REPORT TO

ROYAL HASKONING DHV

ON

REMEDIATION ACTION PLAN

FOR

PROPOSED SEAWALL REPAIRS

AT

SHORELINE FRONTING 148 HUDSON PARADE, CLAREVILLE, NSW

Date: 2 June 2021

Ref: E32115Brpt2-RAP-rev1

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Executive Summary

Royal Haskoning DHV (RHDHV) ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the seawall repairs along a portion of the southern foreshore of Pittwater immediately to the north of 148 Hudson Parade, Clareville, NSW. The development area (the 'site') is shown on Figure 1 and the RAP applied to the development boundaries shown on Figure 2 attached in the appendices.

JKE has previously completed a preliminary contamination and waste classification screening (PCS) for the proposed repairs at the site in 2019. The PCS identified fill contaminated with fibre cement fragments (FCF) containing asbestos (ACM) in the investigation area. The fill also contained hydrocarbons which were below the criteria for public open spaces. A summary of previous investigation and site information is included in Section 2.

JK Geotechnics (JKG) has completed a geotechnical investigation for the proposed seawall repairs at the site in January 2020. JKG have since prepared reports outlining the specifications required for the seawall repairs. This RAP should be read in conjunction with the JKG reports.

The RAP has been prepared to support the lodgement of a development application (DA) with Northern Beaches Council. The goal of the remediation is to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to reduce the human health and environmental risks posed by site contamination to an acceptable level. The primary objectives of the RAP are to:

- Summarise previous investigations and historical contamination data;
- Provide a methodology to remediate and validate the site;
- Provide a contingency plan and unexpected finds protocol for the remediation works; and
- Outline site management procedures to be implemented during remediation.

The preferred option for remediation is Option 3 which includes consolidation and capping the asbestos-impacted soils on-site beneath a suitably designed capping system and management via a Long-Term Environmental Management Plan (LTEMP) (Option 5). This option is considered to be appropriate on the basis that the strategy aligns with the remediation hierarchy and NEPM principals for minimising unnecessary disturbance of asbestos contaminated soils (i.e. in contrast to a strategy where all asbestos contaminated fill was to be excavated and disposed to landfill). However, some removal of contaminated material and disposal to appropriate facilities (Option 4) may be required as part of the seawall repair works. Remediation details are presented in the RAP.

JKE are of the opinion that the site can be made suitable for the proposed development provided this RAP is implemented. A site validation report is to be prepared on completion of remediation activities and submitted to the consent authority to demonstrate that the site is suitable for the proposed development.

Following remediation/validation the site will require management under a LTEMP. The LTEMP will provide a passive management approach which would not impose any constraints on the day-to-day site use under the proposed development scenario. The LTEMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential of exposure to the underlying fill. The LTEMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

Public notification and enforcement mechanisms for the LTEMP are to be arranged and Council is to be provided with a draft copy of the LTEMP for consultation prior to finalisation of the document. The notification and enforcement mechanisms are to include notation on the planning certificate under Section 10.7 of the Environmental Planning and Assessment Act (1979) and a covenant registered on the title to land under Section 88B of the Conveyancing Act (1919).

Surface ACM were identified at the site during the JKE PCS. The risk posed by asbestos should be addressed as a priority. As a duty of care, we recommend clearing the site surface of asbestos followed by a surface clearance from an SafeWork NSW Licensed Asbestos Assessor. An Asbestos Management Plan (AMP) should be prepared for the site.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of this report.

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Abbreviations

Asbestos Fines/Fibrous Asbestos	**AF/FA**
Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Below Ground Level	**BGL**
Benzo(a)pyrene Toxicity Equivalent Factor	**BaP TEQ**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Ecological Investigation Level	**EIL**
Environmental Investigation Services	**EIS**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environment Protection Authority	**EPA**
Environment Protection Licence	**EPL**
Environmental Site Assessment	**ESA**
Ecological Screening Level	**ESL**
Excavated Natural Material	**ENM**
Health Investigation Level	**HILs**
Health Screening Level	**HSL**
JK Environments	**JKE**
Long Term EMP	**LTEMP**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Polychlorinated Biphenyls	**PCBs**
Per-and Polyfluoroalkyl Substances	**PFAS**
Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Quality Assurance	**QA**
Quality Control	**QC**
Remediation Action Plan	**RAP**
Review of Environmental Factors	**REF**
Relative Percentage Difference	**RPD**
Remedial Works Plan	**RWP**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Source, Pathway, Receptor	**SPR**
Standing Water Level	**SWL**

Total Recoverable Hydrocarbons	**TRH**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Underground Storage Tank	**UST**
Validation Assessment Criteria	**VAC**
Virgin Excavated Natural Material	**VENM**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millilitres	**ml or mL**
Milligrams per Kilogram	**mg/kg**
Percentage	**%**
Percentage weight for weight	**%w/w**

1 INTRODUCTION

Royal Haskoning DHV (RHDHV) ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the seawall repairs along a portion of the southern foreshore of Pittwater immediately to the north of 148 Hudson Parade, Clareville, NSW. The development area (the 'site') is shown on Figure 1 and the RAP applied to the development boundaries shown on Figure 2 attached in the appendices.

JKE has previously completed a preliminary contamination and waste classification screening (PCS) for the proposed repairs at the site in 2019[1]. The PCS identified fill contaminated with fibre cement fragments (FCF) containing asbestos (ACM) in the investigation area. The fill also contained hydrocarbons which were below the criteria for public open spaces. A summary of previous investigation and site information is included in Section 2.

JK Geotechnics (JKG) has completed a geotechnical investigation for the proposed seawall repairs at the site in January 2020[2]. JKG have since prepared reports outlining the specifications required for the seawall repairs. This RAP should be read in conjunction with the JKG reports.

The RAP has been prepared to support the lodgement of a development application (DA) with Northern Beaches Council.

1.1 Proposed Development Details

JKE were provided with the following information for the PCS:

- A site survey plan (Plan No A1 – 10981D1B, dated 16 October 2018) prepared by Byrne and Associates;
- A document (Ref PA1900 – 100NT001, dated 1 August 2018) prepared by RHDHV detail the results of a site meeting held with Council representatives; and
- A report on the condition of the seawall (Project No 30014279, Register No SI – ST001, dated 29 May 2018) prepared on behalf of Council by SMEC.

The SMEC 2018 report recommended a range of short and long term remediation options in order to improve safety which included four potential methods of improving the stability of the existing seawall. Based on the results of the site meeting between RHDHV and Council, a permanent seawall stabilisation solution was required by Council, which addressed the following design consideration: 50 year design life; safety in design; site access constraints; cost effective design; structural integrity; durability; local and global stability; minimum demolition/excavation; erosion of the bedrock in front of the wall; acceptable tenure arrangements; environmental impact; and new stairs to the east of the seawall.

[1] JKE (2019), '*Report to Royal Haskoning DHV on Preliminary Contamination and Waste Classification Screening for Proposed Seawall Reports at Shoreline Fronting 148 Hudson Parade, Clareville, NSW*', Report Reference: E32115Brpt, dated 21 June 2019 (Referred to as JKE PCS report)

[2] JKG (2020), '*Report to Royal Haskoning DHV on Geotechnical Investigation for Proposed Seawall Repairs at Foreshore Area Adjacent to 148 Hudson Parade, Clareville, NSW*', Report Reference: 32115Rrpt Rev1, dated 31 January 2020 (Referred to as JKG report)

1.2 Remediation Goal, Aims and Objectives

The goal of the remediation is to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to reduce the human health and environmental risks posed by site contamination to an acceptable level.

The primary objectives of the RAP are to:

- Summarise previous investigations and historical contamination data;
- Provide a methodology to remediate and validate the site;
- Provide a contingency plan and unexpected finds protocol for the remediation works; and
- Outline site management procedures to be implemented during remediation.

1.3 Scope of Work

The RAP was prepared generally in accordance with a JKE proposal (Ref: EP53545B) of 11 February 2021 and written acceptance from the client of 22 February 2020. The scope of work included consultation with the client, a review of previous reports and Conceptual Site Model (CSM), and preparation of the RAP.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[3], State Environmental Planning Policy No.55 – Remediation of Land (1998)[4] and other guidelines made under or with regards to the Contaminated Land Management Act (1997)[5], including the Consultants Reporting on Contaminated Land (2020)[6] guidelines.

A list of reference documents/guidelines is included in the appendices.

[3] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

[4] *State Environmental Planning Policy No. 55 – Remediation of Land 1998* (NSW) (referred to as SEPP55)

[5] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

[6] NSW EPA, (2020). *Consultants reporting on contaminated land, Contaminated Land Guidelines.* (referred to as Consultants Reporting Guidelines)

2 SITE INFORMATION

2.1 Background / Summary of Site History

JKE prepared a PCS report for the proposed development in 2019. The primary aim of the PCS was to identify the potential for site contamination, make a preliminary assessment of the soil contamination conditions and provide a preliminary waste classification for the soil.

The scope of work included a review of site information; preparation of a Conceptual Site Model (CSM); design and implementation of a sampling, analysis and quality plan (SAQP); interpretation of the analytical results against the adopted Site Assessment Criteria (SAC); data Quality Assessment; and preparation of a report including a Tier 1 risk assessment.

