Sunshine Coast Airport

Sunshine Coast Airport Expansion Project

Mount Emu She-oak Translocation and Management Plan

252448-TP-2.0

Final | 19 December 2017

Job number 252448

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1 Introduction

This Mount Emu She-oak *Allocasuarina emuina* Translocation Plan describes the commitments and on-site mitigation measures to be implemented for the management of the known Mount Emu She-oak populations that will be subject to translocation and protection as part of the Sunshine Coast Airport Expansion Project (SCAEP). The translocation is necessary to compensate for unavoidable impacts to the Commonwealth listed species resulting from the proposed construction and operation of a new runway to replace the existing runway at the Sunshine Coast Airport (SCA). The balance of the Mount Emu She-oak area that will not be impacted will require ongoing monitoring and maintenance to manage a viable population in the long-term.

In October 2017 a draft Translocation and Management Plan was prepared by Arup to support a request for quote from suitably qualified contractors to implement the plan. In November 2017, FuturePlus Environmental (FPE) were awarded the contract and a workshop was held on 6 December to finalise details of the plan. This current version of this plan has been updated to include details on the final translocation, habitat restoration and management requirements for the three year maintenance period. This plan will be published on the SCAEP project website, prior to the commencement of translocation works. It will remain a live document during the translocation works and ongoing maintenance to track the progress of the mitigation measures to protect and restore the Mount Emu She-oak population within the SCAEP area.

1.1 Background

SCA is proposing to construct and operate a new runway to replace the existing runway at the airport. The Sunshine Coast Airport Expansion Project (the Project or SCAEP), has been designated a coordinated project under the Queensland *State Development and Public Works Organisation Act 1971* (SDPWO Act) and a controlled action under the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

An Environmental Impact Statement (EIS) has been prepared by SCA for the Project, with the EIS process being led by the Queensland Coordinator-General, with the Australian Department of Environment (DOE) carrying out an assessment of relevant matters of National environmental significance (MNES) under the bilateral agreement. The Coordinator-General recommended that the Project proceed and the final report on the EIS was published in May 2016. Approval under the EPBC Act for MNES species affected by the proposal was granted in July 2016.

The project includes the construction of a new 2,450m runway, in a northwest/southwest alignment on existing SCA land that is predominately former sugar cane fields. The new alignment will result in the clearing of approximately 3.69 ha of habitat supporting a known population of Mount Emu She-oak, located within the Project area (the Impact Area) (Figure 1).

A Biodiversity Offset Strategy (BOS) has been developed by SCA which identifies strategies and commitments for compensating impacts to Mount Emu She-oak as a result of the Project. This includes transplantation of the 4.41ha of impacted Mount Emu She-oak to an alternative habitat area to the north of the site using tile movement methodology.

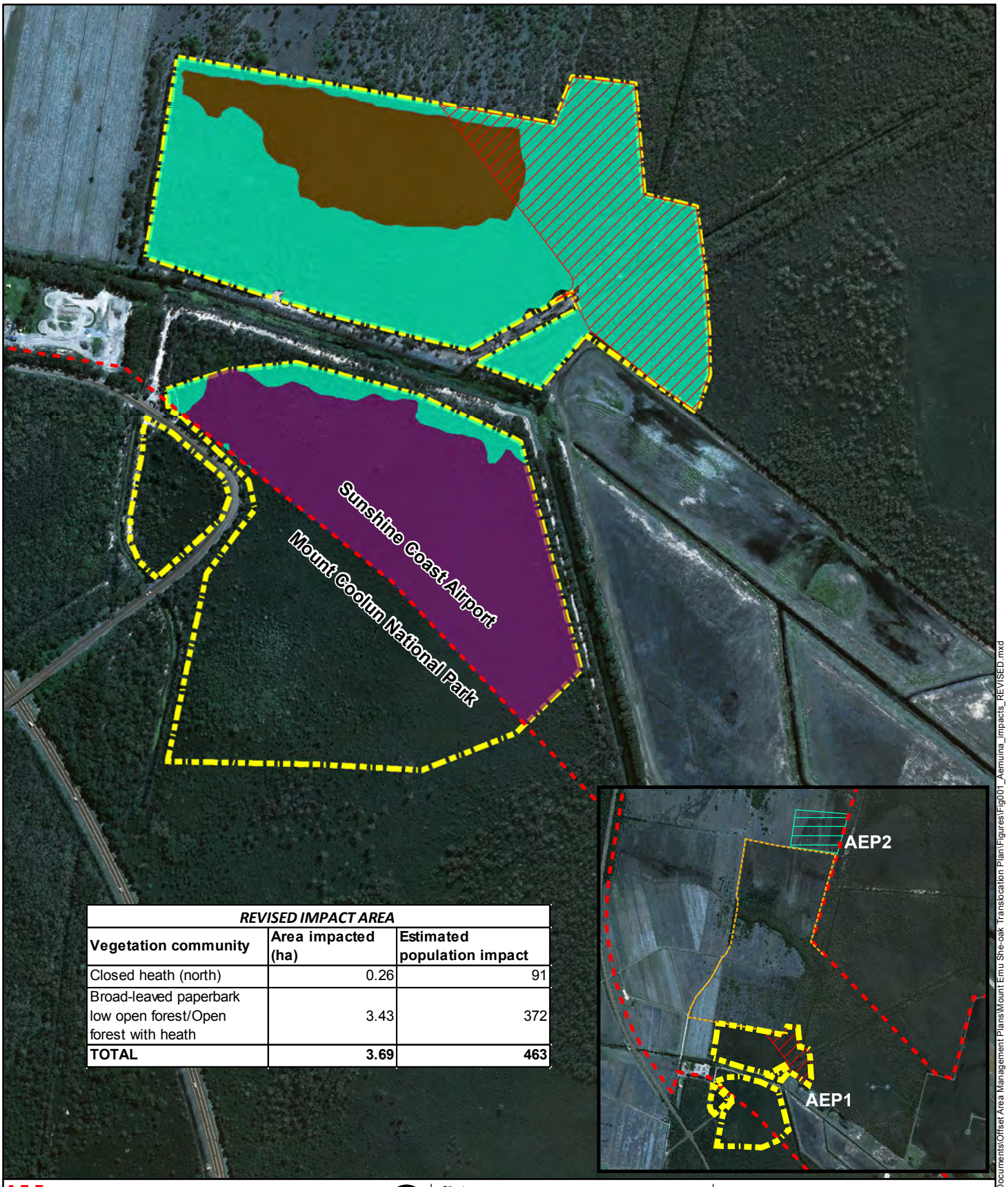
This Mt Emu She-oak Translocation Plan follows the recommendations set out in the BOS and addresses Conditions 1-11 of the EPBC Act approval.

1.2 Objectives of the Translocation

This Translocation and Management Plan aims to support the conservation of two known Mount Emu She-oak*)* populations located at SCA by establishing and maintaining self-sustaining populations that have the capacity to survive in the short and long term. More specifically, the objectives of this plan are to meet the outcomes for the site prescribed by the EPBC Act approval (Table 1).

Table 1: Mt Emu She-oak Translocation Objectives

Outcome	**Criteria**	**Timeframe**
Outcome 1	Ensure no net loss in the condition and extent of *Allocasuarina emuina* within the known population area (excluding the population area impact)	For the life of the approval
Outcome 2	Ensure no net less in the condition and extent of *Allocasuarina emuina* translocated from the population area impact compared to the baseline condition and extent	Within 5 years after the commencement of the translocation and then on for the life of the approval
Outcome 3	Ensure a minimum of 2.6 times increase in the count of *Allocasuarina emuina* translocated from the population area impact compared to the baseline count	Within 20 years after the commencement of the translocation and then on for the life of the approval



REVISED IMPACT AREA		
Vegetation community	**Area impacted (ha)**	**Estimated population impact**
Closed heath (north)	0.26	91
Broad-leaved paperbark low open forest/Open forest with heath	3.43	372
TOTAL	**3.69**	**463**

- Airport Boundary
- Known Population Area
- Initial impact area
- Revised impact area
- Translocation Receiving Site
- Vehicle Access Track

Habitat Type:

- Broad-leaved paperbark low open forest
- Closed heath (north)
- Closed heath (south)

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Mount Emu She-oak Impact Site

Meters
0 50 100 150 200

Issue	Date	By	Chkd	Appd
D1	18/12/2017	CW	MJD	LOM

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Scale at A4	Map Status
1:5,000	Final

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	001

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2 Mount Emu She-oak

Mount Emu She-oak is a coastal heathland plant species listed as endangered under the EPBC Act (Commonwealth) and the Queensland *Nature Conservation Act 1992* (NC Act) (Qld). A National Recovery Plan for Mount Emu She-oak *Allocasuarina emuina* (the Recovery Plan) has been prepared by the Environmental Protection Agency (Queensland Government).

A detailed description of the taxonomy, biology and ecology of Mount Emu She-oak can be found within the Recovery Plan (Environmental Protection Agency 2007); however relevant information has been included here to assist with on-site species identification and to give an understanding of how ecological processes have influenced the abundance and distribution of the species at SCA.

2.1 Species description

Mount Emu She-oak belongs to the family *Casuarinaceae* (Environmental Protection Agency 2007). The following description has been adapted from Halford (1993) and Johnson (1989) (cited in, Environmental Protection Agency 2007):

Mount Emu She-oak is a dioecious spreading shrub to 2.5m with smooth bark (Photograph 1). Branchlets up to 12cm long ascend the branch; sectioned by small, smooth articles (4-8 mm long, 0.5-0.9mm in diameter) with soft down in the furrows. Each ridge of the branchlet article has 6-8 teeth (0.3-0.7mm long) erect to slightly spreading and not overlapping. Male flowers are unbranched and without stalks. They are approximately 1-3cm long with 8.5-9.5 whorls per centimetre. A small leaf structure, differing in form from the foliage leaves remain attached to the plant beyond the expected time of falling and is associated with the male flowers. The pollen bearing part of the flower can be 0.8-0.9mm long. The cones are cylindrical and 12-28mm long, 6-15mm in diameter and with a sterile apex. The stalk is 3-13mm long and slender. The seeds are dark brown to black and are 4.5-7.5mm long.

Photograph 1: Mount Emu She-oak
Allocasuarina emuina (David Halford 2013)

2.2 Description of the SCA population

Mount Emu She-oak is currently known from 11 populations on the Sunshine Coast. Surveys undertaken at SCA as a part of the Environmental Impact Statement (EIS) for the Project identified two populations occurring on the site. One Mount Emu She-oak Population (AEP1) is located within the Project area and the second population (AEP2) is located north of the Project area, on the western edge of Mount Coolum National Park (see Figure 1).

Mount Emu She-oak population 1 (AEP1) is known as the Finland Road population within the Recovery Plan (Environmental Protection Agency 2007). The population area includes Sunshine Coast Council (SCC) owned freehold land, State land and the South Marcoola Section of the Mount Coolum National Park. The Recovery Plan states that individuals are scattered over the entire area (Environmental Protection Agency 2007).

According to population surveys undertaken in 2003 and 2006, the Finland population constitutes a significant population (Lamont 2010), having:

- The greatest number of individuals out of the other populations described by Lamont (2010) and the Recovery Plan; and
- Representing 47% of the known population (based on 2003 population estimates within the Recovery Plan), or 29% of the known population based on Lamont's (2010) survey in 2006.

This is due to AEP1's large area compared to the other populations as opposed to an extraordinarily high density of plants. Density estimates across all 11 populations were 994 plants/ha, with a standard deviation of 525.6 plants/ha (Lamont 2010). Lamont (2010) estimated 12,429 individuals of Mount Emu She-oak existed in the Finland Road populations in 2006 having sampled an area of 11.2ha south of the drainage channel, excluding the area of Wallum Hakea dominated habitat north of the drainage channel (~1,109 plants/ha).

The 4.41ha area of AEP1 that will be subject to translocation at SCA equates to approximately 5% of the Finland Road population. Modifications to the project design, including the diversion of the main access road around areas of high quality habitat, have assisted to minimise this area. These are discussed in the project EIS.

2.3 The ecology of Mount Emu She-oak at SCA

Mount Emu She-oak is restricted to heathland areas between Beerburrum and Noosa in Queensland's Sunshine Coast. The two populations at SCA are located in a flat coastal area between 2m to 4m elevation. Olsen (2002, cited in Environmental Protection Agency 2007) has indicated that the species prefers wetter heath soils, distinguishing it from its close relative *Allocasuarina thalassoscopica*, which occurs predominantly on dry heath soils. Mount Emu She-oak exists on nutrient poor light to medium clays or sandy loams with weak acidic reaction (Environmental Protection Agency 2007).

The current distribution of Mount Emu She-oak at AEP1 and 2 is restricted by conditions provided by cleared habitat and melaleuca forest, the depth of coffee rock and the varying fire history in the two population areas. There does appear to be suitable heath habitat south of AEP1 within the southern Marcoola sections of Mount Coolum National Park, though the population is not known to inhabit this area. Even if the species once existed in this area, the direction of prevailing winds may be limiting the rate of recolonisation. This is because the wind-dispersed seeds have short dispersal distances, with much of the seed germinating within one metre of the adult plant. Thus, whilst northwest winds are common in the autumn months, prevailing south and south-east winds (Lamont 2010) could be reducing the rate of southerly colonisation/recolonisation.

The species has a close relationship with fire. During fire, the above ground parts of Mount Emu She-oak can be irreparably damaged; though seeds are often retained in the cones until they open after fire, allowing the species to successfully regenerate. Surviving adult plants are also able to flower in the growing season following fire whilst there is also evidence suggesting the species can resprout from viable lignotubers when the above ground parts of the plant are destroyed (Environmental Protection Agency 2007).

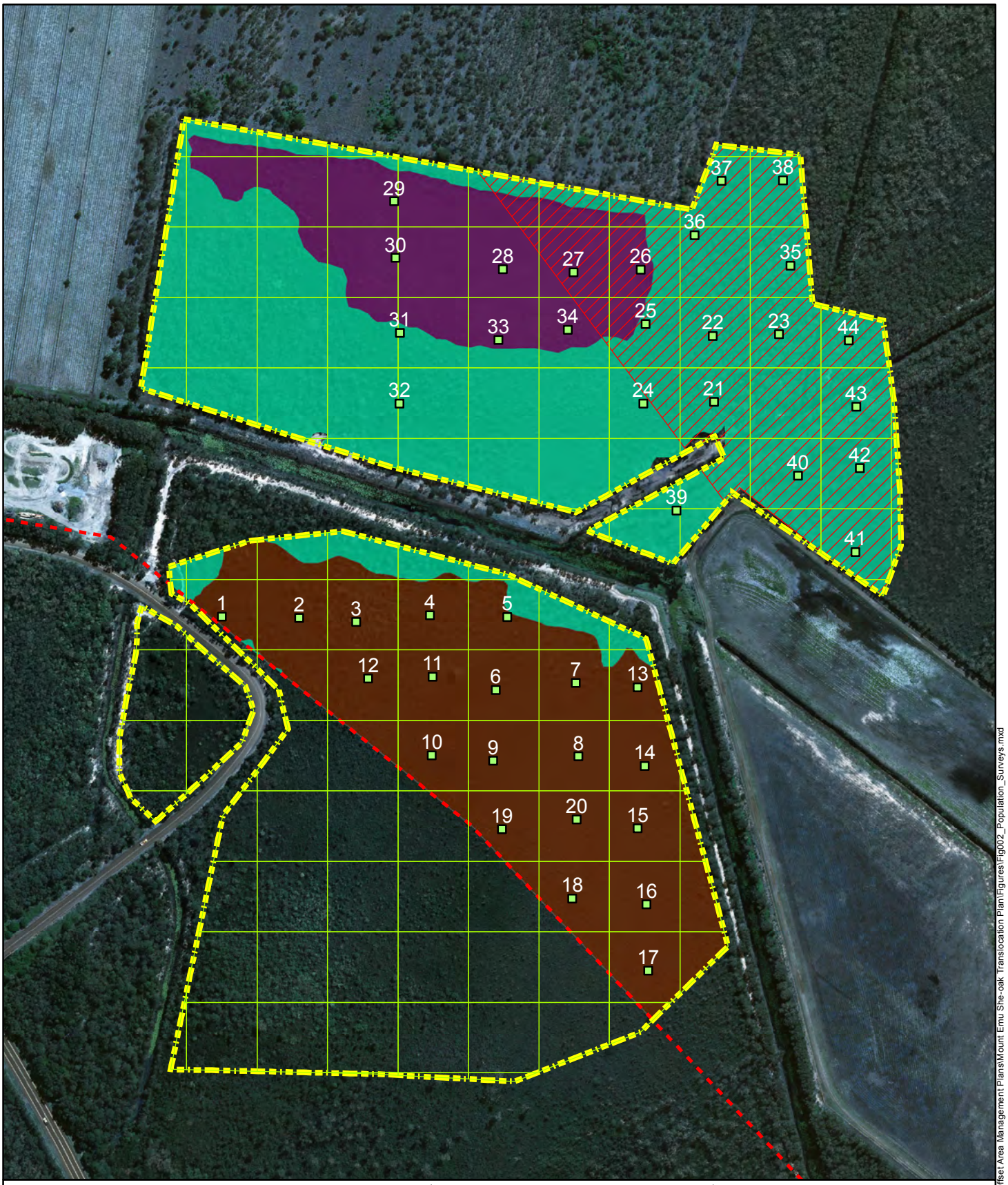
Across all known Mount Emu She-oak populations on the Sunshine Coast, Lamont (2010) found that the northern and southern population groups (separated by the Maroochy River) were genetically distinct. In the northern region, AEP1 and 2 were found to be genetically distinct from the other nine populations and displayed a high level of genetic similarity despite their current distance of over 1km. Little exchange was detected with the populations that lie approximately 12km to the north (Lamont, pp. 90). AEP1 and 2 were revealed to have a relatively low genetic diversity compared to other populations.

3 Baseline Population Surveys

A baseline survey of AEP1 was carried out on 5th and 14th July 2017 by Arup ecologists to estimate the size, condition and extent of the population occurring within SCA land prior to the translocation works. The purpose of the survey was to (1) quantify the direct impacts of the project on Mount Emu She-oak population size at SCA and (2) allow the required 2.6 times increase in population size to be calculated.

Replicating the EIS methodology, forty-four (44) quadrats were systematically surveyed for Mount Emu She-oak (Figure 2). Quadrats of 10 m x 10 m were equally spaced using a 50m x 50m grid overlayed on aerial photography of the site. One quadrat was positioned within the centre of each grid square, except where areas could not be accessed due to dense ground cover or the existence of other physical barriers such as drainage lines. In each quadrat, two ecologists counted the number of individual Mount Emu She-oak plants present. To allow efficient and effective field identification and detectability, surveys were undertaken during the peak flowering period for the species.

The mean density of Mount Emu She-oak was estimated for the SCA population area within each vegetation type: Closed heath and Broad-leaved paperbark low open forest/ Open forest with heath. Closed heath to the north and south of the drainage channel were assessed as separate habitat types to reduce error in population estimates due to floristic differences in the vegetation impacting Mount Emu She-oak density. These habitat areas are referred to as Closed heath south (i.e. south of the drainage channel) and Closed heath north (i.e. north of the drainage channel).



- Airport Boundary
- Known Population Area
- Impact Site
- 50m Grid
- Quadrats

Vegetation Community

- Broad-leaved paperbark low open forest
- Closed heath north
- Closed heath south

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Mount Emu She-oak Population Survey Transect Locations

Meters
0 40 80 120 160

Issue	Date	By	Chkd	Appd
D1	6/10/2017	CW	MJD	LOM

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Scale at A4	Map Status
1:3,690	Final

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	002

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Table 2 shows the results of the population estimates obtained for AEP1 within the 17.35ha of SCA land. A total of 6,752 *A.emuina* individuals were estimated for the area with 628 plants (~9.3%) occurring within the 4.41ha impact area. This is consistent with the EIS estimate of approximately 550 plants in 2013.

Mount Emu She-oak density varied between habitat types with the highest density of Mount Emu She-oak observed in the closed heath located south of the drainage channel (Figure 3). Here, plant density was found to be 880 plants/ ha, with the estimated number of plants in this area being 4,805 (SCA land only).

As discussed in the project EIS, the closed heath area to the north of the drainage channel is dominated by a thick layer of Wallum Hakea that partially restricts the establishment and persistence of other flora. For this reason, Mount Emu She-oak density was found to be 350 plants/ ha, with a total estimate of 953 plants. This is significantly lower than the southern area of AEP1. When compared to closed heath to the south, northern closed heath areas appeared to be in a later stage of succession, where Wallum Hakea has out-competed Mount Emu She-oak in the absence of an appropriate fire regime.

In areas of Broad-leaved paper bark low open forest/ Open forest with heath, Mount Emu She-oak density was found to be 108 plants/ ha. In this vegetation community, it is estimated that 993 plants occur.

When including southern sections of the population area located within Mount Coolum National Park property, AEP1 is estimated to contain 12,096 individuals over a total area of 23.85ha with impacted Mount Emu She-oak accounting for 5% of this total population size. This total population size is consistent with the EIS estimate of 12,152 in 2012 and slightly lower than Lamont's estimate of 12,429 in 2010 (Lamont 2010). However, Lamont's study was based on an assessment of closed heath to south alone and is likely to have overestimated population size for open heath areas to the north of the drainage channel.

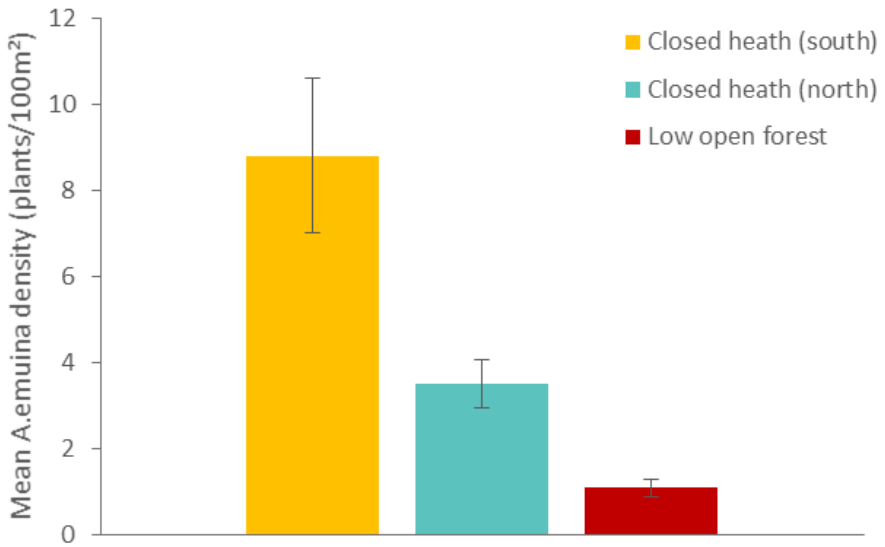


Figure 3: Mean Mount Emu She-oak density in the three different habitat types: Closed heath (south), closed heath (north) and low open forest. Bars represent the standard error.

Table 2: Mount Emu She-oak population estimate by habitat type within SCA land.

Habitat type	**Habitat area (ha)**		**Area sampled (ha)**	**Plants counted *no.***	**Density (plants/ha)**	**Habitat N**	
	Retained	**Impacted**				**Retained**	**Impacted**
Open heath (south)	5.46	0.00	0.20	176	880	4,805	0
Closed heath (north)	2.46	0.26	0.12	42	350	862	91
Broad-leaved paperbark low open forest/Open forest with heath	5.74	3.43	0.12	13	108	621	372
TOTAL	**13.66**	**3.69**	**0.44**	**231**	**-**	**6,124**	**463**

4 Translocation Receiving Site

4.1 Land Tenure and Security

A suitable receiving site for the translocation of the 4.41ha of impacted Mount Emu She-oak population (AEP1) was identified during the EIS process and as a part of the BOS. The site is located on Sunshine Coast Council land immediately north of the Project area. Land owner details for the site are provided in Table 3.

Table 3: Landowner details for Lot 1 SP269581

Landowner Details			
Registered Owner/s on Title:	Sunshine Coast Regional Council		
Real Property Description (Lot and Plan):	Lot 1 SP269581 (Finland Rd, Marcoola) – Airport needs		
Lessee: **(if applicable)**		**Trustee:** **(if applicable)**	
ABN/CAN: **(if applicable)**	37 876 973 913		
Phone number:	07 5475 7272	**Mobile Number:** **(if applicable)**	NA
Facsimile: **(if applicable)**	07 5475 7277	**Primary contact person (if required):**	NA
Email:	mail@sunshinecoast.qld.gov.au		
Postal Address:	Locked Bag 72 Sunshine Coast Mail Centre		

The land will be subject to an Environmental Offsets Agreement under the *Queensland Environmental Offsets Act 2014* to ensure its protection into perpetuity.

4.2 Receiving site suitability

To ensure the translocation of Mount Emu She-oak is most successful, plants should be relocated to areas that offer suitable soil and groundwater conditions.

