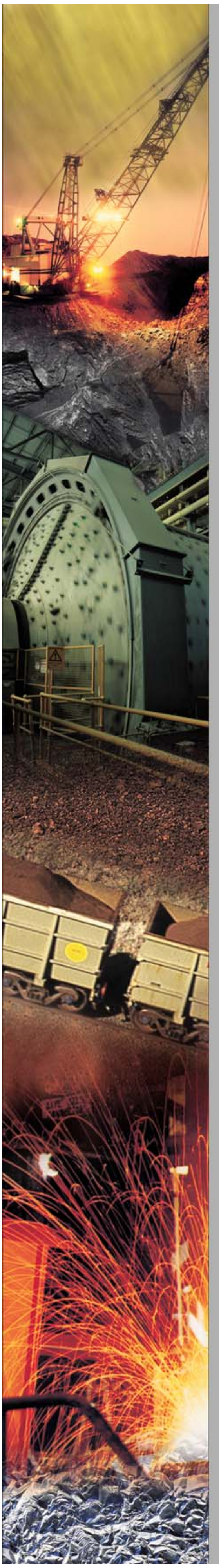

BRADKEN

PUBLIC ENVIRONMENTAL REPORT

PROPOSED UPGRADE AND EXPANSION OF AN EXISTING FOUNDRY

80 CROMWELL ROAD
KILBURN

FEBRUARY 2007

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EXECUTIVE SUMMARY

Bradken Resources Pty Ltd (Bradken) seeks to upgrade its existing foundry at 80 Cromwell Road, Kilburn. The upgrade will include an expansion of the production capacity of the site. Bradken is a market-leading Australian manufacturing company providing consumable parts, capital equipment and associated maintenance and refurbishment services to the Australian Resources sector and freight rail industry. The products produced at the Kilburn site include mill liners, crusher liners and crawler shoes.

The objectives of the proposed upgrade are:

- to provide sufficient manufacturing capacity at the site to meet Bradken's immediate critical shortfall in supply together with projected export demand for the company's expanding core product lines.

  Bradken has identified that an increase in capacity from 12,500 tonnes dressed product per annum (ie tonnes of product to customers) to 32,000 tonnes dressed product per annum is required over the next 3 years in order to meet this objective;

- to achieve long-term cost competitiveness and profitability through the use of "best technology" plant and equipment and processes.

  The increase in capacity provides the company with the "economy of scale" required to upgrade equipment, improve efficiency of production and reduce manufacturing costs in order to remain cost competitive;

- to enter new market segments complimentary to current product lines which are currently outside of the facility's manufacturing capability.

  Bradken has identified that an Electric Arc Furnace (EAF) of 20 tonne melting capacity is required to enable the production of large primary gyratory crusher mantles, bucket lips and large industrial castings from the Adelaide site, which are to be supplied to growing markets throughout Australasia;

- to provide a financial platform to develop state of the art manufacturing processes that are able to meet the relevant environmental requirements of the site into the future.

The nature of the production processes undertaken at the site will not change as a result of the proposed upgrade. The production increase will be achieved through the replacement of the existing 10 tonne EAF with a new 20 tonne EAF and the installation of a fast loop moulding and cooling system. The proposal also involves the reorganisation of inefficient processes and upgrading of equipment to significantly improve the environmental performance of the site and to improve employee health and safety.

The building works required to achieve the above objectives essentially comprise the demolition of portion of the existing foundry building and the construction of new building additions totalling 3,885m^2 to house the new "best technology" 20 tonne EAF, mould pouring, sand mixing and aftercast production processes. Improvements to product storage facilities, landscaping, access arrangements and car parking areas are also proposed.

The current facility employs approximately 180 people. An additional 100 staff are expected to be employed at the upgraded facility (approximately 280 staff in total), with operations to continue, as currently, over 24 hours each day (three shifts per day) for 6 days a week.

The proposed upgrade has been planned to take place in two principal stages over a three year period to spread capital expenditure and to minimise plant disruptions during the upgrade work. Stage 1 is proposed to commence shortly after all necessary approvals have been obtained, with completion within 18 months. Stage 1 will allow for an increase in production capacity from 12,500 tonnes dressed product per annum to 16,500 tonnes per annum. Stage 2 (final development) will allow for an increase in production to a total of 32,000 tonnes dressed product per annum within 3 years of commencement.

The estimated capital expenditure of some $40 million over a 3 year period represents a significant stimulus to the State's manufacturing sector and will generate jobs growth and positive flow on and multiplier effects on allied industries/activities. To this end, it has been estimated that the upgrade will deliver the following broad economic outcomes:

- at a regional level (North West Adelaide), the upgrade is expected to create 213 new jobs annually from 2011 onwards, and be responsible for generating new incomes in the State of $16 million. Over the period 2006 to 2015, the upgrade is estimated at creating in the region, new incomes with a value of $77 million (present value) – with $44 million of these incomes for residents employed at Bradken itself; and

- at a State level, the incremental increase in economic activity (relative to the no investment case) is for the creation of 500 new jobs in the State from 2011 onward, with incomes generated of almost $40 million per year. Over the period 2006 to 2015, the present value of this impact is almost $175 million – with $63 million of this being in the form of wages and salaries paid at Bradken itself, while the balance ($112 million) is activity supported elsewhere in the economy.

Note that the above economic benefits are only achievable via expansion of the capacity of the current site. Use of any alternative location would result in significant "up-front" capital costs in the order of 4-5 times that of upgrading on the current site, resulting in a significant 10% (approximate) increase in ongoing financing costs. These additional up-front costs would prevent Bradken from maintaining its cost competitiveness. More importantly, relocation to another site would require a temporary duplicate workforce (in the order of 100 staff) to operate the facility during commissioning. In practice, it is extremely unlikely that experienced foundry operators could be sourced on a temporary basis to commission the new facility given that, in Bradken's experience, employees with the requisite skills are in short supply both within South Australia and interstate. As such, construction of a new facility on an alternative site is not a practical or viable option.

Accordingly, if the Adelaide site is not upgraded (with upgrading being dependant upon the ability to expand production capacity) then it will become an unviable prospect for the company and will, most likely, be forced to close within the next five to ten years. Adelaide's existing market supply would be shifted to one of Bradken's other foundries interstate. Alternatively, the market may be lost to overseas producers. The negative impact on the local and state economies would be significant. The employment of the existing 180 staff members would be terminated and the flow on effect to the local community and economy would be considerable.

In respect of the environmental performance of the upgraded site, various expert reports have been prepared in relation to potential impacts involving noise, odour, dust and other air emissions, traffic, wastewater and stormwater. These confirm that the upgrade will result in a net environmental gain when compared with current operations and that the upgrade will effectively manage within statutory limits, off-site impacts so as to improve the amenity of nearby owners/occupiers.

Environmental assessments undertaken for the proposal identify the following:

- the upgraded facility will deliver air quality and odour improvements for residential occupiers within the locality relative to current performance as a result of improved technologies and processes. The modelling undertaken for the proposal identifies that the effects of odour and particulates will be significantly reduced from current levels and future levels will meet environmental guidelines;

- the upgraded facility will result in improvements to local air quality and has been designed to meet relevant EPA air quality guidelines;

- modelling undertaken for the upgraded facility identifies that it will use less electricity per tonne of product than the current facility due to improved efficiencies of the new 20 tonne EAF;

- the upgraded facility will use less water per tonne of product due to improved productivity and increased heat loss efficiency of the larger EAF;

- the upgraded facility will generate less greenhouse gas emissions per tonne of product relative to the current operation, and will exceed foundry industry best practice benchmarks for greenhouse gas emissions;
- the upgraded facility will use less sand per tonne of product through the use of a different chemical binder which will improve sand efficiencies by enabling greater quantities of sand recovered after use to be recycled back through the process;
- noise levels generated by the upgraded facility will meet EPA guidelines;
- additional traffic associated with the upgraded facility is unlikely to result in any significant noticeable impact upon residents within the locality or to impact unreasonably upon local road networks;
- visual amenity is to be improved through a general site clean-up, comprehensive landscape improvements along the Cromwell Road frontage and eastern portion of the land and using an appropriate exterior colour palette for the proposed buildings;
- stormwater quality will be more effectively managed via a comprehensive stormwater management plan aimed at improving water quality and preventing pollution of groundwater; and
- the site will be effectively managed via a detailed Construction Environmental Management Plan (CEMP) and Environmental Management and Monitoring Plan (EMMP).

A Health Risk assessment undertaken according to national risk assessment guidelines identifies that:

- predicted ground level concentrations indicate a potential improvement in air quality around the site as a result of the upgrade, with generally lower concentrations and an associated higher margin of safety than for current operations;
- the cumulative impact Hazard Index (HI) for emissions after the upgrade is within reference values and about three times lower than the HI value for the current operation;
- the maximum ground level concentrations for emissions expected to be generated by the future operations do not exceed Health-related reference values and the cumulative impact of these emissions on air quality and health is not considered to be a cause for concern; and
- risk indices for maximum ground level concentrations for future emissions are not a cause for concern for either cancer or non-cancer effects.

The proposed foundry upgrade falls within the ambit of a declaration by the Minister for Urban Development and Planning made pursuant to Section 46 of the Development Act 1993. Accordingly, the proposal is deemed to be one of major environmental, social or economic importance. The Major Developments Panel has determined that the proposal will be subject to the processes and procedures of a Public Environmental Report so as to enable a full and proper assessment of the proposed work.

This Public Environmental Report is submitted to the Minister for consideration and addresses the issues and effects of the proposal as detailed in the *Guidelines for the preparation of a Public Environmental Report for the Upgrading and expansion of a Foundry at Cromwell Road, Kilburn* (released June 2006).

1.0 INTRODUCTION

1.1 BACKGROUND

The Minister for Urban Development and Planning has declared, by Government Gazette notice dated 25 January 2006, that development for the purpose of, or ancillary to, operating a cast metal manufacturing plant at 80 Cromwell Road be assessed as a Major Development (pursuant to section 46(1) of the Development Act, 1993). That declaration was later varied by gazettal notice published on 13 April 2006 so as to exclude the following forms of development from that original declaration:

(a) construction of a new amenity building for employees and demolition of existing amenity building;

(b) extension of existing eastern noise attenuation mound to 4.5m in height;

(c) construction of an additional 4.5m high noise attenuation mound in the north-eastern corner of the site;

(d) construction and demolition associated with relocation and replacement of heat treatment ovens and relocation of wash bay;

(e) realignment of internal roads.

Bradken Resources Pty Ltd (Bradken) proposes to upgrade its existing foundry operations on its existing site at 80 Cromwell Road within the ambit of the declaration made by the Minister.

Applications for the above forms of development (a – e) have been lodged directly with the City of Port Adelaide Enfield pursuant to Division 1 of Part 4 of the Development Act 1993, for its assessment and determination under the 'normal' planning process. These forms of development have been taken out of the Major Developments declaration since they are proposed to be undertaken by Bradken regardless of whether the upgrading under the Major Developments process is ultimately approved and implemented.

In accordance with procedures detailed by the Act, the following actions have occurred to date in relation to the Major Development:

- the proponent, Bradken, has prepared and lodged a development application with the Minister outlining the nature and parameters of the proposal;
- the Major Developments Panel has prepared an Issues Paper outlining the proposal and a preliminary description of significant issues;
- the Issues Paper has been placed on exhibition and written submissions received from interested parties and the public;
- written submissions have been considered in the preparation of the *Guidelines for the preparation of a Public Environmental Report for the Upgrading and expansion of a Foundry at Cromwell Road, Kilburn* (released June 2006) ("the Guidelines") which has been placed on public exhibition; and
- the Guidelines identified that, having taken into account all relevant factors including the criteria specified by the Regulations under the Act, a Pubic Environmental Report (PER) constitutes the required level of assessment for the proposal and accordingly details the range of issues and effects requiring assessment.

This PER addresses the matters identified by the Guidelines.

1.2 THE PROPONENT

The proponent of the proposed upgrade is Bradken Resources Pty Ltd (Bradken), a division of Bradken Limited.

The company has an 80 year history, beginning as a steel foundry in Sydney during the 1920s. Today, Bradken is a market-leading Australian manufacturing company providing consumable parts, capital equipment and associated maintenance and refurbishment services to the Australian resources and freight rail industries.

The company services its markets through four strategic business units, being Mining, Mineral Processing, Rail and Industrial, which are supported by a network of 14 manufacturing facilities across Australia and New Zealand. All facilities are focused to provide low cost, high quality products incorporating the latest technologies with equipment appropriate to the products produced.

The company is headquartered in Newcastle, NSW. It employs approximately 2,500 people within Australia and in key locations overseas and has sales approaching $600 million per annum.

Bradken's foundry at Kilburn was commissioned in 1949, and currently employs approximately 180 people. It is a well established, significant employer of trade labour and manufacturing skills in South Australia. The facility produces 12,500 tonnes of cast metal (known as "dressed product") for its customers per annum, supplying the mining and mineral processing industry with grinding mill liners, crusher liners and crawler shoes among other products. The foundry supplies customers such as BHP Billiton, Rio Tinto, PT Freeport Indonesia, Escondida (Chile) and Newcrest. The foundry also services Australia-wide industrial customers, such as Simsmetal and Smorgon Steel Recycling, as well as the quarry industry, including Boral and Adelaide Brighton Cement.

Bradken has strong, well established alliances with leading international organisations, including Amsted Industries (ASF) for the supply of railway components and ESCO Corporation for mining components.

Bradken is a publicly listed company on the Australian Stock Exchange and is well placed to ensure that the financial, operational and management obligations of the proposal can be met.

1.3 STAGING AND TIMING

The proposed upgrading has been planned to take place in two principal stages over a three year period to spread capital expenditure and to minimise plant disruptions during the upgrade work. Stage 1 will commence shortly after all necessary approvals have been obtained (refer Appendix A for anticipated construction staging). The Stage 1 work is scheduled for completion 18 months after commencement and will allow for an increase in capacity from an existing 12,500 tonnes dressed product per annum to 16,500 tonnes dressed product per annum through the following works:

- construction of a new furnace building;
- installation of a 20 tonne Electric Arc Furnace (EAF);
- installation of new noise attenuation and fume extraction equipment;
- all landscaping works and signage.

Stage 2 will involve additional works to allow an increase in production to a total capacity of 32,000 tonnes dressed product per annum (final development) within 3 years of commencement.

Notwithstanding the timeframes provided at Appendix A, it is proposed that the upgrade will be staged in line with market demand over the proposed 3 year construction period.

1.4 LEGISLATIVE REQUIREMENTS AND APPROVAL PROCESSES

The proposed upgrade falls within the ambit of the declaration by the Minister for Urban Development and Planning, making it subject to Division 2 of Part 4 of the Development Act 1993 (Major Developments or Projects). The specific requirements of this part of the Act are contained in section 46 to section 48 (reproduced at Appendix B) and are as detailed in the Guidelines Paper.

In addition to the requirements of the Development Act, elements of the proposed upgrade will be subject to other legislative requirements relating primarily, to environment protection and water issues.

The PER process is framed to identify relevant legislative issues and the extent, generally, to which the proposal will be able to satisfy necessary requirements. The grant of any licence is not subject to detailed consideration at this stage of the assessment process, however, relevant Agencies have been consulted as to the ability of the proposal to conform to specific requirements.

1.5 THE PUBLIC ENVIRONMENTAL REPORT PROCESS

The PER process requires Bradken to present the proposal to the Minister in sufficient detail so as to enable a full and proper assessment of the proposal against the criteria specified by the Act. Further, the Guidelines Paper prepared by the Major Developments Panel sets the framework against which the proposal may be assessed and identifies key issues and investigations requiring address by Bradken.

Section 46C of the Development Act 1993 identified that this PER must address/include:

- a statement of the expected environmental, social and economic effects of the proposal;
- a statement of the extent to which the expected effects of the proposal are consistent with the provisions of any relevant Development Plan, the Planning Strategy and any matters prescribed by the regulations;
- if the proposal involves, or is for the purpose of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, a statement of the extent to which the expected effects of the proposal are consistent with the objects of the *Environment Protection Act 1993*, the general environmental duty under that Act and relevant environment protection policies under that Act;
- a statement of Bradken's commitments to meet conditions (if any) that should be observed in order to avoid, mitigate or satisfactorily manage and control any potentially adverse effects of the proposal on the environment; and
- a statement of any other particulars in relation to the proposal required by the regulations or the Minister.

Once the PER is submitted to the Minister, the following actions will occur:

- the PER will be referred to The City of Port Adelaide Enfield (the Council), the Environment Protection Authority and other relevant authorities or bodies as determined appropriate by the Minister for comment and report within the time prescribed by the regulations;
- the PER will be placed on public exhibition for at least 30 business days, with written submissions invited;
- a public meeting will be conducted within the public exhibition period;
- any submissions will be forwarded to Bradken for comment;

- Bradken must prepare a written response in a 'Response Document' to any matters raised in the public submissions or by the Minister, the Environment Protection Authority, the Council or any other prescribed body;

- the Minister will then prepare an Assessment Report which is to include an assessment of the proposal and consideration of submissions made and Bradken's response to them;

- the PER, Assessment Report and Response Document are to be kept available for inspection and purchase at a place and for a period determined by the Minister and a copy provided to the City of Port Adelaide Enfield;

- the PER, Assessment Report and Response Document are forwarded to the Governor for a decision. In arriving at a decision the Governor must have regard to the relevant provisions of the Development Plan and Development Regulations, the Building Rules (if relevant), the Planning Strategy, the PER and Assessment Report and the *Environment Protection Act 1993;*

- the decision of the Governor is published in the *South Australian Government Gazette.*

2.0 NEED FOR THE PROPOSAL AND EXPECTED OUTCOMES

2.1 NEED FOR THE PROPOSAL

Bradken is currently experiencing a strong and growing market for its products driven by the expansion of the Chinese economy and others directly influencing the demand for Australian mining commodities.

Australia's close proximity to Asia coupled with the low cost position of Australian mines on the world stage should see sustainable long term increases in mine production. Bradken's principal strategies are to expand current capacity and capability to capitalize on this market growth.[1]

There is an immediate need for Bradken to increase its capacity at the Kilburn site if it is to support the current and forecast growth in the Australasian Copper and Gold Mining market, and to support BHP Billiton's expansion of the Olympic Dam mine at Roxby Downs. Bradken also requires additional capacity at its Kilburn site in order to support other proposed South Australian mining developments such as Oxiana's Prominent Hill, OneSteel's Project Magnet and Hillgrove Resources' Kanmantoo developments.

Further, Bradken is positioning itself to support the performance of the South Australian ASC's AWD (Frigate) contract. It is expected that there will be a large volume of steel castings required in association with that contract. At present, the Kilburn site does not have the capacity to participate in that work.

Bradken also has an industry recognised research and development capability, which is sought out by customers in Australia and overseas. A number of patented products have resulted from this work. However, the product development opportunities of the company have, so far, been stifled by the lack of capacity to manufacture the patented products on this site. The upgrade will address this shortfall.

Bradken's reputation has always been of low cost, high quality products, and in the past, short lead times in meeting customer requirements. In recent years Bradken has maintained its high product quality, but lead times have increased significantly due to constraints on production capacity. The proposed upgrade will not only allow Bradken to improve its lead times, but it will also allow improvements to product quality, cost efficiency and environmental performance. This will ensure that Bradken maintains its position in the market.

The current Kilburn facility, built in 1949, is no longer internationally competitive and sustainable, but approval for the proposed upgrade will ensure the long-term future of Bradken's South Australian operations. It will provide an appropriate foundation for any future development in South Australia, revitalise the current operations, and provide a more efficient, reliable and environmentally sustainable service to the industries that Bradken supports.

The proposed upgrade at Kilburn is therefore part of the company's larger expansion plans across its key market segments to capitalise on existing and projected growth in Australian Mining Commodities. The upgrading of equipment and processes on the site contributes towards the company's aim of providing low cost, high quality products whilst improving Occupational Health and Safety and environmental performance.

2.2 OBJECTIVES OF THE PROPOSAL

As can be appreciated from the discussion under item 2.1 above, significant existing and sustained future demand exists for the product lines currently manufactured at Bradken's Kilburn site. The proposed upgrade allows the company to meet that demand whilst also providing an opportunity to update current, outdated, manufacturing technologies on the

[1] *Bradken Ltd Annual Report 2005*

site in order to improve efficiencies, significantly reduce local environmental impacts (relative to current performance) and improve work place safety.