The CSM identified the following areas of environmental concern (AEC) on the site:

- Fill material (entire site) – The site appears to have been historically filled to achieve the existing levels. The fill may have been imported from various sources and could be contaminated. The boreholes drilled for the investigation encountered fill ranging in depth from approximately 0.3m to 1.2m below ground level (BGL). ACM were encountered at the surface;
- Use of pesticides – Pesticides may have been used at the site for pest control; and
- Hazardous Building Material – Hazardous building materials may be present as a result of former building and/or demolition activities. These materials may have been imported onto the site with the fill.

Soil samples for the PCS were collected from five locations. Two ACM were obtained for the site surface. The sampling locations are shown on Figure 2.

The laboratory results identified the following:

- Slight detections of Total Recoverable Hydrocarbons (TRH) F1, ethylbenzene and total xylenes were encountered in fill sample BH5 (0-0.1m). A natural soil sample analysed from the same borehole at a depth of approximately 0.4-0.5m did not detect these Contaminants of Potential Concern (CoPC) indicating the impact is confined to the fill soil. These CoPC are not limiting (NL) under the NEMP 2013 Public open space human health SAC. Considering that no buildings or confined spaces are proposed for the development, the SAC is considered applicable to the development; and
- ACM was detected at the surface. The majority of the ACM were detected in the top (south) section of the site in the vicinity of BH5 as shown on the attached Figure 2. The ACM is considered to pose a risk to human receptors and will require remediation.

Based on the findings of the assessment, the PCS concluded that the ACM encountered at the site poses a risk to human receptors and will require remediation. The PCS recommended the following:

- Undertake a Stage 2 Environment Assessment (ESA) or Detailed Site Investigation (DSI) to identify and map the extent of ACM at the site;
- Prepare a RAP for the proposed development;
- Prepare an Asbestos Management Plan (AMP) for the proposed development works; and
- Prepare a Site Validation Report for the remediation works undertaken at the site.

2.2 Site Identification

Table 2-1: Site Identification

Site Address:	172A Hudson Parade and 30-32 Delecta Avenue, Clareville, NSW
Lot & Deposited Plan:	Part of Lot 142 in DP13760
Current Land Use:	Vacant – Foreshore
Proposed Land Use:	Seawall Repairs
Local Government Authority:	Northern Beaches
Current Zoning:	RE1 – Public Recreation
Site Area (m^2):	Approx. 300m^2
RL (AHD in m) (approx.):	0-10
Geographical Location (decimal degrees) (approx.):	Latitude: -33.635235837 Longitude: 151.308547946
Site Location Plan:	Figure 1
Sample Location Plan:	Figure 2

2.3 Site Condition and Surrounding Environment

2.3.1 Location and Regional Setting

The site is located in a residential part of Clareville, NSW at the base of a hillside that steps and slopes down to a portion of the southern foreshore of Pittwater. The subject portion of the foreshore slope extends down to the north from the northern boundary of No. 148 Hudson Parade. Clareville Beach Reserve is located approximately 200m to the east of the site.

2.3.2 Topography

The site is located on a north facing, steep hillside which steps down at approximately 30°. The site falls from approximately RL 11.2m on the southern portion to RL 0.57m on the northern portion of site. The site is approximately 16.2m wide and 14m deep.

2.3.3 Site Inspection

A walkover inspection of the site was undertaken by JKE on 9 May 2019 for the PCS. JKE understand that the landuse remains largely unchanged other than some erosion that has occurred along the cliff face with some of the fill being lost to sea.

At the time of the inspection, the site was a seawall. Refer to the following sub-sections for further details.

2.3.3.1 Current Site Use and/or Indicators of Former Site Use

At the time of the 2019 inspection, a concrete seawall approximately 3m high with a bessa block top was located along the interface of the site and the intertidal zone. Cracking and expansion were observed in the bessa block section of the seawall. The terrace extended from the seawall back towards the residence in the centre of the site. The terraces were retained by small sandstone block walls. A concrete path extended from the uppermost level of the site (backyard of the residential property) down through the terraces connecting them to the intertidal zone. The lower two terraces were observed to be predominantly covered in thick grass cover.

2.3.3.2 Boundary Conditions, Soil Stability and Erosion

Fill containing building and demolition rubble was observed on the surface of the uppermost terrace. This fill was observed to extend laterally out of the site boundary and along the public pedestrian walkway (to the east).

2.3.3.3 Visible or Olfactory Indicators of Contamination

Over ten ACM fragments were encountered on the surface and imbedded in the surface fill during the inspection. Most of the fragments were observed along the exposed fill soil in the uppermost terrace, however one fragment (KTF2) was encountered in the fill on the lower terrace. Two representative fragments (KTF1 and KTF2) were sampled for laboratory analysis. The ACM fragment sampling locations are shown on Figure 2 attached in the appendices.

2.3.3.4 Drainage

Considering the steep nature of the site, surface water would drain to the north towards Pittwater.

2.3.3.5 Sensitive Environments

The foreshore and Pittwater water body are considered as a sensitive environment.

2.3.4 Surrounding Land Use

During the site inspection, JKE observed the following land uses in the immediate surrounds:

- North – Pittwater foreshore;
- South – 148 Hudson Parade and Hudson Parade beyond;
- East – public reserve; and
- West – public reserve.

JKE did not observe any land uses in the immediate surrounds that were identified as potential contamination sources for the site.

2.4 Summary of Geology, Soils and Hydrogeology

2.4.1 Regional Geology

Regional geological information presented in the PCS report indicated that the site is underlain by sandstone of the Newport and Garie formation which typically consists of interbedded laminate, shale and quartz, to lithic quartz sandstone with minor red claystone north of Hawkesbury River; and clay pellet sandstone south of Hawkesbury River. The soil landscape map of Sydney indicates that the site is located in an area mapped as colluvial soil of the Watagan formation.

2.4.2 Acid Sulfate Soil (ASS) Risk and Planning

ASS information presented in the PCS report indicated that the site is located within a Class 5 ASS risk area. Works in Class 5 areas that could pose an environmental risk in terms of ASS include works within 500m of adjacent Class 1,2,3,4 land which are likely to lower the water table below 1m AHD on the adjacent Class 1,2,3,4 land.

2.4.3 Hydrogeology

Hydrogeological information presented in the PCS report indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were a total of 12 registered bores within the report buffer of 2,000m. In summary:

- The nearest registered bore was located approximately 153m to the east, cross gradient from the site and was registered for domestic purposes;
- The majority of the bores were registered for domestic and recreational (irrigation) purposes; and
- The standing water levels (SWLs) in the bores within 500m radius ranged from 1mBGL to 4mBGL.

The use of groundwater is not proposed as part of the development. There is a reticulated water supply in the area and consumption of groundwater is not expected to occur.

Considering the local topography and surrounding land features, JKE would generally expect groundwater to flow towards Pittwater.

2.4.4 Receiving Water Bodies

The site location and regional topography indicates that surface water flows have the potential to enter Pittwater located to the immediate north of the site. This water body is a potential receptor.

3 SITE CHARACTERISATION AND CONCEPTUAL SITE MODEL

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM for the site is presented in the following sub-sections and is based on the previous investigation data, site history and site information presented in Section 2.

3.1 Summary of Contamination (Site Characterisation)

ACM were detected at the surface of the site. The majority of the ACM were detected in the top (south) section of the site in the vicinity of BH5 as shown on the attached Figure 2. The ACM is considered to pose a risk to human receptors and will require remediation.

For the PCS asbestos was assessed on the basis of presence/absence. The NEMP 2013 asbestos Health Screening Levels (HSLs) were not adopted and asbestos quantification was not undertaken for the PCS screening. Although the PCS recommended that a Stage 2 or DSI be undertaken to meet the NSW EPA Sampling Design Guidelines 1995 to further assess the extent of ACM contamination, upon further review of available information we considered the seawall repairs can proceed directly to remediation based on the following lines of evidence which suggest that the ACM in fill soil contamination is widespread at the site:

- The site has been subject to widespread filling containing visible ACM at the surface and imbedded in the surface fill soil;
- Asbestos was either visually identified during field works and/or via laboratory analysis and was widespread at the site as shown on Figure 2 and the photographs provided in PCS;
- The Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (2009)[7] (endorsed in NEPM 2013) suggest that a DSI and associated extensive may not be necessary if an in-situ remediation /management approach is adopted and further states that a DSI should only be undertaken when delineation of asbestos impacts must be accurate. Therefore, a potential cap and contain remediation/management approach for the site is preferable; and
- Other than asbestos, CoPC were not encountered at concentrations above the adopted SAC. Therefore, the potential risk posed by these CoPC is consider to be low.

Based on the findings of the PCS and the information above, the ACM at the site is considered to pose a risk to site receptors and will require remediation.

3.2 CSM

The table below includes a review of the CSM which has been used to design the remediation strategy. The CSM will require further review if additional site data becomes available.

[7] Western Australian (WA) Department of Health (DoH), (2009). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia. (referred to as WA DoH 2009)

Table 3-1: CSM

Contaminant source(s) and contaminants of concern	Fill soil impacted by asbestos (ACM).
Affected media	Soil has been identified as the affected medium. However, it is noted that asbestos fibres can also affect the air and this will be considered as part of the site management during remediation and validation.
Receptor identification	Human receptors include site workers and public who may access the area. Off-site human receptors include adjacent land users primarily in the residential setting surrounding the site.
Exposure pathways and mechanisms	The exposure pathway relevant to the receptors includes inhalation of airborne asbestos fibres. Such fibres could be generated and exposure could occur during disturbance of soil containing ACM.
Evaluation of data gaps	The ACM present on the site could be in a friable form and should be handled by a Class A licensed contractor under the requirements of an Asbestos Management Plan (AMP).