Wallum and heathland vegetation communities are commonly associated with shallow water tables (particularly after rain), which perch (or semi-perch) on a hardpan layer such as coffee rock. Coffee rock can also inhibit the growth of large trees, such as Broad-leaved Paperbark by limiting root development.

To ensure the receiving site is suitable for supporting coastal heath, soil and groundwater investigations were completed within the site in 2013. The boreholes in the receiving site indicate that there is a coffee rock layer between 0.5m and 1.2m below ground level and the upper soil horizons are sandy loams. These are similar ground conditions to the Mount Emu She-oak impact area. The existence of a smaller population of Mount Emu She-oak and heathland to the east also provides evidence that the area is likely to offer suitable soil and groundwater conditions for the heathland translocation.

Additional soil sampling has been undertaken at the receiving site, prior to the commencement of the translocation works at 19 locations using a hand auger. These investigations have been used to further refine the most suitable location for the translocated Mount Emu She-oak within the receiving site.

Soil samples have been systematically collected using a 50m x 50m grid overlayed on aerial photography of the translocation site. Using a hand auger, each sample will be taken within the centre of each grid square and will involve the collection of soil in 20cm increments up to a depth of 1.5m. Each sample will be deposited on a tarp where the physical properties of the soil will be visually assessed. Data will be collected for soil type, groundwater level and depth to coffee rock. Where soil observations obtained for each grid square are within the suitable ranges identified, these locations will be prioritised for receiving Mount Emu She-oak (Table 4).

Table 4: Suitable soil and groundwater conditions for Mount Emu She-oak

Key Attributes	**Ideal parameters**
Soil type	Nutrient poor light to medium clays or sandy loams with weak acidic reaction
Groundwater level	0.9m to 2.1m below ground level
Depth to coffee rock	0.5m to 0.8m below ground level

During the week commencing 11 December 2017, FPE completed 19 boreholes using a hand auger across the translocation receiving site to assess the parameters specified in Table 4. Preliminary results from these boreholes have been used to finalise the optimal location of placing heath tiles.

5 Translocation Procedures

This section provides a summary of the procedures proposed for the translocation of impacted Mount Emu She-oak at SCA to ensure the protection and appropriate management of impacted and retained populations. Two translocation methods are proposed for use, depending on the target vegetation community:

- Within closed heath habitat areas, translocation works will be undertaken using heath tile movement methodology. The methods for this approach are based on the successful heath tile translocation of a similar vegetation community at the Brightwater Residential Development and the University of the Sunshine Coast.
- Translocation works for impacted plants within areas of Broad-leaved paperbark low open forest/Open forest with heath will involve the movement of individual Mount Emu She-oak plants into areas of the site that will require vegetation management to establish a closed heath community.

There are practical and ecological reasons for utilising a combination of translocation methods to achieve the required outcomes for the maintenance and enhancement of the Mount Emu She-oak population at the SCA.

5.1 General requirements

5.1.1 Qualifications and experience of Project Team

The project team for the translocation and restoration works is provided in Table 5.

The translocation project will be carried out under the direct supervision of a suitably qualified ecologist or bushland restoration specialist. This person must have a university degree in ecology, botany, environmental science or a similar and relevant field. All phases of the planning, implementation, completion and monitoring of the project must be reviewed by the supervising ecologist or bushland restoration specialists.

The on-ground works will be coordinated and supervised by qualified and experienced personnel within minimum qualifications in Certificate III in Horticulture, Conservation Land Management (CaLM) or equivalent experience. The project shall be undertaken by conservation land management specialists who have experience in the collection, propagation and translocation of threatened flora species, especially species belonging to coastal heath communities. Site maintenance will be undertaken by bush regeneration specialists with minimum qualifications in Certificate III Conservation and Land Management or equivalent and at least 10 years of practical ecological rehabilitation experience.

Monitoring and associated reports shall be prepared by a suitably qualified ecologist in preparing ecological monitoring reports.

Table 5: Translocation and restoration project team, role, qualifications, experience and responsibilites

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Paul Wood Company Director / Principal Environmental Scientist	Project Director	BEnvSc MUDIA MEIANZ	Paul is a Director of FPE and has very strong leadership skills and a wealth of relevant industry experience in environmental monitoring, management and regulatory (compliance) reporting. Paul will be responsible for all certification of reports associated with the proposed scope of services.	Certification of final report deliverables to meet FPE quality assurance objectives, regulatory compliance and client expectations.
Kaine Pritchard Contract Administrator/ Senior Environmental Scientist	Project Manager / Ecologist / WHS Manager	BSc (Plant Science and Environmental Studies) Cert IV in Work Health and Safety Cert IV in Assessment and Workplace Training AC/DC Licence	Kaine is a qualified Environmental Scientist with over 12 years' consulting experience in the environmental industry. Kaine has significant experience in environmental management, undertaking weed surveys, experience in habitat restoration and bush regeneration and holds an ACDC licence.	Liaison with Client; Budgeting and resource coordination to achieve project delivery timeframes and budgets; Desktop assessment; Field survey assistance to principal ecologists; Preparation and technical review of all report deliverables; Subcontractor management; and Development of WHS Plan and EMP and site specific SWMS.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Dr Peter Young Principal Ecologist / Suitably Qualified Person	Principal Botanist / Ecologist	PhD BSc (Plant Ecology & Plant Geography) (Hons) BA (Geography)	Peter is a plant ecologist with over 30 years' experience and has extensive knowledge in the survey, mapping and assessment of native vegetation, fire ecology, regional ecosystems, rainforest botany and ecology, rare and threatened plants/ecosystems, and weed/invasive plant species. Much of his expertise has been developed within southern and central Queensland and has spent 20 years in Queensland Government agencies including Queensland Parks and Wildlife Service (QPWS) and the Department of Environment and Resource Management (DERM). With respect to coastal heath, Peter has detailed understanding of species and community ecology especially fire and soil water relationships as demonstrated by his recent PhD thesis and work history associated with defining and describing regional ecosystems and their conservation requirements in southern Qld.	Specialist input into ecology of Mt Emu She-oak and Wallum Heath Management; Field Survey Lead (Mt Emu She-oak and weeds); and Data analysis, statistical analysis, technical review of reports including recommendations on translocation and weed management.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Luke Craig Civil Works Site Foreman	Civil Works Coordinator	BSci (Environmental) CPESC	Luke has extensive >15 years' experience in environmental management, investigation, planning, compliance, auditing, monitoring, risk assessment, and regulatory liaison. Over the last five to ten years Luke has successfully fulfilled environmental coordinator and advisor roles or gas and mining civil works around Australia and Papua New Guinea. Luke is a member of IECA and active ESCP professional, skilled in the design, development and certification of ESC for infrastructure projects. Luke has previously managed the Brightwater Estate Heath-Tile translocation as the contracted environmental management consultant.	ESCP development & Certification (CPESC) Manage and supervise civil works for works under the contract; Liaison with Client; Resource coordination to achieve project delivery timeframes and budgets; Inductions and WHS management.
Shadforths Civil Engineering Contractors Civil Contractor	Civil Contractor	Not applicable	Shadforths Civil Engineering Contractors is one of Queensland's largest family owned civil contracting companies with over 500 in-house staff, and one of the state's largest in-house fleets. Shadforths has been operating in QLD for over 40 years and have extensive experience in the relocation of wallum heath vegetation. Shadforths own a specialised transportation truck and associated slabbing bucket and skids for the removal and transport of vegetation tiles.	Delivery and commissioning of site facilities and demobilisation; Carry out all clearing / grooming and mulching works. Undertake the heath tile movement translocation of approximately 1.25ha of closed heath containing the target species; and Miscellaneous civil, ASS and ESC items as specified.
Jim Stuart Weed / Maintenance Coordinator	Weed / Translocation Coordinator	Associate Diploma of Forestry Environmental Management (Short Course) AC/DC Licence Construction White Card	Jim leads a team of over 15 bush regenerators and has had over 30 years in the forestry and natural areas profession.	On-ground weed and translocation management, scheduling and plant maintenance.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Nick Evans Ecologist / Environmental Scientist	Ecologist / Fauna Spotter	BEnvSc	Nick Evans is an Environmental Scientist / Ecologist with 5 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees
Simone Forman Ecologist / Environmental Scientist	Ecologist / Fauna Spotter	BSc (Environmental & Animal Ecology)	Simone Forman is an Environmental Scientist / Ecologist with 2 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees
Jono Hooper	Ecologist / Fauna	BSc (Environmental) / B.Sc	Jono Hoper is an Environmental Scientist / Ecologist with 5 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, GIS mapping and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Ann Moran Mt Emu She-oak Specialist / Botanist	Technical advise on translocation of Mt Emu She-oak	B.Sc (Environmental Science)	Ann is an experienced botanist who has worked throughout Queensland for over 35 years. She has extensive plant knowledge, particularly of flora on the Sunshine Coast. Ann previously operated her own botanist consultancy and is a well-respected flora expert. Ann has 35 years with specific field experience in translocating mature Mt Emu She-oak plants with 99% success and was involved in the first flora and fauna survey for the Sunshine Coast Airport in 1989 for Maroochy Council.	Specialist input into translocation of Mt Emu She-oak; and Attendance at Full Day Workshop.
Dr. Alison Shapcott Mt Emu She-oak Specialist	Technical advise on translocation of Mt Emu She-oak	BSc(Hons), PhD	Associate Professor Shapcott has been an active participant in several threatened species recovery teams and communicating between land managers, scientists, conservation groups and industry organisations to enable practical solutions. She has been involved in several restoration projects where she provided expert advice and or lead the ecological aspects of the project in collaboration with external bodies. These have included a 15 Ha heath translocation project which included translocation of populations of five vulnerable or rare plant species, a recovery project for the endangered species *Allocasuarina emuina* and a translocation project for the endangered *Cycas megacarpa.*	Specialist input into translocation of Mt Emu She-oak as required.

5.1.2 Environmental Management Plans

The following Environmental Management Plans have been prepared for the translocation and ecological restoration works. These assist with minimising adverse of impacts to the environment as a result of the works and include an:

- Erosion and Sediment Control Plan (Refer to Appendix A); and
- Acid Sulphate Soils Management Plan (Refer to Appendix B).

All site works must be undertaken in accordance with the requirements of these environmental management plans. The Contractor will be required to update the ESCP an ASS management plans in line with the final translocation and restoration methodology.

5.2 Translocation timing

Translocation of Mount Emu She-oak will be timed to coincide with the commencement of the SCAEP early works; expected to be January - March 2018. Although site preparation works are likely to commence immediately, it may be preferable to delay the movement of any plants until the wet season (January to April) so to minimise watering requirements post-works.

5.3 Seed collection and storage

Seed was collected from the impacted and retained population of Mount Emu She-oak on 3 August 2017. Ten fruit each from twenty individual plants in both the closed heath (north) and twenty individuals from the closed heath (south) vegetation communities were collected. These seeds will be stored in a nursery, with germination trials commencing to assess any differences in viability between seeds collected from the different habitat types.

During the pre-clearing survey within areas of Broad-leaved Paperbark open forest to identify individual plants for translocation, seed will be collected from these plants.

A program of germination will be carried out to provide saplings for installation within the closed heath restoration area and, if require, the heath translocation zone. Seed viability is likely to decline over time so it will be necessary for planting and additional seed collection programs to be carried out during the maintenance and monitoring phase of the translocation and restoration works.

5.4 Impact site preparation and treatment

Due to the difference in the type and structure of the vegetation communities that support Mount Emu She-oak in the impacted population area, two types of translocation works are proposed. Areas of closed heath with a lower canopy cover of paperbark trees will be subject to the heath tile translocation procedures and areas that are underneath a canopy of taller trees will be subject to individual plant translocations (Figure 4).

Prior to translocation of the Mount Emu She-oak from the impact site, areas of suitable habitat types to be relocated using the heath tile methodology will be surveyed and pegged by the FPE Principal Botanist. The location of access tracks into the impact area to carry out the translocation works are to be confirmed and surveyed.

5.4.1 Heath tile translocation zone

Based on preliminary mapping prepared for this plan, the total area to be subject to translocation using the heath tile method is approximately 1.25ha. High visibility flagging tape and fencing will be used to ensure impact areas can be easily identified on ground and to mark out the extent of the heath tile translocation works. Tree Protection Fencing and Signs are to be established in accordance with Australian Standards AS4970-2009 *Protection of trees on development sites* to ensure the protection of Mount Emu She-oak population areas to be retained.

The impact area that will be subject to heath tile translocation will need to be slashed and cleared to reduce above ground biomass of Wallum Hakea and other shrub and canopy trees. This may be completed using a forestry mulcher attachment on a positrack or excavator, or a chopper roller. The above ground biomass should be removed to no higher than 500mm above natural ground level. Larger canopy trees need to be felled individually. Felled material is to be mulched on site and retained on the area to be impacted. This will assist in the retention of seed from Mount Emu She-oak plants within the translocation area and will reduce the potential for loss of soil moisture through evaporation.

Impacted areas of heath to be translocated in tiles should also be watered prior to removal to reduce the likelihood of transplanting shock and to assist with establishment in the receiving site.

5.4.2 Individual plant translocation

A flora survey of the balance of the impacted area will be completed to mark all Mount Emu She-oak plants. The survey will be completed by the FPE survey team, led by Principal Botanist Dr Peter Young.

A georeferenced map of the impact area will be created that has transect lines overlayed utilising Arc GIS. Based on the orientation of the impact site transects would run in a north-westerly to south-easterly direction. This map will be downloaded onto field tablets and utilised during the survey.

Systematic searches for Mt Emu She-Oak plants will be undertaken by walking in swaths of 15 m across the entire impact area. This will involve having three persons spaced evenly apart over the 15 m, covering a search radius of 5m each. Based on this approach, preliminary estimations assume that approximately 3km of transects will need to be covered.

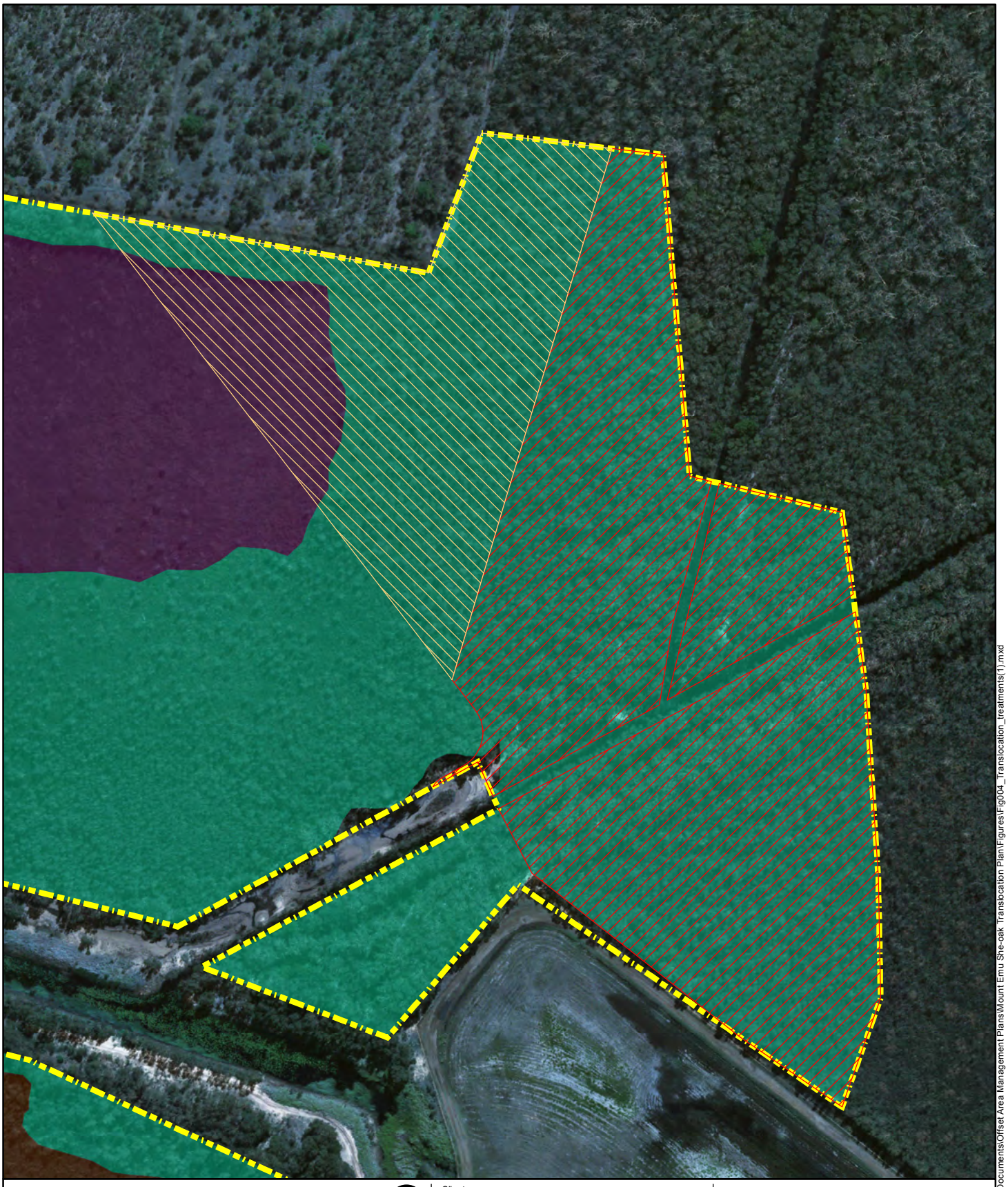
Any individual plants found will be clearly marked with high visibility flagging tape, the GPS position logged using a Differential GPS (DGPS), with an accuracy within 1m, a unique identifier assigned (i.e. AEP1) and the following details collected:

- Height
- Number of stems
- Presence of flower/fruits; and
- Comments on the vigour or health of the plant.

A vinyl tree tag will also be applied to the base of each She-Oak plant, with its unique identifier displayed. The data from the DGPS can then be downloaded, converted and mapped. The information and mapping resulting from the field surveys will be instrumental in refining translocation methodologies. The spread of the individual plants will determine the location of the access tracks through the Melaleuca forest to ensure the most efficient system of plant extraction.

Plants will be watered prior to removal to reduce the likelihood of transplanting shock. The plants will be removed early in the morning and will not be moved during periods of high temperature or strong drying winds. The plant including the root mass and sufficient soil to hold the root system together, will be carefully moved using a spade or a mattock. The area around the root systems is to be carefully excavated to identify the tap root, with any impacts or damage to this tap root to be avoided as much as practical.

The removed plants will be protected from wind and sun exposure, using wet hessian or a similar cover, to minimise stress factors during transport from the impact site to the receiving site. Plants will be installed directly into the receiving site location.



Known Population Area

Translocation treatments

Heath tile translocation

Individual plants translocation

Vegetation Community

Broad-leaved paperbark low open forest

Closed heath north

Closed heath south

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Translocation treatment types

Meters

0	20	40	60	80

Issue	Date	By	Chkd	Appd
D1	18/12/2017	CW	MJD	LOM

ARUP

Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
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Scale at A4	Map Status
1:1,714	Final

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	004

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5.5 Receiving site preparation and treatment

The receiving site for the establishment of the translocated Mount Emu She-oak population is located approximately 2km to the north of the impact site. A total area of approximately 4.4 ha has been allocated to receive the 1.25ha heath tile translocation, with the balance of the new population area requiring ecological restoration to reinstate a closed heath vegetation community. Figure 5 shows an indicative layout of the heath tile translocation site and revegetation site, with a schematic representation of other required site works.

5.5.1 Site survey and vegetation clearing

Prior to removing any Mount Emu She-oak from the impact site, the receiving site will be surveyed and pegged to allow for the on-ground identification of areas that will be receiving the translocated heath tiles and individual Mount Emu She-oak plants. The final location and dimensions of the heath tile translocation areas will be dependent on the results of the soil sampling and the recommendations of the ecologist or rehabilitation specialist.

The soil and geology assessments completed by FPE during the week commencing 11 December 2017, identified an area in the south-west corner of the receiving site that contained coffee rock at a suitable depth below ground level. In this area, coffee rock was detected at 1.0m below ground level. Coffee rock was not detected at any other locations across the receiving site.

The site consists predominantly of exotic pasture with occasional *Melaleuca quinquenervia* as a scattered canopy tree. However areas of dense Melaleuca/slash pine regrowth are also located along the eastern boundary. All existing vegetation on the site will be cleared to natural ground level in preparation of receiving translocated Mount Emu She-oak and to allow for machinery and vehicle access.

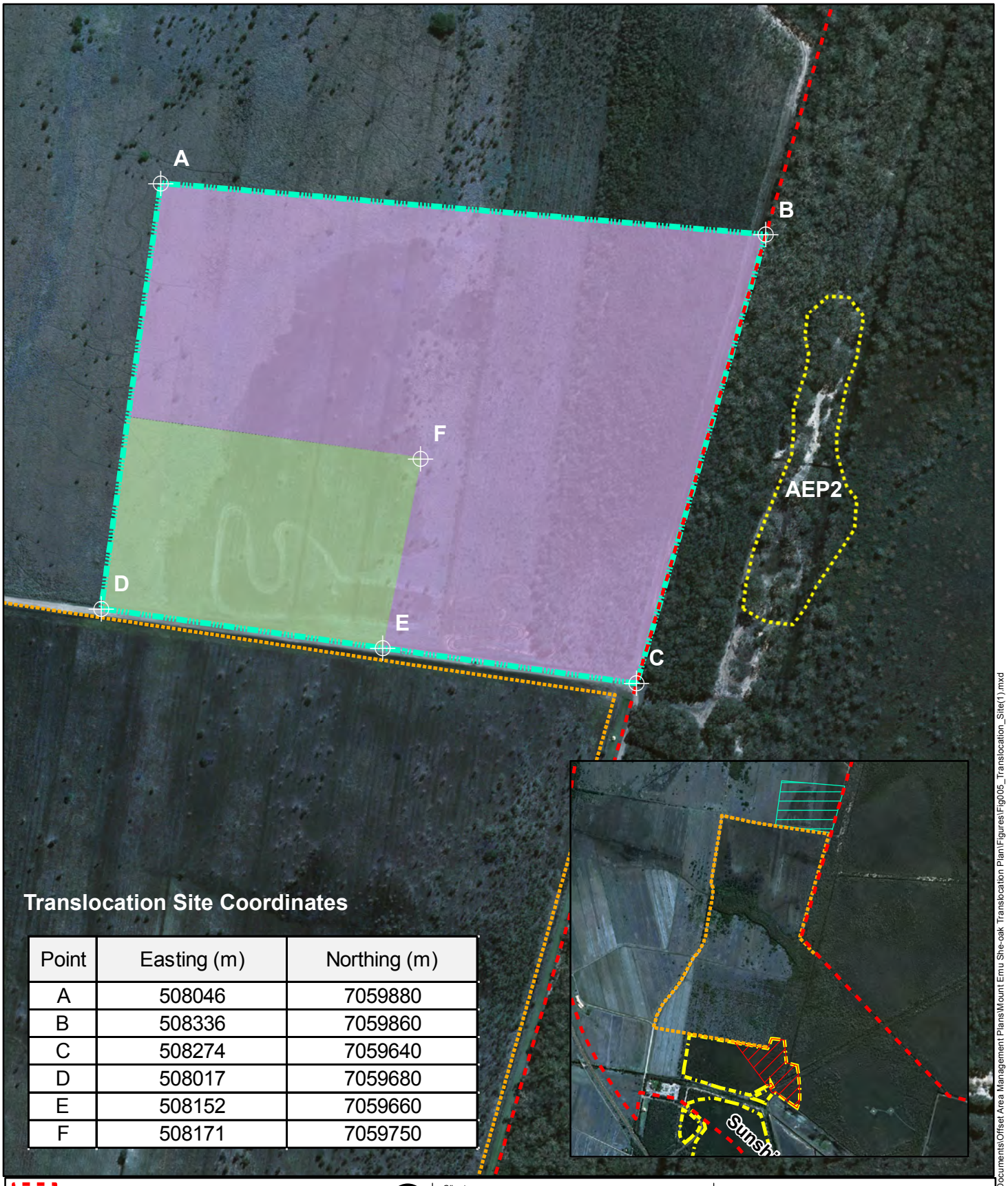
Prior to the commencement of clearing works, Tree Protection Fencing and Signs are to be established in accordance with Australian Standards AS4970-2009 *Protection of trees on development sites.* These are to be maintained on site for the duration of the translocation works. Immediately before clearing, a licensed wildlife spotter/catcher is to inspect all vegetation to be removed. Any fauna encountered are to be relocated/ ushered to adjoining vegetation.

Whilst the clearing works are being undertaken, a registered fauna spotter/catcher should be on-site in the event that fauna are observed which require relocation or in case of fauna injury. All vegetation removed is to be mulched on-site and stockpiled in cleared open areas on site. Exotic vegetation is to be disposed of at an approved offsite disposal facility.