Accordingly, the primary objectives of Bradken in undertaking the proposed upgrade are:

- to provide sufficient manufacturing capacity at the site to meet the company's immediate critical shortfall in supply together with projected export demand for the company's expanding core product lines (ie grinding mill liners and crawler shoes). Bradken has identified that an increase in capacity from 12,500 tonnes dressed product per annum to 32,000 tonnes dressed product per annum is required over the next 3 year period in order to meet this objective;

- to achieve long-term cost competitiveness and profitability through the use of "best technology" plant and equipment and processes. The increase in production capacity provides the company with the "economy of scale" required to upgrade equipment, improve efficiency of production and reduce manufacturing costs in order to remain cost competitive;

- to enter new market segments complimentary to current product lines which are currently outside of the facility's manufacturing capability. Bradken has identified that an Electric Arc Furnace (EAF) of 20 tonne melting capacity is required to enable the production of large primary gyratory crusher mantles, bucket lips and large industrial castings from the Adelaide site, which are to be supplied to growing markets throughout Australasia; and

- to provide a financial platform to develop state of the art manufacturing processes which can meet the relevant environmental requirements of the site into the future.

2.3 BENEFITS AND COSTS

2.3.1 Economic

The estimated capital expenditure of some $40 million over a 3 year period represents a significant stimulus to the State's manufacturing sector and will generate jobs growth and positive flow on and multiplier effects on allied industries/activities. A detailed economic analysis quantifying these effects is contained within Appendix C.

The analysis estimates that the upgrade will deliver the following broad economic outcomes:

- at a regional level (North West Adelaide), the upgrade is expected to create 213 new jobs annually from 2011 onwards, and be responsible for generating new incomes in the State of $16 million. Over the period 2006 to 2015, the upgrade is estimated at creating in the region, new incomes with a value of $77 million (present value) – with $44 million of these incomes for residents employed at Bradken itself; and

- at a State level, the incremental increase in economic activity (relative to the no investment case) is for the creation of 500 new jobs in the State from 2011 onward, with incomes generated of almost $40 million per year. Over the period 2006 to 2015, the present value of this impact is almost $175 million – with $63 million of this being in the form of wages and salaries paid at Bradken itself, while the balance ($112 million) is activity supported elsewhere in the economy.

2.3.2 Social

The proposal will result in approximately 100 new jobs at the site within the next three years and in the creation of 213 new jobs in the region annually from 2011 onwards.

Improvements to environmental performance of the facility will result in improvements to resident amenity in terms of noise from the facility, odour and air quality (dust and other emissions).

The proposal will result in significant improvements to the current visual amenity of the site through the removal of external equipment from the existing foundry building, changes to the location of certain untidy processes to less visible locations and the introduction of a coordinated landscaping scheme to improve presentation to the Cromwell Road frontage and assist in screening the site from residences to the east of the land.

Traffic will continue to use the same access points on Cromwell Road. Traffic numbers associated with the upgrade are projected to increase only marginally and the peaks will be maintained at current times throughout the day such that the effects of the increase will not be noticeable.

2.3.3 Environmental

In respect of environmental impacts, the analysis and modelling undertaken for the proposal (summarised under item 2.4 below) identifies the following:

- at a local level, the upgraded facility will deliver air quality, noise and odour improvements for residential occupiers within the locality relative to current performance as a result of improved technologies and processes. The modelling undertaken for the proposal identifies that the effects of odour, noise and particulates will be significantly reduced from current levels and will meet prescribed statutory limits.

- at a State level, modelling undertaken for the upgraded facility identifies that it will use less electricity per tonne of product than the current facility due to improved efficiencies of the new 20 tonne EAF.

  The upgraded facility will use less water per tonne of product than the current facility due to improved productivity and increased heat loss efficiency of the larger EAF.

  The upgraded facility will generate less greenhouse gas emissions per tonne of product than the current facility, and will exceed foundry industry best practice benchmarks for greenhouse gas emissions.

  The upgraded facility will use less sand per tonne of product than the current facility through the use of a different chemical binder which will improve sand efficiencies by enabling greater quantities of sand recovered after use to be recycled back through the process.

  The upgraded facility is to include improved stormwater management and monitoring aimed at minimising adverse impacts on water quality within the catchment.

  No improvements to public infrastructure by State or Local Government are anticipated to be required as a result of the proposal proceeding.

2.4 SUMMARY OF NET ENVIRONMENTAL GAINS EXPECTED

Environmental gains that will be achieved by the upgrade include both absolute gains in comparison to the current situation, as well as improved efficiencies that result in a smaller usage of resources, or smaller impact on the environment, per unit of dressed metal produced. These gains are set out in the table below.

Aspect of Operations	Environmental Gain after Upgrade (including capacity expansion)
Air Quality (odour)	Modelled maximum ground level odour concentration (3 minute averaging period, 99.9^{th} percentile) will be reduced to 1.57 OU after the upgrade. Odour levels after the upgrade will comply with EPA guidelines for odour.

Air Quality (particulates)	Modelled maximum ground level concentrations for particulates smaller than 10 micrometres in diameter (“PM_{10}”) (daily averaging period, 100^{th} percentile) will be reduced to 13.5 µg/m^3 after the upgrade. Modelled maximum ground level concentrations for particulates smaller than 2.5 micrometres in diameter (“$PM_{2.5}$”) (daily averaging period, 100^{th} percentile) will be reduced to 4.25 µg/m^3 after the upgrade. Modelled maximum ground level concentrations for particulates smaller than 2.5 micrometres in diameter (“$PM_{2.5}$”) (annual averaging period, 100^{th} percentile) will be reduced to 1.43 µg/m^3 after the upgrade.
Air Quality (other emissions)	Modelled maximum ground level concentrations for nitrogen oxides, ammonia, benzene, formaldehyde, phenol, xylene and more than 20 other substances (3 minute averaging period) will be lower than current levels after the upgrade. All modelled maximum ground level concentrations will comply with the EPA design ground level criteria after the upgrade.
Fugitive Dust	Potential for dust generation on site will be reduced by sealing of additional areas, relocation of stockpiles indoors or offsite and upgrades to bunkers with water sprays and enclosures.
Noise	Noise levels at all sensitive receivers will comply with the Environment Protection (Industrial Noise) Policy 1994 and the draft Environment Protection (Noise) Policy 2004 after the upgrade for both day and night time noise levels, despite increased production. Equivalent day and night time noise levels at sensitive receivers in average (westerly wind) weather conditions will be 53 dB(A) and 49 dB(A) respectively .
Visual Amenity	A new front fence on the Cromwell Road boundary, significant landscaping of the Cromwell Road façade and the eastern side of the site, modern buildings and a co-ordinated paint colour scheme will significantly improve the visual amenity of the site, which currently features minimal landscaping and discoloured, old buildings.
Water Use	Improved productivity will result in less water consumption per tonne of dressed product. Water usage will reduce from 0.53 KL per dressed tonne to 0.41 KL per dressed tonne as a result of the upgrade.
Stormwater	Stormwater quality in the retention pond and discharging to the stormwater system will improve due to the increased proportion of roof area to hardstand area resulting from the upgrade and the installation of oil and grit separators. Further, Bradken will implement a stormwater management plan for the upgraded site, addressing monitoring and site management, improving water quality and expanding the capacity of the stormwater retention pond. Bradken will also develop procedures to minimise hydrocarbon contamination and increase the frequency of infrastructure inspections and housekeeping.

Wastewater generation	Improved production efficiency resulting from the upgrade will reduce process wastewater generation per tonne of dressed product. Process wastewater will reduce from 0.064 KL per dressed tonne to 0.05 KL per dressed tonne.
Solid Waste	Use of the proposed new Furane resin binder system in casting will significantly improve the site's sand reclamation efficiency. As such, volumes of waste foundry sand will remain almost identical to current levels after the upgrade.
Greenhouse Gas	More efficient use of fuels by the new foundry plant will result in less greenhouse gas generated per tonne of dressed product. Greenhouse gas generated by foundry operations (both direct and indirect) will reduce from 2.0 t CO_2-e per tonne of dressed product to 1.6 t CO_2-e per tonne of dressed product after the upgrade.

2.5 ALTERNATIVE OPTIONS

A review of Bradken's business operations determined the current Adelaide site to be most amenable to upgrading, with the relevant product lines currently manufactured at the site and the required blend of semi-automated and jobbing moulding skills existing within the workforce. The Adelaide site is centrally located with respect to existing and future customers, providing transport cost efficiencies and rapid response to customers. The site has a mature and positive Industrial Relations environment and a strong track record of OH&S, Environmental and Business performance.

Alternatives to the proposed upgrading of the existing site were assessed by Bradken during the feasibility phase of the project. The options considered in the feasibility study were:

- relocation of the foundry to a new site in South Australia;
- relocation of the foundry to another site interstate;
- upgrade/expansion of the existing foundry; or
- do nothing.

The option of relocating the foundry to a new site at the Cast Metals Precinct in Wingfield or to an alternative site interstate was considered during the early stages of the feasibility assessment. These options were not progressed principally because of the lack of available human resources that would be necessary for Bradken to meet its supply obligations under existing sales contracts while at the same time commissioning and operating a new facility, as well as the significant additional financial costs (when compared with upgrading the existing site) of establishing a new site.

During commissioning of a new site, it is envisaged that duplicate workforces would be required to ensure that the existing foundry continued to meet customer demand while a second workforce progressed with commissioning of the new facility (which can take many months). On completion of commissioning, the duplicate workforce would have to be dismissed. In practice, Bradken considers it extremely unlikely that experienced foundry operators from the local and regional workforces could be sourced on a temporary basis to commission the new facility given that, in its experience, employees with the requisite skills are in short supply both within South Australia and interstate. This inability to source immediate, temporary foundry staff (in excess of 100 staff) is a critical 'road block' to any relocation proposal. Relocation is therefore not a practical or viable option for this reason alone.

Notwithstanding the above 'practical' considerations, the theoretical financial implications of relocation (versus upgrade of the current site) have also been assessed by Bradken as follows.

Bradken estimates that the development of a new foundry complex would cost over $180 million, including purchase of suitable land, construction, infrastructure, establishment and relocation costs, as outlined below.

Description	**$(millions)**
Purchase land (10 hectares)	10
Civil development, (concrete roads on site, setdown areas, stormwater, external roads)	15
Services development on site (sewer, water, gas, electrical, compressed air)	15
Services development off site (sewer, water, gas, electrical, compressed air)	5
Buildings, (Foundry, Furnace , Aftercast, Machine shop, Office, amenities)	40
Equipment relocations (silos, extraction equipment, shakeout, machine tools, shot blast, mixers, pattern and maintenance shop, including foundations etc.)	20
Facilities relocation, (racks, storage, access platforms, stairs, lights, welding bays, grinding, fans, screens, bollards, hot boxes)	5
New Plant and Equipment (new furnace, fast loop moulding line, floor mixers etc.)	30
Sub total	**140**
Engineering design 5%	7
Project management 5%	7
Contingency and inflation 20%	28
Grand total	**182**

By comparison, the proposed investment at the Kilburn site required for the proposed upgrade has been estimated by Bradken to be in the order of $40 million – approximately 22% (or less than a quarter) of the overall cost of relocation and with less potential for disruption to production and risk of loss of current and potential business.

The economic modelling undertaken for the proposal (at Appendix C) also estimates additional ongoing financing costs of $5 to $10million per year (real costs only, nominal costs could be higher) to relocate to the Cast Metals Precinct. This compares to an operating spend which would reach in the order of $70 million by 2011 if market potential is met.

The consequence of this extra cost will be either:

- a reduction in profitability of the South Australian operations; or
- a reduction in competitiveness, as product prices would need to increase to cover up to around a 10% increase in costs (for the extra financing cost). This would reduce Bradken's prospects of achieving the sales levels mooted in the proposal, increase costs for local activities currently supplied by Bradken, and fail to achieve one of the principal aims of the proposal, which is to reduce manufacturing costs in order to remain competitive.

Whilst relocation to the Cast Metals Precinct will provide for larger buffer distances between processes and off-site receivers, and will thus enable less effective and therefore cheaper equipment to be used (as a larger area can be affected by noise, dust, odour etc), the total operating costs of a new site in the Cast Metals Precinct will be greater than an upgraded site because of the additional financing costs discussed above. It is still more cost effective to upgrade the extraction equipment and processes on the current site (which have higher ongoing operating costs) to effectively reduce buffer distances (ie reduce the area affected) by containing the offsite impacts to a smaller area and within acceptable statutory limits than to establish a new, larger site. The upgrading of the facility on the current site is likely to result in lower operating expenses and less emissions than a similar facility within the Cast Metals Precinct and those emissions will cover a smaller geographic area.

Taking a wider view, upgrading the existing facility results in less energy consumption than constructing a new facility elsewhere. The expansion of the capacity of the current facility capitalizes on the embodied energy of the existing buildings on the site, whereas demolition of the existing facility (which is likely to occur if the site was to be vacated) and construction of new buildings on another site will result in energy losses (ie loss of embodied energy) from the demolition and increased energy use for construction of the new facility.

In terms of infrastructure provision, the existing site is already serviced with appropriate water supply and wastewater disposal facilities. Additional electricity requirements to accommodate the proposed increase in production can be efficiently and economically met at the current site.

The economic implications of the facility moving to another site are detailed in the Economic Impact Assessment report provided at Appendix C.

2.6 IMPLICATIONS FOR SITE OPERATIONS OF THE “DO NOTHING” OPTION

Bradken is committed to providing high quality, differentiated and reliable products while meeting prevailing safety and environmental performance standards in order to compete with low-cost offshore manufacturers. However, there is an expectation that there will, over the next 3-5 years, be increasing competition from low-cost and aggressive off-shore suppliers eager to increase their share of the Australian market. PT Growth, Norcast and ME - Electmetal are expected to provide the main competition, with suppliers in China (and to a lesser extent India) a threat in the longer term.

Mining customers also pursue global purchasing strategies including procurement through mining company supported purchasing portals, internet auctions and global tenders, which encourage open market conditions. Competition globally is limited to companies with sufficient scale to provide the level of service and cost structure to satisfy the demands of the end user. Relatively low levels of loyalty are afforded to domestic producers.

To continue to be viable, Bradken must remain a manufacturer with sufficient scale to compete both domestically and in targeted export markets and must significantly reduce manufacturing costs by upgrading existing manufacturing facilities and developing world competitive production capability.

Currently the Adelaide site:

- is capacity constrained (12,500 dressed tonnes per annum);
- is unable to remain cost competitive due to:
  - its undersized and inefficient furnace;
  - outdated, labour-intensive processes across the plant;
  - insufficient economies of scale;
- has safety and environmental compliance issues associated with old plant and equipment.

Accordingly, if the Adelaide site is not upgraded (with upgrading being dependant upon the ability to expand the production capacity of the site) then it will become an unviable prospect for the company and will, most likely, be forced to close within the next five to ten years. Adelaide's existing market supply would be shifted to one of Bradken's other foundries interstate. Alternatively, the market may be lost to overseas producers. The negative impact on the local and state economies would be significant. The employment of the existing 180 staff members would be terminated and the flow on effect to the local community and economy would be considerable.

Economic modelling undertaken for the 'no investment' scenario at Appendix C indicates that, if direct employment at the facility was only reduced by half (ie 90 direct jobs), the outcome for South Australia would be a total decline in jobs within the State from 330 to around 170 jobs, with incomes generated to decline from $23 million currently, to $12 million. This is significant when compared with the State economic effect of the proposal proceeding, which is estimated to result in the creation of 500 jobs to the State from 2011 onward and almost $40 million per year.

2.7 POTENTIAL FOR AND LIMITATIONS TO FUTURE EXPANSION

Expansion of the production capacity of the facility to 32,000 dressed tonnes per annum is required in response to both an immediate need to meet the likely increase in demand for steel products from new mines and mine expansions planned in Australia over the next few years, as well as the need to reduce the site's manufacturing costs in order to remain competitive whilst at the same time meeting the relevant South Australian safety and environmental performance requirements for a facility such as this at this site.

The proposed 32,000 tonne per annum capacity is considered sufficient to meet Bradken's customers' needs until 2011/12. To forecast beyond this date is extremely difficult, however there is an expectation that once this higher production level is reached it would most likely be maintained beyond 2012.

Optimistically, given that mining production in Australia for major minerals is forecast to increase by a cumulative average of 13% over the 2006 to 2009 period[2], there may be an opportunity for Bradken to increase its customer requirements beyond the proposed level in the future.

The ultimate melting capacity of the proposed 20 tonne arc furnace is approximately 45,000 dressed tonnes per annum. However, for the facility to increase production capacity to this level, other capacity limits at the site (heat treatment capacity, sand reclamation etc) would need to be addressed. Further, because of the limited working area of the site, significant outsourcing of non-core processes such as pattern making, machining, and despatch would also be required.

[2] *Australian Bureau of Agricultural and Resource Economics*

3.0 DESCRIPTION OF THE LAND

3.1 DESCRIPTION

The land the subject of this application lies approximately 8km north, north-west of the Adelaide GPO. It lies on the northern side of Cromwell Road in Kilburn, equidistant between Churchill and Prospect Roads and approximately 400m south of Grand Junction Road.

The land, known as 80 Cromwell Road, is more particularly described in Certificates of Title Register Book Volume 5776, Folio 177 and Volume 5875, Folio 196 (containing the foundry operations) and Volume 5875 Folio 205 which together cover 32-36 Cromwell Road, in the Area named Kilburn, Hundred of Yatala. The subject land lies within the General Industry (1) Zone of the Port Adelaide Enfield (City) Development Plan.

The land has an area of approximately 5ha and contains an existing 12,500 dressed tonne per annum capacity foundry, operated by Bradken Resources Pty Ltd. A Locality Plan, showing the location of the subject land relative to adjoining land uses, is provided at Appendix D. Details of the existing site layout and equipment are provided at Appendix E.

3.1.1 Adjoining Roads

The land is bounded to the south by Cromwell Road (the primary road frontage). Access is also provided to the east of the land via Marmion Avenue, which terminates at the eastern site boundary.

- *Cromwell Road*

- sealed and kerbed residential road with wide verge and concrete footpath on either side. The road runs east-west along the southern boundary of the subject land between Churchill Road and Prospect Road;
- current weekday traffic volume of approximately 1,350 vehicles per day[3];
- total site frontage of approximately 250m to the subject land.

- *Marmion Avenue*

- sealed and kerbed residential street with concrete footpath on its northern side. The street runs east-west between the subject land and Prospect Road;
- current weekday traffic volume of 204-239 vehicles per day[3];
- total site frontage of approximately 9m to the subject land.

3.1.2 Adjacent Activities

The immediate locality comprises:

- South, directly opposite the subject land on Cromwell Road – the SA Canine Association Inc. including offices and substantial open grassed grounds. The Canine Association land contains sparse vegetation close to Cromwell Road, behind a well worn 2m high chain mesh security fence. A pedestrian walkway runs along the western boundary of the Canine Association's land, providing pedestrian access between Montgomery Road (to the south) and Cromwell Road;

- North – the Port Adelaide Enfield Kilburn Depot, including disused materials storage areas, office facilities and large ancillary car parking areas accessed off Grand Junction Road via Mill Court;

- East – established single storey residential development fronting Nelson Street and Marmion Avenue of predominantly post-war construction, but also including examples

[3] *Tonkin Consulting, Bradken Development – Traffic Assessment Report, August 2006*

of more recent infill development. There are a variety of dwelling types found within the locality, including detached dwellings, semi-detached (duplex) and group dwelling formats of varying periods, styles and quality.

- West – immediately adjacent the land to the west lies the Enfield Community Centre (housed in a 1960-70s styled office building) at the corner of Cromwell Road and Blackburn Street together with the operations of Plastics Granulating Services fronting Blackburn Street and further removed to the north-west of the subject land, on Inwood Avenue.

3.1.3 The Broader Locality

The subject land lies within the southern portion of the significant General Industry (1) Zone of the Port Adelaide Enfield (City) Development Plan, which covers an area of some $10km^2$ and extends across the suburbs of Regency Park, Kilburn, Wingfield, Dry Creek and Gepps Cross. The Zone contains railway maintenance facilities, transport operations, waste management facilities, large scale warehousing and medium to heavy manufacturing industries (eg furniture manufacturing and metal galvanising).

The wider area generally to the north of the subject land (bounded by Churchill Road, Grand Junction Road and Prospect Road) contains the following principal businesses:

- Korvest Ltd - Metal Fabrication;
- Junction Market - Fruit and Vegetable wholesale;
- OneSteel - piping, sheet metal, aluminium products;
- Coventry Fasteners – manufacturing bolts, nuts, etc;
- Motor Traders;
- IJF Australia – furniture manufacturers/contractors;
- Building and Landscape Supplies;
- Port Adelaide Enfield Council Depot;
- Plastics Granulating Services.

Further industrial and commercial uses are found on the western side of Churchill Road and following the railway corridor towards Islington Railway Yards to the South West.

The remainder of the broader locality is largely residential in nature, with the exception of the South Australian Canine Association, opposite the subject land, and the Kilburn Primary School at the corner of Churchill Road and Montgomery Road. Residential amenity within the locality can be described as fair, as can be anticipated at the edge of one of the State's most expansive and active general industrial areas.

