Site Contamination

23

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23 Site Contamination

23.1 Introduction

This chapter of the EIS details known or potential sources of contaminated land and the likelihood of Acid Sulfate Soils (ASS) occurring on the site. The methodology for this assessment consisted of a desktop review and a site inspection to identify potential constraints and issues relating to the proposed redevelopment project. The assessment is also based on an interpretation of the significance of environmental attributes as evidenced by desktop information, onsite observations and the observations of others. It is the specific intention of White Horse Australia Pty Ltd that project construction and operation activities will not cause contamination that will result in the land requiring listing on the State's Environmental Management Register or Contaminated Land Register.

Refer to **Appendix J -** Error! Reference source not found. for the technical assessment prepared by Cardno on this matter.

Addendum: *This EIS was initially prepared assuming that the safe harbour was to be part of the Lindeman Great Barrier Reef Resort Project. With the commencement of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dredging Coral Reef Habitat Policy (2016), further impacts on Great Barrier Reef coral reef habitats from yet more bleaching, and the recent impacts from Tropical Cyclone Debbie, the proponent no longer seeks assessment and approval to construct a safe harbour at Lindeman Island. Instead the proponent seeks assessment and approval for upgrades to the existing jetty and additional moorings in sheltered locations around the island to enable the resort's marine craft to obtain safe shelter under a range of wind and wave conditions. Accordingly, remaining references to, and images of, a safe harbour on various figures and maps in the EIS are no longer current.*

23.2 Legislative Framework

The following legislation, policy and guidelines are relevant to identifying values, mitigating and managing potential impacts associated with land contamination:

- *Environmental Protection Act 1994* and subordinate legislation;
- *Australian Standard 4482.1-2005 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil;*
- *National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No 1) (NEPM); and*
- *Queensland Auditor Handbook for Contaminated Land, Module 5: Contaminated Land Investigation Documents, Auditor Certification and Compliance Assessment, DEHP, 2015.*

23.3 Existing Environmental Values

23.3.1 General Site Description

Lindeman Island is located approximately 35 kilometres south-east from Shute Harbour on the mainland and some 15 kilometres from Hamilton Island. Lindeman Island has a total area of approximately 637 hectares. The resort redevelopment on land occupies perpetual and term leases totalling approximately 139 hectares. The balance of Lindeman Island is declared National Park and included in Lot 429 NPW622. Lindeman Island is within the jurisdiction of Mackay Regional Council. The existing resort previously owned by Club Med is located on the south-west corner of Lindeman Island. All infrastructure has remained since the resort closure in 2012 which currently comprises of 225 rooms, restaurant/s, golf course, staff accommodation, administration buildings, two grassed airstrips and recreational facilities including tennis courts, one guest and one staff swimming pool. Various infrastructure ancillary to and necessary for the function of the Resort were established and include sewage and waste water treatment plants, two water storage dams, staff recreational buildings and walkways.

23.3.2 Potential for Occurrence of Acid Sulfate Soils

Acid Sulfate Soils (ASS) are the common name given to naturally occurring sediments and soils containing iron sulphides. The Queensland Acid Sulfate Soil Technical Manual (2014) stipulates that ASS is associated with low lying areas below 5m Australian Height Datum (AHD) include sediments of recent geological age (Holocene) within marine or estuarine sediments and tidal lakes. ASS can be found or can form in any anoxic, aqueous environment where sulfate-reducing bacteria are provided with organic matter (their energy source) and available sulfate ions. Examples include bottom sediments in drains, dams, constructed and natural waterways, swamps and billabongs, periodically stagnant creeks and places with perched water tables. These environments are not restricted to coastal areas. They can occur anywhere where the above conditions for sulfate reducing bacteria can be met. While most coastal ASS is geologically young (<10,000 years old), inland ASS can be found in much older sediments. These occurrences are not limited by stratigraphy or age. In an undisturbed and waterlogged state, ASS soils may pose no or low risk. However, the exposure of ASS to oxygen (e.g. during excavation activities) leads to the generation of sulfuric acid and increase bioavailability of metals which has the capacity to directly impact upon soil, water, flora and fauna. These impacts, in turn, can have adverse effects on visual amenity and long-term site management.

The Cretaceous age of the volcanic geology of Lindeman Island is not typical of geologies which contain ASS. Consequently no previous ASS surveys have been carried out by QASSIT on Lindeman Island.

Mapping and other documentation reviewed for determining the potential for ASS on Lindeman Island included:

- Queensland Globe Acid Sulfate Soils of the Airlie beach area, North Queensland 1:25 000 series;
- Queensland Globe Acid Sulfate Soils of the Mackay area, North Queensland 1:50 000 series;
- Department of Local Government 2007, Planning, Sport and Recreation, Whitsunday Shire Strategic Infrastructure and Service Plan; and
- Whitsunday Regional Council 2009, Whitsunday Shire Planning Scheme 1:300 000 series (2009 Whitsunday Shire Planning Scheme).

An ASS Natural Hazards Overlay Map ('the map') provided within the 2009 Whitsunday Shire Planning Scheme was the only available map for the region (refer to **Appendix J**). The map primarily focuses on the

mainland with some limited information provided for neighbouring Whitsunday and Hook Islands where no ASS areas were identified. No areas underlain by ASS are shown for Lindeman Island.