3.3 Remediation Extent

For the purpose of the RAP, remediation will extend across the entire site as shown on Figure 2 in the appendices and includes the vertical and horizontal extent of fill material within the site. This decision was based on the CSM and site characterisation information presented above.

4 REMEDIATION OPTIONS

4.1 Soil Remediation

The NSW EPA follows the hierarchy set out in NEPM 2013 for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

1. On-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated material so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

Or if the above are not practicable:

3. Consolidation and isolation of the soil by on-site containment within a properly designed barrier; and
4. Removal of contaminated material to an approved site or facility, followed where necessary by replacement with clean material; or
5. Where the assessment indicates that remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

For simplicity herein, the above hierarchy are respectively referred to as Option 1, Option 2, Option 3 etc.

The NEPM 2013 and WA DoH 2009 prefer the following asbestos remediation hierarchy:

1. Minimisation of public risk;
2. Minimisation of contaminated soil disturbance; and
3. Minimisation of contaminated material/soil moved to landfill.

The NSW EPA Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition) (2017)[8] provides the following additional requirements to be taken into consideration:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed; and
- Where there are large quantities of soil with low levels of contamination, alternative strategies should be considered or developed.

[8] NSW EPA, (2017). *Contaminated land Management, Guidelines for the NSW Site Auditor Scheme (3rd ed.).* (referred to as Site Auditor Guidelines 2017)

4.2 Remediation Options Assessment

The table below discusses and assesses a range of remediation options:

Table 4-1: Consideration of Remediation Options

Option	Discussion	Assessment/Applicability
Option 1 **On-site treatment of contaminated soil**	On-site treatment can provide a mechanism to reuse the processed material, and in some instances, avoid the need for large scale earthworks. Treatment options are contaminant-specific and can include bio-remediation, soil washing, air sparging and soil vapour extraction, thermal desorption for specific CoPC. However physical removal of fragments is the only real option for bonded ACM. Depending on the treatment option, licences may be necessary for specific individual waste streams due to the potential for air pollution and the formation of harmful by-products during incineration processes. Licences for re-use of treated material/waste may also be required.	Not technically feasible or economically viable based on the widespread ACM in fill and potential for friable asbestos.
Option 2 **Off-site treatment of contaminated soil**	Contaminated soils are excavated, transported to an approved/licensed treatment facility, treated to remove/stabilise the contaminants then returned to the subject site, transported to an alternative site or disposed to an approved landfill facility. This option is also contaminant-specific. The cost per tonne for transport to and from the site and for treatment is considered to be relatively high. The material would also have to be assessed in terms of suitability for reuse as part of the proposed development works under the waste and resource recovery regulatory framework.	Not applicable.
Option 3 **Consolidation and isolation of impacted soil by cap and containment**	This would include the consolidation of ACM-impacted soil within an appropriately designed capping system, followed by the placement of an appropriate barrier over the material to reduce the potential for future disturbance. The capping and/or containment must be appropriate for the specific contaminants of concern. Depending on the concentrations of contaminants being encapsulated, an ongoing Long-term Environmental Management Plan (LTEMP) will be required and will need to be publicly notified and made to be legally enforceable (e.g. via listings in the Section 10.7 planning certificate and on the land title).	Most applicable option for this project as it: aligns with the seawall repair work; is technically feasible; economically viable; poses the lowest risk in relation to asbestos; and is in-line with the principles of ecologically sustainable development as it reduces the amount of waste to be transported to landfill.

Option	Discussion	Assessment/Applicability
<u>Option 4</u> Removal of contaminated material to an appropriate facility and reinstatement with clean material	Contaminated soils would be classified in accordance with NSW EPA guidelines for waste disposal, excavated and disposed of off-site to a licensed landfill. The material would have to meet the requirements for landfill disposal. Landfill gate fees (which may be significant) would apply in addition to transport costs.	Technically achievable, however would not be in-line with the principles of ecologically sustainable development. The extent of excavation would also pose a greater risk in relation to asbestos due to increased soil disturbance. This option would also not be economically viable in the context of the proposed development and is not commensurate with the level of risk posed by the contamination and would be logistically difficult to execute due to the limited site access to machinery.
<u>Option 5</u> Implementation of management strategy	Contaminated soils would be managed in such a way to reduce risks to the receptors and monitor the conditions over time so that there is an on-going minimisation of risk. This will require the preparation of a LTEMP to ongoingly manage the contamination at the site.	Applicable for the long-term management of asbestos capped at the site.

4.3 Rationale for the Preferred Option for Remediation

The preferred option for remediation is Option 3 which includes consolidation and capping the asbestos-impacted soils on-site beneath a suitably designed capping system and management via LTEMP (Option 5). This option is considered to be appropriate on the basis that the strategy aligns with the remediation hierarchy and NEPM principals for minimising unnecessary disturbance of asbestos contaminated soils (i.e. in contrast to a strategy where all asbestos contaminated fill was to be excavated and disposed to landfill). However, some removal of contaminated material and disposal to appropriate facilities (Option 4) may be required as part of the seawall repair works.

5 REMEDIATION DETAILS

5.1 Roles and Responsibilities

Table 5-1: Roles and Responsibilities

Role	Responsibility
Client	Northern Beaches Council Contact: To Be Appointed (TBA) The developer is required to appoint the project team for the remediation and must provide all investigation reports including this RAP to the project manager, remediation contractor, consent authority and any other relevant parties involved in the project.
Project Manager	To be appointed. The project manager is required to review all documents prepared for the project and manage the implementation of the procedures outlined in this RAP. The project manager is to take reasonable steps so that the remediation contractor and others have understood the RAP and will implement it in its totality. The project manager will review the RAP and other documents and will update the parties involved of any changes to the development or remediation sequence (in consultation with the validation consultant).
Remediation Contractor	To be appointed. The remediation contractor is required to review all documents prepared for the project, apply for any relevant removal licences or permits and implement the remediation requirements outlined in this RAP. The remediation contractor may also be the construction contractor. The remediation contractor is required to collect all necessary documentation associated with the remediation activities and forward this documentation onto the client, project manager and validation consultant as they become available. The remediation contractor is required to advise the validation consultant at key points in the remediation and validation programme, and implement various aspects of the validation plan assigned to them.
Validation Consultant	JKE – subject to formal engagement Contact: Vittal Boggaram The validation consultant provides consulting advice and validation services in relation to the remediation, and prepares the site validation report, LTEMP and any other associated documentation such as the Asbestos Management Plan (AMP). The validation consultant is to have a SafeWork Licensed Asbestos Assessor on staff to provide the necessary surface clearance inspections and certificates for the project. The validation consultant is required to liaise with the client, project manager and remediation contractor on all matters pertaining to the site contamination, remediation and validation, carry out the required site inspections during capping, and collect validation samples for imported materials.

5.2 Pre-commencement

The project team is to have a pre-commencement meeting to discuss the sequence of remediation, and the remediation and validation tasks. The site management plan for remediation works (see Section 8) should be reviewed by the project manager and remediation contractor, and appropriate steps are to be taken to ensure the adequate implementation of the plan.

5.3 Asbestos Management Plan (AMP)

An AMP must be prepared for the site by an Asbestos Assessor licensed by SafeWork NSW prior to the removal of the concrete slabs, retaining walls and excavation. The AMP should address the measures required for the disturbance of potential friable asbestos.

5.4 Remediation and Associated Tasks

The following general sequence of works is anticipated:

- Preparation of an AMP for the proposed development;
- Site establishment;
- Excavation and off-site disposal of fill soils for installation of the new sea wall (if required);
- Capping of contamination fill over the entire site; and
- Validation of the works would occur progressively throughout the remediation program.

Details in relation to the above are outlined in the following subsections. Reference should be made to the JKG geotechnical report for further information regarding site preparation works required for the proposed development.

5.4.1 Site Establishment

The remediation contractor is to establish on site as required to facilitate the remediation. Consideration must be given to the work sequence and extent of remediation so that the site establishment (e.g. site sheds, fencing, access points etc) does not inhibit the remediation works.

5.4.2 Remediation (and Validation)

Remediation is primarily based around the installation of an appropriate capping system over the asbestos contaminated soil. This capping system will extend over the entire site shown on Figure 2 where fill material is present. Capping is not considered necessary in the north section of the site, in the foreshore area where exposed bedrock or natural soil is evident at the surface.

The capping specification is outlined in the following table and example conceptual cross-sections included in the JKG reports prepared for the seawall specifications are attached in Appendix B. In the event that the capping specification is to be altered following the initial consultation, this must be documented by JKE in an addendum to the RAP.

Table 5-2: Capping Specification

Area / Finished Surface	Capping Specification
Seawall	Capping specifications for the seawall will follow the JKG geotechnical specifications and will include the installation of rock bolts, steel mesh and fabric underlay. The fabric underlay (marker layer) should be coloured (preferably orange) over the ground surface, followed by the other layers as per the relevant engineering specification. All imported materials placed as temporary batters for the new seawall and material imported for the new seawall should be appropriately validated.
Foot Paths and other access areas	Coloured (preferably orange) geofabric[9] marker layer placed over the ground surface, followed by subbase/base course and pavement/hardstand as per the relevant engineering specification. All imported materials placed above the marker layer are to be appropriately validated.

A minimum overlap of 500mm is recommended between each length of geofabric and the geofabric is to be appropriately secured to the ground using soil nails (e.g. 'u' nails or pegs) or other appropriate methods.