3.1.4 Metropolitan Context

The scale and nature of the industries present in this locality (including the Bradken Foundry) represent the kinds of industrial investment encouraged within the Port Adelaide Enfield (City) General Industry Zone and supported also by the Planning Strategy for Metropolitan Adelaide (August 2006), which positions the subject land and surrounding industry within one of two "significant employment nodes" in the north western quadrant of metropolitan Adelaide (the other node being Port Adelaide). The locality forms part of the "business and industry employment area" extending from Port Adelaide through the north-western suburbs of Metropolitan Adelaide to Elizabeth. Industrial investment is strongly encouraged in this location, given the existing strategic links to major transport routes and port facilities, as is the protection of industry from incompatible land uses.

4.0 DESCRIPTION OF THE PROPOSAL

4.1 OVERVIEW

The proposal involves the upgrading of the existing foundry to improve performance and increase production capacity from 12,500 dressed tonnes to 32,000 dressed tonnes per annum over a projected three year period, primarily to meet existing and projected demand for steel products due to growth in the mining and industrial sectors. The structural elements of the proposal are detailed in plans prepared by Advitech for Bradken, at Appendix F.

The foundry process involves the production of steel castings from the melting of scrap steel feedstock in an EAF and the pouring of molten metal into sand moulds. The products produced at the site include mill liners, crushers and crawler shoes. There are essentially four stages in production:

- raw material handling and preparation;
- metal melting;
- mould and core production;
- casting and finishing.

The current facility employs approximately 180 staff. An additional 100 staff are expected to be employed at the upgraded facility (approximately 280 staff in total), with operations to continue, as currently, over 24 hours each day (three shifts per day) for 6 days a week.

The nature of the processes undertaken at the facility will not change as a result of the proposed upgrade. The production increase will be achieved through the replacement of the existing 10 tonne EAF with a new 20 tonne EAF and the installation of a fast loop moulding and cooling system. The proposal also involves the reorganisation of inefficient processes and upgrading of equipment to improve the quality of environmental outputs from the site and improve employee health and safety.

The proposal involves the following:

- demolition of the existing core bay and heat treatment building (Stage 1) and demolition of the existing pattern storage/alloy storage building (Stage 2);
- construction of a new furnace building (Stage 1) and a foundry bay extension to that building (Stage 2). The new building is to take the form of an addition to the eastern side of the existing foundry building;
- installation of a 20 tonne EAF at the northern end of the new furnace building, including installation of a fume control system;
- construction of a furnace control room and laboratory building;
- relocation of the mould pouring area from the main foundry building to the centre of the new furnace building;
- decommissioning of the original 10 tonne EAF within the existing foundry building;
- relocation of the existing jobbing/sand mixing area to the southern end of the new furnace building;
- relocation of the mould cooling area into the new furnace building;

- installation of a fast loop mould system within the existing foundry building;

- relocation of the pattern storage area to the southern end of the existing foundry building;

- relocation of the core bay area to the existing moulding building;

- extension to the western side of the aftercast building to accommodate additional workstations for the finishing of castings.

A more detailed description of the physical appearance of the proposed buildings and the function of the proposed plant is provided in the following sections.

4.2 BUILT FORM

The built form proposed essentially involves additions and alterations to the existing foundry building and after-cast building as follows:

4.2.1 Foundry Building Additions

An addition is proposed along the eastern wall of the existing foundry building. The addition is to comprise four principal building components, as follows:

- a furnace area of 840m^2;
- a furnace support area of 175m^2;
- a mould pouring area of 1,100m^2;
- a sand mixing area of 1,250m^2

The addition is to have a total floor area of 3,365m^2, a wall height of approximately 17.8m and a ridge height of 21.5m. The overall building height is dictated by the height and necessary clearances of the proposed EAF to be located within the building.

The building addition is to be externally clad in colorbond sheeting matching the material profile of the existing foundry building. The building colour is to be chosen from Bradken's corporate colour selection (which is consistent across all Bradken sites throughout Australia) and will include:

- *Walls and Roof* – a combination of colorbond "shale grey" and colorbond "surf mist";

- *Trim* – colorbond "deep ocean".

4.2.2 Aftercast Building Additions

A relatively minor addition is proposed to the eastern side of the existing aftercast building. The addition is to have a floor area of approximately 520m^2, an overall height of 9.85m, and is to be externally clad in colorbond sheeting matching the profile and colour of the proposed foundry building.

4.2.3 Product Storage Facilities

The proposal will provide the following storage facilities:

- Chemical store;
- Flammable liquids store;
- Chemical storage tanks;
- Diesel tank;
- Scrap steel storage;
- Used sand stockpile; and
- Waste sand/dust bunkers

The locations of each of these facilities on the site are shown in site plans provided at Appendix F.

4.3 LANDSCAPING

Minimal landscaping exists on the site, and is principally found around the existing stormwater detention basin on the eastern side of the property and along the Cromwell Road frontage. There is currently no landscaping theme or regular landscaping maintenance schedule.

As part of Bradken's commitment to general site improvement as part of the upgrade, a new landscaping scheme is proposed along the Cromwell Road frontage and eastern portion of the site to improve visual amenity for users of Cromwell Road and adjoining residential neighbours to the east.

The landscaping scheme is to comprise mass plantings of low-maintenance, high amenity plant species, including many native plants. Dense plantings are proposed in front of the car parking area and foundry buildings, fronting Cromwell Road, and further amenity landscaping is proposed within the front setback of the office building.

Additional dense plantings of native trees and shrubs are also proposed close to the eastern boundary of the site, between the acoustic mound and eastern property boundary.

All plantings will be irrigated and maintained in good condition by Bradken.

Details of the proposed landscaping scheme are provided in Appendix G.

4.4 VEHICLE PARKING ARRANGEMENTS

The existing staff car park provides 101 marked parking spaces. Several other informal parking spaces are provided throughout the remainder of the site.

It is proposed to extend the existing car park to the east in order to provide a total of 170 car parks – catering for shift overlap and maintaining the current level of parking provision on the site.

The car parking area is to be extended in line with staff demand generated at each stage of the upgrade.

Car parking areas are to be sealed and line marked in accordance with relevant Australian Standards.

4.5 ACCESS/ROAD NETWORK

There are currently six gated vehicle access points to the site along the Cromwell Road frontage, and an emergency-only access to Marmion Avenue.

Analysis of the frequency and nature of traffic currently using each Cromwell Road access point has been undertaken by Tonkin Consulting. The use of each access point, labelled A to F on the site plan appended to the traffic report at Appendix H, is not proposed to alter significantly as a result of the upgrade, and is as follows:

- Gate A –a minor access gate used infrequently by production traffic as an alternate exit to the main entrance when necessary.
- Gate B – the main entry/exit gate for all production traffic. Where necessary vehicles make their way around to the weighbridge on the eastern side of the aftercast building before travelling around the rear of the site and unloading product (ie scrap metal, sand, etc) at the foundry building or storage areas. Unloading/loading areas will be relocated as a result of the relocated processing positions (eg scrap metal will be delivered to the rear of the foundry building rather than the front of the building as

currently). Otherwise, traffic movements within the site will remain largely unaltered as a result of the proposal.

- Gate C and D – these provide access to the visitor parking entry/exit loop within the front setback of the existing site office building. Domestic vehicles and small delivery vehicles are to continue to use these entrances.

- Gate E – currently used by a small number of staff vehicles to access informal parking areas at the rear of the office building. This access is to be closed as part of the upgrade to rationalise office parking and to improve visual amenity.

- Gate F –a secure gated entry to serve the existing staff car park. This access will not be altered.

Details of the nature and frequency of the traffic entering/exiting each access point are provided in the traffic assessment report prepared by Tonkin Consulting at Appendix H.

4.6 TRAFFIC GENERATION/FORECASTS

The report at Appendix H details the nature and volume of vehicle movement likely to be generated by the upgraded facility as well as the likely vehicle movement anticipated during the construction period. The results of the analysis of the existing situation and projected figures are summarised below.

4.6.1 Operation

4.6.1.1 Existing Situation

The report estimates that the current average weekday daily traffic volume on Cromwell Road is 1,350 vehicles per day (range 1,235 – 1,500) which is within the acceptable threshold for a residential street.

The percentage of commercial vehicles (2 axle truck or larger) using Cromwell Road on weekdays is approximately 7-9% which is higher than normal for other residential streets.

Existing 12 hour volumes on Cromwell Road (between 6am and 6pm) are 1,060 – 1, 226 vehicles. The Bradken site generates 10.9 – 15.3% of this volume.

Over a 12 hour period, manual count driveway surveys indicate that approximately 300 vehicle movements can be attributed to the Bradken site (150 inbound and 150 outbound).

4.6.1.2 Future Traffic Generation

Traffic associated with the existing facility has been separated into three groups and multiplied by the following factors to determine the likely future traffic generated by the upgrade:

- production traffic x 2.56
  This is based on a directly proportional increase to production. This is likely to be an over-estimation, however, as it does not include efficiency gains through the new production process, which is described in section 4.7.2 below;

- visitor and administration traffic x 1.5;
  While administration and visitor traffic may increase, it is unlikely to be proportional to the increase in production;

- general staff traffic x 1.55
  This is directly proportional to the proposed increase in staff numbers.

On the above basis, 12 hour traffic volumes in Cromwell Road will increase by a modest 117-181 vehicles as a result of the upgrade and will be split between the eastern and western legs of Cromwell Road.

Therefore, total future 12 hour traffic volumes in Cromwell Road will be 1,177 – 1,407 vehicles. This represents an increase in traffic volumes of around 11-15% of the current 12 hour volumes, resulting in 24 hour volumes closer to the 1,500 vehicles per day accepted threshold for residential streets.

Approximately 25-40% of the increase in traffic will be attributed to additional staff numbers which will still be concentrated at the start and end of shift times. The general increase in production traffic will be spread throughout the day, typically between 7.00am and 4.00pm on weekdays.

4.6.2 Construction

The traffic report identifies that quantification of construction traffic volumes is difficult given the number of variables involved. However, based upon the anticipated value of the upgrade, and making some preliminary estimates of average truck loadings, the report estimates that 800 truck movements might be generated during the period of construction. This equates to approximately 6.4 truck movements per week (2.5 years and 50 weeks per annum), or an average of 1 per day.

The amount of construction traffic will vary from day to day depending on the actual work being undertaken. Construction labour will typically be between 15-30 people, but will vary throughout the construction period from anywhere between 4 to 45 staff.

These construction traffic estimates are not in addition to the future traffic generation at this site, since production cannot reach capacity until after the upgrade is complete.

4.7 PROCESS DESCRIPTION

The main processing operations at the site include: raw materials handling, metal melting, mould and core preparation, mould pouring, mould cooling, knockout and shakeout, knock off, heat treatment and finishing (which includes cleaning and fettling of the final castings and may also include welding and/or machining).

A detailed description of each of these processes is provided for both the current and proposed upgraded facility under items 4.7.1 and 4.7.2 below. These should be read in conjunction with the process flow diagrams prepared by Bradken at Appendix I.

4.7.1 Current Production Process: 12,500 tonnes per annum

Raw materials handling

Raw materials handling involves the receiving, unloading, storing and transferring of all raw materials required for processing in the foundry.

Raw materials currently supplied to the foundry include mild steel scrap (predominately car industry steel scrap) purchased from scrap merchants (eg Sims and Smorgon), alloy scrap (essentially worn out parts that Bradken has previously supplied to customers and which have been returned for recycling), manganese and chrome alloys, limestone flux, foundry sand (washed, graded and dried), mould paint, chemical binders and catalysts.

The materials are received in trucks as bulk, on pallets, or packaged in 1000 litre or 220 litre containers, where they are then transferred to on-site storage in open stockpiles, enclosed storage areas, silos or tanks.

“Buy back” alloy scrap is currently stored on-site and prepared by cutting any larger pieces of steel to a size suitable to fit into the furnace. This cutting process is currently undertaken adjacent the arc air bay.

Metal melting

The metal melting process includes:

- scrap preparation;
- furnace charging - in which metal scrap, alloys, carbon and flux (a metal cleaning agent) are added to the furnace;
- melting - during which the furnace remains closed;
- refining - where the alloy concentrations are adjusted to meet the metal specification required, this process is aided by;
- oxygen lancing - where oxygen is injected into the molten metal; and
- tapping the molten metal into a ladle to transfer to the moulds.

The current furnace is a 10 tonne EAF, which has three electrodes and is lined with heat resisting refractory bricks.

Scrap, alloys and flux are prepared and placed into the furnace (by removing the furnace lid) using "charging buckets" which are suspended from an overhead crane. Once the furnace is full the lid is closed and the melting process begins.

Electricity is passed through the three electrodes which then "arcs" to the steel, heating and gradually melting it. More alloys may be added to the molten steel to ensure that the metal is within the desired specification. Currently it takes approximately 3 hours to melt and refine 10 tonnes of steel. Metal fume is produced by this melting process, which is captured at and above the furnace and filtered using a baghouse.

The baghouse filters the particulate matter and discharges cleaned air. Particulates and fumes that are not caught by the extraction system become fugitives.

The molten metal is tapped by tilting the furnace and pouring the molten steel through a spout into a pre-heated ladle (also suspended from a crane).

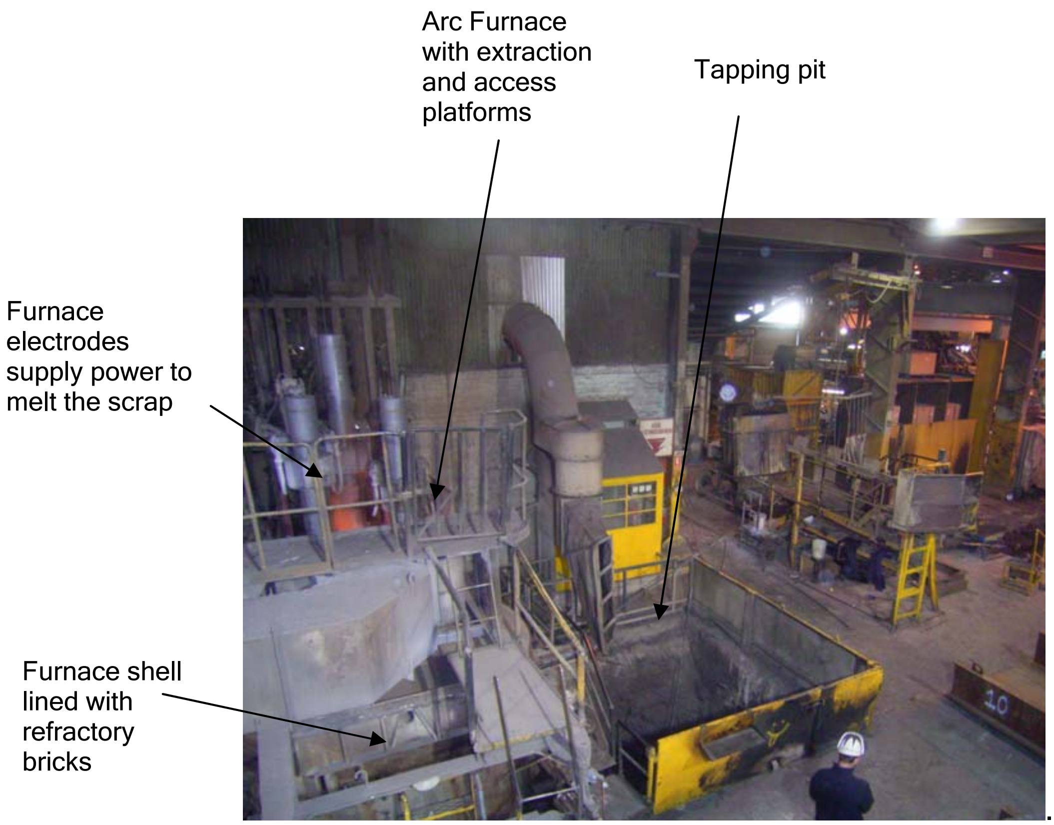

Figure 2: Scrap metal is placed into the arc furnace and melted using electricity

Figure 3: Molten metal from the furnace is tapped into a ladle for transport to the waiting sand moulds

Moulding, pouring and cooling

The mould design and specification is given to the "pattern shop" that makes a timber model (pattern) of the product. The pattern is placed into a steel "box" and sand (including binder) is poured around it and allowed to set. The pattern is removed and the sand mould painted ready to be used. For larger moulds, several boxes may be stacked on top of each other. This is currently a manual process.

"Moulds" are forms used to shape the casting exterior. "Cores" are sand forms used to make internal features of castings (e.g. bolt holes). Bradken makes these cores and moulds from sand which is mixed with a chemical binder.

At present, Bradken uses a binder system that falls within the generic binder group known as "alkali (or alkaline) phenolic". This system utilises two parts – a phenol/formaldehyde/urea resin, and a glyceryl triacetate and ester solvent mixture - that are combined with the sand. The parts react together and harden to hold the sand mould or core in the desired shape. Further information about the chemistry of this binder system is provided in Appendix J.

Molten metal is then poured from the ladle into the moulds and allowed to cool. The cooling is done in the "cooling shed" which is purpose built to capture and disperse the odour associated with cooling. Currently only 60 to 80% of moulds are cooled in the cooling shed, the remainder are too large to be moved and remain in the main foundry building.

Figure 4: Timber patterns are used to produce a cavity in the sand moulds and are a replica of the steel casting to be produced

Figure 5: Mixed sand covers the pattern and sets to produce a hard sand mould. The sand is contained within a steel moulding box and the wooden pattern is removed and reused.

Figure 6: The sand moulds are coated with refractory paint to obtain a good surface finish on the castings

Figure 7: Molten metal is poured from the ladle into individual sand moulds.

Figure 8: Poured moulds are stored for cooling, nominally up to 48 hours before knockout

Knock out and shakeout

Once the moulds are cool enough, they are "knocked out" to remove the casting from the sand moulds. Currently, there is not sufficient room within the cooling shed to accommodate this process.

The sand from the mould is then placed in the "sand shakeout" which screens tramp metal (unwanted metal) from the sand and transfers the sand to the reclamation area where it is cleaned, screened and made available for reuse. The shakeout operation has its own dedicated dust extraction and baghouse filter to collect the dust.

The sand used for making moulds is a combination of new sand and recycled sand. The current ratio is 40% new sand to 60% recycled sand. Any sand that is not recycled is a waste stream and sent to either beneficial reuse or to landfill.

Figure 9: The steel castings are retrieved from the sand mould in the knockout area

Knock off

“Risers” and “runners” which are used to assist the flow of molten metal into and around the mould, but are not part of the finished casting, result in large amounts of surplus metal being attached to the castings that is “knocked off” using a pendulum on a forklift. This surplus metal, known as “steel returns”, is returned to the furnace for remelting, and can be up to 30% of the steel that was melted for the casting.

Heat treatment

The castings are then heat-treated in annealing ovens, which use natural gas to heat the casting and maintain the casting temperature at around 1100°C. The castings are then either quenched in water or air cooled. The heating time, the holding temperature and the cooling rate are different for different products and are computer controlled. Heat-treatment alters the properties of the steel, making it stronger and harder.

Cleaning, fettling and despatch

After heat-treatment the casting is cleaned in a “shot blast” machine where steel shot (thousands of small balls, similar to a shot gun cartridge) is thrown at the casting to clean the surface of the casting - removing sand and scale that may remain from the heat treatment process.

Cleaning and fettling is carried out in the “aftercast” building. This involves using grinders to remove any excess steel from the casting. The arc-air gouging system and oxy-acetylene cutting is used to cut larger pieces of steel.

Some castings are machined in the “machine shop” where they require steel removal for “fit up” to mating parts or are machined (e.g. a casting may need a 20cm diameter hole machined through it).

Castings are inspected to make sure that they meet specification, some of which are painted, palletised and despatched.

Figure 10: Casting are cleaned and dressed in the Aftercast area

Figure 11: Castings are made ready for despatch after dressing, some are also machined and painted before despatch

4.7.2 Proposed Production Process: 32,000 tonnes per annum

The basic foundry process at the site will not change as a result of the proposed increase in capacity. Steel will continue to be produced by melting scrap, alloying, moulding, and finishing. Bradken will also continue to supply similar products into the same markets that are currently being supplied.

However, the capacity increase is achieved by upgrading plant and processes which will have significantly improved environmental controls in metal melting, pouring, mould cooling and arc air. The upgrade will also introduce a new chemical binder that will produce stronger sand moulds and improved sand reclamation rate than the existing phenolic binder.

The new arc furnace will improve melting electrical efficiency, reducing greenhouse gas emissions per tonne of metal produced, and the new moulding equipment will further improve sand and production efficiencies.

The proposed upgrade involves the following process, plant and equipment changes.

Raw material handling

Raw materials handling on site will be reduced from current levels. The majority of scrap cutting is to be carried out by scrap suppliers off-site, rather than at the foundry site.

The new chemical binder will allow the recycled sand ratio to be increased to 20% new sand and 80% recycled sand. This will enable the proposed increase in production without increasing the current level of new sand used since more sand is recoverable after use.

