APPENDIX 12

DETAILED SITE INVESTIGATION AND GEOTECHNICAL ASSESSMENT [HW]

17 115

17 December 2019

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Haigh Workman Ltd '*Geoenvironmental Appraisal 1 Richard Street, Opua for Doug's Opua Boat Yard Limited*'
Ref: 17 115, dated December 2019

We confirm that Mr Schmuck has provided confirmation that the intellectual property of data and factual information collected by Haigh Workman can be released to GWE Consulting Engineers.

Please note that we do not warrant the suitability of the intellectual property.

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Geoenvironmental Appraisal

1 Richard Street, Opua

For

Doug's Opua Boat Yard Limited

Haigh Workman Reference: 17 115

December 2019

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Revision History

Revision Nº	Issued By	Description	Date
A	Edward Collings	First Issue	16 April 2019
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Report Checklist

Summary of report type and sections presented within this document. Items present are indicated by 'X'.

Report Type (As set out in MFE Contaminated Land Management Guideline No. 1: 2011)

Preliminary Site Investigation Report	☐
Detailed Site Investigation Report	☒
Remediation Action Plan	☒
Site Validation Report	☐

Report Sections

Executive Summary	☒
Scope of Work	☒
Site Identification	☒
Site History	☒
Site Condition and Surrounding Environment	☒
Geology and Hydrology	☒
Sampling and Analysis Plan and Sampling Methodology	☒
Field Quality Assurance and Quality Control (QA/QC)	☒
Laboratory QA/QC	☒
Data Evaluation QA/QC	☒
Basis for Guideline Values	☒
Results	☒
Site Characterisation	☒
Remedial Actions	☒
Validation	☐
Site Management Plan	☒
Ongoing Site Monitoring	☐
Conclusions and Recommendations	☒

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Executive Summary

This Geoenvironmental Appraisal comprising a detailed site investigation, remediation action plan and site management plan has been performed for land at 1 Richardson Street, Opua and the adjacent esplanade reserve and CMA. Current and historic boat yard activities at the site primarily include vessel maintenance which subject the site to assessment under the HAIL and NES-CS. It is understood that the client wishes to redevelop the commercial aspects of the site to establish an environmentally sustainable boat yard servicing a reduced capacity from historical levels of vessel maintenance.

Through a detailed desktop study of information available to Haigh Workman, an assessment of the proposed redevelopment and the interpretation of analytical test results for the site setting the investigation has revealed:

- Localised contamination above various thresholds comprising:
    - Select heavy metals, arsenic (in borehole BH26) and lead (in boreholes BH26, BH28 and BH29) up to 0.3 m below ground level (bgl) within the commercial zone. Locally, select PAHs were recorded within samples ES8 an ES15 associated with oil and grease application to the winch and wire rope.
    - Locally elevated lead (in boreholes BH2, BH18, BH22 and BH23) generally to 0.30 m bgl but to 0.5 m bgl within BH18 within the recreational zone from post 1960s boat yard activities. BH2 is associated with the historic boat yard (pre 1960s) and not as a result of the client's activities at the site.
    - Copper representing phytotoxic concentrations to proposed planting as a screen and physical site barrier in the reserve.
    - Elevated copper, lead, mercury and zinc within surface sediment samples within the footprint of the slipway in the CMA foreshore.
    - Elevated copper, lead and zinc within saline groundwater with the potential to pose a risk to the aquatic environment.
    - Potential for cut to waste soils to leach elevated copper and lead within a landfill environment if not treated prior to off-site disposal.
    - Potential for contaminated soils to generate leachate under acid rain conditions with elevated concentrations of copper and lead capable of leaching to controlled waters.

Remediation is required at the site to reduce the risk to human and ecological receptors in the Revised Conceptual Site Model (RCSM) to low or within acceptable limits for the proposed end-use. A proposed remediation plan is presented within Appendix A as Drawing No. 17 115/10, outlining the area and volume of proposed remediation.

Remediation is proposed by excavation, treatment and off-site disposal of contaminated soils. Following successful validation of remediation works, the remaining volume of earthwork cut to fill can be classed as cleanfill by MfE, NRC and FNDC cleanfill definitions.

The proposed earthworks breach the permitted activity earthwork rules under the FNDC District Plan, NRC Regional Soil and Water Plan and NES-CS regulations. Furthermore, it can be concluded following the ground investigation that the soil contamination exceeds the applicable standard in regulation 7; NES-CS Rule 10(2)(b). Provided the consent authority has the report, the proposed activity can be classed as a restricted discretionary activity according to the NES-CS.

Remedial methods outlined in this report should be agreed with the consent authority and the resource consent conditions reviewed by a Suitably Qualified and Experienced Practitioner (SQEP). Further works have been identified comprising:

- Review of final development plans by a SQEP familiar with the findings of this report to confirm the recommendations of this report do not need amendment;
- Construction monitoring and site validation testing as outlined by this report by a SQEP, and;
- A site validation report completed by a SQEP upon completion of successful remediation, submitted to the consent authority by the client or their agent.

1 Introduction

Haigh Workman Limited (Haigh Workman) was commissioned by Doug's Opua Boat Yard (the Client) to undertake a Geoenvironmental Appraisal comprising a detailed site investigation, remediation action plan and site management plan for land at 1 Richardson Street, Opua and the adjacent esplanade reserve and CMA (the site).

Current and historic boat yard activities at the site primarily include vessel maintenance which subject the site to assessment under the Hazardous Activities and Industries List (HAIL) and Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations[1] (NES-CS).

1.1 Proposed Development

It is understood that the client wishes to redevelop the commercial aspects of the site to establish an environmentally sustainable boat yard servicing a reduced capacity from historical levels of vessel maintenance. The proposed development subject to this investigation includes:

- Earthworks to excavate the existing slipway to a shallower grade of 4 to 8 %;
- Specific engineering design and construction of slipway excavation retaining walls;
- Dredging of the CMA;
- Relocation of boat yard winching system;
- Installation of critical boat yard stormwater management infrastructure, and;
- Earthwork and maintenance area stabilisation with impermeable surfaces.

A combined proposed development plan has been reproduced by Haigh Workman, included within Appendix A as Drawing No. 17 115/02. The proposed development plan has been re-produced from the following drawings provided by the client at the time of writing:

- Thomson Survey Limited Drawings Set Ref. 8095, dated 6 March 2019;
- Total Marine Services Ltd Drawing Set Ref, 0155-0504, dated 17 January 2019, and;
- Littoralis Landscape Architectural Drawing Ref. 1253_C1_20190325.

1.2 Land-use and Exposure Scenario

An assessment of the land-uses and exposure scenarios has been conducted in accordance with Ministry for Environment (MfE) Contaminated Land Management Guidelines[2] (CLMG), Methodology for Deriving Contaminants for the Protection of Human Health[3] (*Methodology*) and the NES-CS.

It is understood the current and proposed land-uses will remain the same following soil disturbance activities and can be classified by two of the five exposure scenarios for which Soil Contaminant Standards (SCSs) have been derived in Section 7 of the *Methodology*. Therefore, this investigation has been designed and conducted

[1] Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations, 2011
[2] Ministry for Environment, *Contaminated Land Management Guidelines Nos. 1 to 5*, 2011
[3] Ministry for Environment, *Methodology for Deriving Contaminants for Protection of Human Health,* 2011

based on Regulation 7(2) of the NES-CS. Relevant exposure scenarios to assess the effects of contaminants upon human health for the site comprise:

- Commercial/ industrial (outdoor worker or unpaved) within the footprint of 1 Richardson Street;
- Parks/ recreational within the footprint of the reserve, walking track and CMA.

The balance of the site comprises dense natural bush and is not considered a piece of land subject to HAIL according to the definitions in Regulation 7 of the NES-CS. The exposure scenario designations are presented as Drawing No. 17 115/03 within Appendix A.

1.3 Scope of Work

This report presents the factual information available during a desktop study, interpretation of data obtained from a ground investigation and laboratory analysis and geoenvironmental recommendations relevant to the proposed works.

The purpose of this investigation was to determine the risk to human and ecological receptors at the site from ground contamination arising from historical activities conducted at the site or the proposed development. The scope of works conducted by Haigh Workman comprise:

- Research, compile and review available desk study information.
- Site mapping and sample collection appropriate to the Conceptual Site Model (CSM) and rationale presented within this report;
- Laboratory analysis of priority contaminants by a specialist sub-contractor including scheduling of samples, instructions and interpretation of results by Haigh Workman, and;
- Preparation of this report with site specific recommendations and necessary remedial actions required from any observed levels of land, groundwater and/or controlled water contamination relevant to the protection of receptors identified within the CSM.

2 Site Description

Published historical and GIS data has been reviewed in detail. A summary of relevant information pertaining to the site is provided in this section. Relevant site photography including historical aerials, historical photographs provided by the client and site photography taken by Haigh Workman are provided as Appendixes B, C and D, respectively.

2.1 Identification

Address:	1 Richardson Street, Opua
Legal Description:	Boat Yard – Pt Lot 1, Lot 2 Blk XXXII Town of Opua Reserve – Section 1, Section 2, Section 3, SO68634 CMA – Pt RUSSELL Harbour Bed DP 18044
Co-ordinates:	Topo 50 – AV29 015 918 NZTM – 1701474mE, 6091848 mN
Total Site Area:	1,581 m^2 (0.1581 ha)
Area Subject to HAIL:	1,040 m^2 (0.104 ha)

A site location plan is presented as Drawing No. 17 115/01 within Appendix A. The 1,040 m^2 subject to HAIL is recorded on the HAIL and Exposure Scenario Plan, Drawing No. 17 115/03 within Appendix A.

2.2 Site Setting

The site, including Doug's Opua Boat Yard, the reserve and CMA forms an irregular shaped parcel of land situated approximately 480 m north west of Opua Township. Historic and current land use remains broadly the same comprising an established boat yard with associated structures and maintenance areas to the south west. An area of Public Open Space (POS) that is utilised for recreational activities is situated to the south east, and the CMA situated to the east provides a riparian margin to coastal waters.

Topographically, the site forms the base of a small valley and catchment trending from south west to north east which has a broad bottom forming the existing boat yard and reserve. It is understood from information and photographs provided by the client that the broad valley is attributable to earthworks conducted in c. 1960s to excavate the southern facing slope.

The existing boat yard is formed with mixed surface coverings comprising metalled hard fill and concrete. The boat shed forms the only existing structure; rectangular in plan shape and triangular in face height the structure sets the architectural style of the site. A turntable is located at the crest of the slipway which extends to the CMA. From the turntable, historical maintenance areas extend to the north west, west and south. However, rails used for access to these areas have been recently removed.

The adjacent reserve is rectangular in plan with a maintained grassed surface covering those parts subject to boat yard activities, and a gentle gradient from the boat yard to the CMA. The current profile of the reserve is indicative of some fill at the crest, placed prior to the client's occupation of the site. The CMA includes a sandy beach trending the width of the site delineated by a small wall and walking track. Access from the boat yard to

the CMA is required for hauling vessels. The slipway is situated adjacent to the northern site boundary. The remainder of the site includes dense natural bush upon steep sided hill slopes.

3 Site History

Table 3.1 outlines a summary of HAIL and ANZSIC codes identified during the desk study and site walkover survey relevant to the site and surrounding land (up to 500 m).

Table 3.1 – HAIL Code Definitions

HAIL Code	Activities	Common Contaminants
A17 G400000	Storage tanks or drums for fuel, chemicals or liquid waste.	Hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs).
F5 C239200	Port activities including dry docks or vessel maintenance.	Metals, paint residues (tin, copper and lead), tributyltin (TBT) and hydrocarbons associated with fuel storage.
F7 G400000	Service station including retail or commercial refuelling facilities.	Petroleum hydrocarbons (including BTEX and PAHs), lead.

Source: CLMG Schedule B:2004 and ANZSIC Codes V2.0:2006.

3.1 Ownership & Site Uses

A summary of historical site ownership and uses is provided in Table 3.2. Where applicable, relevant HAIL codes and commonly arising contaminants are listed derived with reference to CLMG Schedule B[4], ANZSIC:2006[5] and AS 4482.1:2005[6] and site-specific research by Haigh Workman. Relevant Certificate of Title documents are provided within Appendix J.

Table 3.2 – Historical Site Ownership & Uses

		Comments	
Date Range	**Ownership**	**Land Use**	**HAIL & ANZSIC Code**
01/03/1898 – 30/04/1932	William Stewart (Kawakawa Shopkeeper)	Residential (non-commercial);	NA
30/04/1932 – 27/06/1962	Blanche Wall (Kawakawa Married Woman)	Small WW2 army barrack to south east of site*; Possible boat yard from c. 1950[#] within the reserve.	F5, A17 C239200
27/06/1962 – 17/11/1966	Anthony & Denise Tubine (Salesman)	Boat shed and slipway within reserve*[#].	
17/11/1966 – 22/10/1982	Edward Thurlow Leeds (Boat Builder)	Boat shed and slipway in current layout and location but with no turntable*.	

[4] Ministry for Environment, *Contaminated Land Management Guidelines Schedule B: Hazardous Activities and Industries List (HAIL) with Hazardous Substances,* 2004
[5] Australian and New Zealand Standard Industrial Classification, 2006
[6] Australian Standard, *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part1: Non-Volatile and Semi-Volatile Compounds,* 2005

22/10/1982 – 16/01/1992	Brian & Carol Elliott (Yacht master)	Turntable and additional rails/ maintenance areas added in c. 2000*	
20/05/1994 – Present	Doug & Carl Schmuck (Boat builder)		

Sources: * - Historical site photography (see Appendix D); # - Historical aerial photography (see Appendix B).

Aerial photography review suggests immediately adjacent land to the site has not been subject to activities defined by the HAIL. The closest activities listed by the HAIL are situated within Opua Township. Topography and lateral distance confirm evidence of contamination at the site from these sources is highly unlikely. Contaminants discharged to water from these sources may migrate to the site under tidal flows. These contaminants would be in a dispersed or diluted form. A summary of historical land uses listed on the HAIL of surrounding land is presented as Figure 1.

Figure 1 – Surrounding Land HAIL Plan

3.1.1 Historical Photography

A review of relevant available aerial photography and historic site photography is included in Table 3.3. Referenced historical aerial and land photography is presented in Appendix B & C respectively. The location of historical site features are presented on Drawing No. 17 115/04.

Table 3.3 – Historical Aerial and Land Photography Review

Date Range	Review
c. 1940 – 1981	1940 – Structures are located adjacent to the CMA within the area of reserve comprising a small dwelling and a small boat shed. Site topography at this time forms the natural bush-clad, v-shaped valley profile. Photography indicates a small watercourse in the base of the valley, see Figure 14. 1943 – Structures above have been added to and are utilised as barracks for the United States army for which it is understood no weapons were present. The site occupation is limited at this period to the southern corner of the reserve and CMA, delineated at this time by a small dry-stone cobble wall. See Figure 15, Figure 16 and Figure 17. 1950 to 1962 – No significant visible changes to the site or surrounding land. Some former shed structures have been demolished and cleared. See Figure 18 and Figure 19. 1962 – Possible slipway constructed associated with the historic boat shed to the southern corner of the reserve. See Figure 20. 1965 – Aerial is low quality. No specific site features visible; however, the site appears to have undergone major earthworks. See Figure 4. 1966 – Site photograph with the aforementioned earthworks, historic boat yard and slipway within the reserve are clear. From this photograph major earthworks included cutting and benching and re-grading of the southern facing slope. The small watercourse noted in the 1940 site photograph trended adjacent to the structure in this photograph. Earthworks have filled in this watercourse. See Figure 21.
1981 – Present	1981 – The former boat shed, and slipway located in the reserve in the 1966 aerial has been demolished and cleared from the site. Mature, dense bush has re-vegetated the adjacent slopes suggesting no further earthworks have taken place. The site has been re-developed (c. November 1971 based on approved building consents) including the present-day boat shed, slipway including rails and two small sheds to the southern boundary of the site and reserve. However, the only rails are along the slipway and it is assumed the turntable and other rails have not been constructed at this time. See Figure 5. 2000 – Site and surrounding land remains broadly the same with increased residential development. The present-day turntable and rails to 3 additional maintenance areas has been constructed. 2000 to 2017 – No significant visible changes to the site or surrounding land. 2017 to 2019 – Three maintenance areas leading from the turntable, constructed between 1981 and 2000 have been decommissioned. Associated rails have been removed but the turntable remains in-situ. See Haigh Workman 2017 and 2019 site photography.

Source: Haigh Workman archives, google earth, client photographic records, FNDC and Retrolens[7].

[7] www.retrolens.nz

4 Consents and Permits

Haigh Workman conducted a detailed review of the available property file and the Far North District Council (FNDC) GIS database. A summary of relevant information pertaining to building permits, licences, resource consents and complaints are presented.

Table 4.1 – Site Zoning Designations

Legal Description	Zone (Current)	Comments
Pt Section 1, Section 2 and Section 3 TN OF Blk XXXII Opua	Commercial	Forming the existing boat shed, maintenance areas and yards these properties are zoned commercial and have an industrial land-use limited to boat yard activities.
Section 1, Section 2 SO 68634 and Section 3 SO 68634	Conservation	Zoned as esplanade reserve with a recreational land-use. However, resource consents held by the client at the time of writing allow for use of the reserve areas for commercial purposes, in particular the existing slipway. Since Haigh Workman first visited the site in 2017, only Section 2 (forming the existing slipway) has been noted to be used in a commercial aspect.

4.1 Permits, Licences and Consents

Consents and permits were available within the property file, as summarised in Table 4.2. No complaints have been recorded within the property file maintained by FNDC.

Table 4.2 – Relevant Permits/Licenses/Consents

Date(s)	Permit No. & Legal Description	Proposed Works	Compliance Record
17/11/1971	ABP 4008493. Pt Sec 1 All 2 Blk XI.	New workshop.	Building permit applied for by E.T. Leeds.
10/01/1979	ABP 9035362. Sections 2, 3 & Pt 1 Blk XXXII.	New boat shed (16 m^2).	Building permit applied for by E.T. & M.C. Leeds.
08/11/1982	ABP 442.	Plumbing and drainage work for a proposed house.	Building permit applied for by B.D. Elliott & C.A. Elliott.
14/11/1988	TCP 782035.	Construct a jetty parallel to existing slipway.	Approved consent applied for by Elliotts Boatyard.
08/06/1989	ABP 6070999. Adjacent to 410/44 Blk XXXII.	Construction of a new jetty.	Building consent applied for by B.D. Elliott.
14/09/1995	ABA 990297. Sections 2, 3 & Pt 1 Blk XXXII.	Alteration to living accommodation part of shed (80 m^2).	Building consent applied for by Douglas Schmuck.
08/11/1998	Not available.	Use of a floating structure for maintaining and servicing charter yachts (pontoon).	Resource consent applied for by Douglas Schmuck.

1998	RC 1980055. Sections 2, 3 & Pt 1 Blk XXXII.	Submission on the proposed District Plan. Request to stop development of road adjacent to Elliotts Boatyard, Opua.	Resource consent applied for by Douglas Schmuck.
02/09/2003	ABA 20031770. Sections 2, 3 & Pt 1 Blk XXXII.	Wharf extension.	Building consent applied for by Douglas Schmuck.
02/09/2003	ABA 20020021. Sections 2, 3 & Pt 1 Blk XXXII.	Add a new storage lean to existing building.	Code of Compliance Certificate (CCC) applied for by Douglas Schmuck.
26/11/2013	BC 2012965. Sections 2, 3 & Pt 1 Blk XXXII.	Decommission of an on-site effluent disposal and to connect to FNDC reticulated sewerage scheme.	CCC applied for by Douglas Schmuck, Carl Schmuck and Irene Schmuck.

5 Environmental Setting

A review of available GIS data held by the territorial (FNDC) and regional (Northland Regional Council (NRC)) authorities was conducted in relation to flooding, discharges and waste management.

5.1 Flooding and Hydrology

The site situated at the coastal margin which identifies it as potentially subject to flooding. Events under consideration include those with an Annual Return Interval (ARI) of 10 and 100 years. Table 5.1 provides a summary of the potential flood risks and existing known hydrological sources.

Table 5.1 – Summary of Potential Flooding and Hydrological Occurrences

	Presence/ Location	Comments
Watercourses within 500 m (Classified and Unclassified)	Coastal waters at the eastern site boundary.	The Veronica Channel is tidal.
Surface Water Features within 250 m (Ponds, lakes etc)	Historic watercourse within site boundaries.	The former watercourse trended roughly east to west through the boat yard and reserve, discharging to the CMA adjacent to the former pre-1960 boat yard. It is understood this watercourse was filled with site-won materials during 1960s earthworks. Existing culverts in the location of the watercourse were not identified at the CMA.
Flood Risk	Coastal flood hazards up to CMA boundary and river flood hazard by FNDC maps.	Coastal flood hazard is indicated at the eastern property boundary with the CMA from NRC Coastal Hazard Report[8]. The proposed slipway excavations lie within this hazard while existing structures are sited above the hazard. Flood hazard is anticipated at the site according to FNDC maps.

[8] Tonkin & Taylor, Report Ref. 1001049, *Coastal Flood Hazard Zones for Select Northland Sites* for NRC, December 2017 Update.

Flood Susceptibility	High.	Geology mapping does not indicate the site to be underlain by alluvial soils. However, alluvium in the form of marine sediment can be anticipated at the eastern site boundary and within the profile of the watercourse. Stormwater management will be required to minimise flood risk for the proposed development.
Licensed Abstractions within 1 km **(Surface and Ground water)**	No surface water abstractions recorded. 1 no. groundwater abstraction recorded within the site.	Groundwater abstraction at the site is understood to be consented.
Private wells within 1 km	16 no. active private wells. The closest is situated approx. 80 m south west of the site. (LOC. 203137)	In brief the recorded private wells are for mixed purposes including domestic, monitoring and exploration. The closest private well is recorded as for exploration purposes. Formed in 1984 to a depth of 13.50 m with static groundwater at 2.50 m. The borehole is within the adjacent scenic reserve land (Section 23, TN of Blk XI Opua), on land above the site and Richardson Street.
Source Protection Zones within 500 m	None recorded on GIS system. Coastal waters at the site boundary.	Coastal waters form protected bodies; contamination pathways should not be established to them without prior consent. Erosion and sediment control during the earthworks period will require specific design and adequate monitoring to minimise the risk of contaminant discharge.

5.2 Discharges and Waste Management

Relevant information is summarised in Table 5.2 relating to waste management and discharges to land, air and water within the vicinity of the site.

Table 5.2 – Summary of Discharges and Waste Management

	Presence/ Location	Comments
Materials and/ or Wastes Associated with the Site	General wastes for landfill are stored on site adjacent to driveway.	Stored wastes awaiting disposal from site to landfill include general waste, batteries, and paint or product containers for a short term prior to landfill disposal. Products stored within the boat shed include paints and chemical products for vessel maintenance. No visible and/or olfactory evidence of ground contamination recorded.
Hydrocarbon Storage within 500 m	Small volume of diesel and oil stored in 5 litre drums adjacent to waste storage. Closest off-site fuel storage approximately 450 m south east at Opua Port.	Fuel tanks at Opua Port do not pose an environmental contamination risk to the site.
Product Spill/ Loss History within 1 km	None recorded.	Minor spillage was noted at the winch, beneath the wire rope and area of fuel storage. Visual evidence including discolouration of the hard fill surface and associated hydrocarbon odour. The client advises the product to include grease and oil.
Recorded Discharges to Land, Air and Water	Discharge consents currently operated by the client.	Approved discharge consents for the site are in operation including stormwater discharges to controlled waters. Discharges to air are controlled by the client. The proposed development aims to improve the effects of discharges to water, air and land through specific engineering design.
Landfilling/ Tipping on or within 250 m	None recorded.	All stored wastes are disposed of to an approved landfill facility.
Waste Management Facilities within 1 km	None recorded.	

Ground Gas Risk	Low to moderate	Areas of the site may contain deep made ground, alluvium and/or hydrocarbon deposits. The earthworks in 1960s minimise the risk across the boat yard as weathered rock is present at or close to the surface. Ground gas does not pose a risk to the reserve and CMA as no enclosed structures exist or are proposed. No site-specific ground gas risk assessment is warranted.

6 Geology

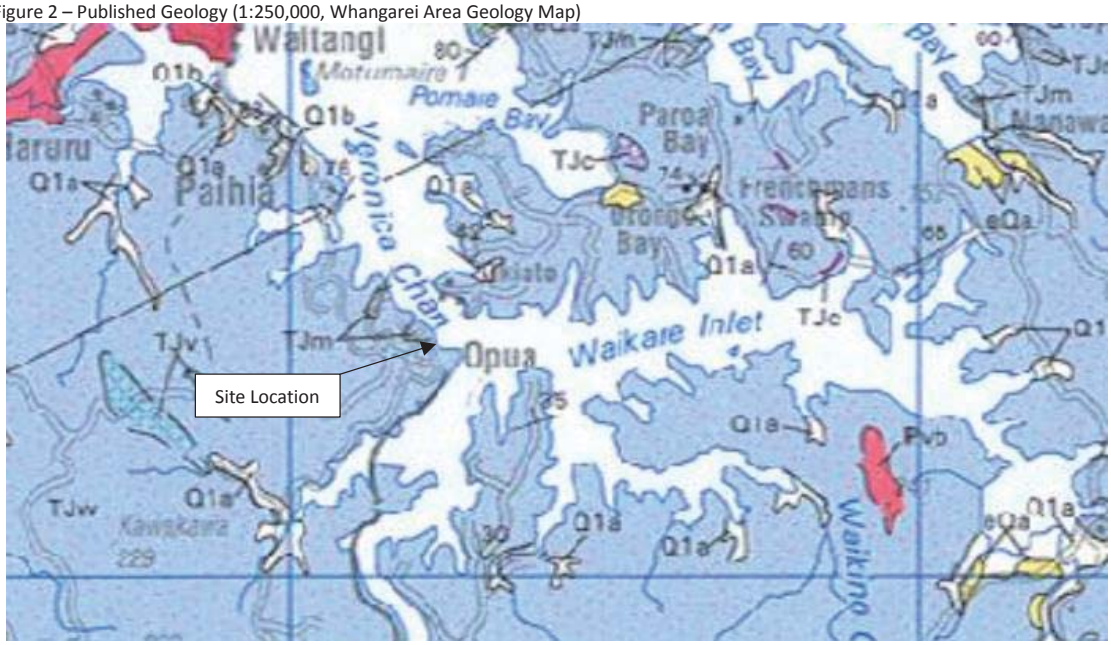
6.1 Published Geology

The published geology map for the area[9] indicates the basement geology for the area as Greywackes of the Waipapa (composite) Terrane. Greywacke rocks at the site are described as *'massive to thin-bedded, lithic volcaniclastic sandstone and argillite',* as shown in Figure 2.

Local geomorphology of the Greywacke terrane in the wider Bay of Islands includes steep hill slopes and coastal cliffs. Blue-grey fine-grained sandstone is noted that with depth weathers to yellow-brown weak to very weak rocks with closely spaced bedding planes and discontinuities which allows shallow surface rock falls. Instabilities and soil movements tend to occur at the residual soil/ completely weathered bedrock interface due to groundwater. These rocks weather to form residual soils yellow-brown soft sandy clay to depths of 30 m.

At the site the natural valley profile (pre-1960s) is v-shaped, eroded by the unclassified watercourse like similar adjacent valleys and anticipated to contain some localised alluvium, increasing to the marine environment at the eastern site boundary. The valley bottom has been widened through cut and fill earthworks with very weak weathered rocks anticipated either at or close to the surface across the northern half of the site including the slipway. The current reserve ground profile is anticipated to have been formed through filling of site-worn materials.

Figure 2 – Published Geology (1:250,000, Whangarei Area Geology Map)



[9] Institute of Geological & Nuclear Sciences, 1:250,000 Scale, 2009: *Geology of the Whangarei Area.*

7 Preliminary Conceptual Site Model

Based on the desk study findings, a combined Preliminary Conceptual Site Model (PCSM) and conceptual exposure model has been developed for the proposed development and future exposure scenarios (commercial/ industrial (outdoor worker or unpaved) and parks/ recreational. Drawing No. 17 115/03 within Appendix A presents the adopted location of each exposure scenario.

The PCSM summarises the understanding of the surface and sub-surface features, the potential contaminant sources, transport pathways and receptors in order to assess potential contaminant linkages. In assessing the likely primary contaminants present at the site, reference has been made to CLMG Schedule B[10] and *Methodology.* A qualitative risk assessment has also been made of the likelihood of any potential contaminant linkage and significance. The PCSM is presented schematically as Drawing No. 17 115/04 within Appendix A.

In summary, the PCSM has identified the following potential contaminant linkages which could result in an unacceptable risk to human and/or ecological receptors:

- Ingestion, inhalation of dust, dermal contact and plant uptake with potential heavy metals, hydrocarbons (including Total Petroleum Hydrocarbons (TPHs) and Polycyclic Aromatic Hydrocarbons (PAHs)) in surface, made ground and/or shallow natural soils associated with current and historical site activities (boat yard and vessel maintenance to 1960). Considered to pose a **high** risk to site end-users, construction workers, adjacent land users, the built environment and proposed landscaping.
- Possible leachable heavy metals and hydrocarbons (including TPHs and PAHs) in surface, made ground and/or shallow natural soils associated with current and historical site activities posing a **high** risk to controlled coastal waters (marine ecosystem and groundwater) associated with the former filled watercourse via migration.

7.1 Data Integrity

This desk study has been collated from information provided by and within interviews with the Client, the property file held by FNDC, available online GIS databases, aerial mapping, site photography and Haigh Workman archives. These sources provide a high level of confidence in the desk study and PCSM at this stage.

[10] Ministry for Environment, *Contaminated Land Management Guidelines Schedule B: Hazardous Activities and Industries List (HAIL) with Hazardous Substances,* 2004

8 Geoenvironmental Investigations

Haigh Workman scoped a contaminated land ground investigation in accordance with CLMG and NES-CS. The investigation was designed to comply with Rule 8(2) of the NES-CS. Fieldworks were conducted by a Suitably Qualified and Experienced Practitioner (SQEP). In total, two ground investigations were conducted as follows:

- Preliminary investigation; 9 May 2017. Comprised the sampling of surface and shallow made ground and natural soils from 13 locations to retrieve 15 samples designated ES1 to ES15 to a maximum depth of 0.10 m below ground level (bgl). The purpose of this preliminary investigation was to determine whether elevated concentrations of contaminants are present at the site.
- Detailed investigation; 31 January and 1 February 2019. Comprised the stratified grid sampling of made ground and natural soils from 55 exploratory holes (BH1 to BH55, inclusive) to retrieve 154 samples (ES101 to ES254, inclusive). Samples were taken from the surface (up to 0.10 m bgl) and sub-surface soils (up to 0.60 m bgl). Three saline groundwater samples (GW1, GW3 and GW4) were also taken from CMA exploratory holes BH52, BH54 and BH53, respectively.

The purpose of this detailed investigation was to ascertain the lateral and horizontal extent of ground contamination above relevant SCSs within the boat yard, reserve and CMA in relation to the proposed development and historical site activities.

8.1 Geoenvironmental Boreholes

Geoenvironmental boreholes adopted hand augering techniques to depths ranging from 0.50 m to 0.60 m bgl. The purpose of the hand augered boreholes was to visually log the site-wide soil conditions extracted from the ground and to obtain samples. Exploratory hole locations were generally formed on a 5 m by 5 m grid across the reserve and maintenance areas and increased density of 3 m by 3 m within the slipway and CMA within the slipway. The exploratory hole layout and environmental sample schedule is depicted on Drawing No. 17 115/06.

All materials retrieved from boreholes were logged in accordance with the NZGS publication, 2005[11]. Hand auger logs are presented as Appendix E.

8.2 Access Constraints

Access was made available to Haigh Workman across the entire site. Constraints which prevented sampling of strata were as follows:

- Concrete hardstanding at the base of the slipway at the boundary with the CMA;
- Concrete turntable, and;
- Plastic covering of the slipway which limited sampling to the edges of sheets.

It is recommended that should any of the aforementioned concrete structures be excavated and cleared from the site, the exposed surface should be sampled to confirm any residual levels of ground contamination within the footprints.

[11] NZGS, 2005: 'Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes'.

8.3 Sampling and Analysis Quality Objectives

Objectives of the derived sampling regime were to:

- Sample all strata which may come into contact with receptors identified in the PCSM;
- Delineate the extent and migration potential of any Contaminants of Concern (CoC) above the relevant exposure scenario SCSs which may cause harm to receptors identified in the PCSM;
- Provide a detailed, consistent site coverage to determine specific remediation volumes, if any;
- Conduct sufficient analytical testing by an accredited laboratory to conduct statistical analysis on contaminants above the relevant SCS, and;
- Confirm the accuracy of results through duplicate testing.

8.4 Sampling Methodology & Analysis Plan

Minor ground disturbance for sampling activities was conducted as a permitted activity under NES-CS regulation 8(2), where soil sampling is defined within regulation 5(3) to *'determine whether or not it is contaminated, and if it is, the amount and kind of contamination'.* Any adverse effects from sampling activities are considered to be minor.

The PCSM and desk study formed the basis of the systematic sampling plan with an increased sample density and focus upon the slipway and CMA subject to proposed excavations. The procedures and principles outlined in CLMG No. 5[12] were followed when determining sample quantities and location. CLMG No. 5 Appendix B provides calculations to determine the number of samples when forming a grid and the associated reliability of data at 95 % confidence level. Based on a conservative piece of land to be sampled of 1,835 m^2 a minimum of 26 samples are required on a 5 m grid.

This Geoenvironmental Appraisal summarises the results of the preliminary investigation. The preliminary sampling plan formed a judgemental sampling pattern with soil samples retrieved from areas of likely contamination, i.e. the slipway and maintenance area footprints, areas of surface staining by the winch system. A summary of the sample rationale for the detailed investigation is presented in Table 8.1.

