AusNet Services
23-Oct-2014

Brunswick Terminal Station Augmentation Project

Construction Environmental Management Plan

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Construction Environmental Management Plan

Client: AusNet Services

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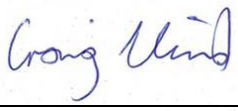
H	23-Oct-2014	With Planning Permit Approval	Craig Hind Technical Director	

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1.0 Introduction

1.1 About AusNet Services

On 4 August 2014, SP AusNet changed its trading name to AusNet Services[1]. AusNet Services is an energy business that provides essential services across three Victorian energy networks, comprising electricity transmission, electricity distribution and gas distribution. AusNet Services provides electricity distribution to approximately 668,000 customers across eastern Victoria and gas supply to approximately 633,000 customers across central and western Victoria.

AusNet Services owns and manages the Brunswick Terminal Station (BTS) (see **Figure 1**). This is critical transmission infrastructure that reduces the voltage of electricity transmitted to a level suitable for domestic distribution. CitiPower and Jemena are responsible for the distribution of electricity from BTS to electricity customers.

1.2 Project Overview

The BTS Augmentation Project (BTS upgrade) is a significant construction project for AusNet Services.

The BTS upgrade comprises upgrade of the existing terminal station to a 66kV terminal station including associated decommissioning, partial demolition and construction activities at the existing site in King Street, East Brunswick. Upon completion, it is expected that the project will increase the station's maximum installed capacity to supply an additional 65,000 customers in Melbourne's CBD and inner suburbs.

The project activities covered by this Construction Environmental Management Plan (CEMP) include demolition of redundant assets and construction of the upgraded terminal station.

1.2.1 Timing of Construction

The general timeframes for activities covered by this CEMP are outlined in **Table 1**. It is noted that minor works commenced as part of Stage Two that were considered acceptable under the existing approved planning conditions. Stage Three, particularly landscaping, will overlap with Stage Two works as agreed with Moreland City Council to enable the staged establishment of new vegetation before the conclusion of the project.

Table 1 Timing of Construction

Stage and key activities	Indicative Timing
Stage One (Mobilisation) – early works, site mobilisation, site set up, existing building demolition and removal	December 2012 – July 2013 (8 months) - Complete
Stage Two (Construction) – excavation, building construction, electrical equipment installation and remaining demolition works	July 2014 – July 2016 (24 months)
Stage Three (Demobilisation) – fencing, landscaping and revegetation	December 2015 – December 2016 (12 months)

[1] On 4 August 2014, SP AusNet changed its trading name to AusNet Services. Any residual references to SP AusNet in the Appendices should refer to AusNet Services.

Figure 1 Aerial photo of the features at BTS prior to project commencement

1.3 Purpose and Objectives of the CEMP

1.3.1 Purpose

This CEMP details the environmental management and mitigation measures which will be implemented during the construction phase of the BTS upgrade, with the primary objective of reducing any associated adverse environmental impacts and meeting regulatory requirements. This CEMP provides a framework for actions, responsibilities and protocols associated with environmental management which AusNet Services and their Delivery Partners (DPs) are required to deliver at all times.

The mitigation and management measures detailed in this CEMP (and the associated sub-plans and Standard Operating Procedures) are required as a minimum to meet the requirements of AusNet Services Environmental Management System (including the Environmental Policy), the Brunswick Terminal Station Incorporated Document 2012 and Planning Permit (MPS/2014/87). Accordingly, this CEMP should be read in conjunction with the project specific sub-plans, including:

- Noise and Vibration Management Sub-plan (**Appendix A**)
- Traffic Management Sub-plan (**Appendix B**)
- Flora and Fauna Management Sub-plan (**Appendix C**)
- Air Quality Management Sub-plan (**Appendix D**)
- Contamination Management Sub-plan (**Appendix E**)
- Erosion, Sedimentation and Earthworks Management Sub-plan (**Appendix F**).

1.3.2 Objectives

The objectives of this CEMP are to:

- achieve no adverse environmental impacts
- achieve compliance with relevant environmental legislation and policy
- ensure application of appropriate environmental management
- ensure stakeholder and community commitments are adhered to
- ensure responsibility for environmental management is allocated for all roles and responsibilities on the project
- ensure appropriate management of environmental risks
- ensure conformance with the CEMP.

1.4 Environmental Policy Commitments

AusNet Services has implemented an Environmental Management System (EMS) to manage the development, implementation, achievement, review and maintenance of its environmental policy. The Environmental Policy (AusNet Services 2009) makes the following overall commitment to environmental management:

"We strive to be a leader in the management of environmental issues associated with energy delivery infrastructure for gas and electricity networks in Australia. We are committed to creating a sustainable business – a business that seeks to balance the environmental, economic and social needs of today without sacrificing the interests of future generations."

AusNet Services environmental management commitments, as outlined in the Environmental Policy, are as follows:

- **Compliance** – we conduct our operations in an environmentally sound manner, satisfying all applicable legal and regulatory requirements, as well as relevant industry codes of practice and Company standards.
- **Minimising impacts** – we integrate environmental considerations into our business planning and decision-making processes. We work with customers and business partners to reduce environmental impacts as much as practicable while preventing pollution and promoting waste minimisation and recycling.
- **Climate change** – we acknowledge the impact of climate change on our business, the community and our customers. We seek to accurately determine and report our greenhouse gas emissions profile and energy consumption. We are committed to showing leadership in adapting our business to respond to emerging energy markets, climate change policies and changing customer sentiment.
- **Emergency response** – we maintain contingency plans and procedures to deal effectively with emergencies such as accidental spills and discharges.
- **Renewable energy** – we support the development of more efficient, less carbon intensive energy sources, including large and small scale renewable projects, through the network connections and supply of off-grid alternatives where applicable.
- **Public reporting** – we publicly report on our environmental progress and accomplishments every year, taking into account global reporting standards and best practices.
- **Stakeholder engagement** – we employ effective means to identify and communicate with our stakeholders to ensure we deliver energy solutions with minimal impact on the environment and the communities in which we operate. Our stakeholders include owners, employees, Delivery Partners, customers, suppliers, business partners, regulators, citizens, environmental groups, research institutions, non-governmental organisations and the wider community in which we operate.

This CEMP has been developed in accordance with AusNet Services Environmental Policy.

1.5 Community Commitments

A comprehensive consultation program has been undertaken to inform the local community on the project and to seek feedback on the design process. Community commitments relevant to the construction phase, and this CEMP, are presented in **Table 2**.

Table 2 Community Commitments

Environmental Aspect	Commitment	CEMP Section
Visual Amenity	- Removal of all redundant buildings.	6.12
Environment	- Ensure that construction workers are aware of the site's environmental and community sensitivities and context. - Ensure construction workers are aware of their responsibilities. - Prevent spread of weed species from the site. - Prevent the infestation of animal pest, particularly foxes, rabbits and rats.	6.0

Environmental Aspect	Commitment	CEMP Section
	- Prevent adverse environmental and community impacts from construction. - Prevent loss of soil and creation of dust. - Minimise any degradation of the quality of water leaving the site. - Minimise the generation of excessive construction waste, including litter. - Minimise contamination of the environment from dust.	
Contamination	- To further analyse and characterise Contaminants of Potential Concern (COPC) and to have area specific contamination management and response plans in place prior to the commencement of any earthworks, construction or demolition activities. - To minimise the risks to the environment and human health associated with earthworks and construction and demolition activities. - To ensure construction workers engaged in earthworks, construction or demolition activities or off-site disposal of soil are aware of potential contamination issues through site inductions, environmental training and at daily toolbox meetings, and undertake these activities in accordance with applicable Federal and State legislative and policy requirements. - To ensure that all earthworks, construction and demolition activities which could intercept or expose contaminants of potential concern are managed to prevent stormwater or dust discharges. - Any stormwater captured within the bunded areas will continue to be directed to the onsite oil-water separation facilities. Any oil collected in the onsite holding tank is periodically removed off-site. - Stormwater runoff will be directed to the existing legal point of discharge adjacent to Merri Creek. The new transformers will be bunded to the same standard as those existing; such that a major oil spill would be completely contained onsite.	6.8
Health and Safety	- The upgrade of the BTS will comply with all relevant health, safety and environmental standards and guidelines. - Prevent adverse environmental and community impacts from construction. - To ensure all personnel have relevant knowledge of environmental management, know their own (and others) environmental responsibilities and carry out their duties in order to successfully implement the CEMP.	3.4 and 6.0
Noise	- Use of lowest practicable noise emitting equipment and plant; noise levels will be considered in the selection of all plant and equipment, including the use of bored piles rather than driven piles where appropriate. - Visual inspection of all equipment to operate onsite to ensure that any noise mitigation (e.g. mufflers) is suitable for the use.	6.4

Environmental Aspect	Commitment	CEMP Section
	- Stationary plant items such as generators will be sited as far from sensitive receivers as practical and screening will be provided as required. - Use of sound proof generators. - Regular servicing of machinery and vehicles. - Noisy activities will be undertaken during less sensitive times where practicable. - Quiet (broadband) reversing alarms. - EPA Publication 1254 identifies the following hours of operation: • Normal ▪ 7am – 6pm Monday to Friday ▪ 7am – 1pm Saturday • Weekend / Evening ▪ 6pm – 10pm Monday to Friday ▪ 1pm – 10pm Saturday ▪ 7am – 10pm Sundays and public holidays During these hours, noise level at any residential property should not exceed background noise by: ▪ 10dB(A) or more for up to 18 months after project commencement ▪ 5 dB(A) or more after 18 months • Night ▪ 10pm – 7am Monday to Sunday Noise should be inaudible within a habitable room of any residential property. - AusNet Services will comply with the requirements of EPA Publication 1254.	
Vibration	- To seek to minimise the effect of noise and vibration on the local community. - All site personnel are to be inducted with respect to the requirements of the noise and vibration sub plan. These inductions include: • work hours • delivery hours and locations • noise minimisation measures • the importance of regular plant maintenance. - Ongoing training will ensure updates to noise management procedures are implemented and maintained. - Records will be kept of all personnel undertaking the site induction and training, including the contents of the training, date and name of trainer.	6.4
Traffic	- Prevent vehicle accidents and protect life and property. - Avoid or minimise environmental damage and visual and noise disturbance due to vehicular traffic.	6.5

Environmental Aspect	Commitment	CEMP Section
Construction Timing and Impacts	- To provide appropriate mechanisms for the collection, treatment, recycling, reuse and disposal of construction waste and litter. - To prevent environmental degradation caused by the inappropriate disposal of construction waste and litter. - To provide for the environmentally responsible disposal of all construction wastes and litter. - To conserve resources and to maximise the recovery of reusable materials. - The construction Delivery Partner will formulate and implement a waste minimisation strategy.	1.2
Design Principles	- Minimise construction impacts on the community.	6.0

1.6 Document Control

Document control for the CEMP and associated documentation, will be undertaken in accordance with the following AusNet Services procedures:

- Records Management QMS 20-02
- Document and Data Control 20-04

An electronic copy of the CEMP will be maintained and updated as required to reflect any changes in circumstances including changes in the construction plan, as outlined in **Section 1.7**. An electronic copy of this CEMP will be maintained on the AusNet Services Environment Drive.

The distribution list of registered copies is outlined in **Section 1.6.1**. The distribution list will be maintained by the AusNet Services Project Manager and all copies will be issued electronically. It is the AusNet Services Project Manager's responsibility to ensure personnel are aware of the location of the most recent version of this document.

1.6.1 Distribution List of Registered Copies

All hardcopies of the CEMP, labelled with their distribution numbers / document issue number in the footer and on the front cover, will be provided to the personnel listed in **Table 3.**

Table 3 Distribution List

Distribution No.	Personnel Issued To
1	AusNet Services Project Manager
2	ISP Project Manager
3	Delivery Partner Construction Manager
4	AusNet Services Environment Manager (or delegate)
5	Moreland City Council
6	Design Service Provider
Electronic Copy	Latest version maintained on AusNet Services Environment Drive

1.6.2 Environmental Record Management

Environmental records will be maintained by the AusNet Services Construction Manager. Records will be maintained in accordance with **Table 4** and AusNet Services *Records Management QMS 20-02* procedure.

Table 4 Environmental Record Locations

Document	Electronic(E) or Hardcopy (H)	Storage Location	Period of Retention (minimum)
Daily site diary / checklists	E & H	Environment drive	3 years
Weekly site inspection checklists	E & H	Environment drive	7 years
Internal and external audit reports	E & H	Environment drive	7 years
Incident / non-conformance reports	E & H	Environment drive	7 years
Environmental training records	E & H	Environment drive	7 years
Complaint and enquiry records	E & H	Community Consultation drive	7 years

1.7 Plan Review

This CEMP is a live document and will be reviewed and updated where necessary to reflect the plan of construction, relevant legislation and policy, any recommendations arising from site inspections, audits, meetings and non-conformances. Triggers for CEMP review include:

- identification of new environmental risks
- changes in legislation and best practice environmental management standards
- changes in the landscape (including changes as a result of a natural disaster)
- requests from AusNet Services.

Any revisions to the CEMP will be approved by the AusNet Services Project Manager and the updated CEMP will be provided to the Delivery Partner Project Manager and stakeholders according to **Section 1.6.1**. In addition, all construction staff will be informed of any important changes to the CEMP during toolbox sessions prior to the start of the working day. A hard copy of the CEMP will be kept onsite at all times and at the AusNet Services Project Manager's Office, where it can be viewed upon request.

A record of review / updates to the CEMP will be maintained in a register for audit purposes, in line with AusNet Services *Document and Data Control QMS 20-04* procedure.

2.0 Project Description

2.1 Existing Site Context

2.1.1 Site Description

The BTS site is located on the north eastern corner of King Street and Alister Street in Brunswick East, approximately 5km north of Melbourne's CBD. The site is irregular in shape, with a frontage of approximately 294m to King Street and a frontage of approximately 149m on Alister Street. The overall site covers an area of 4.06 hectares. An aerial photograph of the site prior to project commencement is shown in **Figure 1**.

BTS is located in a predominantly residential area, and has been in operation on the existing site since 1939. The eastern boundary of the site abuts Merri Creek, which is an open space reserve, and a watercourse that has been significantly rehabilitated, landscaped and developed with shared cycle and pedestrian paths. The site also abuts Sumner Park which is a well-used formal recreation reserve. Adjacent land to the south and west comprises residential properties. The Merri Creek bicycle track runs through the north-eastern section of the site and is currently being leased to Moreland City Council. There are two effective access points to the site which include a vehicle cross over and main entrance gate located on the corner of Alister and King Street and a gate located on King Street.

The surface of the site is generally flat with the northern boundary sloping down to the east and north to Merri Creek with an elevation of approximately 43m. The Merri Creek corridor extends from the north-east of the site to the south-east, and flows in a south-easterly direction.

There is an existing terminal station which is housed in the northern area of the site which converts electricity from an external power station from 220kV to 22kV. In addition, a disused 66kV switchyard is located on the eastern side of the site. There are also 220kV overhead lines entering the site from the north and a 220kV underground cable which enters the site from the east. An underground cable transports electricity between Richmond Terminal Station and BTS. A total of 23 x 22kV underground feeders leave the site in several directions, transporting the reduced voltage electricity to substations in the surrounding area. Redundant buildings and structures including a compressor room, maintenance building, workshop buildings, 66kv switchyard, machine room and storerooms were demolished and removed as part of Stage 1 (Mobilisation) works undertaken in 2013.

The perimeter of the site is secured by two separate fences. There is a standard chain wire mesh fence around the perimeter of the site and within this fence there is a second security fence which is electrified.

2.1.2 Environmental Conditions

Vegetation exists along the site boundaries, and includes planted natives and exotic species.

2.1.3 Key Environmental Sensitivities

Merri Creek is the key environmental sensitivity located near the construction area. This watercourse exists approximately 10m to the north-east of the site and as a whole is known to support a range of flora and fauna and vegetation communities[2].

2.2 Description of Works

The BTS upgrade will increase the capacity of the supply infrastructure from 225MVA to 900 MVA, increasing reliability and security of power supply to Melbourne's inner northern suburbs. The project will include the following construction activities, as shown in **Figure 2.**

- establishment of a control room abutting the 220kV room that is approximately 27m x 16m and approximately 6m in height
- establishment of a 66kV building towards the southern end of the site. This building will house the 66kV Gas Insulated Switchgear (GIS), transformers, and the capacitor banks. The building will be approximately 57m x 50m. This building will be divided roughly into thirds with each third incrementally stepping up and away from Alister Street – approximately 7m, 9m then 10m in height

[2] AECOM 2012, Brunswick Terminal Station Augmentation Project: Flora and Fauna Management Plan, August 2012.

- relocation of the existing perimeter and security fences. The electrified security fence is to be set back from its existing position and the perimeter fence will be replaced with a fence made of a combination of palisade and chain-wire mesh. This fence will be set-back along the frontages closest to the King and Alister Streets intersection
- removal of the redundant 66kV switchyard located in the eastern area of the BTS site
- removal of the existing compressor room
- removal of the workshop buildings and sheds located in the south east corner of the site
- removal of redundant buildings along King Street (including the maintenance building, cooling tower and machine room)
- replacement of the line termination rack at the northern end of the site - the new rack will be of tubular rather than lattice construction
- replacement of the existing outdoor 220kV switchyard with new indoor GIS. The building will be located near the eastern site boundary and will be approximately 26m x 27m and approximately 10m high.
- removal of the tower on the King Street side of the site
- complete removal of the disused access point mid-way along King Street
- ancillary and temporary works

To address concerns of visual amenity, the majority of the new infrastructure will be contained within buildings. As such, the proposal does not incorporate any structures of heights greater than existing buildings or infrastructure on the site.

2.2.1 Stages of Works

For the purposes of this document, the construction activities outlined above will be undertaken over three stages as outlined in **Table 5**.

Table 5 Construction Stages

Stage	Timing	Typical Activities
1 (Mobilisation)	8 months (Complete)	Early works
		Site set-up
		Existing building demolition and removal
		Clean-up
2 (Construction)	24 months	Onsite excavations
		Building construction
		Electrical equipment installation
		Final demolition works
3 (Demobilisation)	12 months	Fencing
		Landscaping
		Site demobilisation

A diagram of the proposed upgrade is shown in **Figure 2.**

Temporary works – as part of the construction schedule, temporary works will be necessary for the purpose of enabling the progressive (staged) augmentation of the station whilst not impacting on electricity supply. These works may include, but are not limited to:

- Temporary civil works, structural and overhead line arrangements to facilitate bypass requirements.
- Temporary locations and operation of transformers, racks, towers, overhead lines, underground cables, electrical apparatus and switching equipment for operational staging.
- Temporary scaffolding works, platforms and landings to facilitate building construction.
- Temporary access tracks and landing sites to facilitate equipment movements' onsite.
- Temporary fencing and security arrangements to maintain a safe operational site.

Note: BTS will remain in operation throughout the construction period. The locations of these temporary works may shift during the life of the construction period due to site constraints. All temporary works will comply with environmental, planning approvals and amenity commitments. All temporary works will be deconstructed within the project schedule prior to project completion.

2.2.2 Hours of Work

EPA Noise Control Guidelines, Publication 1254 (see **Appendix A**) outlines the working hours for construction sites. These restrictions are presented in **Table 6**.

Table 6 EPA Publication 1254 Working Hour Restrictions for Construction Sites

Working Hours
Normal
- 7am – 6pm Monday to Friday - 7am – 1pm Saturday
• **Weekend / Evening**
- 6pm – 10pm Monday to Friday - 1pm – 10pm Saturday - 7am – 10pm Sundays and public holidays During these hours, noise level at any residential property should not exceed background noise by: - 10dB(A) or more for up to 18 months after project commencement - 5 dB(A) or more after 18 months
• **Night**
- 10pm – 7am Monday to Sunday Noise should be inaudible within a habitable room of any residential property.

To reduce impacts to nearby residents, AusNet Services aims to further restrict their working hours where possible. Further detail regarding working hours can be found in the Noise and Vibration Management Sub-plan, provided in **Appendix A**.

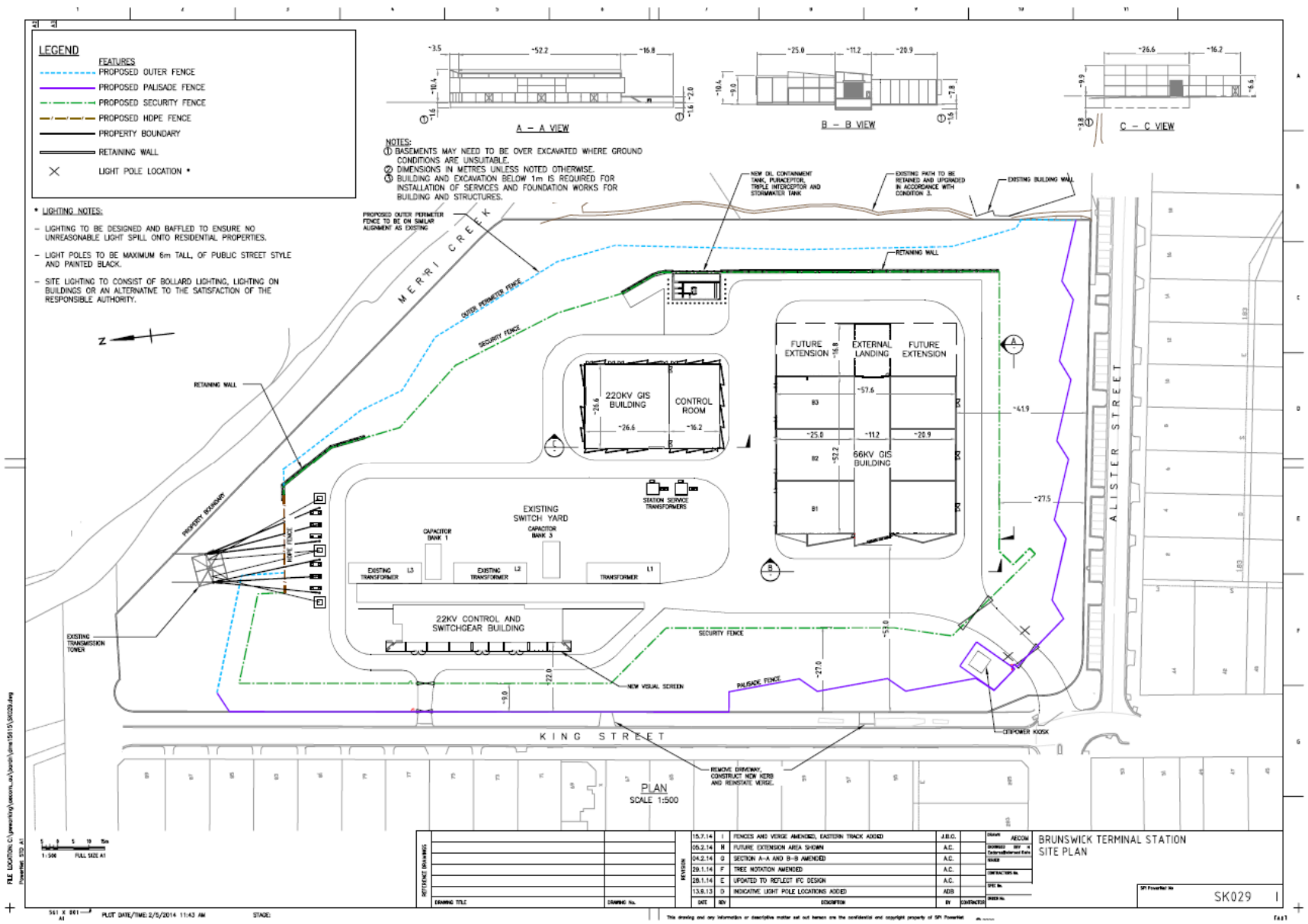


Figure 2 Indicative layout of BTS post upgrade

2.3 Handling and Storage of Hazardous Materials

Handling and storage of hazardous materials, including chemicals, fuels and oils will be controlled in accordance with AusNet Services *Chemical Management HSP 05-10* procedure, the Contamination Management Sub-plan provided in **Appendix E** and with the procedures and guidelines set by the EPA. Where the Delivery Partner identifies the necessity to store materials that are not covered by AusNet Services *Chemical Management HSP 05-10* procedure, the Delivery Partner will prepare a project-specific method statement for approval by the AusNet Services Environment or Safety Manager. When determining if project specific methods are needed for handling and storage of materials, the Delivery Partner Project Manager will include consideration of the potential environmental consequences if materials are handled or stored incorrectly (e.g. water quality impacts and soil contamination).

The Delivery Partner Project Manager will ensure that manufacturer's instructions and / or Safety Data Sheets (SDS) for substances are obtained and kept in the Project Safety Management File or electronic database which will be readily available to site personnel when needed.

The Delivery Partner will minimise the storage of hazardous materials onsite and refuelling of large excavation equipment will be undertaken via small fuel tankers. Any chemicals stored onsite will be appropriately stored, including the use of a purpose built lockable hazardous material storage cupboard.

2.4 Maintenance of Plant and Equipment

Plant and equipment will be maintained and serviced regularly in accordance with manufacturers' recommendations and documentation detailing the service history, including the calibration of monitoring equipment will be kept in the Project Safety Management File. All plant and equipment will be assessed upon arrival onsite to confirm safety and operability and controlled in accordance with the procedures and guidelines set by the EPA. Maintenance of all plant and equipment onsite is the responsibility of the Delivery Partner Construction Manager (or delegate). Proposed environmental control measures for construction plant and equipment are outlined in **Table 7**.

Table 7: Plant and equipment control

Type	Environmental Control Measure	Documents Required
Plant (including trucks, dozers, cranes)	- within specified noise level - engine covers secured - no excessive vibration - within specified air pollutant level - fuel, oil, hydraulic fluid and coolant leaks	Pre-use checklist / maintenance log
Fuel, oil, chemicals and lubricant	- lids/cover secured - no leakage/spillage - markings/identification	Relevant SDSs
Equipment (generators, pumps)	- within specified noise level - no excessive vibration - fuel and oil leaks	Pre-use checklist / maintenance log

Testing and calibration of equipment will be undertaken in accordance with AusNet Services *Inspection Measuring and Test Equipment QMS 20-09* and *Monitoring and Measurement of Operations EMS 21-59* procedures.

All plant and equipment should be evaluated against health, safety and environmental performance, prior to purchase or hire. An example of the checklist that can be utilised to undertake this assessment is AusNet Services *Pre-purchase HSE Evaluation for Plant and Equipment HSP 02-01A*. Should plant or equipment not comply with the relevant checklist and / or plant instruction manual, use will cease immediately and the non-conformance and / or incident will be addressed. Further detail on the procedure to be followed in the event of a non-conformance or incident is outlined in **Section 8.4**.

3.0 Structure and Responsibilities

3.1 Environmental Management System

AusNet Services is committed to achieving outstanding performance in relation to environmental management. To achieve this, the environment, community and stakeholders will be considered in all activities related to the BTS upgrade.

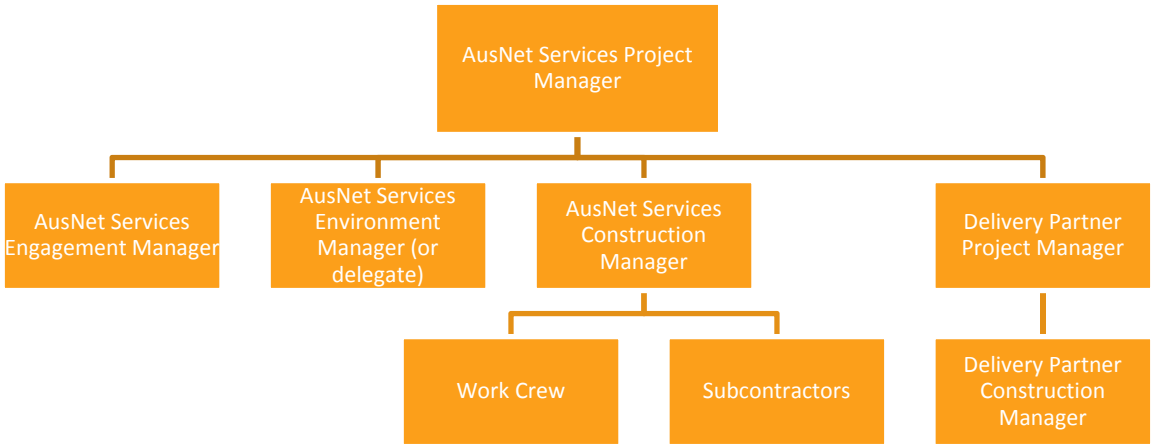
This CEMP has been prepared in accordance with AusNet Services (including the Environmental Policy), Brunswick Terminal Station Incorporated Document 2012 and Planning Permit (MPS/2014/87) and is to be implemented by all members of the AusNet Services and Delivery Partner workforce, including sub-contractors. AusNet Services EMS is certified to Australian and International Standards AS/NZS ISO 14001 and is used to achieve compliance with relevant legislation and policy and meet AusNet Services environmental objectives.

3.2 Project Organisational Structure

The BTS project will be delivered by a combined team of AusNet Services and Delivery Partner representatives. The project will be managed by the Project Delivery Team as per the organisational chart presented in **Figure 3**. The AusNet Services Project Manager is accountable for the ongoing compliance with the CEMP and the overall environmental performance of the project. This will include implementation of AusNet Services Environmental Policy and EMS and for overall supervision of construction personnel. The Delivery Partner Project Manager will be supported by the AusNet Services Environment Manager (or delegate) who will be responsible for managing environmental procedures onsite.

During the construction period, all construction personnel (AusNet Services, Delivery Partner and sub-contractor personnel) have general responsibilities in the development of a positive environmental management culture and for ensuring all activities are conducted in a manner which is consistent with this CEMP.

Figure 3 Project Organisational Structure



3.3 Roles and Responsibilities

A list of key project roles and their responsibilities is detailed in this section of the CEMP. The Delivery Partner is responsible for preparing and keeping current an environmental key contacts list which will identify the name and contact number for the roles described below. This contact list will be publically available to all personnel at the project site.

3.3.1 AusNet Services Project Manager

The AusNet Services Project Manager is responsible for the overall management, performance and delivery of all aspects of the BTS upgrade and day-to-day planning and administration. The AusNet Services Project Manager is responsible for:

- reviewing and authorising CEMP and EMS project documentation, which identifies the project specific environmental impacts, aspects, objectives and targets
- ensuring project personnel are provided with the appropriate documentation
- ensuring subcontractors have a contractual obligation to comply with the requirements of all CEMP and EMS documentation (including legislation, regulations, SEPP etc.)
- reviewing and authorising personnel to amend the CEMP
- reporting incidents to Senior Management and consult in resolution and investigation
- reviewing performance of the CEMP and EMS with the Environment Manager (or delegate), and reporting to senior management.

3.3.2 Delivery Partner Project Manager

The Delivery Partner Project Manager reports directly to the AusNet Services Project Manager and is responsible for the day-to-day management and environmental performance on the project. The Delivery Partner Project Manager is ultimately responsible for the implementation of the requirements contained within this CEMP. The Delivery Partner Project Manager is responsible for:

- overseeing implementation of the CEMP
- instructing project personnel on how to comply with AusNet Services Environmental Policy, EMS and procedures
- ensuring that employees and sub-contractors are aware of and comply with this CEMP, relevant to their respective activities
- environmental impacts which occur as a result of the actions of all personnel that are invited onto the site including sub-contractors and visitors'
- ensuring periodic monitoring, inspections and audits are undertaken when required by suitably trained personnel
- monthly evaluation of how effectively environmental controls are performing
- ensuring any issues / non-conformance/ incidents are addressed appropriately
- initiating remedial measures when environmental deficiencies are observed or in response to environmental complaints
- restriction of construction activities affected by any environmental deficiencies until remedial action has been undertaken maintaining environmental performance records (such as incidents and non-conformances).

3.3.3 AusNet Services Construction Manager

The AusNet Services Construction Manager will liaise with the Delivery Partner Construction Manager throughout the duration of the project, and report directly to the AusNet Services Project Manager. The AusNet Services Construction Manager is responsible for:

- planning and undertaking work activities in consideration of the CEMP
- ensuring through the continual daily surveillance of project work, that subcontractors and all personnel onsite comply with the requirements of this CEMP, associated sub plans and SOP

- taking into account weather conditions when programming daily work activities
- conducting toolbox sessions prior to work commencing each morning
- reporting environmental incidents (both actual and potential) to the AusNet Services Environmental Manager and assisting in resolution
- participating in fortnightly environmental inspections and external environmental inspections and audits if requested
- carrying out maintenance on environmental controls as required
- undertake daily inspections, maintain site records and ensure environmental corrective actions associated with any site inspections, audits or meetings are closed out.
- ensuring all employees and subcontractors have been inducted and recognise the requirements outlined in the CEMP and EMS
- reporting environmental incidents and assisting in resolution
- identifying and reporting to the AusNet Services Environment Manager (or delegate) the need to prepare any environmental procedures relating to the stages of work as required.

3.3.4 AusNet Services Engagement Manager

The AusNet Services Engagement Manager will liaise with the AusNet Services Construction Manager and Delivery Partner Construction Manager throughout the duration of the project, and report directly to the AusNet Services Project Manager. The AusNet Services Engagement Manager is responsible for:

- ensuring appropriate communications protocols and procedures are approved by the AusNet Services Project Manager
- ensuring complaints and enquiry procedures are reviewed on a regular basis, to develop and implement additional pre-emptive or corrective strategies
- responding to all incidents, internal and external, from a communications perspective
- appropriately responding to community complaints and media enquiries within an appropriate time frame
- evaluating community feedback and or outputs from stakeholder meetings and site visits to identify any emerging issue trends.