Metal melting

The metal melting process operations will not change after the upgrade. However, the new EAF will melt and refine 20 tonnes of steel in 1.5 hours, providing four times the melting capacity of the existing arc furnace. The new furnace also provides an improved level of occupational health and safety compliance.

The new EAF will have a higher fume extraction efficiency than the current model, significantly reducing fugitive fume from current levels.

The new furnace is to be surrounded by a noise attenuating enclosure which will also connect to the fume extraction system to minimise escape of fugitive emissions from this process.

Moulding, pouring and cooling.

The general moulding process will not change from that currently undertaken, however a higher level of automation is proposed. The proposed new binder will provide improved productivity, reduced sand and chemical use and a reduced level of rejects.

Bradken proposes to convert to a resin binder system that consists of two products:

- a furfuryl alcohol mixture
- a catalyst that is a mixture of sulphonic acid, and lactic acid

This system falls within the binder group that is known in industry as “Furane binders”. Further information about the chemistry of this binder system is provided in Appendix J.

The new moulding equipment will automatically transport moulds using conveyors and will be established within a central mould pouring area and a consolidated mould cooling area. The central mould pouring and cooling area will be fitted with a new fume extraction system (including baghouse filter) above the pouring area. This represents a significant improvement to existing management of fugitive pouring fume and odour emissions.

Fume and odour extraction is also proposed over the cooling area in order to eliminate the remaining fugitive odour emitted during the mould cooling process.

Knock out and shakeout

The knock out area will be relocated to sit inside the new building. Fume emissions and fugitive particulates will be collected and filtered by the new pouring area extraction system.

Knock off

The knock off process remains unaltered from that currently undertaken.

Heat treatment

The current heat treatment process remains unaltered as a result of the proposal.

Cleaning, fettling and despatch

The shot blast process remains unchanged.

Cleaning and fettling will use larger grinders to improve production efficiencies. Additional fume and particulate extraction plant will be installed to eliminate fugitive particulates and fume from the arc air process.

The machine shop, painting and despatch processes will also remain unchanged.

4.8 INFRASTRUCTURE/SERVICES REQUIREMENTS AND AVAILABILITY

4.8.1 Power

Electric power is presently supplied to the existing Bradken foundry site from ETSA Utilities infrastructure.

ETSA advises that a new dedicated transformer for the Bradken site will be required at the Kilburn substation together with a new 11kV power supply line in order to supply increased electrical demand generated by the proposed 20 tonne arc furnace. The site currently uses approximately 15,804 MWhrs per annum. It is estimated that the upgraded facility will use approximately 27,500 MWhrs per annum.

The ETSA Kilburn substation will be upgraded by ETSA and a new dedicated transformer installed to directly supply the new EAF. This will ensure that no electrical supply instability in the surrounding neighbourhood (e.g. lights dipping when the EAF is switched on) will occur. The existing power supply line from the Kilburn substation to the Bradken site will be upgraded and a new line installed by ETSA running underground from the north western intersection of Churchill Road and Grand Junction Road and along the eastern side of Churchill Road to Cromwell Road.

4.8.2 Water Supply

All water to the site, including process water, is supplied by SA Water through the metered supply system.

Based on actual metered potable water consumption, the existing facility uses approximately 6,600 kilolitres per calendar year (or 0.53 kilolitres per tonne of product produced). Water consumption for the upgraded facility is projected to be approximately 13,200 kilolitres per year (or 0.41 kilolitres per tonne of product produced). This improvement to water use per tonne is primarily due to increased labour productivity. As the number of additional employees on site is less than proportional to increased production capacity, the increase in employee water use (for toilet flushing, hand washing, showering and drinking) after the upgrade will also be less than proportional.

After the upgrade, some stormwater will also be captured for reuse in process areas, which will reduce the volume of water required from SA Water.

SA Water has confirmed that it can accommodate the requirements of the proposal without impacting upon existing users within the locality.

4.8.3 Natural Gas Supply

Natural Gas is supplied to the site under contract by AGL. Natural Gas is currently used on site primarily for heat treatment. Its use is to be extended to pre-heating of scrap metal in the new arc furnace since this is more efficient and cost effective than use of electricity for this process. Existing annual gas consumption is estimated at 121,089 GJ. The upgraded facility is anticipated to use 310,000 GJ per annum.

AGL advises that there is sufficient capacity within the existing system to accommodate these additional requirements.

4.9 MANAGEMENT OF CONSTRUCTION AND OPERATIONS

4.9.1 Construction Environmental Management Plan

Appendix M contains a Construction Environmental Management Plan (CEMP) for the proposal. The CEMP addresses the environmental control requirements to be applied during the construction phase of the proposal in order to mitigate construction impacts, and is based on AS/NZS ISO14001:2004 “Environmental management systems – Specification with guidance for use”.

4.9.2 Environmental Management and Monitoring Plan

The current site has Environmental Management Systems that are certified to AS/NZS ISO14001:2004 and is therefore subject to independent six monthly surveillance audits and a requirement to demonstrate continuous environmental improvement.

It is proposed that the site maintain this ISO certification and operate under a comprehensive "Environmental Management and Monitoring Plan" (EMMP) which is to provide the framework for managing and/or mitigating environmental outputs for the life of the facility as well as a tool for auditing the effectiveness of the proposed environmental protection measures and procedures.

A draft EMMP is contained within Appendix N.

4.9.3 Stormwater Management

A large proportion of the foundry site is built up or covered with an impervious surface, such as asphalt or concrete. Currently half of the stormwater run-off from impervious areas of the site is directed to a retention pond at the eastern side of the site. The retention pond is designed to allow infiltration of the collected stormwater into the underlying shallow unconfined groundwater aquifer. The remaining stormwater run-off, largely from the southern and western portions of the site, currently discharges to the roadside stormwater drains through a network of stormwater drains.

Details of the existing stormwater infrastructure on site are provided by Coffey Environments at Appendix K, and the Stormwater Management Plan prepared by Tonkin Consulting provided in Appendix L.

Surface water runoff from the southern and western half of the site will remain largely unaltered by the proposed upgrade, given that the impervious surface areas over the land will remain essentially unchanged from the current situation, and so no changes to existing stormwater infrastructure for that part of the site are required to accommodate the upgraded facility. However, stormwater from the roof of the new foundry building will be collected in part for reuse on site in process areas.

The upgrade will increase the impervious area draining into the retention pond by 17%. Some roof runoff from the Aftercast building will be collected for reuse on site. However, Bradken proposes to increase the capacity of the pond to 900kL to ensure that discharge rates into the Council infrastructure are minimised during high rainfall events.

Bradken is also committed to improving surface water management practices on site through implementation of actions contained within Table 5 of the Environmental Management and Monitoring Plan prepared for the facility. This involves regular cleaning and maintenance of hard stand areas and stormwater management infrastructure. A Stormwater Management Plan has also been prepared by Bradken which identifies areas for improvement to the existing system. The plan includes upgrading/improvements to water quality devices and the retention system.

4.9.4 Wastewater Management

All wastewater generated at the site (except that which is lost to evaporation) is discharged to the existing SA Water sewerage system. This system will remain unchanged for the upgraded facility. Trade waste volumes will, however, increase from 800 kilolitres per year to 1600 kilolitres per year due to the increased production.

Trade waste water discharges include: quench tank water and furnace cooling water discharged to allow cleaning; cooling tower blowdown from the furnace, quench, reclamation and transformer cooling towers; and machinery wash water discharged via the oil/water separator. These are tested in accordance with the requirements of the site's existing SA Water Trade Waste discharge permit for total dissolved solids, suspended solids, pH, oil and grease, chlorine, phenols, phosphorus, and various metals. Measured levels are compared against the allowable chemical characteristics for discharge as set out in the Trade Waste Permit.

SA Water advises that there is sufficient capacity in the existing Trade Waste system to accommodate the liquid waste volumes anticipated from the upgraded facility.

4.9.5 Solid Waste Management and Recycling

Activities associated with solid waste management are to be limited to segregation and collection on site. No processing of waste will be undertaken and all waste generated will be disposed or recycled as appropriate.

4.9.5.1 Construction

Solid waste generated through construction activities will primarily consist of the following:

- Excavation materials for building foundations;
- Existing concrete floors and foundations;
- Redundant building steelwork, roof and wall sheeting;
- Miscellaneous building materials;
- Waste water from construction activities;
- Packaging materials;
- Office and domestic waste.

The primary principles of Avoidance, Reduce, Reuse, Recycle and Acceptable Disposal will be applied to the demolition and construction activities.

The following controls are proposed:

- Work Instruction BK3-E001 General Environmental Rules;
- Work Instruction BK3-E-015 Disposal of Empty Spray cans;
- Wherever possible, bulk excavation material will be re-used on site;
- Surplus excavation material and concrete will be made available as clean fill;
- Waste demolition materials will be separated and stored in suitable containers for recycling;
- General wastewater from construction activities will be monitored and contained within the existing storm water runoff retention system;
- Liquid wastes shall be processed through the existing Bradken system (See BK3-E-009 Disposal of Liquid Wastes);
- Packaging materials, office waste and domestic waste will be processed through the existing Bradken waste management systems. (See BK3-E-010 Disposal of General Wastes).
- Contractors will be required to manage their waste streams as part of their contract. Details of which will become part of their Contract Conditions;
- All waste that is disposed of off-site will be transported to a licensed facility in accordance with EPA requirements.

Specific responsibilities and requirements for waste management during construction are outlined in the Construction Environmental Management Plan for the upgrade (refer Appendix M).

4.9.5.2 Operation

During production, the foundry produces the following solid waste materials:

- used foundry sand;
- sand reclamation plant baghouse dust;
- shot blast baghouse dust;
- furnace baghouse dust;
- furnace slag and waste refractory and ceramics;
- mixer washing sand and core bay sand;
- sand pebbles from reclamation plant;
- dust from road sweeper;
- spray cans for painting and dye;
- general waste.

These are to be handled and disposed of in accordance with sound waste management practices by suitable licensed contractors as detailed under Table 2 of the Environmental Management and Monitoring Plan for the site at Appendix N.

The following waste minimisation/recycling initiatives are also proposed:

- sorting and storage of wooden pallets for recycling;
- collection and storage of 200 litre drums for recycling;
- used foundry sand recycled through an attrition mill and returned to the silo for further use in moulds. Up to 90% of foundry sand can be recycled;
- collection and recycling of waste lubricating oils
- collection and recycling of office paper
- principles and initiatives developed by Zero Waste SA.

4.10 OTHER MISCELLANEOUS WORKS

Existing fencing along the Cromwell Road frontage is to be upgraded as provided in landscape plans at Appendix G.

Signage is to be limited to directional signage only. No new advertising signage is proposed as part of the upgrade. Any new signage will be dealt with via a separate application.

5.0 ANALYSIS OF EFFECTS

5.1 PREAMBLE

The Guidelines identified the main issues surrounding the proposal and detail the range of effects requiring examination and consideration. The proposed upgrade as presented in this Public Environment Report (PER) has been designed and refined to reflect, where required, the findings of the investigations carried pursuant to the Guidelines.

In formulating the proposal, and in preparing this PER, Bradken has drawn upon the extensive experience and technical resources of its company in the matters of market analysis, design efficiency and environmental best practice. In addition, the following experts have analysed the proposal (and relevant components) providing advice and input into the final function and design:

- Advitech Pty Ltd – engineering, project design, air and noise modelling;
- Economic Research Consultants Pty Ltd – economic analysis;
- Tonkin Consulting – stormwater management, traffic and parking assessment;
- Coffey Environments Pty Ltd – water quality;
- Golder Associates – Health Risk Assessment;
- Sonus Pty Ltd – noise assessment;
- Landscape Construction Services – landscape design;
- Nolan Rumsby Planners – town planning matters;
- Finlaysons – legal advice (environmental).

A detailed list of the project team and their qualifications is provided at Appendix Zi.

This section of the PER addresses matters raised by the Guidelines identified under the heading “Assessment of Expected Environmental, Social and Economic Effects”.

5.2 ECONOMIC ISSUES

A detailed assessment of the economic implications of the proposal is provided by Economic Research Consultants at Appendix C. The report provides an economic overview of the proposal from a number of perspectives, namely:

- the magnitude of the direct investment itself for the Region and State;
- the value of flow on effects to the Region and State (both direct and indirect);
- employment generation;
- considerations of State and Local Government costs.

The following sections of this report provide a summary of the findings of this report.

5.2.1 Local and State Economic Effects

The economic impacts of the proposed upgrade can be summarised as having 3 elements:

- the impacts of the investment expenditure;
- the impacts of the increased activity on site (both direct and indirect or downstream);
- other impacts – including environmental, social, and upstream economic impacts for customers of the company.

The upgrade investment spend is estimated at $40 million between the years 2007 to 2011, comprising $3.7 million for design and development, $7.6 million for building construction and $28.7 million for plant and equipment.

5.2.1.1 Impacts at the State Level

Design and Development

The investment associated with the design and development of the facility itself is estimated to generate a total of 95 person years of employment directly, and an additional 167 person years of employment through indirect impacts in the State. The present value of the outcomes in 2006 values for the State is estimated at $20 million, with the majority of this activity occurring in 2008 and 2009.

Operations

The direct employment levels from operation of the facility are estimated to reach 281 full time equivalents (FTEs) in 2010, and direct wages and salaries reach $17.6 million – with indirect impacts increasing the employment outcomes by a further 360 people and producing incomes in other economic entities with incomes of over $30 million per year by 2011. Therefore, associated with the proposal, there will be an estimated total of 640 jobs and incomes within the State of $50 million.

Of the 187 jobs directly created at Bradken, 117 jobs would be for skilled employees, while the balance of 70 jobs are for semi-skilled. The indirect impacts will be a mix of professional (business services), skilled, semi-skilled and unskilled positions.

Total State Economic Impact

The incremental increase in total economic activity if the investment is to occur (relative to the no investment case) is the creation of around 500 jobs in the State from 2011 on, with incomes generated of almost $40 million per year. Over the period 2006 to 2015, which entails the construction period in mainly 2008 and 2009, building up to full production potential by 2011 (and assuming 5 years of operation at this level) the present value in a 2006 context is almost $175 million in a total perspective. $63 million of this is wages and salaries paid at Bradken itself, while the balance is activity supported elsewhere in the economy.

5.2.1.2 Impacts at the Regional Level

This section estimates the economic impact of the proposal within the north west region of Adelaide.

Design and Development

The impact of the investment activity within the north west region of Adelaide has been estimated to generate 28 person years of employment directly, and a further 27 person years of employment through indirect impacts. However, it is anticipated that the workforce and suppliers to the activity will be drawn from all over the State. The present value of the outcomes in 2006 values for the region is $4 million, with the majority of this activity occurring in 2008 and 2009.

Operations

The direct employment levels for the region from operation of the facility are estimated to reach 197 (FTEs) in 2010, and direct wages and salaries reach $12.3 million – with indirect impacts increasing the employment outcomes by a further 107 people and producing incomes in other economic entities with incomes of over $9 million per year by 2011. Therefore, associated with the proposal, there will be an estimated total of 304 jobs and incomes within the region of $22 million.

Total Regional Economic Impact

The upgrade is estimated to be creating 213 new jobs in the region annually from 2011 on, and generating new incomes in the region of $16 million. Over the period 2006 to 2015, the upgrade is estimated as creating in the region, new incomes with a value of $77 million (present value) – with $44 million of this in the form of incomes for residents employed at Bradken itself.

5.2.2 Other Economic Outcomes

A further aspect of the analysis involves the context of Bradken's customers. It is expected that much of the growth in Bradken's business is expected to come from activity in the State – including the resources and defence sectors.

It is also reasonable to expect that Bradken's existence as a local supplier adds value to its customers, (increased security of supply, delivery cost efficiency, local technical assistance, etc) making the customers more competitive and thus enhancing the State's economic future in this context.

A final economic impact aspect is the implications for State and Local Government. In the case of State Government there is the taxation implications of increased economic activity (ie GST payments, payroll tax, land tax, etc). This is more limited from a Local Government perspective. There is no information presented on specific costs that would be faced by either tier of government on the basis of this proposal. However, no improvements to public infrastructure by State or Local Government are anticipated to be required as a result of the proposal going ahead.

5.2.3 Relevance of Location

Given that a significantly larger investment would need to be undertaken by Bradken to relocate operations to an alternative site, the economic benefits discussed above can only be achieved by the upgrade and expansion of capacity of the current site. If Bradken were to relocate its operations, the cost of producing each tonne of product would be higher. As such, Bradken would either be forced to reduce profitability by not recovering those additional costs from its customers, or risk reducing its competitiveness and possibly losing customers by increasing its prices to cover the additional costs.

There is also a significantly higher risk that Bradken will not be able to meet customer demand during the transition from the existing site to the alternative site (relative to the risk posed by an on-site upgrade), which would result in the possible loss of both existing customers and potential new customers.

Further, Bradken's use of the existing infrastructure at the Kilburn site to generate economic benefit frees up land at the Cast Metals Precinct for new investment, which will in turn provide further economic benefit to South Australia and the Northern region of Adelaide.

5.3 EFFECTS ON COMMUNITIES

5.3.1 Employment

5.3.1.1 Construction

Preliminary resource projections for construction of the upgrade anticipate employment in mechanical, electrical, civil, concrete and general building trades. A preliminary outline of the level of construction labour required throughout the construction period is provided at Appendix O.

It is envisaged that the majority of the workforce will be sourced from within metropolitan Adelaide, however contractors will be required to "win" that work on a competitive tender basis, which may also include tenders submitted by interstate contractors for selected trades.

The remainder of the construction workforce may be sourced from interstate or overseas and is likely to consist of specialised technical assistance from specialist engineering consultancies during construction and from equipment suppliers during commissioning. These people will most likely seek short term accommodation either within the local area or within the city centre, as is the current practice for visiting persons/specialists.

5.3.1.2 Operations

Details of the projected operating employment for the proposed facility is provided within Table 6 of the Economic Impact Assessment Analysis report provided at Appendix C.

Some 100 new jobs are to be created between 2008 and 2011 in order to operate the facility at its proposed new capacity. The current level of employment, at 182 FTEs is projected to remain relatively stable between 2006 and 2008, with the majority of operating employment growth to occur between 2009 and 2011. It is anticipated that 58 of these jobs will be for skilled employees and the remaining 42 for semi-skilled labour. Such numbers, whilst significant in employment and income generation terms, are not of themselves of such magnitude so as to impact significantly upon the provision of local and regional social services present within the area.

5.3.2 Amenity and Health Impact

Details of air emission investigations in relation to odour, particulates and other emissions, carried out by Advitech, are provided at Appendix P and are also discussed in Section 5.4 of this PER. A noise modelling report detailing expected noise levels at nearby receivers is provided at Appendix Q and the conclusions of the report are discussed in Section 5.4.2 of this PER.

Ground level odour and particulate levels currently experienced at nearby residences and other receivers will all decrease as a result of the upgrade. Further, the ground levels of a number of other air emissions such as nitrogen oxides, ammonia, benzene, formaldehyde, phenol, xylene and more than 20 other substances are also expected to decrease below current levels as a result of the upgrade.

The impacts on receivers and the improvements to amenity generated by the upgrade were considered by Golder Associates in preparing a Health Risk Assessment (HRA). The report prepared by Golder Associates is provided at Appendix R.

Golder undertook the HRA according to national risk assessment guidelines published by enHealth in 2004. The HRA process comprised issues identification, hazard assessment, exposure assessment, risk characterisation and uncertainty assessment. Forty-six substances of interest were considered in the HRA. These were particulates (PM_{10} and $PM_{2.5}$) and dioxins, which were designated substances of interest by the Guidelines, and 43 substances that were identified from recent tests at the Bradken facility in Western Australia using the current Alkali Phenolic resin and the proposed future Furane resin. Substances that were not detected in any of the testing were not considered in the HRA.

The ground level concentrations of each substance considered in the HRA were those modelled by Advitech, presented in Appendix P and section 5.4 of this PER. The air modelling was reviewed independently by CSIRO Marine and Atmospheric Research and found to be appropriate given the location of the foundry and the types of emission sources present.

The findings of the Health Risk Assessment are that:

- The maximum ground level concentrations (calculated over a 3-minute averaging period) for the emissions generated by the current operations and proposed future operations indicate a potential improvement in air quality around the site as a result of the upgrade, even though production rates would be increased, with generally lower concentrations and an associated higher margin of safety;

- The cumulative impact Hazard Index (HI) for emissions after the upgrade is within reference values and about three times lower than the HI value for the current operation;

- The maximum ground level concentrations (calculated variously over 1 hour, 24 hour and annual averaging periods) for the criteria pollutant emissions expected to be generated by the future operations (carbon monoxide, nitrogen oxides, sulphur dioxide and particulates) do not exceed Health-related reference values, either when considered alone or in addition to average background concentrations;

- The maximum ground level concentrations (calculated over 24 hour and annual averaging periods) for the inorganic and organic emissions expected to be generated by the future operations do not exceed Health-related reference values. The cumulative impact of these emissions on air quality and health is not considered to be a cause for concern;

- Assessment of the excess lifetime cancer risks associated with maximum ground level concentrations (calculated over an annual averaging period) indicates that they are not a cause for concern.