Additionally, a visual inspection of the sides and bottom of existing turning basin and navigation channel (carried out by Cardno Marine Ecologists on 19-21 January 2016) noted the absence of lenses of sediments and soils below the coral and coral derived surface material.

Given the above lines of evidence and based on an overall understanding of the likelihood of distribution of ASS in similar geologies across Australia, additional intrusive investigations to confirm the absence of ASS is not considered warranted on Lindeman Island. Management measures to be considered to manage any residual risk from naturally occurring soil acidity would include soil baseline sampling and pH testing during construction to ensure acidic soils disturbed are suitable for landscaping and do not generate an inappropriate level of risk to waterways.

23.3.3 Surface Hydrology

Gap Creek Dam is the primary water supply source on Lindeman Island and has a full supply capacity of approximately 200ML. Black Water Dam is located to the south of the Gap Creek Dam and is used for golf course irrigation purposes. Stormwater runoff from the island is generally conveyed along natural vegetated gullies and drainage lines to ocean outfalls. The discharge of storm water in the vicinity of the existing resort area relies upon water running within a naturally occurring gully located beside an existing road alignment (Club Med Lindeman Island Road) from the jetty to upper portions of the site.

23.3.4 Groundwater Resources

A Department of Natural Resources and Mines (DNRM) registered bore search was conducted for the purposes of this investigation. The search identified no registered bores on Lindeman Island. Six groundwater bores were installed during Club Med operations (Bore Pump 1 - 6) (pers comm D Stuart). Anecdotally, water quality and pumping tests have been conducted on these bores during Club Med operations. The bore water is understood to be suitable for drinking purposes. No data in relation to these groundwater bores were available, with water testing commencing on the only currently operational Bore Pump 5 in March 2016.

23.3.5 EMR/CLR Searches

Queensland Department of Environment and Heritage Protection (DEHP) is the lead agent for environmental protection. The Environmental Protection Act 1994 (EP Act) requires that all persons have a general environmental duty to take all reasonable and practical measures to prevent or minimise environmental harm. Activities identified as being likely to cause contamination are listed as Notifiable Activities under Schedule 3 of the EP Act. Common land uses which can cause contamination (Notifiable Activities) include, for example, service stations, cattle dips, tanneries, wood treatment sites, landfills, wastewater treatment plants, fuel storage and refuse tips. It is a requirement of the EP Act that DEHP be informed of any land used for Notifiable Activities or contaminated by hazardous contaminants. DEHP maintains and manages two registers the Environmental Management Register (EMR) and the Contaminated Land Register (CLR). The EMR is a land use planning and management register that records land that has been used for a Notifiable Activity or land that has been contaminated by hazardous contaminants which pose or are suspected to pose a risk to human health and the environment based on their history. The CLR is a register of ‘known risk’ sites which have been

scientifically proven to be contaminated and actions are required to either remediate or manage the site to reduce the risk of causing harm to human health and the environment. The EMR also provides 'Area Management Advice' (AMAs) regarding land areas where there is a potential for more widespread contamination from elevated metal concentrations due to natural mineralization or the possibility of unexploded ordnance (UXO) from Department of Defence training activities. An AMA is an administrative arrangement developed by the EPA, Local Government and other parties for land where detailed information is not available but alerts the community to information that aids in managing land contamination.

The results of the DEHP register searches conducted indicated that Lot 2 CP858366, Lot 8 HR1954 and Lot 429 NPW622 are not listed on the EMR and CLR register. Where properties are listed on the EMR and CLR register, all subsequent lot configurations associated with the property remain on the register until such time that it can be shown that it will not result in environmental harm.

Lot B-D HR2029 (strata titles) were recently subdivided from a larger lot which included Lot 429 NPW622. As Lot 429 NPW622 is not included on the EMR, this indicates that any potential contaminating activity associated with Lot B-D HR2029 would be limited to the time period since the boundary realignment. As these lots have remained undisturbed since the property subdivision, it is considered likely that Lot B-D HR2029 is not listed on the EMR and CLR register. It should be noted that EMR and CLR register searches are unavailable for strata titles such as Lot B-D HR2029. A copy of the results of the EMR and CLR register searches are provided in Appendix J.

23.3.5.1 Additional Notifiable Activities

The current diesel storage of 60,000 litres (L) at the site is considered a notifiable activity which warrants inclusion on the EMR. The owner or occupier has a responsibility to notify DEHP when they become aware that their land has been or is being used to carry out a notifiable activity.

The wastewater treatment plant is below the threshold to be classified as a notifiable activity. It should be noted, in cases where Notifiable Activities are positively identified during operations and/or construction works, landowners, or occupiers have a responsibility to notify DEHP when they become aware that their land has been or is being used for a notifiable activity or contaminated by a hazardous contaminant for inclusion on the EMR.