5.5.2 Earthworks

Following vegetation clearing works the existing topsoil will need to be excavated and removed from the heath tile receiving area. Top soil is to be removed from areas identified for receiving translocated heath to a depth of 300mm. Soils are to be stockpiled in cleared open areas on site for reuse at the impact site to fill the hole left from the translocated heath.

All works must be undertaken in accordance with the Erosion and Sediment Plan prepared for the project (**Appendix A**).



Translocation Site Coordinates

Point	Easting (m)	Northing (m)
A	508046	7059880
B	508336	7059860
C	508274	7059640
D	508017	7059680
E	508152	7059660
F	508171	7059750

Airport boundary
Translocation Site Receiving Area
Vehicle Access Track

Indicative Management Areas

Heath tile translocation
Heath restoration and translocated plants

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Mount Emu She-oak Translocation Site

Meters
0 30 60 90 120

Issue	Date	By	Chkd	Appd
D1	12/10/2017	CW	MJD	LOM

ARUP
Level 4, 108 Wickham Street
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www.arup.com

Scale at A4	Map Status
1:2,500	Final

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	005

J:\252000\252448-00 Biodiversity Offset Strategy\Work\Internal\Documents\Offset Area Management Plans\Mount Emu She-oak Translocation Plan\Figures\Fig005_Translocation_Site(1).mxd

5.6 Heath tile preparation, removal and installation

The intent of the heath tile translocation is to move the top 300mm of topsoil, with associated root systems and soil ecosystem, from the impacted site to the prepared translocation receiving site. It is recommended that an excavator with a fabricated tray-shaped bucket should be used to remove the heath in tiles (Photograph 3). The heath tiles will contain the vegetation, topsoil and the existing seed bank. By translocating the entire vegetation community and the soil seed bank, it is considered that there will be a higher chance of success in establishing a viable Mount Emu She-oak population.

FPE's proposed methodology, although based on past methodologies has been developed specifically for the target species and site conditions. The proposed methods have been based on the use of existing equipment held for previous projects, removing the need for project delays due to equipment fabrication.

Specific requirements have been detailed as follows;

- The cut interface shall be kept moist at all times by regular passes of the Moxy water cart;
- Using a fabricated heath tile cutting bucket fitted to a 30 tonne digger (or similar) a 4m2 tile of heath shall be cut with each pass;
- Each tile shall be dug to approximately 300mm and retain the top 500mm of vegetation. This is to ensure the roots and soil associated with identified vegetation are left relatively undisturbed during the process;
- The tiles are then placed on a tile unit carrier which can hold two (2) tiles (8m2 in total) with a void in the middle around the quick hitch which is capable of carrying additional soils and mulch that may have fallen from the tile;
- A 6-wheel Moxie, with fabricated flat trays large enough to fit two carrier trays, shall be loaded for direct haulage to the receival area;
- In addition, two slides which can carry up to three unit carriers have also been fabricated to assist in wet areas and or inclement weather where Moxie access off haul roads is not possible;
- Works will include around 30 loads per working day, totalling approximately 500m2 of heath;
- Post heath tile movement a guard layer of fine grained agricultural lime shall be spread at 5 kg/m2 in accordance with the approved ASSMP and hydromulched for temporary soil stabilisation;
- At the receival area the tiles shall be placed gently on moist (Moxy water cart to maintain 50m2 wetted area ahead of tile placement) and lightly ripped (using digging bucket teeth) subsoils in the same order, orientation and approved level;
- Immediate watering shall be undertaken by the water cart in accordance with the proposed watering regime; and
- Daily records of the tile quantities, plant movements, watering details and monitoring shall be kept by FPE.

Photograph 2: Example heath tile translocation methodology employed by Shadforths Civil Contractors.

5.7 Closed heath habitat restoration

Within the balance area that will not be subject to heath tile translocation, ecological restoration works will be required to remove exotic species and Broad-leaved Paperbark regrowth to create areas of closed heathland that is suitable for supporting Mount Emu She-oak. The treatments to these areas will be a combination of assisted regeneration and revegetation works. The scale of any revegetation works will need to be informed by the maintenance and monitoring results. These areas will be used for installation of the individual Mount Emu She-oak plants that are translocated from the receiving site and planting of nursery-raised plants

Primary actions associated with areas requiring assisted regeneration are the control of exotic and declared pest plants. There is currently evidence of recruitment of native trees, shrubs and groundcovers in this area. Fire management within these areas is recommended to be excluded for the maintenance period to allow sufficient time for natural regeneration of canopy and shrubs to occur. Introduction of ecological burns at this early stage in succession can reduce canopy and shrub cover.

Preliminary soil tests are to be undertaken to set a baseline of soil condition and composition prior to any revegetation works. A minimum of 4 samples are to be taken from the site with physical and chemical analysis undertaken by a NATA accredited soil analysis laboratory. Information received from testing may inform the requirements of planting hole fertilisation or soil amelioration to benefit plant establishment.

5.7.1 Weed and exotic species treatment

A site survey is to identify all restricted invasive plants and environmental weeds. Specific weed treatments are to be in accordance with the Department of Agriculture and Fisheries (DAF) information sheets (http://www.daff.qld.gov.au/4790_10168.htm#L). Specific control methods are to be dependent on the age, size, location and health of the weed specimen. For example, hand removal or foliar spraying for small woody weeds or grasses and cut-stumping or stem scaping for large woody weeds. When applying chemical treatments native trees and shrubs are to be avoided. Follow up weed removal should be timed to treat weeds and exotic species prior to seed set.

Following chemical treatment of grassy exotic species, slashing is to occur and the slashed vegetative material retained on site as mulch. If required to achieve suitable ground protection, native mulch (composted) is to be applied on the site.

Following any chemical treatment of exotic grasses the dead vegetative material should be slashed and retained on the site to provide soils stabilisation and cover. Native forest mulch should then be applied to any bare soil to a depth of 75mm. It is recommended that native vegetation from the SCAP clearing site is chipped on site, stored and allowed to compost into mulch. Any externally sourced mulch material should also include a Weed Hygiene Declaration to ensure the material is free from any weed propagules.

Fencing around the northern, southern and western property boundary will be installed to minimise the spread of weed seed from outside of the site entering the translocation and restoration site. This will consist of hessian panels strung between star pickets. The fence is recommended to be approximately 2m in height, with the bottom of the fence fastened to the ground or buried just below ground level.

5.7.2 Live topsoil placement

Opportunities to utilise topsoil from areas of impacted, remnant native vegetation across the SCAEP project site should also be investigated to improve the seed bank of the restoration area. It is recommended that a map of suitable areas of impacted coastal heath is prepared by a suitably qualified ecologist or botanist. During preliminary earthworks for the SCAEP project the topsoil in these areas should be stored separately and moved to the closed heath habitat restoration areas.

If live topsoil is to be implemented, the topsoil from the restoration site that contains weed or exotic seed material should be removed and disposed of outside the site. The area and depth of topsoil to be stripped should be sufficient to receive the volume of translocation to

5.7.3 Infill planting

Depending on the progress of the ecological restoration works, revegetation and infill planting may be carried out the habitat restoration zone. The planting density within each zone has been estimated to achieve a plant community structure consistent with the remnant clearing area. Planting densities may be adjusted depending on the rate of natural recruitment evident. The densities provided in Table 6 are to be used for site monitoring to assess the success of the rehabilitation and to guide subsequent planting events over the maintenance period.

Table 6: Flora species suggested to be used for infill planting if required.

Stratum	Species name	Common name
Shrub (3 plant/m^2)	*Allocasuarina emuina*	Black She-oak
	Baeckea frutescens	Weeping Baeckea
	Baekea imbricata	Spindly Baekea
	Banksia robur	Wallum Banksia
	Bauera capitata	Wallum Baurea
	Boronia falcifolia	Wallum Boronia
	Boronia parviflora	Swamp Boronia
	Conospermum taxifolium	Devil's Rice
	Dillwynia floribunda	Showy Parrot Pea
	Dillwynia retorta	Heath Parrot Pea
	Epachris microphylla	Coral Heath
	Epachris pulchella	Wallum Heath
	Goodenia stelligera	Wallum Goodenia
	Hakea actides	Wallum Hakea
	Leptospermum liversidgei	Wallum Tea-tree
	Leptospermum thymifolia	
	Melaleuca pachyphylla	Swamp Bottlebrush

Stratum	Species name	Common name
	Melastoma malabathricum subsp. malabathricum	Native Blue-tongue
	Persoonia virgata	Wallum Geebung
	Petrophile shirleyae	Conesticks
	Philotheca queenslandica	Queensland Wax Flower
	Pultenaea myrtoides	Swamp Pea
	Pultanaea robusta	Tall Swamp Pea
	Strangea linearis	
	Woolsia pungens	Woolsia
Ground (5 plants/m^2)	*Baumea articulata*	Jointed Twigrush
	Baumea rubiginosa	Soft Twigrush
	Baumea teretifolia	Twigrush
	Chorizandra cymbaria	Bristle Rush
	Empodisma minus	Spreading Rope Rush
	Gahnia sieberiana	Red-fruited Saw Sedge
	Goodenia stelligera	Wallum Goodenia
	Hibbertia scandens	Twining Guinea Flower
	Leersia hexandra	Swamp Rice Grass
	Lepironia articulata	Grey Segde
	Sporadanthus interruptus	
	Xanthorrhoea fulva	Swamp Grass Tree

5.8 Practical completion performance objectives and criteria

Following the implementation of the translocation and restoration works, the performance objectives and criteria defined in Table 7 will need to be met to achieve practical completion and commence the maintenance works.

Table 7: Performance objectives and criteria to achieve practical completion

Performance objective	Measureable criteria
Translocation of approximately 1.25ha of closed heath vegetation community	• Evidence that the root systems have established into the receiving environment. • Adequate watering records provided to demonstrate translocated area was sufficiently watered in.
Evidence of growth and establishment of Mount Emu She-oak plants within heath tile translocation site	• Recorded evidence of recruitment of Mount Emu She-oak plants. • Evidence of population increases through yearly surveys.
Reduction in cover of exotic and weed species in the restoration sites	• No more than 10% cover of exotic species across the entire translocation and restoration site. • No more than 5% cover of restricted invasive plants across the entire translocation and restoration area
Evidence of native species regeneration within the translocation site and restoration site.	• Records of at least 20 species from Table 6 of this report within the restoration area. • No reduction in species richness within the translocation site. • Recorded evidence of native species recruitment within the restoration and translocation site.

6 Short-term Management and Maintenance

The following section presents the management and maintenance requirements that must be implemented at the translocation and restoration site within the first three years following practical completion of the translocation and restoration work.

These prescribed measures are crucial to achieving the objectives identified in Section 1.2 and are to be implemented until such a time as Mount Emu She-oak have become established and evidence of recruitment is observed.

Figure 5 shows indicative receiving areas for translocated Mount Emu She-oak heath (Area 1) and individual plants (Area 2) at the site. Different approaches to the management of these areas may be required in the short-term to establish and/or maintain a suitable wallum/closed heath habitat for Mount Emu She-oak.

To minimise the loss of translocated plants, after-care is to occur following the translocation works and any subsequent planting events on an as-needs basis.

6.1 Watering

The translocated heath tiles will require sufficent watering to encourage successful establishment. There is limited access to a reliable water supply at the translocaton site, so there may be a requirements to install a water tank that is filled periodically to irrigate the area of translocated Mount Emu She-oak and restored heath habitat. **Error! Reference source not found.** Figure 5 shows the proposed location of the water tank to be confirmed by the appointed contractor. Consideration for the installation of an irrigation system will also be required to ensure all areas of the translocation and restoration sites can be suitably irrigated.

Table 8: Proposed watering regime for translocated Mount Emu She-oak

Week	Frequency
Week 1 & 2	Once every day
Week 3 & 4	Once every second day
Week 5 - 8	Twice every week
Week 9 - 12	Once a week

Areas containing translocated heath tiles and individual Mount Emu She-oak plants (Area 1 & 2) are to be watered immediately after planting. Watering will occur regularly throughout the initial establishment period, becoming less frequent with time.

Table 8 provides an indicative watering schedule for the site. However, local rainfall levels and soil moisture content should be appropriately monitored and watering regimes altered as necessary.

An irrigation system will be established on the site, that consists of:

- Two x 22,500 L galvanised tanks will be delivered to site and placement in vicinity of the translocation area for access by water truck;
- Establish a water source onsite sourced from the existing drain located to the south east of the translocation area
- Powering of pumps to pump water to the storage tanks will consist of either a submersible pump and solar panel power, or fuel powered generator (or similar);

- Delivery of water to the irrigation area will be powered by fuel powered generator and pump (or similar);
- For the initial heath tile translocation, temporary “solid set” type irrigation is proposed. In this type of irrigation, sprinklers with an inlet pipe diameter size of 20 - 25mm shall be utilised at either rectangular or triangular spacing. The application rate of these sprinklers shall not exceed the uptake rate of the soil;
- Pipework supplying the sprinklers shall be laid on the ground, with the sprinklers being supported by star pickets. The intent of the system is temporary, no longer than 12 months, with the subsequent removal not requiring a high labour input;
- A subsequent planting of young She-oaks is expected to be carried out in 2020 that will also require temporary irrigation. In this instance, direct watering is proposed; and
- The irrigation system including tanks, delivery pipe and sprinklers will be demobilised upon approval by the project principal ecologist.

6.2 Supplementary planting

Supplementary planting may be necessary where the translocated Mount Emu She-oak do not establish or self-propagate. This is to include the planting of nursery-raised Mount Emu She-oak seedlings germinated from seed sourced from the SCA Mount Emu She-oak populations.

6.3 Weed control

Weed control should commence immediately following the translocation with ongoing control implemented over the three year maintenance period at the following frequencies:

- Year 1: Twelve visits to target exotic and restricted invasive species
- Year 2: Six visits to target exotic and restricted invasive species
- Year 3 Six visits to target exotic and restricted invasive species

Area 2 is likely to be particularly susceptible to weed invasion until suitable native species cover is established. More regular weed control within this area may be necessary. Care needs to be taken to avoid harming Mount Emu She-oak plants and seedlings with a preference given to hand-weeding methods. Herbicide treatments using a Glyphosate based bioactive safe for use in waterway environments should only be used where it is determined hand weeding is inadequate.

6.4 Thinning

The continued management of any Melaleuca thickening at the translocation site will be required; particularly within Area 2. Subject to monitoring and the scale of thickening, this may involve the individual removal of Melaleuca plants or slashing of the entire area.

6.5 Fires

Fires must be controlled at the translocation site to allow adequate time for Mount Emu She-oak to establish and juvenile plants to mature and set seed. It is estimated that Mount Emu She-oak plants

grown from seedlings will require two growing seasons before flowering and another six (6) months for seeds to mature. As such, a burn of the translocated area should be scheduled for no sooner than 2020.

6.6 Maintenance period performance objectives and criteria

The translocated population and the retained population will require ongoing monitoring to assess the progress of the works towards the ultimate requirement to achieve a 2.6 times increase in population size within 20 years.

The maintenance requirements in this section relate to the initial three year maintenance requirements to be implemented by the Contractor. Table 9 defines performance criteria that are to be met during the initial three year maintenance period so that off-maintenance can be achieved and Table 10 provides a summary of the actions required each year during the maintenance period. Following this initial three year maintenance period, further maintenance will be required.

Table 9: Performance criteria to be reviewed with yearly monitoring and reporting requirements.

Performance objective	Measureable criteria
Establishment of a closed heath vegetation community	• Flora species richness and diversity characteristic of a remnant closed heath community. • Floristic structure, including shrub and groundcover height and Foliage Projective Cover (FPC), characteristic of a remnant closed heath community.
Self-sustaining Mount Emu She-oak population	• Recorded evidence of recruitment of Mount Emu She-oak plants. • Evidence of population increases through yearly surveys.
Absence of exotic species and weeds	• No more than 5% cover of exotic species across the entire translocation and restoration site. • No restricted invasive plants
Implementation of appropriate fire regimes	• Investigate the suitability of commencing a prescribed burn regime, using a patch mosaic pattern in the translocation area commencing in 2020. • Development of fire management plan defining a patch mosaic burn regime with areas to be burnt every 8-12 years.

Table 10: Indicative schedule of maintenance tasks

Performance criteria and management actions	Year 1	Year 2	Year 3
Maintenance actions			
Weed control	Intensive mechanical and chemical weed control, with 12 visits by team required to target weed species prior to seeding.	Intensive mechanical and chemical weed control, with 6 visits by team required to target weed species prior to seeding.	Intensive mechanical and chemical weed control, with 6 visits by team required to target weed species prior to seeding.
Erosion control and mulching	Erosion control and mulch to be installed where required following weed treatment and removal works.	Reapply mulch as needed to bare ground or new plantings	Reapply mulch as needed to bare ground or new plantings
Watering	As required	As required	As required
Live topsoil placement	As required	As required	As required
Infill planting	Sourcing of seedlings or seeds from local provenance plant material. Identification and preparation of planting sites	Monitoring for success and replacement of failed plants.	Monitoring for success and replacement of failed plants.
Installation of individual Mount Emu She-oak plants	No actions	Planting, watering and weed control around installed plants	Planting, watering and weed control around installed plants
Ecological burns	No actions	No actions	Plan for ecological burn at end of maintenance period.

7 Indicative implementation and maintenance program

TAKSK	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Year 1				Year 2				Year 3			
Implementation phase																						
Pre-start meeting																						
Finalise environmental management plans																						
Site establishment and mobilisation																						
Survey and peg area to be translocated																						
Survey and mark individual Mount Emu She-oak plants																						
Carry out soil investigations within receiving site																						
Survey and peg translocation receiving site																						
Carry out heath tile translocation																						
Carry out weed treatment in restoration area																						
Remove individual plants and transfer to receiving site																						
On maintenance inspection																						
Three year maintenance phase																						
Weed treatment																						
Watering																						
Infill planting (if required)																						
Live topsoil installation (if required)																						
Ecological monitoring																						

8 Long-Term Management of Mount Emu She-oak Populations

This section identifies measures that must be implemented for the long-term protection and management of both retained and translocated Mount Emu She-oak populations at SCA. These prescribed measures are crucial to achieving the objectives identified in Section 1.2 and are to be implemented immediately for retained Mount Emu She-oak population areas and subsequently for translocated population areas.

Long term management of Mount Emu She-oak populations at SCA is to occur indefinitely. However, a 20 year timeframe has been set for achieving the required 2.6 times increase in the translocated Mount Emu She-oak population size.

The Recovery Plan identifies several threats known to the Finland Road Mount Emu She-oak population (AEP1). If not appropriately managed, these have the potential to impact the long-term success and viability of translocated and retained Mount Emu She-oak habitat areas at SCA. These are discussed further below.

8.1 Airport development

Closed heath vegetation communities are particularly dependent on a shallow groundwater aquifer, especially the perched aquifer above the coffee rock. Runway construction as a part of the SCAEP may impact the condition and extent of retained and translocated Mount Emu She-oak populations at SCA indirectly through changes in groundwater quality (particularly salinity) and levels. Hydraulically delivered sand used in runway construction may cause saline water to infiltrate areas of surrounding habitat, increasing salinity levels and raising groundwater levels. Proposed mitigation measures including strict development controls and the use of a high quality liner within the base of the new runway area are aimed to minimise the potential for this to occur. These measures are discussed further in the project EIS.

Surface and groundwater monitoring will also be undertaken by SCC during the SCAEP works to monitor and manage any potential development impacts to Mount Emu She-oak populations. This will include observing salinity and groundwater levels obtained from boreholes located within the vicinity of retained and translocated Mount Emu She-oak populations.

8.2 Inappropriate fire regimes

Inappropriate fire regimes may impact the viability of Mount Emu She-oak plants (Environmental Protection Agency 2007). Field observations have suggested that Mount Emu She-oak may begin to senesce after approximately 10-15 years in the absence of fire (Olsen 2002 in Lamont 2010) whilst parent plants may succumb to fungal attack from *Phytophthora cinnamomii* (Lamont 2010). The viability of the seedbank of several species of *Allocasuarina* has been found to decrease over similar timeframes (Halford 1993a; Pannell & Myerscough 1993; McKiernan 1997 in Lamont 2010).

Fire initiates the germination of soil-stored seeds and facilitates the release of seeds from cones stored on adult plants (Environmental Protection Agency 2007). However, despite the species' adaptation to fire, there are a few factors that can influence reproduction success post fire (Halford 1993, in Environmental Protection Agency 2007), including:

- Fire frequency: it is suggested that the plant requires two growing seasons before reproduction commences and another six months before the seeds can mature
- Fire intensity: A low intensity fire may not sufficiently stimulate the opening of cones
- Fire seasonality: Seasonal rainfall levels, soil and ambient temperatures and levels of sunlight post fire could also affect seedling recruitment after fire.

Within AEP1, wildfires are reported as occurring in 1994 and 2002 for the southern area (Queensland Parks and Wildlife Service, 2012), whilst the Recovery Plan for the species notes that a fire occurred in 2001. The 2001 fire mentioned in the Recovery Plan may in fact be the same as the 2002 fire mentioned by the Queensland Parks and Wildlife Service (QPWS), given that the QPWS actively manages fire within the area. There is no recent evidence of fire within the area of Mount Emu She-oak habitat north of the drainage channel, as evidenced by the differing vegetation characteristics between the north and south areas. This is likely due to the fact that this area is SCA land and fires managed by QPWS were restricted to lands south of the drainage channel (i.e. predominantly the National Park area). Here, the Mount Emu She-oak habitat contains a dense layer of tall Wallum Hakea whilst the southern area is more open and floristically diverse. The Recovery Plan notes that the AEP1 population exhibited germination after a fire in 2001 (pp. 9), potentially explaining why the population density of Mount Emu She-oak is much higher in the southern portion.

According to Watson (2001), fires occurring at a range of frequencies between 7 and 20 years, but more commonly between 8 to 12 years are preferable for maintaining coastal heathland biodiversity. Burns should be planned to occur following rainfall events when the substrate is saturated (Watson 2001). This will assist to avoid the risk of peat fire which can cause major shifts in species composition (Brown & Podger 1982, cited in Watson 2001).

Table 11 outlines the proposed fire requirements for Mount Emu She-oak populations at SCA.

Table 11: Proposed fire requirements for Mount Emu She-oak populations at SCA

Fire intervals	**8-12 years**
Spatial scale of burn	Small scale, patch mosaic burns within pre-determined areas taking into account the age/class structure of the Mount Emu She-oak populations.
Interval till next fire event	Translocated populations will require sufficient time to establish and any juvenile plants to mature and set seed. The first burn in the translocated population area is recommended no sooner than 2020. A burn should be planned for retained areas of AEP1 shortly after the completion of translocation works (i.e. 2018-2019).
Fire intensity	Natural vegetation on site will determine what fire intensity will be achieved. A fire load base will need to be determined so as timing of the burn will result in a moderate intensity fire. The heath substrate must be saturated to avoid the risk of peat fire.
Fire season	Autumn and winter

8.3 Weed invasion and competition

Weed control measures are to be implemented on site for the duration of the maintenance period to minimise the competitive impacts of exotic species on Mount Emu She-oak. Weeds may establish at the edge of retained heathland habitat as a result of disturbance and increased nutrient inputs from SCA activities including runway construction works. Translocated habitat areas are also likely to incur some weeds from propagules stored within the soil or deposited from machinery and vehicles undertaking the

translocation and maintenance works. If not appropriately managed, weeds may pose a considerable threat to the long-term viability of Mount Emu She-oak populations at SCA.

Control and removal of invasive weeds will ensure Mount Emu She-oak are provided with favourable conditions for population establishment, expansion and persistence. Table 12 provides a list of weed species that are known to occur on site and preferred control methods. Inspections of the site should be carried out at least once every six (6) months to identify and control any weed species present.

Table 12: Exotic species known to occur at SCA and preferred control methods

Family	**Species Name**	**Common Name**	**Biosecurity Act 2014 classification**	**Control Methods**
Asteraceae	*Baccharis halimifolia*	Groundsel Bush	Restricted invasive	Hand pull small plants. Dig out larger plants or cut stump and immediately spray or paint with herbicide.
Poaceae	*Megathyrsusmaximus var. maximum*	Guinea Grass	-	Foliar spray with herbicide
Pinaceae	*Pinus elliottii*	Slash Pine	-	Stem injection or cut stump and paint with herbicide.

9 Monitoring and Reporting Requirements

Following the translocation works, a population monitoring program will be implemented for the translocated and retained populations of Mount Emu She-oak at the SCA site. The monitoring program will measure annual progress towards achieving the translocation objectives identified in Section 1.2 for a period of 20 years. This section provides a description of the performance objectives and criteria to be achieved by the end of the three year maintenance period. However, monitoring beyond this time period is recommended to inform the ongoing management of retained and translocated Mount Emu She-oak populations at SCA.

9.1 Methodology

To assess the condition of the translocated community, four (4) permanent 100 m x 50 m transects will be placed throughout the translocation site. The centre point of each transect will be marked with a star picket, and the coordinates of the start point and centre point will be recorded, as well as the bearing.

