Appendix U

Groundwater Quality Report

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

GROUNDWATER MONITORING ASSESSMENT BRADKEN KILBURN FOUNDRY CROMWELL ROAD, KILBURN, SOUTH AUSTRALIA

Prepared for:

Bradken Resources Pty Ltd
80 Cromwell Road
KILBURN South Australia

Report Date: 12 October 2006
Project Ref: ENVITHEB05076AA

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ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Aboveground Storage Tank
C_6-C_{36}	Hydrocarbon chainlength fraction
Bgs	below ground surface
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COC	Chain of Custody
DO	Dissolved Oxygen
EC	Electrical Conductivity
Eh	Oxidation/Reduction Potential
ESA	Environmental Site Assessment
ID	Identification
IP	Interface Probe
LOR	Limit of Reporting
MDL	Method Detection Limit
µg/L	micrograms per litre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
MW	Monitoring Well
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NSW EPA	Environment Protection Authority of New South Wales

ABBREVIATIONS

OCP	Organochlorine Pesticide
OPP	Organophosphorous Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionisation Detector
Ppm	parts per million
ppmv	parts per million by volume
PSH	Phase Separated Hydrocarbon
QA	Quality Assurance
QC	Quality Control
RL	Reduced Level
RPD	Relative Percent Difference
SB	Soil Bore
SWL	Static Water Level
TCE	Trichloroethylene
TD	Total Depth
TDS	Total Dissolved Solid
TOC	Top of Casing
TPH	Total Petroleum Hydrocarbon
UST	Underground Storage Tank
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Coffey Environments Pty Ltd (Coffey Environments) was contracted by Bradken Resources Pty Ltd (Bradken) to undertake an assessment of the quality of groundwater at the Bradken Kilburn Foundry located on Cromwell Road, Kilburn, South Australia (the site). The scope of works for the current investigation is based upon the acceptance of the proposal prepared by Coffey Environments dated 26 July 2006.

The objectives of this project were to provide a snapshot of groundwater quality from selected locations from the existing groundwater monitoring well network present at the site, to update findings from previous reports completed at the site and to qualitatively evaluate the potential impact of the proposed development on groundwater quality at the site.

The scope of works included groundwater gauging and sampling of the eight monitoring wells located on the Bradken site on the 1st and 2nd August 2006.

Groundwater flow direction was noted to be to the west and south west and was found to be generally consistent with the work completed in 2001.

Benzene exceeded the adopted investigation level (IL) in the sample collected at monitoring well MW9A. Although other petroleum related hydrocarbons were noted at this well and MW12 to the west, none of these concentrations exceeded the adopted IL.

Zinc concentrations exceeding the adopted IL (aquaculture) were detected in six of eight groundwater samples.

All remaining analytes were reported as either below the adopted IL or below the laboratory limit of reporting (LOR).

No further remedial action is required or warranted in the vicinity of MW9A in the south-west portion of the site. The concentrations of benzene and ethylbenzene detected in groundwater at this location have significantly reduced over time, since the excavation of contaminated soil and replacement with clean fill was completed in 2003.

Based upon a review of limited information related to the proposed extension to the facility, and assuming that there are no significant changes to the way that the site is operated, there are unlikely to be significant changes to the current potential impacts from site operations to groundwater at the site.

The future management of stormwater at the site is considered one of the most important factors in managing potential future impacts to groundwater at the site, given the current stormwater retention pond infiltration design. Therefore, it is recommended that measures to protect groundwater should be included in any environmental management plan developed for the site to address both the construction and operation phase of the proposed development.

All conclusions and findings of this report are subject to the attached Coffey Environments Statement of Limitations.

1 INTRODUCTION

1.1 Background

Coffey Environments Pty Ltd (Coffey Environments) was contracted by Bradken Resources Pty Ltd (Bradken) to undertake an assessment of the quality of groundwater at the Bradken Kilburn Foundry located on Cromwell Road, Kilburn, South Australia (the site). The scope of works for the current investigation is based upon the acceptance of the proposal prepared by Coffey Environments dated 26 July 2006.

1.2 Objectives

The objectives of this project were:

- to provide a snapshot of groundwater quality from selected locations from the existing groundwater monitoring network present at the site;
- to update findings from previous reports completed at the site; and
- to qualitatively evaluate the potential impact of the proposed development on groundwater quality at the site.

The findings of this report will address selected aspects of the *Guidelines for the preparation of a Public Environmental Report for the Upgrading and expansion of a Foundry at Cromwell Road, Kilburn*, Planning SA, June 2006.

1.3 Scope of Works

All works were undertaken in accordance with the *National Environment Protection (Assessment of Site Contamination) Measures (NEPM) (1999)*, highest industrial standards and Coffey Environments' standard work practices.

To achieve the objectives of this project, the following scope of work was completed:

- Preparation for site work, including the development of a sampling plan and site safety plan;
- Groundwater gauging and field water quality parameters were recorded for eight groundwater monitoring wells (MW2, MW3, MW6, MW8, MW9A, MW10, MW11 and MW12) previous installed at the site. A site plan with the sampling locations is included as Figure 1;
- Sampling and analysis of the above mentioned monitoring wells for Benzene, Toluene, Ethylbenzene and Xylene (BTEX), Total Petroleum Hydrocarbons (TPH), total Polycyclic Aromatic Hydrocarbons (PAH's), metals screen and volatile organic compounds (VOCs); and
- Development of a summary report outlining the results of this work.

2 BACKGROUND INFORMATION

The Bradken site is approximately 50,000 square metres in size and is generally flat. It has an established groundwater monitoring well network, which has been in place since 2001. After a comprehensive groundwater evaluation in 2001, intermittent sampling has been completed, predominantly to address hydrocarbon related contamination in the south-west portion of the site. The following sections briefly summarise the sampling completed by Bradken and available for review by Coffey Environments for this project.

A report titled *Project Resources: Phase II Site Contamination Assessment Adelaide*, URS November 2001 (Reference 49306_002_R001-A.DOC) summarized the installation of 33 soil borings and 11 related monitoring wells. Monitoring well gauging, sampling, data evaluation and subsequent reporting was completed during this project. The findings indicated concentrations of total petroleum hydrocarbon (TPH), benzene, toluene, ethylbenzene, xylenes, (BTEX), polycyclic aromatic hydrocarbons (PAH), including 2,4 dimethylphenol and naphthalene in MW9 and concentrations of TPH, ethylbenzene and total xylenes at MW12. These concentrations were related to the presumed release of hydrocarbons from an underground storage tank (UST), containing petroleum products, formerly located at this part of the site. This UST was removed in 1995. It was recommended that the tank pit be excavated and that further monitoring take place.

Based upon the recommendations from the URS report, Bradken engaged MPL to conduct further groundwater assessments at the site in 2002, 2003 and 2004. A brief summary of each report is detailed below, along with other work that was completed to address the findings detailed in the 2001 URS report. In addition, agreements Bradken made with the South Australia Environment Protection Agency (SA EPA), following the official reporting of the release are summarised below.

- 2002 - Ten Monitoring wells were gauged for standing water level. Of these, two wells in the vicinity of petroleum hydrocarbon contamination noted in the original URS groundwater study were sampled and analysed for TPH, BTEX and total PAH's. MW9 reported concentrations of TPH and BTEX and total PAH.
- 2003 - One groundwater monitoring well (MW9) was sampled for TPH, BTEX and PAH. Concentrations of BTEX, TPH (C_6-C_{14}) and total PAH were reported.
- 2003 - Adelaide Environmental Consulting completed a report titled *Preliminary Risk Assessment Hydrocarbon Contamination*, December 2003. This report only focused on the south west corner of the site, where petroleum hydrocarbon contamination was noted. This report concluded that there was no significant human health risk to onsite and offsite receptors and that groundwater monitoring should be continued.
- 2003 - Excavation and contaminated soil removal was completed by McMahon Services for Bradken in 2003 at the former UST pit. MW9, which was lost during this process, was replaced by two monitoring wells (MW9A and MW9B), placed in the excavation and backfilled with clean soil. No detailed construction information is available for these monitoring wells. This work was completed, based upon agreements made between Bradken and the South Australia Environment Protection Authority. These agreements included a commitment from Bradken to continue to monitor groundwater at the site.

2004 - Eleven monitoring wells were gauged for standing water level (SWL). Of these three wells (MW9A, MW9B and MW12) were sampled and analysed for BTEX, TPH and PAH. All monitoring wells reported concentrations of BTEX, TPH and total PAH less than the Environmental Protection (Water Quality) Policy, Water Quality Criteria, (Potable). It was concluded that there had been a significant reduction in the concentration of petroleum hydrocarbon concentrations noted at this location. It was concluded that the plume of groundwater contamination may have migrated offsite.

2.1 Summary of Field Investigation

The field activities conducted at the site are summarised below.

Activity	**Details**
Date of Field Activity	1-2 August 2006
Well Gauging	Monitoring wells MW2, MW3, MW6, MW8, MW9A, MW10, MW11 and MW12 were gauged using a Solinist oil/water interface probe (IP). Previously installed wells, MW1, MW4, MW5 and MW7, either could not be accessed or were lost, destroyed. MW9B, which is located within 5 meters of MW9A was considered a duplicate data point and not sampled.
Well Purging	A minimum of three well volumes were removed from each of the eight monitoring wells or bailed dry, using a new disposable bailer for each well. Measurement of water quality parameters was conducted after every well volume. Purging continued until parameters stabilised.
Sampling Method	Disposable bailers were used to obtain groundwater samples from monitoring wells.
Decontamination Procedure	Water sampling equipment such as field filters and the IP, were decontaminated with laboratory grade detergent and rinsed with demineralised water between wells. One disposable bailer was used per well.
Sample Preservation	Samples were placed in laboratory supplied bottles containing appropriate preservatives. Samples were stored on ice (<4^{o}C) in an esky while on site and in transit to the laboratory. Samples collected for metals analysis were filtered in the field.
Disposal of Purged Groundwater	Purged groundwater was temporarily stored at the well and then disposed at an interceptor within the Bradken site.

3 SITE HYDROGEOLOGY

Pre-purge groundwater gauging data was collected on 1 August 2006. Based on the gauging data, groundwater elevation contours are shown in Figure 1. Groundwater gauging results are summarised below:

- Groundwater elevation across the area of investigation range between 2.346 metres Australian Height Datum (mAHD) (MW11) and 2.643 mAHD (MW2);
- The inferred groundwater flow direction is to the south-west. This is generally consistent with the original work completed by URS in 2001. The loss of a number of wells since the original works completed in 2001 limits the interpretation that could be completed;
- There is likely to be some local mounding in the vicinity of the stormwater retention pond, given that the design included an infiltration system to groundwater. Field surveying of surface water elevation in the pond, indicated that the surface water elevation was approximately one meter higher than groundwater in adjacent monitoring wells; and
- Water quality information gathered during this investigation is broadly consistent with information gathered during previous work at the Bradken site. Total dissolved solids (TDS) ranged from 300 mg/l to over 3800 mg/l. pH measurements were noted to have decreased to within a range of 7.5 to 8.5.

4 ADOPTED INVESTIGATION LEVELS

The adopted investigation levels (IL) for groundwater at the Bradken site are presented below.

- South Australia Environment Protection Authority SA EPA (2003) *Environmental Protection (Water Quality) Policy*, Water Quality Criteria for Underground Waters, including criteria for the Aquatic ecosystem, Recreation and aesthetics, Potable, Agriculture/aquaculture and Industrial (protected environmental values) are the primary evaluation criteria.
- For groundwater, including cases where a water body is protected for more than one of the environmental values, the most stringent water quality criteria will apply.
- In addition, it is suggested that the Environmental Protection (Water Quality) Policy, Water Quality Criteria, (Potable) is the highest potential beneficial use of groundwater at the site and this criteria is specifically compared to the results as a point of reference.

5 SUMMARY OF ANALYTICAL FINDINGS

The following summary describes the findings of the GME at the Bradken site. The concentrations noted above the adopted IL are presented in Table 1.

- The concentration of benzene detected in the sample collected from MW9A (0.0026 mg/L) was reported above the adopted IL (0.001 mg/L). This result is consistent with the previous analytical results for this section of the site.
- The concentration of ethylbenzene in MW9A (0.077 mg/L) did not exceed any adopted IL (0.3 mg/L). Concentrations of TPH C_{10} - C_{36}, ethylbenzene and total xylenes in MW12, did not exceed any adopted IL. These detections are consistent with previous petroleum hydrocarbon detections, related to a previous hydrocarbon release at this location.
- Zinc was noted to exceed the adopted IL (Aquaculture) (0.005 mg/L) in six of eight samples. This result was consistent with previous sampling at the site.

All remaining analytes were reported as either below the adopted IL or below the laboratory LOR.

6 QUALITY ASSURANCE RESULTS

Certified laboratory reports for chemical analysis, laboratory quality control (QC), including chain of custody and analysis request documentation have been provided to Bradken.

Relative percent difference (RPD) was calculated between the primary and duplicate groundwater sample concentrations as an indicator of reliability and repeatability of laboratory analytical results. Results are considered to be acceptable if the RPD is less than or equal to 50%.

RPDs were considered to be acceptable for all analytes between the sample pair MW9A and QC1, with the exception of TPH C_{10}- C_{14} (70 %). The elevated RPD can be attributed to the low concentrations of both the primary and duplicate samples, causing an exaggeration of the actual difference between the two samples.

As such, all primary sample results are considered to be acceptable for use in evaluating environmental conditions at the sampling locations.

Laboratory quality control (QC) samples (spike recoveries and sample duplicates) were all reported to be within an acceptable range All spike recoveries were within the acceptable range of 70 – 130 % with the exception of the following samples:

- 0608003/001 (MW2)- Surrogate recovery for volatile, C_6-C_9, BTEX fell outside the laboratory guideline limits due to poor sample matrix;
- 0608003/002 - (MW3)- Surrogate recovery for volatile, C_6-C_9, BTEX fell outside the laboratory guideline limits due to poor sample matrix; and
- 0608003/044 - spike recovery reported some phenol analytes outside the acceptable range of 70-130 %. However, as no phenol concentrations were detected in any primary sample above the LOR, this low percentage of spike recovery is considered irrelevant.

In addition, the laboratory limit of reporting (LOR) for samples 0608003/005 (MW9A) and 0608003/008 (MW12) for some volatile testing (volatiles, C6-C9and BTEX) were increased due to matrix interference.

However, as the increased LOR was below the adopted IL the above samples are not expected to influence the conclusions of this report.

No analytes were detected above the laboratory LOR in the equipment rinsate sample (QC1), the field blank (QC2) or the trip blank (QC3) and are therefore considered to be acceptable.

Coffey Environments considers that the field and laboratory QA/QC results are acceptable for the purposes of confirming the reliability and repeatability of the sampling and laboratory analysis procedures.

7 SUMMARY AND CONCLUSIONS

Groundwater gauging and sampling was completed at the Bradken site on 1 and 2 August 2006 from the eight monitoring wells available to be sampled. Groundwater flow direction was noted to be to the west and south-west, generally consistent with the work completed in 2001.

Benzene exceeded the adopted site IL at MW9A. Although other petroleum related hydrocarbons were noted at this well and MW12 to the west, none of these concentrations exceeded the adopted IL.

Zinc concentrations exceeded the adopted IL (aquaculture) in six of eight groundwater samples.

8 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations have been developed, based upon the findings of this report and observations made during the field investigation.

The localised detection of petroleum hydrocarbon contaminants in groundwater at MW9A and MW12 are consistent with the continuing decline of petroleum hydrocarbon-related contaminant concentrations at this location.

No further remedial action is required or warranted in the vicinity of MW9A in the south-west portion of the site. The concentrations of benzene and ethylbenzene detected in groundwater at this location have significantly reduced over time, since the excavation of contaminated soil and replacement with clean fill was completed in 2003.

Based upon the removal, to the practical extent possible, of contaminated soil at that location in 2003 and the related reduction in contaminated groundwater, it is reasonable to conclude that this trend is likely to continue. Continued periodic monitoring of selected wells is warranted, to document this trend.

Based upon a review of limited information related to the proposed extension to the facility, and assuming that there are no significant changes to the way that the site is operated, there are unlikely to be significant changes to the current potential impacts from site operations to groundwater at the site.

The future management of stormwater at the site is considered one of the most important factors in managing potential future impacts to groundwater at the site, given the current stormwater retention pond infiltration design.

It is recommended that measures to protect groundwater should be included in any environmental management plan developed for the site to address both the construction and operation phase of the proposed development.

It is specifically recommended that appropriate precautions be taken during the construction phase of the project, to ensure that any potential releases at the site are appropriately managed, to ensure that there is no impact to groundwater at the site during this phase of the development.

9 STATEMENT OF LIMITATIONS

All conclusions and findings of this report are subject to the attached Coffey Environments Statement of Limitations.

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SPECIALISTS IN LIVING AND WORKING PLACES

Important information about your **Coffey** Environmental Report

Uncertainties as to what lies below the ground on potentially contaminated sites can lead to remediation costs blow outs, reduction in the value of the land and to delays in the redevelopment of land. These uncertainties are an inherent part of dealing with land contamination. The following notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report has been written for a specific purpose

Your report has been developed on the basis of a specific purpose as understood by Coffey and applies only to the site or area investigated. For example, the purpose of your report may be:

- To assess the environmental effects of an on-going operation.
- To provide due diligence on behalf of a property vendor.
- To provide due diligence on behalf of a property purchaser.
- To provide information related to redevelopment of the site due to a proposed change in use, for example, industrial use to a residential use.
- To assess the existing baseline environmental, and sometimes geological and hydrological conditions or constraints of a site prior to an activity which may alter the sites environmental, geological or hydrological condition.

For each purpose, a specific approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible, quantify risks that both recognised and unrecognised contamination pose to the proposed activity. Such risks may be both financial (for example, clean up costs or limitations to the site use) and physical (for example, potential health risks to users of the site or the general public).

Scope of Investigations

The work was conducted, and the report has been prepared, in response to specific instructions from the client to whom this report is addressed, within practical time and budgetary constraints, and in reliance on certain data and information made available to Coffey. The analyses, evaluations, opinions and conclusions presented in this report are based on those instructions, requirements, data or information, and they could change if such instructions etc. are in fact inaccurate or incomplete.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man and may change with time. For example, groundwater levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project and/or on the property.

Interpretation of factual data

Environmental site assessments identify actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from indirect field measurements and sometimes other reports on the site are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how well qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of Coffey through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other problems encountered on site.

