SITE REMEDIATION AND VALIDATION

PARK RESIDENTIAL HONEYSUCKLE DEVELOPMENT ESTATE

Prepared for

Honeysuckle Development Corporation

Prepared by

RCA AUSTRALIA

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RCA AUSTRALIA

ABN 53 063 515 711

Sydney Office
34/15 Valediction Road, KINGS PARK NSW 2148

Telephone: +61 2 9421 1900
Facsimile: +61 2 9421 1999
Email: sydney@rca.com.au
Internet: www.rca.com.au

Newcastle Office
92 Hill Street, CARRINGTON NSW 2294

Telephone: +61 2 4902 9200
Facsimile: +61 2 4902 9299
Email: newcastle@rca.com.au
Internet: www.rca.com.au

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Honeysuckle Development Corporation
Level 2, 251 Wharf Road
NEWCASTLE NSW 2300

Attention: Jacob Whiting
CC: Graeme Nyland

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SITE REMEDIATION AND VALIDATION
PARK RESIDENTIAL
HONEYSUCKLE DEVELOPMENT ESTATE

EXECUTIVE SUMMARY

This report presents the findings of the site remediation and validation works undertaken at the Park Residential site. The report and remedial work was commissioned by Honeysuckle Development Corporation (HDC).

Park Residential is located along Honeysuckle Drive, bounded to the north by Worth Place Park and a disused tug boat wharf and Newcastle Harbour approximately 50m further to the north of the site.

The site remediation objective was to remediate identified site contaminants to concentrations suitable for the proposed medium density residential development.

The objective of site validation work was to verify the remediation of the site in accordance with the Park Residential Remedial Action Plan (RAP). The Site Remediation and Validation report is to be reviewed by a NSWEPA accredited contaminated site auditor.

Robert Carr & Associates Pty Ltd
T/A RCA Australia ABN 53 063 515 711

92 Hill St Carrington Newcastle NSW 2294
Ph 02 **4902 9200** **Fax** 02 **4902 9299**

Email administrator@rca.com.au
Web www.rca.com.au

The site auditor will review the site in accordance with the Decision Process for assessing Urban Redevelopment Sites from the NSWEPA Publication "Contaminated Sites, Guidelines for the NSW Site Auditor Scheme" (Ref 10). The following is a checklist summarising the key points for auditor review.

- All site assessment, remediation and validation reports follow the 1997 EPA publication Guidelines for Consultants Reporting on Contaminated Sites – this report covers the site assessment (including a summary of previous investigations), remedial works and validation.

- Aesthetic issues have been addressed – see Section 12.4, Assessment of Aesthetics.

- Soils have been assessed against the lower of the appropriate health-based investigation levels and provisional phytotoxicity-based investigation levels – see Section 9, Basis for Assessment Criteria and Section 12.2, Results.

- Any issues relating to local area background soil concentrations that exceed appropriate site soil criteria have been adequately addressed in the site assessment report – see Section 4, Site History.

- All impacts of chemical mixtures have been assessed – see Section 10, Site Characterisation.

- The site management strategy is appropriate – the site is suitable for use as a residential development and a site management plan is not required.

Work undertaken to remediate and validate the site involved:

- The compilation and assessment of analytical results from previous investigations undertaken on the site identifying the contaminated sections of the site.

- The development of a Sampling, Analytical and Quality Plan (SAQP) in accordance with the RAP (RCA 2004, Ref 1).

- The supervision of remedial works required.

- The validation of remedial works.

Previous work at the site (Refs 1 and 2) indicated the presence of fill material across the entire site area overlying natural alluvial sands. The RAP (Ref 1) recommended removal of the fill material to a depth of 0.5m in the area of the bitumen sealed or formerly bitumen sealed area. Results indicate elevated concentrations of contaminants (TPH C_{10}-C_{36}, Benzo(a)pyrene, Total PAH's) generally limited to the top 0.5m of material in the area of the former Wharf Road. The PAH's identified within the fill consisted primarily of the heavier PAH compounds and, as such, were considered to be relatively immobile.

Groundwater was identified at a depth of approximately 2.0m below existing ground surface, with zinc concentrations detected on site marginally above guideline limits. This was considered representative of regional background conditions.

Remedial works at the site involved the excavation of the former Wharf Road area to an approximate depth of 0.5m below the existing level. All material was classified as Inert Asphalt Waste under the NSWEPA Waste Guidelines (Ref 9) based on the presence of asphaltenes, and the material being derived from road construction activities. Approximately 500m^3 of material was removed and transported to Summerhill Waste Emplacement Facility. Backfilling of the excavation had not been undertaken at the time of writing. As part of recontouring works at the site, cut to fill levelling will be undertaken across the Park Residential site and imported fill will not be required.

Removal of stockpiles located on the Park Residential site during remedial works was undertaken. The stockpile material (approximate volume 1200m^3) was removed from the Lot 4 site during remedial works and was stockpiled on black plastic material on the Park Residential site for landfarming. The stockpile material was placed on an area of approximately 10m x 40m. This material was removed and transported to the adjacent site during remedial works, and was stockpiled with other Lot 4 stockpile material for further landfarming.