23.3.6 Aerial Photography and Literature Review

Aerial photography was used to identify the potential nature and frequency of potential contamination within the project area. The results of the aerial photography review are included in **Appendix J – Contaminated Land.** A literature review of the preliminary geotechnical assessment undertaken by Cardno Ullman & Nolan Geotechnical Pty Ltd (Cardno Ullman & Nolan 2015) and "*The Whitsunday Islands An Historical Dictionary*" (Blackwood, 1997) was also conducted. The key findings of the mapping, literature and aerial review pertaining to potential sources of contamination are as follows:

- Since European settlement land uses on Lindeman Island have changed over time from a grazing property through to a Club Med Resort in the 1990s which remains on the island. In 1928, the first guests arrived and were accommodated in grass huts and cabins. Although sheep have been historically grazed on Lindeman Island, anecdotally, it is understood that no dip sites are present on Lindeman Island. The site inspection confirmed the lack of structures associated with historical dipping practices. The likelihood that a dip site exists on the Island is considered low.
- In the 1940's a number of tracks were constructed to provide access to scenic views. These existing tracks appear to have been maintained by the Forestry Department since 1950.

- In 1956 the existing air-strip was extended to meet Department of Civil Aviation standards for smaller aircrafts. In 1957 a new air-strip was constructed in a north-south direction, cutting across the old northwest-southeast strip to accommodate larger planes.
- In 1959 new guest accommodation was built and a swimming pool was added. The last of the grass huts were demolished at this time.
- In 1961 the whole island was surrendered and replaced by a perpetual lease over 152 acres covering the resort area and airstrip, that area being excised from the National Park.
- In 1970 a six-hole golf course was constructed west of the air-strip and running towards Piccaninny Point. To provide water for the golf course and for gardening and general use at the resort a dam was constructed at the same time across Boat Port Creek on the western side of the island north of Piccaninny Point.
- P&O Cruises Australia operated a small 48 room resort in the 1980s before being purchased by Adelstein Investments who increased the size of the resort by 104 rooms in 1988.
- The resort was purchased by Club Med in 1990 and the current 225 room resort was opened in January 2012 for business following extensive refurbishment, demolition and construction work that was conducted over a two year period. These demolition works included the demolition of structures containing asbestos.

An overview of potential environmental impacts from historic and current activities based on the aerial and literature review are detailed below in **Table 23-1.**

Table 23-1. Potential Sources of Contamination.

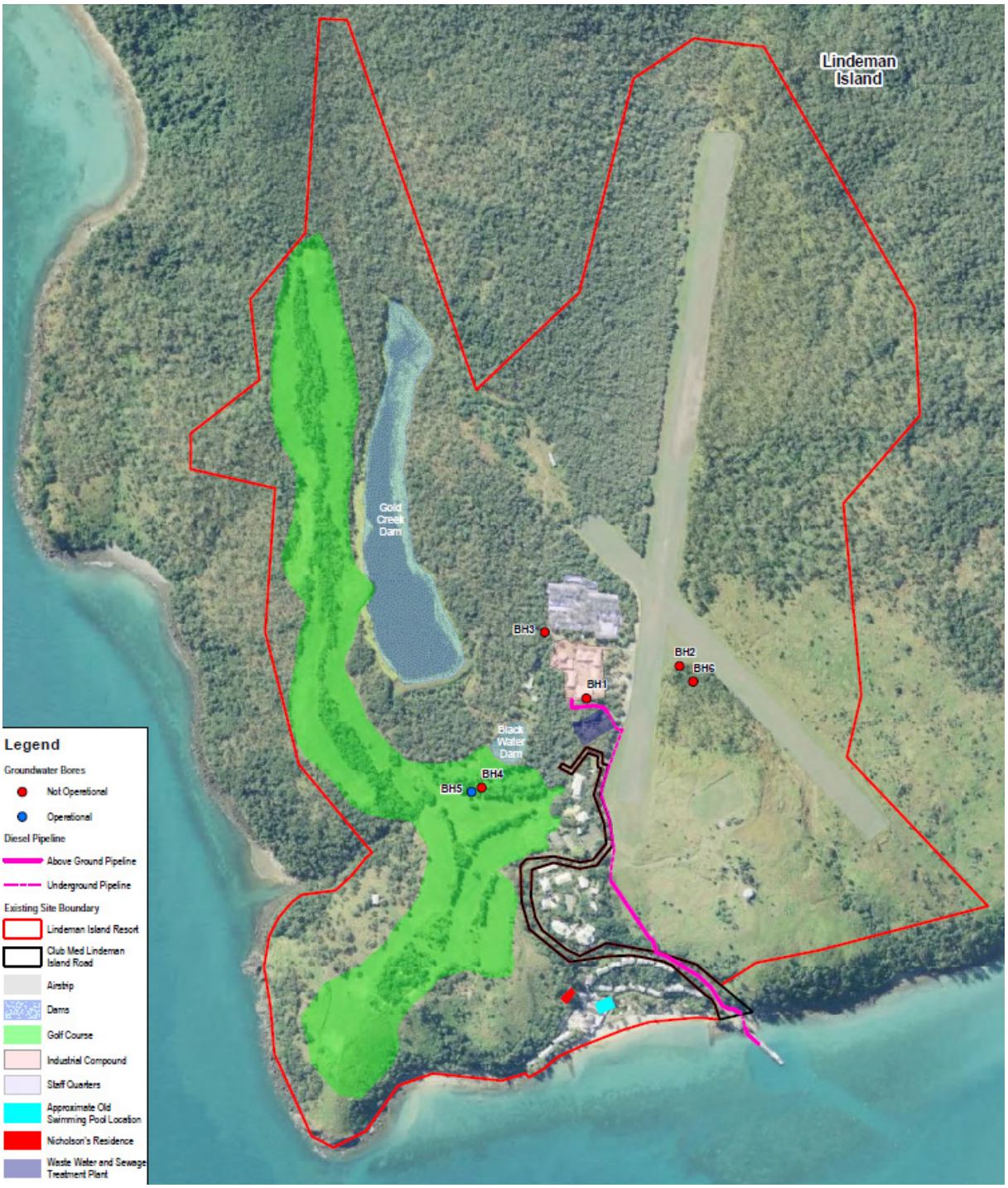
Current Activity Summary	Activity Details	Comments
Accommodation Areas	Large scale accommodation	Potential for minor fuel/chemical/oil/waste oil storage/spills
Airstrip	Unsealed airstrip	Potential minor fuel/oil storage and spills Potential use of herbicides/pesticides
Golf Course	Golf Course	Potential imported fill of unknown origin Potential imported material of previously contaminated soil into area Potential contamination from irrigated effluent Potential contamination from the irregular use of insecticides, pesticides, herbicides and fungicides
Water and Sewage Treatment Plants	Water and Sewage Treatment Plants	Potential contaminants of concern including aluminium, arsenic, cadmium, chromium, cobalt, lead, nickel, fluoride, lime and zinc, nitrates and micro-organisms
Black Water Dam	Proposed conversion of the dam to a golf course	Potential contaminants of concern including aluminium, arsenic, cadmium, chromium, cobalt, lead, nickel, fluoride, lime and zinc in sediments from historic effluent disposal to dam.
Fuel and chemical storage tanks	Fuel/chemical storage in above ground storage tanks	Potential for fuel spills during transportation from the jetty to the stored tank via a aboveground pipeline
Workshop	Vehicle maintenance workshop	Potential for minor fuel/chemical/oil/waster oil storage/spills
Backfilling of Swimming Pool Area during 1990s refurbishment	Fill material from unknown origins	Potential unregistered asbestos disposal area Potential for hazardous material storage