Data on the floristic structure and condition of the vegetation community will be collected using the methodology defined in BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2 (Eyre et al 2015). Each transect will be surveyed annually during peak flowering season for 20 years.

Annual surveys of the retained and translocated Mount Emu She-oak populations will also be carried out to monitor changes in population size compared with baseline estimates. As per the baseline population surveys, 10 m x 10 m transects will be equally spaced using of a 50 m x 50 m grid overlayed on aerial photography of the population areas. One quadrat will be positioned within the centre of each grid, except where areas cannot be accessed due to dense ground cover or the existence of other physical barriers such as drainage lines. In each quadrat, two ecologists/ botanists will count the number of individual Mount Emu She-oak plants present.

9.2 Reporting

During the 20 year monitoring period, annual reports will be prepared to assess the progress of the translocation and restoration works towards the required outcomes. The aim of the reports will be to document progress towards addressing the objectives outlined in Section 1.2. This includes achieving the required 2.6 times increase in population size of translocated Mount Emu She-oak populations. And meeting the performance objectives defined in Section 8.1 of this report.

Monitoring reports are to include schedules of any management works undertaken for retained and translocation Mount Emu She-oak population at SCA.

The results of surface and groundwater monitoring undertaken by SCC at SCA during the SCAEP works should also be addressed within monitoring documentation. This is to include salinity and groundwater levels obtained from boreholes located within the vicinity of retained and translocated Mount Emu She-oak populations.

10 References

Environmental Protection Agency 2007. *National recovery plan for Mt Emu She-oak Allocasuarina emuina.* Report to Australian Government Department of the Environment and Water Resources. Queensland Parks and Wildlife Service, Brisbane.

Eyre. T.J., Kelly, A.L., Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. 2015. *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual*. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Hall Contracting Pty Ltd. No date. *Completed projects: Brightwater vegetation Translocation*. Buderim.

Lamont, R.W. 2010. *Conservation genetics and ecology of the endangered heathland shrub, Allocasuarina emuina.* PHD Thesis.

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Appendix A

Erosion and Sediment Control Plan

Our Ref: 5141

14 December, 2017

Erosion and Sediment Control Plan

Mt Emu She-Oak Translocation Project

Sunshine Coast Airport Expansion Project, Marcoola

Client: Sunshine Coast Council

Future-Plus Environmental (Sunshine Coast)
4/40 Technology Drive, Warana QLD 4556

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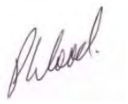
Signed on behalf of
Future-Plus Environmental

Date: 14 December 2017



Paul Wood
Director

DOCUMENT CONTROL INFORMATION

Project Number: 5141

Project Manager: Kaine Pritchard

Client: Sunshine Coast Council

Report Title: Construction Environmental Management Plan

Project: Sunshine Coast Airport Expansion Project

Site Address: Marcoola, QLD 4564

Document Review

Document Version	Document Status	Author	Reviewed By	Approved By
FPE Ref: 5141-171212-1.0_ESCP	Client Issue	LC	KP	PW

Issue Approval

Destination	Document Version	Date Dispatched
Sunshine Coast Council	0.1	14/12/2017

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1.0 INTRODUCTION

Future-Plus Environmental (FPE) are pleased to provide the revised Erosion and Sediment Control Plan (ESCP) for the Mt Emu She Oak Translocation Project hereafter referred to as the 'Project", for the Sunshine Coast Airport Expansion Project (SCAEP). FPE are the principal contractor for the Project.

The site has a very low erosion risk, with the EIS report estimating a soil loss rate of 14 t/ha/y during construction. Potential erosion impacts are lessoned by the sandy nature of the sites soils and slopes significantly less than 1%. The EIS identifies waterway banks and stockpile embankments as areas where erosion is most likely to occur during the construction works. The purpose of the following ESCP is to manage the environmental impacts associated with the exposure and disturbance of soils during the project works.

2.0 EROSION AND SEDIMENT CONTROL PLAN

2.1 PERFORMANCE OBJECTIVES

All E&SC's shall be in accordance with the Manual for Erosion & Sediment Control, Version 1.2, (Sunshine Coast Regional Council, 2008), and Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites. E&SC measures shall be constructed to achieve stable discharges from the construction site during a 25.9mm rainfall event (1 year, 2 hr ARI Marcoola).

The ESCP also aims to:

- Minimise the area of disturbance to no greater than the area necessary for construction works to occur;
- Minimise erosion of soils during construction works;
- Minimise loss of sediment from site during construction works; and
- Controls meet the following criteria:
  - pH >4.5[1]
  - Suspended Solids < 50mg/L
  - Turbidity < 75 NTU

2.2 METHODOLOGY

The management strategy for erosion and sediment control is as follows:

[1] Note: Due to the pH sensitive receiving environment (i.e. Wallum heath ecosystem which are naturally acidic) no treatment of discharge waters, to increase pH, is recommended unless pH <4.5.

- Phase 1 – Site Set Up
- Phase 2 – Heath Tile Translocation Works
- Phase 3 – Individual Translocation Works
- Phase 4 – Completion

An ESCP has been drafted for each of the project phases. The plans are attached as Appendix A.

2.3 MONITORING

A rain gauge shall be installed at the site office and checked daily at 9am for direct comparisons with the BOM weather station situated within the project area. FPE's site supervisor shall undertake daily checks on weather forecasts and warnings.

Weekly inspections will be carried out to check:

- Works are only occurring within designated area and no-go fencing is in place;
- Erosion and Sediment Control measures, to ensure they are cleaned out and maintained in working order;
- Stabilisation is occurring in accordance with the plans;
- For litter and debris; and
- For discharges from sediment traps.

2.4 ACTIONS SIGNIFICANT RAIN EVENTS

Should a significant rainfall event be predicted within the seven day BOM outlook for the works area, the site foreman shall inspect the works area two days prior and ensure all ESC's are in place and functional (i.e. in good working order and have sufficient sediment storage capacities 70%). Post rainfall, prior to starting works, the foreman shall undertake a post rainfall ESC inspection to identify any controls requiring maintenance.

2.5 REPORTING

FPE's site supervisor shall maintain a log of inspections, maintenance actions which shall be detailed in the site diary. Records (including inspections and monitoring) are to be logged and kept for verification of compliance on a as need basis.

2.6 INCIDENTS AND CORRECTIVE ACTIONS

An incident shall be raised when erosion and sediment controls are not effectively protecting the waterway/downstream environment. Corrective actions shall include but not limited to:

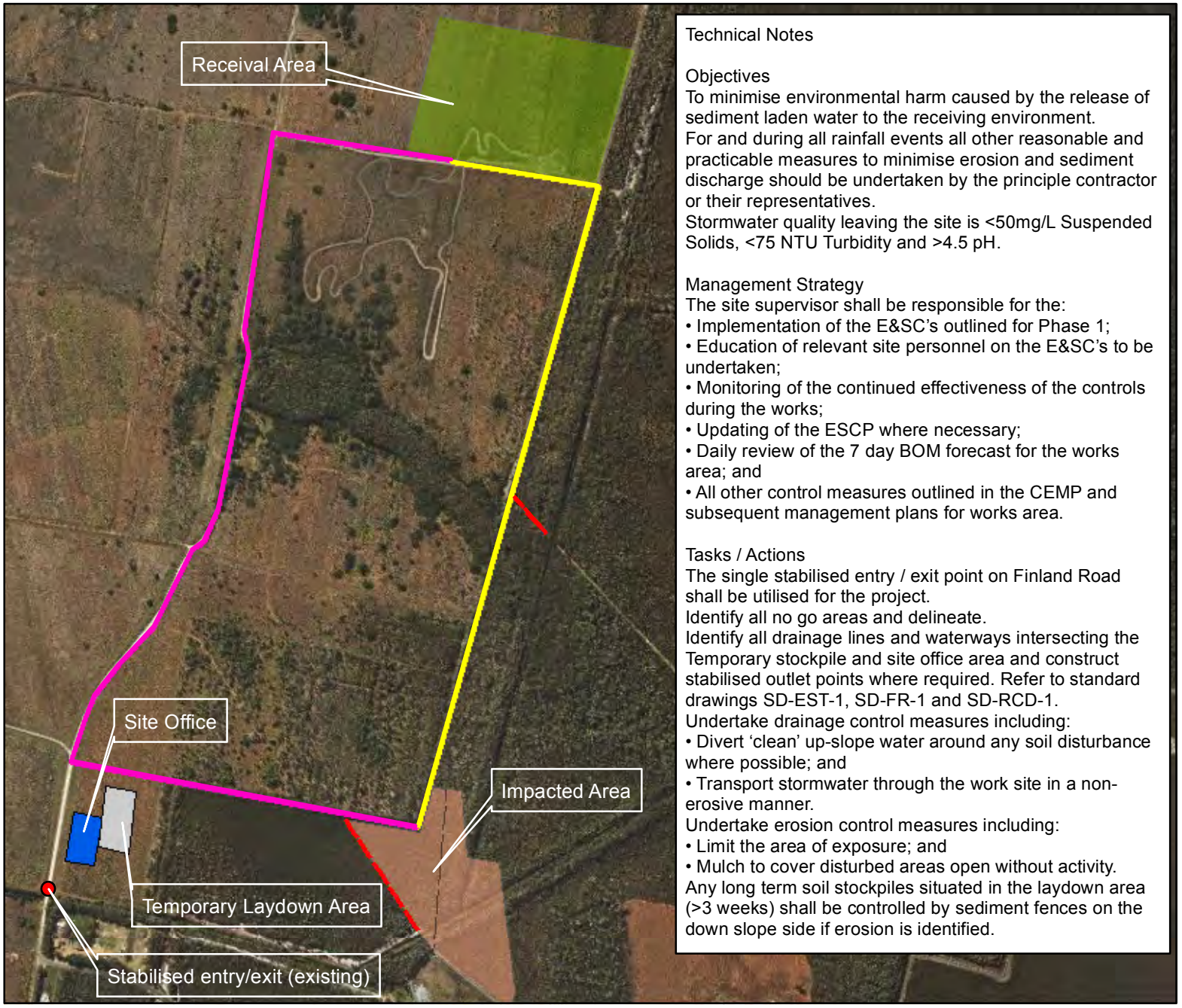
- Undertake a survey of erosion and sediment control measures and determine effectiveness of current controls;
- Reassess the risks of the works areas and determine if further controls will remedy any problems;
- Seek the assistance of an appropriately qualified professional for advice on erosion sediment control devices; and
- Implement all required works and recommendations to achieve compliance.

3.0 SUMMARY

It is expected that the controls detailed in the above-mentioned plans will form the minimum base of controls required during the project and that FPE will audit the project throughout the construction phase to identify any additional controls required to comply with the project's environmental objectives. Furthermore, it is expected that FPE will continue to prepare progressive plans that address the specific staging of works and or reflect changes made to the erosion and sediment controls detailed in the above-mentioned plans.

Appendix A.

ESCPs



Technical Notes

Objectives
To minimise environmental harm caused by the release of sediment laden water to the receiving environment.
For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.
Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy
The site supervisor shall be responsible for the:
• Implementation of the E&SC's outlined for Phase 1;
• Education of relevant site personnel on the E&SC's to be undertaken;
• Monitoring of the continued effectiveness of the controls during the works;
• Updating of the ESCP where necessary;
• Daily review of the 7 day BOM forecast for the works area; and
• All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions
The single stabilised entry / exit point on Finland Road shall be utilised for the project.
Identify all no go areas and delineate.
Identify all drainage lines and waterways intersecting the Temporary stockpile and site office area and construct stabilised outlet points where required. Refer to standard drawings SD-EST-1, SD-FR-1 and SD-RCD-1.
Undertake drainage control measures including:
• Divert 'clean' up-slope water around any soil disturbance where possible; and
• Transport stormwater through the work site in a non-erosive manner.
Undertake erosion control measures including:
• Limit the area of exposure; and
• Mulch to cover disturbed areas open without activity.
Any long term soil stockpiles situated in the laydown area (>3 weeks) shall be controlled by sediment fences on the down slope side if erosion is identified.

Legend
- LV/HV (limited) access
- HV access
- No Go Zone

N

90 45 0 90 Meters

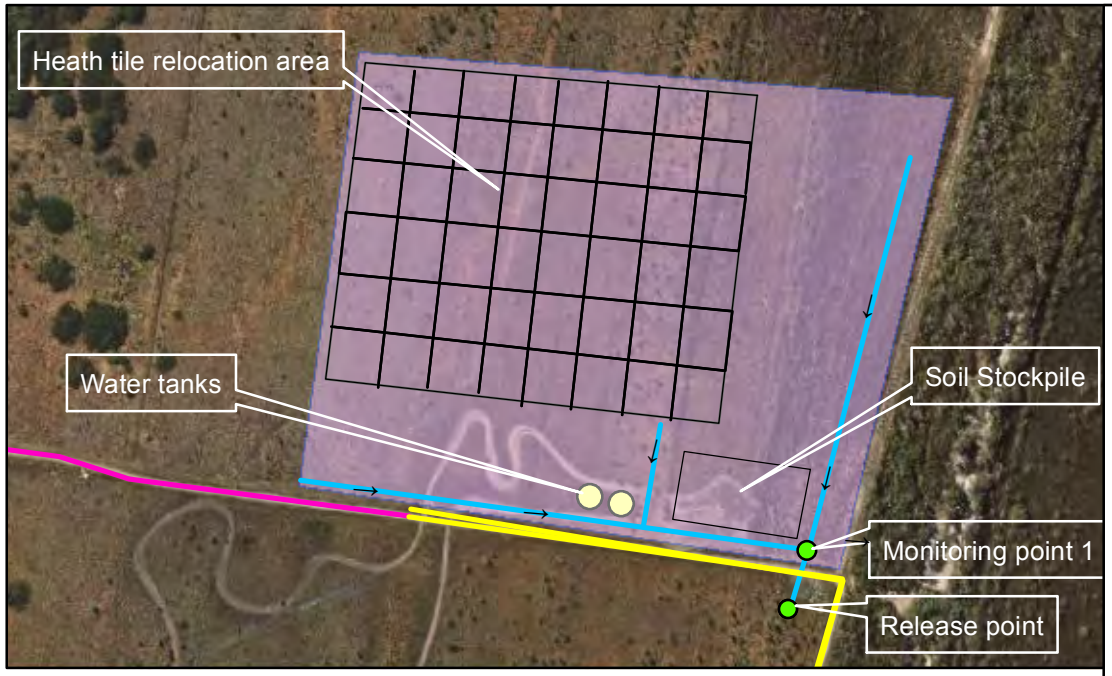
1 cm = 89 m

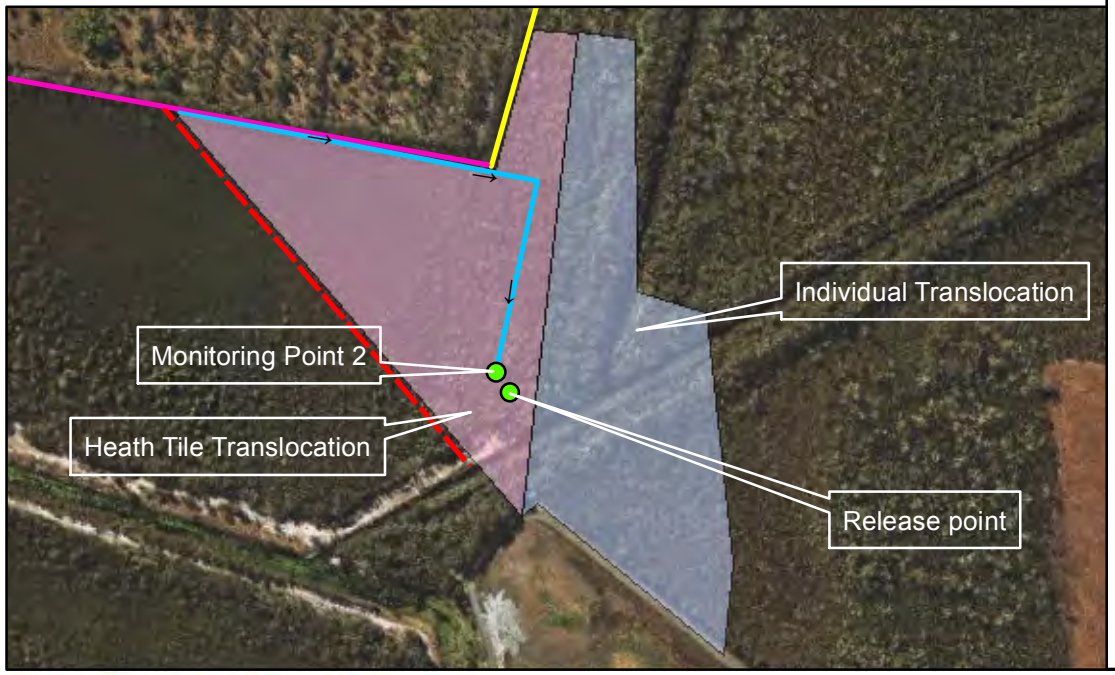
future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN:
PHASE 1 - SITE SETUP
Document Name: 5141-171212_P1

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994





Technical Notes

Objectives

To minimise environmental harm caused by the release of sediment laden water to the receiving environment.

For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.

Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy

The site supervisor shall be responsible for the:

- Implementation of the E&SC's outlined for Phase 1;
- Education of relevant site personnel on the E&SC's to be undertaken;
- Monitoring of the continued effectiveness of the controls during the works;
- Updating of the ESCP where necessary;
- Daily review of the 7 day BOM forecast for the works area; and
- All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions

All stormwater captured from the void post tile translocation, at both the impacted and receival areas, shall be diverted by constructing shallow catch drains, to a sediment trap for settling and testing and subsequent release (by pumping or similar). It should be noted that the void itself acts as a large sediment trap for all rainfall events and the sediment trap shall be used more as a collection sump.

Monitoring points (MP1 and MP2) shall be monitored during release events for water quality parameters listed above.

The pump release points shall be stabilised by mulch bunds or similar, and pump rates set to ensure no soil offsite is entrained.

The temporary soil stockpile at the receival site shall be stabilised by constructing a sediment fence on the down slope side.

Legend

- Indicative shallow drainage line
- HV access
- LV/HV (limited) access
- No Go Zone

N

40 20 0 40 Meters

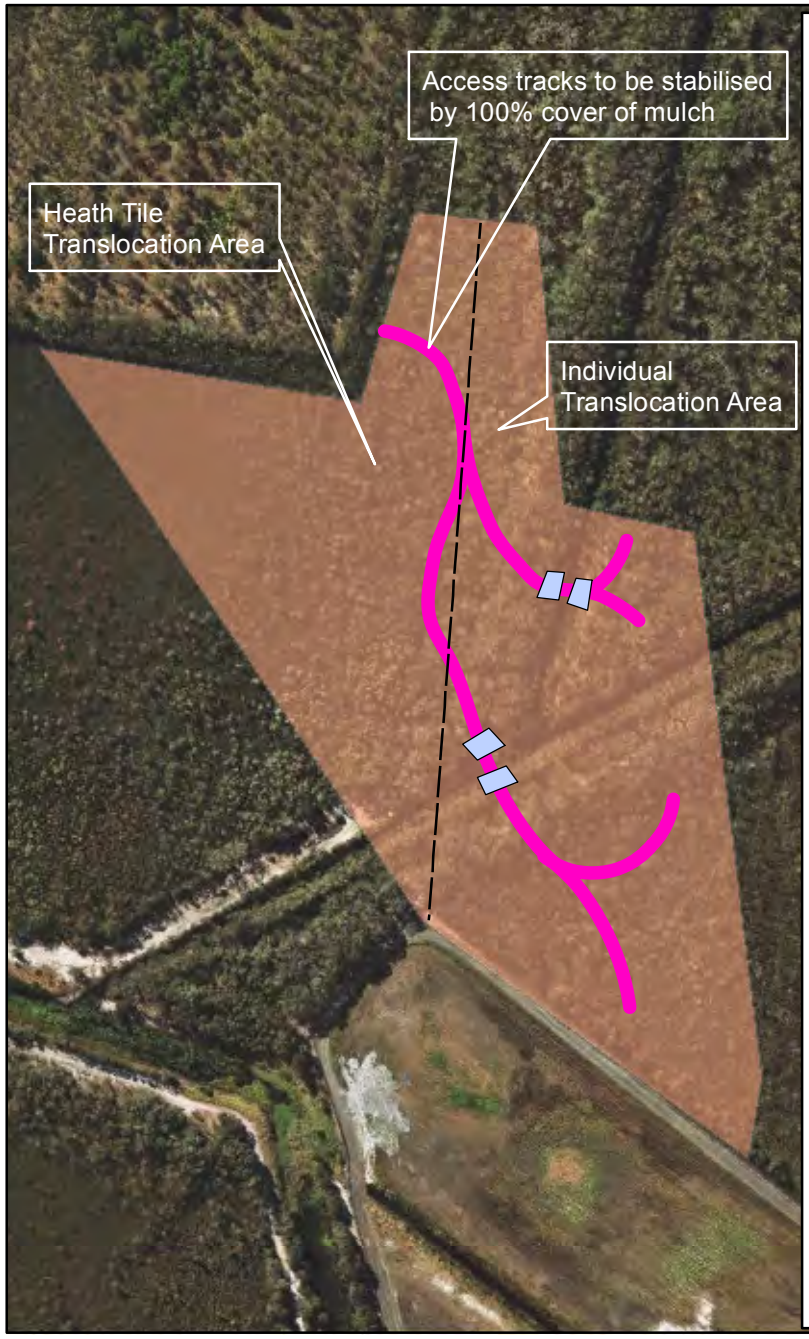
1 cm = 40 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN:
PHASE 2 - HEATH TILE TRANSLOCATION WORKS
Document Name: 5141-171212_P2

Project: MT EMU SHE-OAK TRANLOSCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994



Technical Notes

Objectives
To minimise environmental harm caused by the release of sediment laden water to the receiving environment.
For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.
Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy
The site supervisor shall be responsible for the:
• Implementation of the E&SC's outlined for Phase 1;
• Education of relevant site personnel on the E&SC's to be undertaken;
• Monitoring of the continued effectiveness of the controls during the works;
• Updating of the ESCP where necessary;
• Daily review of the 7 day BOM forecast for the works area; and
• All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions
The individual relocation is to be undertaken by hand, using shovels for the majority of plants however some larger plants may require mechanical aid to be dug. The plants shall be transported directly to the receival area for immediate replanting. The disturbances to soils shall be limited to vegetation clearing for access tracks and the installation of the temporary drain crossings.
The access tracks shall be constructed by mulching the vegetation to ground level leaving the mulch insitu for LV trafficability. 100% cover of the access tracks is required for LV access therefore achieving best practise E&SC objectives. In areas of the tracks where insufficient mulch exists, mulch shall be transported and spread to ensure 100% cover.
The installation of two temporary drain crossings shall be constructed by:
• Scheduling the works within a BOM predicted two to three day fine weather event;
• Should rainfall be predicted prior to final stabilisation works, all batters shall be mulched to achieve 100% cover; and
• All concentrated flow paths exiting directly into the drains from the temporary crossing stabilised by adequate velocity controls (e.g. SD-FR-1 and SD-RCD-1 or similar).