3.3.5 Delivery Partner Construction Manager

The Delivery Partner Construction Manager will liaise with the AusNet Services Construction Manager and Delivery Partner Project Manager throughout the duration of the project. It is the Delivery Partner Construction Manager's responsibility to ensure day-to-day on-ground implementation of the CEMP. The Delivery Partner Construction Manager is responsible for:

- managing subcontractors and construction activities on a daily basis to ensure appropriate environmental controls are implemented and maintained
- ensuring all staff are inducted into the site and attend daily toolbox sessions
- ensuring site personnel are trained and provided with the relevant safety and environmental protection equipment
- ensuring all site personnel are provided with, utilise and are appropriately trained in the requirements of Personal Protective Equipment (PPE) and environmental management equipment such as spill kits
- undertake daily site inspections and maintain records of environmental actions when required
- ensuring inquiries or complaints are referred immediately to the AusNet Services Project Manager
- attending onsite meetings at the request of the Project Manager
- immediately address any non-conformance or incident.

3.3.6 AusNet Services Environment Manager (or delegate)

The AusNet Services Environment Manger (or delegate) will liaise with the Delivery Partner Project Manager and Delivery Partner Construction Manager for the duration of the project and is responsible for tracking and reporting environmental performance as well as direct implementation of this CEMP. Other responsibilities include:

- ensuring the Delivery Partner Construction Manager are aware of the environmental obligations of the project as detailed within this CEMP and AusNet Services Environmental Policy and EMS
- oversee implementation of the CEMP and associated sub-plans
- updating the CEMP, where required (including revisions and re-issue)
- undertaking regular site inspections and the active pursuit of opportunities to enhance environmental outcomes
- tracking and reporting of environmental performance.

3.3.7 Work Crew and Contractors

All construction personnel will have a responsibility for implementing this CEMP and environmental management procedures relevant to their work activities. All personnel have a responsibility to

- attend toolbox sessions
- maintain site safety, site cleanliness and order
- carry out any corrective actions issued as a result of any site inspections, audit or meetings
- report any incidents and non-conformances to the Delivery Partner Construction Manager
- follow instructions issued by AusNet Services and Delivery Partner management staff
- reporting any environmental management concerns to the Delivery Partner Construction Manager for reporting to the Environment Manager (or delegate)
- observe AusNet Services commitments to the community and minimise construction impacts to neighbouring residents where possible.

3.4 Environmental Awareness and Training

3.4.1 Site Induction

The site induction process, in addition to any environmental awareness training undertaken, is designed to improve site personnel awareness of the likely impact of construction works on the local environment and community as well as address other construction issues such as occupational health and safety. The environmental component of the induction details the significant environmental impacts and introduces this CEMP as the management tool used to control and mitigate/minimise these impacts. This site induction process and any relevant environmental awareness training are to include ALL site personnel including sub-contractors and will inform them of their environmental responsibilities along with any safety issues to be aware of whilst onsite.

All visitors' to the site must undergo a visitor induction which may be tailored where there is reduced potential for harmful effects to health and the environment. Sub-contractors are responsible for the actions of their visitors'. All visitors' to site must be accompanied by a fully inducted representative at all times. The induction of all staff is the AusNet Services Construction Manager's (or delegate's) responsibility.

Personnel will be trained on environmentally sustainable work practices, environmental management procedures outlined in this CEMP and their roles and responsibilities when onsite. The agenda for the environmental component of the induction session will include the following:

- specific CEMP requirements for compliance with the relevant legislation, including noise, water quality and other requirements
- environmental issues and high risk tasks associated with construction activities, including any new issues that may arise
- environmentally significant / sensitive areas within the site and immediate vicinity including 'no-go zones'
- emergency procedures and emergency contact numbers

- where further information regarding environmental management can be located.

An induction register will be maintained at the site by the AusNet Services Construction Manager (or delegate).

3.4.2 Toolbox Sessions

A toolbox session will be conducted by the Delivery Partner Construction Manager (or delegate) at the beginning of each working day. All personnel working onsite will be required to attend the toolbox session for that day prior to commencing work. The toolbox session will inform the construction activities scheduled for that day as well as any evolving issues on the site, particularly in response to significant environmental and safety incidents. A discussion on environmental issues will feature heavily within the toolbox sessions.

A written record of toolbox discussions and attendees will be maintained at the site.

3.5 Management of Sub-contractors

All sub-contractors will be required to comply with this CEMP at all times and will have the same environmental management responsibilities as the Delivery Partner. The Delivery Partner Project Manager is directly responsible for ensuring that sub-contractors implement the appropriate environmental management requirements during construction. The Delivery Partner Project Manager will ensure that the requirements of this CEMP are included in any commercial agreements or subcontracts with Delivery Partner subcontractors.

Sub-contractors undertaking works that are beyond the scope of this CEMP are required to submit a Standard Operating Procedure to the AusNet Services Environment Manager (or delegate) for approval prior to commencing works.

4.0 Statutory Framework and Obligations

4.1 Policy and Legislative Compliance

Procedures outlined in this CEMP aim to comply with the relevant environmental legislation, policies, regulations, and standards. Legislation and policy relevant to the BTS upgrade are detailed in **Table 8**.

Table 8 Legislation and Policy

Legislation or Policy	Relevant Authority	Description
Commonwealth		
Environment Protection and Biodiversity Act 1999	Department of Environment	The *Environment Protection and Biodiversity Act 1999* (EPBC Act) is the Commonwealth Government's key piece of legislation for environmental protection. One of the main aims of the EPBC Act is to protect Matters of National Environmental Significance (MNES). Under the EPBC Act, actions[3] that are likely[4] to have a significant impact upon MNES are required to be referred to the Environment Minister for approval. **The project is considered to have no significant impact on MNES and therefore no approval is required.**
Aboriginal and Torres Strait Island Heritage Protection Act 1984	Department of Environment	This Act aims to protect areas and objects of Aboriginal and Torres Strait Islander significance from activities likely to have a significant impact upon them. **There are no such sites in the construction area and the project is unlikely to impact such sites.**
State		
Planning and Environment Act 1987	Department of Transport, Planning and Local Infrastructure (DTPLI)	This Act aims to facilitate development in line with a set of principles which include the fair, orderly, economic and sustainable use and development of land. Development is controlled through municipal planning schemes. State approval is required for amendments to Planning Schemes. This project is located in the City of Moreland, and is therefore subject to the Moreland Planning Scheme. Under Amendment C140 to the Moreland Planning Scheme, the site was re-zoned in early 2012 from Residential 1 to Special Use Zone (SUZ3). A Planning Permit (MPS/2014/87) has been issued by Moreland City Council, and encompasses work not approved as part of the 2012 Incorporated Document.

[3] Under the EPBC Act an 'action' includes any project, development, undertaking, activity or series of activities.
[4] Under the EPBC Act 'likely' refers to when the potential for a significant impact on the environment to be real or not a remote chance or possibility.

Legislation or Policy	Relevant Authority	Description
Environment Protection Act 1970	EPA Victoria	The *Environment Protection Act 1970* (EP Act) aims to ensure sustainable management of the environment, prohibiting unauthorised pollution of land, air and water. The Act regulates industrial waste management, noise emissions, notifiable chemicals, and the transport of prescribed wastes. The EP Act establishes a system of licences and works approval for certain premises, making provisions for the development of State Environment Protection Policies (SEPPs). Applicable SEPPs include: - *SEPP Air Quality Management 2001* - *SEPP Ambient Air Quality 1999* - *SEPP Control of Noise from Commerce, Industry and Trade No. N-1 (2001)* - *SEPP Groundwaters of Victoria 2002* - *SEPP Prevention and Management of Contaminated Land in Victoria 2002* - *SEPP Waters of Victoria 2004.* These are described in greater detail below.
Aboriginal Heritage Act 2006	Department of Transport, Planning and Local Infrastructure (DTPLI)	The Act aims to protect and conserve objects and places of Aboriginal cultural heritage. Under this act any activity likely to adversely impact these areas require a cultural heritage permit to be obtained or a Cultural Heritage Management Plan (CHMP) to be developed and provided to the Minister for Planning for approval. **A CHMP is not required for this project. Should any Aboriginal artefacts be found during the construction, works must cease and the Project Manager notified.**
Aboriginal Heritage Regulations 2007	Department of Transport, Planning and Local Infrastructure (DTPLI)	These Regulations State the circumstances in which a Cultural Heritage Management Plan (CHMP) is required to be prepared and the standards for its preparation.
Water Act 1989	EPA Victoria	This Act provides a framework for water management in Victoria, governing the issue and allocation of water entitlements. The Act aims to ensure water resources are conserved and managed for sustainable use. **This project proposes measures to protect the quality of surface water and groundwater.**

Legislation or Policy	Relevant Authority	Description
Heritage Act 1995	Department of Transport, Planning and Local Infrastructure (DTPLI)	This Act establishes a legislative framework for the protection, conservation and registration of places and objects of cultural heritage significance in Victoria. The Act establishes the Heritage Council of Victoria, the Heritage Register and the Heritage Inventory. **A permit is not required under this Act for this project. Should any cultural heritage artefacts be found during construction, all works must cease and the Project Manager notified.**
Road Management Act 2004	Department of Transport, Planning and Local Infrastructure (DTPLI)	This Act provides a framework for the coordinated management of public roads for safe and efficient State and local public road networks. **VicRoads must be notified and consent obtained to undertake works which have the potential to impact on local traffic.**
Flora and Fauna Guarantee Act 1988	Department of Environment and Primary Industries (DEPI)	This Act provides a legal framework for enabling and promoting the conservation of all Victoria's native flora and fauna, and to enable management of potentially threatening processes. A permit from DEPI is required to 'take'[5] listed flora and fauna species from public land, including the removal of native vegetation. A permit is not required under the FFG Act for private land unless listed species are present and the land is declared 'critical habitat' for the species. The project is considered to not require a permit from DEPI in relation to threatened flora and fauna. Planning Permit (MPS/2014/87) secures approval to remove vegetation (as detailed in section 4.2). **The project is considered to have no significant impact on threatened flora and fauna on public land, therefore a permit from DEPI is not required.**

[5] Under the FFG Act 'take' refers to means to kill, injure, disturb or collect flora.

Legislation or Policy	Relevant Authority	Description
Wildlife Act 1976	DEPI	The *Wildlife Act 1975* forms the basis for the protection and conservation of native wildlife within Victoria. With the exception of pest animals declared under the CaLP Act or wildlife declared to be unprotected wildlife, the Wildlife Act makes it an offence to hunt, take or destroy protected or threatened wildlife without authorisation. **In accordance with this Act, if protected wildlife is located within vegetation (habitat) proposed for clearing, salvage and translocation of such wildlife may need to be conducted by a sufficiently qualified professional.**
Catchment and Land Protection Act 1994	DEPI	The CaLP Act is the principle legislation relating to the management of pest plants and animals in Victoria. Under the Act landowners have a responsibility to avoid causing or contributing to land degradation including taking all reasonable steps to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and, where possible, eradicate established pest animals as declared under the CaLP Act. **AusNet Services is responsible for preventing introduction and spread of weeds on the site.**
Permitted clearing of native vegetation: biodiversity assessment guidelines (formerly known as Victoria's Native Vegetation Management Framework: A Framework for Action)	DEPI	*Permitted clearing of native vegetation: biodiversity assessment guidelines* (formerly known as the Native Vegetation Management Framework) aims to guide how impacts on biodiversity should be considered when assessing an application for a permit to remove, lop or destroy native vegetation. These guidelines are incorporated in the Victoria Planning Provisions and all planning schemes in Victoria. **No remnant vegetation was identified at BTS; therefore any vegetation removal at the site does not require offsetting under these guidelines. Planning Permit (MPS/2014/87) secures approval to remove vegetation (as detailed in Section 4.2).**

State Environment Protection Policies (SEPPs)		
SEPP (Waters of Victoria) 2004	EPA Victoria	This SEPP provides measures for the protection of all surface waters in Victoria. The SEPP has the objective to maintain and improve surface water quality where possible and identifies potential risks to surface waters and provides a framework for their management.
SEPP (Groundwaters of Victoria) 2002	EPA Victoria	This SEPP provides a framework for the protection of groundwater from activities potentially detrimental to groundwater quality and includes a classification of groundwater quality on the basis of background concentrations of salinity measured as total dissolved solids.
SEPP (Air Quality Management) 2001	EPA Victoria	This SEPP aims to improve air quality and applies the appropriate air quality management strategies in Victoria, including measures to reduce greenhouse gas emissions. **Air quality management is discussed in Appendix D.**
SEPP (Ambient Air Quality) 1999	EPA Victoria	This SEPP sets objectives for the protection of air quality in Victoria, including health-based objectives, visibility objectives and vegetation objects. The SEPP specifies how pollutants should be monitored and reported.

4.2 Moreland Planning Scheme Amendment C140

In February 2012, BTS was re-zoned from Residential 1 Zone to Special Use Zone SUZ (Schedule 3), and the existing Environmental Significance Overlay (ESO) Schedule 1 was amended to include an exemption for buildings and works carried out in accordance with the Brunswick Terminal Station Incorporated Document 2012.

Due to the perceived conflict between works shown in the Incorporated Document 2012 and secondary controls in the Moreland Planning Scheme, AusNet Services has secured a planning permit (MPS/2014/87) from Moreland City Council (issued 9th October 2014) for:

Removal of vegetation, construction of fences within a Land Subject to Inundation Overlay and a Special Building Overlay, excavation works at depths greater than one metre, two lot subdivision and minor alterations for the development of the land not generally in accordance with the Brunswick Terminal Station Incorporated Document 2012.

The Planning application report documented the following outstanding works that required a planning permit:

- The construction of a fence and alterations to ground level (works) within the Land Subject to Inundation Overlay (LSIO)
- The removal of vegetation including dead vegetation, weed species, planted vegetation and regrowth
- Excavations greater than 1m in depth
- The construction of a fence within the Special Building Overlay (SBO)
- A two lot subdivision (to recognise the location of the Merri Creek shared path)

This report also documented the following activities that are considered by Council to be generally not in accordance with the existing Incorporated Document 2012:

- Outer perimeter fence
- Palisade fence

- Security fence
- Roadway and car spaces to 22kV building
- Oil containment tank
- Excavation works to 66kV building
- Lighting columns
- CitiPower kiosk
- Station service transformers
- Landscaping
- Retaining walls

Not all of the above works require a planning permit.

ESO1 (Merri Creek and Environs) states that a permit is not required to construct a building or to construct or carry out works (including foundation works of less than 1m below ground level) for the purpose of utility installation at 46 King Street, Brunswick East if in accordance with the Incorporated Document 2012 provided that sites of archaeological sensitivity, known Aboriginal heritage sites or areas of remnant vegetation are not disturbed.

The purpose of SUZ3 (Brunswick Terminal Station) is to promote the use and development of the land consistent with the Incorporated Document 2012.

Other environmental approvals and permits may be required throughout the construction phase if any legislative requirements are triggered, as outlined in **Table 8**, for which the AusNet Services Construction Manager is responsible for coordinating.

Planning Permit (MPS/2014/87) includes endorsed plans and conditions associated with the approval (please refer to the Planning Permit for project specific conditions). The requirements outlined in **Table 9**, from the Incorporated Document 2012, apply to this CEMP.

Table 9 Requirements for Use and Development of the BTS as Outlined in the Brunswick Terminal Station Incorporated Document, 2012

Requirement Detail	CEMP Section
Setbacks	
Provide a minimum setback of 35m of buildings and equipment from the Alister Street frontage	Refer detailed design
Noise Attenuation	
All noise emanating from any plant or equipment on the site must comply with the State Environment Protection Policy SEPP N1 - Control of noise from commerce, industry and trade (as applicable).	Refer detailed design
Electromagnetic fields (EMF)	
The use and development of the land must be compliant with National Health & Medical Research Council (NHMRC) interim guidelines (1989) and the Australian Radiation Protection & Nuclear Safety Agency (ARPANSA) standards (or any variation of these policies).	Refer detailed design
Erosion Management	
The design and construction of all buildings and works must take into account areas of the site which are susceptible to slope instability and erosion, and constructed in accordance with any requirements of a suitably qualified geotechnical engineer.	6.10
Melbourne Water Conditions	
No polluted and/or sediment laden water is to be discharged directly or indirectly into Melbourne Water's drains or watercourses	6.9
Any works taking place within 15m of Merri Creek (including underground service connections) require (prior to commencement of construction) separate application to Melbourne Water's Asset Services Team for approval.	6.9
Finished floor levels must be a minimum of 600mm above the applicable flood level	Refer detailed design
Construction Management	
Prior to the commencement of any buildings and / or works, a Construction Management Plan specifying the measures proposed to ensure that construction activity has minimal impact on surrounding areas must be submitted to the Responsible Authority. The Construction Management Plan must include the following sub-plans to address the key environmental management issues including: - Project management - Environmental awareness and training - Noise and vibration - Traffic - Surface water and drainage - Soil and Earthworks - Construction waste - Dust - Contamination - Dangerous goods and refuelling All buildings and/or works must be constructed or carried out in accordance with the Construction Management Plan*	6.0

***Note: The Construction Environmental Management Plan (this document) is the plan referred to as the Construction Management Plan.

Requirement Detail	CEMP Section
Stormwater Management	
All stormwater from the land, where it is not collected in rainwater tanks for re-use, must be collected by an underground pipe drain approved by and to the satisfaction of the Responsible Authority.	6.9
Landscaping	
Provide advanced canopy trees capable of growing to a substantial height (6-12m) within the site and along the following frontages – King Street, Alister Street, Merri Creek, Sumner Park	6.12

4.3 Guidelines

Guidelines incorporated into the environmental compliance framework for this project are:

- EPA Environmental Guidelines for Major Construction Sites; Publication 480
- EPA Noise Control Guidelines; Publication 1254
- VicRoads Environmental Management Guidelines, 2006
- EPA Bunding Guidelines, Publication 347
- EPA Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes, Publication 441
- EPA Classification of Wastes, Publication 488.1
- EPA Groundwater Sampling Guidelines, Publication 669
- Permitted clearing of native vegetation: Biodiversity assessment guidelines (formerly known as Victoria's Native Vegetation Management Framework)

Actions relevant to these guidelines are detailed in the relevant environmental management sub-plans.

4.4 Consultation Process

A comprehensive program of stakeholder and community consultation was undertaken during the planning and design phase of the project. A summary of the key agencies and stakeholders associated with the BTS upgrade is detailed in **Section 4.4.1**.

4.4.1 Key Agencies and Stakeholders

Key stakeholders, agencies and community groups consulted with as part of the consultation process include:

- Moreland City Council – meetings with the CEO and other Senior Executives, including the head of planning and communications team, Directors of Planning and Economic Development and City Infrastructure, and regular meetings with Council Planning Officers
- Merri Creek Management Committee – consulted on the development of the Landscape Concept Plan
- Melbourne Water Corporation - for advice on issue of a Works on Waterway permit
- BTS Community Working Group (BTSCWG) – consisted of representatives from the community, and Cities of Moreland, Yarra, and Darebin. The BTSCWG was consulted with a number of times during the design and consultation process, prior to each Community Information Session.
- Local community – the local community was consulted with over a two year period in the lead up to construction via a number of mechanisms including a series of community information sessions, issue of community newsletters and updates, media releases and in-home meetings. The local community included immediate neighbours, nearby schools, local business, local community groups and sporting groups.

4.4.2 Community Consultation Activities

Community consultation activities for the BTS upgrade include:

- meeting with the BTSCWG for input regarding planning and design
- meeting with the Merri Creek Management Committee on the development of the Landscape Concept Plan
- community information sessions for presentation of information related to the project and to gain feedback from the community establishing two way communications
- hand delivering community newsletters, letters and factsheets to residents in the area and individuals who signed up through the project website and at the Community Information Sessions. Newsletter drops will continue to be undertaken at significant announcements / milestones
- door knocking residents directly impacted by works
- local media releases - eight have been made since October 2010, including publishing notices in the Moreland, Northcote and Melbourne Leader newspapers
- website information (http://www.ausnetservices.com.au) including project updates and FAQs
- email (brunswickts@ausnetservices.com.au) and 24 hour telephone number (1800 INFO BTS / 1800 4636 287) for enquiries
- information booklets to provide an overview of Community Information Session 3 and encourage feedback on the four design options
- in-home meetings with interested residents located directly opposite to the BTS, and offering in-home EMF measurements
- monthly communication reports and project milestone notifications
- erecting information signage outside the site with relevant contact details

An online consultation tool ‘Consultation Manager’ has been used to track stakeholder input to date, and will continue to be used for the duration of the project.

5.0 Environmental Risk Management

5.1 Risk Assessment

5.1.1 Risk Assessment Process

An assessment of the unmitigated risk of environmental issues at the site, relevant to the BTS upgrade, was undertaken using a likelihood and consequence risk assessment matrix. The level of risk determined from the matrix identified the level of mitigation required for that environmental aspect during construction. These risks will be mitigated through the application of measures identified in this CEMP.

The assessment identified the significance of environmental risks and potential impacts using the following four-step approach:

1) identify each element of a construction activity with the potential to interact with the environment (e.g. characteristics and sensitivity of the environment)

2) determine the potential impacts resulting from the activity including their duration, intensity and degree to which they can be mitigated

3) rank risks based on the likelihood of adverse impacts and the severity of the consequence, using the 'worst case scenario', as defined by the 'likelihood and consequence probability' risk matrix

4) identify the level of mitigation required for each environmental aspect (e.g. the higher the potential severity of adverse environmental effects and the greater the consequence of those unmanaged effects the higher the degree of environmental management required).

This assessment allowed the prioritisation of issues for assessment, prior to consideration of the application of mitigation measures to manage environmental effects. In all cases, appropriate and proven mitigation measures, chosen based upon the experience of regulators and other similar projects will be used to minimise potential impacts. These mitigation measures are outlined in **Section 6.0** of this CEMP.

5.1.2 Key Issues

Based on the results of the environmental risk assessment, the following key environmental issues were identified:

- **noise and vibration** generated from demolition of redundant buildings, lay down of construction materials, rock breaking, construction of access roads and general construction traffic
- **dust** generated from demolition of redundant buildings, construction of temporary and access roads, excavation, stockpiling and construction traffic
- **local amenity and access** impacts from lay down of construction materials and construction traffic
- **sedimentation** impacts from construction of temporary access roads, excavation and stockpiling.

Activities scoring Low, with no legislative compliance requirements have not been included in the list above. Medium to Extreme risk activities identified as part of this assessment process will be discussed in toolbox sessions and progress meetings to ensure awareness of environmental issues and appropriate mitigation.

6.0 Environmental Management and Controls

6.1 Introduction

The following section sets out the environmental management activities and management measures which will be implemented during construction of the BTS upgrade. The Delivery Partner Project Manager will ensure that personnel responsible for undertaking the works are aware of their roles and responsibilities detailed in this CEMP.

Sub-plans have been prepared for key issues associated with the BTS upgrade and are appended to this CEMP as follows:

- Noise and Vibration Management Sub-plan (**Appendix A**)
- Traffic Management Sub-plan (**Appendix B**)
- Flora and Fauna Management Sub-plan (**Appendix C**)
- Air Quality Management Sub-plan (**Appendix D**)
- Contamination Management Sub-plan (**Appendix E**)
- Erosion, Sedimentation and Earthworks Management Sub-plan (**Appendix F**).

Where a sub-plan has been prepared for a particular issue the environmental management activities and management measures to be implemented during construction are detailed in the sub plan (presented as an Appendix to this CEMP) and not in this section.

6.2 Standard Operating Procedures

A series of Standard Operating Procedures (SOPs) have been developed for BTS that provide methodology on managing key environmental risk areas. These, in combination with the BTS CEMP, are required to meet the requirements of AusNet Services Environmental Management System (including the Environmental Policy), Brunswick Terminal Station Incorporated Document 2012 and Planning Permit (MPS/2014/87).

The SOPs developed for BTS include:

- Aboriginal and European Cultural Heritage (refer **section 6.13**)
- Chemical Spill Control (refer **section 2.3**)
- Groundwater and Stormwater Dewatering (refer **Appendix F**)
- Environmental Incident Management and Emergency Response (refer **section 7.0**)
- Fauna salvage (refer **Appendix C**)
- Refuelling (refer **section 2.4**)
- Stockpile Management (refer **Appendix F**)
- Water Quality Monitoring (refer **Appendix F**)
- Weed Control (refer **Appendix C**)

6.3 General Site Management

This section outlines the general environmental management procedures to be implemented onsite to minimise the potential impacts of construction activities on the environment. All construction personnel will be made aware of these procedures during site inductions and toolbox sessions. More detailed management measures are provided in **Sections 6.4** to **6.14**.

6.3.1 Signage

Clear and visible signage should be displayed onsite at all times for the appropriate work activity and location. This includes signage for ‘no go’ zones in areas of stockpiling, first aid locations, site access details, PPE requirements and emergency contacts. The AusNet Services Construction Manager will be responsible for undertaking periodic inspection to ensure signage is appropriate and visible.

6.3.2 Fencing

Non-conductive temporary fencing will be erected within the site to distinguish any areas identified as 'no go' zones including areas where construction vehicles are not permitted to enter, stockpiles, and for areas which have been re-vegetated. Silt fences will be erected around the perimeter of stockpiles (if it is to remain in the same location for greater than 7 days) to help minimise sediment and erosion. The AusNet Services Construction Manager will be responsible for undertaking periodic inspection of fencing (including silt fences) to ensure it is appropriate, in working order and visible.

6.4 Noise and Vibration

Refer to the Noise and Vibration Management Sub-plan presented as **Appendix A**.

6.5 Traffic and Access

Refer to the Traffic Management Sub-plan presented as **Appendix B**.

6.6 Flora and Fauna

Refer to the Flora and Fauna Management Sub-plan presented as **Appendix C**.

6.7 Air Quality

Refer to the Air Quality Management Sub-plan presented as **Appendix D**.

6.8 Contamination and Asbestos

Refer to the Contamination Management Sub-plan presented as **Appendix E**.

6.9 Water Quality and Hydrology

Refer to the Contamination Management Sub-plan presented in **Appendix E** for further information.

6.10 Soil and Groundwater

Refer to the Contamination Management Sub-plan presented as **Appendix E,** and the Soil, Sedimentation and Earthworks Management Sub-plan presented as **Appendix F**.

6.11 Geotechnical Risks

Refer to the Soil, Erosion, and Excavation Management Sub-plan presented as **Appendix F**.

6.12 Visual Amenity

The BTS Augmentation Project has been designed to address comments raised by members of the community as part of the community consultation process. Visual amenity impacts of construction were identified during the consultation process as being of concern to the local community. AusNet Services made the following commitment in relation to visual amenity:

- *Removal of all redundant buildings*

Management measures detailed in Table 10 are proposed to minimise the potential impacts on visual amenity.

Table 10 Visual Amenity Management Measures

Management Measure	Responsibility
Vehicles and Machinery	
All construction vehicles and machinery will be located onsite at all times except when vehicles are entering and exiting the site. There will be no off-site parking for vehicles and machinery.	Delivery Partner Construction Manager
Removal of Redundant Buildings	
Taller buildings will be constructed towards the centre of the site.	N/A - addressed in design
Site Rehabilitation	
Landscaping works will commence as early as practicable on areas that will not be impacted during construction.	Delivery Partner Construction Manager
Significant landscaping works will be undertaken once construction works are completed, with immature canopy trees planted onsite to help conceal the BTS.	Delivery Partner Construction Manager
Landscaping will be in line with the natural character of Merri Creek and adjacent mature trees and open space parkland, improving integration with the Merri Creek Corridor.	Delivery Partner Construction Manager

6.13 Cultural Heritage

The following European and Aboriginal cultural heritage impacts have the potential to occur as a result of this project:

- disturbance of unknown cultural heritage places or objects.

Table 11 Cultural Heritage Management Measures

Management Measure	Responsibility
Uncovering of Artefacts	
If any **European** artefacts are discovered all works will cease and access to the area will be restricted. The Delivery Partner Project Manager should be immediately notified of the discovery and will be responsible for notifying AusNet Services Project Manager and Heritage Victoria for approval for their disturbance.	Delivery Partner Project Manager
If any **Aboriginal** artefacts are discovered all works will cease and access to the site will be restricted. The Delivery Partner Project Manager should be immediately notified of the discovery and will be responsible for notifying AusNet Services Project Manager and the Victorian Aboriginal Heritage Council for advice regarding preparation of a Cultural Heritage Management Plan (CHMP). Further detail regarding permits to be obtained if archaeological artefacts are found can be found in the *Aboriginal Cultural Heritage Standard Operating Procedure*.	Delivery Partner Project Manager

6.14 Sustainability

Greenhouse and ozone gases will be emitted as a result of construction activities, and could have adverse impacts on the surrounding vegetation, waterway, health implications for workers and residents, and contribute to climate change. The following impacts have the potential to occur as a result of this project:

- emissions associated with transport of vehicles to and from the site
- emissions associated with resources used during construction, and the embodied energy of materials.
- indirect emissions associated with extraction, production and transport of fuels used by construction plant and equipment.

Although there is no specific legislation applying to sustainability during construction, one of AusNet Services objectives outlined in their Environmental Policy is to "*support the development of more efficient, less carbon intensive energy sources, including large and small scale renewable projects, through the network connections and supply of off-grid alternatives where applicable*".

Management measures detailed in **Table 12** are proposed to minimise the potential impacts of greenhouse gas generation and ozone emissions.

Table 12 Greenhouse Gas and Ozone Emissions Mitigation Measures

Mitigation Measure	Responsibility
Greenhouse Gas	
Reduce the number of vehicle trips to the site by sourcing from local suppliers. Materials sourced locally can include concrete, steel, and cladding and roofing.	Delivery Partner Construction Manager
Sustainability	
Recycle, reuse, or return to supplier for redistribution any unused construction materials and packaging.	Delivery Partner Construction Manager
Implementing the waste management hierarchy for all construction waste (refer Appendix E)	Delivery Partner Construction Manager

6.15 Cumulative Impacts

Other works within the vicinity of the site of no relation to this project have the potential to be undertaken at the same time as construction of the BTS upgrade. Collectively, these works have the potential to compound the following impacts:

- safety and access
- noise and vibrations
- visual amenity.

Provided the mitigation measures outlined in this CEMP are implemented at all times, cumulative impacts will be minimal. Management measures outlined in **Table 13** will be implemented to minimise any cumulative impacts arising from other works in the vicinity of the BTS.

Table 13 Cumulative Impacts Management Measures

Management Measure	Responsibility
Access to Glenlyon Road	
Revision of the Traffic Management Sub-plan, to coordinate and manage traffic.	Delivery Partner Construction Manager
Noise and Vibration	
Revision of scheduling and location of noisy construction activities, and updating the Noise and Vibration Management Sub-plan, where relevant.	Delivery Partner Construction Manager
Consultation with sensitive receptors (i.e. residential properties adjacent to the site).	AusNet Services Community Consultation Representative
Visual Amenity	
All construction activities and vehicles will be located onsite.	Delivery Partner Construction Manager
Site boundary fencing will be replaced or repaired immediately if it is damaged.	Delivery Partner Construction Manager

AusNet Services was not aware of any proposals to undertake works in the immediate vicinity of the BTS at the time of this CEMP being developed.

7.0 Incident Management and Emergency Response

7.1 Introduction

An environmental incident is an unplanned event which occurs onsite and has the potential to result in adverse environmental impacts onsite and / or in the surrounding area (e.g. a chemical spill). The general emergency response procedure for an environmental incident is to:

- ensure site safety and move people from the immediate area
- warn traffic / pedestrians in the immediate area of any hazard which impacts traffic and access (use lights and / or warning signs where possible)
- take any practical steps to contain the hazard and prevent it from spreading
- notify relevant authorities (if necessary).

Incidents onsite that are likely to result in pollution will be reported immediately to the Delivery Partner Project Manager who will in turn notify the AusNet Services Project Manager and the AusNet Services Environment Manager (or delegate). Where required by legislation, (e.g. where an incident has the potential to result in off-site environmental harm), the AusNet Services Environment Manager (or delegate) will notify the EPA and meet with the notifying party as soon as practicable following an incident in order to commence investigations and make recommendations.

Any spills or accidents, and details of the corrective actions undertaken will be documented with a Non-Conformance and Corrective Action Report. Adverse environmental impacts as a result of the incident should be recorded in AusNet Services Incident Management System (IMS).

In the case on an emergency the procedures as described in **Section 7.2** should be implemented.

7.2 Emergency Response

Emergency response is required when an unplanned incident occurs which has the potential to have a detrimental impact on the environment. These incidents can include chemical spills, disturbance of acid sulphate soils, damage to heritage values, and injury to fauna. Any minor incidents which can be contained on the site and removed within 24 hours do not require an emergency response.

A site specific Emergency Response Plan has been developed by the Delivery Partner in accordance with AusNet Services *Integrated Response and Contingency System (SPIRACS)* and approved by the AusNet Services Project Manager prior to construction. The Emergency Response Plan should include the following:

- site layout and fire protection drawing
- dangerous goods locations
- emergency contact list (including after-hours emergency contacts)
- evacuation system
- Safety Data Sheets (SDSs).

Any incidents requiring emergency response should be immediately reported to the AusNet Services Project Manager. Following an emergency procedure the AusNet Services Project Manager will review the success of existing emergency procedures and amend or provide additional training if necessary.

The standard emergency response procedure is as follows:

- clear the immediate area of any personnel
- notify pedestrians and traffic if the incident has the potential to adversely impact traffic and access
- prevent spread of the hazard
- notify relevant authorities as listed in **Section 7.3**
- complete the Incident Notification Form located in **Appendix H**.

All personnel will be inducted into the use of emergency procedures and provided emergency contact numbers via the general and site specific inductions. All incidents and details of corrective actions will be recorded as per the procedure explained in **Section 8.4**). Incidents resulting in adverse impacts on the environment should be recorded in AusNet Services IMS.

7.3 Emergency Contacts

A list of emergency contacts will be developed by the Delivery Partner Construction Manager and be made readily available to site personnel. The list should contain the information provided in **Table 14**.

