Environmental

ABN 36 926 003 197

PHASE 2

DETAILED

ENVIRONMENTAL

SITE ASSESSMENT

Pelican Beach Resort

740-742 Pacific Highway

Sapphire Beach NSW 2450

Lot 100 DP 629555

Lot 101 DP 629555

Lot 2 DP 800836

Prepared for:

Sapphire Beach Development Pty. Ltd.

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Brookvale, 2100, NSW

Prepared by:

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June 2009

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Executive Summary

David Lane Associates (DLA) was commissioned by Mr. William Jenner on behalf of Sapphire Beach Development Pty Ltd to prepare a Phase 2 – Detailed Environmental Assessment on the property identified as Pelican Beach Resort, located at 740-742 Pacific Highway, Sapphire Beach NSW 2450 (Site).

This assessment has been formed in response to the Director General Requirements for the Project Application 09_0060; in particular;

'4.1 Provide an appropriately detailed contaminated site assessment in accordance with the National Environmental Protection (Assessment of Site Contamination) Measure (National Environmental Protection Council, 1999) and all relevant Contaminated Site Guidelines published by the NSW EPA. A site history should also form part of this assessment. In accordance with 10(b) of the approved Statement of Commitment, identify site remediation works required as a result of the above assessment and detail how this will be addressed prior to commencement of works.'

The site occupies the area east of the Pacific Highway to the Tasman Sea and is situated on three (3) separate lots. The entire property was a tourist resort, which comprises of a number of structures for accommodation and recreation and is no longer operational.

The site is situated in the Local Government Area of Coffs Harbour City Council (CHC) and is currently zoned Residential 2E Tourist Zone with an Environmental Protection 7A Habitat and Catchment Zone in the middle of the property. The Environmental Protection 7A Habitat and Catchment Zone is situated on the steep north-eastern area of the site. This area has remained heavily vegetated to protect habitat values.

The project objectives of this Environmental Assessment are to satisfy the stated DECC Detailed Site Investigation requirements in accordance with *NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, the NSW EPA Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*

and, in the absence of any prior assessments, will also incorporate the requirements of a Preliminary Site Investigation.

Sampling was conducted in accordance with NSW EPA Sample Design Guidelines 1994. A total of forty-eight (48) locations were sampled across the site, of which fifteen (15) samples were collected from the banana plantation area. The five (5) locations sampled as part of the Preliminary Site Investigation were used to supplement the Phase 2 Investigation, of which two (2) locations were within the banana plantation area.

A total of seven (7) bulk asbestos samples were collected from the fill materials adjacent the restaurant.
The number of samples was considered to be adequate to ensure appropriate confidence in the decision making process. Where possible depth samples were obtained and extended to the base of any fill material. Additionally duplicate and triplicate samples were also obtained as required to meet the stated Data Quality Objectives (DQOs).

The general site adopted statistical criteria being applied to the *National Environment Protection (Assessment of Site Contamination) Measures, (National Environment Protection Council 1999), Table 5a Column A – Residential with Minimal Access to Soils* is:

> The arithmetic mean using 95% UCL does not exceed the assessment criteria;
>
> The individual contaminant concentration should not exceed the assessment criteria by more than 250%, and;
>
> The standard deviation of individual contaminants should not exceed 50% of the criteria;

The site exhibited very little sign of general contamination. The site appears to have been cut and benched as part of previous earthworks during construction of the resort in the early to mid 1980's. A portion of the site is now covered by the resort buildings and facilities.

It is believed that that a portion of the site previously contained a small scale banana plantation. Although low concentrations of residual OCPs and Arsenic (As) were detected within this area, analysis confirmed all chemical analytes complied with the site acceptance criteria *NEPM 1999 Table 5a Column A – Residential with Minimal Access to Soils* and the *NSW EPA Guidelines for Assessing Banana Plantation Sites.*

Although all samples analysed for Arsenic (As) were below the *NEPM 1999 Table 5a Column A – Residential with Minimal Access to Soils* and the *NSW EPA Guidelines for Assessing Banana Plantation Sites* site acceptance criteria, a total of six (6) samples exceeded the Phytotoxicity Criteria of 20mg/kg.

Phytotoxicity (i.e. toxicity to plants) is used as the indicative environmental effect to be dealt with in the context of land redevelopment. The use of a single criteria for all ecosystems has significant limitations as biological responses to the chronic or acute effects of toxicity vary significantly between species. Bioavailability depends on soil conditions, geography, climate and species behaviour, which govern exposure pathways and need to be factored into any assessment. The provisional phytotoxicity-based investigation levels are criteria that are intended for use as a screen guide only. Phytotoxicity criteria are not usually associated with industrial/commercial or open space developments.

In the event of any future earthworks it is envisaged project design will further limit any bioavailability to the local ecology. All materials generated from this area either being disposed of or beneficially reused on site should be managed appropriately.

Asbestos cement sheet fragments of a bonded nature were found within localised fill materials. Asbestos based materials were also identified within the structures presently located on the site. The fill materials and structural asbestos materials prior to demolition or future development should be handled in accordance with the report titled ‘Hazardous Materials Survey and Register, Former Pelican Beach Resort 740-742 Pacific Highway, Sapphire Beach NSW 2450’, prepare by DLA dated June 2009.

Any waste materials generated on Site by excavation or demolition should be characterised and disposed of in accordance with the NSW DECC 2008 Waste Guidelines.

Based on this Site Assessment the Site is deemed suitable for the most sensitive intended land use, compliant with the requirements as outlined in *Table 5a Column A – Residential with Access to Soils, NEPM 1999,* and the *NSW EPA Guidelines for Assessing Banana Plantation Sites.* A Remedial Action Plan is therefore not required to address contamination concerns.

If the current land use of the site, i.e. Residential with Minimal Access to Soils, is to be changed in the future the Site Assessment should be reviewed to ensure compliance with suitable soil investigation levels for the appropriate end land use or zoning.

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ABBREVIATIONS

ADWG	Australian Drinking Water Guidelines
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)Pyrene
BH	Borehole
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
COC	Chain of Custody documentation
CHC	Coffs Harbour Council
CLM	Contaminated Land Management
DA	Development Application
DECC	Department of Environment and Climate Change (formerly DEC and EPA)
DLA	David Lane Associates
DNR	NSW Department of Natural Resources (now split between DWE and DECC)
DWE	NSW Department of Water and Energy
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EIL	Ecological Investigation Level
EPA	Environment Protection Authority, New South Wales (now part of DECC)
EQL	Estimated Quantitation Limit
HIL	Health Based Investigation Level
HM	Heavy Metals
MW	Monitoring Well
NATA	National Association of Testing Authorities, Australia
NEPM.	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides
OH&S	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
RAP	Remedial Action Plan
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SAC	Site Acceptance Criteria
SEPP	State Environmental Planning Policy
sPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfate
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

1.0 Introduction

1.1 General

David Lane Associates (DLA) was commissioned by Mr. William Jenner on behalf of Sapphire Beach Development Pty Ltd to prepare a Phase 2 – Detailed Environmental Assessment on the property identified as Pelican Beach Resort, located at 740-742 Pacific Highway, Sapphire Beach NSW 2450 (Site).