Legend
Temporary Crossing
Access roads

N

30 15 0 30 Meters

1 cm = 27.9 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN:
PHASE 3 - INDIVIDUAL PLANT RELOCATION WORKS
Document Name: 5141-171212-P3

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

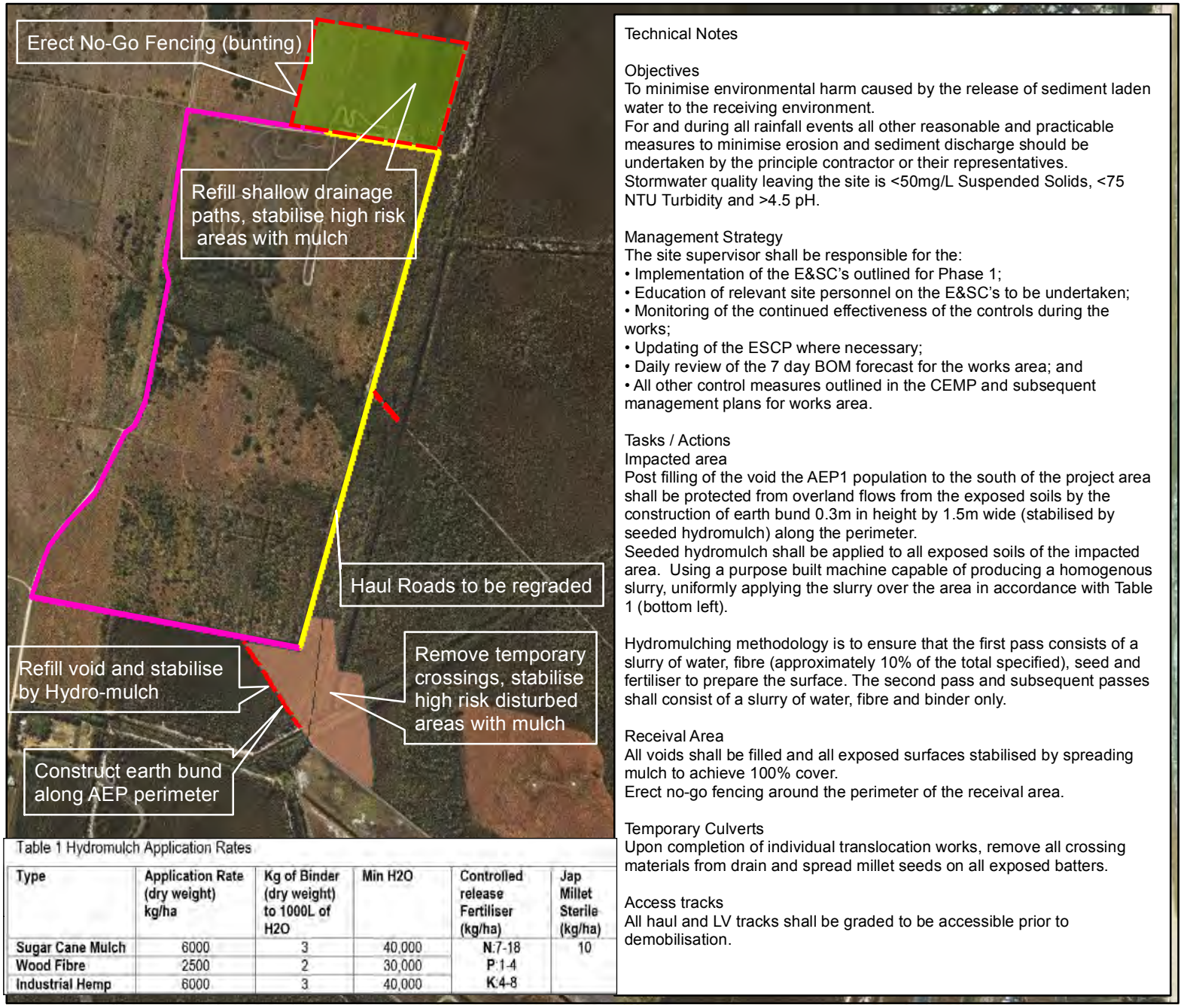


Table 1 Hydromulch Application Rates

Type	Application Rate (dry weight) kg/ha	Kg of Binder (dry weight) to 1000L of H2O	Min H2O	Controlled release Fertiliser (kg/ha)	Jap Millet Sterile (kg/ha)
Sugar Cane Mulch	6000	3	40,000	N:7-18	10
Wood Fibre	2500	2	30,000	P:1-4	
Industrial Hemp	6000	3	40,000	K:4-8	

Technical Notes

Objectives
To minimise environmental harm caused by the release of sediment laden water to the receiving environment.
For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.
Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy
The site supervisor shall be responsible for the:
• Implementation of the E&SC's outlined for Phase 1;
• Education of relevant site personnel on the E&SC's to be undertaken;
• Monitoring of the continued effectiveness of the controls during the works;
• Updating of the ESCP where necessary;
• Daily review of the 7 day BOM forecast for the works area; and
• All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions
Impacted area
Post filling of the void the AEP1 population to the south of the project area shall be protected from overland flows from the exposed soils by the construction of earth bund 0.3m in height by 1.5m wide (stabilised by seeded hydromulch) along the perimeter.
Seeded hydromulch shall be applied to all exposed soils of the impacted area. Using a purpose built machine capable of producing a homogenous slurry, uniformly applying the slurry over the area in accordance with Table 1 (bottom left).

Hydromulching methodology is to ensure that the first pass consists of a slurry of water, fibre (approximately 10% of the total specified), seed and fertiliser to prepare the surface. The second pass and subsequent passes shall consist of a slurry of water, fibre and binder only.

Receival Area
All voids shall be filled and all exposed surfaces stabilised by spreading mulch to achieve 100% cover.
Erect no-go fencing around the perimeter of the receival area.

Temporary Culverts
Upon completion of individual translocation works, remove all crossing materials from drain and spread millet seeds on all exposed batters.

Access tracks
All haul and LV tracks shall be graded to be accessible prior to demobilisation.

Legend
- LV/HV (limited) access
- HV access
- No Go Zone

N

110 55 0 110 Meters

1 cm = 115 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN: PHASE 4 - SITE COMPLETION
Document Name: 5141-171212_P4

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

Appendix B

Acid Sulphate Soils Management Plan

Our Ref: 5141

14 December, 2017

ASS Risk Assessment and Revised Management Plan

Mt Emu She-oak Translocation Project

Sunshine Coast Airport Expansion Project, Marcoola

Client: Sunshine Coast Council

Future-Plus Environmental (Sunshine Coast)
4/40 Technology Drive, Warana QLD 4556

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www.future-plus.com.au
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ABN 23 658 506 336

DOCUMENT CONTROL INFORMATION

Project Number: 5141

Project Manager: Kaine Pritchard

Client: Sunshine Coast Council

Report Title: ASS Risk Assessment and Revised Management Plan

Project: Sunshine Coast Airport Expansion Project

Site Address: Marcoola, QLD 4564

Document Review

Document Version	Document Status	Author	Reviewed By	Approved By
5141-171212-0.1_ASS	Client Issue	LC	KP	PW

Issue Approval

Destination	Document Version	Date Dispatched
Sunshine Coast Council	0.1	14 December 2017

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Signed on behalf of
Future-Plus Environmental

Date: 14 December 2017

Paul Wood

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LIST OF APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE

The Mt Emu She-oak (*Allocasuarina emuina*) Translocation Project (Project) is necessary to compensate for the unavoidable impacts to the EPBC listed endangered species resulting from the Sunshine Coast Airport Expansion Project (SCAEP). Heaths where Mt Emu She-Oak exists are described as Closed Wallum Heath. Wallum heaths are naturally acidic and are pH sensitive environments. Any treatment of Acid Sulfate Soils (ASS) in close proximity to, or in areas that are hydrologically connected to the Wallum Heath, can have a negative affect on the heaths acidic ecology.

The Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines (2014) state:

'Disturbance of acid sulfate soils adjacent to sensitive, acidic soft water environments must be avoided since use of neutralising agents will produce leachates that raise aquatic pH, adding hardness to water and putting acidophilic ecosystems at risk. Essentially, addressing one problem will create another'.

Following discussions with Wallum Heath Ecologists, it was agreed that if the risk of ASS (or strongly acidic soils) disturbance was low enough, to not justify the spreading of lime adjacent to the non impacted heath community, it would be of benefit. The purpose of the risk assessment is to determine:

- If the recommended treatment options outlined in the approved ASSMP (Core, 2017) for the site are required for soils to be placed adjacent to the Wallum Heath communities; and
- Where treatment is recommended, to ensure the treatment does not impact Wallum Heath communities onsite or adjacent to the site.

1.2 PROPOSED SOIL DISTURBANCES

The project is proposing to undertake two methods of translocation of the Mt Emu She-oak:

1. Heath Tile Method (up to 2ha); and
2. Individual Relocation (approximately 411 plants).

The proposed heath tile translocation operation will comprise excavations to a depth of 300 mm and relocating them to the proposed receival area. The receival area will be prepared by stripping 300 mm depth of topsoil material prior to the vegetation replacement. The spoil from the receival area will be used to fill the excavation left within the translocation area. Approximately 3,000m^3 of topsoils shall be disturbed per hectare of heath tile translocation.

The individual relocation is to be undertaken by hand, using shovels for the majority of plants however some larger plants may require mechanical aid to be dug. The plants shall be transported directly to the receival area for immediate replanting.

1.3 ASS INVESTIGATIONS

Core on behalf of the Sunshine Coast Council (SCC) has undertaken both ASS and Groundwater Investigations for both the impact and receival areas. The Core ASSMP is attached as **Appendix A**. In summary Core identified actionable levels of net acidity within the upper 0.5m bgl. However, Core noted that:

- The acidity was 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated.
- The existing acidity present may be due to organic acids rather than oxidised sulfur (note in only one sample, BH17 0.0-0.25m which is now outside of the proposed receival area boundary, recorded net sulfuric acidity of 0.02%S).

Core concluded that the soil results:

"indicate there is likely to be disturbance of soils with existing acidity during the proposed translocation of the Emu Mountain She Oak. However, the levels of existing acidity are generally low, and the proposed disturbance is considered unlikely to generate further acidity or cause further acidity to migrate offsite."

1.4 ASSMP TREATMENT RECOMMENDATIONS

The Core ASSMP recommends the spreading of a 5kg/m^2 lime guard layer prior to the refilling the void post heath tiling at the Impacted Area. Liming of the disturbed soils is not recommended if the soils are to remain onsite (which is proposed).

2.0 RISK ASSESSMENT

The following risk assessment process is based on the risk guide from the AS/NZS ISO31000: 2009. The assessment considers risks to the environment from the disturbance of ASS (or strongly acidic soils). Measures of consequence and risk have been contextualised by the following:

- Core ASS Investigation and Management Plan (2017);
- Proposed soil disturbances during the Mt Emu She-oak Translocation Project; and
- End point ASS management of applying a lime guard layer adjacent to Wallum Heath containing Endangered species listed under the EPBC Act.

2.1 RISK ASSESSMENT TABLES

Table 1: Defined measures of consequence

Level	Descriptor	Consequence
1	Insignificant	Insignificant impact or not detectable environmental impact
2	Minor	Potentially harmful to site ecosystems with impacts contained to site
3	Moderate	Potentially harmful to adjacent ecosystem with local impacts primarily contained to on-site
4	Major	Potentially lethal to local ecosystem; predominantly local, but potential for off-site impacts
5	Catastrophic	Potentially lethal to regional ecosystem or threatened species; widespread on-site and off-site impacts

Table 2 Risk Ratings

Likelihood	Consequence				
	1 Significant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A Rare	Low	Low	Low	High	High
B Unlikely	Low	Low	Moderate	High	Very High
C Possible	Low	Moderate	High	Very High	Very High
D Likely	Low	Moderate	High	Very High	Very High
E Almost certain	Low	Moderate	High	Very High	Very High

Based on the above guidance a risk assessment has been undertaken and is presented in **Table 3** below.

Table 3 Hazard Identification and Risk Assessment for ASS Management and Treatment during the Mt Emu She-oak Translocation Project

Source	Hazardous event	Hazard type	Risk Information	Maximum Risk Rating			Preventative Measure	Residual Risk Rating		
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Acidic leachate post filling the void	Increasing the acidity of the receiving environment post refilling of the void at the impacted area.	Enviro	Soil pH_{KCl} of the soils to be used to fill void presently range between 4.5-5.1. No potential sulfuric acidity exists within the soil. Receiving environment acidic.	2	B	Low	A 5 kg/m^2 guard layer shall be applied to the balance of Impacted Area if the average pH_f of the stockpiled soils is <4.	3	A	**Low**
Liming of soils	Treatment of ASS using neutralising agent causes changes adjacent Wallum Heath ecosystem.	Enviro	Neutralising agents will produce leachates that raise aquatic pH, adding hardness to water and putting acidophilic ecosystems at risk	3	C	High	NO lime guard layer shall be applied within 20m of the non-impacted heath population. Note the soils used for refilling the void shall be tested for acidity and must achieve an average pH_f of >4 prior to being used as fill.	2	B	**Low**

3.0 CONCLUSION AND RECOMMENDATIONS

Based on the above risk assessment the following management shall be undertaken for disturbed soils during the translocation works:

- NO lime guard layer shall be applied within 20m of the non-impacted heath population located adjacent to the south of the impacted area, however soils to be used as fill shall have an average pH_f of >4;
- A 5 kg/m^2 guard layer shall be applied to the balance of the impacted area before placement of the soils (transported from the receival area) if the average pH_f of the stockpiled soils is <4.0; and
- Testing the stockpiled soils to be undertaken at a rate of 1 sample per 500m^3.

4.0 VERIFICATION AND MONITORING

All monitoring results, photographs and lime delivery dockets shall be kept and presented in the daily dairy for quality assurance and validation purposes.

Appendix A.

Core ASSMP 2017

Acid Sulfate Soil Investigation
Emu Mountain She Oak
Sunshine Coast Airport Expansion, Finland Road,

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Sunshine Coast Airport Expansion Project
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Report Number: J000030-0012-R-Rev0

August 2017

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1.0 INTRODUCTION

Core Consultants Pty Ltd (Core) were requested by Sunshine Coast Council (SCC) to undertake an Acid Sulfate Soil (ASS) Investigation on two areas of Sunshine Coat Airport (SCA) Expansion Project located at Finland Road, Marcoola. The two areas consisted of the Emu Mountain She-Oak translocation area and the receival area. The location of the both areas is shown in Plate 1 below.

It is understood that SCC require the ASS investigation as part of the relocation of a population of Emu Mountain She-Oak located within the SCA Expansion area.

The ASS Investigation was carried out by Core in accordance with our proposal Q001087-001-L-Rev0, dated 18 July 2017.

The assessment included a desk top review of published maps and data relating to the topography, ASS mapping and geology of the site in addition to an ASS intrusive investigation to establish the presence or absence of ASS within the proposed translocation and receival areas.

Plate 1:Translocation and Receival Area Locations ***(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)***

2.0 PROPOSED EMU MOUNTAIN SHE OAK TRANSLOCATION

Information provided by SCC indicates that the proposed translocation area covers approximately 4.5 ha, and the receival area will be of a similar footprint.

Recent discussions with SCA indicates that the proposed translocation operation will comprise excavation of heath tiles to a depth of 300 mm and relocating them to the proposed receival area. The receival area will be prepared by stripping 300 mm depth of topsoil material prior to the vegetation replacement.

The spoil from the receival area will be used to fill the excavation left within the translocation area. The operation will be undertaken in several stages so that excess topsoil spoil management is limited to low stockpile volumes.

3.0 SITE LOCATION

The investigation areas are located with the proposes SCA Expansion area and are shown in Plate 1 above. The translocation area is dominated by Emu Mountain She Oak (Refer to Photograph No. 1), while the receival area is cleared. Both areas are relatively flat with elevations close to 0 m Australian Height Datum (AHD). There are several man-made drains for the existing Sunshine Coast Airport that intersect the translocation area, while the nearest surface water receptor to the receival area is the Marcoola drain located approximately 450 m to the north.

Photograph 1 – Borehole Location BH5, Emu Mountain She Oak Translocation Area.

4.0 ACID SULFATE SOIL OVERVIEW

The formation of ASS is commonly the result of marine or estuarine deposition of sulfate and iron bearing sediments in the presence of an abundant source of readily decomposable organic matter resulting in the deposition of pyrite. This pyrite is stable within the soil so long as anoxic conditions prevail. Oxidation of this material produces acidic conditions. Oxidation typically occurs when the material below the water table is exposed to air following excavation, or is drained by lowering the water table during dewatering processes.

Previous experience and available guidelines indicate that ASS are normally restricted in extent to recent (Holocene to Pleistocene age) soil horizons deposited in a saline environment below RL 5 m. The State Planning Policy 2014 (SPP14) "State Interest Guideline – Water Quality" (August 2014) (SPP14) applies to land, soil and sediment at or below 5 m AHD where the natural ground level is less than 20 m AHD. Within such areas the SPP applies to development involving any of the following:

- Excavating or otherwise removing 100 m³ or more of soil or sediment; or
- Filling of land involving 500 m³ or more of material with an average depth of 0.5 m or greater.

The SCA expansion area, which occupies some 460 hectares, lies below 5m AHD and is situated mainly on recent alluvial deposits of Quaternary age (interpreted as being mainly of Pleistocene age) overlying residual geology, predominantly sandstone of the Landsborough Sandstone formation. The entirety of the expansion area is underlain by 'undifferentiated coastal plain' comprising "sands and mud" that is known to also contain "clay/silt (active stream channel and low terraces)" which include some Holocene age deposits likely to include ASS. Typically, ASS occur only in Holocene deposits, although some low level ASS may occur in the more recent of the older Pleistocene deposits.

The proposed development involves excavations that would exceed the above trigger levels. SPP14 is therefore applicable to this site due to the extent of proposed earthworks activities and an assessment of potential disturbance of ASS is required.

The aims of this investigation were to:

- Conduct an ASS investigation in general accordance with the requirements of the State Planning Policy 2014 "State Interest Guideline – Water Quality" (August 2014) with sampling and analysis planned to use the Queensland Department of Natural Resources and Mines (NRM) "Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland - 1998", developed by the Queensland Acid Sulfate Soils Investigation Team (QASSIT).
- Quantitatively identify the presence or absence of ASS across the proposed disturbance areas;
- If necessary, assess the likely impact of the proposed development on ASS and groundwater;
- If necessary, provide prudent management measures so that the release of acid leachate from disturbed soil and groundwater does not have significant adverse effects on the natural and built environment or human health; and
- Advise whether a stand-alone ASS Environmental Management Plan (ASS EMP) is required for the proposed works.

The results of the ASS investigation are set out in the following sections and follow the format set out in the State Planning Policy 2014 Guideline.

5.0 METHODOLOGY

5.1 Published Information

Assessment and review of published maps and data of the following criteria was undertaken for the proposed development area:

- Topography and height above sea level (AHD);

- Published maps of ASS distribution in South East Queensland; and
- Regional geology and indicative soil types and their origins.

The findings from the desktop assessment are presented in Section 6.1.

5.2 Field Investigation

In line with the Queensland Guidelines, two boreholes per ha for areas >4 ha are required for an ASS investigation. It should be noted that the Queensland Guidelines require an ASS investigation to extend to 1 m below the proposed depth of disturbance.

Twenty boreholes, including two groundwater monitoring wells were advanced to depths of up to 1.5 m below ground level (bgl) within the translocation and receival areas. Borehole locations are shown on Plates 2 and 3 and are summarised in Table 1 below.

Table 1: Borehole Distribution

Translocation Area (<5 m AHD)	Receival Area (<5m AHD)
10 boreholes to 1.5 m depth (BH1-EMS to BH10-EMS) including one groundwater monitoring well (GW1)	10 boreholes to 1.5 m depth (BH11-EMS to BH20-EMS) including one groundwater monitoring well (GW2)

Boreholes were drilled using a combination of 4WD-mounted solid flight auger rig (using push tube sample techniques to recover undisturbed soil samples where possible) and hand augering due to access constraints. The fieldwork was carried out in the presences of an experienced Environmental Scientist from Core.

Samples for ASS testing were recovered from the boreholes at approximately 0.25 m intervals to the depth of each borehole. ASS sampling protocols outlined in the “Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1988” (Ahern et al., 1998) were observed in the field to minimise oxidation of the samples prior to laboratory testing.

The location of each borehole was recorded using a hand-held GPS unit with a differential correction signal, having an accuracy of ± 5 m. Borehole coordinates are presented on the Reports of Boreholes in Appendix A, together with explanatory notes. Subsurface conditions are discussed in Section 6.2.

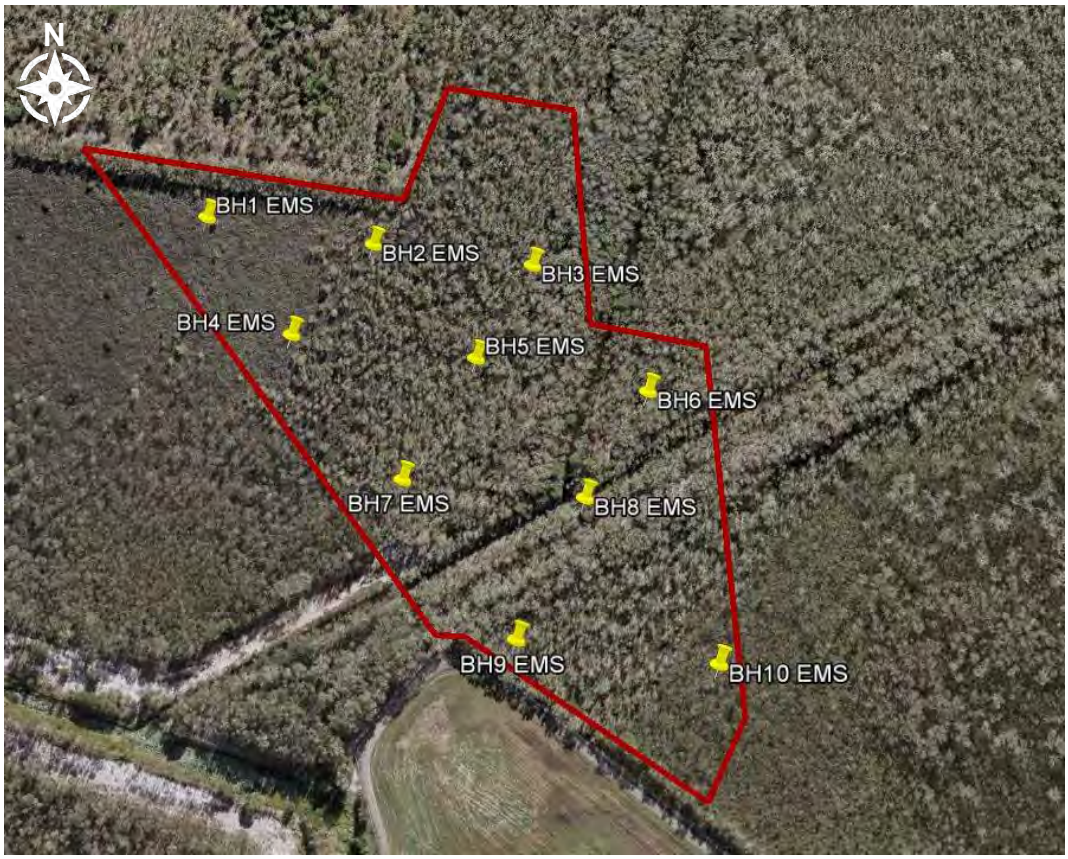


Plate 2: Borehole Locations – Translocation Area ***(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)***

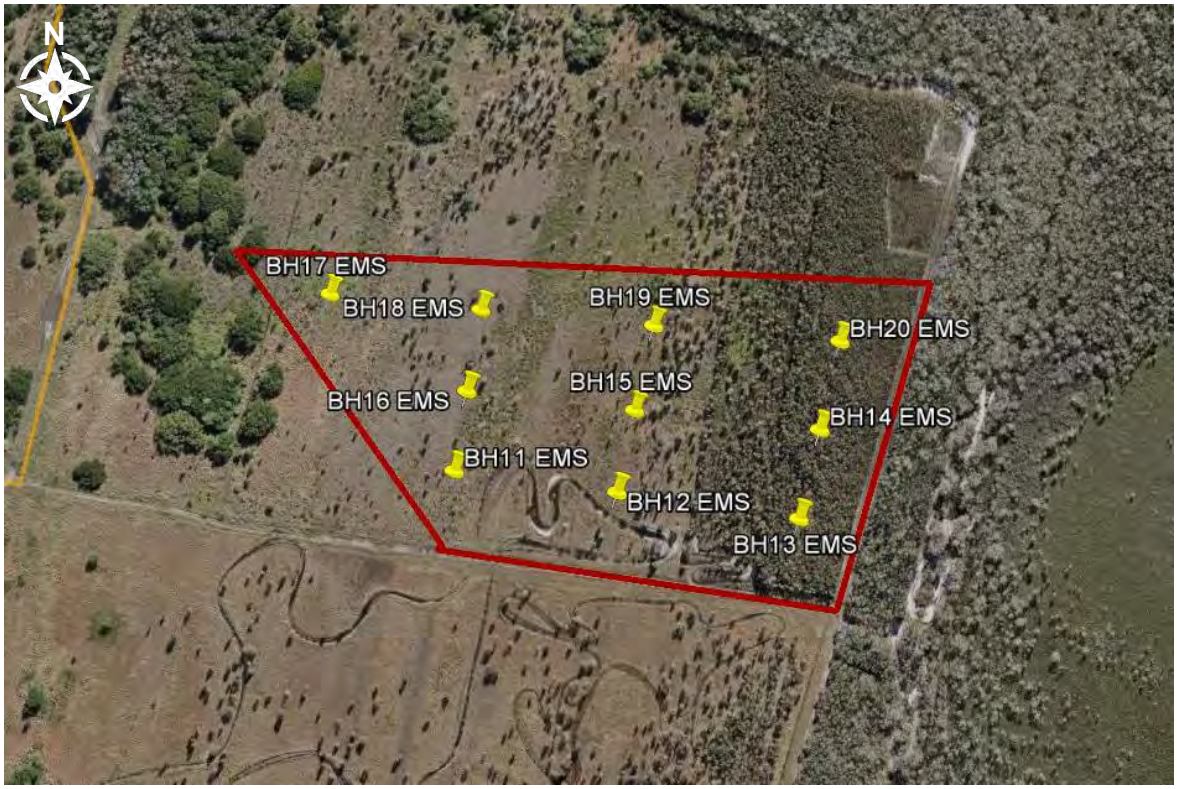


Plate 3: Borehole Locations – Receival Area ***(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)***

5.3 Groundwater Monitoring Well Installation and Sampling

Groundwater monitoring wells (GW1 and GW2) were installed in boreholes BH7-EMS and BH12-EMS, respectively. The wells were constructed using 50 mm diameter PVC pipe slotted over the bottom 1.0 m. The screened sections were gravel packed and then sealed with a bentonite plug. Well construction details are shown on the borehole reports (ref. Appendix A).