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SPECIALISTS IN LIVING AND WORKING PLACES

Important information about your **Coffey** Environmental Report

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered with redevelopment or on-going use of the site. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. In particular, a due diligence report for a property vendor may not be suitable for satisfying the needs of a purchaser. Your report should not be applied for any purpose other than that originally specified at the time the report was issued.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other professionals who are affected by the report. Have Coffey explain the report implications to professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel), field testing and laboratory evaluation of field samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Contact Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to land development and land use. It is common that not all approaches will be necessarily dealt with in your environmental site assessment report due to concepts proposed at that time. As a project progresses through planning and design toward construction and/or maintenance, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Environmental reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

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Tables

Groundwater Monitoring Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

TABLE 1
WELL GAUGING DETAILS
BRADKEN KILBURN FOUNDRY
GROUNDWATER MONITORING EVENT

Well ID	Date Measured	Total Depth (m)	Top of Well Casing Elevation (mAHD)	Depth to Water (mbtoc)	Depth to PSH (mbtoc)	PSH Thickness (m)	Product Gravity	Hydraulic Equivalent (m)	Corrected Depth to Water (mbtoc)	Corrected Water Elevation (mAHD)	Comments
MW 1	8/01/2006	Well could not be located									
MW 2	8/01/2006	5.093	5.878	3.235					3.235	2.643	
MW 3	8/01/2006	4.470	5.860	3.268					3.268	2.592	
MW 4	8/01/2006	Well could not be gauged due to restricted access									
MW 5	8/01/2006	Well could not be gauged due to restricted access									
MW 6	8/01/2006	5.105	5.909	3.330					3.330	2.579	
MW 8	8/01/2006	4.990	5.686	3.301					3.301	2.385	
MW 10	8/01/2006	5.340	7.122	4.459					4.459	2.663	
MW 11	8/01/2006	3.665	5.231	2.885					2.885	2.346	
MW 12	8/01/2006	4.205	5.446	3.055					3.055	2.391	

Notes:
MW, GW = monitoring wells
ID = identification
m = metres
mAHD = metres Australian Height Datum
mbtoc = m below top of casing
PSH = phase separated hydrocarbons (sheen = < 0.002 m)
NK = not known

Field Equipment Used:
ORS Interface Probe

Table 2

Summary of Results of Groundwater Sampling Above Adopted Investigation Levels

Bradken Resources, August 1 and 2 2006

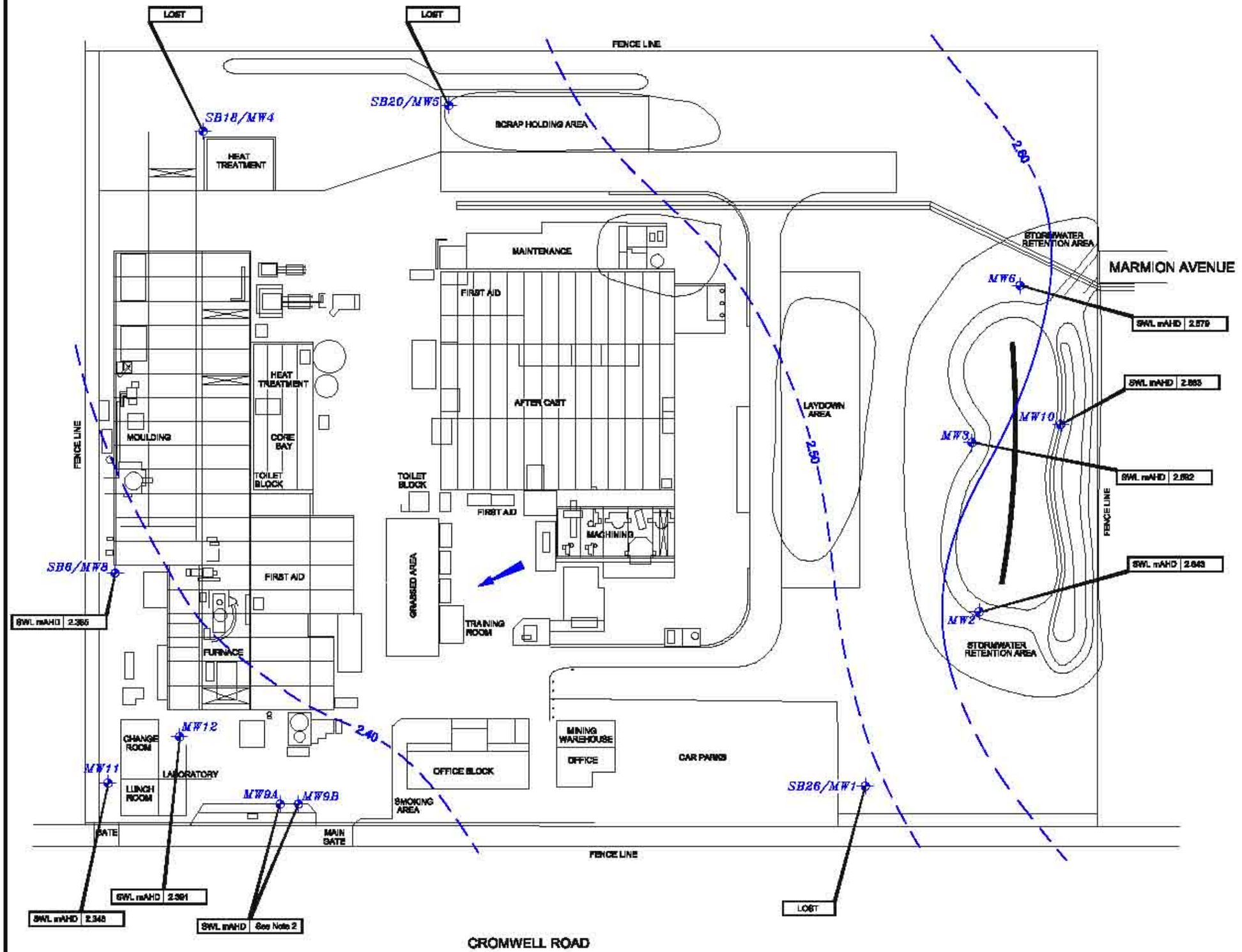
Analyte	**Adopted Investigation Level, Based on SA EPA Water Quality Policy Criteria (mg/L)**	**MW2 (mg/L)**	**MW3 (mg/L)**	**MW6 (mg/L)**	**MW8 (mg/L)**	**MW9A (mg/L)**	**MW10 (mg/L)**	**MW11 (mg/L)**	**MW12 (mg/L)**	**SA EPA Water Quality Policy Potable Criteria (mg/L)**
Benzene	0.001	<0.0005	<0.0005	<0.0005	<0.0005	**0.0026**	<0.0005	<0.0005	<0.0010	0.001
Zinc	0.005	**0.006**	0.002	0.002	**0.005**	**0.005**	**0.011**	**0.043**	**0.072**	NA

Notes:
The most protective water quality criteria has been selected as an adopted IL.
The Potable criteria has been included for reference as the most relevant criteria for groundwater.
Only analytes with detections in excess of the adopted IL have been included in this table.
mg/L – milligrams per litre
NA Not Applicable

Figures

Groundwater Monitoring Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

A3



LEGEND

- INFERRED GROUNDWATER FLOW DIRECTION
- MW — GROUNDWATER MONITORING WELL LOCATIONS
- 1.50 — INFERRED GROUNDWATER ELEVATION CONTOUR (mAHD)
- SWL mAHD — GROUNDWATER ELEVATION (mAHD)

NOTE:

1. Survey data from URS, 2001.
2. MW9A & MW9B are unsurveyed replacement wells.

SCALE 1:1000 (A3) METRES 0 10 20 30 40 50

NOTE:
ALL LOCATIONS ARE APPROXIMATE.
DIMENSIONS IN METRES.

Coffey Environments Pty Ltd ©

Rev	Date	Revision Details	Dm
B	16.08.06	ESA ISSUE EDITS	MW
A	01.08.06	ESA ISSUE	GR

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Client:
BRADKEN RESOURCES

Project:
BRADKEN GROUNDWATER SAMPLING

Location:
CROMWELL ROAD
KILBURN, SOUTH AUSTRALIA

Drawing Title:
HYDROGEOLOGICAL INFORMATION (1 AUGUST 2006)

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Appendix A
References

Groundwater Monitoring Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

REFERENCES

Adelaide Environmental Consulting (2003) Preliminary Risk Assessment Hydrocarbon Contamination. Bradken Cromwell Road, Kilburn. Report Issued 10th December 2003. Report No.: 0555A

MPL (2002) Collection and Analysis of Groundwaters. Bradken Mineral Processing. Report issued November 2002. Report No.: SA4179

MPL (2004) Bore Water Sampling and Analysis. Cromwell Road, Kilburn. Report Issued 12th November 2004. Report No.: 50.0315.01

NSW EPA (1994): Guidelines for Assessing Service Station-sites. ISBN 0-7310-3712-X.

NEPM (1999) National Environment Protection (Assessment of Contaminated Sites) Measure.

Planning SA (PIRSA) (2006) Guidelines for the preparation of a public Environment Report for the Upgrading and expansion of a Foundry at Cromwell Road, Kilburn. Proposal by Bradken Resources Pty Ltd. Issued June 2006

Planning SA (PIRSA) (2006) Issues Paper. Proposal for an upgrading and expansion of a Foundry at Cromwell Road, Kilburn. Proposal by Bradken Resources Pty Ltd. Issued April 2006

South Australian Environment Protection Authority (2003) Environment Protection (Water Quality) Policy and Explanatory Report 2003. ISBN 1-876562-39-0.

URS (2001) Project Resources: Phase II Site Contamination Assessment Adelaide. Report Issued 30th November 2001. Report No.: 49306_002_R001-A.DOC

Appendix B
Laboratory Reports & Chain of Custody Documentation

Groundwater Monitoring Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

14 AUG 2006

amdel
www.amdel.com

Analytical Report

Coffey Environments Pty Ltd (Adelaide)
27 QUEENS STREET
THEBARTON

SA 5031

Contact	: **COLIN CAMPBELL**
Batch Number	: **0608003**
Job Ref	: **J505076A**
Sample(s) Received	: **03/08/2006**
Report No	: **171381**

Methods:

202 Bicarbonate Alkalinity by Titration
202 Carbonate Alkalinity by Titration
202 Total Alkalinity by Titration
208 Anions by Ion Chromatography, mg/L
208 Nitrate (As N) by Ion Chromatography, mg N/L
402-AES Elements by ICP-AES, mg/L
404FIMS Mercury by Vapour AAS, mg/L
406-MS Elements by ICP-MS, mg/L
501-FID Total Petroleum Hydrocarbons, mg/L
504P&T VOC Priority Organics (8260), mg/L
512-MS Individual Phenols & Cresols, mg/L
512-MS Polyaromatic Hydrocarbons, mg/L
512-MS Polyaromatic Hydrocarbons, Surrogates
513P&T BTEX/MAH (Purge & Trap), mg/L
513P&T C6-C9 (Purge & Trap), mg/L
513P&T MAH/TPH, Surrogate

Attached Results Approved by:

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NATA

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025.

NATA ENDORSED DOCUMENT

NATA Accreditation No. 1645 (Chemical Testing) NATA Accreditation No. 14278 (Biological Testing)

** This is the Final Report which supersedes any reports previously issued relating to the sample(s) included.*

All samples tested as submitted by client.

 # Denotes methods not covered by NATA scope of accreditation

Results

Report No: 171381

	0608003/001 MW2	0608003/002 MW3	0608003/003 MW6	0608003/004 MW8	0608003/005 MW9A
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
ALKALINITY					
Method: 202 Units:mg CaCO3/L					
Bicarbonate Alkalinity	190	210	480	610	850
Carbonate Alkalinity	<10	<10	<10	<10	<10
Total Alkalinity	190	210	480	610	850
ANIONS by ION CHROMATOGRAPHY					
Method: 208 Units: mg/L					
Chloride	18	53	300	640	1300
Sulphate	16	39	190	290	110
BTEX/MAH (PURGE & TRAP)					
Method: 513P&T Units: mg/L					
Benzene	<0.0005	<0.0005	<0.0005	<0.0005	0.026
Ethylbenzene	<0.001	<0.001	<0.001	<0.001	0.077
meta & para-Xylenes	<0.002	<0.002	<0.002	<0.002	0.011
ortho-Xylene	<0.001	<0.001	<0.001	<0.001	0.005
Toluene	<0.001	<0.001	<0.001	<0.001	<0.002
ELEMENTS by ICP-AES					
Method: 402-AES Units: mg/L					
Iron	40	15	3.5	2.6	0.7
ELEMENTS by ICP-AES, AS RECEIVED					
Method: 402-AES Units: mg/L					
Calcium	3.4	2.1	5.5	53	46
Magnesium	10	5.5	9.6	72	100
Potassium	17	12	16	45	44
Sodium	110	140	530	690	900
HYDROCARBONS (C6-C9) in SOLUTION					
Method: 513P&T Units: mg/L					
TPH C6 - C9	<0.02	<0.02	<0.02	<0.02	0.36
HYDROCARBONS in SOLUTION					
Method: 501-FID Units: mg/L					
TPH C10 - C14	0.06	0.08	<0.04	<0.04	0.27
TPH C15 - C28	<0.1	<0.1	<0.1	<0.1	<0.1
TPH C29 - C36	<0.1	<0.1	<0.1	<0.1	<0.1
INDIVIDUAL PHENOLS & CRESOLS					
Method: 512-MS Units: mg/L					
2,3,4,5 & 2,3,4,6 -Tetrachlorophenol	-	-	-	-	<0.02
2,3,4-Trichlorophenol	-	-	-	-	<0.01
2,3,5,6-Tetrachlorophenol	-	-	-	-	<0.01
2,3,5-Trichlorophenol	-	-	-	-	<0.01

Results

Report No: 171381

	0608003/001 MW2	0608003/002 MW3	0608003/003 MW6	0608003/004 MW8	0608003/005 MW9A
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
2,3,6-Trichlorophenol	-	-	-	-	<0.01
2,3-Dichlorophenol	-	-	-	-	<0.02
2,4 Dichlorophenol	-	-	-	-	<0.02
2,4,6-Trichlorophenol	-	-	-	-	<0.01
2,4-dinitrophenol #	-	-	-	-	<0.05
2,5-Dichlorophenol	-	-	-	-	<0.02
2,6-Dichlorophenol	-	-	-	-	<0.01
2-Chlorophenol	-	-	-	-	<0.01
3 & 4-Chlorophenol	-	-	-	-	<0.01
3,4 Dichlorophenol	-	-	-	-	<0.02
3,5-Dichlorophenol	-	-	-	-	<0.02
4-Chloro-3-methylphenol	-	-	-	-	<0.01
Pentachlorophenol	-	-	-	-	<0.03
Phenol	-	-	-	-	<0.01
MERCURY by VAPOUR-AAS					
Method:404FIMS Units: mg/L					
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
METALS by ICP-MS					
Method: 406-MS Units: mg/L					
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	<0.001	<0.001	0.001	0.005	0.004
Copper	<0.001	<0.001	0.001	<0.001	0.002
Lead	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	<0.001	0.002
Zinc	0.006	0.002	0.002	0.005	0.005
NITROGEN by ION CHROMATOGRAPHY					
Method: 208 Units: mg N/L					
Nitrate (as Nitrogen)	<0.01	<0.01	<0.01	9.9	0.06
POLYAROMATIC HYDROCARBONS					
Method: 512-MS Units: mg/L					
Acenaphthene	<0.001	<0.001	-	<0.001	<0.001
Acenaphthylene	<0.001	<0.001	-	<0.001	<0.001
Anthracene	<0.001	<0.001	-	<0.001	<0.001
Benz(a)anthracene	<0.001	<0.001	-	<0.001	<0.001
Benzo(a)pyrene	<0.001	<0.001	-	<0.001	<0.001
Benzo(b)fluoranthene	<0.001	<0.001	-	<0.001	<0.001
Benzo(g,h,i)perylene	<0.001	<0.001	-	<0.001	<0.001
Benzo(k)fluoranthene	<0.001	<0.001	-	<0.001	<0.001
Chrysene	<0.001	<0.001	-	<0.001	<0.001
Dibenz(a,h)anthracene	<0.001	<0.001	-	<0.001	<0.001

Results

Report No: 171381

	0608003/001 MW2	0608003/002 MW3	0608003/003 MW6	0608003/004 MW8	0608003/005 MW9A
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
Fluoranthene	<0.001	<0.001	-	<0.001	<0.001
Fluorene	<0.001	<0.001	-	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene	<0.001	<0.001	-	<0.001	<0.001
Naphthalene	<0.001	<0.001	-	<0.001	0.013
Phenanthrene	<0.001	<0.001	-	<0.001	<0.001
Pyrene	<0.001	<0.001	-	<0.001	<0.001
POLYAROMATIC HYDROCARBONS, SURROGATE RECOVERIES					
Method: 512-MS Units: % Recovered					
Pyrene-d10, Surrogate Rec.	103	88.0	-	129	88.5
VOLATILE ORGANICS (PURGE & TRAP), AS RECEIVED					
Method: 504P&T Units: mg/L					
1,1,1,2-Tetrachloroethane	-	<0.005	-	-	<0.010
1,1,1-Trichloroethane	-	<0.005	-	-	<0.010
1,1,2,2-Tetrachloroethane	-	<0.005	-	-	<0.010
1,1,2-Trichloroethane	-	<0.005	-	-	<0.010
1,1-Dichloroethane	-	<0.005	-	-	<0.010
1,1-Dichloroethene	-	<0.005	-	-	<0.010
1,1-Dichloropropene	-	<0.005	-	-	<0.010
1,2(cis)-dichloroethene	-	<0.005	-	-	<0.010
1,2(trans)-dichloroethene	-	<0.005	-	-	<0.010
1,2,3-Trichlorobenzene	-	<0.005	-	-	<0.010
1,2,3-Trichloropropane	-	<0.005	-	-	<0.010
1,2,4-Trichlorobenzene	-	<0.005	-	-	<0.010
1,2,4-Trimethylbenzene	-	<0.005	-	-	0.022
1,2-Dibromoethane	-	<0.005	-	-	<0.010
1,2-Dichlorobenzene	-	<0.005	-	-	<0.010
1,2-Dichloroethane	-	<0.005	-	-	<0.010
1,2-Dichloropropane	-	<0.005	-	-	<0.010
1,2Dibromo-3-chloropropane	-	<0.005	-	-	<0.010
1,3(cis)-dichloropropene	-	<0.005	-	-	<0.010
1,3(trans)-dichloropropene	-	<0.005	-	-	<0.010
1,3,5-Trimethylbenzene	-	<0.005	-	-	<0.010
1,3-Dichlorobenzene	-	<0.005	-	-	<0.010
1,3-Dichloropropane	-	<0.005	-	-	<0.010
1,4-Dichlorobenzene	-	<0.005	-	-	<0.010
2 - Chlorotoluene	-	<0.005	-	-	<0.010
2,2-Dichloropropane	-	<0.005	-	-	<0.010
2-Chloroethylvinyl ether	-	<0.005	-	-	<0.010
4 - Chlorotoluene	-	<0.005	-	-	<0.010
Acetone	-	<0.05	-	-	<0.10
Benzene	-	<0.0005	-	-	0.026

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	0608003/001 MW2	0608003/002 MW3	0608003/003 MW6	0608003/004 MW8	0608003/005 MW9A
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
Bromobenzene	-	<0.005	-	-	<0.010
Bromodichloromethane	-	<0.005	-	-	<0.010
Bromoform	-	<0.005	-	-	<0.010
Bromomethane	-	<0.005	-	-	<0.010
Carbon Disulfide	-	<0.005	-	-	<0.010
Carbon Tetrachloride	-	<0.005	-	-	<0.010
Chlorobenzene	-	<0.005	-	-	<0.010
Chloroethane	-	<0.005	-	-	<0.010
Chloroform	-	<0.01	-	-	<0.02
Chloromethane	-	<0.005	-	-	<0.010
Dibromochloromethane	-	<0.005	-	-	<0.010
Dibromomethane	-	<0.005	-	-	<0.010
Dichlorodifluromethane	-	<0.005	-	-	<0.010
Dichloromethane	-	<0.005	-	-	<0.010
Ethylbenzene	-	<0.001	-	-	0.077
Hexachlorobutadiene	-	<0.005	-	-	<0.010
Iodomethane	-	<0.005	-	-	<0.010
Isopropyl Benzene (Cumene)	-	<0.001	-	-	<0.001
MBK, 2-Hexanone	-	<0.05	-	-	<0.10
meta & para-Xylenes	-	<0.002	-	-	0.011
Methyl ethyl Ketone (MEK)	-	<0.05	-	-	<0.10
MIBK, 4-methyl-2-pentanone	-	<0.05	-	-	<0.10
n-Butylbenzene	-	<0.005	-	-	<0.010
n-Propylbenzene	-	<0.005	-	-	0.017
Naphthalene	-	<0.005	-	-	<0.010
ortho-Xylene	-	<0.001	-	-	0.005
p-Isopropyltoluene	-	<0.005	-	-	<0.010
sec-Butylbenzene	-	<0.005	-	-	<0.010
Styrene	-	<0.001	-	-	<0.001
tert-Butylbenzene	-	<0.005	-	-	<0.010
Tetrachloroethene	-	<0.005	-	-	<0.010
Toluene	-	<0.001	-	-	<0.002
Trichloroethene	-	<0.005	-	-	<0.010
Trichlorofluoromethane	-	<0.005	-	-	<0.010
Vinyl Acetate	-	<0.005	-	-	<0.010
Vinyl Chloride	-	<0.005	-	-	<0.010
VOLATILES (PURGE & TRAP), SURROGATE RECOVERIES					
Method: 513P&T Units: % Recovered					
4-Bromoflurobenzene Surrogate Rec.	-	-	-	-	77.0

Results

Report No: 171381

	0608003/006 MW10	0608003/007 MW11	0608003/008 MW12	0608003/009 QC1	0608003/010 QC2
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
ALKALINITY					
Method: 202 Units:mg CaCO3/L					
Bicarbonate Alkalinity	360	770	590	860	<10
Carbonate Alkalinity	<10	<10	<10	<10	<10
Total Alkalinity	360	770	590	860	<20
ANIONS by ION CHROMATOGRAPHY					
Method: 208 Units: mg/L					
Chloride	480	480	240	1200	<0.5
Sulphate	160	300	92	100	<0.5
BTEX/MAH (PURGE & TRAP)					
Method: 513P&T Units: mg/L					
Benzene	<0.0005	<0.0005	<0.0010	0.021	<0.0005
Ethylbenzene	<0.001	<0.001	0.12	0.080	<0.001
meta & para-Xylenes	<0.002	<0.002	0.057	0.016	<0.002
ortho-Xylene	<0.001	<0.001	<0.002	0.005	<0.001
Toluene	<0.001	<0.001	<0.002	<0.001	<0.001
ELEMENTS by ICP-AES					
Method: 402-AES Units: mg/L					
Iron	2.5	1.6	1.6	0.6	<0.1
ELEMENTS by ICP-AES, AS RECEIVED					
Method: 402-AES Units: mg/L					
Calcium	14	21	22	46	<0.1
Magnesium	20	28	43	100	<0.1
Potassium	32	27	19	44	<1.0
Sodium	480	740	360	880	<0.1
HYDROCARBONS (C6-C9) in SOLUTION					
Method: 513P&T Units: mg/L					
TPH C6 - C9	<0.02	<0.02	0.18	0.42	<0.02
HYDROCARBONS in SOLUTION					
Method: 501-FID Units: mg/L					
TPH C10 - C14	<0.04	0.08	0.50	0.13	<0.04
TPH C15 - C28	<0.1	<0.1	<0.1	<0.1	<0.1
TPH C29 - C36	<0.1	<0.1	<0.1	<0.1	<0.1
INDIVIDUAL PHENOLS & CRESOLS					
Method: 512-MS Units: mg/L					
2,3,4,5 & 2,3,4,6 -Tetrachlorophenol	-	-	-	<0.02	<0.02
2,3,4-Trichlorophenol	-	-	-	<0.01	<0.01
2,3,5,6-Tetrachlorophenol	-	-	-	<0.01	<0.01
2,3,5-Trichlorophenol	-	-	-	<0.01	<0.01