Table 8.1 – Sampling Rationale

Borehole ID	Sample ID	Rationale
BH1 to BH8 BH10 to BH13 BH15 to BH18 BH20 to BH23	ES100 to ES122 ES126 to ESES137 ES140 to ES151 ES154 to ES165	Samples retrieved from the reserve to ascertain contamination levels, if any and to determine contaminant migration from the boat yard activities. BH9, BH14, BH19 and BH24 to BH46 were retrieved from grassed areas adjacent to the slipway, within the reserve consented for use as a slipway. Exploratory hole density on a 5 x 5 m grid.
BH9 BH14 BH19 BH24 to BH46	ES123 to ES125 ES138 to ES139 ES152 and ES153 ES166 to ES201	Samples retrieved from areas of vessel maintenance to confirm the area and volume of soil with contaminants above relevant SCS thresholds. In addition, the highest contaminant levels would be selectively scheduled for leachability testing to determine the potential contaminant migration to controlled waters and landfill classification.

[12] Ministry for Environment, *Contaminated Land Management Guidelines No.* (Ministry for Environment) *5*, 2011

BH36 to BH46	ES202 to ES230	Samples retrieved from the reserve area utilised as the slipway. Sample density increased to approximately 3 m spacing to obtain a sample from either side of the existing rails and one from within the rails. The existing surface covering included plastic sheeting which was not disturbed as it provides some ground protection from site activities. Sample locations were positioned at joints in the sheeting or adjacent to the rails. Samples could not be retrieved from an area with concrete hard standing approximately 4 m square at the base of the slipway.
BH47 to BH55	ES231 to ES254	Samples retrieved from the CMA, primarily from beach deposits within the slipway alignment to sample the area of anticipated maximum probable contamination. Samples retrieved on a 3 x 3 m grid. Samples included soil and where encountered, saline ground water.

Exploratory hole locations are presented on Drawing No. 17 115/06 within Appendix A. The grid and exploratory hole locations were measured out on site by hand from known boundary positions.

8.4.1 Sampling Methods and Field Quality Assurance and Quality Control (QA/QC)

Exploratory holes were formed utilising either a 100 mm or 50 mm diameter hand auger and samples retrieved directly from the auger. Between samples, the equipment was decontaminated by brushing, spraying with clean potable water and rinsing with high purity de-ionised water.

Appropriate Personal Protective Equipment (PPE) was worn by Haigh Workman staff throughout fieldworks including disposable nitrile gloves, highly visible vest and steel toe capped boots.

Samples were immediately sealed and labelled within appropriate sample jars including:

- Plastic jars with plastic lids for heavy metal analysis;
- Small plastic jars with nitric acid for leachability analysis, and;
- Glass jars with sealed metal lids for TPH and PAH analysis (2017 preliminary investigation).

Samples were stored and transported to Hill Laboratories in Hamilton within cool-boxes within 24 hours of sampling. Temperatures were maintained by frozen cool packs. Records of fieldworks and quality control including sample records and chain of custodies are included within Appendix F.

8.4.2 Laboratory QA and QC

Selected samples of shallow natural soils were scheduled and tested for the primary contaminants under subcontract with R J Hill Laboratories Limited, an IANZ[13] and NZS/ISO/IEC 17025:2018[14] accredited laboratory incorporating the aspects of ISO 9000:2015[15] relevant to testing laboratories.

Records of laboratory quality assurance and quality control are presented in Appendix F and G of this report. The results of soil analysis including testing methodologies as received from the laboratory, are presented in Appendix H of this report.

[13] International Accreditation New Zealand which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC).
[14] New Zealand Standard, General Requirements for the Competence of Testing and Calibration Laboratories, 2018.
[15] ISO9000: Quality Management Systems.

Information on the overall variability or precision of both the sampling technique and the analytical laboratory was performed by duplicate analysis. Duplicate samples were retrieved in accordance with CLMG No. 5 Section 3.9.1.

Retrieving a duplicate sample involves two samples from the same sampling location (primary and secondary samples). Both samples are placed in separate containers and sent to the laboratory under different names. A single duplicate sample was collected for every 10 samples. The sample results can then be compared to assess whether they comply with an acceptable percentage difference (30 to 50 %, CLMG No. 5). The results of duplicate variance analysis are presented in Table 9.6.

9 Geoenvironmental Assessment

9.1 Data Evaluation (QA/QC)

Laboratory test data, as received was reviewed by Haigh Workman for completeness and consistency.

For each analyte, the results were evaluated against the relevant exposure scenario SCS presented within the *Methodology*, reproduced by Haigh Workman and included as Appendix I. The volume of samples enabled statistical analysis of the dataset to calculate confidence in the results and to identify any outliers. Statistical analysis has been conducted in accordance with NSW EPA:1995[16]. This guideline is recommended for statistical analysis by Appendix A of CLMG No. 5.

9.2 Basis for Guideline Values

In reference to CLMG Schedule B, priority contaminants within boat yards include select inorganic heavy metals. In particular, copper, tin and lead arising from vessel maintenance, including lead and/or copper-based antifouling paints. It is accepted that other contaminants present in these products, but the presence of copper and lead would signify their presence[17].

Copper and lead form two of the seven elements highlighted by the *Methodology* document as priority contaminants. The two exposure scenarios (commercial and recreational) also form two of the five recorded in the *Methodology.* Therefore, laboratory results can be compared directly to published SCS values for the commercial/ industrial (outdoor worker or unpaved) scenario or parks/ recreational scenario within the areas designated on Drawing No. 17 115/03 of Appendix A as Regulation 7(2) of the NES-CS is satisfied.

Adopted SCS values within this report have derived from the *Methodology* publication, summarised by Haigh Workman and presented as Appendix I. Where a contaminant is listed within the *Methodology* as having No Limit (NL), a SCS of 10,000 mg/kg has been applied as an initial trigger threshold for further evaluation against the *Methodology*.

In the case of the priority contaminants at the site, copper is listed as NL. However, the presence of copper in concentrations greater than 10,000 mg/kg would generally indicate other active ingredients such as lead above the SCS. A threshold of 10,000 mg/kg is reasonable for the purpose of the preliminary investigation. Where 10,000 mg/kg has been exceeded, the detailed investigation specifically assesses and modifies the SCSs.

9.3 Results (Preliminary Investigation)

Thirteen samples were analysed from surface soils within the boat yard, slipway and immediately adjacent areas of the reserve for heavy metals, and three select samples were tested for a suite of TPH and PAHs common within diesel and hydrocarbon based produced from the zone adjacent to the existing winch and wire rope.

[16] New South Wales Environment Protection Authority, *Sample Design Guidelines*, 1995.
[17] Copper is an active ingredient of marine antifouling paints, New Zealand Environmental Protection Authority, *Evaluation and Review Report APP201051 – Antifouling Paints,* 2013.

Table 9.1 summarises the results and associated assessment criteria SCS for thirteen surface samples retrieved from the site, one of which was taken from the reserve (recreational exposure scenario zone).

Table 9.1 – Summary of Preliminary Investigation Results

Analyte	Commercial Zone (mg/kg)		Recreational Zone (mg/kg)		Samples Exceeding SCS
	Result	SCS	Result	SCS	
Heavy Metals					
Arsenic	11 – 45	70	11	80	
Boron	< 20 – < 400+	NL	<20	NL	
Cadmium	0.15 – 4.5	1,300	<0.1	400	
Trivalent Chromium (III)	10 – 260	NL	12	NL	
Hexavalent Chromium (IV)	< 0.4	6,300	<0.4	2,700	
Copper	790 – 107,000	NL	1,090	NL	ES6 (107,000 mg/kg) ES9 (25,000 mg/kg) ES10 (104,000 mg/kg) ES15 (29,000 mg/kg)
Lead	108 – 8,400	3,300	410	880	ES4 (4,700 mg/kg) ES6 (7,400 mg/kg) ES7 (3,900 mg/kg) ES10 (8,400 mg/kg)
Mercury	< 0.1 – 14	4,200	1.23	1,800	
Polycyclic Aromatic Hydrocarbons[18];					
Acenaphthene	< 0.03 – 0.22	NL	NA		
Acenaphthylene	< 0.03 – 0.04	NL			
Anthracene	< 0.03 – 0.09	NL			
Benzo(a)anthracene	< 0.03 – 2.8	1.1*			
Benzo(a)pyrene (BaP)	< 0.03 – 1.67	11			
Benzo(b)fluoranthene & Benzo(j)fluoranthene	0.04 – 4.3	1.1*			ES15 (4.3 mg/kg)
Benzo(g,h,i)perylene	0.04 – 1.5	NL			
Benzo(k)fluoranthene	< 0.03 – 1.79	1.1*			
Chrysene	< 0.03 – 2.7	0.11*			ES8 (0.51 mg/kg) ES15 (2.7 mg/kg)
Dibenzo(a,h)anthracene	< 0.03 – 0.38	11*			
Fluoranthene	< 0.03 – 3.6	0.11*			ES8 (0.92 mg/kg) ES15 (3.6 mg/kg)
Indeno(1,2,3-c,d) pyrene	0.04 – 1.94	1.1*			
Naphthalene	< 0.12 – <0.6	230			
Phenanthrene	0.06 – 1.37	NL			
Pyrene	0.16 – 2.8	NL			
Total Petroleum Hydrocarbons[19]					
C7 – C9	< 8 – < 9	8,800	NA		
C10 – C14	<20 – 109	1,900			
C15 – C36	410 – 17,300	20,000			
Total Hydrocarbons (C7 – C36)	410 – 17,400	30,700			

* - Represents Potency Equivalence Factor (PEF) with Benzo(a)pyrene as a surrogate marker in a cohesive soil; + - Higher Limit of Detection due to copper concentrations.

[18] SCS derived from Ministry for Environment, *Guidelines for Assessing and managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, 2011 Tables 4.10, 4.11 and 4.12 for a silty clay surface soil.

[19] SCS derived from Ministry for Environment, *Guidelines for Assessing and managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, 2011 Tables 4.13, 4.14 and 4.15 for a silty clay surface soil.

9.4 Site Characterisation (Preliminary Investigation)

Analysis of surface samples as a preliminary determination of the presence or absence of contaminants above relevant exposure scenario SCS recorded elevated concentrations of copper, lead and locally, within the vicinity of the winching system, select PAHs.

This is as anticipated by the desk study and PCSM which indicates the use of the slipway and vessel maintenance areas since the present site layout was established in the 1976.

9.4.1 Heavy Metals (Inorganics)

It is considered the recorded elevated heavy metals arise from activities at the boat yard, principally the application of copper and lead based paints from antifouling applications since the 1960s. Copper and lead elevations above the SCS were observed only within the boat yard or the commercial/ industrial area.

For copper, *Methodology* Section 6.5.1 states *'derived values greater than 10,000 mg/kg have been shown as 'no limit' (NL). In practice, such high concentrations are unlikely to be found on most sites. The derived values may be found in Appendix 1. Soil concentrations well below the derived concentrations may be above the phytotoxic threshold. If high copper concentrations are encountered on a site, the risk assessor will need to consider whether this could affect the use to which a site could be put'.*

In reference to *Methodology* Appendix 1[20] the copper soil ingestion pathway SCS has been adjusted to 288,826 mg/kg for the commercial zone and 89,206 mg/kg for the recreational zone. *Methodology* Appendix 1 confirms the copper dermal absorption and inhalation pathways are not a risk to human health, listed as 'na'. From herein, the above modified SCS for copper is adopted to assess the risk to human health.

In consideration of this, no samples recorded concentrations of copper above the 288,826 mg/kg threshold. However, the preliminary investigation confirms substantial concentrations of copper are present, particularly within the boat yard, as expected from the desk study. Copper has therefore been included within the scheduling of detailed testing to determine site-wide concentrations.

It would be prudent to note that the SCSs published within the *Methodology* are aimed at protection of human health with no assessment of phytotoxicity (risk to plant life). The *Methodology*, Page 145[21] states, '*the underlying premise in existing New Zealand industry-based guidelines is that protection of on-site ecosystems is only required to the extent necessary to facilitate the use of the land'.* In the case of the proposed development, phytotoxicity has only therefore been considered where planting is proposed as a physical barrier between the exposure scenario zones.

New Zealand timber treatment guidelines[22] has considered the effect of select heavy metals of concern upon human health and plant phytotoxicity. The document states, *'Phytotoxicity is the major concern with some heavy metals, particularly copper and Chromium (III), in residential use'.* A phytotoxic SCS value of 500 – 1000mg/kg has been derived and adopted by this investigation for neutral pH clay soils[23]. For this stage of

[20] *Methodology* Appendix 1, Page 121.
[21] Methodology Appendix 5, Section A5.2 *Regulatory Context*, Page 145.
[22] Ministry for Environment, *Health and Environmental Guidelines for Selected Timber Treatment Chemicals*, 1997.
[23] Presented within Table 5.3 of *Health and Environmental Guidelines for Selected Timber Treatment Chemicals*, 1997. Estimated on the basis of copper bioavailability in neutral clay soils.

analysis, samples ES1 and ES13 are situated within the zone of proposed planting and exhibited copper concentrations > 1,000 mg/kg. This may cause phytotoxic effects upon the proposed planting. It is recommended detailed testing targets the area of proposed planting to map areas of copper >1,000 mg/kg for remediation, considering the lower, 500 mg/kg threshold is more specifically aimed at produce plants rather than shrubs/trees and general landscape planting proposed.

The *Methodology* publication stated '*the derived SCSs for lead are dominated by the ingestion pathway. The dermal pathway has no influence'.* Adopting the Ministry for Environment published SCS values in Table 9.1 and Appendix I, lead is recorded at elevated concentrations within the boat yard at four sample locations (ES4, ES6, ES7 and ES10). Lead has therefore also been scoped within detailed testing to determine the lateral and vertical extents of contamination and subject to remediation accordingly, as set out in this report.

9.4.2 PAH and TPH

Two samples recorded elevated concentrations of PAHs above the relevant SCS derived from Toxic Equivalence Factors (TEFs). These samples included ES8 at the site of localised staining at the winch and ES15 between the winch and existing boat shed structure. In comparison to the TPH chromatogram for sample ES8 (presented within Appendix H), a lubricating oil product of approximate SAE-30 grade can be identified. This is in line with the localised, historic applications to the winch and ground surface staining.

Sample ES15 included three PAH ingredients above the relevant SCS whereas ES8 identified two elevated analytes. Similarly, 'heavy' TPH fractions >C20 were recorded and indicate an oil-based hydrocarbon product typically used for lubrication rather than diesel or petrol. The sample represents a highly weathered lubricating or hydraulic oil used on the winching system.

The results indicate a localised zone of the site has PAHs above the relevant SCS, delineated by the presence of visual surface staining. Some PAH ingredients are present in concentrations posing a risk to human health which will require attention in the proposed development.

Module 4 Section 4.3.4[24] details that for soil contamination to pose a risk to a receptor, a complete pathway must exist between the source of contamination and the receptor. Where the exposure pathway is incomplete there is no risk; a key principal underlying a barrier approach to risk management.

9.5 Results (Detailed Investigation)

The results of the preliminary investigation recorded lead with elevated concentrations above the commercial/ industrial (outdoor worker or unpaved) exposure scenario. Significant elevations of both copper and lead were observed across areas of the boat yard within the area of proposed excavations.

The detailed 2019 contaminant mapping investigation was scoped based on systematic grid sampling across the reserve, parts of the boat yard comprising the slipway and vessel maintenance areas and the foreshore likely to have received contaminants since the 1960s. The rationale for testing was as follows:

- Testing of all surface samples for a suite of heavy metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc);

[24] Ministry for Environment, *Guidelines for Assessing and managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, 2011.

- Testing of sub-surface (0.30 m bgl and if necessary, 0.50 m bgl) samples in the location of elevations for the exceeding priority contaminants;
- Leachability testing of select samples with the highest elevations by nitric acid digestion and the extract tested for copper and lead. Two methods of leachability analysis were adopted including:
    - Toxicity Characteristics Leaching Procedure (TCLP) for the assessment of soils excavated for off-site disposal to landfill;
    - Synthetic Precipitation Leaching Procedure (SPLP) to determine the migration potential to controlled waters;
- Saline groundwater testing for heavy metals, where encountered.

The results of detailed testing are summarised in this section. Table 9.2 presents the results of heavy metal testing from 27 exploratory holes within the commercial exposure scenario area. Table 9.3 presents a summary of heavy metal testing of 20 exploratory holes within the recreational exposure scenario area. In turn, Table 9.4 presents the results of TCLP and SPLP leachate analysis and Table 9.5 presents groundwater testing results.

All surface samples were retrieved from 0.00 m to 0.05 m bgl and sub-surface samples generally at 0.30 m and 0.50 m bgl. Results are presented in full in Appendix I and the location of exploratory holes on Drawing No. 17 115/06 within Appendix A.

Table 9.2 – Summary of Commercial Zone Results

Analyte	SCS	Result (0.00 m bgl)	Result (0.30 m bgl)	Result (0.50 m bgl)	Samples Exceeding SCS	Depth Range of Exceedance
Heavy Metals in Soil (mg/kg)						
Arsenic	70	10 – 87	19	NA	BH26 ES171 (87 mg/kg)	0.00 – 0.30
Cadmium	1,300	0.18 – 4.5	NA			
Chromium	6,300	10 – 260				
Copper	288,826*	370 – 117,000	11 – 13,300	5,500 – 14,300		
Lead	3,300	92 – 8,700	10.7 – 1,570	480 – 1,240	BH26 ES171 (5,800 mg/kg) BH28 ES177 (3,800 mg/kg) BH29 ES180 (4,900 mg/kg)	0.00 – 0.30 0.00 – 0.30 0.00 – 0.30
Mercury	4,200	0.15 – 66	NA	NA		
Nickel	NL	8 – 152				
Zinc	NL	310 – 30,000				
Heavy Metals in Sediment (mg/kg)						
Arsenic	20 (70)	24 – 36	NA	NA		
Cadmium	1.5 (10)	<0.1	NA	NA		
Chromium	80 (370)	11 – 15	NA	NA		
Copper	65 (270)	184 – 2,000	NA	NA	All locations (BH47 to BH55)	0.00 – 0.30 (Assumed)
Lead	50 (220)	40 – 140	NA	NA	BH47 to BH54 (All below GV-High)	0.00 – 0.30 (Assumed)
Mercury	0.15 (1.0)	0.13 – 0.25	NA	NA	All below GV-High	0.00 – 0.30 (Assumed)
Nickel	21 (52)	8 – 11	NA	NA		
Zinc	200 (410)	210 – 770	NA	NA	BH48, BH51, BH54 above GV-High	0.00 – 0.30 (Assumed)

* - Modified SCS, as Section 9.4.1; ^ - See reference in Section 9.6.3 for SCS source. SCS applied to the extract concentrations; SCS in brackets represent GV-high values.

Table 9.3 – Summary of Recreational Zone Results

Analyte	SCS	Result (0.00 m bgl)	Result (0.30 m bgl)	Result (0.50 m bgl)	Exploratory Hole Exceeding	Samples Exceeding SCS	Depth Range of Exceedance
Arsenic	80	8 – 56	NA	NA			
Cadmium	400	0.12 – 2					
Chromium	2700	7 – 163					
Copper	89,206* 1,000^	128 – 29,000	74 – 1,020	NA	BH15 BH18 BH20 BH21 BH22 BH23	ES140 (1,590 mg/kg) ES149 (15,000 mg/kg) ES154 (2,100 mg/kg) ES157 (2,100 mg/kg) ES160 (29,000 mg/kg) ES163 (11,700 mg/kg)	0.00 – 0.30 Phytotoxic only 0.00 – 0.30 Phytotoxic only 0.00 – 0.30 Phytotoxic only 0.00 – 0.30 Phytotoxic only 0.00 – 0.30 Phytotoxic only 0.00 – 0.30 Phytotoxic only
Lead	880	46 – 3,000	28 – 910	NA	BH2 BH18 BH18 BH22 BH23	ES140 (960 mg/kg) ES149 (970 mg/kg) ES150 (910 mg/kg) ES160 (3,000 mg/kg) ES163 (980 mg/kg)	0.00 – 0.30 Assumed 0.00 – 0.50 Assumed 0.00 – 0.30 0.00 – 0.30
Mercury	1,800	0.22 – 20	NA	NA			
Nickel	NL	4 – 52					
Zinc	NL	99 – 7,100					

* - Modified SCS, as Section 9.4.1; ^ - Phytotoxic SCS, not applicable to human health assessment' Values in green represent a phytotoxic exceedance only – no risk to human health is present via the ingestion pathway.

Table 9.4 – Summary of Leachate Results

Analyte	SCS	Result (µg/l)	Comments
TCLP Leachate Analysis (mg/l)			
Initial pH		7.4 – 8.1	
Post Extraction pH		2.6 – 5.6	
Total Copper (Extract)	5^	440 – 460	All samples above TCLP threshold for Class A landfill
Total Lead (Extract)	5^	36 – 39	All samples above TCLP threshold for Class A landfill
SPLP Leachate Analysis (µg/l)			
SLPL Final pH		8.7 – 8.9	
Total Copper (Extract)	8	680	
Total Lead (Extract)	12	25 – 35	

SCS listed at least conservative, 80 % species protection threshold.

Table 9.5 – Summary of Groundwater Results

	Threshold (% Species Protection) (µg/l)						
Analyte	99	95	90	80	Result (µg/l)	Exploratory Hole Exceeding	Samples Exceeding SCS
Arsenic	ID	ID	ID	ID	<110		
Cadmium	0.7	5.5	14	36	<5.3		
Chromium	0.14	4.4	20	85	<53		
Copper	0.3	1.3	3	8	<53 – 3,100	BH52, BH53	GW1 (1,290 µg/l), GW3 (3,100 µg/l)
Lead	2.2	4.4	6.6	12	<11 – 290	BH52, BH53	GW1 (290 µg/l), GW3 (250 µg/l)
Nickel	7	70	200	560	<53		
Zinc	7	15	23	43	<110 – 930	BH52, BH53	GW1 (930 µg/l), GW3 (450 µg/l)

SCS derived from Water Quality Guidelines 2018; < - below Limit of Detection; ID - Insufficient data to derive a reliable trigger value (ANZECC 2000, Table 3.4.1).

9.6 Site Characterisation (Detailed Investigation)

Analytical testing of the detailed investigation samples retrieved on a systematic grid revealed localised areas of heavy metal exceedances focussed around areas of current and historical site activities. Heavy metals such as copper and lead were adopted as indicators to the presence of the paints and products used within historical site activities. Localised elevations of copper and lead conforms with the PCSM.

Drawings 17 115/07 and 17 115/08 present the areas of the site with recorded elevations summarised in this section for surface samples and sub-surface (0.20 to 0.30 m bgl) samples, respectively.

9.6.1 Commercial Exposure Scenario Zone

Adopting a modified copper SCS of 288,826 mg/kg in accordance with the *Methodology* for the soil ingestion pathway, no exceedances were observed. However, significant concentrations of copper up to 117,000 mg/kg were recorded. Due to the significant concentrations and known presence of copper within products used at the site, copper was selected as an analyte upon all further sub-surface samples.

Statistical analysis[25] was adopted to show a representative copper concentration at 95 % confidence. Calculations indicate a representative concentration of copper at 37,810 mg/kg within surface samples, reducing to 3,796 mg/kg at a depth range of 0.20 to 0.30 m bgl. This indicates that copper migration is relatively immobile and some sub-surface samples (BH31 ES187 and BH32 ES190) adjacent to the boat shed recorded typical background concentrations of copper. The risk of copper concentrations to ecological receptors has been further analysed in this section.

Exceedances of lead against the commercial threshold of 3,300 mg/kg were observed within the main areas of vessel maintenance. Typically, elevated copper concentrations above background thresholds were also observed in these areas. Statistical analysis confirms a representative concentration of lead at 2590 mg/kg at the surface reducing to 564 mg/kg at 0.30 m bgl. The representative site wide data concludes that lead contamination is not above the SCS, however localised elevations represent hotspots around areas of vessel maintenance. Similar to copper, lead recorded numerous back ground level concentrations at 0.30 m bgl indicating a relatively immobile substance.

A single exceedance of arsenic (87 mg/kg) was recorded at the surface, within BH26 ES171 compared to the arsenic SCS of 70 mg/kg. Arsenic concentrations reduced to acceptable levels at 0.30 m bgl.

Areas of the commercial zone above the relevant SCSs will require remediation as part of the proposed development works. Drawing No. 17 115/07 indicates the area of exceedances within the commercial zone.

9.6.2 Recreational Exposure Scenario Zone

Similar to the commercial zone, elevations of copper against a modified soil ingestion SCS of 89,206 mg/kg were not recorded. However, from the Timber Treatment Guidelines, a SCS of 1,000 mg/kg for plant phytotoxicity was adopted and recorded the elevation of copper within six surface samples from areas of the reserve adjacent to the boat yard (commercial zone). Other samples within the recreational zone recorded exceedances of this 1,000 mg/kg SCS, however the results were only compared to the SCS where planting is proposed, as Landscape Architect Plan Drawing No. 1253_C1_20190325. Statistical analysis confirms representative copper concentrations of 10,421 mg/kg at the surface, reducing to 753 mg/kg at 0.30 m bgl within the recreational zone.

[25] US Environment Protection Authority ProUCL software was adopted for statistical calculations.

Lead exceeded the recreational threshold SCS locally within the recreational area at its peripheries. Exceeding areas line up closely with commercial zone lead exceedances. Statistics confirm representative lead concentrations of 770 mg/kg at the surface and 582 mg/kg at 0.30 m bgl below the SCS which indicate a localised exceedance rather than area wide gross contamination.

Results show a risk to human health for copper in a recreational exposure scenario is not present. The results indicate a minor impact at the peripherals of the reserve associated with lead concentrations which will require remediation to provide a safe environment for a recreational exposure scenario in the future. Elevations of lead against the human health threshold and copper for phytotoxicity overlap and it is recommended remediation is extended to cover areas of copper phytotoxicity. Drawing Nos. 17 115/07 and 17 115/08 within Appendix A present the areas of the recreational zone which exceed SCSs and which require remediation.

An outlier to the lead results was observed at BH2, sample ES104 which recorded lead concentrations of 960 mg/kg compared to the SCS of 880 mg/kg. This exceedance is considered to represent historical activities associated with the former (approx. 1960s established - refer to Figure 21 (1966)) boat yard located in this area. No commercial activities conducted by the client have occurred in this area and the sample location is within the area of historical boat yard development.

9.6.3 CMA Zone Surface Sediment Samples

Surface samples retrieved from the CMA on a 3 m by 3 m grid were compared to SCS provided within Table 1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality[26] (Water Quality Guidelines). Toxicant Default Guideline Values (TDGVs) are provided for sediment quality at two levels; the Default Guideline Value (DGV) and the Guideline Value-high (GV-high) which could be considered as more likely to be associated with biological effects than the DGV but the extent of that impact is not known within the scope of the Water Quality Guidelines.

Within the relatively small sampling area (36 m^2), the nine samples tested at the surface recorded concentrations of copper, lead, mercury and zinc above the DGVs. Only copper and zinc recorded concentrations above the GV-high threshold.

The bioavailability and toxicity of contaminants depends primarily on grain size. All CMA exploratory holes were recorded with cohesive sediment. The DGV data within the Water Quality Guidelines are described as largely associated with silty rather than granular sediments and are most applicable to silty sediments. Contaminants are therefore considered to bind to the cohesive sediment material at the site.

Contaminants within the foreshore are considered to be localised subject to minor vessel maintenance or scraping within this zone. Remediation of the foreshore CMA within the slipway can be incorporated into the proposed slipway excavations and adjacent dredging activities. The location of sample exceedances from the DGVs are presented on Drawing No. 17 115/07 within Appendix A.

9.6.4 Groundwater

Where encountered, groundwater samples were retrieved and tested for a suite of heavy metals. Groundwater was only encountered within the investigation as saline ground water within the foreshore. The Water Quality Guidelines provide DGVs for the selected analytes at various levels of species protection, ranging from 80 to 99%.

[26] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2018 update, http://www.waterquality.gov.au/anz-guidelines.

Samples BH52, GW1 and BH54, GW3 recorded concentrations of copper, lead and zinc above all DGVs. Bioaccumulation and secondary poisoning effects may be applicable for these toxicants within marine life. However, the samples were retrieved as ground water from exploratory holes with similarly elevated heavy metal concentrations which will be subject to remediation rather than from the water body.

It is recommended as part of the remediation process that a marine water sample is retrieved from this area pre and post remediation activities to confirm whether the toxicants are at similar levels within the marine environment and if so, that remediation has prevented further leaching from the sediments to controlled marine waters.

9.6.5 Leachability

Leachability testing was conducted upon samples which recorded the highest concentrations of boat yard priority contaminants (copper and lead). The results represent a worst-credible scenario should the entire site have been contaminated with copper in the order of 117,000 mg/kg and lead of 8,700 mg/kg. Actual site effects are considered to be substantially less than indicated by this testing.

Procedures and principles for analysing and interpreting samples for landfill acceptance was conducted in accordance with Module 2 of the Hazardous Waste Guidelines[27] and the US EPA TCLP Test Method 1311[28]. Ministry for Environment defines cleanfill material as *'material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:*

- *Combustible putrescible, degradable or leachable components;*
- *Hazardous substances;*
- *Products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices;*
- *Materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances;*
- *Liquid waste.'*

Soils proposed for cut to waste (landfill) at the site can be categorised by the NZ Waste List[29] as code '17 05 – Soil (including excavated soil from contaminated sites), stones and dredging spoil'. The NZ Waste List does not classify materials under this code as hazardous waste in accordance with the definition provided within Module 1 of the Hazardous Waste Guidelines[30]. Waste contaminated materials are acceptable for disposal at a Class A or Class B landfill.

As the results indicate, copper and lead concentrations are generally in exceedance of the screening criteria for class A landfill disposal (100 mg/kg). TCLP analysis was scheduled on two samples and the leachate extract tested for copper and lead concentrations. Results indicate copper and lead concentrations within the leachate aqueous extract in excess of the 5 mg/l leachability limit[31]. Soils cut to waste within the remediation process

[27] Ministry for Environment, *Module 2 – Hazardous Waste Guidelines - Landfill Waste Acceptance Criteria and Landfill Classification*, 2004.
[28] US EPA SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure, 1992.
[29] Ministry for Environment, *Waste Guidance and Technical Information, Waste List, Reviewed 2015.*
[30] Ministry for Environment, *Module 1 – Hazardous Waste Guidelines – Identification and Record-Keeping*, 2004.
[31] Ministry for Environment, *Module 2 – Hazardous Waste Guidelines - Landfill Waste Acceptance Criteria and Landfill Classification*, Appendix A, 2004.

should be subject to treatment prior to off-site disposal. Methods for suitable treatment are outlined by this report.

Samples with similar concentrations of copper and lead were subject to SPLP to determine the potential for migration to controlled water sources (groundwater and/or coastal waters) under acid rain conditions through the US EPA SPLP Test Method 1312[32]. The subsequent leachate extract was analysed for copper and lead concentrations and the results of testing compared to published Water Quality Guideline DGVs for marine water. Results were similar to groundwater analysis, confirming the potential for leaching within the highest sample concentrations. It is considered that remediation and subsequent removal of this material from site will mitigate against the contaminant migration leaching pathway.

9.7 Laboratory QA/QC

The quality assurance and quality control of the data precision was conducted through duplicate analysis. Based on a duplicate analysis intensity of 1 duplicate analysis per 10 samples and 55 total samples analysed from surface horizons, six duplicate samples were scheduled for analysis in accordance with CLMG No. 5.

A relative percentage difference for duplicates in the order of 30 to 50 % is acceptable as a data quality objective of CLMG No. 5 using the equation:

$$Relative\ Percentage\ Difference = \frac{(Result\ No.1 - Result\ No.2)}{Mean\ Result} x100$$

A summary of applying this equation to the duplicate results is included within Table 9.6.

Table 9.6 – Summary of Duplicate Relative Differences

	Relative Difference of Surface Samples (%)					
Analyte	**BH3**	**BH13**	**BH16**	**BH32**	**BH42**	**BH54**
Arsenic	7.4	8.7	8.7	23.5	0.0	7.4
Cadmium	6.9	0.0	0.0	33.1	25.0	0.0
Chromium	0.0	0.0	26.1	46.5	22.2	0.0
Copper	6.1	7.7	15.5	48.7	**86.7**	9.0
Lead	0.0	9.5	1.3	39.0	13.8	15.4
Mercury	15.4	42.1	24.4	31.5	16.4	12.5
Nickel	0.0	0.0	22.2	28.6	40.0	0.0
Zinc	3.7	3.5	24.6	38.9	**54.2**	12.7
Within Acceptable Limits	**Yes**	**Yes**	**Yes**	**Yes**	**No – Copper Zinc**	**Yes**

Duplicate testing was scheduled to target each a representative sample of various activities and exposure scenarios including the recreational zone, commercial zone, areas of vessel maintenance, the slipway and CMA. In general, samples exhibited relative differences < 50 %; only exploratory hole BH42, sample ES222 recorded relative differences >50 % for copper (86.7 %) and zinc (54.2 %).

This sample was located adjacent to the main slipway rail and the exceedances are active ingredients of antifouling paints. The sample was logged as including paint fragments which is considered to represent the reason for excessive relative differences. A varying quantity of paint fragments analysed for the main sample and duplicate test would give rise to highly variable results. The duplicate sample results for copper and lead were significantly lower within the duplicate test than the main result, suggesting fewer paint fragments. As the

[32] US EPA SW-846 Test Method 1312: Synthetic Precipitation Leaching Procedure.

higher concentration (main result) has been adopted for site characterisation and the potential for remediation it is considered no further analysis is required to confirm relative differences and a conservative approach to contamination within exploratory hole BH42 has been adopted.

10 Revised Conceptual Site Model

The PCSM has been revised in light of the ground investigation and the interpretation of chemical analysis results by Haigh Workman. The Revised Conceptual Site Model (RCSM) has been created to form a basis and understanding of site remediation requirements for the proposed works under mixed final land-use scenarios including commercial/ industrial (outdoor worker or unpaved) and parks/ recreational as identified on Drawing No. 17 115/03 within Appendix A.