This assessment has been formed in response to the Director General Requirements for the Project Application 09_0060; in particular;

'4.1 Provide an appropriately detailed contaminated site assessment in accordance with the National Environmental Protection (Assessment of Site Contamination) Measure (National Environmental Protection Council, 1999) and all relevant Contaminated Site Guidelines published by the NSW EPA. A site history should also form part of this assessment. In accordance with 10(b) of the approved Statement of Commitment, identify site remediation works required as a result of the above assessment and detail how this will be addressed prior to commencement of works.'

The site occupies the area east of the Pacific Highway to the Tasman Sea and is situated on three (3) separate lots. The entire property was a tourist resort, which comprises of a number of structures for accommodation and recreation and is no longer operational.

The site is situated in the Local Government Area of Coffs Harbour City Council (CHC) and is currently zoned Residential 2E Tourist Zone with an Environmental Protection 7A Habitat and Catchment Zone in the middle of the property. The Environmental Protection 7A Habitat and Catchment Zone is situated on the steep north-eastern area of the site. This area has remained heavily vegetated to protect habitat values.

Refer to **Figure 1** - *Site Location* and **Figure 2** - *Site Survey*

1.2 Objectives of the Assessment

The Department of Environment and Climate Change (DECC) indicates that a Detailed Site Environmental Investigation should provide comprehensive information on:

- Any issues raised in preliminary investigations;
- The type, extent and level of contamination and assess:
- Contaminant dispersal in the air, surface water, groundwater, soil and dust
- The potential effects of contaminants on public health, the environment and building structures
- (where applicable) off-site impacts on soil, sediment and biota
- The adequacy and completeness of all information available to be used in making decisions on remediation

The project objectives of this Environmental Assessment are to satisfy the stated DECC Detailed Site Investigation requirements in accordance with *NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, the NSW EPA Guidelines for Assessing Banana Plantation Sites* and in the absence of any prior assessments, will also incorporate the requirements of a Preliminary Site Investigation, which should:

- Identify all past and present potentially contaminating activities;
- Identify potential contamination types;
- Discuss the site condition;
- Provide a detailed assessment of site contamination; and,
- Assess the need for further investigations.

The proposed investigation program and the Detailed Site Assessment are designed to be suitable to assess the presence of any unacceptable risk to human health or the environment – on-site or off-site. The report will draw conclusions regarding the suitability of the Site for the proposed Residential land use or provide recommendations to enable such conclusions and determine the need for a Remediation Action Plan.

1.3 Data Quality Objectives

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM) and Australian Standard (AS) 4482.1-2005 recommend that data quality objectives (DQOs) be implemented during the investigation of potentially contaminated sites. The DQO process described in AS 4482.1-2005 outlines seven (7) distinct steps to outline the project goals, decisions, constraints and an assessment of the project uncertainties and how to address these when they arise. They define the quality and quantity of data needed to support decisions relating to the environmental condition of a site. They also outline the defining criteria that a data collection design should satisfy, including when, where, how and how many samples to be collected.

The Data Quality Objectives for the sampling and analysis investigations were to:

State the Problem.

Determine, from a contamination point of view, if the land is suitable to be developed for Residential land use in accordance with the requirements of *State Environmental Planning Policy No. 55* and the *Environmental Planning and Assessment Act. 1979*. This includes researching previous site investigations, historical searches (titles, landuse of site and adjacent sites, and aerial photographs), identification of chemicals of concern, media they inhabit and possible migration pathways (to and from the site), potential exposures to human or/and environmental receptors, and concerns with the potential clean up and desired future landuse of the property. Refer **1.2** *Site History,* **1.3** *Future Landuse* and **1.4** *Potential Contamination Summary*.

Identify the Decision.

The decisions to be made on the contamination and the new environmental data required includes considering relevant site contamination criteria for each medium (fill, soil and sediment). A proposed use of the 95% UCL on the mean concentrations for all soil chemicals of potential concern must be less than the site criteria identified for Residential with Access to Soils land use suitability. Decisions include:

Has the use of the Site as a tourist resort affected the level of contamination?

Has the use of portions of the Site as a banana plantation affected the level of Pesticide and Heavy Metal contaminants present in fill material or natural soils?

Has the presence of operational buildings impacted soils at the Site i.e.: asbestos contamination?

Identify Inputs to Decision.

This step requires the identification of the environmental variables/characteristics that need measuring, identification of which media (fill, soil etc.) need to be collected, identification of the site criteria for each medium of concern and appropriate analytical testing. This will include collection and analysis of representative samples from each of the materials identified at the Site. Particular attention will be given to assessing pesticide and arsenic concentrations within the vicinity of the identified banana plantation location and determining the general concentrations of heavy metals, pesticides, PCB's and PAH's across the Site including areas in the vicinity of buildings and other resort facilities.

Define the Study Boundaries.

Specify the spatial and temporal aspects of the environmental media that the data must represent to support decision. To identify the boundaries (both spatial and temporal) of the investigation and to identify any restrictions that may hinder the assessment process. This includes on and off site inspections and discussions with informed individuals. The physical study will focus on fill materials and natural soils within the confines of the proposed lot boundary

Refer **Figure 2** - *Site Survey Plan* and **Figure 3** – Site Layout with Sample Locations

Develop a Decision Rule.

To define the parameter(s) of interest, specify the action level and provide a logical basis for choosing from alternative actions.

The following publications have been reviewed with respect to the assessment criteria and sampling methodology of soils and water at the Site

NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

NSW EPA Contaminated Sites: Guidelines for Assessing Banana Plantation Sites

Schedule B1 Guideline on the Investigation Levels for Soil and Groundwater from the National Environment Protection (Assessment of Site Contamination) Measure 1999 Table 5a Column A –Industrial/Commercial.

NSW DEC Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination, 2007

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000);

NSW EPA Guidelines for Assessing Service Station Sites, 1994;

NSW EPA Contaminated Sites: Sampling Design Guidelines, 1995;

NSW EPA Guidelines for the NSW Site Auditor Scheme, second edition 2006.

National Occupational Health and Safety Commission (NOHSC) Worksafe Australia Asbestos: Code of Practice and Guidance Notes – August 1988;

The general site adopted statistical criteria being applied to the *NEPM 1999 Table 5a Column A – Residential with Minimal Access to Soils*:

The 95% Upper Confidence Limit (UCL) of the arithmetic mean does not exceed the Site Assessment Criteria (SAC);

The individual contaminant concentration should not exceed the SAC by more than 250%, and;

The standard deviation of individual contaminants should not exceed 50% of the SAC;

Refer **4.3** Soil and Groundwater Criteria

Specify Limits on Decision Errors.

Specify the decision-maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data. Incorrect decisions are caused by using data that is not representative of site conditions because of sampling or analytical error.

A Site under investigation is assumed to be contaminated until statistically proven otherwise (eg: H_o= Analyte 95% UCL exceeds the SAC), therefore two types of error are possible; Type 1 error (α or false negative), where the Site is assessed to be uncontaminated when it is actually is, and Type 2 error (β or false positive), when the Site is assessed to be contaminated though is actually not. Type 1 errors represent greater risk to the environment and human health and are therefore set at 5% probability, whilst Type 2 errors are set at 20% probability limit.