The remediation steps for the general site area capping (excluding excavation and disposal of contaminated fill) are outlined in the following table. The detailed validation plan relevant to this aspect of the remediation is provided in Section 6.

Table 5-3: Remediation – General Site Capping

Step	Primary Role/ Responsibility	Procedure
1.	Validation consultant	<u>Preparation of Asbestos Management Plan (AMP):</u> Prior to commencement of work an AMP is to be prepared for the remediation works. The AMP is to be implemented by the remediation contractor (and their nominated subcontractors where relevant) throughout the subsequent steps. The AMP should address the potential presence of friable asbestos in the fill soil.
2.	Remediation contractor	<u>Implementation of Asbestos/Management Controls:</u> The site management and AMP controls are to be established by the remediation contractor in accordance with this RAP and the AMP referenced in Step 1 above.
3.	Remediation contractor (with input from the validation consultant)	<u>Earthworks and Consolidation of Asbestos-contaminated Soils:</u> Earthworks, shoring and other preparations are to occur to the design levels to facilitate construction of the cap. Depending on the sequence of works, consideration could be given to temporary/interim capping measures over parts of the site to enable works to continue in these areas without the need for full asbestos controls under the AMP.

[9] Reference to 'geofabric' in the context of the addendum RAP includes a high visibility (e.g. orange), non-woven product that is also suitable from a free drainage, engineering and geotechnical point of view as required.

Step	Primary Role/ Responsibility	Procedure
4.	Remediation contractor Validation consultant	Capping Procedure: Once the required levels are achieved, the cap is to be constructed as per the capping specification documented previously in this RAP, to the satisfaction of the validation consultant. The marker layers, imported materials and capping layers are to be validated by the remediation contractor and validation consultant in accordance with Section 6 and as noted below. The validation consultant and the remediation contractor are to document the installation of the capping in person and photographically.

The remediation steps for the excavation and disposal of contaminated fill are outlined in the following table. The detailed validation plan relevant to this aspect of the remediation is provided in Section 6.

Table 5-4: Remediation Details – Excavation and disposal of contaminated fill

Step	Primary Role/ Responsibility	Procedure
1.	Validation Consultant – Asbestos Assessor	Preparation and Implementation of Asbestos Management Plan (AMP): Prior to commencement of work, an AMP is to be prepared for the remediation works. The AMP is to be implemented by the remediation contractor (and their nominated subcontractors where relevant) throughout the subsequent steps. The AMP should address the potential presence of friable asbestos in the fill soil.
2.	Remediation Contractor	Removal of contaminated fill: Excavation of the remediation area will be undertaken as follows: • Areas where fill will be removed for the installation of the new sea wall, foundations and new paths etc. should be marked; • Submit an application to dispose the fill (in accordance with the assigned waste classification) to a landfill licensed by the NSW EPA to receive the waste and obtain authorisation to dispose; • Submit an application with the NSW EPA on the Waste Locate portal (**https://wastelocate.epa.nsw.gov.au/**) for tracking the asbestos impacted fill from site to the landfill; • A water system will need to be in place to spray the excavated soil during excavation/ remediation works and to decontaminate the barge or loaders entering the work area. The general site area should be kept damp during remediation works to minimise the generation of dust and asbestos fibre monitoring should be undertaken in accordance with an AMP; • The fill should be excavated from the marked areas to the depths required for the development. The details of the excavation depths will need to be agreed with the remediation contractor. The works should be done in the most efficient manner that minimises spreading of contaminated fill on site; • Load the fill onto the barge and dispose in accordance with the assigned waste classification. The receiving licenced landfill facility; and • All documents including landfill dockets should be retained and forwarded to the client and validation consultant for inclusion into the validation report.
3.	Remediation Contractor Validation Consultant	Backfilling and Capping Procedure: Once the required levels are achieved, the capping of the area should meet the capping specification documented in this RAP, to the satisfaction of the validation consultant. The capping layers and imported materials are to be validated by the remediation contractor and validation consultant in accordance with Section 6.

5.5 Remediation Documentation

The remediation contractor must retain all documentation associated with the remediation, including but not limited to:

- Waste register (see below);
- Asbestos management documentation, including all relevant notifications and monitoring reports;
- Photographs of remediation works;
- Waste tracking documentation (where applicable);
- Survey information (including site boundary and as-builts detailing the capping details and thicknesses); and
- Imported materials documentation from suppliers, including any routine analysis reports, product specifications and dockets for imported materials.

Copies of these documents must be forwarded to the project manager and the validation consultant on completion of the remediation for inclusion in the validation report.

5.5.1 Waste Register

All waste removed from the site is to be appropriately tracked and managed in accordance with the relevant regulations. The remediation contractor (and/or their nominated construction contractor) is to maintain adequate records and retain all documentation for waste disposal activities including:

- A summary register including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with waste disposal docket numbers; and
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste. Legible dockets are to be provided for all waste materials so they can be reconciled with the register.

Any soil waste classification documentation is to be prepared in accordance with the reporting requirements specified by the NSW EPA. Reports are to include:

- The full name, address, Australian Company Number (ACN) or Australian Business Number (ABN) of the organisation and person(s) providing the waste classification;
- Location of the site where the waste was generated, including the source site address;
- History of the material and the processes and activities that have taken place to produce the waste;
- Potential contaminating activities that may have occurred at the site where the waste was generated;
- Description of the waste, including photographs, visible signs of contamination, such as discolouration, staining, odours, etc;
- Quantity of the waste;
- Number of samples collected and analysed;
- Sampling method including pattern, depth, locations, sampling devices, procedures, and photos of the sample locations and samples;

- Contaminants tested;
- Laboratory documentation – chain-of-custody (COC), sample receipt, laboratory report;
- All results regardless of whether they are not used in the classification process;
- Results of sample mean, sample standard deviation and the 95% upper confidence limit (UCL) where relevant;
- Brief summary of findings including discussion of results; and
- A clear statement of the classification of the waste as at the time of the report.

A soil volume analysis should be undertaken on completion of remediation and reconciled with the quantities shown on the soil disposal dockets. This information is to be reviewed by the validation consultant on completion of the works and an assessment of the quantities of soil disposed off-site (e.g. comparison with the estimated and actual volumes) is to be included in the validation report. A review of the disposal facility's licence issued under the Protection of the Environment Operations (POEO) Act (1997)[10] should also be undertaken to assess whether the facility is appropriately licensed to receive the waste.

5.5.2 Imported Materials Register

The remediation contractor (and/or their nominated construction contractor) is to maintain for the duration of the project an imported material register. This must include a register (preferably in Microsoft Excel format) with details of each imported material type, supplier details, summary record of where the imported materials were placed on site, and importation docket numbers and a tally of quantities (separated for each import stream). Legible dockets for imported materials are to be provided electronically so these can be reconciled with the register.

The above information is to be provided to the validation consultant for inclusion in the validation report. It is recommended that the register be set up at the beginning of the project and provided to the validation consultant regularly (say on a monthly or two-monthly basis) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

[10]NSW Government, (1997)). *Protection of Environment Operations Act*.(referred to as POEO Act 1997)

6 VALIDATION PLAN

Validation is necessary to demonstrate that remedial measures described in the RAP have been successful and that the site is suitable for the intended land use. The sampling program for the validation is outlined in Section 6.1. This is the minimum requirement based on the remedial strategies provided. Additional validation sampling may be required based on observations made during remediation or in the event of an unexpected find.

6.1 Validation Sampling and Documentation

The table below outlines the validation requirements for the site:

Table 6-1: Validation Requirements

Aspect	Sampling	Analysis	Observations and Documentation
Capping			
Survey of site levels.	NA	NA	**Remediation contractor** to obtain the survey prior to and at the completion of the capping to assess and document the capping thicknesses It is also expected that the remediation contractor or their nominated construction contractor will provide as-built drawings for the project which document the capping layers. A survey plan showing the site/capped area is also required.
Inspections.	NA	NA	**Validation consultant** to carry out inspections to document the installation of the cap. Key hold points for inspections include: - Fabric underlay/Geotextile installation; - During importation of materials used to construct the cap; and - Finished surface levels. A photographic record is to be maintained by the **remediation contractor** and **validation consultant**.
Validation of imported materials.	As indicated below.	As indicated below.	As indicated below

Aspect	Sampling	Analysis	Observations and Documentation
Imported Materials – validation of imported materials is required for any materials imported onto the site during the remediation and to the point in time that the site validation report is prepared (e.g. general fill to raise the site levels or reinstate remedial excavations, imported materials to create piling platform, gravels for site preparation, material used for capping layers etc).			
Imported VENM backfill (if required) Imported garden mix/topsoil and mulches	Minimum of three samples per source	Heavy metals (as above), TRHs, BTEX, PAHs, OCPs, PCBs and asbestos (500ml). Additional analysis may be required depending on the site history of the source property. Analysis of mulch can be limited to visual observations to confirm there is limited anthropogenic material and no visible asbestos materials.	**Remediation contractor** to supply existing VENM documentation/report (report to be prepared in accordance with the NSW EPA waste classification reporting requirements). A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Material is to be inspected upon importation by the **validation consultant** to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Photographic documentation and an inspection log are to be maintained. Where check sampling occurs by the **validation consultant** due to deficiencies or irregularities in existing VENM documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the Validation Assessment Criteria (VAC).
Imported engineering materials such as recycled aggregate, road base etc or ENM	Minimum of three samples per source/material type. Additional testing may be required for ENM to meet the specification within the ENM Order.	Heavy metals (as above), TRHs, BTEX, PAHs, OCPs, PCBs and asbestos (500ml analysis and asbestos quantification). Additional testing may be required for ENM (e.g. foreign materials, pH and electrical conductivity) depending on available documentation.	**Remediation contractor** to provide product specification and documentation to confirm the material has been classified with reference to a relevant Resource Recovery Order/Exemption. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the facility's Environment Protection Licence (EPL). Material is to be inspected by the **validation consultant** upon importation to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Where check sampling occurs by the **validation consultant** due to deficiencies or

Aspect	Sampling	Analysis	Observations and Documentation
			irregularities in existing documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the VAC.
Imported engineering materials comprising only natural quarried products.	At the validation consultant's discretion based on robustness of supplier documentation.	At the validation consultant's discretion based on robustness of supplier documentation.	**Remediation contractor** to provide documentation from the supplier confirming the material is a natural quarried product. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the quarry's EPL. Material is to be inspected by the **validation consultant** upon importation to confirm it is free of anthropogenic materials, visible and olfactory indicators of contamination, and is consistent with documentation. Where check sampling occurs by the **validation consultant** due to deficiencies or irregularities in existing documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the VAC.