Results

Report No: 171381

	0608003/006 MW10	0608003/007 MW11	0608003/008 MW12	0608003/009 QC1	0608003/010 QC2
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
2,3,6-Trichlorophenol	-	-	-	<0.01	<0.01
2,3-Dichlorophenol	-	-	-	<0.02	<0.02
2,4 Dichlorophenol	-	-	-	<0.02	<0.02
2,4,6-Trichlorophenol	-	-	-	<0.01	<0.01
2,4-dinitrophenol #	-	-	-	<0.05	<0.05
2,5-Dichlorophenol	-	-	-	<0.02	<0.02
2,6-Dichlorophenol	-	-	-	<0.01	<0.01
2-Chlorophenol	-	-	-	<0.01	<0.01
3 & 4-Chlorophenol	-	-	-	<0.01	<0.01
3,4 Dichlorophenol	-	-	-	<0.02	<0.02
3,5-Dichlorophenol	-	-	-	<0.02	<0.02
4-Chloro-3-methylphenol	-	-	-	<0.01	<0.01
Pentachlorophenol	-	-	-	<0.03	<0.03
Phenol	-	-	-	<0.01	<0.01
MERCURY by VAPOUR-AAS					
Method:404FIMS Units: mg/L					
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
METALS by ICP-MS					
Method: 406-MS Units: mg/L					
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	<0.001	0.002	0.002	0.004	<0.001
Copper	<0.001	0.007	<0.001	0.002	<0.001
Lead	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	0.002	<0.001
Zinc	0.011	0.043	0.072	0.005	<0.001
NITROGEN by ION CHROMATOGRAPHY					
Method: 208 Units: mg N/L					
Nitrate (as Nitrogen)	0.12	7.7	0.24	0.06	<0.01
POLYAROMATIC HYDROCARBONS					
Method: 512-MS Units: mg/L					
Acenaphthene	-	<0.001	<0.001	<0.001	<0.001
Acenaphthylene	-	<0.001	<0.001	<0.001	<0.001
Anthracene	-	<0.001	<0.001	<0.001	<0.001
Benz(a)anthracene	-	<0.001	<0.001	<0.001	<0.001
Benzo(a)pyrene	-	<0.001	<0.001	<0.001	<0.001
Benzo(b)fluoranthene	-	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene	-	<0.001	<0.001	<0.001	<0.001
Benzo(k)fluoranthene	-	<0.001	<0.001	<0.001	<0.001
Chrysene	-	<0.001	<0.001	<0.001	<0.001
Dibenz(a,h)anthracene	-	<0.001	<0.001	<0.001	<0.001

Results

Report No: 171381

	0608003/006 MW10	0608003/007 MW11	0608003/008 MW12	0608003/009 QC1	0608003/010 QC2
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
Fluoranthene	-	<0.001	<0.001	<0.001	<0.001
Fluorene	-	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene	-	<0.001	<0.001	<0.001	<0.001
Naphthalene	-	<0.001	0.018	0.008	<0.001
Phenanthrene	-	<0.001	<0.001	<0.001	<0.001
Pyrene	-	<0.001	<0.001	<0.001	<0.001
POLYAROMATIC HYDROCARBONS, SURROGATE RECOVERIES					
Method: 512-MS Units: % Recovered					
Pyrene-d10, Surrogate Rec.	-	104	93.5	100	108
VOLATILE ORGANICS (PURGE & TRAP), AS RECEIVED					
Method: 504P&T Units: mg/L					
1,1,1,2-Tetrachloroethane	-	-	<0.010	<0.005	<0.005
1,1,1-Trichloroethane	-	-	<0.010	<0.005	<0.005
1,1,2,2-Tetrachloroethane	-	-	<0.010	<0.005	<0.005
1,1,2-Trichloroethane	-	-	<0.010	<0.005	<0.005
1,1-Dichloroethane	-	-	<0.010	<0.005	<0.005
1,1-Dichloroethene	-	-	<0.010	<0.005	<0.005
1,1-Dichloropropene	-	-	<0.010	<0.005	<0.005
1,2(cis)-dichloroethene	-	-	<0.010	<0.005	<0.005
1,2(trans)-dichloroethene	-	-	<0.010	<0.005	<0.005
1,2,3-Trichlorobenzene	-	-	<0.010	<0.005	<0.005
1,2,3-Trichloropropane	-	-	<0.010	<0.005	<0.005
1,2,4-Trichlorobenzene	-	-	<0.010	<0.005	<0.005
1,2,4-Trimethylbenzene	-	-	0.050	0.050	<0.005
1,2-Dibromoethane	-	-	<0.010	<0.005	<0.005
1,2-Dichlorobenzene	-	-	<0.010	<0.005	<0.005
1,2-Dichloroethane	-	-	<0.010	<0.005	<0.005
1,2-Dichloropropane	-	-	<0.010	<0.005	<0.005
1,2Dibromo-3-chloropropane	-	-	<0.010	<0.005	<0.005
1,3(cis)-dichloropropene	-	-	<0.010	<0.005	<0.005
1,3(trans)-dichloropropene	-	-	<0.010	<0.005	<0.005
1,3,5-Trimethylbenzene	-	-	<0.010	0.019	<0.005
1,3-Dichlorobenzene	-	-	<0.010	<0.005	<0.005
1,3-Dichloropropane	-	-	<0.010	<0.005	<0.005
1,4-Dichlorobenzene	-	-	<0.010	<0.005	<0.005
2 - Chlorotoluene	-	-	<0.010	<0.005	<0.005
2,2-Dichloropropane	-	-	<0.010	<0.005	<0.005
2-Chloroethylvinyl ether	-	-	<0.010	<0.005	<0.005
4 - Chlorotoluene	-	-	<0.010	<0.005	<0.005
Acetone	-	-	<0.10	<0.05	<0.05
Benzene	-	-	<0.0010	0.021	<0.0005

Results

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	0608003/006 MW10	0608003/007 MW11	0608003/008 MW12	0608003/009 QC1	0608003/010 QC2
	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06	1/08/06 3/08/06
Bromobenzene	-	-	<0.010	<0.005	<0.005
Bromodichloromethane	-	-	<0.010	<0.005	<0.005
Bromoform	-	-	<0.010	<0.005	<0.005
Bromomethane	-	-	<0.010	<0.005	<0.005
Carbon Disulfide	-	-	<0.010	<0.005	<0.005
Carbon Tetrachloride	-	-	<0.010	<0.005	<0.005
Chlorobenzene	-	-	<0.010	<0.005	<0.005
Chloroethane	-	-	<0.010	<0.005	<0.005
Chloroform	-	-	<0.02	<0.01	<0.01
Chloromethane	-	-	<0.010	<0.005	<0.005
Dibromochloromethane	-	-	<0.010	<0.005	<0.005
Dibromomethane	-	-	<0.010	<0.005	<0.005
Dichlorodifluromethane	-	-	<0.010	<0.005	<0.005
Dichloromethane	-	-	<0.010	<0.005	<0.005
Ethylbenzene	-	-	0.12	0.080	<0.001
Hexachlorobutadiene	-	-	<0.010	<0.005	<0.005
Iodomethane	-	-	<0.010	<0.005	<0.005
Isopropyl Benzene (Cumene)	-	-	<0.002	<0.001	<0.001
MBK, 2-Hexanone	-	-	<0.10	<0.05	<0.05
meta & para-Xylenes	-	-	0.057	0.016	<0.002
Methyl ethyl Ketone (MEK)	-	-	<0.10	<0.05	<0.05
MIBK, 4-methyl-2-pentanone	-	-	<0.10	<0.05	<0.05
n-Butylbenzene	-	-	<0.010	<0.005	<0.005
n-Propylbenzene	-	-	0.070	0.026	<0.005
Naphthalene	-	-	0.012	0.015	<0.005
ortho-Xylene	-	-	<0.002	0.005	<0.001
p-Isopropyltoluene	-	-	<0.010	<0.005	<0.005
sec-Butylbenzene	-	-	<0.010	<0.005	<0.005
Styrene	-	-	<0.002	<0.001	<0.001
tert-Butylbenzene	-	-	<0.010	<0.005	<0.005
Tetrachloroethene	-	-	<0.010	<0.005	<0.005
Toluene	-	-	<0.002	<0.001	<0.001
Trichloroethene	-	-	<0.010	<0.005	<0.005
Trichlorofluoromethane	-	-	<0.010	<0.005	<0.005
Vinyl Acetate	-	-	<0.010	<0.005	<0.005
Vinyl Chloride	-	-	<0.010	<0.005	<0.005
VOLATILES (PURGE & TRAP), SURROGATE RECOVERIES					
Method: 513P&T Units: % Recovered					
4-Bromoflurobenzene Surrogate Rec.	-	-	72.2	73.2	-

Results

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	0608003/011
	QC3
	1/08/06
	3/08/06

VOLATILE ORGANICS (PURGE & TRAP), AS RECEIVED

Method: 504P&T Units: mg/L

1,1,1,2-Tetrachloroethane	<0.010
1,1,1-Trichloroethane	<0.010
1,1,2,2-Tetrachloroethane	<0.010
1,1,2-Trichloroethane	<0.010
1,1-Dichloroethane	<0.010
1,1-Dichloroethene	<0.010
1,1-Dichloropropene	<0.010
1,2(cis)-dichloroethene	<0.010
1,2(trans)-dichloroethene	<0.010
1,2,3-Trichlorobenzene	<0.010
1,2,3-Trichloropropane	<0.010
1,2,4-Trichlorobenzene	<0.010
1,2,4-Trimethylbenzene	0.022
1,2-Dibromoethane	<0.010
1,2-Dichlorobenzene	<0.010
1,2-Dichloroethane	<0.010
1,2-Dichloropropane	<0.010
1,2Dibromo-3-chloropropane	<0.010
1,3(cis)-dichloropropene	<0.010
1,3(trans)-dichloropropene	<0.010
1,3,5-Trimethylbenzene	<0.010
1,3-Dichlorobenzene	<0.010
1,3-Dichloropropane	<0.010
1,4-Dichlorobenzene	<0.010
2 - Chlorotoluene	<0.010
2,2-Dichloropropane	<0.010
2-Chloroethylvinyl ether	<0.010
4 - Chlorotoluene	<0.010
Acetone	<0.10
Benzene	<0.0005
Bromobenzene	<0.010
Bromodichloromethane	<0.010
Bromoform	<0.010
Bromomethane	<0.010
Carbon Disulfide	<0.010
Carbon Tetrachloride	<0.010
Chlorobenzene	<0.010
Chloroethane	<0.010
Chloroform	<0.02

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	0608003/011 QC3
	1/08/06 3/08/06
Chloromethane	<0.010
Dibromochloromethane	<0.010
Dibromomethane	<0.010
Dichlorodifluromethane	<0.010
Dichloromethane	<0.010
Ethylbenzene	<0.001
Hexachlorobutadiene	<0.010
Iodomethane	<0.010
Isopropyl Benzene (Cumene)	<0.001
MBK, 2-Hexanone	<0.10
meta & para-Xylenes	<0.002
Methyl ethyl Ketone (MEK)	<0.10
MIBK, 4-methyl-2-pentanone	<0.10
n-Butylbenzene	<0.010
n-Propylbenzene	0.017
Naphthalene	<0.010
ortho-Xylene	<0.001
p-Isopropyltoluene	<0.010
sec-Butylbenzene	<0.010
Styrene	<0.001
tert-Butylbenzene	<0.010
Tetrachloroethene	<0.010
Toluene	<0.001
Trichloroethene	<0.010
Trichlorofluoromethane	<0.010
Vinyl Acetate	<0.010
Vinyl Chloride	<0.010

Quality Results

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	0608003Q012 SOLUTION BLANK	0608003Q013 Spike Recovery Lab Control	0608003Q014 Duplicate 0608003/010	0608003Q015 Spike Recovery 0608003/010	0608003Q016 Duplicate 0608003/010
			4/08/06		4/08/06
	3/08/06	4/08/06	4/08/06	4/08/06	4/08/06
	3/08/06	4/08/06		4/08/06	
MERCURY by VAPOUR-AAS					
Method:404FIMS Units: mg/L					
Mercury	<0.0001	-	-	-	-
METALS by ICP-MS					
Method: 406-MS Units: mg/L					
Arsenic	<0.001	-	-	-	-
Cadmium	<0.001	-	-	-	-
Chromium	<0.001	-	-	-	-
Copper	<0.001	-	-	-	-
Lead	<0.001	-	-	-	-
Nickel	<0.001	-	-	-	-
Zinc	<0.001	-	-	-	-
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Arsenic	-	-	-	-	<1.0
Cadmium	-	-	-	-	<1.0
Chromium	-	-	-	-	<1.0
Copper	-	-	-	-	<1.0
Lead	-	-	-	-	<1.0
Nickel	-	-	-	-	<1.0
Zinc	-	-	-	-	<1.0
Mercury	-	-	<1.0	-	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Mercury	-	95.0	-	83.6	-

Quality Results

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	0608003Q017 Spike Recovery 0608003/010 3/08/06 4/08/06	0608003Q018 Spike Recovery Lab Control 4/08/06 4/08/06	0608003Q019 Spike Recovery Lab Control 4/08/06 4/08/06	0608003Q020 Duplicate 0608003/001 4/08/06 4/08/06	0608003Q021 QCBlank METHOD BLANK 4/08/06 4/08/06
HYDROCARBONS (C6-C9) in SOLUTION					
Method: 513P&T Units: mg/L					
TPH C6 - C9	-	-	-	-	<0.02
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Calcium	-	-	-	5.0	-
Iron	-	-	-	7.7	-
Magnesium	-	-	-	7.7	-
Potassium	-	-	-	6.0	-
Sodium	-	-	-	<1.0	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Arsenic	-	96.4	-	-	-
Cadmium	96.3	94.1	-	-	-
Calcium	-	-	99.5	-	-
Chromium	85.5	88.2	-	-	-
Copper	88.7	87.8	-	-	-
Iron	-	-	103	-	-
Lead	104	116	-	-	-
Magnesium	-	-	105	-	-
Nickel	83.6	84.0	-	-	-
Potassium	-	-	94.6	-	-
Sodium	-	-	99.3	-	-
Zinc	118	86.0	-	-	-

Quality Results

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	0608003Q022 QCBlank METHOD BLANK 4/08/06 4/08/06	0608003Q023 Spike Recovery SPK 4/08/06 4/08/06	0608003Q024 QCBlank METHOD BLANK 4/08/06 4/08/06	0608003Q025 QCBlank METHOD BLANK 4/08/06 4/08/06	0608003Q026 Duplicate 0608003/003 4/08/06 4/08/06
BTEX/MAH (PURGE & TRAP)					
Method: 513P&T Units: mg/L					
Benzene	<0.0005	-	-	<0.0005	-
Ethylbenzene	<0.001	-	-	<0.001	-
meta & para-Xylenes	<0.002	-	-	<0.002	-
ortho-Xylene	<0.001	-	-	<0.001	-
Toluene	<0.001	-	-	<0.001	-
Xylenes	<0.003	-	-	<0.003	-
HYDROCARBONS (C6-C9) in SOLUTION					
Method: 513P&T Units: mg/L					
TPH C6 - C9	-	-	<0.02	-	-
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
TPH C6 - C9	-	-	-	-	<1.0
Benzene	-	-	-	-	<1.0
Ethylbenzene	-	-	-	-	<1.0
meta & para-Xylenes	-	-	-	-	<1.0
ortho-Xylene	-	-	-	-	<1.0
Toluene	-	-	-	-	<1.0
Xylenes	-	-	-	-	<1.0
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
meta & para-Xylenes	-	96.0	-	-	-
ortho-Xylene	-	92.0	-	-	-
TPH C6 - C9	-	109	-	-	-
Benzene	-	106	-	-	-
Ethylbenzene	-	88.0	-	-	-
Toluene	-	100	-	-	-
Xylenes	-	95.3	-	-	-

Quality Results

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	0608003Q027 Spike Recovery lab control	0608003Q028 Spike Recovery SPK	0608003Q029 Spike Recovery 0608003/001	0608003Q030 Duplicate 0608003/003	0608003Q033 QCBlank METHOD BLANK
	4/08/06	4/08/06	4/08/06	4/08/06	4/08/06
	4/08/06	4/08/06	4/08/06		7/08/06
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
TPH C6 - C9	-	-	-	<1.0	-
Benzene	-	-	-	<1.0	-
Ethylbenzene	-	-	-	<1.0	-
meta & para-Xylenes	-	-	-	<1.0	-
ortho-Xylene	-	-	-	<1.0	-
Toluene	-	-	-	<1.0	-
Xylenes	-	-	-	<1.0	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
meta & para-Xylenes	95.0	96.0	108	-	-
ortho-Xylene	90.0	92.0	95.4	-	-
TPH C6 - C9	92.9	109	70.9	-	-
Benzene	100	106	-	-	-
Ethylbenzene	100	88.0	91.5	-	-
Toluene	90.0	100	110	-	-
Xylenes	93.3	95.3	104	-	-
VOLATILES HALOGENATED (P&T)					
Method: 504P&T Units: mg/L					
1,1,1,2-Tetrachloroethane	-	-	-	-	<0.005
1,1,1-Trichloroethane	-	-	-	-	<0.005
1,1,2,2-Tetrachloroethane	-	-	-	-	<0.005
1,1,2-Trichloroethane	-	-	-	-	<0.005
1,1-Dichloroethane	-	-	-	-	<0.005
1,1-Dichloroethene	-	-	-	-	<0.005
1,2(cis)-dichloroethene	-	-	-	-	<0.005
1,2(trans)-dichloroethene	-	-	-	-	<0.005
1,2-Dichloroethane	-	-	-	-	<0.005
1,2-Dichloropropane	-	-	-	-	<0.005
1,3(trans)-dichloropropene	-	-	-	-	<0.005
2 - Chlorotoluene	-	-	-	-	<0.005
4 - Chlorotoluene	-	-	-	-	<0.005
Bromochloromethane	-	-	-	-	<0.005
Bromodichloromethane	-	-	-	-	<0.005
Bromoform	-	-	-	-	<0.005
Carbon Tetrachloride	-	-	-	-	<0.005
Chlorobenzene	-	-	-	-	<0.005
Chloroethane	-	-	-	-	<0.005
Chloroform	-	-	-	-	<0.01
Dibromochloromethane	-	-	-	-	<0.005

Quality Results

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	0608003Q027 Spike Recovery lab control 4/08/06 4/08/06	0608003Q028 Spike Recovery SPK 4/08/06 4/08/06	0608003Q029 Spike Recovery 0608003/001 4/08/06 4/08/06	0608003Q030 Duplicate 0608003/003 4/08/06 4/08/06	0608003Q033 QCBlank METHOD BLANK 4/08/06 7/08/06
Dibromomethane	-	-	-	-	<0.005
Dichloromethane	-	-	-	-	<0.005
Tetrachloroethene	-	-	-	-	<0.005
Trichloroethene	-	-	-	-	<0.005
Trichlorofluoromethane	-	-	-	-	<0.005
Vinyl Chloride	-	-	-	-	<0.005

Quality Results

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	0608003Q034 QCBlank METHOD BLANK 4/08/06 7/08/06	0608003Q035 Spike Recovery SPIKE 4/08/06 7/08/06	0608003Q036 Spike Recovery LAB CONTROL 4/08/06 7/08/06	0608003Q037 Duplicate 0608003/002 4/08/06 7/08/06	0608003Q038 Spike Recovery 0608003/010 4/08/06 7/08/06
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Acetone	-	-	-	<1.0	-
Methyl isobutyl ketone # (MIBK)	-	-	-	<1.0	-
Methylethyl ketone (MEK) #	-	-	-	<1.0	-
Vinyl Chloride #	-	-	-	<1.0	-
1,1,1-Trichloroethane	-	-	-	<1.0	-
1,1,2,2-Tetrachloroethane	-	-	-	<1.0	-
1,1,2-Trichloroethane	-	-	-	<1.0	-
1,1-Dichloroethane	-	-	-	<1.0	-
1,1-Dichloroethene	-	-	-	<1.0	-
1,2(cis)-dichloroethene	-	-	-	<1.0	-
1,2(trans)-dichloroethene	-	-	-	<1.0	-
1,2-Dichloroethane	-	-	-	<1.0	-
1,2-Dichloropropane	-	-	-	<1.0	-
1,3(cis)-dichloropropene	-	-	-	<1.0	-
4-Chlorotoluene	-	-	-	<1.0	-
Bromochloromethane	-	-	-	<1.0	-
Bromodichloromethane	-	-	-	<1.0	-
Bromoform	-	-	-	<1.0	-
Carbon Tetrachloride	-	-	-	<1.0	-
Chlorobenzene	-	-	-	<1.0	-
Chloroform	-	-	-	<1.0	-
Dibromochloromethane	-	-	-	<1.0	-
Dibromomethane	-	-	-	<1.0	-
Dichloromethane	-	-	-	<1.0	-
n-Propylbenzene	-	-	-	<1.0	-
Tetrachloroethene	-	-	-	<1.0	-
trans-1,3-dichloropropene	-	-	-	<1.0	-
Trichloroethene	-	-	-	<1.0	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Acetone	-	118	-	-	-
Methyl ethyl Ketone (MEK)	-	113	-	-	-
Methyl isobutyl ketone # (MIBK)	-	113	-	-	-
Vinyl Chloride	-	111	-	-	-
1,1,1-Trichloroethane	-	109	106	-	123
1,1,2,2-Tetrachloroethane	-	116	-	-	-
1,1,2-Trichloroethane	-	103	104	-	114