All project personnel will be encouraged to follow AusNet Services safety management plan and protocols for incident and emergency response. It is the Delivery Partner Construction Manager's responsibility to review this list periodically to ensure information is kept up-to-date.

AusNet Services 24 hour a day emergency control room contact number is 1800 111 164. This is the emergency response number and is displayed at the site entrance. For all community and project related enquiries the project information hotline 1800 INFO BTS / 1800 4636 287.

Table 14 Emergency Contacts

Contact
Emergency Services
Police / Fire / Ambulance
Brunswick Police Station
The Royal Melbourne Hospital
Agencies and Utilities
EPA Victoria
Water – Melbourne Water
Gas – AusNet Services
Electricity – AusNet Services
AusNet Services
Project Manager
Construction Manager
Environment Manager (or delegate)
Safety Manager
Engagement Manager
Delivery Partner
Project Manager
Construction Manager
Environment Manager (or delegate)
Safety Manager
Stakeholders
Moreland City Council

When contacting an authority in relation to an emergency, the following information should be:

1. your name and role
2. type of incident and any injuries
3. emergency services required or already requested
4. available access points at the site
5. actions already undertaken to minimise hazard
6. your contact details.

7.4 Enquiries and Complaints Procedure

AusNet Services has the appropriate processes in place to effectively record, respond and manage media and community enquiries and complaints.

All media and community enquiries should be directed to the following avenues:

- The BTS email address: brunswickts@ausnetservices.com.au
- The BTS hotline phone number: 1800 INFO BTS (1800 4636 287)

The originator of the enquiry will receive a response as soon as possible from a member of the BTS Communications and Stakeholder Team.

7.5 Municipal Emergency Management

Like all municipalities in Victoria, Moreland Council has its own Municipal Emergency Management Plan for handling natural disasters and emergencies.

The Moreland City Council Municipal Emergency Management Plan has been produced pursuant to Section 20(2) of the Emergency Management Act 1986. This plan, coordinated through the Victoria Police by a Municipal Emergency Response Coordinator, sets out the procedures to be followed when Council and community resources are required in the case of an emergency. A Community Emergency Risk Management (CERM) process of all perceived threats to the municipality has been conducted by the Municipal Emergency Management Planning Committee.

8.0 Monitoring, Reporting, and Performance Review

8.1 Environmental Audit Program

The audit program for the BTS upgrade will be undertaken as follows:

- Six monthly internal audits for compliance against this CEMP and the AusNet Services EMS. These audits will be undertaken as a joint audit with AusNet Services and Delivery Partner representatives in attendance. The AusNet Services Project Manager is responsible for managing and reviewing these audits. They will include an audit of the site and subcontractor activities to assess compliance with the CEMP and relevant approvals, licences and permits obtained in relation to the BTS upgrade.
- Each month a report will be provided by the Delivery Partner to the AusNet Services Project Manager detailing compliance with the CEMP. This report will include updates on the project status and any incidents and corrective actions which have been implemented onsite as well as overall environmental management and performance tracking.
- Incident reports will be prepared by the Delivery Partner following any onsite environmental incidents. This report will document the investigations undertaken and detail possible contributory factors and recommended system improvements. Incident reports are to be provided to the AusNet Services Project Manager when requested.

All documentation will be filed in accordance with **Section 1.7**. If required, the findings of audits will be reported to external stakeholders such as the Moreland City Council.

8.2 Environmental Inspections

In addition to formal auditing and monitoring identified in this CEMP, the following environmental inspections will be undertaken:

- Site supervisory personnel (such as the Delivery Partner Construction Manager) will, as part of their daily duties, inspect the site (including all subcontractor activities) and issues arising will be noted in the site diary and communicated to the Environment Manager (or delegate).
- The Environment Manager (or delegate) will conduct an inspection of the site on a weekly basis. Recommendations (and any non-conformances) raised in previous inspections will be re-inspected for close-out or ongoing monitoring. As a minimum the Environment Inspection Checklist will include inspection of the following site activities and features:
    - site drainage including cut off and diversion drains
    - sediment controls, silt fences and traps
    - haul roads
    - stockpiles, bare slopes and un-vegetated areas
    - vehicles and machinery
    - chemical and fuel storage areas
    - litter controls.

The Environment Inspection Checklist consists of two forms and can be found in **Appendix G**.

- The Environment Manager (or delegate) will conduct formal inspections of the site with the Delivery Partner Construction Manager or Delivery Partner Project Manager on at least a monthly basis and more frequently at times as required. Checklists will be used to record and report on activities for compliance with this CEMP and specific issues addressed which present significant environmental risks.
- AusNet Services representatives (such as the AusNet Services Construction Manager) will undertake site inspections periodically or as required.
- The AusNet Services Project Manager will inspect the site at least once each quarter.

Regulatory agencies such as EPA, Melbourne Water and the local Council may also conduct site inspections at their request. The Delivery Partner Project Manager and Environment Manager (or delegate) will attend these inspections as required.

Site inspections should be undertaken randomly at a different time each day and immediately prior to and following extreme weather events. The Environment Inspection Checklist will be completed during each periodic inspection undertaken by the Environment Manager (or delegate) at least weekly.

8.3 Audit and Inspection Schedule

The audit / inspection schedule during the construction phase of the BTS upgrade is presented in **Table 15**.

Table 15 Audit Schedule

Timing	Detail
Daily	- Site supervisory personnel will inspect the site and subcontractor activities.
Weekly	- Environment Manager (or delegate) will conduct an inspection of the site on a weekly basis, completing the Environment Inspection Checklist.
Monthly	- Report provided by the Delivery partner to the AusNet Services Project Manager detailing compliance with the CEMP. - Environment Manager (or delegate) will conduct formal inspections of the site with the Delivery Partner Construction Manager or Delivery Partner Project Manager on at least a monthly basis. - Internal audits for compliance against this CEMP and the AusNet Services Environmental Management System.
Three-monthly	- AusNet Services Project Manager will inspect the site.
Six-monthly	- An internal audit conducted by a suitably qualified environmental auditor will be conducted, with AusNet Services and Delivery Partner representatives in attendance. - This will include an audit of the site and subcontractor activities to assess compliance with the CEMP and relevant approvals, licences and permits obtained in relation to the BTS upgrade.

8.4 Non-conformances and Corrective Action

All non-conformances will be investigated and recorded in an Incident Notification Form. A summary of all non-conformances will be provided to the AusNet Services Project Manager on a monthly basis.

The Delivery Partner Construction Manager is responsible for addressing non-conformances and ensuring that corrective actions are implemented. The Delivery Partner will address non-conformances in accordance with AusNet Services *Corrective Action Management QMS 21- 04* procedure, which outlines the procedure for addressing non-conformances and the activities to be undertaken in relation to corrective actions,

All non-conformances and corrective actions (separate to those identified in periodic inspections) should be reported immediately to the Environment Manager (or delegate) and recorded in an Environment Incident Register.

It is the responsibility of the Delivery Partner Construction Manager to immediately initiate corrective actions, if required.

The occurrence of such an event will be brought to the attention of personnel responsible and environmental controls will be updated to prevent a reoccurrence. The issues, corrective and preventative actions proposed and the responsibilities and timing for completion of the actions will be detailed in the Environment Incident Register.

The Delivery Partner Project Manager will review the Environment Incident Register on a monthly basis to ensure actions are completed and that controls are effective.

Appendix A

Noise and Vibration Management Sub-plan

Appendix A Noise and Vibration Management Sub-plan

This Noise and Vibration Management Sub-plan outlines procedures to minimise and control potential noise and vibration impacts on the environment and local community, associated with the construction phase of the BTS upgrade.

Community commitments made by AusNet Services in relation to noise and vibration include:

- *Noisy activities will be undertaken during less sensitive times where practicable.*
- *Stationary plant items such as generators will be sited as far away from sensitive receivers as practical and screening will be provided as required.*
- *Use of sound proof generators.*
- *Regular servicing of machinery and vehicles.*
- *Visual inspection of all equipment to operate onsite, to ensure that any noise mitigation (e.g. mufflers) is suitable for the use.*

Construction noise and vibration is expected to result primarily from building demolition, earthworks, construction machinery, and material deliveries.

This sub-plan has been developed as a supplementary management plan to the BTS Augmentation Project CEMP.

1.1 Sensitive Receptors

The nearest sensitive receptors to noise and vibration are residents and businesses which are adjacent to the construction site on the western side of King Street and southern side of Alister Street, approximately 25m from the BTS site boundary. Depending on the location and nature of construction activities there may be varying impacts on sensitive receptors.

1.2 Existing Conditions

Noise measurements were undertaken by Arup in April and June 2011 and identified that background noise at sensitive receptors is dominated by tram, train and road traffic noise on Nicholson Street and St Georges Road. Noise from Merri Creek and operational noise from the BTS was also determined to be audible at times.

1.3 Legislative Requirements

No statutory controls exist for control of noise and vibration impacts during construction works. However, construction noise should be managed in accordance with the following Guidelines:

- EPA Environmental Guidelines for Major Construction Sites, Publication 480
- EPA Noise Control Guideline, Publication 1254

It should be noted that the State Environment Protection Policy No. N-1 (SEPP N-1) does not apply to "*noise from construction or demolition activities from building sites"* and was therefore not considered in this sub-plan. Operational noise at BTS will need to consider this guideline as per the Incorporated Document 2012, conditions from the Planning Scheme Amendment (C140) and Planning Permit (MPS/2014/87).

1.3.1 Noise

As per the EPA Noise Control Guidelines, Publication 1254, the construction site noise restrictions outlined in **Table A 1** apply.

Table A 1 Working Hours

Working Hours
Normal
- 7am – 6pm Monday to Friday - 7am – 1pm Saturday
Weekend / Evening
- 6pm – 10pm Monday to Friday - 1pm – 10pm Saturday - 7am – 10pm Sundays and public holidays During these hours, noise level at any residential property should not exceed background noise by: - 10dB(A) or more for up to 18 months after project commencement - 5 dB(A) or more after 18 months
Night
- 10pm – 7am Monday to Sunday During these hours, noise should be inaudible within a habitable room of any residential property.

During construction, works outside of normal working hours may be required where there are network constraints or to comply with traffic management requirements.

The EPA Noise Control Guidelines, Publication 1254 states that *"if unavoidable works were done in an unnecessarily noise way, this may be considered to be unreasonable".* The publication advises that in the case of large projects, those responsible are required to '*Inform potentially noise-affected neighbours about the stages of construction and noise reduction measures'*.

Should works be required outside of the EPA Noise Control Guidelines, Publication 1254 Schedule (as noted in Table B1), any affected premises should be notified and the relevant authority must be contacted and any necessary approvals sought.

1.3.2 Vibration

Structural damage from vibration criteria are presented in the British Standard *BS7385-Part 2:1993: Evaluation and Measurement for Vibration in Buildings*. **Table A 2** presents vibration limits to prevent structural damage to buildings.

Table A 2 Vibration Standards

Building Type	Peak Component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures, and industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Dwellings and buildings of similar design and / or use	15 mm/s at 4Hz to 20 mm/s at 15 Hz	20mm/s at 15 Hz to 50 mm/s at 40 Hz and above

1.4 Potential Impacts

Noise and vibration has the potential to impact on the local amenity and occupational health of surrounding residents and site personnel. In addition excessive vibration levels can result in structural damage to surrounding buildings and infrastructure.

The relevant noise and vibration impacts associated with each stage of construction for the BTS Upgrade project are detailed in **Table A 3**.

Table A 3 Stages of Noise and Vibration Impacts

Stage	Impact
1	This stage consists of mobilisation, site set up and preliminary demolition works and is expected to be six months in duration. Approximately 20 people will be working onsite during this phase. Equipment expected to generate noise during this phase, potentially audible beyond the site boundary include: drill rigs, semi-trailers, skid loaders, excavators and cranes. Buildings will be mechanically dismantled, and demolished offsite in some cases. Noise will only be audible at times during normal working hours.
2	This stage involves the construction of buildings, removal of existing electrical assets demolition of existing structures, installation of electrical assets, testing and commission. These works include building of the control room extension and 220kV and 66kV buildings, and relocation of the 22kV transformer. Cable installation will occur during this phase. This stage is expected to last 18 months in duration. Equipment that may generate noise potentially audible beyond the site boundary includes equipment used during stage 1 as well as knuckle boom lifts, concrete trucks and 20 tonne excavators. Noise will only be audible at times during normal working hours. Piling may occur during this stage and may generate high levels of vibration at nearby buildings.
3	This stage involves demobilisation, demolition of remaining redundant structures, landscaping and fencing. Equipment expected to create noise audible beyond the site boundary include trucks used to remove soil, a skid loader, and semi-trailers. Noise will only be audible at times during normal working hours.
Power Circuit Cutover	Power circuit cutover may be required to be undertaken at times of low energy usage, such as the early morning or late evening period. Equipment expected to create noise audible beyond the site boundary includes a tally handler, cranes, and diesel generated mobile light booms. This phase exceeds the criteria proposed in EPA Noise Control Guideline, Publication 1254, however it is considered to be unavoidable necessary work. All measures will be undertaken to minimise noise and the community and local authorities will be informed of the exact timing of these works.

1.5 Estimated Construction Noise Levels

Estimated construction noise levels at sensitive receptors have not yet been determined for the BTS Upgrade project.

1.6 Management Measures

AusNet Services is committed to the management of potential construction noise and vibration impacts. Management measures for noise and vibration impacts are outlined in **Table A 4**.

Table A 4 Noise and Vibration Management Measures

Management Measure	Responsibility
Timing of Works	
Undertake works between 7am and 6pm on weekdays and 7am to 1pm on Saturdays. Should works outside of the EPA Noise Control Guidelines, Publication 1254 be required, approval from the Moreland City Council and community notification would be required.	Delivery Partner Construction Manager
Avoid scheduling works on the weekend and evenings including movement of vehicles to and from the site.	Delivery Partner Construction Manager
Ensure that any work undertaken during weekend working hours does not exceed background noise by 10dB (A) or more for up to 18 months after the project commencement and 5dB (A) or more after 18 months.	Delivery Partner Construction Manager
Ensure that construction noise from works undertaken during night working hours is inaudible to any residential property.	Delivery Partner Construction Manager
Ensure nearby residents / potentially noise-affected neighbours are notified of the stages of construction works and noise reduction measures to be implemented.	Delivery Partner Construction Manager
Ensure nearby residents / potentially noise-affected neighbours are notified of periods of particularly noisy works e.g. demolition and out of hours works.	Delivery Partner Construction Manager
Ensure nearby residents / potentially noise-affected neighbours are notified of the progress of construction activities on a regular basis.	Delivery Partner Construction Manager
Particularly noisy activities (e.g. rock breaking) should be scheduled to less-sensitive times of the day such as the late morning or early afternoon (when residents are less likely to be at home) where practicable.	Delivery Partner Construction Manager
Deliveries to the site should only be scheduled during normal working hours.	Delivery Partner Construction Manager
Location of Works	
All construction vehicles (light and heavy) will be parked on the site and clear turning circles provided to reduce engine noise associated with revving and reversing beepers.	Delivery Partner Construction Manager
No construction vehicles should be left idling with their engine running in any streets adjacent to residential properties.	Delivery Partner Construction Manager
Enquiries and Complaints	
A principal contact person should be appointed, preferably the AusNet Services Project Manager or designated communications officer, to deal with any noise-related queries.	Delivery Partner Construction Manager
24-hour contact details of the nominated contact person should be provided to the nearby residential areas through letter-drops and site signage.	Delivery Partner Construction Manager
The complaints procedure outlined in **Section 7.4** of this CEMP should be followed for any noise and vibration related complaints.	Delivery Partner Construction Manager

Management Measure	Responsibility
Equipment and Machinery	
Noise from vehicles and machinery should not exceed the manufacturer's specifications, and all plant should be serviced regularly.	Delivery Partner Construction Manager
Respite breaks should be provided between particularly noise works such as rock breaking and jack-hammer works, and reasonable mitigation controls applied where practicable (e.g. temporary sound barriers)	Delivery Partner Construction Manager
All mechanical plant should be fitted with silencers / noise suppression devices. Silencers should be maintained to manufacturer's specifications and should be fitted on the air exhaust port of pneumatic tools such as jack-hammers.	Delivery Partner Construction Manager
Vehicles used regularly during construction should be fitted with less noisy reversing warning systems, such as BBS-Tek Reversing Systems Sensors which emit a broadband sound (which dissipates rapidly) rather than a single frequency sound that most reversing alarms emit.	Delivery Partner Construction Manager
All equipment, machinery, and vehicles should be turned off when not in use. Specifically, no trucks should be left standing with their engine on in any of the streets adjacent to residential properties.	Delivery Partner Construction Manager
Monitoring	
Noise should be monitored on an on-going basis by a suitably qualified professional to ensure relevant noise and vibration measures are not breached.	Delivery Partner Construction Manager
During night-time works, the following procedures will be undertaken: - Noise monitoring at strategically selected locations by a suitable qualified acoustics specialist - All residents within 150m of the works are will be advised of the works schedule at least seven days prior commencement of each stage of works - Residents will be provided with the nominated AusNet Services Project Manager or designated communications officer's phone number for any queries during night time works.	Delivery Partner Construction Manager
Should any vibration intensive activities occur vibration measurements will be undertaken at affected residences.	Delivery Partner Construction Manager

A Community Consultation Program will be implemented by AusNet Services throughout the construction phase of the project to ensure potentially affected residents are notified of any construction activities which have the potential for significant noise and vibration impacts.

1.7 Training and Awareness

To ensure noise management procedures are implemented ongoing training will be provided to all site personnel. Induction will include the following areas:

- work hours
- delivery hours and locations
- location of sensitive receptors
- noise minimisation measures
- importance of regular plant maintenance

Records of training will be kept for all personnel undertaking site induction and training, as detailed in **Section 3.4** of this CEMP.

1.8 Monitoring

Noise monitoring will be carried out by a suitably qualified professional at sensitive receptors at the commencement of any particularly noisy works to assess the potential impacts to sensitive receptors.

Noise monitoring will be conducted at sensitive receptors for any works that are to be scheduled to occur during evening or weekend periods, as defined by EPA Publication 1254, to determine the potential for non-compliance with the applicable noise criteria at noise sensitive receptors.

Where any works are to occur during the night-time, noise measurements should also be conducted to determine whether the works will be audible inside nearby residences. This should be done prior to the undertaking of such works during the night period so that the potential for audibility can be established, and appropriate action such as notifying residents or rescheduling of the works can be undertaken.

Where particular activities must be undertaken during the night-time, and where the noise from the activities may be audible inside residences, continuous monitoring should be undertaken to assess the likely impacts.

Noise measurements will be undertaken in accordance with *EPA Publication 1254, Noise Control Guidelines.*

Where vibration-inducing activities such as piling are to be undertaken, ground vibration monitoring will be undertaken at the commencement of the activities to assess the potential for damage to nearby building structures.

Where it is determined that vibration levels will exceed the limits that have been established to avoid structural damage, works will cease and alternative construction methods will be explored.

Where it is determined that the ground vibration levels are lower than the limits but within range of the limits, continuous ground vibration monitoring will be undertaken in the vicinity of the nearby buildings. Where increases in the measured ground vibration levels are measured such that exceedance of the limits is imminent, the works will cease and alternative construction methods will be explored.

Such vibration monitoring may be undertaken by continuous attended measurements, or by using monitoring equipment that sends an SMS alert or activates a flashing light when an exceedance is recorded.

As such, noise monitoring depends on the daily task to be undertaken and is therefore considered is a day-to-day management issue.

1.9 Reporting and Corrective Action

All noise and vibration monitoring results will be supplied to the AusNet Services Environment Manager (or delegate). Should there be any community complaints associated with noise and vibration levels this should be reported to the AusNet Services Environment Manager (or delegate) or AusNet Services Project Manager immediately.

The corrective action process to be followed for any non-conformance is outlined in **Section 8.4** of this CEMP.

1.10 Performance Indicators

Performance indicators relating to noise and vibration management are:

- noise and vibration levels have complied with this sub-plan
- all complaints from local community and other stakeholders have been addressed in a timely manner.

GUIDELINES

NOISE CONTROL GUIDELINES

Publication 1254 October 2008

INTRODUCTION

These guidelines are primarily intended to be used by municipal officers to assist in the resolution of complaints or to avert a possible noise nuisance. Some guidelines have been prepared so that they could be incorporated into a permit condition of a development or embodied as a local law. The guidelines are designed, however, to be the basis of assessment and not the last word.

Many of the guidelines do not require an actual measurement of the noise. In these cases, the inherent nature of the activity outside of the hours suggested is sufficient to consider the activity unreasonable.

EPA appreciates feedback on issues where additional noise control guidelines are considered useful or where refinements to existing guidelines are considered necessary.

Note: These guidelines are a reproduction of the former EPA publication TG302/92. The publication has been updated to reflect regulatory changes under the *Environment Protection (Residential Noise) Regulations 2008* and to address queries raised through consultation for these regulations. The sections for fixed domestic plant; for construction and demolition site noise and for noise assessment have been updated, and the ordering of sections has been changed. Other minor amendments are:

- a requirement for waste collection has been added
- references and standards for aircraft noise, scaregun noise and noise from shops have been updated.

ACKNOWLEDGEMENT

Some of the guidelines were adopted from noise control guidelines developed by the New South Wales Department of Environment and Climate Change (formerly the State Pollution Control Commission).

CONTENTS

1 FIXED DOMESTIC PLANT AND HOME OCCUPATION NOISE

(such as domestic air conditioners, swimming pool equipment, spas, ducted heating, internal vacuum systems and home occupation noise)

Noise from fixed domestic plant is subject to Section 48A of the *Environment Protection Act 1970* (EP Act) and the *Environment Protection (Residential Noise) Regulations 2008*.

Night operation

Noise from any fixed domestic plant must not be audible within a habitable room of any other residence (regardless of whether any door or window giving access to the room is open) during prohibited hours prescribed by the *Environment Protection (Residential Noise) Regulations 2008*.

The following **prohibited hours** apply to air conditioners, swimming pool and spa pumps, ducted heating systems and the like:

- 10 pm – 7 am Monday–Friday.
- 10 pm – 9 am weekends & public holidays.

Day/evening operation (non-prohibited times)

This guideline can assist assessment of the decibel intensity of fixed domestic plant noise. Noise measurements can contribute to assessment under s48A of the EP Act, where all the factors under s48A(4) must be taken into account.

Noise levels not meeting this guideline may be considered unreasonable if they interfere with use of home or property on a recurring or ongoing basis.

Where noise from any fixed domestic plant is audible beyond the boundary of the residential premises on which the plant is situated, the intrusive noise shall not exceed the background noise level by more than 5 dB at the measurement position.

Noise assessment must be made in accordance with noise assessment techniques listed in section 17 of these guidelines. Adjustment for tonality and/or impulsiveness must be included if applicable.

Assess at a time and circumstance representative of the likely worst case of impact, considering:

- when equipment is likely to be operating
- the equipment settings representative of normal operation (discuss with affected person and owner)
- that multiple items that generally operate together be assessed together
- representative background noise levels – noise from domestic plant will be more intrusive when background levels are lower.

For example, where noise affects a neighbour in the late evening, measurements of background and intrusive noise should be made at this time.

Background noise levels are normally lower in the evening than in the day and are highest during periods of peak traffic.

Measurement position

The measurement location must be representative of the relevant indoor and/or outdoor area affected by the noise.

Relevant outdoor areas

Relevant outdoor areas will generally exclude areas not normally used by the affected resident for rest, recreation or enjoyment, such as an access walkway.

The microphone should be located at the boundary of the property where the noise source is located. Where this is not practicable or not representative of an affected area, then a measurement within the affected area should be made.

Relevant indoor areas

Relevant indoor areas are not limited to habitable rooms, but may exclude infrequently and briefly used rooms such as a laundry.

Where possible, a representative outdoor measurement (example, near the façade of the affected area) should be taken for noise affecting indoor areas. This helps to avoid potential indoor measurement complications such as reflections or internal extraneous noise.

2 CONSTRUCTION AND DEMOLITION SITE NOISE

This applies to:

- industrial and commercial premises
- large-scale residential premises under construction in non-residential zones, as defined in regulation 9 of the *Environment Protection (Residential Noise) Regulations 2008*.

Other than for some large-scale residential premises, this guideline does not apply to noise from construction of private residential dwelling(s). These are subject to the *Environment Protection (Residential Noise) Regulations 2008*.

The purpose of this guideline is to protect nearby residential premises from unreasonable noise. Commercial and other premises affected by noise should be considered and reasonable measures implemented to reduce impact on these premises.

Community consultation and work scheduling

Community consultation is essential for large-scale projects or high-impact works. Where the community will be significantly impacted, consult on the benefits and drawbacks of different scheduling, planning and remediation options.

The following requirements apply to large projects with nearby sensitive uses:

- Inform potentially noise-affected neighbours about the nature of construction stages and noise reduction measures.
- Give notice as early as possible for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- Appoint a principal contact person for community queries.
- Provide 24-hour contact details through letters and site signage. Record complaints and follow a complaint response procedure suitable to the scale of works.
- Within normal working hours, where it is reasonable to do so:
    - schedule noisy activities for less sensitive times, (for example, delay a rock-breaking task to the later morning or afternoon)
    - provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise).
- The weekend/evening work hours in the schedule (including Saturday afternoon or Sunday) are more sensitive times and have noise requirements consistent with quieter work.
- The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times.

Work requirements

Noise reduction measures should be developed through initial project planning, tenders for equipment and subcontracts. Larger projects should develop a noise management plan (potentially part of a broader environmental management plan) and may require advice from an acoustic specialist, particularly if works are proposed outside of normal working hours.

The following measures apply:

- Where work is conducted in a residential area or other noise-sensitive location, use the lowest-noise work practices and equipment that meet the requirements of the job.
- Site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures should be used. The site should be planned to minimise the need for reversing of vehicles.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Fit all pneumatic tools operated near a residential area with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Special assessment of vibration risks may be needed, such as for pile-driving or works structurally connected to sensitive premises.
- Noise from the site needs to comply with the requirements of the schedule, except for:
    - unavoidable works
    - night period low-noise or managed-impact works approved by the local authority.

Unavoidable works are works that cannot practicably meet the schedule requirements because the work involves continuous work – such as a concrete pour – or would otherwise pose an unacceptable risk to life or property, or risk a major traffic hazard. Affected premises should be notified of the intended work, its duration and times of occurrence. The relevant authority must be contacted and any necessary approvals sought.

Low-noise or managed-impact works are works approved by the local authority:

- that are inherently quiet or unobtrusive (for example, manual painting, internal fit-outs, cabling)

or

- where the noise impacts are mitigated (for example, no impulsive noise and average noise levels over any half hour do not exceed the background) through actions specified in a noise management plan supported by expert acoustic assessment.

Low-noise or managed-impact works do not feature intrusive characteristics such as impulsive noise or tonal movement alarms.

Schedule: Construction and demolition site noise

Normal working hours

Noise to follow the requirements above during the hours of:

7 am – 6 pm Monday to Friday

7 am – 1 pm Saturdays

Weekend/evening work hours

Noise level at any residential premises not to exceed background noise by:

10 dB(A) or more for up to 18 months after project commencement

5 dB(A) or more after 18 months

during the hours of:

6–10 pm Monday to Friday

1–10 pm Saturdays

7 am – 10 pm Sundays and public holidays

Night period

Noise inaudible within a habitable room of any residential premises during the hours of:

10 pm – 7 am Monday to Sunday

Note: Noise from construction of large-scale residential premises in non-residential zones (see regulation 9 of the *Environment Protection (Residential Noise) Regulations 2008*) is subject to the unreasonable noise provisions of s48A(3) of the EP Act at all times of day. In all circumstances, the assessment may have regard to this noise control guideline.

This guideline affirms the minimum expectation that noise from these sites must not be audible within a habitable room of any residential premises between 10 pm and 7 am. This is considered unreasonable noise under the EP Act. However, provision is made for circumstances of unavoidable works or low-noise or managed-impact works.

This guideline does not limit the general ability of a local government or police officer to assess the unreasonableness of noise at any time. For example, if unavoidable works were done in an unnecessarily noisy way, this may be considered to be unreasonable. General noise at any time during the day might still be considered unreasonable, taking into account the work practices and circumstances of the noise. As specified in s48A(4) of the EP Act, assessment must consider the attributes of the noise and the time, place and circumstances in which it is emitted.

3 ROAD REPAIR AND TRACK MAINTENANCE

The following guidelines have been designed to limit the amount of noise impinging solely on residential premises. To this end, affected premises such as offices may be considered exempt from the schedule.

- All pneumatic tools operated in a residential area should be fitted with an effective silencer on their exhaust port.
- The unit with the lowest noise reading which meets the requirements of the job should be used where work is conducted in a residential area or other noise-sensitive location.
- All mechanical plant must be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Unless involved in emergency repair or for safety reasons, all work should be conducted during the hours specified in the schedule.
- If routine work is planned outside the hours specified by the schedule, all affected premises in the residential area must be notified of the intended work, its duration and times of occurrence.
- Work that creates the most noise should be scheduled to minimise the impact on residential premises.

Schedule: Road repair and track maintenance

7 am – 6 pm Monday to Saturday

9 am – 6 pm Sunday and Public Holidays

4 DOG KENNELS

The problems caused by the perpetual barking of dogs has been known to exist at distances as far as 500 metres from the actual source. The following criteria for dog kennels have therefore been assembled to limit both the physical stimuli to the dogs and the outbreak of noise from the kennels.

- The kennels should be located at least 500 metres from residential areas.
- Some fully enclosed or acoustically baffled kennels should be available to house particularly noisy animals, at a ratio of 1:15.
- Electronic masking noise devices should be provided to reduce audible stimuli to the dogs.
- Kennels should be constructed to visually screen stimuli such as other dogs, animals, traffic or passers-by.
- Access to kennels should be restricted solely to staff.

- Feeding of the dogs should be restricted to the daytime hours of 7 am – 6 pm.
- Exercise of the dogs may only be performed between the hours of 9 am and 5 pm.
- A responsible person must be available on site 24 hours per day.
- Kennels should be constructed of such a material so as to provide an appropriate reduction in the emission of noise. Materials such as masonry and cement sheeting would provide a suitable structural basis.
- The kennels should be positioned so as to utilise the ability of the topography to reduce noise.

Note: Noise originating from dog kennels may be assessed using *State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1.*

5 DOMESTIC REFUSE COLLECTION

The main annoyance produced by domestic refuse collections occurs in the early morning (in other words, before 7 am). Therefore, if possible, routes should be selected to provide the least impact on residential areas during that time.

Collection of refuse should follow the following criteria:

- Collections occurring once a week should be restricted to the hours 6 am – 6 pm Monday to Saturday
- Collections occurring more than once a week should be restricted to the hours 7 am – 6 pm Monday to Saturday
- Compaction should only be carried out while on the move.
- Bottles should not be broken up at the point of collection.
- Routes that service entirely residential areas should be altered regularly to reduce early-morning disturbance.
- Noisy verbal communication between operators should be avoided where possible.

6 INDUSTRIAL WASTE COLLECTION

Annoyance created by industrial waste collection tends to intensify in the early-morning period. To this end, early-morning collections should be restricted to non-residential areas to minimise early morning disturbances. Where a residential area is impacted by noise from the collection of refuse, then collections should be restricted to the times contained within the schedule.

- Refuse bins should be located at sites that provide minimal annoyance to residential premises.
- Compaction should be carried out while the vehicle is moving.
- Bottles should not be broken up at collection site.
- Routes which service predominantly residential areas should be altered regularly to reduce early morning disturbances.
- Noisy verbal communication between operators should be avoided where possible.

Schedule: Industrial waste collection

One collection per week

6:30 am – 8 pm Monday to Saturday

9 am – 8 pm Sunday and public holidays

Two or more collections per week

7 am – 8 pm Monday to Saturday

9 am – 8 pm Sunday and public holidays

7 MOBILE VENDORS

The owner or person in charge of a vehicle should not use or operate in any public place a noise or loudspeaker device for the purpose of informing members of the public that articles are on sale from that vehicle, or to promote a related business activity:

- while the vehicle is stationary
- before 9 am or after 9 pm on any day
- for longer than 30 seconds in any period of three minutes

or

- more than once in any period of one hour in a section of a road between two intersecting crossroads which are nearest in each direction.

8 TRUCK-MOUNTED REFRIGERATION UNITS

Whether parked on residential or non-residential premises, the noise from the operation of a truck-mounted refrigeration unit must not be audible within a habitable room of any other residence (regardless of whether any door or window giving access to the room is open) during the hours contained in the schedule.

Schedule: Truck-mounted refrigeration units

Non-residential premises (e.g., noise from a delivery truck, whether moving or parked on the street)

10 pm – 7 am Monday to Saturday

10 pm – 9 am Sundays and public holidays

Residential premises (including a truck owner keeping their vehicle on the street outside their home)

8 pm – 7 am Monday to Friday

8 pm – 9 am weekends and public holidays

Note: Section 48(A) of the *Environment Protection Act 1970* deals with the emission of unreasonable noise from residential premises. This provision of the Act is

not limited to the schedule and may be enforced at any time.

9 DELIVERIES TO SHOPS, SUPERMARKETS AND SERVICE STATIONS

Where a residential area will be impacted by noise from deliveries, then deliveries should be inaudible in a habitable room of any residential premises (regardless of whether any door or window giving access to the room is open) outside the hours contained in the schedule.

Schedule: Deliveries to shops, supermarkets & service stations
7 am – 10 pm Monday to Saturday
9 am – 10 pm Sundays and public holidays

Note: All ancillary motors or trucks should be turned off whilst making the delivery.

10 NOISE FROM SHOPS

Where amplified speech or music from shops (spruiking) is to be controlled, the following conditions may be specified.