The RCSM summarises the understanding of sub-surface ground conditions and features, the potential contaminant sources, transport pathways and receptors at risk. The RCSM is presented schematically within Appendix A as Drawing No. 17 115/09. In summary, the RCSM has identified the following confirmed contaminant linkages which could result in an unacceptable risk to human and/or ecological receptors:

- Direct ingestion of locally elevated arsenic (BH26) and lead (BH26, BH28 and BH29) up to 0.30 m bgl within the commercial exposure scenario area associated with historical site activities post 1960s, principally painting within areas of designated vessel maintenance. Considered to pose a **high** risk to construction workers and site end-users.
    - In addition, localised risk to human health via direct ingestion, dermal contact and inhalation of dust of select PAHs.
- Direct ingestion of locally elevated lead (BH18, BH22 and BH23) generally to 0.30 m bgl but within BH18, up to 0.50 m bgl (assumed) within the parks/ recreational exposure scenario area associated with historical site activities post 1960s at the boundary of the commercial and recreational zones. Considered to pose a **moderate to high** risk to site end-users.
    - As a result of previous site activities associated with the pre 1960 boat yard and not associated with the client/ current ownership. Direct ingestion of locally elevated lead within BH2 up to 0.30 m bgl (assumed). Considered to pose a **moderate to high** risk to site end-users.
- Copper at phytotoxic concentrations within areas of proposed planting (BH15, BH18, BH20, BH21, BH22 and BH23) within existing topsoil up to 0.30 m bgl associated with historic site activities post 1960s at the boundary of the commercial and recreational zones. Considered to pose a **high** risk to proposed planting.
- Elevated copper, lead, mercury and zinc within surface sediment samples up to 0.05 m bgl within the footprint of the existing slipway associated with historic site activities post 1960s. Considered to pose a **high** risk to the aquatic ecosystem.
- Elevated copper, lead and zinc within saline groundwater (BH49 and BH54) with the potential to pose a **high** risk to the wider, immediate aquatic ecosystem by migration.
- Potential for un-treated soils cut to landfill waste to generate leachate with elevated copper and lead concentrations within a Class A landfill facility.
- If no remediation takes place. Potential for existing soils to generate leachate under acid rain conditions in which elevated copper and lead pose a risk to controlled waters (groundwater and marine aquatic ecosystem) if left in-situ.

The RCSM has confirmed elements of the site which pose a risk to human health, proposed planting and aquatic ecosystems if left un-treated. It is understood the client wishes to conduct full remediation within the scope of proposed development works. It is considered the remediation of the items identified by the RCSM can be conducted with an economically viable solution which provides a combined benefit to the community.

11 Remediation Action Plan

Ground remediation outlined in this report should be conducted in-situ by a suitably qualified and experienced contractor, overseen and validated by a SQEP familiar with recommendations set out in this report. Remediation design and methodologies are subject to approval by regional and territorial authorities. Drawings No. 17 115/07 and 17 115/08 within Appendix A present the location of elevated ground contamination at the surface and sub-surface, respectively.

11.1 Remediation Goals

It is projected that remediation conducted in accordance with this report will reduce the risks outlined on the RCSM to low/negligible and can achieve:

- The level of risk to human receptors, primarily site end-users of both the commercial and recreational site areas is reduced to low, or acceptable;
- Proposed plants and vegetation will not be exposed to phytotoxic levels of contaminants;
- Excavation of contaminated soils, including dredging within the CMA will prevent the potential for further leachable contaminants to the aquatic marine ecosystems;
- All contaminated excavated soils will be treated, and contaminants reduced to an acceptable level for disposal at a Class A landfill facility;
- No preferential pathways should exist between ground contamination and human or ecological receptors, and;
- The site will be redeveloped adopting specific engineering design to prevent future contamination.

11.2 Remediation Options

The proposed re-development works include earthworks to excavate the existing slipway to a shallower grade of 4 to 8 %. It is appropriate that remediation can be conducted at the time of earthworks. This section provides an outline of suitable remediation options and where they should be adopted within the site and proposed development.

11.2.1 Cut to Waste

A proposed remediation plan is presented as Drawing No. 17 115/10. This drawing indicates the extent of proposed earthworks (including foreshore dredging) and the extent of soils with heavy metal contamination above the SCS for human health and phytotoxicity for proposed planting. The area of soils posing a risk to human health and ecological receptors is proposed to be cut to waste within an approved Class A landfill as part of the first stage of site-wide redevelopment earthworks.

By removing contaminated soils from the site and validating the excavation as within the relevant SCS thresholds for the site end-uses, a clean development platform can be established for proposed cut and fill earthworks.

11.2.2 Treatment of Cut Soils for Landfill Disposal

Initial soil contaminant screening against landfill criteria and leachability results indicate the highest recorded site elevations of copper and lead within proposed cut to waste remediation excavations are unsuitable for direct disposal at a Class A landfill. Soils will require in-situ treatment to be suitable for disposal off site.

It is recommended that soil treatment by immobilisation techniques are adopted which are designed to decrease the leaching potential of heavy metal impacted soils. The use of lime as a binding material has proved effective in studies. One particular study shows the incorporation of lime to soil at a ratio of 1:21 reduced lead concentrations by up to 88 %. In general, the process of increasing soil pH through solidification/stabilisation in a cement matrix with pH up to 10 decreases heavy metal solubility.

Following a stabilisation period and TCLP validation testing, it is anticipated the cut to waste soils will be suitable for disposal to a class A landfill facility.

11.2.3 Cut to In-situ Clean Fill

Following cut to waste remediation, the remainder of the proposed excavation area for re-development outlined on Drawing No. 17 115/11 is considered suitable for cut/fill earthworks within the commercial zone. As the remaining materials will only contain residual greywacke soil or completely weathered bedrock not posing a hazard to human or ecological receptors, the material meets the definition of clean fill.

To prevent future contamination as a result of continued boat yard activities at the site, the management plan outlined in this report should be adopted in addition to site specific stormwater recommendations to maintain water quality.

11.3 Remediation Rationale

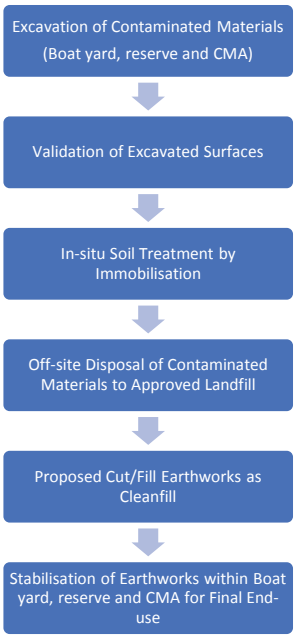
Rationale for conducting remediation outlined in Section 11.2 includes:

- All soils posing a risk to human health, ecological receptors and aquatic environments with heavy metal contamination will be removed from the site;
- The proposed remediation can be conducted in a suitable time scale and with economic viability;
- The proposed remediation will create a suitable development platform for the proposed redevelopment works, and;
- Through remediation of contaminated soils within the CMA and soils within the site with leaching potential, the contaminative risk to the aquatic ecosystem will be prevented.

11.4 Remediation Design

The implementation of remedial design and methodologies are subject to approval by the local and territorial authorities. Conditions should be agreed with FNDC and NRC during the resource consent process. In general, remediation is proposed with the excavation of contaminated materials and off-site disposal to an approved landfill facility. An overview of the remediation process is presented as Figure 3.

Figure 3 – Overview of Remediation Process



It is recommended that ground remediation is conducted by excavating all soils recorded within the ground investigation as above adopted SCS thresholds and DGVs within the CMA. Erosion and sediment control measures should be in place prior to remediation earthworks.

In general, it is expected that successful ground remediation can be achieved with a 0.30 m deep excavation within the areas outlined on Drawing No. 17 115/10. Locally, the excavation will require deepening to 0.50 m bgl within the areas defined on Drawing Nos. 17 115/09 and 17 115/10.

Due to the cohesive nature of the residual soils or the presence of weathered bedrock, remediation excavations can be achieved without battering. The excavated contaminated materials designated for off-site disposal should be temporarily stockpiled on site within the area defined on Drawing No. 17 115/10, to the south of and adjacent to the historic vessel maintenance area. This will enable excavation of all contaminated materials for treatment.

It is anticipated that excavated soils will comprise topsoil from peripheral areas of the reserve, cohesive residual soils, some completely weathered bedrock and generally cohesive sediment from the CMA. Excavated materials are indicated to have a roughly neutral to slightly alkaline pH of 7.5 to 9. Once soils have been relocated to the temporary storage area it is proposed that all soils are thoroughly mixed with lime mortar as a binding medium for heavy metal immobilisation. It is recommended that a lime to soil ratio of 1:20 is adopted to increase the pH to an alkaline matrix of at least 10. Following a period of immobilisation and TCLP validation testing (outlined in this report) which indicate heavy metals have been immobilised, the temporarily stockpiled contaminated spoil may be transported to an approved class A landfill facility.

At the stage of in-situ treatment, validation testing from the base of excavations should be taken and analysed for the priority contaminants of concern. Provided the samples confirm that all contaminated materials have been excavated and that the existing surfaces are within SCS threshold limits for human health, SPLP leachability potential to controlled waters and DGVs for a marine aqueous environment, the proposed earthworks and development may progress as scheduled. Soils proposed for cut to fill may form clean fill. Earthworks have been designed by others and summarised by Haigh Workman on Drawing No. 17 115/11 within Appendix A.

11.5 Remediation Extent

A proposed remediation plan is presented within Appendix A as Drawing No. 17 115/10. A summary of proposed remediation earthworks and follow-on earthworks to form the proposed slipway is presented as Table 11.1.

Table 11.1 – Summary of Proposed Earthworks

Activity	Area (m^2)	Volume (m^3)
Remediation Excavation (Total for off-site Disposal)	420	157
Remediation Excavation (Within Slipway Footprint)	42	13
Slipway Excavation (Total)	200	184
Slipway Excavation (Following Remediation)	200	171
Proposed Cleanfill (In-situ)		171

The ratio of remediation surface area to gross site area is 0.23.

11.6 Regulatory Requirements

Resource and building consent will be required to complete the proposed development from the territorial (FNDC) and regional (NRC) authorities. Haigh Workman has assessed relevant rules of the FNDC District Plan, NRC Regional Plan and NES-CS based on the site preserving the current zoning.

11.6.1 District Plan Assessment

The operational District Plan zones the site as follows:

Lot 2 Blk XXXII TN OF Opua	(Boat Yard)	Commercial Zone
Pt Lot 1 Blk XXXII TN OF Opua	(Boat Yard)	Commercial Zone
Sec 3 Blk XXXII TN OF Opua	(Boat Yard)	Commercial Zone
Sec 2 SO 68634	(Slipway)	Conservation Zone
Sec 3 SO 68634	(Reserve)	Conservation Zone

Permitted activity earthwork rules for the Conservation and Commercial zones are provided by rules 12.3.6.1.2 and 12.3.6.1.4 of the District Plan, respectively. The rules state:

Rule 12.3.6.1.2 – Excavation and/or filling including obtaining roading material but excluding mining and quarrying on any site in the conservation zone is a permitted activity provided that:

(a) It does not exceed 300 m^3 in any 12-month period per site; and
(b) It does not involve a cut or filled face exceeding 1.5 m in height i.e. the maximum permitted cut and fill height may be 3 m.

The site is not designated as either an outstanding landscape feature or outstanding natural feature on the Resource Maps or a Coastal Hazard 1 or 2 area on the FNDC Coastal Hazard Maps. The proposed activities include a total of 85 m^3 cut within the Conservation zone to form the slipway, 35 m^3 for remediation and no filling. This totals 120 m^3 which complies with the permitted activity rule and as such does not require resource consent.

Specific earthwork rules are not present for the commercial zone.

The proposed earthworks within the commercial area include 99 m^3 cut to form the slipway, 55 m^3 additional as remediation excavations and 171 m^3 proposed clean fill within the site. This totals 325 m^3 earthworks cut and fill within the Commercial zone.

Once all contaminated materials have been removed from the site, it is anticipated the remaining earthwork volumes designated for cut to fill will meet FNDC filling standards as follows:

Rule 12.3.6.1.4:

(a) The fill material shall not contain putrescible, pollutant, inflammable or hazardous components, and;
(b) The fill shall not consist of material other than soil, rock, stone, aggregate, gravel, sand, silt or demolition materials, and;
(c) The fill material shall not comprise more than 5 % vegetation (by volume) of any load.

11.6.2 Regional Plan Assessment

Specific stormwater design including stormwater quality has been conducted by a third party to Haigh Workman. In accordance with Proposed Regional Plan Rule C.6.4.4, stormwater discharge from the site (designated as contaminated land and high-risk industrial trade premises) will form a **discretionary activity.**

Following remediation of the site, it is considered that discharges from the site into water, or onto or into land will meet the requirement of a permitted activity outlined by Proposed Regional Plan Rule C.6.8.2 2.(a), confirmed through validation testing.

The proposed activities will form a **discretionary activity** under rule 34.3 of the NRC Regional Soil and Water Plan. Land disturbance activities within the Riparian Management Zone.

11.6.3 NES-CS

Permitted earthwork activity rules defined by the NES-CS read as follows:

Rule 8(3)(c) – The volume of the disturbance of the soils of the piece of land must be no more than 25 m^3 per 500 m^2.

Rule 8(3)(d)(ii) – Soil must not be taken away in the course of the activity, except that for all other purposes combined, a maximum of 5 m^3 per 500 m^2 of soil may be taken away per year.

In accordance with these rules and based on a piece of land measuring 1040 m^2 a total of 52 m^3 is allowed to be disturbed and 10.4 m^3 removed from the site as a permitted activity. Based on the proposed activities and this rule, proposed earthworks cannot be classed as a permitted activity by the NES-CS and will require resource consent.

Following interpretation of analytical testing it is concluded that the soil contamination exceeds the applicable standard set in regulation 7 of the NES. Provided this report is submitted to the consent authority (NES Rule 10(2)(c), the activities can be classed as **restricted discretionary** in relation to the NES-CS.

11.7 Remediation Personnel

The hierarchy of personnel to be involved with site remediation works who are responsible and subject to health and safety requirements of the project are presented in Table 11.2. Contact details should be updated once a suitably experienced contractor has been engaged to conduct remediation works.

Table 11.2 – Site Remediation Personnel

Title	Company	Name	Contact Number
Consent Authority	FNDC & NRC	NA	0800 920 029 (FNDC) 0800 002 004 (NRC)
Client/ Developer	Doug's Opua Boat Yard	Doug Schmuck	021 143 7719
Engineer	Haigh Workman Ltd	Edward Collings	09 283 5919
Contractor	TBC	TBC	TBC

11.8 Remediation Schedule

Remediation works can be completed within a timely manner by adopting standard site hours of operation, between 08:00 and 18:00, Monday to Friday subject to approval by the consent authority. A preliminary, estimated schedule of proposed works developed by Haigh Workman is set out in Table 11.3. Timings have been assumed from the time of resource consent approval.

Table 11.3 – Estimated Schedule of Works

Phase of Works	Estimated Time Frame (Working Days)
Site establishment and mobilisation including health and safety inductions with safe systems of work. Segregation of site from third party access by temporary fencing.	2
Set-out of site areas including remediation excavations by a professional surveyor.	1
Excavation of contaminated soils as outlined by this report and place within the temporary stock pile area.	5
Immobilisation of heavy metal contaminants by lime mortar stabilisation. Includes site validation sampling and testing of excavations to confirm below SCS.	30
Transport contaminated soils to an approved Class A landfill facility	2
Excavation of slipway to approved plans	10
Site stabilisation and construction including importing of clean topsoil for placement in the reserve, construction of retaining walls and stabilisation of earthworks with impermeable surfaces.	30
Total days of remediation	**40**
Total Schedule	**80**

11.9 Validation Testing

Confirmation that contaminated soils above relevant threshold SCSs and DGVs have been accurately delineated and removed will be crucial to achieving the remediation goals. The most appropriate way of this will be through validation sampling and analysis. The following validation sample plan has been designed by Haigh Workman in accordance with recommendations made in NSW EPA:1995 Section 4 as directed by CLMG No. 1 Section 2.4. The proposed validation sampling plan is presented as Table 11.4.

Table 11.4 – Validation Sampling Plan

Stage of Works	Location and Density	Scheduled Testing
Prior to undertaking works.	Marine waters. Three water samples including at the slipway, to the north and south of the boatyard.	1) Copper, lead and zinc (aqueous).

Upon completion of contaminated land excavation.	Slipway excavations (boat yard and CMA) and peripheral reserve excavations. Soil samples collected from surface of the residual layer (0.00 to 0.15 m) and walls of the excavation with a minimum of 27 samples based on a 485 m^2 total remediation excavation and a 5 m grid[33]. Marine waters. Three water samples including at the slipway, to the north and south of the boatyard.	1) Copper and lead; 2) SPLP Leachability (copper and lead on leachate extract);
Upon completion of treatment period.	Stockpile of excavated contaminated soils which have been treated with lime mortar for a minimum of 30 days tested. Minimum of two samples from the stockpile.	1) TCLP Leachability (copper and lead on leachate extract).
Prior to importing clean topsoil to reserve.	Selected topsoil fill for the reserve excavations. Two samples retrieved for testing.	1) Heavy metal suite; 2) TPH & PAH; 3) Organochlorine and Organo-phosphate Pesticide suite.

It is proposed that the results of validation testing are compared to SCSs or DGVs in the same manner as for this investigation as follows:

- Validation samples from the boat yard excavations compared to soil SCS for a commercial/ industrial (outdoor worker or unpaved exposure scenario) and where required, aqueous marine water DGVs for SPLP samples (minimum 80 % species protection in accordance with NRC Regional Plan). This is appropriate as the final location of these soils, which are subject to further excavations to form the proposed re-graded slipway will be within the southern portion of the boat yard.
- Validation samples from the reserve excavations compared to soil SC for a park/ recreational exposure scenario. This is conservative as the surface of excavations will not form final surface coverings and will be stabilised with topsoil.
- Validation samples from the CMA compared to soil SCS for sediment.
- Validation samples from the stockpile following stabilisation compared to Class A landfill TCLP criteria.
- Pre and post remediation aqueous marine water samples compared to DGVs for a marine ecosystem to minimum 80 % species protection according to the NRC Regional Plan.

11.10 Contingency Plan

A high degree of confidence can be anticipated to achieving the outlined remediation goals. This is provided the methodology for remediation works are conducted with careful consideration to contaminated land and excavations within marine waters and the methodology of remediation is conducted in accordance with Section 12.1, supervised and monitored by a SQEP.

The adequacy of remediation works will be subject to validation sampling results within adopted SCS and DGV limits. Validation samples should be taken and analysed during the period of contaminated soil stabilisation (minimum 30 days).

Should soil samples retrieved from the base of excavations within the boat yard, reserve and CMA exceed adopted commercial or recreational contaminant threshold limits (as appropriate) it is recommended the excavation within the area of exceedance is extended by an additional 0.20 m to 0.50 m bgl. This process should

[33] Validation sample plan in accordance with Section 4 of NSW EPA:1995.

be continued for any further exceedances until the residual surface soil layer is within SCS limits for the designated end-use for human health.

Within the reserve, soils outside of the main remediation excavation only pose a phytotoxic level to plants and not human health. In this area, should validation samples exceed the relevant SCS for phytotoxicity, either:

- Deep-rooted plans (>0.30 m) should not be planted in this area, or;
- Deep-rooted plans should be planted in suitably sized pots.

12 Site Management Plan

Remediation methodology and site management has taken the following into account:

- Community relations;
- Stormwater and soil management;
- Noise and odour control;
- Dust control;
- Contingency to respond to site incidents to avoid potential effects on the surrounding environment and community. Paying particular attention to the adjacent marine environment.

Ground remediation should be conducted under the supervision and instruction of a SQEP familiar with the requirements of this report.

12.1 Remediation Methodology

The methodology of the proposed remediation is as follows:

1) Mobilisation and site preparation.
    a. Pre-start meeting held with the client, engineer and contractor to outline the remediation methodology, conduct site inductions and outline the procedures and principles of this report.
    b. Professional land surveyor to mark out all proposed excavations including remediation excavations.
    c. Engineer to obtain and test three marine water samples pre-works as outlined by the validation testing section of this report.
    d. Contractor to provide and install temporary fencing as a physical barrier between the site and third parties. Particularly to segregate the reserve from third parties during site works.
    e. Mobilisation of construction plant, equipment and materials to site.
    f. Contractor to install erosion and sediment control measures in accordance with approved erosion and sediment control plan (prepared by others).
2) Excavate and treatment of contaminated soils.
    a. Contractor to excavate soils from the area marked out accurately by a professional surveyor to 0.30 m bgl, locally extended to 0.50 m bgl where required by Drawing No. 17 115/11.
    b. Immediately transport excavated contaminated soils to the temporary stockpile area by dumper. Temporary stockpile to be covered by plastic sheeting such as visqueen.
    c. Engineer to inspect the area and depth of remediation excavations, extending as required based on visual and/or olfactory evidence of contamination within the residual surface soils.
    d. Temporary stockpile to be mixed with lime in the ratio of 1:20 lime to soil and left to stabilise for a minimum of 30 days.
    e. Engineer to take validation samples at the end of the treatment period of the temporary stockpile and base of excavations and schedule testing in accordance with validation section of this report.
    f. If required, excavations over-deepened by 0.20 m where exceedances are recorded and repeat of steps 2b, 2c and 2e.

g. When engineer confirms the residual surface of excavations is below the appropriate SCS and the temporary stockpile is stabilised sufficiently for disposal to a class A landfill. Remove all temporarily stockpiled soils by truck and trailer to a Class A landfill facility.

3) Construction and Stabilisation
   a. Excavate soils to form the proposed slipway, placing and compacting soils in the proposed fill area to approved compaction standards.
   b. Construct retaining walls, concrete surface covering, boat shed redevelopment and equipment (winch) for the slipway re-development as outlined by approved building consent plans.
   c. Construction works within the CMA as prepared by others.
   d. Engineer to sample and schedule proposed topsoil for the reserve final surface covering in accordance with the validation sampling section of this report.
   e. Upon confirmation by engineer of clean soils, import topsoil, place and lightly compact within the reserve.
   f. Planting within the reserve as outlined by the landscape architect.
   g. Stabilisation of clean fill areas with final proposed surface covering (to be finalised).
   h. Remaining site areas which have exposed bare earth including slipway, hard fill areas and car parking subject to disturbance stabilised with 100 mm compacted hard fill and concrete surface covering.
4) Demobilisation of plant, equipment and surplus materials.
5) SQEP to prepare site validation report upon completion of site works, submitted by the client or their agent to the consent authority.

12.2 Remediation Air Quality

Some remediation procedures, in particular excavating, moving soil around site and soil handling have the potential to generate significant quantities of dust. Whilst heavy metals recorded in exceedance at the site do not provide a risk to human health by the inhalation pathway, the generation of dust should be minimised to prevent contaminant migration, prevent nuisance to adjacent land users and to maintain good health and safety procedures. The cohesive nature and natural moisture content, in particular of CMA soils will minimise the potential for dust generation until the soils are in the temporary stockpile as a minimum.

It is recognised that dust generation associated with proposed remediation works of this report can be generated from, but not limited to the following sources:

- Excavation works;
- Vehicle movements;
- Placement of imported materials, and;
- The application of lime mortar to the temporary stockpile.

12.3 Dust Management Plan

The following dust management plan is designed to minimise dust as part of remediation works.

12.3.1 Control Measures

It is recommended that simple control measures are adopted to minimise the risk of dust generation during remedial site works, comprising:

- Minimising access to excavation areas, in particular by vehicles;
- Provision of water sprays on site to lightly wet any soils causing airborne dust;
- Stop works during periods of high winds, and;
- Careful application of lime mortar during a period of low wind speed.
- Covering of the temporary stockpile by plastic sheeting during the immobilisation period.

Should excessive dust be generated during the construction process, works should be stopped until further mitigation measures have been agreed between the engineer and contractor and implemented on site.

12.3.2 Action Levels and Responses

In lieu of site-specific air monitoring, the action threshold for airborne dust shall be visible signs. At any point should the threshold be exceeded, or complaints be received from adjacent land users or third parties all ground disturbance works shall cease and the control measures reconsidered and revised where necessary by the engineer and contractor.

12.3.3 Site Induction and Training

The methodology of remediation identifies that all staff and visitors to the site will be inducted either prior to works commencing or prior to site access. The site induction register shall be kept on site and updated as required. The site induction will include as a minimum:

- Remediation goals and principles of works;
- Outline of proposed development, remediation requirements and the findings of this report;
- Appropriate Personal Protective Equipment (PPE);
- Methodologies of work;
- Safe systems of work and site hazards;
- Acceptable vehicle movements;
- Hours of work;
- Monitoring procedures and control measures for dust;
- Key project contacts/ personnel roles and responsibilities, and;
- Procedures for limiting third party access.

12.4 Occupational Health and Safety

All works shall be conducted in accordance with the Health and Safety at Work Act 2015.

Site welfare for construction workers shall be established on site by the contractor, including as a minimum, hand-wash facilities to prevent ingestion of contaminated materials. Waste bins shall be provided by the contractor for all disposable PPE to be sealed daily and disposed of throughout the site work period to a suitable landfill facility.

12.4.1 Personal Protective Equipment

Minimal PPE for any person entering the site will include:

- Steel toe-capped boots;
- Highly visible vest;
- Hard hat when working near machinery;
- Single use disposable nitrile gloves to prevent dermal contact with contaminated soils.

All single-use PPE should be classed as contaminated following use and be disposed of via appropriate routes to the class A landfill facility.

13 Further Works

Remedial methods outlined in this report should be agreed with the consent authority and the resource consent conditions reviewed by a SQEP. Further works have been identified comprising:

- Review of final development plans by a SQEP familiar with the findings of this report to confirm the recommendations of this report do not need amendment;
- Construction monitoring and site validation testing as outlined by this report by a SQEP, and;
- A site validation report completed by a SQEP upon completion of successful remediation, submitted to the consent authority by the client or their agent.

14 Limitations

This report has been prepared for the use of Doug's Opua Boat Yard with respect to the particular brief outlined to us. This report is to be used by our Client and their Consultants and may be relied upon when considering contaminated land advice. The information and opinions contained within this report shall not be used in any other context for any other purpose without prior review and agreement by Haigh Workman Ltd.

If any of the assumptions outlined in Section 1 are incorrect, then amendments to the recommendations made in this report may be required. The comments and opinions presented in this report are based on the findings of the desk study, ground conditions encountered during an intrusive sampling visit performed by Haigh Workman and the results of tests carried out within one or more laboratories. There may be other conditions prevailing on the site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation.

Any diagram or opinion on the possible configuration of strata, contamination or other spatially variable features between or beyond investigation positions is conjectural and given for guidance only. Confirmation of ground conditions between sampling points should be undertaken if deemed necessary.

It should be noted that ground gas and groundwater levels may vary due to seasonal fluctuations, tidal flows and/or other effects.

15 References

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Appendix A – Drawings

Drawing No.	Drawing Title	Scale
17 115/01	Site Location Plan	1:5,000
17 115/02	Proposed Development Plan	1:250
17 115/03	HAIL and Exposure Scenario Plan	1:250
17 115/04	Site Features Plan	1:250
17 115/05	Preliminary Conceptual Site Model	NTS
17 115/06	Exploratory Hole Location Plan	1:250
17 115/07	Contaminant Exceedance Plan – Surface Samples (0.00 – 0.10 m bgl)	1:250
17 115/08	Contaminant Exceedance Plan – Subsurface Samples (0.20 – 0.50 m bgl)	1:250
17 115/09	Revised Conceptual Site Model	NTS
17 115/10	Proposed Remediation Plan	1:250
17 115/11	Proposed Earthworks Plan	1:250

NTS: Not to Scale

NOTES:

1. LOT BOUNDARIES AND AERIAL PHOTO INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG Site Location Plan

Scale 1:5000 @A3 (50 25 0 50 100 150 m) Date 05/12/2019

Drawn EC Checked CJ Approved JP

File Z:\17 JOBS\17 115 DOUGS OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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1 Richardson Street, Opua

Client Doug's Opua Boat Yard

Project No. 17115 RC no.

DWG No. 17 115/01

Sheet No. 1 of 11

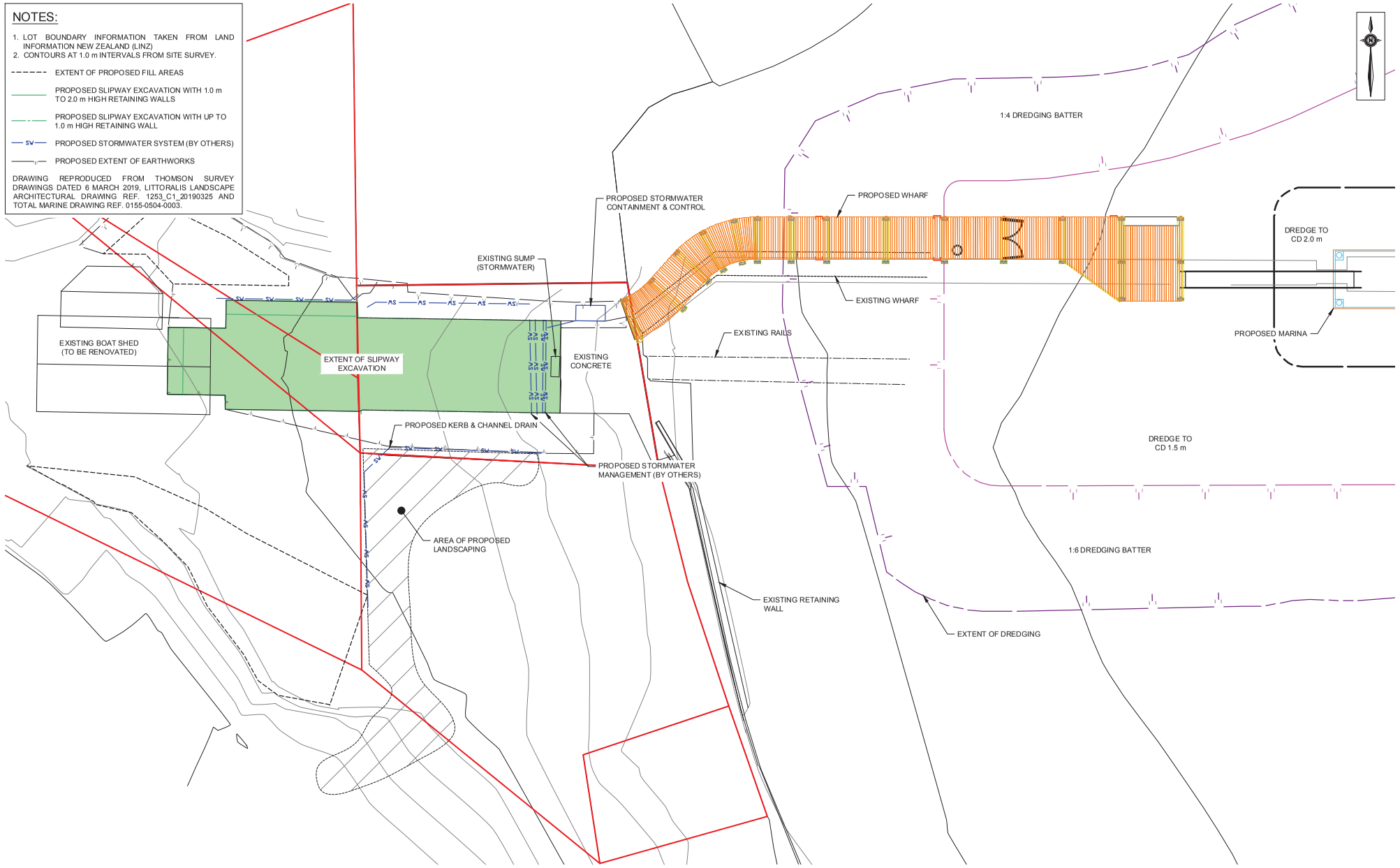
Plotted By Catherine Johnson at 16/12/2019 10:48:26 a.m.

NOTES:

1. LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ)
2. CONTOURS AT 1.0 m INTERVALS FROM SITE SURVEY.

- EXTENT OF PROPOSED FILL AREAS
- PROPOSED SLIPWAY EXCAVATION WITH 1.0 m TO 2.0 m HIGH RETAINING WALLS
- PROPOSED SLIPWAY EXCAVATION WITH UP TO 1.0 m HIGH RETAINING WALL
- PROPOSED STORMWATER SYSTEM (BY OTHERS)
- PROPOSED EXTENT OF EARTHWORKS

DRAWING REPRODUCED FROM THOMSON SURVEY DRAWINGS DATED 6 MARCH 2019, LITTORALIS LANDSCAPE ARCHITECTURAL DRAWING REF. 1253_C1_20190325 AND TOTAL MARINE DRAWING REF. 0155-0504-0003.



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG: Proposed Development Plan

Scale: 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date: 05/12/2019

Drawn: EC Checked: CJ Approved: JP

File: Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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Client: Doug's Opua Boat Yard

Project No. 17115 RC no.

DWG No. 17 115/02

Sheet No. 2 of 11

Plotted By Catherine Johnson at 16/12/2019 10:49:45 a.m.