Current Activity Summary	Activity Details	Comments
Nicholson's Residence	Identified Asbestos area	Potential exposure to Asbestos Containing Material (ACM)

23.4 Consultation and Site Inspections

A site inspection was conducted by an experienced Cardno Senior Environmental Scientist (Lynn Morrissey) on 27th October 2015. The Cardno representative interviewed a Lindeman Island Resort employee (Caretaker - Darren Stuart) with explicit knowledge of the history of the operation. Mr. Stuart was a caretaker during Club Med operations and remained in that role following the resort closure in 2012. Observations made during the site inspection were recorded on field documentation with features of interest photographed and are denoted on **Figure 23-1. Areas of Potential Environmental Concern.**

Figure 23-1. Areas of Potential Environmental Concern.



23.4.1 Water and Sewage Treatment Plants

The water and sewage treatment plants were observed in the maintenance and services area and surrounds. Mr Stuart indicated that a number of chemicals were typically used during operations which ceased following resort closure. Chemicals used are detailed in **Table 23-2.** Mr. Stuart indicated these non-hazardous chemicals were stored in the maintenance and services area.

Table 23-2. Chemicals used in the Water and Sewage Treatment Plants.

Chemical	Use/Purpose
Copper sulphate	Used to control algae
Hydrated lime and Soda ash	Used to control bicarbonate and noncarbonated hardness
Sodium bicarbonate	pH adjustment
Flocon	Flocculent
Bulk sodium hypochlorite	Disinfection of wastewater effluent

No incidents or accidental spills resulting in environmental harm were reported during or following resort operations. The water and sewage treatment plants appeared to have been well maintained during operations.

23.4.2 Golf Course Irrigation Areas

Recycled wastewater from the resort facilities was used for irrigation water on the golf course. This eliminated the need to discharge wastewater. Following processing in the water and sewage treatment plants, waste water was transferred to the Black Water Dam for storage prior to irrigating activities resulting in the additional sedimentation of remaining sludge particles. The quality of irrigated effluent is unclear and analytical results for irrigated effluent and soil quality were unavailable. Site management discussions confirmed irrigation activities has not occurred since the resort closure and therefore it is considered environmentally low risk.

Potential contaminants of environmental concern include metals, nitrates and micro-organisms. **Table 23-3 below** provides guidance concentrations of potential contaminants of environmental concern[1] found in recycled wastewater.

Table 23-3. Anticipated Concentrations of Potential Contaminants of Environmental Concern within Recycled Wastewater

Chemical	Anticipated Concentrations	Chemical	Anticipated Concentrations
Aluminium	2.2 mg/L	Lead	0.06 mg/L
Arsenic	0.015 mg/L	Mercury	0.007 mg/L
Cadmium	0.004 mg/L	Nickel	0.6 mg/L
Chromium	0.11 mg/L	Zinc	0.25 mg/L

[1] As provided in Table 4.4 of the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), 2008*

Chemical	Anticipated Concentrations	Chemical	Anticipated Concentrations
Copper	0.4 mg/L	Nitrogen	25-30 mg/L
		Phosphorus	5 mg/L

A baseline soil assessment should be undertaken to determine the contamination status of subsurface soils prior to recommencing irrigation activities within the golf course area.