Quality Results

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	0608003Q034 QCBlank METHOD BLANK 4/08/06 7/08/06	0608003Q035 Spike Recovery SPIKE 4/08/06 7/08/06	0608003Q036 Spike Recovery LAB CONTROL 4/08/06 7/08/06	0608003Q037 Duplicate 0608003/002 4/08/06 7/08/06	0608003Q038 Spike Recovery 0608003/010 4/08/06 7/08/06
1,1-Dichloroethane	-	104	97.0	-	128
1,1-Dichloroethene	-	107	112	-	128
1,2(cis)-dichloroethene	-	106	-	-	-
1,2(trans)-dichloroethene	-	107	108	-	120
1,2-Dichloroethane	-	105	106	-	127
1,2-Dichloropropane	-	107	105	-	-
1,3(cis)-dichloropropene	-	102	71.8	-	83.6
4-Chlorotoluene	-	107	-	-	-
Bromochloromethane	-	107	-	-	-
Bromodichloromethane	-	105	94.6	-	115
Bromoform	-	100	-	-	-
Carbon Tetrachloride	-	105	99.3	-	118
Chlorobenzene	-	100	-	-	-
Chloroform	-	106	106	-	-
Dibromochloromethane	-	103	89.2	-	106
Dibromomethane	-	108	-	-	-
Dichloromethane	-	109	97.9	-	109
n-Propylbenzene	-	100	-	-	-
Tetrachloroethene	-	101	77.1	-	98.9
trans-1,3-dichloropropene	-	99.0	-	-	78.4
Trichloroethene	-	107	107	-	109
VOLATILES HALOGENATED (P&T)					
Method: 504P&T Units: mg/L					
1,2-Dichlorobenzene	<0.005	-	-	-	-
1,3-Dichlorobenzene	<0.005	-	-	-	-
1,4-Dichlorobenzene	<0.005	-	-	-	-

Quality Results

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	0608003Q039 Spike Recovery SPIKE 4/08/06 7/08/06	0608003Q040 Spike Recovery LAB CONTROL 4/08/06 7/08/06	0608003Q041 Duplicate 0608003/002 4/08/06 7/08/06	0608003Q042 Spike Recovery 0608003/010 4/08/06 7/08/06	0608003Q043 QCBlank METHOD BLK 3/08/06 8/08/06
INDIVIDUAL PHENOLS & CRESOLS					
Method: 512-MS Units: mg/L					
2,3,4-Trichlorophenol	-	-	-	-	<0.01
2,3,5,6-Tetrachlorophenol	-	-	-	-	<0.01
2,3,5-Trichlorophenol	-	-	-	-	<0.01
2,3,6-Trichlorophenol	-	-	-	-	<0.01
2,3-Dichlorophenol	-	-	-	-	<0.02
2,4 Dichlorophenol	-	-	-	-	<0.02
2,4,6-Trichlorophenol	-	-	-	-	<0.01
2,4-dinitrophenol #	-	-	-	-	<0.05
2,5-Dichlorophenol	-	-	-	-	<0.02
2,6-Dichlorophenol	-	-	-	-	<0.01
2-Chlorophenol	-	-	-	-	<0.01
2-Methylphenol (o-Cresol)	-	-	-	-	<0.01
3 & 4-Chlorophenol	-	-	-	-	<0.01
3 & 4-Methylphenol (m & p-Cresol)	-	-	-	-	<0.01
3,4 Dichlorophenol	-	-	-	-	<0.02
3,5-Dichlorophenol	-	-	-	-	<0.02
4-Chloro-3-methylphenol	-	-	-	-	<0.01
Pentachlorophenol	-	-	-	-	<0.03
Phenol	-	-	-	-	<0.01
Total Cresols	-	-	-	-	<0.02
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
1,2,4-Trimethylbenzene	-	-	<1.0	-	-
n-Butylbenzene mg/L	-	-	<1.0	-	-
p-Isopropyltoluene	-	-	<1.0	-	-
1,2-Dichlorobenzene	-	-	<1.0	-	-
1,3-Dichlorobenzene	-	-	<1.0	-	-
1,4-Dichlorobenzene	-	-	<1.0	-	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
1,2,4-Trimethylbenzene	106	-	-	-	-
n-Butylbenzene	107	104	-	113	-
p-Isopropyltoluene	107	105	-	115	-
1,2-Dichlorobenzene	106	-	-	-	-
1,3-Dichlorobenzene	107	-	-	-	-
1,4-Dichlorobenzene	105	99.2	-	114	-

Quality Results

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	0608003Q044 Spike Recovery LAB CONTROL 3/08/06 8/08/06	0608003Q045 QCBlank method blk 3/08/06 8/08/06	0608003Q046 Spike Recovery lab control 3/08/06 8/08/06	0608003Q047 Duplicate 0608003/001 3/08/06 8/08/06	0608003Q048 QCBlank METHOD BLANK 7/08/06 8/08/06
HYDROCARBONS in SOLUTION					
Method: 501-FID Units: mg/L					
TPH C10 - C14	-	-	-	-	<0.04
TPH C15 - C28	-	-	-	-	<0.1
TPH C29 - C36	-	-	-	-	<0.1
POLYAROMATIC HYDROCARBONS					
Method: 512-MS Units: mg/L					
Acenaphthene	-	<0.001	-	-	-
Acenaphthylene	-	<0.001	-	-	-
Anthracene	-	<0.001	-	-	-
Benz(a)anthracene	-	<0.001	-	-	-
Benzo(a)pyrene	-	<0.001	-	-	-
Benzo(b)fluoranthene	-	<0.001	-	-	-
Benzo(g,h,i)perylene	-	<0.001	-	-	-
Benzo(k)fluoranthene	-	<0.001	-	-	-
Chrysene	-	<0.001	-	-	-
Dibenz(a,h)anthracene	-	<0.001	-	-	-
Fluoranthene	-	<0.001	-	-	-
Fluorene	-	<0.001	-	-	-
Indeno(1,2,3-c,d)pyrene	-	<0.001	-	-	-
Naphthalene	-	<0.001	-	-	-
Phenanthrene	-	<0.001	-	-	-
Pyrene	-	<0.001	-	-	-
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Acenaphthene	-	-	-	<1.0	-
Acenaphthylene	-	-	-	<1.0	-
Anthracene	-	-	-	<1.0	-
Benz(a)anthracene	-	-	-	<1.0	-
Benzo(a)pyrene	-	-	-	<1.0	-
Benzo(b)fluoranthene	-	-	-	<1.0	-
Benzo(g,h,i)perylene	-	-	-	<1.0	-
Benzo(k)fluoranthene	-	-	-	<1.0	-
Chrysene	-	-	-	<1.0	-
Dibenz(a,h)anthracene	-	-	-	<1.0	-
Fluoranthene	-	-	-	<1.0	-
Fluorene	-	-	-	<1.0	-
Indeno(1,2,3-c,d)pyrene	-	-	-	<1.0	-
Naphthalene	-	-	-	<1.0	-
Phenanthrene	-	-	-	<1.0	-
Pyrene	-	-	-	<1.0	-

Quality Results

Report No: 171381

	0608003Q044 Spike Recovery LAB CONTROL 3/08/06 8/08/06	0608003Q045 QCBlank method blk 3/08/06 8/08/06	0608003Q046 Spike Recovery lab control 3/08/06 8/08/06	0608003Q047 Duplicate 0608003/001 3/08/06 8/08/06	0608003Q048 QCBlank METHOD BLANK 7/08/06 8/08/06
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
2,3,4-Trichlorophenol	95.6	-	-	-	-
2,3,5,6-Tetrachlorophenol	128	-	-	-	-
2,3,5-Trichlorophenol	108	-	-	-	-
2,3,6-Trichlorophenol	114	-	-	-	-
2,3-Dichlorophenol	84.4	-	-	-	-
2,4 Dichlorophenol	74.4	-	-	-	-
2,4,6-Trichlorophenol	63.1	-	-	-	-
2,4-dinitrophenol #	41.2	-	-	-	-
2,5-Dichlorophenol	91.9	-	-	-	-
2,6-Dichlorophenol	90.6	-	-	-	-
2-Chlorophenol	80.0	-	-	-	-
3 & 4-Chlorophenol	42.2	-	-	-	-
3,4 Dichlorophenol	68.1	-	-	-	-
3,5-Dichlorophenol	66.2	-	-	-	-
4-Chloro-3-methylphenol	74.4	-	-	-	-
Pentachlorophenol	113	-	-	-	-
Phenol	16.2	-	-	-	-
Total Cresol	40.0	-	-	-	-
Acenaphthene	-	-	81.2	-	-
Anthracene	-	-	102	-	-
Benz(a)anthracene	-	-	104	-	-
Benzo(a)pyrene	-	-	110	-	-
Benzo(b)fluoranthene	-	-	126	-	-
Benzo(g,h,i)perylene	-	-	109	-	-
Benzo(k)fluoranthene	-	-	87.5	-	-
Chrysene	-	-	91.2	-	-
Dibenz(a,h)anthracene	-	-	111	-	-
Fluoranthene	-	-	93.8	-	-
Fluorene	-	-	86.2	-	-
Indeno(1,2,3-c,d)pyrene	-	-	110	-	-
Naphthalene	-	-	111	-	-
Phenanthrene	-	-	96.2	-	-
Pyrene	-	-	86.2	-	-

Quality Results

Report No: 171381

	0608003Q049 Spike Recovery LAB CONTROL 7/08/06 8/08/06	0608003Q050 Duplicate 0608003/001 7/08/06 8/08/06	0608003Q051 Spike Recovery 0608003/003 7/08/06 8/08/06	0608003Q056 QCBlank method blk 4/08/00 8/08/06	0608003Q057 Spike Recovery lab control 4/08/00 8/08/06
POLYAROMATIC HYDROCARBONS					
Method: 512-MS Units: mg/L					
Acenaphthene	-	-	-	<0.001	-
Acenaphthylene	-	-	-	<0.001	-
Anthracene	-	-	-	<0.001	-
Benz(a)anthracene	-	-	-	<0.001	-
Benzo(a)pyrene	-	-	-	<0.001	-
Benzo(b)fluoranthene	-	-	-	<0.001	-
Benzo(g,h,i)perylene	-	-	-	<0.001	-
Benzo(k)fluoranthene	-	-	-	<0.001	-
Chrysene	-	-	-	<0.001	-
Dibenz(a,h)anthracene	-	-	-	<0.001	-
Fluoranthene	-	-	-	<0.001	-
Fluorene	-	-	-	<0.001	-
Indeno(1,2,3-c,d)pyrene	-	-	-	<0.001	-
Naphthalene	-	-	-	<0.001	-
Phenanthrene	-	-	-	<0.001	-
Pyrene	-	-	-	<0.001	-
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
TPH C10 - C14	-	15.4	-	-	-
TPH C15 - C28	-	<1.0	-	-	-
TPH C29 - C36	-	<1.0	-	-	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
TPH C10 - C14	108	-	88.0	-	-
TPH C15 - C28	112	-	92.0	-	-
TPH C29 - C36	128	-	92.0	-	-
Acenaphthene	-	-	-	-	106
Acenaphthylene	-	-	-	-	108
Anthracene	-	-	-	-	111
Benz(a)anthracene	-	-	-	-	105
Benzo(a)pyrene	-	-	-	-	100
Benzo(b)fluoranthene	-	-	-	-	102
Benzo(g,h,i)perylene	-	-	-	-	102
Benzo(k)fluoranthene	-	-	-	-	100
Chrysene	-	-	-	-	105
Dibenz(a,h)anthracene	-	-	-	-	105
Fluoranthene	-	-	-	-	102
Fluorene	-	-	-	-	104
Indeno(1,2,3-c,d)pyrene	-	-	-	-	104

Quality Results

Report No: 171381

	0608003Q049 Spike Recovery LAB CONTROL 7/08/06 8/08/06	0608003Q050 Duplicate 0608003/001 7/08/06 8/08/06	0608003Q051 Spike Recovery 0608003/003 7/08/06 8/08/06	0608003Q056 QCBlank method blk 4/08/00 8/08/06	0608003Q057 Spike Recovery lab control 4/08/00 8/08/06
Naphthalene	-	-	-	-	105
Phenanthrene	-	-	-	-	105
Pyrene	-	-	-	-	102

Quality Results

Report No: 171381

0608003Q058
Spike
Recovery
0608003/002

4/08/00
8/08/06

QC RESULTS - SPIKED SAMPLES

Percent Recovery, %

Acenaphthene	101
Acenaphthylene	116
Anthracene	114
Benz(a)anthracene	96.2
Benzo(a)pyrene	101
Benzo(b)fluoranthene	90.0
Benzo(g,h,i)perylene	87.5
Benzo(k)fluoranthene	98.8
Chrysene	92.5
Dibenz(a,h)anthracene	86.2
Fluoranthene	93.8
Fluorene	97.5
Indeno(1,2,3-c,d)pyrene	86.2
Naphthalene	97.5
Phenanthrene	101
Pyrene	100

Quality Results provided in this report are for laboratory Quality Control purposes.

Results

Report No: 171381

Sample Comments:

0608003/001	Surrogate recovery for some volatile analysis (volatiles, C6-C9, BTEX, MAH etc) fell outside the laboratory guideline limits. Repeat analysis confirmed the surrogate recovery failed due to poor sample matrix. Acceptance limits were acheived for all other QC in relation to this batch (Lab Control, Sample Spike and Duplicates). Some individual compounds for multi-analyte semivolatile analysis have failed. However the QC sample is considered acceptable if 80% of the analytes within these groups (PAH, OC,OP etc) satisfy our QC protocol.
0608003/002	Surrogate recovery for some volatile analysis (volatiles, C6-C9, BTEX, MAH etc) fell outside the laboratory guideline limits. Repeat analysis confirmed the surrogate recovery failed due to poor sample matrix. Acceptance limits were acheived for all other QC in relation to this batch (Lab Control, Sample Spike and Duplicates).
0608003/005	Limit of reporting (LOR) for some volatile testing (volatiles, C6-C9, BTEX, MAH etc) was increased due to matrix interference. This matrix inerference is either from high levels of non specific material (sediment, non target organics, metals etc) or because of the high levels of other target compounds in the same analysis. As a result a dilution was required to analyse some compounds or to remove the matrix interference.
0608003/008	Limit of reporting (LOR) for some volatile testing (volatiles, C6-C9, BTEX, MAH etc) was increased due to matrix interference. This matrix inerference is either from high levels of non specific material (sediment, non target organics, metals etc) or because of the high levels of other target compounds in the same analysis. As a result a dilution was required to analyse some compounds or to remove the matrix interference.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

52693

IT Environmental (Australia) Pty Ltd
ABN 89 003 931 057
www.itenviro.com.au
A Subsidiary of Coffey International Limited

Coffey

- ☑ **Adelaide:** Tel (08) 8443 5600 Fax (08) 8443 6499 — 27 Queen Street, Thebarton SA 5031
- ☐ **Brisbane:** Tel (07) 3899 8359 Fax (07) 3899 9692 — Unit 7, 20 Smallwood Place, Murarrie QLD 4172
- ☐ **Hobart:** Tel (03) 6208 6860 Fax (03) 6208 6869 — Suite 2, 31-33 Tower Road, New Town TAS 7008
- ☐ **Melbourne:** Tel (03) 9473 1400 Fax (03) 9473 1450 — 126 Trenerry Crescent, Abbotsford VIC 3067
- ☐ **Perth:** Tel (08) 9347 0300 Fax (08) 9347 0399 — 24 Hasler Road, Herdsma
- ☐ **Sydney:** Tel: (02) 9502 4 — 17 Forrester Street, Kings
- ☐ **Other:**

ITENSA Rec:03/08/06
MW2
0608003/001

Project No:	J5050760A
Project Name:	Bradken Kilburn GME
Samplers Name:	Monique Jensen
Special Instructions:	Please fax back COC's upon receipt Please provide electronic tables
Task No:	
Laboratory:	Amdel
Project Manager:	Colin Campbell

Analysis Request Section

Lab. No.	Sample ID	Sample Location	Sample Depth	Sample Date	Time	Matrix (Soil ... etc)	Container Type & Preservative*	T-A-T (Specify)	TPH	BTEX	METALS (Specify) 8 inc Hg	PAHs	PHENOLS	OC's / OP's	Cations / Anions	VOC's	NOTES
	MW2	Kilburn	–	1/8/06	PM	Water	3G, 2V, 2P + Ice	48hr									
	MW3			2/8/06	PM		3G, 3V, 2P + Ice										
	MW6			↓	PM		2G, 2V, 2P + Ice										
	MW8			1/8/06	PM		3G, 2V, 2P + Ice										
	MW9A			2/8/06	AM		4G, 3V, 2P + Ice										
	MW10			↓	PM		2G, 2V, 2P + Ice										
	MW11			1/8/06	PM		3G, 2V, 2P + Ice										
	MW12			↓			3G, 2V, 2P + Ice										
	QC1			2/8/06			4G, 3V, 2P + Ice										
	QC2			↓			↓										
	QC3			↓	↓		1V + Ice										

0884436499

RELINQUISHED BY:		RECEIVED BY:	
Signature: Jensen	Date: 2/8/06	Signature:	Date: 3/8/06
Company: Coffey Environments	Time: 4 pm	Company: AMDEL	Time: 9:00am
Signature:	Date:	Signature:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: *(Lab Use Only)*

- All Samples Received in Good Condition . . . ☑
- All Documentation is in Proper Order . . . . . ☑
- Samples Received Properly Chilled . . . . . ☑

Lab. Ref/Batch No. 0608003

* **Container Type & Preservation Codes:** P - Plastic, G - Solvent Washed Acid Rinsed Glass Bottle, V - Vial, N - Nitric Acid Preserved
C - Hydrochloric Acid Preserved, S - Sulphuric Acid Preserved, I - Ice

Appendix C
Field Data Summary Sheets

Groundwater Monitoring Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

coffey environments

WELL MONITORING (GAUGING) FORM

Project No:	JS05076A
Date:	11/8/06
Page	1 of 1

Project Name: Bradken

Field Personnel (Initials): MJ

Project Manager (Initials): CC

Equipment: Herron IP.

Time	Well ID	Well Diameter (mm)	Depth to PSH (Product) (mBTOC) (A)	Depth to Groundwater (mBTOC) (B)	Total Well Depth (mBTOC)	PSH (Product) Thickness (mm) (B - A)	Height of Well Stickup (mm)	Comments (e.g Odour*, colour, sheen, product (and its colour), remediation system etc…)
10:15	MW10			4.459	5.340			
10:25	MW6			3.330	5.105			
10:30	MW3			3.268	4.470			
10:35	MW2			3.235	5.093			
	~~MW1~~							
11:12.	MW12			3.055	4.205			Bailer in Well.
11:15.	MW11			2.885	3.665			4
11:20	MW8			3.301	4.990			
11:30	MW9A			4.120	4.850			H/C Odour on IP T/P.
	MW1							Not found
	MW5							Suspect buried
	MW4							covered with foundry materials

** Do not attempt to sniff the monitoring well to detect any odours, only note any apparent odour when the well cap is opened*

coffey environments

GROUNDWATER SAMPLING FORM (A)

PAGE ____ OF ____

PROJECT NAME: _____ PROJECT NUMBER: JS05076A

FIELD PERSONNEL: _____ DATE: _____

PROJECT MANAGER: _____

WELL ID: MW2 METER ID: _____ TOTAL WELL DEPTH: _____ SCREEN INTERVAL: _____

EQUIPMENT USED: BAILER ☐ WATERRA ☐ Other: _____ WELL DIAMETER: _____ WELL STICK-UP: _____

WELL GAUGING AND PURGE VOLUME CALCULATIONS

TOTAL WELL DEPTH (-) WATER LEVEL (=) WATER COLUMN

5.093 m (-) 3.235 (=) 1.8. m

Using the water column calculation on the left, refer to the Well Volume Calculation Form for the correct volume to be removed from the well and enter it on the right

LITRES PER 1 WELL VOLUME

10. L

TIME OF DAY	CYCLE/ PUMP RATE (ml/min)	VOLUME (L)	DEPTH TO WATER (m)	DISSOLVED OXYGEN (mg/l)		ELECTRICAL CONDUCTIVITY (mS or µS/cm)		pH (pH units)		REDOX POTENTIAL (mV)		TEMPERATURE (°C)		COMMENTS (ODOUR/ COLOUR/ SEDIMENTS/ PSH COLLECTED?)
				READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	
0	NA	10		1.2		552		7.41		412		16.40		
		20		3.3		540		7.39		425		16.60		
		28		2.3		531		7.39		430		16.57		
STABILISATION CRITERIA (3 Readings within following Ranges)			± 0.05	± 10%		± 10 mv		± 10%		± 10%		± 0.1°C		

DUPLICATE COLLECTED: Y ☐ N ☐ DUPLICATE ID: _____ TRIPLICATE COLLECTED: Y ☐ N ☐ TRIPLICATE ID: _____

WERE METALS FIELD FILTERED? Y ☐ N ☐ (UNFILTERED SAMPLES MUST NOT BE PUT INTO A PRESERVED CONTAINER (IE. 'METALS' BOTTLE))

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GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: _____ PROJECT NUMBER: JS050760A

FIELD PERSONNEL: _____ DATE: 1/8/06

PROJECT MANAGER: _____

WELL ID: MW3 METER ID: _____ TOTAL WELL DEPTH: _____ SCREEN INTERVAL: _____

EQUIPMENT USED: BAILER ☐ WATERRA ☐ Other: _____ WELL DIAMETER: _____ WELL STICK-UP: _____

WELL GAUGING AND PURGE VOLUME CALCULATIONS

TOTAL WELL DEPTH (-) WATER LEVEL (=) WATER COLUMN

4.470 m (-) 3.268 (=) 1.2 m

Using the water column calculation on the left, refer to the Well Volume Calculation Form for the correct volume to be removed from the well and enter it on the right