Validation sampling of the base of the excavation indicated that all samples were below the acceptance criteria for the site with the exception of two (2) sample locations. These samples were slightly elevated above site criteria for Benzo(a)Pyrene and Total PAH's. However, this is not considered significant as the risk to human health and ecological exposure is low due to low leachability of the contaminants (low concentrations of PAH's were detected in groundwater) and the proposed surfacing of the entire site as part of the future medium density residential development minimising access to the soil and infiltration.

Concentrations of contaminants in samples collected from the walls of the excavations were below the site acceptance criteria.

Validation sampling across the area of the former stockpiles indicated that all samples were below the acceptance criteria for the site with the exception of one (1) sample location. Additional surface scraping of this area was undertaken with approximately 20m^3 of material transported to the adjacent site for landfarming. Validation sampling across this area indicated that all samples were below the acceptance criteria for the site.

The validation programme has confirmed the successful remediation of known site contamination. Based on the investigation and remediation undertaken, the site is now considered suitable for the proposed medium density residential development.

1 INTRODUCTION

This report presents the findings of site remediation and validation undertaken at Park Residential, which forms part of the Honeysuckle Development Estate. The site location is presented in Drawing 1. The report and remedial work was commissioned by Honeysuckle Development Corporation (HDC).

The scope of work comprised:

- The compilation and assessment of analytical results from previous investigations undertaken which identified the areas of site contamination.
- The development of a Sampling, Analytical and Quality Plan (SAQP) in accordance with the RAP (RCA 2003, Ref 1).
- The supervision of remedial works required.
- The validation of remedial works.

2 SITE IDENTIFICATION

The site location, description, legal titles, zoning, topography, geology and hydrogeology have all been addressed in previous reports by RCA Australia (Ref 1) and Parsons Brinckerhoff (PB) (Ref 2) and can be summarised as follows.

2.1 SITE LOCATION AND DESCRIPTION

Park Residential is located along Honeysuckle Drive in the Honeysuckle Development Estate. It is bound to the north by Worth Place Park and a disused tug boat wharf and approximately 50m further to the north by Newcastle Harbour. The site borders Worth Place (street access) to the east and a vacant wharf area to the west. Drawing 1 indicates the location of the site with respect to Newcastle. The site area is approximately 7300m^2.

2.2 LEGAL TITLE AND ZONING

The site has been designated as Part Lot 1111 on DP 1027135.

Under the Newcastle Draft Local Environmental Plan (LEP) 2003, the site is zoned 3(c) City Centre. This zoning allows for a variety of activities including residential apartments, commercial development and recreational facilities.

3 SITE CONDITION AND SURROUNDING ENVIRONMENT

The site is bounded to the north by vacant land (Worth Place Park) and Newcastle Harbour, see Drawing 1, and is approximately 7300m^2 in size. The northern portion of the site was sealed with bitumen, as an old road surface (former Wharf Road), as shown on Drawing 2.

The site is predominantly flat and has been subject to at least 2.3m of filling. At the time of investigation a grassed soil stockpile was present along the southern boundary of the site. At the time of remediation, approximately 1200m^3 of material was present in stockpiles along the western central area of the site. This material had been transported from an adjacent HDC site, Lot 4, for remediation. Soils removed from Lot 4 were contaminated with Total Petroleum Hydrocarbons (TPH's) and Polycyclic Aromatic Hydrocarbons (PAH's).

4 SITE HISTORY AND BACKGROUND INFORMATION

Reports detailing site history and background information for the Park Residential site were reviewed in detail (Ref 2).

A review of aerial photos undertaken by PB indicated that the site has been occupied by workshops and railway lines up until 25 February 1993, and was cleared and grassed in January 2001. The following is an excerpt from the ESA undertaken by PB (Ref 2).

The key contamination sources and activities identified in this report and the analytes that would typically be required for identification of potential contamination from each activity are summarised in Table 1*. Identified potential contaminants for park residential are those that have already been identified in previous investigations at or near the site. Additional potential contaminants are those that are also likely to be present on the site based on land use history.*

Table 1 *PB's Summary of Potential Contaminants*

Former Site Operations/Issues	Identified Potential Contaminants	Additional Potential Contaminants
Fill Material	TPH, PAH and Heavy Metals (Cu, Pb, Zn)	BTEX, OCP's/OPP's/PCB's, and Heavy metals (As, Cd, Cr, Hg, Mn, Ni)
Railway Facilities/workshops/ storage sheds	TPH, BTEX, PAH and Heavy Metals (Cr, Cu, Pb and Zn)	PCBs, Heavy metals (As, Cd, Co, Hg, Mn, Ni) and Asbestos
Stockpiled Soil	Heavy Metals (As, Cu, Pb and Zn)	TPH, BTEX, PAH's, OCP's/PCB's and Heavy metals (Cd, Cr, Hg and Ni)

No additional site history investigation has been undertaken by RCA Australia as part of this investigation, however HDC provided some general information about the Honeysuckle Point area, which is summarised as follows:

- The current site was previously part of the Harbour and has been filled as part of the development of timber cargo wharves from 1908. This involved the construction of a straight-line retaining wall along the edge of the harbour, with nine acres of fill drawn primarily from dredging operations placed behind the wall to construct the wharves.

