September 2021

North One Hotel Development and Apartments

ACID SULPHATE SOILS MANAGEMENT PLAN

BPL Environmental

CONTROL AND REVISION HISTORY

Revisions

Version	Document	Author	Reviewer/Approver	Date Reviewed
Version 1.0	ASSMP	Sharon Arena – BPL	John Hamilton - Urbanscope	10 Sept 2021

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List of Abbreviations

Abbreviation	Meaning
AHD	Above Height Datum
ASS	Acid Sulphate Soils
ASSMP	Acid Sulphate Soils Management Plan
BPL	BPL Environmental
Development/Project	North One Hotel and Apartment Development
ha	Hectare
km	Kilometre
KTT	KTT Investment Pty Ltd
PASS	Potential Acid Sulphate Soils
NSW	New South Wales
NT	Northern Territory
WA	Western Australia

1 INTRODUCTION

KTT Investment Pty Ltd (the **Proponent**) proposes to develop a multi-story hotel/villa and apartment complex at Little Mindil Beach (the **Project**). Given the coastal location of the Development, this Acid Sulphate Soils Management Plan (**ASSMP**) has been prepared to detail how Acid Sulphate Soils (**ASS**) will be managed during the construction phase.

1.1 PROJECT OVERVIEW

The proposed North One Hotel and Apartment Development (the **Development**) is situated at 25 Gilruth Avenue, The Gardens, Northern Territory, is approximately 2.5 kilometres (**km**) north-west of the Darwin Central Business District (**Figure 1-1**).

The 5.13 hectare (**ha**) Project site is largely cleared with a partially developed at-grade carpark, associated landscaping and a large lawn area. The north-eastern boundary of the site abuts a densely vegetated tidal creek; an escarpment bounds the southern perimeter and Little Mindil beach is to the north-west.

The Project will consist of five buildings comprising the following:

- 150 hotel rooms, including 16 lagoon villas and 3 garden villas;
- 53 serviced apartments;
- Six retail spaces;
- 277 car parks; and
- Beachfront food and beverage venue.

A constructed lagoon, roof top and ground level landscaping and water features will also be incorporated into the complex design.

1.2 PROPONENT DETAILS

Proponent details for the Little Mindil development are summarised in **Table 1-1**.

Table 1-1: Proponent Details

Proponent	KTT Investment Pty Ltd
Contact	John Hamilton – Urbanscope (Australia) Pty Ltd
Postal address	c/- 459 Harris Street Ultimo NSW 2007
Phone	+61 2 9042 0600
Fax	+61 2 9660 7681
Email	johnha@urbanscope.com.au
Proponent ABN	70 634 253 197

0 50 100 m

Project Location

Parcel 7651 boundary

Date: 26/02/2021
CRS: GDA 1994 MGA Zone 52
Author: eleanor@animalplantmineral.com.au

1.3 OBJECTIVES

The objectives of this ASSMP are to minimise the risk to the environment resulting from ASS by:

- Defining areas of ASS;
- Outlining proposed management actions;
- Describing proposed monitoring requirements and contingency methods for implementation;
- Outlining the proposed reporting, review and audit requirements.

1.4 LEGISLATION

Relevant Policies and Guidelines include:

- *Environme*nt *Protection Act 2019*
- *National Acid Sulfate Soils Sampling and Identification Methods Manual* (Sullivan et al., 2018)
- NT EPA Env*ironmental Guidelines for Reclamation in Coastal Areas 2006*
- *National Environment Protection (Assessment of Site Contamination) Measure 2013*
- *NT EPA Northern Territory Contaminated Land Guideline 2017*

2 ACID SULPHATE SOILS

Acid Sulphate Soils (**ASS**) are a characteristic natural feature of lowland coastal environments in Darwin, particularly where landform elevations are below 5m AHD. They contain highly reactive iron sulphides, generally in the form of framboidal pyrite. When in a waterlogged state ASS is benign; however, when drained or excavated oxygen from the atmosphere reacts with the iron sulphides in the soil, resulting in the production of sulphuric acid and the potential release of metal compounds from disturbed soils (SLR, 2020). This acidity releases elements such as metals and nutrients from the soil profile which can then be mobilised/transported to waterways, wetlands and groundwater systems, often with damaging environmental and economic impacts (DER, 2015a).