LITRES PER 1 WELL VOLUME: 7. L

TIME OF DAY	CYCLE/ PUMP RATE (ml/min)	VOLUME (L)	DEPTH TO WATER (m)	DISSOLVED OXYGEN (mg/l)		ELECTRICAL CONDUCTIVITY (mS or µS/cm)		pH (pH units)		REDOX POTENTIAL (mV)		TEMPERATURE (°C)		COMMENTS (ODOUR/ COLOUR/ SEDIMENTS/ PSH COLLECTED?)
				READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	
0	NA	14		1.3		587		8.26		452		17.32		When 1 WV was
		21		[illegible]	[illegible]	635		8.33		445		17.24		purged WQP
				1.5										did not function
STABILISATION CRITERIA (3 Readings within following Ranges)			± 0.05	± 10%		± 10 mv		± 10%		± 10%		± 0.1°C		

DUPLICATE COLLECTED: Y ☐ N ☐ DUPLICATE ID: _____ TRIPLICATE COLLECTED: Y ☐ N ☐ TRIPLICATE ID: _____

WERE METALS FIELD FILTERED? Y ☐ N ☐ (UNFILTERED SAMPLES MUST NOT BE PUT INTO A PRESERVED CONTAINER (IE. 'METALS' BOTTLE))

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GROUNDWATER SAMPLING FORM (A)

PAGE ____ OF ____

PROJECT NAME: _____ PROJECT NUMBER: J5050 76A

FIELD PERSONNEL: MJ. DATE: _____

PROJECT MANAGER: _____

WELL ID: MW8. METER ID: _____ TOTAL WELL DEPTH: _____ SCREEN INTERVAL: _____

EQUIPMENT USED: BAILER ☐ WATERRA ☐ Other: _____ WELL DIAMETER: _____ WELL STICK-UP: _____

WELL GAUGING AND PURGE VOLUME CALCULATIONS

TOTAL WELL DEPTH (-) WATER LEVEL (=) WATER COLUMN

4.99 m (-) 3.301 (=) 1.6 m

Using the water column calculation on the left, refer to the Well Volume Calculation Form for the correct volume to be removed from the well and enter it on the right

LITRES PER 1 WELL VOLUME: 9. L

TIME OF DAY	CYCLE/ PUMP RATE (ml/min)	VOLUME (L)	DEPTH TO WATER (m)	DISSOLVED OXYGEN (mg/l)		ELECTRICAL CONDUCTIVITY (mS or µS/cm)		pH (pH units)		REDOX POTENTIAL (mV)		TEMPERATURE (°C)		COMMENTS (ODOUR/ COLOUR/ SEDIMENTS/ PSH COLLECTED?)
				READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	
0	NA	9.		1-8		4096		7.89		464.		17.31		
		18		1.6		4403		7.40		474		17.33		
		27		2.0		4325		7.38		470		17.50		
STABILISATION CRITERIA (3 Readings within following Ranges)			± 0.05	± 10%		± 10 mv		± 10%		± 10%		± 0.1°C		

DUPLICATE COLLECTED: Y ☐ N ☐ DUPLICATE ID: _____ TRIPLICATE COLLECTED: Y ☐ N ☐ TRIPLICATE ID: _____

WERE METALS FIELD FILTERED? Y ☐ N ☐ (UNFILTERED SAMPLES MUST NOT BE PUT INTO A PRESERVED CONTAINER (IE. 'METALS' BOTTLE))

TABLE X
GROUNDWATER GAUGING AND FIELD QUALITY PARAMETER RESULTS

PROJECT NO: J50 5076rr

SURVEY MARK: _____

DATE: 2/8/06

ARR: _____ am/pm

DEP: _____ am/pm

OPERATOR: _____

EQUIP: DO/Conductivity/ Temperature/pH/ Redox Meters/IP

Well ID	Date	Time	TD (m)	TOC Elevation (mAHD)	Depth to SWL (m)	Depth to PSH (m)	PSH Thick. (m)	Event *	Temp (°C)	Turbidity (NTU)	DO (mg/L)	DO_{sat} (%)	Eh (mv)	pH	Salinity (ppt)	EC (µS/cm)	TDS ** (mg/L)	Purge Vol. (L)	Comments
MW9A SL			4.85		4.120			Pre	19.00		1.5		466	7.92		5246		5	DNAPL ??
								Post	19.00		1.8		456	7.99		5074		10	
								Pre	18.97		1.9		449	8.02		~~5060~~		15	Sampled AM.
								Post								5058			
~~MW8~~								Pre											
								Post											
MW6		12:00	5.105		3.330			Pre	18.41		~~1.5~~	1.4	455	8.24		2296		10L	10L.
								Post	18.40		1.2		458	8.23		2374		20L	
								Pre	18.32		1.4		456	8.25		2418		30L	Sampled PM.
								Post	~~18.27~~				~~455~~	~~7.75~~					
MW10 (6L)		12:45	5.340		4.459			Pre	18.27		1.4		455	7.75		2185		6L	
								Post	18.41		1.4		466	7.76		2138		12	
								Pre	18.24		1.5		490	7.78		2197		18L	Sampled PM.
								Post											
								Pre											
								Post											
								Pre											
								Post											

Notes:

TD = Total depth of well
TOC = Top of casing
SWL = Static water level
SG = specific gravity of PSH
DO = dissolved oxygen

DO_{sat} = Percent diss * Please circle correct event
EC = Electrical conductivity
Eh = Oxidation/reduction potential (ORP)
TDS = total dissolved solids
** TDS (mg/L) determined from laboratory analysis and/or field estimates

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GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: _____ PROJECT NUMBER: J5050764

FIELD PERSONNEL: _____ DATE: 1/8/06

PROJECT MANAGER: _____

WELL ID: MW11 METER ID: _____ TOTAL WELL DEPTH: _____ SCREEN INTERVAL: _____

EQUIPMENT USED: BAILER ☐ WATERRA ☐ Other: _____ WELL DIAMETER: _____ WELL STICK-UP: _____

WELL GAUGING AND PURGE VOLUME CALCULATIONS

TOTAL WELL DEPTH (-) WATER LEVEL (=) WATER COLUMN

3.665 m (-) 2.885 (=) 0.8 m

Using the water column calculation on the left, refer to the Well Volume Calculation Form for the correct volume to be removed from the well and enter it on the right

LITRES PER 1 WELL VOLUME: 5 L

TIME OF DAY	CYCLE/ PUMP RATE (ml/min)	VOLUME (L)	DEPTH TO WATER (m)	DISSOLVED OXYGEN (mg/l)		ELECTRICAL CONDUCTIVITY (mS or µS/cm)		pH (pH units)		REDOX POTENTIAL (mV)		TEMPERATURE (°C)		COMMENTS (ODOUR/ COLOUR/ SEDIMENTS/ PSH COLLECTED?)
				READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	
0	NA	5		1.5		3828		7.35		440		18.44		
		10		1.1		3858		7.36		458		18.72		
		15		1.5		3896		7.37		454		18.53		
STABILISATION CRITERIA (3 Readings within following Ranges)			± 0.05	± 10%		± 10 mv		± 10%		± 10%		± 0.1°C		

DUPLICATE COLLECTED: Y ☐ N ☐ DUPLICATE ID: _____ TRIPLICATE COLLECTED: Y ☐ N ☐ TRIPLICATE ID: _____

WERE METALS FIELD FILTERED? Y ☐ N ☐ (UNFILTERED SAMPLES MUST NOT BE PUT INTO A PRESERVED CONTAINER (IE. 'METALS' BOTTLE))

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GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: Bradken
PROJECT NUMBER: JS05076A
FIELD PERSONNEL: MJ
DATE: 1/8/06
PROJECT MANAGER: CC
Sampled PM.

WELL ID: MW12 METER ID: TOTAL WELL DEPTH: 4.205 SCREEN INTERVAL:
EQUIPMENT USED: BAILER ☐ WATERRA ☐ Other: WELL DIAMETER: WELL STICK-UP:

WELL GAUGING AND PURGE VOLUME CALCULATIONS

TOTAL WELL DEPTH (-) WATER LEVEL (=) WATER COLUMN

4.205 m (-) 3.055 (=) 1.15 m

Using the water column calculation on the left, refer to the Well Volume Calculation Form for the correct volume to be removed from the well and enter it on the right

LITRES PER 1 WELL VOLUME: 7. L

TIME OF DAY	CYCLE/ PUMP RATE (ml/min)	VOLUME (L)	DEPTH TO WATER (m)	DISSOLVED OXYGEN (mg/l)		ELECTRICAL CONDUCTIVITY (mS or µS/cm)		pH (pH units)		REDOX POTENTIAL (mV)		TEMPERATURE (°C)		COMMENTS (ODOUR/ COLOUR/ SEDIMENTS/ PSH COLLECTED?)
				READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	
0	NA	7		1.4		1905		7.38		490		17.04		H/C Odour Slight
		14		1.5		2117		7.38		440		17.38		
		21		1.7		2158		7.39		380		17.01		
STABILISATION CRITERIA (3 Readings within following Ranges)			± 0.05	± 10%		± 10 mv		± 10%		± 10%		± 0.1°C		

DUPLICATE COLLECTED: Y ☐ N ☑ DUPLICATE ID: TRIPLICATE COLLECTED: Y ☐ N ☐ TRIPLICATE ID:

WERE METALS FIELD FILTERED? Y ☐ N ☑ (UNFILTERED SAMPLES MUST NOT BE PUT INTO A PRESERVED CONTAINER (IE. 'METALS' BOTTLE))

Appendix V

Water Balance

Water Balance

Assumptions of Model

- Details of cooling circuit recirculation water volume, circuit cleanout and operating parameters have been supplied by Bradken to assist in reconciling the water balance calculation.
- The existing foundry facility has 180 full time equivalent employees (FTEs). The upgraded foundry will have 280 FTEs.
- A FTE consumes an average of 68 L potable water per 8 hour work day. This water is used for toilet flushing, hand-washing, showering and drinking.
- The foundry operates for sixteen hours per day for 243 days per year.
- The foundry has twenty pairs of faucets. Of these, 4 are assumed to be leaking that each waste 2 kL per month of potable water.
- Drift losses from cooling towers are assumed to be 0.1% of the cooling tower recirculation flow.
- Cooling tower recirculation flows have been estimated on supplied outlet bore diameters of recirculation pumps, estimated static head, circuit losses equivalent to 50% of the estimated static head and pump curves for the Elite series of pump obtained from www.ksbajax.com.au.
- The existing foundry has a production capacity of 12 500 dressed tonnes of metal product. The proposed upgraded foundry will have a production capacity of 32 000 dressed tonnes of metal product.
- Based on actual metered potable water consumption, the average potable water usage for the existing foundry facility is 6 600 kL per calendar year.
- For the proposed upgraded foundry, cooling tower evaporative losses, blowdown rates and drift losses are directly proportional to the estimated existing cooling tower water recirculation rates.

1. RESULTS

Table 1: Existing Facility Water Balance

	Potable water average metered consumption[1] (kL/year)	Potable Water Consumption Identifier (kL/year)	Estimated consumption (kL/year)	Discharge point
	6 600	Employee usage	3 000	sewer
		Cooling tower circuit cleanout replenishment	200	sewer
		Cooling tower blowdown	600	sewer
		Cooling tower evaporative and drift losses	2 700	atmosphere
		Losses through faucet leaks	100	sewer
Total	6 600		6 600	

Note:
[1]- Based on three years of potable water consumption.

Table 2: Upgraded Facility Water Balance

Potable Water Consumption Identifier (kL/year)	Estimated consumption (kL/year)	Discharge point
Employee usage	4 700	sewer
Cooling tower circuit cleanout replenishment	200	sewer
Cooling tower blowdown	1 400	sewer
Cooling tower evaporative and drift losses	6 800	atmosphere
Losses through faucet leaks	100	sewer
Total	13 200	

Table 3: Water usage comparison

Identifier	kL/tonne
Existing operation (12 500 tonne/year)	0.53
Upgraded operation (32 000 tonne/year)	0.41

Appendix W

Materials Balance

Materials Balance

Table 1: Current Annual Materials Balance (Nominal 12,500 tpa production)

INPUTS		OUTPUTS		
FURNACE - METAL MELTING (ARC FURNACE)				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Scrap steel (tonnes)	11,100	Molten steel poured into moulds (tonnes)	17,850	
Alloys (tonnes) & additives	2,640			
Steel returns (tonnes), internal recycle from knockout	4,700	**INTERNALLY RECYCLED MATERIALS**		
Steel returns (tonnes), internal recycle from metal pigs	1,200	Metal pigs returned to melting	1200	Estimate - this is the molten metal that is left in the ladle after all the moulds are poured
Graphite	60			
Iron ore	30	**SOLID WASTES**		
Oxygen (used to remove carbon from the molten metal)	50	Furnace baghouse dust collected (tonnes)	69	
Limestone (assisting in removing impurities from the molten metal)	530			
Fluorospar (calcium fluoride CaF2)(assisting in removing impurities from the molten metal)	45	Slag collected (tonnes)	987	Note: the limestone will initially decompose to form CO2 & CaO [caCO3 => CO2 = CaO]
		GASEOUS EMISSIONS		
		carbon dioxide	233	Combustion of graphite, organic contaminants in scrap & heating of the limestone
		carbon monoxide	9	Combustion of the graphite
		Traces of VOCs, nitric oxides	2	From the scrap contaminants
		Traces of fugitive particulates	4	NPI factor
TOTAL	**20,355**		**20, 353**	

INPUTS		OUTPUTS		
MOULDING - WITH SAND MIXER ON THE JOBBINIG FLOOR OR LOOP				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Total mould sand (sand metal ratio 4.5:1)	80,325	Moulding boxes ready to be filled with the molten metal	81,302	
New Sand to produce moulds (tonnes). The sand is primarily silica sand but some chromite san (728 T) is used to improve casting quality in particular areas.	20,081			
Reclaimed Sand (tonnes) internally recycled from sand plant. (Recycle to ratio 75%)	60,244	**INTERNALLY RECYCLED MATERIALS**		
Phenolic catalyst mixed with sand (tonnes) (5% resin)	48	Sand, chills and core irons	100	These are separated at the shakeout process for recylcing
PHenolic binder mixed with sand (tonnes) the binder is mixed at 1.2% by weight of resin to sand	964			
Mould paint (tonnes) - ceramic powder in an acrylic emulsion used to provide a better surface finish to the casting - prevent sand burn on. Some mould dpaint is water based & some is methylated spirit based	50	**SOLID WASTES**		
Mould paint solvent (methylated spirits)	35	Sand mixer calibration runs	50	A small amount of sand & resin mixed & checked to ensure quality
Ceramic sleeves - provides thermal insulation for molten metal entering the mould	10	**GASEOUS EMISSIONS**		
Exothermic rings - provides additional heat to keep metal molten in certain parts of the mould	5	Some resin odour is emitted inside the building		This is not detectable off site
		Ethanol - mould paint fumes	14	The solvent is either evaporated off or burnt after it is painted on to remove all traces of liquid that would otherwise be an explosion hazard
Chills - pieces of steel added to the mould to rapicly cool the molten metal in certain areas to improve quality	50	Ethanol combustion products CO2 & H2O	71	The methylated spirits either evaporates or burns - Bradken believe 60% of the methylated spirits is burnt off from the moulds
Core irons - shaped cextions of steel reinforcing rods used to reinforce the shaped sand moulds	50			
TOTAL	**81,537**		**81,537**	

INPUTS		OUTPUTS		
POURING & COOLING				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Molten steel from the furnace poured into moulds (tonnes)	17,850	Poured moulds	97,921	
Moulding boxes	81,302	Test bars	10	
Ferrux – this is an exothermic compound used to cover the exposed molten metal to keep it hot to allow it to fill any voids created due to shrinkage from cooling.	10	**INTERNALLY RECYCLED MATERIALS**		
		Remains in the ladle (pigs)	1200	The left over molten metal is solidified and returned to the furnace for reuse
		SOLID WASTES		
		None		
		GASEOUS EMISSIONS		
		Pouring & cooling emissions – there is an odour associated with these emissions	31	Range of organic and inorganic gases and fumes emitted by the burning sands at various levels including: CO, SO2, H2S, NH3, HCN, NO2, NO CS2, benzene, toluene, xylene, various phenols, various cresols, formaldehyde, naphthalene, various PAHs, various amines, various hydrocarbons & others.
TOTAL	**99,162**		**99,162**	

INPUTS		OUTPUTS		
SHAKE-OUT & KNOCK OFF **Separation of metal castings, removal of runners & risers and sand reclamation**				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Poured Moulds	97,921	Rough castings	12,604	
		Tramp steel recovered	546	Sent to metal recyclers as it is the wrong alloy mix or quality to be remelted in the furnace
		INTERNALLY RECYCLED MATERIALS		
		Runners & risers collected for remelting	4,700	The runners and risers are the metal that solidified in the tubes leading into and out of the mould cavity
		Used foundry sand to recycle plant	60,244	The sand is fed through a screening and crushing plant to reuse it back in the moulding area
		Chilils & core irons	100	These are removed from the shakeout screen for reuse
		SOLID WASTES		
		Used foundry sand to offsite reuse/landfill (tonnes)	19,088	This is excess of internal recylcinig amounts and must be removed to maintain sand quality
		Reclaim baghouse dust/particulates collected (tonnes)	630	The baghouse dust is the fines from the sand and is a mix of sand paricultes and solidified resin particles with traces of metal fines
		GASEOUS EMISSIONS		
		Particulates	6	Fugitive stack emissions
		Shakeout emissions & sand reclamation plant emissions	3	Range of organic and inorganic gases and fumes emitted by the burning sands at various levels including: CO,SO2, H2S, NH3, HCN, NO2, NO CX2, benzene, toluene, xylene, various phenols, various cresols, formaldehyde, naphthalene, various PAHs, varios amines, various hydrocarbons & others.
TOTAL	**97,921**		**97,921**	

INPUTS		OUTPUTS		
FINISHING AND MACHINING				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Rough castings (tonnes)	12,604	Dressed castings to despatch (tonnes)	12,500	
Shot for shotblast machine (tonnes)	12			
Welding rods and wire	4	**INTERNALLY RECYCLED MATERIALS**		
Abrasives		none		
Paint	0.5			
		SOLID WASTES		
		Shot blast baghouse dust/scale collected (tonnes)	40	
		Heat treatment scale collected	20	
		Fugitive particulates and fume (tonnes)	3	
		Machining swarf to recycle	54	
		GASEOUS EMISSIONS		
		Welding fumes - minor particulates	1	
		Arc air fumes - minor particuluates	2	
		Paint fumes - minor VOCs	1	
TOTAL	**12,621**		**12, 621**	

Table 2: Proposed Annual Materials Balance (Nominal 32,000 tpa production)

INPUTS		OUTPUTS		
FURNACE – METAL MELTING (ARC FURNACE)				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Scrap steel (tonnes)	27,800	Molten steel poured into moulds (tonnes)	44,000	
Alloys (tonnes) & additives	7,200			
Steel returns (tonnes), internal recycle from knockout	10,800	**INTERNALLY RECYCLED MATERIALS**		
Steel returns (tonnes), internal recycle from metal pigs	2,900	Metal pigs returned to melting	2,900	Estimate – this is the molten metal that is left in the ladle after all the moulds are poured
Graphite	0			
Iron ore	0	**SOLID WASTES**		
Oxygen (used to remove carbon from the molten metal)	0	Furnace baghouse dust collected (tonnes)	0	
L limestone (assisting in removing impurities from the molten metal)	0			
Fluorospar (calcium fluoride CaF2)(assisting in removing impurities from the molten metal)	0	Slag collected (tonnes)	1,946	Note: the limestone will initially decompose to form CO2 & CaO [caCO3 => CO2 = CaO]
		GASEOUS EMISSIONS		
		carbon dioxide	0	Combustion of graphite, organic contaminants in scrap & heating of the limestone
		carbon monoxide	22	Combustion of the graphite
		Traces of VOCs, nitric oxides	4	From the scrap contaminants
		Traces of fugitive particulates	9	NPI factor
TOTAL	**48,700**		**48,881**	

INPUTS		OUTPUTS		
MOULDING – WITH SAND MIXER ON THE JOBBING FLOOR OR LOOP				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Total mould sand (sand metal ratio 4:1)	176,000	Moulding boxes ready to be filled with the molten metal	178,200	
New Sand to produce moulds (tonnes). The sand is primarily silica sand but some chromite san (728 T) is used to improve casting quality in particular areas.	17,600			
Reclaimed Sand (tonnes) internally recycled from sand plant. (Recycle to ratio 90%)	158,400	**INTERNALLY RECYCLED MATERIALS**		
Phenolic catalyst (25% of resin) mixed with sand (tonnes)	440	Sand, chills and core irons	0	These are separated at the shakeout process for recycling
Phenolic binder mixed with sand (tonnes) the binder is mixed at 1.0% by weight of resin to sand	1,760			
Mould paint (tonnes) – ceramic powder in an acrylic emulsion used to provide a better surface finish to the casting – prevent sand burn on. Some mould dpaint is water based & some is methylated spirit based	0	**SOLID WASTES**		
Mould paint solvent (methylated spirits)	0	Sand mixer calibration runs	50	A small amount of sand & resin mixed & checked to ensure quality
Ceramic sleeves – provides thermal insulation for molten metal entering the mould	0	**GASEOUS EMISSIONS**		
Exothermic rings – provides additional heat to keep metal molten in certain parts of the mould	0	Some resin odour is emitted inside the building		This is not detectable off site
		Ethanol – mould paint fumes	75	The solvent is either evaporated off or burnt after it is painted on to remove all traces of liquid that would otherwise be an explosion hazard
Chills – pieces of steel added to the mould to rapicly cool the molten metal in certain areas to improve quality	0	Ethanol combustion products CO2 & H2O	0	The methylated spirits either evaporates or burns – Bradken believe 60% of the methylated spirits is burnt off from the moulds
Core irons – shaped sections of steel reinforcing rods used to reinforce the shaped sand moulds	0			
TOTAL	**178,200**		**178,325**	