- Railway workshops operated in the area, and presumably on the site, up until 1978/1979. These workshops included machine shops, painting, blacksmiths and a foundry (closed in 1958).

No specific information about the operations at the site has been identified.

At the time of the investigation the site was vacant and unused.

4.1 PREVIOUS REPORTS

The following presents a summary of the two primary documents relating to the investigation and assessment of the Park Residential site:

4.1.1 ENVIRONMENTAL SITE ASSESSMENT, PARK RESIDENTIAL (PART LOT 1111 DP 1027135), HONEYSUCKLE NSW, PARSONS BRINCKERHOFF, NOVEMBER 2002, REV B

RCA Australia reviewed this report and the following presents a summary of the results and conclusions. It has been assumed that the quality of the report is suitable for use in validation.

This investigation was undertaken on Park Residential, and consisted of the collection of thirty three (33) soil samples at eighteen (18) locations. A groundwater sample was collected as part of an overall groundwater assessment from PRBH10/PRMW10. Previous sample locations are shown on Drawing 2.

Results for Park Residential have been summarised in Appendix B, with RCA Australia performing the statistical analysis. Contamination indicated includes:

- Two (2) samples contained concentrations of Benzo(a)pyrene in excess of minimal soil access residential guidelines (NEPM HIL Level 'D', Ref 3) and one of these at hotspot levels.

- One (1) sample contained concentrations of Total PAH's in excess of the minimal soil access residential guidelines (HIL 'D') at hotspot levels.

- One (1) sample contained concentrations of TPH C10-C36 in excess of the Service Station guidelines (Ref 5).

- Numerous samples contained concentrations of metals in excess of Ecological Investigation Levels (EIL's).

- Comparison of the groundwater concentrations to the ANZECC Marine 95% protection level guidelines for the PAH components anthracene, fluoranthene, benzo(a)pyrene and copper could not be met due to the PQL's applied. TPH and other heavy metals were not detected and heavy metal concentrations were within the ANZECC Marine 95% protection level guidelines (Ref 4). TPH concentrations were below the Dutch Intervention Levels for groundwater (Ref 11).

PB stated that remediation is required if the site is to be used for residential use with minimal soil access and/or commercial/industrial land uses and recommended remediation and management conditions. These conditions included further sampling to delineate the extent of the contamination and characterisation for disposal and the preparation of a RAP.

4.1.2 CONTAMINANT DELINEATION AND REMEDIAL ACTION PLAN, PARK RESIDENTIAL, NEWCASTLE, RCA AUSTRALIA, MARCH 2004, 3655-002/1 (REF 1)

This investigation was undertaken on Park Residential and consisted of the collection of thirty (30) soil samples from sixteen (16) locations. Two (2) groundwater samples were also collected from the site. The investigation was undertaken to delineate the contamination noted by PB in 2002. Additional surface sampling and analysis for OCP/PCB's, phenols and respirable asbestos fibres was also required as limited or no analysis was undertaken in the initial investigation (Ref 2) for these analytes.

Results for Park Residential have been summarised in Appendix B. Contamination indicated includes:

- Five (5) samples contained concentrations of Benzo(a)pyrene and five (5) samples contained concentrations of Total PAH's in excess of minimal soil access residential guidelines HIL 'D' (Ref 3). Three samples contained Benzo(a)pyrene and Total PAH's at hotspot concentrations.

- Three (3) samples contained concentrations of TPH C10-C36 in excess of the Service Station guidelines (Ref 5). Two of these samples were at hotspot concentrations.

- Two groundwater samples contained concentrations of Zinc in excess of the 95% ANZECC guidelines (Ref 4).

Elevated concentrations of TPH and PAH's were identified at locations noted during the PB investigation (Ref 2) along the former Wharf Road. Contaminants were identified at the surface and at shallow depth within the fill material. The PAH's identified within the fill consisted primarily of the heavier PAH compounds, and would therefore be considered relatively mobile. Based on the positive results from the asphaltene analysis and the locations of the elevated heavier end PAH concentrations, the contamination was considered related to the presence of roadbase material and the former Wharf Road at the site.

Additional groundwater assessment was also undertaken as part of the investigation, with elevated concentrations of some Heavy Metals only (namely Zinc), detected in groundwater. These concentrations were within regional concentrations and were therefore considered typical for the area around Newcastle foreshore. Remediation of groundwater was therefore not required.

Several options for the remediation of soil were outlined, with disposal to landfill considered the most appropriate method of remediation.

5 GEOLOGY AND HYDROGEOLOGY

5.1 SOIL STRATIGRAPHY

The site is underlain with quaternary alluvial deposits of the Cainozoic era comprising gravel, fine sandy clay and silt (Ref 6).