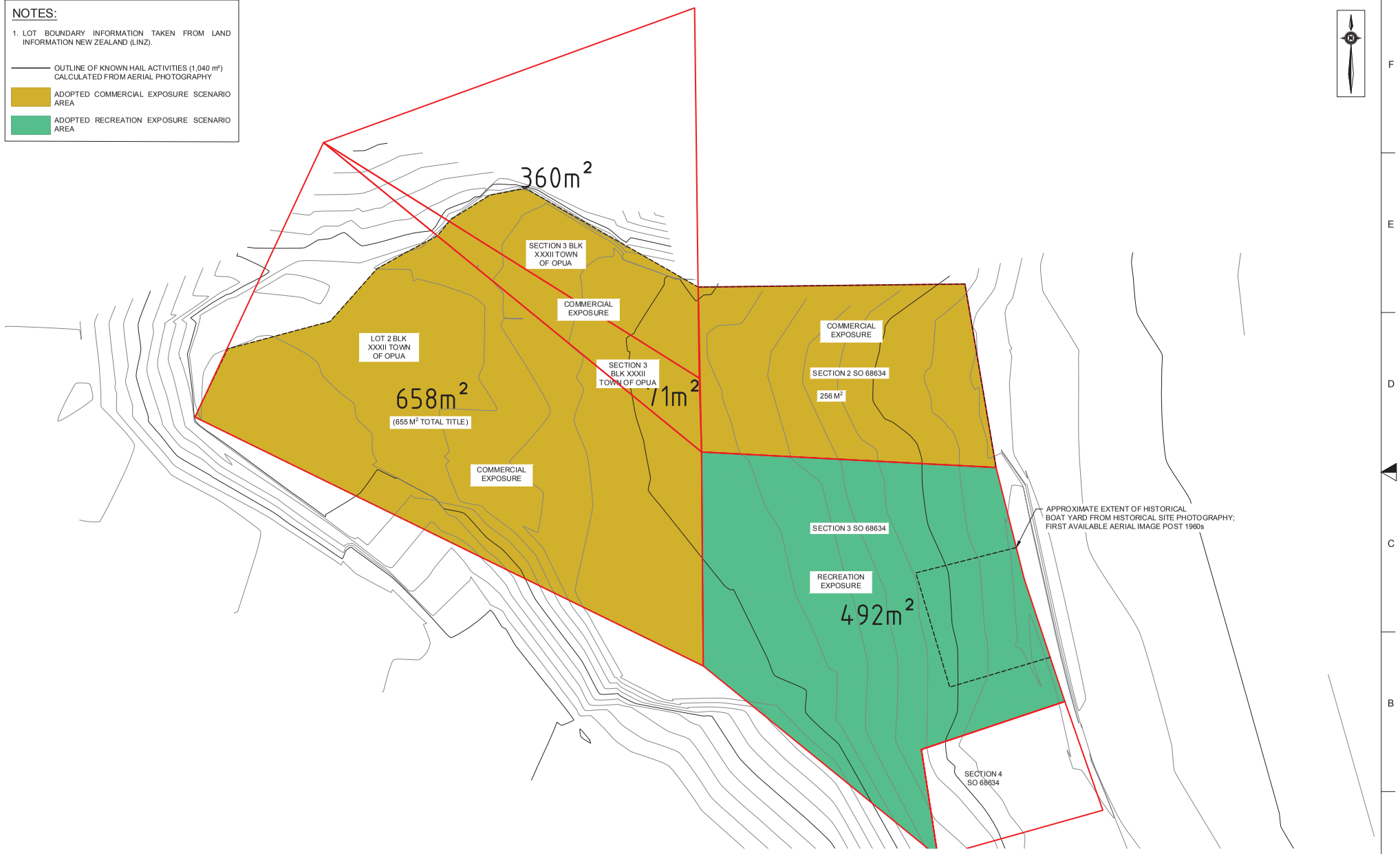
NOTES:

1. LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

OUTLINE OF KNOWN HAIL ACTIVITIES (1,040 m²) CALCULATED FROM AERIAL PHOTOGRAPHY

ADOPTED COMMERCIAL EXPOSURE SCENARIO AREA

ADOPTED RECREATION EXPOSURE SCENARIO AREA



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG HAIL and Exposure Scenario Plan

Scale 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date 05/12/2019

Drawn EC Checked CJ Approved JP

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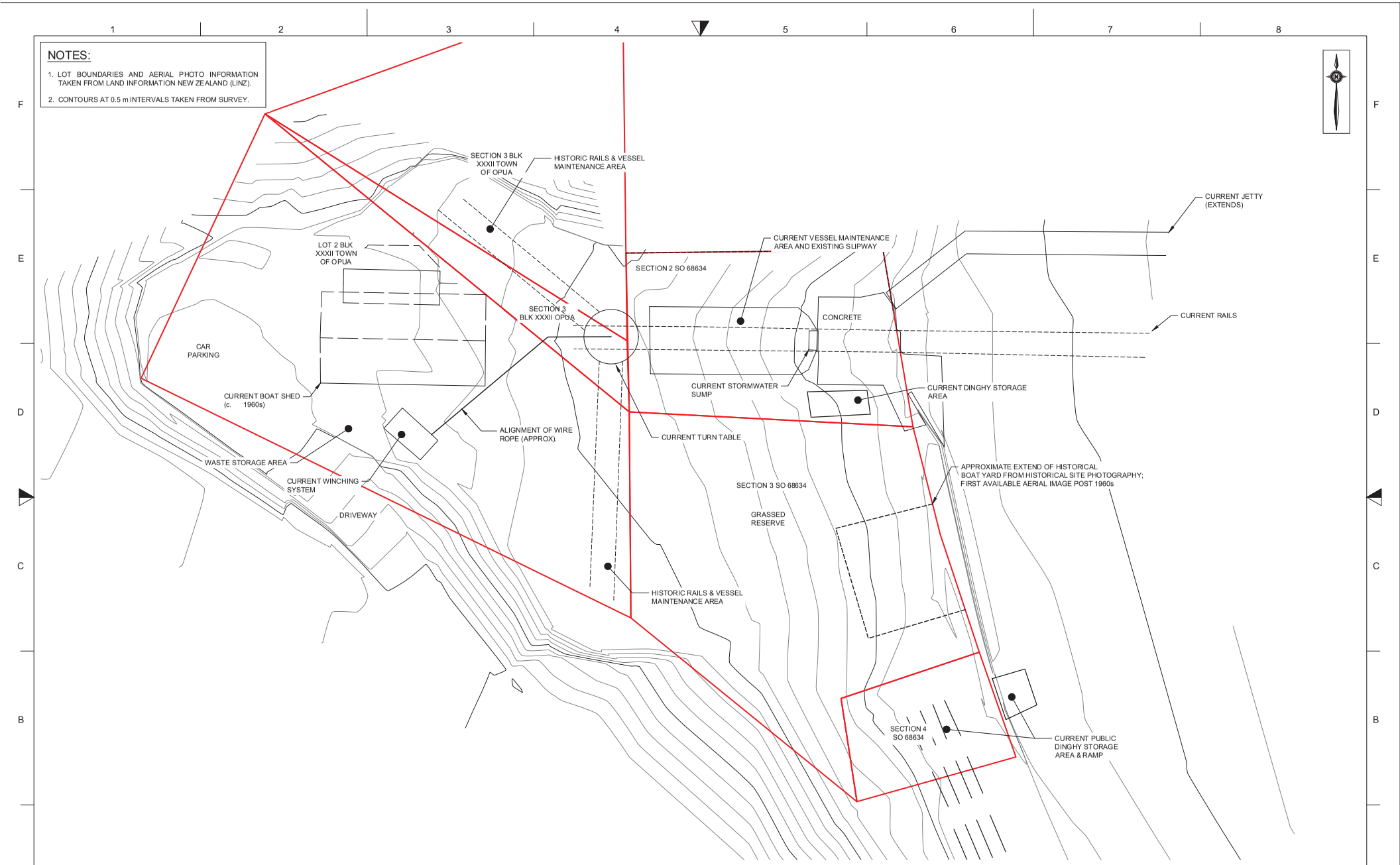
Client Doug's Opua Boat Yard

Project No. 17115 RC no.

DWG No. 17 115/03

Sheet No. 3 of 11

Plotted By Catherine Johnson at 16/12/2019 10:51:02 a.m.



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG Site Features Plan

Scale 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date 05/12/2019

Drawn EC | Checked CJ | Approved JP

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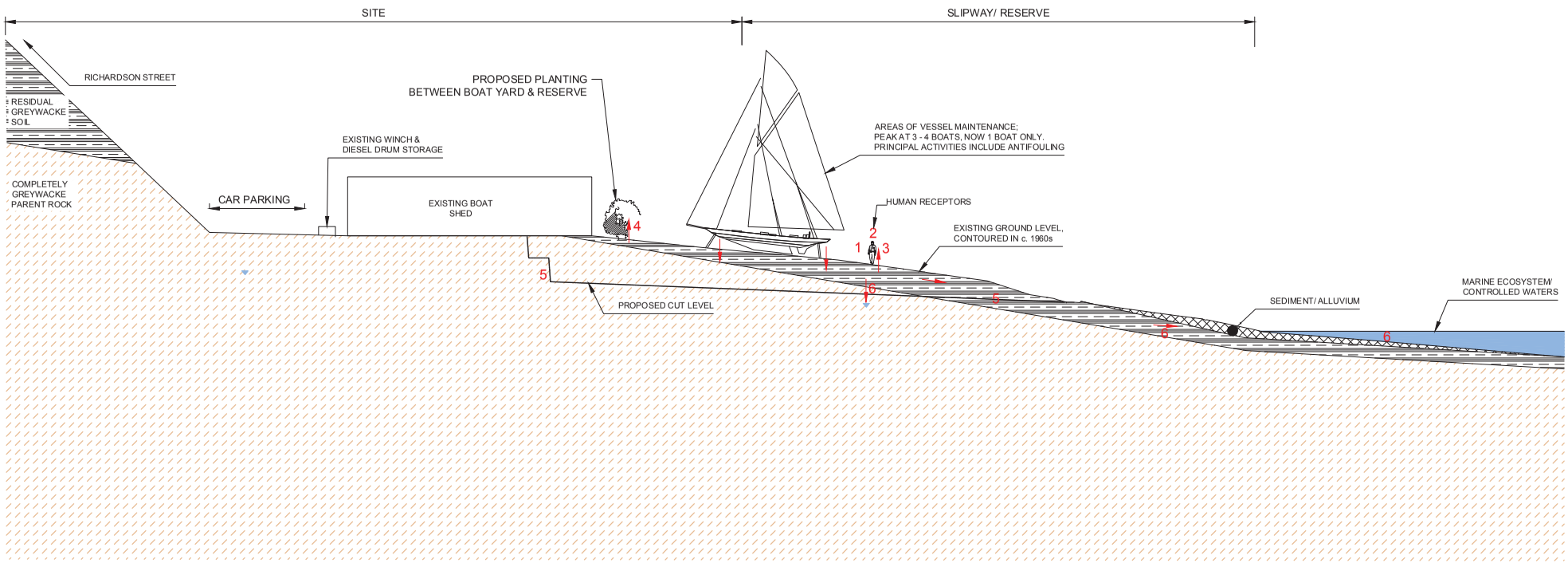
Client Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/04

Sheet No. 4 of 11

Plotted By Catherine Johnson at 16/12/2019 10:52:13 a.m.



POTENTIAL CONTAMINANTS	PATHWAYS	RECEPTORS	LIKELIHOOD OF SIGNIFICANT POLLUTANT LINKAGE
POTENTIAL HEAVY METALS, LOCALISED HYDROCARBONS (TPHS & PAHS) IN SURFACE, MADE GROUND AND/ OR SHALLOW NATURAL SOILS ASSOCIATED WTH CURRENT AND HISTORICAL SITE ACTIVITIES (BOATYARD AND VESSEL MAINTENANCE).	1. INGESTION 2. INHALATION OF DUST 3. DERMAL CONTACT 4. PLANT UPTAKE 5. BUILT ENVIRONMENT	SITE END-USERS, CONSTRUCTION WORKERS, ADJACENT LAND-USERS, THE BUILD ENVIRONMENT AND PROPOSED LANDSCAPING	HIGH
POSSIBLE LEACHABLE HEAVY METALS AND HYDROCARBONS (TPHS & PAHS) IN SURFACE, MADE GROUND AND/OR SHALLOW NATURAL SOILS ASSOCIATED WITH CURRENT AND HISTORICAL SITE ACTIVITIES.	6. MIGRATION	CONTROLLED WATERS: MARINE ECOSYSTEM AND GROUNDWATER	HIGH

Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG Preliminary Conceptual Site Model

Scale NTS | Date 05/12/2019

Drawn EC | Checked CJ | Approved JP

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Client: Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/05

Sheet No. 5 of 11

Plotted By Catherine Johnson at 16/12/2019 10:53:59 a.m.

NOTES:

LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

HAIGH WORKMAN ENVIRONMENTAL SAMPLE LOCATION, MAY 2017

HAIGH WORKMAN EXPLORATORY HOLE (HAND AUGER) FOR SAMPLE COLLECTION, JANUARY/FEBRUARY 2019

HAIGH WORKMAN HAND AUGER BOREHOLE, MAY 2017

HAIGH WORKMAN DYNAMIC CONE PENETROMETER, MAY 2017

SAMPLE REFERENCE:

HOLE ID	SAMPLE REF.	DEPTHS (m bgl)
* - REFUSED AT DEPTH OF DEEPEST SAMPLE		
BH1	ES101, ES102, ES103	0.00, 0.30, 0.50
BH2	ES104, ES105, ES106	0.00, 0.30, 0.50
BH3	ES107, ES108, ES109	0.00, 0.30, 0.50
BH4	ES110, ES111, ES112	0.00, 0.30, 0.50
BH5	ES113, ES114, ES115	0.00, 0.30, 0.50
BH6	ES116, ES117, ES118	0.00, 0.30, 0.50
BH7*	ES119, ES120	0.00, 0.30
BH8*	ES121, ES122	0.00, 0.30
BH9	ES123, ES124, ES125	0.00, 0.20, 0.40
BH10	ES126, ES127, ES128	0.00, 0.30, 0.50
BH11	ES129, ES130, ES131	0.00, 0.30, 0.50
BH12	ES132, ES133, ES134	0.00, 0.30, 0.50
BH13	ES135, ES136, ES137	0.00, 0.30, 0.50
BH14*	ES138, ES139	0.00, 0.20
BH15	ES140, ES141, ES142	0.00, 0.30, 0.50
BH16	ES143, ES144, ES145	0.00, 0.30, 0.50
BH17	ES146, ES147, ES148	0.00, 0.30, 0.50
BH18	ES149, ES150, ES151	0.00, 0.30, 0.50
BH19*	ES152, ES153	0.00, 0.20
BH20	ES154, ES155, ES156	0.00, 0.30, 0.50
BH21	ES157, ES158, ES159	0.00, 0.30, 0.50
BH22	ES160, ES161, ES162	0.00, 0.30, 0.50
BH23	ES163, ES164, ES165	0.00, 0.30, 0.50
BH24	ES166, ES167, ES168	0.00, 0.30, 0.60
BH25	ES169, ES170	0.00, 0.10
BH26	ES171, ES172, ES173	0.00, 0.30, 0.50
BH27	ES174, ES175, ES176	0.00, 0.30, 0.50
BH28	ES177, ES178, ES179	0.00, 0.30, 0.50
BH29	ES180, ES181, ES182	0.00, 0.30, 0.50
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BH33	ES192, ES193, ES194	0.00, 0.30, 0.50
BH34	ES195, ES196, ES197, ES198	0.0, 0.1, 0.2, 0.3
BH35	ES199, ES200, ES201	0.00, 0.30, 0.50
BH36	ES202, ES203, ES204	0.00, 0.30, 0.50
BH37	ES205, ES206, ES207	0.00, 0.30, 0.50
BH38	ES208, ES209, ES210	0.00, 0.30, 0.50
BH39	ES211, ES212, ES213	0.00, 0.30, 0.50
BH40	ES214, ES215, ES216	0.00, 0.30, 0.50
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BH42*	ES220, ES221	0.00, 0.20
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BH46*	ES229, ES230	0.00, 0.20
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BH50	ES239, ES240	0.00, 0.30
BH51	ES241, ES242, ES243	0.00, 0.30, 0.50
BH52	ES244, ES245, GW1	0.00, 0.30, GW
BH53	ES246, ES247, GW4	0.00, 0.30, GW
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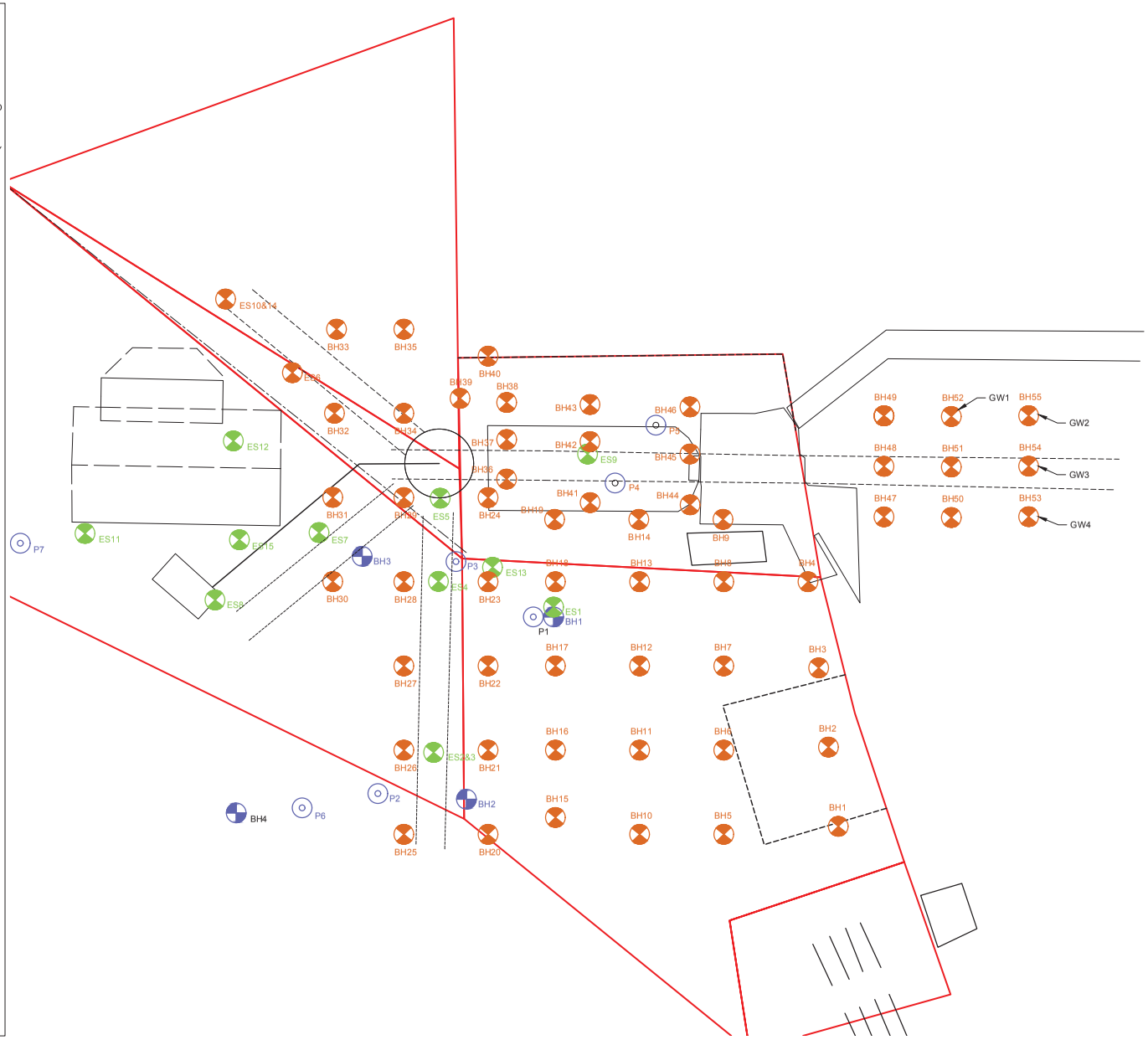

Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG: Exploratory Hole Location Plan

Scale: 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date: 05/12/2019

Drawn: EC Checked: CJ Approved: JP

File: Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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Project: Doug's Opua Boat Yard
1 Richardson Street, Opua

Client: Doug's Opua Boat Yard

Project No. 17115 RC no.

DWG No. 17 115/06

Sheet No. 6 of 11

Plotted By Catherine Johnson at 16/12/2019 10:55:00 a.m.

NOTES:

1. LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

SURFACE SAMPLE EXCEEDING SCS OR DGV (REQUIRES REMEDIATION)

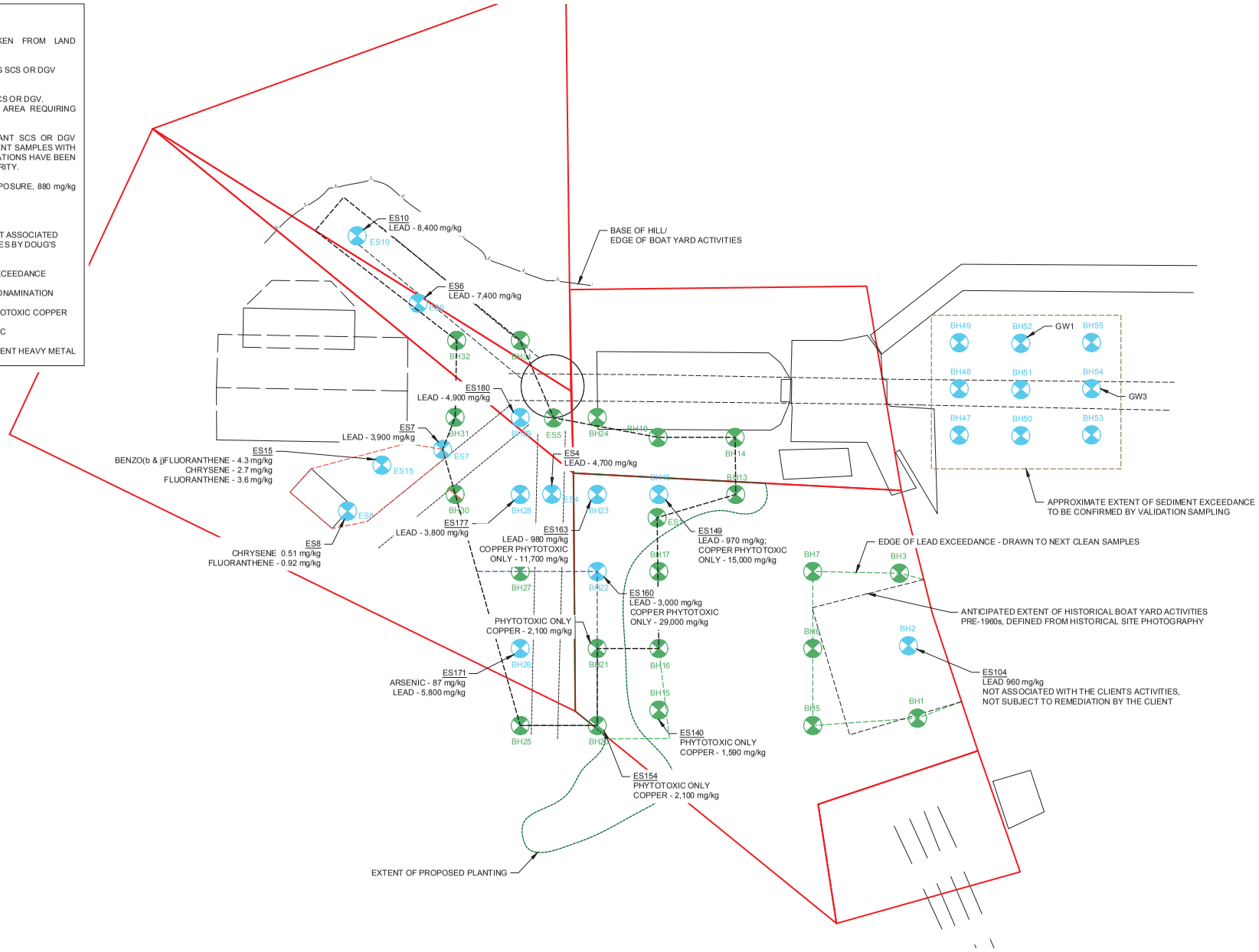
NEAREST SAMPLES BELOW SCS OR DGV. PROVIDES A CONSERVATIVE AREA REQUIRING REMEDIATION

SAMPLES NOT EXCEEDING THE RELEVANT SCS OR DGV AND WHICH DO NOT REPRESENT ADJACENT SAMPLES WITH ACCEPTABLE CONTAMINANT CONCENTRATIONS HAVE BEEN REMOVED FROM THIS DRAWING FOR CLARITY.

LEAD SCS - 3,000 mg/kg COMMERCIAL EXPOSURE, 880 mg/kg RECREATIONAL EXPOSURE

COPPER SCS (PHYTOXICITY) - 1,000 mg/kg

- AREA OF CONTAMINATION NOT ASSOCIATED WITH THE CLIENT OR ACTIVITIES BY DOUG'S OPUA BOAT YARD
- EXTENT OF LEAD SURFACE EXCEEDANCE
- EXTENSION TO COVER PAH CONAMINATION
- EXTENSION TO REMOVE PHYTOTOXIC COPPER
- AREA ALSO INCLUDES ARSENIC
- EXTENT (ASSUMED) OF SEDIMENT HEAVY METAL CONTAMINATION



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG: Contaminant Exceedance Plan
Surface Samples (0.00 to 0.10 m bgl)

Scale 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date 05/12/2019

Drawn EC | Checked CJ | Approved JP

File Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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1 Richardson Street, Opua

Client: Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/07

Sheet No. 7 of 11

Plotted By Catherine Johnson at 16/12/2019 10:56:17 a.m.

NOTES:

1. LOT BOUNDARIES INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

SURFACE SAMPLE EXCEEDING SCS OR DGV (REQUIRES REMEDIATION)

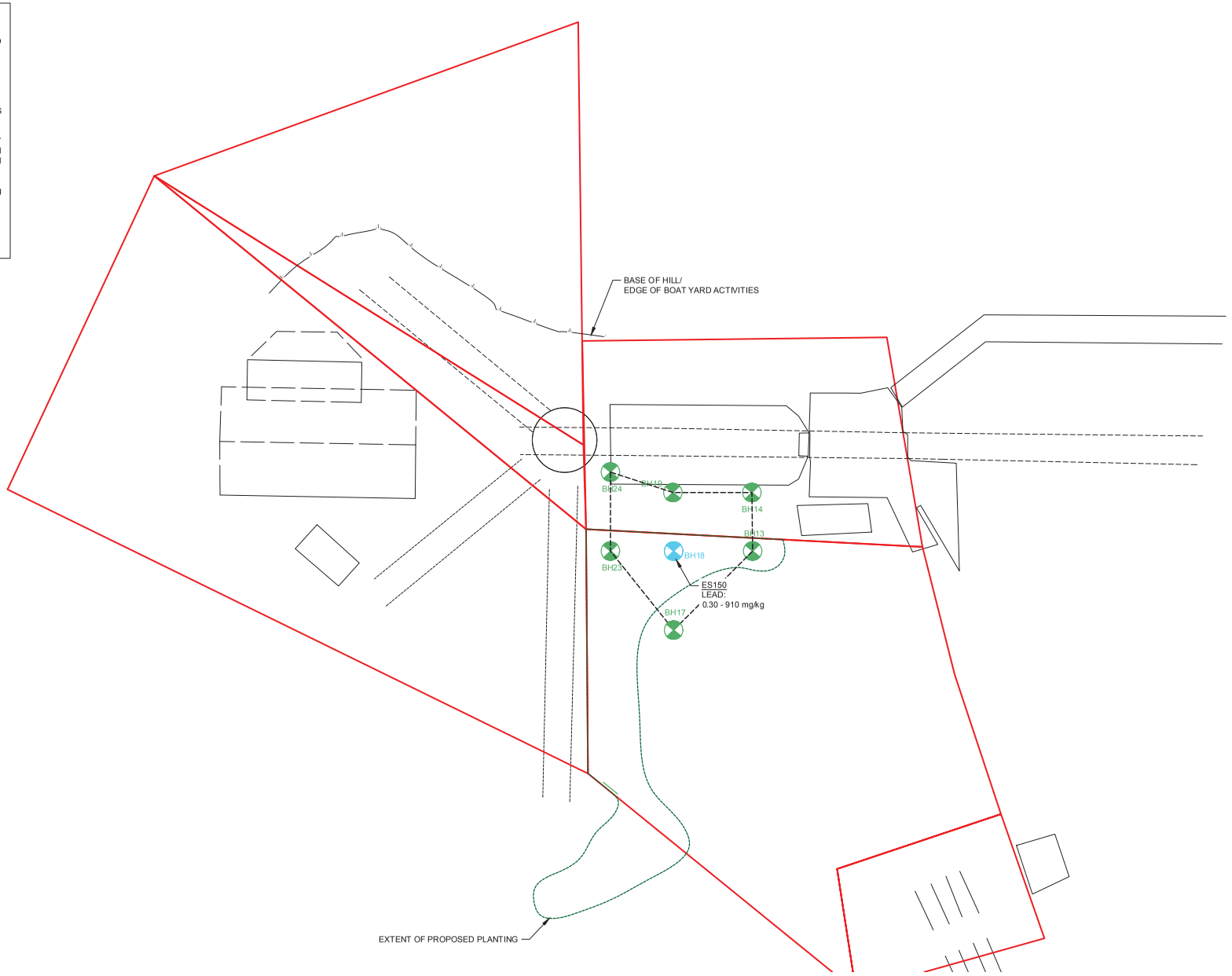
NEAREST SAMPLES BELOW SCS OR DGV. PROVIDES A CONSERVATIVE AREA REQUIRING REMEDIATION

SAMPLES NOT EXCEEDING THE RELEVANT SCS OR DGV AND WHICH DO NOT REPRESENT ADJACENT SAMPLES WITH ACCEPTABLE CONTAMINANT CONCENTRATIONS HAVE BEEN REMOVED FROM THIS DRAWING FOR CLARITY.

LEAD SCS - 3,000 mg/kg COMMERCIAL EXPOSURE, 880 mg/kg RECREATIONAL EXPOSURE

COPPER SCS (PHYTOXICITY) - 1,000 mg/kg

EXTENT OF LEAD SURFACE EXCEEDANCE



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG: Contaminant Exceedance Plan
Sub-Surface Samples (0.20 to 0.50 m bgl)

Scale 1:250 @A3 | 2.5 1.25 0 2.5 5 7.5 m | Date 05/12/2019
Drawn EC | Checked CJ | Approved JP
File Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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Project: Doug's Opua Boat Yard
1 Richardson Street, Opua

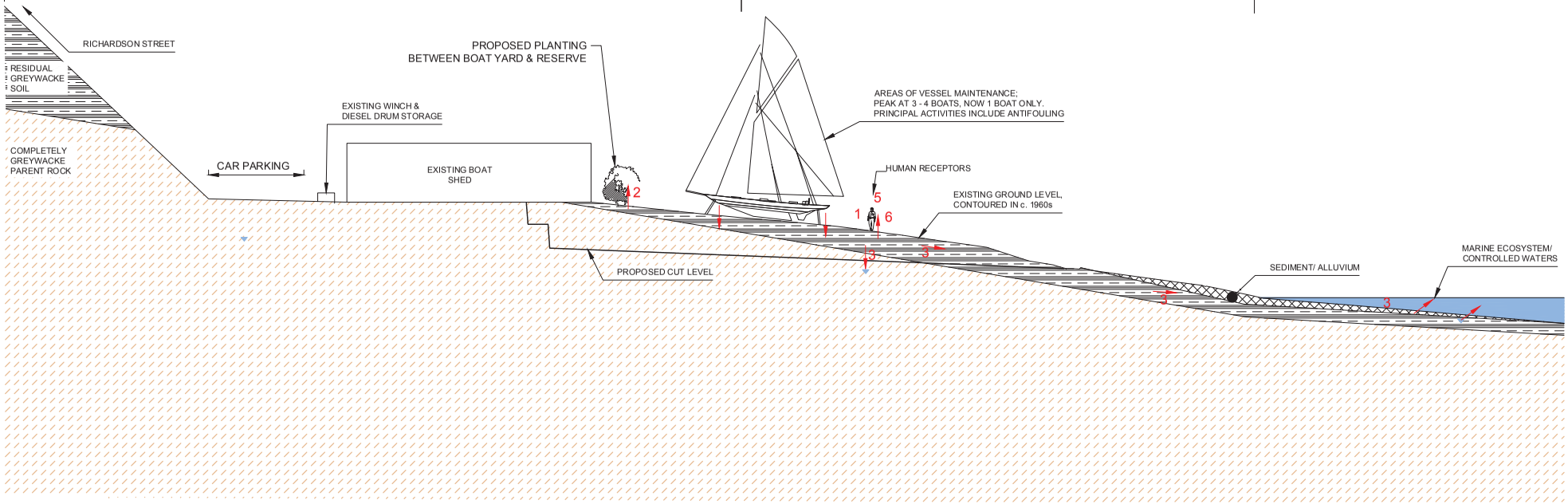
Client: Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/08

Sheet No. 8 of 11

Plotted By Catherine Johnson at 16/12/2019 10:57:19 a.m.



POTENTIAL CONTAMINANTS	PATHWAYS	RECEPTORS	LIKELIHOOD OF SIGNIFICANT POLLUTANT LINKAGE
LOCALLY ELEVATED ARSENIC (BH26) AND LEAD (BH26, BH28 AND BH29 UP TO 0.30 M BGL WITHIN THE COMMERCIAL EXPOSURE SCENARIO AREA ASSOCIATED WITH HISTORICAL SITE ACTIVITIES, PRINCIPALLY PAINTING WITHIN AREAS OF DESIGNATED VESSEL MAINTENANCE.	1. INGESTION	CONSTRUCTION WORKERS AND SITE END-USERS	HIGH
LOCALLY ELEVATED LEAD (BH18, BH22 AND BH23) GENERALLY TO 0.30 M BGL BUT WITHIN BH18 UP TO 0.50 M BGL (ASSUMED) WITHIN THE PARKS/ RECREATIONAL EXPOSURE SCENARIO AREA ASSOCIATED WITH HISTORICAL SITE ACTIVITIES AT THE BOUNDARY OF THE COMMERCIAL AND RECREATIONAL ZONES.	1. INGESTION	SITE END-USERS	MODERATE TO HIGH
LOCALISED ELEVATED SELECT PAHS (ES8 AND ES15) ASSOCIATED WITH THE APPLICATION OF OIL AND GREASE TO THE WINCH AND WIRE ROPE.	1. INGESTION 5. INHALATION OF DUST 6. DERMAL CONTACT	CONSTRUCTION WORKERS, SITE-END USERS	MODERATE
ELEVATED COPPER AT PHYTOTOXIC CONCENTRATIONS WITHIN AREAS OF PROPOSED PLANTING (BH15, BH18, BH20, BH21, BH22 AND BH23) WITHIN EXISTING TOPSOIL UP TO 0.30 M BGL ASSOCIATED WITH HISTORIC SITE ACTIVITIES AT THE BOUNDARY OF THE COMMERCIAL AND RECREATIONAL ZONES.	2. PLANT UPTAKE	PROPOSED PLANTING	HIGH
ELEVATED COPPER, LEAD, MERCURY AND ZINC WITHIN SURFACE SEDIMENT SAMPLES UP TO 0.05 M BGL WITHIN THE FOOTPRINT OF THE EXISTING SLIPWAY ASSOCIATED WITH HISTORIC SITE ACTIVITIES.	3. MIGRATION	CONTROLLED WATERS - AQUATIC MARINE ECOSYSTEM	HIGH
ELEVATED COPPER, LEAD AND ZINC WITHIN SALINE GROUNDWATER (BH49 AND BH54)	3. MIGRATION	CONTROLLED WATERS - AQUATIC MARINE ECOSYSTEM	HIGH
POTENTIAL FOR UN-TREATED SOILS CUT TO LANDFILL WASTE TO GENERATE LEACHATE WITH ELEVATED COPPER AND LEAD CONCENTRATIONS WITHIN A CLASS A LANDFILL FACILITY	4. LEACHING	OFF-SITE CLASS A LANDFILL LEACHATE	MODERATE TO HIGH

Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG Revised Conceptual Site Model

Scale NTS | Date 05/12/2019

Drawn EC | Checked CJ | Approved JP

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Project Doug's Opua Boat Yard
1 Richardson Street, Opua

Client Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/09

Sheet No. 9 of 11

Plotted By Catherine Johnson at 16/12/2019 10:58:26 a.m.