INPUTS		OUTPUTS		
POURING & COOLING				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Molten steel from the furnace poured into moulds (tonnes)	44,000	Poured moulds	219, 243	
Moulding boxes	178,200	Test bars	26	
Ferrux – this is an exothermic compound used to cover the exposed molten metal to keep it hot to allow it to fill any voids created due to shrinkage from cooling.	0	**INTERNALLY RECYCLED MATERIALS**		
		Remains in the ladle (pigs)	2,900	The left over molten metal is solidified and returned to the furnace for reuse
		SOLID WASTES		
		None		
		GASEOUS EMISSIONS		
		Pouring & cooling emissions – there is an odour associated with these emissions	57	Range of organic and inorganic gases and fumes emitted by the burning sands at various levels including: CO, SO2, H2S, NH3, HCN, NO2, NO CS2, benzene, toluene, xylene, various phenols, various cresols, formaldehyde, naphthalene, various PAHs, various amines, various hydrocarbons & others.
TOTAL	**222,200**		**222,226**	

INPUTS		OUTPUTS		
SHAKE-OUT & KNOCK OFF **Separation of metal castings, removal of runners & risers and sand reclamation**				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Poured Moulds	219, 243	Rough castings	32,200	
		Tramp steel recovered	546	Sent to metal recyclers as it is the wrong alloy mix or quality to be remelted in the furnace
		INTERNALLY RECYCLED MATERIALS		
		Runners & risers collected for remelting	10,800	The runners and risers are the metal that solidified in the tubes leading into and out of the mould cavity
		Used foundry sand	158,400	The sand is fed through a screening and crushing plant to reuse it back in the moulding area
		Chills & core irons	0	These are removed from the shakeout screen for reuse
		SOLID WASTES		
		Used foundry sand to offsite reuse/landfill (tonnes)	17,019	This is excess of internal recylcinig amounts and must be removed to maintain sand quality
		Reclaim baghouse dust/particulates collected (tonnes)	0	The baghouse dust is the fines from the sand and is a mix of sand particulates and solidified resin particles with traces of metal fines
		GASEOUS EMISSIONS		
		Particulates	16	Fugitive stack emissions
		Shakeout emissions & sand reclamation plant emissions	6	Range of organic and inorganic gases and fumes emitted by the burning sands at various levels including: CO,SO2, H2S, NH3, HCN, NO2, NO CX2, benzene, toluene, xylene, various phenols, various cresols, formaldehyde, naphthalene, various PAHs, varios amines, various hydrocarbons & others.
TOTAL	**219,243**		**218,987**	

INPUTS		OUTPUTS		
FINISHING AND MACHINING				
RAW MATERIALS		**PRODUCT**		**COMMENTS**
Rough castings (tonnes)	32,200	Dressed castings to despatch (tonnes)	32,200	
Shot for shotblast machine (tonnes)	0			
Welding rods and wire	0	**INTERNALLY RECYCLED MATERIALS**		
Abrasives	1	none		
Paint	0			
		SOLID WASTES		
		Shot blast baghouse dust/scale collected (tonnes)	0	
		Heat treatment scale collected	0	
		Fugitive particulates and fume (tonnes)	0	
		Machining swarf to recycle	0	
		GASEOUS EMISSIONS		
		Welding fumes - minor particulates	1	
		Arc air fumes - minor particuluates	3	
		Paint fumes - minor VOCs	1	
TOTAL	**32,201**		**32,005**	

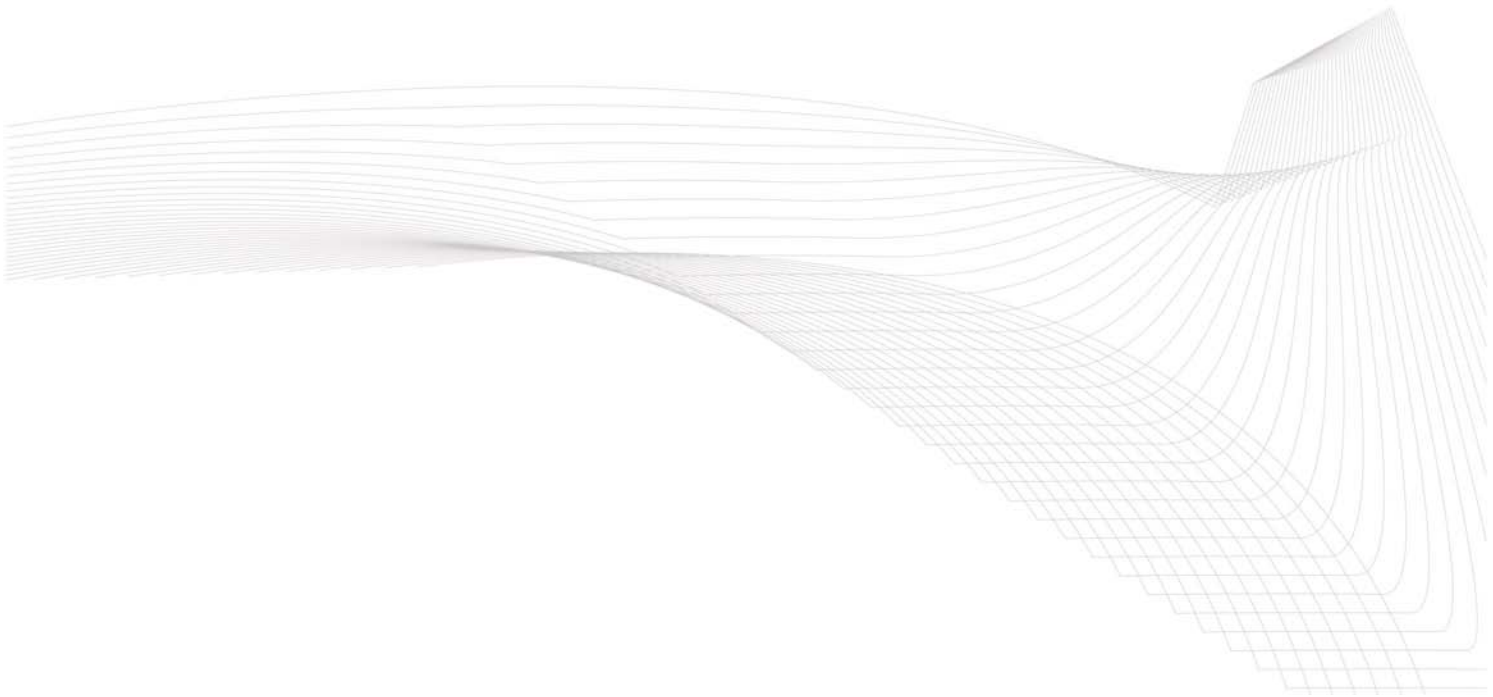
Appendix X

Risk Assessment Report

PER Risk Assessment

Upgrade of Kilburn Foundry

Bradken Adelaide



PER Risk Assessment

Upgrade of Kilburn Foundry

Bradken Adelaide

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File Name: PER Risk Assessment Report (d).doc

This report has been collated and prepared by:

10/08/06

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10/08/06

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Managing Director

August, 2006
Final Report
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TABLE OF CONTENTS

1. INTRODUCTION

Advitech Pty Limited (Advitech) was engaged by Bradken Adelaide (Bradken) to facilitate a risk assessment workshop and record outcomes in the form of a summarised risk register in spreadsheet format.

This report aims to provide an overview of the methodology used and assumptions made in these sessions, in order to clarify the results and ensure they are taken in context. It is particularly important that this report be read in conjunction with risk assessment results when reviewed by individuals not involved in the actual workshop sessions.

Bradken is currently in the process of gaining development consent for a proposed upgrade of their Kilburn foundry in South Australia. A Public Environmental Report (PER) has been identified as the appropriate level of assessment required by Section 46C of the *SA Development Act 1993* of which this risk assessment will form a part. The risk assessment was based on the upgrade design (Bradken drawing 5696021 Rev.D) to be submitted as part of the PER.

The scope of this risk assessment was limited to those risks that were deemed to have potential planning implications. Following qualitative and semi-quantitative analysis of risk scenarios identified during the sessions, the majority of issues were determined not to result in off-site impacts.

The risk assessment was conducted over two days at Bradken's Kilburn foundry, on Tuesday 1 and Wednesday 2 August.

2. RISK MANAGEMENT CONTEXT

The context for this risk assessment was defined during the risk assessment workshop with input from all attendees.

2.1 Objectives

The purpose of this risk assessment was:

- To identify and evaluate risks that have the potential to create off-site impacts.

2.2 Scope of Risk Assessment

The scope and boundaries of this risk assessment included:

- The proposed plant upgrade as defined in drawing 5696021 Rev. D;
- To exclude transport and noise issues which are covered in other studies.

2.3 Stakeholders

The stakeholders considered during this risk assessment included:

- Planning SA;
- Bradken;
- Local management; and
- Adelaide community (employees and residents).

3. RISK ASSESSMENT METHODOLOGY

The risk assessment was conducted in the form of a structured workshop, facilitated by Advitech and attended by Bradken personnel involved in the facility's design, development and operation. A systematic approach was used to identify risk scenarios and minimise the possibility of missing important information. The minutes of the meeting provide a record of the procedure used and the information obtained (**Appendix 1**).

3.1 Participants

An objective assessment requires a team with a variety of experience and skills, so that discussion is stimulated and issues are assessed from various points of view. The workshop team included personnel involved with various aspects of the plant who provided their expertise and technical input to identify risks and determine appropriate actions. The role of Advitech is to facilitate and document the workshops. The members of the workshop team are listed in **Table 1**.

Table 1: Workshop Team

Attendees	Position	Days Attended
John Fardon	Bradken Plant Engineer	All
Kevin Gilbert	Bradken Project Manager	All
Niel Russel	Bradken Technical Manager	All
Darren Elliott	Bradken Manufacturing Manager	All (part time)
Chris Schoneweiss	Bradken OHS Coordinator	All
Gordon Paterson	Advitech Leading Engineer	All
Larry Platt	Advitech Facilitator	All
Susan Kay	Advitech Scribe	All

3.2 Terms and Definitions

At the commencement of each workshop, the team is briefed on the context of the risk assessment and the methodology that will be used. The terms and definitions shown in **Table 2** are discussed at relevant stages during the workshop.

Table 2: Risk Assessment Terms and Definitions

Term	Definition
Risk Assessment	The formalised means by which hazards are systematically identified, assessed, ranked according to perceived risk, and addressed by means of appropriate and effective controls. Such an assessment is generally undertaken by a group with extensive knowledge of the system or area being reviewed.
Asset	Tangible and intangible items of value or processes, procedures or tasks performing as intended.
Hazard	A source of potential harm or a situation with the potential to cause loss.
Risk Scenario	An identified situation where an asset and hazard could come together to create a risk event.

Term	Definition
Barrier	The current intended systems, procedures or equipment in place (or included as part of the design) or actions taken to eliminate or mitigate a hazard, or render the risk of occurrence acceptable.
Consequence	The outcome of a risk scenario expressed qualitatively, being a loss, injury, disadvantage or gain.
Likelihood	The likely frequency of a risk scenario occurring.
Risk	The chance of a potential hazard being realised that will have an impact on a desired outcome. It is measured in terms of consequence and likelihood.

3.3 Key Elements

A risk assessment would be unproductive if participants attempted to study a system as a whole. A more effective study is possible when systems are divided into smaller elements, which can each be studied individually. At the start of the risk assessment, the project was divided into sections and assets (as defined in **Table 2** above).

The Kilburn foundry upgrade was initially divided into sections and then processes or systems undertaken within each section. The processes and systems were the assets studied in the risk assessment. The list of assets is included in **Table 3**.

Table 3: Assets

Section	Asset
Melt Shop	1. Scrap handling and processing
	2. Metal melting and refining
	3. Molten metal delivery
	4. Fume and dust extraction
	5. Cooling water system
Moulding	1. Sand mixing and core making
	2. Mould painting and drying
	3. Mould pouring
	4. Mould cooling
	5. Shakeout and reclaim
Heat Treatment	1. Heating system
	2. Quenching system
	3. Air cooling system
	4. Knock-off
Aftercast and Machine Shop	1. Shotblast
	2. Arc air, grinding, welding and dressing
	3. Materials handling
	4. Machining operations
Maintenance	1. Diesel storage and use;
	2. Cleaning bay

Section	Asset
	3. In use paint storage
	4. Parts refurbishment
Pattern Shop	1. Pattern storage
	2. Wood machining
	3. Painting
	4. Pattern refurbishment
Dangerous Goods	1. Chemical Store
	2. Flammable Store
	3. LPG Bullet
	4. Oxygen Tank
	5. Argon Tank
	6. CO2 Tank
	7. Oxy-acetylene storage
General Store	1. Dangerous goods
Internal Roadways	1. Hazardous material movements.
Waste Management	1. Solid waste
	2. Listed waste
	3. Hazardous waste
	4. Liquid waste

Advitech provided some generic hazard guidewords to enable risk scenarios with planning implications to be comprehensively identified. The hazard guidewords used during the risk assessment of the upgraded facility are listed in **Table 4**.

Table 4: Hazard Guidewords

Hazard Guidewords
1. Fire/Explosion
2. Fire/BLEVE
3. Toxic
4. Non-compliance
5. Asphyxiation
6. Dust
7. Odour
8. Legionella
9. Fume
10. Noise
11. Spillage
12. Oil

3.4 Risk Identification

The risk identification process was conducted in a comprehensive and systematic manner, so that as far as practicable, all possible risk scenarios were identified. Each asset relating to the upgrade of the foundry listed in **Table 3** was paired systematically with the Hazard Guidewords (**Table 4)**.

For each asset-hazard pair, the workshop team determined whether a plausible risk scenario existed. If a risk scenario did exist, it was further studied according to **Section 3.5 – Risk Analysis**. If no scenario existed, the team moved on to the next pair. In some cases, more than one scenario existed for one asset-hazard pair.

3.5 Risk Analysis

For each risk scenario identified, the workshop team described the possible causes and potential consequences of the risk scenario, and the current barriers in place to prevent the risk scenario occurring or minimise the consequences. Each risk scenario was then scored, and actions to eliminate or mitigate the risk were proposed. Consequences were scored according to **Table 5**, and then Likelihood was scored according to **Table 6**.

It should be noted that when determining consequence scores for each risk scenario, the 'most probable' consequence was scored, with all current barriers deemed to have failed. The likelihood score for each scenario was then assessed presuming the current barriers were in place. The resulting risk score was determined by the Qualitative Risk Assessment Matrix (**Table 7**). The possible risk scores ranged from 1-25, where scores of 10-17 were considered to be high risk and 18 and over extreme risk.

Table 5: Qualitative Measures of Consequence or Impact or Severity

Level		People	Environmental Harm	Equipment Damage	Production Loss
1	Insignificant	No injuries	No off-site effects	Low financial loss	No production loss
2	Minor	First aid treatment	Onsite release immediately contained	Medium financial loss	Up to 1 day production loss
3	Moderate	Medical treatment	Onsite release contained with outside assistance	High financial loss	Between 1 to 5 days production loss
4	Major	Extensive treatment	Offsite release with no detrimental effects	Major financial loss	Between 5 to 20 days production loss
5	Catastrophic	Death	Toxic release offsite with detrimental effects	Huge financial loss	More than 20 days production loss

Table 6: Qualitative Measures of Likelihood

Level		Description
A	Almost Certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur in most circumstances
C	Moderate	The event should occur at some time
D	Unlikely	The event could occur at some time
E	Rare	The event may only occur in exceptional circumstances

Table 7: Qualitative Risk Assessment Matrix

		Consequences				
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
Likelihood	A Almost Certain	11	16	20	23	25
	B Likely	7	12	17	21	24
	C Moderate	4	8	13	18	22
	D Unlikely	2	5	9	14	19
	E Rare	1	3	6	10	15

Table 8: Risk Categories

Risk	Categories
18-25	**Extreme Risk** - Detailed research and management planning required at senior level
10-17	**High Risk** - Senior management attention needed
6-9	**Moderate Risk** - Management responsibility must be specified
1-5	**Low Risk** - Managed by routine procedures

Adapted from AS4360-1999 Risk Management

3.6 Risk Treatment

In general, each identified risk scenario had actions assigned by the workshop team, to treat the risk. In some cases, the workshop team deemed current barriers to be adequate to address the risk, and no further action was required.

Risk treatment actions recorded in the workshop aimed to reduce the identified risk to **As Low As Reasonably Practicable** (ALARP). Most identified risks cannot be eliminated, but can be mitigated or reduced in some way. The preferred method of risk treatment uses engineered (physical) barriers to prevent the risk occurring, otherwise procedural controls may be proposed to prevent the risk, or respond appropriately if the risk scenario does occur.

It should be noted that in a workshop setting, it is inefficient to discuss detailed design issues when determining the most appropriate treatment for a risk scenario. As such, the actions recorded tend to be general in nature, e.g. “investigate further”, “consider issue in final design”, etc. The project team is responsible for designing suitable solutions, as well as ensuring that personnel are assigned responsibility for actions, and that every identified risk scenario is addressed.

4. RESULTS

Results of the risk assessment were recorded during the workshop directly into a spreadsheet template provided by Advitech. The spreadsheet is treated as the formal minutes of the workshop, and ultimately forms the risk register for the project. These risk assessment spreadsheet is contained in **Appendix I**.

4.1 Multi-Level Risk Assessment

A number of dangerous goods are stored within the foundry, with some increases in quantity expected following the upgrade. Due to the sensitive nature of the surrounding land uses it was considered imperative that all potential off-site impacts resulting from dangerous goods storage were assessed, regardless of whether plausible risk scenarios were identified during the risk assessment.

In order to assess the proposed dangerous goods storage at the upgraded facility, the document 'SEPP 33 Multi-level Risk Assessment' (NSW Department of Urban Affairs and Planning. 1997) was consulted. This guideline provides a recognised method for determining if hazardous materials present on site are likely to pose a significant risk to surrounding land users.

Table 9 provides information about each dangerous good proposed to be stored at the upgraded facility and the screening threshold from SEPP 33. For screening purposes some substances have been grouped according to their DG Class.

In the case of DG Class 1.1, 1.2 and 3 a graphical method incorporating the screening threshold and the distance of the nearest storage location to the boundary is used to determine if the substance is potentially hazardous.

Table 9: Dangerous Goods Screening Thresholds

Substance	DG Class	Packaging Group	Quantity	Mode of Storage	Distance from Boundary (DG classes 1.1, 1.2 and 3)	Screening Threshold	Potentially Hazardous?
Paints	3	II	1 100L	Miscellaneous containers		2 000L	No
Paints	3	II	5 700L	Miscellaneous containers	80 metres	2 000L	No
Furnace Consumables	4.3		45.2 tonnes			1 tonne	**Yes**
Binder	6.1b	III	40 000L	Above ground tank		2 500L	**Yes**
Catalyst	8	III	8 000L	Above ground tank		50 000L	No
Acetylene	2.1		>5 00L	Above ground tank		5 000L	No
Aerosols	2.1		>10L	Aerosol cans			
LPG	2.1		2 500L	Above ground tank		16 000L	No
Argon and Carbon dioxide	2.2		4 900L	Above ground tanks		N/A	N/A

It is important to recognise that the screening test is conservative and it should not automatically be assumed that exceeding the threshold means there is a significant risk. **Table 9** indicates that the SEPP 33 screening procedure has identified that the quantity of class 4.3 (furnace consumables) and Class 6.1(b) (binder) dangerous goods are potentially hazardous.

To further assess the hazard potential of these stores, the risk classification and prioritisation methodology is outlined in the Department of Planning guideline *Multi Level Risk Assessment* (1997) has been used.

The classification and effect factors applied in the risk assessment have been taken from the International Atomic Energy Agency (IAEA) publication *Manual for the classification and prioritisation of risks due to major accidents in process and related industries* (1993), as reproduced in the *Multi Level Risk Assessment* (1997) guideline.

The initial step in the IAEA method involves the classification of substances by effect categories. IAEA Table IV(A) (NSW Department of Urban Affairs and Planning, 1997) binder is classified as a 'toxic liquid' with low toxicity in bunded storage. It is proposed to store 50 tonnes of binder following the upgrade and the IAEA table indicates that at this volume the effects are 'ignorable'.

No effect category exists for furnace consumables and as these are metallic alloys with no foreseeable effects on surrounding land uses, it can therefore be assumed that the level of risk is acceptable.

4.2 Risk Register

The workshop team identified a number of risk scenarios. However, as the objective of the risk assessment was to identify scenarios with planning implications, only those scenarios with a high – extreme risk and the potential for impacting the community were considered relevant. **Table 10** summarises these scenarios in decreasing order of risk.

Other identified risks not included for further discussion were those that resulted in on-site impacts such as personnel injuries or damage to plant or equipment or those with the potential for minimal, if any risk to the community.