Groundwater quality monitoring was undertaken to enable an appraisal of the influence of ASS (if any) on water quality.

The groundwater levels were measured at each well by an experienced Environmental Scientist on 29 June 2017. A groundwater sample was only recovered from GW1, as GW2 contained insufficient water for sampling. The groundwater sample from GW1 was tested in the field for temperature, pH, salinity and electrical conductivity (EC) using a calibrated water quality meter.

The sample was then dispatched to Australian Laboratory Service (ASL) to undergo further analysis. ALS is National Association of Testing Authorities (NATA) accredited for the analytical tests. Results of groundwater monitoring are summarised in Section 6.4. ALS laboratory results are attached in Appendix C.

Groundwater sampling, field testing, sample handling and dispatch procedures were performed in accordance with Core procedures, the Department of Environment and Heritage Protection (EHP) *Monitoring and Sampling Manual 2009* Version 2 September 2010 and the Murray Darling Basin Groundwater Quality Sampling Guidelines (MBDC 1997).

5.4 Laboratory Testing Program

A total of 120 samples were screened at Core's Maroochydore laboratory to assess field pH (pH_F) and pH after oxidation (pH_{FOX}) using 30 % hydrogen solution buffered to between pH 4.5 to pH 5.5.

The pH_F/pH_{FOX} screening method consists of two steps. In the first step, the field pH of a 1:5 soil/water suspension is measured (pH_F). In the second step, a 30% Hydrogen Peroxide solution is added to the sample which is then heated to accelerate the oxidation of the sample. The pH after oxidation (pH_{FOX}) is then measured. A significant difference between the pH_F and pH_{FOX} results is indicative of PASS; however, test results may be affected by other inclusions such as shell material and organics.

Based upon the results of these screening tests, 40 samples (approximately two samples per borehole) were selected and dispatched to Eurofins/MGT laboratory to undergo quantitative analysis by the Chromium Reducible Sulfur suite in accordance with ASS Method 23F and 22B laboratory procedures of Ahern et al (2004).

This method includes analysis of 'inherent buffering capacity' from naturally occurring alkaline materials (i.e. calcite, coral debris, fine shell fragments) and 'retained acidity' which includes sulfur held in stable oxidation minerals such as 'jarosite' and allows for calculation of 'net acidity'. The Chromium Reducible Sulfur test method was selected in preference to the Suspension Peroxide Oxidation Combined Acidity & Sulfur (SPOCAS) method as it gives more accurate indications of pyrite content where significant amounts of organic matter (and organic derived acidity) are present in the soil samples.

An overall acid-base accounting method was used to calculate a 'net acidity' value which is used to qualify analytical test results and calculate liming rates. This equation is given by:

> Net Acidity = Actual Acidity (as TAA) + Retained Acidity (as S_{NAS}) + Potential Acidity (as S_{CR}) - insitu Acid Neutralising Capacity (ANC).

The Eurofins/MGT laboratory certificates of analysis, chain of custody documents and laboratory quality control documents are attached in Appendix C and the results are summarised in Appendix B, Table B1. Observations and discussion on the laboratory findings are given in Sections 6.7.

6.0 RESULTS OF THE INVESTIGATION

6.1 Published Data

The 1:100,000 Series Nambour Special Geological Map (Sheet 9444 & Part 9544, First Edition 1999) indicates that most of the site is underlain by Quaternary (Pleistocene) age '*undifferentiated coastal plains'* comprising '*sands and mud'* that is known to also contain "*clay/silt (active stream channel and low terraces*)". The Quaternary deposits are inferred to be underlain by the older Landsborough Sandstone and/or Nambour Formation.

The Nambour Special Geology Map shows Holocene alluvium comprising "clay/silts of the active stream channels and lower terraces" to the north west of the site (denoted Qhct in Plate 4), associated with the South Maroochy River.

An extract from the abovementioned geology map is provided in Plate 4 below.

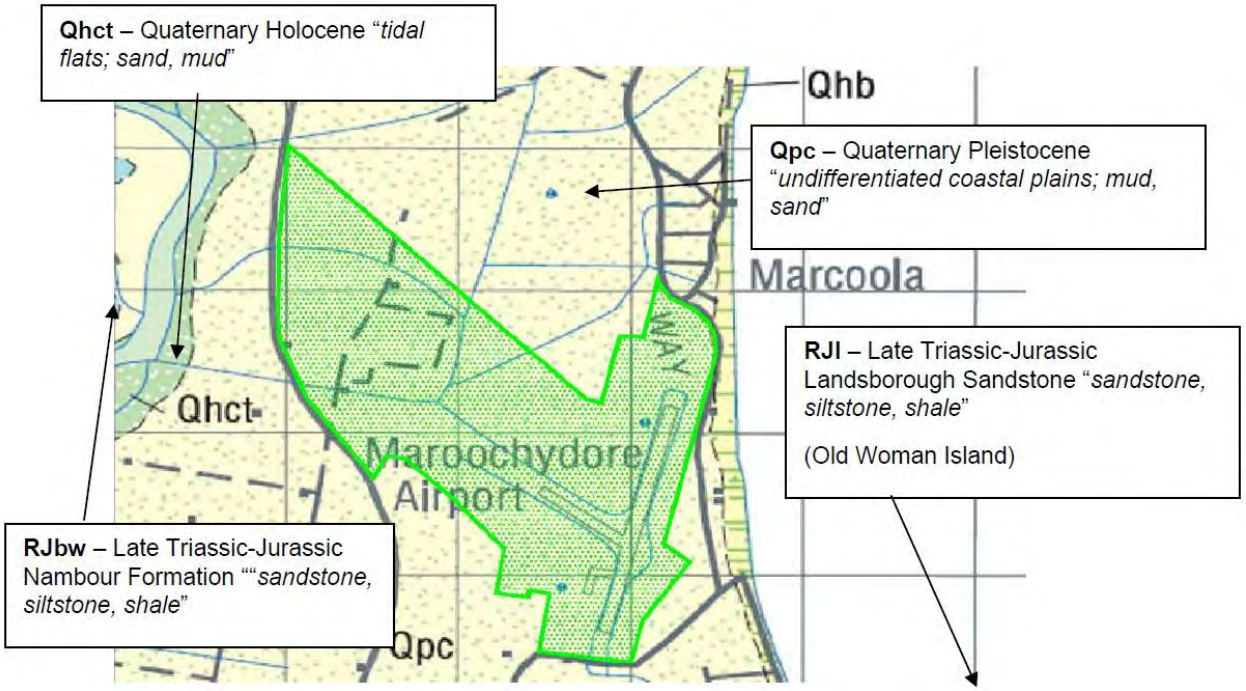
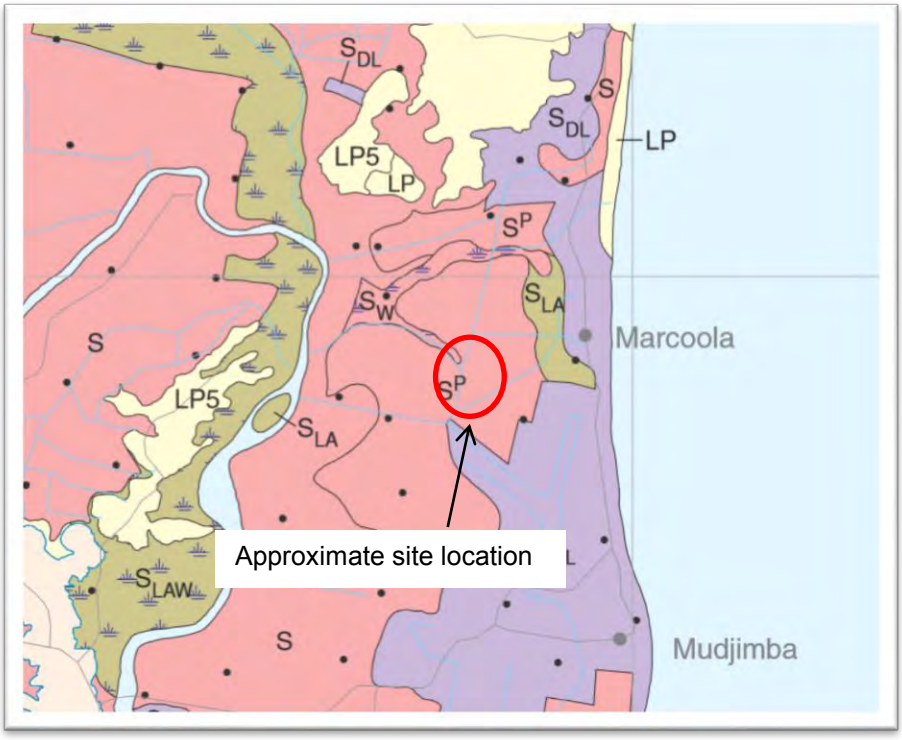


Plate 4: Extract of Regional Geology Map

Reference to the Acid Sulfate Soils Map for the Redcliffe to Teewah area prepared by the Queensland Government, Department of Natural Resources 1999, indicates that the area is underlain by "Disturbed urban or industrial land (<5 m AHD) likely to contain Acid Sulfate Soil".

An extract from the abovementioned acid sulfate soils map is provided in Plate 5 below.



ACID SULFATE SOILS (ASS)[1] ON RELATIVELY UNDISTURBED LAND

S

Land where ASS occurs within 5m of the surface. Virtually all land in this category has at least one 'potential acid sulfate soil' layer[3] and some of this land will have an 'actual acid sulfate soil' layer[2].

NOTE: S^P - indicates sediments of Pleistocene age[1].

Plate 5: Extract from published ASS map

6.2 Subsurface Conditions

The soil profiles encountered were consistent across both areas and generally comprised:

- Silty Sand (Topsoil), dark grey / grey, fine to medium grained with organics to depths of up to 0.5 m bgl, underlain by;
- Alluvial, fine to medium grained, Sand, Silty Sand with the sands at most locations displaying various strengths of cementation to depths ranging between 0.9 m bgl to 1.5 m bgl.

Reports of boreholes and explanatory notes are presented in Appendix A.

6.3 Groundwater

Groundwater seepage/inflow was observed at depths of between 0.4 m bgl to 1.5 m bgl at the time of drilling. Results of seepage/inflow observations are included on the individual borehole reports in Appendix A.

The groundwater level was found to range from 0.45 m bgl to 0.8 m bgl during groundwater monitoring on 29 June 2017. Results of monitoring observations are included in Table 2 below.

It should be noted that the investigation was carried out during a seasonal dry period, and that groundwater levels would be expected to rise above present levels during wet weather events and following periods of heavy or persistent rainfall.

6.4 Groundwater Quality Analysis

A groundwater sample was collected from GW1 on 29 June 2017 to provide an initial assessment of groundwater conditions. The results are summarised in Table 2.

Table 2: Results of Groundwater Analysis

Parameter	GW1
Field Results	
Groundwater Level (m bgl)	0.45
Field pH	4.7
Electrical Conductivity (µS/cm)	261
Temperature (°C)	22.0
Observations	turbid, dark brown
Laboratory Results	
Total Dissolved Solids (mg/L)	412
Total Alkalinity as $CaCO_3$ (mg/L)	<1
Acidity as $CaCO_3$ (mg/L)	238
Sulfate as SO_4 (mg/L)	21
Chloride (mg/L)	83
Cl:SO_4 Ratio	-
Calcium (mg/L)	3
Magnesium (mg/L)	5
Potassium (mg/L)	<1
Sodium (mg/L)	48
Aluminium (filtered) (mg/L)	0.23
Iron (filtered) (mg/L)	4.45

The groundwater level was measured at 0.45 m bgl on 29 June 2017. It is anticipated that the extent of groundwater seepage encountered during the proposed Emu Mountain She Oak translocation will be dependent upon the prevailing weather conditions at that time, but could rise closer to the ground surface.

The groundwater pH result of 4.7 indicates that the groundwater is moderately acidic. Electrical conductivity (EC) value of 261 µs/cm, indicates the groundwater is fresh.

The Chloride:Sulfate (Cl^-:SO_4^{2-}) ratio is used to assess whether elevated sulfate levels have derived from exposure of acid sulfate soils. A Cl:SO4 ratios of less than two are generally considered to be a strong indication of an extra source of sulphate from previous oxidation of ASS. In this case the chloride and sulfate concentrations recorded from GW1 were considered too low to provide reliable information from which any conclusions could be drawn.

Dissolved iron (Fe) concentrations in the groundwater was relatively high which is indicative of an iron rich environment, common along coastal Southeast Queensland. Dissolved aluminium (Al) concentrations recorded was relatively low.

6.5 Preliminary Screening Results

Results of preliminary screening are summarised in Appendix B, Table B1.

In this investigation, soil pH (represented by pH_F results) was found to range between pH 4.4 and pH 5.8 (moderately acidic to slightly acidic), with a significant number of samples being between pH 4.0 to pH 5.0, indicating a low to moderate probability of the presence of actual ASS at most locations.

Generally, only slight differences in the pH_{FOX} and pH_F test results were recorded for most of the samples tested. All samples displayed a mixture of low to moderate level reactions to the addition of hydrogen peroxide. The pH_{FOX} ranged from pH 1.5 to pH 4.9 and was generally observed below pH 3.0 for most samples. This suggests a moderate to high potential for the presence of potential ASS (PASS).

6.6 Quantitative Soils Analysis

Table 3 below shows the ASS action levels adopted in Queensland. These categories are used to identify whether action / management of ASS spoil is required, based on 'net acidity'. For major fill works and disturbances of more than 1,000 tonnes, an action criterion of 0.03% S equivalents (18 moles / tonne) is adopted for all soil types.

Table 3: ASS Action Criteria

Type of Material		**Action Criteria 1-1000 tonnes disturbed**		**Action Criteria > 1000 tonnes disturbed (and major fill projects)**	
		Existing + Potential Acidity		Existing + Potential Acidity	
Texture range McDonald et al. (1990)	Approx. clay content (%)	Equivalent sulfur %S oxidisable	Equivalent acid mol H^+/ tonne	Equivalent sulfur %S oxidisable (oven-dry basis)	Equivalent acid mol H^+/ tonne (oven-dry basis)
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5 – 40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.10	62	0.03	18

Results of the 40 samples analysed are summarised below:

Translocation Area

- One sample returned a Titratable Actual Acidity (TAA) results above the action criterion of 18 mol H+/ tonne with a concentration 75 mol H+/ tonne.
- Oxidisable Sulfur was not present as S_{CR} at levels above action criteria of 0.03%S in any of the 20 samples analysed.
- No samples returned pH_{KCl} values exceeding pH 6.5, and as such no further analysis for acid neutralising capacity (ANC) was carried out.
- No samples returned pHKCl values less than pH 4.5, and as such no further analysis for retained acidity (S_{NAS}) was carried out.

The quantitative test results for samples analysed indicate low levels of existing acidity with levels ranging from below the laboratory limit of reporting (2 mol H+/tonne) up to 75 mol H+/tonne.

Results of S_{CR} tests indicate negligible levels of PASS recorded with potential acidity levels below the QASSIT 'Action Criteria' and the laboratory detection levels (<0.005%S).

Of the 20 samples analysed, net acidity exceeded the relevant QASSIT 'Action Criteria' (for bulk earthworks) in one sample (BH6 0.0-0.25 m) and was equal to the exceedance criteria at 2 other locations (BH3 0.25-0.5 m and BH7 0.0-0.25 m), indicating that some level of management and/or lime neutralisation treatment may be required if these soils are disturbed.

Receival Area

- Ten samples returned Titratable Actual Acidity (TAA) results equal to or above the action criterion of 18 mol H+/ tonne (0.03%S), ranging between 18 mol H+/ tonne to 95 mol H+/ tonne.
- Oxidisable Sulfur was not present as S_{CR} at levels above action criteria of 0.03%S in any of the 20 samples analysed.
- No samples returned pH_{KCl} values exceeding pH 6.5, and as such no further analysis for acid neutralising capacity (ANC) was carried out.
- No samples returned pHKCl values less than pH 4.5, and as such no further analysis for retained acidity (S_{NAS}) was carried out.

The quantitative test results for samples analysed indicated low levels of existing acidity were identified in the samples collected, with levels ranging from below the laboratory limit of reporting (2 mol H+/tonne) up to 95 mol H+/tonne.

Results of S_{CR} tests indicate low to negligible levels of PASS with potential acidity levels below the QASSIT 'Action Criteria' with concentrations ranging from <0.005%S to 0.01%S.

Of the 20 samples analysed, net acidity exceeded the relevant QASSIT 'Action Criteria' (for bulk earthworks) in nine samples indicating that some level of management and/or lime neutralisation treatment may be required if these soils are disturbed.

6.7 Extent and severity

The SPP14 Guidelines require that the level of treatment for management of ASS is based on treatment of all existing and potential acidity. The results of the laboratory testing have been accumulated in an Acid-Base Account to give the Net Acidity for each sample in units of mol H+/tonne as presented in Table B1 in Appendix B. This value has been calculated from sulfur trail potential acidity (S_{cr}) plus actual acidity (TAA).

Translocation Area

Based on testing carried out to date, soils with actionable levels of existing acidity appear to be distributed within the upper 0.5 m bgl. It should be noted that 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated. The existing acidity present may be due to organic acids rather than oxidised sulfur. Recommended liming rates for these soils if disposed off-site or used in other areas of the SCA project are presented below in Table 4.

Receival Area

Based on testing carried out to date, soils with actionable levels of existing acidity appear to be distributed within the upper 0.5 m bgl. It should be noted that 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated. The existing acidity present may be due to organic acids and minor oxidised sulfur. Recommended liming rates for these soils if disposed off-site or used in other areas of the SCA project are presented below in Table 4.

Table 4: Recommended Liming Rates

Location	Treatment Rate
Translocation Area	10 kg $CaCO_3/m^3$ *
Receival Area	13 kg CaCO3/m^3 *

Note: * Liming rate based on highest individual values within the areas.

6.8 Risk Assessment

Technically, given the large size of the planned translocation and receival area, the level of management of ASS required in accordance with the Queensland Soil Management Guidelines - Table 4-2 (i.e. the use of

greater than 25 tonnes of aglime) would likely be classified as EH (extremely high level). However, given the proposed depth of excavation, the low levels of acidity detected within the areas and the low to negligible risk of future generation of additional acidity the overall risk is consider low to moderate.

Furthermore, spoil won from the excavation of the receival area is to be placed directly into the excavation from the translocation area. Given the naturally acidic natural of the local environment and the similar soil properties and chemistry this method of translocation is consider to pose a non-worsening effect.

Nonetheless, management of this existing acidity will be needed to be addressed and specific management measures must be carried out in order to further reduce the overall risk.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The results of this investigation indicate there is likely to be disturbance of soils with existing acidity during the proposed translocation of the Emu Mountain She Oak. However, the levels of existing acidity are generally low, and the proposed disturbance is considered unlikely to generate further acidity or cause further acidity to migrate offsite.

The following recommendations should be adopted to manage the risk of environmental harm during proposed earthworks:

- Spoil won from the receival area should be placed directly within the excavation of the translocation area. If stockpiling is required additional management measures are provided in Section 7.1
- A lime guard layer should be applied to the base of translocation area following removal of the heath tiles. Lime guard layers should be applied at the rate of 5 kg of lime per m^2.
- No lime guard layer will be required at the base of the receival area.
- Groundwater is unlikely to be encountered within the proposed shallow excavations of the translocation and receival areas. Management of rainfall collected from the site is incorporated in Section 7.2.
- If acidic soils are to be removed off-site or placed in other areas of the SCA project, lime treatment should be carried out to neutralise acidity as per Table 4 above. If lime treatment is required than additional management measure (i.e. lime treatment pads, mixing procedures, verification testing etc.) will be required and a stand-alone ASS MP should be developed.
- An accurate spatial tracking system should be developed to control the movement and final location of excavated soil.

7.1 Stockpiles and Handling

Wherever practical, earthworks handling should involve transporting directly from cut to fill areas and stockpiling of acidic soils should be avoided.

Where it is necessary to stockpile acidic soils the following additional management measures must be followed:

- Stockpiles are to be contained by bunds with stormwater runoff directed to a collection sump. Bunds are to be constructed from low permeability materials that are not acid soils or have been fully lime treated.
- A guard layer of neutralising agent should be spread across the soil surface prior to placement of the stockpile. The rate of neutralising agent applied should be based on 0.3 times the average total potential plus existing acidity for every 1 m height of soil in the stockpile.
- The surface area of the stockpile is to be minimised by shaping and sealed by surface compaction to reduce moisture loss and rainfall entry.

7.2 Water Management

Groundwater is unlikely to be encountered during excavations. However, any waters collected within the excavation areas should be directed into a temporary basin/holding point for testing prior to any discharge.

8.0 LIMITATIONS

Should you require any further information please contact the undersigned. We draw your attention to the document, Limitations, which is included in Appendix D.

Core Consultants Pty Ltd

Yours sincerely,

Cameron Kay BSc(ENV) MEIANZ CEnvP

Senior Environmental Scientist

Josh Mitchel BSc(ENV) CEnvP MEIANZ CPSS

Associate/Senior Environmental Scientist

CK/JM/ck

A.B.N. 75 603 384 050

APPENDIX A
Reports of Boreholes

REPORT OF BOREHOLE: BH 1 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507898.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058628.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace rootlets			
			0.5	*0.50*				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
				0.70					Becoming pale yellow			
		Groundwater encountered at 1.2m depth	1.0							M - W		
				1.20				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 2 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507972.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058615.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
			0.5	0.50				SP	SAND (ALLUVIUM): fine to medium grained, brown, trace silt	M		
			1.0	0.80					Becoming pale brown			
				1.30					Becoming dark grey	M - W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 3 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508042.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058605.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
		Groundwater encounted at 0.9m depth	0.5									
			1.0							M - W		
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 4 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507939.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058573.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace organics, trace rootlets			
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt	M		
		Groundwater encountered at 0.8m depth	0.5							M - W		
			1.0	*1.00*				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 5 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508019.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058562.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace silt			
				0.50				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
		Groundwater encountered at 1.0m depth	1.0							M - W		
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 6 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508093.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058547.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey and brown, trace silt			
			0.5							M		
			1.0									
				1.30				SP	Becoming grey			
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 7/GW1 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507990.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058508.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			GW1 1.0m Stick up Bentonite
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, pale brown, trace silt			
			0.5									
				0.60					Becoming pale brown and grey	M		
		Groundwater encountered at 1.3m depth	1.0									Sand Filter Pack Slotted Screen
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	M - W W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 8 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508067.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058500.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace rootlets			
				0.40				SP	SAND (ALLUVIUM): fine to medium grained, brown, trace silt	M		
			0.5									
				0.90					Becoming pale grey			
			1.0							M - W		
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
		▽	1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
		Groundwater encountered at 1.5m depth	2.0									