Based on previous investigative works, fill is present across the site and comprises sand (medium to coarse grained) to sandy gravel to gravel (angular). Fill was encountered across the site to depths of 2.3m (limit of excavation), with estuarine silts, sands and clays present below. Previous investigations at the site indicate fill to approximately 0.6m and indicated that underlying material to 4.0m was alluvial. It is considered by RCA that the shelly sands found at the site from approximately 1.0m to 4.0m consist of dredged material from the harbour used as fill and have mistakenly been classified as alluvial material previously.

5.2 LOCATION AND EXTENT OF IMPORTED AND LOCALLY DERIVED FILL

Fill was encountered in all test pits excavated during the contaminant delineation investigation to a depth up to 2.3m. Test pit and bore logs indicate the extent of the fill and are presented in Ref 1.

5.3 DETAILED DESCRIPTION OF THE LOCATION, DESIGN AND CONSTRUCTION OF ON-SITE WELLS

No monitoring wells were installed during the current investigation. Bore logs of those established at the site are presented in the corresponding reports (Refs 1 and 2).

5.4 DESCRIPTION AND LOCATION OF SPRINGS AND WELLS IN THE VICINITY

No springs or wells were observed in the vicinity.

5.5 DEPTH TO THE GROUNDWATER TABLE

Groundwater was encountered in the two monitoring wells at depths of 2.0m although, when sampled, groundwater was measured at between ~2.0 – ~3.0m below the surface.

5.6 DIRECTION AND RATE OF GROUNDWATER FLOW

Works undertaken by PB prior to this investigation involved the installation of twenty (20) groundwater monitoring wells across 12 sites within the Honeysuckle Precinct. Results of the water level gauging indicate that groundwater flow is generally directed in the north/north east direction towards Newcastle Harbour.

5.7 DIRECTION OF SURFACE WATER RUNOFF

No surface water was observed at the site, however it is envisaged that the majority of rainfall would infiltrate into the unpaved surface. Any runoff would be likely to flow to the north into Newcastle Harbour.

5.8 BACKGROUND WATER QUALITY

No background water quality analysis was undertaken, however the previous PB groundwater investigation indicates that elevated concentrations of heavy metals is considered a regional phenomenon in the vicinity of the Newcastle Harbour.

5.9 PREFERENTIAL WATER COURSES

No watercourses were observed on the site.

5.10 SUMMARY OF LOCAL METEOROLOGY

Newcastle is located at approximately latitude 32^{o}50' south and longitude 151^{o}45' east. Winds are steady trade winds in summer and stable anticyclonic weather in winter. The mean temperatures range from a maximum of 27^{o}C in summer to a minimum of 4°C in winter. The most rainfall occurs between January and June and averages 1142mm (Ref 7).

6 PROPOSED DEVELOPMENT

Based on information provided to RCA Australia, it is understood that the proposed site use is for a medium density residential development, comprising high rise apartments. As part of recontouring works at the site, cut to fill levelling will be undertaken.

7 SAMPLING AND ANALYSIS PLAN AND SAMPLING METHODOLOGY

7.1 SAMPLING, ANALYSIS AND DATA QUALITY OBJECTIVES (DQO'S)

Sampling procedures and DQO's for the current investigation are discussed in Appendix C.

7.2 RATIONALE FOR THE SELECTION OF

7.2.1 SAMPLING PATTERN

Validation sampling was undertaken from the walls and the base of the excavation. Walls samples were collected at a spacing of ~45m while base samples were collected on an approximate ~8m grid based on a triangular grid.

Validation sampling undertaken across the area of the former stockpiles was undertaken on an approximate 8m grid based on a triangular grid.

7.2.2 SAMPLING DENSITY INCLUDING AN ESTIMATED SIZE OF THE RESIDENTIAL HOTSPOTS THAT MAY REMAIN UNDETECTED

A total of 18 sample locations have been undertaken across the base of the excavation, on an approximate 8m grid. Based on the remediation area of ~1000m^2, this relates to a hotspot of <4m diameter that could remain undetected.

A total of eight (8) sample locations have been undertaken across the area of the former stockpiles, on an approximate 8m grid. This relates to a hotspot of <4m diameter that could remain undetected.

7.2.3 SAMPLING LOCATIONS INCLUDING LOCATIONS SHOWN ON A SITE MAP

All previous and current sampling locations are shown on Drawing 2.

7.2.4 SAMPLING DEPTHS

All sampling depths for previous samples and samples from the current investigation are shown in the results summary, Appendices B and D.

7.2.5 ANALYTES FOR SAMPLES

Previous investigations undertaken at the site indicated elevated concentrations of TPH C10-C36, Benzo(a)pyrene, Total PAH's and cobalt in the shallow fill material generally confined to the area identified as the former Wharf Road, Drawing 2.

All validation samples from the base and walls of the excavation collected in the RCA assessment were analysed for TPH, BTEX, PAH's and heavy metals. All validation samples collected from across the former stockpile area were analysed for TPH, BTEX and PAH's.