Field and laboratory quality controls are implemented to avoid error and to ensure the action levels exceed the measurement detection limits for Contaminants Of Concern (COC) detected in field blanks, rinsate blanks, volatile-spiked trip samples and laboratory method blanks. The performance of decision making inputs will be enhanced through the application of Data quality indicators (DQI), defined as follows:

Data Precision and Accuracy	
Adequate Sampling Density	Sampling carried out in accordance with the NSW EPA *Contaminated Sites: Sampling Design Guidelines*, 1995 and NSW EPA *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*, 1997;
	Use of analytical laboratories with adequately trained and experienced testing staff experienced in the analyses undertaken, with appropriate NATA certification.
Acceptable field and laboratory Relative Percentage Difference (RPD) for duplicate comparison	>10 x LOR: 30% inorganics; 50% organics (Field) 5-10 x LOR: 75% (Field) >5 x LOR: 50% (laboratory) <5 x LOR: Any RPD acceptable (All)
In accordance with AS4482.1 – 2005 field duplicate RPD criteria is increased with organic analytes and for low concentrations. These criteria cannot reasonably exceed the laboratory's precision, therefore laboratory criteria have been adopted.	
Trip Blanks/ Rinsate Blanks	No Detection above LOR
Adequate laboratory performance	Based on acceptance criteria of laboratory as specified on certificate of analysis: includes: blank samples, matrix spikes, control samples, and surrogate spike samples

Data Representativeness	
	Representativeness of all potential contaminants
Trip Blanks/ Rinsate Blanks	No Detection above LOR
	Adequate duplicate, split, rinsate and trip blank sample numbers
	Adequate laboratory internal quality control and quality assurance methods, complying with the NEPM.
Documentation Completeness	
chain of custody records	Laboratory sample receipt information received confirming receipt of samples intact and appropriate chain of custody
	NATA registered laboratory results certificates provided
Data Completeness	
	Analysis for all potential contaminants of concern.
	Field duplicate sample numbers complying with NEPM
	Rinsate samples recovered regularly
	Trip spike samples prepared and sent with field samples regularly
Comparability	
	Use of NATA registered laboratories
	Test methods consistent for each sample in accordance with the Sampling Analysis and Quality Plan
	Detailed logs of all sample locations to be recorded
	Test methods comparable between primary and secondary laboratory
	Acceptable RPD's between original samples and field duplicates and inter-laboratory triplicate samples.

Optimise the Design for Obtaining Data.

Identify a resource-effective sampling and analysis design for data collection that satisfy the DQO's. The sampling and analytical plan is designed to avoid Type 1 and Type 2 errors and includes defining minimum sample numbers required to detect contamination as determined with formulas provided in the NSW EPA 1995 Sampling Design Guidelines, NSW EPA *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*, 1997 and AS 4482.1 - 2005.

Refer to **4.0** *Site Assessment Plan.*

1.4 Statutory Framework

Environmental Legislation in NSW is primarily divided into four (4) areas:

- Environmental Planning;
- Pollution Control;
- Nature and Cultural Conservation; and,
- Resource Allocation.

The pollution control and environmental planning statutes in NSW, which are most likely to apply, are:

- Contaminated Land Management Act 1997;
- Protection of the Environment Operations Act 1997;
- Dangerous Goods Act 1975;
- Waste Minimisation and Management Act 1995;
- Water Board (Corporatisation) Act 1994;
- Environmental Planning and Assessment Act 1979; and
- Local Government Act 1993.

In addition, regulations and planning instruments made under these Acts may also apply such as State Environmental Planning Policy (SEPP) 55.

The Environmental Planning and Assessment Act, 1989 gives local authorities the power to regulate development within their areas of responsibility and to impose specific consent conditions, which cover environmental issues. In addition, the Local Government Act 1993 requires approval from Council for certain works/activities to be obtained.

The Contaminated Land Management Act, 1997 specifies the legal requirements for the registration, investigation and remediation of contaminated land, and for the registration and accreditation of site auditors. It repeals the requirements of the

Environmentally Hazardous Chemicals Act, 1985 in relation to audits and the accreditation of site auditors.

In addition there are a number of Australian Standards and Codes of Practice, which either complement Legislation or which are directly referenced in Legislation. The following examples, which may apply, include:

- AS 1940, The Australian Standard for the Storage and Handling of Flammable and Combustible Liquids;
- AS 1596, The Australian LPG Gas Code;
- AS 1692, Tanks for Flammable and Combustible Liquids;
- The Australian Dangerous Goods Code;
- WorkSafe Australia Guidance Notes for the Completion of Material Safety Data Sheets (MSDS);
- NOHSC 2002:2005 Code of Practice for the Safe Removal of Asbestos; and
- AS 2508, Safe Storage and Handling Information Cards for Hazardous Chemicals.

1.5 Scope of Work

The investigation and assessment was conducted using the following methods:

- Search and review of past reports, records and site plans available locally and from the DECC and the DNR;
- Review of historical aerial photographs available from the Land Information Centre;
- Reviewing all environmental conditions of the Site including the geology and hydrogeology.
- Conduct Soil and Groundwater Sampling and Analysis.
- Providing a comprehensive overview of the Site's past and current land uses and contamination status.

- Investigation of issues relating to local background soil concentrations that exceed appropriate site criteria;
- Assessment of the impacts of chemical mixtures;

The assessment and report has been conducted in accordance with the following:

- The National Environment Protection (Assessment of Site Contamination) Measure (NEPM) published by the National Environment Protection Council 1999.
- NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, November 1997;
- NSW EPA Contaminated Sites: Guidelines for the NSW Site Auditor Scheme, second edition 2006;
- NSW EPA Contaminated Sites: Guidelines for the Assessing Banana Plantation Sites 1997;
- NSW EPA Guidelines for Assessing Service Station Sites, 1994.
- The Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, published by Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council (NHMRC), January 1992; and,
- Classification of contaminated material is conducted in accordance with Waste Classification Guidelines (NSW DECC, 2008).

1.6 Limitations Of The Report

The conclusions presented in this report are relevant to the condition of the site and the state of legislation currently enacted as at the date of this report. We do not make any representation or warranty that the conclusions in this report will be applicable in the future as there may be changes in the condition of the site, applicable legislation or other factors that would affect the conclusions contained in this report.

David Lane Associates has used a degree of skill and care ordinarily exercised by reputable members of our profession practicing in the same or similar locality. Conclusions are based on representative samples on the site, the intensity of those

samples being in accordance with the usual levels of testing carried out for this type of investigation. Due to the inherent variability in natural soils we cannot warrant that the whole overall condition of the site is identical or substantially similar to the representative samples.

This Detailed Environmental Assessment Phase 2 has been conducted for the purpose stated in this report. This report and the information contained in it, is the intellectual property of David Lane Associates and Sapphire Beach Development Pty Ltd.