Each loudspeaker or loudspeaker system to be placed in such a position that, while it is in use, it remains:

- located entirely inside the shop
- situated not less than three metres from any public entrance to the shop
- directed in such a manner that the device does not point towards any wall which contains an external window or entrance to the shop unless the wall is more than 15 metres from the device itself
- operating at a level that does not exceed 65 dB(L_{Aeq}) two metres from the facade.

11 GARDENING ON NON-RESIDENTIAL PROPERTY

This guideline is intended to limit the amount of noise created by lopping or removal of trees, cutting of grass and so forth.

All internal combustion engines must be fitted with a suitable muffler in good repair.

Work carried out in proximity to a residential area should be restricted to the hours:

7 am – 6 pm Monday to Saturday
9 am – 6 pm Sundays and public holidays, unless involved in emergency work.

12 SCAREGUNS

Background

Scareguns are devices for producing a loud explosive sound for the purpose of scaring away birds from crops and orchards. Scare guns, also known as gas guns or scatter guns, produce an explosive noise by the ignition of a charge of gas and air. Some scare guns rotate after firing so that the next blast is emitted in a different direction, which is intended to increase the surprise effect on birds.

Scareguns, when used as the sole bird deterrent, are likely to become significantly less effective after a few days. This is due to the birds becoming accustomed to the noise. For scareguns to remain effective it is necessary to vary and enforce the frightening effect. Methods which do this include the relocating of the scare gun every day or so and the use of 'birdfright' explosive cartridges.

The rate of firing the scaregun must be carefully considered. If the firing rate is set too high, the birds will very quickly become accustomed to the noise. However, if set too low, the birds will return from cover after being frightened away and will have time to feed.

For the guns to be most effective they should be used when the birds are most actively feeding. This will normally be in the early morning and late afternoon; but this could be dependent on the species. Most scareguns can be fitted with a timer that enables them to be automatically turned on and off.

Scareguns are not the only method of bird control available. Where scareguns cannot be used, other bird controls should be considered by the producer. These include:

- kites, shaped like birds of prey
- chemical sprays that are unpalatable to some species of small birds
- plastic strips that hum in the wind
- nets and plastic mesh
- noise generators such as 'Av-alarm', 'Pestaway Agricultural Noise Generator' or a 'white noise' generator. (The first two produce a high level of noise which may cause annoyance to residents if living nearby. The last-mentioned device produces a cicada-like sound and has been found to be particularly effective with silvereyes).

Discussion

Birds that attack fruit and crops can cause significant losses to a producer. A scaregun, if used correctly, does offer some protection against this problem. However, the noise that frightens the birds can also cause significant annoyance to neighbours living in the area. As a consequence, when scareguns are used, there needs to be a balance set between the

producer's needs and the rights of residents. This guideline attempts to set this balance and should be seen as a reasonable compromise for both parties.

Guidelines for the control of noise from scareguns

- A scaregun must not be used if the distance between the scaregun and any complainant's house is less than 300 m (See Note 2).
- The scaregun must not emit more than 70 blasts/day.
- The scaregun must not be used earlier than 7 am or later than sunset. Earlier starting times will be allowed if this is agreed to by the complainants.
- The total time of operation of a scaregun must not exceed 12 hours in any one day. However, the time of operation may be divided into two separate periods, provided the interval between blasts is not less than six minutes.
- The scaregun must be located as far away as possible from any complainant's house.
- Wherever possible, the shielding effects of natural features, buildings and so on shall be used to reduce the level of the blasts at complainants' houses.
- Wherever possible, the use of the scaregun shall be minimised.

Notes:

1. These guidelines are based on an average maximum level of 100 dB LIN Peak of the loudest 20 per cent of blasts measured at the complainant's home when the weather favours noise propagation. The dB LIN Peak is measured with the sound level meter set to linear ('Z') frequency-weighting and peak ('P') time weighting.
2. Where the level of the blast from a scaregun can be adjusted, then the distance between the scaregun and any complainant's house may be less than 300 m. In this case the adjusting mechanism must be permanently fixed such that the average maximum level of the blasts at the house does not exceed 100 dB LIN Peak.
3. Weather conditions affect the propagation of noise. Received levels are loudest when the wind blows from the source to the receiver. Temperature inversions, which often occur in the early mornings after a clear night, also increase noise propagation.

13 PUBLIC ADDRESS SYSTEMS

Public address systems are commonly used in conjunction with outdoor entertainment and sporting activities and can cause annoyance if used inappropriately. For the purpose of this guideline public address systems may be divided into two categories: low-power units needed for control of persons engaged in the activities or events; and high-power units used for making public commentaries and announcements.

Objectives

In all cases, the environmental objective should be noise intrusion of not more than 5 dB(A) above background at any affected residences or other noise-sensitive locations. Corrections for tonal or impulsive noise usually are not necessary, and further tolerance of up to 5 dB(A) may be allowed for unique or very infrequent activities with recognised social merit. Amplifier level settings must be minimised whilst ensuring conveyance of information to audience or participants is adequate.

Restrictions on the times of use of public address systems should be considered. Noise from PA systems must not be audible inside a residential dwelling during normal sleeping hours.

Low-power systems for event control

These are usually small systems such as are used for controlling competitors in events like BMX bike races and go-kart races. Where such systems may cause noise annoyance, the following criteria should be applied:

- The public address system must only be used to control the event, not for giving commentaries, advertising or playing music.
- Speakers may only be installed in the essential control areas, such as marshalling sites.
- Speakers should be small, low-power horn units no more than 20 cm across the horn opening and operated by an amplifier of no more than 30 watts.
- Horn units are to incline downwards at an angle of approximately 45º, point in the appropriate direction and be mounted on poles approximately three metres tall, in such a way that the speaker is held firmly and cannot be rotated.
- A sound level limiting circuit should be incorporated in the amplifier to control the signal amplitude to a fixed level, regardless of the loudness of the operator's voice.
- Once the control knobs have been set to the correct positions, they should be removed and the potentiometer spindles covered with a fixed metal channel attached to the front panel of the amplifier.
- The spare microphone inputs should be covered with metal plates securely fitted to the rear or front panel of the amplifier, as the case may be.

High-power systems for commentaries and announcements

These are usually much larger systems used, for example, to give a running commentary during a

sporting event or race meeting, to keep spectators entertained or for carnival-type advertising.

- Most of the criteria for lower power systems are applicable.
- Rather than use high-powered speakers placed in a few locations, it is preferable to place more low-powered speakers to cover the entire perimeter of the grounds, each pointing downward and inward towards the ground where the event is taking place.

Note:

1. Consideration should be given to substitution of sound systems by visual displays such as electronic scoreboards and video screens for large operations.
2. PA systems used for paging staff and patrons in business and catering operations may also be replaced where they adversely affect residences. In business, two-way radios or pocket beepers may be used. In hotels, meal ticket numbers may be presented on digital display boards instead of being announced.

14 MINI-MOTORCYCLE CIRCUITS

Introduction

This guideline is intended to limit the amount of noise created by mini-motorcycles at a circuit controlled by a non-profit organisation within the Melbourne metropolitan area.

Definitions

Circuit means the entire area controlled by the club and includes, but is not restricted to, the track area, pits area, warm-up area and car park area.

Mini-motorcycle means any two-wheeled vehicle, powered by an internal combustion engine, that cannot be registered for road use.

Public holiday means public holiday as published in the *Victoria Government Gazette* from time to time.

Standard exhaust system means either the complete exhaust system fitted to the mini-motorcycle at the time of manufacture or a complete system specified and distributed by the manufacturer of the mini-motorcycle as a suitable replacement.

Noise guidelines

Only mini-motorcycles having an engine capacity of 100 cc or less should be permitted on the track, pits or warm-up areas and the engine of any mini-motorcycle may only be operated when the cycle is in one of these areas or being ridden between these areas.

All mini-motorcycles ridden on the track, pits or warm-up areas must have fitted a standard exhaust system or equivalent system capable of reducing the noise emissions to a level of 96 dB(A) or less when tested in accordance with the motor cycle provisions of the *Environment Protection (Vehicle Emissions) Regulations 2003* made under the *Environment Protection Act 1970.*

No more than 15 mini-motorcycles are to be ridden on the track area at any one time, either during practice sessions or races of any kind.

The engines of mini-motorcycles located at the starting line prior to the start of any race are not to be operated for longer than two minutes.

No more than two mini-motorcycles are to be operated on the warm-up area at any one time.

The engines of mini-motorcycles located in the pits area should not be operated for excessive periods of time.

Public address systems: Section 13 of these guidelines cover the installation and use of these systems.

A sign or signs must be erected and maintained by the club, indicating that the circuit is only to be used by club members. The erection of a sign may need to comply with the requirements of the relevant planning scheme.

Regular club activities should be restricted to Saturdays, Sundays and public holidays, and the hours during which the engine of a mini-motorcycle can be operated on the circuit must fall within the interval 9 am to 6 pm on any Saturday and 10 am and 6 pm on any Sunday or public holiday. On each day that mini-motorcycles are ridden on a circuit there must be a continuous period of at least 45 minutes between 12 noon and 2 pm when the engine of any mini-motorcycle is not to be operated.

In any period of four consecutive weeks there should be at least one entire weekend during which no mini-motorcycles are to be operated on the circuit.

For each new circuit, the distance between any zone in which the use of mini-motorcycles is prohibited under the relevant planning scheme and the nearest part of the track area, pits area or warm-up area should not be less than 350 metres. In addition, consideration must be given to the following:

- other lawful uses in the same zone or reservation that are likely to be sensitive to noise, or whether any permits have been issued for such uses.
- any proposed rezoning or reservation of the area.

15 AIRCRAFT

The impact of aircraft noise is generally of major concern only in the vicinity of airports. In these situations levels of noise exposure can be mapped using either the Australian Noise Exposure Forecast (ANEF) system or the maximum noise levels from aircraft where an ANEF is not available.

The Commonwealth regulations for aircraft noise are the *Air Navigation (Aircraft Noise) Regulations 1984*. Complaints about noise from aircraft in flight should be directed to Airservices Australia, a Commonwealth government agency.

Table 15.1: Building site acceptability near airports

Building type	ANEF zone of site		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF(Note 1)	20 to 25 ANEF(Note 2)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF(Note 1)	20 to 25 ANEF(Note 2)	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF(Note 1)	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF(Note 1)	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Notes:

1 The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, AS 2021–2000 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction* specifies additional procedures for building sites outside but near to the 20 ANEF contour.

2 Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land-use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate (see also Figure A1 of Appendix A of AS 2021–2000 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*).

3 There will be cases where a building of a particular type will contain spaces used for activities that would generally be found in a different type of building (for example, an office in an industrial building). In these cases this table should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3 of AS 2021–2000 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*.

Table 15.2: Building site acceptability based on maximum noise levels without ANEF charts

Building site	Aircraft noise level expected at building site, dB(A)					
	20 or fewer flights per day			More than 20 flights per day		
	Acceptable	Conditionally acceptable	Unacceptable	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	<80	80 to 90	>90	<75	75 to 85	>85
Hotel, motel, hostel	<85	85 to 95	>95	<80	80 to 90	>90
School, university	<80	80 to 90	>90	<75	75 to 85	>85
Hospital, nursing homes	<80	80 to 90	>90	<75	75 to 85	>85
Public building	<85	85 to 95	>95	<80	80 to 90	>90
Commercial building	<90	90 to 100	>100	<80	80 to 90	>90
Light industrial	<95	95 to 105	>105	<90	90 to 100	>100
Heavy industrial	No limit					

NOTE: The forecast daily average number of aircraft flights affecting the site should be obtained from the aerodrome owner. However, each night-time flight between 7 pm and 7 am is to count as four operations.

Reference: AS 2021–2000 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*.

16 HELICOPTERS

Noise level criteria

The criteria comprise three separate components, each of which should be satisfied at the nearest affected buildings:

- The measured $L_{Aeq,T}$(measured over the entire daily operating time of the helipad) shall not exceed 55 dB(A) for a residence.
- The measured maximum noise level $L_{A\ max}$ shall not exceed 82 dB(A) at the nearest residential premises (See Note below).
- Operation outside the hours between 7 am and 10 pm shall not be permitted except for emergency flights.

Note: These levels will generally be met by a separation between the landing site and the residential premises of 150 m for helicopters of less than two tonnes all-up-weight, and 250 m for helicopters of less than 15 tonnes all-up-weight.

17 NOISE ASSESSMENT TECHNIQUE

When measurement of noise emissions is deemed necessary in the application of these guidelines then they should be performed in accordance with Australian Standard 1055.1–1997, *Acoustics – Description and Measurement of Environmental Noise. Part 1: General Procedures*.

Alternatively, a simple procedure that can be used for measuring environmental noise is described below.

Measurement equipment

The equipment used should conform to the specifications for sound level meters of Class 1 or Class 2 as contained in *Australian Standard AS IEC 61672.1-2004, Electroacoustics – Sound level meters*.

Laboratory calibration and maintenance

The sound level meter and portable sound level calibrator must be calibrated at least every two years by a calibration laboratory, as specified in AS 1055.1–1997.

Field calibration checks

The performance of the sound level meter when in use shall be checked periodically with a portable sound level calibrator, pistonphone or other portable checking device appropriate to the sound level meter, and immediately before and after measurements are made.

For extended measurement periods, these checks should be performed before and after each measurement sequence.

If the instrumentation system registers a calibration discrepancy equal to or greater than ±1 dB between consecutive checks, any measurements in the interval between the two checks shall be considered invalid.

Measurement procedure

Measurement location

Having regard to any measurement location specified for a category of noise, the microphone will be located at a point where the highest sound pressure level of the noise under investigation will be obtained.

The measurement should be taken outdoors. The microphone of the sound level meter should be located between a height of 1.2 and 1.5 metres above the ground.

The measurement point should be no less than 3.5 metres from any reflective surface, such as walls or buildings, other than the ground.

The surface on which a noise source (such as an air conditioner) is located and the property boundary from where the noise is emitted are not considered as reflective surfaces.

Where it is not possible to locate the measurement point 3.5 metres from reflective structures, such as outdoor measurements near buildings, the preferred measurement positions are one metre from the facade and 1.2 to 1.5 metres above each floor level of interest.

Where the sound is directly incident on that facade, an adjustment of –2.5 dB should be made to the measured sound pressure level. 'Directly incident' means where the sound under observation is emitted from a location approximately opposite to the point on that facade nearest to where the measurement is being made.

Where measurement is made inside a habitable room of the noise-affected residential premises and a window or door is the major transmission path for the noise, it shall be fully open during the measurement.

Measurement settings

Equivalent continuous sound pressure level (L_{eq}) for noise under assessment

The sound level meter must be set on A-frequency-weighting and equivalent continuous sound pressure level (L_{eq}) integrating function. The level should be determined over a sufficiently long time to be representative of the noise and will be measured for not less than five minutes. The level must not include extraneous noise that could affect the level of the noise being assessed – extraneous noise must be excluded using the pause function of the meter.

Alternative to L_{eq}

For meters without an L_{eq} function, the average instantaneous A-weighted sound pressure level (L_{PA}) can be used as an equivalent, by taking the average of the levels measured during the time interval considered (for example, noting no less than 40 needle readings on the meter over the period of measurement and taking the arithmetic average of these levels). This method of assessment is only suited to steady noise sources that do not vary by more than 8 dBA.

Method of background measurement

90 per cent exceedance sound pressure level (L90) for background measurement

The sound level meter shall be located at the measurement point used to determine the equivalent continuous sound pressure level (L_{eq}) of the noise under assessment.

The meter must be set on A-weighting, fast response and L90 statistical weighting function. The level must be determined over a sufficiently long time to be representative of the background at the time of noise impact and will be measured for not less than five minutes. The intrusive noise under assessment and non-typical local noises (such as local construction noise or street cleaning) must be excluded.

Alternative to L90

For meters without a statistical weighting function, the background A-weighted sound pressure level (LA_{bg}) shall be determined by taking the average of the lowest levels measured using the F (fast) time weighting, at the time of noise impact. The intrusive noise under assessment and non-typical local noises must be excluded.

Adjustments

Adjustments may have to be made to the measured sound pressure level in some cases. The adjusted sound pressure level is the measured sound pressure level adjusted for tonal (for example, humming or whining) and impulsive (for example, hammering) characteristics of the noise. The presence of tonal or impulsive characteristics creates additional annoyance.

Assessment of tonality should consider both high-frequency and low-frequency tones. If a tone is present in the noise being measured, the adjustment shall be +2 dB for a tone just detectable by the observer and +5 dB for a tonal component prominently audible.

If impulsiveness is a significant characteristic of the noise being measured, the adjustment shall be +2 dB for an impulsiveness just detectable by the observer and +5 dB if it is readily detectable.

Non-standard circumstances

The above measurement procedure may not be appropriate for some noise circumstances, e.g. fixed domestic plant generating intrusive low frequency noise, increased low frequency noise within the affected premises, or structurally transmitted noise.

In such cases a subjective judgement of impact may be needed, taking into account the place of effect (e.g. while lying in bed) and nature of the noise impact.

18. OTHER NOISE GUIDELINES AND USEFUL REFERENCES

A number of these publications are available from EPA's Information Centre, ground floor, 40 City Road, Southbank, Victoria 3006 (phone 03 9695 2722), or from www.epa.vic.gov.au/noise.

1. *Interim guidelines for control of noise from industry in country Victoria*. EPA publication N3/89.
2. *Interim gunshot noise guidelines*. EPA publication N6/91.
3. *Using the interim gunshot noise guidelines*. EPA publication 920
4. *State Environment Protection Policy (Control of noise from commerce, industry and trade)*. No. N-1. Victorian Government Gazette No. S31, 15 June 1989.
5. *Explanatory notes: State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1*. EPA Publication N4/91.
6. *State Environment Protection Policy (Control of music noise from public premises) No. N-2*. Victorian Government Gazette No. S43, 3 August 1989.
7. *Explanatory notes: State Environment Protection Policy (Control of music noise from public premises) No.N-2*.
8. *A guide to the measurement and analysis of noise*. EPA publication 280.
9. *Annoyed by noise?* EPA publication 406.
10. *Environment Protection (Residential Noise) Regulations 2008*.

Note: Regulations can be obtained from Information Victoria, 505 Little Collins St, Melbourne, Victoria 3000 (phone 1300 366 356).

Noise complaints from major industry and commerce can be made to EPA's Pollution Watch Line, phone 03 9695 2777.

Appendix B

Traffic Management Sub-plan

Brunswick Terminal Station Update Project: Construction Traffic Management Plan Overview

Proposed Upgrade

A Construction Traffic Management Plan (CTMP) has been produced to plan for and mitigate traffic and transport issues during the demolition and construction phases of the proposed upgrade at Brunswick Terminal Station (BTS).

Proposed Development Traffic Access Routes and Times

Vehicle Access

All vehicles (both general and construction) will enter and exit the BTS site via Glenlyon Road to minimise impact on local residents.

BTS Upgrade Working Hours

The normal working hours for the BTS upgrade are proposed as follows:

- 7:00am to 6:00pm – Monday to Friday
- 7:00am to 01:00pm – Saturday

The above timings are proposed for vehicle access to and from the BTS site during construction. To minimise impact to the local road network, users and local residents, indicative timings will be adhered to wherever possible. There may, however, be occasions where deliveries or vehicle access for other works may occur outside these prescribed hours.

Please also note that, as part of ongoing operational requirements, vehicles may enter and leave the site outside these hours.

Typical Vehicle Types to/from BTS site

Vehicle Type	Vehicle Speeds	Comment
General workers vehicles / Medium Rigid Vehicles and below	As posted on local road network.	No Comment.
Heavy Rigid and Articulated Vehicles – without traffic management	40km/h or 30km/h speed limit suggested between arterial road network and site.	No Comment.
Heavy Rigid and Articulated Vehicles – with traffic management	40km/h or 30km/h speed limit suggested between arterial road network and site.	Occur only outside of typical local road network peak operational times in order to minimise disruption.
Over-Dimensional Vehicles	Usually undertaken with convoy at controlled speeds of 20kph and lower.	Typically undertaken overnight on weekends as these vehicles require special routes and control measures during travel. Relevant authorities will be involved in coordination and surrounding community informed about any traffic management measures, such as road closures or temporary changes to parking arrangements.

Traffic Generation

Construction traffic activity is expected to peak between 6:00am and 7:00am, and between 5:00pm and 6:00pm with around 49 vehicles per hour as shown below.

Construction Traffic Generation Peak Periods

Peak Time Periods	Private Vehicles	Heavy Vehicles	Total
AM Peak 6:00-7:00am	44 arrivals	5 arrivals, 5 departures	49 vehicles per hour
PM Peak 5:00pm-6:00pm	44 departures	5 arrivals, 5 departures	49 vehicles per hour

Appendix C

Flora and Fauna Management Sub-plan

Appendix C Flora and Fauna Management Sub-plan

This Flora and Fauna Management Sub-plan outlines measures to manage potential adverse impacts to flora and fauna associated with the construction of the BTS Augmentation Project, in particular to threatened species and ecological communities.

Community commitments made by AusNet Services in relation to flora and fauna management include:

- *Ensure that construction workers are aware of the site's environmental and community sensitivities and context.*
- *Ensure construction workers are aware of their responsibilities.*
- *Prevent spread of weed species from the site.*
- *Prevent the infestation of animal pest, particularly foxes, rabbits and rats.*
- *Prevent adverse environmental and community impacts from construction.*

The following general construction activities have the potential to impact on flora and fauna:

- all earthworks and the transportation of excavated materials and stockpiles which may generate dust
- demolition works
- using unsealed access and egress roads which may generate dust
- exhaust emissions from the use of vehicles, plant, and other machinery onsite.

This sub-plan has been developed as a supplementary management plan to the BTS Augmentation Project CEMP, in accordance with:

- Moreland Planning Scheme Amendment C140, Incorporated Document 2012 and Planning Permit MPS/2014/87
- Flora and Fauna Management Plan (including site assessment) developed by AECOM (June 2012) for the BTS
- DEPI Permitted clearing of native vegetation: Biodiversity assessment guidelines.

1.1 Sensitive Receptors

Merri Creek is the key environmental sensitivity located near the construction area. This watercourse exists approximately 10m to the north-east of the site and as a whole is known to support a range of flora and fauna and vegetation communities.

1.2 Existing Conditions

An ecological assessment was undertaken by AECOM in June 2012, identifying that the BTS is dominated by exotic weeds and pasture grasses. No threatened flora, fauna or ecological communities were identified as occurring or having the potential to occur at the site.

The site consists of planted non-indigenous Australian trees and exotic trees which may provide potential habitat for local fauna.

1.3 Legislative Requirements

Legislation and policy applicable to the management of flora and fauna at the BTS is as follows:

- *Environmental Protection and Biodiversity Conservation Act 1999 (Cmwlth)*
- *Planning and Environment Act 1987 (Vic)*
- *Flora and Fauna Guarantee Act 1988 (Vic)*
- *Environmental Effects Act 1987 (Vic)*
- *Catchment and Land Protection Act 1994 (Vic)*
- *Wildlife Act 1975 (Vic)*
- *Permitted clearing of native vegetation: Biodiversity assessment guidelines (formerly known as Victoria's Native Vegetation Management Framework) (DEPI, 2013)* and related documents

As detailed in Section 4.2 of the CEMP, BTS was re-zoned from Residential 1 Zone to Special Use Zone (Schedule 3), and the existing Environmental Significance Overlay was amended to include an exemption for buildings and works carried out in accordance with the Brunswick Terminal Station Incorporated Document 2012. However due to the perceived conflict between works shown in the Incorporated Document 2012 and controls in the Moreland Planning Scheme, a planning permit (MPS/2014/87) was lodged and approved by Moreland City Council which covers the "removal of vegetation."

1.4 Potential Impacts

Potential flora and fauna incidents which may occur as a result of the upgrade or vegetation removal at BTS may include:

- injury to common native fauna
- spreading of weeds offsite
- introduction of weeds onto the site
- indirect impacts to Merri Creek through sedimentation and water contamination.

The Flora and Fauna Assessment undertaken by AECOM in June 2012 for the BTS did not identify any threatened flora or fauna at the site. Given the highly modified nature of the site the likelihood of threatened species occurring at the site, with the exception of the Brown Toadlet, is considered to be low to unlikely.

In consideration of the results and the legislative obligations identified for the BTS, management measures outlined in **Section 1.5** are recommended for consideration by AusNet Services.

1.5 Management Measures

AusNet Services is committed to the management of flora and fauna during construction of the BTS Augmentation Project. Measures for flora and fauna control are outlined in **Table C 1** below.

Table C 1 Flora Fauna Management Measures

Management Measure	Responsibility
Delineating Vegetation to be Cleared	
Vegetation to be removed should be clearly marked on work plans prior to construction activities commencing in accordance with the TreeMap Arboriculture Assessment Report (February 2014). All vegetation removal will be managed using this arborist report and site developed vegetation protocols that require sign off/authority from the relevant project personnel before removal	Delivery Partner Construction Manager
All trees to be retained (as per Landscaping Plans in the Planning Permit MPS/2014/87) will have temporary fencing installed around the tree drip line	Delivery Partner Construction Manager

Management Measure	Responsibility
Vegetation Clearance	
A suitably qualified arborist should undertake removal or trimming of any problematic or unsafe branches.	Delivery Partner Construction Manager
All trees will be felled in the construction zone.	Delivery Partner Construction Manager
A suitably qualified ecologist will be engaged to undertake searches for native fauna in vegetation to be cleared, immediately prior to vegetation clearing or demolition activities. This will include checking vegetation for any nests.	Delivery Partner Construction Manager
Should any animals be encountered by site personnel when a suitably qualified ecologist is not present, the Fauna Salvage Standard Operating Procedure should be followed.	Delivery Partner Construction Manager
Cleared vegetation matter will be mulched and stockpiled for use in erosion and sediment control or landscaping. Root systems will be retained for erosion control.	Delivery Partner Construction Manager
Mulch stockpile heights will be: - kept to less than 1m - regularly turned to prevent drying out and rot development - kept at least 1m away from buildings and structures to reduce the risk of fire.	Delivery Partner Construction Manager
Erosion and sediment control will be implemented at the same time as vegetation removal / clearing activities. Erosion and sediment control will be undertaken in accordance with the Erosion, Sedimentation and Earthworks Management Sub-plan.	Delivery Partner Construction Manager
Any vegetation removal and animal encounters should be recorded in AusNet Services Environmental Inspection Checklist. Post clearing inspections should also be recorded in this checklist.	Delivery Partner Construction Manager
Aquatic Flora and Fauna	
Merri Creek, and associated flora and fauna, will be protected from sediment impacts in accordance with the Erosion, Sedimentation and Earthworks Management Sub-plan.	Delivery Partner Construction Manager
Merri Creek, and associated flora and fauna, will be protected from contamination impacts in accordance with the Contamination Management Sub-plan.	Delivery Partner Construction Manager
Weeds	
Weeds should be managed in accordance with the BTS standard operating procedure for minimising spread of weeds and pathogens.	Delivery Partner Construction Manager
Revegetation	
Locally indigenous plants will be used in landscaping. All revegetation and tree maintenance will be undertaken in accordance with the Landscaping & Maintenance Plan, forming part of the Planning Permit (MPS/2014/87).	Delivery Partner Construction Manager
Construction Lighting	
Where practicable, site lighting will be directed away from Merri Creek and mature trees on site if night works are required.	Delivery Partner Construction Manager

1.6 Training and Awareness

To ensure flora and fauna management procedures are implemented, ongoing training will be provided to all site personnel. Induction will include the following areas:

- flora and fauna issues
- location of potential habitat areas
- vegetation clearing protocols
- fauna salvage protocols
- existing weed control
- construction activities with the potential to impact flora and fauna
- implementation of management measures outlined in this sub-plan.

Records of training will be kept for all personnel undertaking site induction and training, as detailed in **Section 3.4** of this CEMP.

1.7 Monitoring

Ongoing monitoring of the site to detect any new weed infestations or spread will be undertaken during the construction phase, in accordance with the Weekly Environmental Inspection Checklist.

Monitoring measures outlined in the other sub-plans will provide sufficient protection of any existing native flora and fauna the project has the potential to impact.

1.8 Reporting and Corrective Action

Any issues, impacts, and community complaints associated with flora and fauna at the site should be reported to the AusNet Services Environmental Manager or Delivery Partner Construction Manager immediately.

Should any shocked, injured, or juvenile fauna or eggs be observed on the site, the procedures outlined in the Fauna Salvage procedure developed by AECOM should be followed.

The corrective action process to be followed for any non-conformance is outlined in **Section 8.4** of this CEMP

1.9 Performance Indicators

Performance indicators relating to flora and fauna management are:

- compliance with this sub-plan
- no increased spread of weeds and no new weeds at site
- no injury to fauna
- no unauthorised removal of trees.

Appendix D

Air Quality Management Sub-plan

Appendix D Air Quality Management Sub-plan

This Air Quality Management Sub-plan outlines procedures to minimise air quality pollution associated with the construction phase of the BTS upgrade including the emission of greenhouse and ozone gases and the potential impacts on the environment and surrounding community.

Air pollution and dust have the potential to impact on the amenity of the surrounding area and the health of the local community and construction workers.

Community commitments made by AusNet Services in relation to air quality management include:

- *To minimise the risks to the environment and human health associated with earthworks and construction and demolition activities.*
- *Minimise contamination of the environment from dust*
- *To ensure that all earthworks, construction and demolition activities which could intercept or expose contaminants of potential concern are managed to prevent stormwater or dust discharges.*

Air quality pollution is likely to result from the following general construction activities:

- all earthworks and the transportation of excavated materials and stockpiles which may generate dust
- demolition works
- using unsealed access and egress roads which may generate dust
- power / electricity usage, creating greenhouse gas emissions
- exhaust emissions from use of vehicles, plant, and other machinery onsite.

Air quality is not expected to be impacted by vegetation clearance, as this activity is not proposed as part of the construction works.

This sub-plan has been developed as a supplementary management plan to the BTS Augmentation Project CEMP.

1.1 Sensitive Receptors

The nearest sensitive receptors to air quality pollution are residents and businesses located adjacent to the construction site on the western side of King Street and southern side of Alister Street, approximately 25m from the BTS site boundary. However, the entire neighbourhood, bounded by Nicholson Street and Glenlyon Road has the potential to be impacted by air quality pollution generated from the construction site.

1.2 Existing Conditions

No information on existing air quality conditions is currently available.

1.3 Legislative Requirements

The *Environment Protection Act 1970* provides for the protection of air quality in Victoria. Air quality will be managed in accordance with the following policies and guidelines:

- EPA Environmental Guidelines for Major Construction Sites, Publication 480
- State Environment Protection Policy (Air Quality Management)
- State Environment Protection Policy (Ambient Air Quality)

1.4 Potential Impacts

Air pollution has the potential to impact local amenity as well as the health and wellbeing of the local community. Air quality may also impact on water quality and vegetation health, including local flora and fauna.

1.5 Management Measures

AusNet Services is committed to the management of air quality during construction of the BTS Upgrade project. Measures for air quality control are outlined in **Table D- 1** below.

Table D- 1 Air Quality Management Measure

Management Measure	Responsibility
Dust Suppression	
Periodically watering all unsealed / exposed surfaces in a manner that does not cause bogging. This includes haul roads, stockpiles, and areas of revegetation. During dry conditions, watering frequency should be increased.	Delivery Partner Construction Manager
Sealing all haul roads where possible.	Delivery Partner Construction Manager
Keeping vehicles to defined haul roads and minimising vehicle movement on unsealed / exposed surfaces.	Delivery Partner Construction Manager
Enforcing vehicle speed limits on the construction site.	Delivery Partner Construction Manager
Constructing silt fences around stockpiles and covering stockpiles (when stockpiled for greater than 7 days at the one location).	Delivery Partner Construction Manager
Avoiding excavation and backfilling works during windy weather conditions.	Delivery Partner Construction Manager
Minimising ground disturbance as much as practicable.	Delivery Partner Construction Manager
Ensuring spoil is not dispersed via surface spraying with water during dry conditions.	Delivery Partner Construction Manager
Removal of any spoil not intended for reuse onsite every one to two days.	Delivery Partner Construction Manager
Wash-down of vehicles before exiting the site.	Delivery Partner Construction Manager
Sweeping of streets located directly adjacent to the construction site to remove any sources of dust.	Delivery Partner Construction Manager
Revegetating or sealing disturbed surfaces as soon as practicable.	Delivery Partner Construction Manager
Appropriately covering revegetated areas to prevent dust until grass cover / vegetation has established e.g. coarse jute matting.	Delivery Partner Construction Manager

Management Measure	Responsibility
Should visible dust emissions occur cease related works and undertake dust suppression measures immediately.	Delivery Partner Construction Manager
Where cutting or drilling is being undertaken watering the face of the material to suppress dust.	Delivery Partner Construction Manager
Replacement of insufficient silt fences (as determined by weekly inspections undertaken by the Environment Manager (or delegate))	Delivery Partner Construction Manager
General	
Ensuring all site personnel are made aware, during the toolbox sessions, of their requirement to report any visible signs of dust and excessive exhaust emissions to the site Delivery Partner Construction Manager.	Delivery Partner Construction Manager
The Delivery Partner Construction Manager ensuring appropriate control methods are implemented should excessive / visible dust or exhaust be generated. Should the controls be ineffective, works should cease until appropriate control measures can be implemented.	Delivery Partner Construction Manager
Handling any complaints from the local community regarding air pollution from the construction site in accordance with the complaints procedure outlined in **Section 7.4** of this CEMP.	Delivery Partner Construction Manager
Greenhouse and ozone	
Reducing energy use where possible, by - reducing vehicle movement to and from the site - turning vehicles and machinery off when not in use - ensuring maintenance of mufflers and vehicle exhaust emission controls, to manufacturer's specifications - selecting equipment suitable for the scale of the job - servicing all vehicles regularly - turning off all equipment, machinery, and vehicles when not in use. Specifically, no trucks should be left standing with their engine on any streets adjacent to residential properties.	Delivery Partner Construction Manager

Please refer to **Appendix I** for a list of equipment (e.g. stockpile covers) to be used for the implementation of air quality management measures.

