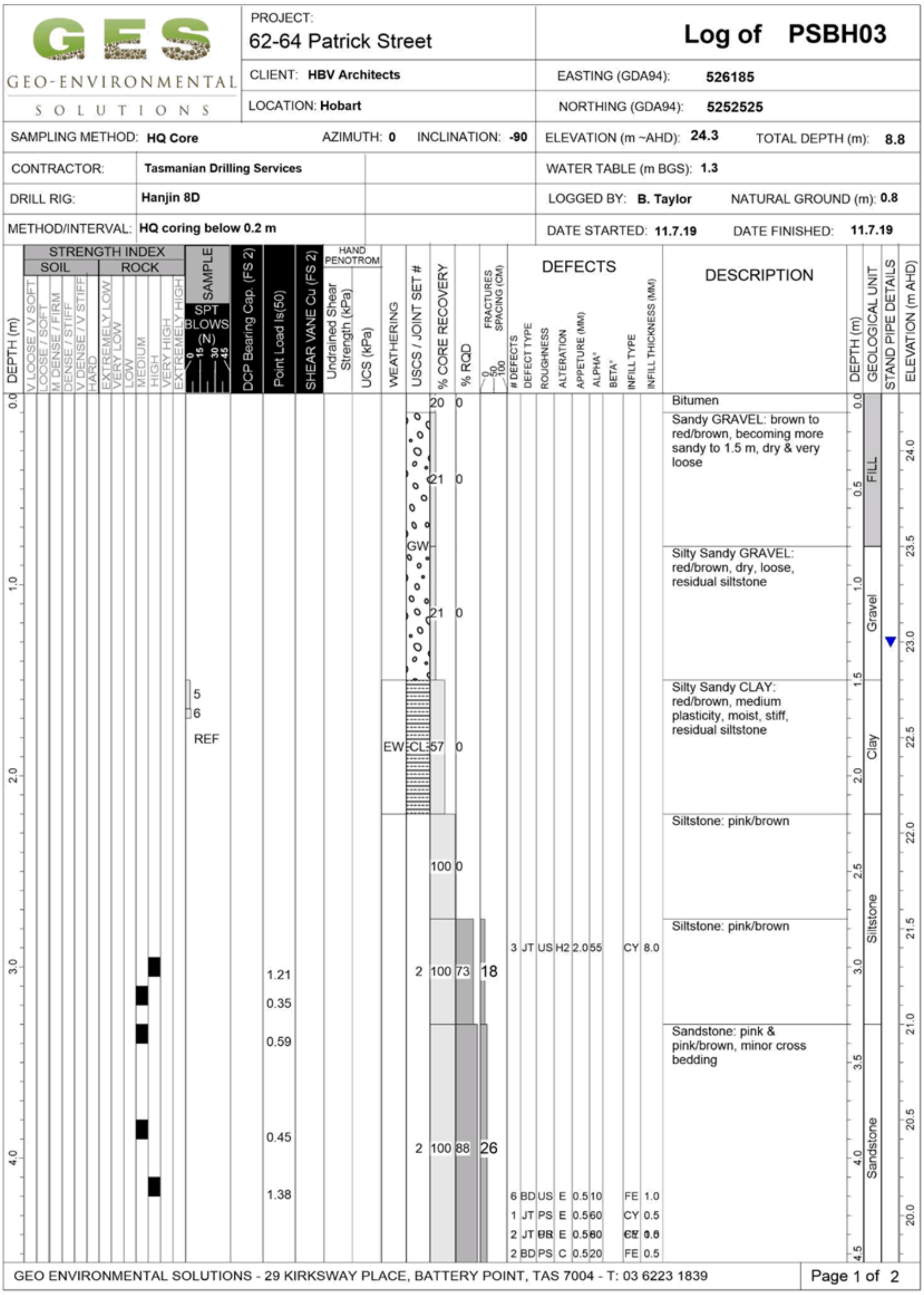
DEFECTS

# DEFECTS	DEFECT TYPE	ROUGHNESS	ALTERATION	APPETURE (MM)	ALPHA°	BETA°	INFILL TYPE	INFILL THICKNESS (MM)
1	JT	PS	C	0.5	85		FE	0.1
1	JT	UR	G1	3.0	65		FE	3.0
1	JT	UR	E	1.0	85		CY	1.0
1	JT	UR	C	1.0	85		FE	0.1
2	JT	UR	C	0.5	45		FE	0.1
1	BD	UR	C	0.5	15		FE	0.1
2	BD	UR	C	0.5	25		FE	0.1
2	JT	UR	C	0.5	70		FE	0.1

DESCRIPTION

Siltstone, minor sandstone, banded pink/grey & red

Siltstone, minor sandstone, banded pink/grey & red



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH03

CLIENT: **HBV Architects**

LOCATION: **Hobart**

EASTING (GDA94): **526185**

NORTHING (GDA94): **5252525**

SAMPLING METHOD: **HQ Core**
AZIMUTH: **0**
INCLINATION: **-90**
ELEVATION (m ~AHD): **24.3**
TOTAL DEPTH (m): **8.8**

CONTRACTOR: **Tasmanian Drilling Services**
WATER TABLE (m BGS): **1.3**

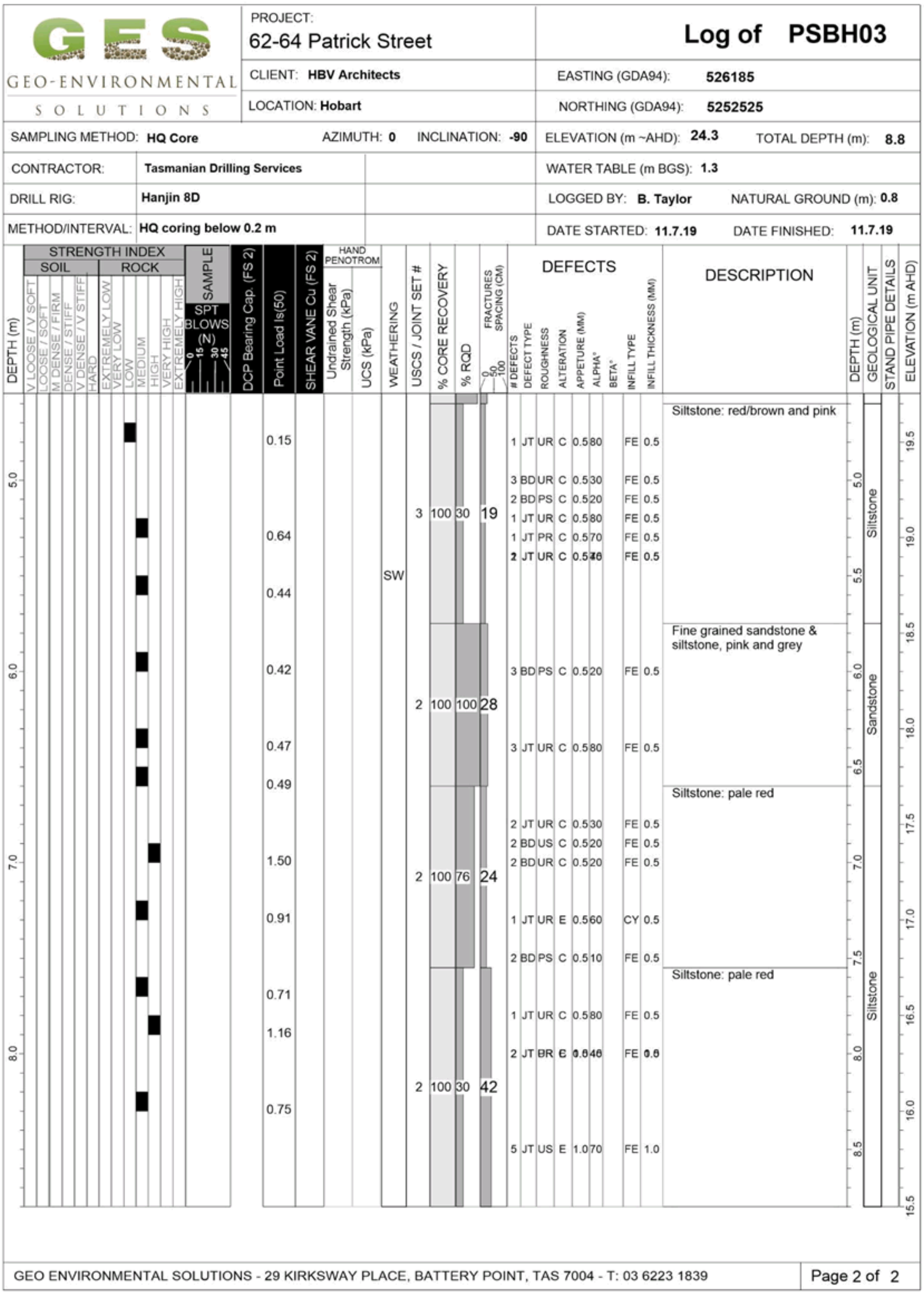
DRILL RIG: **Hanjin 8D**
LOGGED BY: **B. Taylor**
NATURAL GROUND (m): **0.8**

METHOD/INTERVAL: **HQ coring below 0.2 m**
DATE STARTED: **11.7.19**
DATE FINISHED: **11.7.19**

DESCRIPTION	GEOLOGICAL UNIT	SPT BLOWS (N)	Point Load Is(50)	WEATHERING	USCS / JOINT SET #	% CORE RECOVERY	% RQD	FRACTURES SPACING (CM)	# DEFECTS	DEFECT TYPE	ROUGHNESS	ALTERATION	APPETURE (MM)	ALPHA°	BETA°	INFILL TYPE	INFILL THICKNESS (MM)
Bitumen	FILL					20	0										
Sandy GRAVEL: brown to red/brown, becoming more sandy to 1.5 m, dry & very loose					GW	21	0										
Silty Sandy GRAVEL: red/brown, dry, loose, residual siltstone	Gravel					21	0										
Silty Sandy CLAY: red/brown, medium plasticity, moist, stiff, residual siltstone	Clay	5 6 REF		EW	CL	57	0										
Siltstone: pink/brown	Siltstone					100	0										
Siltstone: pink/brown			1.21 0.35 0.59		2	100	73	18	3	JT	US	H2	2.0	55		CY	8.0
Sandstone: pink & pink/brown, minor cross bedding	Sandstone		0.45 1.38		2	100	88	26	6 1 2 2	BD JT JT BD	US PS [illegible] PS	E E E C	0.5 0.5 0.5 0.5	10 60 60 20		FE CY [illegible] FE	1.0 0.5 [illegible] 0.5

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT, TAS 7004 - T: 03 6223 1839

Page 1 of 2



GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 62-64 Patrick Street

Log of PSBH03

CLIENT:	HBV Architects	EASTING (GDA94):	526185
LOCATION:	Hobart	NORTHING (GDA94):	5252525
SAMPLING METHOD:	HQ Core AZIMUTH: 0 INCLINATION: -90	ELEVATION (m ~AHD): 24.3	TOTAL DEPTH (m): 8.8
CONTRACTOR:	Tasmanian Drilling Services	WATER TABLE (m BGS):	1.3
DRILL RIG:	Hanjin 8D	LOGGED BY: B. Taylor	NATURAL GROUND (m): 0.8
METHOD/INTERVAL:	HQ coring below 0.2 m	DATE STARTED: 11.7.19	DATE FINISHED: 11.7.19

Point Load Is(50): 0.15, 0.64, 0.44, 0.42, 0.47, 0.49, 1.50, 0.91, 0.71, 1.16, 0.75

WEATHERING: SW

USCS / JOINT SET #	% CORE RECOVERY	% RQD	FRACTURES SPACING (CM)	GEOLOGICAL UNIT
3	100	30	19	Siltstone
2	100	100	28	Sandstone
2	100	76	24	Siltstone
2	100	30	42	

DEFECTS

# DEFECTS	DEFECT TYPE	ROUGHNESS	ALTERATION	APPETURE (MM)	ALPHA°	BETA°	INFILL TYPE	INFILL THICKNESS (MM)
1	JT	UR	C	0.5	80		FE	0.5
3	BD	UR	C	0.5	30		FE	0.5
2	BD	PS	C	0.5	20		FE	0.5
1	JT	UR	C	0.5	80		FE	0.5
1	JT	PR	C	0.5	70		FE	0.5
2	JT	UR	C	0.5	40		FE	0.5
3	BD	PS	C	0.5	20		FE	0.5
3	JT	UR	C	0.5	80		FE	0.5
2	JT	UR	C	0.5	30		FE	0.5
2	BD	US	C	0.5	20		FE	0.5
2	BD	UR	C	0.5	20		FE	0.5
1	JT	UR	E	0.5	60		CY	0.5
2	BD	PS	C	0.5	10		FE	0.5
1	JT	UR	C	0.5	80		FE	0.5
2	JT	BR	E	0.5	40		FE	0.5
5	JT	US	E	1.0	70		FE	1.0

DESCRIPTION

Siltstone: red/brown and pink

Fine grained sandstone & siltstone, pink and grey

Siltstone: pale red

Siltstone: pale red

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT, TAS 7004 - T: 03 6223 1839

Page 2 of 2

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SOLUTIONS

EXPLANATORY NOTES FOR GEOTECHNICAL REPORTING

Introduction

These notes have been provided to assist in the interpretation of this geotechnical report in regards to classification methods, field procedures and terminology.

Geotechnical reporting is based on information gained from limited subsurface test boring and sampling, integrated with knowledge of local geology and geotechnical engineering experience. For this reason, these reports must be regarded as interpretive rather than factual documents, limited by the scope of data on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based largely on Australian Standard 1726 – Geotechnical Site Investigations (AS 1726), with reference to Australian Standard 1289 – Methods for testing soils for engineering purposes (AS 1289).

Soil Classification	**Particle Size**
Clay	Less than 0.002mm
Silt	0.002 – 0.06mm
Fine/Medium Sand	0.06 – 2.0mm
Coarse Sand	2.0mm – 4.75mm
Gravel	4.75mm – 60.00mm

Grain size analysis is performed by two processes depending on particle size. Sand silt and clay particles are assessed using a standardised hydrometer test, and coarse sand and larger is assessed through sieving by USCS certified sieves. For more detail see the following section.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil and rock. Disturbed samples taken during drilling provide information on colour, lithology, grain sizes, horizon, rock unit etc. as well as some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube into the soil and removing a sample of soil in a relatively undisturbed state. These samples provide information on soil bulk density, structure, strength, and are necessary for laboratory testing of linear shrinkage and atterburg limits where appropriate.

Drilling Methods

The following is a brief summary of drilling methods currently in use by Geo Environmental Solutions, along with some comments on their uses and applications.

Test Pits – These are excavated with a backhoe or a tracked excavator allowing close examination of the in-situ soils if it safe to do so. Any excavation over 1.5m deep is benched to ensure consultant safety. Test pitting allows for easy access to soil horizons of interest and ease of associated shear vane, DCP or PSP testing.

Hydraulic Direct Push Tube Sampling – A 1200mm solid push tube with a plastic inner liner is advanced into the ground by a hydraulic percussion hammer drill, and removed to extrude the sample. This is a highly reliably drilling method as the core of soil remains intact, and thus soil moisture and structure remains largely unchanged. The rig is mounted on a 4WD Nissan Patrol is highly mobile and simultaneously very capable.

Continuous Spiral Flight Augers – The hole is advanced using a 90-115mm diameter continuous spiral auger which can be withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in cohesive soils. Augering in non-cohesive soils, and in particular below any water table is ineffective with this drilling method. Samples returned are highly disturbed and as such make assessment of soil structure difficult. Information from the drilling is of relatively lower reliability due to remoulding, contamination or softening of samples by groundwater.

Rotary Air Blast Drilling – The hole is advanced by a rotary bit, with air being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only significant changes in stratification can be determined from the cuttings, together with some information from rate of penetration and drilling resistance.

Diamond Core Drilling – A continuous core samples is obtained using a diamond tipped core barrel, 62mm internal diameter. Providing full core recovery is achieved (which is not always possible in very weak rocks and granular or non-cohesive soils), this technique provides a very reliable method of investigation. A number of various geotechnical tests may be carried out on the core, such as point load testing of recovered material. The only downfall of this technique is that it is relatively expensive method of drilling.

Standard Penetration Tests – Standard penetration tests (SPT) are used in most soils types as a means of determining density of strength, however samples that are collected are often disturbed. The test procedure is described in AS 1289 Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm may not be practicable, and the test is discontinued – indicated by 'Ref' on the logs.

SPT results are commonly displayed in two ways. In the case where full penetration is obtained with successive blow counts an N is provided in the logs. In the case where the test is discontinued short of full penetration an N value is replaced with 'Ref'. The results of the tests can be related empirically to the engineering properties of the soil.

Shear Vane Testing – This test is used for determining the shear strength of soils in the field by measuring the torque required to cause a vane of cruciform section to shear the soil, in accordance with AS 1289, method 6.2.1. The method is used for very soft to firm non-fissured clays. The advantage of this test is that it can be performed at any depth, in situ, in association with push tube sampling.

Point Load Testing – This test is used to determine the point load strength index of rock cores. This index test is performed by subjecting a rock specimen to an increasingly concentrated load until failure occurs by splitting the specimen. The concentrated load is applied through coaxial, truncated conical platens. The failure load is used to calculate the point load strength index and to estimate the uniaxial compressive strength.

DCP and PSP weighted penetrometer tests – Dynamic Cone Penetrometer (DCP) and Perth Sand Penetrometer (PSP) tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods. The methods for the two tests are quite similar.

- Dynamic Cone Penetrometer – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2).
- Perth Sand Penetrometer – a 16mm diameter flat-ended rod is driven with a 9kg hammer, dropping 600mm (AS 1289 Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.

Bore Logs – The Bore Logs presented herein are an engineering and/or geological interpretation of the subsurface condition, and their reliability will depend to some extent on frequency of sampling and the method of drilling. The units are defined according to the geological map sheet referenced in the geology section of this report. Regardless of drilling process used, it is important to note that boreholes 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, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Groundwater – Where groundwater levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time 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 changed. They may not be the same at the time of construction as are indicated in the report.
- 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 is water observations 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, seal in a particular stratum, may be advisable in low permeability soils or where there may be interference a perched water table.

Engineering Results – Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg a three story building), the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty story building).

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

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

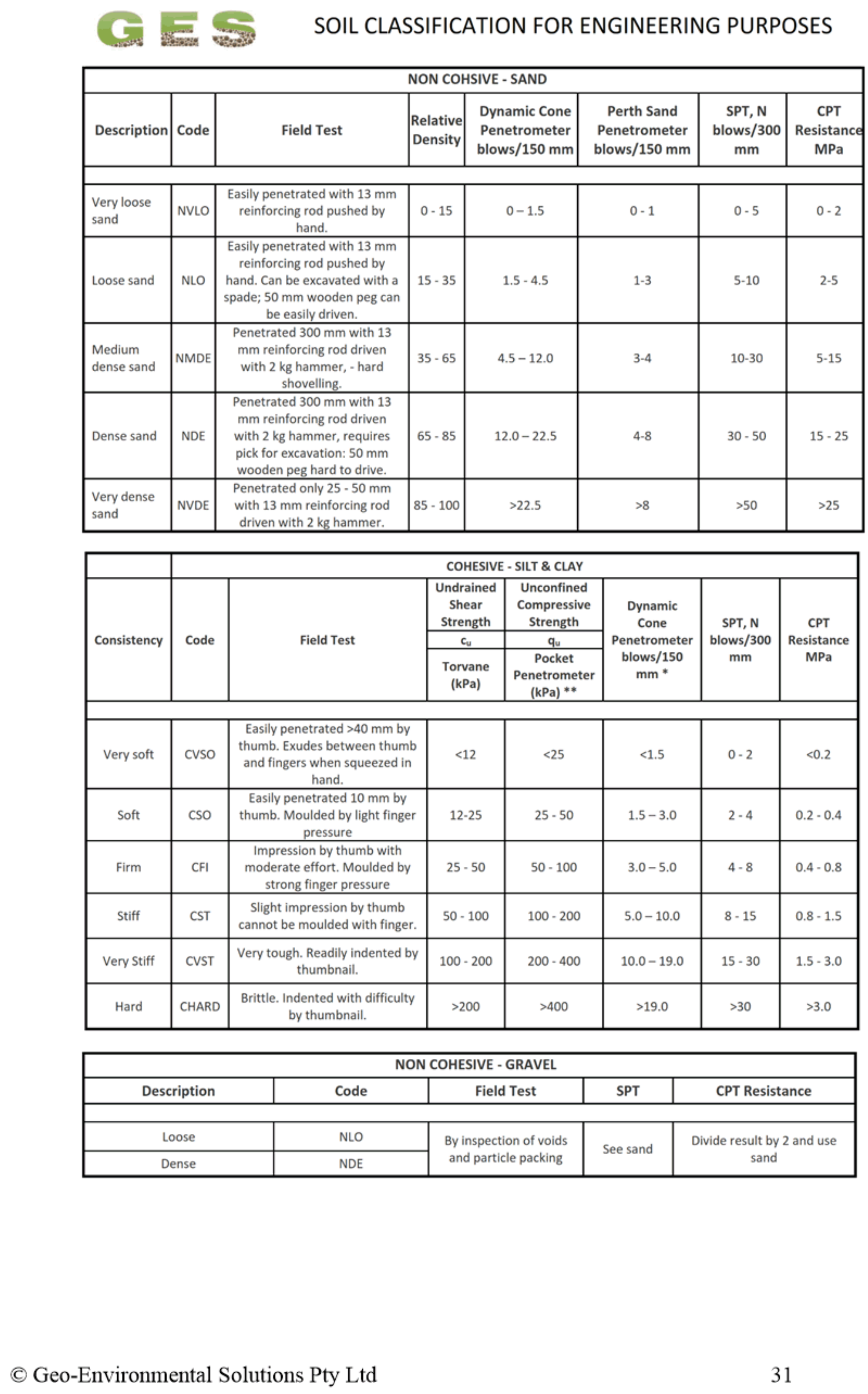
If these occur, Geo Environmental Solutions will be pleased to assist in investigation or advice to resolve the matter.

Site Anomalies – In the event conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Geo Environmental Solutions requests that it be immediately notified.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation 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. Geo Environmental Solutions 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 – Geo Environmental Solutions will provide engineering inspection services for geotechnical 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.



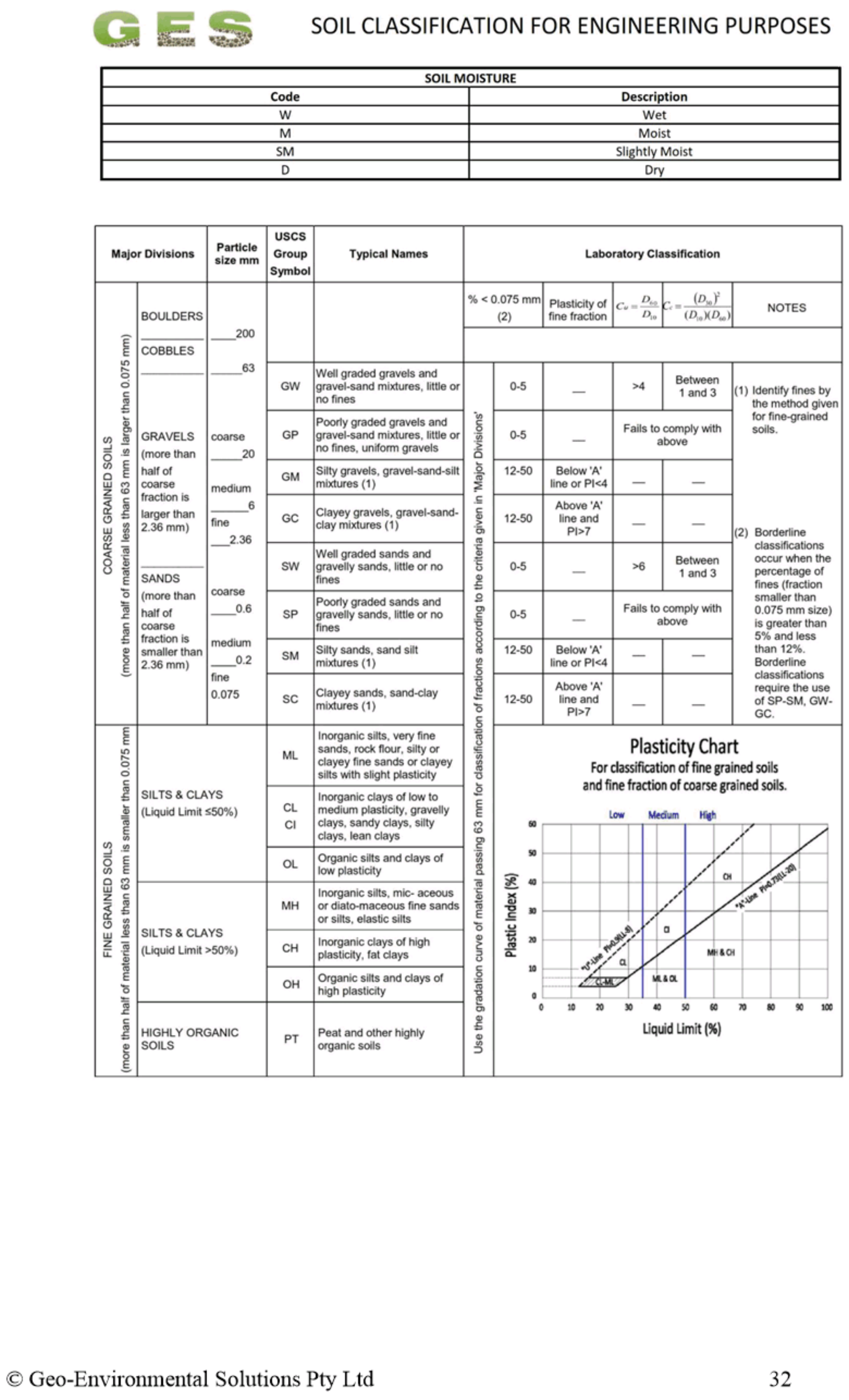
GES

SOIL CLASSIFICATION FOR ENGINEERING PURPOSES

NON COHSIVE - SAND							
Description	**Code**	**Field Test**	**Relative Density**	**Dynamic Cone Penetrometer blows/150 mm**	**Perth Sand Penetrometer blows/150 mm**	**SPT, N blows/300 mm**	**CPT Resistance MPa**
Very loose sand	NVLO	Easily penetrated with 13 mm reinforcing rod pushed by hand.	0 - 15	0 – 1.5	0 - 1	0 - 5	0 - 2
Loose sand	NLO	Easily penetrated with 13 mm reinforcing rod pushed by hand. Can be excavated with a spade; 50 mm wooden peg can be easily driven.	15 - 35	1.5 - 4.5	1-3	5-10	2-5
Medium dense sand	NMDE	Penetrated 300 mm with 13 mm reinforcing rod driven with 2 kg hammer, - hard shovelling.	35 - 65	4.5 – 12.0	3-4	10-30	5-15
Dense sand	NDE	Penetrated 300 mm with 13 mm reinforcing rod driven with 2 kg hammer, requires pick for excavation: 50 mm wooden peg hard to drive.	65 - 85	12.0 – 22.5	4-8	30 - 50	15 - 25
Very dense sand	NVDE	Penetrated only 25 - 50 mm with 13 mm reinforcing rod driven with 2 kg hammer.	85 - 100	>22.5	>8	>50	>25

	COHESIVE - SILT & CLAY						
Consistency	**Code**	**Field Test**	**Undrained Shear Strength** c_u **Torvane (kPa)**	**Unconfined Compressive Strength** q_u **Pocket Penetrometer (kPa) ****	**Dynamic Cone Penetrometer blows/150 mm ***	**SPT, N blows/300 mm**	**CPT Resistance MPa**
Very soft	CVSO	Easily penetrated >40 mm by thumb. Exudes between thumb and fingers when squeezed in hand.	<12	<25	<1.5	0 - 2	<0.2
Soft	CSO	Easily penetrated 10 mm by thumb. Moulded by light finger pressure	12-25	25 - 50	1.5 – 3.0	2 - 4	0.2 - 0.4
Firm	CFI	Impression by thumb with moderate effort. Moulded by strong finger pressure	25 - 50	50 - 100	3.0 – 5.0	4 - 8	0.4 - 0.8
Stiff	CST	Slight impression by thumb cannot be moulded with finger.	50 - 100	100 - 200	5.0 – 10.0	8 - 15	0.8 - 1.5
Very Stiff	CVST	Very tough. Readily indented by thumbnail.	100 - 200	200 - 400	10.0 – 19.0	15 - 30	1.5 - 3.0
Hard	CHARD	Brittle. Indented with difficulty by thumbnail.	>200	>400	>19.0	>30	>3.0

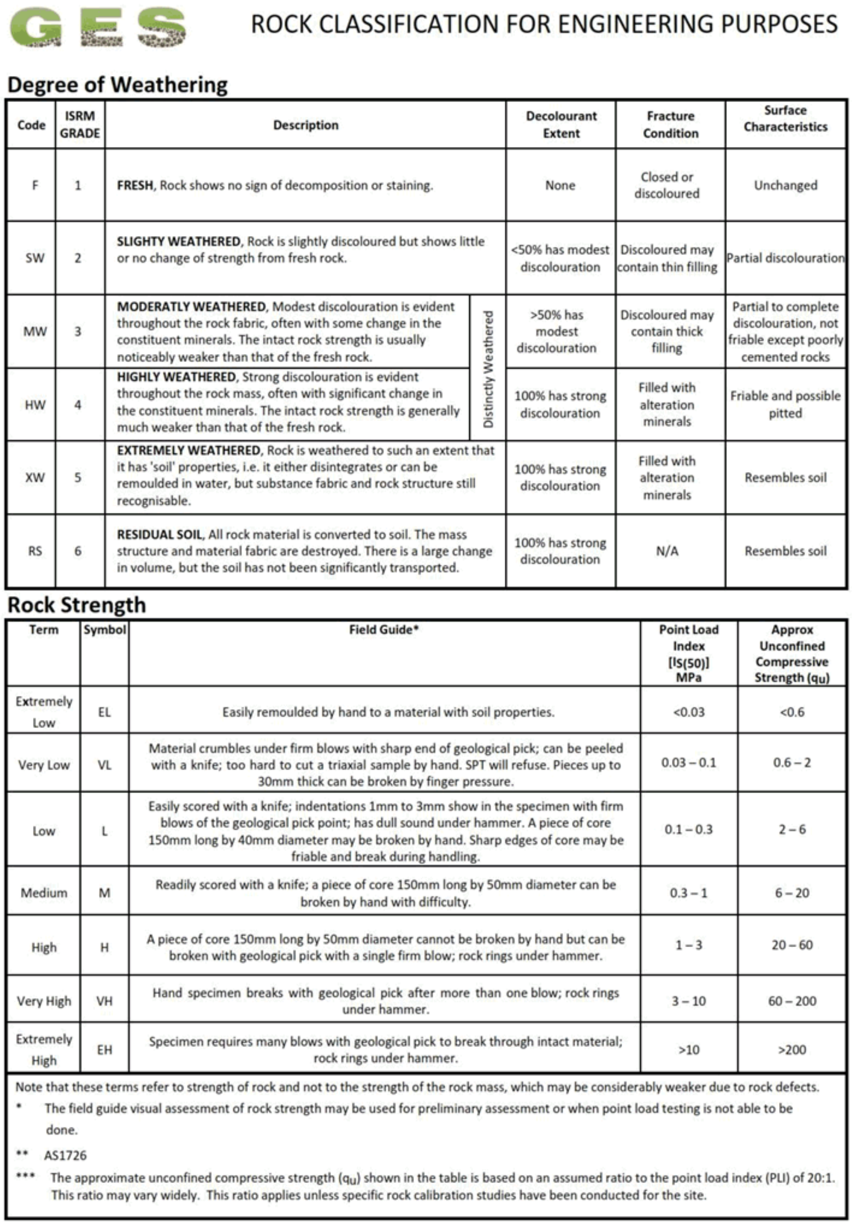
NON COHESIVE - GRAVEL				
Description	**Code**	**Field Test**	**SPT**	**CPT Resistance**
Loose	NLO	By inspection of voids and particle packing	See sand	Divide result by 2 and use sand
Dense	NDE			



SOIL CLASSIFICATION FOR ENGINEERING PURPOSES

SOIL MOISTURE	
Code	**Description**
W	Wet
M	Moist
SM	Slightly Moist
D	Dry

Major Divisions		**Particle size mm**	**USCS Group Symbol**	**Typical Names**	**Laboratory Classification**					
						% < 0.075 mm (2)	Plasticity of fine fraction	$C_u = \frac{D_{60}}{D_{10}}$	$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})}$	NOTES
COARSE GRAINED SOILS (more than half of material less than 63 mm is larger than 0.075 mm)	BOULDERS	____200								
	COBBLES	____63								
	GRAVELS (more than half of coarse fraction is larger than 2.36 mm)	coarse ____20	GW	Well graded gravels and gravel-sand mixtures, little or no fines	Use the gradation curve of material passing 63 mm for classification of fractions according to the criteria given in 'Major Divisions'	0-5	—	>4	Between 1 and 3	(1) Identify fines by the method given for fine-grained soils.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels		0-5	—	Fails to comply with above		
		medium ____6	GM	Silty gravels, gravel-sand-silt mixtures (1)		12-50	Below 'A' line or PI<4	—	—	
		fine ____2.36	GC	Clayey gravels, gravel-sand-clay mixtures (1)		12-50	Above 'A' line and PI>7	—	—	
	SANDS (more than half of coarse fraction is smaller than 2.36 mm)	coarse	SW	Well graded sands and gravelly sands, little or no fines		0-5	—	>6	Between 1 and 3	(2) Borderline classifications occur when the percentage of fines (fraction smaller than 0.075 mm size) is greater than 5% and less than 12%. Borderline classifications require the use of SP-SM, GW-GC.
		____0.6	SP	Poorly graded sands and gravelly sands, little or no fines		0-5	—	Fails to comply with above		
		medium ____0.2	SM	Silty sands, sand silt mixtures (1)		12-50	Below 'A' line or PI<4	—	—	
		fine 0.075	SC	Clayey sands, sand-clay mixtures (1)		12-50	Above 'A' line and PI>7	—	—	
FINE GRAINED SOILS (more than half of material less than 63 mm is smaller than 0.075 mm)	SILTS & CLAYS (Liquid Limit ≤50%)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity		Plasticity Chart For classification of fine grained soils and fine fraction of coarse grained soils.				
			CL CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays						
			OL	Organic silts and clays of low plasticity						
	SILTS & CLAYS (Liquid Limit >50%)		MH	Inorganic silts, mic- aceous or diato-maceous fine sands or silts, elastic silts						
			CH	Inorganic clays of high plasticity, fat clays						
			OH	Organic silts and clays of high plasticity						
	HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils						



ROCK CLASSIFICATION FOR ENGINEERING PURPOSES

Degree of Weathering

Code	ISRM GRADE	Description		Decolourant Extent	Fracture Condition	Surface Characteristics
F	1	**FRESH**, Rock shows no sign of decomposition or staining.		None	Closed or discoloured	Unchanged
SW	2	**SLIGHTY WEATHERED**, Rock is slightly discoloured but shows little or no change of strength from fresh rock.		<50% has modest discolouration	Discoloured may contain thin filling	Partial discolouration
MW	3	**MODERATLY WEATHERED**, Modest discolouration is evident throughout the rock fabric, often with some change in the constituent minerals. The intact rock strength is usually noticeably weaker than that of the fresh rock.	Distinctly Weathered	>50% has modest discolouration	Discoloured may contain thick filling	Partial to complete discolouration, not friable except poorly cemented rocks
HW	4	**HIGHLY WEATHERED**, Strong discolouration is evident throughout the rock mass, often with significant change in the constituent minerals. The intact rock strength is generally much weaker than that of the fresh rock.		100% has strong discolouration	Filled with alteration minerals	Friable and possible pitted
XW	5	**EXTREMELY WEATHERED**, Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water, but substance fabric and rock structure still recognisable.		100% has strong discolouration	Filled with alteration minerals	Resembles soil
RS	6	**RESIDUAL SOIL**, All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.		100% has strong discolouration	N/A	Resembles soil

Rock Strength

Term	Symbol	Field Guide*	Point Load Index [$I_{S(50)}$] MPa	Approx Unconfined Compressive Strength (q_u)
Extremely Low	EL	Easily remoulded by hand to a material with soil properties.	<0.03	<0.6
Very Low	VL	Material crumbles under firm blows with sharp end of geological pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 30mm thick can be broken by finger pressure.	0.03 – 0.1	0.6 – 2
Low	L	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the geological pick point; has dull sound under hammer. A piece of core 150mm long by 40mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1 – 0.3	2 – 6
Medium	M	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.	0.3 – 1	6 – 20
High	H	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken with geological pick with a single firm blow; rock rings under hammer.	1 – 3	20 – 60
Very High	VH	Hand specimen breaks with geological pick after more than one blow; rock rings under hammer.	3 – 10	60 – 200
Extremely High	EH	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	>10	>200

Note that these terms refer to strength of rock and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide visual assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** AS1726

*** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index (PLI) of 20:1. This ratio may vary widely. This ratio applies unless specific rock calibration studies have been conducted for the site.