The oxidation of metal sulfides is a natural weathering process that generally occurs slowly and does not pose an environmental concern. However, excavation and drainage can exponentially increase the rate of acid generation. Additionally, water draining from oxidised ASS can be strongly acid, which acts on soils and sediment to produce high solution concentrations of toxic metals, especially aluminium and iron. These high concentrations of metals may have a deleterious effect on human health, the environment and potentially damage infrastructure.

ASS which has not been oxidised by exposure to air is known as Potential Acid Sulphate Soils (**PASS**). For the purpose of this management plan, the term ASS also includes PASS.

2.1 EXISTING ENVIRONMENT

A review of the *Land Systems of the Northern Part of the NT (1:250,000)*, conducted by SLR (2020), indicated the North One Development site exists within the Darwin Coastal geomorphic zone and is classified as level tidal flats with channels and estuaries and minor dunes. It is a common occurrence for ASS to exist on tidal flats, coastal floodplains, and some coastal sand plains.

Figure 2-1 provides an extract of the NT NR Maps *Acid Sulphate Soils Risk Map* overlay for the site, which confirms the probability of ASS. No definitive assessment has been conducted on the site to date; KTT will complete an assessment to confirm the presence or absence of ASS at the Development site prior to commencement of surface disturbance.

Figure 2-1: Acid Sulphate Soils Risk Map (as accessed from NR Maps on 23.04.2020)

2.2 HYDROLOGY

The following hydrological features have been identified adjacent to the site and are indicated in **Figure 2-2**:

- Little Mindil Creek, an open channel natural creek running parallel to the northern boundary of the site;
- Fannie Bay and Little Mindil Beach Foreshore to the north-west of the Development area.

No other forms of surface water are present in proximity to the North One Development.

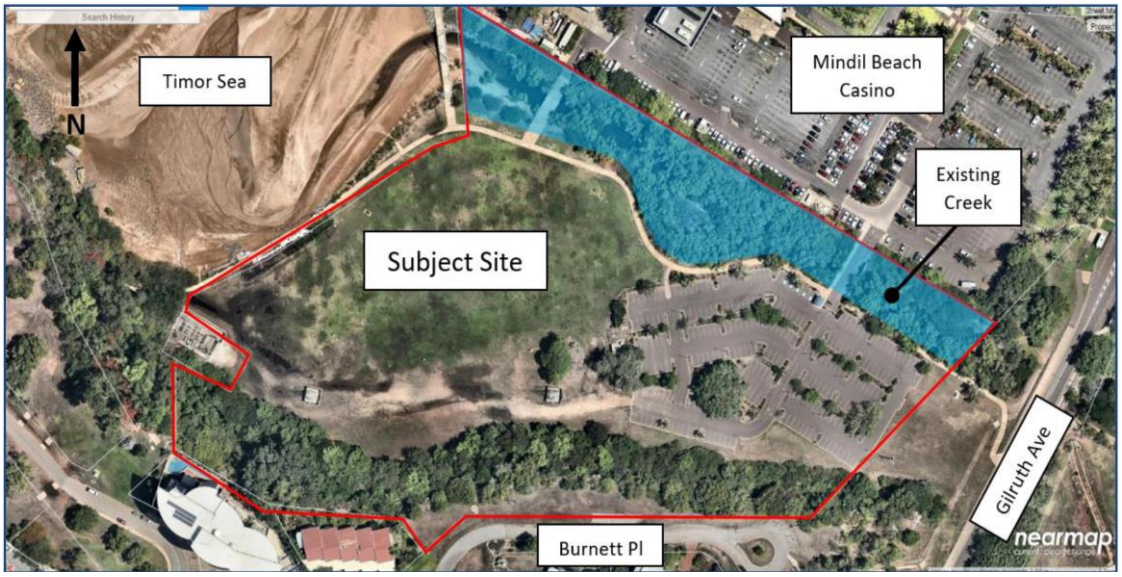

Figure 2-2: Surface Water Features of the North One Development Site

3 DEVELOPMENT ACTIVITIES AFFECTING ACID SULPHATE SOILS

The North One Hotel and Apartment Development has the potential to disturb ASS during the construction phase of the Project. Once operational, there will be no requirement for excavation or disturbance of existing soils.

The site will be predominantly filled during construction to raise the building level above the storm surge height. The majority of excavation will occur within the fill zone, however, partial excavation and disturbance of existing soils will result from the following:

- Initial site leveling and removal of topsoil layers;
- Excavation required for installation of erosion and sediment control infrastructure;
- Construction of the semi-basement carparking facilities (note – this will be built half within the fill zone and half within the existing soil profile);
- Excavation for some underground utility services (most excavation expected within the fill zone); and
- Localised excavation for piering.