1.6 Training and Awareness

To ensure air quality management procedures are implemented ongoing training will be provided to all site personnel. Induction will include the following areas:

- air quality issues
- construction activities with the potential to impact air quality
- implementation of management measures outlined in this sub-plan
- weather conditions which may increase the risk of dust

Records of training will be kept for all personnel undertaking site induction and training, as detailed in **Section 3.4** of this CEMP.

1.7 Monitoring

AusNet Services will undertake air quality monitoring on a monthly basis at sensitive receptor locations for the duration of construction works. **Table D- 1** lists the monitoring measures that will be implemented.

Air quality monitoring will be undertaken in by a suitably qualified professional in accordance with *EPA Publication 440.1: A Guide to the Sampling and Analysis of Air Emissions and Air Quality*.

1.8 Reporting and Corrective Action

Should any air quality issues arise during construction the AusNet Services Environment Manager (or delegate) should be notified immediately. In the event of a non-conformance an Incident Notification Form should be completed in accordance with **Section 8.4** of this CEMP.

Should there be any community complaints associated with air pollution this should be reported to the Environment Manager (or delegate) or Delivery Partner Construction Manager immediately.

1.9 Performance Indicators

Performance indicators relating to air quality management are:

- compliance with this sub-plan
- no complaints from sensitive receptors
- vehicle emissions are not visible for more than ten seconds.

Appendix E

Contamination Management Sub-plan

Appendix E Contamination Management Sub-plan

This Contamination Management Sub-plan outlines procedures to manage contaminated soil, surface water and groundwater associated with the construction phase of the BTS upgrade and minimise the risk of entry of contaminants into the environment.

Community commitments made by AusNet Services in relation to contamination include:

- *To further analyse and characterise Contaminants of Potential Concern (COPC) and to have area specific contamination management and response plans in place prior to the commencement of any earthworks, construction or demolition activities.*
- *To minimise the risks to the environment and human health associated with earthworks and construction and demolition activities.*
- *To ensure construction workers engaged in earthworks, construction or demolition activities or off-site disposal of soil are aware of potential contamination issues through site inductions, environmental training and at daily toolbox meetings, and undertake these activities in accordance with applicable Federal and State legislative and policy requirements.*
- *To ensure that all earthworks, construction and demolition activities which could intercept or expose COPC are managed to prevent stormwater or dust discharges.*
- *Stormwater captured within bunded areas will continue to be directed to onsite oil-water separation facilities. Any oil collected in the onsite holding tank will be periodically removed off-site.*
- *Stormwater runoff will be directed to the existing legal point of discharge adjacent to Merri Creek. The new transformers will be bunded to the same standard as those existing; such that a major oil spill would be completely contained onsite.*

Contamination of soil, groundwater and surface waters have the potential to occur as a result of:

- inappropriate storage and handling of chemicals
- fuel and oil leakage from vehicles and equipment due to misuse or irregular maintenance
- construction/demolition activities that impact subsurface soil (e.g. impacts to asbestos in buildings that are transferred to soil)
- existing contamination at the site.

This sub-plan has been developed as a supplementary management plan to the BTS Augmentation Project CEMP.

1.1 Sensitive Receptors

The direct receptors to contamination on the construction site are site personnel, and existing residents, businesses and public located adjacent to the construction site on Alister, King, and Sumner streets. Sensitive ecological receptors such as Merri Creek and local flora and fauna also have the potential to be impacted as a result of surface water and / or groundwater contamination.

1.2 Existing Conditions

A Preliminary Environmental Site Assessment (ESA), consisting of a desktop study of potentially contaminating historical activities, a site inspection and limited soil sampling program was undertaken by Coffey Environments (Coffey) in May 2011. The Preliminary ESA was conducted to inform AusNet Services and to form part of the original Planning Application for the project.

The Preliminary ESA identified a number of potentially contaminating features at the site, including imported fill, terminal infrastructure, storage of chemicals and oils, an oil separator and treatment facility, and potential spills of transformer oil. Due to the close proximity of Merri Creek to the site, there is also the potential for contamination to impact off-site locations.

Coffey identified the major site features shown in **Table E1** that may act as a source of contamination at the site.

Table E 1 Potential Sources of Contamination and Contaminants of Potential Concern on Site

Site Features	Contaminants of Potential Concern (CoPC)
Imported fill (gravel for bund base material), general fill, fill used to backfill previous quarry at site, stockpiled material and similar	Metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons, semi and non-volatile organic compounds (such as polychlorinated biphenyls (PCBs), pesticide, herbicides and asbestos)
Buildings	Asbestos and similar hazardous building materials
Terminal Infrastructure	PCBs and mineral oil contained in transformer insulation oil, petroleum hydrocarbons
Chemical Storage	Small volumes of chemicals associated with site maintenance including paints, cleaners and degreasers
Oil Separator	Petroleum hydrocarbons, PAHs
Oil treatment facility	Petroleum hydrocarbons, PAHs, and metals
Contaminated fill resulting from transformer oil spills	Transformer spills in the past may have contaminated fill within and outside bunds, resulting in PCB or general hydrocarbon contamination
Oil storage	Potential storage of transformer oil or fuels onsite. Contaminants may include PCB and petroleum hydrocarbons.

AECOM undertook soil classification works in areas proposed to be subjected to excavation during the redevelopment of the site. The details of this assessment and its findings are reported in *Soil, groundwater and basement water investigation works at Brunswick Terminal Station, King Street, Brunswick* (2013). The outcomes of this assessment are summarised below.

- All fill material within the areas sampled was classified as **'Category C'** waste for offsite disposal in accordance with Vic EPA Industrial Waste Resource Guidelines (IWRG) 621 (2009).
- The natural soil within the areas sampled was classified as '**Fill Material'** in accordance with Vic EPA IWRG 621 (2009) with the exception noted below.
- Natural soil within the vicinity of boreholes BH1, BH5 BH13 and BH35 reported chemical concentrations in the range of **'Category C'** in accordance with Vic EPA IWRG 621 (2009) contaminated soils and should be disposed of accordingly.

Soils encountered during works should be managed in accordance with the Erosion, Sedimentation and Earthworks Management Sub-plan presented as **Appendix F**. However, due to the limited nature of the soil investigation, the potential remains for impacted soil to be present in parts of the site which were not assessed by either Coffey or AECOM.

Although the chemical status of the soil across the site is largely known, soil encountered outside the areas investigated should be considered to be impacted. Furthermore, some natural soil may also be impacted and should be treated as such if noted as being odorous or stained or in the vicinity of the areas mentioned in **Table E1.**

An Asbestos in Soil Management Plan (ASMP) was developed by Bureau Veritas HSE for BTS in response to identification of Asbestos Containing Material (ACM) fragments and asbestos fibres in soils at various locations at BTS (*Asbestos in Soil Management Plan, Reference 2731665, 2013*). This report is still in draft and will be finalised pending conclusion of further assessment works undertaken onsite. The objective of the ASMP is to provide guidance for the appropriate management for asbestos contamination identified in soils at BTS. The key measures from this report are listed in **Table E 3.**

The measures outlined in this Contamination Management Sub-plan should be adopted for all fill material and natural soil which fits the above description, until additional assessment works indicate otherwise. The measures outlined in this sub-plan should also be adopted in the event of a spill of fuel, oil or other chemicals.

1.3 Legislative Requirements

Key legislation, regulations, codes and guidelines relevant to management of contamination at the construction site are shown in **Table E 2.**

Table E 2 Legislation and Policy

Victorian Legislation
- *Environment Protection Act* 1970 - *Occupational Health and Safety Act* 2004
Victorian Regulations
- Environment Protection (Industrial Waste Resource) Regulations 2009 - Occupational Health and Safety Regulations 2007
Victorian Codes
- Code of Practice No 13 – Building And Construction Workplaces, Work Safe Victoria, (Oct.1990) - Code of Practice No 14 – Demolition, Work Safe Victoria, (Oct. 1991 + Feb. 1998 amendment) - Code of Practice No 24 – Hazardous Substances, Work Safe Victoria, (Jun. 2000)
Guidelines, Policies, and Standards
- Adopted National Exposure Standards for Airborne Contaminants in the Occupational Environment, [NOHSC 1003:1995] Safe Work Australia (1995 + subsequent amendments) - EPA Victoria Publication 480, *Environmental Guidelines for Major Construction Sites*, , 996 - Industrial Waste Resource Guideline – I, EPA Victoria Publication 621, 2009 - Industrial Waste Resource Guideline – *Soil Sampling*, EPA Victoria Publication 702, 2009 - Industrial Waste Resource Guideline – Asbestos Transport and disposal, EPA Victoria Publication 611.1, 2009 - Industrial Waste Resource Guideline – *Polychlorinated Biphenyls (PCB) Management*, EPA Victoria Publication 643.1, 2009 - Industry Standard – *Contaminated Construction Sites*, Work Safe Victoria, June 2005 - *Draft National Environment Protection (Assessment of Site Contamination) Measure*, NEPC, 2011 - SEPP, *Prevention and Management of Contamination of Land*) No. S95, EPA Victoria, 2002 - SEPP, *Groundwaters of Victoria*, No. S160, EPA Victoria, 1997 - ANZECC, *Guidelines for fresh and marine water quality*, 2000 - CRC CARE, *Health screening levels for petroleum hydrocarbons in soil and groundwater*, 2011 - EPA Victoria Publication 669, *Groundwater Sampling Guidelines*, 2000 - Western Australian Department of Health, *Guidelines for the Assessment, Remediation and Management of Asbestos-contaminated Sites in Western Australia*, 2009. - Australian Standard AS4482.1, *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*, 2005, Standards Australia. - Australian Standard AS4482.2, *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Substances*, 1999, Standards Australia. - Australian Standard AS3600, *Concrete Structures*, 1994 - Office of Environment and Heritage, *Service station sites: assessment and remediation*, 2013

1.4 Potential Impacts

Contamination has the potential to impact on community health (including the construction workforce) and ecological receptors including Merri Creek and local flora and fauna. Work activities onsite with the potential to contaminate air, soil, groundwater, and surface waters include:

- excavation
- movement of soil within the site
- reuse of soil or stockpiling of soil

- offsite disposal of soil
- offsite disposal of water, including extracted groundwater
- maintenance and disposal of waste from triple interceptor system
- importation of soil / fill
- incorrect stormwater management
- demolition of identified redundant buildings
- landscaping activities
- refuelling
- handling / and storage of chemicals.

1.5 Potential Exposure Pathways

Potential pathways for exposure of site personnel with CoPC listed in **Table E1** during the construction phase include:

- PAHs, petroleum hydrocarbons, semi and non-volatile organic compounds (such as PCBs, pesticide, herbicides)
    - inhalation (e.g. of dust)
    - ingestion of soil or water
    - dermal (skin) contact.
- Metals
    - inhalation (e.g. of dust)
    - ingestion of soil or water
- Asbestos
    - inhalation.

In the event that volatile contaminants are encountered (e.g. odorous soil), additional controls may be required for site personnel. Measures for reducing exposure of site personnel to COPC are detailed in **Section 1.6.**

1.6 Management Measures

AusNet Services is committed to the management of contamination during construction of the BTS Upgrade project and preventing its entry into the environment. Measures for management of contaminants are outlined in in Table E3 below.

Table E 3 Contamination Management Measures

Management Measure	Responsibility
Contaminated Soil	
Advising the AusNet Services Construction Manager immediately should previously unidentified impacted soil (as defined in **Section 1.2**), water or underground features such as storage tanks be identified at the site. Assessment of any potentially impacted soil or water groundwater should be undertaken by a suitably qualified and experienced environmental assessor. Sampling results should, at a minimum, be compared to NEPM Health Investigation Levels (HIL) F – for Commercial / Industrial Use to assess the human health risk and determine suitability to remain onsite. Additionally results should be compared with Environmental Investigation Levels (EIL) to assess the risk to ecological receptors. It is noted that a site specific risk assessment may show that soils with higher concentrations are suitable to remain onsite.	Delivery Partner Construction Manager
Prior to offsite disposal, soil should be classified in accordance EPA Industrial Waste Resource Guideline (IWRG) Publications 621 and 702. Soil classified as Category A, B or C should be disposed of at an appropriately licensed landfill. Transportation of impacted soil and water should be undertaken by appropriately licensed waste transport vehicles in accordance with EPA Victoria Waste Transport Regulations. AECOM concluded in their soil, groundwater and basement water investigation report that the site is suitable for the ongoing industrial/commercial land use. It should be noted that the AECOM investigation focussed on areas proposed to be excavated. If intrusive works are to be undertaken outside the subject area then additional assessment works may be required.	Delivery Partner Construction Manager
Cleaning equipment used to move impacted and potentially impacted soil prior to exiting the site.	Delivery Partner Construction Manager
Excavation Validation	
Where impacted soil or infrastructure is being removed (refer to **Section 1.2**), sampling of the residual soil (i.e. validation sampling) by a suitably qualified and experienced environmental assessor and analysis undertaken by a National Associated of Testing Authorities (NATA) accredited laboratory. If concentrations of CoPC exceed clean fill criteria, the soil should be assessed to determine whether it is suitable to remain onsite or requires additional work (remediation).	Delivery Partner Construction Manager
Movement of Soil within the Site	
The AusNet Services Environment Manager (or delegate) or a suitably trained delegate must check the appearance of the soil encountered during excavations, and confirm consistency with findings of the soil assessment. Should impacted or potentially impacted soil, be observed it must be stockpiled separately and sampled by a suitably qualified and experienced environmental assessor using a NATA-accredited laboratory for analysis.	Delivery Partner Construction Manager
Where Potential or actual impacted soils are moved around the site, it must be tracked. Tracking will involve collection of the following site details on the Soil Tracking Form included at the end of this sub-plan: - location of source - contamination type (if known) - quantity of impacted soil - movement, treatment type, and disposal location, with dates and times - the name of the treatment, or disposal, facility must be recorded if the soil is disposed offsite.	Delivery Partner Construction Manager

Management Measure	Responsibility
Soil identified as containing, or potentially containing, chemical concentrations exceeding NEPM HIL F guidelines should be stockpiled on High Density Polyethylene (HDPE) sheeting or other impermeable material. The stockpile should be managed in accordance with the Erosion, Sedimentation and Earthworks Management Sub-plan presented in **Appendix F**.	Delivery Partner Construction Manager
Sediment and Runoff Control	
Potential or actual impacted soil should be stockpiled in a manner as to minimise its impact on the environment via soil and/or leachate movement through wind and/or water erosion. This is achieved by adopting appropriate stockpile management protocols as documented in the sub-Plan presented in **Appendix F**.	Delivery Partner Construction Manager
Importation of Fill	
Soil or other imported material brought to site for backfilling purposes must be chemically and physically suitable in accordance with IWRG 621 (2009) criteria. That is, the concentrations of CoPC must not exceed those for 'Fill Material' indicated in Table 2 of VIC EPA Publication 621 (2009). Furthermore, the soil must not be 'offensive to the senses' in accordance with the SEPP 2002. This classification work must be undertaken by a suitably qualified and experienced environmental assessor in line with the relevant IWRG publications.	Delivery Partner Construction Manager
Offsite Disposal of Soil	
Soil generated during the redevelopment that cannot be reused onsite must be classified in accordance with EPA Victoria IWRG Publications 621 (2009) and IWRG 702 (2009). Following classification works the soil is to transported to an appropriate receiving body licensed to accept that specific Classification of waste.	Delivery Partner Construction Manager
Should excess soil be generated, the Delivery Partner Construction Manager or Environmental Manager must be notified immediately so soil classification can be undertaken and relevant documentation prepared for disposal. Soil volumes and origin should also be documented.	Delivery Partner Construction Manager and Environment Manager (or delegate)
Asbestos	
Under Division 6, of Part 4.3 of the Occupational Health and Safety Regulations 2007, an asbestos audit of the site should be undertaken prior to demolition. Any asbestos identified should be removed as far as reasonably practicable prior to demolition by a suitably qualified professional.	Delivery Partner Construction Manager and Safety Manager
Management of asbestos encountered onsite / in waste soil must be undertaken in accordance with the Industrial Waste Resource Guidelines (IWRG) 611.1 – Asbestos Transport and Disposal (EPA Victoria) and AusNet Services Asbestos Management HS 05-05 procedure. Construction / demolition activities should be undertaken in such a manner as to avoid asbestos impacts to soil.	Delivery Partner Construction Manager and Safety Manager
Where asbestos is being removed, sampling of the residual soil should be undertaken in accordance with the WA Department of Health guidelines (2009). These works are required to be undertaken by a suitably qualified environmental assessor by a NATA accredited laboratory.	Delivery Partner Construction Manager and Safety Manager
Should intrusive works be conducted in areas where asbestos containing material is suspected to be present in the soil, a site walkover of the area should be undertaken by appropriately trained personnel, a preliminary soil investigation should be conducted by a qualified environmental consultant to confirm the presence of suspected asbestos, and representative soil samples should be collected by the environmental consultant and	Delivery Partner Construction Manager and Safety Manager

Management Measure	Responsibility
submitted to the laboratory (refer to *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013).*	
For the retention of asbestos containing soils onsite, areas identified as asbestos contaminated are to be isolated with a barrier layer. Asbestos contaminated soil should either be removed from site as asbestos waste or undergo a process to remove all asbestos containing material prior to any intended reuse. Care is required to avoid cross contamination with soils not containing asbestos. Prior to the remediated soils being reused onsite, the appointed environmental consultant should conduct a validation sampling programme to confirm the asbestos concentrations (refer to *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013).*	Delivery Partner Construction Manager and Safety Manager
The transportation and disposal of asbestos contaminated soils must be undertaken in accordance with EPA Vic Publication IWRG 611.1 and *Worksafe guidance Note Asbestos-contaminated soil* (refer to the *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013).*	Delivery Partner Construction Manager and Safety Manager
If asbestos contaminated soils are retained onsite and managed in-situ any intrusive works requiring penetration of the barrier layer and involving contact with the asbestos contaminated soil should be conducted by a Class A licensed asbestos removalist; must comply with all appropriate Occupational Health and Safety Regulations; must reinstate the barrier layer to an appropriate level once works are complete; and if onsite storage is required for waste soils generated during maintenance works, these soils shall be handled in accordance with the *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013*	Delivery Partner Construction Manager and Safety Manager
Appropriate PPE and clothing must be used for all works undertaken in areas where asbestos containing material is suspected to be present or has been identified in the site soils (refer to *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013*)	Delivery Partner Construction Manager and Safety Manager
Personal decontamination should be carried out in a designated area at the site each time the site personnel leave the impacted work area and at the completion of the asbestos removal works (refer to *Asbestos in Soil Management Plan, Reference 2731665 R1.2, 2013*)	Delivery Partner Construction Manager and Safety Manager
Plant, Vehicles, and Equipment Leaks	
Check all plant and equipment, used in transporting and handling of hazardous chemicals including oil and fuel, periodically for serviceability, including monitoring of transfer equipment for any deterioration.	Delivery Partner Construction Manager
Refuelling of plant and machinery will occur within the site on a bunded hardstand area away from Merri Creek and any drainage points. Please refer to AusNet Services Standard Operating Procedure for Refuelling.	Delivery Partner Construction Manager
Refuelling of machinery will occur with mini-tankers where possible, to avoid onsite storage of fuel. An appropriately sized spill kit will be available during refuelling.	Delivery Partner Construction Manager
Stormwater	
Ensure impacted soil does not enter the local stormwater system. Refer to the Erosion, Sedimentation and Earthworks Management Sub-plan presented in **Appendix F** for specific stormwater management measures.	Delivery Partner Construction Manager
Surface water that pools on impacted soil should be assessed by a suitably qualified environmental assessor prior to disposal.	Delivery Partner Construction Manager
Groundwater and Dewatering	
Groundwater has been assessed onsite as containing slightly elevated heavy metal	Delivery Partner

Management Measure	Responsibility
concentrations and cannot be disposed of without treatment, or by sub-contractors not licensed to handle such waste.	Construction Manager
Handling of Fuels, Oils, and Chemicals	
Maintaining a register of hazardous materials and Safety Data Sheets (SDSs) for all materials used and kept onsite. Materials will be handled in accordance with directions on the relevant SDS.	Delivery Partner Construction Manager
Ceasing works if potentially impacted material is encountered, until the issue is resolved.	Delivery Partner Construction Manager
Cleaning up spills and leaks immediately, in accordance with AusNet Services Chemical Spill Control Standard Operating Procedure**.**	Delivery Partner Construction Manager
Ensuring oil hoses and pumps are not left unattended whilst in use.	Delivery Partner Construction Manager
Implementing appropriate storage and management of fuels and chemicals onsite and ensuring that chemical storage areas incorporate adequate controls (e.g. bunding and spill kits) to minimise the potential for stormwater, soil and groundwater pollution.	Delivery Partner Construction Manager
Ensuring chemicals are not located in areas where they are likely to enter a drain gutter or stormwater outlet.	Delivery Partner Construction Manager
Maintaining emergency spill kits and ensuring they are readily available during handling and transportation of fluid, oil, and other chemicals.	Delivery Partner Construction Manager
Training site personnel on procedures to be implemented in the management of fuel and chemical spills, and the location of spill kits.	Delivery Partner Construction Manager
Displaying an emergency spill procedure adjacent to the fuel / chemical storage area.	Delivery Partner Construction Manager
Immediately reporting major spills to the Fire Brigade, in accordance with the procedure outlined in Section 8.3 of the CEMP.	Delivery Partner Construction Manager
Dust Control	
Dust control should be undertaken via measures outlined in **Appendix D**. If dusty conditions are encountered, mitigation measures may include: - Using a water spray to dampen work areas and soil whilst being worked - Avoiding soil movement activity likely to create dust on windy days - Avoiding extending stockpiling soil - Minimising excavation and movement of soils - Minimising movement of equipment onsite - Covering soil stockpiles with straw, netting, matting, or plastic sheeting as necessary to minimise generation of dust and to limit runoff of impacted sediment.	Delivery Partner Construction Manager
Health and Safety	
Any works conducted on the site should be conducted in accordance with a site specific Health and Safety Plan (HASP) to be developed by the Delivery Partner and approved by	Delivery Partner Construction

Management Measure	Responsibility
AusNet Services. This HASP should provide guidance with respect to the minimum personal protective equipment requirements where workers are likely to come into contact with impacted soil/water as identified in **Section 1.2**.	Manager
Specific safe work method statements (SWMS) for each task to be performed should also be included in the HASP.	Delivery Partner Construction Manager
The HASP should address the following: - Details of the appropriate personal protective equipment (PPE) to protect against contact with identified contamination. As a minimum it is recommended that the following be used: • Protective gloves. • Close toed safety boots. • Long sleeved shirt and trousers. With sleeves rolled down. • Gloves when handling soil. • Safety Glasses. - Depending on potential hazards that may be encountered, additional PPE such as half or full face respirators, masks with particulate or organic filters and disposable coveralls may be required. - Maintaining good personal hygiene (washing hands prior to eating or smoking).	Delivery Partner Construction Manager
Visitors to the site who have not completed the full induction must be accompanied by a nominated site representative at all times. Only specific site personnel will be permitted to work in areas containing impacted soil.	Delivery Partner Construction Manager

1.6.1 Waste Management

The potential impacts of waste generated from demolition and construction activities (e.g. solid inert wastes such as concrete, plastic, timber, bitumen, and putrescibles wastes such as food scraps) can be reduced by minimising the volume and maximising reuse of materials. Waste is classified into one of three categories: non-liquid, liquid or gaseous. Construction is likely to result in mainly non-liquid waste, including construction rubble. Strategies for waste management are outlined in **Table E 4**.

Community commitments made by AusNet Services, specific to waste management, are:

- *Prevent the infestation of animal pest, particularly foxes, rabbits and rats.*
- *To provide appropriate mechanisms for the collection, treatment, recycling, reuse and disposal of construction waste and litter.*
- *To prevent environmental degradation caused by the inappropriate disposal of construction waste and litter.*
- *To provide for the environmentally responsible disposal of all construction wastes and litter.*
- *To conserve resources and to maximise the recovery of reusable materials.*
- *The construction Delivery Partner will formulate and implement a waste minimisation strategy.*

An effective disposal program should be implemented, including frequent monitoring of waste generated.

Table E 4 Waste Management Methods

Strategy	Description
Avoidance	- Request supplier provides materials with minimum packaging.
Re-use	- If material of existing buildings to be demolished is suitable for future re-use, materials will be cleaned and retained onsite for construction of the new buildings.
Recycling	- Demolition and construction materials should be sent to recycling facilities where possible, including materials removed from existing buildings and packaging materials e.g. cardboard, steel, glass, concrete and brick. - Waste collection points will be located onsite for recyclables, including segregation facilities.
Recovery of energy	- Where possible, recover energy from waste materials generated onsite.
Treatment	- Where possible, ensure waste materials are treated appropriately.
Containment	- Rubble should be used as backfill in landscaping areas, where possible.
Disposal	- Wastes which cannot be reused onsite should be disposed of at an appropriately licensed facility. - Litter should be cleaned regularly – litter bins for putrescibles waste including food wastes will be provided onsite. - Effluent should be discharged into a local sewage system or septic tanks or portable self-contained toilets should be provided. - Maintain and clean vehicles. - Waste should be transported and disposed of in accordance with EPA Victoria Industrial Waste Resource Guidelines.
Monitoring	- All records of wastes should be recorded and maintained in an online database, with the following details: • Type of material • Quantities ordered, reused, recycled or scrapped.

1.7 Training and Awareness

To ensure contamination management measures are implemented, ongoing training will be provided to all site personnel. Inductions will include the following areas of discussion:

- Areas containing impacted soil and/or water onsite, and relevant signage
- Areas requiring further chemical assessment or validation before works can continue
- Potential avenues for entry of contaminants into the site
- Refuelling locations

Records of training will be kept for all personnel undertaking site induction and training, as detailed in **Section 3.4** of this CEMP.

1.8 Monitoring

Regular monitoring should be undertaken in accordance with the management measures detailed in **Table E 3** and **Table E 4**.

1.9 Reporting and Corrective Action

Should any contamination issues arise during construction, the Construction Manager and/or Environment Manager (or delegate) should be notified immediately. In the event of a non-conformance, an Incident Notification Form should be completed in accordance with **Section 8.4** of this CEMP.

1.10 Performance Indicators

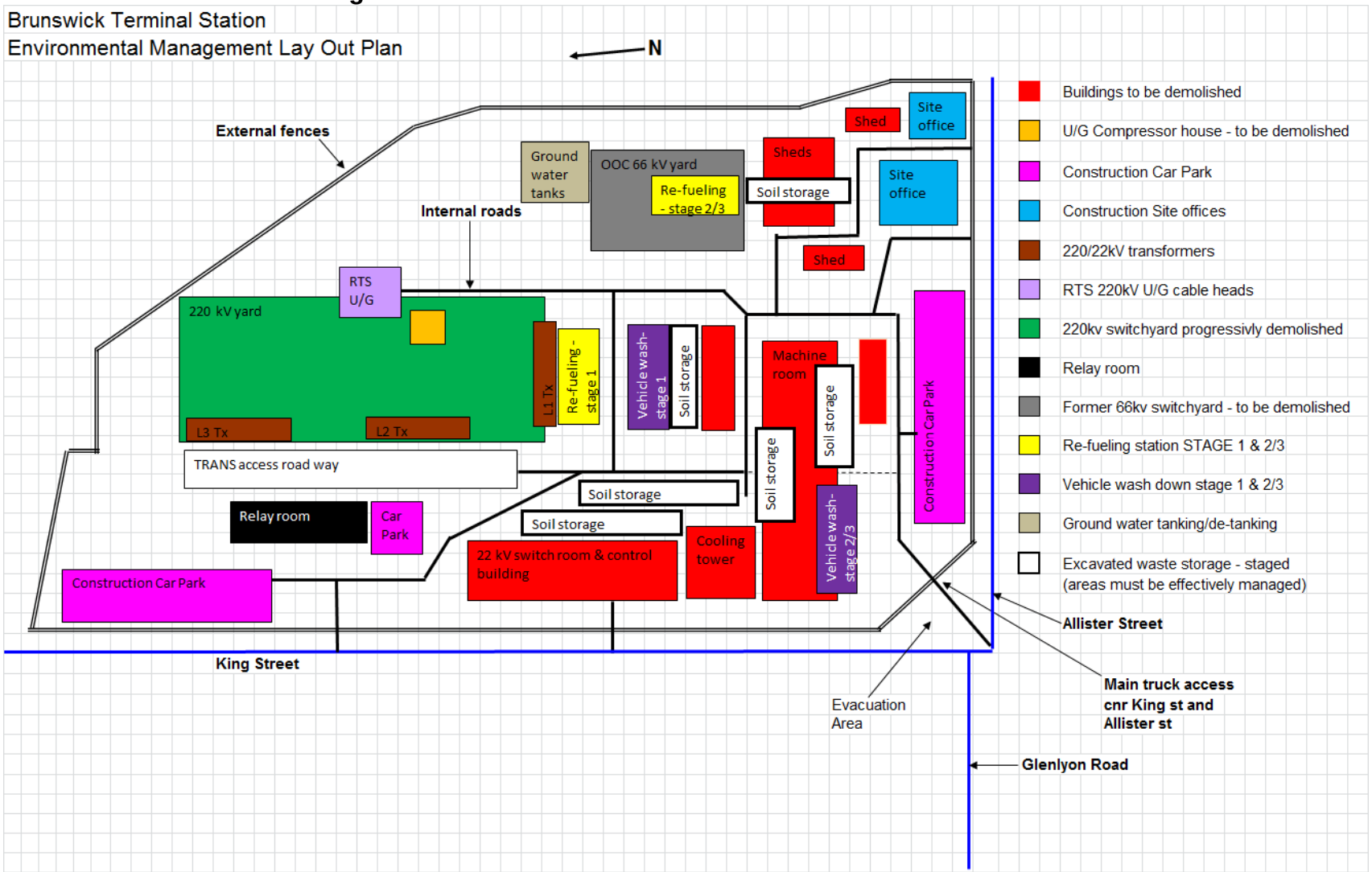
Performance indicators relating to management of contaminants are:

- No complaints in relation to contamination from the local community
- No downstream impacts from contamination of local waterways on flora and fauna
- No impact to non-impacted material at the site
- No discharge of impacted water to stormwater / sewer systems
- Water quality contaminant levels below regulatory limits, detailed in **Table E 3**.

Soil Tracking Form

Date Excavated	Soil Origin	Stockpile ID	Stockpile Location	Soil Description	Samples Collected (Y/N)	Laboratory Analyses (Y/N)	Final Soil Classification (Fill; Cat A, B or C Contaminated Soil)	Final Destination (Landfill name, other site name or onsite)	Notes	Logged By

Plan of Environmental Management Activities



Appendix F

Erosion, Sedimentation and Earthworks Management Sub-plan

Appendix F Erosion, Sedimentation and Earthworks Management Sub-plan

This Erosion, Sediment and Earthworks Management Sub-plan outlines procedures to minimise erosion and sedimentation associated with the construction phase of the BTS upgrade, and provides detail on managing earthworks appropriately.

Community commitments made by AusNet Services in relation to erosion and sediment management include:

- *Prevent loss of soil and creation of dust.*
- *Minimise any degradation of the quality of water leaving the site.*
- *To minimise the risks to the environment and human health associated with earthworks and construction and demolition activities.*
- *To ensure that all earthworks, construction and demolition activities which could intercept or expose contaminants of potential concern are managed to prevent stormwater or dust discharges.*

This sub-plan has been developed as a supplementary management plan to the BTS Augmentation Project CEMP.

Work activities onsite with the potential to increase erosion and sedimentation include:

- excavation
- stockpiling of soil
- construction vehicle movement
- inappropriate stormwater management

1.1 Sensitive Receptors

The nearest sensitive receptors to erosion and sediment issues are residents and businesses adjacent to the construction site on the eastern side of King Street and southern side of Alister Street. Off-site impacts as a result of sedimentation are likely to result downstream of surface water, adversely impacting local flora and fauna and Merri Creek.

1.2 Existing Conditions

Coffey Geotechnics undertook a preliminary geotechnical assessment of the BTS site. The Delivery Partner should refer to the assessment report (provided at the end of this Appendix) for further detail regarding the geotechnical profile of the site and its stability.

The report identified that the risk of landslide, and thus a major risk of erosion and sedimentation, ranges from very low to moderate depending on the soil types. Due to the variability in soil types on the BTS site, which includes natural clays, moisture variations were identified which presents some implications in terms of the location and types of construction activities. Measures proposed by Coffey Geotechnics are presented in Table F-1.

The geotechnical assessment was based on a limited number of boreholes and test pits, therefore should conditions vary from those described in the report, a geotechnical engineer should be engaged to review conditions and provide advice.

1.3 Legislative Requirements

The State Environment Protection Policy (Waters of Victoria) is relevant to erosion and sedimentation control. Management measures detailed in this sub-plan have been developed in accordance with this policy and *EPA Environmental Guidelines for Major Construction Sites, Publication 480.*

1.4 Potential Impacts

Potential impacts from erosion and sedimentation as a result of the BTS Upgrade project include:

- dust causing health issues in the local community
- dust settling on local vegetation, inhibiting growth if not removed
- sedimentation increasing turbidity of water in Merri Creek and associated drainage networks impacting water quality and flora and fauna
- contamination offsite as a result of movement of soil.

Contamination offsite as a result of dust and sedimentation is addressed in the Contamination Management Sub-plan.

1.5 Management Measures

AusNet Services is committed to the management of erosion, sedimentation and earthworks. Measures for management of erosion, sedimentation, and earthworks are outlined in **Table F- 1** below.