Table 10: Risk Scenarios

Risk No.	Area	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Actions
1	Moulding	Sand Mixing and Coring	Fire/Explosion	Binder and catalyst react and cause explosion	Separation distance not adequate. Binder pumped into catalyst accidentally	Explosion. Personnel injuries. Plant damage. Neighbour complaints. Off-site projectiles.	Awareness of issue	5	D	19	Ensure separation of tanks adequate in design. Review procedures for delivery and handling of catalyst and binder. Review design of pipe work connections to prevent cross-contamination
2	Melt Shop	Metal Melting and Refining	Fire/Explosion	Transformer explosion	Inadequate inspection of transformer oil. No bunding for oil.	Production loss (up to 8 months) Release to stormwater. Neighbour complaints EPA fines Potential loss of building. Damage to plant Potential injuries	Explosion rated firewall. Roofed. Preventative maintenance on transformer. Transformer monitoring system.	5	E	15	Ensure diversion of escaped oil away from building into bund. Ensure appropriate fire protection system.
3	Moulding	Mould Cooling	Odour	Ventilation failure	Mechanical breakdown Power failure	Odour complaints Fugitive odour at ground level Health impacts for operators Production loss	Preventative maintenance and monitoring	4	D	14	Consider redundancy in ventilation system Maintain testing regime at Henderson to provide design data Consider inter-connection between fume extraction systems for emergency conditions
4	Dangerous Goods	LPG Tank	Fire/BLEVE	Impact by mobile machinery Hot work and a leaking fitting Procedural non-compliance during filling and decanting	Operator error Failure to follow procedures	Fire Neighbour/personnel injuries Production loss Equipment damage	Training and procedures Impact barrier Water sprays Fire hydrants Licensed supplier	4	D	14	Ensure the facility is compliant with AS1596

Risk No.	Area	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Actions
5	Moulding	Shakeout and Reclaim	Fire/Explosion	Fire in baghouse	Hot work Static discharge Glowing embers	Smoke from flue Odour complaints EPA fines SafeWork SA	Procedures Training	3	C	13	Enforce hotwork permit procedures Determine if dust is combustible and if so whether (AS 2430) applies Ductwork and baghouse to be earthed and bonded subject to dust investigation Consider providing an ember knock-out vessel

4.3 Risk Analysis

Due to the residential nature of the land uses surrounding the foundry, it is important to ensure that all identified scenarios are adequately addressed and that the potential for off-site impacts is reduced to ALARP.

All risks identified in **Table 10** are referred to by their Risk Number and are analysed below.

4.3.1 Risk 1

The scenario most likely to result in an off-site impact is that of a delivery truck inadvertently pumping the binder into the catalyst storage or vice-versa, resulting in an explosion. This scenario will be prevented by the action identified by the workshop team of ensuring that the design of the transfer point differs between the catalyst and the binder, making cross-contamination impossible.

4.3.2 Risk 2

The scenario most likely to result in an off-site impact is inadequate inspection and testing of the transformer oil possibly resulting in an explosion of the main furnace transformer. The main off-site impact is likely to be the release of minimal quantities of transformer oil to stormwater. Complaints from neighbours may also be received due to noise associated with the explosion or smoke from a fire. The temperature of transformer oil is such that it will burn and may result in a localised fire. The loss of the building from the fire is 'worst case' and highly unlikely considering the current barriers identified in **Table 10**.

In order to mitigate these impacts Bradken proposes to ensure that in the unlikely event of a transformer explosion, leaking oil is directed immediately away from the building to a bund for collection. This will avoid pollution of the stormwater and minimise the likelihood of a building fire.

4.3.3 Risk 3

The scenario most likely to result in an off-site impact from the moulding process is the failure of the ventilation system resulting in odour release to the community. Two causes were identified for this scenario, mechanical breakdown and a power failure. In the case of mechanical breakdown of the ventilation, undiluted odour would be released to the atmosphere resulting in an unpleasant environment for surrounding residents.

In order to mitigate the consequences of mechanical breakdown Bradken will consider redundancy in the ventilation system within the moulding process. Options include an additional fan and inter-connecting the foundry fume extraction systems for situations where ventilation in an area fails.

The second identified cause was that of power failure. In the event of a power failure not only would the ventilation cease but also all odour generating foundry operations and consequently this scenario will not result in any significant off-site odour concerns.

4.3.4 Risk 4

A fire or BLEVE (boiling liquid expanding vapour explosion) from the LPG tank was identified as a scenario that may result in off-site impacts. A variety of causes were identified:

- The tank is impacted by mobile machinery and ruptured;
- Hot work being undertaken adjacent to the tank while a fitting is leaking; or
- Procedural non-compliance during filling or decanting.

Bradken has barriers currently in place (both engineered and procedural) to minimise the likelihood of the identified scenario. However, to further minimise the documented consequences the workshop team acknowledged that the existing LPG storage tank should be brought up to the requirements of AS 1596 - 2002.

The identified action and existing barriers will minimise the risk of a fire or BLEVE from the LPG tank. Further, **Table 9** indicates that the quantities of LPG stored on site are not likely to result in off-site impacts.

4.3.5 Risk 5

The scenario most likely to result in off-site effects is that of a fire in the moulding area baghouse, where smoke and odour impact on adjacent residents. The most likely causes of such a scenario are:

- Hot work occurring adjacent to the baghouse;
- Static discharge; or
- Glowing embers.

Past experience has identified glowing embers as the most likely cause of a baghouse fire and the workshop team have recommended the installation of an ember knock-out vessel.

The upgraded Kilburn facility will employ a different binder and catalyst to that currently used. The new binder and catalyst will result in cost savings and a better sand recovery rate. However, the chemical attributes of the binder and catalyst in terms of combustibility and solubility are not yet known. Testing has been commissioned on the binder and catalyst to determine their properties; however at this stage the results are not available. Actions have been proposed in the risk assessment that are dependent on the outcomes of these tests.

It is important to note that the majority of scenarios involving the binder and catalyst were ranked as medium – low by the workshop team and consequently regardless of their properties they are unlikely to result in significant off-site impacts.

4.4 Additional Comments

A number of general findings were made during the risk assessment as follows:

- No start-up/commissioning or shut down issues were identified in the risk assessment.
- The current site specific Work Instructions are generally appropriate for the upgraded facility. However to ensure that they reflect any new substances or processes Work Instructions should be reviewed to ensure relevance with the plant upgrade.
- All storage, construction and location of dangerous goods stores will be compliant with the appropriate Australian Standards. By complying with Australian Standards, community requirements are inherently met.
- Emergency vehicle access to and around the upgraded facility has been deemed adequate by the Metropolitan Fire Service.
- Bradken Adelaide is confident that in regard to risks associated with internal roadways and external transporters, the risk will be reduced to ALARP.
- Bradken Adelaide currently has standard operating procedures and site specific Work Instructions to mitigate spillages involving dangerous and hazardous substances. These procedures will be reviewed in the context of the upgraded facility.
- Adelaide is recognised as having some risk of seismic related loads on structures. All new structures associated with the plant upgrade have been designed considering seismic loads (AS 1170.4–1993) and therefore the implications of any seismic activity would be minimal.
- All cooling water towers will continued to be tested and maintained in accordance with AS 3896-1998 *Examination for legionellae including Legionella pneumophila.*
- Studies additional to this risk assessment will consider transport and noise issues associated with the upgrade and consequently these issues were not covered in the risk assessment.

5. CONCLUSIONS AND RECOMMENDATIONS

The workshop identified a number of issues associated with the upgrade of the Kilburn foundry. The following recommendations are made:

- Testing of the new binder and catalyst to determine their chemical properties. The actions identified in the risk assessment in regard to binder and catalyst are dependent on the outcomes of these tests.
- Review existing site specific Work Instructions to ensure relevance with the upgraded facility, including the location and content of spill kits.
- Review the existing stormwater system to ensure it is sufficient for the upgraded facility.

It is the responsibility of the customer to see that risks are adequately addressed after the completion of each risk assessment, and that further studies are conducted if particular aspects of a project change post workshop.

6. REFERENCES

Department of Urban Affairs and Planning, 1997. *Multi-Level Risk Assessment.* New South Wales Government.

Appendix I

Risk Assessment Minutes

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Melt Shop

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Scrap Handling and Processing	Fire and Explosion	Contaminated scrap, water in scrap with roof on	Failure to inspect scrap by supplier Contamination of scrap during delivery (ie. rain) Failure of operator to inspect scrap	Hot metal explosion Operator injuries Plant damage SafeWork SA fines/investigation Neighbour complaints	Supplier specification Final inspection procedure of operator Furnace inside doghouse	4	d	14	Ensure supplier specifications are adequate
	Scrap Handling and Processing	Fire and Explosion	Contaminated scrap, water in scrap with roof off	Failure to inspect scrap by supplier Contamination of scrap during delivery (ie. rain) Failure of operator to inspect scrap	Hot metal explosion Operator injuries Plant damage SafeWork SA fines/investigation Neighbour complaints	Supplier specification Final inspection procedure of operator Separation distance procedure during scrap charging	3	d	9	Ensure supplier specifications are adequate Ensure training in separation procedures
	Scrap Handling and Processing	Toxic Gas	Contaminated scrap	Scrap contaminated with toxic foreign materials	Toxic gas released to atmosphere Neighbour complaints	Supplier specification Final inspection by operator Supplier QA Extraction system	2	c	8	Ensure supplier specifications are adequate
	Metal Melting and Refining	Dust	Baghouse failure	Temperature control failure Bag wear and tear	Dust released to atmosphere Neighbour complaints EPA fines	Maintenance procedures Particulate monitoring of stack, manual shutdown and alarms Roof and side vent systems	3	d	9	Robust preventative maintenance program Plant to be shut down as soon as practicably possible
	Metal Melting and Refining	Fire and Explosion	Loss of hot metal due to refractory failure	Wear and tear Failure of regular inspections	Hot metal release Hydraulic fire Plant damage	Routine preventative maintenace program Metal drains to low-point bund Firewall Supplier specifications for quality of refractory	3	e	6	

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Melt Shop

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Metal Melting and Refining	Fire and Explosion	Transformer explosion	Inadequate inspection of transformer oil No bunding for oil	Production loss (up to 8 months) Release to stormwater Neighbour complaints EPA fines Potential loss of building Damage to plant Potential injuries	Explosion rated firewall Roofed Preventative maintenance on transformer Transformer monitoring system	5	e	15	Ensure diversion of escaped oil away from building into bund Ensure appropriate fire protection system
	Metal Melting and Refining	Toxic Gas	Loss of containment of ferroalloys and contact with water	Incorrect storage and handling Lack of training	Minor escape of toxic/flammable gas Employee respiratory irritation	Stored in bags or drums Minimal stock Lumped Undercover/dry storage area	1	d	2	Ensure training of employees is adequate Update manifest to include new volumes Update signage
	Molten Metal Delivery	Fire and Explosion	Unplanned discharge contacts moisture	Stopper failure Refractory failure Equipment failure (crane etc.) Operator error/inattention Roof leak Failed water supply lines Contact with wet moulding flasks Contact with moist sand Failed cooling water pipework around furnace	Steam explosion Personnel injuries Equipment damage Fume release into building	Regular maintenance of refractories Testing of stopper assembly and operation Sand floor PPE and training Allocated discharge area Fume extraction from building	4	e	10	Ensure services pipework to be protected or located appropriately. Ensure allocated unplanned discharge area identified in design. Ensure design does not allow for water pooling on pouring floor. Manage incidental activities within hazardous zone. Implement a JSA procedure. Review escape routes and separation distances for a hot metal escape incident.

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Melt Shop

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Fume and Dust Extraction	Dust	Release of dust during emptying of baghouse	Operator error Over-filled bag Hole in screw feeder or bag Bag failure	Fugitive dust release Potential release to stormwater	Procedures Training Hardstand area Audits of baghouse procedures	2	c	8	Separation of stormwater from area of dust release
	Cooling Water System	Legionella	Neighbour or operator infection due to contaminated mist of cooling tower	Poor tower maintenace and testing of cooling water system	Respiratory infections SafeWork SA fines Adverse publicity	Preventative maintenance, cleaning and monitoring to AS	4	e	10	Auditing of contractor Verify contractor credentials and reference checks Independent analysis of legionella contamination

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Moulding

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Sand Mixing and Coring	Toxic	Loss of class 6.1 binder to stormwater, damage to ecosystem	Non-compliance with AS for 6.1 substances	EPA fines Bad publicity	Bunded area Procedures for off-loading and loading	4	e	10	Ensure new installation to AS and tested Review design of day tank level control and overflow system
	Sand Mixing and Coring	Toxic	Accidental contact whilst during moulding activities or mixing	Failure to follow procedures or use required PPE Lack of awareness Failure to monitor procedures	Poisoning Skin irritation Respiratory irritation	Procedures PPE Training	2	d	5	Enforce use of PPE and awareness
	Sand Mixing and Coring	Toxic	SO2 release from catalyst during mixing	Reaction by-product	Throat, eye irritation	Ventilation	2	d	5	Test concentration of SO2 (elsewhere) Consider PPE for mixing area Consider selection of appropriate employees (asthma) Consider respirometer testing
	Sand Mixing and Coring	Toxic	Loss of class 8 catalyst to stormwater, damage to ecosystem	Non-compliance with AS 3780 for class 8 substances	EPA fines Bad publicity	Bunded area Procedures for off-loading and loading	3	e	6	Ensure new installation to AS and tested Review design of day tank level control and overflow system

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Moulding

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Sand Mixing and Coring	Fire/Explosion	Binder and catalyst react and cause explosion	Separation distance not adequate Binder pumped into catalyst accidently	Explosion Personnel injuries Plant damage Neighbour complaints Off-site projectiles	Awareness of issue	5	d	19	Ensure separation of tanks adequate in design Review procedures for delivery and handling of catalyst and binder Review design of pipe work connections to prevent cross-contamination
X	Mould Painting and Drying								0	
	Mould Pouring		Hot metal contacting hardened resin						0	Subject to separate air assessment studies
	Mould Pouring	Fire/Explosion	Unplanned discharge contacts moisture	Mould failure	Personnel injuries Equipment damage Fume release into building	Sand floor PPE and training Fume extraction from building	3	d	9	Ensure services pipework to be protected or located appropriately. Ensure design does not allow for water pooling around pouring floor. Manage incidental activities within hazardous zone. Implement a JSA procedure. Review escape routes and separation distances for a hot metal escape incident.

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Moulding

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Mould Cooling	Odour	Ventilation failure	Mechanical breakdown Power failure	Odour complaints Fugitive odour at ground level Health impacts for operators Production loss	Preventative maintenance and monitoring	4	d	14	Consider redundancy in ventilation system Maintain testing regime at Henderson to provide design data Consider inter-connection between fume extraction systems for emergency conditions
	Shakeout and Reclaim	Odour/Dust	Ventilation failure of bag filter	Mechanical breakdown Power failure	Odour complaints Fugitive odour and dust at ground level Production loss	Preventative maintenance and monitoring	2	d	5	Consider redundancy in ventilation system Maintain testing regime at Henderson to provide design data Consider inter-connection between fume extraction systems for emergency conditions Determine if dust is combustible (AS 2430)
	Shakeout and Reclaim	Fire/Explosion	Fire in baghouse	Hot work Static discharge Glowing embers	Smoke from flue Odour complaints EPA fines SafeWork SA	Procedures Training	3	c	13	Enforce hotwork permit procedures Determine if dust is combustibe (AS 2430) Ductwork and baghouse to be earthed and bonded subject to dust investigation Consider providing an ember knock-out vessel

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Moulding

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Shakeout and Reclaim	Dust	Fugitive dust from jobbing floor knockout	Mechanical breakdown of lump breaker Processing spent sand	Fugitive dust on site Potential leaching of chemicals from sand to stormwater	Preventative maintenance and monitoring Road sweeper Stormwater interceptors Most activity undercover and within bunded area	2	c	8	Determine chemical properties of sand to determine if binder will leach

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Heat Treatment

Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
Heating System	Fire/Explosion	Gas leak on fitting or flange	Mechanical damage	Fire or explosion	Built to AGA standards Hot work permit system Excavation work permit	3	e	6	System is maintained and designed to AGA standard and consequently is acceptable Design engineering review of pipe runs to ensure they are suitable
Quenching System	Legionella	Neighbour or operator infection due to contaminated mist of cooling tower	Poor tower maintenace and testing of cooling water system	Respiratory infections SafeWork SA fines Adverse publicity	Preventative maintenance, cleaning and monitoring to AS	4	e	10	Auditing of contractor Verify contractor credentials and reference checks Independent analysis of legionella contamination
Quenching System	Toxic	Cooling tower blow-down to ground	Existing process	Potential leaching of chemicals from sand to stormwater	Clean castings	2	d	5	Determine chemical properties of sand to determine if binder will leach
Quenching System	Toxic	Tank leakage into groundwater	Corrosion Poor installation	EPA fines Remediation expense	Groundwater monitoring	4	e	10	Ensure coating system adequate in design Determine toxicity of chemical addition Consider secondary containment if chemicals are toxic
Quenching System	Toxic	Tank overflow to stormwater	Corrosion Poor design Operator error	EPA fines Remediation expense	Retention basin	4	e	10	Consider overflow catchment system and/or emergency isolation valves if chemicals are toxic

Context: PER Risk Assessment **Date:** 1/08/2006

Section: Heat Treatment

Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
Air Cooling System	Fire	Adjacent combustible material (eg. packing boxes, electrical equipment etc)	Poor housekeeping Inappropriate plant layout	Local fire Smoke, fumes Plant damage	Procedures Nominated laydown areas	2	e	3	
Air Cooling System	Dust	Laydown of hot castings "burns"/drys-out sand and cause fugitive dust	High temperature castings and radiant heat	Fugitive dust Neighbour complaints	Sweeper Housekeeping	1	b	7	Design concrete laydown area considering minimising casting contact with concrete
Knock-off								0	

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Aftercast

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Shotblast	Dust	Extraction or baghouse failure	Power failure Mechanical failure	Dust release, neighbour complaints EPA fines OH&S issues Production loss	Programmed maintenance Located away from site boundary	2	d	5	Consider including dust monitoring sensor in design Management procedures to cease to operate shotblaster if extraction system fails Investigate dust to determine combustibility
	Shotblast	Dust	Fugitive dust escape from emptying of dust hoppers	Operator error	Local dust release OH&S issue	Training and procedures	1	c	4	
	Arc Air etc.	Fume	Extraction or baghouse failure	Power failure Mechanical failure	Dust release, neighbour complaints EPA fines OH&S issues Production loss	Programmed maintenance Located away from site boundary Broken bag detection	3	d	9	Management procedures to cease to operate arc air if extraction system fails Investigate dust to determine combustibility
	Arc Air etc.	Fire/Explosion	Gas leak on pre-heating ovens	Mechanical damage	Fire or explosion	Built to AGA standards Hot work permit system	3	e	6	System is maintained and designed to AGA standard and consequently is acceptable Design engineering review of pipe runs to ensure they are suitable
	Arc Air etc.	Dust	Stormwater pollution from cooling and grinding water discharge	Cooling and grinding water enters stormwater drain Failure of capture system	Non-compliance with EPA licence conditions	Containment of cooling and grinding water in upgrade design	1	d	2	

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Aftercast

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Materials Handling	Fume/Dust/ Odour	Fugitive dust during operation of mobile machinery	Vehicle entrained dust Inadequate housekeeping Poor road/floor surfaces	Neighbour complaints	Road sweeper Source capture of dust and odour	3	d	9	Consider appropriate road/floor surfaces Improved housekeeping
	Materials Handling	Noise							0	Full noise report
	Arc Air etc.	Fire	Grinding and welding fire	Poor housekeeping Wood storage (pattern shop) adjacent to grinding and welding area	Fire Loss of patterns Neighbour complaints (no health effects) Production loss OH&S injuries	Sheet metal partition Fire fighting equipment in pattern shop and welding area MFS approved hydrant system	3	d	9	Consider upgrading partition to firewall
X	Machining Operations								0	
	Paint Booth	Fire	Hotwork or electrical	Failure to follow procedures Inadequate separation distances to ignition sources	Fire Loss of patterns Neighbour complaints (no health effects) Production loss OH&S injuries	Fire fighting equipment Procedures and training Flammable goods cabinet Air operated hoist	3	d	9	Ensure separation distances are adequate (AS2430)
	Paint Booth	Fire	Hotwork being undertaken while decanting paints and thinners	Separation distances not adequate during decanting - hotwork or electrical ignites fire	Fire Loss of patterns Neighbour complaints (no health effects) Production loss OH&S injuries	Fire fighting equipment Procedures and training Flammable goods cabinet Air operated hoist	3	c	13	Ensure separation distances are adequate (AS2430)

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Maintenance

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Diesel Storage and Use	Fire	Diesel fire from hotwork	Failure to follow hotwork procedures	Local fire	Designed to AS1940 and SafeWork SA regulations	2	d	5	
	Diesel Storage and Use	Spillage	Diesel loss to outside of bund	Operator inattention Nozzle shut-off failure Fire water overflow	Contamination of stormwater/groundwater EPA fines	Bund around tank and vehicle loading spillage containment	2	d	5	
	Cleaning Bay	Oil	Oil enters tradewaste	Operator inattention Failure of oil/water separator	Non-compliance with SA Water Tradewaste licence	Equipment maintenance Procedures	2	d	5	
	In-use Paint Storage	Fire	Hot work setting fire to combustible/flammable thinners and paints	Operator error Poor housekeeping Poor design	Loss of pattern shop Neighbour complaints Production loss	Trade skills and housekeeping Procedures	3	d	9	Review paint storage design and maintenance shop activities Flammable goods cabinet
X	Parts Refurbishment								0	