4 IMPACT AND RISK ASSESSMENT

A systematic risk assessment process has been adopted by the Project for environmental and social management. This methodology is used to identify activities that have the potential to result in adverse impacts on social and environmental aspects. By developing management measures and controls to reduce the risks identified, “Residual Risks” can be reduced to as low as reasonably practicable.

4.1 IMPACTS

Unmanaged disturbance of areas of ASS and consequent acid drainage from these areas can cause adverse impacts to the terrestrial environment, including, but not limited to:

- Adverse changes to the quality of soil and water;
- Degradation of Little Mindil Creek (**Figure 4-1**), water-dependent ecosystems and ecosystem services;
- Loss of habitat ecosystem complexity and biodiversity, both terrestrial and aquatic;
- Invasion and dominance of acid-tolerant water plants and plankton species in waterways;
- Reduction of soil stability and fertility;
- Deterioration in water quality sources for human use by increasing acidity and heavy metal concentrations;
- Acidification of surface water bodies increasing mosquito breeding, which may increase the prevalence of mosquito-borne diseases such as Ross River virus;
- Loss of visual amenity due to rust coloured stains from iron precipitates at the soil surface;
- Long term infrastructure damage through acidic water corroding metallic and concrete structures; and
- Increased financial burden of treating and rehabilitating affected areas and maintenance of infrastructure.

Figure 4-1: Little Mindil Creek

4.2 RISK ASSESSMENT

Risk assessment is a process which determines the frequency of occurrence of an event and the probable magnitude of adverse effects. It involves identifying environmental aspects, related hazardous events, their causes and environmental impacts. Risk analysis examines the controls to prevent the environmental impact from occurring or mitigate the severity of the impact (consequence). It also analyses the potential consequence and the likelihood of an impact of this severity occurring. **Table 4-1** and **Table 4-2** define the Likelihood and Consequence categories used in the risk assessment, whilst **Table 4-3** shows the Environmental Risk Matrix.

An indicative summary of the key potential impacts expected with construction of the North One Hotel and Apartment Development, with respect to ASS and the associated management measures are provided in **Table 4-4,** along with the associated severity, likelihood and residual risk. This risk assessment is subject to change as the project develops and will be reviewed and updated as necessary throughout the life of the project.

Table 4-1: Likelihood of an Environmental Risk Occurring

Likelihood	#	Description
Almost Certain	A	The event/ impact will occur or is expected to occur. The impact occurs regularly in association with similar projects and/ or in similar environments.
Likely	B	The impact will probably occur in most circumstances but there is some uncertainty about the likelihood. The impact has occurred on more than one occasion in association with similar projects and/ or in similar environments.
Possible	C	The impact could occur in some circumstances. The impact has occurred infrequently on similar projects and/ or in similar environments.
Unlikely	D	The impact is not expected to occur. The impact occurs very infrequently on similar projects and/ or in similar environments.
Rare	E	The impact is very unlikely to occur. The impact has not occurred on similar projects and/ or in similar environments.

Table 4-2: Consequence of an Environmental Risk

Consequence	#	Description
Insignificant No noticeable/ measurable impact to values	1	No measurable soil disturbance, erosion or contamination.
Minor A Minor impact has two or more of the following characteristics: Limited - Impact limited to the Site Very Low - Impact does not significantly alter the quality, distribution or abundance of environmental values Short term - Impact that is felt up to completion of construction	2	Short term soil disturbance, erosion or contamination in the vicinity of the Site that is reversible without significant remedial works.

Consequence	#	Description
Moderate A Moderate impact has two or more of the following characteristics: Localised - Impact is confined to the Site and areas directly adjacent to the Site, such as other allotments, Elizabeth River, and estuarine watercourses adjacent to the Site Low - Impact alters the quality, abundance or distribution of environmental values without compromising their integrity, and can be easily and cheaply reversed Medium term - Impact that is felt up to completion of operations	3	Medium term soil disturbance, erosion or contamination in the vicinity of the Site that that alters soil characteristics but with no measurable impact to environmental values that rely on good soil quality and can be remediated.
Major Regional - Impact extends to the Darwin/ Palmerston region, and/ or greater Darwin Harbour Moderate - Integrity of environmental values altered but impact can practicably be reversed Long term - Impact that is measurable post-Project	4	Soil disturbance, erosion or contamination that compromises regional environmental values that rely on good soil quality, and would be costly and technically challenging to remediate
Severe A Severe impact has two or more of the following characteristics: Widespread - Impact occurs at a NT, national, international or global scale High Intensity - Impact irreversibly compromises the integrity of environmental values Permanent - environmental values will not recover on human time scales	5	Soil disturbance, erosion or contamination that is measurably and permanently impacting environmental values that rely on good soil quality throughout the NT