6.2 Validation Assessment Criteria and Data Assessment

The VAC to be adopted for the validation assessment are outlined in the table below:

Table 6-2: VAC

Validation Aspect	VAC
Soil Validation	Where applicable soil data to be assessed against relevant health-based and ecological-based screening levels presented in Schedule B1 of NEPM 2013. The 'Parks Open Spaces' landuse setting is to be adopted for the validation assessment criteria. Risk-based assessment is required depending on the potential fate of the material.
Validation of capping	Validation of capping will occur via a review of survey information, as-built drawings and via the inspection process. The validation report is to include cross-sections documenting the completed capping details for the various areas of the site.
Imported materials	Material imported as general fill must only be VENM or ENM. VENM is defined in the Protection of the Environment Operations Act (1997)[11] as material: • That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • That does not contain sulfidic ores or other waste; and • Includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette. ENM and recycled materials are to meet the criteria of the relevant exemption/order under which they are produced. Analytical results for VENM and other imported materials will need to be consistent with expectations for those materials. For VENM, it is expected that: - Heavy metal concentrations are to be less than the most conservative Added Contaminant Limit (ACL) concentrations for an URPOS exposure setting presented in Schedule B1 of the NEPM 2013; and - Organic compounds are to be less than the laboratory Practical Quantitation Limits (PQLs) and asbestos to be absent. All materials imported onto the site must also be adequately assessed as being appropriate for the final use of the site. A risk-based assessment approach is to be adopted with regards to the tier 1 screening criteria presented in Schedule B1 of NEPM 2013. Aesthetics: all imported materials are to be free of staining and odours.

Data should initially be assessed as above or below the VAC. Statistical analysis may be applied if deemed appropriate by the consultant and undertaken in accordance with the NEPM 2013.

[11] Protection of Environment Operations Act 1997 (NSW) (POEO Act 1997)

6.3 Validation Sampling, Analysis and Quality Plan (SAQP)

Appropriate Quality Assurance/Quality Control (QA/QC) samples should be obtained during the validation (where applicable) and analysed for the same suite of contaminants as the primary samples. As a minimum, QA/QC sampling should include duplicates (5% inter-laboratory and 5% intra-laboratory), trip spikes and trip blanks. Rinsate samples should be obtained if re-usable sampling equipment is utilised.

Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) should be clearly outlined and assessed as part of the validation process. A framework for the DQO and DQI process is outlined below and should be reflected in the validation report.

DQOs have been broadly established for the validation with regards to the seven-step process outlined NEPM (2013). The seven steps include the following which are detailed further in the following subsections:

- State the problem;
- Identify the decisions/goal of the study;
- Identify information inputs;
- Define the study boundary;
- Develop the analytical approach/decision rule;
- Specify the performance/acceptance criteria; and
- Optimise the design for obtaining the data.

DQIs are to be assessed based on field and laboratory considerations for precision, accuracy, representativeness, completeness and comparability.

6.3.1 Step 1 - State the Problem

Validation data is required to demonstrate that the remediation is successful and that the site is suitable for the proposed land use described in Section 1.1.

6.3.2 Step 2 - Identify the Decisions of the Study

The remediation goal, aims and objectives are defined in Section 1.2. The decisions to be made reflect these objectives and are as follows:

- Was the remediation undertaken in accordance with the RAP?
- If there were any deviations, what were these and how do they impact the outcome of the validation?
- Are any of the validation results above the VAC?
- Is the site suitable for the proposed development from a contamination viewpoint?

6.3.3 Step 3 - Identify Information Inputs

The primary information inputs required to address the decisions outlined in Step 2 include the following:

- Existing relevant data from previous reports;
- Site information, including site observations, inspections, survey information, as-built drawings, waste and imported materials registers;

- Validation sampling of imported materials; and
- Field and laboratory QA/QC data.

6.3.4 Step 4 - Define the Study Boundary

The remediation and validation will be confined to the site boundaries as shown in Figure 2 in Appendix A and will be limited vertically to the approximate depth of fill.

6.3.5 Step 5 - Develop an Analytical Approach (or Decision Rule)

6.3.5.1 VAC

The validation data will be assessed in accordance with the requirements outlined in Section 6.2.

6.3.5.2 Field and Laboratory QA/QC

Field QA/QC is to include analysis of inter-laboratory duplicates (5% frequency), intra-laboratory duplicates (5% frequency), trip spike, trip blank and rinsate samples (one each for the assessment to demonstrate adequacy of standard sampling/handling procedures). Field QA/QC samples are to be analysed for the contaminants of concern, except asbestos. The trip spike will only be analysed for BTEX as BTEX will be considered a surrogate to assess potential loss of volatiles from TRH (F2).

DQIs for field and laboratory QA/QC samples are defined below:

Field Duplicates

Acceptable targets for precision of field duplicates will be 30% or less, consistent with NEPM (2013). Relative Percent Difference (RPD) failures will be considered qualitatively on a case-by-case basis taking into account factors such as the concentrations used to calculate the RPD (i.e. RPD exceedance where concentrations are close to the PQL are typically not as significant as those where concentrations are reported at least five or 10 times the PQL), sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Trip Blanks

Acceptable targets for trip blank samples will be less than the PQL for organic analytes. Metals will be considered on a case-by-case basis with regards to the reference material used as the blank medium.

Trip Spikes

Acceptable targets for trip spike samples will be 70% to 130%.

Laboratory QA/QC

The suitability of the laboratory data will be assessed against the laboratory QA/QC criteria. These criteria are developed and implemented in accordance with the laboratory's NATA accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

A summary of the typical limits is provided below:

RPDs

- Results that are <5 times the PQL, any RPD is acceptable; and
- Results >5 times the PQL, RPDs between 0-50% are acceptable.

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics; and
- 60-140% recovery acceptable for organics.

Surrogate Spikes

- 60-140% recovery acceptable for general organics.

Method Blanks

- All results less than PQL.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence will be reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory is to be undertaken in an effort to establish the cause of the non-conformance. Where uncertainty exists, the validation consultant is to adopt the most conservative concentration reported.

6.3.5.3 Appropriateness of PQLs

The PQLs of the analytical methods are to be considered in relation to the VAC to confirm that the PQLs are less than the VAC. In cases where the PQLs are greater than the VAC, a discussion of this is to be provided.

6.3.6 Step 6 – Specify Limits on Decision Errors

To limit the potential for decision errors, a range of quality assurance processes are adopted. A quantitative assessment of the potential for false positives and false negatives in the analytical results is to be undertaken with reference to Schedule B(3) of NEPM (2013) using the data quality assurance information collected.

6.3.7 Step 7 - Optimise the Design for Obtaining Data

The design is to be optimised via the collection of validation data to demonstrate the success of the key aspects of the remediation. Data collection will be via various methods including inspections and sampling.

6.3.8 Sampling Plan

The proposed sampling plan for the validation of imported materials is described in Section 6.1.

6.4 Validation Report and LTEMP

As part of the site validation process, a validation report will be prepared by the validation consultant. The report will present the results of the validation assessment and will be prepared in accordance with the Consultants Reporting Guidelines.

A LTEMP will be required to manage the contamination that is to be capped at the site and the LTEMP will be documented as part of the overall validation process. Public notification and enforcement mechanisms for the LTEMP are to be arranged and Council is to be provided with a draft copy of the LTEMP for consultation prior to finalisation of the document.

The notification and enforcement mechanisms are to include notation on the planning certificate under Section 10.7 of the Environmental Planning and Assessment Act (1979) and a covenant registered on the title to land under Section 88B of the Conveyancing Act (1919).

The LTEMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential of exposure to the underlying fill. The LTEMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

7 CONTINGENCY PLAN

A review of the proposed remediation works has indicated that the greatest risks that may affect the success of the remediation include unexpected finds. A contingency plan for the remediation is provided below:

7.1 Unexpected Finds

Residual hazards that may exist at the site would generally be expected to be detectable through visual or olfactory means. The procedure to be followed in the event of an unexpected find is presented below:

- In the event of an unexpected find, all work in the immediate vicinity should cease and the remediation contractor should contact the validation consultant and the project manager;
- Temporary barricades should be erected to isolate the area from access to workers;
- The validation consultant is to attend the site, adequately characterise the contamination and provide advice in relation to site management and remediation. In the event that remediation differs from the procedures outlined in this RAP, an addendum RAP or Remediation Works Plan (RWP) must be prepared in consultation with the project stakeholders and submitted to the determining authority; and
- Contamination should be remediated and validated in accordance with the advice provided, and the results should be included in the validation report.