23.4.3 Black Water Dam

Treated wastewater was stored in Black Water Dam for storage and sedimentation purposes. Potential contaminants of environmental concern including metals, nitrates and micro-organisms may have been present within historic wastewater flows. These contaminants may be concentrated in the sludge and in remaining water in the dam. It is understood that Black Water Dam will be backfilled and this area will be used as a golf course. Testing of sludge will be required should sludge removal and disposal from the Blackwater Dam be necessary.

23.4.4 Composting Areas

Sludges and biosolids from the sewage treatment plant and green waste were composted in an area to the north of the site. Potential contaminants of concern as a result of the sewage treatment process include heavy metals, organic pollutants and pathogens which have not been removed during treatment may be concentrated in biosolids.

During construction stage sampling of the composting area will be required to establish a baseline of remaining contamination prior to establishing the new composting area.

23.4.5 Industrial Compound

23.4.5.1 Fuel Storage and Associated Infrastructure

Three Above Ground Storage Tanks (ASTs) Containing Class C1 Combustible Diesel were observed during the site inspection in the maintenance and services area. The ASTs were located in a bunded area and were found to be in good condition with no evidence of corrosion or rusting. During operations, fuel was transported from the jetty to the ASTs from a pipeline. The pipeline is both aboveground and below ground in places as indicated in **Figure 23-1**. No other petroleum storage was observed during the site inspection. No incidents or accidental spills resulting in environmental harm were reported during or following resort operations.

The condition of the pipeline is currently unknown. Integrity testing and a visual inspection of all fuel related infrastructure with possible follow up sampling is required prior to re-commissioning and ongoing usage at which time the relevant approvals will be sought under the *Environmental Protection Act 1994*. Should evidence of hydrocarbon related impacts be identified, remediation activities should be undertaken under the supervision of a Suitably Quality Person (SQP). If land is to be included in the Environmental Management Register, an assessment of land contamination and any associated risks will be done by a person who is suitably qualified under the *Environmental Protection Act 1994*. Recommendations regarding the contamination status of land and the suitably of the land for different land uses, including recreation and resorts, would be confirmed through an auditor's certification.

23.4.5.2 Landscaping and Nursery Maintenance Shed

Minor chemical storage was observed in the landscaping and nursery maintenance shed as outlined in **Table 23-4**. All chemicals were appropriately stored and labelled. The shed is also surrounded by a well maintained concrete hardstand. No major stains were observed during the site investigation.

Table 23-4. Chemicals storage in the Landscaping and Nursery Maintenance Shed.

Chemical Name	Chemical Composition	Use/Purpose	Approximate Volume
Asulox	Asulam present as sodium salt concentrate	Herbicide	20 litres
Broadside	MCPA present as iso-octyl ester, bromoxynil present as octanoate ester, dicamba, hydrocarbon solvent		40 litres
Brushkiller 600	Tricopyr present as the butoxyethyl ester, picloram present as hexyloxypropylamine salt		500 grams
Chipco Fairway	oxadiazon		20 litres
Sempra Monsanto	Halosulfuron-methyl		5 litres
Weedmaster Duo	Glyphosate		20 litres
Albarol	white oil	Insecticide	20 litres
Pyrethrum	Pyrethrum, piperonyl butoxide, ethanol	Pesticide	1 litre
Daconil	Chlorothalonil	Fungicide	20 litres
Liquid Potash	Potassium, phosphorus	Liquid fertiliser	20 litres
Chelated Iron	A soluble complex of iron, sodium and a chelating agent (e.g. ethylenediaminetetraacetate)	Used to make the iron soluble in water for the purposes of making it accessible to plants	250 grams
Ken-Met 600	Metsulfuron Methyl	Herbicide	500 grams
Cypricide	Copper Ethanolamine	Algicide	20 litres
Chipco Dimension	Dithiopyr	Herbicide	5 litres

Given the small volume of chemicals, the application rates and concentrations used for landscaping purposes, any environmental risk is considered low. This low risk rating is based on the assumption that products are used as per the manufacturers' specifications.

23.4.5.3 Workshop

Additional chemical storage was observed in the workshop used for vehicle and motor maintenance as detailed in **Table 23-5**. General maintenance products observed included degreaser, WD40 and numerous tins of paint and varnish. All chemicals and products stored in the workshop appear to be labelled and stored appropriately. The workshop located in the industrial compound is surrounded by a well maintained concrete hardstand which is in good condition. No major stains were observed during the site investigation.

Table 23-5. Chemicals storage in the Workshop.

Chemical	Chemical Composition	Use/Purpose
Oasis Compact Cleaner Disinfectant	Quaternary ammonium compound, non-ionic surfactant	Disinfectant
Slime puncture sealant	Green colour thixotropic liquid with mild odour	Sealant
Septone Rust Prime	Phosphoric acid	Rust Prime
Brake Cleaner	Heptone, acetone	Brake Cleaner
Sta-bil fuel stabiliser	isoparaffins petroleum hydrotreated HFP	Fuel Stabiliser

As the workshop is surrounded by a concrete hardstand and due to the small volume chemicals stored, any environmental risk is considered low. This low risk rating is based on the assumption that products are used as per the manufacturers' specifications and all maintenance activities were conducted in the workshop.