Table 4-3: Environmental Risk Matrix

			Consequence				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Severe
Likelihood	A	Almost Certain	Medium	Medium	High	Very High	Very High
	B	Likely	Medium	Medium	High	Very High	Very High
	C	Possible	Low	Medium	Medium	High	Very High
	D	Unlikely	Low	Low	Medium	Medium	High
	E	Rare	Low	Low	Low	Medium	High

Table 4-4: Environmental Risk Assessment

Environmental Aspect	Risk Pathways	Impacts	Inherent Risk Rating	Risk Treatment/Management/Mitigation Strategy	Residual Risk Rating	Certainty	Phase
Disturbance of ASS (**ASS**) or Potentially Acid Sulfate Soils during construction activities	Acidification of soils, surface water and groundwater Leaching of toxic metals due to acid drainage that contaminates soil, surface water and groundwater	Adverse changes to the quality of soil and water Degradation of ecological receptors (soil/flora/fauna) of the creek and beach area Loss of habitat ecosystem complexity and biodiversity Invasion and dominance of creek ecosystem and waterways by acid-tolerant water plants andplankton species Reduction of soil stability and fertility Acidification of surface waterbodies increasing mosquito breeding, which may increase the prevalence of mosquito-borne diseases such as Ross River virus Loss of visual amenity due to rust-coloured stains from iron precipitate at the soil surface Long term infrastructure damage through acidic water corroding metallic and concrete structures	High (B3)	Implement the ASS Management including the following: • Undertake a geotechnical assessment prior to construction, to identify areas of occurrence of ASS. • Disturbance of ASS to be avoided where possible, including constructing infrastructure above natural ground level wherever possible. • Excavated ASS to be treated during construction in accordance with requirements of the ASS Management Plan to prevent acidic fluids leaching into surface water or groundwater. Implementation of the Erosion and Sediment Control Plan (**ESCP**) and management procedure in the Construction Environmental Management Plan (**CEMP**) (**Appendix 7** of Referral) to avoid erosion	Medium (D3)	High	Construction

It should be noted that whilst the risk of ASS for the Development is indicated to have a medium residual risk, this risk is short-term and localised in nature and therefore the overall risk of ASS impacts when considering the life of the Project is low. This is due to no ASS impacts being associated with operation of the Hotel Complex.

5 MANAGEMENT AND MITIGATION

5.1 MANAGEMENT OF ASS MATERIAL

Prior to construction, investigations for ASS will be undertaken in areas to be disturbed, to assess the extent of ASS. In order to verify the nature of the disturbed or excavated material during construction, material will be sampled and tested in a laboratory using National Association of Testing Authorities approved methods.

Where possible, disturbance of ASS will be avoided. Installation of services and infrastructure will be limited to the fill zone wherever practicable. Where disturbance is unavoidable, excavation will be minimised or otherwise managed to prevent environmental impacts caused by the oxidation of ASS. Potential management actions are outlined in **Table 5-1**.