8 QUALITY ASSURANCE AND QUALITY CONTROL

An assessment of the quality assurance and control results for this project is presented in Appendix C. Results are tabulated in Appendix D and Laboratory Reports are presented in Appendix F. An assessment of the quality assurance and control results for previous investigations is presented in the supporting documents.

In summary, the ALS and Labmark QA/QC data for the documented soil samples were determined to be of sufficient quality to be considered acceptable to comply with the RCA Australia's quality protocols for the environmental assessment the JN 4489c, Site Remediation and Validation, Park Residential, Honeysuckle. This report has therefore concluded that the QA/QC data and field duplicate results are free of systematic and method biases.

Some uncertainty applies to the Naphthalene and cadmium results from two reports due to unacceptable interlaboratory duplicate performance, reports ES0500855 and 020967, however based on external duplicates, surrogates and lcs results, this uncertainty is not considered significant.

9 BASIS FOR ASSESSMENT CRITERIA

9.1.1 NEPM – NATIONAL ENVIRONMENT PROTECTION (ASSESSMENT OF SITE CONTAMINATION) MEASURE (1999)

The criteria used for the assessment of the soil on site were sourced from the National Environment Protection Measure (NEPM) for the Assessment of Site Contamination, 1999 (Ref 3). Schedule B(1) of this measure provides a table for the investigation concentrations for contaminants based on human health risk and certain exposure scenarios due to site use.

Based on information provided to RCA Australia, it is understood that the proposed site use is as medium density residential apartments. Therefore the results have been compared to the following guidelines:

- HIL 'D' residential, minimal soil access, no poultry, no fruit or vegetable consumption, no groundwater consumption, includes dwellings with fully and permanently paved yard space such as high rise apartments and flats.

Results were also compared to the ecological investigation levels (EIL's).

The NEPM sets out an acceptance procedure by which sites can be considered as suitable for use depending on the sample results. The mean of the sample results can be compared to the guidelines as long as:

- No sample exceeds the chosen guidelines by more than 250%.
- The standard deviation of the analyte does not exceed 50% of the guideline.

However, this approach does not allow for sampling and analytical variability, therefore the Sampling Design Guidelines (Ref 8) recommends the use of the 95%UCL_{ave} for comparison with the guidelines.

9.1.2 NSWEPA – SERVICE STATION CRITERIA

The acceptance criteria adopted for TPH C6-C9, and BTEX were the "Guidelines for Assessing Service Station Sites" produced by the NSWEPA, December 1994, (Ref 5). These guidelines provide assessment criteria for soil and water on service station sites and are applicable for all sites where fuel has been stored. Guidelines for TPH C10-C36 from this reference were also used for screening of samples prior to additional aromatic and aliphatic testing as required by the NEPM.

9.1.3 NSWEPA – ASSESSMENT, CLASSIFICATION AND MANAGEMENT OF LIQUID AND NON-LIQUID WASTES

These guidelines were compiled to enable classification of waste material depending on contamination status (Ref 9). These guidelines will be utilised to classify any material designated for disposal to a licensed waste facility.

Classification is two tiered. The first set of guidelines is based on total contaminant concentrations only, whereas the second set of guidelines is based on a TCLP concentration and a total contaminant concentration. The total concentrations guidelines are generally higher in conjunction with TCLP testing than if it was not undertaken. Material can be classified as Inert Waste, Solid Waste, Industrial Waste or Hazardous Waste by these guidelines.

9.2 APPROPRIATENESS OF THE GUIDELINES

The NEPM document has been approved by the NSWEPA for use on potentially contaminated sites and supersedes most of the preceding reference documents. The Service Station Guidelines are still current for TPH and BTEX concentrations.

The exposure settings on which the NEPM criteria are based directly affect the investigation concentration used to assess the contamination status of the site. While the development appears to fit into the listed categories it is possible that a change in the development may designate the site into a more sensitive land use.

At present there are no endorsed groundwater guidelines in Australia, therefore guidelines are chosen based on the receiving waters. The results therefore do not necessarily represent the final concentration of the contaminants in the Harbour and may be conservative.

10 SITE CHARACTERISATION

10.1 SOIL

Previous work at the site (Refs 1 and 2) indicated the presence of fill material across the entire site area overlying natural alluvial sands. The RAP (Ref 1) recommended removal of the fill material to a depth of 0.5m in the area of the bitumen sealed or formerly bitumen sealed area.

As determined during previous investigative works at the site, fill material was present across the entire site area, with elevated concentrations of contaminants (TPH C_{10}-C_{36}, benzo(a)pyrene, Total PAH's) generally limited to the top 0.5m of material in the area of the former Wharf Road, Drawing 2.

The following presents a summary of the results from investigative works undertaken by PB and RCA within the designated remediation area. The locations of elevated concentrations are shown on Drawings 3 and 4, with a summary shown in Table 2.