ROCK CLASSIFICATION FOR ENGINEERING PURPOSES

Degree of Fracturing

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plan perpendicular to the core axis.

Note the recording of actual spacing and range of spacing is preferred in place of the terms below.

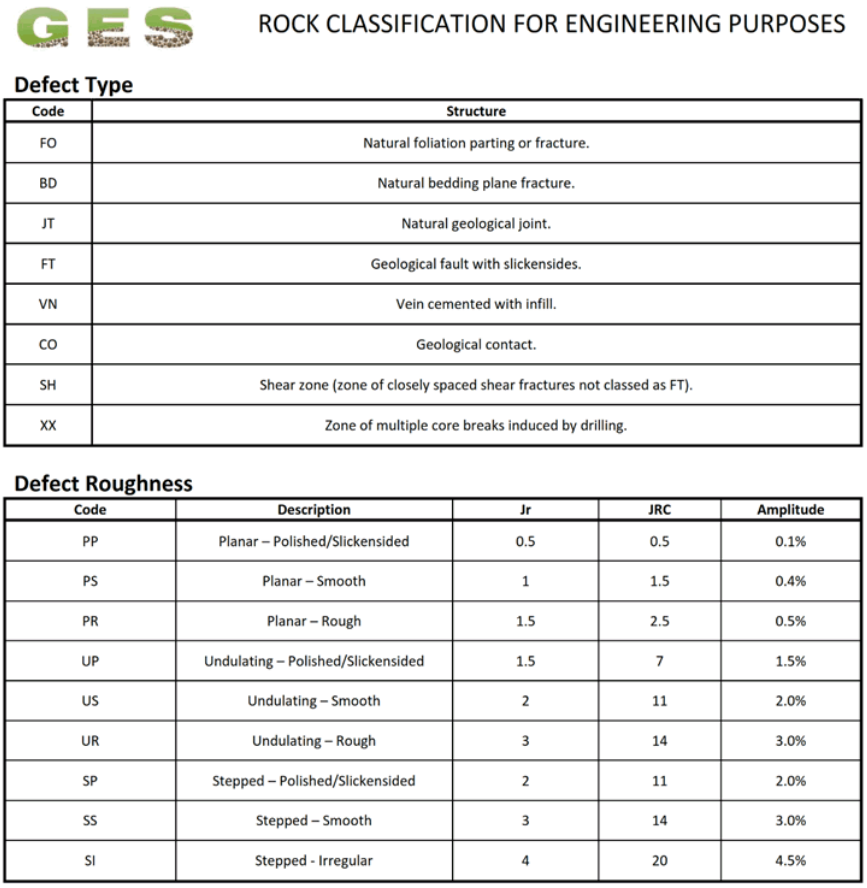
Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter.
Highly fractured	Core lengths are generally less than 20mm to 40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm to 100mm with occasional shorter and longer sections.
Slightly fractured	Core lengths are generally 300mm to 1000mm with occasional longer sections and occasional sections of 100mm to 300mm.
Unbroken	The core does not contain any fracture.

Rock Quality Designation (RQD)

This is defined as the ratio of sound (ie low strength or better) core in lengths of greater than 100mm to the total length of the core, expressed in precent. If the core is broken by handling or by the drilling process (i.e. fracture surfaces are fresh, irregular breaks rather than joint surfaces), the fresh broken pieces are fitted together and counted as one piece.

Bedding/Foliation Spacing

Code	Term	Spacing
VWB	Very Widely Bedded/Foliated	>2m
WB	Widely Bedded/Foliated	0.6 – 2m
MB	Moderately Bedded/Foliated	0.2 – 0.6m
CB	Closely Bedded/Foliated	0.06 – 0.2m
VCB	Very Closely Bedded/Foliated	20mm – 60mm
L	Laminated	6mm – 20mm
CL	Closely Laminated	<6mm



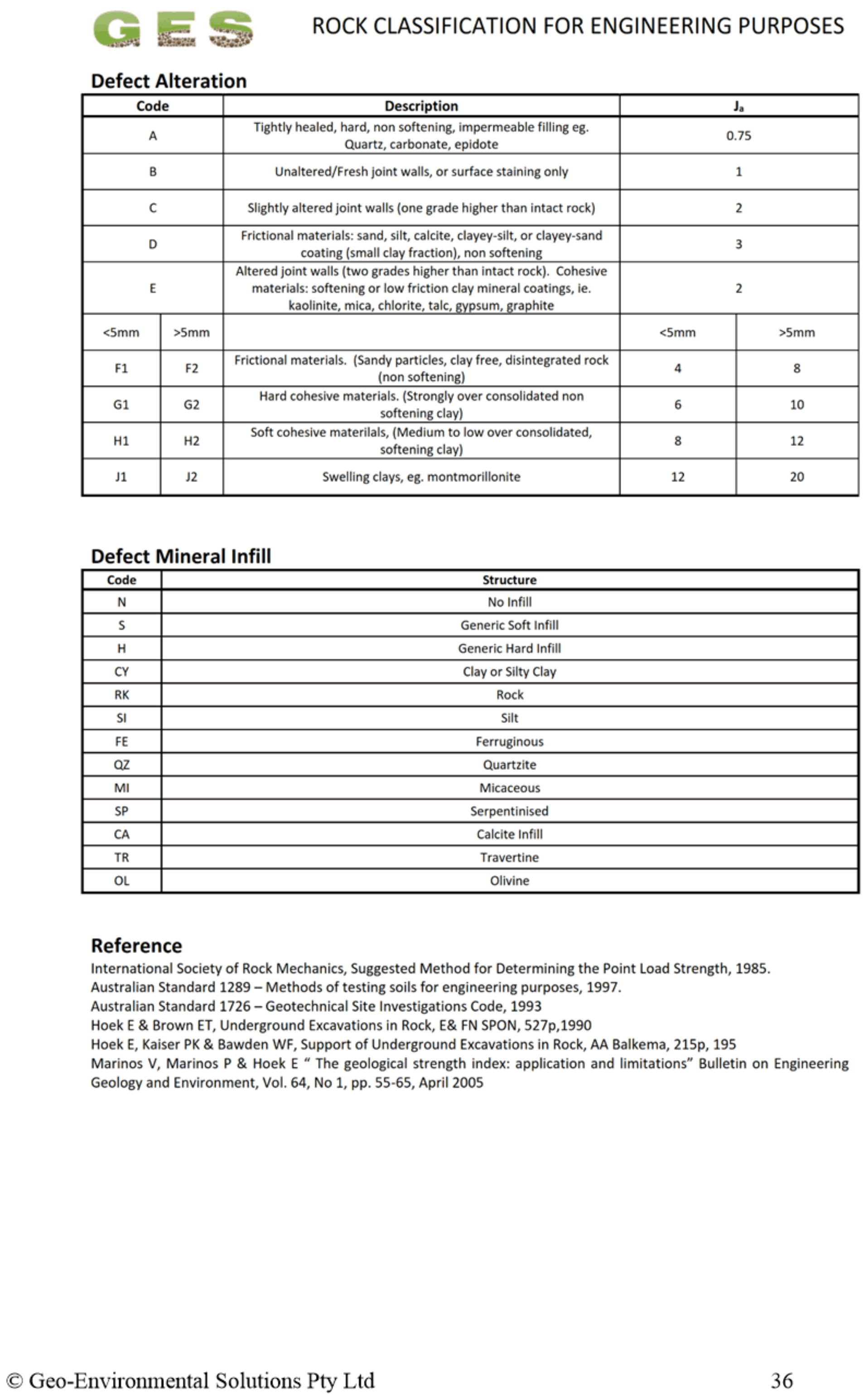
ROCK CLASSIFICATION FOR ENGINEERING PURPOSES

Defect Type

Code	Structure
FO	Natural foliation parting or fracture.
BD	Natural bedding plane fracture.
JT	Natural geological joint.
FT	Geological fault with slickensides.
VN	Vein cemented with infill.
CO	Geological contact.
SH	Shear zone (zone of closely spaced shear fractures not classed as FT).
XX	Zone of multiple core breaks induced by drilling.

Defect Roughness

Code	Description	Jr	JRC	Amplitude
PP	Planar – Polished/Slickensided	0.5	0.5	0.1%
PS	Planar – Smooth	1	1.5	0.4%
PR	Planar – Rough	1.5	2.5	0.5%
UP	Undulating – Polished/Slickensided	1.5	7	1.5%
US	Undulating – Smooth	2	11	2.0%
UR	Undulating – Rough	3	14	3.0%
SP	Stepped – Polished/Slickensided	2	11	2.0%
SS	Stepped – Smooth	3	14	3.0%
SI	Stepped - Irregular	4	20	4.5%



ROCK CLASSIFICATION FOR ENGINEERING PURPOSES

Defect Alteration

Code		Description	J_a	
A		Tightly healed, hard, non softening, impermeable filling eg. Quartz, carbonate, epidote	0.75	
B		Unaltered/Fresh joint walls, or surface staining only	1	
C		Slightly altered joint walls (one grade higher than intact rock)	2	
D		Frictional materials: sand, silt, calcite, clayey-silt, or clayey-sand coating (small clay fraction), non softening	3	
E		Altered joint walls (two grades higher than intact rock). Cohesive materials: softening or low friction clay mineral coatings, ie. kaolinite, mica, chlorite, talc, gypsum, graphite	2	
<5mm	>5mm		<5mm	>5mm
F1	F2	Frictional materials. (Sandy particles, clay free, disintegrated rock (non softening)	4	8
G1	G2	Hard cohesive materials. (Strongly over consolidated non softening clay)	6	10
H1	H2	Soft cohesive materilals, (Medium to low over consolidated, softening clay)	8	12
J1	J2	Swelling clays, eg. montmorillonite	12	20

Defect Mineral Infill

Code	Structure
N	No Infill
S	Generic Soft Infill
H	Generic Hard Infill
CY	Clay or Silty Clay
RK	Rock
SI	Silt
FE	Ferruginous
QZ	Quartzite
MI	Micaceous
SP	Serpentinised
CA	Calcite Infill
TR	Travertine
OL	Olivine

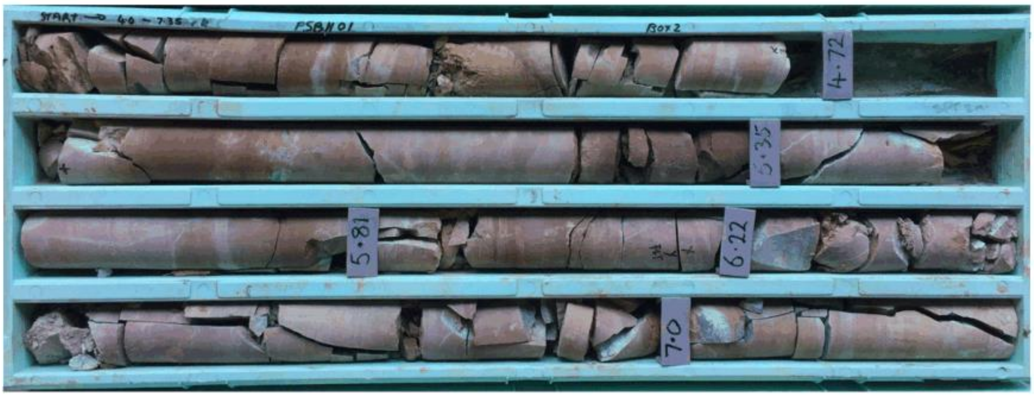
Reference

International Society of Rock Mechanics, Suggested Method for Determining the Point Load Strength, 1985.
Australian Standard 1289 – Methods of testing soils for engineering purposes, 1997.
Australian Standard 1726 – Geotechnical Site Investigations Code, 1993
Hoek E & Brown ET, Underground Excavations in Rock, E& FN SPON, 527p,1990
Hoek E, Kaiser PK & Bawden WF, Support of Underground Excavations in Rock, AA Balkema, 215p, 195
Marinos V, Marinos P & Hoek E " The geological strength index: application and limitations" Bulletin on Engineering Geology and Environment, Vol. 64, No 1, pp. 55-65, April 2005

APPENDIX 2 – CORE PHOTOGRAPHS

BOREHOLE ID: PSBH01
DEPTH: 0.0 to 4.0 m

BOREHOLE ID: PSBH01
DEPTH: 4.0 to 7.3 m



BOREHOLE ID: PSBH01
DEPTH: 7.3 to 9.05 m (EOH)

BOREHOLE ID: PSBH02

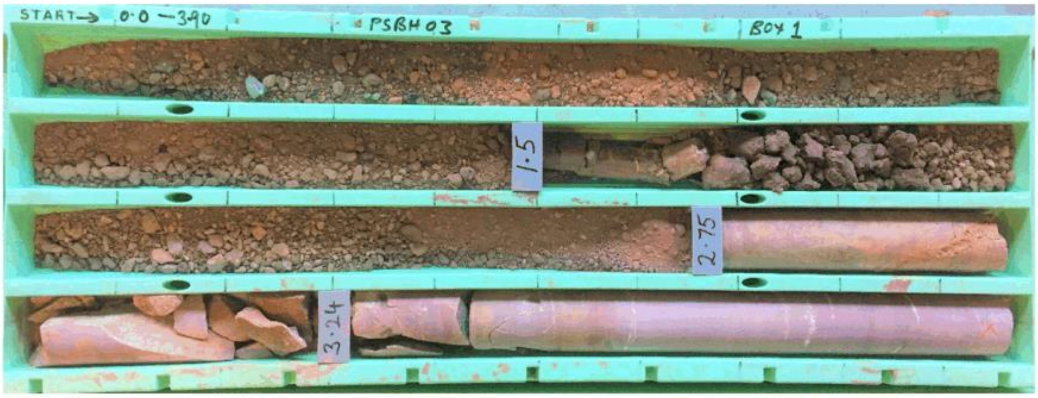
DEPTH: 0.0 to 5.0 m

BOREHOLE ID: PSBH02

DEPTH: 5.0 to 8.3 m

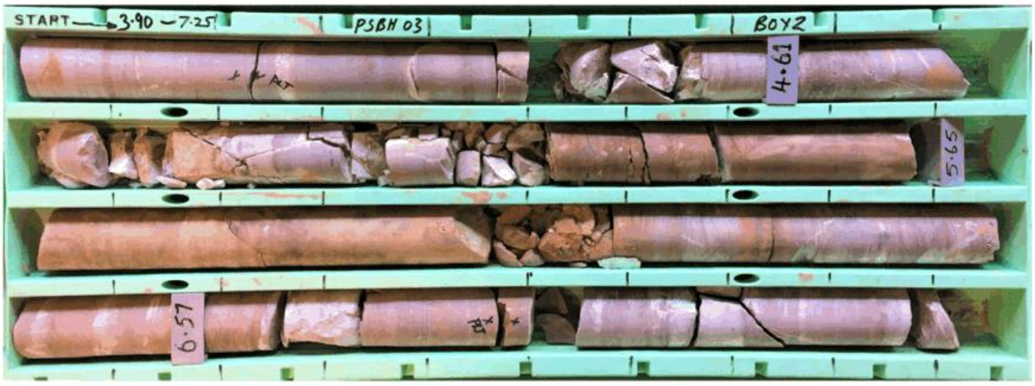
BOREHOLE ID: PSBH03

DEPTH: 0.0 to 3.9 m



BOREHOLE ID: PSBH03

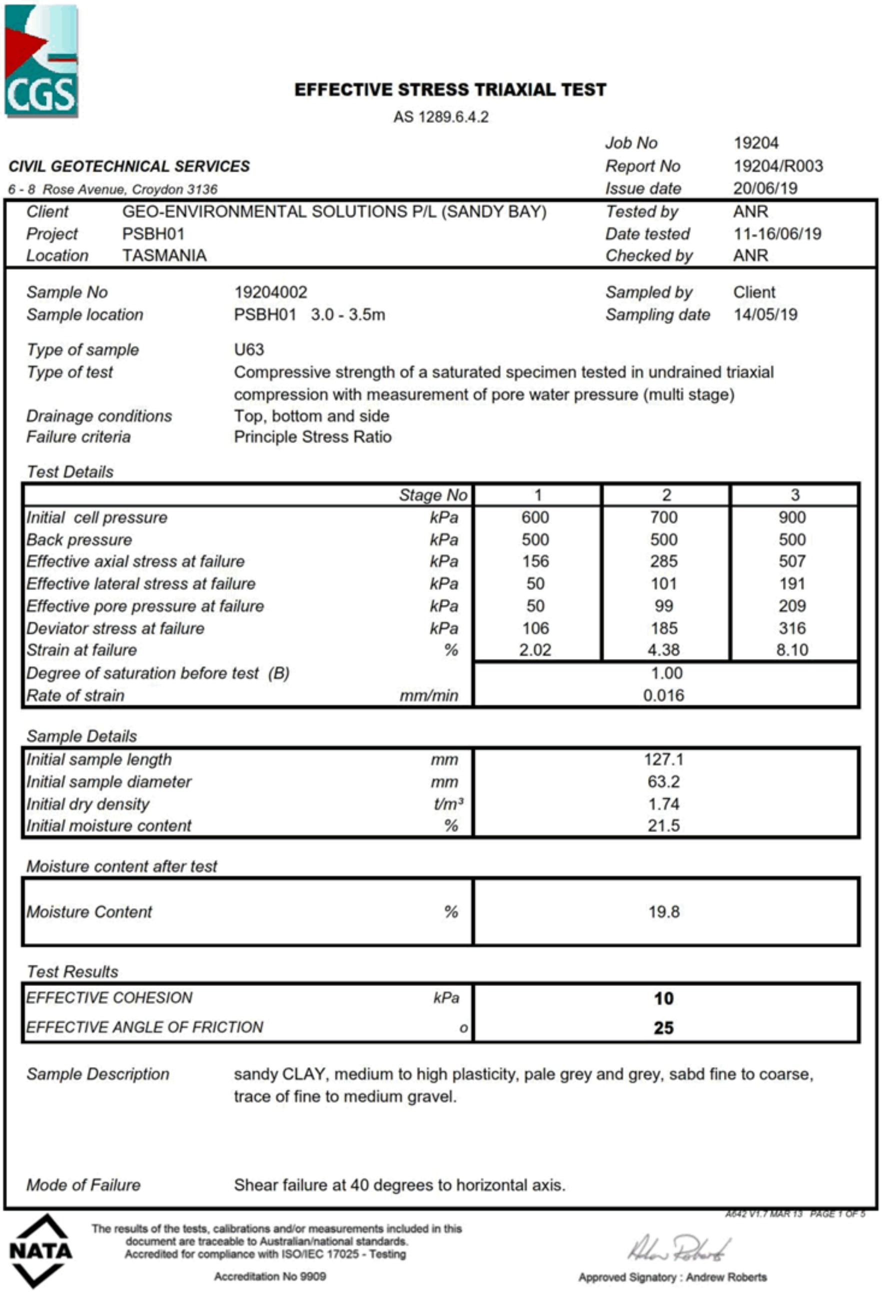
DEPTH: 3.9 to 7.25 m



BOREHOLE ID: PSBH03

DEPTH: 7.25 to 8.4 m (EOH)

APPENDIX 3 – LABORATORY TESTING CERTIFICATES



EFFECTIVE STRESS TRIAXIAL TEST

AS 1289.6.4.2

CIVIL GEOTECHNICAL SERVICES
6 - 8 Rose Avenue, Croydon 3136

Job No	19204		
Report No	19204/R003		
Issue date	20/06/19		
Client	GEO-ENVIRONMENTAL SOLUTIONS P/L (SANDY BAY)	*Tested by*	ANR
Project	PSBH01	*Date tested*	11-16/06/19
Location	TASMANIA	*Checked by*	ANR
Sample No	19204002	*Sampled by*	Client
Sample location	PSBH01 3.0 - 3.5m	*Sampling date*	14/05/19
Type of sample	U63		
Type of test	Compressive strength of a saturated specimen tested in undrained triaxial compression with measurement of pore water pressure (multi stage)		
Drainage conditions	Top, bottom and side		
Failure criteria	Principle Stress Ratio		

Test Details

	Stage No	1	2	3
Initial cell pressure	*kPa*	600	700	900
Back pressure	*kPa*	500	500	500
Effective axial stress at failure	*kPa*	156	285	507
Effective lateral stress at failure	*kPa*	50	101	191
Effective pore pressure at failure	*kPa*	50	99	209
Deviator stress at failure	*kPa*	106	185	316
Strain at failure	*%*	2.02	4.38	8.10
Degree of saturation before test (B)		1.00		
Rate of strain	*mm/min*	0.016		

Sample Details

Initial sample length	*mm*	127.1
Initial sample diameter	*mm*	63.2
Initial dry density	*t/m³*	1.74
Initial moisture content	*%*	21.5

Moisture content after test

Moisture Content	*%*	19.8

Test Results

EFFECTIVE COHESION	*kPa*	**10**
EFFECTIVE ANGLE OF FRICTION	*o*	**25**

Sample Description sandy CLAY, medium to high plasticity, pale grey and grey, sabd fine to coarse, trace of fine to medium gravel.

Mode of Failure Shear failure at 40 degrees to horizontal axis.

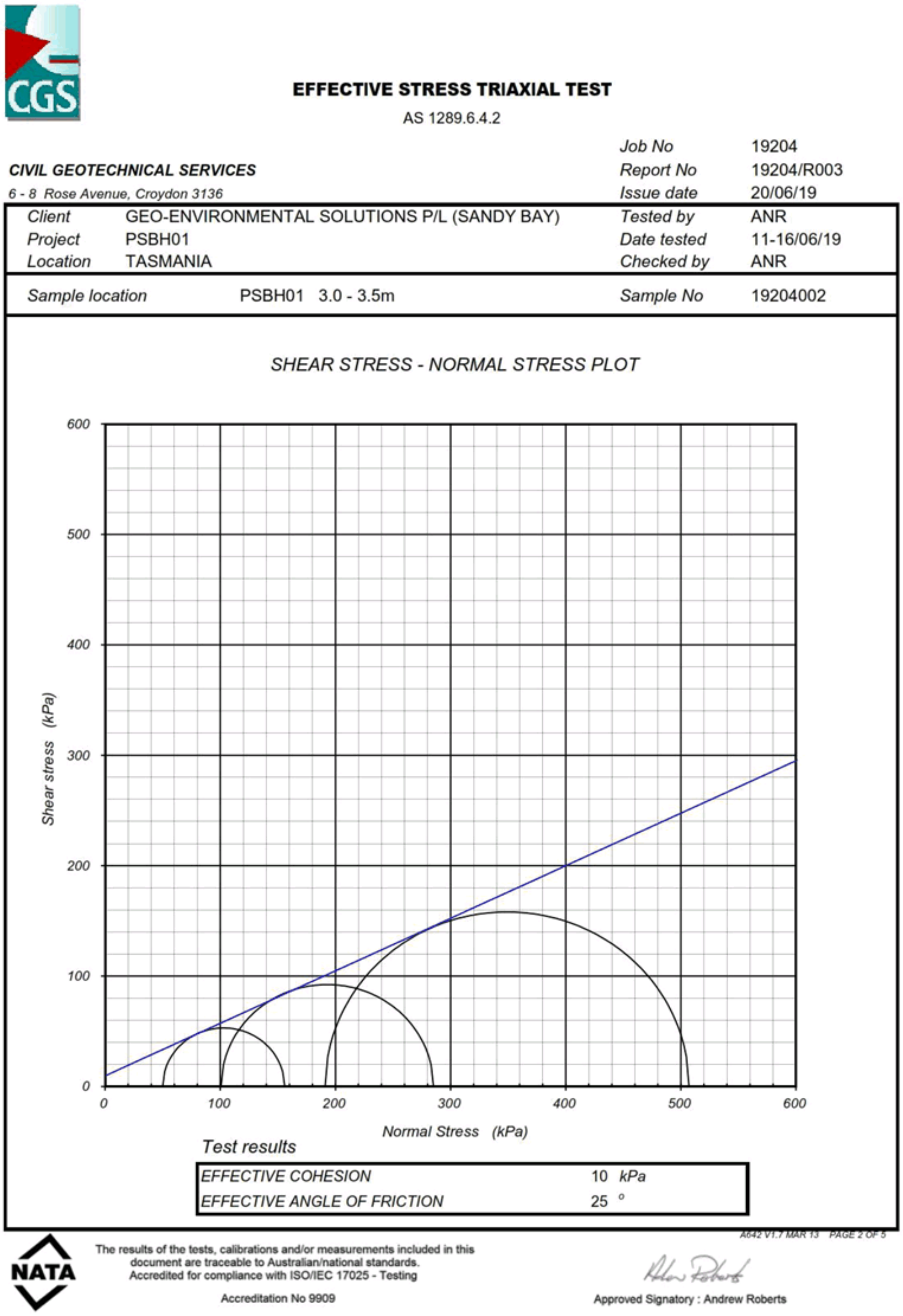
A642 V1.7 MAR 13 PAGE 1 OF 5

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No 9909

Approved Signatory : Andrew Roberts



EFFECTIVE STRESS TRIAXIAL TEST

AS 1289.6.4.2

CIVIL GEOTECHNICAL SERVICES
6 - 8 Rose Avenue, Croydon 3136

Job No 19204
Report No 19204/R003
Issue date 20/06/19

Client GEO-ENVIRONMENTAL SOLUTIONS P/L (SANDY BAY)
Project PSBH01
Location TASMANIA
Tested by ANR
Date tested 11-16/06/19
Checked by ANR

Sample location PSBH01 3.0 - 3.5m
Sample No 19204002

SHEAR STRESS - NORMAL STRESS PLOT

Test results

EFFECTIVE COHESION	10 *kPa*
EFFECTIVE ANGLE OF FRICTION	25 °

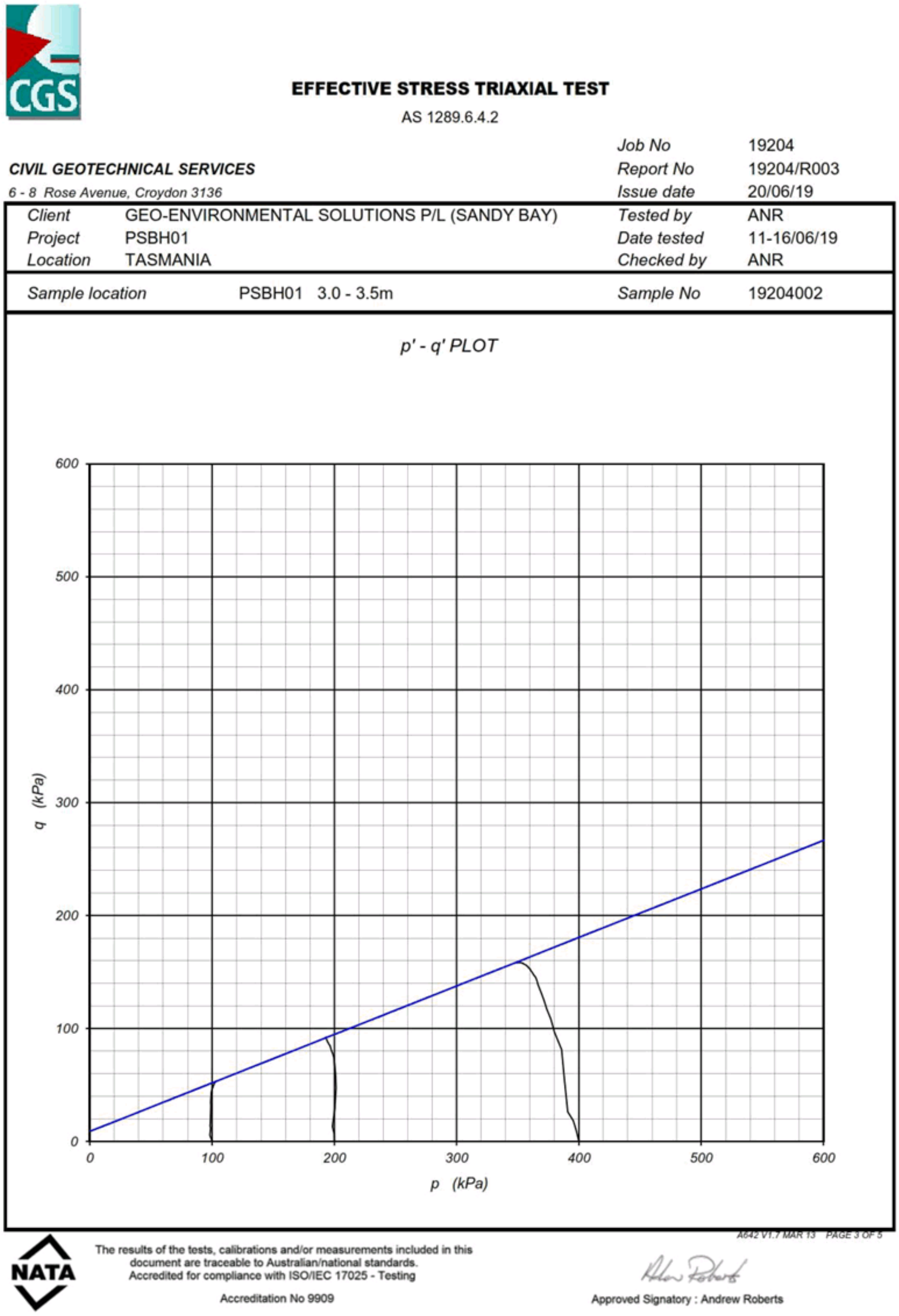
A642 V1.7 MAR 13 PAGE 2 OF 5

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No 9909

Approved Signatory : Andrew Roberts



EFFECTIVE STRESS TRIAXIAL TEST

AS 1289.6.4.2

CIVIL GEOTECHNICAL SERVICES
6 - 8 Rose Avenue, Croydon 3136

		Job No	19204
		Report No	19204/R003
		Issue date	20/06/19
Client	GEO-ENVIRONMENTAL SOLUTIONS P/L (SANDY BAY)	*Tested by*	ANR
Project	PSBH01	*Date tested*	11-16/06/19
Location	TASMANIA	*Checked by*	ANR
Sample location	PSBH01 3.0 - 3.5m	*Sample No*	19204002

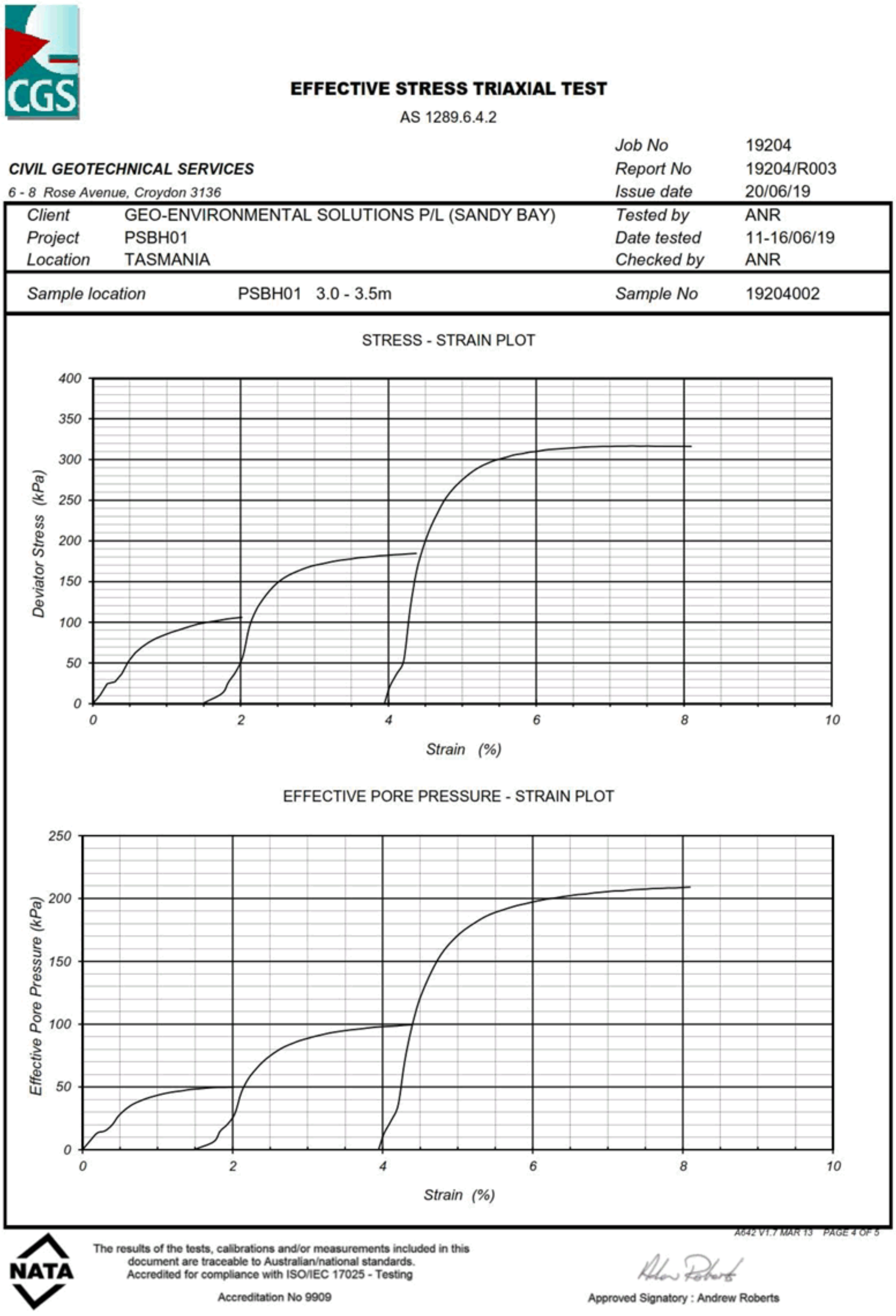
p' - q' PLOT

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No 9909

A642 V1.7 MAR 13 PAGE 3 OF 5

Approved Signatory : Andrew Roberts



EFFECTIVE STRESS TRIAXIAL TEST

AS 1289.6.4.2

CIVIL GEOTECHNICAL SERVICES
6 - 8 Rose Avenue, Croydon 3136

Job No 19204
Report No 19204/R003
Issue date 20/06/19

Client	GEO-ENVIRONMENTAL SOLUTIONS P/L (SANDY BAY)	*Tested by*	ANR
Project	PSBH01	*Date tested*	11-16/06/19
Location	TASMANIA	*Checked by*	ANR
Sample location	PSBH01 3.0 - 3.5m	*Sample No*	19204002

STRESS - STRAIN PLOT

EFFECTIVE PORE PRESSURE - STRAIN PLOT

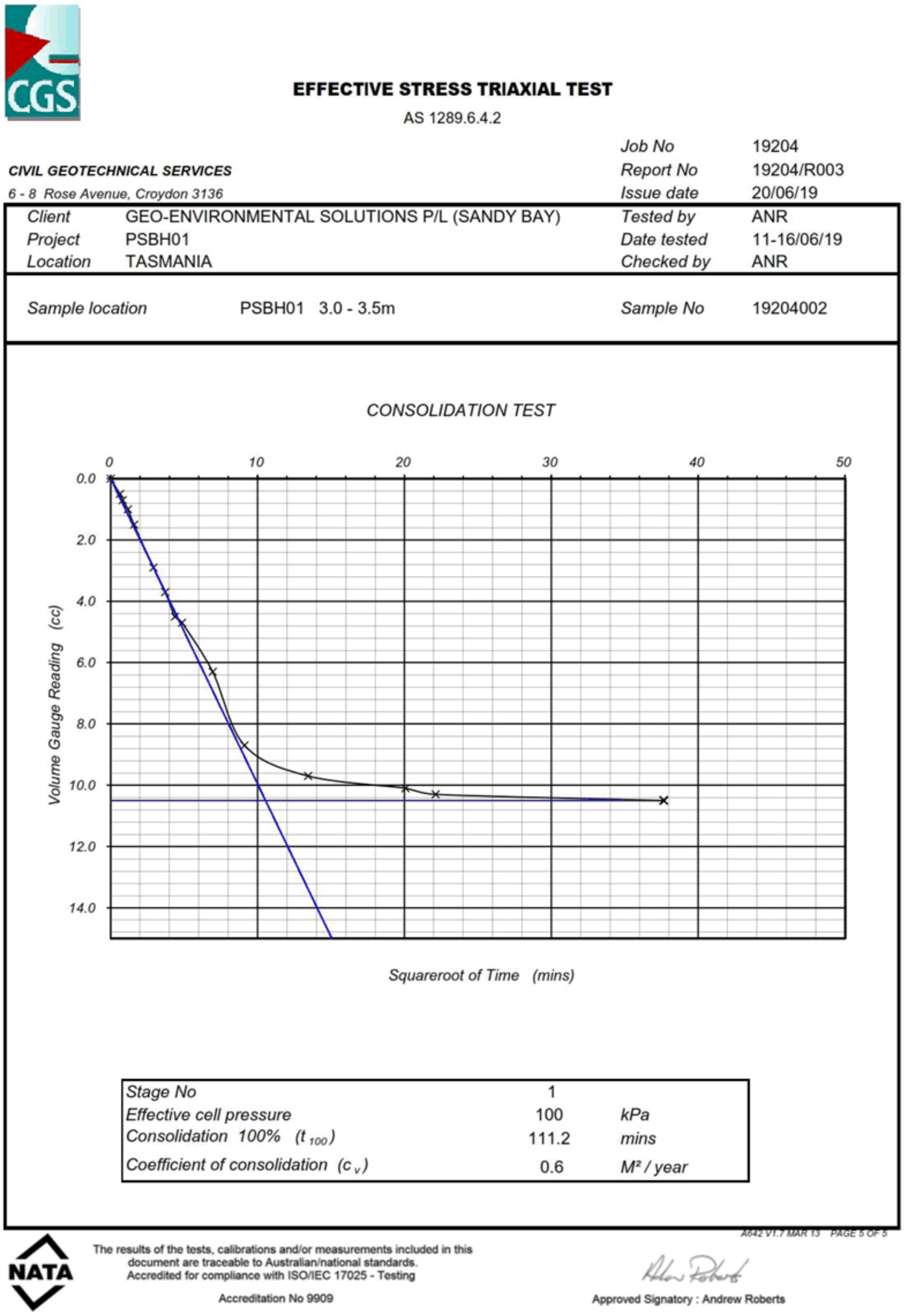
A642 V1.7 MAR 13 PAGE 4 OF 5

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No 9909

Approved Signatory : Andrew Roberts



CGS

EFFECTIVE STRESS TRIAXIAL TEST

AS 1289.6.4.2

CIVIL GEOTECHNICAL SERVICES
6 - 8 Rose Avenue, Croydon 3136

		Job No	19204
		Report No	19204/R003
		Issue date	20/06/19
Client	GEO-ENVIRONMENTAL SOLUTIONS P/L (SANDY BAY)	Tested by	ANR
Project	PSBH01	Date tested	11-16/06/19
Location	TASMANIA	Checked by	ANR
Sample location	PSBH01 3.0 - 3.5m	Sample No	19204002

CONSOLIDATION TEST

Stage No	1	
Effective cell pressure	100	kPa
Consolidation 100% (t_{100})	111.2	mins
Coefficient of consolidation (c_v)	0.6	M^2 / year

A642 V1.7 MAR 13 PAGE 5 OF 5

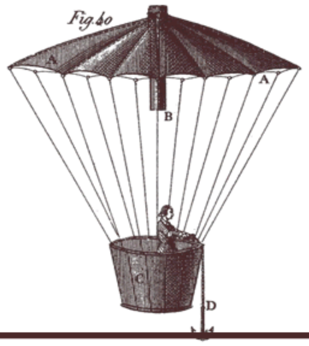
NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No 9909

Approved Signatory : Andrew Roberts

GANDY AND ROBERTS
159 DAVEY ST
HOBART TASMANIA
AUSTRALIA 7000
CONSULTING
ENGINEERS



62-64 Patrick Street

Inundation Risk Management Plan

for 6 Failla Avenue Pty Ltd

13/11/2019

Version control

Revision	Description	Issue date	Issued by
A	Planning Approval	13/11/2019	Joshua Farner

PROJECT NUMBER **18.0591**
REPORT AUTHOR **Joshua Farner**
CHECKED BY **Simon Palmer**

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Contents

Figures

Table

1 Context

Gandy and Roberts were engaged by 6 Failla Avenue Pty Ltd to undertake an inundation assessment for 62-64 Patrick Street, Hobart, as required in response to the City of Hobart's (CoH) Request for Further Information (RFI), dated 2 October 2019 for the planning application PLN-19-486.