Table 5-1: Mitigation measures to avoid or minimise the impact of ASS

Activity	Commitment
Site Preparation and Design	A geotechnical assessment of development footprint will be undertaken prior to construction, to identify areas of occurrence of ASS.
	Disturbance of ASS will be avoided where possible, including constructing infrastructure within the fill zone.
	Awareness training of ASS handling requirements will be provided to personnel involved with the movement of soils, particularly during the construction phase.
Excavation	Any material identified or suspected of being ASS will be directed to the Treatment Pad immediately.
	The site will be inspected for spilled soil material. Any spilled ASS will be transferred to the ASS treatment pad.
	Bunds will not be constructed with material containing ASS.
	Where the volume of ASS to be disturbed is greater than 100 m3, disturbance will be staged such that potential effects on any area disturbed at any one time are limited and managed, the amount of time that ASS is exposed to the atmosphere is minimised (i.e. minimise the time that excavations are left open) and neutralisation of ASS materials occurs as soon as practicable
ASS Treatment	When preparing compliant ASS treatment pads the area will be fully contained/constructed such that drainage/runoff water from the pad is directed to an appropriate receptacle for testing and treatment (if required).
	The Treatment Pad will be located above the 1000-year storm surge elevation
	Treatment of ASS and potential ASS will involve the following: ● ASS treatment pads will have a guard layer of agricultural lime applied at a nominal rate of 10kg/m^2; ● ASS material will be transferred to the treatment pad and placed on top of the guard layer. If ASS is to be treated in more than one layer, enough time will be allowed for validation testing and compliance of a layer before addition of extra material; ● ASS material is to be spread out in windrows of 300 mm loose thickness for drying. Once dry, fine agricultural lime will be applied evenly over the surface and thoroughly mixed into the soil; ● Lime will be stored in a containment area adjoining the treatment pad (so that any discharge from the area is directed into the treatment pad). Hydrated lime will be stored in appropriate weatherproof storage
	The Acid Neutralising Value of the agricultural lime supplied may not be 100% (as assumed for pure lime) and will be identified from documentation provided by the lime supplier. If less than 100%, a correction factor of 100/ Acid Neutralising Value will be applied to reach the equivalent of pure fine agricultural lime.
	Treated ASS shall not be removed from site until validation monitoring indicates that performance indicators have been met.
Stormwater Management	All stormwater, retained water or ASS leachate from stockpiles or other exposed areas shall be: ● Diverted to a retention pond for monitoring and treatment (if required); ● Monitored for changes in pH, water level, Electrical Conductivity, total iron and aluminium concentrations; and

Activity	Commitment
	● Treated with hydrated lime for pH adjustment of water if required.
Erosion of ASS	Implementation of the Erosion and Sediment Control Plan (Appendix 12 of the Referral)

The recommended neutralising agent is fine agricultural lime (Aglime) composed of a minimum 97% (preferably 99%) calcium carbonate ($CaCO_3$). Liming rate has been identified as one kilogram (kg) $CaCO_3$/t of ASS. A Lime Register detailing deliveries and lime application records will be maintained. Treated soils may be used as backfill or disposed of at designated sites.

5.2 UNDISTURBED ACID SULPHATE SOILS

Undisturbed in situ ASS can be covered with a significant volume of fill. A suitable depth of fill will be determined on a location specific basis, depending on the severity and extent of ASS.

5.3 STOCKPILING

Significant quantities of acid can build up, especially in porous sandy stockpiles, if left in an oxidising condition for even short periods of time. Large stockpiles are difficult to neutralise, primarily due to the earthmoving needed. Stockpiles will be created, up-gradient of development sites, such that all leachate and run-off water will be directed towards already-disturbed ASS areas.

Stockpiling of untreated ASS will only be undertaken as a short-term activity. Short-term stockpiling may be needed due to weather conditions preventing treatment or delays obtaining laboratory results.

6 MONITORING AND REPORTING

6.1 MONITORING

Monitoring activities will be undertaken throughout the life of the Project in relation to the identified objectives and targets. The detail of monitoring activities will be determined once infrastructure design and associated construction methodologies have been decided upon, following completion of geotechnical investigations.

Indicative monitoring includes:

- Treated soil will be monitored for successful neutralisation before being moved or covered. One test (comprising six composite samples) of the limed material will be conducted per 250 m^3 of treated material. Sample handling, transport and testing will be conducted using the appropriate guidelines, chain-of-custody protocols and accredited laboratory.
- Monitoring of pH and total acidity of any pools of water collected within bunds and treatment of water to keep the pH in the range of baseline data.

Aspects of ASS management that are influenced by stormwater are also managed under the stormwater Management Plan. Monitoring of the stormwater system will be conducted under the Stormwater Management Plan. The monitoring program will be identified in the detailed design phase however indicative monitoring includes:

- Regular inspection of the stormwater system to ensure no erosion is occurring (and therefore exposing ASS soils); and
- Regular water quality monitoring, where exposure to ASS is suspected.

6.2 OBJECTIVES, TARGETS AND INDICATORS

The objectives, targets and indicators for the management of ASS are shown in **Table 6-1**.