2.0 Site Description

2.1 Site Identification

The investigation Site is located approximately ten (10) kilometres north of the Coffs Harbour Township. The site comprises three (3) parcels of land with the following titles: Lot 100 DP 629555, Lot 101 DP 629555 and Lot 2 DP 800836; covering a total area of approximately 41,500 square metres (4.15 Hectares).

The land is zoned Residential 2E Tourist and a vegetated area northeast of the main structure on the property is zoned Environmental Protection 7A Habitat and Catchment under the provisions of the Coffs Harbour City Local Environmental Plan (LEP) 2000.

Refer **Figure 3** - Site Layout with sampling locations

2.2 Boundary Conditions and Surrounding Land Use

The boundaries at the site are in a stable condition with no significant cross impaction from adjoining sites. The site falls in an area of mixed residential and tourist/resort landuse.

- To the north a medium density residential development followed by a resort development situated off the Pacific Highway similar to Pelican Beach Resort ,
- to the south is a residential subdivision development,
- to the west is the Pacific Highway followed by rural residential development, and,
- to the east is the Tasman Sea – South Pacific Ocean Bay

2.3 Future Land Use

It is understood that Sapphire Beach Development Pty Ltd are planning to redevelop the site with a residential subdivision consistent with the surrounding built.

Refer to **Figure 4:** Concept Plan

2.4 Site History

2.4.1 Aerial Photograph Review

Aerial photographs from 1954 to 2004, available from the NSW Lands Department, were reviewed with relevant observations being summarised below.

Aerial Photograph	Description
• 1954 Run 6	The Coffs Harbour to Grafton Road winds through the area, along Coachmans Close and Campbell Close. Some farmland is present in the western (upper) area of the site with two (2) structures present centrally on the site. No development appears to have impacted on the eastern (lower) area of the site. Farmland dominates the surrounding area, to the North, South and West.
• Aug 1964 Run 6	One (1) new structure is present in the site's North-East. Some dwellings have been constructed around Coachmans Close to the South. Farmland still present to the North, South and West.
• 18.08.1974 Run 4	Three (3) structures are present in the site's North-West and two (2) more structures are present in the site's North-East. Vegetation in the site's East had been cleared. The Pacific Highway is now present transecting the winding path of Coachmans Close and Campbell Close. All structures on Coachmans Close have been levelled. Small coastal villages of Moonee to the North and Korora to the South have appeared. Farmland remains to the immediate North, South and West of the site.

Aerial Photograph	Description
• 02.09.1984 Run 4	Eight (8) structures, possibly tourist cabins, are present in a row in the site's South-East. Vegetation to the West of the site has been further cleared with four (4) more structures located centrally on the site. The seafood restaurant structure in the site's North-West is also present with three (3) pre-existing structures to its rear. Further residential has taken place at Moonee and Korora, with more farm houses appearing to the West. A residential development is present to the site's immediate North, with semi-rural land use to the South and West.
• 17.06.1993 Run 22-43	Pelican Beach Resort is now present and in its current configuration with tennis courts, swimming pool and open grassed area. All pre-existing structures in the site's southern area have been levelled for construction of the resort. Four (4) structures are now present at the restaurant's rear. Residential land use is present to the North with semi-rural land use to the West. Earthmoving activities are occurring to the site's immediate South.
• 07.09.2002 Run 7	No significant changes to present site. New residential development to the site's South and on Coachmans Close.
• 07.08.2004 Run 30	The four (4) structures to the rear of the seafood restaurant are no longer present. No significant changes to surrounds.

2.4.2 Site History Summary

Following discussion with informed individuals it was concluded that the site remained undeveloped until the late 1970's and early 1980's, when the seafood restaurant and 4 other small buildings were constructed in the north western corner of the site. The restaurant building is the only structure still remaining in the north western corner of the site with the other buildings being demolished. Construction of the resort and associated facilities began in the early 1980's and were completed with the resort opening in approximately 1987, with the layout remaining relatively unchanged until the present day.

It is also believed that that a small portion of the site previously contained a small scale banana plantation

2.5 Onsite Inspection

2.5.1 Dangerous Goods and Hazardous Materials

No evidence of Dangerous Goods or Hazardous materials being stored onsite was observed.

2.5.2 Asbestos

Preliminary assessments identified asbestos containing fill materials to the east of the restaurant structure atop of the plateau area.

2.5.3 PCB's

No evidence of PCB containing materials onsite such as transformers or fluorescent lights.

2.5.4 Lead Based Paints

No evidence of lead base paints used onsite.

2.5.5 Heritage / Archaeological Items

No Heritage / Archaeological items identified onsite.

2.6 Off-Site Observations

The surrounding environment is consistent with residential/tourism landuse with no observed potential sources of contamination.

2.7 Potential Contamination Summary

The main source of potential contamination onsite is associated with the location of the banana plantation. The *NSW EPA Guidelines for Assessing Banana Plantation Sites* identifies Arsenic (As), Lead (Pb) and pesticides such as Aldrin and Dieldrin as the

chemicals of concern associated with the cultivation of banana crops. Preliminary investigations also identified asbestos containing fill materials adjacent to the restaurant structure.

3.0 Environmental Setting

3.1 Site Topography

The land at Pelican Beach Resort, Sapphire Beach has generally an eastern aspect. The eastern frontage of the site adjoins the Sapphire Beach sand dune system which appears to have been widely disturbed by development. The hind dune area which has been levelled and cleared, extends approximately 110m to the centre of the site. The site rises approximately 120m over 40m to the west behind the sand dune flat. The Environmental Protection 7A Habitat and Catchment Zone exists at the northern section of this slope. The southern portion of the site has been cut to accommodate the resort facilities. A bench plateau exists west of the environment zone.

3.2 Site Geology and Soils

The area and its surrounds is underlain by Quaternary Beach and Dune Sand and then Greywacke, Slate and Siliceous Argillite of the Carboniferous Coramba Beds. These deposits were investigated at the time of the site assessment; by the Dorrigo-Coffs Harbour Map 1: 250 000.

The Land and Water Conservation ASS Risk Mapping Data Set (1997) identified that Acid Sulphate Soils (ASS) do not exist on the site identified as 740-742 Pacific Highway, Sapphire Beach. ASS were discovered during the search, classified as 'high risk ASS >3m below the surface' exist approximately 500 metres south of the property. These are not expected to impact on the site.

3.3 Site Hydrology and Hydrogeology

A Geotechnical Investigation conducted by Network Geotechnics revealed that groundwater was at a depth of 4.2 and 3.5 metres in one of the boreholes. Groundwater is predicted to flow in an eastern direction towards the Tasman Sea.

A groundwater sample was collected as part of the preliminary investigation. The analytes comprised; Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, and Xylene (BTEX), Organochlorine and Organophosphates Pesticides

(OCP/OPP), Polycyclic Aromatic Hydrocarbons (PAH), Benzene (a) Pyrene (BaP), and Polychlorinated Biphenyls (PCB's). Twelve (12) Heavy Metals were tested including arsenic, beryllium, boron cadmium, cobalt, chromium, copper, lead, manganese, mercury, nickel and zinc. These analytes are considered to be appropriate for assessing the quality of water at the site.