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Pattern Shop

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Pattern Storage/Making	Fire	Electrical fault or dust fire	Failure to follow procedures Poor house keeping Poor maintenance	Loss of pattern shop Neighbour complaints Production loss	Trade skills and procedures Fire extinguishers Maintenance program Housekeeping	3	d	9	Maintain current good practices and ensure awareness of adjacent fire risks
	Pattern Storage/Making	Fire	Fire in extraction system	Mechanical fault Static buildup in ducting Spark ignition from cutting nails Dust buildup in ducting	Equipment damage Production loss Neighbour complaints Loss of patterns	Trade skills and procedures Fire extinguishers and fire water tank Maintenance program Housekeeping	3	d	9	Ensure ductwork and baghouse are earthed and bonded Develop procedures for fighting baghouse fires
	Pattern Storage/Making	Dust	Bag failure	Wear and tear	Visible dust plume Neighbour complaints EPA fines Possible odour	Programmed maintenance	2	d	5	Consider bag failure detection
	Painting	Fire	Painting, solvents ignited by hot work	Failure to follow procedures Poor house keeping Ignition from power tools Power tools poorly maintained	Equipment damage Production loss Neighbour complaints Loss of patterns	Trade skills and procedures Fire extinguishers Maintenance program Housekeeping	3	e	6	Ensure procedures for using power tools are adequate and enforced Determine flammability of paints

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Dangerous Goods

Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
Chemical Store	Non-compliance	Mixed classes of dangerous goods stored together	Minor quantities of chemicals required Failure to follow regulations	Non-compliance	Dangerous goods to be stored in compliance with regulations	1	e	1	
Flammable Store	Fire	Hot work ignites flammable substance	Failure to follow procedures	Local fire	Flammable substances to be stored in compliance with regulations	2	e	3	
LPG Tank	Fire/BLEVE	Impact by mobile machinery Hot work and a leaking fitting Procedural non-compliance during filling and decanting	Operator error Failure to follow procedures	Fire Neighbour/personnel injuries Production loss Equipment damage	Training and procedures Impact barrier Water sprays Fire hydrants Licenced supplier	4	d	14	Ensure the facility is compliant with AS1596
Oxygen Tank	Fire/Explosion	Impact by mobile machinery Hot work Procedural non-compliance during filling	Operator error Failure to follow procedures	Rupture Personnel injuries Production loss Equipment damage	Training and procedures Impact barrier Water sprays Fire hydrants Licenced supplier	4	e	10	Ensure the facility is compliant with AS1894
Argon Tank	Asphixiation	Impact by mobile machinery Procedural non-compliance during filling	Operator error Failure to follow procedures	Rupture Personnel injuries Production loss Equipment damage	Training and procedures Impact barrier Tank located outside Licenced supplier	4	d	14	Ensure the facility is compliant with AS1894
CO2 Tank	Asphixiation	Impact by mobile machinery Procedural non-compliance during filling	Operator error Failure to follow procedures	Rupture Personnel injuries Production loss Equipment damage	Training and procedures Impact barrier Tank located outside Licenced supplier	4	e	10	Ensure the facility is compliant with AS1894

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Dangerous Goods

Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
Oxy-acetylene Storage	Fire/Explosion	Impact by mobile machinery or vehicles Incorrect handling	Separation distances inadequate Operator error Failure to follow procedures	Explosion Personnel injuries	Training and procedures	3	e	6	Ensure the facility is compliant with AS4332

Context: PER Risk Assessment **Date:** 2/08/2006

Section: General Store

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Dangerous Goods	Non-compliance	Storage does not comply with AS						0	Ensure facility is designed to appropriate AS

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Internal Roadways

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Hazardous Materials Movement	Toxic	Chemical supply truck or mobile machinery collision or incident results in loss of containment	Driver error Congestion Poor lighting Road condition	Pollution of stormwater/groundwater EPA fine	Training Licenced vehicles Adequate lighting Posted speed limits Traffic management plan Spillage containment Emergency response	4	d	14	Review current stormwater system Review spillkit content and location
	Hazardous Materials Movement	Fire/BLEVE	LPG truck or mobile machinery collision results in loss of containment	Driver error Congestion Poor lighting Road condition	Loss of administration block Personnel injuries Neighbour complaints Production loss	Training Licenced vehicles Adequate lighting Posted speed limits Traffic management plan Emergency response	4	e	10	Review current access strategy Considered as low as reasonably practicable (ALARP)
	Hazardous Materials Movement	Dust	Fugitive dust created by vehicle movements	Dusty roadways Increased vehicle movements	Neighbour complaints	Sweeper Sealed roadways Traffic management plan	2	d	5	Ensure housekeeping procedures are maintained

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Waste Management

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Solid Waste	Non-compliance	UFS sand disposed of inappropriately	Failure to follow procedures Failure to specify waste disposal location	Non-compliance with EPA guidelines	Procedures Approved disposal sites Experienced contractor Consignment notes and weigh bridge dockets	2	d	5	Ensure procedures are enforced and audited Ensure reclassification of new process sand
	Solid Waste	Non-compliance	Slag, refractories disposed of inappropriately	Failure to follow procedures Failure to specify waste disposal location	Non-compliance with EPA guidelines	Procedures Approved disposal sites Experienced contractor	2	d	5	Ensure procedures are enforced and audited Ensure reclassification of new process slag
	Solid Waste	Toxic	Leaching of waste - chemicals enter groundwater	Failure to follow procedures Excessive stock pile	Non-compliance with EPA guidelines Contaminated stormwater/groundwater	Stockpiled on hardstand	2	d	5	Investigate leaching properties of binder Appropriate drainage to be installed subject to outcomes of binder testing.
	Listed Waste	Non-compliance	Furnace baghouse dust disposed of inappropriately	Failure to follow procedures Failure to specify waste disposal location	Non-compliance with EPA licence	Procedures Approved disposal sites Experienced contractor Formal waste tracking process	3	e	6	Ensure procedures are enforced and audited
	Listed Waste	Non-compliance	Oil from oil water separator disposed of inappropriately	Failure to follow procedures Failure to specify waste disposal location	Non-compliance with EPA guidelines	Procedures Approved disposal sites Experienced contractor Low volume	2	d	5	Ensure procedures are enforced and audited

Context: PER Risk Assessment **Date:** 2/08/2006

Section: Waste Management

N/A	Asset	Hazard	Scenario	Cause	Consequence	Current Barriers	C	L	R	Action
	Hazardous Waste	Explosion	Disposal tanker collects binder waste and catalyst waste in one load	Failure to follow procedures Inadequate training or awareness of hazard	Explosion or violent reaction Personnel injuries Neighbour complaints SafeWork SA issue Requirement to report to EPA	Current disposal procedure to be updated	3	e	6	Update procedure and training for disposal of waste binder and catalyst to reflect hazards associated with expanded facility Investigate neutralisation and dilution process for catalyst
	Liquid Waste	Toxic	Incident during movement of trade waste water tank results in loss of containment	Driver error Congestion Poor lighting Road condition	Pollution of stormwater/groundwater EPA fine	Training Licenced vehicles Adequate lighting Posted speed limits Traffic management plan Spillage containment Emergency response Sealed/good roads	2	d	5	Review spill kit content and location

Appendix Y

Dangerous Goods

Summary of Dangerous Goods Travelling to/from the Site

Dangerous Good	Dangerous Good Class	On site storage	Nature of Delivery	Current Deliveries per Month	Proposed Deliveries per Month
LPG	2.1 Flammable gas.	2500 litres in licensed tank	LPG road tanker.	4	8
Liquid Oxygen	2.2, 5.1 Non flammable, non toxic gas. Oxidizing gas	5000 litre vertical tank	Oxygen road tanker.	4	8
Argon	2.2 Non flammable, non toxic gas.	1500 litre vertical tank	Argon road tanker.	3	7
CO_2	2.2 Non flammable, non toxic gas.	1500 litre vertical tank	CO_2 road tanker.	3	7
Acetylene	2.1 Flammable gas	Cylinders	Batches of cylinders	4	10
Methylated Spirits	3.1 Flammable liquid	205 litre drums in licensed store area	Batches of 205 litre drums on pallet.	8	21
Paint	3.1 Flammable liquid	205 litre drums in licensed store area	Batches of 205 litre drums on pallet.	20, once per day	20, once per day
Turpentine	3.1 Flammable liquid	205 litre drum in licensed store area	Single 205 litre drums.	1	2
Phenolic resin (binder)	8 Corrosive	20,000 litre licensed tank	Chemical road tanker	2	nil
Phenolic resin (catalyst)	8 Corrosive	1,000 litre plastic container	Batch of two containers	10	nil
Furane (binder)	6.1 Toxic substance	20,000 litre licensed tank	Chemical road tanker	Not currently used	4
Furane (catalyst)	8 Corrosive	4 x 1000 litre plastic containers	1000 litre plastic returnable container	Not currently used	2
Ferrosilicon	4.3, 6.1 Dangerous when wet, Toxic	Undercover store	1000kg bulka bags	1	2
Calcium Manganese Silicon	4.3 Dangerous when wet	Undercover store	1000kg bulka bags	1	2
Ferrosilicon Zirconium	4.3, 6.1 Dangerous when wet, Toxic	Undercover store	1000kg bulka bags	1	2

Appendix Z

Development Plan Provisions

Relevant Provisions –
Port Adelaide Enfield (City) Development Plan

General Industry (1) Zone

OBJECTIVES

Objectives 1: A zone accommodating light and general industries.

Objective 2: A zone accommodating road transport terminals.

Objective 3: A zone accommodating warehousing and storage.

PRINCIPLES OF DEVELOPMENT CONTROL

1 Development undertaken in the General Industry (1) Zone should be primarily light and general industries, road transport terminals, warehousing and storage.

1 Existing special industry located within the Policy Area 46 on Maps PAdE/49 and 55 can adapt and modify their operations to enable their continued operation within the zone.

3 No building should be erected, added to or altered on any land so that any portion of such building would intersect an imaginary line drawn at a 20 degree angle from ground level at the main street alignment and extending across the allotment or any line drawn from any proposed street alignment as shown on the plan deposited under the provisions of the Metropolitan Adelaide Road Widening Plan Act, 1972.

Council Wide

OBJECTIVES

Form of Development

Objective 1: Orderly and economic development.

Objective 4: To establish an urban area in which living, recreational, shopping, community, commercial and industrial activities:

(a) are integrated with and have regard to the impacts of transport networks;
(b) are distributed to avoid incompatibility between land uses;
(c) are compatible with the natural features of, and limitations imposed by the local environment; and
(d) make economic and effective use of infrastructure services and community facilities.

Objective 14: Industrial land and activities protected from encroachment by incompatible land uses.

Land earmarked for industrial purposes requires protection from encroachment by incompatible land uses. In particular, residential land uses can encroach upon existing industrial activities over time. As residential development moves closer to these industries, the capacity of industry to operate properly or to expand can be threatened. Similarly, increases in residential densities close to industrial areas can also have implications for industry.

Objective 25: Development at the interface between industrial activities and sensitive uses that is compatible with surrounding activities, particularly those in adjoining zones.

Objective 26: The separation of industrial and residential land uses, except as provided for by objective numbered 34.

Objective 27: The development of attractive and functional industrial areas.

Objective 28: The re-development of older industrial areas to conform to the desired future character of industrial areas.

Movement of People and Goods

Objective 36: The encouragement of the use of alternative forms of transport by establishing pedestrian and cycle routes throughout the council area, with particular priority to pedestrian movement and safety around schools, shops, community facilities, public transport facilities, parks and places of entertainment.

Objective 39: A safe and efficient vehicular, cyclist and pedestrian movement system in accordance with a functional hierarchy of roads as a basis for assessing and implementing traffic management and related land use measures.

Objective 41: A compatible arrangement between land uses and the transport system which will:

(a) ensure minimal noise and air pollution;
(b) protect amenity of existing and future land uses;
(c) provide adequate access; and
(d) ensure maximum safety.

Objective 43: Encourage non-local and through-traffic to utilise primary and secondary arterial roads and major collector roads, rather than minor collector and local streets. Conversely cyclists should not be discouraged from the use of local streets.

Objective 44: Development, other than residential or local community service activities located and designed to avoid directing traffic into local streets.

Objective 45: Encourage and facilitate cyclist movement within and to the council area and improve recreational and commuting cycling opportunities.

Objective 49: Improvement in the environment and amenity of the Council area through a reduction in energy consumption and pollution generated by motor traffic, facilitated through the promotion of cycling as a mode of transport.

Conservation

Objective 55: To manage and conserve stormwater through the adoption of suitable water harvesting techniques to minimise run-off and to regulate the discharge of excess water into the drainage system.

Objective 56: To promote building design, siting and construction techniques which minimise energy consumption necessary for lighting, heating, cooling and ventilation.

Appearance of Land and Buildings

Objective 80: The amenity of localities not impaired by the appearance of land, buildings and objects.

Objective 81: Enhancement of the townscape and built-form character of the council area generally, and in particular, historic areas, important landmarks and views.

Objective 82: Enhancement of streets, railway reserves, public areas, land and development through appropriate tree planting and other landscaping works.

Stormwater Management

Objective 111: Development which maximises the use of stormwater.

Objective 112: Development designed and located to protect stormwater from pollution sources.

Objective 113: Development designed and located to protect or enhance the environmental values of receiving waters.

Objective 114: Development designed and located to prevent or minimise the risk of downstream flooding.

Objective 115: Development designed and located to prevent erosion.

PRINCIPLES OF DEVELOPMENT CONTROL

Form of Development

3 Development should be in accordance with the Port Adelaide Enfield Development Plan, Maps PAdE/1 (Overlay) Part A and Part B and Maps PAdE/1 (Overlay 1 to 8).

4 Development should be orderly and economic.

6 Land used for the erection of buildings should be suitable for the construction of buildings.

8 Development in localities having a bad or unsatisfactory layout, or unhealthy or obsolete development should improve or rectify those conditions.

Design and Appearance of Development

25 The appearance of land, buildings, and objects should not impair the amenity of the locality in which they are situated.

26 Development should be designed to utilize materials, colours and finishes that enhance the amenity of the townscape, public streets and spaces in its locality, and reflect any particular townscape character sought in the respective zones or policy areas.

27 Development should be of a high architectural standard and be designed to allow for landscaping where appropriate.

28 Development should not cause nuisance or hazard arising from:

(a) microclimatic conditions;
(b) excessive noise;
(c) odours;
(d) overlooking;
(e) overshadowing;
(f) visual intrusion; and
(g) unreasonable cutting off of views.

29 Development should incorporate design, siting and constructional techniques that assist in minimising energy consumption.

30 Development should be designed so as to provide access and facilities for disabled people.

31 All development should provide unobtrusive, screened areas for the storage and removal of waste materials.

Industrial Development

67 Industrial development should be located in general, light or special industrial areas.

69 Industrial development should be of a high architectural standard.

71 Development involving the manufacture or storage of hazardous or toxic goods and material should be located in accordance with an assessment of environmental and industrial risk to establish operational standards and design standards to protect residential uses in near residential zones.

72 Where industrial areas abut residential areas light industrial development should be located near the residential area to minimise the nuisance to householders.

74 Industries should not cause nuisance through the emission of excessive noise, vibration, smell, fumes, smoke, vapour, steam, soot, ash, dust, waste water, waste products, grit, oil, or intrusive light to any premises located on an abutting site and within any residential zone.

76 Development within industrial zones should provide:

(a) adequate access to the rear of all premises;
(b) for all loading and unloading of vehicles to take place on the site of the development;
(c) that the number, location and access points to a road or thoroughfare are designed to best ensure the safety of the public and the free flow of traffic in the locality;
(d) establish parking areas, the design, layout and pavement of which are designed so as to best ensure the safety of the public and the free flow of traffic in the locality;
(e) office buildings of masonry construction;
(f) for cladding all buildings, other than masonry buildings, with pretreated coloured materials. This provision does not apply to roofs except where the pitch of the roof is greater than 30 degrees;
(g) for open storage areas to be screened from view from all surrounding streets;
(h) for security fences to be constructed on or behind the building line or behind the landscaped areas;
(i) for a minimum of 10 percent of the development site to be landscaped unless otherwise specified in the relevant zone;
(j) for landscaping within a site to be carried out in the following manner:
(i) at least 50 percent of the landscaping should be provided adjacent to the street alignment;
    (ii) 50 percent of the plantings should include trees which can be expected to grow to at least the maximum height of the main building on the site;
    (iii) a substantial proportion of the trees should be planted within the car parking areas; and
    (iv) trees, shrubs and grasses should be planted within three months of first occupation;
(k) for landscaping:
    (i) to be maintained at all times;
    (ii) to include the provision of smaller trees, shrubs and ground cover;
    (iii) to enhance the amenity of the locality; and
    (iv) to contribute towards mitigating the effects of solar radiation, glare, wind and noise.

78 Non-masonry clad industrial buildings that will be prominently visible from a public place or residential area should be finished in materials and colours that enhance the appearance of the structure when viewed from a public place or residential area.

Movement of People and Goods

80 Development and associated points of access and egress should not create conditions that cause interference with the free flow of traffic on adjoining roads.

81 Development should provide safe and convenient access for private vehicles, cyclists, pedestrians, service vehicles, emergency vehicles and public utility vehicles.

82 Development should include appropriate provision on the site to enable the parking, loading, unloading, manoeuvring and fuelling of vehicles.

83 Access and egress points to development should be located and designed so as to:
(a) minimise traffic hazards and the free flow of traffic on adjoining roads;
(b) avoid vehicle queuing on public roads;
(c) avoid the generation of traffic into adjacent residential areas;
(d) minimise right turn movements onto arterial roads; and
(e) minimise interference with the function of intersections, junctions and traffic control devices.

92 Where Centre, Commercial or Industrial development is likely to give rise to a demand for cyclist facilities, such development should, where practical, incorporate facilities such as:
(a) sheltered and secure bicycle parking facilities of appropriate scale for employees and visitors in accordance with principle of development control numbered 154; and
(b) end of journey facilities of appropriate scale for employees and visitors including:
(i) clean, functional, secure, showers and changing facilities; and
(ii) secure lockers for cyclists to store cycling attire and equipment.

Car Parking and Access

97 Development should provide sufficient off-street car parking to meet its anticipated parking demand for resident, visitor, customer, employee and service vehicles. In particular the car parking requirement contained in Table PAdE/3 should be met for those kinds of development specified, unless otherwise specified in the relevant zone.

98 Off-street car parking, unless otherwise specified in the relevant zone, should be developed in accordance with the appropriate Australian Standard AS2890.1 as approved by the Standards Association of Australia and in accordance with the requirements established in Table PAdE/3.

99 Car parking areas should be located and designed in a manner that will:
(a) facilitate safe and convenient pedestrian linkages to development and areas of significant activity or interest in the vicinity of the development;
(b) provide safe and convenient traffic circulation;
(c) result in minimal conflict between customer and service vehicles;
(d) avoid the use of public roads when moving from one part of a parking area to another;
(e) minimise the number of access points to public roads;
(f) avoid the necessity for backing onto public roads;
(g) provide the opportunity for the shared use of car parking and integration of car parking areas with adjoining development so as to reduce the total extent of car parking areas and the requirement for access points, where reasonably possible; and
(h) provide one space in every 25 spaces for use by the disabled up to a maximum of at least five spaces. Parking for the disabled should be located conveniently to major building entrances and ramps and adequately signposted or identified as being for the disabled only.

100 Car parks should be designed to reduce opportunities for crime and should:
(a) maximise the potential for passive surveillance by ensuring car parks can be overlooked from nearby buildings and roads;
(b) incorporate walls and landscaping in accordance with principle of development control numbered 246, which do not obscure vehicles or provide potential hiding places;
(c) incorporate clearly identified and legible pedestrian routes;
(d) maximise lines of sight between parking spaces and pedestrian exits and between parking spaces and pay-booths; and
(e) incorporate clearly visible exits and directional signage.

101 Car parking areas should be paved and parking bays delineated by line marking or other suitable means and maintained to a satisfactory standard.

102 Car parking areas should be landscaped with suitable trees and shrubs to provide shelter, shade and appropriate screening and enhance their appearance and amenity.

Safety and Security

113 Development should promote the security of property through the clear delineation of public and private space. This can be achieved through the incorporation of building features, shrubbery, changes of level, low to medium-height fencing and clear directional signs into developments that clearly delineate ownership.

Stormwater Management

132 Development should incorporate appropriate measures to minimise any concentrated stormwater discharge from the site.

133 Development should incorporate appropriate measures to minimise the discharge of sediment, suspended solids, organic matter, nutrients, bacteria and litter and other contaminants to the stormwater system and may incorporate systems for treatment or use on site.

Landscaping

187 Development should incorporate landscaping as an integral part of the design of the development to:
(a) enhance the appearance of the development and the locality;
(b) establish buffers to adjacent development and areas;
(c) provide shade and shelter for pedestrian areas and car parks; and
(d) screen service yards, loading areas, outdoor storage areas and car parks.

188 Existing substantial vegetation should be retained and incorporated within landscaping of development where practicable.

189 Landscaping species should be appropriately selected for their beauty, ability to perform a particular function, ease of maintenance and so as not to affect the structural integrity of adjacent development.

Appendix Zi

Project Team

Project Team

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