7.2 Importation Failure for VENM or other Imported Materials

Where material to be imported onto the site does not meet the importation VAC detailed in Section 6.2, the material should not be imported. Alternative material must be sourced that meets the importation requirements.

8 SITE MANAGEMENT PLAN FOR REMEDIATION WORKS

The information outlined in this section of the RAP is for the remediation work only. The client should make reference to the development consent for specific site management requirements for the overall development of the site.

8.1 Asbestos Management Plan

Prior to the commencement of any soil disturbance in the remediation areas, an AMP is to be prepared by the validation consultant (or the remediation contractor) to document the asbestos-related management requirements for the remediation. The AMP is to be implemented by the remediation contractor (and their nominated subcontractors where relevant) throughout the remediation. It is recommended that the AMP consider the presence of potentially friable asbestos at the site.

8.2 Project Contacts

Emergency procedures and contact telephone numbers should be displayed in a prominent position at the site entrance gate and within the main site working areas. The available contact details are summarised in the following table:

Table 8-1: Project Contacts

Role	Company	Contact Details
Client/developer	To be appointed	-
Project Manager	To be appointed	-
Remediation Contractor	To be appointed	-
Validation Consultant	JKE – subject to being formally engaged	Vittal Boggaram / Mitchell Delaney JK Environments P: 9888 5000
Certifier	To be appointed	-
NSW EPA	Pollution Line	131 555
Emergency Services	Ambulance, Police, Fire	000

8.3 Security

Appropriate fencing should be installed as required to secure the site and to isolate the remediation areas. Warning signs should be erected, which outline the personal protective equipment (PPE) required for remediation work.

8.4 Timing and Sequencing of Remediation Works

The anticipated sequence of remediation works is outlined in Section 5.4. Remediation will occur concurrently with the development works as outlined in the RAP.

8.5 Site Soil and Water Management Plan

The remediation contractor should prepare a detailed soil and water management plan prior to the commencement of site works and this should consider the requirements of the AMP. Silt fences should be used to control the surface water runoff at all appropriate locations of the site and appropriate measures are to be implemented to manage soil/water disturbance to the satisfaction of the regulator/determining authority. Reference should be made to the consent conditions for further details.

All stockpiled materials should be placed within an erosion containment boundary with silt fences and sandbags employed to limit sediment movement. No liquid waste, runoff or sediment should be discharged to the stormwater, sewerage system or directly to the Pittwater water body without the approval of the appropriate authorities.

8.6 Noise and Vibration Control Plan

The guidelines for minimisation of noise on construction sites outlined in AS-2460 (2002)[12] should be adopted. Other measures specified in the consent conditions should also be complied with. Noise producing machinery and equipment should only be operated between the hours approved by the determining authority (refer to consent documents).

All practicable measures should be taken to reduce the generation of noise and vibration to within acceptable limits. In the event that short-term noisy operations are necessary, and where these are likely to affect residences, notifications should be provided to the relevant authorities and the residents by the project manager, specifying the expected duration of the noisy works.

8.7 Dust Control Plan

All practicable measures should be taken to reduce dust emanating from the site. Factors that contribute to dust production are:

- Wind over a cleared surface;
- Wind over stockpiled material; and
- Movement of machinery in unpaved areas.

Visible dust should not be present at the site boundary. Measures to minimise the potential for dust generation include:

- Use of water sprays on unsealed or exposed soil surfaces;

[12] Australian Standard, (2002). *AS2460: Acoustics - Measurement of the Reverberation Time in Rooms.*

- Covering of stockpiled materials and excavation faces (particularly during periods of site inactivity and/or during windy conditions) or alternatively the erection of hessian fences around stockpiled soil or large exposed areas of soil;
- Establishment of dust screens consisting of a 2m high shade cloth or similar material secured to a chain wire fence;
- Maintenance of dust control measures to keep the facilities in good operating condition;
- Stopping work during strong winds;
- Loading or unloading of dry soil as close as possible to stockpiles to prevent spreading of loose material around the development area; and
- Geofabric/geotextile could be placed over exposed soils in the event that excavation is staged.

If stockpiles are to remain on-site or soil remains exposed for a period of longer than several days, dust monitoring should be undertaken at the site. If excessive dust is generated all site activities should cease until either wind conditions are more acceptable or a revised method of excavation/remediation is developed. Reference is also to be made to the AMP in this regard.

Dust is also produced during the transfer of material to and from the site. All material should be covered during transport and should be properly disposed of on delivery. No material is to be left in an exposed, un-monitored condition.

All equipment and machinery should be brushed or washed down before leaving the site to limit dust and sediment movement off-site. In the event of prolonged rain and lack of paved areas all vehicles should be washed down prior to exit from the site, and any soil or dirt on the wheels of the vehicles removed. Water used to clean the vehicles should be collected and tested prior to appropriate disposal under the relevant waste classification guidelines.

8.8 Dewatering

Temporary dewatering is not anticipated to be required as part of the remediation works. If a rain event occurs, this water should be managed appropriately on site in accordance with the remediation contractor's soil and water management plan. This water should not be pumped to stormwater, sewer or directly to the Pittwater water body unless a prior application is made and this is approved by the relevant authorities.

8.9 Air Monitoring

Reference is to be made to the AMP for details regarding asbestos air fibre monitoring. Air monitoring must only be carried out by personnel registered and accredited by NATA (National Association of Testing Authorities). Filter analysis must only be carried out within a NATA certified laboratory. The monitoring results must conform to the requirements of the NOHSC Guidance note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003 (2005)].

A monitoring program will be used to assess whether the control procedures being applied are satisfactory and that criteria for airborne asbestos fibre levels are not being exceeded. The following levels will be used as action criteria during the air monitoring:

- <0.01 Fibres/ml: Work procedures deemed to be successful;
- 0.01 to 0.02 Fibres/ml: Inspection of the site and review of procedures; and
- >0.02 Fibres/ml: Stop work, inspection of the site, review of procedures, clean-up, rectification works where required and notify the relevant regulator.

8.10 Odour Control Plan

All activities undertaken at the site should be completed in a manner that minimises emissions of smoke, fumes and vapour into the atmosphere and any odours arising from the works or stockpiled material should be controlled. Control measures may include:

- Maintenance of construction equipment so that exhaust emissions comply with the Clean Air Regulations issued under the Protection of the Environment Operations Act (1997) (POEO);
- Demolition materials and other combustible waste should not be burnt on site;
- The spraying of a suitable proprietary product to suppress any odours that may be generated by excavated materials; and
- Use of protective covers (e.g. builder's plastic).

All practicable measures should be taken to reduce fugitive emissions emanating from the site so that associated odours do not constitute a nuisance and that the ambient air quality is not adversely impacted.

The following odour management plan should be implemented to limit the exposure of site personnel and surrounding residents to unpleasant odours:

- Excavation and stockpiling of material should be scheduled during periods with low winds if possible;
- A suitable proprietary product could be sprayed on material during excavation and following stockpiling to reduce odours (subject to an appropriate assessment of the product by the validation consultant);
- All complaints from workers and neighbours should be logged and a response provided. Work should be rescheduled as necessary to minimise odour problems;
- The site foreman should consider the following odour control measures:
  - reduce the exposed surface of the odorous materials;
  - time excavation activities to reduce off-site nuisance (particularly during strong winds); and
  - cover exposed excavation faces overnight or during periods of low excavation activity.
- If continued complaints are received, alternative odour management strategies should be considered and implemented.

8.11 Work Health and Safety (WHS) Plan

A site specific WHS plan should be prepared by the remediation contractor for all work to be undertaken at the site. The WHS plan should meet all the requirements outlined in SafeWork NSW WHS regulations.

As a minimum requirement, personnel must wear appropriate protective clothing, including long sleeve shirts, long trousers, steel cap boots and hard hats. Additional asbestos-related PPE will be required and this will be specified in the AMP. Washroom and lunchroom facilities should also be provided to allow workers to remove potential contamination from their hands and clothing prior to eating or drinking.

8.12 Waste Management

Prior to commencement of remedial works and excavation for the proposed development, the remediation contractor should develop a waste management or recycling plan to minimise the amount of waste produced by the site. Consideration should be given to re-use material wherever possible.

8.13 Incident Management Contingency

The validation consultant should be contacted if any unexpected conditions are encountered at the site. This should enable the scope of remedial/validation works to be adjusted as required. Similarly, if any incident occurs at the site, the validation consultant should be advised to assess potential impacts on contamination conditions and the remediation/validation timetable.

8.14 Hours of Operation

Hours of operation should be between those approved by the determining authority under the development approval process.

8.15 Community Consultation and Complaints

The remediation contractor should provide details for managing community consultation and complaints within their Construction Environmental Management Plan (CEMP).

9 CONCLUSIONS

JKE are of the opinion that the site can be made suitable for the proposed development provided this RAP is implemented. A site validation report is to be prepared on completion of remediation activities and submitted to the consent authority to demonstrate that the site is suitable for the proposed development.