Table F- 1 Erosion, Sedimentation and Earthworks Management Measures

Measure	Responsibility
Soil Stability	
Paving the edge of new buildings to limit soil moisture variations due to seasonal wetting and drying. The paved surface should be graded away from the building such that rainfall run-off drains away and water cannot pond against the building.	Delivery Partner Construction Manager
Restricting tree planting in the vicinity of the building. It is recommended that trees be planted no closer to the building than a distance equal to their mature height on Class H sites (refer to the Coffey Geotechnical Preliminary Assessment provided at the end of this Appendix). This distance should be increased where rows or groups of trees are involved.	Delivery Partner Construction Manager
Avoiding service trenches beneath buildings, particularly plumbing and drainage. Where service trenches are to pass beneath of near to the building, they should be backfilled with a low permeability material, such as compacted clay, to prevent the ingress of water.	Delivery Partner Construction Manager
Repairing any leaking or damaged underground services promptly.	Delivery Partner Construction Manager
Ensuring that footing excavations in clay are not exposed to the weather for extended periods i.e. more than one week. Water should not be allowed to pond in these areas, nor should they be left unprotect to dry and crack in the sun.	Delivery Partner Construction Manager
If it is proposed the buildings are supported by engineered fill, geotechnical advice should be sought.	Delivery Partner Construction Manager
Provision of a granular bridging layer in some areas of clay surfaces to reduce difficulty of trafficability of wheeled vehicles reducing erosion. S	Delivery Partner Construction Manager
Providing surface protection for batter slopes in line with the Coffey Geotechnical Preliminary Assessment provided at the end of this Appendix.	Delivery Partner Construction Manager
Providing drainage at the top of batter slopes up to 3m in height to divert runoff away from the slope face. Where higher batter slopes are proposed further geotechnical advice should be sought.	Delivery Partner Construction Manager

Measure	Responsibility
Dust and Sedimentation	
Maintain a Site Environment Management Plan (or Erosion and Sediment Control Plan) that details all sediment controls, access tracks, chemical storage, drainage etc. as per Melbourne Water requirements in the Planning Permit MPS/2014/8	Delivery Partner Construction Manager and AusNet Services Construction Manager
Periodically watering all unsealed / exposed surfaces in a manner that does not cause bogging, including haul roads, stockpiles, and revegetated areas. During dry conditions, watering frequency should be increased.	Delivery Partner Construction Manager
Paving or sealing all haul roads, where possible.	Delivery Partner Construction Manager
Keeping vehicles to defined haul roads and minimising vehicle movement on unsealed / exposed surfaces	Delivery Partner Construction Manager
Enforcing vehicle speed limits on the construction site	Delivery Partner Construction Manager
Avoiding excavation and backfilling works during windy weather conditions	Delivery Partner Construction Manager
Scheduling works which require use of heaviest machinery onsite for the driest months of the year and lowest flow in the waterway (where possible)	Delivery Partner Construction Manager
Undertaking clearing progressively to avoid unnecessary long periods of degraded land	Delivery Partner Construction Manager
Avoiding areas of highly erodible soils and steep slopes – refer to the Coffey Geotechnical Preliminary Assessment provided at the end of this Appendix	Delivery Partner Construction Manager
Constructing stockpiles with no slope greater than 2:1 (horizontal to vertical), and less steep depending on the erosion risk.	Delivery Partner Construction Manager
Surrounding all un-stabilised stockpiles and batters with silt fences / sediment barriers.	Delivery Partner Construction Manager
Protecting stockpiles from erosion by constructing wind fences around them and covering / securing with a waterproof fabric.	Delivery Partner Construction Manager
Minimising ground disturbance as much as practicable.	Delivery Partner Construction Manager
Installing erosion and sediment control measures before construction commences	Delivery Partner Construction Manager
Installing a silt fence made of non-conductive fencing, such as para webbing, along the eastern border of the site	Delivery Partner Construction Manager
Reducing exposure of soils during summer and periods of intense rainstorms.	Delivery Partner Construction Manager
Ensuring spoil is not dispersed via surface spraying with water during dry conditions	Delivery Partner Construction Manager
Removal of any spoil onsite every one to two days and immediate removal of spoil accidentally spilt outside of the construction area.	Delivery Partner Construction Manager
Removing excess silt build-up following large storms	Delivery Partner Construction Manager

Measure	Responsibility
Ensure a bobcat with a street sweeper attachment is located onsite at all times to ensure surrounding streets are kept mud free. The bobcat will need to be road registered or a VicRoads permit for land/road closure would be required.	Delivery Partner Construction Manager
Replacing sand bag / silt bags if they are punctured or not working effectively.	Delivery Partner Construction Manager
Wash-down of vehicles before exiting the site.	Delivery Partner Construction Manager
The Delivery Partner Construction Manager should inspect the surrounding area of the construction site for any spoil or other materials that may have been lost from the site.	Delivery Partner Construction Manager
Sweeping of streets located directly adjacent to the construction site to remove any sources of dust.	Delivery Partner Construction Manager
Revegetating or sealing disturbed surfaces as soon as practicable.	Delivery Partner Construction Manager
Appropriately covering revegetated areas to prevent dust, until grass cover has established e.g. coarse jute.	Delivery Partner Construction Manager
Should visible dust emissions occur, ceasing works and undertaking dust suppression measures undertaken.	Delivery Partner Construction Manager
Where cutting or drilling is being undertaken, watering the face of the material to suppress dust.	Delivery Partner Construction Manager
Replacement of silt fences as determined by weekly inspections undertaken by the Environment Manager (or delegate)	Delivery Partner Construction Manager
Stormwater	
Diverting stormwater away from areas where soil is exposed, using diversion banks. Drainage system should be installed before the land is disturbed.	Delivery Partner Construction Manager
Only connecting onsite inlets after the site has stabilised, to prevent stormwater escaping the site.	Delivery Partner Construction Manager
In areas where high water flows are expected installing rock structures. Constructing sediment fences at the bottom of the slopes to contain sediment run-off.	Delivery Partner Construction Manager
Replacing sand bag / silt bags if they are punctured or not working effectively.	Delivery Partner Construction Manager
Reducing water velocities of stormwater, wherever possible	Delivery Partner Construction Manager

1.6 Training and Awareness

To ensure erosion and sediment control measures and appropriate earthworks are implemented, ongoing training will be provided to all site personnel. Induction will include the following areas of discussion:

- timing and extent of earthworks
- potential erosion and sedimentation issues and appropriate management measures

Records of training will be kept for all personnel undertaking site induction and training, as detailed in **Section 3.4** of this CEMP.

1.7 Monitoring

Please refer to the Air Quality Management Sub-plan (**Appendix D**) for detail on dust monitoring, and the Contamination Management Sub-plan (**Appendix E**) for detail regarding water quality testing.

1.8 Reporting and Corrective Action

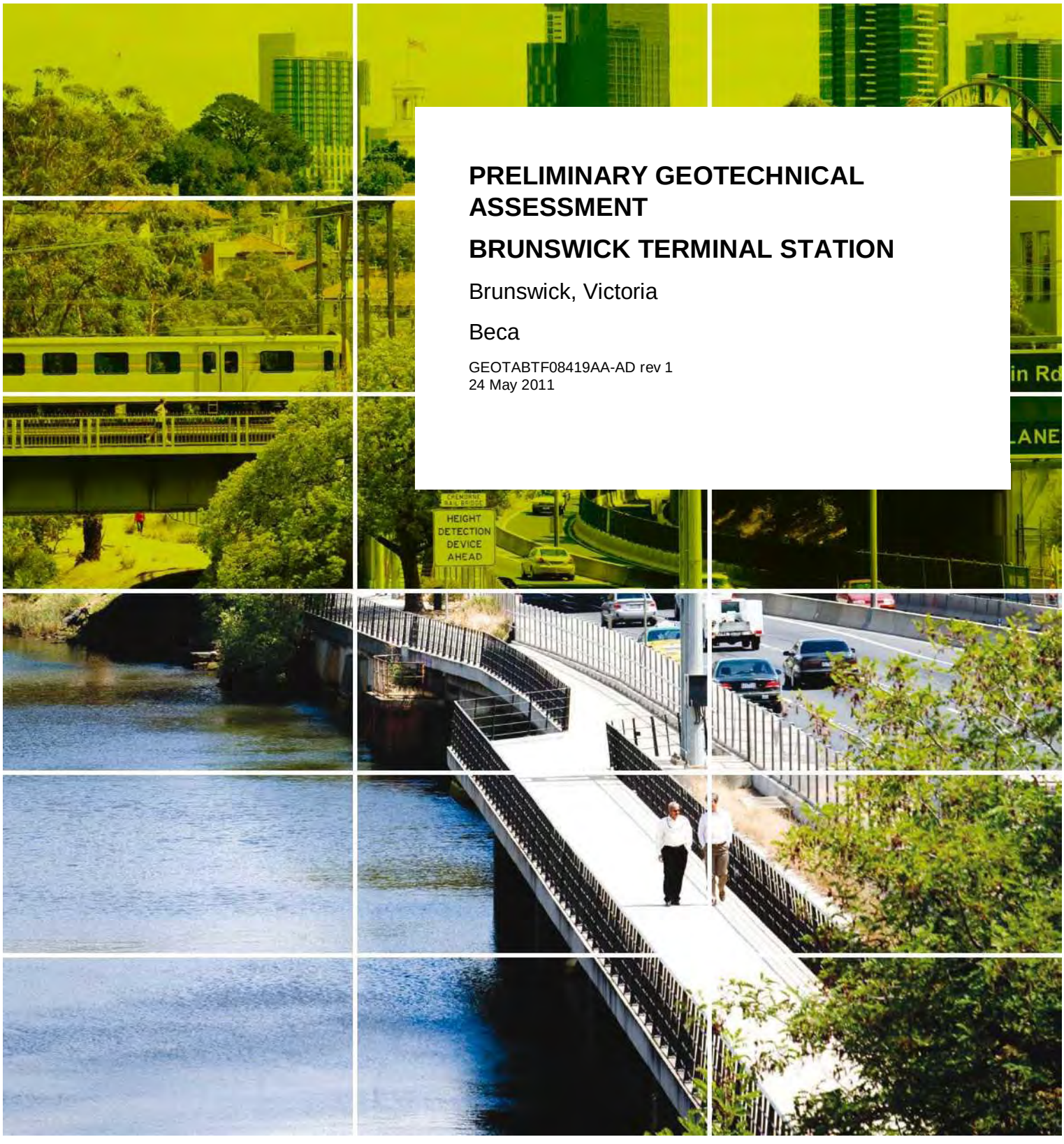
Should any contamination issues arise during construction, the Environment Manager (or delegate) should be notified immediately, and the non-conformance or emergency procedure followed where appropriate, as outlined in **Section 8.4** of this CEMP

1.9 Performance Indicators

Performance indicators relating to management of contaminants are:

- no complaints from the local community in relation to dust
- no downstream impacts of local waterways on flora and fauna
- water quality turbidity levels below regulatory limits, detailed in **Table F- 1.**

coffey geotechnics
SPECIALISTS MANAGING THE EARTH



PRELIMINARY GEOTECHNICAL ASSESSMENT

BRUNSWICK TERMINAL STATION

Brunswick, Victoria

Beca

GEOTABTF08419AA-AD rev 1
24 May 2011

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1 INTRODUCTION

This report presents the results of a geotechnical investigation carried out by Coffey Geotechnics Pty Ltd (Coffey) for the proposed redevelopment of the Brunswick Terminal Station located at the corner of Alister Street and King Street Brunswick, Victoria. The investigation was performed in general accordance with Coffey proposal GEOTABTF08419AA-AB dated 8 April 2011.

Based on the information provided at the time of preparing this report, the proposed redevelopment of the Brunswick Terminal Station is to comprise the construction of the following elements;

- Two new gantry structures at the northern end of the site;
- Two switch house buildings which will also house transformers and current limiting devices.

The aims of the geotechnical investigation were as follows:

- To conduct a preliminary geotechnical assessment (PGA) to assess the potential for erosion, landslip or other degredation hazards and assess the landslide risk in accordance with the Australian Geomechanics Society Procedure (AGS 2007c)
- To provide a preliminary assessment of the geotechnical conditions present at the site with regard to the proposed development and to address the conditions of the permit that was proposed during the original planning process.
- To provide comments and recommendations regarding founding depths, allowable bearing pressures for spread footings and unit stresses for piled footings.
- Advice on the order of likely ground movements including settlements and potential shrink swell movements including a site classification in accordance with AS2870 - 2011 Residential slabs and footings".
- To provide comments and recommendations regarding excavation conditions, including depth to basalt rock as well as temporary and permanent batter slopes.
- Identification of any ground conditions encountered during the investigation that may lead to construction difficulties.

2 GEOTECHNICAL INVESTIGATION

2.1 Fieldwork

Eleven boreholes were drilled during the period 29 April to 12 May 2011. Eight of the boreholes were drilled using a track mounted rotary drilling rig supplied and operated by Urban Drilling while the remaining three boreholes were drilled using a hand auger. The boreholes designated BH1 to BH10 were advanced to depths of between 0.4m and 20.0m below the existing surface using a hand auger and solid flight augering techniques in soils and rotary coring in the weathered rock. The locations of the boreholes are shown on Figure 1.

Disturbed samples of soil were collected from the boreholes for visual classification, to assist with logging and assessing soil consistency/density and to provide samples for laboratory testing. Recovered rock core was boxed and photographed. On completion of drilling, the boreholes were backfilled with drill cuttings and tamped into place at the surface.

In addition to the boreholes, three test pits, designated TP1 to TP3, were excavated on 12 May 2011 using a 5 tonne excavator supplied and operated by Kingston Plant Hire. The test pits were excavated to depths of between 2.5m and 3.6m below the existing surface. The locations of the test pits are shown on Figure 1.

Disturbed samples were collected from the test pits for visual classification, to assist with logging and assessing soil consistency/density. On completion each test pit was backfilled with the excavated spoil and tamped with the excavator bucket, before being traversed with the excavator tracks.

The engineering logs describing the subsurface conditions encountered in the boreholes and test pits are presented in Appendix A, preceded by summary sheets of descriptive terms and symbols used in their preparation.

The geotechnical fieldwork was performed in the presence of a geotechnical engineer from Coffey who located the boreholes and test pits using a handheld GPS, nominated testing and sampling and prepared the engineering logs.

3 RESULTS OF GEOTECHNICAL INVESTIGATION

3.1 Site Conditions

At the time of the field work, the site is occupied by the existing terminal station infrastructure. The site is bounded by Merri Creek to the east and north, King Street to the west and Alister Street to the south. The surface of the site is generally flat with a batter on the east and north boundary sloping down to the east and north to Merri Creek. At the time of the investigation, the site was trafficable to 4WD vehicles.

The batter present on the eastern boundary of the site comprises fill materials that have been in place for up to about 50 years. The fill is between about 2m to 4m high and slopes at an angle of between about 25^{o} to 40^{o}. The fill batter lies atop an existing slope which extends for about 15m to Merri Creek below. The natural slope is between about 15^{o} to 30^{o} with a 0.9m high retaining wall and a boardwalk structure about 7m from the river bank. The fill batter is sparsely vegetated with mainly weeds and some native grasses. The natural slope is well vegetated with grasses and large trees. There is an area where water has been allowed to flow over the batter from the terminal station site to the merri creek below and as such the fill and natural soils at this location have become saturated.

At the time of the fieldwork, there is no evidence of instability or erosion within the fill batter. The lack of evidence of batter instability on this site is consistent with the age, dimensions and general undrained nature of the fill batter. There are some signs of soil creep evident in the natural slope as indicated by the lean of some of the large trees.

3.2 Regional Geology

The Geological Survey of Victoria published 1:63,360 Warburton map sheet indicates that the site is underlain by Quaternary age Newer Volcanics Basalt and associated residual soils. Quaternary age Alluvial soils comprising clays, silts, sands and gravels are located on the eastern part of the site and are associated with Merri Creek.

The subsurface conditions encountered in the boreholes and test pits are generally consistent with the geological map indications with the exception of the uncontrolled fill which was encountered in a number of the boreholes and test pits.

3.3 Subsurface Conditions

The generalised subsurface profile encountered in boreholes and test pits undertaken are presented in Table 1. Engineering logs of the boreholes and test pits are presented in Appendix A.

Table 1: Generalised Subsurface Profile Encountered in the Boreholes and Test Pits

Interpreted Geological Unit	Approximate Depth to Top of Unit (m)	Approximate Thickness of Unit (m)	Description of Material
Fill	0	0.2 to 4.0	**ASPHALT (20mm),** borehole 8 only. **GRAVELLY CLAY / SANDY GRAVEL / SAND:** high plasticity, black, grey, brown, white, with fine to coarse sand and gravel and some basalt cobbles, dry to moist, stiff to very stiff, loose to dense.
Residual soil	0.0 to 4.0	0.25 to 0.95	**CLAY / SILTY CLAY:** high plasticity, grey, brown, with some fine to coarse sand and gravel, moist to wet, stiff to very stiff. Not encountered in BH5
Quaternary age Newer Volcanics **Weathered Basalt**	0.25 to 4.25	Not Penetrated	**BASALT:** fresh to extremely weathered, typically slightly weathered, high to very high strength, grey, brown, vesicular, with some iron staining, highly fractured zones and clay seams.

3.4 Groundwater

No groundwater was encountered during the auger drilling and the use of water during the coring process did not allow for the measurement of groundwater inflows below the depth at which rock was encountered. It is considered that perched water may occur within the fill materials during extended periods of wet weather.

4 DISCUSSION AND RECOMMENDATIONS

4.1 Site Classification

The boreholes test pits excavated at the Brunswick Terminal Station site showed a subsurface profile comprising a variable fill up to 4.0m thick, overlying stiff to very stiff high plasticity residual clay. Basalt rock was encountered in the majority of the boreholes and test pits at depth between 0.25m and 4.0m below the existing surface level.

Given the presence of uncontrolled fill in excess of 0.4m thick, a site classification of Class P is applicable to this site in accordance with AS2870.

It is noted that the proposed locations of the switch house buildings are in areas where the fill is typically less than 0.4m thick. As such the site classification for these buildings would be dependent on the subsurface conditions below the fill.

Where Basalt rock was encountered at depth no greater than 0.4m, a site classification of Class S would be applicable in accordance with AS2870. Where natural clay soils are present to depths in excess of 0.4m and the fill is no greater than 0.4m thick, a site classification of H1 or H2 may be applicable.

The natural basaltic clays are generally considered as being extremely reactive. Based on our experience with sites with natural basaltic clay, it is considered that characteristic surface movements (y_s) similar to those for a Class H1 or H2 site (i.e. 40mm > y_s > 75mm) should be expected for the Brunswick Terminal Station site. Shrink swell testing of the onsite soils would be required to provide a design y_s value.

Given the high reactivity of the natural clays, it is recommended that precautions be taken to control moisture variations within the founding soils. To assist in maintaining a constant soil moisture regime in the vicinity of the building the following precautions are recommended:

- Provide paving to the edge of the building to limit soil moisture variations due to seasonal wetting and drying. The paved surface should be graded away from the building such that rainfall run-off drains away and water cannot pond against the building.
- Restrict tree planting in the vicinity of the building. It is recommended that trees be planted no closer to the building than a distance equal to their mature height on Class H sites. This distance should be increased where rows or groups of trees are involved.
- Service trenches, particularly plumbing and drainage, should be avoided beneath buildings. Where service trenches are to pass beneath or near to the building they should be backfilled with a low permeability material, such as compacted clay, to prevent the ingress of water.
- Any leaking or damaged underground services should be repaired promptly.
- During construction the exposed footing excavations in clay should not be left exposed to the weather for extended periods. Water should not be allowed to pond in these areas nor should they be left unprotected to dry and crack in the sun.

It should be noted that the use of standard footings as presented in AS2870 are only applicable to residential type footings founded within the natural ground and for buildings having loads and a construction style similar to that of a residential dwelling. For larger, more highly loaded buildings, the AS2870 standard footings may not be appropriate.

If it is proposed to support the buildings on engineered fill, the site classification should be reviewed and specific geotechnical advice be sought.

4.2 Foundations Conditions

4.2.1 Spread Footings

Footings at the proposed redevelopment of the Brunswick Terminal site should be founded beneath the fill and within the natural stiff to very stiff clay or weathered basalt and may be proportioned for the maximum allowable bearing pressures presented in Table 2.

Table 2: Allowable Bearing Pressures for Spread Footings

Founding Material	Maximum Allowable Bearing Pressure (kPa)	
	Pad Footing	Strip Footings
CLAY (CH): stiff to very stiff	100	80
BASALT: predominately distinctly weathered	1500	1500
BASALT: predominately slightly weathered	2000	2000

It is recommended that footing excavations be assessed by a suitably experienced geotechnical engineer during construction to confirm that the founding conditions are consistent with those on which the design recommendations are based.

4.2.2 Bored Piles Foundations

Consideration could be given to supporting the proposed gantry structures on bored piles to resist axial loads. Bored piles should be founded within the weathered basalt rock, and would derive their capacity from end bearing and socket adhesion. The ultimate unit stresses presented in Table 3 may be adopted for design of bored piles socketed into weathered basalt rock and having a depth to diameter ratio of at least 4, where the depth is the depth of penetration into the founding material.

Table 3: Ultimate Unit Stresses for Preliminary Assessment of Bored Piles

Founding Material	Ultimate Unit Stresses (kPa)	
	End Bearing	Side Friction
BASALT, predominantly distinctly weathered	4,500	400
BASALT, distinctly to slightly or less weathered	6,000	600

In order to assess pile capacity, a geotechnical strength reduction factor (ϕ_g) is applied to the above ultimate unit stresses presented in Table 3 in accordance with AS2159-2009 “Piling – Design and Installation.” The appropriate ϕ_g value will depend on many factors associated with the site, design, installation and testing, some of which are not known at the time of preparing this report. The various factors to be considered include the following:

- Geological complexity of the site;
- Extent of geotechnical investigation with consideration of pile founding levels;
- Available geotechnical data and method of assessment of geotechnical parameters;
- Design experience and methods adopted;
- Level of construction control and performance monitoring;
- Pile testing undertaken.

Based on some typical broad assumptions regarding the use of bored piles on this site, it is considered that a ϕ_g of between 0.48 and 0.56 may adopted for preliminary pile design purposes, assuming that no load testing of constructed piles is to be undertaken. However, designers should make their own assessment of appropriate ϕ_g values based on the particular risk circumstances, experience and testing regime appropriate for their design and a different value may apply. Should load testing be undertaken on constructed piles, then a higher ϕ_g value may be adopted in accordance with the procedures of AS2159-2009.

An appropriate load factor also needs to be applied to the pile loading.

In order for the shaft adhesions given in Table 3 to be adopted, the pile shaft must be rough and free of clay smear. A suitable roughness is grooves and scratches about 5mm deep at an average spacing of 100mm to 200mm. With good drilling practices this level of roughness is generally achieved without the need for additional roughening.

As for spread footings, it is recommended bored pile excavations be inspected by a geotechnical engineer during construction to ensure that founding conditions are consistent with those on which the design recommendations are based. Such inspection should involve a full time presence by a suitably experienced geotechnical engineer during the drilling of the piles, to assess rock strength and weathering, and to allow the refinement of actual pile depths to achieve design loads. Care should be taken to ensure that the base and side of any pile excavations are clean of loose material, water and clay smear prior to pouring concrete. Depending on the degree of cleanliness achieved, some reduction in the base bearing area for the calculation of pile capacity may be appropriate. Any such reduction would need to be assessed at the time of construction.

Should piles be subject to significant moments or lateral loading, it is recommended that further advice be sought.

4.3 Settlements

Settlements of footings and piles will depend on the type of footing selected, the founding material and the applied load. Based on the allowable bearing pressures presented in Table 2, settlements in the range of 10mm to 30mm may be anticipated for spread footings for preliminary purposes, with a proportion of this settlement likely to occur during construction. For piled foundations, settlements of less than 10mm may be anticipated for preliminary purposes.

It should be noted that our settlement estimates relate to load effects and that seasonal shrink and swell effects, due to moisture changes in the soil, may occur in addition to these estimates. Of particular importance is the potential differential settlement should a composite foundation system be proposed and this should be assess once details regarding the footing layouts and loadings are known.

4.4 Excavation Conditions

Shallow footing and trench excavations are expected to encounter gravel and clay fill materials, natural stiff to very stiff clay and weathered basalt rock. It is considered that the fill and natural clay may be excavated using conventional mechanical equipment such as tracked excavators and large bull dozers. The use of ripper attachments or hydraulic hammers may be required to excavate the weathered basalt rock.

Personnel should not be permitted to enter confined excavations in excess of 1.5m deep unless such excavations are battered or shored appropriately.

No groundwater was encountered during the drilling of the boreholes or the excavation of the test pits. However, it is considered that perched water may be present within the fill materials during the wetter periods of the year. The use of water during the coring process did not allow for the measurement of groundwater inflows below the depth at which rock was encountered. It is possible that groundwater may be encountered during excavation through basalt for basement excavations.

4.5 Batter Slopes

Batter slopes up to 3m depth in the fill and natural soils should be trimmed to no steeper than 1H:1V (45°) for the temporary case and 2H:1V (27°) for the permanent case. The presence of groundwater or perched water within the fill may locally affect stability.

It may be possible to steepen batter slopes in distinctly or less weathered basalt, subject to an assessment by an experienced geotechnical engineer of the orientation of potential failure plains including joints and bedding at the time of excavation.

Batter slopes are likely to be subject to fretting and local loss of material, particularly if exposed to weather for extended periods. Therefore, it is recommended that surface protection be provided to permanent batter slopes. Batter slope cuts in the rock may also experience local instability due to the presence of unfavourable joint set combinations, fractured zones, clay seams or similar. Should zones of seepage, major fractures, clay seams or unfavourably orientated jointing be observed in the rock then the adopted batter slopes may need to be revised and remedial measures adopted. It is recommended that batter slopes should be observed by a suitable experienced geotechnical engineer progressively during excavation.

Drainage should be provided at the top of batter slopes to divert runoff away from the slope face. The above recommendations are provided for batter slopes up to 3m in height, further geotechnical advice should be sought where higher batter slopes are proposed.

4.6 Trafficability

Trafficability in clayey materials for wheeled vehicles can be expected to be difficult during and following rainfall. Depending on the conditions at the time of construction, the provision of a granular bridging layer may be required in some areas.

5 LANDSLIDE RISK ASSESSMENT

We understand that a specific requirement of the planning permit is to provide a geotechnical report which:

- *identifies any erosion, landslip or other land degradation hazards on the land;*
- *provides a Landslide Risk Assessment of the land and proposed buildings and works in accordance with Practice Note Guidelines for Landslide Risk Management 2007*[1]*) ("AGS 2007c");*
- *states the landslide risk in accordance with AGS 2007c;*
- *and makes any relevant recommendations to reduce the risk of erosion, landslip or other land degradation processes to maintain an "acceptable" level of risk in accordance with AGS 2007c."*

5.1 Risk to property

In Table 4 we list our judgements about the likelihood, consequences and risk to property associated with the potential slope hazards related to the proposed works. The assessment applies only to the proposed works, as outlined in Section 1 above. This risk assessment may change if the site development is varied.

Table 4: Summary of landslide risk assessment (risk to property) (1)

What might happen	Likelihood	Consequence	Risk
Local Failures of the Fill Batter	Possible (Unlikely) (2)	Insignificant to Minor	Moderate to Very Low (Low to Very Low)
Local failure of Natural Slope	Likely (Unlikely) (2)	Insignificant to Minor	Low to Moderate (Low to Very Low) (2)

Notes: (1) – Refer Appendix B for definitions of likelihood, consequence and risk terms.

(2) – Resulting likelihoods and risks if recommendations provided in Section 4 are incorporated into the design and construction for the works.

Based on these judgements, we consider that the risk to property associated with slope instability at the site is Low to Very Low risk provided the engineering recommendations recommended in Section 4 this report are followed in the design and construction of the proposed works.

[1] AGS, 2007, "Practice Note Guidelines for Landslide Risk Management", Australian Geomechanics Society, Australian Geomechanics Vol 42 No1 March

5.2 Risk to life

The AGS Guidelines makes it clear that risk to life should be considered when assessing landslide risk. The landslide record from Australia and elsewhere indicates that most deaths and injuries are associated with fast landslides that travel some distance when there is insufficient warning for people present to take evasive action. People are most vulnerable if buried in open space, trapped in vehicles that are buried and crushed or in a building that collapses or is inundated with debris.

Provided the recommendations noted in Section 4 of this report are followed, we can envisage no credible risk to life associated with landslides for the proposed development.

6 LIMITATIONS

The subsurface conditions and geotechnical model described in this report are based on a limited number of boreholes and test pits at the time of the investigation, carried out in the proximity of the proposed site. Subsurface conditions can vary over relatively short distances. Should conditions revealed during the site works vary from those described in this report, a suitably experienced geotechnical engineer should be engaged to review conditions and provide geotechnical advice as required.

Your attention is drawn to the document entitled “Important Information about your Coffey Report” attached to this report.

For and on behalf of Coffey Geotechnics Pty Ltd

7 REFERENCES

- AGS, 2007, “Practice Note Guidelines for Landslide Risk Management”, Australian Geomechanics Society, Australian Geomechanics Vol 42 No1 March

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Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

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Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures

BH6 (4.3m) Denotes Approximate Location of Borehole and depth rock was encountered.