23.4.5.4 Waste Transfer Station

A Waste Compactor was observed in the accommodation area adjacent to the beach area. During operations it had capacity to cater for waste generated by up to 700 guests and staff. Waste was managed and collected by JJ Richards's group during operations. The waste transfer station infrastructure appears to be well maintained and in good condition.

23.4.5.5 Additional Industrial Compound Infrastructure

Other environmentally relevant infrastructure observed in the industrial compound concrete hardstand area included:

- An Intermittent Bulk Container (IBC) in a bunded area;
- Four fuel drums and an intermittent bulk container containing hypochlorite solution;
- A corroding steel tank formerly used for water storage; and
- Coolant storage tank used for the site generator.

23.4.6 Asbestos

Asbestos products commonly found in older buildings include:

- Flat sheeting (known as 'fibro' or 'AC sheeting');
- Corrugated sheeting (larger profile is known as 'super six');

- Water or flue pipes;
- Roof slates;
- Flexible, profiled, textured or coloured building boards; and
- Imitation brick cladding.

Undisturbed asbestos firmly interwoven in a material is described in the above examples are referred to as bonded Asbestos Containing Material (ACM). Bonded ACM is not of high concern until disturbed through renovations or demolishing of structures whereby asbestos particles can become airborne and represent a significant human health risk.

23.4.6.1 Staff Quarters

An asbestos survey of the buildings was not conducted as part of this contaminated land technical report as it was considered outside the objectives of this assessment. However, the 'Staff Quarters' prefabricated buildings were inspected and were found to contain ACM.

23.4.6.2 Nicholson's Residence

It is understood that the Nicholson's residence was built by 1936 and is located in the centre of the main resort area. The building has undergone various extensions and changes since its construction and is externally clad with weatherboard and asbestos. The building is also lined with asbestos internally (*Converge Heritage and Community, February 2016*).

23.4.6.3 Areas of Uncontrolled Fill

The pool area was backfilled during refurbishments works conducted by Club Med (refer to **Figure 23-1.Figure 23-1. Areas of Potential Environmental Concern.**). It is understood that works were conducted over a two year period prior to the resort reopening in 1990. The source of pool filling material is unknown. It appears likely that filling material was sourced from building debris from nearby demolition works. Due to the age of the buildings this debris is likely to contain ACM. It has been established that activities on site have been limited to sheep grazing and use as a resort.

23.4.6.4 Asbestos Management Strategy

An asbestos survey shall be conducted by a qualified specialist to confirm the presence of ACM prior to disturbance activities. A comprehensive management plan shall be developed and any identified ACM shall be removed by a licensed asbestos removalist.

23.5 Summary of Existing Contamination Sources

Based on the review undertaken above, existing activities to be considered as potential sources of contamination are as follows:

- The above ground diesel storage within the industrial compound and transfer of diesel from the jetty to the existing storage has the potential to impact both soil and groundwater;
- Historic effluent irrigation of the golf course has the potential to create minor impacts to soil, however the flows are not considered sufficient to create impact to groundwater. No analytical results for irrigated effluent and soil quality were available at the time of preparation of the EIS;
- Historic storage and sedimentation in Black Water Dam;
- Minor chemical storages in the workshop and landscaping shed. Chemicals of potential environmental concern include pesticides, herbicides, fungicides, insecticides and vehicle maintenance products;
- Potential ACM in the staff quarters prefabricated building and Nicholson's residence has the potential to contaminate soil if improperly disposed;
- Historic uncontrolled filling of the beachside pool area (old swimming pool location) has the potential to contain ACM; and
- Historic localised soil contamination may be present within the composting area.

23.6 Impacts, Mitigation and Management

Potential contaminated land related impacts from the project fall into two basic categories:

- *Existing contamination:* Potential impacts from existing contamination within the project affected area through increased contact/ exposure to the sites. This could include increased human contact during construction and/ or post construction activities, and possible human and aquatic ecosystem exposures if the contamination migrates to watercourses, making the contaminants potentially available in the water column and sediments; or
- *Potential future contamination*: Potential impacts of project construction, operation and maintenance activities that could cause releases of substances that could cause land to become contaminated.

Due to the low likelihood of Acid Sulfate Soil occurrence, proposed mitigation and management measures are not proposed but measures to manage residual risk from soil acidity are included in the proposed Environmental Management Plan (refer to **Chapter 28 – Environmental Management Plan**).

23.6.1 Potential Contamination Impacts

It has been established that activities on site have been limited to sheep grazing and use as a resort. Existing activities to be considered as potential sources of contamination are as follows:

- The above ground diesel storage within the industrial compound and transfer of diesel from the jetty to the existing storage has the potential to impact both soil and groundwater both prior to and following demolition;
- Historic effluent irrigation of the golf course has the potential to have impacted soil, however the flows are not considered sufficient to have impacted groundwater. No analytical results for irrigated effluent and soil quality were available during preparation of the EIS;
- Historic sediments from effluent in Black Water Dam may contaminate soils during works in this area and possibly groundwater if Dam integrity is breached;
- Minor chemical storages in the workshop and landscaping shed may impact the surrounding area if spilled or released to the environment. Chemicals of potential environmental concern include pesticides, herbicides, fungicides, insecticides and vehicle maintenance products;
- Potential ACM in the staff quarters prefabricated building and Nicholson's residence has the potential to contaminate soil if improperly disposed or managed during demolition via transmission of asbestos fibres;
- Historic uncontrolled filling of the beachside pool area has the potential to contain ACM which may impact human health once disturbed; and
- Historic localised soil contamination may be present within the composting area with the potential to impact human health if disturbed.