The RFI notes that the site is adjacent to the Warwick Rivulet, and may be subject to inland flooding. In order to enable the Council to assess the application against the relevant provisions of the Inundation Prone Land Code of Hobart Interim Planning Scheme 2015, Council require:

"An Inundation Risk Management Plan and any accompanying calculations and plans showing the inundation risk of the proposed development site for a 1% AEP at 2100 (including climate change)."

The management plan must:

1. Be prepared by a suitably qualified engineer;
2. Show the risk of inundation of the site, proposed building and building floor levels based on a predicted 1% annual exceedance probability (AEP) flood event for the year 2100 (including consideration of climate change). Clearly state the vertical clearance between the proposed finished floor level of any habitable rooms and the flood level;
3. Show the impact of the proposed development upon the risk of inundation of other land, buildings and infrastructure (including frequency, extent, depth and velocity);
4. Detail any inundation control measures or design features proposed to be employed to reduce the risk, and the resultant level of risk; and
5. Confirmation that the proposed works will be designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation.

This report presents the methodology and findings of an inundation assessment for the site undertaken by Gandy and Roberts, and provides appropriate information in order to assess PLN-19-486 against the Inundation Prone Land Code of the Hobart Interim Planning Scheme 2015.

2 Site Description

The proposed development site at 62-64 Patrick Street is located toward the Northern fringe of the Hobart CBD. The site is situated within the Warwick Catchment of the CoH stormwater network, and while the immediate surrounding area is characterised by a highly urban environment, approximately 75% of the catchment is characterised by residential lots, with approximately 45% impervious area.

The catchment reporting to 62-64 Patrick Street was delineated to be approximately 1.1 km^2 and is located to the north and to the east of the proposed development site. Figure 1 below illustrates the site location, while Figure 2 shows the delineated stormwater catchments reporting to the development site.

A previous private inundation assessment was undertaken for the local vicinity in 2017 by Pitt & Sherry in order to assess flooding for a proposed development at 240 Elizabeth Street. The report author viewed this report at the Hobart City Council chambers on 4 November 2019, and this report has been undertaken with an awareness of this previous modelling in the area.

Figure 1. 62-64 Patrick Street site location.

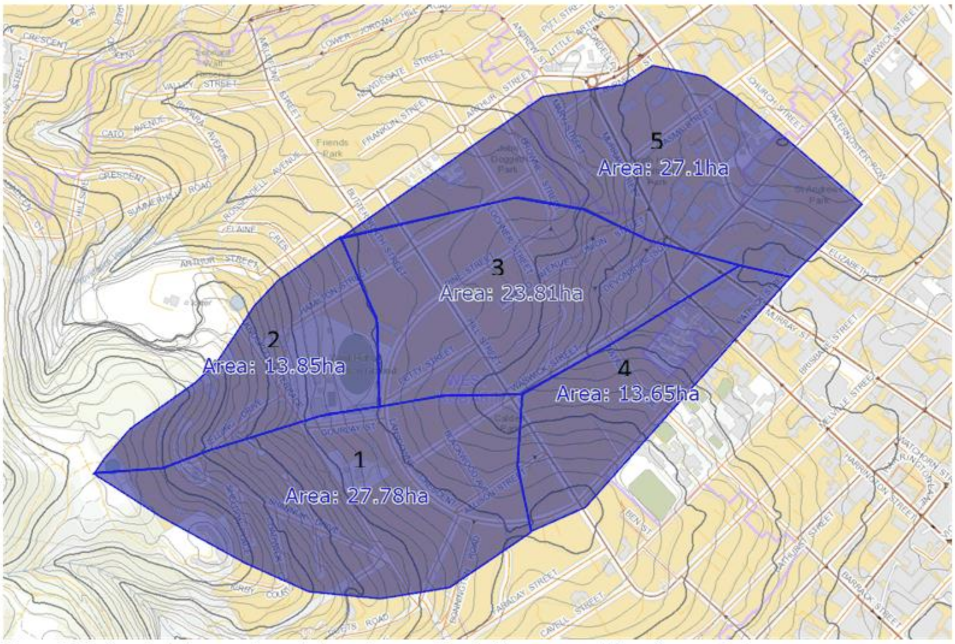


Figure 2. Delineated stormwater catchments reporting to the proposed development site.

3 Hydrological Analysis

In order to determine the flow hydrograph reporting to 62-64 Patrick Street for a defined design storm, a hydrological analysis of the local catchment was undertaken in XPSTORM 2018 using the methods recommended by Australian Rainfall and Runoff (ARR) 2016.

The catchment was analysed based on the delineation illustrated in Figure 2, with an estimated 45% of the catchment designated as impervious area for residential sub-catchments 1-4, and 80% impervious area estimated for the more urban sub-catchment 5. Rainfall data for the site was extracted from the Bureau of Meteorology (BOM), with an increase of 15% applied to account for an increase due to climate change at the year 2100, and temporal patterns were downloaded from the ARR Data Hub.

Table 1. Sub-catchment properties for hydrological analysis

Catchment	Area (Ha)	Average slope	% Impervious
1	13.85	18%	45
2	27.78	19%	45
3	23.81	9%	45
4	16.65	10%	45
5	27.1	7%	80

Initial and continuing losses for the region were derived from the ARR Data Hub to be 27 mm and 4 mm/h, respectively. These losses were considered appropriate for sub-catchments 1 and 2, but as recommended by ARR are not considered applicable for catchments in more urban environments. For sub-catchments 3-5, initial and continuing losses were set to 6.5 mm and 1.5 mm/h respectively, based on the Pitt & Sherry 2017 flood analysis for the local vicinity.

A comparison between the 15, 20, 25 and 30 minute storm durations at 1% AEP is shown in Figure 3. It was determined that the 15 minute storm event was the critical duration for this catchment, which concurred with the Pitt & Sherry 2017 inundation assessment. Storm pattern two was determined to be the median pattern for this event, and the flow output for this storm event, as shown in Figure 4, was selected as the design storm hydrograph for this inundation assessment.

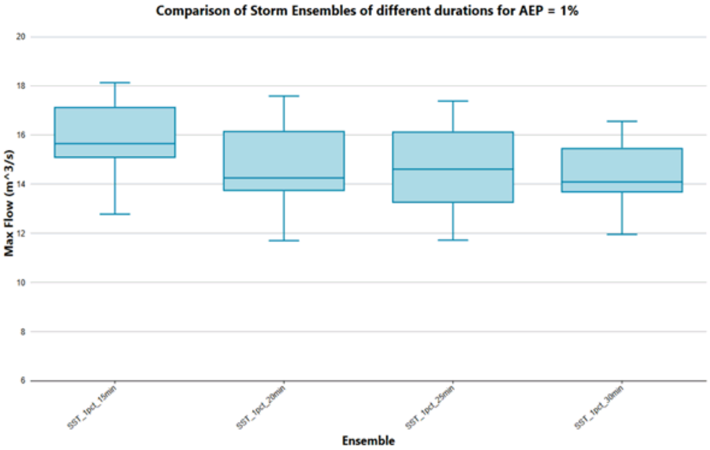


Figure 3. Box and whisker plot comparison of storm ensembles of different durations for 1% AEP.

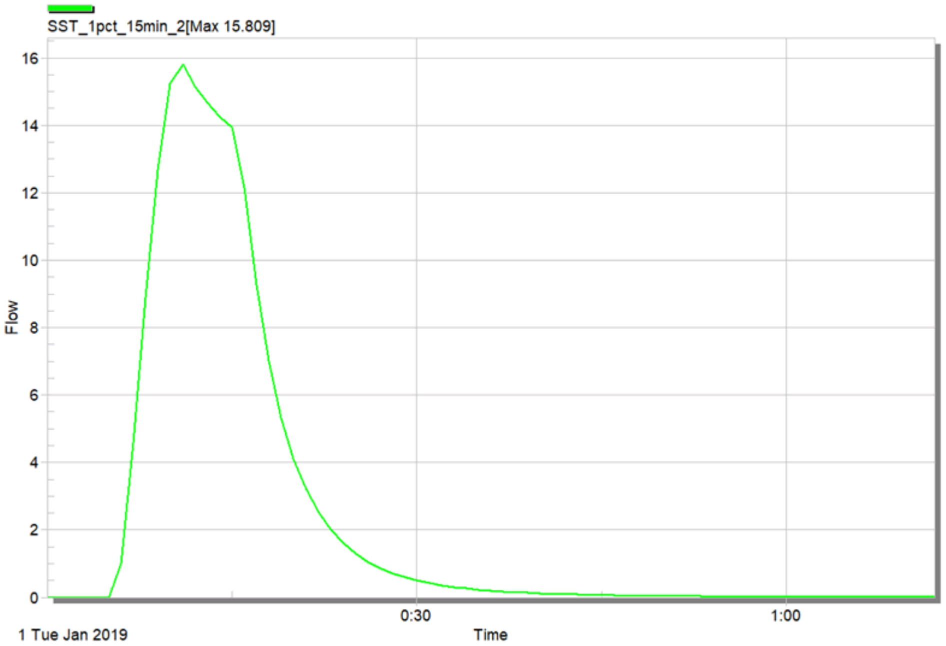


Figure 4. Flow hydrograph for the 1% AEP critical storm duration median pattern (15 min duration; temporal rain pattern 2).

4 Hydraulic Modelling

In order to assess the the risk of inundation to the site and the possible impact of the proposed development on the risk of inundation of adjacent land, a coupled 1D/2D simulation was modelled in XPSTORM 2018. Model data was amalgamated from publicly available LiDAR data and stormwater network information available on the City of Hobart Stormwater online database. The flow hydrograph for the analysis was derived as outlined in Section 3, with a design flow modelled for the 1% AEP rain event plus climate change.

4.1 Model configuration

4.1.1 1D Links

Data for the underground stormwater network in the local vicinity was derived from the City of Hobart online Stormwater database. As invert elevations were not available, it was assumed that pipes follow the grade of the surface topography, and invert depths were assigned to provide a nominal cover. An appropriate inlet capacity was selected to ensure that the pipes were conveying flow but not at maximum capacity, in order to ensure that the model did not overestimate the volume of water able to be accepted by the network in the local vicinity under peak 1% AEP flow conditions.

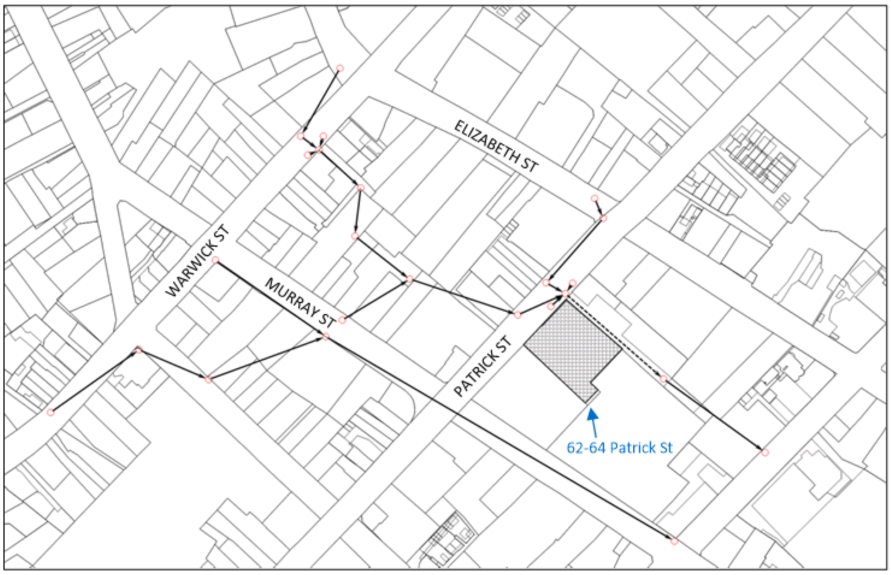


Figure 5. XPSTORM modelled underground pipe network.

4.1.2 2D Surface Model

Publicly available LiDAR from the Mount Wellington River Derwent 2010 dataset (published by Geoscience Australia, accessed 5 November 2019) was used to create a Digital Terrain Model (DTM) for the study site, with a 4.5m 2D grid step size employed. This was selected as the smallest grid size computationally possible for this analysis, due to the relatively large study extent.

Due to the highly urbanised environment in the vicinity of 62-64 Patrick Street, a number of 2D extent modifiers were utilised in order to best model the local site features. These modifiers included a Manning's value of 0.013 for asphalt roadways, and a value of 0.3 for buildings, which is considered a conservative method by which to simulate flow impedance by building structures.

The planned floor elevation of the proposed development at 62-64 Patrick Street was simulated using a height modification to the DTM, and adjusting the building footprint to the proposed level of 24.2 mAHD. A schematic of the 2D model is shown below in Figure 6.

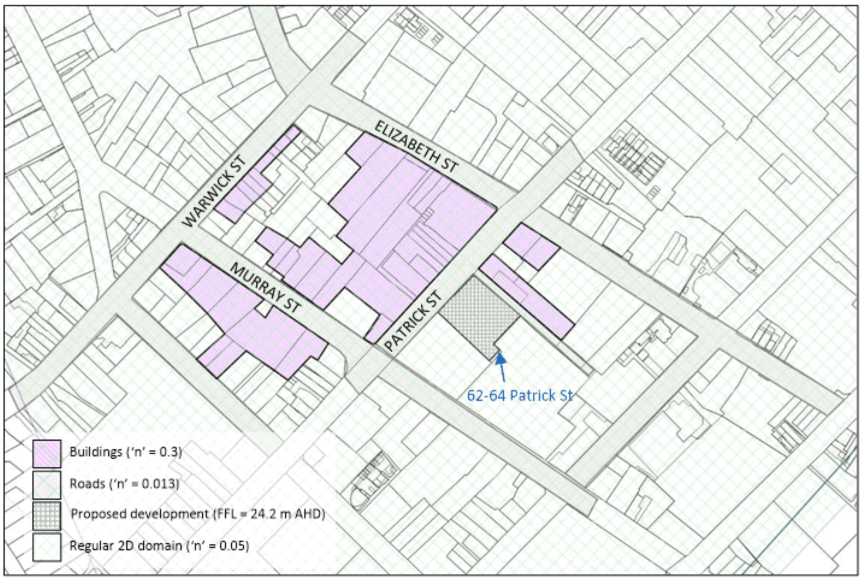


Figure 6. 2D model schematic.

4.1.3 Boundary Conditions

The model boundaries were set at a sufficient distance upstream and downstream of the area of interest so that they would not affect the conditions at the site. The inflow was applied based on the hydrological analysis undertaken in Section 3, and was modelled entering the 2D domain at the northern and eastern boundaries. A free outfall condition was simulated at the southern boundary of the 2D model extent, in order to allow water to exit the model.

4.2 Modelled Scenarios

In order to assess the risk of inundation to the site and the possible impact of the proposed development on the risk of inundation of adjacent land, two scenarios were modelled as outlined below:

Scenario 1: Pre-development of 62-64 Patrick Street – In this scenario, the model was run to simulate existing site conditions, pre-development of 62-64 Patrick Street.

Scenario 2: Post-development of 62-64 Patrick Street – In this scenario, the proposed building footprint was included in the site model in order to assess inundation at the site and the possible impact of the proposed development.

5 Model Results

5.1 Scenario 1: Pre-development

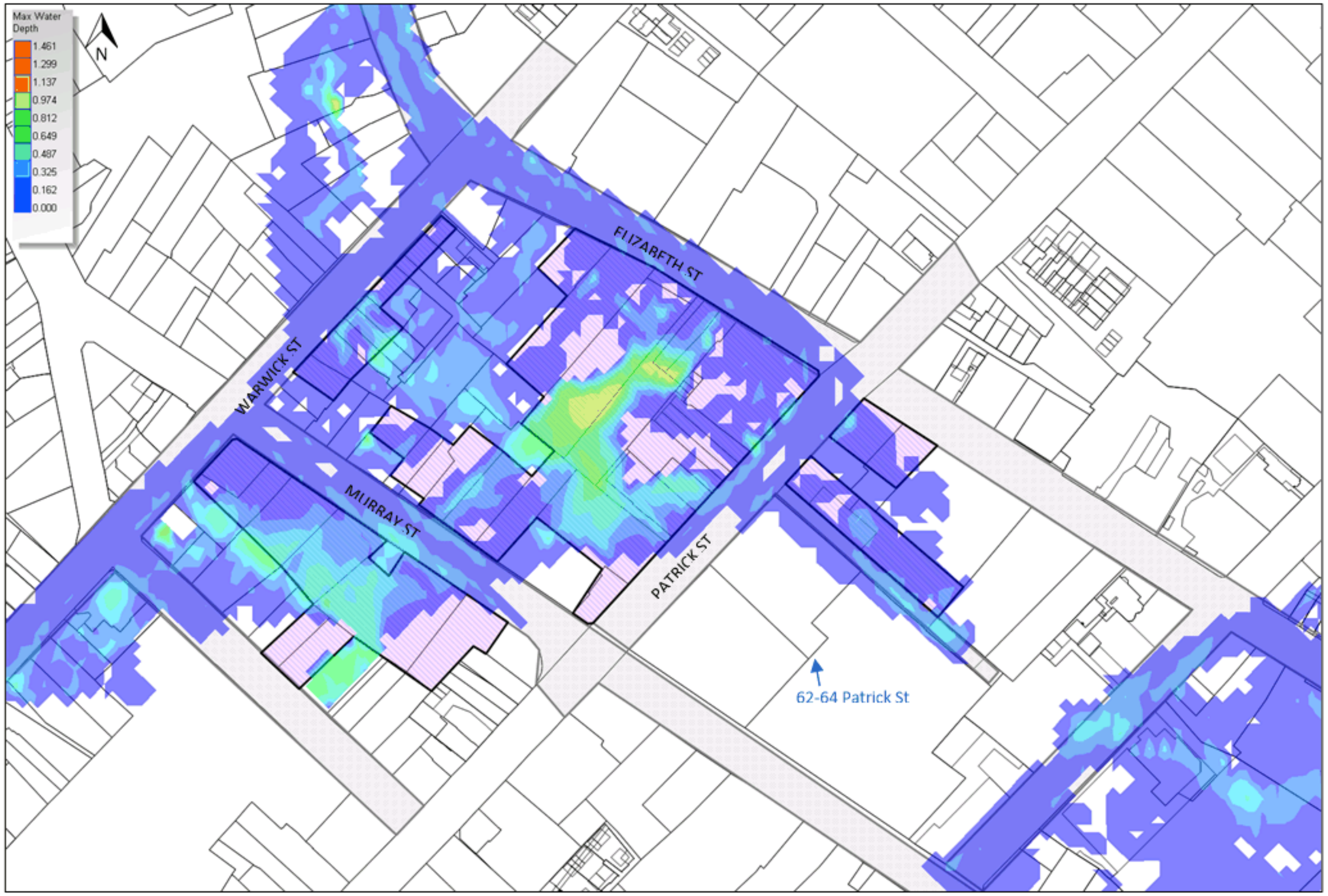


Figure 7. Scenario 1: Pre development maximum flood extent and depth for 1% AEP plus climate change. Flood depth in meters.

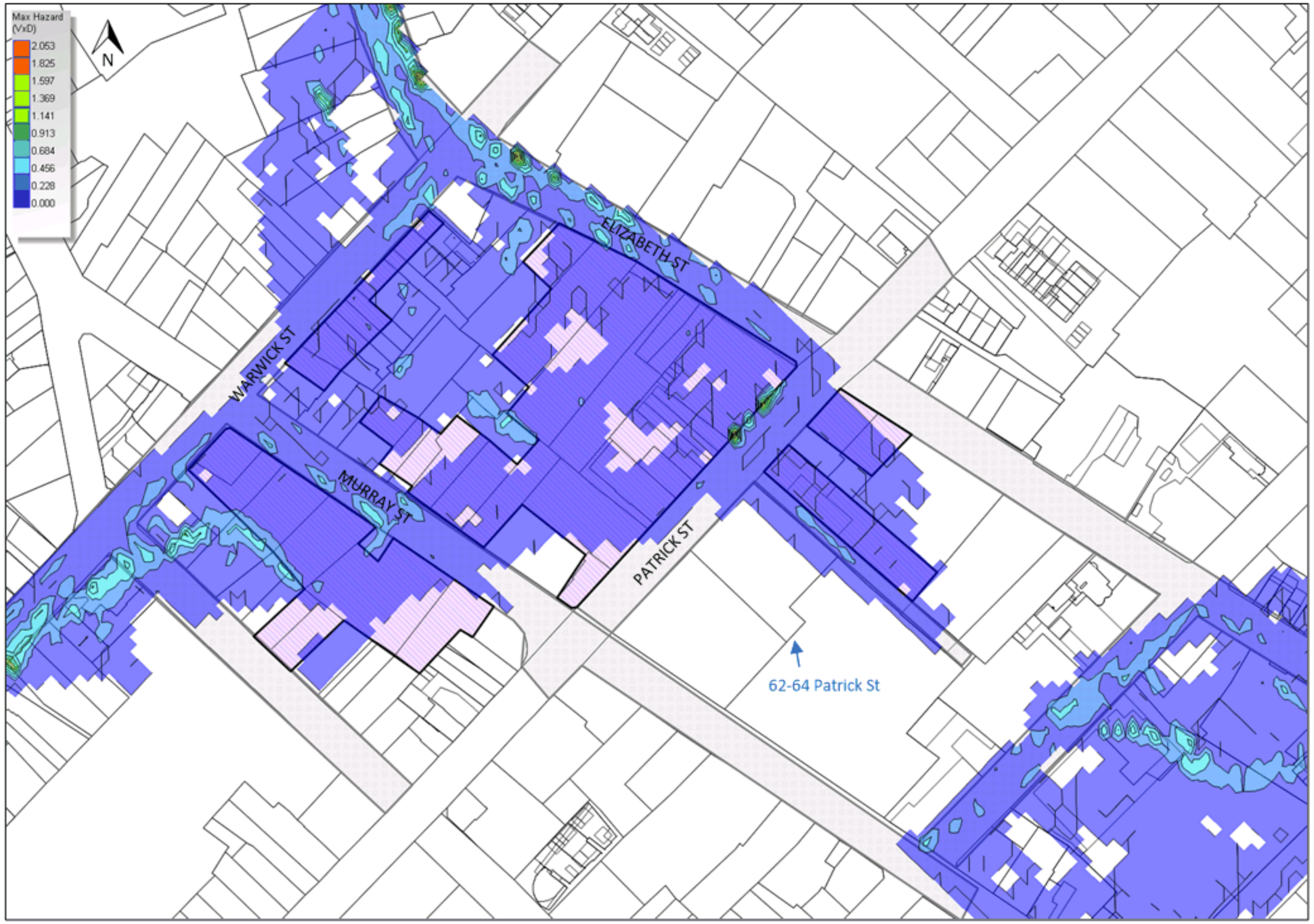


Figure 8. Scenario 1: Pre development maximum flood hazard (DxV) for 1% AEP plus climate change.

5.2 Scenario 2: Post-development

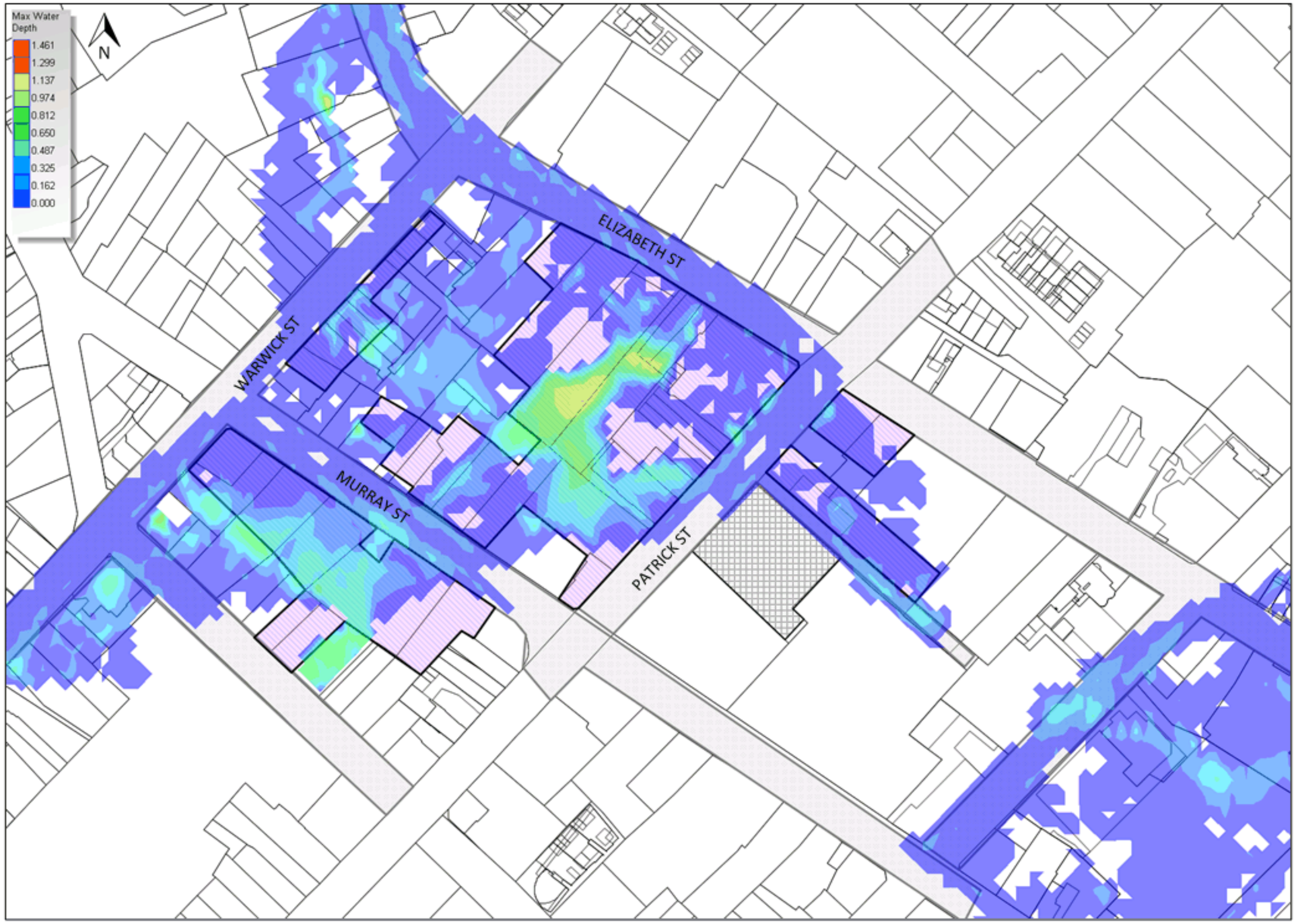


Figure 9. Scenario 2: Post development maximum flood extent and depth for 1% AEP plus climate change. Flood depth in meters.

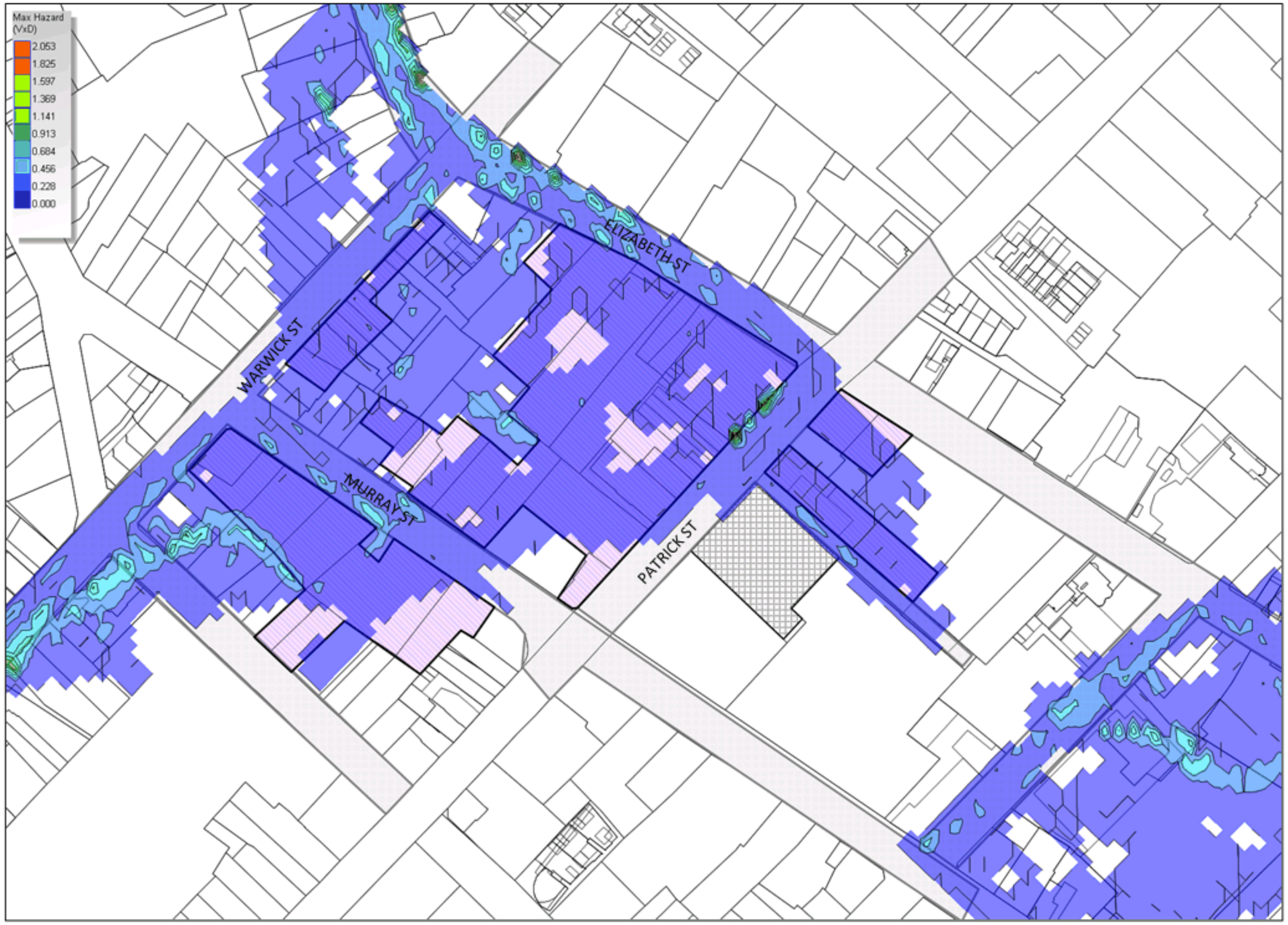


Figure 10. Scenario 2: Post development maximum flood hazard (DxV) for 1% AEP plus climate change.