TP1 Denotes Approximate Location of Test Pit

A Cross Section Allignment

Approximate Location of Proposed Structures

BASE IMAGE SOURCE: NEARMAP.COM

drawn	DBA/DA
approved	DBA
date	5/5/2011
scale	NTS
original size	A3

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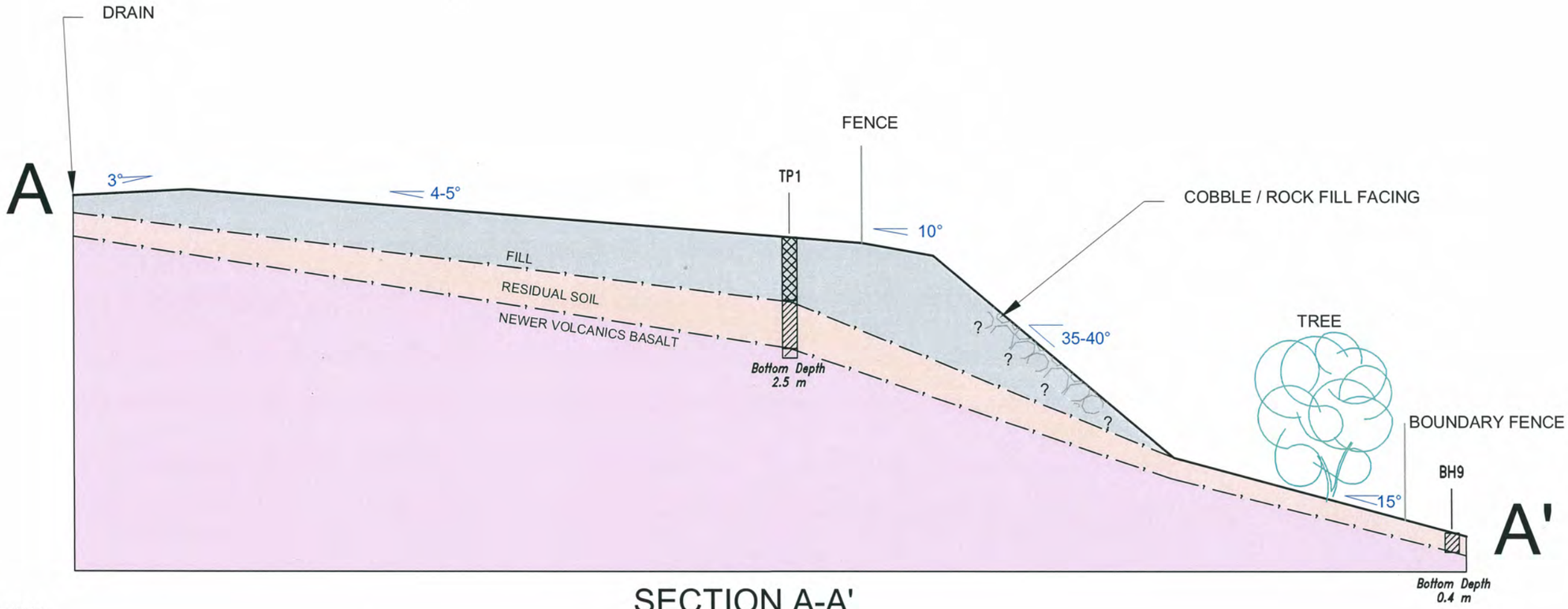
client:	BECA
project:	BRUNSWICK TERMINAL STATION GEOTECHNICAL INVESTIGATION
title:	BOREHOLE LOCATIONS PLAN
project no:	GEOTABTF08419AA
figure no:	FIGURE 1



SECTION A-A'

LEGEND:

- FILL
- RESIDUAL SOIL
- BASALT

revision	description	drawn	approved	date

SCALE 0 1 2 3 4 5 METRES 1:100 (A3)

drawn	DA/GG
approved	DBA
date	18/05/2011
scale	1:100
original size	A3

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SPECIALISTS MANAGING THE EARTH

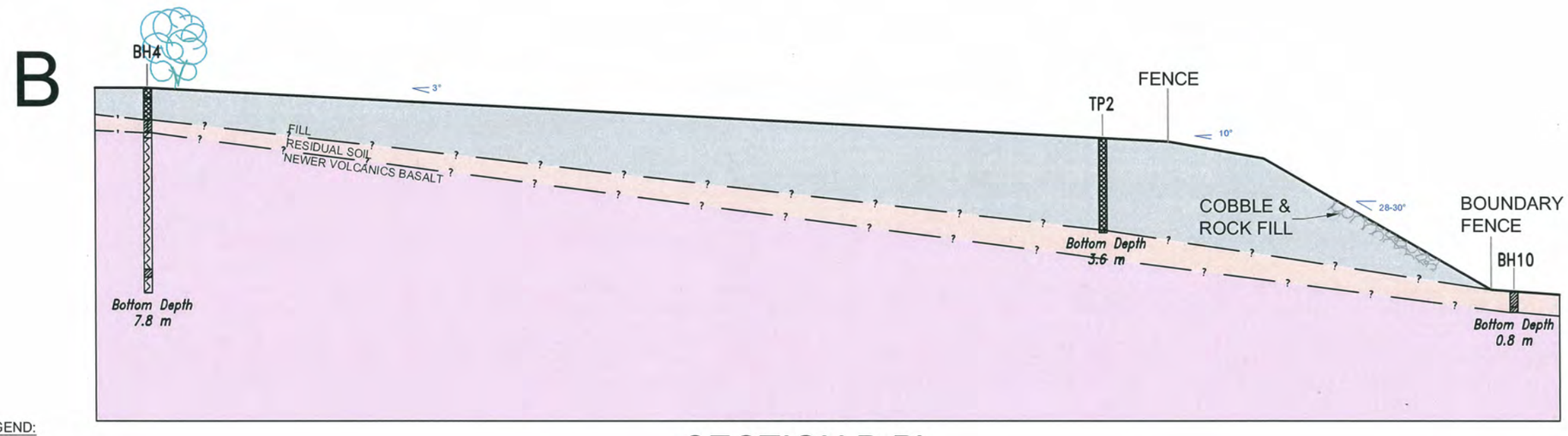
client: BECA

project: GEOTECHNICAL INVESTIGATION
BRUNSWICK TERMINAL STATION

title: SECTION A-A'

project no: GEOTABTF08419AA-AD

FIGURE 2



LEGEND:

- FILL
- RESIDUAL SOIL
- BASALT ROCK

SECTION B-B'

revision	description	drawn	approved	date

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

drawn	DA/GG
approved	DBA
date	18/05/2011
scale	1:200
original size	A3

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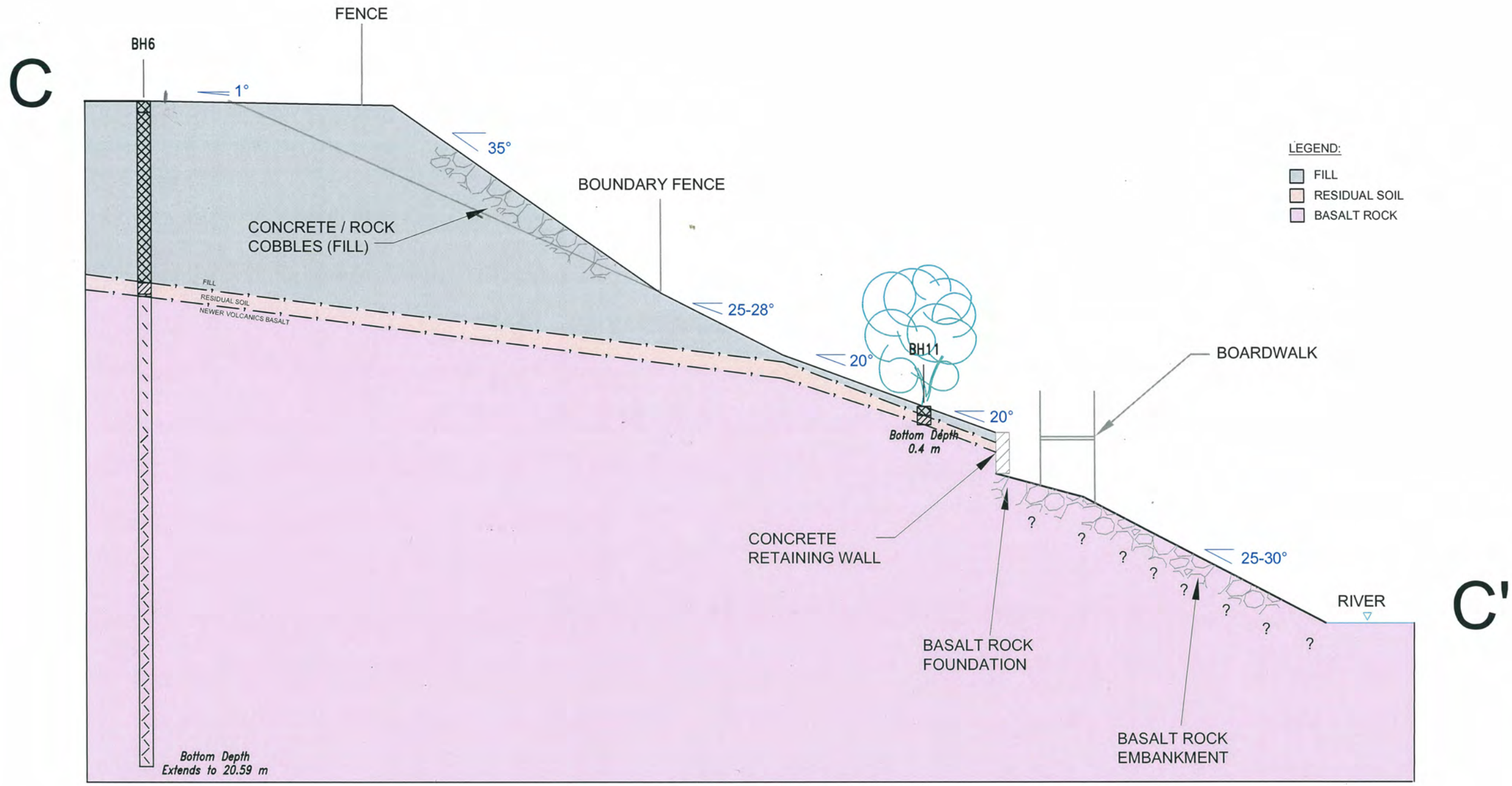
client: BECA

project: GEOTECHNICAL INVESTIGATION
BRUNSWICK TERMINAL STATION

title: SECTION B-B'

project no: GEOTABTF08419AA-AD

FIGURE 3



SECTION C-C'

revision	description	drawn	approved	date

0 1 2 3 4 5
SCALE 1:100 (A3) METRES

drawn	DA/GG
approved	D&A
date	18/05/2011
scale	1:100
original size	A3

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SPECIALISTS MANAGING THE EARTH

client: BECA

project: GEOTECHNICAL INVESTIGATION
BRUNSWICK TERMINAL STATION

title: SECTION C-C'

project no: GEOTABTF08419AA-AD

FIGURE 4

Appendix A:
Site Photographs

PHOTOGRAPH 1 – SATURATED SOILS

PHOTOGRAPH 2 – LEANING TREE

drawn	**DA**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**BECA**
approved			project:	**GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION**
date	**18/05/2011**			
scale	**Not to scale**		title:	**SITE PHOTOGRAPHS**
original size	**A4**		project no: **GEOTABTF08419AA-AD**	figure no: **APPENDIX A**

PHOTOGRAPH 3 – FILL BATTER (SECTION C-C')

drawn	**DA**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client: **BECA**	
approved			project: **GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION**	
date	**18/05/2011**			
scale	**Not to scale**		title: **SITE PHOTOGRAPHS**	
original size	**A4**		project no: **GEOTABTF08419AA-AD**	figure no: **APPENDIX A**

Appendix B:
Results of the Fieldwork

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

• Low plasticity – Liquid Limit W_L less than 35%. • Modium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms roch substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

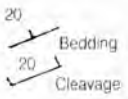
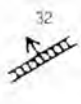
Term	Abbrev-iation	Point Load Index, I_S50 (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

coffey

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

DEFECT SHAPE TERMS	
Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS	
Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS	
Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS	
Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH1**
Sheet	1 of 3
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**29.4.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DA

drill model and mounting: DB 520 Tracked | Easting: 322504 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Northing 5817399 | bearing: | datum: N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		C						GW	**FILL: SANDY GRAVEL:** fine to coarse grained, grey brown, fine to coarse grained sand	M	L		FILL
								CH	**CLAY:** high plasticity, dark grey, some brown mottling, trace of fine grained gravel		VSt		RESIDUAL SOIL
			None Observed			1			Borehole BH1 continued as cored hole				
						2							
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH1**
Sheet	2 of 3
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**29.4.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322504 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Drilling fluid: Water | Northing: 5817399 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log / core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						Continued from non-cored borehole			D A			
HQ		None Observed		1		**BASALT:** grey, slightly vesicular, vesicles up to 15mm	SW		6.7 5.3	100		— JT, 20°, IR, RO, CN
										0		— SM, 80°, PL, RO, clay infill
												— JT, 0°, IR, RO, CN
				2		vesicle content decreasing						JT, 0°, PL/IR, RO, CN
												JT, 10°, PL/IR, RO, CN
									D A			
									7.7 7.4	73		— JT, 20°, PL, RO, CN
												— SM, 0°, PL, 40mm thick, clay infill
												SM, 90°, CU, clay infill, 10mm thick
				3								— SM, 40°, PL, clay infill, 10mm thick
												— SM, 40°, PL, clay infill, 60mm thick
						BASALT: grey, some iron staining, some healed joints						— multi joints
				4								— JT, 0°, IR, RO, VN
												— JTx2, 10°, PL, RO, CN
												JTx4, 10°, PL, RO, CN
												JT, 20°, IR, RO, CN
												JT, 20°, IR, RO, VN
				5								highly fractured zone
												JTx2, 10-30°, PL, RO, VN
												JT, 20°, IR, RO, VN
												JT, 0°, IR, RO, VN
												XW SM, 90°, IR, 5mm thick
												CS, 0°, IR, 10mm thick
												CS, 0°, IR, 10mm thick
												JT, 0°, IR, RO, CO
				6								multiple JT's, 0-90°, PL/IR, RO, CN
												— JT, 10°, PL, RO, VN
												JT, 70°, PL, RO, VN
												JT, 5°, IR, RO, CN
												CS, 10°, PL, RO, FeSN
				7								highly fractured zone
									D			— JT, 20°, IR, RO, CN
									1.2			multiple JT's, 10°, PL, RO, CN
												JT, 10°, PL, RO, CN
						GRAVELLY SEAM: fine to medium grained, dark grey, orange	HW					7.37 - 7.46 SM fine to medium gravel, dark grey, orange
						BASALT: grey/brown, some iron staining	MW					JT, 0°, IR, RO, FeSN
						CLAY SEAM: high plasticity, brown, with	XW					JT, 50°, PL, RO, VN
				8								

Defects mostly - JT, 20 to 60°, PL, RO, CN, FeSN, CO, VN

CORED BOREHOLE GEOTABTF08419AA.GPJ COFFEY.GDT 20.5.11

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method
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
NMLC NMLC core
NQ, HQ, PQ wireline core

core-lift
casing used
barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material
no core recovered

water
10/1/98 water level on date shown
water inflow
partial drill fluid loss
complete drill fluid loss
25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR irregular

roughness
VR very rough
RO rough
SO smooth
SL slickensided

coating
CN clean
SN stained
VN veneer
CO coating
Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH1**
Sheet	3 of 3
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**29.4.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322504 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Drilling fluid: Water | Northing: 5817399 | bearing: | datum: N/A

drilling information					material substance						rock mass defects			
method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial		RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness particular / general	
				9		pieces of fine to coarse grained basalt gravel							7.63 - 7.76 SM Clay, high plasticity, brown, fine to coarse gravel	
						BH1 terminated at 7.76m								
				10										
				11										
				12										
				13										
				14										
				15										
				16										

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating
Fe	iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH2**
Sheet	1 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**29.4.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting: DB 520 Tracked | Easting: 322467 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Northing 5817434 | bearing: | datum: N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		N						CH	**CLAY:** high plasticity, dark grey/brown	M	VSt		RESIDUAL SOIL
			None Observed			1			Borehole BH2 continued as cored hole				
						2							
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH2**
Sheet	2 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**29.4.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322467 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Drilling fluid: Water | Northing: 5817434 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						Continued from non-cored borehole						
HQ		None Observed		1		**BASALT:** grey, trace of vesicles up to 5mm	SW/FR		D 4.2 A 6.8	96		— SM, 0°, PL, clay infill, 15mm thick
												— SM, 15°, PL, clay and basalt infill
				2								— JT, 70°, PL, RO, VN — JT, 70°, PL, RO, CN — JT, 5°, PL, RO, CN — JT, 60°, CU, RO, VN — JT, 5°, PL/IR, RO, CN — multiple JT's, 50°, PL, RO, CN — CS, 0°, IR, RO, CN, 20mm thick — highly fractured zone
						becoming slightly vesicular				43		
				3								— SM, 60°, PL, clay infill 5mm thick
										36		— JT, 0°, IR, RO, CN — multiple JT's, 0-70°, PL/IR, RO, VN
				4					D 2.7 A 5.9			— SM, 20°, IR, RO, CN — SM, 0°, PL, 10mm thick clay infill — JT, 0°, PL, RO, FeSN — JT, 70°, PL/IR, RO, CN — multiple JT's, 0°, PL, RO, CN
				5						84		
						BH2 terminated at 5m				0		Defects mostly - JT, 20 to 60°, PL, RO, CN, CO, VN
				6								
				7								
				8								

CORED BOREHOLE GEOTABTF08419AA.GPJ COFFEY.GDT 19.5.11

Form GEO 5.5 Issue 3 Rev. 3

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH3**
Sheet	1 of 3
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**2.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA/KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting:	DB 520 Tracked	Easting:	322315	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	120 mm	Northing	5817451	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		N	None Observed					GW	**FILL: SANDY GRAVEL:** fine to coarse grained, grey, white, fine to coarse grained sand	M	L		FILL
								CH	**CLAY:** high plasticity, dark grey, trace of fine grained gravel		VSt		RESIDUAL SOIL
									Refusal on basalt rock				
									Borehole BH3 continued as cored hole				

1 2 3 4 5 6 7 8

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description
based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH3**
Sheet	2 of 3
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**29.4.2011**
Principal:	**SP Ausnet**
Date completed:	**2.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA/KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322315 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Drilling fluid: Water | Northing: 5817451 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						Continued from non-cored borehole						
HQ		None Observed		1		**BASALT:** grey, 15% vesicular, vesicles up to 10mm, with some iron staining	DW		D 6.6 A 7	77		— JT, 20°, UN, RO, clay CO SM, 10°, clay, 30mm SM, 40°, clay 10mm — JTx3, 30-60°, PL, RO, CN
						porous, <1% vesicular						— SM, 10°, clay, 60mm
				2		10% vesicular, vesicles up to 10mm				83		— SM, 40°, clay, 10mm — JTx2, 10-40°, CU, RO, clay VN
						25% vesicular, vesicles up to 15mm, heavily iron stained						— JT, 50°, PL, RO, clay CO JT, 0°, IR, RO, CN — SM, 5-20°, clay (XW), 70mm
				3		red-brown						— JTx4, 10-30°, IR, RO, FeSN SM, 10°, clay, 10mm — JT, 90°, CU, RO, clay VN
						CLAY: medium to high plasticity, mottled grey, red-brown, orange, with some bands of distinctly weathered basalt, red-brown, medium to high strength	XW		D 6.1 A 5.4	11		
				4		**NO CORE:** 250mm						
						BASALT: red-brown, 20% vesicular, vesicles up to 10mm	DW		D 4 A 0.34	34		— SM, 0°, gravelly clay, 20mm — JT, 40°, PL, RO, FeSN
						grey-brown, vesicles up to 15mm						
				5		grey, 5% vesicular, iron stained				56		
									D 7.3 A 4.9			
				6		10% vesicular						— JT, 60°, PL, RO, clay CO JT, 50°, PL, RO, FeSN SM, 30°, clay, 50mm JT, 70°, CU, RO, clay CO
						porous				32		— JT, 70°, PL, RO, FeSN JT, 50°, CU, RO, FeSN cemented, 20°, 5mm spacing JT, 90°, ST, RO, clay infill JTx3, 90°, PL, RO, clay VN
				7		10% vesicular						— JT, 40°, PL, RO, FeSN JTx2, 50°, UN, RO, FeSN FZ, 30mm, clay infill JT, 30°, ST, RO, CN
						CLAY: medium to high plasticity, pale grey-brown, trace of distinctly weathered BASALT bands, medium to high strength	XW			24		
				8			DW		D A	24		— JT, 60°, CU, RO, clay CO

Defects mostly JT's, 0-20°, PL, RO, CN-FeSN

method
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
NMLC NMLC core
NQ, HQ, PQ wireline core

core-lift
casing used
barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material
no core recovered

water
10/1/98 water level on date shown
water inflow
partial drill fluid loss
complete drill fluid loss
25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR irregular

roughness
VR very rough
RO rough
SO smooth
SL slickensided

coating
CN clean
SN stained
VN veneer
CO coating
Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH3**		
Sheet	3 of 3		
Project No:	**GEOTABTF08419AA**		
Client:	**BECA**	Date started:	**29.4.2011**
Principal:	**SP Ausnet**	Date completed:	**2.5.2011**
Project:	**Brunswick Terminal Station**	Logged by:	**DA/KJ**
Borehole Location:	**Refer to Figure 1**	Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322315 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 120 mm | Drilling fluid: Water | Northing: 5817451 | bearing: | datum: N/A

drilling information					material substance					rock mass defects			
method	core-lift	water	RL	depth metres	graphic log / core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						BASALT: grey-brown, porous, iron stained *(continued)*			7.2 6.3	24		
						BH3 terminated at 8.13m						

9 10 11 12 13 14 15 16

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating
Fe	iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH4**
Sheet	1 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**2.5.2011**
Principal:	**SP Ausnet**
Date completed:	**2.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting: DB 520 Tracked | Easting: 322506 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Northing 5817478 | bearing: | datum: N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADV		C	None Observed			0		GP	**FILL: SANDY GRAVEL:** fine to coarse grained, grey, fine to coarse grained sand	M	MD		FILL
								CH	**FILL: GRAVELLY CLAY:** high plasticity, dark grey, fine to coarse grained gravel, sub angular		VSt		
		N				1							
				D				CH	**SILTY CLAY:** high plasticity, dark grey		St	X	RESIDUAL SOIL PP off augered clay clumps
									becoming grey				
						2			**BASALT:** distinctly weathered, grey-brown, medium to high strength				NEWER VOLCANICS BASALT
									Borehole BH4 continued as cored hole				
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH4**
Sheet	2 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**2.5.2011**
Principal:	**SP Ausnet**
Date completed:	**2.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322506 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817478 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
				1								
				2		Continued from non-cored borehole			D A			
HQ		None Observed		2		**BASALT:** red-brown, 25% vesicular, vesicles up to 15m	DW		3.3 2.6	52		— JT, 60°, CU, RO, clay, VN / JT, 90°, CU, RO, clay VN — SM, XW, 0°, clay, 180mm — JT, 70°, ST, RO, CN — SM, 50°, clay, 60mm — SM, 10°, clay, 140mm
				3								— SM, 20-40°, clay 10mm — SM, 20-50°, clay 50mm / SM, 10°, clay, 30mm / SM, 10°, IR, 30mm / SM, 50°, clay, 30mm / SM, 0°, clay, 30mm / SM, 10°, clay20mm / JT, 80°, CU, RO, FeSN
				4					D A 4.2 2.4	54		
				5								— JT, 50°, PL, RO, clay CO
				6					D A 6.4 5.9	84		
				6		porous, trace of vesicles up to 10mm	SW			0		— JT, 40°, PL, RO, clay VN / SM, 30°, clay 40mm — SM, 20°, clay, 10mm — JT, 70°, CU, RO, CN
				7		**CLAY:** medium to high plasticity, pale grey-brown, with some orange mottles	XW					
				7		**BASALT:** red-brown, 25% vesicular, vesicles up to 15m	SW		D 6.6	65		— JT, 40°, CU, RO, FeSN — JTx2, 30-40°, PL, RO, CN — SM, 40°, clay 60mm — JT, 80°, CU, RO, CN
				8		BH4 terminated at 7.8m						

Defects mostly JTs, 5-20°, PL-IR, RO, FeSN

method
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
NMLC NMLC core
NQ, HQ, PQ wireline core

core-lift
casing used
barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material
no core recovered

water
10/1/98 water level on date shown
water inflow
partial drill fluid loss
complete drill fluid loss
25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

roughness
VR very rough
RO rough
SO smooth
SL slickensided

planarity
PL planar
CU curved
UN undulating
ST stepped
IR irregular

coating
CN clean
SN stained
VN veneer
CO coating
Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH5**
Sheet	2 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**2.5.2011**
Principal:	**SP Ausnet**
Date completed:	**3.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ/DBA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322501 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817426 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D-diametral A-axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						Continued from non-cored borehole						
HQ		None Observed		1		**BASALT:** grey, slighlty vesicular	SW			93		— clay infill
				2					D 5.7 A 7			— JT, 45°, PL, RO, clay infill 10mm / JT, 45°, PL, RO, CN — JT, 0°, IR, RO, CN / JT, 45°, PL, RO CN / JT, 45°, PL, RO, VN / JT, 0-10°, PL, RO, CO
				3						83		— JT, 45° CU, RO, CN / clay infill, 50mm — JT, 0°, PL, RO, CN / JT, 45°, PL, RO, CN / JT, 10°, PL, RO, CO — JT, 45-60°, CU, RO, CO
				4			HW DW		D 6.1 A 7.4	41		— JT, 0°, PL, RO, CN / JT, 60°, PL, RO, CO / JT, 45°, PL, RO, CN / JT, 45°, PL, RO, CN / JT, 20°, PL, RO, VN / JT, 70°, PL, SO, SN
				5		BH5 terminated at 5m						Defects mostly JT, 0-10°, CU-IR, RO, CN
				6								
				7								
				8								

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH6**
Sheet	1 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**3.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ/DBA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting:	DB 520 Tracked	Easting:	322497	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	110 mm	Northing	5817576	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
ADV		C				0		GP	**FILL: SANDY GRAVEL:** fine to coarse grained gravels and sands, grey, white	D	L		FILL
								CH	**FILL: GRAVELLY CLAY:** high plasticity, brown, with fine to coarse grained gravel and some basalt cobbles	M	St/VSt		
				SPT 4,3,7 N*=10		1							
		N				2							
				SPT 2,5,5 N*=10		3							
				SPT 3,4,- N*=R		4		CH	**CLAY:** high plasticity, dark grey	M-W	St		RESIDUAL SOIL SPT refusal double bouncing
									BASALT: distinctly weathered, grey, high strength				NEWER VOLCANICS BASALT
									Borehole BH6 continued as cored hole				
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH6**
Sheet	2 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**3.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ/DBA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322497 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817576 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
				1								
				2								
				3								
				4		Continued from non-cored borehole						
HQ				5		**BASALT:** grey, porous, iron stained	DW		D 6.2	26		— JT, 60°, PL, RO, clay CO SM, 10°, clay 30mm CR SM, 40°, 80mm
				6		15% vesicular, vesicles up to 15mm				13		— JTx3, 70-90°, CU, RO, CN — JT, 40°, PL, RO, CN
				7						37		— JT, 30°, ST, RO, CN — JT, 60°, PL, RO, FeSN SM, 20°, clay, 40mm — JTx2, 50°, IR, RO, FeSN
				8					D A 5.8 1.9	81		— SM, 20°, clay, 40mm — JTx2, 60°, PL, RO, FeSN JT, 90°, CU, RO, clay CO SM, 50°, clay, 30mm SM, 0-40°, clay, 100mm — JT, 70°, UN, RO, CN
										0		— SM, 5-30°, clay, 100mm — SM, 50°, CLAY, 10MM — JT, 60°, UN, RO, FeSN — CR zone, JTx2, 90°, UN, RO, CN with

Defects mostly JTS, 5-30°, PL-CU, RO, CN-FeSN

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Form GEO 5.5 Issue 3 Rev. 3

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- water pressure test result (lugeons) for depth interval shown (25)

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating
Fe	iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Client:	**BECA**	Borehole No.	**BH6**
Principal:	**SP Ausnet**	Sheet	3 of 4
Project:	**Brunswick Terminal Station**	Project No:	**GEOTABTF08419AA**
Borehole Location:	**Refer to Figure 1**	Date started:	**3.5.2011**
		Date completed:	**4.5.2011**
		Logged by:	**KJ/DBA**
		Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322497 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817576 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
HQ				9		**BASALT:** grey, porous, iron stained *(continued)*	DW			0		Interestinct JTs 400mm — SM, 0°, clay, 110mm
						5% vesicular, vesicles up to 10mm, infilled with orange-brown clay						— SM, 5°, clay 10mm — SM, 0°, gravelly clay, 50mm JT, 90°, CU, RO, FeSN heavily fractured, drill breaks, 170mm laminated defects, 0-20°, PL, RO, CN-FeSN, 5-30mm spacing, 370mm
				10		20% vesicular, vesicles up to 10mm			D 3.2 A 2.6	23		— JT, 40°, CU, RO, CN — JTx3, 50°, CU, RO, FeSN
												— SM, 20°, clay, 10mm JT, 80°, IR, RO, FeSN
				11		trace of white mineral infill in vesicles				29		
									D 2.7 A 2.8			— JT, 50°, PL, RO, FeSN
				12					D 2.1 A 5.6			
						porous, iron stained				11		— JT, 40°, CU, RO, CN — JT, 80°, CU, RO, CN — JTx3, 50°, PL, RO, FeSN, 20mm spacing
				13								drill breaks, 100mm JT, 70°, UN, RO, FeSN
										16		— CR SM, 60°, 90mm
												— JT, 60°, IR, RO, CN
				14		trace of iron staining	SW					
									D 12			— JT, 70°, CU, RO FeSN
							DW			55		— JTx3, 80-90°, CU, RO, FeSN — FZ, 60°, 80mm
				15		**NO CORE:** 370mm						
						BASALT: grey, porous, iron stained, with vesicular bands, 10% vesicles up to 10mm grey-brown	DW			0		— JTx2, 60°, PL, RO, FeSN — heavily fractured, defects 10-60°, CU, RO, FeSN, with some clay infill
				16						19		

Defects mostly JTS, 5-30°, PL-CU, RO, CN-FeSN

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

roughness
VR very rough; RO rough; SO smooth; SL slickensided

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH6**
Sheet	4 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**3.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ/DBA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322497 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817576 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log / core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
HQ				17		**BASALT:** grey, porous, iron stained, with vesicular bands, 10% vesicles up to 10mm *(continued)*	DW			19		— JT, 40°, PL, RO, CN
												— JT, 90°, CU, RO, FeSN
												— JT, 50°, PL, RO, FeSN
												— JT, 85°, CU, RO, FeSN
									D A 3.8 2.7	0		— JT, 40°, CU, RO, FeSN / JT, 30°, IR, RO, FeSN
				18		**NO CORE:** 50mm						
		◁				**BASALT:** grey, 10% vesicular, vesicles up to 10mm, iron stained porous, <1% vesicles up to 5mm	DW					— JT, 40°, CU, RO, CN / SM, 30°, clay, 40mm water loss 20-25%
												— JT, 50° CL, RO, CN
									D A 1.6 2.5	52		— JT, 50°, CU, RO, CN / JT, 60°, CU, RO, FeSN
				19								— JT, 50°, PL, RO, FeSN
												— FZ?, JTs, 5-40°, PL, RO, FeSN, 140mm, 10mm spacing
							SW					Defects mostly JTS, 5-30°, PL-CU, RO, CN-FeSN
									D A 8.7 7.9	79		
				20								
				21		BH6 terminated at 20.59m						
				22								
				23								
				24								

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH7**
Sheet	1 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**4.5.2011**
Principal:	**SP Ausnet**
Date completed:	**5.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting: DB 520 Tracked | Easting: | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Northing | bearing: | datum: N/A

drilling information

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres
ADV		N	None Observed	E E SPT 2,4,6 N*=10 SPT >12,-,- N*=R		1 2 3 4 5 6 7 8

material substance

graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
	GP	**FILL: CRUSHED ROCK: SANDY GRAVEL:** fine to coarse grained, grey, fine to coarse grained sand	D	MD		FILL
	CH	**FILL: GRAVELLY CLAY:** high plasticity, dark grey-black, fine to medium grained gravel, black angular	M	St/VSt		
		gravel is black, pale brown (basalt and siltstone)				
		cobble, 150mm				
	CH	**SILTY CLAY:** high plasticity, dark grey				RESIDUAL SOIL
						SPT refusal, 12 blows for 140mm, hammer bouncing
		BASALT: grey, distinctly weathered, high strength				NEWER VOLCANICS BASALT
		Borehole BH7 continued as cored hole				

BOREHOLE GEOTABTF08419AA.GPJ COFFEY.GDT 19.5.11

Form GEO 5.3 Issue 3 Rev.2

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description
based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH7**
Sheet	2 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**4.5.2011**
Principal:	**SP Ausnet**
Date completed:	**5.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
				1								
				2		Continued from non-cored borehole						
HQ		None Observed		3		**BASALT:** grey, porous, trace of vesicles up to 20mm, trace of iron staining	SW		D 4.4 A 4.7	83		— SM, 30°, clay, 30mm — clay infill, 10mm
				4								
				5		**NO CORE:** 50mm **BASALT:** grey, porous, trace of iron staining	SW		D 6.9	76		— SM, 0°, clay, 80mm — SM, 10°, clay, 10mm — SM, 20°, clay, 10mm
				6					D 7.5	95		
				7					D 6.9 A 7.1	18		— SM, 40°, clay, 150mm — JT, 60°, PL, RO, CN
				8						83		Defects mostly JTs, 20-40°, PL-CU, RO, CN

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH7**
Sheet	3 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**4.5.2011**
Principal:	**SP Ausnet**
Date completed:	**5.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log / core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
HQ		None Observed		9		**BASALT:** grey, porous, trace of iron staining *(continued)*	SW		D 5.3	83		— JT, 50°, PL, RO, clay CO / JT, 85°, PL, RO, clay VN — SM, 20°, clay, 10mm — JT, 70°, IR, RO, clay VN / JT, 80°, PL, RO, clay VN
				10		with iron stained bands trace of iron staining	DW SW			40		— JT, 70°, PL, RO, CN / SM, 60°, clay, 60mm / JTx2, 50°, PL, RO, CN / JTx7, 50°, PL, RO, FeSN — JT, 90°, CU, RO, CN — laminated, 10-30°, CU, FeSN, 100mm, 5-20mm spacing
				11					D 11 A 9.5	40		— JT, 60°, IR, RO, CN — JTx3, 75°, CU, RO, FeSN, (FZ?)
				12						70		— JT, 60°, PL, RO, FeSN — JT, 70°, PL, RO, clay VN — JT, 70°, IR, RO, FeSN, clay infill 10mm
				13					D 9.8 A 6	30		
				14						93		— JT, 10°, ST, RO, CN — JT, 60°, PL, RO, CN
				15					D 13 A 9.2			— JT, 0°, PL, RO, CN
									D 12	100		
				16					D 9.6 A 7.3	93		— JT, 50°, PL, RO, clay CO — JT, 70°, PL, RO, FeSN

Defects mostly JTs, 20-40°, PL-CU, RO, CN

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating; Fe iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH7**
Sheet	4 of 4
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**4.5.2011**
Principal:	**SP Ausnet**
Date completed:	**5.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: | bearing: | datum: N/A

drilling information					material substance					rock mass defects			
method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular	general
HQ		None Observed		17		**BASALT:** grey, porous, trace of iron staining *(continued)*	SW		D 12	93		— JT, 70°, PL, RO, CN	Defects mostly JTs, 20-40°, PL-CU, RO, CN
				18						100		— JT, 0°, ST, RO, CN	
				19					D 10 A 9.1 D 11	96			
				20								— JT, 85°, PL, RO, clay VN	
						BH7 terminated at 20m						~~JT, 70°, CU, RO, CN~~	
				21									
				22									
				23									
				24									

CORED BOREHOLE GEOTABTF08419AA.GPJ COFFEY.GDT 19.5.11

Form GEO 5.5 Issue 3 Rev. 3

method
- DT diatube
- AS auger screwing
- AD auger drilling
- RR roller/tricone
- CB claw or blade bit
- NMLC NMLC core
- NQ, HQ, PQ wireline core

core-lift
- casing used
- barrel withdrawn

graphic log/core recovery
- core recovered - graphic symbols indicate material
- no core recovered

water
- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering
- FR fresh
- SW slightly weathered
- MW moderately weathered
- HW highly weathered
- XW extremely weathered
- DW distinctly weathered (covers MW and HW)

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- JT joint
- PT parting
- SM seam
- SZ sheared zone
- SS sheared surface
- CS crushed seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR irregular

roughness
- VR very rough
- RO rough
- SO smooth
- SL slickensided

coating
- CN clean
- SN stained
- VN veneer
- CO coating
- Fe iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH5**
Sheet	1 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**2.5.2011**
Principal:	**SP Ausnet**
Date completed:	**3.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ/DBA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting:	DB 520 Tracked	Easting:	322501	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	110 mm	Northing	5817426	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
ADV		N	None Observed			0		SP	**FILL: SAND:** fine to coarse grained, pale brown, trace of silt	M	L-MD		FILL
									BASALT: distinctly weathered, grey, high strength				NEWER VOLCANICS BASALT
									Borehole BH5 continued as cored hole				
						1							
						2							
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH8**
Sheet	1 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**5.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting: DB 520 Tracked | Easting: 322464 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Northing 5817406 | bearing: | datum: N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV		N	None Observed	E				GP	**FILL: ASPHALT:** 20mm	D	D		FILL/PAVEMENT
								CH	**FILL: CRUSHED ROCK: SANDY GRAVEL:** fine to medium grained, grey, fine to coarse grained sand	M	St-VSt		RESIDUAL SOIL
									SILTY CLAY: high plasticity, grey, trace of orange and brown mottles				
									BASALT: distinctly weathered, grey, cobble				NEWER VOLCANICS BASALT
						1			Borehole BH8 continued as cored hole				
						2							
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, C casing, N nil

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH8**
Sheet	1 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**5.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model & mounting: DB 520 Tracked | Easting: 322464 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817406 | bearing: | datum: N/A