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REPORT OF BOREHOLE: BH 9 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508040.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058440.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		
				0.45				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt			
			0.5									
				0.80					Becoming pale brown and yellow	M - W		
			1.0									
				1.40				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurared	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 10 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508123.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058430.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Groundwater encountered at 0.4m depth	0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics	M		
				0.25				SP	SAND (ALLUVIUM): fine to medium grained, brown	W		
			0.5									
			1.0	*1.10*				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated			
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 11 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508036.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059716.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Groundwater seepage encountered at 0.7m depth	0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIAL): fine to medium grained, dark grey, trace rootlets	M - W		
				0.30				SP	SAND (ALLUVIAL): fine to medium grained, grey, trace silt	M		
			0.5									
				0.80					Becoming pale grey	M - W		
			1.0									
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 12/GW2 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508135.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059703.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS
		Groundwater encountered at 0.8m depth	0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		GW2 1.0m Stickup
				0.20				SP	SAND (ALLUVIAL): fine to medium grained, pale brown and grey, trace silt			Bentonite
			0.5	0.50					Becoming grey			
			1.0									Sand Filter Pack
				1.20				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey			Slotted Screen
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 13 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508245.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059687.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics, trace rootlets			
				0.25				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt	M		
		Groundwater encountered at 1.1m depth	0.5									
			1.0							W		
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 14 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508257.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059741.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey, with some silt			
		Groundwater encountered at 1.0m depth	0.5							M		
			1.0									
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 15 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508144.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059753.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Groundwater encountered at 0.6m depth	0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, grey, low plasticity clay, trace rootlets			
				0.20				SP	SAND (ALLUVIUM): fine to medium grained, pale grey	M - W		
			0.5									
			1.0									
				1.20				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 16 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508041.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059765.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey to pale brown	M		
				0.40				SP	SAND (ALLUVIUM): fine to medium grained, brown and yellow	W		
		Groundwater encountered at 0.5m depth	0.5									
			1.0									
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 17 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507953.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059826.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, dark grey, medium plasticity clay, trace rootlets	M - W		
				0.40					Becoming brown	M		
			0.5									
				1.00				SP	SAND (ALLUVIUM): fine to medium grained, brown	M - W		
			1.0	*1.30*				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
		Groundwater encountered at 1.1m depth	1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 18 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508047.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059816.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected in 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, dark grey, medium plasticity clay, trace rootlets	M - W		
				0.35				SP	SAND (ALLUVIUM): fine to medium, grey, trace silt	M		
		Groundwater encountered at 0.5m depth	0.5									
				0.60					Becoming pale grey			
				0.90				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
			1.0									
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 19 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508154.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059806.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SP	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
				0.40				SP	SAND (ALLUVIUM): fine to medium grained, pale grey	M		
			0.5									
			1.0									
		Groundwater encountered at 1.2m depth		*1.20*					Becoming pale grey	M - W		
				1.30				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 20 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508269.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059796.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.2m intervals			SP	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics			
				0.30				SM	SAND (ALLUVIUM): fine to medium grained, dark grey			
			0.5							M		
				0.80					Becoming pale grey			
			1.0									
		Groundwater encountered at 1.1m depth								M - W		
				1.40				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

core consultants pty ltd

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

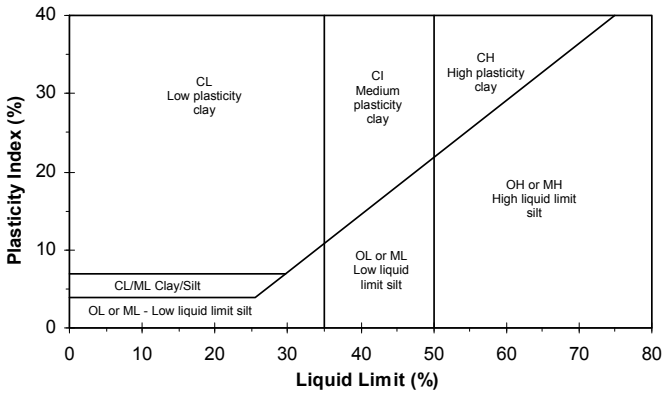
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

APPENDIX B

Table B1: Summary of ASS Field and Laboratory Analysis Results

BH ID	Depth (m)	BH	Description	Quick Screening Test					Remark	Existing Acidity		Potential Acidity		Acid Neutralising Capacity			Retained Acidity					Acid Base Accounting			Required Lime Rate	
				pH_F	AASS likelihood[1]	pH_{FOX}	PASS likelihood [2]	Reaction		pH KCl	Titratable Actual Acidity	Chromium Reducible Sulfur	acidity - Chromium Reducible Sulfur	Acid Neutralising Capacity	acidity - Acid Neutralising Capacity	sulfidic - Acid Neutralising Capacity	Net Acid Soluble Sulfur	acidity - Net Acid Soluble Sulfur	sulfidic - Net Acid Soluble Sulfur	KCl Extractable Sulfur	HCl Extractable Sulfur	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)		
				pH Unit		pH Unit				pH Unit	mole H+ / t	% S	mole H+ / t	% CaCO3	mole H+ / t	% pyrite S	% S	mole H+ / t	% pyrite S	% S	% S		% S	mole H+ / t	kg CaCO3/t	kg CaCO3/m^3
BH1	0.0_0.25	BH1_0.0_0.25	Silty SAND (Topsoil), grey	5.0	L	4.1	L	l-m		5.2	7.2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.25_0.5	BH1_0.25_0.5		5.2	L	4.6	L	l-m																		
	0.5_0.75	BH1_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	4.7	L	m		5.5	2.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH1_0.75_1.0	SAND(Alluvium), pale yellow	5.2	L	4.6	L	m																		
	1.0_1.25	BH1_1.0_1.25		5.1	L	4.9	L	l																		
	1.25_1.5	BH1_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	3.7	L	l																		
BH2	0.0_0.25	BH2_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	3.0	M	l		5.0	13.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.02	13	< 1	1
	0.25_0.5	BH2_0.25_0.5		4.8	M	3.5	L	L																		
	0.5_0.75	BH2_0.5_0.75	SAND (Alluvium), brown	5.2	L	4.1	L	L																		
	0.75_1.0	BH2_0.75_1.0	SAND (Alluvium), pale brown	5.2	L	4.8	L	L		5.4	3.9	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH2_1.0_1.25		5.1	L	4.3	L	L																		
	1.25_1.5	BH2_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	4.5	L	L																		
BH3	0.0_0.25	BH3_0.0_0.25	Silty SAND (Topsoil), grey	4.9	M	3.1	L	L		4.8	17.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	17	1.2	2
	0.25_0.5	BH3_0.25_0.5	SAND (Alluvium), pale brown	5.1	L	4.6	L	L																		
	0.5_0.75	BH3_0.5_0.75		5.1	L	4.3	L	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH3_0.75_1.0		5.1	L	4.7	L	L																		
	1.0_1.25	BH3_1.0_1.25		5.1	L	4.7	L	L																		
	1.25_1.5	BH3_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.9	M	3.1	L	L																		
BH4	0.0_0.25	BH4_0.0_0.25	Silty SAND (Topsoil), grey	5.0	M	2.8	H	L																		
	0.25_0.5	BH4_0.25_0.5		4.8	M	3.4	L	L		5.2	5.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH4_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	4.3	L	L																		
	0.75_1.0	BH4_0.75_1.0		4.8	M	4.4	L	L		5.4	4.3	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH4_1.0_1.25	Silty SAND ("Coffee Rock"), dark grey	4.9	M	3.6	L	L																		
	1.25_1.5	BH4_1.25_1.5		4.9	M	3.9	L	L																		
BH5	0.0_0.25	BH5_0.0_0.25	Silty SAND (Topsoil), grey	5.2	L	2.6	H	L																		
	0.25_0.5	BH5_0.25_0.5		5.4	L	3.9	L	L		5.5	3.1	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH5_0.5_0.75	SAND (Alluvium), pale brown	5.3	L	3.9	L	L																		
	0.75_1.0	BH5_0.75_1.0		5.3	L	4.3	L	L																		
	1.0_1.25	BH5_1.0_1.25		5.2	L	2.9	H	M		5.5	2.5	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH5_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	2.0	H	M																		
BH6	0.0_0.25	BH6_0.0_0.25	Silty SAND (Topsoil), dark grey	5.0	M	1.7	H	M		4.5	75.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.12	75	5.6	10
	0.25_0.5	BH6_0.25_0.5		5.1	L	1.8	H	M																		
	0.5_0.75	BH6_0.5_0.75	SAND (Alluvium), pale grey	5.2	L	2.2	H	M		5.3	5.3	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH6_0.75_1.0		5.1	L	1.8	H	M																		
	1.0_1.25	BH6_1.0_1.25		5.1	L	1.8	H	M																		
	1.25_1.5	BH6_1.25_1.5	SAND (Alluvium), grey	5.1	L	2.2	H	M																		
BH7	0.0_0.25	BH7_0.0_0.25	Silty SAND (Topsoil), dark grey	5.1	L	2.1	H	M		4.8	18.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	18	1.4	3
	0.25_0.5	BH7_0.25_0.5		5.2	L	2.4	H	L																		
	0.5_0.75	BH7_0.5_0.75	SAND (Alluvium), pale brown	5.2	L	2.4	H	L																		
	0.75_1.0	BH7_0.75_1.0	SAND (Alluvium), pale grey	5.2	L	2.6	H	L		5.7	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH7_1.0_1.25		5.2	L	2.3	H	L																		
	1.25_1.5	BH7_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	3.1	L	L																		
BH8	0.0_0.25	BH8_0.0_0.25	Silty SAND (Topsoil), grey	4.8	M	1.8	H	L																		
	0.25_0.5	BH8_0.25_0.5		5.2	L	2.6	H	L		5.1	8.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH8_0.5_0.75	SAND (Alluvium), pale brown	5.2	L	2.9	H	L																		
	0.75_1.0	BH8_0.75_1.0	SAND (Alluvium), pale grey	5.2	L	2.5	H	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH8_1.0_1.25		5.1	L	2.8	H	L																		
	1.25_1.5	BH8_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	1.7	H	L																		
BH9	0.0_0.25	BH9_0.0_0.25	Silty SAND (Topsoil), dark grey	5.3	L	2.0	H	L																		
	0.25_0.5	BH9_0.25_0.5		5.8	L	3.0	H	L		5.4	2.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH9_0.5_0.75	SAND (Alluvium), grey	5.5	L	2.5	H	L																		
	0.75_1.0	BH9_0.75_1.0	SAND (Alluvium), pale brown	5.5	L	3.3	M	L		5.8	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH9_1.0_1.25		5.5	L	3.1	M	L																		
	1.25_1.5	BH9_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.5	L	3.7	L	L																		
BH10	0.0_0.25	BH10_0.0_0.25	Silty SAND (Topsoil), dark grey	4.7	M	2.5	H	L		5.0	9.1	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.25_0.5	BH10_0.25_0.5		4.4	M	2.6	M	L																		
	0.5_0.75	BH10_0.5_0.75	SAND (Alluvium), pale brown	4.8	M	2.5	H	L		5.2	5.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH10_0.75_1.0		5.2	L	3.6	L	L																		
	1.0_1.25	BH10_1.0_1.25		5.2	L	2.8	H	L																		
	1.25_1.5	BH10_1.25_1.5	SAND (Alluvium),grey	5.2	L	3.3	L	L																		

BH ID	Depth (m)	BH	Description	Quick Screening Test					Remark	Existing Acidity		Potential Acidity		Acid Neutralising Capacity			Retained Acidity					Acid Base Accounting			Required Lime Rate	
				pH_F	AASS likelihood[1]	pH_{FOX}	PASS likelihood [2]	Reaction		pH KCl	Titratable Actual Acidity	Chromium Reducible Sulfur	acidity - Chromium Reducible Sulfur	Acid Neutralising Capacity	acidity - Acid Neutralising Capacity	sulfidic - Acid Neutralising Capacity	Net Acid Soluble Sulfur	acidity - Net Acid Soluble Sulfur	sulfidic - Net Acid Soluble Sulfur	KCl Extractable Sulfur	HCl Extractable Sulfur	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)	kg CaCO3/t	kg CaCO3/m^3
				pH Unit		pH Unit				pH Unit	mole H+ / t	% S	mole H+ / t	% CaCO3	mole H+ / t	% pyrite S	% S	mole H+ / t	% pyrite S	% S	% S		% S	mole H+ / t		
BH11	0.0_0.25	BH11_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	3.3	L	L																		
	0.25_0.5	BH11_0.25_0.5		4.8	M	3.7	L	L		5.1	7.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH11_0.5_0.75	SAND (Alluvium), grey	4.8	M	3.3	L	L																		
	0.75_1.0	BH11_0.75_1.0		4.7	M	3.3	L	L		5.3	4.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH11_1.0_1.25		4.8	M	3.1	L	L																		
	1.25_1.5	BH11_1.25_1.5	SAND (Alluvium), pale grey	4.7	M	3.1	L	L																		
BH12	0.0_0.25	BH12_0.0_0.25	Silty SAND (Topsoil), dark grey	5.0	M	3.1	L	L																		
	0.25_0.5	BH12_0.25_0.5		4.7	M	3.2	L	L		5.1	8.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH12_0.5_0.75	SAND (Alluvium), pale brown	4.8	M	3.0	M	L																		
	0.75_1.0	BH12_0.75_1.0		4.8	M	2.8	H	L																		
	1.0_1.25	BH12_1.0_1.25		4.8	M	2.8	H	L		5.6	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH12_1.25_1.5	SAND (Alluvium), dark grey	4.9	M	2.7	H	L																		
BH13	0.0_0.25	BH13_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.8	H	L																		
	0.25_0.5	BH13_0.25_0.5		4.7	M	2.7	H	L		4.8	22.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.04	22	1.7	3
	0.5_0.75	BH13_0.5_0.75	SAND (Alluvium), pale grey	4.8	M	2.7	H	L																		
	0.75_1.0	BH13_0.75_1.0		4.9	M	3.1	L	L																		
	1.0_1.25	BH13_1.0_1.25		4.7	M	2.6	H	L		5.2	7.6	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH13_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	3.0	H	L																		
BH14	0.0_0.25	BH14_0.0_0.25	Silty SAND (Topsoil), dark grey	4.6	M	2.8	M	M																		
	0.25_0.5	BH14_0.25_0.5		4.4	M	2.3	H	M		4.7	28.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	28	2.1	4
	0.5_0.75	BH14_0.5_0.75	SAND (Alluvium), grey	4.8	M	2.7	H	L																		
	0.75_1.0	BH14_0.75_1.0		4.7	M	3.0	M	L																		
	1.0_1.25	BH14_1.0_1.25		4.9	M	2.6	H	L																		
	1.25_1.5	BH14_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	1.5	H	M		4.8	30.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	30	2.3	4
BH15	0.0_0.25	BH15_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.0	H	M																		
	0.25_0.5	BH15_0.25_0.5		4.8	M	2.9	M	L		5.0	13.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.02	13	1.0	2
	0.5_0.75	BH15_0.5_0.75	SAND (Alluvium), pale grey	4.9	M	2.9	H	L																		
	0.75_1.0	BH15_0.75_1.0		4.9	M	2.8	H	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH15_1.0_1.25		5.0	M	2.6	H	L																		
	1.25_1.5	BH15_1.25_1.5	SAND (Alluvium), grey	4.9	M	2.5	H	L																		
BH16	0.0_0.25	BH16_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.0	H	M		4.8	23.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.04	23	1.7	3
	0.25_0.5	BH16_0.25_0.5		4.9	M	2.4	H	M																		
	0.5_0.75	BH16_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	2.6	H	L		5.3	3.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH16_0.75_1.0		5.0	M	2.7	H	L																		
	1.0_1.25	BH16_1.0_1.25		5.0	M	2.5	H	L																		
	1.25_1.5	BH16_1.25_1.5	SAND (Alluvium), pale brown	5.0	M	2.8	H	L																		
BH17	0.0_0.25	BH17_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.0	H	M		4.5	92.0	< 0.005	< 3	n/a	n/a	n/a	< 0.02	< 10	< 0.02	< 0.02	< 0.02	1.5	0.15	92	6.9	12
	0.25_0.5	BH17_0.25_0.5		4.9	M	2.0	H	H		4.5	95.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.15	95	7.1	13
	0.5_0.75	BH17_0.5_0.75	SAND (Alluvium), pale brown	4.9	M	2.3	H	L																		
	0.75_1.0	BH17_0.75_1.0		4.6	M	2.0	H	L																		
	1.0_1.25	BH17_1.0_1.25		4.7	M	2.4	H	L																		
	1.25_1.5	BH17_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.5	H	L																		
BH18	0.0_0.25	BH18_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.4	H	L		4.8	25.0	0.01	3.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	29	2.2	4
	0.25_0.5	BH18_0.25_0.5		4.8	M	2.2	H	L																		
	0.5_0.75	BH18_0.5_0.75	SAND (Alluvium), pale grey	4.9	M	2.4	H	L		5.4	2.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH18_0.75_1.0		4.8	M	2.5	H	L																		
	1.0_1.25	BH18_1.0_1.25		4.7	M	2.3	H	L																		
	1.25_1.5	BH18_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.5	H	L																		
BH19	0.0_0.25	BH19_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.7	H	L																		
	0.25_0.5	BH19_0.25_0.5		4.8	M	2.7	H	L		4.9	18.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	18	1.4	3
	0.5_0.75	BH19_0.5_0.75	SAND (Alluvium), pale grey	4.6	M	2.1	H	L																		
	0.75_1.0	BH19_0.75_1.0		4.8	M	2.7	H	L																		
	1.0_1.25	BH19_1.0_1.25		4.8	M	2.6	H	L		5.6	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH19_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.9	M	L																		
BH20	0.0_0.25	BH20_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.8	H	M		4.6	39.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.06	39	2.9	5
	0.25_0.5	BH20_0.25_0.5		4.9	M	2.9	H	M		4.7	35.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.06	35	2.6	5
	0.5_0.75	BH20_0.5_0.75	SAND (Alluvium), pale grey	4.8	M	2.6	H	L																		
	0.75_1.0	BH20_0.75_1.0		5.0	M	3.0	H	L																		
	1.0_1.25	BH20_1.0_1.25		4.9	M	3.0	M	L																		
	1.25_1.5	BH20_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.8	M	2.2	H	L																		

1. Actual Acid Sulfate Soil (AASS) likelihood is indicated by Low (L & no shade)(pH_F > 5), Medium (M & yellow shade)(pH_F 5 ≤ pH_F < 4) and High (H & red shade)(pH_F ≤ 4).
2. Potential Acid Sulfate Soil (PASS) likelihood is indicated by Low (L & no shade)(Δ pH from pH_F to pH_{FOX} is < 2 pH units), Medium (M & yellow shade)(Δ pH from pHF to pH_{FOX} is ≥ 2 pH units OR pHFOX is <3)) and High (H & red shade)(Δ pH from pHF to pH_{FOX} is ≥ 2 pH units AND pHFOX is <3)
3. Reaction L = Low strength, M = Medium strength, H = High strength, X = Extreme strength.
4. The letter in the remark column indicates the presence of the following; O - Organic; S - Shells;iron- Iron/Iron Oxide; P - Pyrite; and C - Coral.
5. Shaded TAA & S_{CR} results are those exceeding the QASSIT action levels of 18 mol H^+/t or 0.03 %S.
6. Acid-Base Account = Total Acidity (i.e.. Potential + Actual + Retained) - Total ANC
7. Shaded Net Acidity (sulfur units) %S and Net Acidity (acidity units) /t results are those exceeding the QASSIT action levels of 0.03 %S or 18 mol H+/t
8. Required Lime Rate is calculated from the net Acid-Base Account with a factor of safety = 1.5 and bulk density of 1.8 t/m³

APPENDIX C

ASS Soil Laboratory Testing Results

TEST REQUEST FORM

Eurofins | mgt
1/21 Smallwood Place, Murarrie QLD 4172Phone: 3902 4600

Order No.: PO001180
Job No.: J000030 TASK 12000
Job Name: SCC/SCA Expansion/Finland Road

C.O.C. No.: TR-03 Quotation No.

Sampled By: SR Contact Name: Josh Mitchell

Email Report to: jmitchell@coreconsult.com.au

Prior Storage: Core Lab Freezer

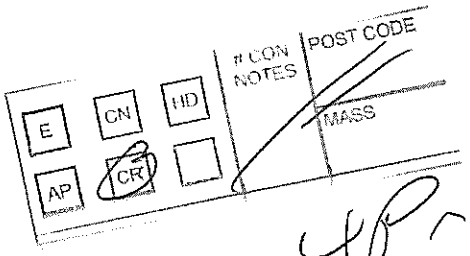
Borehole Number (BH#)	Sample Depth (m)		Media	No. of Bags	SAMPLE DATE		pH Field	pH ox	CRS Chromium Suite														Remarks and or Other Details
1	0	0.25	Soil	1	15/06/2017				X														
1	0.5	0.75	Soil	1	15/06/2017				X														
2	0	0.25	Soil	1	15/06/2017				X														
2	0.75	1	Soil	1	15/06/2017				X														
3	0	0.25	Soil	1	15/06/2017				X														
3	0.5	0.75	Soil	1	15/06/2017				X														
4	0.25	0.5	Soil	1	15/06/2017				X														
4	0.75	1	Soil	1	15/06/2017				X														
5	0.25	0.5	Soil	1	15/06/2017				X														
5	1	1.25	Soil	1	15/06/2017				X														
6	0	0.25	Soil	1	15/06/2017				X														
6	0.5	0.75	Soil	1	15/06/2017				X														
7	0	0.25	Soil	1	15/06/2017				X														
7	0.75	1	Soil	1	15/06/2017				X														
8	0.25	0.5	Soil	1	15/06/2017				X														
8	0.75	1	Soil	1	15/06/2017				X														
9	0.25	0.5	Soil	1	15/06/2017				X														
9	0.75	1	Soil	1	15/06/2017				X														
10	0	0.25	Soil	1	15/06/2017				X														
10	0.5	0.75	Soil	1	15/06/2017				X														
11	0.25	0.5	Soil	1	14/06/2017				X														
11	0.75	1	Soil	1	14/06/2017				X														
12	0.25	0.5	Soil	1	14/06/2017				X														
12	1	1.25	Soil	1	14/06/2017				X														
13	0.25	0.5	Soil	1	14/06/2017				X														
13	1	1.25	Soil	1	14/06/2017				X														
14	0.25	0.5	Soil	1	14/06/2017				X														
14	1.25	1.5	Soil	1	14/06/2017				X														
15	0.25	0.5	Soil	1	14/06/2017				X														
15	0.75	1	Soil	1	14/06/2017				X														
16	0	0.25	Soil	1	14/06/2017				X														
16	0.5	0.75	Soil	1	14/06/2017				X														
17	0	0.25	Soil	1	14/06/2017				X														
17	0.25	0.5	Soil	1	14/06/2017				X														
18	0	0.25	Soil	1	14/06/2017				X														
18	0.5	0.75	Soil	1	14/06/2017				X														
19	0.25	0.5	Soil	1	14/06/2017				X														
19	1	1.25	Soil	1	14/06/2017				X														
20	0	0.25	Soil	1	14/06/2017				X														
20	0.25	0.5	Soil	1	14/06/2017				X														

Checked by:

Date Sent: 15/6/17

Date Received By Eurofins: 22/6/17

core consultants pty ltd
55 Kingsford Smith Parade
Maroochydore QLD 4558
Phone: 5475 5900



17.8
18.4
17.6
17.93

Melbourne
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Oakleigh Vic 3166
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NATA # 1261
Site # 1254 & 14271

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NATA # 1261 Site # 18217

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**Core Consultants Pty Ltd**
Contact name:	Josh Mitchell
Project name:	SCC/SCA EXPANSION/FINLAND ROAD
Project ID:	J000030
COC number:	TR_03
Turn around time:	5 Day
Date/Time received:	Jun 22, 2017 4:00 PM
Eurofins | mgt reference:	**551297**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Ryan Gilbert on Phone : or by e.mail: RyanGilbert@eurofins.com

Results will be delivered electronically via e.mail to Josh Mitchell - jmitchell@coreconsultants.com.au.

eurofins | mgt

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Phone : +61 8 9251 9600
NATA # 1261
Site # 18217

Company Name: Core Consultants Pty Ltd
Address: 55 Kingford Smith Parade
Maroochydore
QLD 4558

Project Name: SCC/SCA EXPANSION/FINLAND ROAD
Project ID: J000030

Order No.: PO001180
Report #: 551297
Phone: 07 5475 5900
Fax:

Received: Jun 22, 2017 4:00 PM
Due: Jun 29, 2017
Priority: 5 Day
Contact Name: Josh Mitchell

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1_0_0.25	Jun 15, 2017		Soil	B17-Jn22784	X	X
2	BH1_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22785	X	X
3	BH2_0_0.25	Jun 15, 2017		Soil	B17-Jn22786	X	X
4	BH2_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22787	X	X
5	BH3_0_0.25	Jun 15, 2017		Soil	B17-Jn22788	X	X
6	BH3_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22789	X	X
7	BH4_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22790	X	X
8	BH4_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22791	X	X
9	BH5_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22792	X	X

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NATA # 1261 Site # 18217

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NATA # 1261 Site # 20794

Perth
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NATA # 1261
Site # 18217

Company Name: Core Consultants Pty Ltd
Address: 55 Kingford Smith Parade
Maroochydore
QLD 4558

Project Name: SCC/SCA EXPANSION/FINLAND ROAD
Project ID: J000030

Order No.: PO001180
Report #: 551297
Phone: 07 5475 5900
Fax:

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Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
10	BH5_1.0_1.25	Jun 15, 2017		Soil	B17-Jn22793	X	X
11	BH6_0_0.25	Jun 15, 2017		Soil	B17-Jn22794	X	X
12	BH6_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22795	X	X
13	BH7_0_0.25	Jun 15, 2017		Soil	B17-Jn22796	X	X
14	BH7_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22797	X	X
15	BH8_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22798	X	X
16	BH8_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22799	X	X
17	BH9_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22800	X	X
18	BH9_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22801	X	X
19	BH10_0_0.25	Jun 15, 2017		Soil	B17-Jn22802	X	X
20	BH10_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22803	X	X

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Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
21	BH11_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22804	X	X
22	BH11_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22805	X	X
23	BH12_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22806	X	X
24	BH12_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22807	X	X
25	BH13_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22808	X	X
26	BH13_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22809	X	X
27	BH14_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22810	X	X