Table 2 *Statistical Analysis – Fill material Remediation Area*

Analyte	No. of samples	Max.	Min.	Mean.	95% $UCL_{average}$	Guideline
TPH C10-C36	28	**6365**	<250	698	1305*	1000 [1]
Benzo(a)pyrene	28	**228**	<0.5	23	43*	5 [2]
Total PAH's	28	**297**	<8	326	615*	100 [2]

[1] NSWEPA Guidelines for the Assessment of Service Station Sites, 1994

[2] HIL 'F' of the Health Based Investigation Levels, pg 9 Schedule B1, *National Environment Protection (Assessment of Site Contamination) Measure.*

BOLD *at hotspot concentrations*

* *non-parametric UCL (note all calculations based on lognormal distribution unless otherwise noted)*

Two (2) TPH hotspots and four (4) benzo(a)pyrene and PAH hotspots were identified. Statistical analysis indicates that with the removal of these hotspots, the 95%$UCL_{average}$ is within the guidelines for HIL 'D' and the remainder of the material is therefore suitable to remain on site.

Cobalt concentrations were recorded at concentrations exceeding the site criteria at one location. The results for statistical analysis of cobalt indicate that the 95% $UCL_{average}$ (77.06mg/kg) is within the criteria.

The Ecological Investigation Levels (EIL's) were exceeded at several locations over the site. However, this was not considered an issue due to the following:

- The Phytotoxic guidelines are an interim set of guidelines.
- Chromium exists in two speciation states, Cr(III) and Cr(VI). Initial analysis of soil samples was undertaken for Total Chromium only, and the results were compared to the Cr(VI) guideline. Cr(VI) is a rare and toxic form of Chromium, and it is considered unlikely that the Total Chromium concentrations contain a high proportion of Cr(VI).
- They are based on a sandy loam soil, with a pH of 6-8. This is not consistent with the strata encountered on site.
- Vegetation, where present, was healthy and unaffected. Adjacent land to the south of the site is grassed and the vegetation in good condition.

11 REMEDIATION

11.1 SOIL

Remediation for the site has followed proposals outlined in the Remedial Action Plan (Ref 1). As mentioned previously, TPH and PAH contamination was largely confined to the shallow fill overburden (~0.5m) in the area of the former Wharf Road. This contaminated material required removal and disposal to an offsite landfill.

Previous investigations undertaken at the site indicated the contaminated material appeared in a sandy gravel layer, mostly black in colour, at shallow depths (<0.5m) beneath the former Wharf Road. High concentrations of TPH and PAH's were identified within this layer in the area of the former road. This layer was evident during remedial works, however the underlying dredged sands material, whilst being visually lighter in colour, also comprised minor slag, gravel and asphalt pieces, at a volume estimated <5%. Therefore, excavation was undertaken to a depth of 0.5m from the surface level.

As outlined in that RAP (Ref 1) the hotspot concentration of Benzo(a)pyrene and Total PAH's at the site are related to the presence of roadbase material and the former Wharf Road at the site. Asphaltene analysis was undertaken to determine the presence of asphaltenes in the fill material. The analysis was positive (2.3mg/kg) and therefore the material has been classified as asphalt waste under the NSWEPA Waste Guidelines (Ref 9).

The proposed development at the site will require reinstatement of the excavation to original site levels. At the time of writing, backfilling of the excavation had not been undertaken. It is proposed to use the existing mounded fill at the site (which has been assessed as suitable for the proposed use) for backfill.

Fill material was removed using a 20 tonne excavator and was transported via truck and dog directly for disposal at the Summerhill Waste Facility. Excavation continued to a depth of approximately 0.5m along the area shown on Drawing 5.

All material was transported to Summerhill Waste Centre as Solid Waste, with waste disposal information and waste dockets attached in Appendix E. It is noted that the proposed remedial strategies for Park Residential, and Worth Place Park (located immediately north of the Park Residential site) were the same (ie, the removal of the upper 0.5m of across the paved areas of the site). As such, excavation works were undertaken across both sites concurrently. Waste information provided from Summerhill therefore, relates to material removed from both sites from 20 January 2005 to 28 January 2005. Approximately 7663 tonnes of material was removed from both sites and it is estimated 1000t of material was removed from the Park Residential site.

Approximately 1200m^3 of stockpile material sourced from Lot 4 were removed and placed on the adjacent site for landfarming. Sampling of the surface across the former stockpile area was undertaken. One (1) sample indicated elevated concentrations of PAH's. Further surface scraping of this area was undertaken (approximately 5m x 20m x 0.05m depth). Additional validation sampling was undertaken at the completion of scraping.

Validation of the base and walls of the excavation was undertaken at the completion of excavation.

11.2 GROUNDWATER

No groundwater remediation was required in accordance with the RAP (Ref 1).

12 VALIDATION

12.1 SAMPLING PLAN

12.1.1 EXCAVATION

To validate that the remediation process was successful, samples were collected from the following locations:

- Walls of excavations: These samples were taken from the silty SANDS layer at the margins of the excavation, along the southern and western boundaries of the site. Samples were collected from a depth of 0.3-0.7m from the surface at a spacing of approximately 45m. No samples were collected along the northern boundary as excavation abutted the Worth Place Park excavation with excavations at this site also undertaken to ~0.5m below existing surface level. No samples were collected along the eastern boundary as this bordered Worth Place.