NOTES:

1. LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

EXTENT OF SUITABLE REMEDIATION EXCAVATION TO 0.30 m BGL, SUBJECT TO SETTING OUT BY A PROFESSIONAL SURVEYOR. ALLOWANCE FOR MINOR EXTENSIONS SHOULD BE MADE BASED ON THE RESULTS OF VALIDATION TESTING FROM THE EXCAVATION.

EXCAVATION TO 0.30 m BGL ALLOWS FOR COMBINED REMOVAL OF ELEVATED LEAD, HEAVY METALS WITHIN MARINE SEDIMENT, SELECT PAHs AND PHYTOTOXIC COPPER WITHIN THE RESERVE.

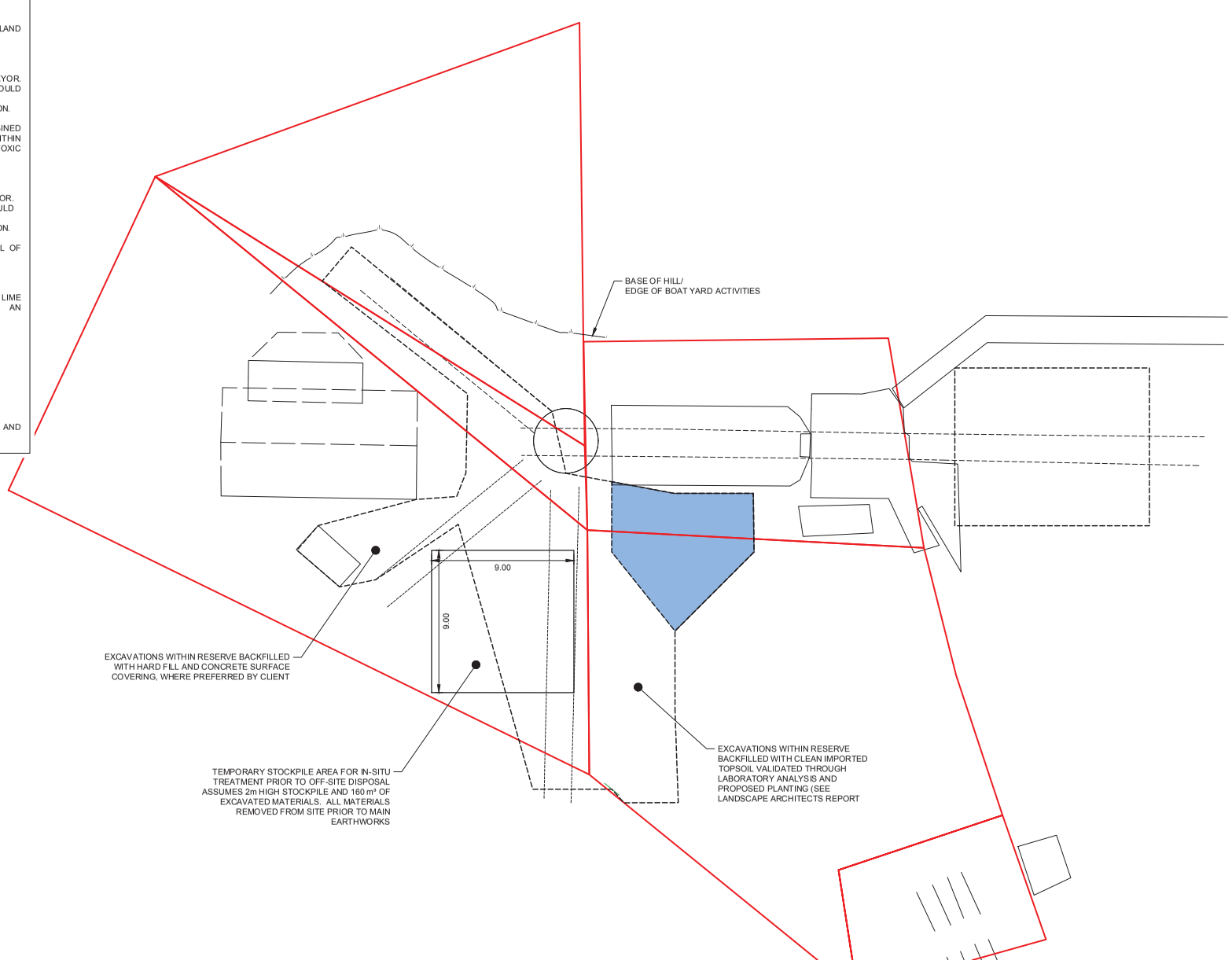
OVER DEEPENING OF REMEDIATION EXCAVATION TO 0.50 m BGL SUBJECT TO SETTING OUT BY A PROFESSIONAL SURVEYOR. ALLOWANCE FOR MINOR EXTENSIONS SHOULD BE MADE BASED ON THE RESULTS OF VALIDATION TESTING FROM THE EXCAVATION.

EXCAVATION TO 0.50 m BGL ALLOWS FOR REMOVAL OF ELEVATED LEAD.

SUMMARY OF REMEDIATION EXCAVATIONS:
ALL REMEDIATION VOLUMES TO BE TREATED BY LIME STABILISATION IN-SITU THEN TRANSPORTED TO AN APPROVED CLASS A LANDFILL FACILITY.

EXCAVATION	AREA OF CUT	VOLUME OF CUT
TO 0.30 m BGL	360 m² (LAND) 123 m² (CMA)	108 m³ 37 m³
TO 0.50 m BGL	60 m²	12 m³
TOTAL	**420 m²**	**157 m³**

EROSION AND SEDIMENT CONTROL DESIGN AND REPORTING BY OTHERS.



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG: Proposed Remediation Plan

Scale: 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date: 05/12/2019

Drawn: EC Checked: CJ Approved: JP

File: Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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Project: Doug's Opua Boat Yard
1 Richardson Street, Opua

Client: Doug's Opua Boat Yard

Project No. 17115 RC no.

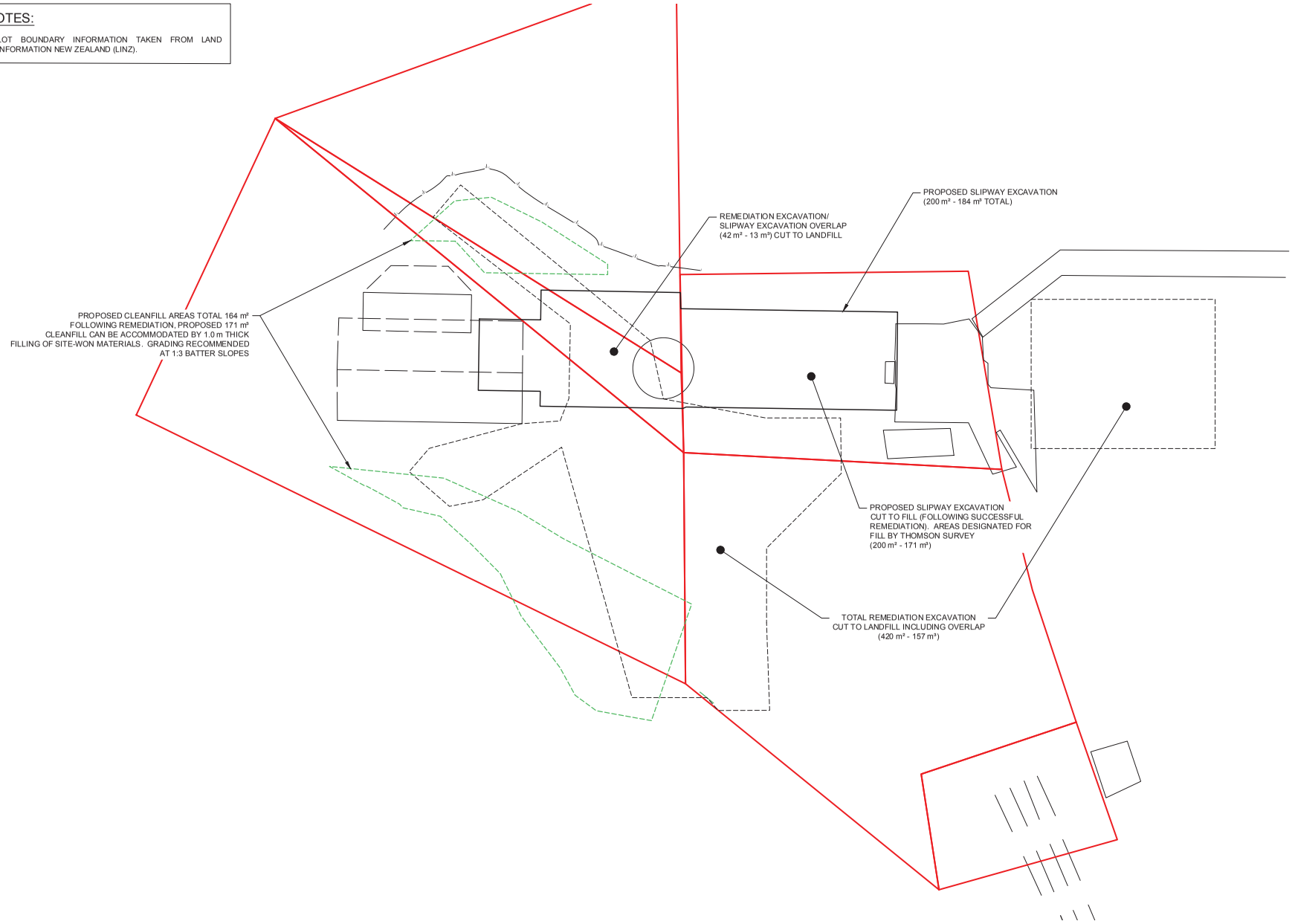
DWG No. 17 115/10

Sheet No. 10 of 11

Plotted By Catherine Johnson at 16/12/2019 10:59:39 a.m.

NOTES:

1. LOT BOUNDARY INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).



Issue	Date	Revision
A	01/04/2018	FIRST ISSUE
B	05/12/2019	SECOND ISSUE

DWG Proposed Earthworks Plan

Scale 1:250 @A3 (2.5 1.25 0 2.5 5 7.5 m) Date 05/12/2019

Drawn EC | Checked CJ | Approved JP

File Z:\17 JOBS\17 115 DOUG'S OPUA BOAT YARD\DRAWINGS\2019 REPORT\17 115 - REPORT DRAWINGS - DEC 2019, REV B.DWG

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Project Doug's Opua Boat Yard
1 Richardson Street, Opua

Client Doug's Opua Boat Yard

Project No. 17115 | RC no.

DWG No. 17 115/11

Sheet No. 11 of 11

Plotted By Catherine Johnson at 16/12/2019 11:00:56 a.m.

Appendix B – Historical Aerial Photographs

Figure 4 – Historic Aerial Photograph – 1965 (Source: Haigh Workman Archive)

Figure 5 - Historic Aerial Photograph - 1981 (Source: Haigh Workman Archive)

Figure 6 - Historic Aerial Photograph - 2000 (Source: Haigh Workman Archive)

Figure 7 - Historic Aerial Photograph - 2004 (Source: Google Earth Pro)

Figure 8 - Historic Aerial Photograph - 2006 (Source: Haigh Workman Archive)

Figure 9 - Historic Aerial Photograph - 2009 (Source: Google Earth Pro)

Figure 10 - Historic Aerial Photograph - 2011 (Source: Google Earth Pro).

Figure 11 - Historic Aerial Photograph - 2013 (Source: Google Earth Pro)

Figure 12 - Historic Aerial Photograph - 2015 (Source: Haigh Workman Archive)

Figure 13 - Historic Aerial Photograph - 2016 (Source: Google Earth Pro)

Appendix C – Historical Photographs

Presented by the client

Figure 14 - Historic Site Photo – c. 1940 - 1941

Figure 15 - Historic Site Photo – 1943

Figure 16 - Historic Site Photo – 1943

Figure 17 - Historic Site Photo – 1943

Figure 18 - Historic Site Photo – 1950

Figure 19 - Historic Site Photo – 1960

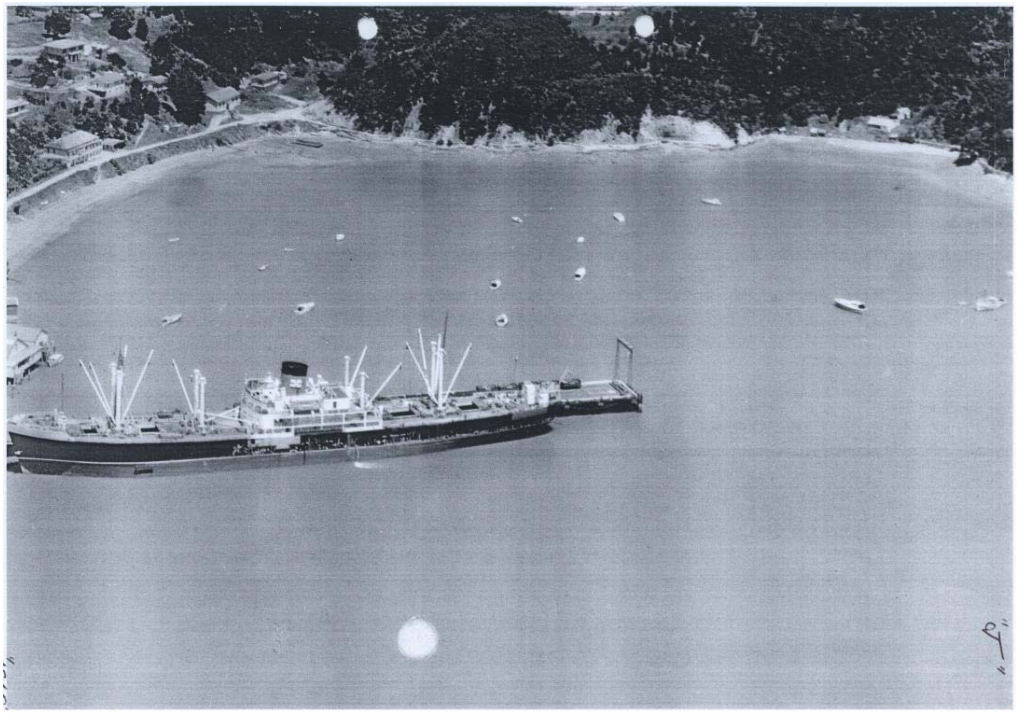

Figure 20 - Historic Site Photo – 1962

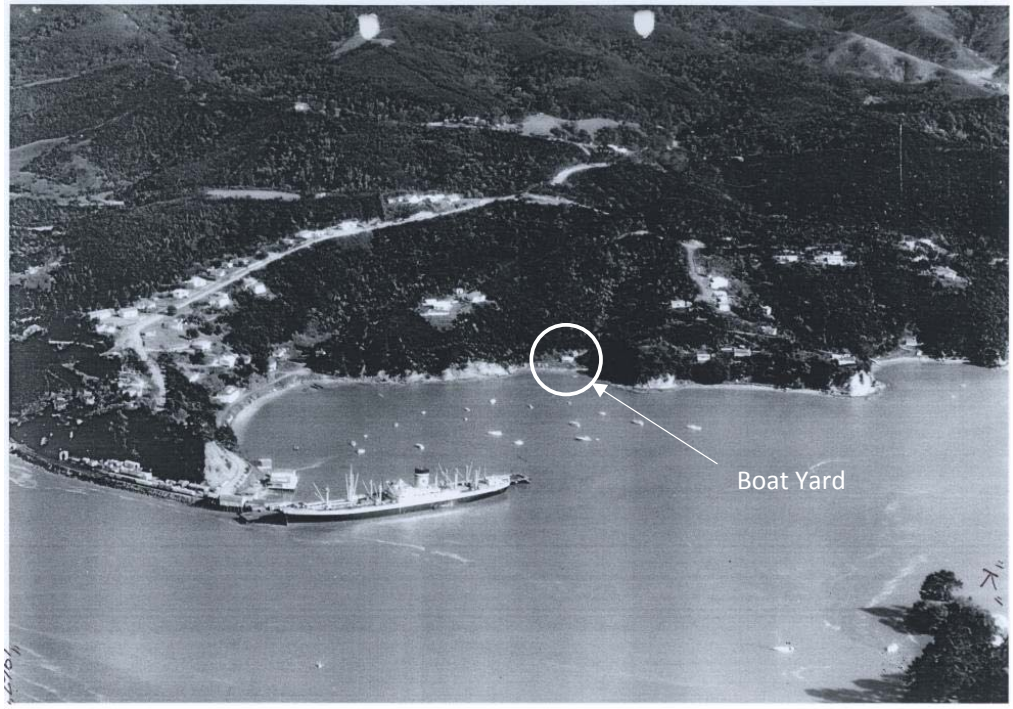

Figure 21 - Historic Site Photo – 1966

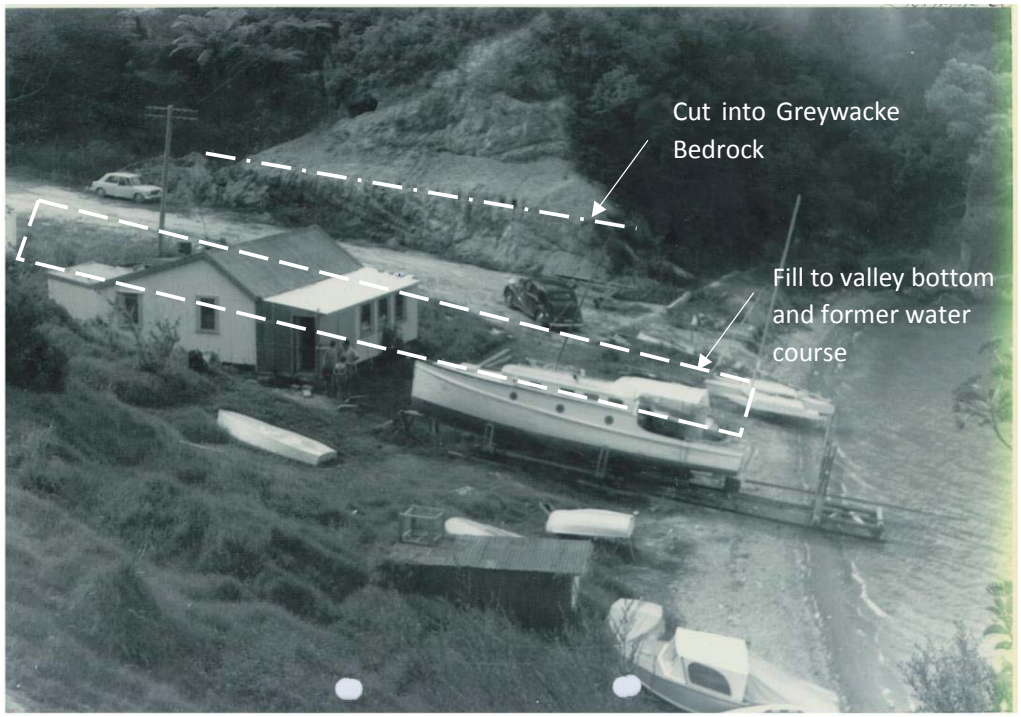

Figure 22 - Historic Site Photo – 1981

Appendix D – Site Photographs

Site Inspection - Tuesday 9 May 2017

Figure 23 - Looking from the boat yard eastwards.

Figure 24 - Boat shed and yard.

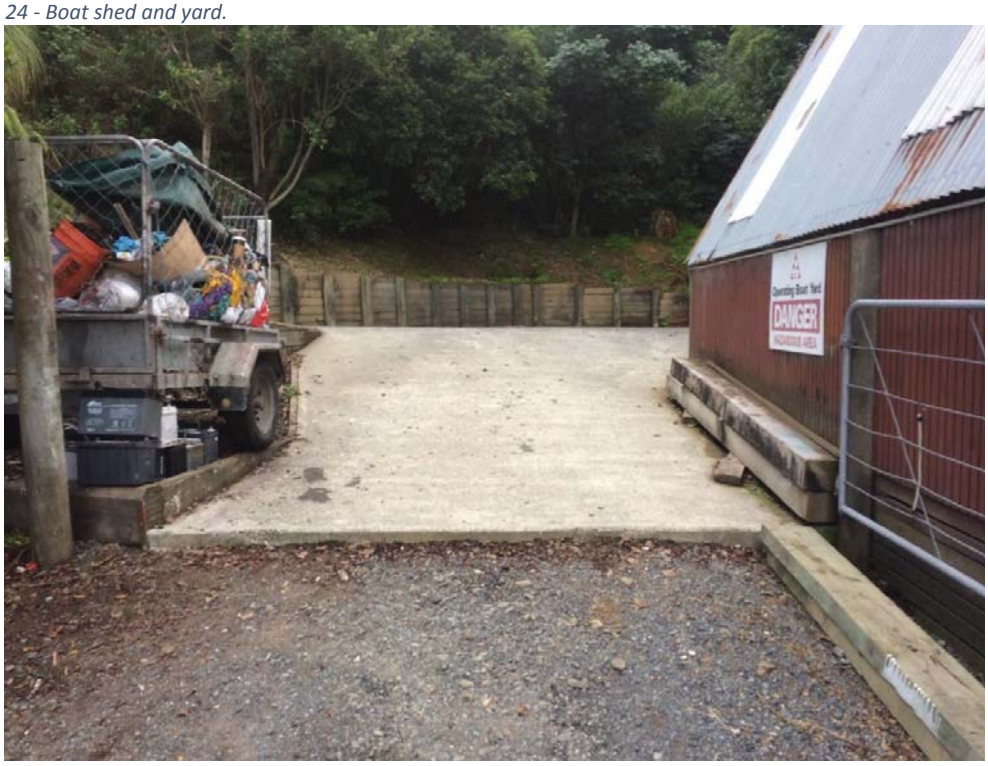

Figure 25 - Site Photo - Looking from the south side of the boat shed across the boat yard.

Figure 26 - Site Photo - Site access leading from Richardson Street into the south of the site.

Figure 27 - Site Photo - Retaining wall.

Figure 28 - Site Photo - Boat pulley system.

Figure 29 - Site Photo - Southern site boundary showing area of metalled yard and gabion retaining wall.

Figure 30 - Site Photo - Boat under maintenance.

Figure 31 - Site Photo - Turntable.

Figure 32 - Site Photo - Boat ramp aligned west to east.

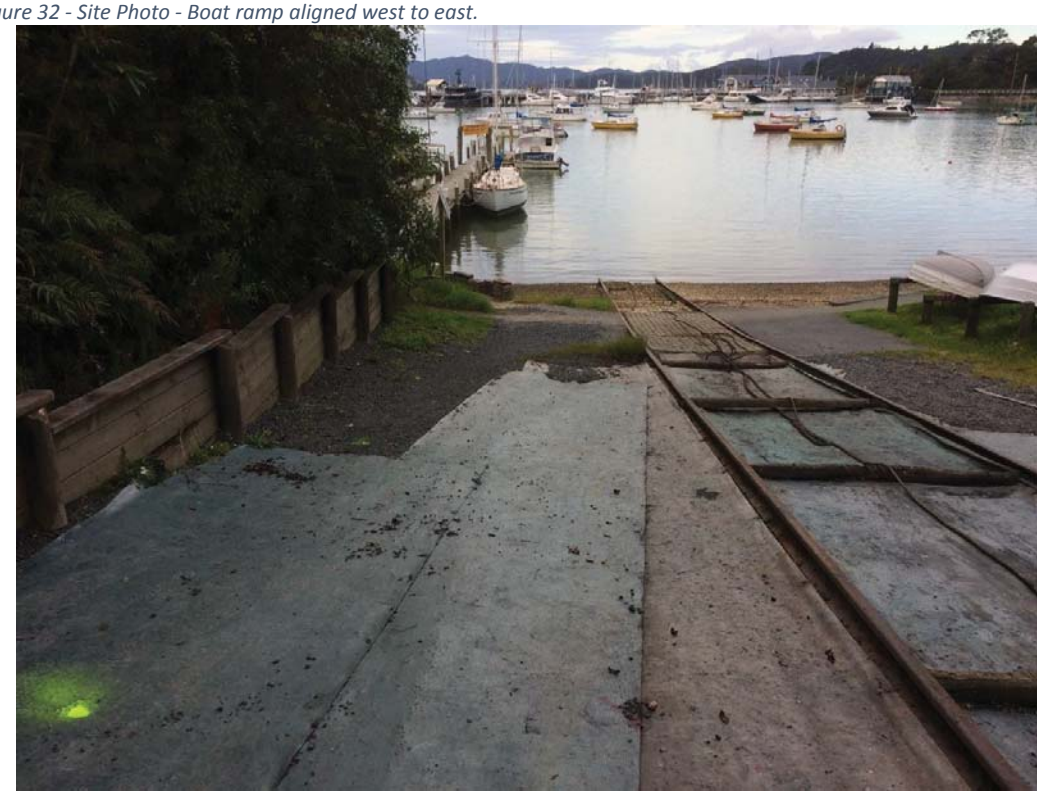

Figure 33 - Site Photo - Boat shed situated to the western corner of site.

Appendix E – Exploratory Hole Records

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Sample Hole Log

Job No.:	17 115	**Samples:**	ES1 - ES15
Client:	Doug's Opua Boat Yard	**Date:**	9-May
Location:	1 Richardson Street, Opua	**Time:**	10:00
Method:	Hand Auger 100 mm diameter & trowel	**Logged:**	EC
Conditions:	Fine	**Checked:**	JP

Sample No.	Soil Description	Depth (m bgl)	Sampling Time	Sample Point Location	Comments
17 115-ES1	MADE GROUND: Clayey SILT with some gravel. Yellowish brown, dry, high plasticity. Gravel is sub-angular to sub-rounded fine to coarse of sandstone.	0.0 - 0.1	**9:40**	Within shallow natural cohesive soils of BH1 on grassed reserve area.	
17 115-ES2	MADE GROUND: CLAY with some gravel. Yellowish brown stained grey and green.	0.0 - 0.1	**9:50**	Within tracks by gabion wall	
17 115-ES3	MADE GROUND: CLAY with some gravel. Yellowish brown stained grey and green.	0.0 - 0.1	**9:55**	Within tracks by gabion wall	Duplicate of sample 17 115-ES2
17 115-ES4	MADE GROUND: Clayey SILT with some gravel. Yellowish brown, dry, high plasticity. Gravel is sub-angular to sub-rounded fine to coarse of sandstone.	0.0 - 0.1	**10:00**	Within tracks by turn table	
17 115-ES5	MADE GROUND: Silty CLAY. Yellowish brown and grey, moist, high plasticity.	0.0 - 0.1	**10:10**	Within tracks to south of turn table	
17 115-ES6	MADE GROUND: Silty CLAY. Yellowish brown and grey, moist, high plasticity.	0.0 - 0.1	**10:15**	To north wes of turn table in old track position	
17 115-ES7	MADE GROUND: Silty CLAY. Yellowish brown and grey, moist, high plasticity.	0.0 - 0.1	**10:20**	To south west of turn table in old track position	
17 115-ES8	MADE GROUND: Hard Fill	0.0 - 0.1	**10:30**	Adjacent to winch in area of staining	Visual and olfactory evidence of oil with fragments of glass and plastic.
17 115-ES9	CLAY. Yellowish brown, moist, high plasticity.	0.0 - 0.1	**10:40**	In slipway, beneath tarp	
17 115-ES10	MADE GROUND: Silty CLAY. Yellowish brown and grey, moist, high plasticity.	0.0 - 0.1	**10:45**	To north east of 17 115-ES	
17 115-ES11	MADE GROUND: Silty CLAY. Dark grey, wet, high plasticity.	0.0 - 0.1	**10:50**	By diesel drums	Strong diesel odour and slight staining. With fragments of glass and plastic.
17 115-ES12	MADE GROUND: Sandy SILT. Light brown, dry, low plasticity.	0.0 - 0.1	**10:50**	In boat shed footprint	
17 115-ES13	MADE GROUND: Clayey SILT with some gravel. Yellowish brown, dry, high plasticity. Gravel is sub-angular to sub-rounded fine to coarse of sandstone.	0.0 - 0.1	**10:55**	On grassed area	Signs of some stress to grass
17 115-ES14	MADE GROUND: Silty CLAY. Yellowish brown and grey, moist, high plasticity.	0.0 - 0.1	**11:45**	To north east of 17 115-ES	Duplicate of sample 17 115-ES10
17 115-ES15	MADE GROUND: Hard Fill	0.0 - 0.1	**11:50**	In area of TPH staining along winch rope line	Visible oil staining on surface

Appendix F – Field QA/QC Records

Job No: 212 0271 Date Recv: 07-Feb-19 08:42

Hill Laboratories
BETTER TESTING BETTER RESULTS

ANALYS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Received by: Alpha Tan

3121202719

Client

Name	Haigh Workman Limited - 217580
Address	PO Box 89, KERIKERI 0245
Phone	09 407 8327 *Fax* 09 407 8378
Client Reference	17 115
Quote No	*Order Number*

Primary Contact	Edward Collings
Submitted By	Edward Collings
Charge To	Haigh Workman Limited - 217580

Results To ☑ Mail Client ☐ Mail Submitter
☐ Fax Results
☑ Email Results edward@haighworkman.co.nz

ADDITIONAL INFORMATION

Office use only Job No:

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories *Date & Time:* *Name:* *Signature:*
☑ *Please tick if you require COC to be faxed back*

Received at Hill Laboratories *Date & Time:* *Name:* *Signature:*

Condition ☐ *Room Temp* ☐ *Chilled* ☐ *Frozen* *Temp:*
☐ Sample Analysis details checked *Signature:*

Priority
☐ Low ☐ Normal ☑ High
☐ Urgent (ASAP, extra charge applies, please contact the lab first)

Requested Reporting Date:

Sample Types

Waters	E	Effluent	G	Geothermal	Pot1	Potable Water (LAS/EU)	Pot2	Potable Water (NZDWS)
	GW	Ground Water	L	Leachate	☐	Audit Monitoring	Pot3	Potable Water (other)
	SW	Surface Water	S	Saline	☐	Check Monitoring	Pool	Swimming/Spa Pool
	TW	Trade Waste						
Solids	ES	Soil	SE	Sediment	SL	Sludge	PL	Plant
Other	O	O Oil	M	Miscellaneous	FS	FS Fish/shellfish/biota	BM	BM Biological Material

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
1	17115 ES101 0.00	31.1.19	ES	HMHgsSoil
2	17115 ES102 0.30	"	ES	Hold cold
3	17115 ES103 0.50	"	ES	Hold cold.
4	17115 ES104 0.00	"	ES	HMHgs Soil
5	17115 ES105 0.30	"	ES	Hold Cold
6	17115 ES106 0.50	"	ES	Hold Cold
7	17115 ES107 0.90	"	ES	HMHgsSoil - create a duplicate sample, label ES107b for same testing
8	17115 ES108 0.30	"	ES	Hold cold
9	17115 ES109 0.50	"	ES	Hold cold
10	17115 ES110 0.00	"	ES	HMHgs Soil

Continued on next page

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
11	17115 ES111 0·30	31·1·19	ES	Hold Cold
12	17115 ES112 0·50	"	"	Hold Cold
13	17115 ES113 0·00	"	"	HMHgs Soil
14	17115 ES114 0·30	"	"	Hold Cold
15	17115 ES115 0·50	"	"	Hold Cold
16	17115 ES116 0·00	"	"	HMHgs Soil
17	17115 ES117 0·30	"	"	Hold Cold
18	17115 ES118 0·50	"	"	Hold Cold
19	17115 ES119 0·00	"	"	HMHgs Soil
20	17115 ES120 0·30	"	"	Hold Cold
21	17115 ES121 0·00	"	"	~~Hold Cold~~ HMHgs Soil
22	17115 ES122 0·30	"	"	~~HMHgs Soil~~ Hold Cold
23	17115 ES123 0·00	"	"	~~Hold Cold~~ HMHgs Soil
24	17115 ES124 0·20	"	"	Hold Cold
25	17115 ES125 0·40	"	"	Hold Cold
26	17115 ES126 0·00	"	"	HMHgs Soil
27	17115 ES127 0·30	"	"	Hold Cold
28	17115 ES128 0·50	"	"	Hold Cold
29	17115 ES129 0·00	"	"	HMHgs Soil
30	17115 ES130 0·30	"	"	Hold Cold
31	17115 ES131 0·50	"	"	Hold Cold
32	17115 ES132 0·00	"	"	HMHgs Soil
33	17115 ES133 0·30	"	"	Hold Cold
34	17115 ES134 0·50	"	"	Hold Cold
35	17115 ES135 0·00	"	"	HMHgs Soil - ~~create duplicate simple~~ label ES135b, save test.
36	17115 ES136 0·30	"	"	Hold Cold
37	17115 ES137 0·50	"	"	Hold Cold
38	17115 ES138 0·00	"	"	HMHgs Soil
39	17115 ES139 0·20	"	"	Hold Cold
40	17115 ES140 . 0·00	"	"	HMHgs Soil

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
41	17115 ES141 0·30	31·1·19	ES	Hold cold
42	17115 ES142 0·50	"	"	Hold cold
43	17115 ES143 0·00	"	"	HMHgs Soil ~~- create duplicate sample~~, label ES143b, same test
44	17115 ES144 0·30	"	"	Hold Cold
45	17115 ES145 0·50	"	"	Hold Cold
46	17115 ES146 0·00	"	"	HMHgs Soil
47	17115 ES147 0·30	"	"	Hold Cold
48	17115 ES148 0·50	"	"	Hold Cold
49	17115 ES149 0·00	"	"	HMHgs Soil
50	17115 ES150 0·30	"	"	Hold Cold
51	17115 ES151 0·50	"	"	Hold Cold
52	17115 ES152 0·00	"	"	HMHgs Soil
53	17115 ES153 0·20	"	"	Hold Cold
54	17115 ES154 0·00	"	"	HMHgs Soil
55	17115 ES155 0·30	"	"	Hold Cold
56	17115 ES156 0·50	"	"	Hold Cold
57	17115 ES157 0·00	"	"	HMHgs Soil
58	17115 ES158 0·30	"	"	Hold Cold
59	17115 ES159 0·50	"	"	Hold Cold
60	17115 ES160 0·00	"	"	HMHgs Soil
61	17115 ES161 0·30	"	"	Hold Cold
62	17115 ES162 0·50	"	"	Hold Cold
63	17115 ES163 0·00	"	"	HMHgs Soil
64	17115 ES164 0·30	"	"	Hold Cold
65	17115 ES165 0·50	"	"	Hold Cold
66	17115 ES166 0·00	"	"	HMHgs Soil
67	17115 ES167 0·30	"	"	Hold Cold
68	17115 ES168 0·60	"	"	Hold Cold
69	17115 ES169 0·00	"	"	HMHgs Soil
70	17115 ES170. 0·10	"	"	Hold Cold.