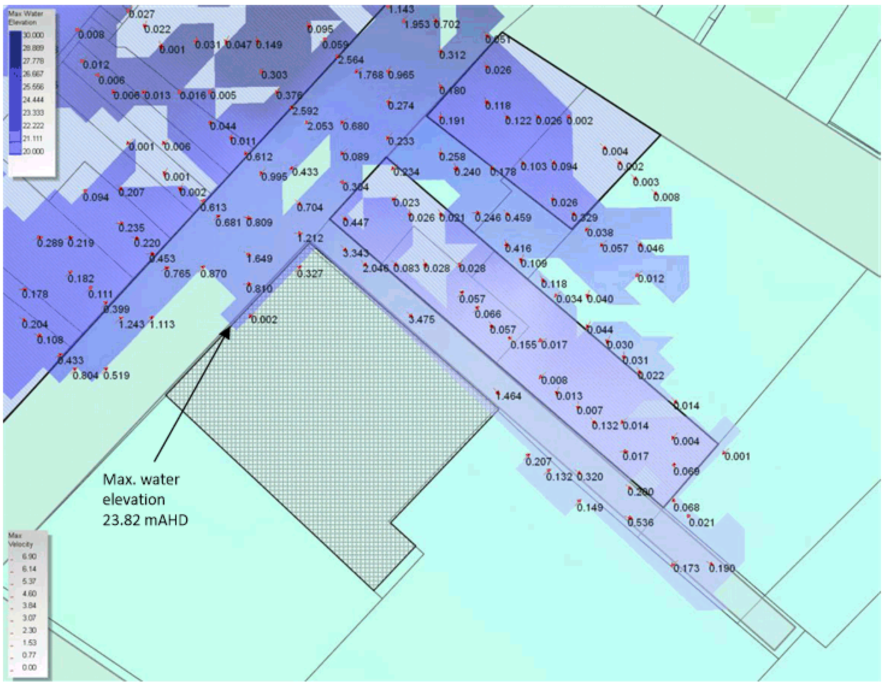
6 Inundation Assessment

From the results of this inundation assessment undertaken by Gandy and Roberts it is predicted that the proposed development will have very minimal impact on the flood extents, depth and velocity within the local area.

From the site survey it is recognised that the low point in Patrick Street is almost directly in line with the North Eastern corner of the 62-64 Patrick Street, and from the pre-development modelling it is apparent that the majority of overland flow is currently directed down the alleyway between 60 Patrick Street and the proposed development site.

It is worth noting that building detail and surface features have not been modelled downstream of the study site, and it is recognised that obstructions within the alleyway may have a localised impact on the flood depths downstream. Due to the steep grade of the alleyway and the relative distance from the study site, however, these effects would not have an impact on the proposed development site, and hence have not been included in this assessment. Furthermore, the DTM model features were identical between the pre and post development scenarios, and thus do not affect the comparison between results.

The maximum post-development flood elevation adjacent to the proposed development site and the maximum flood velocity are illustrated below in Figure 11. No difference in maximum flow depth or velocity within the alleyway was predicted between the pre and post development scenarios.



Max. water elevation 23.82 mAHD

Figure 11. Post development maximum water elevation (mAHD) and flow velocity (labelled; m/s) in the vicinity of 62-64 Patrick Street. Flow vectors are indicated by arrows and labels.

7 Response to City of Hobart RFI

In order to enable the Council to assess the application against the relevant provisions of the Inundation Prone Land Code of Hobart Interim Planning Scheme 2015, the below responses are provided:

2. *Show the risk of inundation of the site, proposed building and building floor levels based on a predicted 1% annual exceedance probability (AEP) flood event for the year 2100 (including consideration of climate change). Clearly state the vertical clearance between the proposed finished floor level of any habitable rooms and the flood level;*

Refer Sections 5 and 6. The maximum post-development water elevation at 62-64 Patrick Street was modelled to be 23.82 mAHD, providing 380 mm freeboard to the entrance floor level of the proposed development (24.2 mAHD).

3. *Show the impact of the proposed development upon the risk of inundation of other land, buildings and infrastructure (including frequency, extent, depth and velocity);*

Refer Sections 5 and 6. No differences in flood depth or velocity in the local area were predicted between the pre and post development scenarios.

4. *Detail any inundation control measures or design features proposed to be employed to reduce the risk, and the resultant level of risk; and*

Due to the >300 mm freeboard predicted for the proposed development, this development meets the Acceptable Solution A1 of E15.7.4 of the Hobart Interim Planning Scheme, and no additional control measure or design features are considered necessary for this development.

5. *Confirmation that the proposed works will be designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation.*

The maximum overland flood depth at 62-64 Patrick Street was modelled to be 290 mm with a maximum velocity of 1.3 m/s. From ARR 2016 the hazard is defined between the H1 and H2 hazard categories: H1 – generally safe for people, vehicles and buildings, and H2 – unsafe for small vehicles. Any building complying with Australian Standards/National Construction Code would be sufficiently able to structurally withstand this level of flooding.

8 References

DPIPWE, “TheList,” Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania, 2019.

Engineers Australia, “Book 6: Flood Hydraulics,” in Australian Rainfall and Runoff, A Guide to Flood Estimation, Engineers Australia, 2016.

Pitt & Sherry, “240 Elizabeth Street Inundation Assessment Report”, 2017. Redacted report released to Gandy and Roberts 21/11/2019.

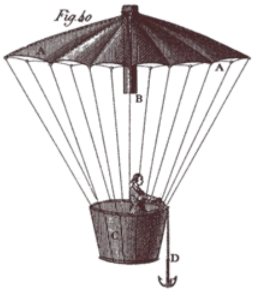


Fig. 40
A
A
B
C
D

DOCUMENT TRANSMITTAL
RESPONSE TO COUNCIL RFI

GANDY AND ROBERTS
159 DAVEY ST
HOBART TASMANIA
AUSTRALIA 7000
CONSULTING ENGINEERS

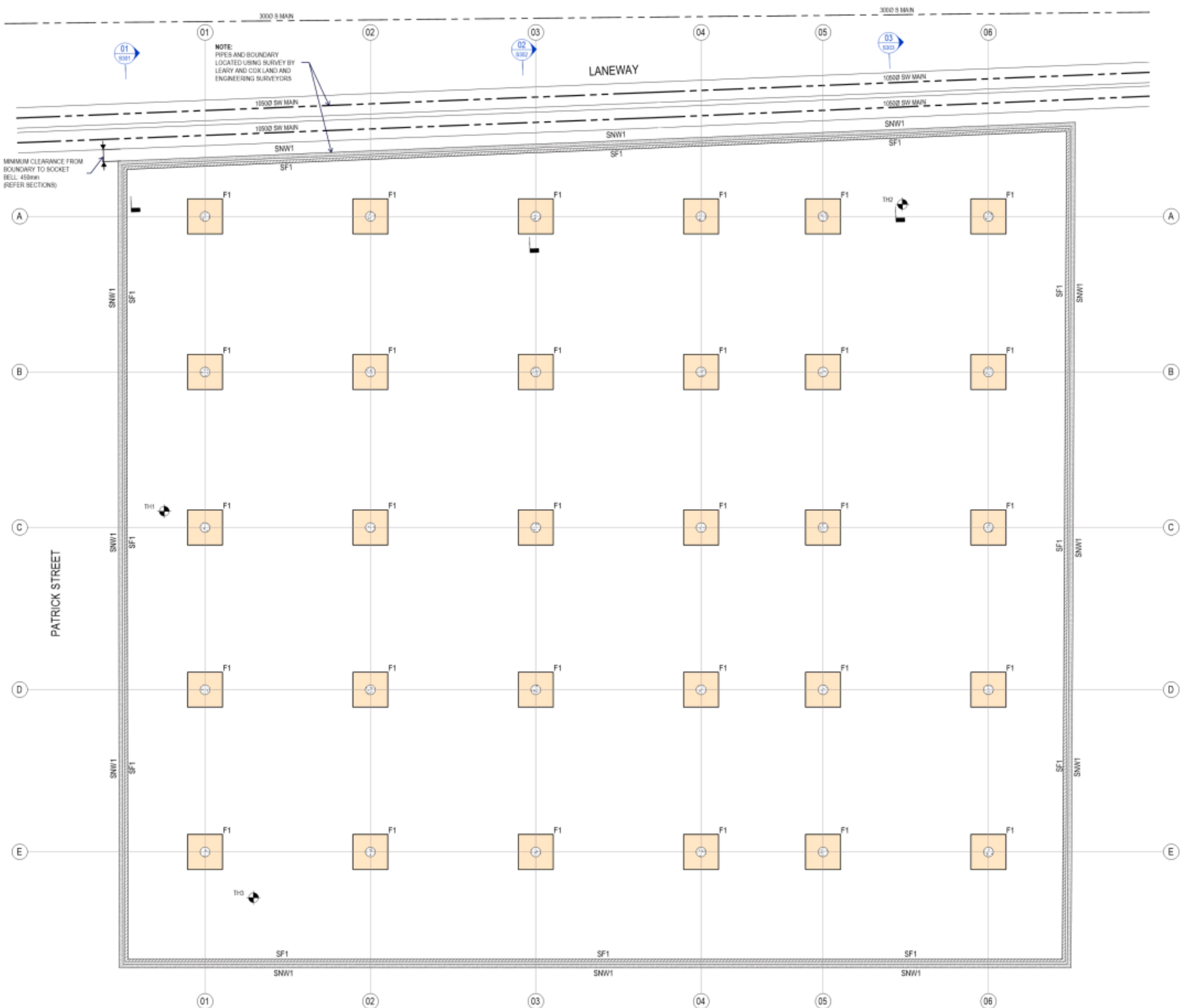
18.0591 62-64 Patrick Street
Structural

Date:	23/12/2019
Transmittal #:	18.0591 TR-S03
From:	Adrian Kay
How Delivered:	Emailed
Issue Type:	Development Approval
Format:	PDF
Subject:	REPONSE TO COUNCIL RFI
Note:	

Distributed To	Company
Jacob Britten	Heffernan Button Voss

We issue herewith the documents listed below. The recipient is responsible to remove superseded issues of the accompanying documents from circulation.

Document (ProjNo_DocNo_Rev_DocName)
18.0591_S101_2_FOOTING PLAN.pdf
18.0591_S301_3_FOOTING DETAILS 01.pdf
18.0591_S302_3_FOOTING DETAILS 02.pdf
18.0591_S303_3_FOOTING DETAILS 03.pdf



LEGEND

WALLS:
- ▭ SOIL NAIL WALL (SNW1)
REFER TO S300 SERIES DRAWINGS FOR DETAILS
- ▨ BLOCKWORK – UNREINFORCED

FOOTINGS:
- SF1 STRIP FOOTINGS
REFER TO S300 SERIES DRAWINGS FOR DETAILS
- TH1 ⊕ TEST HOLE LOCATION
REFER TO SOIL TEST REPORT BY GES.

FOOTING SCHEDULE

MARK	LENGTH	WIDTH	DEPTH	F'c	REINFORCEMENT	NOTES
F1	1800	1800	500			
SF1		450	300			

REV	DESCRIPTION	APP'D	DATE
2	RESPONSE TO COUNCIL RFI	AK	23.12.2019
1	RESPONSE TO COUNCIL RFI	DV	08.11.2019
	INTERNAL REVISION		

THIS DRAWING HAS NOT BEEN APPROVED FOR CONSTRUCTION

GANDY AND ROBERTS
CONSULTING ENGINEERS

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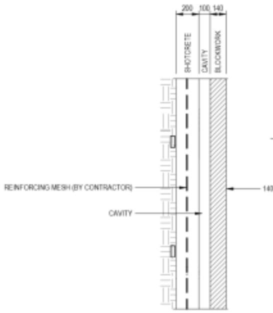
PATRICK STREET APARTMENTS
62-64 PATRICK STREET, HOBART, TAS , 7000

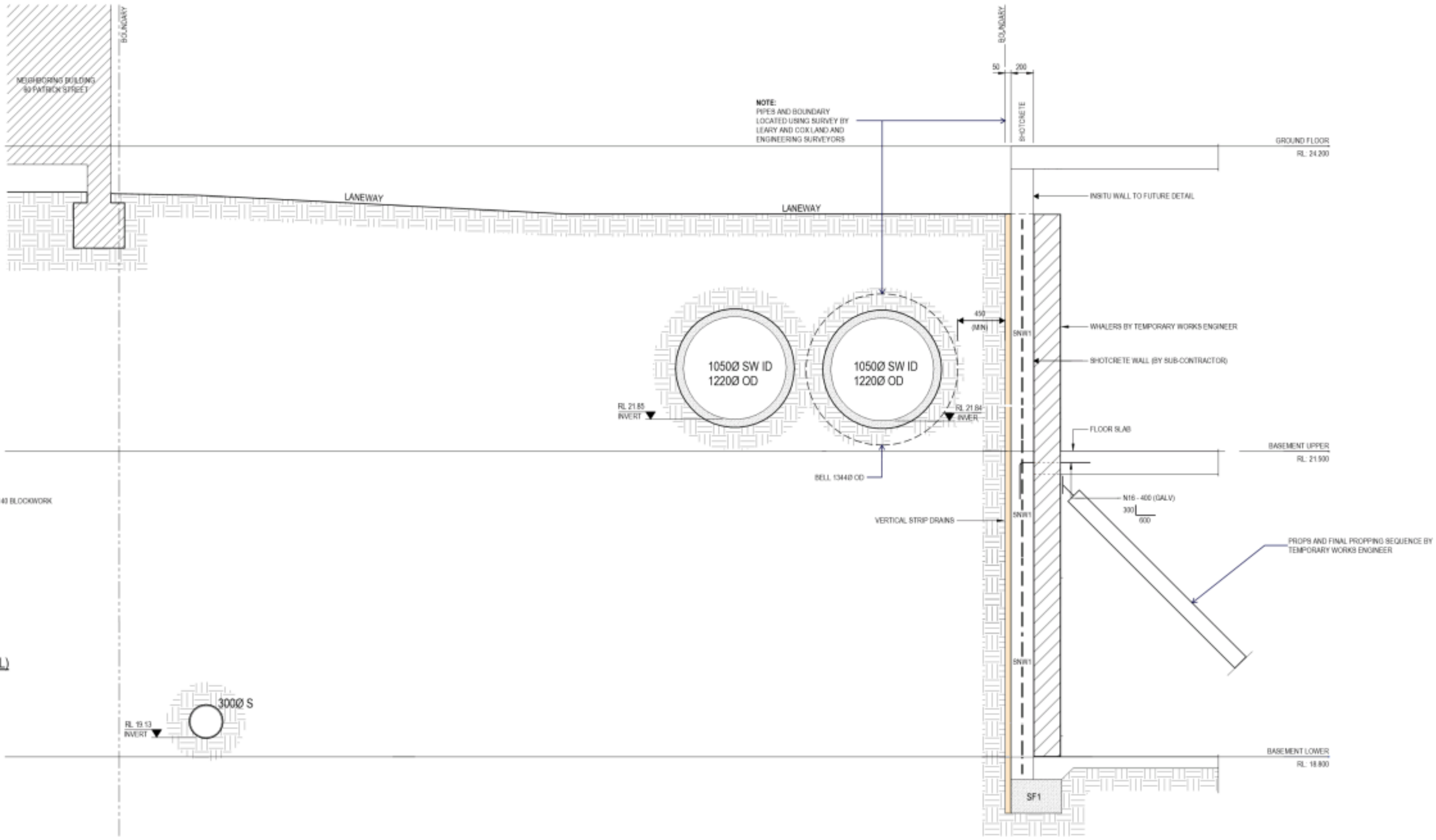
DRAWING TITLE
FOOTING PLAN

0 50mm SCALE 1 : 100@ A1

DESIGNER	DRAWN	CHECKED
DV	MEF	DV
PROJECT	DRAWING	REVISION
18.0591	S101	2



FINAL 'SNW1' DETAIL - PLAN VIEW (TYPICAL)
1 : 20



SECTION 01 / S101
1 : 20

SHOTCRETE WALL CONSTRUCTION SEQUENCE

1. LOCATE ALL SERVICES TO AN ACCURACY OF +/- 100mm PRIOR TO COMMENCING
2. EXCAVATE NOMINALLY 1.8M. PROP EXCAVATION IF REQUIRED. SEEK GEOTECHNICAL ADVICE DURING CONSTRUCTION.
3. INSTALL STRIP DRAINS, MESH AND SPRAY WALLS.
4. INSTALL WHALERS AND PROPS.
5. CONTINUE WITH ROCK EXCAVATION AND SHOTCRETE SEQUENCE, PROPPING AS NECESSARY UNTIL TO FULL DEPTH.
6. INSTALL FLOOR SLABS.
7. SHOTCRETE WALL & PROPPING DESIGN TO ALLOW FINAL PROPPING ARRANGEMENT FROM BELOW BASEMENT UPPER FLOOR.

REV	DESCRIPTION	APP'D	DATE
3	RESPONSE TO COUNCIL RFI	AK	23.12.2019
2	RESPONSE TO COUNCIL RFI	AK	09.12.2019
1	RESPONSE TO COUNCIL RFI	DV	08.11.2019
	INTERNAL REVISION		

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PATRICK STREET APARTMENTS
62-64 PATRICK STREET, HOBART, TAS , 7000

DRAWING TITLE
FOOTING DETAILS 01

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PROJECT	DRAWING	REVISION
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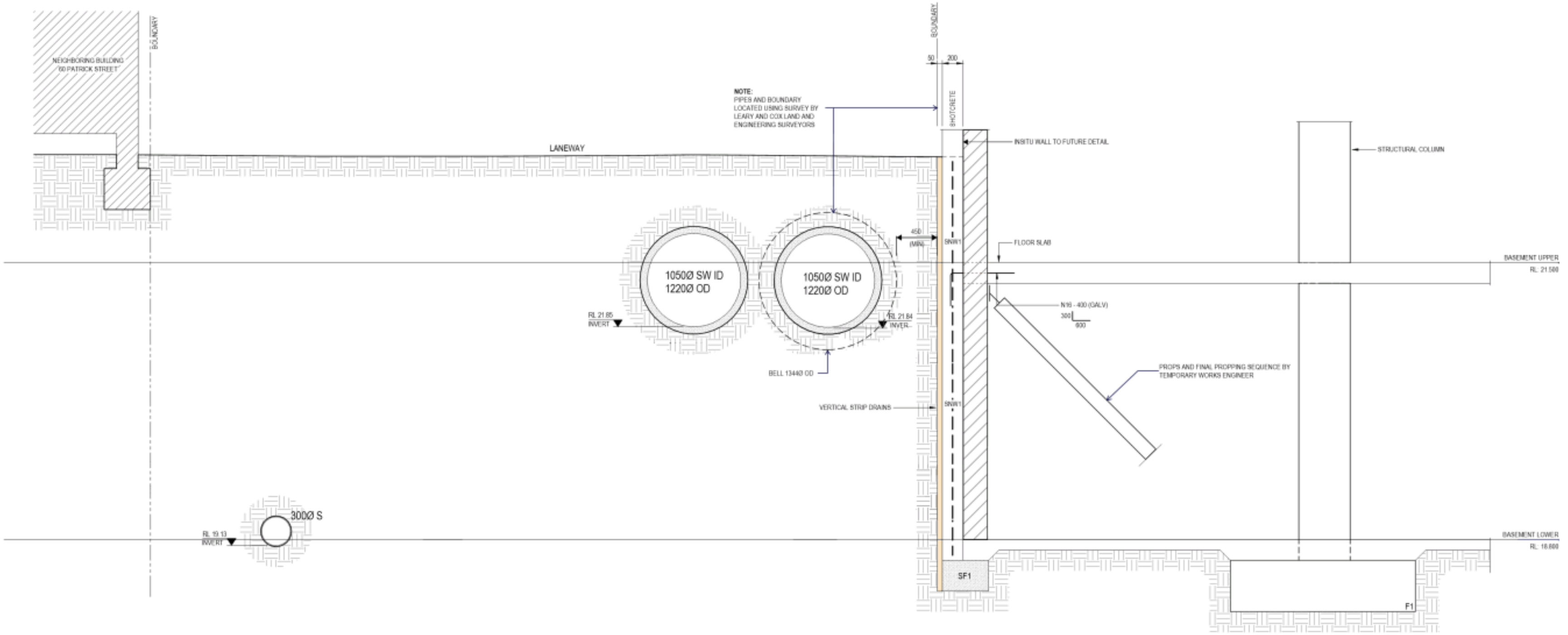

SECTION 02/S101
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SHOTCRETE WALL CONSTRUCTION SEQUENCE

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3. INSTALL STRIP DRAINS, MESH AND SPRAY WALLS.
4. INSTALL WHALERS AND PROPS.
5. CONTINUE WITH ROCK EXCAVATION AND SHOTCRETE SEQUENCE, PROPPING AS NECESSARY UNTIL TO FULL DEPTH.
6. INSTALL FLOOR SLABS.
7. SHOTCRETE WALL & PROPPING DESIGN TO ALLOW FINAL PROPPING ARRANGEMENT FROM BELOW BASEMENT UPPER FLOOR.

3	RESPONSE TO COUNCIL RFI	AK	23.12.2019
2	RESPONSE TO COUNCIL RFI	AK	09.12.2019
1	RESPONSE TO COUNCIL RFI	DV	08.11.2019
	INTERNAL REVISION		
REV	DESCRIPTION	APP'D	DATE

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APPROVED FOR CONSTRUCTION

GANDY AND ROBERTS
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PATRICK STREET APARTMENTS
62-64 PATRICK STREET, HOBART, TAS , 7000

DRAWING TITLE
FOOTING DETAILS 02

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As indicated@ A1

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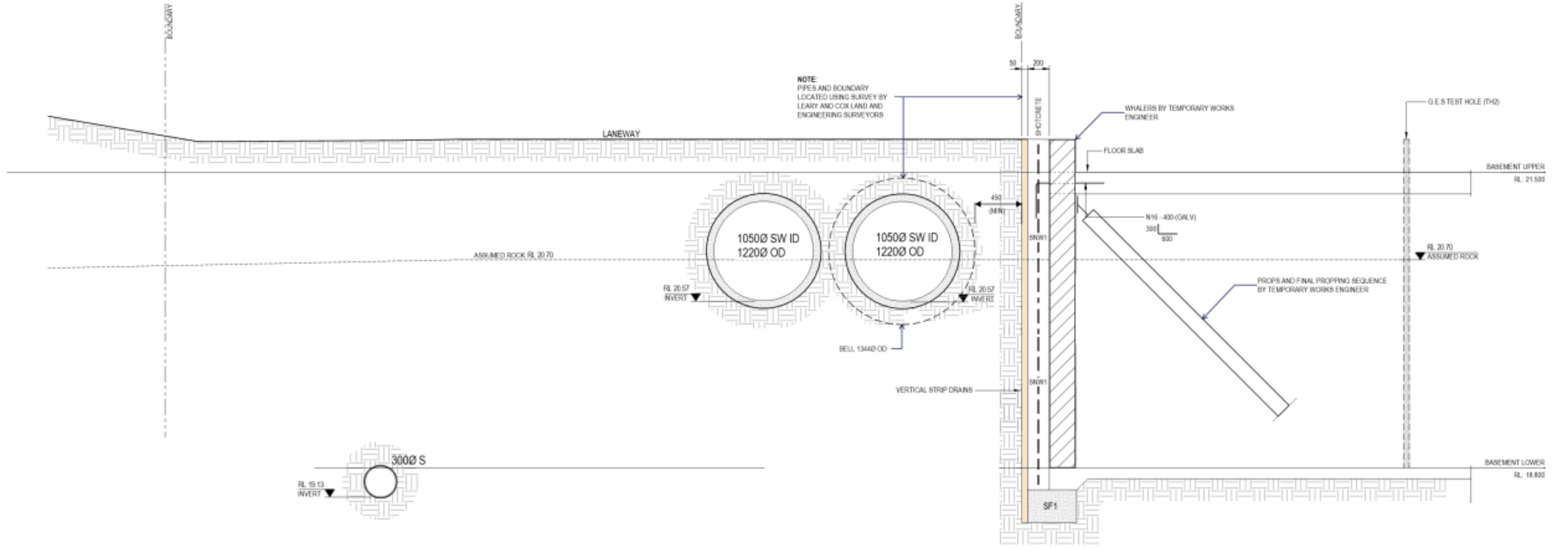

SECTION 03/S101
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SHOTCRETE WALL CONSTRUCTION SEQUENCE

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3. INSTALL STRIP DRAINS, MESH AND SPRAY WALLS.
4. INSTALL WHALERS AND PROPS.
5. CONTINUE WITH ROCK EXCAVATION AND SHOTCRETE SEQUENCE, PROPPING AS NECESSARY UNTIL TO FULL DEPTH.
6. INSTALL FLOOR SLABS.
7. SHOTCRETE WALL & PROPPING DESIGN TO ALLOW FINAL PROPPING ARRANGEMENT FROM BELOW BASEMENT UPPER FLOOR.

REV	DESCRIPTION	APP'D	DATE
3	RESPONSE TO COUNCIL RFI	AK	23.12.2019
2	RESPONSE TO COUNCIL RFI	AK	09.12.2019
1	RESPONSE TO COUNCIL RFI	DV	08.11.2019
	INTERNAL REVISION		

THIS DRAWING HAS NOT BEEN APPROVED FOR CONSTRUCTION

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DRAWING TITLE
FOOTING DETAILS 03

0 50mm SCALE
As indicated@ A1

DESIGNER	DRAWN	CHECKED
DV	MEF	DV
PROJECT	DRAWING	REVISION
18.0591	S303	3

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Statement of Historical Archaeological Potential
Archaeological Impact Assessment &
Archaeological Method Statement

179-191 Murray Street (portion formerly 62 Patrick Street)
Aka 62-64 Patrick Street
HOBART TASMANIA

Brad Williams
Historical Archaeologist

June 2019

Contents:

This document was written by Brad Williams (BA.Hons Archaeology, G.Dip Maritime Archaeology, MA Cultural Heritage Management, G.Dip Environmental Planning) Historical Archaeologist, Heritage Consultant and Director of Praxis Environment. Praxis Environment is a division of Praxis Synergy Pty. Ltd.

Unless otherwise stated, all photographs were taken by Brad Williams, June 2019.

Unless otherwise stated, the north point (or approximate) of maps and plans is to the top of the page.

Cadastral information depicted in this document must not be relied upon without verification by a Surveyor.

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1. Introduction

1.1. Introduction and brief

This report has been commissioned by Heffernan Button Vos Architects in order to accompany an application to the Hobart City Council for a proposed redevelopment of a portion of the place known as 179-191 Murray Street (formerly 62 Patrick Street), Hobart.

The subject site is on the south-eastern side of Patrick Street, between Murray and Elizabeth Streets, Hobart, PID 5950042, and comprising of Certificate of Title 175729/2.

The site is not listed on the Tasmanian Heritage Register, nor is a Heritage Place on Table E.13.1 of the Hobart Interim Planning Scheme 2015 - although it is within the Places of Archaeological Sensitivity as defined by Figure E.13.1 of the Hobart Interim Planning Scheme 2015, therefore the provisions of Part E.13.10 of the planning scheme is applicable. Accordingly, the brief for this project was to develop a **statement of historical archaeological potential** as the basis for archaeological planning in any future development of the subject site.

If archaeological potential is predicted, then this is to inform the design of the proposed development, and if archaeological impact considered possible, then an **archaeological impact assessment** is to be undertaken and if such impact is deemed unavoidable, then an **archaeological method statement** is to be formulated ti industry standard.

Although not listed on the Tasmanian heritage Register, the archaeological approach in this document has been developed with regard to the Tasmanian Heritage Council's Practice Note 2 – *Managing Historical Archaeological Significance in the Works Application Process*[1], and the Tasmanian Heritage Council's *Guidelines for Historical Archaeological Research on Registered Places*[2] as a means of demonstrating a sound and best-practice approach.

---

[1] http://www.heritage.tas.gov.au/media/pdf/2%20Practice%20note%20-%20Archaeology.pdf

[2] http://www.heritage.tas.gov.au/media/pdf/Archae%20ResGlines%20%20FINAL%20-%20June%202009.pdf

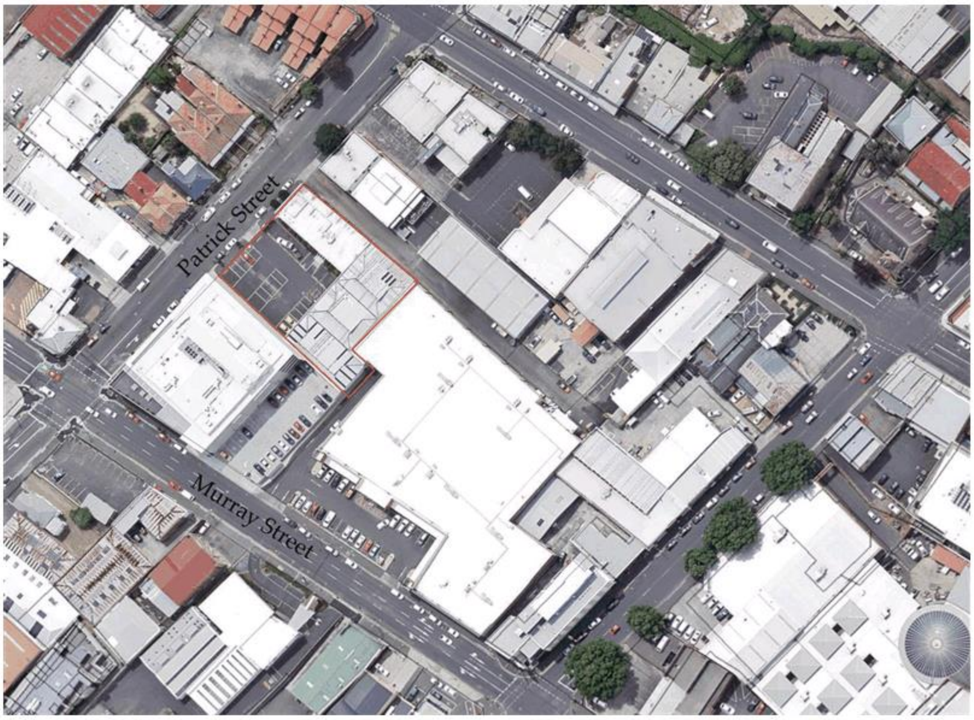

Figure 1.1 – A recent aerial image of the area – the subject site depicted in red. www.thelist.tas.gov.au

Figure 1.2 – Detail of a recent aerial image of the area – the subject site depicted in red. www.thelist.tas.gov.au

Figure 1.3 – Cadastral parcels surrounding the subject site (depicted in red) and surrounds (www.thelist.tas.gov.au).

1.2. Limitations

This document has the following stated limitations:

- This document is largely a predictive analysis (i.e. non-invasive) of the possible archaeological resource and might be subject to further on ground testing to verify findings if deemed necessary by any stakeholder.
- All depictions of the location of site features are approximate. A surveyor should be engaged if any party requires exact confirmation of locations.
- The depiction of expected archaeological features in this report largely relies on the accuracy of historical surveys and data – no guarantee of the accuracy of this historical data is given.
- The scope of this project only included historic heritage values. Consideration of Aboriginal heritage values was outside the scope.
- Any implications of the location of underground services may only be approximate. Confirmation where necessary must be sought from professional underground asset locators.

2. Statutory heritage requirements

This report has been commissioned to consider the historical archaeological potential of the subject site arising from any applicable statutory listings. The following statutory heritage responsibilities that relate to historical archaeology are to be met in any development of the subject site:

2.1 Hobart Interim Planning Scheme 2015

The place is within the area defined in Figure E13.1 of the Hobart Interim Planning Scheme 2015 (the *scheme*) as a *Place of Archaeological Potential,* therefore the provisions of Part E13.10 are applicable.

Part E13.10 of the scheme details the *Development Standards for Places of Archaeological Potential*, with the following *Objectives:*

> *13.10.1: Building, Works and Demolition: To ensure that building, works and demolition at a place of archaeological potential is planned and implemented in a manner that seeks to understand, retain, protect, preserve and otherwise appropriately manage significant archaeological evidence.*
> *13.10.2: Subdivision: To ensure that subdivision does not increase the likelihood of adverse impact on a place of archaeological potential.*

> The scheme prescribes *Performance Criteria* for each of these *Objectives* and pursuant to Part E.13.5 of the scheme, the Planning Authority may require the following to accompany any application for development of a place of archaeological potential in order to assess the proposal against the performance criteria:
>
> *(f) a statement of archaeological potential;*
> *(g) an archaeological impact assessment;*
> *(h) an archaeological method statement;*

Under the definitions of the scheme:

> (f) means:
>
> a report prepared by a suitably qualified person that includes all of the following:
>
> a. a written and illustrated site history;

b. overlay plans depicting the main historical phases of site development and land use on a modern base layer;
c. a disturbance history.
d. a written statement of archaeological significance and potential accompanied by an archaeological sensitivity overlay plan depicting the likely surviving extent of important archaeological evidence (taking into consideration key significant phases of site development and land use, and the impacts of disturbance).

(g) means:

a report prepared by a suitably qualified person that includes a design review and describes the impact of proposed works upon archaeological sensitivity (as defined in a statement of archaeological potential).

(h) means:

a report prepared by a suitably qualified person that includes the following where relevant to the matter under consideration:

a. strategies to identify, protect and/or mitigate impacts to known and/or potential archaeological values (typically as described in a Statement of Archaeological Potential);
b. collections management specifications including proposed storage and curatorial arrangements;
c. identification of measures aimed at achieving a public benefit;
d. details of methods and procedures to be followed in implementing and achieving (a), (b) and (c) above
e. expertise to be employed in achieving (d) above;
f. reporting standards including format/s and content, instructions for dissemination and archiving protocols.

	Acceptable Solution	**Performance Criteria**
E.13.10.1 – Building and Works other than Demolition	*A1. Building and works do not involve excavation or ground disturbance.*	*P1. Buildings, works and demolition must not unnecessarily impact on archaeological resources at places of archaeological potential, having regard to:* *a) the nature of the archaeological evidence, either known or predicted;* *b) measures proposed to investigate the archaeological evidence to confirm predictive statements of potential;* *c) strategies to avoid, minimise and/or control impacts arising from building, works and demolition;* *d) where it is demonstrated there is no prudent and feasible alternative to impacts arising from building, works and demolition, measures proposed to realise both the research potential in the archaeological evidence and a meaningful public benefit from any archaeological investigation;* *(a) measures proposed to preserve significant archaeological evidence 'in situ'.*
E.13.10.2 – Subdivision	*A1. Subdivision provides for building restriction envelopes on titles over land defined as the Place of Archaeological Potential in Table E13.4.*	*P1. Subdivision must not impact on archaeological resources at Places of Archaeological Potential through demonstrating either of the following:* *(a) that no archaeological evidence exists on the land;* *(b) that there is no significant impact upon archaeological potential.*

The current document aims to fulfil those points in a consolidated manner in the assessment of the proposed development to assist the planning authority to make an informed assessment against the performance criteria of the scheme.

2.2. Tasmanian Heritage Register

The subject site is not listed on the Tasmanian Heritage Register therefore is not subject to the provisions of the *Historic Cultural Heritage Act 1995.* Nonetheless, the archaeological approach in this document has been developed with regard to the Tasmanian Heritage Council's Practice Note 2 – *Managing Historical*

Archaeological Significance in the Works Application Process[3], and the Tasmanian Heritage Council's *Guidelines for Historical Archaeological Research on Registered Places*[4] as a means of demonstrating a sound and best-practice approach.

2.3. Other statutory heritage registers/lists

The subject site is not listed on any of the following statutory registers:

- The National Heritage List
- The Commonwealth Heritage List
- The World Heritage List

Nor is it included in any buffer zones arising from those lists, therefore is not subject to the historic heritage provisions of the respective Acts which enable statutory input into development of places on those lists.

2.4. Aboriginal Heritage Act 1975 (amended 2017)

An assessment of any possible Aboriginal heritage values is not part of the brief for this report; nonetheless the provisions of the *Aboriginal Heritage Act 1975* are applicable to the place. A search of the Tasmanian Aboriginal Heritage sites register (Job # 16600566) did not identify any registered Aboriginal relics or apparent risk of impacting Aboriginal relics (search valid until 8/1/2020). The Tasmanian Government *Unanticipated Discovery Plan – Procedure for the management of unanticipated discoveries of Aboriginal relics in Tasmania* must be adhered to in the event that any Aboriginal heritage items are discovered during the course of any works.