Following remediation/validation the site will require management under a LTEMP. The LTEMP will provide a passive management approach which would not impose any constraints on the day to day site use under the proposed development scenario. The LTEMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential of exposure to the underlying fill. The LTEMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

Public notification and enforcement mechanisms for the LTEMP are to be arranged and Council is to be provided with a draft copy of the LTEMP for consultation prior to finalisation of the document. The notification and enforcement mechanisms are to include notation on the planning certificate under Section 10.7 of the Environmental Planning and Assessment Act (1979) and a covenant registered on the title to land under Section 88B of the Conveyancing Act (1919).

Surface ACM were identified at the site during the JKE PCS. The risk posed by asbestos should be addressed as a priority. As a duty of care, we recommend clearing the site surface of asbestos followed by a surface clearance from an SafeWork NSW Licensed Asbestos Assessor. An AMP should be prepared for the site.

9.1 Regulatory Requirements

The regulatory requirements applicable for the remediation are discussed in the following table:

Table 9-1: Regulatory Requirement

Guideline / Legislation / Policy	Applicability
SEPP55	Category 1 remediation works are those undertaken in the following areas specified under Clause 9 of SEPP55: • A designated development; • Carried out on land declared to be a critical habitat; • Development for which another SEPP or Regional Environmental Plan (REP) requires a development consent; or • Carried out in an area or zone classified as: ➢ Coastal Protection; ➢ Conservation or heritage conservation; ➢ Habitat protection, or habitat or wildlife corridor; ➢ Environmental protection; ➢ Escarpment, escarpment protection or preservation; ➢ Floodway or wetland; ➢ Nature reserve, scenic area or scenic protection; etc. • Work that is not carried out in accordance with the site management provisions contained in the consent authority Development Control Plan (DCP)/Local Environmental Plan (LEP) etc.

Guideline / Legislation / Policy	Applicability
	Approval is required from the consent authority for Category 1 remediation work. The RAP needs to be assessed as part of the development consent. Category 1 remediation work is identified as advertised development work unless the remediation work is a designated development or a state significant development (Clause 13 of SEPP55). Based on the proximity of the site to the costal area, JKE are of the opinion that the remediation works will likely fall under Category 1. We recommend consulting with Council in order to determine the requirements under this category.
POEO Act 1997	Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. Appropriate waste tracking is required for all waste that is disposed off-site. Activities should be carried out in a manner which does not result in the pollution of waters.
POEO (Waste) Regulation 2014	Part 7 of the POEO Waste Regulation 2014 set outs the requirements for the transportation and management of asbestos waste and Clause 79 of the POEO Waste Regulation requires waste transporters to provide information to the NSW EPA regarding the movement of any load in NSW of more than 10 square meters of asbestos sheeting, or 100 kilograms of asbestos waste. To fulfil these legal obligations, asbestos waste transporters must use WasteLocate.
SafeWork NSW Code of Practice: How to manage and control asbestos in the workplace (2019)	Sites with asbestos become a 'workplace' when work is carried out there and require a register and AMP. Appropriate SafeWork NSW notification will be required for licensed (e.g. Class A) asbestos removal works or handling.

10 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations
Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: JKE PCS Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM, 28 DEC 2018.

This plan should be read in conjunction with the Environmental report.

Title: **SITE LOCATION PLAN**

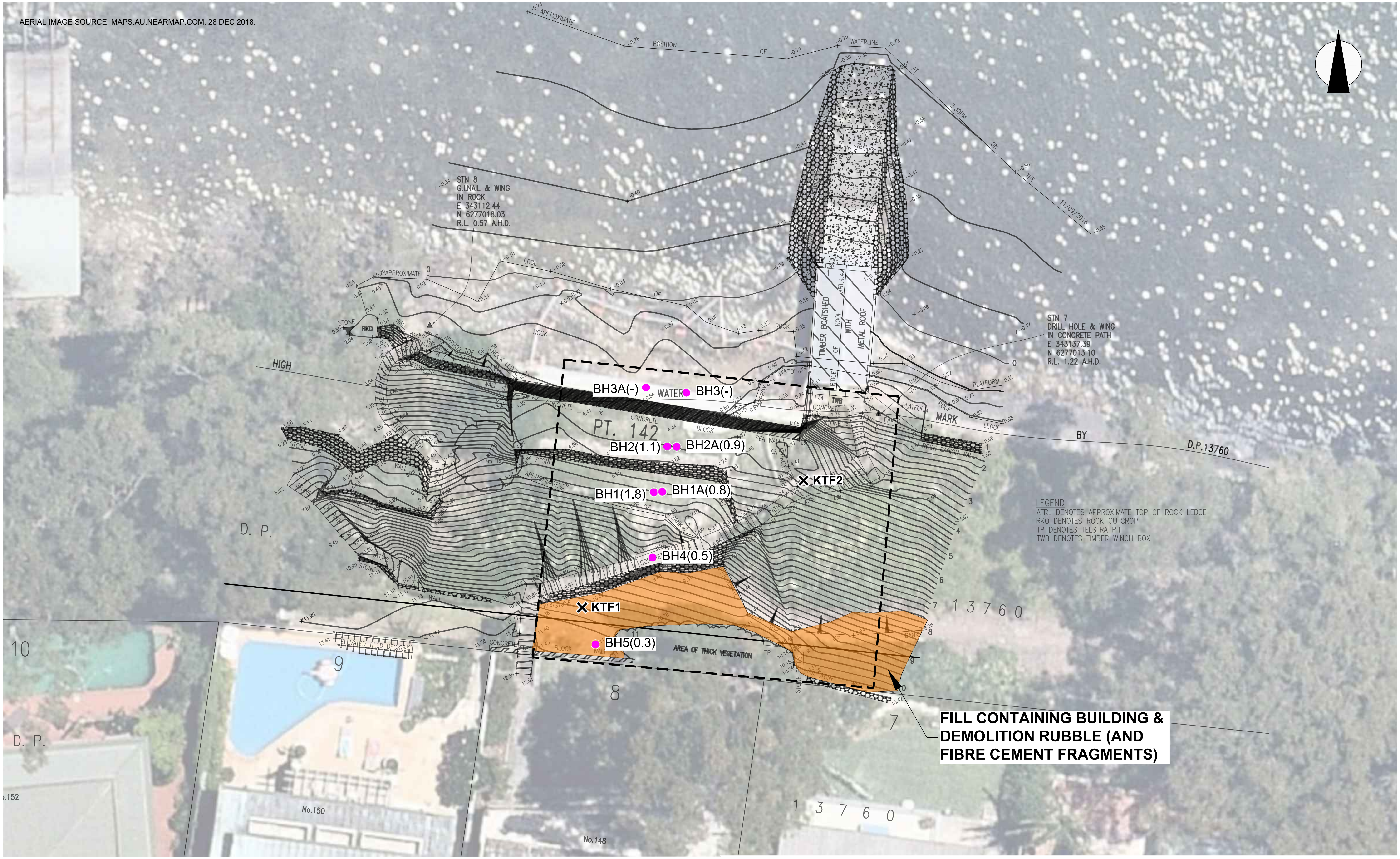
Location: 148 HUDSON PARADE
CLAREVILLE, NSW

Report No: E32115B

Figure No: 1

JKEnvironments

PLOT DATE: 29/05/2019 11:31:09 AM DWG FILE: S:\S EIS\SC EIS JOBS\32000'S\E32115B_CLAREVILLE\CAD\E32115B.DWG



AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM, 28 DEC 2018.
BH3A(-)
BH3(-)
BH2(1.1)
BH2A(0.9)
BH1(1.8)
BH1A(0.8)
KTF2
BH4(0.5)
KTF1
BH5(0.3)
FILL CONTAINING BUILDING & DEMOLITION RUBBLE (AND FIBRE CEMENT FRAGMENTS)
STN 8
G.I.NAIL & WING
IN ROCK
E 343112.44
N 6277018.03
R.L. 0.57 A.H.D.
STN 7
DRILL HOLE & WING
IN CONCRETE PATH
E 343137.39
N 6277013.10
R.L. 1.22 A.H.D.
TIMBER BOATSHED ROOF WITH METAL ROOF
PT. 142
D.P. 13760
LEGEND
ATRL DENOTES APPROXIMATE TOP OF ROCK LEDGE
RKO DENOTES ROCK OUTCROP
TP DENOTES TELSTRA PIT
TWB DENOTES TIMBER WINCH BOX
AREA OF THICK VEGETATION
No.152
No.150
No.148

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH (Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
- KTF1 FIBRE CEMENT FRAGMENT (FCF)

SCALE 0 2 4 6 8 10 METRES 1:200 @A3

This plan should be read in conjunction with the Environmental report.

Title:	**SAMPLE LOCATION PLAN**
Location:	148 HUDSON PARADE CLAREVILLE, NSW
Report No: E32115B	Figure No: 2

JKEnvironments

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Appendix B: JKG Seawall Repair Specification

LEGEND

- ● BOREHOLE
- ⊗ ROW 5 RL1.0m
  ROW 4 RL2.4m
- × ROW 3 RL4.4m
- × ROW 2 RL6.4m OR ABOVE STEP AT REAR OF SLIP
- × ROW 1 RL8.7m

NOTES:

1. ACTUAL BOLT PLACEMENT DEPENDANT ON LOCALISED GEOMETRY & TO BE SET OUT BY GEOTECHNICAL ENGINEER.
2. ROW 4+5 BASED ON ELEVATIONS @ CHAINAGES:
   0.6m, 2.5m, 8.0m, 9.5m, 12.25m, 15.0m, 16.5m, 19.25m AND 22.0m.