Continued on next page

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
71	17115 ES171 0.00	31.1.19	ES	HMHgs Soil
72	17115 ES172 0.30	"	"	Hold Cold
73	17115 ES173. 0.50	"	"	Hold Cold
74	17115 ES174 0.00	"	"	HMHgs Soil
75	17115 ES175 0.30	"	"	Hold Cold
76	17115 ES176 0.50	"	"	Hold Cold
77	17115 ES177 0.00	"	"	HMHgs Soil
78	17115 ES178 0.30	"	"	Hold Cold
79	17115 ES179 0.50	"	"	Hold Cold
80	17115 ES180 0.00	"	"	HMHgs Soil
81	17115 ES181 0.30	"	"	Hold Cold
82	17115 ES182 0.50	"	"	Hold Cold
83	17115 ES183 0.00	01/02/19.	"	HMHgs Soil
84	17115 ES184 0.30	"	"	Hold Cold
85	17115 ES185 0.50	"	"	Hold Cold
86	17115 ES186 0.00	"	"	HMHgs Soil
87	17115 ES187 0.30	"	"	Hold Cold
88	17115 ES188 0.50	"	"	Hold Cold
89	17115 ES189. 0.00	"	"	HMHgs Soil -create duplicate sample label ES189b, same test.
90	17115 ES190. 0.30	"	"	Hold Cold
91	17115 ES191 0.50	"	"	Hold Cold
92	17115 ES192 0.00	"	"	HMHgs Soil
93	17115 ES193 0.30	"	"	Hold Cold
94	17115 ES194 0.50	"	"	Hold Cold
95	17115 ES195 0.00	"	"	HMHgs Soil
96	17115 ES196 0.10	"	"	Hold Cold
97	17115 ES197 0.20	"	"	Hold Cold
98	17115 ES198 0.30	"	"	Hold Cold
99	17115 ES199 0.00	"	"	HMHgs Soil
100	17115 ES200 0.30	"	"	Hold Cold.

Continued on next page

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
101	17115 ES201 0·50	01·02·19	ES	Hold Cold
102	17115 ES202 0·00	"	"	HMHgsSoil
103	17115 ES203 0·30	"	"	Hold Cold
104	17115 ES204 0·50	"	"	Hold Cold
105	17115 ES205 0·00	"	"	HMHgs Soil
106	17115 ES206 0·30	"	"	Hold Cold
107	17115 ES207 0·50	"	"	Hold Cold
108	17115 ES208 0·00	"	"	HMHgs Soil
109	17115 ES209 0·30	"	"	Hold Cold
110	17115 ES210 0·50	"	"	Hold Cold
111	17115 ES211 0·00	"	"	HMHgs Soil
112	17115 ES212 0·30	"	"	Hold Cold
113	17115 ES213 0·50	"	"	Hold Cold
114	17115 ES214 0·00	"	"	HMHgsSoil
115	17115 ES215 0·30	"	"	Hold Cold
116	17115 ES216 0·50	"	"	Hold Cold
117	17115 ES217 0·00	"	"	HMHgs Soil
118	17115 ES218 0·30	"	"	Hold Cold
119	17115 ES219 0·50	"	"	Hold Cold
120	17115 ES220 0·00	"	"	HMHgs Soil
121	17115 ES221 0·20	"	"	Hold Cold
122	17115 ES222 0·00	"	"	HMHgs Soil — create duplicate sample, label ES222b, save test.
123	17115 ES223 0·20	"	"	Hold Cold
124	17115 ES224 0·00	"	"	HMHgsSoil
125	17115 ES225 0·20	"	"	Hold cold
126	17115 ES226 0·00	"	"	HMHgsSoil
127	17115 ES227 0·30	"	"	Hold Cold
128	17115 ES228 0·50	"	"	Hold Cold
129	17115 ES229 0·00	"	"	HMHgs Soil
130	17115 ES230 0·20	"	"	Hold Cold

Continued on next page

No.	Sample Name	Sample Date & Time	Sample Type	Tests Required
131	17115 ES231 0.00	1-2-19	ES	HMHgsSoil
132	17115 ES232 0.30	"	"	Hold Cold
133	17115 ES233 0.00	"	"	HMHgsSoil
134	17115 ES234 0.30	"	"	Hold Cold
135	17115 ES235 0.50	"	"	Hold Cold
136	17115 ES236 0.00	"	"	HMHgsSoil
137	17115 ES237 0.30	"	"	Hold Cold
138	17115 ES238 0.50	"	"	Hold Cold
139	17115 ES239 0.00	"	"	HMHgsSoil
140	17115 ES240 0.30	"	"	Hold Cold
141	17115 ES241 0.00	"	"	HMHgsSoil
142	17115 ES242 0.30	"	"	Hold Cold
143	17115 ES243 0.50	"	"	Hold Cold
144	17115 ES244 0.00	"	"	HMHgsSoil
145	17115 ES245 0.30	"	"	Hold Cold
146	17115 ES246 0.00	"	"	HMHgsSoil
147	17115 ES247 0.30	"	"	Hold Cold
148	17115 ES248 0.00	"	"	HMHgsSoil - create duplicate sample, label ES248b, same test
149	17115 ES249 0.30	"	"	Hold Cold
150	17115 ES250 0.50	"	"	Hold Cold
151	17115 ES251 0.00	"	"	HMHgsSoil
152	17115 ES252 0.30.	"	"	Hold Cold.
153				
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158				
159				
160				

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Hill Laboratories
TRIED, TESTED AND TRUSTED

ANALYSIS REQUEST

R J Hill Laboratories Limited
28 Duke Street, Hamilton 3204
Private Bag 3205
Hamilton 3240, New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Office use only
(Job No)

Quote No

Primary Contact Edward Collings

Submitted By Edward Collings

Client Name Haigh Workman Limited - 217580

Address PO Box 89, Kerikeri

Postcode 0245

Phone 09 407 8327 *Mobile* 09 283 5919

Email edward@haighworkman.co.nz

Charge To Haigh Workman Limited - 217580

Client Reference 17 115

Order No

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ *Email Primary Contact* ☐ *Email Submitter* ☐ *Email Client*

☐ *Email Other*

☐ *Other*

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories *Date & Time:*

Name:

☑ *Tick if you require COC to be emailed back* *Signature:*

Received at Hill Laboratories *Date & Time:*

Name:

Signature:

Condition ☐ *Room Temp* ☐ *Chilled* ☐ *Frozen* Temp:

☐ *Sample and Analysis details checked*

Signature:

ADDITIONAL INFORMATION

- All soil samples in cold storage at Hills
- Water samples couriered to labs 14-2-19.

Priority ☐ Low ☐ Normal ☑ High

☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

Requested Reporting Date:

No.	Sample Name	Sample Date	Sample Time	Sample Type	Tests Required (if not as per Quote)
1	17115 ES124 0 20	31-1-19		ES	Copper, Lead
2	17115 ES136 0 30	31-1-19		ES	Copper, Lead
3	17115 ES147 0 30	31-1-19		ES	Copper Lead
4	17115 ES150 0 30	31-1-19		ES	Copper, Lead
5	17115 ES139 0-20	31-1-19		ES	Copper, Lead
6	17115 ES153 0 20	31-1-19		ES	Copper, Lead
7	17115 ES225 0 20	1-2-19		ES	Copper Lead
8	17115 ES227 0 30	1-2-19		ES	Copper, Lead
9	17115 ES230 0 20	1-2-19		ES	Copper, Lead
10	17115 ES218 0 30	1-2-19		ES	Copper, Lead
11	17115 ES223 0 20	1-2-19		ES	Copper Lead
12	17115 ES221 0 20	1-2-19		ES	Copper, Lead.

Continued on next page

No.	Sample Name		Sample Date	Sample Time	Sample Type	Tests Required (if not as per Quote)
13	17115 ES158	0.30	31.1.19		ES	Copper, lead.
14	17115 ES161	0.30	31.1.19		ES	Copper, lead.
15	17115 ES164	0.30	31.1.19		ES	Copper, lead.
16	17115 ES167	0.30	31.1.19		ES	Copper Lead.
17	17115 ES203	0.30	1.2.19		ES	Copper, lead.
18	17115 ES209	0.30	1.2.19		ES	Copper, lead.
19	17115 ES212	0.30	1.2.19		ES	Copper, lead.
20	17115 ES215	0.30	1.2.19		ES	Copper, lead.
21	17115 ES170	0.10	31.1.19		ES	Copper, Lead.
22	17115 ES172	0.30	31.1.19		ES	Copper, lead, arsenic.
23	17115 ES175	0.30	31.1.19		ES	Copper, Lead.
24	17115 ES178	0.30	31.1.19		ES	Copper, lead.
25	17115 ES181	0.30	31.1.19		ES	Copper, lead.
26	17115 ES196	0.10	~~31.1.19~~ 1.2.19		ES	Copper, lead.
27	17115 ES200	0.30	1.2.19		ES	Copper, lead.
28	17115 ES184	0.30	1.2.19		ES	Copper, lead.
29	17115 ES187	0.30	1.2.19		ES	Copper, lead.
30	17115 ES190	0.30	1.2.19		ES	Copper, Lead.
31	17115 ES193	0.30	1.2.19		ES	Copper, lead.
32	17115 GW1		1.2.19		GW	Heavy metals incl. mercury. (Groundwater)
33	17115 GW2		1.2.19		GW	Heavy metals incl. mercury (Groundwater)
34	17115 GW3		1.2.19		GW	Heavy metals ~~ES~~ incl. mercury (Groundwater)
35	17115 ES180	0.00	31.1.19		ES	Heavy metal leachate
36	17115 ES202	0.00	1.2.19		ES	Heavy metal leachate.
37	17115 ES171	0.00	31.1.19		ES	Heavy metal leachate.
38	17115 ES192	0.00	1.2.19		ES	Heavy metal leachate
39						
40						

Hill Laboratories
TRIED, TESTED AND TRUSTED

ANALYSIS REQUEST

R J Hill Laboratories Limited
28 Duke Street, Hamilton 3204
Private Bag 3205
Hamilton 3240, New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Office use only (Job No)

Quote No

Primary Contact Edward Collings

Submitted By Edward Colling

Client Name Haigh Workman Ltd - 217580

Address PO Box 89, Kerikeri

Postcode 0245

Phone 09 407 8327 *Mobile* 0273680860

Email edward@haighworkman.co.nz

Charge To Haigh Workman Limited - 217580

Client Reference 17 115

Order No

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ *Email Primary Contact* ☐ *Email Submitter* ☐ *Email Client*

☐ *Email Other*

☐ *Other*

ADDITIONAL INFORMATION

Samples already at Hill Labs in cold storage.

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
Date & Time: 28/02/2019
Name: Edward Collings
☑ *Tick if you require COC to be emailed back*
Signature: By email

Received at Hill Laboratories
Date & Time:
Name:
Signature:

Condition ☐ *Room Temp* ☐ *Chilled* ☐ *Frozen* Temp:

☐ *Sample and Analysis details checked*

Signature:

Priority ☐ **Low** ☑ **Normal** ☐ **High**
☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

Requested Reporting Date:

No.	Sample Name	Sample Date	Sample Time	Sample Type	Tests Required (if not as per Quote)
1	17 115 - ES168 - 0.60	31/01/2019		ES	Copper, Lead
2	17 115 - ES173 - 0.50	31/01/2019		ES	Copper, Lead
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Continued on next page

Appendix G – Laboratory QA/QC

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Job Information Summary

Client:	Haigh Workman Limited	**Lab No:**	2120271
Contact:	Edward Collings	**Date Registered:**	07-Feb-2019 9:42 am
	C/- Haigh Workman Limited	**Priority:**	High
	PO Box 89	**Quote No:**	
	Kerikeri 0245	**Order No:**	
		Client Reference:	17115
		Add. Client Ref:	
		Submitted By:	Edward Collings
		Charge To:	Haigh Workman Limited
		Target Date:	07-Mar-2019 4:30 pm

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	17115 ES101 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
2	17115 ES102 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
3	17115 ES103 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
4	17115 ES104 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
5	17115 ES105 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
6	17115 ES106 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
7	17115 ES107 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
8	17115 ES108 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
9	17115 ES109 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
10	17115 ES110 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
11	17115 ES111 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
12	17115 ES112 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
13	17115 ES113 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
14	17115 ES114 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
15	17115 ES115 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
16	17115 ES116 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
17	17115 ES117 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
18	17115 ES118 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
19	17115 ES119 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
20	17115 ES120 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
21	17115 ES121 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
22	17115 ES122 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
23	17115 ES123 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
24	17115 ES124 0.20 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
25	17115 ES125 0.40 31-Jan-2019	Soil	PSoil250	Hold Cold
26	17115 ES126 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
27	17115 ES127 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
28	17115 ES128 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
29	17115 ES129 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
30	17115 ES130 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
31	17115 ES131 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
32	17115 ES132 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
33	17115 ES133 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
34	17115 ES134 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
35	17115 ES135 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
36	17115 ES136 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
37	17115 ES137 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
38	17115 ES138 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
39	17115 ES139 0.20 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
40	17115 ES140 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
41	17115 ES141 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
42	17115 ES142 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
43	17115 ES143 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
44	17115 ES144 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
45	17115 ES145 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
46	17115 ES146 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
47	17115 ES147 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
48	17115 ES148 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
49	17115 ES149 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
50	17115 ES150 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
51	17115 ES151 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
52	17115 ES152 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
53	17115 ES153 0.20 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
54	17115 ES154 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
55	17115 ES155 0.30 31-Jan-2019	Soil	PSoil250	Hold Cold
56	17115 ES156 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
57	17115 ES157 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
58	17115 ES158 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
59	17115 ES159 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
60	17115 ES160 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
61	17115 ES161 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
62	17115 ES162 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
63	17115 ES163 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
64	17115 ES164 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
65	17115 ES165 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
66	17115 ES166 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
67	17115 ES167 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
68	17115 ES168 0.60 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
69	17115 ES169 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
70	17115 ES170 0.10 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
71	17115 ES171 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level; TCLP Profile
72	17115 ES172 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Arsenic; Total Recoverable Copper; Total Recoverable Lead
73	17115 ES173 0.50 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
74	17115 ES174 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
75	17115 ES175 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
76	17115 ES176 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
77	17115 ES177 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
78	17115 ES178 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
79	17115 ES179 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
80	17115 ES180 0.00 31-Jan-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level; TCLP Profile
81	17115 ES181 0.30 31-Jan-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
82	17115 ES182 0.50 31-Jan-2019	Soil	PSoil250	Hold Cold
83	17115 ES183 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
84	17115 ES184 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
85	17115 ES185 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
86	17115 ES186 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
87	17115 ES187 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
88	17115 ES188 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
89	17115 ES189 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
90	17115 ES190 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
91	17115 ES191 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
92	17115 ES192 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level; SPLP Profile
93	17115 ES193 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
94	17115 ES194 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
95	17115 ES195 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
96	17115 ES196 0.10 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
97	17115 ES197 0.20 01-Feb-2019	Soil	PSoil250	Hold Cold
98	17115 ES198 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
99	17115 ES199 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
100	17115 ES200 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
101	17115 ES201 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
102	17115 ES202 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level; SPLP Profile
103	17115 ES203 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
104	17115 ES204 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
105	17115 ES208 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
106	17115 ES209 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
107	17115 ES210 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
108	17115 ES211 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
109	17115 ES212 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
110	17115 ES213 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
111	17115 ES214 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
112	17115 ES215 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
113	17115 ES216 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
114	17115 ES217 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
115	17115 ES218 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
116	17115 ES219 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
117	17115 ES220 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
118	17115 ES221 0.20 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
119	17115 ES222 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
120	17115 ES223 0.20 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
121	17115 ES224 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
122	17115 ES225 0.20 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
123	17115 ES226 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
124	17115 ES227 0.30 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
125	17115 ES228 0.50 01-Feb-2019	Soil	cPSoil	Hold Cold
126	17115 ES229 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
127	17115 ES230 0.20 01-Feb-2019	Soil	PSoil250	Total Recoverable Copper; Total Recoverable Lead
128	17115 ES231 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
129	17115 ES232 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
130	17115 ES233 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
131	17115 ES234 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
132	17115 ES235 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
133	17115 ES236 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
134	17115 ES237 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
135	17115 ES238 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
136	17115 ES239 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
137	17115 ES240 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
138	17115 ES241 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
139	17115 ES242 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
140	17115 ES243 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
141	17115 ES244 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
142	17115 ES245 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
143	17115 ES246 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
144	17115 ES247 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
145	17115 ES248 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
146	17115 ES249 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
147	17115 ES250 0.50 01-Feb-2019	Soil	PSoil250	Hold Cold
148	17115 ES251 0.00 01-Feb-2019	Soil	PSoil250	Heavy Metals with Mercury, Screen Level
149	17115 ES252 0.30 01-Feb-2019	Soil	PSoil250	Hold Cold
150	17115 ES107b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
151	17115 ES135b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
152	17115 ES143b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
153	17115 ES189b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
154	17115 ES222b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
155	17115 ES248b 0.00 [Duplicate]	Soil	cPSoil	Heavy Metals with Mercury, Screen Level
156	17115 ES171 0.00 [TCLP Extract]	TCLP Extract	TCLPext	Total Copper; Total Lead
157	17115 ES180 0.00 [TCLP Extract]	TCLP Extract	TCLPext	Total Copper; Total Lead
158	17115 ES192 0.00 [SPLP Extract]	SPLP Extract	SPLPext	Total Copper; Total Lead
159	17115 ES202 0.00 [SPLP Extract]	SPLP Extract	SPLPext	Total Copper; Total Lead
160	17115 GW1 01-Feb-2019	Ground Water	N100	Total Mercury; Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn
161	17115 GW3 01-Feb-2019	Ground Water	N100	Total Mercury; Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn
162	17115 GW4 01-Feb-2019	Ground Water	N100	Total Mercury; Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Environmental Solids Sample Drying	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1, 4, 7, 10, 13, 16, 19, 21, 23-24, 26, 29, 32, 35-36, 38-40, 43, 46-47, 49-50, 52-54, 57-58, 60-61, 63-64, 66-75, 77-78, 80-81, 83-84, 86-87, 89-90, 92-93, 95-96, 99-100, 102-103, 105-106, 108-109, 111-112, 114-115, 117-124, 126-128, 130, 133, 136, 138, 141, 143, 145, 148, 150-155

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	72
Total Recoverable Copper	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy Metals with Mercury, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1, 4, 7, 10, 13, 16, 19, 21, 23, 26, 29, 32, 35, 38, 40, 43, 46, 49, 52, 54, 57, 60, 63, 66, 69, 71, 74, 77, 80, 83, 86, 89, 92, 95, 99, 102, 105, 108, 111, 114, 117, 119, 121, 123, 126, 128, 130, 133, 136, 138, 141, 143, 145, 148, 150-155
SPLP Profile	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1312	-	92, 102
TCLP Profile	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311	-	71, 80
SPLP Profile			
SPLP Sample Weight	Gravimetric. US EPA 1312.	0.1 g	92, 102
SPLP Extractant Type	US EPA 1312 (Modified for New Zealand conditions to use De-ionised Water unless otherwise specified).	-	92, 102
SPLP Final pH	pH meter. US EPA 1312.	0.1 pH Units	92, 102
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	71, 80
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Extractant Type	US EPA 1311.	-	71, 80
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	160-162
Total Digestion of Extracted Samples	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	156-159
Total Copper	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.011 g/m^3	156-157
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017 / US EPA 200.8.	0.00053 g/m^3	158-159
Total Lead	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.0021 g/m^3	156-157
Total Lead	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017 / US EPA 200.8.	0.00011 g/m^3	158-159
Total Mercury	Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	160-162
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8	0.000053 - 0.0011 g/m^3	160-162

Appendix H – Analytical Test Results

Hill Laboratories
TRIED, TESTED AND TRUSTED

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Certificate of Analysis

Client:	Haigh Workman Limited	**Lab No:**	2120271 SPv5
Contact:	Edward Collings	**Date Received:**	07-Feb-2019
	C/- Haigh Workman Limited	**Date Reported:**	12-Apr-2019 **(Amended)**
	PO Box 89	**Quote No:**	
	Kerikeri 0245	**Order No:**	
		Client Reference:	17115
		Submitted By:	Edward Collings

Sample Type: Soil

Sample Name:		BH1 ES101 0.00 31-Jan-2019	BH2 ES104 0.00 31-Jan-2019	BH3 ES107 0.00 31-Jan-2019	BH4 ES110 0.00 31-Jan-2019	BH5 ES113 0.00 31-Jan-2019
Lab Number:		2120271.1	2120271.4	2120271.7	2120271.10	2120271.13
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	20	55	13	16	15
Total Recoverable Cadmium	mg/kg dry wt	0.33	0.73	0.14	0.21	0.13
Total Recoverable Chromium	mg/kg dry wt	20	81	10	14	12
Total Recoverable Copper	mg/kg dry wt	500	410	128	280	330
Total Recoverable Lead	mg/kg dry wt	142	960	54	130	158
Total Recoverable Mercury	mg/kg dry wt	1.03	10.2	0.42	2.9	0.38
Total Recoverable Nickel	mg/kg dry wt	6	9	5	6	6
Total Recoverable Zinc	mg/kg dry wt	350	590	188	220	160

Sample Name:		BH6 ES116 0.00 31-Jan-2019	BH7 ES119 0.00 31-Jan-2019	BH8 ES121 0.00 31-Jan-2019	BH9 ES123 0.00 31-Jan-2019	BH9 ES124 0.20 31-Jan-2019
Lab Number:		2120271.16	2120271.19	2120271.21	2120271.23	2120271.24
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	-	-	-	310
Total Recoverable Lead	mg/kg dry wt	-	-	-	-	117
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	13	56	16	27	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.35	0.16	0.33	-
Total Recoverable Chromium	mg/kg dry wt	7	48	14	21	-
Total Recoverable Copper	mg/kg dry wt	181	240	270	2,100	-
Total Recoverable Lead	mg/kg dry wt	46	380	178	240	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	6.1	4.6	0.50	-
Total Recoverable Nickel	mg/kg dry wt	5	9	9	12	-
Total Recoverable Zinc	mg/kg dry wt	99	420	210	870	-

Sample Name:		BH10 ES126 0.00 31-Jan-2019	BH11 ES129 0.00 31-Jan-2019	BH12 ES132 0.00 31-Jan-2019	BH13 ES135 0.00 31-Jan-2019	BH13 ES136 0.30 31-Jan-2019
Lab Number:		2120271.26	2120271.29	2120271.32	2120271.35	2120271.36
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	-	-	-	127
Total Recoverable Lead	mg/kg dry wt	-	-	-	-	66
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	12	14	13	11	-
Total Recoverable Cadmium	mg/kg dry wt	0.12	0.13	0.17	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	12	13	18	9	-
Total Recoverable Copper	mg/kg dry wt	730	1,170	1,180	138	-
Total Recoverable Lead	mg/kg dry wt	66	290	310	70	-
Total Recoverable Mercury	mg/kg dry wt	0.22	1.53	20	0.23	-
Total Recoverable Nickel	mg/kg dry wt	4	5	6	8	-
Total Recoverable Zinc	mg/kg dry wt	190	153	230	140	-

ilac-MRA IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Soil						
	Sample Name:	BH14 ES138 0.00 31-Jan-2019	BH14 ES139 0.20 31-Jan-2019	BH15 ES140 0.00 31-Jan-2019	BH16 ES143 0.00 31-Jan-2019	BH17 ES146 0.00 31-Jan-2019
	Lab Number:	2120271.38	2120271.39	2120271.40	2120271.43	2120271.46
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	1,740	-	-	-
Total Recoverable Lead	mg/kg dry wt	-	199	-	-	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	16	-	8	11	20
Total Recoverable Cadmium	mg/kg dry wt	0.70	-	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	21	-	14	10	23
Total Recoverable Copper	mg/kg dry wt	7,700	-	1,590	197	530
Total Recoverable Lead	mg/kg dry wt	300	-	230	77	175
Total Recoverable Mercury	mg/kg dry wt	0.28	-	0.86	0.46	0.70
Total Recoverable Nickel	mg/kg dry wt	12	-	5	4	5
Total Recoverable Zinc	mg/kg dry wt	2,800	-	380	100	220

	Sample Name:	BH17 ES147 0.30 31-Jan-2019	BH18 ES149 0.00 31-Jan-2019	BH18 ES150 0.30 31-Jan-2019	BH19 ES152 0.00 31-Jan-2019	BH19 ES153 0.20 31-Jan-2019
	Lab Number:	2120271.47	2120271.49	2120271.50	2120271.52	2120271.53
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	230	-	1,020	-	5,900
Total Recoverable Lead	mg/kg dry wt	51	-	910	-	340
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	46	-	14	-
Total Recoverable Cadmium	mg/kg dry wt	-	0.78	-	0.53	-
Total Recoverable Chromium	mg/kg dry wt	-	90	-	21	-
Total Recoverable Copper	mg/kg dry wt	-	15,000	-	6,900	-
Total Recoverable Lead	mg/kg dry wt	-	970	-	340	-
Total Recoverable Mercury	mg/kg dry wt	-	1.53	-	0.44	-
Total Recoverable Nickel	mg/kg dry wt	-	45	-	14	-
Total Recoverable Zinc	mg/kg dry wt	-	1,970	-	2,100	-

	Sample Name:	BH20 ES154 0.00 31-Jan-2019	BH21 ES157 0.00 31-Jan-2019	BH21 ES158 0.30 31-Jan-2019	BH22 ES160 0.00 31-Jan-2019	BH22 ES161 0.30 31-Jan-2019
	Lab Number:	2120271.54	2120271.57	2120271.58	2120271.60	2120271.61
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	-	490	-	730
Total Recoverable Lead	mg/kg dry wt	-	-	310	-	128
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	10	11	-	42	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.25	-	2.0	-
Total Recoverable Chromium	mg/kg dry wt	10	31	-	163	-
Total Recoverable Copper	mg/kg dry wt	2,100	2,100	-	29,000	-
Total Recoverable Lead	mg/kg dry wt	46	340	-	3,000	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	0.67	-	6.1	-
Total Recoverable Nickel	mg/kg dry wt	6	12	-	52	-
Total Recoverable Zinc	mg/kg dry wt	147	660	-	7,100	-

	Sample Name:	BH23 ES163 0.00 31-Jan-2019	BH23 ES164 0.30 31-Jan-2019	BH24 ES166 0.00 31-Jan-2019	BH24 ES167 0.30 31-Jan-2019	BH24 ES168 0.60 31-Jan-2019
	Lab Number:	2120271.63	2120271.64	2120271.66	2120271.67	2120271.68
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	74	-	13,300	14,300
Total Recoverable Lead	mg/kg dry wt	-	28	-	900	1,240
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	32	-	20	-	-
Total Recoverable Cadmium	mg/kg dry wt	1.79	-	1.03	-	-
Total Recoverable Chromium	mg/kg dry wt	92	-	120	-	-
Total Recoverable Copper	mg/kg dry wt	11,700	-	14,000	-	-
Total Recoverable Lead	mg/kg dry wt	980	-	970	-	-
Total Recoverable Mercury	mg/kg dry wt	1.04	-	2.4	-	-

Sample Type: Soil						
Sample Name:		BH23 ES163 0.00 31-Jan-2019	BH23 ES164 0.30 31-Jan-2019	BH24 ES166 0.00 31-Jan-2019	BH24 ES167 0.30 31-Jan-2019	BH24 ES168 0.60 31-Jan-2019
Lab Number:		2120271.63	2120271.64	2120271.66	2120271.67	2120271.68
Heavy Metals with Mercury, Screen Level						
Total Recoverable Nickel	mg/kg dry wt	41	-	74	-	-
Total Recoverable Zinc	mg/kg dry wt	4,700	-	6,000	-	-

Sample Name:		BH25 ES169 0.00 31-Jan-2019	BH25 ES170 0.10 31-Jan-2019	BH26 ES171 0.00 31-Jan-2019	BH26 ES172 0.30 31-Jan-2019	BH26 ES173 0.50 31-Jan-2019
Lab Number:		2120271.69	2120271.70	2120271.71	2120271.72	2120271.73
Individual Tests						
TCLP Weight of Sample Taken	g	-	-	50	-	-
TCLP Initial Sample pH	pH Units	-	-	7.4	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	2.6	-	-
TCLP Extractant Type*		-	-	NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-
TCLP Extraction Fluid pH	pH Units	-	-	4.9	-	-
TCLP Post Extraction Sample pH	pH Units	-	-	5.6	-	-
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	19	-
Total Recoverable Copper	mg/kg dry wt	-	4,000	-	11,700	5,500
Total Recoverable Lead	mg/kg dry wt	-	900	-	1,290	480
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	20	-	87	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.39	-	2.2	-	-
Total Recoverable Chromium	mg/kg dry wt	58	-	260	-	-
Total Recoverable Copper	mg/kg dry wt	9,900	-	76,000	-	-
Total Recoverable Lead	mg/kg dry wt	2,900	-	5,800	-	-
Total Recoverable Mercury	mg/kg dry wt	1.14	-	66	-	-
Total Recoverable Nickel	mg/kg dry wt	19	-	67	-	-
Total Recoverable Zinc	mg/kg dry wt	4,400	-	19,300	-	-

Sample Name:		BH27 ES174 0.00 31-Jan-2019	BH27 ES175 0.30 31-Jan-2019	BH28 ES177 0.00 31-Jan-2019	BH28 ES178 0.30 31-Jan-2019	BH29 ES180 0.00 31-Jan-2019
Lab Number:		2120271.74	2120271.75	2120271.77	2120271.78	2120271.80
Individual Tests						
TCLP Weight of Sample Taken	g	-	-	-	-	50
TCLP Initial Sample pH	pH Units	-	-	-	-	8.1
TCLP Acid Adjusted Sample pH	pH Units	-	-	-	-	3.2
TCLP Extractant Type*		-	-	-	-	NaOH/Acetic acid at pH 4.93 +/- 0.05
TCLP Extraction Fluid pH	pH Units	-	-	-	-	4.9
TCLP Post Extraction Sample pH	pH Units	-	-	-	-	5.6
Total Recoverable Copper	mg/kg dry wt	-	2,400	-	560	-
Total Recoverable Lead	mg/kg dry wt	-	640	-	73	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	39	-	37	-	30
Total Recoverable Cadmium	mg/kg dry wt	1.47	-	1.80	-	4.5
Total Recoverable Chromium	mg/kg dry wt	112	-	117	-	139
Total Recoverable Copper	mg/kg dry wt	31,000	-	38,000	-	117,000
Total Recoverable Lead	mg/kg dry wt	3,200	-	3,800	-	4,900
Total Recoverable Mercury	mg/kg dry wt	11.0	-	2.3	-	10.1
Total Recoverable Nickel	mg/kg dry wt	45	-	45	-	55
Total Recoverable Zinc	mg/kg dry wt	4,500	-	8,400	-	15,800

Sample Name:		BH29 ES181 0.30 31-Jan-2019	BH30 ES183 0.00 01-Feb-2019	BH30 ES184 0.30 01-Feb-2019	BH31 ES186 0.00 01-Feb-2019	BH31 ES187 0.30 01-Feb-2019
Lab Number:		2120271.81	2120271.83	2120271.84	2120271.86	2120271.87
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	400	-	192	-	18
Total Recoverable Lead	mg/kg dry wt	35 #1	-	28	-	17.2

Sample Type: Soil						
	Sample Name:	BH29 ES181 0.30 31-Jan-2019	BH30 ES183 0.00 01-Feb-2019	BH30 ES184 0.30 01-Feb-2019	BH31 ES186 0.00 01-Feb-2019	BH31 ES187 0.30 01-Feb-2019
	Lab Number:	2120271.81	2120271.83	2120271.84	2120271.86	2120271.87
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	21	-	15	-
Total Recoverable Cadmium	mg/kg dry wt	-	0.42	-	0.33	-
Total Recoverable Chromium	mg/kg dry wt	-	56	-	29	-
Total Recoverable Copper	mg/kg dry wt	-	13,200	-	3,700	-
Total Recoverable Lead	mg/kg dry wt	-	910	-	760	-
Total Recoverable Mercury	mg/kg dry wt	-	0.32	-	0.92	-
Total Recoverable Nickel	mg/kg dry wt	-	41	-	18	-
Total Recoverable Zinc	mg/kg dry wt	-	4,900	-	1,320	-