3.4 Site Meteorology

The Department of Meteorology NSW presents the average rainfall for the Coffs Harbour area at 1668 mm annually. The annual average maximum temperature of 23.3°C with an average minimum of 14°C.

3.5 Flora and Fauna

A small portion of the site lies with an Environmental Protection 7A Habitat and Catchment Zone. The Environmental Protection 7A Habitat and Catchment Zone is situated on the steep north eastern area of the site. This area has remained heavily vegetated to protect habitat values.

It is anticipated that the design of the proposed residential development will not impact upon this area.

4.0 Site Assessment Plan

4.1 Field Investigation Procedure

Field investigations at Pelican Beach Resort were undertaken between 19th May 2009 and 20th May 2009 and comprised of the following:

- Inspect Site and conduct a review of Site history and aerial photographs to identify appropriate sampling locations prior to the commencement of work.
- The sampling program concentrated on natural soils and fill materials,
- Collection of sixty four (64) soil samples, including five (5) intra laboratory duplicate soil samples and three (3) inter laboratory samples,

Results were analysed statistically to determine the UCL of average contaminant concentrations with reference to the relevant Site Acceptance Criteria (SAC), prior to reporting and making recommendations

4.2 Sampling Strategy

All samples were collected by David Lane Associates who are specifically trained in hazardous waste field investigation techniques and health and safety procedures. All techniques used are specified in David Lane Associates Field Manual for Contaminated Sites, which are based on methods specified by the United States Environment Protection Agency (US EPA) and The National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), 1999.

The area of the investigation site was approximately 4.1 Ha (41,000m^2) of which approximately 0.2 Ha (2000 m^2) is zoned as Environmental Protection 7A Habitat and could not be disturbed reducing the total site area to approximately 3.9Ha (39,000 m^2). The NSW EPA Sample Design Guidelines 1994 state that a total of 50 sample points are required for an area of this size.

Sampling was conducted in accordance with NSW EPA Sample Design Guidelines 1994. A total of forty-eight (48) locations were sampled across the site, of which fifteen (15) samples were collected from the banana plantation area. The five (5) locations sampled as part of the Preliminary Site Investigation were used to supplement the

Phase 2 Investigation, of which two (2) locations were within the banana plantation area.

A total of seven (7) bulk asbestos samples were collected from the fill materials adjacent the restaurant.

The sample numbers were considered to be adequate to ensure appropriate confidence in the decision making process. Where possible depth samples were obtained and extended to the base of any fill material. Additionally duplicate and triplicate samples were also obtained as required to meet the stated DQO's.

4.2.1 Soil Collection

Soil samples for chemical analyses were collected in accordance with the NSW EPA Samples Guidelines 1994, NEPM 1999, the NSW EPA Service Station Guidelines 1994 and *NSW EPA Guidelines for Assessing Banana Plantation Sites*. Representative samples were collected from each layer within the soil profiles, which included sandy loams, loamy sands and clay soils.

Samples were obtained by using a decontaminated trowel from surface soils and test pits excavated at the site, using a 2 tonne excavator. The soil was placed into a non-preserved glass container with a Teflon lined threaded cap.

4.2.2 Analytical Strategy

Primary samples were transported to LabMark Environmental Laboratories Pty Ltd of Hornsby, whilst secondary samples were taken to EnviroLab Services Pty of Chatswood for chemical analysis.

Samples were analysed for a range of contaminant indicators that may be associated with past and present land uses, i.e. imported fill material. Soil samples were analysed by LabMark Environmental Laboratories of Hornsby for the following parameters:

Inorganic

Heavy metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn).

Organic

- Total Petroleum Hydrocarbons (TPH);
- Monocyclic aromatic hydrocarbons (BTEX);
- Volatile TPH (vTPH);
- Organochlorine (OC) Pesticides;
- Organophosphorus (OP) Pesticides;
- Polycyclic Aromatic Hydrocarbons (PAH);
- Polychlorinated Biphenyls (PCB).

No Photo Ionisation Detection (PID) assessments were undertaken as TPH analyses were performed on all relevant samples collected. All samples were analysed for metals whilst sufficient analysis of other contaminants was undertaken to allow confident assessment of all representative areas of the Site.

4.3 Soil and Groundwater Criteria

The following documents were reviewed with respect to selecting appropriate assessment criteria:

- Schedule B1 Guideline on the Investigation Levels for Soil and Groundwater from the National Environment Protection (Assessment of Site Contamination) Measure 1999 Table 5a Column A – Residential with Access to Soilsl,
- Health Based Investigation Levels (HBILs) for differing land uses (Imray, P. and Langley, A.) from the National Environmental Health Forum (NEHF) Monographs, Soil Science No. 1. Levels applicable to Residential (Column A);
- NSW EPA Guidelines for Assessing Service Station Sites 1994
- NSW EPA Guidelines for the NSW Site Auditor Scheme, second edition 2006.
- National Occupational Health and Safety Commission (NOHSC) Worksafe Australia Asbestos: Code of Practice and Guidance Notes – August 1988;
- Guidelines for the Assessment and Management of Groundwater Contamination (DECC 2007);
- Guidelines for the Assessing Banana Plantation Sites (NSW EPA 1997);
- Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (NSW EPA, 1999).

4.3.1 Rationale for the Selection of Assessment Criteria

The criteria selected have been chosen in accordance with current Australian and NSW DECC guidelines. Australian Guidelines have been used in preference to international guidelines where available. These criteria are the most current and widely accepted guidelines in use at present in Australia, and have generally been developed using a risk-based approach. Therefore, the general selected guidelines provide a satisfactory framework for the site assessment.

4.3.2 Soil and Groundwater Criteria

The general site adopted statistical criteria being:

- The arithmetic mean using 95% UCL does not exceed the assessment criteria;
- The individual contaminant concentration should not exceed the assessment criteria by more than 250%, and;
- The standard deviation of individual contaminants should not exceed 50% of the criteria;

Phytotoxicity levels are not relevant in this instance as the development is for a Residential land use. Site Assessment criteria are presented below:

Table 4a – Soil Site Acceptance Criteria

Analytes	Thresholds (mg/kg dry wt)	Sources
Benzene **Toluene** **Ethylbenzene** **Xylene (total)**	1 1.4a/130b 3.1c/50d 14e/25d	NSW Service Station Guidelines
TPH: C6-C9 **TPH: C10-C40**	65 1000	NSW Service Station Guidelines
>C16-C35 Aromatics **>C16-C35 Aliphatics** **>C35 Aliphatics**	90 5600 56000	NEPM 1999, Table 5a, Column A
Arsenic	100	NEPM 1999, Table 5a, Column A NSW EPA Guidelines for Assessing Banana Plantation Sites
Cadmium	20	NEPM 1999, Table 5a, Column A
Chromium	100	NEPM 1999, Table 5a, Column A
Copper	1000	NEPM 1999, Table 5a, Column A
Lead	300	NEPM 1999, Table 5a, Column A NSW EPA Guidelines for Assessing Banana Plantation Sites
Mercury	15	NEPM 1999, Table 5a, Column A
Nickel	600	NEPM 1999, Table 5a, Column A
Zinc	7000	NEPM 1999, Table 5a, Column A
B(a)P	1	NEPM 1999, Table 5a, Column A
Total PAH's	20	NEPM 1999, Table 5a, Column A
PCB	10	NEPM 1999, Table 5a, Column A
Pesticides: **(Aldrin/Dieldrin)** **Chlordane** **DDT+DDE+DDD**	 10 50 200	NEPM 1999, Table 5a, Column A NSW EPA Guidelines for Assessing Banana Plantation Sites

a The toluene threshold concentration is the Netherlands Maximum Permissible Concentration (MPC) to protect terrestrial organisms in soil. This value was obtained by applying the US EPA assessment factor to terrestrial chronic No Observed Effect Concentration (NOEC) data. The MPC is an "indicative" value (Van de Plassche et al 1993: Van de Plassche and Bockting 1993).