5.3.3 Visual Effects

5.3.3.1 Built Form and Landscaping

The subject land is located within the General Industry (1) Zone of the Port Adelaide Enfield (City) Development Plan. Within the zone, large scale industry, and consequently, large scale industrial buildings are anticipated.

Siting

The proposed building extension is to be sited on the eastern side of the existing foundry building, within an existing cluster of processing buildings. The proposed extension is no closer to Cromwell Road frontage than the existing foundry building (having a set back of 29.4m) and does not encroach on the existing setbacks provided to adjoining residential development.

Height

The tallest existing building on the site is the Machine Shop building which has a total height of approximately 14.9m. The proposed furnace building addition is to have a wall height of 17.8m and a ridge height of 21.5m.

The height of the furnace building extension is dictated by the proposed use of the building. The design is, by necessity, driven by function rather than form, with the most efficient management processes being of paramount importance.

To this end, it is noted that the height is required to allow for the safe, efficient and clean operation of the new 20 tonne furnace. The height is determined by the structure and design of the furnace itself, in addition to the clearances required for emissions ducting, crane structure, and standard access for maintenance personnel above the crane.

The following design aspects contribute to the overall height of the building:

- the furnace foundation;
- the furnace structure;
- the furnace side vent ducting and extraction system;

- the crane rail, which must be above the top of the ducting to ensure safe crane operation. The proposal provides minimal clearance between the crane rail and the top of the ducting;
- the crane itself, which must fit under the roof of the building. As it has a 40 tonne carrying capacity, it is a significant structure in its own right. The crane hook will also hang below the crane structure at its maximum height.
- the crane must have an acceptable clearance between the top of the crane and the eaves to enable a safe working environment for maintenance crews. This clearance is, at minimum, standing height;

Other design considerations include:

- a charge bucket is used on every heat. The charge bucket must be able to pass over the furnace in order to load the furnace, and is carried by the crane.
- periodically, new electrodes are fitted to the furnace. These electrodes must be able to pass over the furnace and are carried by the crane.

The overall building height will be designed to the minimum possible height during detailed design phase, however; it will likely remain a similar height based on the design limitations described above as well as the recommended installation heights and clearances required by the furnace and crane supplier.

Materials and Colours

The extensions will be externally clad in colorbond sheeting. The colour scheme for the proposed extensions is to be in accordance with Bradken's corporate colour scheme (which is applied to all of its operations across Australia). The simplest means of reducing visual impact is to repeat the form of the surrounding landscape which, in this instance, consists essentially of a dark land mass and built form at ground level and vast light coloured sky. Accordingly, it is proposed that the corporate colour scheme be applied in the following broad manner:

- Walls up to three metres – be finished in colorbond "shale grey" to provide a dark background to conceal doorways, provide a "shady" background and break up the vertical element of the building;

- Walls above three metres and roof – be finished in colorbond "surf mist" to blend with large masses of the sky;

- Detailed Elements – such as doors, canopies, downpipes etc, to be finished in colorbond "deep ocean".

Views

A series of photomontages of the proposed buildings are provided at Appendix S which demonstrate the likely appearance of the site when viewed from public roadways (taken from nearest residences lining these roads).

Obscured glimpses of the top portion of the proposed foundry building will be possible on approach from the west, when travelling east along Cromwell Road as well as Foote Avenue. Similarly, obscured views of the building will be possible from Marmion Avenue and when approaching from the east along Cromwell Road. Existing built form along Blackburn Street and Nelson Street prevent views of the site from these vantages.

From the Cromwell Road frontage, the overall height of the main foundry building is proposed to be obscured through the addition of new solid 2m high fencing along the property boundary (between the western property boundary and the main gate) which is to be back-planted with trees. This will serve to enclose the streetscape along this section of Cromwell Road so that the fencing and landscaping become the dominant elements, obscuring direct views to the building behind (refer landscape plan provided at Appendix G). Similarly, fencing and plantings across the front of the staff car parking area are to be substantially improved through the addition of a new 2m high open steel fence, back-planted with dense shrubs and canopy trees so that vegetation along this section of the property will become the dominant streetscape element. Presently, the chainmesh and colorbond fencing, with sparse plantings between, could be said to detract from the streetscape. The proposed planting scheme and new fencing will redress this. Further canopy tree plantings are proposed within the staff car park at a rate of 1 tree per 2 parking spaces to provide shade for staff vehicles during summer months and grassing of the road verge is proposed to assist in “greening” the site generally when viewed from Cromwell Road.

Views of the buildings from existing residences to the east of the site will be obscured by dense plantings of native trees and shrubs along the eastern side of the property, between the noise mound and the eastern boundary fence. Views will also be possible from across Cromwell Road, within the SA Canine Association grounds.

The building extension is not an unattractive addition to the existing cluster of processing buildings on the site in any event, and coupled with general site improvements (such as landscaping and moving untidy processes/storage areas to the rear of the site or indoors) the proposed upgrade is expected to result in a tidier looking site when viewed from neighbouring properties and public roadways.

5.3.3.2 Lighting and Signage

The proposed building extension will require external task lighting around loading/unloading areas as well as low level security lighting directed towards doorways, entrances, paths, etc.

All lighting will be suitably angled and baffled so as to avoid nuisance to adjoining residential neighbours and road users within the locality.

Any signage is to be small scale and directional in function. No large scale advertising signage is proposed as part of the upgrade.

5.3.4 Community Consultation

Bradken is committed to maintaining open and constructive communication with relevant government agencies, industry bodies, neighbours and the broader community on environmental matters associated with its steel casting business.

To date, Bradken has communicated with its direct neighbours and local community through the following channels:

- Complaints Handling – Bradken aims to respond promptly and directly to community complaints. An on site Environmental Officer is charged with the responsibility of receiving and responding to any complaints to ensure that appropriate corrective action is carried out in a timely manner. Where the person making the complaint requests it, the Environmental Officer will contact the person again after the necessary action is taken to report on the findings of any investigation and the measures taken to remedy the situation.

- Environmental Forum Attendance - Bradken has maintained active participation in the local Inner Northern Environmental Forum (convened by the Port Adelaide and Enfield Council) since its inception in 2000. The forum involved local residents, industry members and PAE council officers and provided a mechanism for the community to raise concerns, share information and provide feedback to each other. Bradken used these forums to keep the local community informed of new developments and also presented an overview of the business and associated environmental issues to the Forum at an Industry night in 2003. This was attended by local residents, the EPA and Local Government representatives.

- Bradken site tour - In 2002 Bradken, in response to interest at the Forum, agreed to conduct a tour of the Kilburn site to give the local residents a better understanding of the processes carried out in a foundry. The tour was advertised as a regular meeting of the Forum via the Messenger press and flyers were distributed to all regular Forum attendees. It was attended by over 20 local residents, PAE officers, and the EPA. The tour provided Bradken with focused feedback that eventually led to a redirection of environmental priority for the site.

- Resident Reference Group - Bradken has conducted six meetings at the Kilburn site with a local residents' reference group since August 2000. Information was shared with residents and the company had an opportunity to provide and receive feedback on environmental issues.

In relation to the upgrade, Bradken has provided information to the community and obtained feedback from community members through:

- Personal Notification – During the first half of 2006, Bradken has delivered two letters each to 60 residential occupiers within the immediate area to inform local residents of the intention and progress of the proposed upgrade application.

- Resident Meeting – Bradken invited the 12 residents who made public submissions in relation to the Major Development Issues Paper and the People's EPA (which also made a public submission in relation to the Issues Paper) to a meeting in September 2006 at a local hall in Kilburn. At this meeting, the issues and concerns raised in the written submissions were discussed, and Bradken provided further information to the attendees about the proposal and how the upgrade would address those issues and concerns. The meeting attendees also assisted in identifying additional measures for Bradken to consider in developing the proposal and preparing this PER.

Further community consultation during the PER public consultation process will involve attendance by key Bradken personnel and appropriate experts at a public meeting convened by Planning SA at an appropriate venue close to the site to hear public comment on the proposal and provide further information where necessary.

Bradken will continue to attend relevant forums and liaise with local residents, relevant government agencies and community groups to provide information and monitor feedback on its ability to effectively manage site environmental issues. During construction and commissioning of the upgraded plant, Bradken will notify potentially affected residents and will inform the wider community by posting information on the Bradken website.

Further, Bradken's recent consultation with residents has resulted in the implementation of two new measures to improve the ways in which residents can report complaints:

- Phone complaints direct to Bradken – During office hours (8:00am – 4:30pm), phone complaints can be made by calling Bradken reception. These calls are directed to the appropriate person on site for immediate investigation and resolution. Outside those hours, calls to Bradken reception will now give access to a recorded message, directing the caller to the senior person on site at the time who has the authority to investigate the complaint and take immediate corrective action as required.

- Complaints to the EPA - The Bradken Environmental Officer has set up an email link with the EPA licence co-ordinator for the site, who will re-direct to Bradken, as soon as possible, all relevant complaints received by the EPA. The Bradken Environmental Officer will investigate the complaint, ensure corrective action is taken and will report back to the EPA and to the complainant if appropriate.

These measures will be further refined in response to public submissions in respect of this PER, feedback from the public meeting and comments obtained during future community consultation.

5.4 ENVIRONMENTAL ISSUES

5.4.1 Air Quality

The results of odour, particulate and air emission (including dioxin) modelling indicate that after the site is upgraded and production is at the proposed 32,000 tonne level, ground level concentrations of odour, particulates and fume constituents from the foundry operations will all be within relevant design criteria set out in:

- South Australian EPA Guidelines for odour assessment using odour source modelling (February 2006);
- National Environment Protection (Ambient Air Quality) Measure (as varied 2003);
- South Australian EPA Guidelines for air quality impact assessment using design ground level pollutant concentrations (DGLCs) (January 2006);
- National Dioxins Program - National Action Plan for Addressing Dioxins in Australia 2005.

Modelling of odour and chemical emissions to the atmosphere for the current operations using alkali phenolic resin and the proposed future operations using the new Furane resin binder system was undertaken by Advitech to determine the impact of the proposal on the air quality in the surrounding neighbourhood. This modelling is provided at Appendix P and has the following conclusions.

- the predicted Ground Level Concentration (GLC) of odour for the future Furane resin binder operating scenario realizes a significant improvement on the current situation;
- the predicted Ground Level Concentrations (GLCs) of detected chemical substances for the future Furane resin binder operating scenario realize a significant overall improvement on the current situation;
- all modelled air emissions for future operations (Furane binder) are below the design criteria set out in the South Australian EPA Guidelines for air quality impact assessment using Design Ground Level Pollutant Concentrations (DGLCs) (January 2006).

Further, emissions of particulate matter from the site operations will be significantly reduced from current levels after the upgrade.

These improvements are due to a combination of improved ventilation and emission capture, improved stack design and the change of resin binder used in the production of casting moulds.

5.4.1.1 Odour

Since 2004, Bradken has been implementing an EPA-approved Environment Improvement Programme (EIP) at the site, which focuses on odour reduction. Stage 1 of the implementation, which involved the enclosure of processing areas in the north-western corner of the site, is already complete.

The proposed upgrade of the facility will form the second stage of the implementation of the EIP and will feature improved ventilation of the production areas, additional air filtration and the construction of more efficient stacks, which together will more effectively capture, remove and disperse air emissions than the current buildings. Odour control technology will be applied to the mould pouring and cooling emissions stacks. A proposed new Furane resin binder system will also be used in casting operations. This system is the current “best practice” foundry sand binder system that is displacing the use of alkali phenolic resin throughout Europe and in the USA, primarily due to its low odour characteristics.

As such, even when the facility is operating at its expanded capacity, the odour levels experienced in the surrounding areas will be significantly less than current levels,

The odour modelling carried out using odour test results from a trial of the proposed new Furane resin binder system indicates that the maximum ground level odour concentration (99.9^{th} percentile, 3 minute averaging period) after the upgrade will be 1.57 Odour Units (OU). This complies with the odour criteria of 2 OU set out in the South Australian EPA Guidelines for odour assessment using odour source modelling (February 2006).

The air quality model indicates that, to achieve the EPA odour criteria, it is necessary to install emission control technology on the cooling line fugitives, the shakeout baghouse stack and on certain mould cooling and mould pouring emission stacks. At this stage however, the control technologies to be used on these sources have not been finalised and as such only generic efficiencies have been used in the air emission modelling. During the detailed design phase it will be necessary to evaluate the available technologies to select the most suitable system to achieve the predictions presented in the modelling report.

Control of the odorous gases from emission streams to the extent assumed in the modelling can be achieved by the following methods either individually or in combination:

- Dispersion (increasing the height of the stack, increasing discharge velocity);
- Absorption by a liquid solution (liquid scrubbing);
- Adsorption on a porous adsorbent (activated carbon absorption); and
- Chemical conversion of pollutants into benign compounds (incineration)

Initial review of available technologies indicates that adsorption using activated carbon will provide the most feasible control solution with a full scale adsorption system having the potential to remove 99.9% of the odours. Large scale, granular activated carbon adsorption systems have been applied successfully in sewerage pumping stations, sewerage treatment works and are used for odour control in steel foundries overseas.

This initial assessment will however be subject to a more rigorous review by expert environmental design consultants following commencement of the upgrade. Subsequent detailed design will then be completed to satisfy the EPA that the emission reduction efficiencies assumed in the modelling and the predicted ground level concentrations will be achieved.

5.4.1.2 Emissions from Stacks and Fugitive Sources

Details of the current emissions to the atmosphere from stacks and fugitive sources and expected emissions after the upgrade are set out in the report in Appendix P. The expected emissions were modelled using air emission test results from a trial of the proposed new Furane resin binder system at a Bradken facility in Western Australia. Duplicate samples were taken during the trials to ensure the reliability of the results. The air emissions from the current alkali phenolic resin binder were also tested at the Western Australian facility to provide comparable data for the purposes of modelling the current emissions.

Where a substance was detected during the testing in one or more of the air samples for a resin binder system, but not in all of the samples for that resin binder system, the modelling has assumed a “worst case” in relation to the samples in which the substance was not detected, and used the laboratory detection limit for the substance to derive the emission rate. That is, where the actual concentration of the substance in the stack gas was somewhere between zero and the detection limit, the model has assumed that the substance was present at the detection limit. As such, the modelling results for a number of substances set out in Appendix P and in the following table are highly conservative. Actual ground level concentrations are likely to be lower than those given in the modelling results.

The predicted maximum Ground Level Concentrations (GLCs) of detected constituents of foundry emissions for the current operations and for future upgraded operations at full expanded capacity (using the Furane resin binder system) are set out in the table below:

Substance	Maximum GLC		Criteria (Toxicity)	Units	Averaging Period
	Current	Future			
1,3,5 Trimethylbenzene	0.0149	0.000418	4.1 (2)	mg/m^3	3-min
Acetaldehyde	0.0377	0.0219	5.9 (1)	mg/m^3	3-min
Acrolein	0.000563	0.00039	0.00077 (1)	mg/m^3	3-min
Ammonia	0.0197	0.00823	0.6 (1)	mg/m^3	3-min
Benzaldehyde	0.000433	0.00108	0.31(2)	mg/m^3	3-min
Benzene	0.0733 *	0.0139	0.053 (1)	mg/m^3	3-min
Benzo (a) pyrene	3.34×10^{-6}	1.07×10^{-6}	0.00073 (1)	mg/m^3	3-min
Butanaldehyde	0.0174	0.00590	2.42 (2)	mg/m^3	3-min
Butanol	0.000653	0.000856	5.1 (1)	mg/m^3	3-min
Butyl acetate	0.000344	0.00111	23.8 (1)	mg/m^3	3-min
Cresol	0.0181	0.00276	0.73 (2)	mg/m^3	3-min
Cyanide	0.00673	0.00861	0.17 (1)	mg/m^3	3-min
Cyclohexanone	0.000205	0.00103	3.2 (1)	mg/m^3	3-min
Dimethylphenols	0.0342	0.00111	0.3095 (2)	mg/m^3	3-min
Ethyl Acetate	0.0142	0.0051	23.6 (1)	mg/m^3	3-min
Ethylbenzene	0.00522	0.00133	14.5 (1)	mg/m^3	3-min
Formaldehyde	0.0225	0.0183	0.04 (1)	mg/m^3	3-min
Furfural	7.68×10^{-5}	4.16×10^{-5}	0.26 (2)	mg/m^3	3-min
Glutaraldehyde	0.000186	0.000304	0.027 (2)	mg/m^3	3-min
H_2S	ND	0.0171	0.47 (1)	mg/m^3	3-min
Isopropylbenzene	0.000173	0.00339	8.1 (1)	mg/m^3	3-min
Methylethylketone	0.00141	0.0052	16 (1)	mg/m^3	3-min
Methylisobutylketone	0.000708	0.00103	6.7 (1)	mg/m^3	3-min
Naphthalene	0.00168	0.00136	1.73 (2)	mg/m^3	3-min
Pentanaldehyde	0.000521	0.000413	5.8 (2)	mg/m^3	3-min
Phenol	0.0146	0.00263	0.13 (1)	mg/m^3	3-min
Propanaldehyde	0.0173	0.00161	1.58 (2)	mg/m^3	3-min
Styrene	0.000359	0.00119	6.97 (1)	mg/m^3	3-min
Toluene	0.0232	0.262	12.3 (1)	mg/m^3	3-min
Xylene	0.0258	0.0159	11.4 (1)	mg/m^3	3-min
CO	2.87	4.91	29 (1)	mg/m^3	1-hr
NOx	0.0502	0.0464	0.113 (1)	mg/m^3	1-hr
SO_2	0.000972	0.304	0.45 (1)	mg/m^3	1-hr
Dioxin	0.00022	0.000169	0.0037 (3)	ng/m^3	3-min
PAHs					
Acenaphthene	0.0001	2.18×10^{-6}	NIC	mg/m^3	3-min
Acenaphthylene	2.93×10^{-5}	5.29×10^{-6}	NIC	mg/m^3	3-min
Anthracene	0.000223	5.07×10^{-6}	NIC	mg/m^3	3-min
Benz (a) anthracene	5.46×10^{-6}	1.07×10^{-6}	NIC	mg/m^3	3-min
Benzo (a) pyrene	3.34×10^{-6}	1.07×10^{-6}	NIC	mg/m^3	3-min
Benzo (b) fluoranthene	1.05×10^{-4}	1.07×10^{-6}	NIC	mg/m^3	3-min
Chrysene	3.89×10^{-6}	1.07×10^{-6}	NIC	mg/m^3	3-min
Fluoranthene	3.78×10^{-5}	2.05×10^{-6}	NIC	mg/m^3	3-min
Fluorene	1.67×10^{-4}	7.23×10^{-5}	NIC	mg/m^3	3-min
Naphthalene	0.00168	0.00136	NIC	mg/m^3	3-min
Phenanthrene	1.73×10^{-4}	6.03×10^{-5}	NIC	mg/m^3	3-min
Pyrene	1.68×10^{-5}	1.04×10^{-5}	NIC	mg/m^3	3-min
TOTAL PAHs (as components of coal tar pitch and carbon black)	0.00255	0.00152	0.73 (1)	mg/m^3	3-min

(1) – indicates criterion is taken from SA EPA Guidelines for air quality impact assessment using Design Ground Level Pollutant Concentrations (DGLCs) (January 2006).

(2) – indicates criterion is derived from a TWA (time weighted average) or published criteria in accordance with the SA EPA Guidelines for air quality impact assessment using Design Ground Level Pollutant Concentrations (DGLCs) (January 2006). See the Health Risk Assessment prepared by Golder for details of the derivation.

(3) – indicates criterion is taken from the National Dioxins Program – National Action Plan for Addressing Dioxins in Australia 2005.

* – indicates maximum predicted GLC is above the relevant criterion.

ND – indicates substance was not detected in any samples for the relevant resin system.

NIC – indicates no individual criteria.

Potential Formation of Dioxins

Dioxins are groups of organic compounds that are subject to a United Nations Environment Program (Stockholm Convention on Persistent Organic Pollutants).

Dioxins may be produced in small amounts when oils and other hydrocarbons in the presence of salt or other source of chlorine are heated to between 200 and 400°C. Dioxins are generated by a range of sources, including bushfires, coal combustion, cars, oil combustion, cement production, crematoria and electric arc furnaces used in foundries. In the foundry industry, the only identified potential source of dioxins is the furnace operations. The main cause of dioxin creation in foundry furnaces is the melting of metal that has become contaminated with oils and organic matter.