	Sample Name:	BH32 ES189 0.00 01-Feb-2019	BH32 ES190 0.30 01-Feb-2019	BH33 ES192 0.00 01-Feb-2019	BH33 ES193 0.30 01-Feb-2019	BH34 ES195 0.00 01-Feb-2019
	Lab Number:	2120271.89	2120271.90	2120271.92	2120271.93	2120271.95
Individual Tests						
SPLP Sample Weight	g	-	-	50	-	-
SPLP Extractant Type*		-	-	De-ionised Water, pH 5.8 +/- 0.4	-	-
SPLP Final pH	pH Units	-	-	8.9	-	-
Total Recoverable Copper	mg/kg dry wt	-	11	-	300	-
Total Recoverable Lead	mg/kg dry wt	-	10.7	-	45	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	38	-	34	-	17
Total Recoverable Cadmium	mg/kg dry wt	1.02	-	1.68	-	0.39
Total Recoverable Chromium	mg/kg dry wt	114	-	124	-	23
Total Recoverable Copper	mg/kg dry wt	7,400	-	68,000	-	3,800
Total Recoverable Lead	mg/kg dry wt	920	-	2,600	-	280
Total Recoverable Mercury	mg/kg dry wt	2.5	-	2.8	-	1.03
Total Recoverable Nickel	mg/kg dry wt	92	-	96	-	15
Total Recoverable Zinc	mg/kg dry wt	4,300	-	24,000	-	1,550

	Sample Name:	BH34 ES196 0.10 01-Feb-2019	BH35 ES199 0.00 01-Feb-2019	BH35 ES200 0.30 01-Feb-2019	BH36 ES202 0.00 01-Feb-2019	BH36 ES203 0.30 01-Feb-2019
	Lab Number:	2120271.96	2120271.99	2120271.100	2120271.102	2120271.103
Individual Tests						
SPLP Sample Weight	g	-	-	-	50	-
SPLP Extractant Type*		-	-	-	De-ionised Water, pH 5.8 +/- 0.4	-
SPLP Final pH	pH Units	-	-	-	8.7	-
Total Recoverable Copper	mg/kg dry wt	141	-	1,190	-	840
Total Recoverable Lead	mg/kg dry wt	21	-	380	-	123
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	52	-	36	-
Total Recoverable Cadmium	mg/kg dry wt	-	0.86	-	1.94	-
Total Recoverable Chromium	mg/kg dry wt	-	84	-	90	-
Total Recoverable Copper	mg/kg dry wt	-	16,200	-	101,000	-
Total Recoverable Lead	mg/kg dry wt	-	1,170	-	2,000	-
Total Recoverable Mercury	mg/kg dry wt	-	0.98	-	2.1	-
Total Recoverable Nickel	mg/kg dry wt	-	40	-	152	-
Total Recoverable Zinc	mg/kg dry wt	-	4,500	-	30,000	-

	Sample Name:	BH38 ES208 0.00 01-Feb-2019	BH38 ES209 0.30 01-Feb-2019	BH39 ES211 0.00 01-Feb-2019	BH39 ES212 0.30 01-Feb-2019	BH40 ES214 0.00 01-Feb-2019
	Lab Number:	2120271.105	2120271.106	2120271.108	2120271.109	2120271.111
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	240	-	300	-
Total Recoverable Lead	mg/kg dry wt	-	102	-	39	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	31	-	20	-	11 [#1]
Total Recoverable Cadmium	mg/kg dry wt	3.5	-	1.52	-	0.35

Sample Type: Soil						
	Sample Name:	BH38 ES208 0.00 01-Feb-2019	BH38 ES209 0.30 01-Feb-2019	BH39 ES211 0.00 01-Feb-2019	BH39 ES212 0.30 01-Feb-2019	BH40 ES214 0.00 01-Feb-2019
	Lab Number:	2120271.105	2120271.106	2120271.108	2120271.109	2120271.111
Heavy Metals with Mercury, Screen Level						
Total Recoverable Chromium	mg/kg dry wt	55	-	52	-	19 #1
Total Recoverable Copper	mg/kg dry wt	27,000	-	19,500	-	3,400 #1
Total Recoverable Lead	mg/kg dry wt	1,310	-	880	-	195
Total Recoverable Mercury	mg/kg dry wt	29	-	1.75	-	0.22 #1
Total Recoverable Nickel	mg/kg dry wt	30	-	57	-	20
Total Recoverable Zinc	mg/kg dry wt	11,100	-	7,300	-	1,510

	Sample Name:	BH40 ES215 0.30 01-Feb-2019	BH41 ES217 0.00 01-Feb-2019	BH41 ES218 0.30 01-Feb-2019	BH42 ES220 0.00 01-Feb-2019	BH42 ES221 0.20 01-Feb-2019
	Lab Number:	2120271.112	2120271.114	2120271.115	2120271.117	2120271.118
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	960	-	1,970	-	3,100
Total Recoverable Lead	mg/kg dry wt	187	-	980	-	240
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	18	-	44	-
Total Recoverable Cadmium	mg/kg dry wt	-	0.89	-	0.83	-
Total Recoverable Chromium	mg/kg dry wt	-	33	-	23	-
Total Recoverable Copper	mg/kg dry wt	-	14,700	-	8,900	-
Total Recoverable Lead	mg/kg dry wt	-	610	-	1,590	-
Total Recoverable Mercury	mg/kg dry wt	-	0.34	-	0.89	-
Total Recoverable Nickel	mg/kg dry wt	-	26	-	17	-
Total Recoverable Zinc	mg/kg dry wt	-	5,800	-	4,200	-

	Sample Name:	BH43 ES222 0.00 01-Feb-2019	BH43 ES223 0.20 01-Feb-2019	BH44 ES224 0.00 01-Feb-2019	BH44 ES225 0.20 01-Feb-2019	BH45 ES226 0.00 01-Feb-2019
	Lab Number:	2120271.119	2120271.120	2120271.121	2120271.122	2120271.123
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	-	740	-	1,350	-
Total Recoverable Lead	mg/kg dry wt	-	31	-	53	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	10	-	32	-	54
Total Recoverable Cadmium	mg/kg dry wt	0.18	-	1.82	-	3.1
Total Recoverable Chromium	mg/kg dry wt	10	-	50	-	141
Total Recoverable Copper	mg/kg dry wt	1,670	-	14,800	-	33,000
Total Recoverable Lead	mg/kg dry wt	116	-	460	-	8,700
Total Recoverable Mercury	mg/kg dry wt	0.28	-	0.59	-	28
Total Recoverable Nickel	mg/kg dry wt	15	-	23	-	29
Total Recoverable Zinc	mg/kg dry wt	680	-	5,800	-	8,700

	Sample Name:	BH45 ES227 0.30 01-Feb-2019	BH46 ES229 0.00 01-Feb-2019	BH46 ES230 0.20 01-Feb-2019	BH47 ES231 0.00 01-Feb-2019	BH48 ES233 0.00 01-Feb-2019
	Lab Number:	2120271.124	2120271.126	2120271.127	2120271.128	2120271.130
Individual Tests						
Total Recoverable Copper	mg/kg dry wt	2,600	-	340	-	-
Total Recoverable Lead	mg/kg dry wt	1,570	-	37	-	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	14	-	29	34
Total Recoverable Cadmium	mg/kg dry wt	-	0.20	-	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	-	12	-	11	15
Total Recoverable Copper	mg/kg dry wt	-	1,140	-	370	1,280
Total Recoverable Lead	mg/kg dry wt	-	119	-	92	134
Total Recoverable Mercury	mg/kg dry wt	-	0.23	-	0.16	0.15
Total Recoverable Nickel	mg/kg dry wt	-	10	-	8	10
Total Recoverable Zinc	mg/kg dry wt	-	600	-	310	590

Sample Type: Soil						
Sample Name:		BH49 ES236 0.00 01-Feb-2019	BH50 ES239 0.00 01-Feb-2019	BH51 ES241 0.00 01-Feb-2019	BH52 ES244 0.00 01-Feb-2019	BH53 ES246 0.00 01-Feb-2019
Lab Number:		2120271.133	2120271.136	2120271.138	2120271.141	2120271.143
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	25	29	36	26	27
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	11	13	14	13	15
Total Recoverable Copper	mg/kg dry wt	480	370	2,000	450	320
Total Recoverable Lead	mg/kg dry wt	91	90	140	69	66
Total Recoverable Mercury	mg/kg dry wt	0.15	0.20	0.13	0.25	0.19
Total Recoverable Nickel	mg/kg dry wt	9	9	11	9	9
Total Recoverable Zinc	mg/kg dry wt	320	300	770	290	290

Sample Name:		BH54 ES248 0.00 01-Feb-2019	BH55 ES251 0.00 01-Feb-2019	BH3 ES107b 0.00 [Duplicate]	BH13 ES135b 0.00 [Duplicate]	BH16 ES143b 0.00 [Duplicate]
Lab Number:		2120271.145	2120271.148	2120271.150	2120271.151	2120271.152
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	26	24	14	12	12
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	0.15	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	14	13	10	9	13
Total Recoverable Copper	mg/kg dry wt	530	184	136	149	230
Total Recoverable Lead	mg/kg dry wt	84	40	54	77	76
Total Recoverable Mercury	mg/kg dry wt	0.17	0.16	0.36	0.15	0.36
Total Recoverable Nickel	mg/kg dry wt	10	9	5	8	5
Total Recoverable Zinc	mg/kg dry wt	420	210	195	145	128

Sample Name:		BH32 ES189b 0.00 [Duplicate]	BH43 ES222b 0.00 [Duplicate]	BH54 ES248b 0.00 [Duplicate]		
Lab Number:		2120271.153	2120271.154	2120271.155		
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	30	10	28	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.73	0.14	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	71	8	14	-	-
Total Recoverable Copper	mg/kg dry wt	4,500	660	580	-	-
Total Recoverable Lead	mg/kg dry wt	620	101	72	-	-
Total Recoverable Mercury	mg/kg dry wt	1.82	0.33	0.15	-	-
Total Recoverable Nickel	mg/kg dry wt	69	10	10	-	-
Total Recoverable Zinc	mg/kg dry wt	2,900	390	370	-	-

Sample Type: Aqueous						
Sample Name:		BH26 ES171 0.00 [TCLP Extract]	BH29 ES180 0.00 [TCLP Extract]	BH33 ES192 0.00 [SPLP Extract]	BH36 ES202 0.00 [SPLP Extract]	BH52 GW1 01-Feb-2019
Lab Number:		2120271.156	2120271.157	2120271.158	2120271.159	2120271.160
Individual Tests						
Total Copper	g/m³	460	440	0.68	0.68	-
Total Lead	g/m³	36	39	0.035	0.025	-
Total Mercury	g/m³	-	-	-	-	0.0035
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	-	-	-	-	< 0.11
Total Cadmium	g/m³	-	-	-	-	< 0.0053
Total Chromium	g/m³	-	-	-	-	< 0.053
Total Copper	g/m³	-	-	-	-	3.1
Total Lead	g/m³	-	-	-	-	0.29
Total Nickel	g/m³	-	-	-	-	< 0.053
Total Zinc	g/m³	-	-	-	-	0.93

Sample Name:		BH54 GW3 01-Feb-2019	BH53 GW4 01-Feb-2019			
Lab Number:		2120271.161	2120271.162			
Individual Tests						
Total Mercury	g/m³	0.0049	< 0.00008	-	-	-

Sample Type: Aqueous						
Sample Name:		BH54 GW3 01-Feb-2019	BH53 GW4 01-Feb-2019			
Lab Number:		2120271.161	2120271.162			
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m^3	< 0.11	< 0.11	-	-	-
Total Cadmium	g/m^3	< 0.0053	< 0.0053	-	-	-
Total Chromium	g/m^3	< 0.053	< 0.053	-	-	-
Total Copper	g/m^3	1.29	< 0.053	-	-	-
Total Lead	g/m^3	0.25	< 0.011	-	-	-
Total Nickel	g/m^3	< 0.053	< 0.053	-	-	-
Total Zinc	g/m^3	0.45	< 0.11	-	-	-

Analyst's Comments

#1 It should be noted that the replicate analyses performed on this sample as part of our in-house Quality Assurance procedures showed greater variation than would normally be expected. This may reflect the heterogeneity of the sample. The average of the results of the replicate analyses has been reported.

Amended Report: This certificate of analysis replaces an earlier certificate issued on 10 Apr 2019 at 2:14 pm
Reason for amendment: The sample names have been amended as requested.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1, 4, 7, 10, 13, 16, 19, 21, 23-24, 26, 29, 32, 35-36, 38-40, 43, 46-47, 49-50, 52-54, 57-58, 60-61, 63-64, 66-75, 77-78, 80-81, 83-84, 86-87, 89-90, 92-93, 95-96, 99-100, 102-103, 105-106, 108-109, 111-112, 114-115, 117-124, 126-128, 130, 133, 136, 138, 141, 143, 145, 148, 150-155

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	72
Total Recoverable Copper	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	24, 36, 39, 47, 50, 53, 58, 61, 64, 67-68, 70, 72-73, 75, 78, 81, 84, 87, 90, 93, 96, 100, 103, 106, 109, 112, 115, 118, 120, 122, 124, 127

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy Metals with Mercury, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1, 4, 7, 10, 13, 16, 19, 21, 23, 26, 29, 32, 35, 38, 40, 43, 46, 49, 52, 54, 57, 60, 63, 66, 69, 71, 74, 77, 80, 83, 86, 89, 92, 95, 99, 102, 105, 108, 111, 114, 117, 119, 121, 123, 126, 128, 130, 133, 136, 138, 141, 143, 145, 148, 150-155
SPLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1312	-	92, 102
TCLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311	-	71, 80
SPLP Profile			
SPLP Sample Weight	Gravimetric. US EPA 1312.	0.1 g	92, 102
SPLP Extractant Type*	US EPA 1312 (Modified for New Zealand conditions to use De-ionised Water unless otherwise specified).	-	92, 102
SPLP Final pH	pH meter. US EPA 1312.	0.1 pH Units	92, 102
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	71, 80
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Extractant Type*	US EPA 1311.	-	71, 80
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	71, 80

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	160-162
Total Digestion of Extracted Samples*	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	156-159
Total Copper	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.011 g/m^3	156-157
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017 / US EPA 200.8.	0.00053 g/m^3	158-159
Total Lead	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 23rd ed. 2017.	0.0021 g/m^3	156-157
Total Lead	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017 / US EPA 200.8.	0.00011 g/m^3	158-159
Total Mercury	Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	160-162
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8	0.000053 - 0.0011 g/m^3	160-162

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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ANALYSIS REPORT

Client:	Haigh Workman Limited	**Lab No:**	1774093	SPv1
Contact:	Edward Collings	**Date Received:**	12-May-2017	
	C/- Haigh Workman Limited	**Date Reported:**	23-May-2017	
	PO Box 89	**Quote No:**		
	Kerikeri 0245	**Order No:**		
		Client Reference:	17 115	
		Submitted By:	Edward Collings	

Sample Type: Soil

Sample Name:		17 115-ES1 09-May-2017 9:40 am	17 115-ES2 09-May-2017 9:50 am	17 115-ES3 09-May-2017 9:55 am	17 115-ES4 09-May-2017 10:00 am	17 115-ES5 09-May-2017 10:10 am
Lab Number:		1774093.1	1774093.2	1774093.3	1774093.4	1774093.5
Individual Tests						
Dry Matter	g/100g as rcvd	76	83	76	84	76
National Environmental Standards Metals						
Total Recoverable Arsenic	mg/kg dry wt	11	14	11	< 40	12
Total Recoverable Boron	mg/kg dry wt	< 20	< 20	< 20	< 400	< 20
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.40	0.41	< 1.9	0.16
Trivalent Chromium*	mg/kg dry wt	12	27	81	38	10
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Chromium	mg/kg dry wt	12	27	82	38	10
Total Recoverable Copper	mg/kg dry wt	1,090	8,800	10,300	23,000	1,050
Total Recoverable Lead	mg/kg dry wt	410	720	540	4,700	153
Total Recoverable Mercury	mg/kg dry wt	1.23	1.55	1.12	5.8	< 0.10

Sample Name:		17 115-ES6 09-May-2017 10:15 am	17 115-ES7 09-May-2017 10:20 am	17 115-ES8 09-May-2017 10:30 am	17 115-ES9 09-May-2017 10:40 am	17 115-ES10 09-May-2017 10:45 am
Lab Number:		1774093.6	1774093.7	1774093.8	1774093.9	1774093.10
Individual Tests						
Dry Matter	g/100g as rcvd	88	91	95	81	88
National Environmental Standards Metals						
Total Recoverable Arsenic	mg/kg dry wt	< 40	< 40	12	45	< 40
Total Recoverable Boron	mg/kg dry wt	< 400	< 400	< 40	< 20	< 400
Total Recoverable Cadmium	mg/kg dry wt	4.5	3	0.3	4.5	2
Trivalent Chromium*	mg/kg dry wt	260	174	27	82	154
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Chromium	mg/kg dry wt	260	174	27	82	154
Total Recoverable Copper	mg/kg dry wt	107,000	88,000	6,800	25,000	104,000
Total Recoverable Lead	mg/kg dry wt	7,400	3,900	670	2,200	8,400
Total Recoverable Mercury	mg/kg dry wt	9.5	15	0.4	7.0	5
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	-	-	< 0.12	-	-
Acenaphthylene	mg/kg dry wt	-	-	< 0.12	-	-
Anthracene	mg/kg dry wt	-	-	< 0.12	-	-
Benzo[a]anthracene	mg/kg dry wt	-	-	0.51	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	0.48	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	1.55	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	0.65	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	0.65	-	-

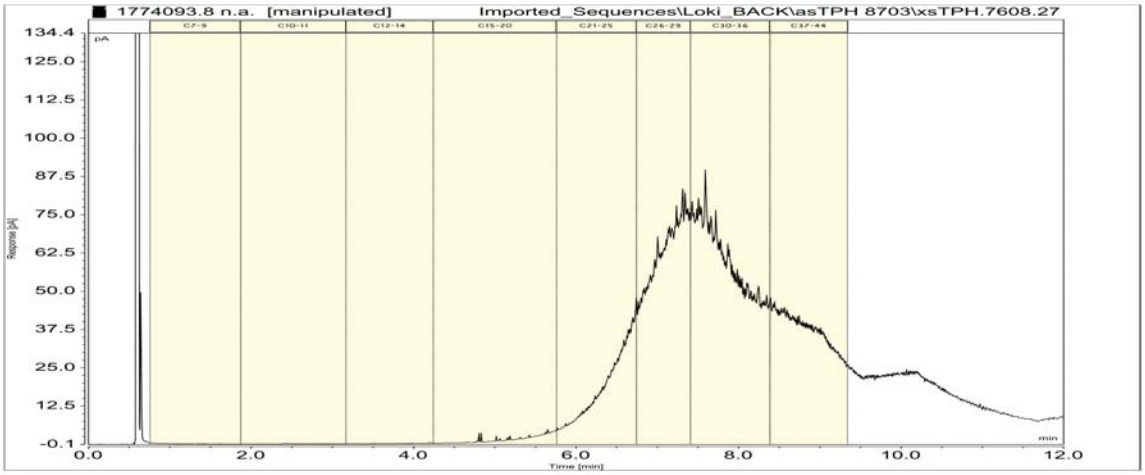
ilac-MRA IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Soil						
Sample Name:		17 115-ES6 09-May-2017 10:15 am	17 115-ES7 09-May-2017 10:20 am	17 115-ES8 09-May-2017 10:30 am	17 115-ES9 09-May-2017 10:40 am	17 115-ES10 09-May-2017 10:45 am
Lab Number:		1774093.6	1774093.7	1774093.8	1774093.9	1774093.10
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Chrysene	mg/kg dry wt	-	-	0.51	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	< 0.12	-	-
Fluoranthene	mg/kg dry wt	-	-	0.92	-	-
Fluorene	mg/kg dry wt	-	-	< 0.12	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	0.56	-	-
Naphthalene	mg/kg dry wt	-	-	< 0.6	-	-
Phenanthrene	mg/kg dry wt	-	-	0.28	-	-
Pyrene	mg/kg dry wt	-	-	0.72	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	-	-	< 8	-	-
C10 - C14	mg/kg dry wt	-	-	48	-	-
C15 - C36	mg/kg dry wt	-	-	17,300	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	-	-	17,400	-	-

Sample Name:		17 115-ES11 09-May-2017 10:50 am	17 115-ES12 09-May-2017 10:50 am	17 115-ES13 09-May-2017 10:55 am	17 115-ES14 09-May-2017 11:45 am	17 115-ES15 09-May-2017 11:50 am
Lab Number:		1774093.11	1774093.12	1774093.13	1774093.14	1774093.15
Individual Tests						
Dry Matter	g/100g as rcvd	76	81	81	90	92
National Environmental Standards Metals						
Total Recoverable Arsenic	mg/kg dry wt	11	29	32	< 40	24
Total Recoverable Boron	mg/kg dry wt	< 20	< 20	< 20	< 400	< 20
Total Recoverable Cadmium	mg/kg dry wt	0.51	0.15	0.90	3	0.81
Trivalent Chromium*	mg/kg dry wt	14	40	166	158	57
Chromium (hexavalent)*	mg/kg dry wt	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Recoverable Chromium	mg/kg dry wt	14	40	166	158	57
Total Recoverable Copper	mg/kg dry wt	790	1,230	14,400	128,000	29,000
Total Recoverable Lead	mg/kg dry wt	108	970	1,130	30,000	2,800
Total Recoverable Mercury	mg/kg dry wt	0.22	4.8	2.0	14	2.8
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	0.22
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	0.04
Anthracene	mg/kg dry wt	< 0.03	-	-	-	0.09
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	2.8
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	1.67
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.04	-	-	-	4.3
Benzo[g,h,i]perylene	mg/kg dry wt	0.04	-	-	-	1.50
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	1.79
Chrysene	mg/kg dry wt	< 0.03	-	-	-	2.7
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	0.38
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	3.6
Fluorene	mg/kg dry wt	0.04	-	-	-	0.06
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.04	-	-	-	1.94
Naphthalene	mg/kg dry wt	< 0.14	-	-	-	< 0.12
Phenanthrene	mg/kg dry wt	0.06	-	-	-	1.37
Pyrene	mg/kg dry wt	0.16	-	-	-	2.8
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 9	-	-	-	< 8
C10 - C14	mg/kg dry wt	109	-	-	-	< 20
C15 - C36	mg/kg dry wt	1,380	-	-	-	410
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,490	-	-	-	410

1774093.8
17 115-ES8 09-May-2017 10:30 am
Client Chromatogram for TPH by FID



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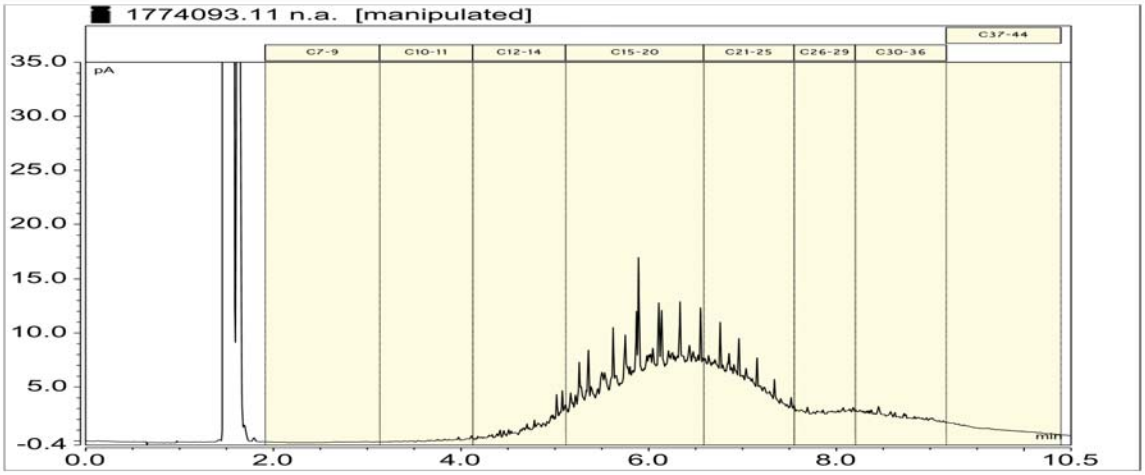
Client Chromatogram for TPH by FID



1774093.15
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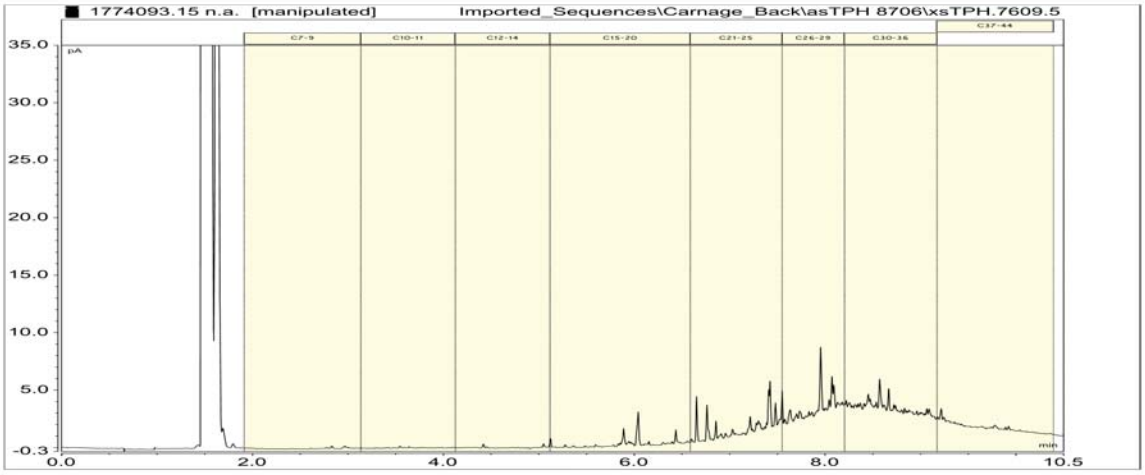
Client Chromatogram for TPH by FID



Analyst's Comments

Samples 1-15 Comment:
It should be noted that the results reported for lead and mercury are total recoverable, not inorganic as specified by the NES standards. This should be kept in mind when interpreting these results.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Client Chromatogram for TPH by FID*	.	-	8, 11, 15
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-15
TPH Oil Industry Profile + PAHscreen	Sonication in DCM extraction, SPE cleanup, GC-FID & GC-MS analysis. Tested on as received sample. US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:5786,2805,10734;2695]	0.010 - 60 mg/kg dry wt	8, 11, 15
National Environmental Standards Metals*		0 - 20 mg/kg dry wt	1-15
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-15
Extraction of Hexavalent Chromium in Environmental Solids*	0.01M KH_2PO_4 Extraction.	-	1-15
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-15
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-15
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1-15
Total Recoverable Cadmium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	1-15
Trivalent Chromium*	Calculation Total Chromium - Hexavalent Chromium.	0 mg/kg dry wt	1-15
Hexavalent Chromium in Environmental Solids*	Phosphate buffer extraction, colorimetry.	0.4 mg/kg dry wt	1-15
Total Recoverable Chromium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-15
Total Recoverable Copper	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-15
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-15
Total Recoverable Mercury	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	1-15
Total hydrocarbons (C7 - C36)	Sonication extraction, Silica cleanup, GC-FID analysis. US EPA 8015B/NZ OIEWG.	60 mg/kg dry wt	8, 11, 15

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

Appendix I – Soil Contaminant Standards

Haigh Workman Limited
Generic Assessment Criteria/Soil Contaminant Standards

Revision: 7 **Date:** 2 November 2018

Parameter	Rural Residential/ Lifestyle Block (mg/kg, unless otherwise stated)			Standard Residential (mg/kg, unless otherwise stated)			High Density Residential (mg/kg, unless otherwise stated)	Recreational (mg/kg, unless otherwise stated)	Commercial / Industrial (Outdoor) (mg/kg, unless otherwise stated)	Note
	No Produce	10% Produce	25% Produce	No Produce	10% Produce	25% Produce				
Metals/Metalloids										
Arsenic	21	17	17	24	20	17	45	80	70	[1],[2]
Boron	NL	NL	NL	NL	NL	NL	NL	NL	NL	[3]
Cadmium	110	3	0.82	110	3	0.82	230	400	1300	
Chromium (III)	NL	NL	NL	NL	NL	NL	NL	NL	NL	[3],[4]
Chromium (VI)	770	460	290	770	460	290	1500	2700	6300	
Copper	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Lead (Inorganic)	250	210	160	250	210	160	500	880	3300	
Mercury (Inorganic)	510	310	200	510	310	200	1000	1800	4200	
Other Inorganics										
pH	<5 or >9			<5 or >9			<5 or >9			
Total Sulphate	2400			2400			2400			[5]
Water-Soluble Sulphate	0.5g/l			0.5g/l			0.5g/l			[5]
Organics										
PAHs	Potency equivalency factor only - see separate sheet for selected individual PAH GACs									
Acenaphthene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Acenaphthylene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Anthracene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Benzo(a)anthracene	0.1									[6]
Benzo(a)pyrene	11	8	6	12	10	7	24	40	35	[7]
Benzo(b)fluoranthene	0.1									[6]
Benzo(k)fluoranthene	0.1									[6]
Benzo(g,h,i)perylene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Chrysene	0.01									[6]
Dibenzo(a,h)anthracene	1	1	1	1	1	1	1	1	1	[6]
Fluoranthene	0.01									[6]
Fluorene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Indeno(1,2,3-c,d)pyrene	0.1									[6]
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Phenanthrene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Pyrene	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Other Organics										
Σ DDT	120	70	45	120	70	45	240	400	1000	
Dieldrin	22	2.6	1.1	22	2.6	1.1	45	70	160	[9]
PCP	55	55	55	55	55	55	110	150	360	
Dioxin (TCDD)	0.18ug/kg	0.15ug/kg	0.12ug/kg	0.18ug/kg	0.15ug/kg	0.12ug/kg	0.35ug/kg	0.60ug/kg	1.4ug/kg	[10]
Dioxin (Dioxin like PCBs)	0.16ug/kg	0.12ug/kg	0.09ug/kg	0.16ug/kg	0.12ug/kg	0.09ug/kg	0.33ug/kg	0.52ug/kg	1.2ug/kg	[10]
Organic Matter	35%									[16]
Total Nitrogen	1%									
Ammonium-Nitrate	LOD									
Sulphate	50									
Total Organic Carbon	3% w/w									
Carbon: Nitrogen Ratio	25%									
Others										
TOC	3%w/w			3%w/w			3%w/w			[11]
Calorific Value	2MJ/kg			2MJ/kg			2MJ/kg			[12]
Asbestos (ACMs)	0.01 % w/w						0.04 % w/w	0.02 % w/w	0.05 % w/w	[15]
Asbestos (Loose/Free Fibres)	0.001 % w/w									[15]

Parameter	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Carcinogen	Note
Organochlorine Pesticides				
Aldrin	390	18	**Yes**	[14]
Alpha-Hexachlorocyclohexane (BHC)	800	36	**Yes**	[14]
Beta-Hexachlorocyclohexane (BHC)	30	1.3	**Yes**	[14]
Gamma-Hexachlorocyclohexane (BHC) - Lindane	57	2.5	**Yes**	[14]
Chlordane (cis and trans)	1.7	7.5	**Yes**	[14]
Endosulfan	4	7000	No	[13],[14]
Endrin	19	250	No	[14]
Heptachlor	13	63	**Yes**	[14]

Heptachlor Epoxide	70	33	**Yes**	[14]
Hexachlorobenzene	21	96	**Yes**	[14]
Methoxyclor	320	4100	No	[14]
Organonitro and Phosphorus Pesticides				
Acetochlor	1300	16000	No	[14]
Alachlor	9.7	41	**Yes**	[14]
Atrazine	2.4	10	**Yes**	[14]
Azinphos-methyl	190	2500	No	[14]
Captan	240	1000	**Yes**	[14]
Carbaryl	6300	82000	No	[14]
Carbofuran	320	4100	No	[14]
Chlorothalonil	180	740	**Yes**	[14]
Chlorpyrifos	63	820	No	[14]
Chlorpyrifos-methyl	630	8200	No	[14]
Cyanazine	65	2.7	**Yes**	[14]
Cyfluthrin	1600	21000	No	[14]
Cyhalothrin	320	4100	No	[14]
Cypermethrin	630	8200	No	[14]
Deltamethrin (including Tralomethrin)	470	6200	No	[14]
Diazinon	44	570	No	[14]
Dichlorvos	1.9	7.9	**Yes**	[14]
Dimethoate	13	160	No	[14]
Diphenylamine	1600	21000	No	[14]
Diuron	130	1600	No	[14]
Fluometuron	820	11000	No	[14]
Flusilazole	44	570	No	[14]
Fluvalinate	630	8200	No	[14]
Haloxyfop-methyl	3.2	41	No	[14]
Hexazinone	2100	27000	No	[14]
Linuron	130	1600	No	[14]
Metalaxyl (Mefonoxam)	3800	49000	No	[14]
Methamidophos	3.2	41	No	[14]
Metolachlor	9500	120000	No	[14]
Metribuzin	1600	21000	No	[14]
Molinate	130	1600	No	[14]
Myclobutanil	1600	21000	No	[14]
Naled	160	2300	No	[14]
Norflurazon	2500	33000	No	[14]
Oxadiazon	320	4100	No	[14]
Oxyflurorfen	190	2500	No	[14]
Paclobutrazol	820	11000	No	[14]
Parathion (ethyl and methyl)	380	4900	No	[14]
Pendimethalin	2500	33000	No	[14]
Permethrin	3200	41000	No	[14]
Prochloraz	3.6	15	**Yes**	[14]
Prometryn	250	3300	No	[14]
Propachlor	820	11000	No	[14]
Propanil	320	4100	No	[14]
Propazine	1300	16000	No	[14]
Propiconazole	820	11000	No	[14]
Quizalofop-ethyl	570	7400	No	[14]
Simazine	4.5	19	**Yes**	[14]
TCMTB	1900	25000	No	[14]
Terbacil	820	11000	No	[14]
Terbufos	2	29	No	[14]
Terbutryn	63	820	No	[14]
Thiobencarb	63	820	No	[14]
Trifluralin	91	420	**Yes**	[14]
Vinclozolin	1600	21000	No	[14]

NL - No limit; LOD - Limit of Detection

Footnotes

[1] Different rural residential and residential exposure durations result in different SCSs because non-threshold substance SCS derivation uses age-adjusted exposure rates.