b Human health and ecological based protection level for toluene. The threshold concentration presented here is the Netherlands intervention value for the protection of terrestrial organisms. Other considerations such as odours and the protection of groundwater may require a lower remediation criterion.

c The ethylbenzene threshold concentration is the Netherlands MPC for the protection terrestrial organisms in soil. No terrestrial ecotoxicological data could be found for use in the Netherlands criteria derivation. Therefore, equilibrium partitioning has been applied to the MPC for water to obtain estimates of the MPC for soil. The MPC for water has been derived from the aquatic ecotoxicological data (Van de Plassche et al 1993: Van de Plassche and Bockting 1993).

d Human health based protection level for ethyl benzene or total xylenes as shown. The threshold concentration presented here is the Netherlands intervention value. Other considerations such as odours and the protection of groundwater may require a lower remediation criterion.

e The xylene threshold concentration is the Netherlands MPC for the protection terrestrial organisms in soil. No terrestrial ecotoxicological data could be found for use in the Netherlands criteria derivation. Therefore, equilibrium partitioning has been applied to the MPC for water to obtain estimates of the MPC for soil. The MPC for water has been derived from the aquatic ecotoxicological data. The concentration shown applies to the total xylenes and is based on the arithmetic average of the individual xylene MPCs (Van de Plassche et al 1993: Van de Plassche and Bockting 1993).

Table 4b – NSW EPA Provisional Phytotoxicity – Metals (mg/kg)

Heavy Metals	NSW EPA Provisional Phytotoxicity (mg/kg)
Arsenic	20
Cadmium	3
Chromium	400
Copper	100
Lead	600
Mercury	1
Nickel	60
Zinc	200

Phytotoxicity (i.e. toxicity to plants) is used as the indicative environmental effect to be dealt with in the context of land redevelopment. The use of single number criteria for all ecosystems has significant

limitations as biological responses to the chronic or acute effects of toxicity vary significantly between species. Bioavailability depends on soil conditions, geography, climate and species behaviour, which govern exposure pathways and need to be factored into any assessment. The provisional phytotoxicity-based investigation levels are criteria that are intended for use as a screen guide only.

4.3.3 Limitations of the Assessment Criteria

All criteria have limitations. Not all chemical analytes are covered by each set of guidelines, requiring some criteria to be sourced from elsewhere. This is particularly relevant to the Dutch guidelines, which provide a guideline for assessment for some analytes not covered by the Australian guidelines. Only criteria relevant to Australia have been used in the interpretation of analytical data on the Site.

4.4 Field Sampling, Analytical and Quality Plan

During the detailed assessment of contaminated sites the integrity of data collected is considered paramount. With the assessment of the site, a number of measures were taken to ensure the quality of the data. These included:

Sample Containers

Soil samples collected during the investigation were placed immediately into laboratory prepared glass jars with Teflon lid inserts. Standard identification labels were adhered to each individual container and labelled according to depth, date, sampling team and media collected.

Decontamination

All equipment used in the sampling program which includes a hand auger, spades and mixing bowl was decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following procedures:

Cleaning equipment in potable water to remove gross contamination;

Cleaning in a solution of Decon 90;

Rinsing in clean demineralised water then wiping with clean lint free cloths;

David Lane Associates also adopted a sampling gradient of lowest to highest potential contamination to minimise the impact of cross contamination. This gradient was determined from the historical review and the on-site inspection that was carried out prior to sampling.

To ensure the effectiveness of decontamination procedures a rinsate sample was obtained from the sampling equipment for each day and analysed for metals. The results indicated that decontamination procedures were adequate.

Sample Tracking and Identification

All samples were identified with a unique sample number and all sampling details were included on the sample label and were reproduced on the field sample log and chain of custody records.

Sample Transport

All samples were packed in ice from the time of collection alongside a trip blank/ trip spike and were transported under chain of custody to the respective laboratories. During the project, the laboratory reported that all the samples arrived intact with appropriate cooling and were analysed within holding times for the respective analytes.

Trip Blank

A trip blank accompanied the sampling for the sampling process. The purpose of the trip blank is to identify whether cross-contamination is occurring during the sample collection and transport process. The blank sample is not separated from the sample collection and transportation process.

The results for the trip blanks collected are provided below and indicate that no cross contamination can be inferred.

Table 4c – Trip Blank Analytical Results – 20/5/09

Analyte	Result µg/l
Benzene	<1
Toluene	<1
Ethyl Benzene	<1
Meta and para-xylene	<2
Ortho-xylene	<1
4 -BFB (Surr @ 100 µg/l)	86%

Trip Spike

A trip spike represents a volatile "leakage" as a measure of appropriate transport and handling of each sample batch. Trip Spike samples were obtained where possible from the laboratory prior to conducting planned field sampling where volatile substances are suspected.

Results for the trip spikes are included in the table below and indicate that handling storage and transport procedures were adequate.

Table 4d – Trip Spike Analytical Results -20/5/09

Analyte	Recovery (%)
Benzene	70
Toluene	70
Ethyl-Benzene	70
m+p Xylene	70
o Xylene	71

Field Duplicate Samples

Field duplicate samples were prepared in the field through the following process:

A larger than normal quantity of soil is recovered from the sample location selected for duplication.

The sample is placed in a decontaminated stainless bowl and mixed as thoroughly as practicable before being divided into equal parts.

Two Portions of the sub-sample are immediately transferred, one for an intra-laboratory duplicate and another for an inter-laboratory duplicate using the decontaminated trowel.

Samples are placed into a labelled, laboratory supplied 250ml glass jar and sealed with an airtight, Teflon screw top lid. The fully filled jars are labelled as the duplicate and immediately placed in a chilled esky.

The remaining portions are stored in the same way and labelled as the original sample.

Duplicate samples were prepared on the basis of sample numbers recovered during the field work. BTEX and C_6-C_9 analysis is omitted from duplicate samples due the volatilisation of these compounds during the mixing process. The duplicate sample frequency was calculated using the total number of samples analysed as part of this assessment. The duplicate sample frequencies are shown below:

Investigative Samples	56 samples	5 intra - laboratory duplicates	10%
	56 samples	3 inter-laboratory duplicate	5.3%

Comparisons were made of the laboratory test results for the duplicate samples with the original samples and the Relative Percentage Difference (RPD) were calculated in order to assess the accuracy of the laboratory test procedures.