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[3] http://www.heritage.tas.gov.au/media/pdf/2%20Practice%20note%20-%20Archaeology.pdf

[4] http://www.heritage.tas.gov.au/media/pdf/Archae%20ResGlines%20%20FINAL%20-%20June%202009.pdf

3. Archaeological Methodology

This statement of archaeological potential is derived from a process which identifies the potential of the site to yield archaeological remains, the significance of any remains, and their potential to yield meaningful information about the site, and which might contribute to relevant key archaeological and historical themes. The following briefly outlines the methodology followed:

> Determining general archaeological potential: Through a desktop analysis of historical data and secondary sources, as well as non-invasive site observations, an understanding of the evolution of the site has been gained which has allowed an assessment of the archaeological potential (however significant) of any part of the site - resulting in substantiated predictions of the likelihood of finding *something* upon any particular part of the site.
>
> This has been done by analysing primary source material, summarizing the developmental history of the site and developing a chronological narrative detailing an overview of the history of all known features to have ever existed on the site. Where possible, developmental overlays have been developed from historic maps, plans, photographs and other visual documentation. This overlay has been supported by other observations providing supplementary information, and also includes processes such as demolition and disturbance which may have removed or destroyed potential remains – and may have diminished the archaeological potential.
>
> Assessing the significance and potential of any likely archaeological resources to yield meaningful information**:** Upon understanding the archaeological potential through desktop and site analysis, the next step was to understand its relationship to any aspect of the identified significance of the place – e.g. do the remains have the potential to demonstrate an aspect of the significance of the site or related key historic theme? The potential for any of the archaeological remains to demonstrate important aspects of the history of the site, whether in a state, regional or thematic context, is to be considered.
>
> Understanding possible impact of development and formulation of management strategies**:** Based on any identified archaeological potential and significance of the site, consideration will be given as to whether the proposed development will impact upon any likely archaeological remains and if necessary broad management strategies will be proposed to manage any impact.

Table 1 (below) demonstrates the steps of this assessment:

Methodology for formulation of the statement of archaeological potential		
	If 'no'	**If 'yes'**
1. Archaeological potential. Are you likely to find something if you dig here? (i.e. a Statement of Archaeological Potential).	Further action may not be required, although a contingency plan may be required for unexpected finds.	The significance of the archaeological potential should be investigated.
2. Significance. Could anything you find here greatly contribute to our understanding of the site or related significant theme?	Further action may not be required.	The likely integrity of the archaeological remains should be investigated.
3. Integrity. Are any archaeological remains likely to be intact?	Further action may not be required, although a contingency plan is required for unexpected integrity.	The likelihood of significant archaeological remains is confirmed.
4. Impact Will proposed works impact upon the significant archaeological remains? i.e. an Archaeological Impact Assessment.	Further action may not be required, although a contingency plan may be required for unexpected impacts.	An Archaeological Method Statement will be required to detail how impact will be managed/mitigated.

4. Historical background of the subject site

4.1. Research methodology

For this initial assessment of archaeological potential, the depiction of the physical history of the site will be the main consideration – with other aspects of site history (i.e. social histories, economic history, associations *et. al*.) likely to be more useful in any post-investigation analysis of findings (i.e. artifact assessment), therefore beyond the scope of the current document. Similarly, the history of other townscape developments is beyond the scope of the current document however may be useful in further detailed analysis of future archaeological findings.

The following overview of the known physical development history of the site aims to aid in the prediction of the likely archaeological remains. This does not represent a comprehensive site history, and has been limited to a history of the physical development of the site as relevant to the archaeological resource.

Primary sources

Broadly, the primary sources consulted in the development of the statement of archaeological potential include:

- Hobart City Council building files (AE417 series, Tasmanian Archive and Heritage Office).
- Historic maps, photographs (NS and PH series) - Tasmanian Archive and Heritage Office.
- Department of Primary Industry, Parks, Water and Environment (DPIPWE) aerial photo collection (Service Tasmania).
- DPIPWE – Land Data Branch, historic map collection (basement)
- DPIPWE – Land Data Branch, titles.
- Historic newspapers, via the National Library of Australia's *Newspapers Online* portal.

Secondary sources

No secondary source documents are known to exist which are of particular relevance to the history or archaeology of the subject site.

In order to gain an overview of what once existed on the site, as the basis for predicting archaeological remains, the following is a brief overview of the historical development of the site based on primary source documents (the subject site depicted in red) as well as overviews drawn from the secondary sources as detailed above. Note that this is a brief historical overview, concentrating solely on physical development, sufficient only for basic archaeological planning. As per above, further historical research is required in order to refine a detailed archaeological research design, which is provided here in Section 5. Such detail is also required to supplement the interpretation of archaeological findings – requiring an iterative process of the assessment of findings against further historical and comparative research from both primary and secondary sources, which should be provided in an archaeological method statement and post-excavation analysis.

4.2. Historical overview

Pre-European settlement

The land was the home of the Mouheneener people for tens of thousands of years, prior to displacement by European settlers in 1804.

Original grants

The subject area comprises all of Lot 1 as depicted on DPIPWE Sealed Plan SP175729. This area is an amalgamation of historic titles which, for simplicity' sake, this report will separate into three distinct 19th century titles, as per the Hobart grants map show in Figure 4.1:

Figure 4.1 – Original land grants in the subject area (from www.thelist.tas.gov.au)

The subject site is shown as undeveloped on the c1832 survey of Hobart (see Figure 4.2).

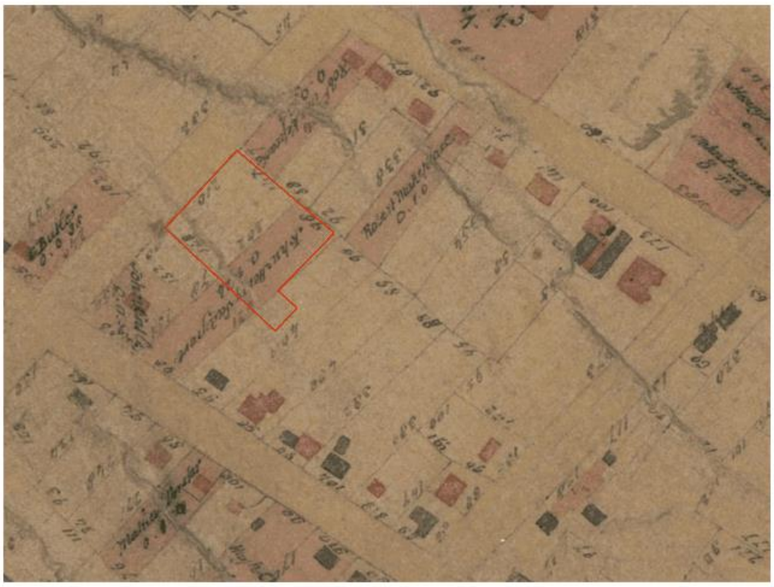

Figure 4.2 – Excerpt from a c1832 map of Hobart and surrounds. DPIPWE Map Hobart.

These portions of each particular grant are shown on Figure 4.3, which will provide some context for the understanding of the historical evolution of the subject site:

Figure 4.3 – Portions of the subject site relating to each of the grants shown in Figure 4.1 and as per the table below (adapted from www.thelist.tas.gov.au).

Blue	The entire grant to John Elliott of 1-rood and 10-perches. This was to be known as 62-70 Patrick Street as 5 residences. This was subdivided c1841 into two lots – Brougham Cottage on the north-eastern portion, and 2x2-xonjoined residence on the south-western portion.
Green	The rear of the grand to John Henry Sadgrove that faced Murray Street. This was to be known as 181 Murray Street and become the Quaker (Friends) Meeting House.
Red	A portion of the central part of the grant to William Cutts that faced Murray Street. This was to be known as 179 Murray Street as a residential property.

Elliott grant: Brougham Cottage (15 perches)

John Elliott, a Hobart corn dealer, was granted 1 acre 10 perches in Patrick Street (see Sprent) in February 1842[5]. This grant appears to have been certification of Elliott's ownership and not the original alienation from the Crown, as the dwelling on the grant known as 'Brougham Cottage' is mentioned as far back as 1833:

> *"J.Holland and Mr Allen may be contacted at Brougham Cottage, next to Rev Millers, Patrick Street"*[6]

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[5] DPIPWE The LIST Mem 2/6115

[6] *Colonial Times* 24 September 1833, p1

"Brougham Cottage" can be seen on Frankland's 1839 survey (see Figure 4.4) with several other buildings on that wider allotment and is surveyed in Hobart 6/31. Sprent's c1843 survey shows a rectangular masonry building erected in the north east corner of the grant (see Figure 4.5); other surveys show additions which make this a substantial L-shaped brick building[7]. Another building is shown to the west on this survey.

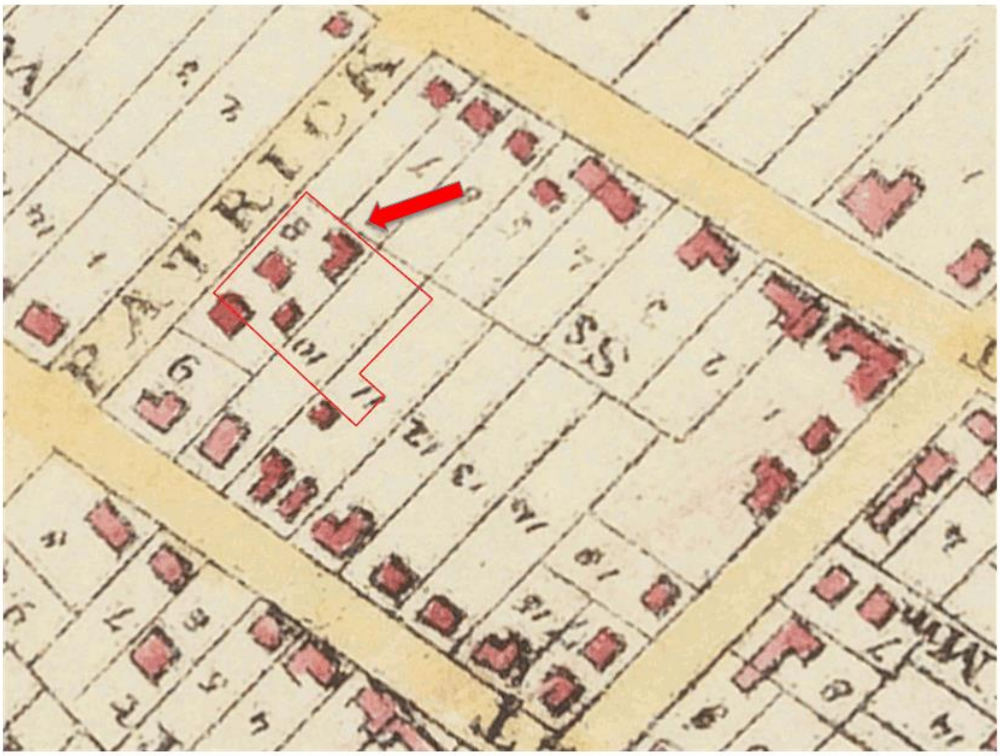

Figure 4.4 – Excerpt from Frankland's 1839 map of Hobart and surrounds (Brougham Cottage denoted by the red arrow). State Library of Tasmania, Allport Stack 912.94661MAP.

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[7] See DPIPWE Hobart 6/31 (Renumbered plan 90019)

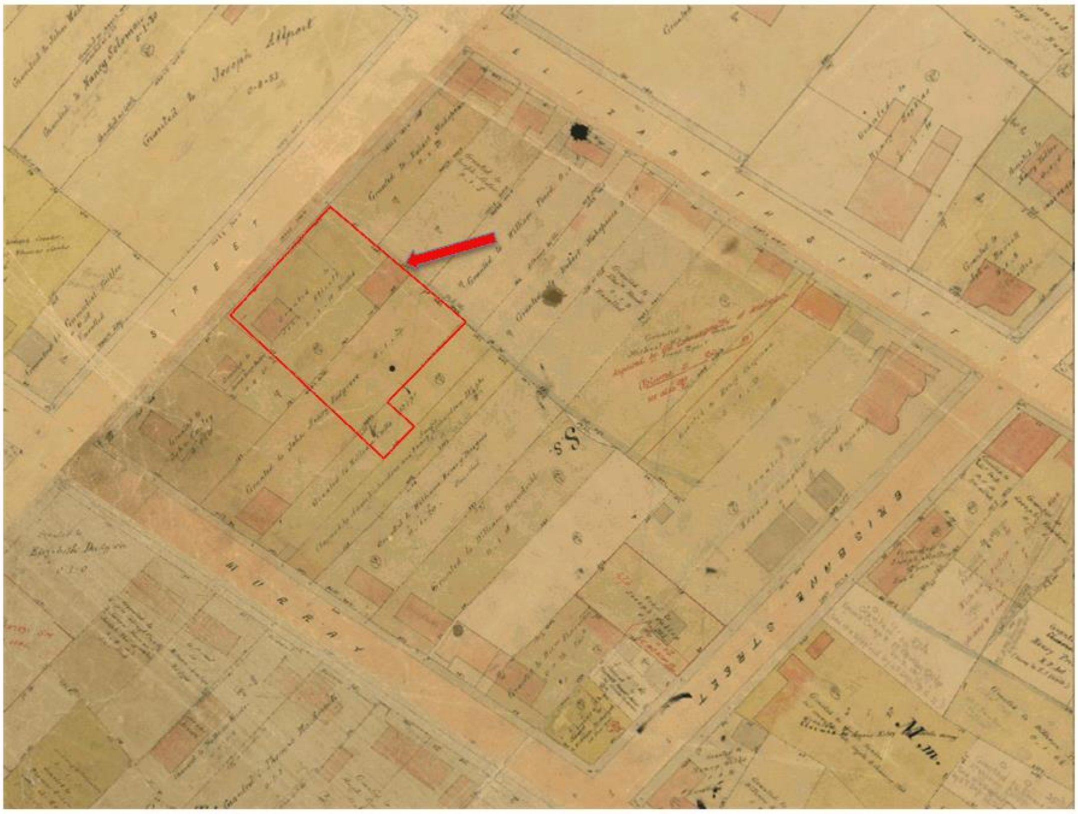

Figure 4.5 - Excerpt from Sprent's c1845 map of Hobart and surrounds – Brougham Cottage denoted by the red arrow. (www.thelist.tas.gov.au).

In October 1842, Elliott subdivided his 1 acre 10 perch grant in order to sell Brougham Cottage with 15 perches of land to Augustus Kramer for £175[8]. Unusually, this memorial includes a plan which depicts the buildings on site at that time:

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[8] DPIPWE The LIST Mem 2/6115

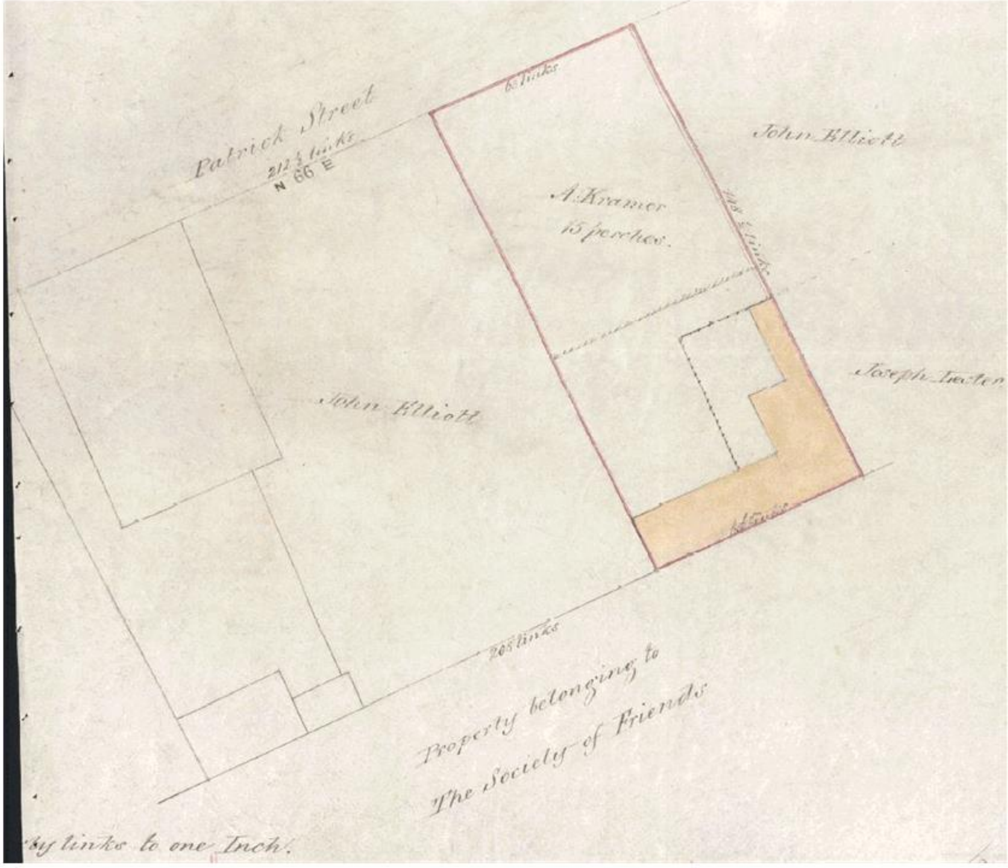

Figure 4.6 - Detail from DPIPWE Mem 2/6115 (October 1842) showing Elliott's block and the 15 perches including 'Brougham Cottage' sold to Augustus Kramer

In May 1849, Brougham Cottage was offered for auction, described as:

> *That neat Residence known as Brougham Cottage; the premises are in excellent repair replete with every convenience; attached is a garden in excellent order well stocked with fruit trees"*[9].

The property however did not sell.

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[9] *The Courier* 26 May 1849 p3

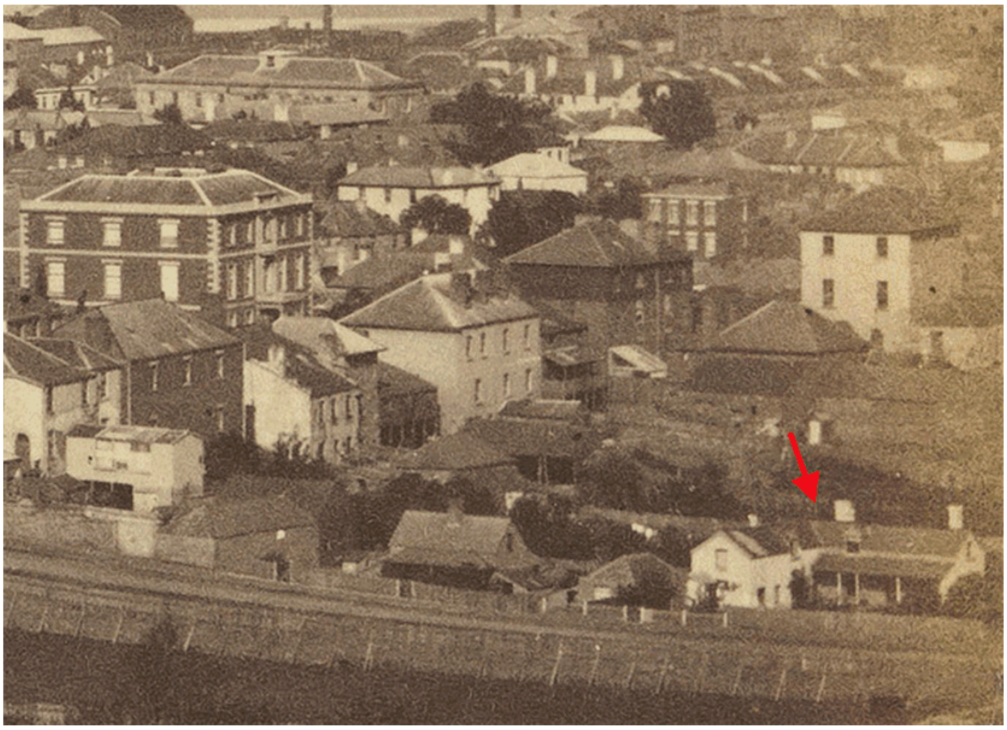

Figure 4.7 – A c1870 photograph looking south-east over Hobart, showing the L-shaped building at the rear of (then) 62 Patrick Street (depicted by red arrow) known as Brougham Cottage. Tasmanian Archive and Heritage Office PH-1-1135.

Augustus Kramer died in March 1853[10], leaving his estate to Christiana Fairbairn[11], who appears to have been the daughter of Kramer's neighbor in Patrick Street. In March 1859, as Christiana Fairbairn was about to marry Robert Hawkins, arrangements were made for a marriage settlement which included providing Christiana with a life interest in 'Brougham Cottage'[12]. Christiana outlived her husband, and in 1885 sold the property to watchmaker Albert Gaylor for £360. At the time, the property was described as "a commodious property in Patrick Street…the house, which is in a thorough state of repair, was only recently reshingled and repainted throughout; it contains 8 rooms besides bathroom, scullery, patent Kitchener, copper, gas, and also garden ground"[13].

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[10] TAHO RGD35/1/3 Number 2215
[11] TAHO AD960/1/3
[12] DPIPWE The LIST Mem 4/7072
[13] *The Mercury* 24 June 1882 p4

Five years later, The *Tasmanian News* reported that Albert Gaylor had sold the property to the Day brothers in September 1891 "for a satisfactory price"[14] . Following the sale, the first Certificate of Title under the Real Property Act was issued for this property, stating that the owners were Charles, Robert and Martin Day had paid £340[15]. The following year, the Day brothers sold the property to bootmaker William Jenkins for £500[16]. Jenkins died in the Patrick Street house in 1934[17], leaving the property to Annie Elizabeth Miller[18]. Miller's heirs then sold the property to Eric Unsworth in 1946[19], who in turn sold the property to Bernard McCann in August 1956. In 1961, George Wills and Company had demolished the 1830s Brougham Cottage and constructed a warehouse on the site which still stands today. McCann held the property until October 1968, when he sold it to George Wills & Company[20] and it was onsold to the Dunlop Rubber Company that same year.

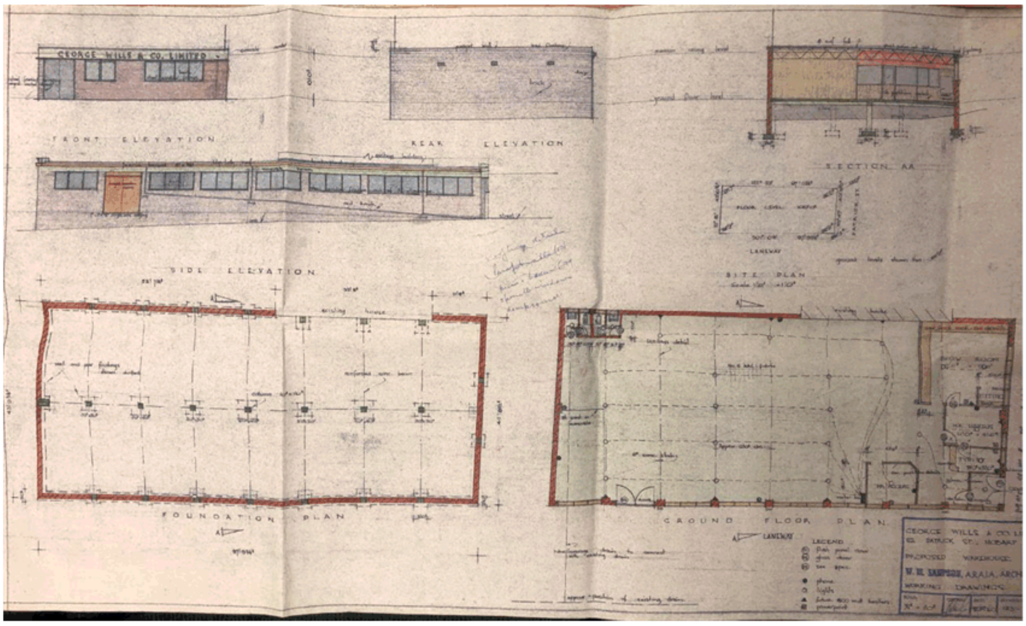

Figure 4.8 – September 1960 plans for George Wills and Co. warehouse. Tasmanian Archive and Heritage Office AE417/3/1562.

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[14] *Tasmanian News* 21 September 1891 p.2
[15] DPIPWE The LIST CT81/31
[16] DPIPWE The LIST CT81/31 and CT82/80
[17] TAHO AF35/1/3 BU31384
[18] DPIPWE The LIST CT82/80
[19] DPIPWE The LIST CT 393/54
[20] DPIPWE The LIST CT 393/54

Elliott grant: Conjoined cottages (approx. 35 perches)

Having sold Brougham Cottage with 15 perches in October 1842, John Elliott was left with 35 perches of his original 1 rood 10 perches (i.e. 55 perches) grant. Sprent's 1839 survey clearly shows that this 35 perches included a masonry structure (see Figure 4.4). In December 1843, Elliott sold this 35 perches block to William Clavey Brown for £320; the sale included the "Dwelling House and outbuildings thereon erected"[21]. Brown

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[21] DPIPWE The LIST Mem 2/6760

died in September 1853[22], leaving the property to his widow Elizabeth Ann Brown[23]. In March 1856, Elizabeth Ann Brown gifted the property to her daughter Mary Elizabeth Brown; at this point, the description of land conveyed only mentions one dwelling house[24]. A lease advertisement from 1864 describes this property (then known as 46 Patrick Street) as a house with 9 rooms, stabling and a coach house[25].

This research has not uncovered how the property left the ownership of Mary Elizabeth Brown. By 1876, 46 Patrick Street was occupied by George Washington Collins and his wife[26]. In December 1888, Collins mortgaged the property to Melbourne financier Mark Moss for £70. The Memorial of Indenture for this mortgage lists the 35 perches block in two lots:

> *"All those two pieces or parcels of land having a frontage of about ninety nine feet to Patrick Street…together with the two dwelling houses erected thereon and being numbers 44 and 46 Patrick Street and secondly all that piece or parcel of land having a frontage of sixty six feet to Patrick Street…"*[27]

Thus, by this point in time (1888) the original 9-room house has either been extended or divided to create the two conjoined houses depicted on Survey Diagram Hobart 9/180 (see below). Valuation rolls from 1880 show the Collins block with this configuration, valuing one of the conjoined cottages at £20 and the other at £26 assessed annual value[28]. This disparity in valuation is supported by the pictorial depictions of the conjoined buildings showing one larger than the other (i.e. see Figure 4.9).

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[22] TAHO RGD35/1/4 Number 440

[23] TAHO AD960/1/3 Number 523

[24] DPIPWE The LIST Mem4/2741

[25] *The Mercury* 27 December 1864 p1. Note that contemporaneous advertisements for domestic staff confirm that this house (46 Patrick Street) is the house owned by Elizabeth Brown and her daughter

[26] See *the Mercury* 1 February 1876 p1 and DPIPWE The LIST Mem 8/1657

[27] DPIPWE The LIST Mem 8/1657

[28] *Hobart Town Gazette* 7 December 1880 p1288

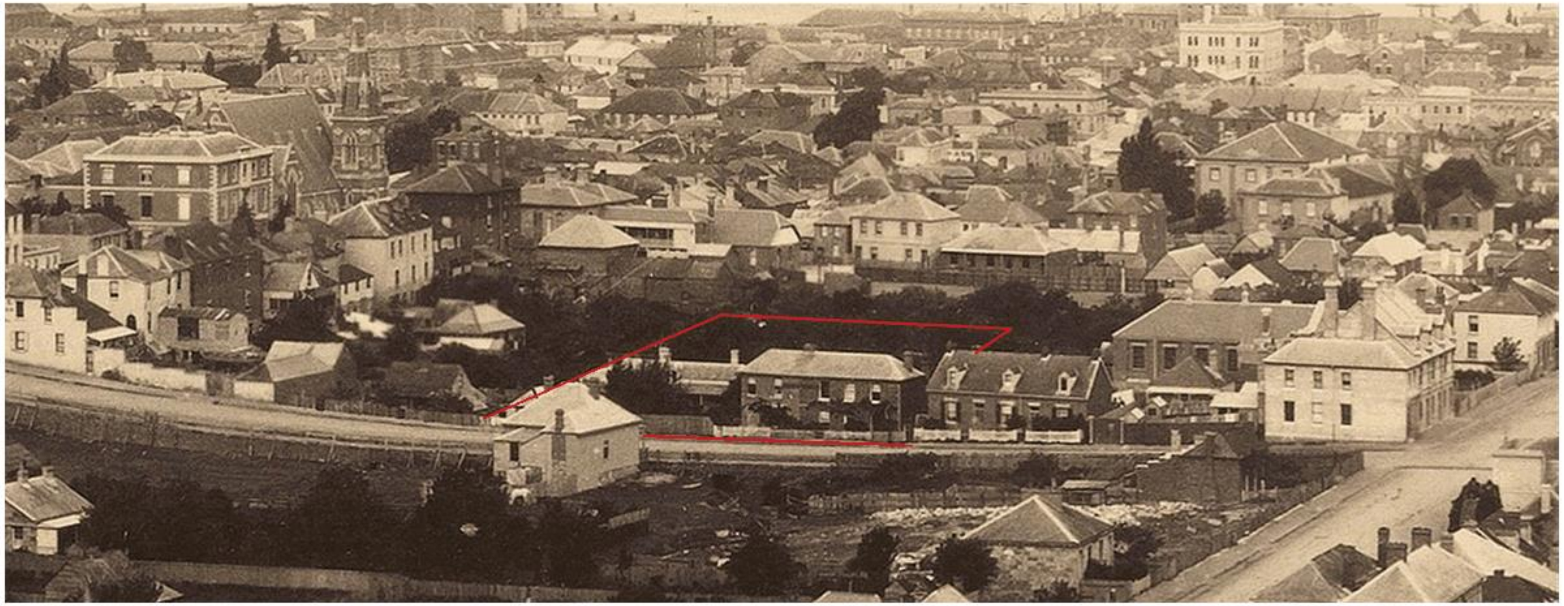


Figure 4.9 – Excerpt from an 1870s panorama of Hobart, showing the 1830s conjoined houses and Brougham Cottage prior to the construction of the larger conjoined houses between (note that the perspective of this image gives the impression of a narrower space between the houses and Brougham Cottage).

By the 1890s, it appears that the land as mentioned above had been developed with another set of conjoined cottages appearing between the earlier buildings, and the neighbouring Brougham Cottage.

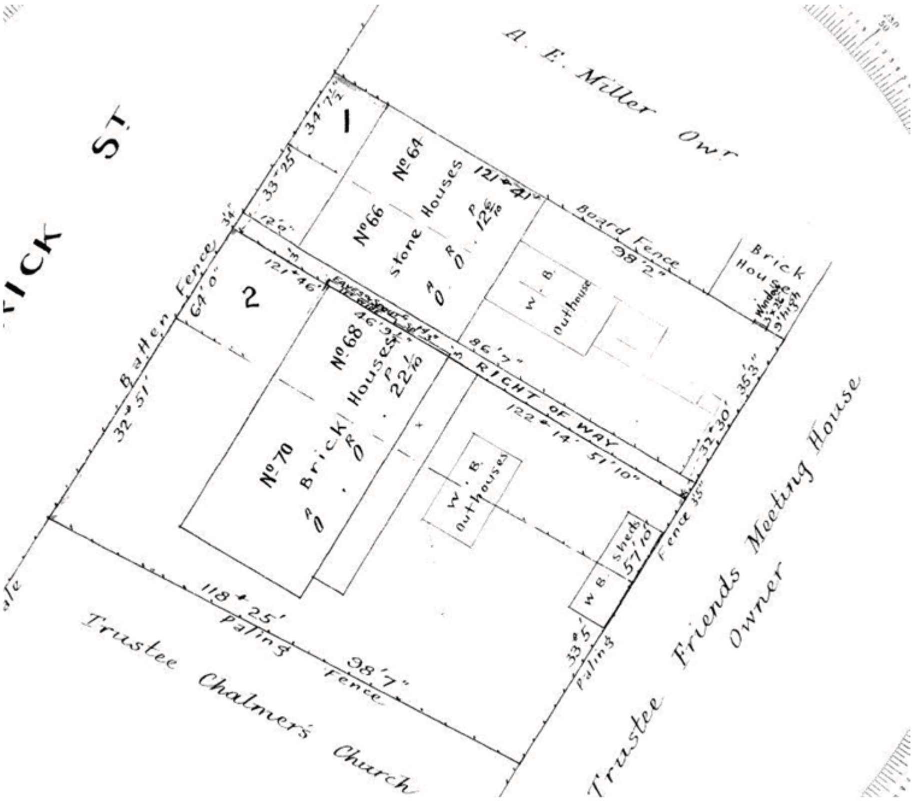


Figure 4.10: Detail from Survey Diagram Hobart 9/180

This block stayed in the Collins family until April 1892, when the heir of Catherine Collins, John Daniel Collins, sold the 35 perch property to Charles John Beck for £950[29]. Beck died in December 1899, leaving the property in the hands of his executors[30]. This property remained a part of Beck's estate until 1937, when it was sold as two lots (one of 22 perches and the other 12.6 perches):

> *'Lot 3: 2 Conjoined brick houses, stone faced, nos 64 and 66 Patrick Street, each containing 6 rooms and kitchenette with all conveniences….Lot 2: Conjoined brick, 2 storey houses, Nos 68 and 70 Patrick Street, each containing 6 rooms, with usual conveniences…there is a cart entrance to No 70"*[31]

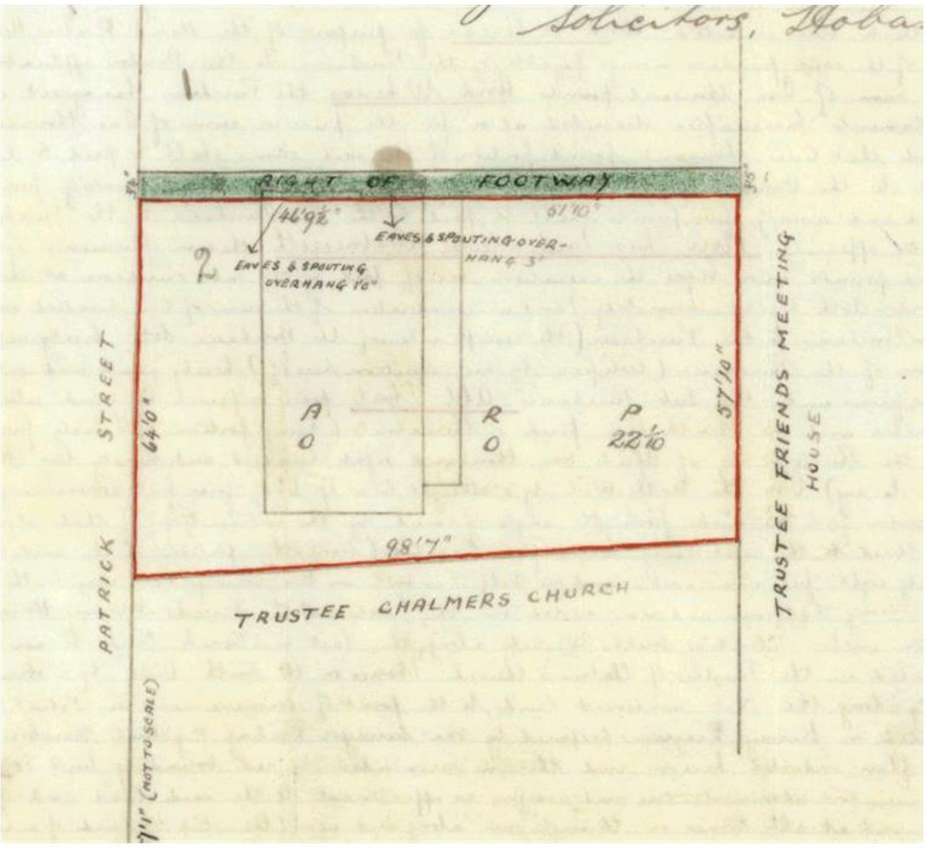
---

[29] DPIPWE The LIST Mem 8/8237

[30] DPIPWE The LIST Mem 20/2204

[31] *The Mercury* 1 September 1937 p14

The 22 perch lot (formerly 68-70 Patrick Street) sold to Christina Walsh in 1937 for £400[32]. Following Christina's death, the property was vested in Cornelius Francis Walsh[33], who in December 1967 sold to Dunlop Rubber Australia for $18,000[34]



4.11 - Detail from DPIPWE The LIST Mem 20/2204 showing 22 perch block (former 68-70 Patrick St)

The remaining 12.6 perch block (64-66 Patrick Street) sold to Donald Hodgman for £1,100[35]. Dunlop Rubber Australia eventually purchased this block from George Wills and Company in February 1968 for $13,000.[36]

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[32] DPIPWE The LIST Mem 20/4961
[33] DPIPWE The LIST Mem 37/1983
[34] DPIPWE The LIST Mem 39/7022
[35] DPIPWE The LIST Mem 20/2228
[36] DPIPWE The LIST Mem 39/8715

Sadgrove grant – former Quaker Meeting House site (1 rood 24 perches)

A portion of the subject site comprises part of a 1 rood 24 perch township allotment granted to the Hobart Town storekeeper John Henry Sadgrove. In August 1836, Sadgrove sold this allotment to Charles McLachlan and Edmund Phillip Robinson, together with the "*Messuage or tenement thereon.*"[37] The following year, this allotment was sold to William Nicoll and Bernard Carron for £230[38].