[2] Derived values are less than 99th percentile of national dataset of background concentrations and therefore take the 99th percentile value.

[3] No limit - the derived value exceeds 10,000mg/kg, a concentration that is unlikely to be exceeded in practice. SGV of 16,112mg/kg for rural residential with 25% produce.

[4] Chromium III is not considered to pose a significant risk to human health.

[5] Sulphate is not considered to pose a potential risk to human health under normal circumstances - this GAC applies to construction cases only and is set at the upper limit for DS-1 Design Sulphate Class concrete.

[6] Figure represents Potency Equivalency Factor for each analyte. Calculations of site specific GAC should be calculated based upon the results of laboratory analysis and guidance presented within MFE Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health 2011 Section 6.8.2.

[7] Benzo(a)pyrene GAC values to be used for surrogate marker approach to other PAH analytes; SCS for other PAHs to be compared with the equivalent BaP concentration calculated as the sum of each of the detected concentrations of the nine PAHs identified in the GAC table. Different rural residential and residential exposure durations result in different SCSs because non-threshold substance SSV derivation uses age-adjusted exposure rates.

[8] See separate GAC pages for TPH values

[9] SCS for dieldrin also applies to aldrin separately, or to the sum of aldrin and dieldrin where both are present.
[10] Consideration should be given to investigating dioxins for PCP concentrations in excess of 0.3mg/kg.
[11] TOC content itself does not represent a potential risk to human health. This GAC is provided for indicative assessment of disposal options, in the case that off-site landfill of soil is required. This GAC is specified at the 'Inert' waste threshold and should be considered as for information purposes only.
[12] Calorific value is not an indication of direct human health risk but may be useful in assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.
[13] No GAC is currently in use by New Zealand for Endosulfan. GAC is derived from Soil Remediation Circular:2009 released by Dutch Ministry of Housing. Under MfE Contaminated Land Management Guidelines No. 2: Hierarchy and Application in New Zealand of Environmental Guideline Values the Dutch guidelines are considered as international risk-based guidelines, protective of both human and ecological receptors.
[14] No GAC is currently in use by New Zealand for individual pesticides/herbicides. GAC is derived from Regional Screening Level Summary Table: November 2015 released by US EPA. Under MfE Contaminated Land Management Guidelines No. 2: Hierarchy and Application in New Zealand of Environmental Guideline Values the US EPA guidelines are considered as international risk-based guidelines, protective of human receptors only.
[15] GAC for asbestos is based upon guidance presented within BRANZ 2017 New Zealand Guidelines for Assessing and Managing Asbestos in Soil. Table 5 - Soil guideline values for asbestos in New Zealand.
[16] In light of no standards in New Zealand for listed organics outside of drinking water the GAC for selected organics in soil have been derived from research conducted by Haigh Workman Ltd. In particular standards have been derived from the following documents. Hills Laboratories Publication Technical Notes: Laboratory Tests for Soil Sulphur in Pastoral Soils; Rajendram et al. Total Sulphur: A Better Predictor of Sulphur Deficiency in Pastoral Soils (2008); Hills Laboratories Publication Technical Paper 3: Soil Tests and Interpreatation.

Haigh Workman Polycyclic Aromatic Hydrocarbon Generic Assessment Criteria

	Residential			Commercial/Industrial			Agricultural		
Soil Type/ Contaminant	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**
SAND									
MAHs									
Benzene	1.1	1.9	2.4	3.0	3.0	9.3	1.1	1.9	2.4
Toluene	(68)	(94)	(230)	(94)	(94)	(770)	(68)	(94)	(230)
Ethylbenzene	(53)	(92)	(120)	(180)	(300)	(390)	(53)	(92)	(120)
Xylenes	(48)	(130)	(180)	(150)	(150)	(580)	(48)	(130)	(180)
PAHs									
Naphthalene	58	70	80	(190)	(230)	(260)	7.2	70	80
Non-carc (Pyrene)	(1,600)	NA	NA	NA	NA	NA	(160)	NA	NA
Benzo(a)pyrene eq.	0.27	(25)	NA	(11)	(25)	NA	0.027	(25)	NA
SANDY SILT									
MAHs									
Benzene	1.1	1.9	2.4	3.6	7.2	9.3	1.1	1.9	2.4
Toluene	(82)	(170)	(240)	(270)	(480)	(790)	(82)	(170)	(240)
Ethylbenzene	(59)	(92)	(140)	(200)	(300)	(450)	(59)	(92)	(140)
Xylenes	(59)	(130)	(180)	(200)	(420)	(590)	(59)	(130)	(180)
PAHs									
Naphthalene	63	83	(130)	(210)	(270)	(420)	7.2	83	(130)
Non-carc (Pyrene)	(1,600)	NA	NA	NA	NA	NA	(160)	NA	NA
Benzo(a)pyrene eq.	0.27	(25)	NA	(11)	(25)	NA	0.027	(25)	NA
SILTY CLAY									
MAHs									
Benzene	1.7	4.6	12	7.2	(20)	(54)	1.7	4.6	12
Toluene	(210)	(950)	(3,000)	(670)	(3,100)	(10,000)	(210)	(950)	(3,000)
Ethylbenzene	(110)	(800)	(2,800)	(350)	(2,600)	(9,100)	(110)	(800)	(2,800)
Xylenes	(160)	(710)	(2,200)	(510)	(2,300)	(7,300)	(160)	(710)	(2,200)
PAHs									
Naphthalene	69	(330)	(1,100)	(230)	(1,100)	(3,500)	7.2	(330)	(1,100)
Non-carc (Pyrene)	(1,600)	NA	NA	NA	NA	NA	(160)	NA	NA
Benzo(a)pyrene eq.	0.27	(25)	NA	(11)	(25)	NA	0.027	(25)	NA
CLAY									
MAHs									
Benzene	2.7	8.8	(26)	11	(41)	(120)	2.7	8.8	(26)
Toluene	(320)	(2,400)	(8,500)	(1,000)	(7,900)	NA	(320)	(2,400)	(8,500)
Ethylbenzene	(160)	NA	NA	(540)	NA	NA	(160)	NA	NA
Xylenes	(250)	(1,800)	(6,500)	(810)	(6,000)	NA	(250)	(1,800)	(6,500)
PAHs									
Naphthalene	71	(360)	(1,200)	(230)	(1,200)	(3,800)	7.2	(360)	(1,200)
Non-carc (Pyrene)	(1,600)	NA	NA	NA	NA	NA	(160)	NA	NA
Benzo(a)pyrene eq.	0.27	(25)	NA	(11)	(25)	NA	0.027	(25)	NA
PEATS AND HIGHLY ORGANIC SOILS									
MAHs									
Benzene	5.7	10	13	28	(44)	(55)	5.7	10	13
Toluene	(2,500)	(2,900)	(3,800)	(7,500)	(7,500)	NA	(2,500)	(2,900)	(3,800)
Ethylbenzene	(2,200)	(2,500)	(3,200)	(7,200)	(8,100)	(10,000)	(2,200)	(2,500)	(3,200)
Xylenes	(1,700)	(2,000)	(2,600)	(5,700)	(6,600)	(8,500)	(1,700)	(2,000)	(2,600)
PAHs									
Naphthalene	72	(2,700)	(3,500)	(8,000)	(9,000)	NA	7.2	(2,700)	(3,500)
Non-carc (Pyrene)	(1,600)	NA	NA	NA	NA	NA	(160)	NA	NA
Benzo(a)pyrene eq.	0.27	(25)	NA	(11)	(25)	NA	0.027	(25)	NA

HAIGH WORKMAN LTD
Civil & Structural Engineers

Revision: 1
Date: February 2017

Notes:

- Table based on protection of human health;
- Table adopted from Ministry for Environment *'Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand'* Module 4 Tables 4.10, 4.11 and 4.12.
- Surface soil acceptance criteria are based on the lower value of volatilisation criteria, other pathway criteria and criteria for the protection of maintenance workers. Criteria for soils at 1 m are based on the lower value of those arising from volatilisation and maintenance criteria. Criteria for 4 m are based on volatilisation only.

NA – indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.

() – denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.

Haigh Workman Total Petroleum Hydrocarbon Generic Assessment Criteria

	Residential			Commercial/Industrial			Agricultural		
Soil Type/ Contaminant	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**	**Surface (< 1 m)**	**1 – 4 m**	**> 4 m**
SOILS									
SAND									
$C_7 – C_9$	120	120	(3,800)	120	120	(12,000)	120	120	(3,800)
$C_{10} – C_{14}$	(470)	(560)	(650)	(1,500)	(1,900)	(2,100)	58	(560)	(650)
$C_{14} – C_{36}$	NA	NA	NA	NA	NA	NA	(4,000)	NA	NA
SANDY SILT									
$C_7 – C_9$	(500)	(500)	(3,800)	(500)	(500)	(3,800)	(500)	(500)	(3,800)
$C_{10} – C_{14}$	(510)	(670)	(1,000)	(1,700)	(2,200)	(3,400)	58	(670)	(4,900)
$C_{14} – C_{36}$	NA	NA	NA	NA	NA	NA	(4,000)	NA	NA
SILTY CLAY									
$C_7 – C_9$	(2,700)	(7,300)	(19,000)	(8,800)	(20,000)	NA	(2,700)	(7,300)	(19,000)
$C_{10} – C_{14}$	(560)	(2,700)	(8,900)	(1,900)	(8,900)	NA	58	(2,700)	(8,900)
$C_{14} – C_{36}$	NA	NA	NA	NA	NA	NA	(4,000)	NA	NA
CLAY									
$C_7 – C_9$	(15,000)	NA	NA	NA	NA	NA	(15,000)	NA	NA
$C_{10} – C_{14}$	(570)	(2,900)	(9,700)	(1,900)	(9,700)	NA	58	(2,900)	(9,700)
$C_{14} – C_{36}$	NA	NA	NA	NA	NAN	NA	(4,000)	NA	NA
PEATS AND HIGHLY ORGANIC SOILS									
$C_7 – C_9$	(6,700)	(6,700)	NA	(6,700)	(6,700)	NA	(6,700)	(6,700)	NA
$C_{10} – C_{14}$	(580)	NA	NA	NA	NA	NA	58	NA	NA
$C_{14} – C_{36}$	NA	NA	NA	NA	NA	NA	(4,000)	NA	NA
PAH GAC (FOR A DIESEL RELEASE USING TPH AS A SURROGATE MARKER) – ALL SOIL TYPES ALL DEPTHS									
Naphthalene (3.1 %w/w)	58			190			7.2		
Pyrene (0.4 %w/w)	1,600			NA			160		

HAIGH WORKMAN Civil & Structural Engineers

Revision: 1
Date: February 2017

Notes:

- Table based on protection of human health; site specific consideration of aesthetic and ecological impact is required.
- Table adopted from Ministry for Environment *'Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand'* Module 4 Tables 4.13, 4.14 and 4.15.

NA – indicates estimated criterion exceeds 20,000 mg/kg. At 20,000 mg/kg residual separate phase is expected to have formed in soil matrix. Some aesthetic impact may be noted.

() – denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons.

$C_7 – C_9$ – based on health effects associated with aliphatic component only. Separate consideration of the health effects associated with the aromatic component (i.e. BTEX) is required.

Appendix J – Certificate of Title Documents

CERTIFICATE OF TITLE No. 21C/265.

JH 4242.

B.362837.1 Variation of the terms of mortgage B.225997.1 - 17.12.1984 at 11.56 o'c

A.L.R.

B.457892.4 Mortgage to Barry William Stichling Wilson and to Jean Wilson as shares 12.9.1985 at 1.45 o'c

C.014268.1.

A.L.R.

B.725997.1 Variation of the terms of Mortgage B.457892.4 - 7.9.1987 at 9.01 o'c

A.L.R.

C.086796.3 Mortgage to ASB Bank Limited - 3.1.1990 at 1.34 o'c

A.L.R.

C.339510.1 Transfer to Peter Rex Fraser of Waiuku manager - 16.1.1992 at 2.53 o'c

~~A.L.R~~

C.339511.1 Mortgage to Lawrence George Mair - 16.1.1992 at 2.53 o'c

C550275.1

A.L.R

C.339511.2 Memorandum of Priority making Mortgage C.339511.1 a first mortgage and Mortgage C.086796.3 a second mortgage - 16.1.1992 at 2.53 o'c

A.L.R.

C.602695.2 Transfer to Douglas C Schmuck of Paihia boatbuilder and Carl E Schmuck and Irene C Schmuck both of United States of America retired - 20.5.1994 at 10.08 oc

A.L.R.

12 SEP 2007 12:13

View Instrument

Instrument Type	Change/Correction of Name
Instrument Number	8041543.2
Status	Registered
Completion Date	20/08/2009
Date & Time Lodged	20/08/2009 09:47:52
Lodged By	Davis, Gregory Leslie
Lodged For	Tumanako Law
Approved By	gdavis002

Affected Computer Registers	Land District
NA21C/265	North Auckland

***** End of Report *****

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References
Prior C/T 87/160, 493/154, 210/264

Transfer No.
N/C. Order No. A.595312

Land and Deeds 69

REGISTER

No. 21/265

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 29th day of October one thousand nine hundred and Seventy-one under the seal of the District Land Registrar of the Land Registration District of NORTH AUCKLAND

WITNESSETH that EDWARD THURLOW LEEDS of Opua boatbuilder

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 1 rood 3 perches more or less being ~~Lots~~ part of Lot 1 and Lot 2 and Section 3 Block XXXII Town of Opua.

1084 - Corrected wb and wb 1.2.1979

METRIC AREA IS 1087 m²
Conversion Factors:
1 Acre = 4046m²
1 Perch = 25.3m²
1 Link = .2012 metres

V Russell S.D.

DISTRICT LAND REGISTRAR NORTH AUCKLAND, N.Z.

Assistant Land Registrar

Subject as to Section 3 to the reservations and conditions imposed by Section 59 of the Land Act 1948.

A.L.R.
20203

321328.1 Transfer to Edward Thurlow Leeds abovenamed and Mary Constance Leeds his wife - 29.4.1975 at 10.14 o'c.

for A.L.R.

659982.1 CAVEAT BY BRENT FRANCIS McCARTY - 9.3.1978 at 9.01 a'c

for A.L.R.

800908.2 Lease to David Bruce Jaffary for a term commencing on the 5th day of August 1978 produced 3.4.1979 at 10.38 o'c and entered 24.4.1979 at 9.00 o'c

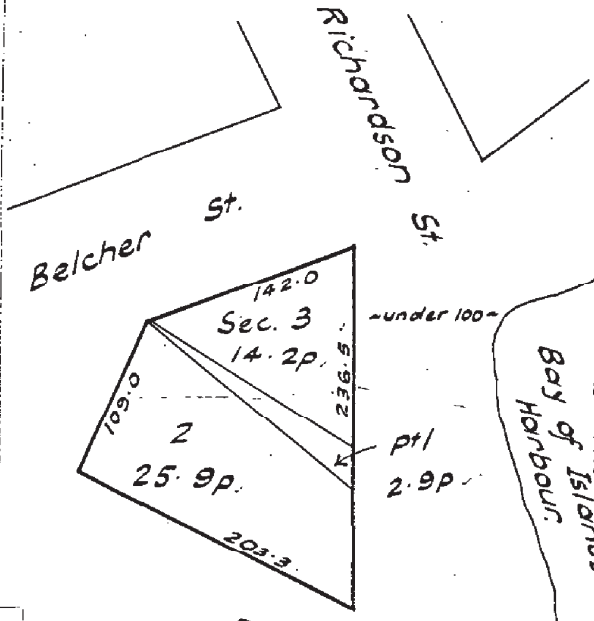
A.L.R.

B.120544.1 Transfer to Brian Dickson Elliott of Kerikeri, Yachtmaster and Carol Althea Elliott his wife - 22.10.1982 at 11.37 o'c.

A.L.R.

B.120544.2 Mortgage to Edward Thurlow Leeds and Mary Constance Leeds - 22.10.1982 at 11.37 o'c.

A.L.R.



Scale: 1 inch = 1 chain.
Total Area = 0-1-03.0 hms
S.O. 24139, 46155

No. 21/265

Register copy for L. & D. 69, 71, 72 OVER.....

21C/265

B.225997.1 Mortgage to Alan Stanley Grant dd 10.1983 at 9.08 oc.

A.L.R.

B.362837.1 Variation of the terms of mortgage B.225997.1 - 17.12.1984 at 11.56 o'c

A.L.R.

B.457892.4 Mortgage to Barry William Stirling Wilson and Jean Wilson as shares 11.9.1985 at 1.49 o'c

A.L.R.

B.725997.1 Variation of the terms of Mortgage B.457892.4 - 7.9.1987 at 9.01 o'c

A.L.R.

C.086796.3 Mortgage to ASB Bank Limited - 8.1.1990 at 1.34 o'c

A.L.R.

C.339510.1 Transfer to Peter Rex Fraser of Waiuku manager - 16.1.1992 at 2.53 o'c

~~A.L.R~~

C.339511.1 Mortgage to Lawrence George Mair - 16.1.1992 at 2.53 o'c

A.L.R

C.339511.2 Memorandum of Priority making Mortgage C.339511.1 a first mortgage and Mortgage C.086796.3 a second mortgage - 16.1.1992 at 2.53 o'c

A.L.R.

C.442342.1 Transfer of Mortgage C.339511.1 to Dorchester Pacific Limited - 21.12.1992 at 2.46 o'c

A.L.R.

C.602695.2 Transfer to Douglas C Schmuck of Paihia boatbuilder and Carl E Schmuck and Irene C Schmuck both of United States of America retired - 20.5.1994 at 10.08 oc

A.L.R.

D316259.1 Notice of New Appellation whereby parts of the adjoining stopped road marked A-D SO Plan 68634 are now known as Sections 1-4 SO Plan 68634.
1.10.1998 at 12.04

for DLR

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Historical Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/265**
Land Registration District	**North Auckland**
Date Issued	29 October 1971

Prior References
NA21C/264 NA493/154 NA87/160

Estate	Fee Simple
Area	1088 square metres more or less
Legal Description	Part Lot 1 and Lot 2 Block XXXII Town of Opua and Section 3 Block XXXII Town of Opua

Original Proprietors
Douglas C Schmuck, Carl E Schmuck and Irene C Schmuck

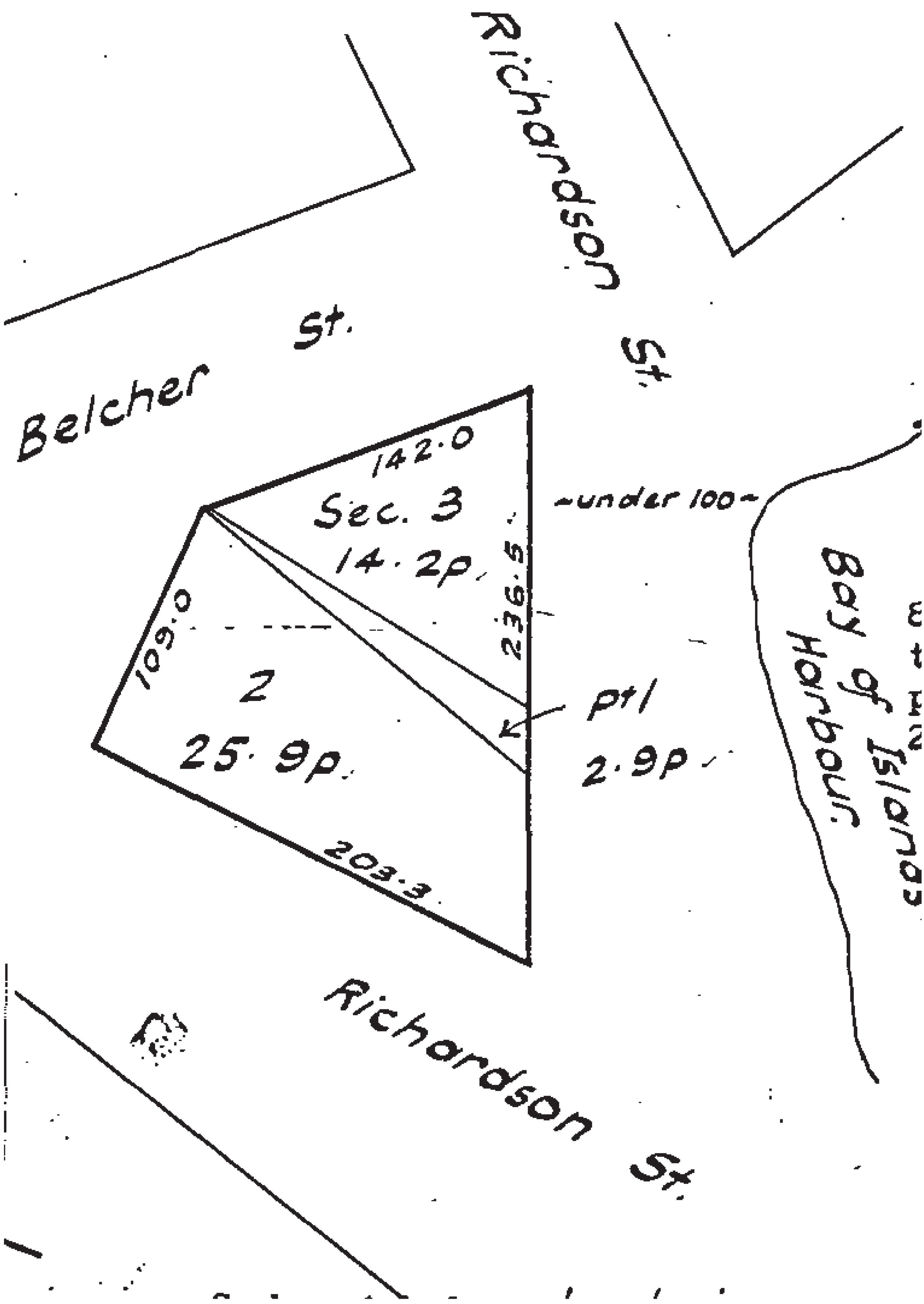
Interests

Subject to Section 59 Land Act 1948 (affects Section 3 Block XXXII Town of Opua)

8041543.1 Transmission to Douglas C Schmuck and Carl E Schmuck as survivor(s) - 20.8.2009 at 9:47 am

8041543.2 Correction of Name of Douglas C Schmuck to Douglas Craig Schmuck and Carl E Schmuck to Carl Emanuel Schmuck - 20.8.2009 at 9:47 am

Appurtenant hereto is a right to access, construct, operate, and maintain a commercial marine slipway, turntable and associated facilities, right of access to and repair and maintenance of vessel on slipway and/or turntable, right of access to and reconstruction of a commercial marine slipway, right to maintain exisiting wooden and stone retaining walls, and right to discharge contaminants and to emit noise created by Easement Instrument 10100695.1 - 27.7.2015 at 3:00 pm


Richardson St.
Belcher St.
142.0
Sec. 3
14.2p.
236.5
~under 100~
109.0
2
25.9p.
pt1
2.9p.
203.3
Bay of Islands
Harbour.
Richardson St.

COMPUTER FREEHOLD REGISTER
UNDER LAND TRANSFER ACT 1952

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA21C/265**
Land Registration District	**North Auckland**
Date Issued	29 October 1971

Prior References
NA21C/264 NA493/154 NA87/160

Estate	Fee Simple
Area	1088 square metres more or less
Legal Description	Part Lot 1 and Lot 2 Block XXXII Town of Opua and Section 3 Block XXXII Town of Opua

Proprietors
Douglas Craig Schmuck and Carl Emanuel Schmuck

Interests

Subject to Section 59 Land Act 1948 (affects Section 3 Block XXXII Town of Opua)

Appurtenant hereto is a right to access, construct, operate, and maintain a commercial marine slipway, turntable and associated facilities, right of access to and repair and maintenance of vessel on slipway and/or turntable, right of access to and reconstruction of a commercial marine slipway, right to maintain exisiting wooden and stone retaining walls, and right to discharge contaminants and to emit noise created by Easement Instrument 10100695.1 - 27.7.2015 at 3:00 pm

View Instrument Details

Instrument Type	Transmission by Survivorship on death of registered proprietor
Instrument No	8041543.1
Status	Registered
Date & Time Lodged	20/08/2009 09:47:52
Lodged By	Gregory Leslie Davis

Affected Computer Registers	**Land District**
NA21C/265	North Auckland

Registered Proprietors/Interest Holders

Irene C Schmuck as to that party's interest

Applicants

Douglas C Schmuck and Carl E Schmuck

Date Acquired

17 April 2000

Applicant Certifications

I certify that I have the authority to act for the Applicant and that the party has the legal capacity to authorise me to lodge this instrument	☑
I certify that I have taken reasonable steps to confirm the identity of the person who gave me authority to lodge this instrument	☑
I certify that any statutory provisions specified by the Registrar for this class of instrument have been complied with or do not apply	☑
I certify that I hold evidence showing the truth of the certifications I have given and will retain that evidence for the prescribed period	☑
I certify that the applicant is entitled to be registered as proprietor by virtue of transmission	☑

Signature

Signed by Gregory Leslie Davis as Applicant Representative on 20/08/2009 09:44 AM

***** End of Report *****

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Reference:
Certificate No. A.595311
P.R. Vol. Folio
Transfer No.

Land and Deeds 72

No. 21C/264

REGISTER

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 29th day of October one thousand nine hundred and Seventy-one under the seal of the District Land Registrar of the Land Registration District of NORTH AUCKLAND being a Certificate in lieu of Grant, **WITNESSETH** that EDWARD THURLOW LEEDS of Opua boatbuilder

is seised of an estate in fee simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, which said land was originally acquired by the abovenamed

as from the 11th day of August one thousand nine hundred and Seventy-one under Section 54 of the Land Act 1948

that is to say: All that parcel of land containing 14.2. perches more or less being Section 3 Block XXXII Town of Opua.

METRIC AREA IS 359 m²
359 m²
Conversion Factors:
1 Acre = 404[illegible] m²
1 Perch = [illegible] m²
1 Link = .2012 metres

V RUSSELL S.D.

DISTRICT LAND REGISTRAR NORTH AUCKLAND N.Z.

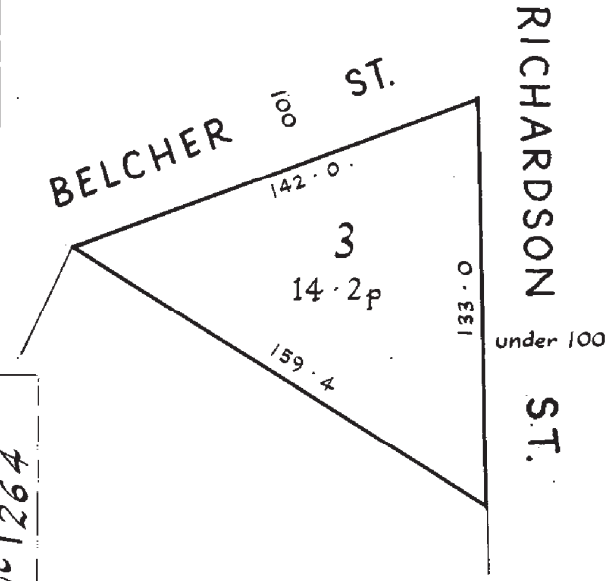
Assistant Land Registrar

Subject to the reservations and conditions imposed by Section 59 of the Land Act 1948.

A.L.R.

A.595312) Cancelled and new C.T.
29.10.71) 21C/265 issued

A.L.R.



Scale 1 inch = 50 links
S.O 46155

No. 21C/264

EDR

CERTIFICATE OF TITLE

21c 264

3,000/11/69—71276 W

Land and Deeds—3.

Schedule I.

NEW ZEALAND.

Reference: Warrant No. 2997
P.R. folio
Transfer No.
Proclamation No. 6791

Register-book. REGISTER
Vol. 493 folio 154

493/154

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT.

This Certificate, dated the twenty-eighth day of August, one thousand nine hundred and twenty-nine under the hand and seal of the District Land Registrar of the Land Registration District of AUCKLAND, being a Certificate in lieu of Grant, under Warrant of His Excellency the Governor-General, in exercise of the powers enabling him in that behalf, Witnesseth that WILLIAM STEWART of Kawakawa, storekeeper,

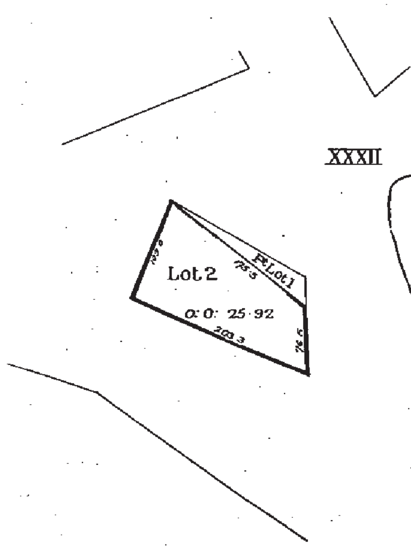
is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial under written or endorsed hereon; subject also to any existing right of the Crown to take and lay off roads under any Act of the General Assembly of New Zealand) in the land hereinafter described, as the same is delineated by the plan hereon, bordered green, be the several admeasurements a little more or less, which said land is in the said Warrant expressed to have been originally acquired by the abovenamed

as from the sixth day of October, one thousand nine hundred and twenty-seven under Section 12 of the Land Act 1924, that is to say: All that parcel of land containing twenty-five perches and ninety-two one hundredths of a perch more or less being Lot two (2) of Block XXXII of the Town of Opua.

William Johnston
District Land Registrar.

METRIC AREA IS 656 m²
656 m²

Town of Opua.



Transfer No 253752 William Stewart to Blanche Wall of Kawakawa Married Woman produced 30/7/30 at 10.19 a.m. ...
A.L.R.

Transfer 682049 to Anthony Bernard Tubini of Opua, salesman and Denise Aileen Tubini his wife as tenants in common in equal shares Produced 27-6-1962 at 9.12 o'c
A.L.R.

Mortgage 523896 to ... Produced 27-6-1962 at 9...
DISCHARGE Produced
A.L.R.

A186825 Transfer to Edward Thurlow Leeds of Opua, boat builder, Produced on 17-11-1966 at 10.56 a.m.
Humphries A.L.R.

THIS REPRODUCTION (ON A REDUCED SCALE) CERTIFIED TO BE A TRUE COPY OF THE ORIGINAL REGISTER FOR THE PURPOSES OF SECTION 215A LAND TRANSFER ACT 1952.
L. G. Stoneman D.L.R.

A65- 20203

Scale: 1 Chains to an inch
O N Campbell
Hunt & Alcock
N. Earle

over

493/154

A595312 ONCT } Cancelled and New CT issued
29.10.1971 } 21C/265

MR 20203

Duplicate Destroyed

4/.

REGISTER

[SCHEDULE 1.

NEW ZEALAND.

Reference: { Warrant No. 1102 - No 2
P.B. folio

Register-book, V. 87, folio 160

811/160

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT.

This Certificate, dated the *first* day of *March*, one thousand eight hundred and ninety-*eight*, under the hand and seal of the District Land Registrar of the Land Registration District of *Auckland*, being a Certificate in lieu of Grant, under Warrant of His Excellency the Governor, in exercise of the powers enabling him in that behalf, **Witnesseth** that *William Stewart of Kawakawa Storekeeper*

is seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or indorsed hereon; subject also to any existing right of the Crown to take and lay off roads under any Act of the General Assembly of New Zealand) in the land hereinafter described, as the same is delineated by the plan hereon, bordered *green*, be the several admeasurements a little more or less, which said land is in the said Warrant expressed to have been originally acquired by *the abovenamed* as from the *twenty sixth* day of *November*, one thousand eight hundred and ninety-*seven*, under *"The Land Act 1892"*, that is to say: All that parcel of land containing *Seventeen (17) perches more or less and being Lot 1 (One) of Block XXXII (Thirty two) of the Town of Opua*

Pm B

TWO SHILLINGS

M M Ruthven
D. District Land Registrar

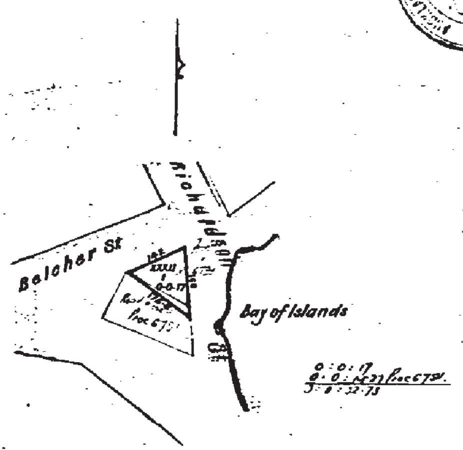
No 6491 Proclamation taking and closing road Entered 13/10/1924 at 12 o'clock
C/T issued for closed road 403/51

Transfer No 253782 of the residue William Stewart to Blanche Wall of Kawa Kawa Married Woman produced 30/1/31 at 10.19 am
A.L.R.

Transfer 682049 of the residue to Anthony Bernard Tubini of Opua salesman and Denise Helen Tubini his wife as tenants in common in equal shares Produced 27.6.1962 at 9.12 o'c
A.L.R.

Mortgage 5238[illegible] Wall Produced 27.[illegible] 14 o'c
A.L.R.

A186825 Transfer to Edward Thurlow Leeds of Opua boat builder Produced 17-11-1966 at 10.56
A.L.R.



METRIC AREA IS 430 m²
430m2

Scale 2 Chains to an inch
Gerhard Mueller Chief Surveyor
Surveyor
Draftsman

THIS REPRODUCTION (ON A REDUCED SCALE) CERTIFIED TO BE A TRUE COPY OF THE ORIGINAL REGISTER FOR THE PURPOSES OF SECTION 215A LAND TRANSFER ACT 1952.
D.L.R.

over

87/160

A595312 ONCT } Cancelled and New CT issued
29.10.1971 } 21C/265

Duplicate Destroyed