23.7 Management Framework

Management of contaminated land in Queensland is regulated by the *Environmental Protection Act 1994* (EP Act) and subordinate policies and regulations. Methodologies are based largely on the following Australian guideline publications:

- the *Australian Standard AS4482.1-1997 Guide to the sampling and investigation of potentially contaminated soil Part 1:Non-volatile and semi-volatile compounds* (Standards Australia 1997);
- *National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No 1)* (NEPM); and
- *Queensland Auditor Handbook for Contaminated Land, Module 5: Contaminated Land Investigation Documents, Auditor Certification and Compliance* Assessment, DEHP, 2015.

These documents provide a framework for assessing and managing contaminated soil and/or groundwater based on an evaluation of three related items.

- Contamination source: Soil and/or groundwater contamination must be present. Contamination is the release of a hazardous contaminant into the environment that is likely to cause serious or material environmental harm because of its physical, chemical, infectious characteristics or concentration;
- Receptors: Humans and/or a receiving environment must be present and be potentially impacted by the identified contaminants; and

- Pathways: The contamination must be able to contact receptors by means such as:
  i. humans – ingestion, skin contact, inhalation; and
  ii. environment – seepage into waterways, wind-blown deposition on plants, root uptake, ingestion, skin contact and inhalation by various life forms.

For a contamination risk to exist, each of these items in the 'risk chain' must be linked.

To ensure that contaminated sites are thoroughly assessed, the DEHP guidelines provide information on how contaminated sites investigations are to be progressively managed through a staged approach, in accordance with national guidelines. These stages include:

- Preliminary site investigation;
- Detailed site investigation;
- Health and environmental assessment and determination of remediation plan; and
- Implementation of agreed remediation plan and validation sampling.

A brief summary of each stage is provided below.

23.7.1 Preliminary Site Investigation

A preliminary site investigation includes the following components:

- Development of a site history;
- EHP register searches;
- An inspection of the site;
- A basic sampling program to determine if contamination is present; and
- Report preparation.

The most important part of a preliminary site investigation is the preparation of a comprehensive site history to identify all past and present potentially contaminating activities.

23.7.2 Detailed Site Investigation

A detailed site investigation is required when the results of preliminary site investigation indicate potential or actual contamination. The detailed site investigation should delineate the lateral and vertical extent of contamination, and provide information about:

- Maximum and average concentrations of the various contaminants,
- Volumes of soil requiring remediation,
- Leachability and mobility of contaminants,
- Potential for groundwater contamination, and
- Possibility of off-site migration through soil, surface water or groundwater.

The decision on how to proceed in the second stage of investigation requires professional judgement of the site specific issues and is dependent on the findings of the preliminary investigation.

23.7.3 Health and Environmental Assessment

The results obtained from the detailed site investigation are used to determine the potential human exposure and environmental impact of the contaminants on the current and proposed land uses.

23.7.4 Remediation and/ or Site Management

When results of a contaminated site investigation indicate that remediation is required, a remediation plan is prepared. The draft remediation plans may include a request for a disposal permit in accordance with the requirements of the EP Act, if necessary, to remove contaminants from the site. Contaminated soil must not be removed from an EMR/CLR listed site without a disposal permit. In some cases, contamination associated risks can be safely managed on- site. Specific procedures for this management are detailed in a Site Management Plan (SMP), including construction, maintenance, and long term monitoring. Approval for this SMP can be sought from the EHP.

Many contaminated sites in Queensland have been effectively assessed and managed according to this process, including diesel storage impacted sites. Typical mitigation options include:

- Do nothing (contaminated site left as is if results of site investigation and assessment of risk determines no action necessary);
- On-site treatment/remediation to reduce contamination;
- Capping of contaminated sites in place;
- Excavation and off-site disposal to landfill/ monocell disposal facility; and
- Excavation and on-site disposal to a suitable location within the project area, with appropriate engineered controls (e.g. liner, cap).

In accordance with the above processes, White Horse Australia Pty Ltd will conduct site investigations and assessments of these sites to determine the need for mitigating actions. Investigation, assessment and management of contaminated sites will be undertaken in conjunction with DEHP's Contaminated Land Unit and in accordance with the *Queensland Auditor Handbook for Contaminated Land, Module 5: Contaminated Land Investigation Documents, Auditor Certification and Compliance Assessment* (DEHP, 2015), NEPM and national water quality criteria. All investigations will be carried out by a suitably qualified person in accordance with requirements of *the EP Act (1994)*. Site investigation reports will be submitted with a statutory declaration by the investigator as required by the DEHP. All work will also be subject to review and approval by a DEHP-approved Contaminated Land Auditor (CLA) where required. Based on these reports and CLA advice, DEHP will determine when the health and environmental risks associated with the sites have been appropriately addressed and managed.