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
						Continued from non-cored borehole						
HQ		None Observed		1		**BASALT COBBLE:**	DW					
						CLAY: high plasticity, grey-brown, trace of fine to coarse grained sand, moist, stiff to very stiff (PP= 220, 180, 350kPa)						
				2		**BASALT:** grey, 2% vesicular, vesicles 2-5mm, with some iron staining	DW					
				3					D 6 A 4.8 D 6.8 A 7.3	77		— JT, 50°, ST, RO, clay VN
				4					D 7 A 6.1	67		— JT, 60°, PL, RO, clay CO — SM, 15°, clay, 10mm — FZ? defects 0-40°, intersecting IR, RO, FeSN, 5-40mm spacing, some closed some with clay CO
						porous, iron stained						
				5								— JT, 90°, UN, RO, clay VN — SM, 5°, clay 20mm
				6					D 5.8 A 4.6 D 1.8 A 6.2	29		— JT, 85°, CU, RO, clay VN — JT, 80°, CU, RO, clay VN — JTx3, 90° UN, RO, FeSN, with intersecting JTs
				7								— JT, 70°, UN, RO, clay CO, FeSN
						grey-brown, non-vesicular, with some white minerals, iron stained						— JT, 5°, ST, RO, CN
				8								Defects mostly JT's, 0-20°, PL-UN, RO, clay infill/CO

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift: casing used; barrel withdrawn

graphic log/core recovery: core recovered - graphic symbols indicate material; no core recovered

water: 10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating
Fe	iron stained

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH8**
Sheet	2 of 2
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**5.5.2011**
Principal:	**SP Ausnet**
Date completed:	**4.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**KJ**
Borehole Location:	**Refer to Figure 1**
Checked by:	DA

drill model & mounting: DB 520 Tracked | Easting: 322464 | slope: -90° | R.L. Surface: Not Measured

hole diameter: 110 mm | Drilling fluid: Water | Northing: 5817406 | bearing: | datum: N/A

drilling information					material substance					rock mass defects		
method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
HQ						with approx 50% EXTREMELY WEATHERED BASALT clay, medium to high plasticity, brown	XW-DW			41		— SM, 30°, gravelly clay, 30mm — SM, 20°, clay, 20mm
						BASALT: grey-brown, non-vesicular, (approx 50%, EXTREMELY WEATHERED BASALT)	DW					
						BASALT: grey, 10% vesicular, vesicles up to 10mm, iron stained						
				9		BH8 terminated at 8.65m						
				10								
				11								
				12								
				13								
				14								
				15								
				16								

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating
Fe	iron stained

coffey geotechnics

Engineering Log - Borehole

Borehole No.	**BH9**
Sheet	1 of 1
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**12.5.2011**
Principal:	**SP Ausnet**
Date completed:	**12.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DBA

drill model and mounting:	Hand auger	Easting:	322564	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	80 mm	Northing	5817440	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HA		N						CH	**CLAY:** high plasticity, dark brown, trace of coarse grained basalt gravel	M	VSt		RESIDUAL SOIL
						0.5			Refusal on basalt cobble Borehole BH9 terminated at 0.4m				
						1.0							
						1.5							
						2.0							
						2.5							
						3.0							
						3.5							
						4.0							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, C casing, N nil

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole No.	**BH10**
Sheet	1 of 1
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**12.5.2011**
Principal:	**SP Ausnet**
Date completed:	**12.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DA

drill model and mounting:	Hand auger	Easting:	322560	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	80 mm	Northing	5817490	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
HA		N						CH	**CLAY:** dark brown, brown	M	St		RESIDUAL SOIL
				D		0.5							
				D				CH	**SANDY CLAY:** high plasticity, dark brown, fine to coarse grained sand, trace of fine to coarse grained gravel	M/W			
						1.0			Refusal on basalt rock or cobble Borehole BH10 terminated at 0.8m				
						1.5							
						2.0							
						2.5							
						3.0							
						3.5							
						4.0							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

BOREHOLE GEOTABTF08419AA.GPJ COFFEY.GDT 19.05.11

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Engineering Log - Borehole

Borehole No.	**BH11**
Sheet	1 of 1
Project No:	**GEOTABTF08419AA**
Client:	**BECA**
Date started:	**16.5.2011**
Principal:	**SP Ausnet**
Date completed:	**16.5.2011**
Project:	**Brunswick Terminal Station**
Logged by:	**DA**
Borehole Location:	**Refer to Figure 1**
Checked by:	DA

drill model and mounting:	Hand auger	Easting:	322512	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	80 mm	Northing	5817586	bearing:		datum:	N/A

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
HT		N						ML	**FILL: CLAYEY SILT:** low plasticity, dark brown, with some basalt cobbles and fine to coarse grained gravel, with root matter, trace of organic matter	D/M	St		FILL
HA								CH	**CLAY:** high plasticity, dark brown	M	VSt		RESIDUAL SOIL
						0.5			Refusal on basalt cobble Borehole BH11 terminated at 0.4m				
						1.0							
						1.5							
						2.0							
						2.5							
						3.0							
						3.5							
						4.0							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

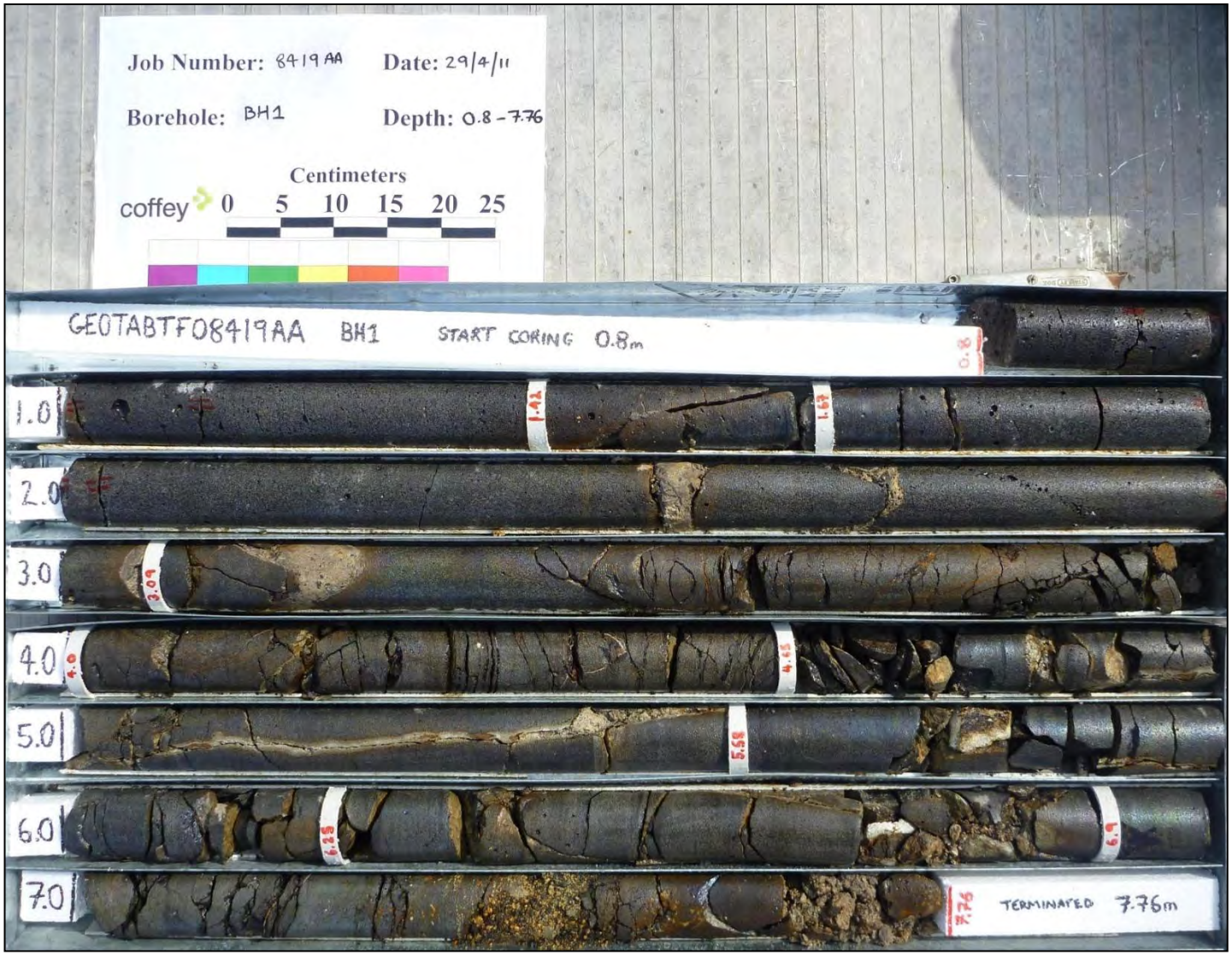
based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense



drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

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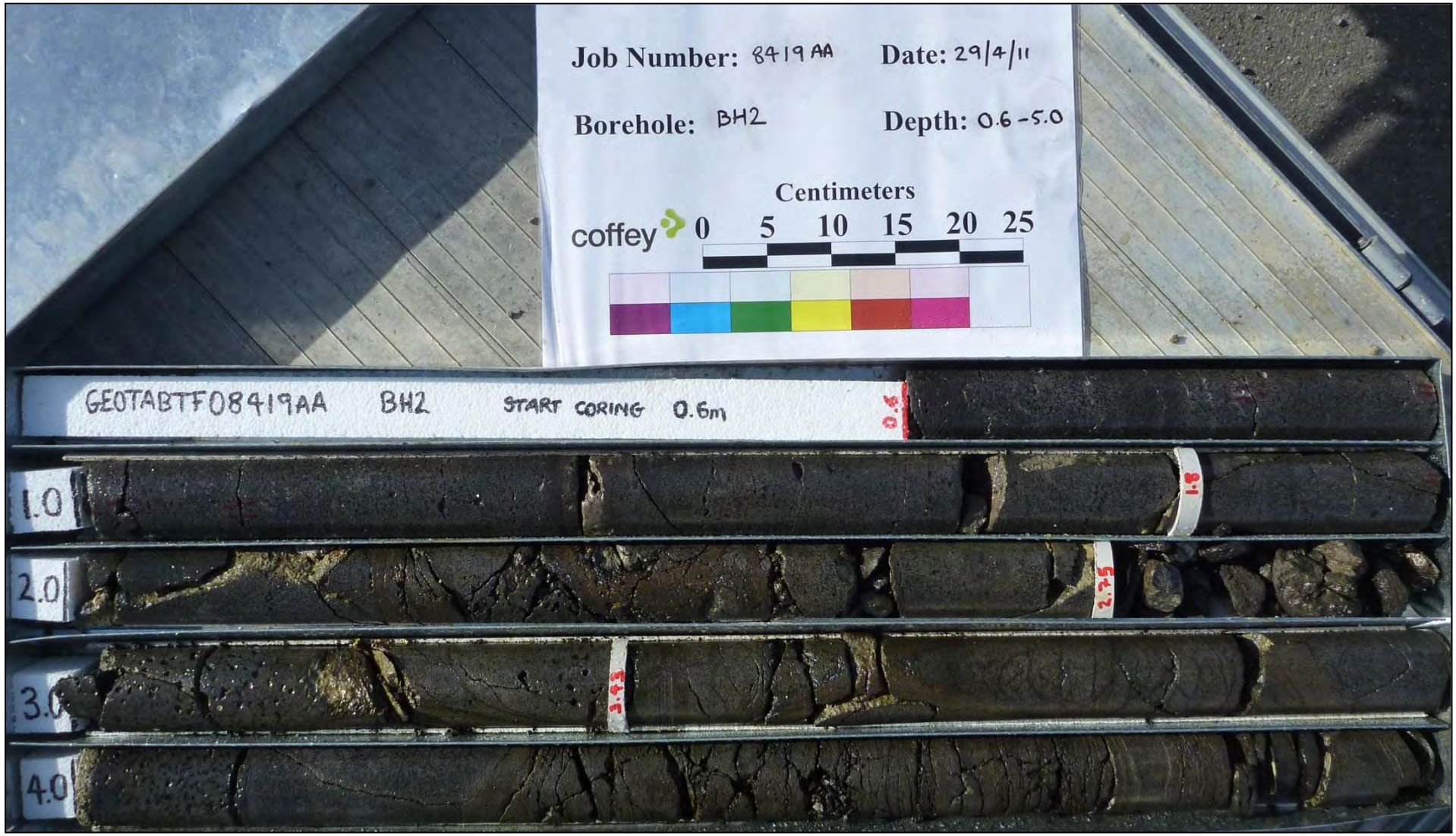
SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH1
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B



drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH2
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

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SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH3
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

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SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH4
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

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SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH5
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

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SPECIALISTS MANAGING THE EARTH

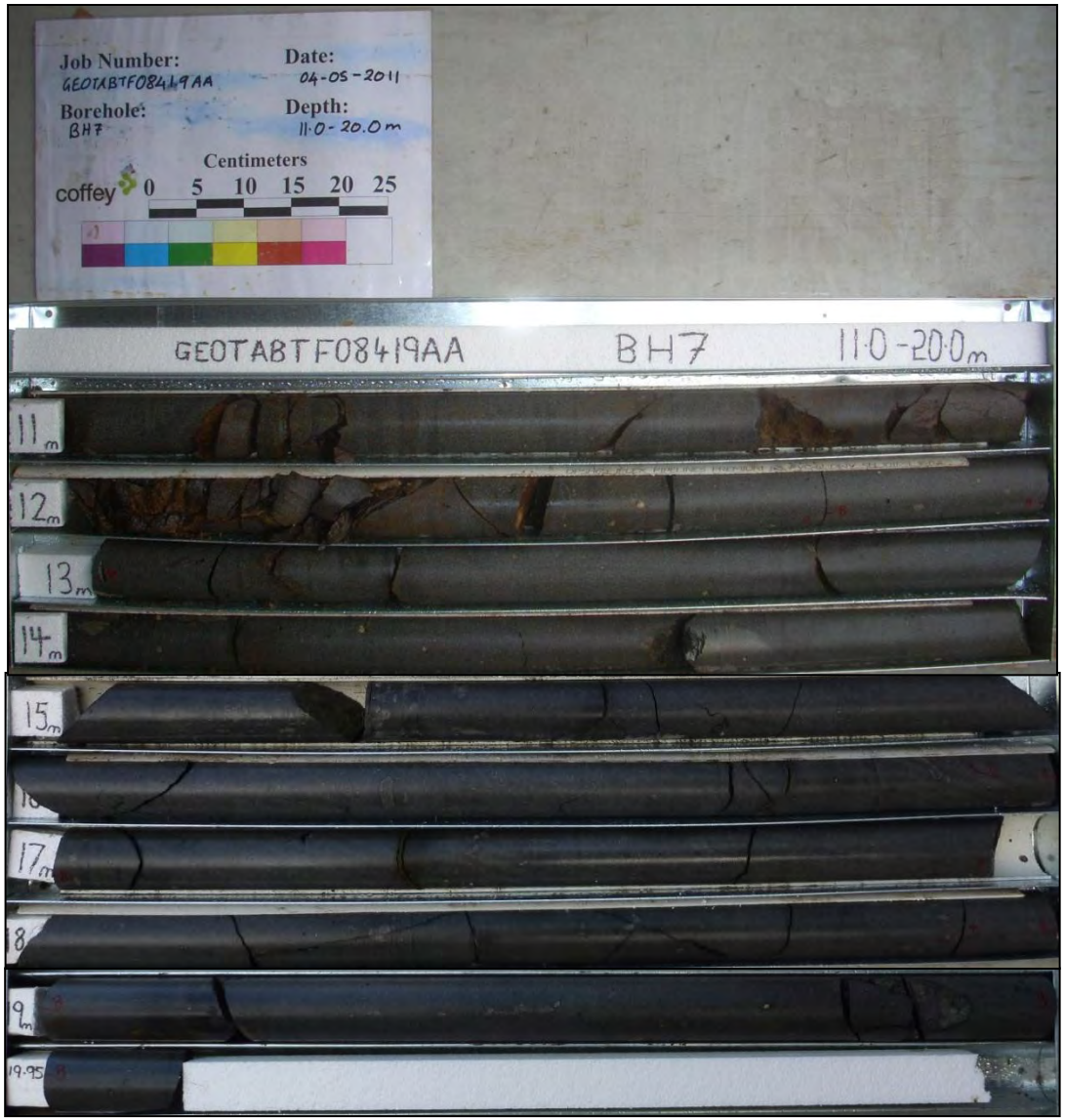
client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH6 (1 of 2)
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH6 (2 of 2)
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	BECA
approved			project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
date	18/5/2011		title:	CORE PHOTOGRAPHS – BH7 (1 of 2)
scale	N.T.S		project no: GEOTABTF08419AA-AD	figure no: APPENDIX B
original size	A4			



drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	BECA
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION
title:	CORE PHOTOGRAPHS – BH7 (2 of 2)
project no: GEOTABTF08419AA-AD	figure no: APPENDIX B

drawn	DA
approved	
date	18/5/2011
scale	N.T.S
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	BECA		
project:	GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION		
title:	CORE PHOTOGRAPHS – BH8		
project no:	GEOTABTF08419AA-AD	figure no:	APPENDIX B

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Engineering Log - Excavation

Excavation No. **TP1**

Sheet 1 of 1

Project No: **GEOTABTF08419AA**

Client: **BECA**

Principal: **SP Ausnet**

Project: **Brunswick Terminal Station**

Test pit location: **Refer to Figure 1**

Date started: **12.5.2011**

Date completed: **12.5.2011**

Logged by: **DA**

Checked by: DA

equipment type and model: CAT 304 CR | Pit Orientation: N-S | Easting: 322543 m | R.L. Surface: Not Measured

excavation dimensions: 2.2m long 0.5m wide | Northing: 5817438 m | datum: Not Measured

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
BH		N			0.5		CH	**FILL: CLAY / GRAVELLY CLAY:** high plasticity, dark brown, with pockets of orange/brown, grey, fine to coarse grained gravel, with basalt cobbles	M	St/VSt	×	FILL
					1.0		CH	**CLAY:** high plasticity, dark brown				RESIDUAL SOIL
					1.5			**BASALT:** moderately to highly weathered, dark brown, some iron staining, high to very high strength				NEWER VOLCANICS BASALT
					2.0			Test pit TP1 terminated at 2.5m				
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP2**

Sheet 1 of 1

Project No: **GEOTABTF08419AA**

Client: **BECA**

Principal: **SP Ausnet**

Project: **Brunswick Terminal Station**

Test pit location: **Refer to Figure 1**

Date started: **12.5.2011**

Date completed: **12.5.2011**

Logged by: **DA**

Checked by: DA

equipment type and model: CAT 304 CR | Pit Orientation: N-S | Easting: 322547 m | R.L. Surface: Not Measured

excavation dimensions: 2.3m long 0.5m wide | Northing: 5817490 m | datum: Not Measured

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
BH		N			0.0		CH	**FILL: CLAY / GRAVELLY CLAY:** high plasticity, dark brown, mottled grey, dark orange, fine to coarse grained gravel, with basalt cobbles and occasional boulders, trace of bricks and steel	M	St/VSt		FILL
					0.5							
					1.0							
					1.5							
					2.0							
					2.5							
					3.0							
					3.5							piece of brick encountered
							CH	**CLAY:** high plasticity, dark brown				RESIDUAL SOIL
					4.0			Test pit TP2 terminated at 3.6m				

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP3**

Sheet 1 of 1

Project No: **GEOTABTF08419AA**

Client: **BECA**

Principal: **SP Ausnet**

Project: **Brunswick Terminal Station**

Test pit location: **Refer to Figure 1**

Date started: **12.5.2011**

Date completed: **12.5.2011**

Logged by: **DA**

Checked by: DBA

equipment type and model: CAT 304 CR | Pit Orientation: N-S | Easting: 322524 m | R.L. Surface: Not Measured

excavation dimensions: 2.2m long 1.4m wide | Northing: 5817540 m | datum: Not Measured

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
BH		N			0.5		CH	**FILL: GRAVELLY CLAY:** high plasticity, dark brown, fine to coarse grained gravel, with basalt boulders and cobbles, with some bricks	M	St/VSt		FILL 1m diameter boulder recovered. Eastern pit wall collapsing. Piece of steel encountered
					1.0 1.5		GW	**FILL: CLAYEY GRAVEL & COBBLES:** fine to coarse grianed, brown, basalt cobbles		MD/D		Possibly top of weathered basalt rock layer
					2.0 2.5 3.0							Eastern pit wall continuing to collapse
					3.5 4.0			Risk of futher testpit collapse Test pit TP3 terminated at 3.1m				

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TEST PIT GEOTABTF08419AA.GPJ COFFEY.GDT 19.05.11

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PHOTOGRAPH 1 – TEST PIT 1

PHOTOGRAPH 2 – TEST PIT 1 SPOIL

drawn	**DA**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client: **BECA**	
approved			project: **GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION**	
date	**18/05/2011**			
scale	**Not to scale**		title: **TEST PIT PHOTOGRAPHS**	
original size	**A4**		project no: **GEOTABTF08419AA-AD**	figure no: **APPENDIX B**

PHOTOGRAPH 3 – TEST PIT 2

PHOTOGRAPH 4 – TEST PIT 2 SPOIL

drawn	**DA**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**BECA**
approved			project:	**GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION**
date	**18/05/2011**		title:	**TEST PIT PHOTOGRAPHS**
scale	**Not to scale**		project no: **GEOTABTF08419AA-AD**	figure no: **APPENDIX B**
original size	**A4**			

PHOTOGRAPH 5 – TEST PIT 3

drawn	**DA**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client: **BECA**	
approved			project: **GEOTECHNICAL INVESTIGATION BRUNSWICK TERMINAL STATION**	
date	**18/05/2011**			
scale	**Not to scale**		title: **TEST PIT PHOTOGRAPHS**	
original size	**A4**		project no: **GEOTABTF08419AA-AD**	figure no: **APPENDIX B**

Appendix C:
Practice Note Guidelines - AGS 2007 Appendix C

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	**1: CATASTROPHIC 200%**	**2: MAJOR 60%**	**3: MEDIUM 20%**	**4: MINOR 5%**	**5: INSIGNIFICANT 0.5%**
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		**Example Implications** (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Landslide Risk Management

Important Information about AGS 2007 Appendix C (1 of 2)

INTRODUCTION

This sheet provides important information on the following Appendix C which has been copied from "Practice note guidelines for landslide risk management 2007". The "Practice Note" and accompanying "Commentary" (References 1 & 2, hereafter referred to as AGS2007) are part of a series of documents on landslide risk management prepared on behalf of, and endorsed by, the Australian Geomechanics Society. These documents were primarily prepared to apply to residential or similar development.

It should be noted that AGS2007 define landslides as "the movement of a mass of rock, debris or earth down a slope". This definition includes falls, topples, slides, spreads and flows from both natural and artificial slopes.

LANDSLIDE LIKELIHOOD ASSESSMENT

The assessment of the likelihood of landsliding requires evidence-based judgements.

Judging how often and how much an existing landslide will move is difficult. Judging the likelihood of a new landslide occurring is even harder. Records of past landslides can provide some information on what has happened, but are invariably incomplete and often provide little or no guidance on less frequent events that may occur. Often judgements have to be made about the likelihood of infrequent events with serious consequences, with little or no help from historical records. Slope models, which reflect evidence-based knowledge of how a slope was formed, how it behaved in the past and how it might behave in the future, are used to support judgements about what might happen. Because of the difficulties in assessing landslide likelihood, different assessors may make different judgements when presented with the same information.

The likelihood terms in Appendix C can be taken to imply that it is possible to distinguish between low probability events (e.g. between events having a probability of 1 in 10,000 and 1 in 100,000). In many circumstances it will not be possible to develop defensibly realistic judgements to do so, and so joint terms need to be used (e.g. Likely or Possible). For further discussion on landslide likelihood and other matters see References 3, 4 and 5.

CONSEQUENCES OF LANDSLIDES

There can be direct (e.g. property damage, injury / loss of life) and indirect (e.g. litigation, loss of business confidence) consequences of a landslide. The assessment of the importance (seriousness) of the consequences is a value judgement best made by those most affected (e.g. client, owner, regulator, public). The main role of the expert is usually to understand and explain what and who might be affected, and what damage or injury might occur.

Appendix C implies that we can anticipate total cost (direct and indirect) of landslide damage to about half an order of magnitude (e.g. the difference between $30,000 and $100,000). This involves predicting the location, size, travel distance and speed of a landslide, the response of a building (often before it has been built), the nature and the extent of damage, repair costs as well as indirect consequences such as legal costs, accommodation etc. There can be other direct and indirect consequences of a landslide which can be difficult to anticipate, let alone quantify and cost. The situation is analogous to the cost of work place accidents where the hidden costs can range from less than one to more than 20 times the visible direct costs (Reference 5).

In many circumstances it will not be possible to develop defensibly realistic judgements to enable use of a single consequence descriptor from Appendix C, and so joint terms need to be used (e.g. Minor or Medium). In our experience, explicit descriptions of potential consequences (e.g. rocks up to 0.5m across may fall on a parked car) help those affected to make their own judgements about the seriousness of the consequences.

RISK MATRIX

The main purpose of a risk matrix is to help rank risks, set priorities and help the decision making process. The risk terms should be regarded only as a guide to the relative level of risk as they are the product of an evidence-based quantitative judgement of likelihood and a value judgement about consequences, both of which involve considerable uncertainty. Different assessors may arrive at different judgements on the risk level.

Using Appendix C, many existing houses on sloping land will be assessed to have a Moderate Risk.

Landslide Risk Management

Important Information about AGS 2007 Appendix C (2 of 2)

RISK LEVEL IMPLICATIONS

In general, it is the responsibility of the client and/or owner and/or regulatory authority and/or others who may be affected to decide whether to accept or treat the risk. The risk assessor and/or other advisers may assist by making risk comparisons, discussing treatment options, explaining the risk management process, advising how others have reacted to risk in similar situations, and making recommendations. Attitudes to risk vary widely and risk evaluation often involves considering more than just property damage (e.g. environmental effects, public reaction, political consequences, business confidence etc).

The risk level implications in Appendix C represent a very specific example and are unlikely to be generally applicable. In our experience the typical response of regulators to assessed risk is as follows:

Assessed risk	**Typical response of client/ owner/ regulator/ person affected**
Very High, High [1]	Treats seriously. Usually requires action to reduce risk. Will generally avoid development.
Moderate	May accept risk. Usually looks for ways to reduce risk if reasonably practicable.
Low, Very Low [1]	Usually regards risk as acceptable. May reduce risk if reasonably practicable.

1 The distinctions between Very High and High and between Low and Very Low risks are usually used to help set priorities.

REFERENCES

1. AGS (2007). "Practice note guidelines for landslide risk management 2007". Australian Geomechanics, Vol. 42, No. 1, pp 63-114.
2. AGS (2007). "Commentary on practice note guidelines for landslide risk management 2007". Australian Geomechanics, Vol. 42, No. 1, pp 115-158.
3. Baynes, F.J., Lee I.K. and Stewart, I.E., (2002). "A study of the accuracy and precision of some landslide risk analyses." Australian Geomechanics, Vol. 37, No. 2, pp 149-156.
4. Baynes, et. al., (2007). "Concerns about the Practice Note Guidelines for Landslide Risk Management 2007." Letter to the editor, Australian Geomechanics, Vol. 2, No. 4, pp 63-114.
5. Moon, A.T., and Wilson, R,A., (2004). "Will it happen? – Quantitative judgements of landslide likelihood". Proceedings of the Australia New Zealand conference on Geomechnics, Centre of continuing education, University of Auckland, Vol. 2, pp 754-760.

Appendix G

Environmental Inspection Checklist

Appendix G Environmental Inspection Checklist

Area:			
Inspection Date			Inspection No
Weather Conditions: Dry ☐ Slight Wind ☐ Calm ☐ Rain ☐ Strong Wind ☐			
WATER QUALITY			**COMMENTS**
1.	Catch drains, sediment traps installed, maintained		
2.	Drains, diversion channels around disturbed areas maintained		
3.	Appropriate bunding around fluids/oils areas		
4.	Spill kit provided		
5.	Silt fences, hay bales installed, maintained		
6.	Monitoring equipment installed & calibrated		
SOIL CONSERVATION			
1.	Erosion & sediment control plans prepared		
2.	Stockpiles protected		
3.	Earthworks protected		
4.	Haul roads drained and maintained		
5.	Cleared areas kept to minimum possible		
6.	Vegetation maintained where possible		
AIR QUALITY			
1.	Dust suppression in place (e.g. water works)		
2.	Use cover crops on stockpiles or spray		
3.	Plant emissions controlled		

NOISE AND VIBRATION			
1.	Plant equipment fitted with silencers		
2.	Acoustic enclosures used as necessary (e.g. piling hammers)		
3.	Temporary acoustic barriers used as necessary		
4.	Dilapidation surveys of utilities, structures and buildings comp		
5.	Construction activities limited to approved hours		
6.	Monitoring equipment installed & calibrated		
FLORA AND FAUNA			
1.	Limits of construction areas clearly identified		
2.	Weed infested areas isolated where possible		
3.	Before clearing and felling, areas checked for fauna		
ARCHAEOLOGY & HERITAGE			
1.	Sites isolated and protected prior to construction		
HAZARDOUS SUBSTANCES			
1.	Secure storage areas		
2.	Bunded and impervious storage for fuels and chemicals		
3.	Refuelling activities controlled		
4.	SDSs available		
WASTE MANAGEMENT			
1.	Waste disposal containers available		
2.	Liquid wastes properly contained		
3.	Effluent discharges controlled		

CONTAMINATED MATERIAL			
1.	Site survey carried out		
2.	Covered vehicles used for waste		
3.	Licensed landfill used for disposal		
OTHER GENERAL COMMENTS/POSITIVE INITIATIVES			
Inspection By:			
Date:			
Signature:			

Area:					
Inspection Date:			**Inspection No**		
Item No.	**OBSERVATION**	ACTION REQUIRED & LOCATION	**COMPLETE BY**	**ACTION BY**	**DONE**
	Water Quality				☐
	Soil Conservation				☐
	Air Quality				☐
	Noise and vibration				☐
	Flora and Fauna				☐
	Landscaping and Rehabilitation				☐
	Archaeology and Heritage				☐
	Hazardous Substances and Dangerous Goods				☐

	Waste Management				☐
	Contaminated Material				☐
	Erosion & Sediment Control				☐
Inspection By:					
Date:					
Signed:					

Appendix H

Incident Notification Form

Appendix H Incident Notification Form

THIS FORM TO BE PROVIDED TO THE ENVIRONMENT MANAGER (or delegate)

Area:
Date of Incident:

PART A: WHAT HAPPENED?

(Summarise the FACTS of the event)

1. Type of Incident:	
Hazardous material (hydrocarbon or chemicals)	☐
Contaminated water discharge	☐
Soil erosion	☐
Dust emissions	☐
Blasting overpressure vibration	☐
Noise	☐
Unauthorised vegetation removal	☐
Other (specify)	
2. Details of Incident	
Where? (attach sketch/map)	
At what time?	
What was the weather or other conditions?	
3. (a) Was Environmental Authority notified?	YES ☐ NO☐
(b) Name of Environmental Authority	
4. Severity Potential:	Breach of Licence Conditions ☐ Fine ☐ Prosecution ☐
5. What property damage MAY HAVE occurred/DID occur? (circle which and describe):	
Will an INSURANCE CLAIM be made? YES ☐ NO ☐	
6. Who was involved? (Provide, NAME, OCCUPATION & EMPLOYER of each person):	

	NAME	OCCUPATION	EMPLOYER
a) Who was at the SCENE?			
b) Who were WITNESSES?			
c) Who was SUPERVISING?			
d) Who REPORTED the incident?			
e) To WHOM?			

PART B: HOW DID IT HAPPEN?

(Explain clearly how the incident occurred; describe the events, conditions, activities, etc. BEFORE, DURING and AFTER including details of environmental and work conditions, the extent of damage, etc.; attach sketches, photographs, witness statements, etc.)

PART C: WHY DID IT HAPPEN?

(Provide an ANALYSIS of the CAUSE of the incident including what acts, failures to act and conditions contributed most directly to it.)

PART D: HOW WILL REPEATS BE PREVENTED?

(Detail WHAT PREVENTIVE ACTIONS must be taken BY WHOM to eliminate the possibility of a similar incident occurring again.)

PART E: AUTHORISATION AND DISTRIBUTION

(To be completed by the personnel who conducted the Investigation and prepared this Report; copies must be issued to PEMR for formal review and authorisation and to others as determined by the Alliance Project Manager.)

INCIDENT INVESTIGATED AND REPORT PREPARED BY:	
Name:	Signature:
Role:	Date:
REPORT AUTHORISED BY:	
Name (PEMR):	Signature:
	Date:
REPORT DISTRIBUTED TO: Environmental Manager, Senior Management , Others (specify)	

PART F: MANAGEMENT REVIEW

(To be completed by Alliance Project Manager)

Name:	Signature:
Role:	Date:

Appendix I

Environmental Management Equipment

Appendix I Environmental Management Equipment

Typical equipment required during construction for environmental management
Noise activities
Automobile Silencers
Muffler (price depends on make and model of vehicle)
Pneumatic tool silencer
Truck reversing systems (low sound emitting)
Traffic
Signage
Cones
Bollards
Contamination
Signage
Fire extinguisher for vehicles
Spill kit (Vehicles)
Spill kit (large)
Fire Blanket
Spill bunding (portable)
Spill bunding for cars and trucks
Lockable storage cupboard for chemicals
Impermeable sheeting for stockpiling of Category A and B contaminated material
Water quality monitoring activities
Water quality monitor
Electronic waterproof pH meter and / or pH strips
Sediment control
Stockpile covers - economy grade tarp or similar
Silt Fence
Silt logs