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 2 4 6 8 10

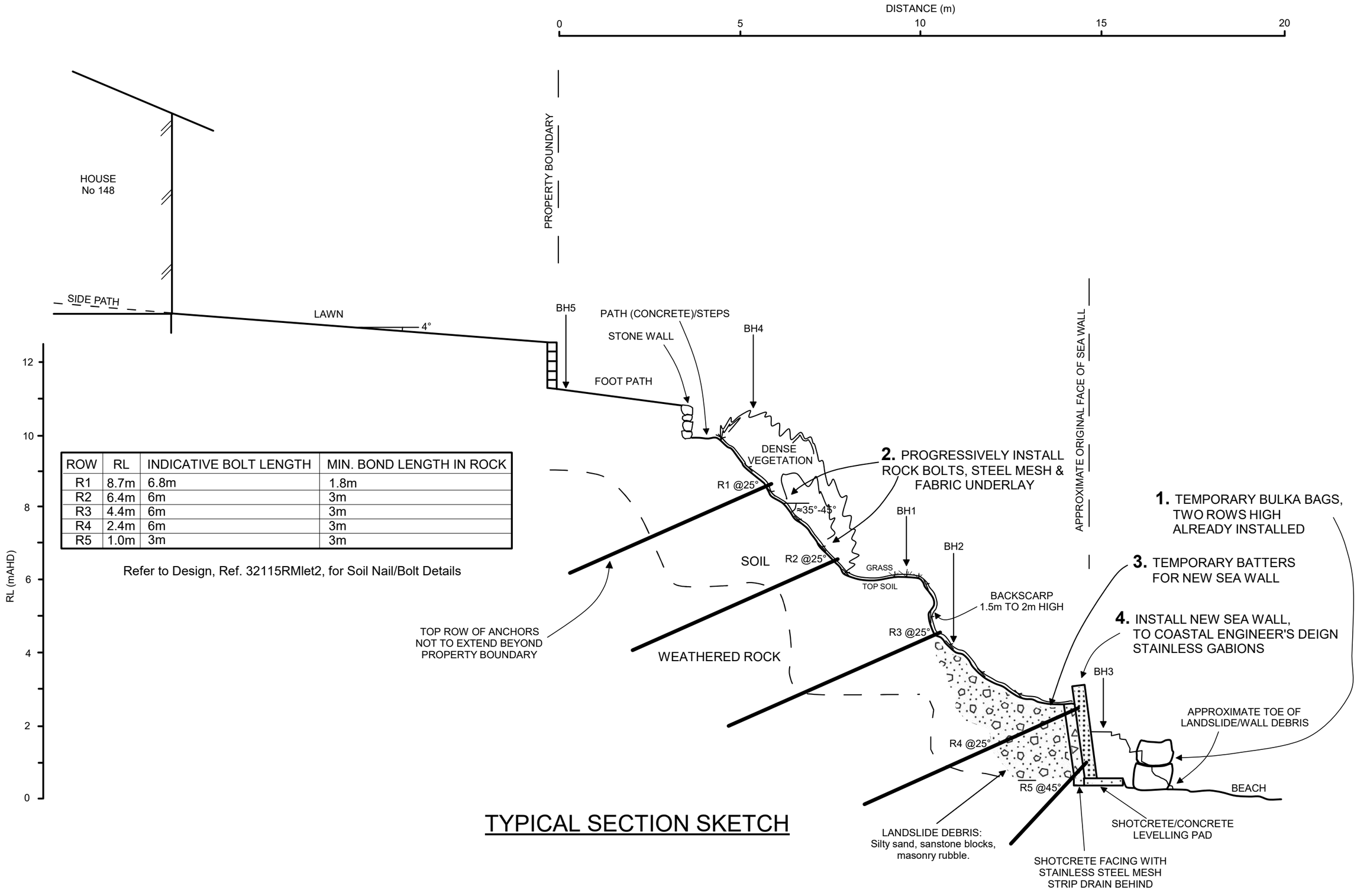
SCALE 1:200 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title:	**SITE PLAN INDICATING PROPOSED ROCK BOLTS**
Location:	148 HUDSON PARADE CLAREVILLE, NSW
Report No:	32115RMspecRev1
Figure No:	1

JKGeotechnics

PLOT DATE: 1/06/2021 11:57:58 AM DWG FILE: Y:\32000'S\32115R CLAREVILLE\CAD\32115RMSPECREV1.DWG



ROW	RL	INDICATIVE BOLT LENGTH	MIN. BOND LENGTH IN ROCK
R1	8.7m	6.8m	1.8m
R2	6.4m	6m	3m
R3	4.4m	6m	3m
R4	2.4m	6m	3m
R5	1.0m	3m	3m

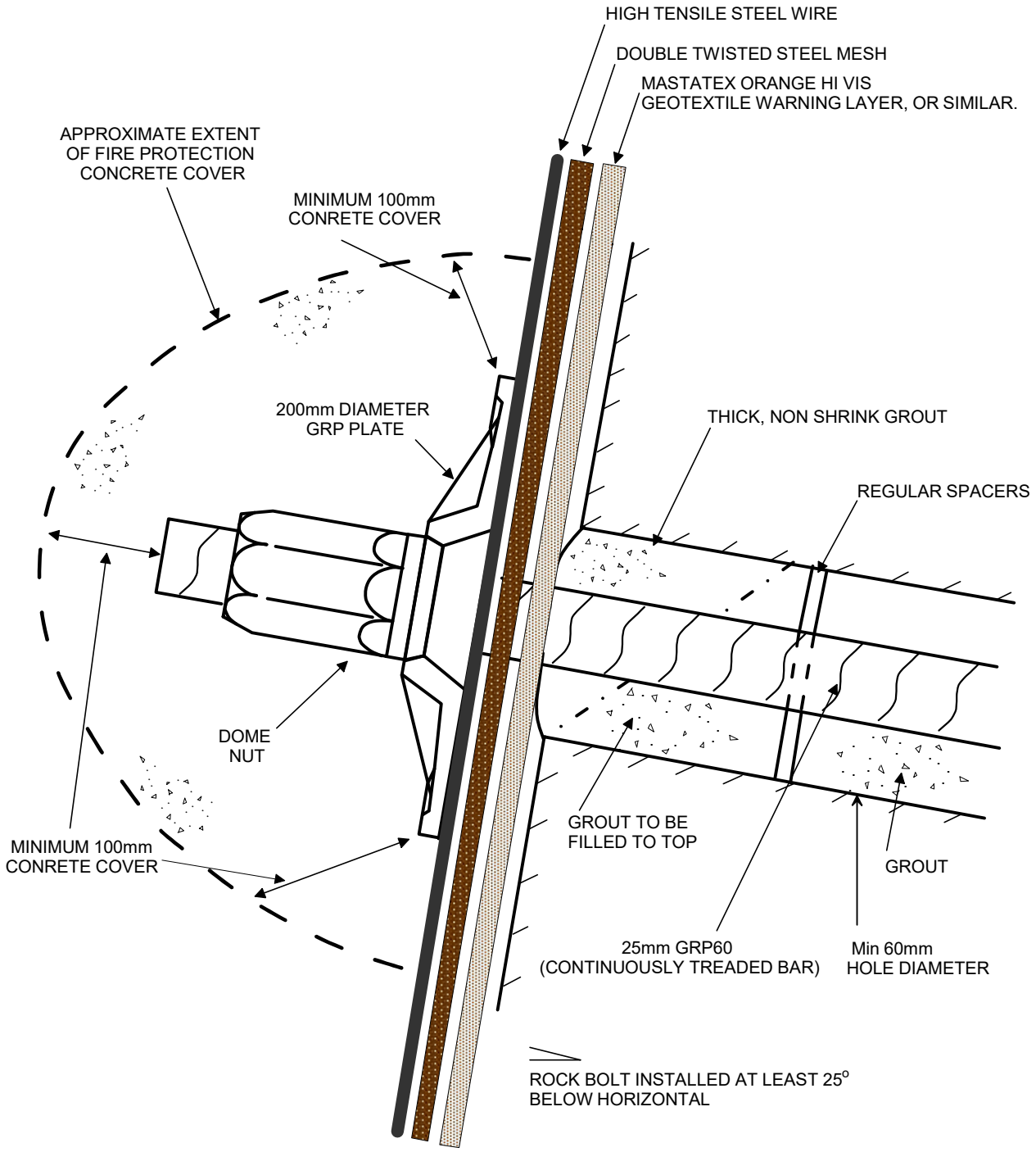
Refer to Design, Ref. 32115RMlet2, for Soil Nail/Bolt Details

TYPICAL SECTION SKETCH

0 5
Scale 1:100 @A3 Metres

JKGeotechnics

Report No. 32115RMspecRev1 Figure No. 2



TYPICAL ROCK BOLT HEAD DETAIL SUPPORTING STEEL MESH FACING

NOTE: REFER TO TEXT OF SPECIFICATIONS FOR FURTHER DETAILS.

NOT TO SCALE

JKGeotechnics

Report No. 32115RMspec Rev1 Figure No. 3

Appendix C: Guidelines and Reference Documents

Contaminated Land Management Act 1997 (NSW)

Conveyancing Act (1919) (NSW).

Environmental Planning and Assessment Act 1979 (NSW)

Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

NSW EPA, (2020). Consultants Reporting on Contaminated Land, Contaminated Land Guidelines

National Environment Protection Council (NEPC), (2013). National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

Protection of the Environment Operations Act 1997 (NSW)

State Environmental Planning Policy No.55 – Remediation of Land 1998 (NSW)