Based on the desktop review of the potential for contamination at the site the specific areas to be investigated by intrusive sampling for the applicable contaminants of concern specified in the desktop assessment are as follows.

- Black Dam Effluent Pond sediment and bottom sludge.
- Decommissioned waste water treatment plant.
- Diesel transfer pipeline area and historic diesel storages.
- The historic green waste composting area.
- Historic effluent irrigation areas.

- Groundwater.
- The uncontrolled fill around the pool area.
- Buildings with the potential to contain ACM.

The sampling density for any intrusive investigation will be as specified in *AS4482: 2005 Guide to the investigation and sampling of sites with potentially contaminated soils*. All required remediation, asbestos removal and/ or site management will be completed and approved prior to commencement of construction. In addition a full Asbestos Register will be compiled for existing resort buildings prior to the commencement of demolition. As such therefore the potential for disturbance of existing contaminated land will be appropriately managed. Any required long-term monitoring will be provided for in the resort operation plans.

23.8 Potential Impacts and Mitigation Measures

A summary of potential impacts and proposed mitigation measures associated with site contamination is provided in **Table 23-6.** Water contamination is separately addressed under the Water Quality chapter.

Table 23-6. Risk assessment matrix – site contamination.

Potential Impact	Significance of Impact: Unmitigated	Mitigation Measures			Significance of Impact: Mitigated
		Design	Construction	Operation	
Land contamination from hazardous materials associated with inappropriate storage, biosolids storage transport or accidental spill.	High (15)	-	• Any additional contamination baseline sampling required carried out immediately prior to demolition and construction • Regular inspections of tanks, bunds and storage areas to ensure integrity • If soil contamination does occur, contaminated spoil will be disposed at an appropriately licensed landfill or a constructed containment cell on the island with the relevant approvals • The EMP shall also document general storage and transport requirements for hazardous substances including: • Provision of readily available Safety Data Sheets (SDS) for all products • Chemicals, fuels and oils will be kept in double skinned tanks (self-bunding) or bunded areas complying with AS1940 • Hazardous and contaminating materials will not be stored in the main dam catchment area • Waste products, (e.g oil/water separator waste, sludges and residues) will be contained within weatherproofed, sealed and bunded areas • Transport of hazardous materials will be conducted using best-practice methods for vessel management and site management to minimise the risk of contaminant spillage • There will be no refueling or/and vessel maintenance facilities jetty/moorings/barge landing point. Live-aboards will not be allowed nor emptying of waste-water or bilges		Low (4)
Asbestos Disturbance and associated impact on human health and soils.	High (15)	-	• Develop and implement Emergency Response Procedures that include requirements for Asbestos identification, sampling and removal e.g. Asbestos inspectors shall be trained, licensed and competent • Regular condition assessments of Asbestos Containing Materials (ACM) • Maintenance of an Asbestos Register • ACM waste disposal shall require supervision and shall be conducted at an appropriately licensed landfill site on the mainland	-	Medium (5)

23.9 Summary

Given the available evidence and based on an overall understanding of the likelihood of distribution of ASS in similar geologies across Australia, additional intrusive investigation to investigate the presence of ASS is not considered warranted on Lindeman Island. Management measures to be considered to manage any residual risk from naturally occurring soil acidity would include soil baseline sampling and pH testing during construction to ensure acidic soils disturbed are suitable for landscaping and do not generate an inappropriate level of risk to waterways.

Land contamination could potentially result from the spillage or on-site disposal of hazardous materials or wastes generated by the demolition of the existing resort and construction and/or operation of the resort. This potential for impact includes the potential for impact and disposal of dredging materials and sediments on land (if required). Project materials and wastes will be managed in a manner that will prevent such contamination. It is the specific intention of the proponent that project construction and operation activities will not cause contamination that will result in the land requiring listing on the EHP's Environmental Management Register or Contaminated Land Register. Procedures for the proper storage and management of hazardous materials are detailed in the Environmental Management Plan, the Hazard and Risk chapter of the EIS and the Emergency Management Plan.

Chemicals, fuels, oils and any other substances such as liquid wastes that, if spilled would cause pollution or contamination of the land or water, will be stored appropriately to minimise the risk of environmental impact. Chemical storage will comply with Australian Standards and Safety Data Sheets (SDS) requirements. SDS for products kept on site will be readily available to employees and contractors. Smaller quantities of chemicals, fuels and oils will be stored in self bunded pallets, within a bunded area in the workshop, or in a bunded container on the site. Diesel will be kept in bulk quantities (up to 130,000 L) in double skinned tanks (self-bunding). Waste products, (e.g oil/water separator waste, sludges and residues), will be contained within weatherproofed, sealed and bunded areas to ensure stability of the waste containment receptacles and prevent any leakages or spills causing environmental harm to soils, surface water or groundwater. Regular inspections will be carried out of the tanks, bunds and storage areas to ensure integrity. If additional baseline contamination sampling is required to manage construction risk, this will be carried out immediately prior to commencement of demolition and construction.

Whilst every care will be taken to avoid contamination of soils, if soil contamination does occur, this will be disposed at an appropriately licensed landfill facility on the mainland or a constructed containment cell on the island in accordance with the relevant approvals.