The comparisons between the duplicates and original samples indicate acceptable RPD's when they comply with criteria which are commonly set at less than 30% for inorganics and 50% for organics when the concentrations are greater than ten (10) times the LOR.

Of the nine (9) RPD's to exceed the DQO's for duplicate metals analysis, six (6) were less than ten (10) times the LOR. The three (3) exceedences were noted for both Cu, Ni and Zn however considering due to the low concentrations compared with the respective assessment data suggests limited risk to human health or the environment can be inferred.

Table 4e - Calculated intra-laboratory RPDs for Metals

Parameter	Metal Analyte							
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Number of Duplicates	5	5	5	5	5	5	5	5
RPD Range %	0-57	0	0	24-80	0-86	12-49	0-67	0-63
Number to Exceed DQO	**1**	**0**	**0**	**2**	**2**	**1**	**1**	**2**
DQO%*	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
EQL**	**1**	**0.1**	**1**	**2**	**2**	**0.05**	**1**	**5**

DQO Assumes >10 x EQL

The DQO's were exceeded on seventeen (17) occasions between inter-laboratory duplicates with respect to heavy metal analysis. A total of sixteen (16) of these duplicate samples had concentrations less than ten (10) times the LOR. The remaining duplicate had insignificant absolute differences relative to the SAC suggesting limited risk to human health or the environment can be inferred if the margin of error is applied to the assessment data.

Table 4f - Calculated inter-laboratory RPDs for Metals

Parameter	Metal Analyte							
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Number of Duplicates	3	3	3	3	3	3	3	3
RPD Range %	16-49	86-133	13-87	13-100	22-74	57-164	40-100	0-62
Number to Exceed DQO	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**1**
DQO%*	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
EQL**	**1/4**	**0.1/0.5**	**1**	**2/1**	**2/1**	**0.05/0.1**	**1**	**5/1**

DQO Assumes >10 x EQL; ** EQL is shown as Labmark/Envirolab/SGS

No Duplicate samples were measured to have any concentration of PCB's or pesticides, PAHs, TPH or BTEX compounds therefore all RPD's were calculated as 0%.

Field duplicates provide an indication of the whole investigation process, including the sampling process, sample preparation and analysis. The relative percent differences (RPD) for the project were exceeded for several of the analytes tested. This outcome does alter the viability of the results as the apparent lack of accuracy can be attributed to the increases in error margins that occur with low detection levels. Compounding the effect of low detection levels is the natural heterogeneity within the soil matrix itself.

4.5 Laboratory Analytical and Quality Plan

The integrity of analytical data provides the second step in the QA/QC process for total data compliance. The data validation techniques adopted by David Lane Associates are based upon techniques published by the US EPA and in line with methods and guidelines adopted by the NSW EPA and outlined in the NEPM, 1999.

Descriptions are provided of the specific mechanisms used in the assessment of accuracy, precision and useability of analytical data within the project. Laboratory QA/QC results are summarised below in Table 8h.

Refer to **Appendix A**- NATA Certified Analytical Results

Table 4g - Laboratory Analysis - Quality Assurance and Quality Control

Duplicate	Frequency	Results	DQO (Pass)
Matrix Spike	1/10 (1/20 NEPM Guidelines)	Rec:63-117%	70-130% (Metals) **(No)** 60-140%(Organics) (Yes)
Laboratory Control Sample	1 per analysis round	Rec: 70-110%	70-130% (Metals) (Yes 60-140% (Organics (Yes)
Certified Reference Material	1 per analysis round	Rec: 95-112%	70-130% (Yes)
Surrogate - OPP	Per target	Rec: 84-113%	60-130% (Yes)
Surrogates - Other	Per target	Rec: 49–121%	50-130% **(No)**
Method Blank	1	<95%	<95% of reported EQL
Laboratory Duplicate	1/10	0-99%	0-100% (<5xEQL) 0-75%(5-10xEQL) 0-30% (>10xEQL)
Laboratory Triplicate	WR	19-20	0-100% (Yes)
Trip blank	1/site visit	1	Yes
Trip spike	1/site visit	1	Yes
Rinsate blank	1/sample event	1	NA

WR – When Required NA – Not Available Rec – Recovery

Blanks

Blanks were used for the identification of false positive data. Laboratory blank samples were analysed.

No cross contamination of samples is said to have occurred as a result of laboratory techniques provided all blanks show concentrations below the levels of detection. No results on blank samples were above the level of reporting for any determination during the project.

Spikes and Control Samples

Control sample spikes were utilised for determination of matrix recovery analysis. This involves analysis of spiked control samples and their duplicates, spiked with a known concentration of relative analyte.

Accuracy was assessed by calculation of the percent recovery (%R). The duplicate sample spikes were used to assess the precision of the methods used. The percentage recovery for one (1) matrix spike analyte exceeded the acceptance criteria.

Duplicates

Laboratory Duplicates are tested to ensure the results meet the requirements of QA/QC. The samples from site showed a percent recovery for all analytes not exceeding the respective laboratory criteria.

Surrogates

To assess the performance of individual organic analysis the laboratory used surrogates. Recoveries were calculated for each surrogate providing an indication of analytical accuracy. One (1) surrogate recovery was outside the acceptable criteria, this does not effect the usefulness of the data. All other recoveries were within recommended control limits, indicating that there was an acceptable degree of accuracy in analysing for organic compounds.

4.5.1 Laboratory Detection Limits

Laboratory detection limits for soil and water analyses by EnviroLab are outlined below:

Table 4h - Method of Soil Analysis – EnviroLab

Analyte	Method	Level of Reporting Soil mg/kg	
Pesticides	USEPA SW-846 Method 8081B, USEPA SW-846 Method 8000, USEPA SW-846 Method 3550, USEPA SW-846 Method 8141B, USEPA SW-846 Method 8000B, USEPA SW-846 Method 3550B,	**4,4 DDT & Methoxychlor** **All other OCP** **Demeton** **All Other OPP**	0.2 0.05 1 0.5
PCB	USEPA SW-846 Method 8081B, USEPA SW-846 Method 8000, USEPA SW-846 Method 3550,	**PCB**	0.5
BTEX	USEPA SW-846 Method 5032, USEPA SW-846 Method 8020, USEPA SW-846 Method 8021,	**Benzene** **Toluene** **Ethylbenzene** **m, p Xylene** **Ortho Xylene**	0.2 0.5 0.5 1 0.5
Metals	USEPA 200.8 Rev 5.5, USEPA 6020 Rev 0, USEPA 3051 USEPA 1631 Rev B	**As Cr Ni** **Hg** **Pb -Cu-** **Zn** **Cd**	1 0.05 2 5 0.1
TPH	USEPA SW-846 Method 5032, USEPA SW-846 Method 8020,	**C_6-C_9** **C_{10}-C_{14}** **C_{15}-C_{28}** **C_{29}-C_{36}**	10 50 100 100
Polycyclic Aromatic Hydrocarbons	USEPA SW-846 Method 8270C, USEPA SW-846 Method 8100, USEPA SW-846 Method 3550,	**Benzo (b)&(k) fluoranthene** **Each other Analyte**	1 0.5

4.6 QA/QC Comments

The results of the field quality assurance and quality control procedures generally reflect the relative nature of the materials being analysed. Low concentrations of analytes, relative to laboratory EQL thresholds, caused some apparent heterogeneity in a number of samples, adversely affecting the overall quality control data set. The DQO's were exceeded for other analytes where the negligible absolute differences in contaminant concentrations, relative to the site acceptance criteria and measured concentrations on-site, implies that these elevated RPD values do not degrade the level of confidence in the assessment data.