"Furans" are another group of organic compounds closely related to dioxins that are subject to the Stockholm Convention on Persistent Organic Pollutants. Furans can be produced when certain organic materials are heated to between 200 and 400 °C in the presence of chlorine. These compounds should not be confused with "Furane binders", which are mixtures containing furfuryl alcohol and acids that are used in steel foundries to produce sand cores and moulds. Furane binders take their name from their main constituent, furfuryl alcohol, and are not linked to the generation of furans. Further information about the chemistry of Furane binders is provided in Appendix J.

Under the National Dioxins Program, Australia's Environment Protection and Heritage Council has produced a National Action Plan for Addressing Dioxins in Australia 2005, which meets part of the obligations to reduce dioxin releases set under article 5 of the Stockholm Convention. The National Action Plan goals for dioxin emissions from combustion sources discharging to atmosphere are 0.1 ng/m^3 (TEQ) at stack exit, and 0.0037 ng/m^3 at ground level.

Recent measurements at the Kilburn site determined that emission levels at stack exit were around 0.0025 ng/m^3 (TEQ). As such, the site is currently discharging at levels equivalent to 2.5% of the stack exit standard. This emission rate is equivalent to 0.034 micrograms per tonne (µg/tonne) of metal melted. Studies in other jurisdictions have found average emission rates for iron and steel foundries to be 1.84 µg/tonne (US), 0.7 - 10 µg/tonne (UK) and 4.3 µg/tonne (the Netherlands).[4] The measured levels from the Kilburn foundry are therefore much lower than those reported from overseas. The modelled ground level concentration for the site as it currently operates is 0.00022 ng/m^3, which is less than 6% of the National Action Plan ground level goal (0.0037 ng/m^3).

Using the measured dioxin emissions from the existing 10 tonne EAF exhaust stack, modelling results for dioxin emissions from the upgraded facility operating at full expanded capacity indicate that the maximum ground level concentration of dioxin from the facility will be 0.000169 ng/m^3, which is around 4.5% of the National Action Plan ground level goal.

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[4] "Sources of Dioxins and Furans in Australia – Air Emissions" (Pacific Air and Environment, 1998), commissioned by the Commonwealth Department of the Environment and Heritage.

The main reason for the low dioxin emission levels at the Bradken foundry is the quality of scrap used and Bradken's "scrap buy back plan" under which Bradken actively buys its products back from its customers at the end of their useful life to remelt and recycle the metal. This has a range of benefits including less potential for furnace contaminants (organics and chlorides) that can produce dioxins.

This scrap buy back plan will continue to be implemented after the upgrade. Bradken will continue to purchase clean scrap, giving preference to buying back Bradken products to recycle. Administrative measures also include purchasing low chlorine-containing fluxes such as limestone and fluorospar. Further, the upgrade will incorporate modern dust and fume extraction equipment, and the new furnace will meet all the relevant criteria set out in the Draft "guidelines on best available techniques and provisional guidance on best environmental practices relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants" (31st Jan, 2005), prepared by the United Nations Environment Programme, such as rapid cooling of furnace gas emissions to below 200°C and treatment of the furnace gas emissions by a baghouse, fitted with a bag leak detection device.

Particulates

Particulate matter that is 10 micrometres (μm) or less in diameter is known as PM_{10}. (There are 1 million micrometres in a metre and 1 thousand micrometres in a millimetre.) Particulate matter that is 2.5 micrometres or less in diameter is known as $PM_{2.5}$.

The levels of particulate matter for the site as it currently operates and the site after the upgrade have been modelled and the full report of the modelling is provided in Appendix P.

The modelling indicates that the maximum PM_{10} concentration (daily average) in a year, at ground level, at any location, resulting from Bradken's current operations is 42 μg/m^3. At locations in the SA Canine Association's grounds across Cromwell Road, the maximum PM_{10} concentration (daily average) in a year from Bradken's operations is around 38 μg/m^3. Taking background concentrations of PM_{10} from traffic and other industrial sources into account, these modelling results correspond well with the monitoring results for ambient PM_{10} levels in the SA Canine Association grounds, reported by the EPA in "Stage 1: Kilburn/Gepps Cross Area Study (July 2006) and "Reporting to the Community: industry environmental improvement project in the Kilburn and Gepps Cross area" (September 2006).

After the upgrade, the maximum PM_{10} concentration (daily average) in a year, at ground level, at any location, resulting from Bradken's operations is expected to be 13.5 μg/m^3. The maximum PM_{10} concentration (daily average) in a year from Bradken's operations in the SA Canine Association's grounds is expected to be around 5 or 6 μg/m^3.

The National Environment Protection (Ambient Air Quality) Measure ("Air Quality NEPM") contains a goal that PM_{10} levels in ambient air around Australia (1 day average) not exceed 50 μg/m^3 more than 5 days a year by 2008. This goal does not relate directly to individual sites, but rather gives a guide for considering the cumulative impacts of industry, traffic and other sources of particulate matter. The significant reduction in Bradken's contribution to ambient levels resulting from the upgrade will greatly assist in enabling the Air Quality NEPM PM_{10} goal to be met in the Kilburn Area.

The Air Quality NEPM also contains Advisory Reporting Standards for $PM_{2.5}$ of 25 μg/m^3 (1 day average) and 8 μg/m^3 (1 year average). Again, these are not formal compliance goals for individual sites. They are levels that are used to evaluate state-wide monitoring results. However, to give an indication of Bradken's contribution to fine particulate levels in ambient air, the Advisory Reporting Standards and the modelled ground level concentrations of $PM_{2.5}$ for Bradken's current and upgraded operations are shown in the table below.

	Ambient Air Quality NEPM Advisory Reporting Standard (µg/m³)	Bradken contribution from current operations (µg/m³)	Bradken contribution from upgraded site (µg/m³)
$PM_{2.5}$ (daily)	25	11.4	4.25
$PM_{2.5}$ (annual)	8	2	1.43

5.4.1.3 Verification of Modelling

As part of the Health Risk Assessment conducted by Golder for the purposes of this PER, the air modelling was reviewed independently by CSIRO Marine and Atmospheric Research. The report of the review is presented as Appendix C of the Golder HRA report, at Appendix R to this PER. The review considered the appropriateness of the modelling software, meteorological data and model assumptions as well as the accuracy of inputs and reporting, and found the modelling be appropriate given the location of the foundry and the types of emission sources present.

Further, the ground level concentration contours produced by the air modelling have been compared against records of complaints, and generally show higher concentrations in locations associated with complaints.

The records available to Bradken relating to complaints in respect of emissions from the site over the last 5 years only identify the complainant's location by reference to the name of the street where the premises from where the complaint was lodged were located. Given that the street numbers for each complaint are unknown, complaint locations cannot be mapped in an accurate or reliable manner. However, complaints received either by Bradken or the EPA in the last 5 years in relation to emissions believed to be associated with the Bradken site were lodged from locations within:

- 600 m to the north-east of the site (Cambridge Street, Blair Athol)
- 1 km to the east of the site (Leslie Street, Blair Athol)
- 1 km to the south-east of the site (Forrest Street, Blair Athol)
- 1.25 km to the south of the site (Hopetoun Avenue, Kilburn)
- 800 m to the south-west of the site (Sunny Brae Road, Kilburn)
- 250 m to the west of the site (Churchill Road, Kilburn)

There are no records of any complaints being lodged from the north of the site. This may be explained by the open and/or industrial nature of the land uses in that area.

This pattern of complaints accords with the air emission modelling contours, which show emissions generally distributed evenly in all directions from the site.

In particular, the modelling results indicate that the highest odour levels at present are found to the immediate west of the site, with higher levels tending to be found to the south-west. This generally correlates with the locations of recorded complaints relating to odour. Given the meteorological conditions in the area, the direction of odour emissions from the site will not alter significantly after the upgrade. However, the odour reduction measures proposed as part of the upgrade will significantly reduce the odour levels experienced at each location.

Further, while complaints in respect of dust/particulate emissions have been lodged from east of the site (for instance, Nelson Street and Marmion Avenue, Kilburn), most complaints relating to dust/particulates from the Bradken site have come from the west and south-west of the site. This correlates with the PM_{10} and $PM_{2.5}$ modelling results for current operations, which show higher levels of particulates to the west and south-west of the site, (although the PM_{10} and $PM_{2.5}$ modelling results do not take into account dust generated from unsealed surfaces or stockpiles). As with odour, the general direction of particulate emissions will not be altered by the upgrade. However, the upgrade will significantly reduce the levels of both particulates from processes as well as general site dust emitted from the site, even once the facility reaches full expanded capacity.

5.4.1.4 Management of Emissions

The principal sources of air emissions in the production process on the site are:

- Metal melting and pouring;
- Sand reclamation plant;
- Arc air.

Metal melting and pouring

The new 20 tonne arc furnace will be installed with "best practice" emission extraction equipment that:

- has five times the extraction and filtration capacity of the existing system.
- will be connected directly into the furnace roof to maximise capture efficiency;
- will have secondary extraction from inside the EAF noise enclosure, and tertiary extraction from the roof of the furnace building.

The new building will be mechanically, rather than naturally, ventilated, so there will no longer be ridge vents at the roof line that allow for escape of fugitives from the building. Fume and particulate levels from the site will therefore be significantly reduced from current levels. An example of a mechanically ventilated building without high level ridge vents is shown in the figure below.

Mechanical extraction from top and bottom of building

Figure 15: Fully sealed building, typical of the proposed new foundry building. Note the mechanical ventilation and absence of ridge vents.

In addition, control of the new EAF will be automated, which eliminates potential for increased fugitives due to operator error.

These improvements, together with the existing environmental procedures such as quality control of scrap being melted (which minimises contaminants in the furnace emissions) and the measures set out in the EMMP, combine to significantly reduce fume and particulate emissions from the site.

Currently, particulates and fume generated by the existing 10 tonne EAF are collected and filtered by an extraction system and baghouse filter. Although this system is adequate for fume and particulate collection during normal melting operations, it does not have sufficient extraction capacity during furnace charging and pouring to capture all of the emissions. This leads to fugitive fume/particulates being emitted during the charging and pouring periods. On occasion, fumes from this process can escape from the building through a door facing Cromwell Road and from ridge vents near the roofline of the current foundry building, necessary for natural ventilation.

The ridge vents in the current foundry buildings used for natural ventilation can be seen in the figure below:

Figure 12: Current foundry building. Note the ridge vents at the roof line associated with the natural ventilation system..

Sand Reclamation Plant

The proposed upgrade includes a second sand reclamation system, which will have redundant capacity in order to manage abnormally large stockpiles and ensure that under normal conditions no sand will be required to be stored outdoors. The second system will be located within the new foundry building to minimise potential for escape of fugitives. Truck loading and silo extraction will also be improved as part of the upgrade works.

Currently, there is one sand reclamation system on-site where sand to be recycled is stockpiled and fed into the shakeout using a front-end loader. This area is undercover during normal operation but can overflow outdoors occasionally (eg in the event of reclamation plant equipment breakdown) where it has potential to be affected during windy conditions.

Arc Air

The upgrade will replace the existing extraction system on the arc air finishing process with a new baghouse filter and cyclone extraction system to more effectively collect emissions and eliminate potential fugitive emissions.

Measures to manage potential failure of emission control equipment

Process failures are not expected to give rise to uncontrolled emissions or fugitives. As such, scenarios assuming uncontrolled emissions in the event of emission control equipment failure have not been modelled for the purposes of this PER.

The primary emission control devices that will operate within the upgraded facility are:

1. EAF baghouse and ventilation system
2. Fastloop cooling ventilation system
3. Jobbing floor (foundry bulkhead) and shake out No.2 ventilation system

A typical baghouse, which acts like a vacuum cleaner to extract fume and particulates from the air, is shown in the figure below.

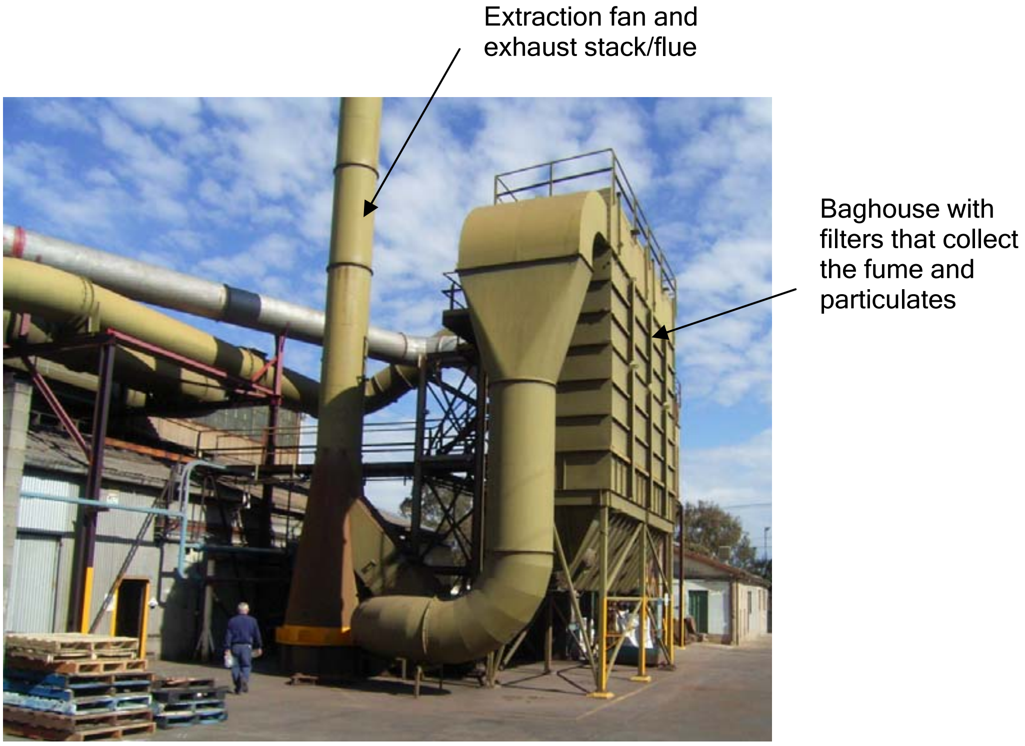

Figure 16: Typical mechanical ventilation system with baghouse filter.

In-built system redundancies that will prevent the release of uncontrolled emissions and/or fugitives are set out in the table below.

Potential source of emissions	Emission control device	Potential process failure	System Redundancy	Result
Fume generated in EAF	Three point fume extraction feeds to baghouse: - from EAF roof - from within noise enclosure - from building roof above EAF	Baghouse filter fails	Dust in flue is detected and system including EAF automatically shuts down	Fume generation stops. No emissions generated.
	Baghouse filter	Electrical power failure	All production systems shut down	Fume generation stops. No emissions generated.
	Two extraction fans (one installed spare)	Fan mechanical failure	Spare fan started up	System integrity intact. Fumes removed in normal manner.

Potential source of emissions	Emission control device	Potential process failure	System Redundancy	Result
Cooling fume & odour on fast loop system	Area completely enclosed and mechanically ventilated with two 100% capacity fans	Electrical power failure	All production systems shut down. Emergency generator started to maintain one fan in operation	Fume generation stops. No emissions generated. Ventilation is maintained
		Fan mechanical failure	Spare fan started up	System integrity intact. Fumes removed in normal manner.
Pouring fume/odour	Two point fume extraction feeds to baghouse: - from pouring line hood on fast loop - from building roof above EAF	Baghouse filter fails	Dust in flue is detected and system including EAF automatically shuts down	Fume generation stops. No emissions generated.
	Baghouse filter	Electrical power failure	All production systems shut down	Fume generation stops. No emissions generated.
	Two extraction fans(one installed spare)	Fan mechanical failure	Spare fan started up	System integrity intact. Fumes removed in normal manner.

Where a power failure occurs, the production systems are shut down. With systems shut down, no additional fumes are generated during the period of the power failure. As such, there is no potential for fumes to be emitted while emission control devices are not in operation.

The EAF ventilation system is serviced by two full capacity fans. Fan No.1 will operate continuously, with fan No.2 only operating for charging and tapping phases. Therefore the failure of one fan would not result in a significant reduction in the efficiency of the ventilation system. In addition the foundry building bulkhead system provides secondary capture of emissions from the furnace and as such would result in capture of any fugitive emissions from the EAF ventilation system.

The fastloop cooling system ventilation also has dual fans proposed and these will both operate on variable speed drives. For normal operation both fans will operate below full capacity and therefore in the event of a fan failure the second fan would be able to provide enough suction to maintain sufficient ventilation to the cooling loop enclosure.

In relation to the failure of individual bags within the EAF baghouse, or other baghouse, the installed control devices for bag failure and leak detection enable continuous data to be provided to measure the performance of the baghouse. These will trigger shut down when failure is detected. Bradken's maintenance and inspection programs will further minimise the event of significant failure of baghouse systems by routinely replacing aging and failed bags. The baghouse cells on the EAF and bulkhead/shakeout No.2 systems will be able to be isolated in the event of bag failure to minimise emissions from these systems as a result of bag failure.

5.4.1.5 Dust

The principal sources of dust generation throughout the site include:

- Scrap handling;
- Knock out;
- Waste storage; and
- General site dust.

As part of the proposed site upgrade, additional controls will be installed and/or implemented to significantly limit and contain dust emissions from the site.

The EMMP also outlines the dust control procedures that will complement these engineering controls.

Scrap Handling

The majority of scrap preparation and storage is proposed to be relocated off-site as part of the upgrade. Only enough stock for daily use will be held on site in newly constructed scrap holding areas, complete with concrete floors. This will redress the potential for fugitive dust to be generated by scrap handling activities.

Currently, scrap is stored on bare earth where dust can be generated from wind and traffic.

Knock Out

The knock out process, where the casting is separated from the sand mould, is currently done partly outdoors, which can result in fugitive dust during dry windy conditions.

The proposal provides for all knocking out to be undertaken indoors and in conjunction with a dust extraction system. This will significantly reduce the amount of fugitive dust caused by wind, and the extraction system will remove any ambient dust from the air. The new fast loop line will also incorporate automatic knockout on-line, which will eliminate double handling of sand with the front end loader. These improved processes represent a significant improvement in dust management.

Waste Storage

Currently waste sand and dust is stored outdoors in a 3-sided enclosure which can be a source of fugitive dust emissions, especially on dry windy days.

A similar working stockpile will be used under the proposed upgrade. However, the enclosure will have a concrete base and water sprays will be installed to mitigate the potential for fugitive dust to become airborne.

General Site Dust

The proposed upgrade will involve sealing and landscaping the majority of areas on the site in order to reduce general site dust. Currently there are some areas of bare earth which, on windy days, can generate dust. A vacuum street-sweeper is used, and will continue to be used, daily to remove accumulated dust from the roads and hard stand areas around the site.

A picture of the vacuum sweeper is provided below.

Figure 19: Vacuum street sweeper used to remove dust from roads and hard stand areas around the site.

5.4.2 Noise

The proposed upgrade includes measures to reduce noise generated in both the existing processing areas as well as the new buildings such that noise levels when the facility is operating at full expanded capacity will be compliant with the Environment Protection (Industrial Noise) Policy.

5.4.2.1 Noise Minimisation Measures

Measures to reduce noise effects on nearby residents include:

- providing acoustic attenuation to Annealing Ovens;
- closing building openings during night time operations;
- making improvements to the existing acoustic mound on the eastern side of the property (subject to separate assessment by the City of Port Adelaide Enfield);
- completely surrounding the EAF with an acoustic enclosure with automatically operated access doors;
- providing acoustic cladding to the eastern side of the new furnace building;
- providing acoustic attenuation to the main ventilation fans and exhaust stack silencers; and
- purchasing an alternative shakeout designed to eliminate low frequency vibrations.

The noise enclosure currently surrounding the shakeout machine is shown in Figure 20 below. This enclosure is similar to the enclosure that is proposed to be installed around the new Arc Furnace.

Also following in Figures 21 and 22 are typical noise enclosure configurations which are proposed to be used for large fans, motors, air compressors and extraction fans.