Wall validation samples were collected at depths of 0.3-0.7m. The layer targeted for remediation was associated with the former Wharf Road. The former Wharf Road ceased along the southern boundary of the excavation, and the impacted layer no longer existed. Therefore, no shallower samples were collected, rather validation samples were collected to assess concentrations of contaminants within the dredged sands layer.

- Base of excavations: these were samples of fill collected from immediately beneath the contaminated layer over an 8m grid.

- Surface soils across former stockpile area: these samples were collected from the surface, across the area of the former stockpiles, on an approximate 8m grid.

The location of validation samples is shown on Drawing 5. The results are summarised in Appendix D. Sample descriptions of all base and wall samples collected from the excavation are detailed in Table 3.

Table 3 *Validation Sample Descriptions*

Sample location	Approximate depth below original surface level (m)	Sample description
PR1	0.6	FILL, Silty Sand, dry, brown to light grey
PR2	0.6	FILL, Silty Sand, dry, brown
PR3	0.7	FILL, Silty Sand, dry, shells, light brown
PR4	0.6	FILL, Silty Sand, dry, shells, light brown, minor asphalt
PR5	0.6	FILL, Silty SAND, light brown, dry, shells
PR6	0.6	FILL, Silty Sand, light brown, dry
PR7	0.4	FILL, Silty Sand, light brown, dry
PR8	0.6	FILL, Silty Sand, light brown, dry
PR9	0.6	FILL, Silty Sand, light brown, dry
PR10	0.7	FILL, Silty Sand, light brown, dry
PR11	0.7	FILL, Silty Sand, light brown, dry
PR12	0.7	FILL, Silty Sand, light brown, dry
PR13	0.3	FILL, Silty Sand, light brown to light grey, dry
PR14	0.6	FILL, Silty Sand, light brown, dry
PR15	0.6	FILL, Silty Sand, light brown, dry
PR16	0.6	FILL, Silty Sand, light brown, dry
PR17	0.6	FILL, Silty Sand, light brown, dry
PR18	0.3	FILL, Silty Sand, light brown, dry
PR19	0.0-0.1	FILL, Gravelly Silty SAND, dry, grey to brown
PR20	0.0-0.1	FILL, Gravelly Silty Sand, dry, brown, fine roots

Sample location	Approximate depth below original surface level (m)	Sample description
PR21	0.0-0.1	FILL, Gravelly Silty Sand, moist to dry, fine roots
PR22	0.0-0.1	FILL, Gravelly Silty Sand, dry, grey to brown, some slag and fine gravel
PR23	0.0-0.1	FILL, Silty Sand, fine, dry, brown to grey
PR24	0.0-0.1	FILL, Sand, some gravel, dry, grey to light grey
PR25	0.0-0.1	FILL, Sand, fine to medium grained, slightly moist, light brown
PR26	0.0-0.1	FILL, Sand, fine to medium grained, light brown, dry
W1	0.6	FILL, Sand, dry, light brown
W2	0.6	FILL, Silty Sand, dry, shells, light brown
W3	0.6	FILL, Silty Sand, dry, shells, light brown
W4	0.4	FILL, Silty Sand, dry, shells, light brown

12.2 EXCAVATION RESULTS

12.2.1 BASE SAMPLES

Results of the base samples were all below the acceptance criteria for the site with the exception of two (2) sample locations PR1 and PR13 (Drawing 5). These samples were elevated above site criteria for Benzo(a)pyrene and Total PAH's. A summary of results obtained for base samples is presented in Table 4. Results are tabulated in Appendix D.

Table 4 *Summary of Levels of Contaminants of Concern, Base Samples*

	TPH C10-C36	B(a)P	PAH
No. of Samples	18	18	18
No. of Samples Above Site Criteria	0	2	2
No. of Hot Spots	0	0	0

12.2.2 WALL SAMPLES

Results of the wall samples were all below the acceptance criteria for the site. A summary of results obtained for wall samples is presented in Table 5. Results are tabulated in Appendix D.

Table 5 *Summary of Levels of Contaminants of Concern, Wall Samples*

	TPH C10-C36	B(a)P	PAH
No. of Samples	4	4	4
No. of Samples Above Site Criteria	0	0	0
No. of Hot Spots	0	0	0

12.2.3 FORMER STOCKPILE AREA

One (1) sample indicated concentrations of Benzo(a)pyrene and Total PAH's above guidelines limits (PR20). This area was removed through further scraping, with additional validation samples indicating low to undetectable concentrations of contaminants.

12.2.4 RESIDUAL CONTAMINATION

Two (2) samples contained concentrations of Benzo(a)pyrene and Total PAH's marginally above guideline limits, at locations PR1 and PR13. These concentrations are not considered to represent a human or ecological health risk, based on the following:

- The site will ultimately be capped with 0.5m of clean fill, limiting soil access.
- The proposed site use is for high density residential apartments (not townhouses) and access will therefore be restricted.
- Low concentrations of PAH's were detected in groundwater, and therefore no impact on groundwater is evident.
- The elevated result represents only a small volume of material based on low concentrations found in all other samples.