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[37] DPIPWE The LIST Mem 2/110 Note – price is unknown as this transaction included a large rural block

[38] DPIPWE The LIST Mem 2/1173

This transaction was followed one month later by a sale to the prominent Quaker James Backhouse, who purchased the property in September 1837 for £350[39]. This site became the first permanent Society of Friends Meeting House in Hobart. However, it should be noted that contemporary maps and photographs clearly show the meeting house at the front of the block, i.e. not in the portion of Sadgrove's grant included in the current subject site. That original pre-1836 building was replaced in the 1880s with a larger purpose-built meeting house, that was demolished in the 1960s. Note also that the Society of Friends burial ground was not located on this site (being in Mellifont Street) – it is presumed that the backyard area of the meeting house was never developed nor had any particular function apart from open space.

In 1960, a new Quaker Meting House was built in Boa Vista Road, New Town. The site of the old meeting house was sold in two allotments, with the rear section (part of the subject area) being sold to Dunlop Rubber Australia in January 1961[40]. As noted above, by 1968, Dunlop also owned 62-70 Patrick Street, hence the amalgamation of these blocks into one title.

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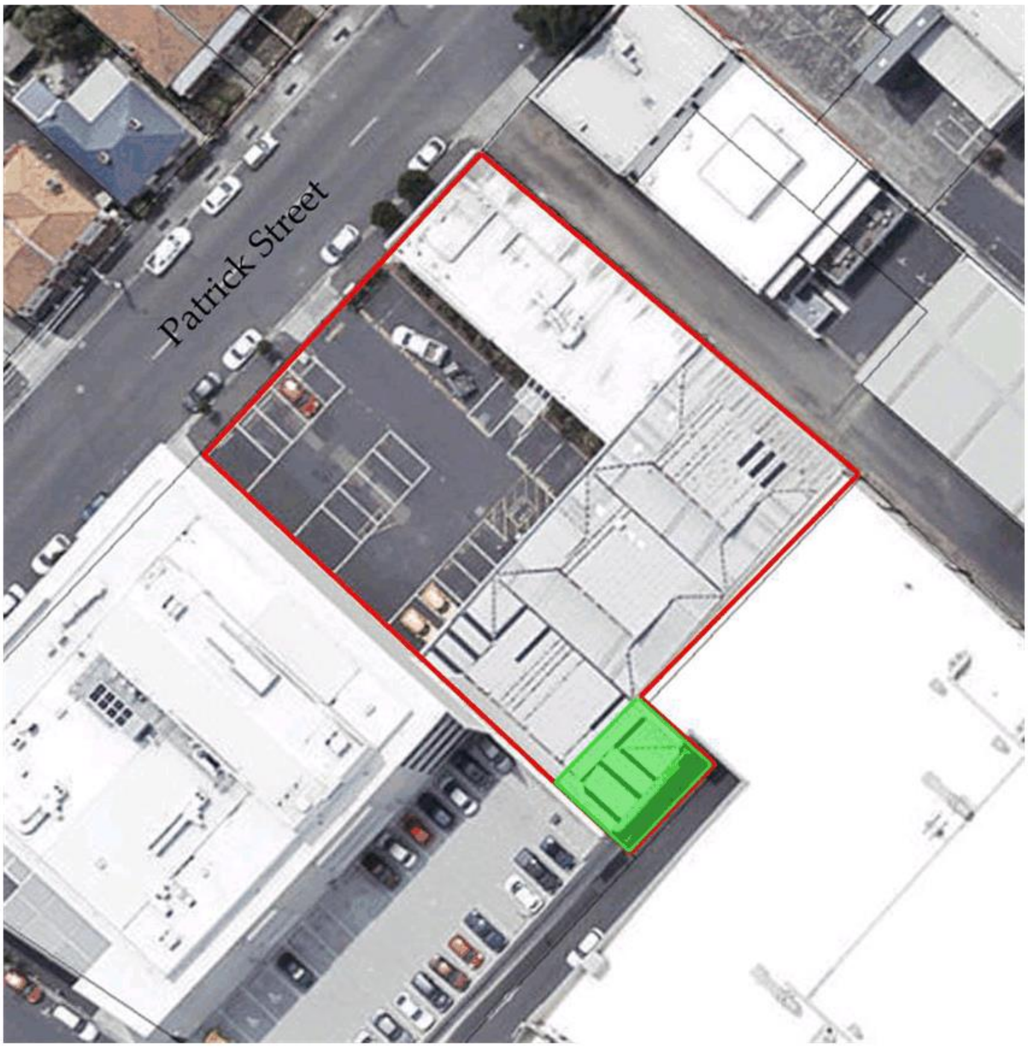
[39] DPIPWE The LIST Mem 2/1174
[40] DPIPWE The LIST CT 887/9

The Cutts Grant (32 ½ perches)



A very small portion of the subject area comprises a portion of 32 ½ perches of land on Murray Street originally located to Edward Whitehouse[41]. Numerous advertisements in the colonial press between 1837 and 1839 seem to indicate that Edward Whitehouse was in considerable financial distress; by November 1839, auctioneer James Duncan announced that he was selling by auction Whitehouses's property in Murray Street[42].

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[41] This research has not uncovered a date for the original location order, other than that it must pre-date 1838

[42] *Hobart Town Courier*, 5 November 1839

At this auction sale, William Cutts purchased a block containing 32 ½ perches fronting on Murray Street. He then applied for, and was granted, title to the land through the Caveat Board, which was duly registered at the Supreme Court as a grant[43]. Cutts appears to have purchased this allotment as vacant land; three years later, he sold then same allotment, "together with the several Messuages or Dwelling Houses" thereon to Joseph Allport in trust for David Lamb, one of Whitehouse's creditors[44]. The description for this sale indicates that the "messuages" were occupied by three people, suggesting three conjoined houses. Three months later (December 1842), Lamb in turn sold the property to James George Babtie[45]. From this point onwards, the property remained in the hands of Babtie's heirs and successors until 1924. During this time, it passed through the ownership of Babtie's son George Orton Babtie[46], his daughter Sophia Ann Stevens, then Mary Ann Collins, Thomas Patrick Ryan and finally Francis Ryan in 1915[47].

There are no nineteenth-century depictions of any substantial buildings/features on this small portion of the overall site. By 1908 there appears to have been ephemeral sheds partially within this part of the subject site.

Finally, in March 1924, the property at 179 Murray Street was offered for sale by the Public Trustee. By this stage, the structure on site was described as "a substantial brick cottage with 5 good rooms & WB outbuildings"[48]. At this point, the sale history of the property becomes difficult to trace, although newspaper advertisements from the 1930's refer to "Scott's Dairy" at 179 Murray Street. In 1926 Mr. C. Scott received building approval for a small brick ice-cream factory at 179 Murray Street, which appears not to have been built within this part of the subject site. [49]

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[43] *Hobart Town Gazette* 11 March 1842
[44] DPIPWE The LIST Mem 2/5629
[45] DPIPWE The LIST Mem 2/5824
[46] TAHO AD960/1/6
[47] See DPIPWE The LIST Mem 10/4320; Mem 16/4878
[48] *The Mercury* 4 March 1924 p.10
[49] TAHO AE417/1/1377

Twentieth-century depictions of the overall subject site

An excerpt from a panoramic photograph shows the smaller and larger conjoined houses on the Patrick Street frontage, much as per the nineteenth-century depictions.

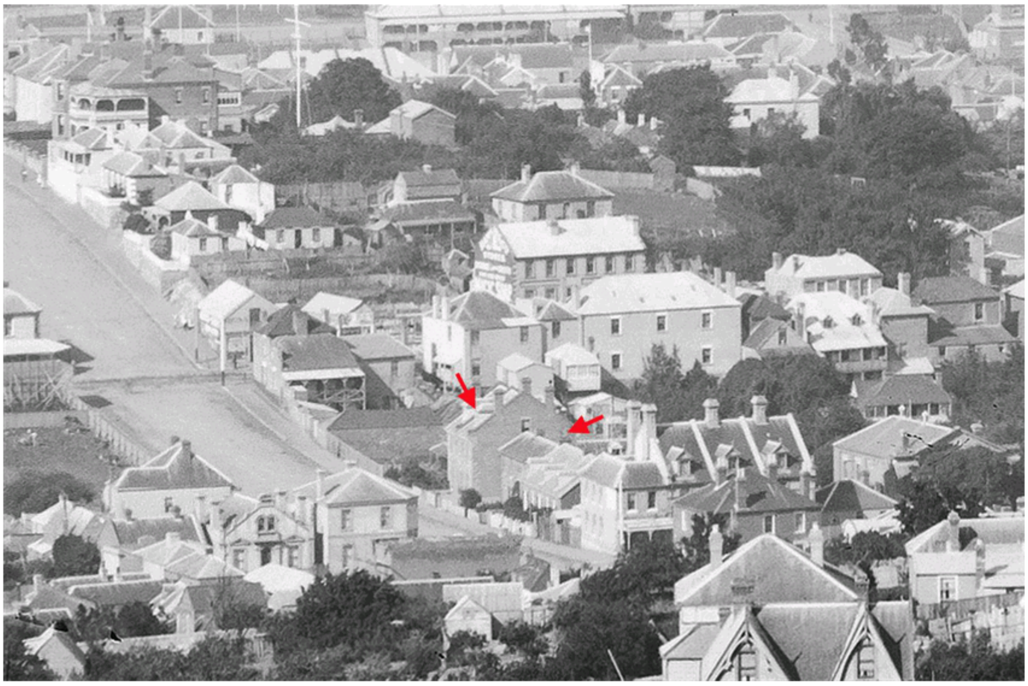

Figure 4.12 – An excerpt from a c1900 panorama of Hobart, showing the side elevations of the conjoined houses (Brougham Cottage is obscured by these foreground buildings). NS1013-1-729 TAHO c1900.

The 1908 Metropolitan Drainage Board plans of Hobart also shows the position of these paired houses, as well as Brougham House. The rear of the 'Quaker Meeting House' that is within the subject site is shown as open space with no development, and the rear of the Cutts allotment is shown with what are probably only yardspaces or ancillary sheds. This arrangement is still seen on the 1946 and 1958 aerial photographs.

Figure 4.13 – 1907 Metropolitan Drainage Board survey showing the subject site and surrounds. (Hobart Sheet 16)

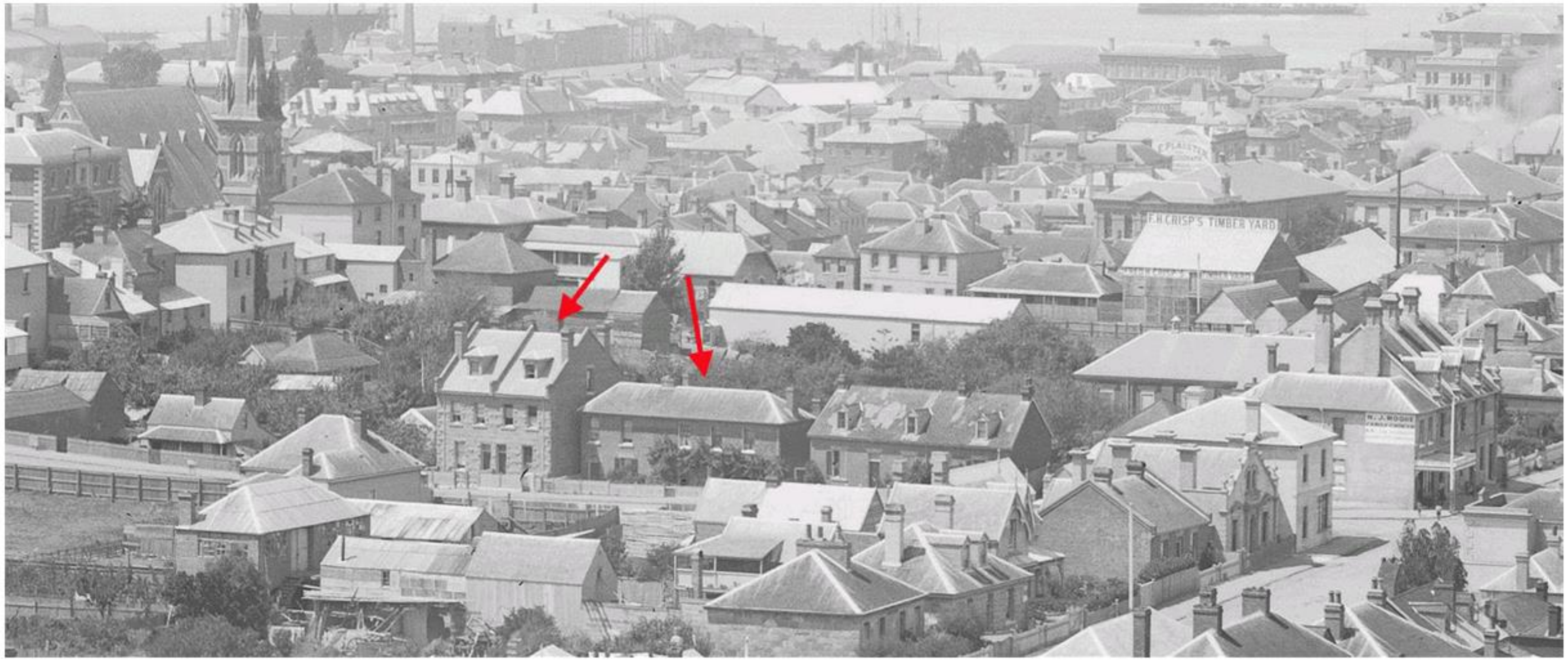

Figure 4.14 – Excerpt from a c1910 panorama of Hobart showing the 2.5-storey conjoined houses at 64-66 Patrick Street and the earlier conjoined houses at 68-70 Patrick Street. The rear of the Quaker Meeting House appears to be open space with advanced plantings. Tasmanian Archive and Heritage Office NS1013-1-522.

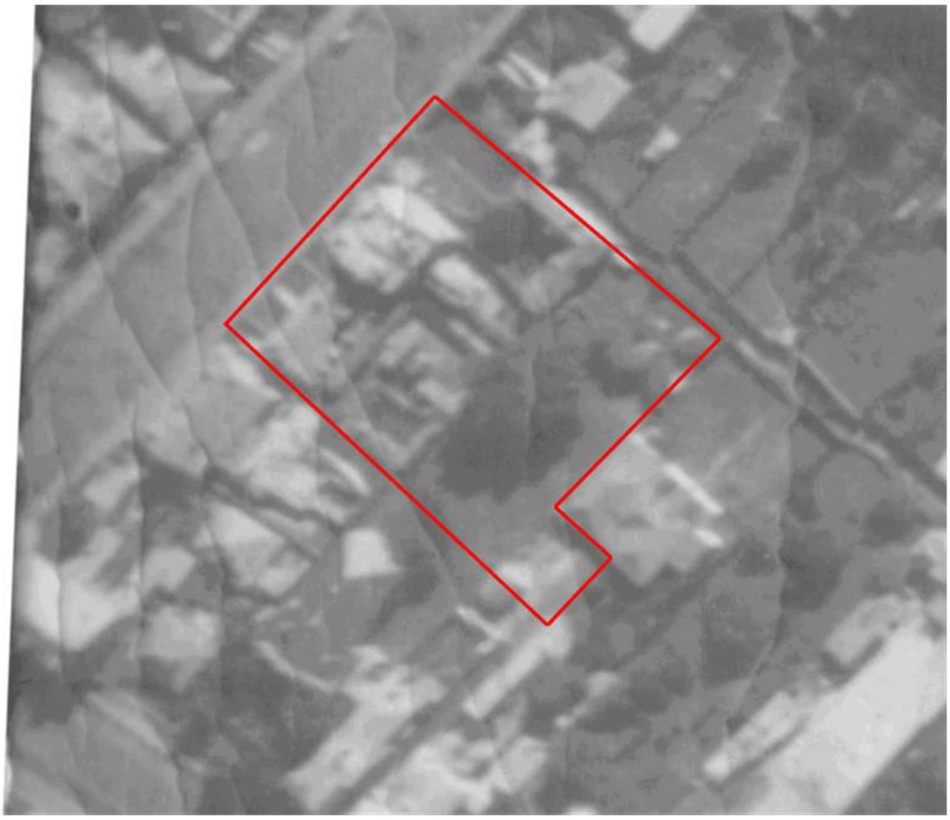

Figure 4.15 - The subject site taken from the 1946 aerial run of Hobart (Run 1, 10894).

Figure 4.16 – Excerpt from the 1958 aerial run of Hobart. Hobart Run 5-T332-12 (March 1958).

Post 1960s development

By 1968, the Friends meeting house had been demolished and the entire footprint of that site had been redeveloped. The two later-c19th conjoined houses fronting Patrick Street and Brougham Cottage had also been demolished, with the G. & R. Willis & Co. warehouse built on that site. The two earlier conjoined houses remained standing however.

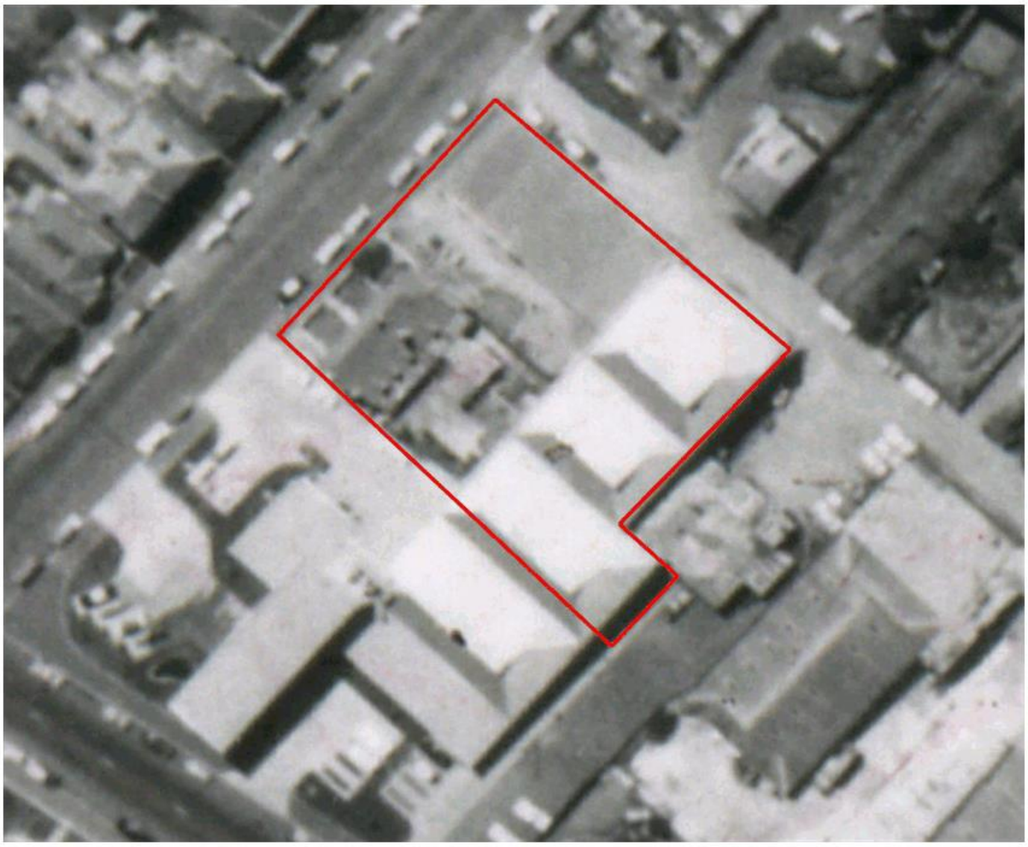

Figure 4.17 - Excerpt from the 1968 aerial photograph of Hobart. Hobart Run 6-153, February 1968.

By 1968 the current workshop buildings had been constructed on the former Cutts and Sadgrove portions of the subject site, which are still standing. As per Figure 4.8, in 1961 George Wills & Co. demolished Brougham Cottage (on the Elliott grant) and built the warehouse that is currently still standing.

Summary of development of the subject site

	The Elliott Grant		**The Sadgrove Grant**	**The Cutts Grant**
				
1830s	Development of Brougham Cottage pre-1833.	Development of two conjoined houses (not identical) pre-1839.	A residence was built on the Murray Street front of the allotment (outside the subject site) by John Sadgrove prior to 1836. Property purchased by Quaker James Backhouse Walker in 1837. Established as the Quaker (Friends) Meeting House.	Located to Whitehouse – undeveloped. Purchased by Cutts and title granted in 1839.
1840s	1841 subdivision of allotment and sale of Brougham Cottage to A. Kramer.	After the 1841 subdivision, allotment sold to William Brown.		Developed with three conjoined dwellings fronting Murray Street (not within portion of subject site) and sold to the Babtie family.
1850s	Death of Kramer in 1853, Brougham Cottage left to Christiana Fairbairn.			Babtie family ownership. No major development apart from probable ephemeral sheds.
1860s				
1870s	Sale to Albert Gaylor in 1885.	Sold from the Brown family by 1876 to George Collins.		

1880s		Collins had subdivided the allotment into two lots by 1888.		New Quaker Meeting House built on the Harrington Street frontage of the allotment to replace the 1830s building (outside the subject site).	
1890s	Sold to the Day brothers in 1891, then to bootmaker William Jenkins in 1892.	Sold to Charles Beck in 1892. It is likely that the two larger conjoined houses were developed by Beck prior to his death in 1899.			
1900s	Occupied by Jenkins until 1934. Left to Annie Miller after his death in 1934.	Both lots remained in the estate of Charles Beck until sold as two lots in 1937.			
1910s					
1920s					
1930s					Scott ownership as a dairy.
1940s	Sold to Eric Unsworth in 1946.	64-66 Patrick Street (i.e. the 1890s conjoined houses) was purchased by Donald Hodgman.	68-70 Patrick Street (i.e. the 1830s conjoined houses) was purchased by Christina Walch.		
1950s	Sold to Bernard McCann in 1956.				
1960s	Brougham Cottage demolished c1961 and warehouse constructed. Sold to George Wills & Co. in 1968then to Dunlop Rubber Company that same year.	Purchased by Dunlop Rubber Company in 1967. Buildings soonafter demolished.	Purchased by Dunlop Rubber Company in 1968. Buildings soonafter demolished.	New Quaker Meeting House established in Boa Vista Road. Allotment sold in two lots – the rear section (i.e. the current subject site) sold to Dunlop Rubber.	Incorporated into adjacent site.

1970s		
1980s	The site was included with the adjacent land (on the corner of Murray and Patrick Streets) as a major redevelopment for the Royal Automobile Club of Tasmania. The buildings on the subject site serving as workshops for the RACT.	
1990s		
2000s	The RACT site was redeveloped in 2009-10 and the subject site was onsold as surplus to requirements.	

The following figures show overlay plans of known historic development on the subject site, drawn from the survey plans depicted above which are considered to have the greatest accuracy

Figure 4.18 – Overlay of the of 18 depiction of the buildings on/near the subject site, as per the 1839 Frankland map (purple) in relation to the subject site (red). Note that the accuracy of this survey is known to be low – merely depicting the *presence* of buildings, rather than necessarily an accurate location – nonetheless the L-shape of Brougham Cottage is depicted.

Figure 4.19 – Overlay of the of the mid-1840s depiction of the buildings on the subject site as per the Sprent survey (green) in relation to the subject site (red). This survey is known to have a very high degree of accuracy.

Figure 4.20 – Overlay of the of the pre-1907 depiction of the buildings on the subject site (blue), as per the Sprent survey (green) in relation to the subject site (red). This survey is known to have a very high accuracy.

Figure 4.21 – Composite overlay of the footprint of all most-accurate known pre-1907 buildings and site features (colours as per coding above) in relation to the subject site (red).

5. The likely significance and research potential of archaeological remains

As depicted above, the subject site has a very simple development history, with the two c1830s development sites (i.e. Brougham Cottage and the earlier conjoined houses) and the later (c1890s) infill terrace houses – all of which are the only layer of development prior to their demolition in the 1960s. The portion of the subject site which was subject to that c19th development was wholly residential and appears to have remained as such until the 1960s.

Given the demolition of the buildings and formation of a generally clearspan warehouse and carpark over any remains in the 1960s, any such remains would be limited to low-level structure (i.e. foundations, possible lower courses of the buildings) and any subsurface features such as basements, wells, cesspits etc. – although no such structures have been determined through historical research (i.e. no such structures are described in early accounts of the buildings, or from living memory), although are considered possible.

There is also the possibility of artefactual remains relating to the habitation and use of the buildings as per the thematic discussion below.

The site may also yield information on site formation processes which have acted upon the site, both pre and during construction (e.g. alteration of the natural landform, construction rubble), use (e.g. occupation deposits), demolition (e.g. demolition rubble) and post-demolition use (e.g. fill and disturbance).

Remains associated with the residences, particularly those dating back to the 1830s, and their domestic occupation are considered to be of high archaeological potential due to their earliness and have the potential to demonstrate 19th century domestic life in the area (and wider Tasmania for that matter). These represent a small contiguous section of an inner-city Hobart community from the 1830s onwards. Such investigations include those undertaken as part of the Menzies Centre (Liverpool/Campbell Streets) excavations, which investigated several prominent 1820s-onwards inner city residences, including Crowther's (Godden Mackay Logan/Arctas). Similarly, investigations at Peter Degraves house in Collins Street (Hadleys Hotel development, Godden Mackay Logan) and preliminary investigations at the original Hobart Port Officer's residence at 100 Salamanca Place (Praxis Environment) have investigated early inner-city residential sites. Forthcoming reports on excavations on other Hobart domestic sites such as Kemp's house (36 Argyle Street), Judge Pedder's house

(173 Macquarie Street), Crowther's house/surgery (177 Macquarie Street) will also act to build upon knowledge and provide comparative datasets of early and substantial Hobart residences.

There have been few examples of archaeological investigations into wider communities around the Hobart CBD, i.e. investigations which cover a wide number of adjacent sites representing different functions (such as the Whale Fishery Inn and adjacent housing). Notable examples however are the range of Wapping investigations (e.g. Austral Archaeology 1996, 1998, 2002, 2009) and the forthcoming report on the Montpelier Retreat excavations undertaken by Austral Tasmania in 2015.

From a wider regional perspective, archaeological data and remains yielded from the subject site, whether coupled with other Hobart/Tasmanian data, has the potential to strengthen a comparative dataset for research into intra-colonial society through comparison with mainland (and indeed inter-colonial society on an international level). For example early inner-city working-class communities such as Broadway, Cumberland/Gloucester Streets and the Rocks (Sydney) and Little Lonsdale Street (Melbourne) and portside working-class areas such as Port Adelaide, all of which have had substantial archaeological works undertaken which include hotel sites and early inner-city housing and would provide useful datasets for the inter-colonial analysis of any Tasmanian data which would in-turn add to the depth and scope of the analysis of those collections on the range of themes as outlined above (and others).

From a temporal perspective, any remains from the investigation of such colonial communities represent a formative period of the settlement of Hobart and are likely to be of significance when considering their research potential.

Consistent with the 'Tiered research question' approach outlined in the Tasmanian Heritage Council's *Guidelines for Historical Archaeological Research on Registered Places*[50], the following questions could be investigated in the archaeological remains expected to be present within the subject site:

Tier 1 Questions: These questions outline the essential knowledge base needed for any site research or significance evaluations. Such questions are often empirical in nature, and straightforward answers can be sought and often identified – generally limited to a physical knowledge of that particular place. Questions relevant to the subject site may include:

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[50] http://www.heritage.tas.gov.au/media/pdf/Archae%20ResGlines%20%20FINAL%20-%20June%202009.pdf

- How closely did the buildings and site features conform to the historic plans?
- What construction methods were used in the buildings and other infrastructure?
- What evidence of alteration of the natural landscape and cultural interventions to the site is archaeologically determinable (e.g. filling of the site, demolition events, site formation processes etc.).
- Are the distinct use/development phases of the buildings distinguishable?
- Can the layout and function of the buildings, and indeed individual rooms or yard spaces be ascertained?
- How thoroughly were the buildings demolished?

Answers to these questions provide a foundation of information about the structure, type, use and duration of site occupation which enables the researcher to consider a second tier of questions.

Tier 2 Questions: Conclusions that can be drawn about a site that connect the material remains found on a site to specific behavior. For instance, do artifacts relate to the lifeways of the households that lived and/or worked on the site? For instance, do any artifacts represent class, gender, taste and health/hygiene of those living/working on the site? Particularly if artifacts can be specifically dated, and with supplementary historical research, artifact assemblages from this site may contribute knowledge and provide tangible connectedness to known inhabitants etc. and how they lived.

Tier 3 Questions: These questions represent the highest level of inquiry. Such questions associate the activities and behavior at individual sites with broad social, technological and cultural developments – which can be of interest on local, national or global lines of enquiry. Whilst these questions posed for a single site may not reach conclusions in the short term (as Tier 1 and 2 questions might) – the collection of data can contribute to future research by the provision of a comparable dataset. The goal of such research is to develop increasingly refined and tested understandings of human cultures within broader theoretical or comparative contexts. Lines of wider enquiry that findings from within the subject site may contribute to are:

- Do any activities archaeologically apparent on the site (e.g. drinking, food, hygiene, entertainment) provide meaningful comparisons on aspects of those themes with other contemporary residential Hobart enclaves or wider Hobart/Tasmania or for that matter Australian or international 1840s+ residential sites?

- Do the conclusions on gender, class, economic and social status of the inhabitants of the residences and associated buildings conform to the ‘normal’ early-mid Victorian households?
- Are there class or status differences evident in the material culture of the inhabitants of this area (subject to further historical research) when compared to, say, other early residential enclaves or sites in contemporary rural areas and/or other cities?

Did any changes in material culture through time in the residences coincide with wider Tasmanian or local events or technology (e.g. urbanisation/development of Hobart, railway/port upgrades, start of rubbish collection etc.)?

6. Current site observations and assessment of prior disturbance

As per the methodology outlined in Section 2.1, Section 3.3 has formed a desktop assessment of the factors which have influenced the development of the possible archaeological resource within the subject site over a 180+ year period.

However, it is critical to understand other factors, in particular site disturbance, which may have impacted upon the archaeological potential of the site and its ability to provide meaningful archaeological remains which answer research questions such as those above.

This section will review site observations and likely scenarios which would have resulted in disturbance, in order to assist in understanding the likelihood of the survival of archaeological remains.

6.1. General site observations

Little insight into the archaeological potential of the site can be gained from site observations. The c1961 warehouse covers the entire title that was associated with Brougham Cottage. Although the footprint of the 2x conjoined houses remain as open space, these are asphalted over and appear to have been raised in level from the likely step down from the street as per the historic topography.

Figure 6.1 – Overview of the site from Patrick Street

Figure 6.2 – Overview of the site looking towards Patrick Street

The carpark area appears to be built up from what is likely to have been a step-down historically, and the surface has a series of undulations – some of which appear to be recent ramping into more modern buildings, however some do correlate with the expected footprint of the two pairs of terrace houses that once stood on the site. The 1960s warehouse appears to retain a wall from the c1890s terrace houses – which would have been a shared party wall and survived the demolition of that earlier building as the wall is integral to the 1860s building. There are cracks in the pavement which correlate with the lines of the front and rear walls of that building. Although that building is not considered to be archaeologically significant, this observation does suggest that there may be substantial and shallow remains of that building beneath the pavement and a not particularly thorough demolition of the building(s). This, coupled with the buildup of the ground level does suggest that the demolition of the buildings were not thorough and that deep excavation of foundations (etc.) may not have occurred. Whilst it is known that the buildings all were demolished at different times, this principal of non-thorough demolition may have been carried through in the desire to build up the site in different eras.

Figure 6.3 – Remnant wall of the c1890s houses incorporated into the 1960s building.

Figure 6.4 – Example of pavement cracking in-line with expected rear wall of the c1890s building.

6.2. Likely specific disturbance events

Whilst the observations above give little real detail on possible disturbance, a disturbance history can also be built from a desktop assessment - i.e. known events which are likely to have impacted upon archaeological remains. Section 3.3 has detailed the evolution of the site from the historical information which is available.

The possible impact upon archaeological remains deriving from each of these events will be detailed below:

Demolition of the 1830s buildings c1960s

The early buildings on the subject site were all demolished in the 1960s, starting with Brougham Cottage in around 1961, then the c1890s conjoined houses prior to 1968, then the c1830s conjoined houses in the late 1960s. No archival details s to these demolitions were found and it is not known how thoroughly they were demolished (i.e. were they demolished only to ground level? Were foundations removed? Was the site bulked out after?). As per the discussion above, given the topography of the site – the front being below street level and the site sloping, it is likely that filling was desired in order to provide a new level site and a site closer to street level (see below).

Construction of subsequent buildings

The buildings at the rear of the site (i.e. on those potions of the subject site that were formerly the back yard of the Quaker Meeting Hall and that small portion of the land that was on the Cutts grant are located on areas where there is no likely earlier major development, therefore the construction of these buildings are unlikely to have impacted upon any archaeological remains. The c1961 construction of the George Wills and Co. warehouse was constructed on the site of the 1830s Brougham Cottage which was demolished just prior to the construction of that building – and detailed plans/specifications exist for that building from which we can gain an understanding of whether that may have impacted upon any post-demolition remains of the earlier building. A section through that proposed building shows a substantial amount of fill beneath, which suggests that filling the site was desired to compensate for the slope of the block and the fact that the frontage was set below the street. Whilst this filling would be shallower towards the rear of the site (i.e. the location of Brougham Cottage) it does indicate the desire to fill, rather than cut, the site which provides a greater chance for the survival of earlier remains. Note also that if the new building was built in quick succession to the demolition of the earlier building (which seems to be the case) then debris from that earlier building may have been used in that fill. The specifications indicate a series of pad footings which appear to have extended into historic ground level (i.e. below the fill) which may have caused some localised, but not widespread, impact on earlier remains.

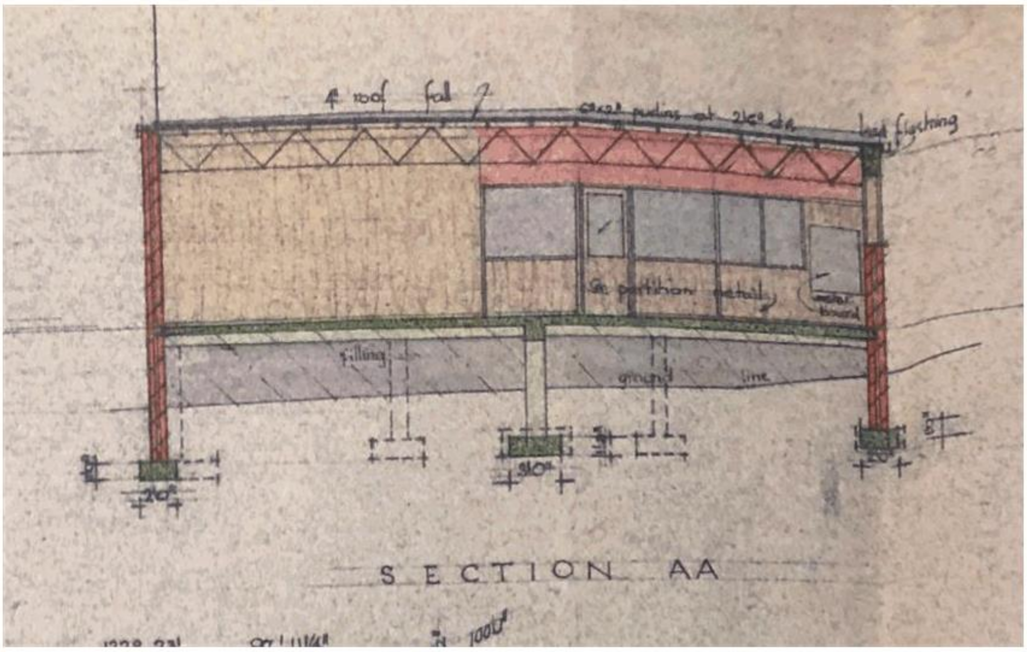

Figure 6.5 – Section of the c1961 building, showing the fill used sub-slab for levelling. Tasmanian Archive and Heritage Office AE417/3/1562.