Extraction System for Dust Control

Automatic opening doors and roof for access 150mm thick concrete

Figure 20: Existing noise enclosure that surrounds the shakeout machine

Double skin steel Construction

Figure 21: Typical Noise Enclosure to be used for large fans, motors and air compressors

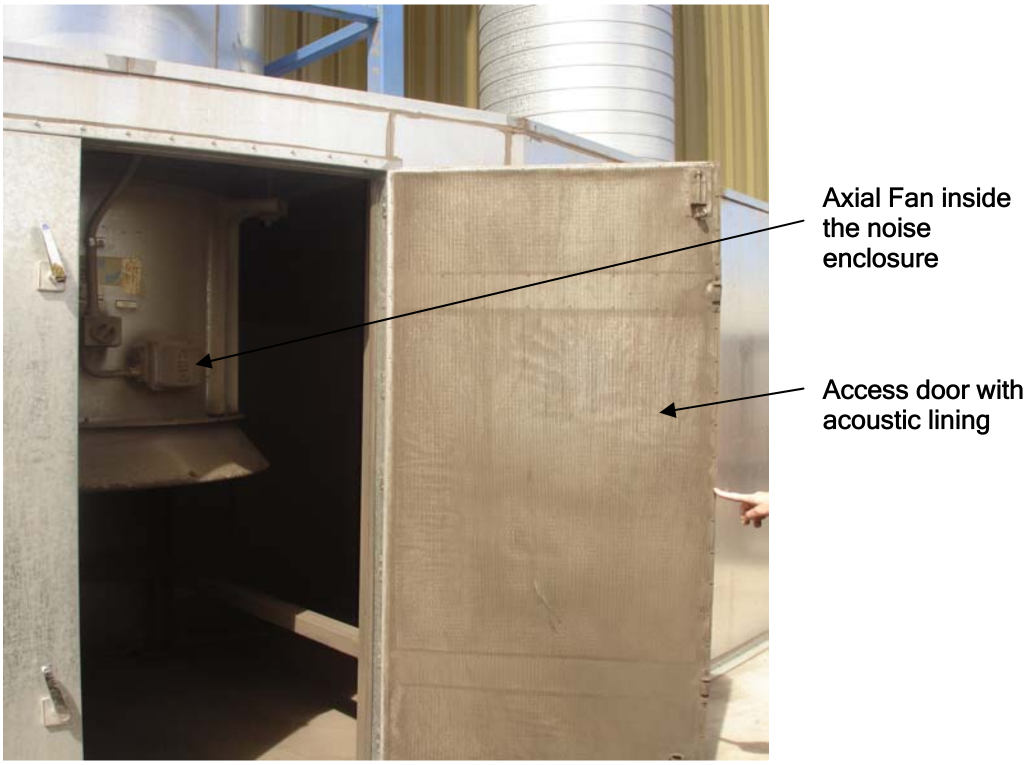

Figure 22: Typical noise enclosure for extraction fans, featuring heavy noise insulating foam sandwiched between perforated metal on the inside and a solid steel outer skin.

The site will also continue to maintain current administrative procedures that aim to minimise noise impacts. These include:

- the main foundry southern doors and the lost foam southern door are to be kept closed from 7.00 pm until 7.00 am each day;
- the machine shop doors are to be closed from 7.00 pm until 7.00 am each day;
- eastern doors on the aftercast building are to be closed from 7.00 pm until 7.00 am each day;
- any portable equipment that has an operating noise level in excess of 80dB(A) shall not be operated in the open before 7.00am Monday to Saturday, before 10.00am Sunday and public holidays, and after 10.00pm on any day;
- truck movements in and out of the factory shall be restricted to between 7.00 am and 7.00 pm each day;
- the loud speaker system is not to be used after 8.00 pm and before 7.00 am each day; and
- afternoon shift employees leaving the site after their shift are to do so quietly.

5.4.2.2 Equivalent Noise Levels

The issue of noise generation by the entire site (including those operations not affected by the upgrade) has been assessed by Advitech. A copy of the noise modelling report is contained within Appendix Q.

The report identifies the following:

- the maximum equivalent day time noise level (LA_{eq}) criteria under the Environment Protection (Industrial Noise) Policy 1994 and draft Environment Protection (Noise) Policy 2004 for adjoining sensitive receivers is day time 58dB(A) and night time 50dB(A);

- after the upgrade, the highest total predicted equivalent noise level experienced by adjoining sensitive receivers as a result of Bradken's operations in neutral wind conditions will be at the former Council Depot, with a day time noise level of 54dB(A) and night time level of 50dB(A). The highest residential reading in neutral conditions will be on the north end of Blackburn Street with a maximum day time and night time noise level of 48dB(A);

- after the upgrade, the highest total predicted equivalent noise level experienced by adjoining sensitive receivers as a result of Bradken's operations in prevailing westerly wind conditions will be at the former Council Depot also, with a day time noise level of 53dB(A) and night time level of 49dB(A). The highest residential reading in westerly wind conditions will be on the northern end of Nelson Street and Tyne Avenue, both having a maximum day time noise level of 51dB(A) and a night time noise level of 49dB(A).

Therefore, LA_{eq} noise levels for the proposed upgraded facility will be compliant with the Environment Protection (Industrial Noise) Policy. The levels will also comply with the provisions of the draft Environment Protection (Noise) Policy 2004.

The noise model includes an assessment of outdoor noise sources such as trucks and forklifts during day time hours (between 7am and 10pm) but excludes operation of trucks and forklifts, with the exception of the heat treatment forklift, during night time hours (between 10pm and 7am). This is consistent with the results of the traffic assessment which anticipates that the vast majority of production vehicle movements are likely to occur between 7am and 4pm.

Noise levels associated with additional traffic movements on Cromwell Road will be insignificant since the actual increase in additional traffic volumes has been identified by the traffic report as relatively modest (ie 117 – 181 vehicles spread throughout the day).

Noise during construction is addressed as part of the CEMP prepared for the site, and is in accordance with relevant EPA policy to include reference to hours of operation for noise generating activities.

5.4.2.3 Maximum Noise Levels

The World Health Organisation (WHO) has developed guidelines for community noise in specific environments.[5] The WHO suggests that in order to avoid sleep disturbance, the maximum noise level (LA_{max}), that is, the loudest individual noise event, experienced inside a residential bedroom at night should be limited to 45dB(A). If windows are assumed to be partially open (allowing residents to open windows on warm nights), the WHO suggests that to achieve this internal noise level, the maximum noise level (LA_{max}) measured outside the bedroom window should be limited to 60dB(A) at night.

This suggestion is reflected in the noise goals set out in the draft Environment Protection (Noise) Policy 2004, which provide that the general environmental duty under the Environment Protection Act will be satisfied if, among other things, the maximum noise level from a source, recorded outside residential premises between 10pm one day and 7am the next day, does not exceed 60dB(A).

While the draft Noise Policy is not currently in effect, Bradken understands that short term noise events at night are currently a source of complaints from nearby residences. As such, Bradken proposes to take all reasonable and practicable measures to minimise the potential for sleep disturbance resulting from operations at the site.

[5] Berglund, Lindvall and Schwela, World Health Organisation 1999, "Guidelines for Community Noise".

An assessment of Bradken's operating practices has indicated that the short term noise events giving rise to complaints are largely associated with metal handling activities and in particular, scrap steel deliveries and scrap handling in the open scrap steel storage area, located on the northern boundary of the site.

As indicated elsewhere in this PER, and particularly in sections 4.2.3 and 5.4.1.5, this existing open scrap steel lay down area will be relocated off-site as part of the upgrade. The majority of scrap preparation (that is, unloading, stacking and cutting) and storage will be carried out off-site and only enough stock for daily use will be held on site in newly constructed scrap holding areas, located within noise attenuated buildings. Stock that is delivered to the site for immediate use will only be delivered between the hours of 7am and 10pm each day. As such, the likelihood of short term noise events occurring at night due to scrap handling after the upgrade will be significantly less than at present.

Figure 23: Scrap Handling and sorting using excavator. Currently scrap handling is a source of impact noise. It is proposed that this process is to be relocated to an off site location and only minimum stock of scrap will be held on site.

In addition, the existing noise attenuation mound on the eastern side of the site will be upgraded, and an additional noise attenuation mound constructed, as part of ongoing site improvements that are subject to a separate development application lodged with the City of Port Adelaide Enfield. The improved noise mounds are expected to further reduce noise impacts from operations on residences to the east of the site.

Measurements recently taken at the Kilburn site during an assessment of noise sources indicate that scrap delivery currently can generate LA_{max} sound levels up to 10dB above the Equivalent Noise Level (LA_{eq}) measured at residential receivers. As such, adding a 10dB factor to the LA_{eq} noise level predicted in the noise model can be used to give a very conservative indication of the LA_{max} noise level at each of the sensitive receivers after the upgrade (given that the 10dB factor does not take into account the removal of bulk scrap deliveries and scrap handling off-site, the relocation of scrap holding areas into noise attenuated buildings or the other mitigation measures outlined above). However, even without taking these measures into account, use of the 10dB factor and the equivalent noise level modelling discussed earlier in this PER suggests that the LA_{max} experienced at night by residential receivers after the upgrade will be no more than 58dB(A) in neutral wind conditions and 59 dB(A) in prevailing westerly wind conditions. Actual maximum noise levels experienced at night by residential receivers after the upgrade are expected to be less than these figures.

5.4.2.4 Car Park Extension

The proposal includes an eastern extension to the existing staff car park off Cromwell Road, the location of which was chosen to minimise potential off-site impacts from increased staff vehicle numbers. This extension will bring the eastern edge of the staff car park closer to the eastern boundary of the site. Noise levels at residences to the east of the site, associated with use of the car park, will be minimised by the establishment of a 2.1 metre high Colorbond noise attenuation fence along the eastern edge of the expanded car park. Further, the car park entrance will remain at the western end of the car park, in order to maximise separation between residences and the location of the highest concentration of vehicle movements within the car park. With these measures in place, the noise from the car park is predicted to achieve the requirements of the WHO sleep disturbance guidelines and the criteria in the Environment Protection (Industrial Noise) Policy 1994 and draft Environment Protection (Noise) Policy 2004. Details of the assessment of noise associated with the car park extension, carried out by Sonus Pty Ltd, are provided in Appendix T.

Administrative procedures are also currently in place to require employees to minimise noise associated with closing doors, talking and revving engines when arriving at and leaving the site. These procedures are and will be reinforced through frequent awareness training. Bradken will also introduce further measures as the upgrade proceeds, such as requiring staff making shift changeovers at night to use spaces at the western side of the car park in order to further reduce any potential impacts on residents to the east of the site.

5.4.3 Stormwater Management

Approximately two thirds of the stormwater on site is directed to the existing stormwater retention pond located on the eastern side of the site. Stormwater from the southern and western sides of the site is directed to the stormwater drains in Cromwell Road.

Recent testing of stormwater on site indicated that concentrations of chromium, copper, lead, manganese, molybdenum and zinc in the stormwater pond exceeded the water quality criteria for inland surface waters as specified in the Environment Protection (Water Quality) Policy 2003.

However, only copper, lead and zinc in the stormwater pond exceeded the criteria for freshwater aquatic ecosystems set out in the Water Quality Policy. This set of criteria gives a more practical comparison in the circumstances of the Bradken site, as it does not include levels set for potable water use or aquaculture use. The stormwater assessment report is provided at Appendix K.

The EMMP, CEMP and Stormwater Management Plan set out measures that Bradken takes and will take to minimise the potential for contaminants to enter the stormwater system. Identified contaminants of concern include aluminium, zinc, phenols, ammonia, total petroleum hydrocarbons, iron and lead. Bradken conducts annual monitoring of stormwater at the pond and near the south-western discharge point to the street drain to monitor pollutant levels and compare them against the relevant criteria in the Environment Protection (Water Quality) Policy 2003.

The total sealed area on the southern and western sides of the site will not change significantly as a result of the upgrade. However, the ratio of roof area to hardstand area will increase. It is likely that stormwater collected on roofs will have less opportunity to come into contact with contaminants than stormwater that flows across the ground. As such, the water quality of stormwater on that side of the site after the upgrade is expected to be slightly better than current levels.

The total sealed area draining into the retention basin will increase by around 17% as a result of the upgrade. Oil and grit separators will be installed at all discharge points. This will further improve water quality entering the detention basin and drains. Siltation in the basin will further improve the quality of water leaving the basin.

Bradken will be implementing the recommendations made by Coffey Environments, provided at Appendix K, to further improve their stormwater management. Bradken has developed a Stormwater Management Plan for the upgraded site. This plan addresses stormwater management as well as water quality. Further, Bradken will develop procedures to minimise the potential for stormwater flowing near truck parking areas to pick up hydrocarbons through contact with fuel and will increase the frequency of stormwater system inspection and housekeeping in order to minimise the build up of sediments in the system. The procedures will address the frequency of stormwater monitoring, the frequency of stormwater system inspection (in order to minimise the build up of sediments), general housekeeping and will also include identification and implementation of continuous improvements. Details of the proposed Stormwater Management Plan for the upgraded site, prepared by Tonkin Consulting, is provided at Appendix L.

5.4.3.1 Monitoring and Reporting

Stormwater in the retention basin on the eastern side of the site and in the south western sump that discharges to the local stormwater drain is sampled annually in autumn at first flush. Samples are analysed for Total Dissolved Solids, pH, metals, phenols and hydrocarbons and results are compared against the water quality criteria set out in the Environment Protection (Water Quality) Policy 2003. If results indicate that "serious or material environmental harm" may have occurred or been threatened, the Environment Protection Authority will be notified in accordance with section 83 of the Environment Protection Act.

5.4.4 Groundwater

An assessment of groundwater quality for the site has been undertaken by Coffey Environments. The report is provided at Appendix U.

A summary of the method and findings of that report is set out below:

- groundwater gauging and sampling from the eight already available bores on site was completed on 1 and 2 August 2006;
- groundwater elevation was found to be between 2.346 metres Australian Height Datum (mAHD) in the south-western corner of the site, and 2.643 mAHD on the eastern side of the site near the stormwater pond;
- groundwater flow direction was determined to be to the west and south-west;
- zinc concentrations in six of the eight groundwater samples exceeded the most sensitive of the water quality criteria for underground waters (aquaculture) as set out in the Environment Protection (Water Quality) Policy 2003. However, only one sample (well 12) had a zinc concentration exceeding the water quality criteria for the 'potable' protected environmental value;
- concentrations of benzene exceeded the water quality criteria for underground waters at well 9A, located towards the south-western corner of the site near the former location of an underground storage tank (refer plans at Appendix U). Other petroleum related hydrocarbons were also detected in this well and well 12 to the west.

The localised low levels of petroleum hydrocarbon contaminants detected in groundwater in the south-western corner of the site near the former location of an underground storage tank (wells 9A and 12) is consistent with the continuing decline of contaminant concentrations at this location since the removal of the tank and remediation of the soil in the vicinity. This remediation work was completed based upon agreements between Bradken and the SA EPA with the decline currently being monitored. This decline in concentration will continue over time. No further remedial action is understood to be required or warranted for this location.

The existing stormwater retention pond on the site is designed to allow infiltration of the collected stormwater into the underlying shallow unconfined groundwater aquifer. Accordingly, the future management of stormwater at the site is considered an important factor in managing potential future impacts to groundwater at the site. The report recommends that measures to protect groundwater should be included in any environmental management plan developed for the site to address both the construction and operation phases of the proposal. These recommendations have been adopted by Bradken, with measures for groundwater and stormwater protection included in the Construction Environment Management Plan (CEMP), Environment Management and Monitoring Plan (EMMP) and Stormwater Management Plan prepared for the proposal. Further, Bradken acknowledges that targets for improvement of the quality of groundwater under the site should be set. Bradken will work in consultation with the EPA to determine appropriate targets to be inserted into the EMMP.

The report concludes that, based upon the information known about the proposed upgrade of 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.

5.4.4.1 Monitoring and Reporting

Groundwater is monitored annually from eight on site bores for the presence of hydrocarbons, BTEX and heavy metals. If results indicate that "serious or material environmental harm" may have occurred or been threatened, the Environment Protection Authority will be notified in accordance with section 83 of the Environment Protection Act.

5.4.5 Soil Quality

The majority of existing operational areas on site are sealed, hardstand areas. All new production areas proposed as part of the upgrade will also be sealed, as will all roadways. As such, there is minimal opportunity for process materials to have direct contact with soil or groundwater. Some settling of air emission constituents may occur in the vicinity of the site. Air modelling indicates that ground level concentrations of constituents after the upgrade will generally be the same or less than current levels. As such, impacts to soil are unlikely to change as a result of the upgrade.

5.4.6 Water Balance

Details of the water balance (ie water in versus water out of the site) for the existing facility and proposed upgraded facility are provided at Appendix V.

Results of water balance modelling identify that water consumption for processing will increase from an existing 6,600 KL/year to 12,300KL/year for the upgraded facility at full capacity. This equates to an improvement in water use from an existing 0.53 KL/tonne produced to 0.41KL/tonne for the upgraded facility. Water is supplied by SA Water through the metered supply system.

Bradken does not propose to alter this supply source, and this is reflected in the water balance model. Given that the volumes of waste process water generated at the site are low and are only generated during occasional cleaning of the cooling tower circuit, it is not feasible to treat waste process water for reuse. It is also not feasible to install a grey water recycling circuit at the site in respect of water used by employees for hand washing, showering, dishwashing and drinking. However, water-saving shower heads will be installed in the new amenities block (which is subject to a separate development application lodged with the City of Port Adelaide Enfield) to minimise grey water losses to the greatest practical extent.

Bradken has also identified in its Stormwater Management Plan that it can, subsequent to the upgrade, direct rainwater from the new buildings into on-site storage to supply part of the water requirements for top-up of cooling towers and the quench tank.

Process water used at the site is discharged into the sewer in accordance with a Trade Waste Discharge Permit from SA Water.

5.4.6.1 Monitoring and Reporting

Monitoring of the quality of process water discharged to sewer is undertaken in accordance with Work Instruction BK3-E-004: Environmental Sampling and Monitoring.

Before water from the quench tank; furnace cooling tower; reclaim cooling tower, and the transformer cooling tower is discharged for cleaning, the water is tested for Total Dissolved Solids, pH, oil, grease and metals. Results are compared with discharge criteria specified in the Trade Waste Discharge permit and reported to SA Water in accordance with the Permit.

5.4.7 Material Balance

A materials balance for the existing and proposed upgraded facility is provided in table form at Appendix W. The table identifies the quantities of all inputs and outputs in the production process. No process materials discharge to land, groundwater, surface water or stormwater systems. Around half of the process water used on site is discharged as trade waste to sewer in accordance with the conditions of the site's Trade Waste Permit from SA Water. The table also identifies that the upgraded facility will discharge less emissions to air (through fugitive particulates and fume) than the current facility.

5.4.8 Greenhouse Gas Emissions and Energy Efficiency - Operations

The following section details the calculation of greenhouse gas (GHG) emissions based on actual energy consumption data and estimated increases in energy consumption for the upgraded facility. This section also outlines the energy conservation practices and potential efficiencies and mitigation measures that may be achieved through the upgrading of the facility.

5.4.8.1 Methodology

Greenhouse Gas Emissions

Annual energy consumption data from the facility for the 12 months ending June 2005 forms the basis of the assessment for both the existing operation and the proposed future operation.

The two primary energy sources supplied to the facility are electricity and natural gas. Estimation of the future electricity usage is predominantly determined from the manufacturer supplied full cycle electricity consumption for the new EAF, and secondly from the additional fan drives associated with the ventilation system.

The remaining estimation of energy usage includes natural gas (NG) for non-transport uses, liquid petroleum gas (LPG) and automotive diesel (diesel). The estimated future usage of these energy types is calculated on the proposed increase in production capacity. As such the estimated increase in energy consumption could be up to 2.56 times the current energy consumption. This is a simplistic and worst case scenario, as significant improvement in the efficiency is proposed for the operation.

Calculation of GHG emissions was undertaken using the Australian Greenhouse Office (AGO) publication *AGO Factors and Methods Workbook (December 2005)*.

There are two types of emissions from which GHG emissions can be estimated, direct and indirect emissions:

Direct emissions - are produced from sources within the boundary of a facility and are a direct result of the activities at the facility.

Indirect emissions - are emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation. The most important category of indirect emissions is from the consumption of electricity.

Emission factors for calculating direct emissions are generally expressed in the form of a quantity of a given GHG emitted per unit of energy (kg CO2-e /GJ), fuel (t CH4/t coal) or similar measure. Emission factors are used to calculate GHG emissions by multiplying the factor (e.g. kg CO2/GJ energy in diesel) with activity data (e.g. kilolitres x energy density of diesel used).

Calculated GHG emissions are expressed as kilograms of CO_2 equivalent (kg CO2-e). This enables the GHG impact of other gases such as methane and synthetic refrigerants to be expressed in consistent units.

This assessment has considered the direct emissions from the direct consumption of NG, LPG and diesel within the facility and also the indirect emissions via the consumption of electricity from an external electricity generator.

5.4.8.2 Greenhouse Gas Calculation

The primary sources of energy consumed at the facility are electricity, NG, LPG and diesel. Table 1 details the actual (existing) and estimated (future) annual energy consumption data.

Table 1: Annual energy consumption

Energy Type	Existing	Future
Electricity (MWhr)	15 804	27 500
Natural Gas (GJ) (non-transport)	121 089	310 000
LPG (transport) (kL)	20	51
Diesel (transport) (kL)	113	289

Table 2 provides specific emission factors for each energy type.

Table 2: Emission factors

Energy Type	Emission Factor	
Electricity	1.007	kg CO_2-e/kWh
Natural Gas (non-transport)	73.8	kg CO_2-e/GJ
LPG (transport)	1.8	T CO_2/kL
Diesel (transport)	3	T CO_2/kL

Table 3 presents the estimated GHG emissions from the exiting and future facility operations.