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Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
28	BH14_1.25_1.5	Jun 14, 2017		Soil	B17-Jn22811	X	X
29	BH15_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22812	X	X
30	BH15_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22813	X	X
31	BH16_0_0.25	Jun 14, 2017		Soil	B17-Jn22814	X	X
32	BH16_0.5_0.75	Jun 14, 2017		Soil	B17-Jn22815	X	X
33	BH17_0_0.25	Jun 14, 2017		Soil	B17-Jn22816	X	X
34	BH17_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22817	X	X
35	BH18_0_0.25	Jun 14, 2017		Soil	B17-Jn22818	X	X
36	BH18_0.5_0.7	Jun 14, 2017		Soil	B17-Jn22819	X	X

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Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
Address:	55 Kingford Smith Parade Maroochydore QLD 4558	**Report #:**	551297	**Due:**	Jun 29, 2017
		Phone:	07 5475 5900	**Priority:**	5 Day
		Fax:		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
	5						
37	BH19_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22820	X	X
38	BH19_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22821	X	X
39	BH20_0_0.25	Jun 14, 2017		Soil	B17-Jn22822	X	X
40	BH20_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22823	X	X
Test Counts						40	40

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Certificate of Analysis

Core Consultants Pty Ltd
55 Kingford Smith Parade
Maroochydore
QLD 4558

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Josh Mitchell**

Report **551297-S**
Project name SCC/SCA EXPANSION/FINLAND ROAD
Project ID J000030
Received Date Jun 22, 2017

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**BH1_0_0.25** **Soil** **B17-Jn22784** **Jun 15, 2017**	**BH1_0.5_0.75** **Soil** **B17-Jn22785** **Jun 15, 2017**	**BH2_0_0.25** **Soil** **B17-Jn22786** **Jun 15, 2017**	**BH2_0.75_1.0** **Soil** **B17-Jn22787** **Jun 15, 2017**
Chromium Suite						
pH-KCL	0.1	pH Units	5.2	5.5	5.0	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	7.2	2.7	13	3.9
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	13	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	65	100	63	80
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	10	8.1	13	15

Client Sample ID			BH3_0_0.25	BH3_0.5_0.75	BH4_0.25_0.5	BH4_0.75_1.0
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22788**	**B17-Jn22789**	**B17-Jn22790**	**B17-Jn22791**
Date Sampled			**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.5	5.2	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	17	< 2	5.8	4.3
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	17	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.2	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	76	86	90	91
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	12	6.3	15	19

Client Sample ID			BH5_0.25_0.5	BH5_1.0_1.25	BH6_0_0.25	BH6_0.5_0.75
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22792**	**B17-Jn22793**	**B17-Jn22794**	**B17-Jn22795**
Date Sampled			**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.5	5.5	4.5	5.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	3.1	2.5	75	5.3
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.12	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	0.12	< 0.02

Client Sample ID			BH5_0.25_0.5	BH5_1.0_1.25	BH6_0_0.25	BH6_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22792	B17-Jn22793	B17-Jn22794	B17-Jn22795
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	75	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	5.6	< 1
Extraneous Material						
<2mm Fraction	0.005	g	50	85	57	51
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	9.5	13	13	7.1

Client Sample ID			BH7_0_0.25	BH7_0.75_1.0	BH8_0.25_0.5	BH8_0.75_1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22796	B17-Jn22797	B17-Jn22798	B17-Jn22799
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.7	5.1	5.5
Acid trail - Titratable Actual Acidity	2	mol H+/t	18	< 2	8.8	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	18	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.4	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	72	130	99	110
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	9.6	6.8	9.5	13

Client Sample ID			BH9_0.25_0.5	BH9_0.75_1.0	BH10_0_0.25	BH10_0.5_0.75
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22800**	**B17-Jn22801**	**B17-Jn22802**	**B17-Jn22803**
Date Sampled			**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.4	5.8	5.0	5.2
Acid trail - Titratable Actual Acidity	2	mol H+/t	2.4	< 2	9.1	5.4
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	100	81	130	110
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	19	21	21	20

Client Sample ID			BH11_0.25_0.5	BH11_0.75_1.0	BH12_0.25_0.5	BH12_1.0_1.25
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22804**	**B17-Jn22805**	**B17-Jn22806**	**B17-Jn22807**
Date Sampled			**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.1	5.3	5.1	5.6
Acid trail - Titratable Actual Acidity	2	mol H+/t	7.8	4.4	8.7	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02

Client Sample ID			BH11_0.25_0.5	BH11_0.75_1.0	BH12_0.25_0.5	BH12_1.0_1.25
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22804**	**B17-Jn22805**	**B17-Jn22806**	**B17-Jn22807**
Date Sampled			**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	84	87	110	140
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	17	16	17

Client Sample ID			BH13_0.25_0.5	BH13_1.0_1.25	BH14_0.25_0.5	BH14_1.25_1.5
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22808**	**B17-Jn22809**	**B17-Jn22810**	**B17-Jn22811**
Date Sampled			**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.2	4.7	4.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	22	7.6	28	30
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.04	< 0.02	0.05	0.05
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.04	< 0.02	0.05	0.05
Net Acidity (Acidity Units)	10	mol H+/t	22	< 10	28	30
Liming Rate[S01]	1	kg CaCO3/t	1.7	< 1	2.1	2.3
Extraneous Material						
<2mm Fraction	0.005	g	180	150	69	87
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	15	16	14	16

Client Sample ID			BH15_0.25_0.5	BH15_0.75_1.0	BH16_0_0.25	BH16_0.5_0.75
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22812**	**B17-Jn22813**	**B17-Jn22814**	**B17-Jn22815**
Date Sampled			**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.0	5.5	4.8	5.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	13	< 2	23	3.7
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.02	< 0.02	0.04	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.02	< 0.02	0.04	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	13	< 10	23	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.0	< 1	1.7	< 1
Extraneous Material						
<2mm Fraction	0.005	g	92	85	85	65
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	18	19	16

Client Sample ID			BH17_0_0.25	BH17_0.25_0.5	BH18_0_0.25	BH18_0.5_0.75
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22816**	**B17-Jn22817**	**B17-Jn22818**	**B17-Jn22819**
Date Sampled			**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**	**Jun 14, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.5	4.5	4.8	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	92	95	25	2.8
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.15	0.15	0.04	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	3.0	< 3
Sulfur - KCl Extractable	0.02	% S	< 0.02	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	< 0.02	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	< 0.02	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	< 10	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.15	0.15	0.05	< 0.02

Client Sample ID			BH17_0_0.25	BH17_0.25_0.5	BH18_0_0.25	BH18_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22816	B17-Jn22817	B17-Jn22818	B17-Jn22819
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	92	95	29	< 10
Liming Rate[S01]	1	kg CaCO3/t	6.9	7.1	2.2	< 1
Extraneous Material						
<2mm Fraction	0.005	g	68	64	94	120
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	25	22	19	16

Client Sample ID			BH19_0.25_0.5	BH19_1.0_1.25	BH20_0_0.25	BH20_0.25_0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22820	B17-Jn22821	B17-Jn22822	B17-Jn22823
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.9	5.6	4.6	4.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	18	< 2	39	35
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	0.06	0.06
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	0.06	0.06
Net Acidity (Acidity Units)	10	mol H+/t	18	< 10	39	35
Liming Rate[S01]	1	kg CaCO3/t	1.4	< 1	2.9	2.6
Extraneous Material						
<2mm Fraction	0.005	g	93	120	100	98
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	18	20	17

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chromium Suite			
Chromium Suite	Brisbane	Jun 26, 2017	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Jun 26, 2017	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Jun 23, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

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NATA # 1261 Site # 20794

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Site # 18217

Company Name: Core Consultants Pty Ltd
Address: 55 Kingford Smith Parade
Maroochydore
QLD 4558

Project Name: SCC/SCA EXPANSION/FINLAND ROAD
Project ID: J000030

Order No.: PO001180
Report #: 551297
Phone: 07 5475 5900
Fax:

Received: Jun 22, 2017 4:00 PM
Due: Jun 29, 2017
Priority: 5 Day
Contact Name: Josh Mitchell

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1_0_0.25	Jun 15, 2017		Soil	B17-Jn22784	X	X
2	BH1_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22785	X	X
3	BH2_0_0.25	Jun 15, 2017		Soil	B17-Jn22786	X	X
4	BH2_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22787	X	X
5	BH3_0_0.25	Jun 15, 2017		Soil	B17-Jn22788	X	X
6	BH3_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22789	X	X
7	BH4_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22790	X	X
8	BH4_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22791	X	X
9	BH5_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22792	X	X

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Contact Name:	Josh Mitchell	

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Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
10	BH5_1.0_1.25	Jun 15, 2017		Soil	B17-Jn22793	X	X
11	BH6_0_0.25	Jun 15, 2017		Soil	B17-Jn22794	X	X
12	BH6_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22795	X	X
13	BH7_0_0.25	Jun 15, 2017		Soil	B17-Jn22796	X	X
14	BH7_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22797	X	X
15	BH8_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22798	X	X
16	BH8_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22799	X	X
17	BH9_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22800	X	X
18	BH9_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22801	X	X
19	BH10_0_0.25	Jun 15, 2017		Soil	B17-Jn22802	X	X
20	BH10_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22803	X	X

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		Fax:		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
21	BH11_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22804	X	X
22	BH11_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22805	X	X
23	BH12_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22806	X	X
24	BH12_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22807	X	X
25	BH13_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22808	X	X
26	BH13_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22809	X	X
27	BH14_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22810	X	X

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Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
28	BH14_1.25_1.5	Jun 14, 2017		Soil	B17-Jn22811	X	X
29	BH15_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22812	X	X
30	BH15_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22813	X	X
31	BH16_0_0.25	Jun 14, 2017		Soil	B17-Jn22814	X	X
32	BH16_0.5_0.75	Jun 14, 2017		Soil	B17-Jn22815	X	X
33	BH17_0_0.25	Jun 14, 2017		Soil	B17-Jn22816	X	X
34	BH17_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22817	X	X
35	BH18_0_0.25	Jun 14, 2017		Soil	B17-Jn22818	X	X
36	BH18_0.5_0.7	Jun 14, 2017		Soil	B17-Jn22819	X	X

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NATA # 1261 Site # 20794

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Site # 18217

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
Address:	55 Kingford Smith Parade Maroochydore QLD 4558	**Report #:**	551297	**Due:**	Jun 29, 2017
		Phone:	07 5475 5900	**Priority:**	5 Day
		Fax:		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
	5						
37	BH19_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22820	X	X
38	BH19_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22821	X	X
39	BH20_0_0.25	Jun 14, 2017		Soil	B17-Jn22822	X	X
40	BH20_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22823	X	X
Test Counts						40	40

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Chromium Suite									
Chromium Reducible Sulfur			%	94			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22784	CP	pH Units	5.2	5.2	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22784	CP	mol H+/t	7.2	7.4	3.5	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22784	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22784	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22784	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22784	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22784	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22784	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22784	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22784	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B17-Jn22784	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22792	CP	%	9.5	9.3	2.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22794	CP	pH Units	4.5	4.5	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22794	CP	mol H+/t	75	75	<1	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22794	CP	% pyrite S	0.12	0.12	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22794	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22794	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22794	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22794	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22794	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22794	CP	% S	0.12	0.12	n/a	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22794	CP	mol H+/t	75	75	n/a	30%	Pass	
Liming Rate	B17-Jn22794	CP	kg CaCO3/t	5.6	5.6	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22802	CP	%	21	22	3.0	30%	Pass	

Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22804	CP	pH Units	5.1	5.1	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22804	CP	mol H+/t	7.8	8.2	4.3	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22804	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22804	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22804	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22804	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22804	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22804	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22804	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22804	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B17-Jn22804	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22812	CP	%	17	17	1.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22814	CP	pH Units	4.8	4.8	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22814	CP	mol H+/t	23	22	4.7	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22814	CP	% pyrite S	0.04	0.04	5.0	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22814	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22814	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22814	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22814	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22814	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22814	CP	% S	0.04	0.04	n/a	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22814	CP	mol H+/t	23	22	n/a	30%	Pass	
Liming Rate	B17-Jn22814	CP	kg CaCO3/t	1.7	1.7	5.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22822	CP	%	20	21	2.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Ryan Gilbert	Analytical Services Manager
Bryan Wilson	Senior Analyst-Metal (QLD)
Jonathon Angell	Senior Analyst-Inorganic (QLD)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1713441**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017 15:20
Order number	: PO001493 TR13	Date Analysis Commenced	: 01-Jul-2017
C-O-C number	: TR13	Issue Date	: 11-Jul-2017 16:58
Sampler	: SR		
Site	: ----		
Quote number	: BNBQ/061/16		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED041G (Sulfate as SO4): Sample EB1713441_004 was diluted due to matrix interference. LOR adjusted accordingly.
- EA015H (TDS): Unable to report TDS for samples 4-7 (GW4-GW7) due to matrix interference.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Ionic Balance out of acceptable limits for some samples due to analytes not quantified in this report.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW1 - EMS	GW2	GW3	GW4	GW5
			Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	CAS Number	LOR	Unit	EB1713441-001	EB1713441-002	EB1713441-003	EB1713441-004	EB1713441-005
				Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	412	274	499	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	45	<1	29	5
Total Alkalinity as CaCO3	----	1	mg/L	<1	45	<1	29	5
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	238	22	157	127	132
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	21	42	194	<5	79
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	83	13	112	71	32
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	1	4	1	6
Magnesium	7439-95-4	1	mg/L	5	5	28	5	14
Sodium	7440-23-5	1	mg/L	48	41	70	63	34
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.23	1.41	7.25	2.92	0.47
Iron	7439-89-6	0.05	mg/L	4.45	1.21	29.9	2.18	0.56
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	2.78	2.14	7.20	2.58	2.65
Total Cations	----	0.01	meq/L	----	----	7.95	----	----
Total Cations	----	0.01	meq/L	2.65	2.24	----	3.20	2.98
Ionic Balance	----	0.01	%	----	----	4.95	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW6	GW7	GW8	GW9B	GW10A
				Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	CAS Number	LOR	Unit		EB1713441-006	EB1713441-007	EB1713441-008	EB1713441-009	EB1713441-010
					Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		----	----	159	729	283
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		2	4	22	26	7
Total Alkalinity as CaCO3	----	1	mg/L		2	4	22	26	7
ED038A: Acidity									
Acidity as CaCO3	----	1	mg/L		102	44	64	20	80
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		108	48	4	191	19
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		76	31	40	254	55
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		4	2	<1	9	2
Magnesium	7439-95-4	1	mg/L		8	6	2	64	7
Sodium	7440-23-5	1	mg/L		82	32	30	115	41
Potassium	7440-09-7	1	mg/L		2	1	1	3	3
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		0.28	0.10	0.22	0.37	1.79
Iron	7439-89-6	0.05	mg/L		1.84	2.44	0.56	0.07	1.09
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		4.43	1.95	1.65	11.7	2.09
Total Cations	----	0.01	meq/L		4.48	2.01	1.50	10.8	2.54
Ionic Balance	----	0.01	%		0.49	----	----	3.85	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW10B	GW11A	GW11B	GW12	QA1
				Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	CAS Number	LOR	Unit		EB1713441-011	EB1713441-012	EB1713441-013	EB1713441-014	EB1713441-015
					Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		366	247	663	308	760
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		25	1	22	14	24
Total Alkalinity as CaCO3	----	1	mg/L		25	1	22	14	24
ED038A: Acidity									
Acidity as CaCO3	----	1	mg/L		20	44	20	32	15
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		28	4	176	129	191
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		112	28	215	43	257
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		4	1	8	4	9
Magnesium	7439-95-4	1	mg/L		10	2	31	24	66
Sodium	7440-23-5	1	mg/L		74	16	147	49	116
Potassium	7440-09-7	1	mg/L		1	<1	3	<1	4
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		1.32	0.24	0.65	0.45	0.38
Iron	7439-89-6	0.05	mg/L		0.72	0.36	0.09	1.73	0.07
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		4.24	0.89	10.2	4.18	11.7
Total Cations	----	0.01	meq/L		4.27	0.91	9.42	4.31	11.0
Ionic Balance	----	0.01	%		0.30	----	3.81	1.50	2.98

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1713441**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017
Order number	: PO001493 TR13	Date Analysis Commenced	: 01-Jul-2017
C-O-C number	: TR13	Issue Date	: 11-Jul-2017
Sampler	: SR		
Site	: ----		
Quote number	: BNBQ/061/16		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 975765)									
EB1713437-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	60	79	26.8	No Limit
EB1713441-003	GW3	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	499	479	4.16	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 975767)									
EB1713441-014	GW12	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	308	330	6.80	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 975453)									
EB1713414-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	12	10	16.1	0% - 50%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	12	10	16.1	0% - 50%
EB1713441-001	GW1 - EMS	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 975454)									
EB1713441-011	GW10B	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	25	25	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	25	25	0.00	0% - 20%
ED038A: Acidity (QC Lot: 975944)									
EB1713402-001	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	11	11	0.00	0% - 50%
EB1713422-002	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	355	354	0.366	0% - 20%
ED038A: Acidity (QC Lot: 975945)									
EB1713441-009	GW9B	ED038: Acidity as CaCO3	----	1	mg/L	20	20	0.00	0% - 20%
EB1713454-004	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	5	5	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 974723)									
EB1713414-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	24	23	0.00	0% - 20%
EB1713441-006	GW6	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	113	4.53	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 974724)									
EB1713414-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	34	35	0.00	0% - 20%
EB1713441-006	GW6	ED045G: Chloride	16887-00-6	1	mg/L	76	78	2.58	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 975890)									
EB1712899-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	2	2	0.00	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
EB1713441-006	GW6	ED093F: Calcium	7440-70-2	1	mg/L	4	4	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	8	8	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	82	82	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 975891)									
EB1713441-006	GW6	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.28	0.28	0.00	0% - 20%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.84	1.87	1.60	0% - 20%
EB1713287-015	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 975893)									
EB1713454-002	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1713456-004	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 975765)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	99.4	88	112
				<10	2000 mg/L	97.0	88	112
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 975767)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	108	88	112
				<10	2000 mg/L	105	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 975453)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80	120
ED037P: Alkalinity by PC Titrator (QCLot: 975454)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	80	120
ED038A: Acidity (QCLot: 975944)								
ED038: Acidity as CaCO3	----	----	mg/L	----	100 mg/L	100	90	110
ED038A: Acidity (QCLot: 975945)								
ED038: Acidity as CaCO3	----	----	mg/L	----	100 mg/L	100	90	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 974723)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	109	85	118
				<1	100 mg/L	90.7	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 974724)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	102	90	115
				<1	1000 mg/L	103	90	115
ED093F: Dissolved Major Cations (QCLot: 975890)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 975891)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	79	118
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	92.7	82	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 975893)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	79	118
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	94.4	82	114

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 974723)							
EB1713414-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 974724)							
EB1713414-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	99.5	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 975891)							
EB1713414-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	94.7	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 975893)							
EB1713454-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	96.9	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1713441**	Page	: 1 of 6
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017
Site	: ----	Issue Date	: 11-Jul-2017
Sampler	: SR	No. of samples received	: 15
Order number	: PO001493 TR13	No. of samples analysed	: 15

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB1713414--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
GW1 - EMS, GW2, GW3, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**03-Jul-2017**	06-Jul-2017	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**01-Jul-2017**	13-Jul-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED038A: Acidity							
Clear Plastic Bottle - Natural (ED038)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**03-Jul-2017**	13-Jul-2017	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**01-Jul-2017**	27-Jul-2017	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**01-Jul-2017**	27-Jul-2017	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**04-Jul-2017**	27-Jul-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**04-Jul-2017**	26-Dec-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acidity as Calcium Carbonate	ED038	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity by PC Titrator	ED037-P	3	27	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	18	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acidity as Calcium Carbonate	ED038	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity by PC Titrator	ED037-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	18	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	18	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Acidity as Calcium Carbonate	ED038	WATER	In house: Referenced to APHA 2310 B Acidity is determined by titration with a standardised alkali to an end-point pH of 8.3. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB1713441**

Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: JMitchell@coreconsult.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Page	: 1 of 2
Order number	: PO001493 TR13	Quote number	: EB2015CORECON0001 (BNBQ/061/16)
C-O-C number	: TR13	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: SR		

Dates

Date Samples Received	: 30-Jun-2017 15:20	Issue Date	: 30-Jun-2017
Client Requested Due Date	: 06-Jul-2017	Scheduled Reporting Date	: **06-Jul-2017**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 7.5°C - Ice present
Receipt Detail	: MEDIUM ESKY	No. of samples received / analysed	: 15 / 15

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA015H Total Dissolved Solids - High Level	WATER - ED038 Default Acidity as CaCO3 only	WATER - EG020F Dissolved Metals by ICPMS	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB1713441-001	[29-Jun-2017]	GW1 - EMS	✓	✓	✓	✓
EB1713441-002	[29-Jun-2017]	GW2	✓	✓	✓	✓
EB1713441-003	[29-Jun-2017]	GW3	✓	✓	✓	✓
EB1713441-004	[29-Jun-2017]	GW4	✓	✓	✓	✓
EB1713441-005	[29-Jun-2017]	GW5	✓	✓	✓	✓
EB1713441-006	[29-Jun-2017]	GW6	✓	✓	✓	✓
EB1713441-007	[29-Jun-2017]	GW7	✓	✓	✓	✓
EB1713441-008	[29-Jun-2017]	GW8	✓	✓	✓	✓
EB1713441-009	[29-Jun-2017]	GW9B	✓	✓	✓	✓
EB1713441-010	[29-Jun-2017]	GW10A	✓	✓	✓	✓
EB1713441-011	[29-Jun-2017]	GW10B	✓	✓	✓	✓
EB1713441-012	[29-Jun-2017]	GW11A	✓	✓	✓	✓
EB1713441-013	[29-Jun-2017]	GW11B	✓	✓	✓	✓
EB1713441-014	[29-Jun-2017]	GW12	✓	✓	✓	✓
EB1713441-015	[29-Jun-2017]	QA1	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS DEPARTMENT

- A4 - AU Tax Invoice (INV)	Email	accounts@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	accounts@coreconsult.com.au

JOSH MITCHELL

- *AU Certificate of Analysis - NATA (COA)	Email	JMitchell@coreconsult.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	JMitchell@coreconsult.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	JMitchell@coreconsult.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	JMitchell@coreconsult.com.au
- A4 - AU Tax Invoice (INV)	Email	JMitchell@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	JMitchell@coreconsult.com.au
- EDI Format - XTab (XTAB)	Email	JMitchell@coreconsult.com.au

S ROUSE

- *AU Certificate of Analysis - NATA (COA)	Email	srouse@coreconsult.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	srouse@coreconsult.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	srouse@coreconsult.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	srouse@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	srouse@coreconsult.com.au
- EDI Format - XTab (XTAB)	Email	srouse@coreconsult.com.au

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clarity • commitment • passion
55 Kingsford Smith Parade
Maroochydore QLD 4558
Phone: 5475 5900

TEST REQUEST FORM

ALS Environmental
2 Byth Street, Stafford QLD 4053
Phone: 3243 7222

Order No.: PO001493 TR 13
Job No.: J000030
Job Name: Sunshince Coast Airport Expansion - Groundwater Monitoring
C.O.C. No.: TR13 Quotation No.: BN/182/16 A
Sampled By: SR Contact Name: Josh Mitchell
Email Report to: jmitchell@coresonsultants.com.au srouse@coreconsultants.com.au

SAMPLE ID	Media	Plastic Green	Plastic Purple	Plastic Red	Glass Purple	SAMPLE Date	Total Dissolved Solids	Dissolved Aluminum and Iron	Total Acidity	Major Cations (Ca, Mg, Na, K)	Minor Anions (Cl, SO4, Alkalinity												Remarks and or Other Details
1 GW1 - EMS	Water	1		2		29/06/2017	X	X	X	X	X												
2 GW2	Water	1		2		29/06/2017	X	X	X	X	X												
3 GW3	Water	1		2		29/06/2017	X	X	X	X	X												
4 GW4	Water	1		2		29/06/2017	X	X	X	X	X												
5 GW5	Water	1		2		29/06/2017	X	X	X	X	X												
6 GW6	Water	1		2		29/06/2017	X	X	X	X	X												
7 GW7	Water	1		2		29/06/2017	X	X	X	X	X												
8 GW8	Water	1		2		29/06/2017	X	X	X	X	X												
9 GW9B	Water	1		2		0/01/1900	X	X	X	X	X												
10 GW10A	Water	1		2		0/01/1900	X	X	X	X	X												
11 GW10B	Water	1		2		0/01/1900	X	X	X	X	X												
12 GW11A	Water	1		2		0/01/1900	X	X	X	X	X												
13 GW11B	Water	1		2		0/01/1900	X	X	X	X	X												
14 GW12	Water	1		2		0/01/1900	X	X	X	X	X												
15 QA1	Water	1		2		0/01/1900	X	X	X	X	X												

Checked by:
Date Sent: 30-6-2017

Date Received By ALS: Greg 30/6/17 15:20

Environmental Division
Brisbane
Work Order Reference
EB1713441

Telephone : +61-7-3243 7222

APPENDIX D
Limitations

LIMITATIONS

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