Table 6-1: ASS Management Objectives, Targets and Indicators

Objectives	Targets	Indicators
Minimise disturbance of ASS outside designated construction and earthworks areas	No incidents of disturbance to ASS outside of the areas of unavoidable disturbance required for infrastructure construction.	Incident reports indicate the area and quantity of disturbance outside the designated footprint.
Handle and dispose of all excavated ASS in accordance with outlined management strategies	No incidents of excavated ASS handled or disposed in a manner outside of the agreed management strategies.	Records of ASS removal to approved disposal facilities or locations. Incident reports of non-compliance with management strategies.
Disturbed ASS is treated and neutralised in accordance with outlined strategies	All treated ASS is successfully neutralised.	Monitoring of treated ASS indicates no net acidity in soil.
Minimise changes in surface water quality	No significant alteration in pH or heavy metal concentration in surface water on site or within Little Mindil Creek above baseline data range/ANZECC guidelines.	Monitoring results indicate pH and heavy metal concentration are within acceptable data range.

6.3 AUDITING, NON-COMPLIANCE AND CORRECTIVE ACTIONS

The Site Manager will be responsible for ensuring that a regular auditing program of activities and ASS management measures is implemented. The audit program shall aim to ensure compliance with the ASSMP and relevant statutory requirements. The audit will take the form of a visual inspection of the works, treatment sites, associated control measures and a review of monitoring data. A written record of auditing undertaken will be maintained, including details on the date of the audit, activities undertaken, observations made and any nonconformances identified. Frequency of these audits may gradually decrease if a high level of compliance with the ASSMP is evident.

Non-compliance with any of the controls outlined in this document will be classified as an incident. Any non-compliance to the ASSMP must be addressed as soon as practical. The personnel responsible for the non-compliance must be notified immediately for purposes of issuing rectification instructions. The detection of incidents associated with ASS will trigger internal notifications, reporting requirements, investigation and corrective and preventative actions. Incidents include:

- Changes in sediment or surface water pH; or heavy metal concentrations above baseline monitoring data
- Changes in vegetation health adjacent to ASS areas caused by acid drainage
- Non-compliance with the agreed handling, treatment and disposal management procedures of ASS
- Failure to meet identified objectives and targets.

Corrective actions that may be triggered as a result of incident investigations include:

- Increased sampling (frequency and/or location) to confirm the sources of acid leaching or heavy metal contamination
- Construction of leachate drains to capture acidic water for neutralisation
- Neutralising ASS where practicable
- Refresher training to site personnel on ASS management procedures
- Review of ASS management practices to assess practicability of their implementation and/or identify new management practices.

6.4 RESPONSIBILITIES

The Site Manager is responsible for ensuring that all requirements of the ASSMP are met during the construction phase, including ensuring the strategies and procedures outlined in this ASSMP are implemented in accordance with the specified performance criteria.

All other site personnel are responsible for implementing strategies and procedures outlined in the ASSMP, as applicable to their work activities.

6.5 REPORTING REQUIREMENTS

Reporting relative to ASS management will comprise an annual report capturing the key criteria, including volumes of ASS disturbed, monitoring results and quantities and methods of ASS treated and disposed of. The report will discuss and evaluate the performance of the ASSMP, including the effectiveness of the operating strategies, comparison of monitoring results against performance indicators, any incidents that have occurred and the effectiveness of any corrective action adopted.

Should an environmentally significant incident occur, this will be reported to the relevant statutory authority by the Site Manager within 24 hours of the incident being identified.

Following completion of the project, a closure report will be prepared and submitted by the building contractor to the Proponent. The report will include the relevant management measures undertaken at the site, the results of monitoring programs, potential risks to human health or the environment and the discussion of any remedial measures required.

7 TRAINING AND AWARENESS

Training will be conducted for all personnel involved in excavation, transport or handling of soils on site and shall be conducted prior to the disturbance of any soils on site. Training will be designed to ensure that personnel are aware of ASS issues on site, can recognise ASS and are aware of their responsibilities in managing ASS. A training register, listing people trained, training dates, name of trainer and signatures of all trainees, will be maintained by the Building Contractor / KTT Investment.

Toolbox meetings will be conducted on an as needed basis to address issues encountered during the operation and ensure personnel have a current understanding of environmental issues and controls.

8 COMMUNICATIONS

Concerns or complaints raised by the community (or other parties) in relation to ASS will be directed to the Site Manager and KTT Investment for action. The Site Manager will maintain a complaints register including the name of the complainant, the nature of the complaint, details of any investigations, the conclusions from investigations and details of any corrective actions or responses.

Remedial actions (if required) will be discussed and agreed upon with the relevant statutory authority.

9 REVIEW

This ASSMP will be reviewed on an annual basis, unless incidents occur that require amendment of the plan outside of the review process.