The objectives of David Lane Associates were to provide an indication of contamination across the Site. It is considered that sampling techniques, transportation and the analytical data generated is of an acceptable degree of accuracy, representativeness, comparability, completeness and precision for the purpose of assessing the soil quality on the Site.

5.0 Results

5.1 Field observations

The surrounding topography suggests that significant cutting of natural soils was undertaken to accommodate the resort facilities present on site. Archived photographs were also obtained confirming the cutting procedure. Therefore it is not anticipated that imported fill materials had been used on site.

The soil profile appeared to vary between the upper (western) and lower (eastern) portions of the site. The western areas of the site possessed silty clay immediately atop weathered argillite. With the lower section of the site dominated by loamy sands consistent with the dune environment. There were however a few areas of the lower section where orange clays had been used as a levelling layer overlying sands, particular in areas such as the tennis courts.

A small area approximately 150m^2 of the bench plateau area contained fill materials containing minor amounts of asbestos fragments. The fill materials were observed at a maximum depth of 0.2m, indicating that the maximum volume of material is approximately 30m^3

The slope of the site suggested that any banana plantation previously present on site existed on the upper portion of the site. No odours or staining was observed during soil sampling. No other sources of potential contamination apart from banana plantation and minor amounts of fill materials containing asbestos were noted on site.

What appeared to be discarded concrete piers were present between the northern tennis courts and the environmental zone. Although they are not potential sources of contamination, they will need to be removed due to aesthetics.

5.2 Laboratory Results

All analytical results are compared against the site criteria: *NEPM, Table 5a Column A – Residential with Access to Soils*. The sampling regime involved the collection of representative samples from the surface to 0.15m and below the surface to maximum

depth of to 3m. Results of groundwater and soil analysis from the preliminary site investigation have been included in within **Appendix A4**: Nata Certified Analytical Results.

5.2.1 Soil Analysis

A total of sixty four (64) soil samples including five (5) intra laboratory duplicate samples were submitted to LabMark Environmental Laboratories Pty Ltd, three (3) inter laboratory duplicates were submitted to EnviroLab Services Pty Ltd for a range of laboratory analyses. The results of the assessments conducted at the site are summarised below

Volatile Petroleum Hydrocarbons:

Monocyclic Aromatic Hydrocarbons (C_6 – C_9) and BTEX fractions, associated with petrol contamination, were not detected above the acceptance criteria in any of the sixteen (16) samples analysed.

Total Petroleum Hydrocarbons (TPH):

All sixteen (16) samples analysed for Total Petroleum Hydrocarbon (TPH) compounds were measured to contain concentrations below the practical Estimated Quantitation Limit (EQL).

Polycyclic Aromatic Hydrocarbons (PAH)

All thirty-one (31) samples submitted for analysis of PAH compounds were measured to contain concentrations below the practical Estimated Quantitation Limit (EQL).

Pesticides

Forty-seven (47) samples were submitted for pesticide analysis OCP). Three (3) samples C2-2, C3-3 and C17-1 were above the practical Estimated Quantitation Limit (EQL); however, all three (3) were below the site acceptance criteria.

No Organophosphorus pesticides were recorded above the Estimated Quantification Limit (EQL) and are therefore within the site assessment criteria.

Table 5a - OCP in Soil (mg/kg)

Sample ID	Contaminant
	OCP
C2-2	1.43
C2-3	0.09
C17-1	0.06
Criteria (mg/kg)	**10**

Polychlorinated Biphenyls (PCB's)

Seventeen (17) samples were analysed for Polychlorinated Biphenyls (PCB). No concentrations of Polychlorinated Biphenyls were recorded above the Estimated Quantification Limit (EQL) and are therefore within the site assessment criteria.

Heavy Metals

A total of fifty five (55) primary soil samples were submitted for analysis of all eight (8) heavy metals as recommended by the NSW DECC. No elevated concentrations of heavy metals were observed, no sample exceeded the site acceptance criteria of NEHF A – Residential with Access to Soils for any of these eight (8) heavy metals analysed. Six (6) samples exceeded the phytotoxicity criteria of 20mg/kg for Arsenic (As).

Table 5b - Metals in Soil (mg/kg)

Parameter	Acid Extractable Metals							
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Average (n=64)	8	0.1	6.6	9.73	15.1	0.09	2.9	20.3
Standard Deviation	8.96	NA	4.79	6.96	14.71	0.039	2.15	13.04
Min (mg/Kg)	2	<0.1	3	<2	<0.1	<0.05	2	5
Max (mg/Kg)	43	0.8	22	26	68	0.23	11	83
Number Exceeding[1]	0	0	0	0	0	0	0	0
Number Exceeding[2]	5	0	0	0	0	0	0	0
95% UCL	15.5	0.07	10.9	11.8	20.2	0.09	4.3	25.5
Acceptance Criteria	**100[1]**	**20[1]**	**100[1]**	**1000[1]**	**300[1]**	**15[1]**	**600[1]**	**7000[1]**
	20[2]	**3[2]**	**400[2]**	**100[2]**	**600[2]**	**1[2]**	**60[2]**	**200[2]**

[1] NEHF A Criteria [2] NSW EPA Phytotoxicity Criteria

NA – Not Available ND – Non Detect

Table 5c – Arsenic in Soil (mg/kg)

Sample ID & Depth (m)	Contaminant
	As
C-2-2-0.3m	35
C5-1-0.5m	21
C11-2-0.2m	40
C17-1-0.15m	40
C49-1-0.15m	43
HS1-1m	24
Criteria (mg/kg)	**100[1]**
	20[2]

[1] NEHF A Criteria [2] NSW EPA Phytotoxicity Criteria

Refer **Figure 6:** Arsenic Exceedences

5.2.2 Asbestos Analysis

A total of eight (8) bulk soil samples and one (1) fragment of fibrous cement sheet were collected from fill materials present at the Pelican Beach Site for asbestos content

analysis. All eight (8) soil samples returned negative detections for asbestos, with analysis of the fragment returning a positive result.

Refer **Figure 5:** Asbestos Materials and Fill

5.2.3 Groundwater Analysis

Results of groundwater sampling undertaken during Preliminary Investigations have been included within **Appendix A1:** Sample Log and **Appendix A3:** Nata Certified Analytical Results. Although Zinc (Zn) was observed to be in exceedence of the site acceptance criteria, it is believed to be indicative of background concentrations, which imposes no risk upon human health or the environment.