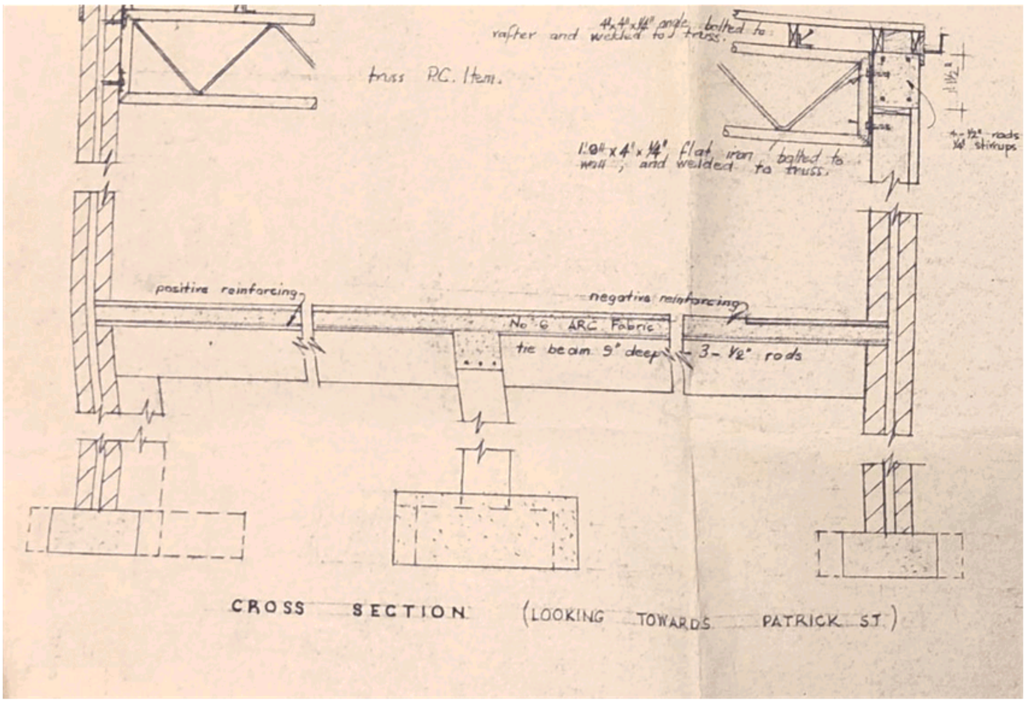

Figure 6.6 – Specifications of the footings for the c1961 building. Tasmanian Archive and Heritage Office AE417/8/1260 and AE417.10/941.

Subsequent service trenches etc.

A search of public underground asset registers via the 1100.com.au system does not reveal any major public underground assets running through the site.[51] Note that this does not necessarily indicate any privately-owned underground assets nor any redundant services which may have caused some localised/linear impact. However, it does appear that the site has not been subject to any extensive/major disturbance from such trenches.

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[51] Note that this search is indicative only and must not be relied upon for the location of services in any construction/excavation process. Professional service locators must be engaged to inform any future excavations.

7. Archaeological zoning plan and policies

As per the methodology outlined in Section 3, this section has built a chronology of site development which has detailed the physical evolution of the site and events/processes which would have acted to build the archaeological record. Section 5 has discussed the likely significance of those archaeological remains and what they may yield in terms of research potential alongside key historic, regional, thematic and temporal lines of enquiry. Section 6 has provided an assessment of the events which are likely to have impacted upon the integrity of those archaeological remains.

From the above, it is therefore plausible to propose that due to the site being the location of early development, which has probably not been subject to substantial disturbance, it may yield archaeological remains which have the potential to contribute to a knowledge of important Tasmanian heritage themes as per the research framework in Section 5.

The site may yield physical remains of those buildings, as well as artifacts relating to the occupation and use of those buildings, which may yield information which is not readily available (or available at all) from historical sources.

Note that the overlay plans of known early building footprints as depicted in Figures 4.18-4.21 do not cover the entire subject site (i.e. are concentrated towards the eastern and northern edges) it is feasible to propose that parts of the subject site have different abilities to yield building remains and remains of concentrated habitation. This is not to imply that archaeological remains are only found within building footprints, but the concentration of such remains is likely to be less the further away from building footprints (noting that there may still be remains of ancillary features and other occupational debris outside building footprints).

Based on the known and likely early building footprints, the following archaeological zoning plan is proposed for the subject site:

Figure 7.1 – Archaeological zoning plan for the subject site. Red denoting areas of high archaeological potential, orange depicting areas of medium archaeological potential and green depicting areas of low archaeological potential.

The following table considers the archaeological remains which may be found within each specific area.

Area	Likely remains	Likely integrity	Significance/potential
Red	Structural remains of c1830s (or earlier) residential buildings. Artifactual remains arising from deposition associated with c130 years of domestic occupation from colonial times through to the 1960s.	Likely to be largely intact owing to the lack of substantial development post demolition.	Of **high archaeological potential** and historical interest in demonstrating the establishment and evolution of the site, the layout and construction of the early buildings and the material culture of those using/inhabiting the buildings throughout the colonial period into the c20th.
Orange	second-generation buildings and the material culture of those using/inhabiting those buildings. This area also is likely to yield remains of ancillary structures and features associated with all phases of development on the site (i.e. from c1830s onwards) e.g. outbuildings, drains, cesspits, paths etc.	Likely to be largely intact owing to the lack of substantial development post demolition.	Of **medium archaeological potential** and historical interest in demonstrating the later evolution of the site, the layout and construction of the later and ancillary buildings/features on the site.
Green	Unlikely to be any significant nor substantial archaeological remains due to a lack of known development in these areas and also being areas where any substantial ancillary infrastructure is likely.		Of **low or no archaeological potential.**

Accordingly, the following archaeological management policies are recommended:

1. Any excavation proposed in areas of **high archaeological potential** must be preceded by an archaeological impact assessment, and if necessary an archaeological method statement, which details measures to be taken to avoid or mitigate impact upon the archaeological resource. That method statement must be in accordance with industry standard (e.g. the Tasmanian Heritage Council's Practice Note 2 – *Managing Historical Archaeological Significance in the Works Application Process*) and implemented in the works process.

2. Any excavation in areas of **medium archaeological potential**, are to be monitored by a historical archaeologist in order to confirm any possible presence of archaeological remains. If it becomes apparent that no such remains exist, then archaeological input may cease. If significant remains are confirmed, then this area is to be managed in accordance with industry standard (e.g. the Tasmanian Heritage Council's Practice Note 2 – *Managing Historical Archaeological Significance in the Works Application Process*) and implemented in the works process. Note that any remains in this area need not be wholly investigated and that an indicative sample of such remains may be investigated at the discretion of the archaeologist – sufficient to yield answers to research questions.

3. No archaeological input is required for excavation in areas of **low archaeological potential**, however any unexpected finds must be reported to a qualified historical archaeologist who is to assess their significance and deal with any significant finds as per (1) and (2) above.

8. The proposed development and archaeological impact

A development has been proposed for a mixed-use development on the site, which will include:

- Entire coverage of the site
- Two levels of basement parking
- Ground floor retail
- Five levels of apartments
- Rooftop terrace

The proposed development is shown on Heffernan Button Vos Architects, 62-64 Patrick Street Apartment Development, Project No. 18.63, Drawings A100-112, A200, 210, A400-401 (DA issue, dated 3/12/18).

The project design is supported by the architect's design statement (supplied to the Council Development Officer as part of the development application package). The pertinent points drawn from the architect's statement in the rationale for bulk excavation of the site are:

- The desire for subterranean parking to sufficiently service the building in-line with practical and planning scheme requirements.
- The aversion to visually obtrusive above-ground level parking, which is considered to impact the architectural merit of the building.
- Subterranean parking will allow an overall lower building height and for the above-ground floorspace to be maximized for retail, publicly accessible and habitable spaces.

The scheme would necessitate the removal of all archaeological remains from the site.

The retention of archaeological remains in-situ with no/minimal disturbance would not allow a feasible or viable subterranean parking area and the above objectives would be compromised – as detailed in the design statement:

> *Basement car parking was deemed the most desirable outcome to service the proposed apartments, as it reduces the overall height, avoids ugly and imposing above ground car parking, and ensures that cars remain off the street. Areas of high archeological*

> *potential will be subject to bulk excavation for the basement levels and we look to offset this by providing developer funded archeological research and installing publicly accessible site interpretation based on the research and findings. Although regrettable, on balance it was viewed as a necessary offset to ensure that the street edge remained active and the overall height of the building is minimised.*

As per the likely significance of archaeological remains in Section 5, although the site does have archaeological potential in its ability to demonstrate early domestic life in Hobart, as per the research framework in that section, it is not considered necessary to retain those remains in-situ, and in this instance it is considered to provide an appropriate offset benefit that any development that the archaeological research potential of the site be yielded ahead of the development and that interpretation of those values be included in that development. It is noted that although these remains represent 1830s residential development in Hobart, there are numerous still-standing examples of such and the archaeological remains, although able to yield archaeological information, do not represent any fabric that should essentially be retained as a remarkable example. It is considered in this instance that yielding the archaeological potential provides a more widespread benefit than retention.

9. Archaeological method statement

Given the archaeological impacts likely to arise from the proposed development as described in Section 3, this section will propose a mitigation strategy in accordance with the Tasmanian Heritage Council's *Practice Note 2 – Managing Historical Archaeological Significance in the Works Application Process* as required by the conditions of approval detailed in Section 1 and the undertakings of the development application.

9.1. Distinct areas, methodology and sequencing.

Based on the likely impacts, the construction plan, desire to 'test' and ground-truth archaeological theories, as well as a range of logistics, the approach to archaeology is proposed to follow the sequence in the table below, as per the areas of archaeological zoning plan on Figure 7.1:

Figure 9.1 – Areas proposed for archaeological investigations, to be read in conjunction with the table below

Area	Location	Types of remains and archaeological Rationale	Proposed archaeological methodology
1	Site of the c1830s conjoined cottages, near the Patrick Street frontage	It is likely that any foundations of these cottages are shallow and substantial – of either brick, or more likely stone. These excavations will reveal the entire building footprint and allow the documentation of any structural remains of the building, yield of any artifacts as well as information on site formation processes on the site which may further guide the archaeological program. As these areas are likely to yield valuable archaeological information, the most stringent methodology will be employed here.	It is proposed that these works be undertaken ahead of the works program (post site-establishment). This area will be excavated under archaeological control as per the methodology below.
2	Site of the c1830 Brougham Cottage at the eastern rear corner of the site.		It is proposed that these works be undertaken as part of any early works package on the site, as the existing building will need to be demolished to facilitate access. This area will be excavated under archaeological control as per the methodology below.
3	Central portion of the site, site of the c1890s conjoined houses and other outbuildings associated with the 1830s conjoined cottages.	It is likely that the remains of the c1890s conjoined houses are very shallow and are most likely sandstone. Given the lower significance of these remains, only a cursory mapping exercise and artifact salvaging will be undertaken – as these remains are more of historical interest than archaeological potential (this may assist in interpretation initiatives). Whilst it is known that there were outbuildings from a variety of periods in this area, these are likely to have been more ephemeral and may not have left as substantial archaeological trace.	It is proposed that this will be undertaken as an archaeological monitoring exercise concurrent with the works program, as this area will not require as stringent detail-excavation and recording as the higher significance areas.

Remainder of the site	Whilst the remainder of the site has not been the location of any known major development there may be archaeological remains of significance/interest across the site that were ancillary to other uses (e.g. drains, cesspits etc.). Whilst these are unlikely to be individually significant, the basic investigation and recording of such structures, or salvage of artifacts may assist in a wider site understanding and/or have interpretive potential.	No archaeological monitoring is proposed for this area, however it is to be managed with call-in provisions for any unexpected finds as per the methodology below.

9.2. Implementation timeframe

As per the table above, it is proposed that the archaeological investigation of the 1830s building sites (i.e. the red zones) be undertaken ahead of the works program and/or during the early works program, so as to allow the full and detailed implementation of the archaeological program without the risk of disrupting the critical timepaths of the works program.

Monitoring of the orange areas will be undertaken concurrently with works. The archaeology and site supervisors will need to liaise closely so as to allow the works to proceed with minimal disruption, but allow the necessary archaeological investigation and recording of the likely remains (noting that this will involve a more basic recording and artifact salvage than those more significant 'red' zones).

9.3. Approach to works

Demolition and removal of non-significant overburden

Demolition of buildings and the mechanical excavation of any non-significant and clearly modern overburden/structure (e.g. slabs of existing buildings) may be undertaken without archaeological supervision.

Following demolition, the archaeological crew will direct their own excavator operator in areas of high potential (i.e. red areas) to clear any overburden which is not readily apparent as modern until such time as in-situ structure and/or in-situ artifact yielding deposits are encountered then mechanical excavation will cease until an understanding of the nature of the remains is ascertained and the provisions for significant remains (below) can be implemented. In medium archaeological potential areas (i.e. orange) either the archaeologist will direct their own excavator operator, or an inducted operator from the works crew (as this is intended to be a works monitoring exercise, rather than a standalone archaeological approach).

If no significant archaeological remains are encountered (to a depth of sterile ground level) then the provisions of 'cessation of archaeological input' (below) will be implemented.

Where significant archaeological remains are encountered in high sensitivity areas (red)

In areas where significant archaeological remains are encountered, those areas will be gridded to the expected horizontal extent of the remains (generally as a liner grid for strip footings), and excavation will continue by hand (as per methodology below), to expose the remains in order to gain further understanding of their nature, and to thoroughly record them (as per methodology below). Mechanical excavation in those areas will only continue if the archaeologist is satisfied that this can occur without detriment, that required outcomes can be achieved and that excavation by hand is not necessary.

The general approach to excavation will be by gridding the area in units which are responsive to the nature of the remains (e.g. in horizontal control units no greater than 1000x1000mm, or the width of the linear trench, in areas where remains appear to be complex or concentrated, or in larger control units where remains are not as complex or concentrated) and removal of each contextual unit or spit (in depths as deemed appropriate by the archaeologist, according to the nature of the strata and/or remains). Apart from non-significant overburden, all spoil will be sieved through mesh of a gauge no greater than 12mm and any significant artifacts managed as per below.

It is expected that in areas of high archaeological potential the stratigraphic sequence will be relatively simple, that of post demolition (possibly including some disturbance), demolition, occupation (which may include several distinct phases including habitation and construction and that of pre-construction. Excavation of remains within the defined contexts in reverse order of deposition will occur and each unit/context thoroughly recorded (as per below) prior to removal to facilitate the development

It is proposed that all depositional strata be removed initially, as per above, with the aim of exposing and retaining any/all structural remains in-situ for holistic recording, prior to their removal ahead of the works excavation program. Any salvageable building materials will be retained for use elsewhere at the discretion of the site owner (possibly in interpretive installations or contemporary recycled features).

Where remains of historical/archaeological interest are encountered in medium sensitivity areas (orange)

In areas of medium sensitivity, a similar methodology to the above will be implemented, however this will be a more broadscale approach without as tight horizontal control – in that the footprints of buildings will be exposed in a less constrained manner and most likely be undertaken via mechanical excavation and horizontal control will be achieved using site features (e.g. building, backyard etc.) rather than as a tight grid. Vertical strata will still be controlled and artifacts yielded from such will be assigned to those contexts. Unless deemed necessary in-field, spoil will not be sieved and only a representative sample of artifacts retained.

It is possible that the any basements of the buildings might be encountered and if present there is a high likelihood that these may contain demolition rubble or fill in a secondary context. Depending on the nature of the fill and whether any significant depositional arrangement is evident, this will be removed by a means deemed pragmatic by the archaeologist in order to expose significant remains and yield as much information as is considered necessary from that fill.

9.4. Call-in provisions – areas of low archaeological potential

The green areas on Figure 7.1 are areas where there is considered to be a low (or no) likelihood of significant archaeological remains present – generally areas of no major development, usually yard spaces, circulation areas etc. Note that this does not necessarily preclude archaeological remains such as occupational debris, unknown minor buildings, ancillary features such as paths, drains etc. It is also possible that more complex/significant features may be found, such as cesspits, wells, etc. – in which case these will be re-designated as areas of high archaeological potential and dealt with as per the provisions above.

Whilst archaeological monitoring of these areas is not considered necessary, the possibility of unforeseen archaeological remains in these areas requires a stringent call-in protocol to be put into place, which will require site excavation crews to immediately call-in an archaeologist should any substantial structure or dense artifact deposits be encountered. **This will require a thorough briefing of the works crew by an archaeologist at the outset of works** – which will include an overview of the site history, discussion on the possibility of the above described possible remains, as well as the process for stop-work and call-in. An archaeologist is to be engaged to periodically 'audit' the site during excavations in areas of low archaeological potential in order to ensure that those protocols will be implemented.

9.5. Cessation of archaeological input

Archaeological input will cease only when the archaeologist is satisfied that all significant remains have been investigated and thoroughly recorded, as per this method statement and any conditions of statutory approvals, or if sterile ground is encountered, and that adequate consultation has been undertaken with Hobart City Council's Heritage Officer to verify that all on-site archaeological requirements have been met (and archaeological conditions satisfied).

9.6. Recording

Any structure or significant cultural deposit encountered in the 'red' areas will be thoroughly recorded (both photographically (from ground level and via drone) and sketched at a scale of no smaller than 1:20 and plotted on the site plan at a scale of a scale no smaller than 1:200). Any structure encountered in the 'orange' areas will be recorded photographically (from ground level and via drone).

9.7. Artifacts

Any significant artifacts found during excavations will be retained and have the required in-field conservation treatments and packaging undertaken. Artifacts will be bagged and tagged with spatial identification and removed from the site (to a secure location) daily. Trench-notes will further detail the context and initial interpretation of artifacts.

Basic post-field curation of artifacts will be undertaken. Glass and ceramic items will be washed, whilst any organics or metals will be dry-brushed. Artifacts will be packaged in acid-free archive bags, tagged with appropriate tags, and boxed in archival quality boxes (with appropriate padding if required). Should any urgent conservation treatment be required, a professional Conservator will be consulted at the earliest possible instance. A detailed catalogue of artifacts will be included in the final report on works.

After any required analysis, these will be archived (with a copy of relevant reports) on-site of the new development (upon completion) – however at the owner's discretion and with the approval of Hobart City Council's Heritage Officer, alternative arrangements for storage and longer-term curation/display may be made with an appropriate repository.

9.8. Reporting requirements

Excavations and monitoring must be recorded to appropriate professional standards (for example Section 4.2 of the Tasmanian Heritage Council's Practice Note 2). A final report must include (at a minimum):

- An executive summary of findings
- Details of the methodology employed
- Detailed interpretations of findings
- Relevant annotated photographs (including drone photographs)

- Site plans at a scale of no less than 1:200
- Trench plans at a scale of no less than 1:50
- Feature plans/sketches at a scale of no less than 1:20
- Overlay plans of structure encountered in relation to historical sources
- Photograph log

A copy of the final report, and project archive, will be deposited with Hobart City Council (and other repositories as listed below) within 6 months of completion of the excavations.

9.9. Public benefit

Subject to the exact nature and findings of the archaeological program, the following public benefit program will be considered by the proponents of the development:

- An interpretation plan which would consider options for the interpretation of the heritage values of the site in the new development (e.g. static/multimedia installations, curated objects, recycling of materials in contemporary installations etc.).
- The project report will be made publicly available, through appropriate repositories such as Hobart City Council, Heritage Tasmania, the State Library of Tasmania and the National Library of Australia (Trove).
- If archaeological results warrant, an academic publication may be produced (not at the proponent's expense). In any case, archaeological results will be made freely available for future archaeological research.

It is not considered feasible to have any on-site public benefit events during the works program – given that this will be a private works site.

9.10. Aboriginal heritage

This document deals primarily with the management of historic cultural heritage and has only briefly considered in-situ Aboriginal cultural heritage insofar as a search of Aboriginal Heritage Tasmania's register was undertaken, which has confirmed that no known Aboriginal heritage remains are within the subject site and that there is a low risk of such. There is the possibility of encountering Aboriginal heritage in a secondary context (e.g. fill). Archaeological monitoring should be mindful of this possibility, and follow the Tasmanian Government's *Unanticipated Discovery Plan – Procedure for the management of unanticipated discoveries of Aboriginal relics in Tasmania*

9.11. Site contamination

It is the responsibility of the proponent of the development to investigate the possibility of site contaminants, and to either verify that no site contaminants are present, or to take required measures to deal with any known or likely contaminants during excavation works (noting that any necessary decontamination works may require archaeological input).

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PROJECT COMMUNICATION

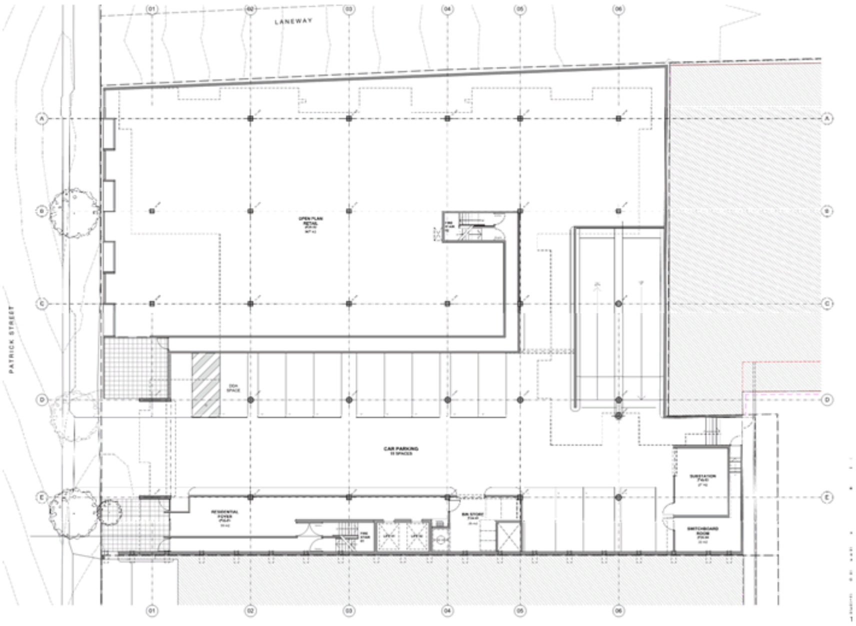
To:	Jacob Britten	PC No:	18275 PC02
Company:	HBV Architects	Date:	6 Aug 2019
From:	David Devenish	No. of Pages:	5
Project:	Patrick Street Apartments	Trade:	Stormwater

Stormwater Management Plan for 62-64 Patrick Street, Hobart

Introduction

'6 Failla Street Pty Ltd' is proposing to develop 6 levels of apartments (68 in total) plus carparking and commercial tenancies at the above address. The site is approximately 2100m^2 in area. This communication addresses the management of stormwater discharge from the proposed development site.

Proposed Development Site – Existing



Proposed Development – Ground Level

Key points to note with the proposed development are:

- The current site is more than 97.5% impervious and so no significant increase in impervious area is involved in the proposed development.
- There is no exposed pavement at ground level. The entire development site will be roofed.
- There will be an increase in carparking spaces by more than 6 spaces. All onsite carparking will be under-cover (per above).
- There are no stormwater overland flow paths crossing this site. See for example the southern end of the site boundary as indicated in the photo below.

South End of Site showing absence of overland flow paths through the site

Proposed Stormwater Network

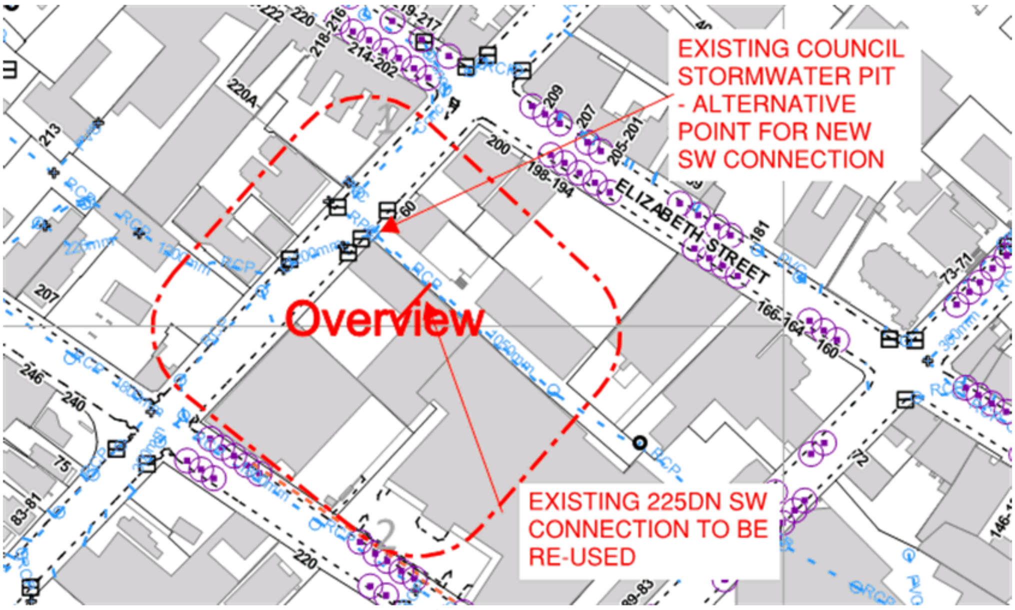
- 100% of runoff from the proposed development will be drained through a new stormwater drainage system prior to discharge from the site to the Council's stormwater infrastructure.
- No onsite detention (OSD) or discharge limits proposed for this development.
- The basement carpark will incorporate a drainage grated pit at its lowest point with pump-out to a holding tank. The holding tank will gravity feed via an oil/water separator to the Council's stormwater infrastructure.
- The entrance to the basement carpark will not be at the lowest point of the site and the small entry ramp off the street prevents the ingress of storm water into the basement carpark levels.

Proposed Stormwater Connection

There is an existing 225mm DN stormwater connection to the site in the laneway to the north-east. This laneway is a separate private title for which the proposed development has no right of way. It is proposed to re-use this stormwater connection for the site since it connects at a low point of the site. As an alternative, a new 225DN connection could be used with the abandonment of this existing connection.

Although not clear from the DBYD image below, the stormwater main running down the private laneway is a 1050mm RCP according to the DBYD information.

Existing stormwater pit for possible new connection (in foreground) – looking down laneway towards the existing connection in the background (behind the tuft of grass)



Proposed Stormwater Connection

Stormwater Quantity Management

The Hobart Interim Planning Scheme 2015, Section E7.0 references the State Stormwater Strategy 2010 (see E7.7.1) which only imposes limits on stormwater quantity when the impervious area is increased by more than 500m^2.

Initial phone discussion with Council's Jennifer Flanagan (25th June) confirm that no stormwater detention requirements apply to this project.

The proposed development removes some small garden beds (50m^2) and replaces them with roofed area. The stormwater flow rates involved are:

Pre-existing run-off:	2050m^2 @ 160mm/hr* x 0.9 (runoff coefficient) is	82.0 l/s
	50m^2 @ 160mm/hr* x 0.25 (runoff coefficient) is	0.6 l/s
	Total	**82.6 l/s**
Proposed new run-off:	2100m^2 @ 160mm/hr* x 0.9 (runoff coefficient) is	**84.0 l/s**

* 5min – ARI 100year

This is a change in discharge from the site of **+1.7%** (for 100yr ARI).

Stormwater Quality Management

The high risk area of the carpark will drain to a sump within the basement level of the carpark. This will collect potential water leakage and stormwater / ground water ingress into the carpark. This water will then be pumped to a holding tank for treatment prior to gravity discharge to the Council stormwater infrastructure.

The proposed treatment of this carpark run-off is a 'Stormwater By-pass Interceptor' (SBI 600) which removes gross pollutants and fine silt from the stormwater run-off, but effectively captures hydrocarbons and other light-liquid pollutants also.

Conclusion

The proposed stormwater system manages both stormwater quantity and quality appropriately in accordance with the objectives of the State Stormwater Strategy.

David Devenish BE(Mech), CPEng, FIEAust.
BP Accreditation No. CC5311T

ELEMENT
TREE SERVICES

DEVELOPMENT IMPACT ASSESSMENT

62 – 64 Patrick Street, Hobart

For: Jacob Britten
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3rd September 2019

1. Terms of Reference

This report was requested by Jacob Britten of HBV Architects, to discuss the impacts of development at 62-64 Patrick Street, Hobart. It will discuss those findings and provide management recommendations for protecting the trees during the construction phase.

In accordance with a Hobart City Council resolution, I will provide a valuation of one tree which may be critically impacted by the works.

Fig. 1 – an aerial image of the site indicating the trees subject to the development. Image courtesy of listmap.

2. The Proposal

The proposed development will be within close proximity to four mature fastigiate hornbeam (*Carpinus betulus* 'Fastigiata'). It appears that the existing crossover will be removed and a new one installed to access a centralised carpark.

The proposed crossover may potentially impact tree 2, but there is scope to replant it 1200mm to the north-east.

PLN 19-486 Road Reserve Works indicates that no other tree will be impacted. Although this may be the case, it will be important to protect the trees during the construction phase to ensure that they remain viable into the future.

While there is to be substantial excavation within the proposed site, it is unlikely that roots will have colonised private property.

3. Development Impacts

The following table will identify the tree protection zone (tpz), structural root zone (srz) and the potential incursions for each tree.

Tree	SRZ	TPZ	Dist. to Boundary	TPZ Area	TPZ Incursion	Notes
1	1.50m	2.0m	2.4m	12.57 m^2	N/A	
2	1.53m	2.0m	2.2m	12.57 m^2	60.8%	Major incursion
3	1.85m	2.52m	2.35m	19.95 m^2	1.04%	
4	1.88m	2.64m	2.3m	21.90 m^2	2.72%	

The crossover will critically damage the structural root zone and tree protection zone of tree 2. In the current design, this tree will need to be removed. There is scope to re-plant this tree nearby to offset its loss.

The incursion into the tpz of tree 3 and 4 is under 10% and is considered minor. Based on this outcome, there is no requirement to alter the design to protect the trees.

4. Discussion

In consultation with the proponents, there is no scope to alter the existing plan to ensure that tree 2 is retained. It appears that it will require removal.

If a council tree is removed as a result of private development, Hobart City Council have a compensation fee that comprises of:

I. The amenity value of the tree,
II. The replacement fee for a tree that includes the purchase cost of an advanced size and the planting and establishment costs.

Using their method, I have calculated this tree as having an amenity value of $2,135.72 (Appendix 1)

5. Tree Protection Measures

The new crossover installation may encounter some roots extending from tree 3. If roots are encountered and need to be removed, they should be pruned off with a sharp tool to leave a clean cut. Although unlikely, If roots >50mm are encountered, advice should be sought from a consulting arborist.

The three trees that are to remain at the site may be impacted during the construction phase. To ensure that this does not occur, I recommend that tree protection zones are established and fenced off. In this situation it is not practical to enforce large zones, unless alternative pedestrian access can be guaranteed.

As the ground surrounding tree 1 is bitumen, root damage through compaction is unlikely. To avoid any physical damage to the above ground components, I recommend that temporary fencing panels are installed around the tree, extending to the edge of the canopy.

Once established, the tree protection zones must be free from the following:

- Machine excavation including trenching;
- Excavation for silt fencing;
- Cultivation;
- Storage;
- Preparation of chemicals, including preparation of cement products;
- Parking of vehicles and plant;
- Refuelling;
- Dumping of waste;
- Wash down and cleaning of equipment;
- Placement of fill;
- Lighting of fires;
- Soil level changes;
- Temporary or permanent installation of utilities and signs, and
- Physical damage to the tree(s).

Tree 3 and 4 are growing close to the boundary. It is expected that scaffolding will be erected near the canopy during the construction phase. It is possible that this may encroach on the trees, but I expect that the branches can be tied back and/or pruned to gain adequate clearance. I do not see this as having a significant impact on the trees if completed by a qualified arborist in accordance with AS 4373 – 2007 *Pruning of amenity trees.*

Fencing in this location may be problematic as it may interfere with the scaffolding. Further information needs to be gained to understand the practicality of installing this. It may be possible to install hoarding around the scaffold to act as tree protection zone fencing.

6. Conclusion

- **In the current design tree 2 will require removal. The loss of this tree may attract a compensation fee from the Hobart City Council.**
- **It is unlikely that excavation at the proposed site will encounter any significant roots.**
- **The remaining three trees can be retained but will require protection during the construction phase.**

Yours sincerely,

Alister Hodgman

Appendix 1 – Tree Valuation (Selections highlighted in yellow)

Basic Value ($) 2017

The basic monetary value of a tree is determined by matching the trunk diameter at breast height (DBH) with its corresponding base value:

DBH cm	Base Value	DBH cm	Base Value	DBH cm	Base Value
6	$ 309.92	**50**	$21,522.33	**100**	$ 86,089.33
8	$ 550.98	**55**	$26,042.03	**105**	$ 94,913.49
10	$ 860.89	**60**	$30,992.16	**110**	$104,168.09
15	$ 1,937.00	**65**	$36,372.74	**115**	$113,853.14
20	$ 3,443.57	**70**	$42,183.77	**120**	$123,968.63
25	$ 5,380.58	**75**	$48,425.25	**125**	$134,514.58
30	$ 7,748.04	**80**	$55,097.17	**130**	$145,490.97
35	$10,545.94	**85**	$62,199.54	**135**	$156,897.81
40	$13,774.29	**90**	$69,732.35	**140**	$168,735.09
45	$17,433.09	**95**	$77,695.62	**145**	$181,002.82
				Base Value	$2,085.66

Species Factor (S)

A tree is assessed according to its known natural life span and its rate of growth in a particular environment. For example, a long-lived tree will be scored higher than a short-lived tree. Significant features to the tree will also modify how the tree is scored. Judgment regarding species factor must be made by a qualified Arborist.

Group	Characteristics	Example Species	Score
1	• trees of short life span (less than 50 years) • fast growth rate	*Prunus, Acacia, Virgillia, Laburnum*	**0.5**
2	• trees of short life span (less than 50 years) • slow growth rate	*Malus, Crataegus, Eugenia, Waterhousia, Pyrus*	**0.6**
3	• trees of medium life span (50 -150 years) • fast growth rate	*Populus, Liquidamber, Eucalyptus, Corymbia, Angophora, Grevillea, Melaleuca, Michelia, Salix, Casaurina, Hakea, Celtis, Acmena*	**0.7**
4	• trees of medium life span (50 - 150 years) • slow growth rate	*Brachychiton, Fraxinus, Gleditsia, Jacaranda, Shinus, Phoenix, Melia, Robinia, Lophostemon, Liriodendron, Agonis, Meterosideros, Syzygium*	**0.8**
5	• trees of long life span (more than 150 years) • fast growth rate	*Cupressus, Platanus, Ficus, Pinus*	**0.9**
6	• trees of long life span (more than 150 years) • slow growth rate	*Ulmus, Quercus, Sequoia, Ginko, Araucaria Lophostemon, Liriodendron, Agonis, Meterosideros, Syzygium*	**1.0**
Modifiers	• Environmental Weeds • dangerous (poor branch attachment) • undesirable characteristics (e.g. allergenic)	*Salix, Fraxinus rotundifolia, Pittosporum undulatum*	**-0.1**

	• a rare species in the locality • a special precious cultivated variety • a 'significant tree' registered by the National Trust • has special historical or other significance	**+0.1**	

Trees named are supplied only as examples in Melbourne conditions* **Species Factor (S) 0.8

Aesthetics (A)

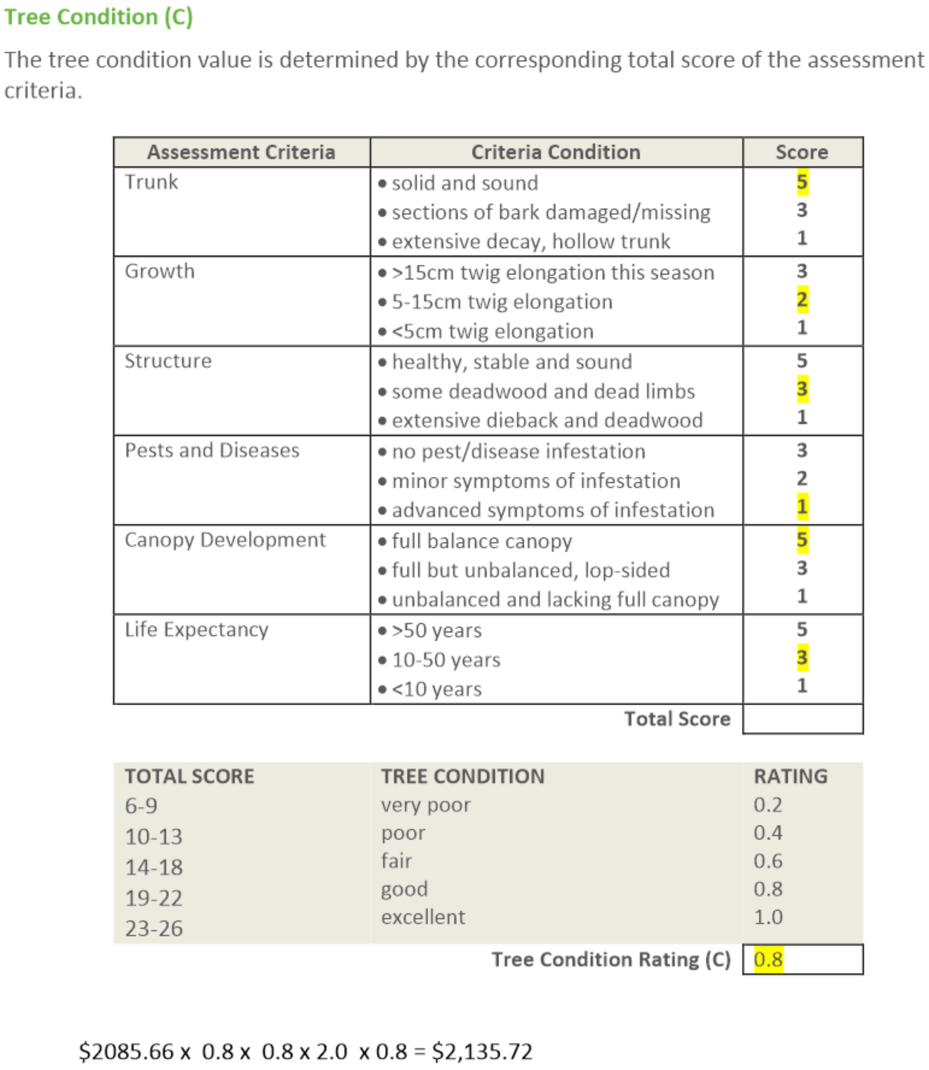
The aesthetic value of a tree is determined by the impact on the landscape if the tree were removed. This category is closely tied to the locality factor (L).