12.3 ASSESSMENT OF POSSIBLE EXPOSURE ROUTES AND EXPOSED POPULATIONS (HUMAN, ECOLOGICAL)

In the site's remediated state it is not considered that there are any populations significantly exposed to the remaining contamination at the base of the excavation. The proposed development will limit this exposure except during the construction phase, where workers engaged in subsurface excavations may be briefly exposed to the remaining contamination. Ecological populations are unlikely to be exposed in the harbour as the residual PAH contamination has been shown to have a minimal leachate potential considering groundwater concentrations are low.

12.4 ASSESSMENT OF AESTHETICS

There are no odours or stained soils remaining at the site and the site's appearance is generally that of a typical sandy site.

13 ONGOING SITE MONITORING

Based on results of groundwater contaminants levels, no significant human health or ecological impacts are considered likely. As such, no ongoing site monitoring is considered necessary for groundwater.

14 CONCLUSION AND RECOMMENDATIONS

This report presents the findings of the validation of remedial works undertaken at the Park Residential site. Previous investigations undertaken at the site identified elevated concentrations of TPH C10-C36 and PAH's and Cobalt at the surface and within the shallow fill material at the site.

Groundwater contaminant concentrations were all below relevant acceptance criteria during previous investigations, with the exception of slightly elevated concentrations of Zinc. These concentrations were considered to be indicative of natural regional conditions and therefore no remediation was required.

Remedial works at the site were undertaken in accordance with the RAP prepared for the site (Ref 1) and involved the removal of TPH and PAH contaminants in the shallow fill profile in the area of the former Wharf Road. Approximately 500m^3 of material was excavated and transported to a licensed waste facility as Solid Waste. Validation of the remedial works has been undertaken.

Validation sampling of the base and walls of the excavation was undertaken and all samples contained low or undetectable concentrations for the primary contaminants of concern, with the exception of two (2) base samples. These samples contained a slightly elevated concentration for Benzo(a)pyrene and Total PAH's, however this is not considered significant given the concentrations in groundwater are low and the site will be backfilled with approximately 0.5m of clean fill material in this area thereby minimising exposure to the soil and limiting infiltration.

Following the remediation the site is now considered suitable for the proposed development given that the residual contaminants at the base of the excavation is minimal in extent and pose no human or ecological risk as the proposed development will further limit exposure pathways.

In its remediated state the site is considered suitable for the proposed residential development, medium density high rise apartments, which conforms to (HIL D).

15 LIMITATIONS

This report has been prepared for Honeysuckle Development Corporation in accordance with the agreement with RCA. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Honeysuckle Development Corporation. The report may not contain sufficient information for purposes of other uses or for parties other than Honeysuckle Development Corporation. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without permission.

Yours faithfully
RCA AUSTRALIA

Susan Adams
Senior Environmental Engineer

Fiona Robinson
Principal Environmental Engineer

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GLOSSARY

95%UCL_{ave}	A statistical calculation – 95% Upper Confidence Limit of the mean concentration.
AHD	Australian Height Datum (m), based on a mean sea level.
Aliphatic	Straight chain formation of carbon atoms.
ANZECC	Australian and New Zealand Environmental Conservation Council.
Aromatic	Ring formation of carbon atoms.

HIL 'D'	HIL 'D' of the Health Based Investigation Levels, Schedule B1 *National Environment Protection (Assessment of Site Contamination) Measure*.
Hotspot	A sample, or location, where contaminant concentrations exceed 250% of the appropriate guideline.
Interlaboratory	Prefix inter – as meaning between. A sample sent to two different laboratories for comparative analysis.
Intralaboratory	Prefix intra – as meaning within. A sample sent twice to the sample laboratory for comparative analysis.
kg	kilogram, 1000 gram.
Leachate	Fluid that has passed through a soil stratum, possibly collects contaminants.
LEP	Local Environment Plan - a planning tool for the Local Government.
μg	microgram, 1/1000 milligram.
mg	milligram, 1/1000 gram.
NEPC	National Environment Protection Council.
NEPM	National Environment Protection Measure.
NHMRC	National Health and Medical Research Council.
Phytotoxicity	Poisonous, or inhibiting, to plant growth.
PID	Photoionisation Detector.
PPE	Personal Protective Equipment.
PQL	Practical Quantitation Limit.
QA	Quality Assurance.
QC	Quality Control.
RPD	Relative Percentage Difference.
SPT	Standard Penetration Test.

TCLP	Toxicity Characteristic Leaching Procedure. An analysis designed to mimic the transfer of contaminants from soil into water. Often used to determine impact in landfill conditions.

Chemical Compounds

BTEX	Benzene, Toluene, Ethylbenzene, Xylene.
OCP's	Organochlorine Pesticides.
PAH	Polycyclic Aromatic Hydrocarbons.
PCBs	Poly Chlorinated Biphenyls.
TPH	Total Petroleum Hydrocarbons.