Aesthetic Factor	Score
Contributes little to the landscape	**0.5**
One of a group of close plantings	**0.6**
Wide plantings	**0.7**
Irregular spacing between trees; regular spacing one side	**0.8**
Street or pathway plantings, regular spacing both sides	**0.9**
Solitary feature specimen tree	**1.0**
Aesthetics (A)	0.8

Locality (L)

The locality factor is determined by the tree's geographical situation. Trees in a Capital City main street or boulevard score highest because of the stressful growing environment in which the tree has to survive. As the location becomes more rural, the significance of the tree diminishes.

Locality Factor	Score
In undeveloped bushland or open forest	**0.5**
In country areas and country roads	**1.0**
In outer suburb areas and residential streets	**1.5**
In inner city suburbs	**1.75**
In City Park or Reserve; significant street near City Centre	**2.0**
In City Garden, City Square, Mall or City Centre secondary street	**2.25**
City Centre Main Street, Principal Boulevard	**2.5**
Locality (L)	2.0



Tree Condition (C)

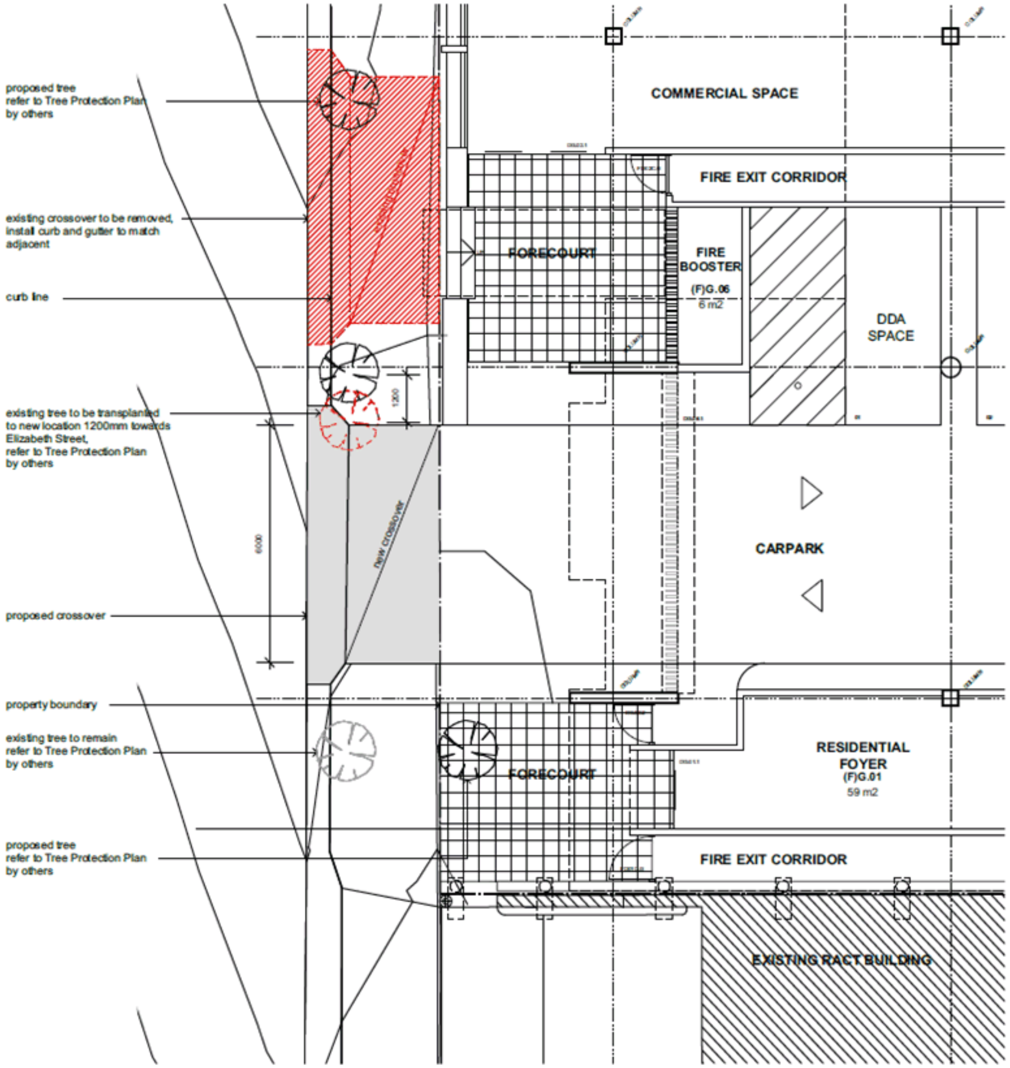
The tree condition value is determined by the corresponding total score of the assessment criteria.

Assessment Criteria	Criteria Condition	Score
Trunk	• solid and sound	5
	• sections of bark damaged/missing	3
	• extensive decay, hollow trunk	1
Growth	• >15cm twig elongation this season	3
	• 5-15cm twig elongation	2
	• <5cm twig elongation	1
Structure	• healthy, stable and sound	5
	• some deadwood and dead limbs	3
	• extensive dieback and deadwood	1
Pests and Diseases	• no pest/disease infestation	3
	• minor symptoms of infestation	2
	• advanced symptoms of infestation	1
Canopy Development	• full balance canopy	5
	• full but unbalanced, lop-sided	3
	• unbalanced and lacking full canopy	1
Life Expectancy	• >50 years	5
	• 10-50 years	3
	• <10 years	1
	Total Score	

TOTAL SCORE	TREE CONDITION	RATING
6-9	very poor	0.2
10-13	poor	0.4
14-18	fair	0.6
19-22	good	0.8
23-26	excellent	1.0
	Tree Condition Rating (C)	0.8

$2085.66 x 0.8 x 0.8 x 2.0 x 0.8 = $2,135.72

Appendix 2 – Road Reserve Works



NOTE:

no other trees located in the council road reserve are proposed to be removed as part of the works

PLN-19-486
INFORMATION

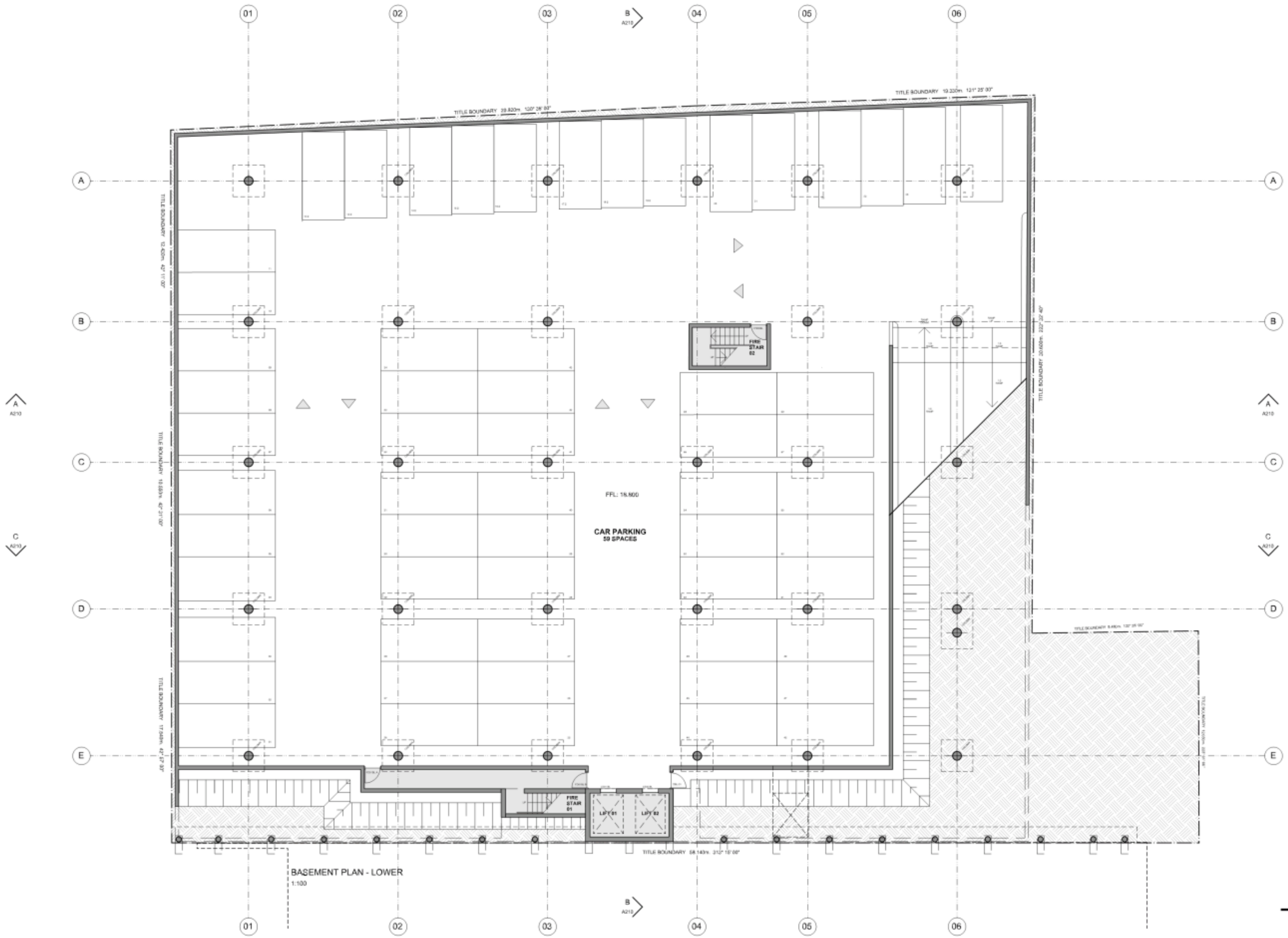
ROAD RESERVE WORKS

PATRICK ST ST

SCALE 1:100@A3
DATE 30 AUGUST 2019

HBV | ARCHITECTS


LANEWAY
PATRICK STREET
DEMOLISH EXISTING CROSSOVER
REMOVE + REPLANT STREET TREE IN NEW LOCATION
EXISTING RACT ROADSIDE AND SERVICE CENTRE TO BE DEMOLISHED
EXTENT OF PROPOSED BULK CUT SHOWN HATCHED.
PROPOSED PROJECT SITE
62-64 PATRICK STREET
2152m2
HARVEY NORMAN
LANEWAY
RACT HOUSE
EXISTING SITE DEMOLITION PLAN
1:100
B STREET TREE REM 05.09.19
A DA SUBMISSION 02.08.19
REV NOTES DATE
DEVELOPMENT APPLICATION
PATRICK STREET APARTMENTS
62-64 PATRICK STREET
EXISTING SITE & DEMOLITION PLAN
A101
SCALE AS@A1
DATE 26 JULY 2019
FAILLA AVENUE PTY LTD
PROPERTY FOLIO
HBV ARCHITECTS



BASEMENT PLAN - LOWER
1:100

B	STREET TREE REM	05.09.19
A	DA SUBMISSION	02.08.19
REV	NOTES	DATE

DEVELOPMENT APPLICATION

PATRICK STREET
APARTMENTS

62-64 PATRICK STREET

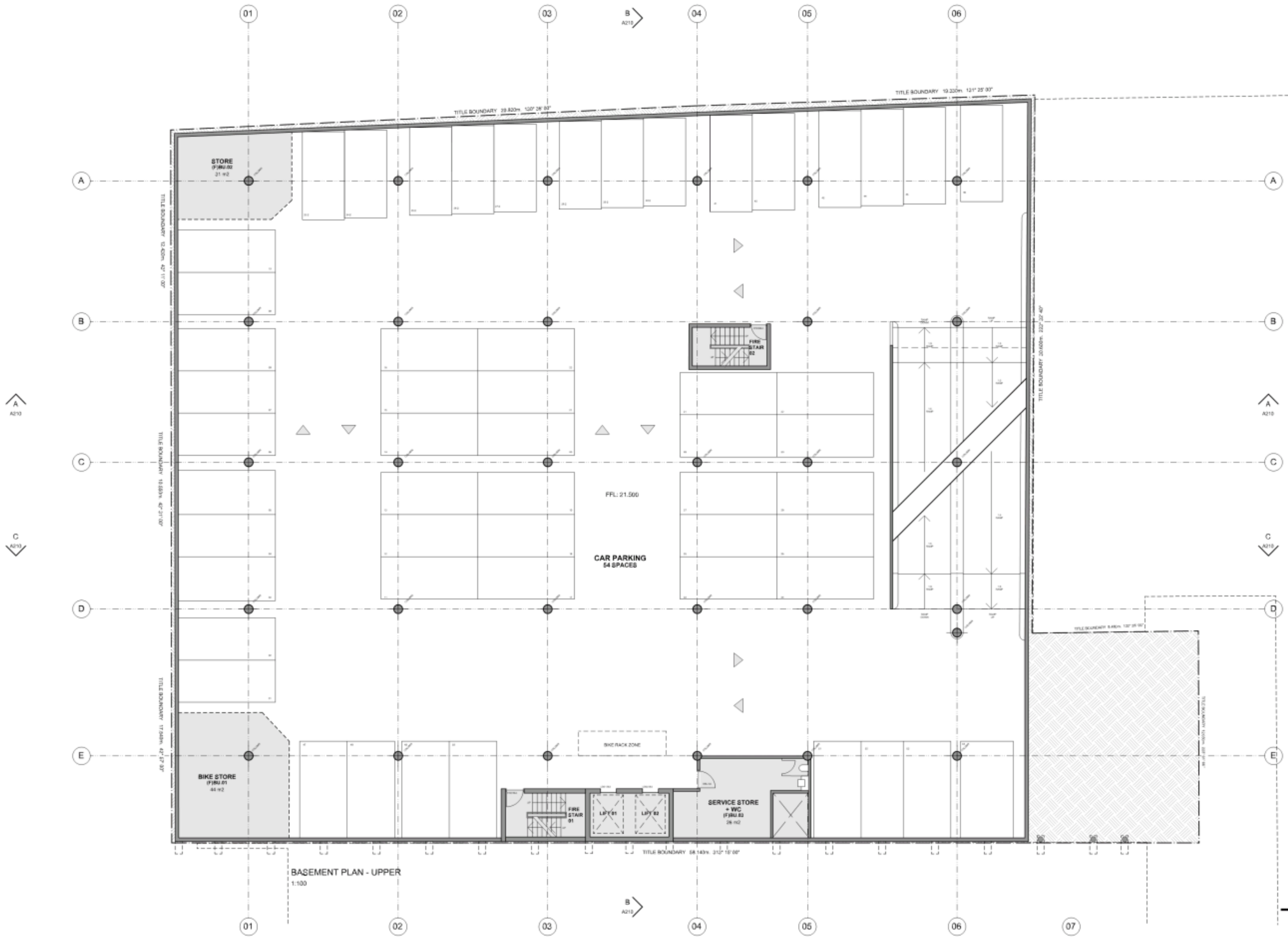
BASEMENT PLAN
- LOWER

A102

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS



BASEMENT PLAN - UPPER
1:100

B	STREET TREE REM	05.03.19
A	DA SUBMISSION	02.08.19
REV	**NOTES**	**DATE**

DEVELOPMENT APPLICATION

PATRICK STREET
APARTMENTS

62-64 PATRICK STREET

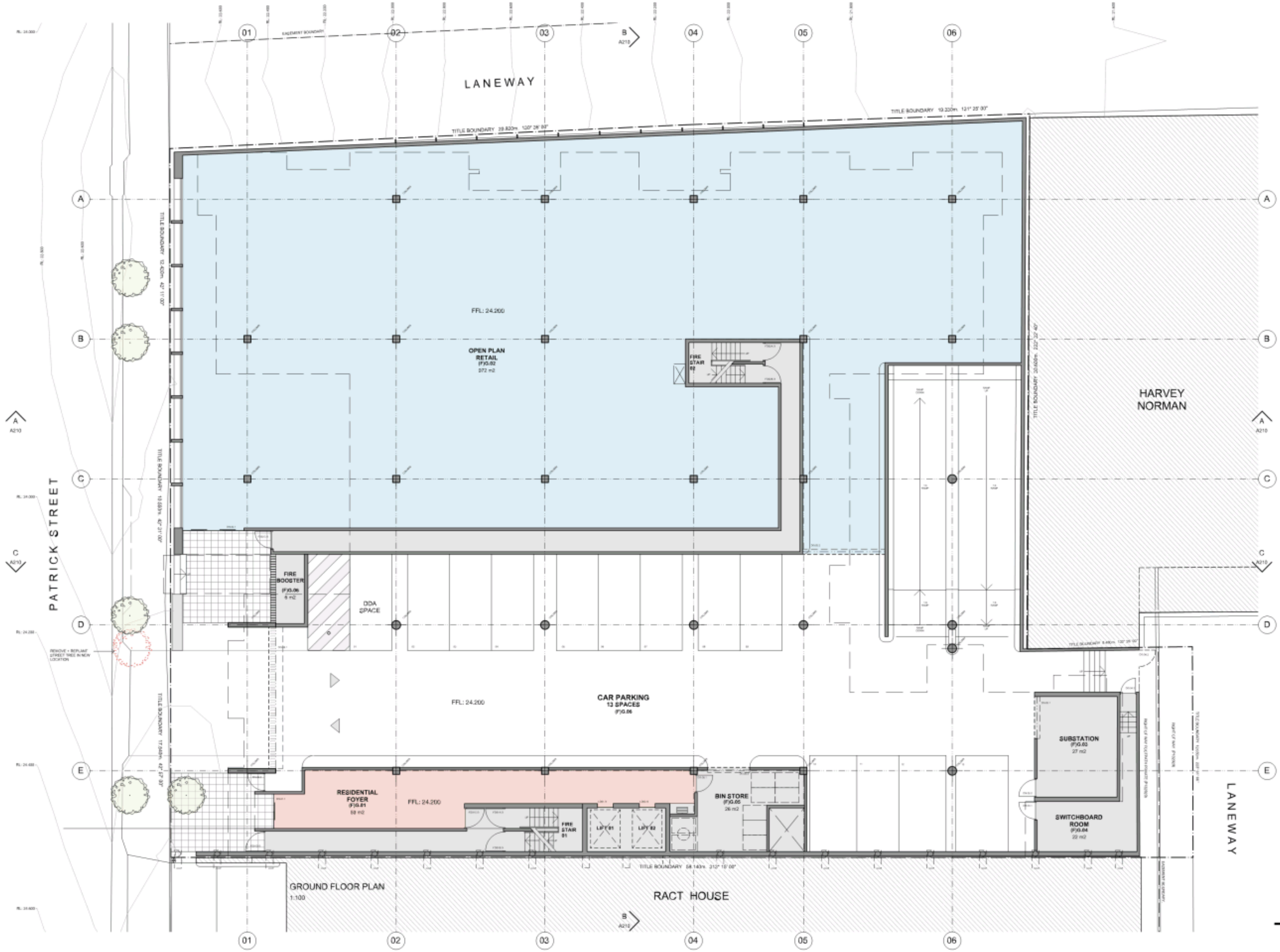
BASEMENT PLAN
- UPPER

A103

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS



B	STREET TREE REM	05.09.19
A	DA SUBMISSION	02.08.19
REV	**NOTES**	**DATE**

DEVELOPMENT APPLICATION

PATRICK STREET
APARTMENTS

62-64 PATRICK STREET

GROUND FLOOR PLAN

A104

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS

City of HOBART

Enquiries to: City Planning
Phone: (03) 6238 2715
Email: coh@hobartcity.com.au

20 September 2019

Frazer Read (All Urban Planning)
19 Mawhera Avenue
SANDY BAY TAS 7005

mailto: frazer@allurbanplanning.com.au

Dear Sir/Madam

62 PATRICK STREET & 179 - 191 MURRAY STREET, HOBART REMOVAL OF TREE IN ROAD RESERVE NOTICE OF LAND OWNER CONSENT TO LODGE A PLANNING APPLICATION - GMC-19-14

Site Address:

179 -191 Murray Street and 62 Patrick Street, Hobart

Description of Proposal:

Proposed apartment development requiring the removal of a street tree

Applicant Name:

Frazer Read
All Urban Planning

PLN *(if applicable)*:

PLN-19-486

I write to advise that pursuant to Section 52 of the *Land Use Planning and Approvals Act 1993*, I grant my consent on behalf of the Hobart City Council as the owner/administrator of the above land for you to make application to the City for a planning permit for the development described above and as per the attached documents.

Please note that the granting of the consent is only for the making of the application and in no way should such consent be seen as prejudicing any decision the Council is required to make as the statutory planning authority.

This consent does not constitute an approval to undertake any works and does not authorise the owner, developer or their agents any right to enter or conduct works on any Council managed land whether subject to this consent or not.

If planning approval is granted by the planning authority, you will be required to seek approvals and permits from the City as both landlord, land manager, or under other statutory powers (such as other legislation or City By-Laws) that are not granted with the issue of a planning permit under a planning scheme. This includes the requirement for you to reapply for a permit to occupy a public space under the City's Public Spaces By-law if the proposal relates to such an area.

Accordingly, I encourage you to continue to engage with the City about these potential requirements.

Yours faithfully

N. Heath

(N D Heath)
GENERAL MANAGER

Relevant documents/plans:

Drawings: A101, A102, A103 & A104 dated 26/07/2019 - HBV Architects

EXISTING SITE DEMOLITION PLAN
1:100

B	STREET TREE REM	05.09.19
A	DA SUBMISSION	02.08.19
REV	NOTES	DATE

DEVELOPMENT APPLICATION

PATRICK STREET
APARTMENTS

62-64 PATRICK STREET

EXISTING SITE &
DEMOLITION PLAN

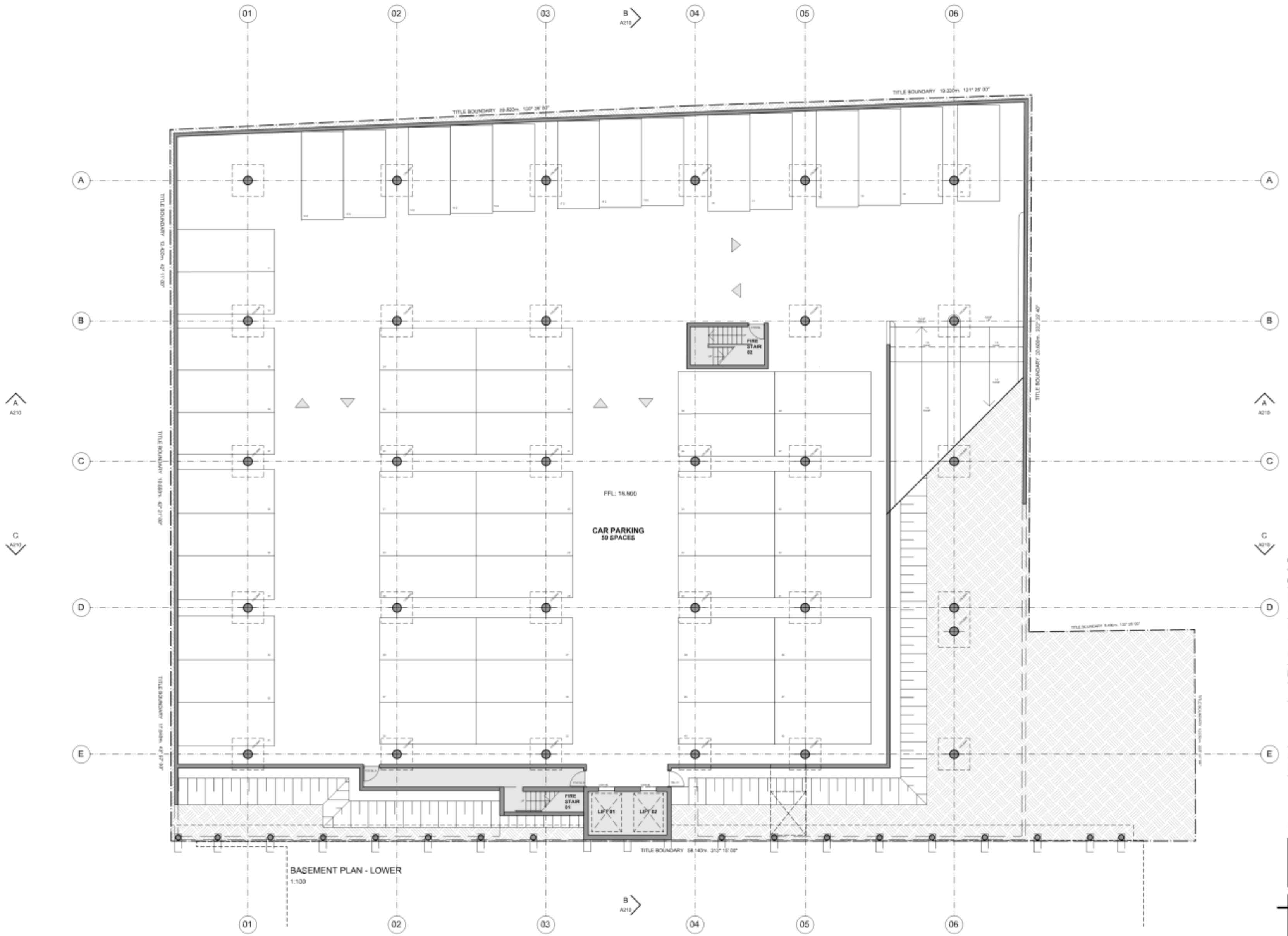
A101

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS

Approved - General
Manager Consent Only
GMC-19-14 20/09/2019



BASEMENT PLAN - LOWER
1:100

REV	NOTES	DATE
B	STREET TREE REM	05.09.19
A	DA SUBMISSION	02.08.19

DEVELOPMENT APPLICATION

PATRICK STREET
APARTMENTS

62-64 PATRICK STREET

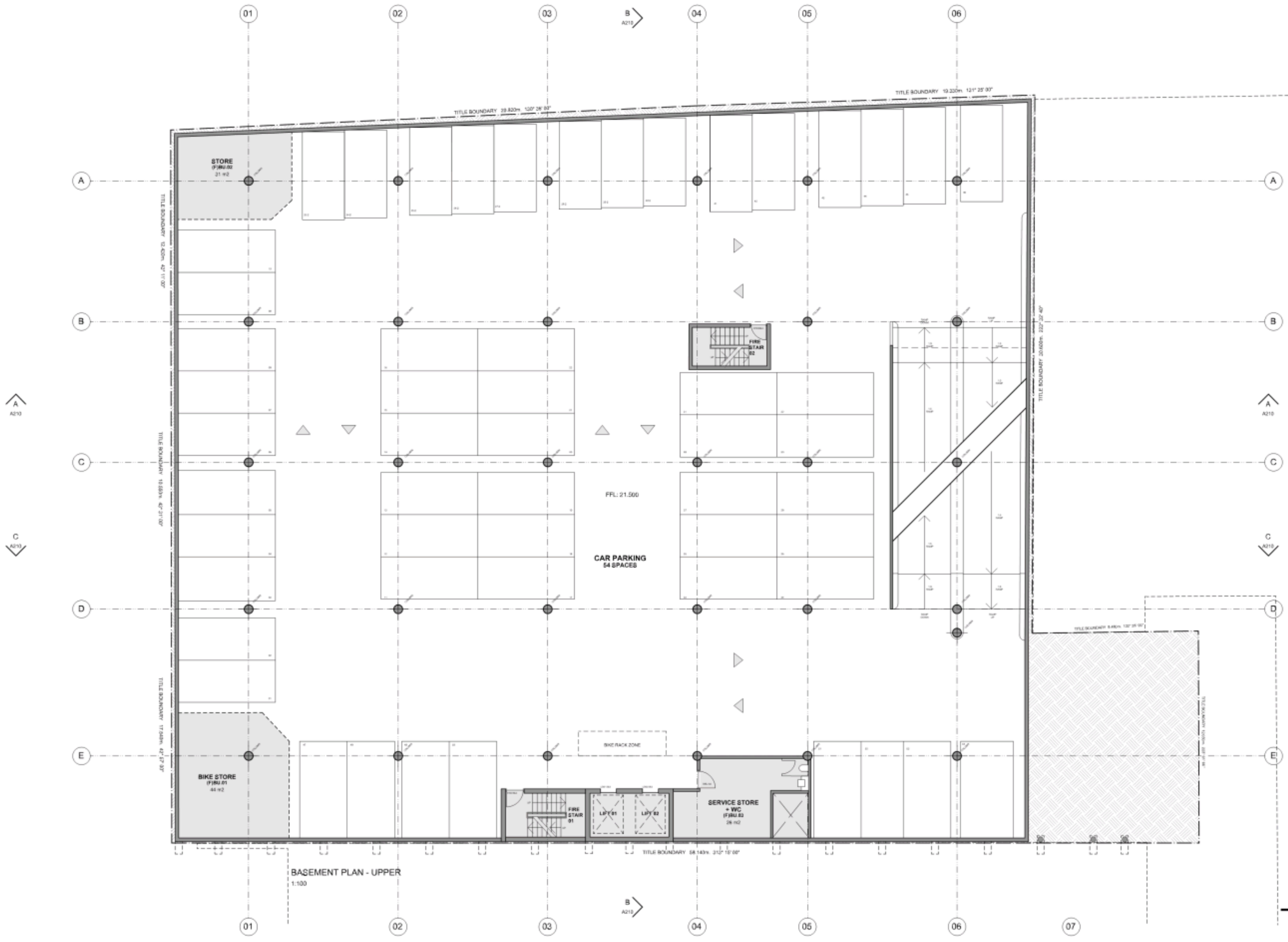
BASEMENT PLAN
- LOWER

A102

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS



BASEMENT PLAN - UPPER
1:100

B	STREET TREE REM	05.03.19
A	DA SUBMISSION	02.08.19
REV	NOTES	DATE

DEVELOPMENT APPLICATION

PATRICK STREET APARTMENTS

62-64 PATRICK STREET

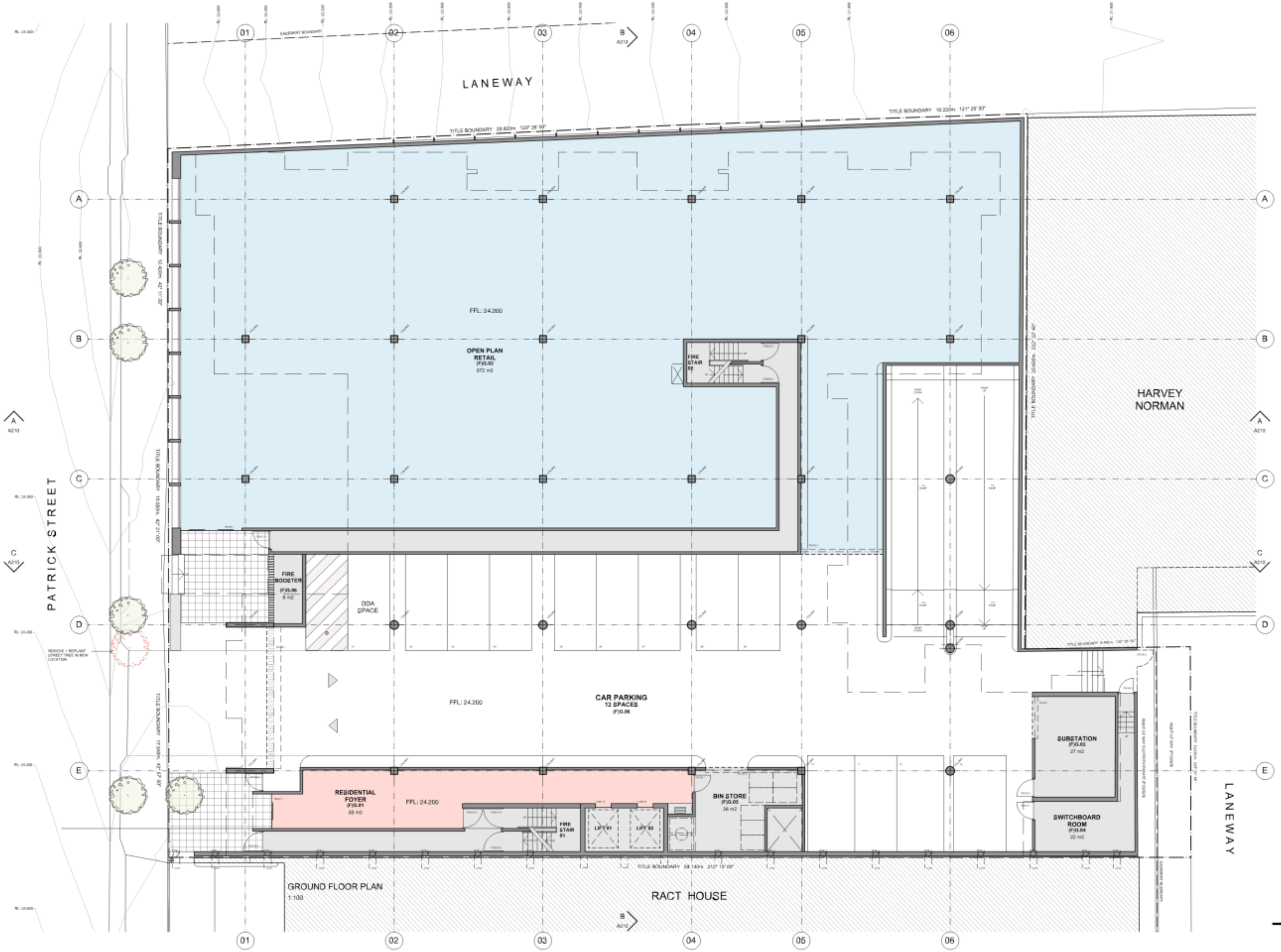
BASEMENT PLAN - UPPER

A103

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS



REV	NOTES	DATE
B	STREET TREE REM	05.09.19
A	DA SUBMISSION	02.08.19

DEVELOPMENT APPLICATION

PATRICK STREET APARTMENTS

62-64 PATRICK STREET

GROUND FLOOR PLAN

A104

SCALE AS@A1
DATE 26 JULY 2019

FAILLA AVENUE PTY LTD
PROPERTY FOLIO

HBV | ARCHITECTS

Approved - General Manager Consent Only
GMC-19-14 20/09/2019