Table 3: GHG emissions (t CO_2-e)

Energy Type	Existing	Future
Electricity	15 915	27 665
Natural Gas (non-transport)	8 936	22 878
LPG (transport)	36	92
Diesel (transport)	339	867

To enable an "efficiency of production" to be determined it is common practice to express the mass of CO_2-e against a relevant unit of production. The relevant unit of production for the Bradken Adelaide facility is tonnes of dressed casting. Table 4 provides the GHG efficiency for both the existing and future operations.

Table 4: GHG efficiency (t CO_2-e/ t dressed casting)

	Existing	Future
Production (tonnes dressed casting)	12 500	32 000
CO_2-e (tonnes)	25 226	51 503
GHG Efficiency (t CO_2-e/ t dressed casting)	2	1.6

The GHG efficiency of the operation is estimated to reduce from 2 t CO_2-e/ t dressed casting (existing) to 1.6 t CO_2-e/ t dressed casting (future).

A comparison between the predicted CO_2-e/t from the upgraded Bradken facility was made against the average CO_2-e emissions from the foundries that participated in the *Theoretical / best practice energy use in metal casting operations May 2004.* The reported average CO_2-e emission from the facilities participating in the best practice assessment was 2.6 CO_2-e/t. The predicted Bradken CO_2-e emission rate (1.6 CO_2-e/t) compares favourably with the best practice assessment.

5.4.8.3 Best Practice

Comparison of the energy consumption and efficiencies of the proposed upgrade of the facility was undertaken using the publications *Theoretical / best practice energy use in metal casting operations May 2004* and *Metalcasting Best Practices June 2005* as a benchmark.

The vast majority of energy usage at the foundry can be split between electricity and natural gas. To provide a meaningful assessment of energy consumption practices at the site, the focus of the best practice comparison has been made on electricity and natural gas only.

Electric arc melting furnaces are the most widely used method for melting steel scrap with over 80 percent of steel foundries utilising this technology[6] . Over 80 percent of arc furnaces used for steel castings are alternating current furnaces with three electrodes. Control of the electrode level above the bath is critical to the melting process efficiency.

Arc melting furnaces are the most widely used method for melting steel scrap as they can melt a wide variety of ferrous scrap materials and can accept certain levels of dirty scrap. They also use “chemical energy” to assist in the melting process and to lower the carbon levels of the molten metal. Since steel castings require low carbon level metallurgy, carbon from scrap metal feedstock and carbon electrodes must be removed from the molten metal.

Little information is available to indicate best practice facilities or processes for steel castings. The two best practice example foundry operations detailed in the best practice benchmark document indicated that the arc melting furnaces typically required 450 kWh to melt one tonne of steel, whereby the typical induction furnace requires 530 to 600 kWh per tonne.

The proposed new EAF to be installed at the Bradken foundry will, as the manufacturers’ specifications indicate with a full melt cycle, have an electricity consumption of 456 kWh per tonne of steel.

Table 5 presents a comparison of the furnace energy requirements for best practice, typical furnace and the proposed Bradken furnace operations.

Table 5: Comparison of Typical, Best Practice and Bradken Furnace Energy Consumption

[6] *Energy and Environmental Profile of the U.S. Metalcasting Industry. DOE. 1999*

Furnace Type	Typical Specific Energy Consumption	Best Practice	Proposed Bradken Energy Consumption
Electric Arc	445-536 kWh/t	451 kWh/t	456 kWh/t

Source: Theoretical / best practice energy use in metal casting operations May 2004

Table 6 presents a comparison of the heat treatment energy requirements for best practice, typical furnace and the proposed Bradken heat treatment operations.

Table 6: Comparison of Typical, Best Practice and Bradken Heat Treatment Energy Consumption

Type	Typical NG Consumption Rate	Best Practice#	Proposed Bradken NG Consumption Rate
Annealing Ovens	11.5-12.1 GJ/t	11.5 GJ/t	9.7 GJ/t

Source: Metalcasting Best Practices June 2005

5.4.8.4 Energy Conservation

A desktop review of energy conservation and mitigation measures and discussion of potential efficiencies that may be realised as a result of the proposed upgrade are discussed below.

Furnace

There are a number of operational practices and material/equipment specifications that can be employed to improve the energy efficiency of the metal melting process. Listed below are the key energy conservation measures that are planned to be employed at the Bradken facility:

- equipment selection, sizing the furnace to enable optimum melting capacity;
- reducing impedance losses throughout the furnace electrical supply network;
- automating and refining electrode level controls to provide maximum power capabilities throughout the melt cycle;
- minimising the time the lid is open for charging and the time the door is open for removing slag to minimise heat loss;
- ensuring the bulk density of the scrap steel is optimised to enable efficient transfer of energy from the electrodes to the furnace charge;
- ensuring the furnace is powered down when not in use; and
- minimising heat loss when the furnace is in standby mode.

Heat Treatment

Heat treatment relies solely on the combustion of natural gas to provide heat for the treatment of cast products. Key practices that are planned to be implemented to ensure efficient energy usage in heat treatment are:

- regularly maintaining burners and combustion air fans to ensure optimum combustion efficiency;
- scheduling of heat treatment activities to ensure maximum efficiency is achieved when heating up and cooling down the ovens; and

- running heat treatment ovens at a reduced temperature or switching them off when not in use.

Ventilation

While not discussed above, the network of ventilation systems installed to achieve acceptable workplace and environmental air quality requirements are a significant consumer of electricity. The proposed upgrade of the foundry will result in a notable improvement to ventilation. This will be achieved through the installation of a number of new ventilation systems. Total electricity consumption from the fan drives will be approximately 2400 MWh per annum. The primary energy conservation measures that are planned to be employed in relation to the ventilation system are:

- use of variable speed drives to enable fan speed to automatically adjust in relation to ventilation requirements. This not only reduces energy consumption but can also reduce maintenance costs;

- maintenance and cleaning of duct work and vent hoods to ensure effective ventilation of work area by removing restrictions to flow and controlling the ingress of dilution air.

General

Energy conservation measures in relation to electricity consumption for general amenities and plant lighting is planned to include the following measures:

- choosing efficient lighting;
- maximising use of natural light to minimise the lighting requirements;
- switching lights off when not in use;
- maintaining and setting thermostats for heating and cooling to better control air conditioning systems; and
- maintaining condensing coils and air filters on air conditioning systems.

5.4.8.5 Conclusions

The GHG and energy assessment indicates that the proposed upgrade of the foundry operation and increase in production will result in a net increase in the GHG but an improvement in energy efficiency of the facility. Manufacturer's specifications indicate that the new EAF will be approximately 11% more efficient than the current EAF and consequently will reduce the consumption of electricity per tonne of dressed casting and the indirect emission of GHG from electricity generation.

Efficiency improvements will also be realised through the reduction in waste casting moulds and subsequent rework following the introduction of a fast loop moulding system. Waste production due to moulds is expected to reduce from 2.5% to 2%.

Other improvements in efficiency will be achieved through economies of scale. That is, there is not a direct linear relationship between energy consumption and production increase.

5.4.9 Greenhouse Gas Emissions – Transport

For the purpose of calculating the greenhouse gas emission contribution associated with the traffic component of the proposed upgrade, the following assumptions have been made:

- vehicle numbers have been based upon the existing vehicle counts provided in the traffic report prepared for the proposal at Appendix H and multiplied by the factors contained within that report to account for additional traffic movements associated with the upgraded site;

- staff and visitor trips average 24km round trip;

- cars and vans/small trucks associated with production average 24km round trip;
- 2 axle trucks and larger associated with production average 1000km round trip.

Using the fuel consumption and emission rates provided by the Australian Greenhouse Office manual, *AGO Factors and Methods Workbook (December 2005)*, the contribution of GHG emissions associated with the traffic component of the proposed upgrade is approximately 16,000 tonnes per year.

5.5 TRAFFIC AND PARKING

An assessment of the ability of the surrounding road network to accommodate additional vehicle movements generated by the upgrade and the adequacy of access and parking arrangements has been undertaken in a report prepared by Tonkin Consulting at Appendix H. The following sections summarise the findings of that report.

5.5.1 Access/Road Network

All current incoming materials and outgoing goods enter and leave the site via access driveways in Cromwell Road. 85-90% of traffic entering the main gate approaches from the west (Churchill Road) and 67-77% of traffic leaving the main gate turns left and heads east toward Prospect Road.

Staff traffic associated with the staff car park is more evenly distributed, with slightly more approaching and departing from the east and Prospect Road.

Overall, the traffic distribution associated with the current Bradken site appears reasonably balanced between the eastern and western legs of Cromwell Road. It is expected that future traffic growth will maintain this distribution.

Two alternate access arrangements have been explored, including the use of Marmion Avenue as an alternate/additional access to/from the staff car park or the construction of a new access for commercial vehicles to the north of the site by constructing an extension to Mill Court. An assessment of these two alternatives is provided in the traffic report at Appendix H.

After assessing the impacts and available options, altering current access arrangements was considered unwarranted.

5.5.2 Traffic Generation

5.5.2.1 Operations

Projections indicate that as a result of the upgrade, 12 hour traffic volumes in Cromwell Road will increase by a modest 117-181 vehicles and will be split between the eastern and western legs of Cromwell Road.

Therefore, total future 12 hour traffic volumes in Cromwell Road will be 1,177 – 1,407 vehicles. This represents an increase in traffic volumes of around 11-15% of the current 12 hour volumes, resulting in 24 hour volumes closer to the 1,500 vehicles per day accepted threshold for residential streets.

The report suggests that the actual increase in traffic may not be noticeable in a practical sense. For example, about 25-40% of the increase in traffic will be attributed to additional staff numbers which will still be concentrated at the start and end of shift times. The general increase in production traffic will be spread throughout the day, typically between 7.00am and 4.00pm on weekdays.

5.5.2.2 Construction

Based upon the anticipated value of the upgrade, and making some preliminary estimates of average truck loadings, the report estimates that 800 truck movements might be generated during the period of construction. This equates to approximately 6.4 truck movements per week (2.5 years and 50 weeks per annum), or an average of 1 per day.

The amount of construction traffic will vary from day to day depending on the actual work being undertaken. Construction labour will typically be between 15-30 people, but will vary throughout the construction period from anywhere between 4 to 45 staff.

These construction traffic estimates are not in addition to the future generation of the facility, since production cannot reach capacity until after the upgrade is complete.

5.5.2.3 Vehicle Parking Arrangements

The existing staff car park provides 101 marked parking spaces. A few other parking spaces are located throughout the remainder of the site. Parking utilisation surveys undertaken indicate that the highest recorded occupancy is 85%.

Proposed shift times indicate that the largest contingent of staff on site will increase from a current 98 staff during the day shift to 159 staff for the proposed day shift.

The Tonkin traffic assessment report identified that in order to maintain the current parking occupancy rate of 85% after the upgrade, provision would need to be made for approximately 70 additional parking spaces.

As part of the upgrade, Bradken proposes to expand the existing car park (located off Cromwell Road on the eastern side of the site) further east to accommodate the additional staff vehicles. The expanded car park will provide a total of 170 marked parking spaces and will avoid any impact on the availability of on-street parking in the vicinity of the site.

Given the layout of the current and proposed manufacturing operations on site, the only feasible potential locations for additional car parking spaces are on the eastern side of the site where there is vacant land available and separation from production areas. Establishing one or more car parking areas within or near the production areas of the site would create significant safety hazards and is therefore excluded as a viable option.

Alternative locations explored include the north eastern corner of the site, the site of the existing stormwater retention pond and the south eastern corner of the site adjacent to the existing car park,

The existing stormwater retention pond is an essential element of the site's stormwater management system, and is hydraulically connected to stormwater infrastructure on the site. As such, its relocation to allow the construction of car parking is not considered viable.

If an additional car park was to be constructed in the north-eastern corner of the site, staff access to the car park would necessarily be via Marmion Avenue. Marmion Avenue is currently a residential cul-de-sac with minimal traffic volumes. The increase in traffic volumes due to the establishment of a northern car park would increase noise levels at the residences and have a detrimental impact on residential amenity.

It is considered that the eastern expansion to the existing car park will have the least impact on amenity of the available options. Access to the car park will continue to be from the Cromwell Road entrance at the western end of the car park, where noise generated by vehicle movements will have less impact on residences to the east. Further, there is sufficient space in this part of the site to accommodate the expanded parking area while still leaving a significant (17 metre wide) buffer between the edge of the car park and the eastern site boundary. This buffer will be extensively vegetated in accordance with the Landscaping Plan provided at Appendix G.

In respect of alternate forms of transport, it is noted that a small number of employees currently walk to work. Bicycle rails can be readily added to the secure staff car parking area. All employees are provided with their own locker and have access to shower facilities.

Given the increased on site car parking capacity to be provided, it is anticipated that the proposal will not impact upon the availability of on street car parking spaces for residents and nearby businesses in the vicinity of the site.

5.5.2.4 Local Road Infrastructure

Vehicles associated with the foundry enter the site via Cromwell Road, accessed from either Prospect Road or Churchill Road intersections.

The traffic assessment report prepared has identified that the marginal increase in vehicle movement associated with the proposed upgrade can be accommodated on Cromwell Road without any need for additional roadworks.

In particular it was found that, in respect of the junctions of Cromwell Road with Churchill Road and Prospect Road, future anticipated traffic volumes are not likely to significantly increase queues or delays in either of these arterial roads and there should be no need for additional right turn storage in Churchill Road or Prospect Road. Further, it was concluded in the report that local access would not be unduly affected by the additional projected traffic numbers or the provision of a larger on site car park. Traffic movements associated with the car park will continue to be concentrated at the start and end of shift times, particularly between 2.30-3.30pm at the conclusion of the day shift and commencement of the afternoon shift.

The current shift times are not likely to change, and are as follows:

Day shift	6.00-7.00am – 2.30-3.30pm
Afternoon shift	2.30-3.30pm – 10.30-11.30pm
Night shift	11.30pm – 6.30am

Accordingly, no changes are considered necessary to the arterial or local road network.

5.5.2.5 Effects on Local Road Users and Adjacent Development

The Kilburn Primary School is located on Montgomery Street. A pedestrian access path exists between Cromwell Road and Montgomery Street, opposite Blackburn Street. Site observations on a school day between 2.45pm and 3.45pm indicate that the path is used by a number of parents and children. Several parents and children also walk through the Canine Association car park. Pedestrian movements were concentrated between 3.10 and 3.30pm. A 25km/h school zone applies to Cromwell Road in this area.

Given the above, the traffic report suggests moving shift times to avoid conflict with the school (particularly around 3.20pm). It is also suggested that Council give consideration to the installation of a formal (Emu) pedestrian crossing adjacent the path. However, these changes are not considered essential given the marginal increase in traffic numbers proposed.

5.6 RISK / HAZARD MANAGEMENT

Bradken has established systems for the management of on-site issues associated with health, safety and environment and, as part of this management system, has developed site specific Work Instructions and operating procedures for prevention of personnel injuries or damage to plant or equipment. These issues have minimal, if any, risk to nearby residential occupiers or to the community generally and are not discussed here.

5.6.1 Risk Assessment

As part of the development of the proposal, Bradken has undertaken a "Risk Assessment" of the processes and procedures undertaken (and proposed to be undertaken) on the site via a risk assessment workshop. The Risk Assessment was carried out in accordance with AS/NZS 4360:2004 Risk Management. Chapter 3 of AS/NZS 4360:2004 describes the key criteria required in the risk management process:

1. Communicate and Consult
2. Establish the Context
3. Identify Risks
4. Analyse Risks
5. Evaluate Risks
6. Treat Risks
7. Monitor and Review
8. Record the Risk Management Process.

At the Bradken Risk Assessment workshop, key personnel with knowledge of the site and the proposed operation of the upgraded site were brought together to provide input. A risk register was developed to identify potential "risk scenarios", as well as causes of those scenarios (analysis), consequences (evaluation) and corrective actions (treatment) including monitoring and review. The risk register and Risk Assessment Report recording the findings of the workshop are provided at Appendix X.

The Risk Assessment for the upgrade identified five main operational risks, relating to:

- the potential for binder to inadvertently be pumped into catalyst storage or vice versa;
- a transformer explosion;
- ventilation failure in the mould cooling area;
- damage or rupture to the LPG tank; and
- a baghouse fire in the moulding area.

Corrective actions were identified during the Risk Assessment to adequately mitigate all operational risks.

In the absence of an equivalent South Australian guideline, the method for determining an appropriate level of risk assessment set out in the document "Multi-level Risk Assessment" (1997) prepared by the NSW Department of Urban Affairs and Planning was applied. This method was specifically developed for assessing risks posed by new facilities and modifications to existing facilities. The method incorporates two screening processes to determine whether hazards that are identified in the early stages of a risk assessment should be subjected to a Level 1 (Qualitative), Level 2 (partially Quantitative) or Level 3 (Quantitative) analysis:

1. Compare each scenario against criteria such as Dangerous Goods Class, threshold quantities, storage method and separation distance from site boundary;

2. Assess scenarios which exceeded the criteria used in the first process against the International Atomic Energy Agency 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 document.

None of the Dangerous Goods identified in the risk assessment workshop were determined to be above the threshold which required a Level 2 or Level 3 assessment to be carried out. As such, the workshop was able to determine, based on the qualitative methods employed, that no significant risks to users of the surrounding land would be created as a result of the upgrade.

The general findings of the Risk Assessment were:

- no start-up/commissioning or shut down issues were identified;

- 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;
- emergency vehicle access to and around the upgraded facility has been deemed adequate by the Metropolitan Fire Service;
- Bradken is confident that in regard to risks associated with internal roadways and external transporters, the risk will be reduced to As Low As Reasonably Practicable (ALARP) during detailed plant design where plant specific risk assessments will be completed;
- Bradken 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 continue to be tested and maintained in accordance with AS 3896-1998 *Examination for legionellae including Legionella pneumophila.*

The following recommendations were made as a result of the above findings:

- to test 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;
- to review the existing stormwater system to ensure it is sufficient for the upgraded facility;
- to review existing site specific Work Instructions to ensure relevance with the upgraded facility, including the location and content of spill kits.

Bradken has already carried out the necessary assessments of the binder and catalyst and the stormwater system. The recommendation regarding Work Instructions will be acted upon as part of the detailed design stage of the proposal.

The vast majority of risks identified in the Risk Assessment Report already exist for the current operations and are effectively controlled by existing management systems.

The following issues are discussed in detail in response to specific issues raised in the Guidelines Paper:

5.6.1.1 Materials Storage

Storage areas and their management are described as follows:

- *Chemical store*

  This is an impervious concrete bunded area and is used for storage of minor volumes of chemicals which are generally contained in 200 litre steel drums. It has a sump to allow retrieval of any spills, is well ventilated and is roofed to eliminate rain water collecting in the bunded area. Construction has been designed to comply with Australian Standards and Safework SA regulations.

  Chemical drums are placed into the store and retrieved using a forklift. This area is controlled by the inwards goods storeman, from an adjacent office.

- *Flammable liquids store*

  This is an existing impervious concrete bunded area which is used for storage of flammable liquids and paints that are generally contained in 200 litre steel drums. It has a sump to allow retrieval of any spills, is well ventilated and is roofed to eliminate rain water collecting in the bunded area. A fire wall provides the required fire separation to the operators in the Machine Shop. Construction has been designed to comply with Australian Standards and Safework SA regulations and is currently licensed by Safework SA.

  Drums containing flammable liquids are placed into the store and retrieved using a forklift. This is controlled by the inwards goods storeman from an adjacent office.

- *Chemical storage tanks*

  Two existing chemical storage tanks are used to store bulk chemicals used in the moulding process. One tank is manufactured from mild steel and the other is stainless steel. They are both located inside the main foundry building and inside an impervious concrete, bunded area. They are designed and installed to Australian Standards and Safework SA regulations and the installation is licensed by Safework SA.

  The tanks are filled from a bulk chemical tanker which unloads from a concrete loading area that contains any leakage and drains away from any stormwater services.

  These existing tanks are to remain after the upgrade and two additional stainless steel storage tanks of similar capacity added within the proposed sand mixing area.

- *Diesel storage tank*

  The existing diesel storage tank is a mild steel, above-ground tank, standing within an impervious concrete bunded area and complete with a sump available for spill retrieval. The area is roofed to eliminate rain water collecting in the bunded area and the tank and the installation is designed to Australian Standards and Safework SA regulations.

  The tank is filled from a bulk diesel tanker which unloads on a concrete loading area that contains any leakage and drains away from any stormwater services

  This tank is to be relocated and upgraded as part of a separate application lodged with the City of Port Adelaide Enfield for the upgrade and relocation of the Heat Treatment Area.

- *Scrap steel storage*

  The existing scrap steel storage area will be relocated from the southern end of the main foundry building to the northern end of the proposed furnace building. The scrap steel will be contained within a bunker with steel retaining walls and a concrete floor.

  The existing open scrap steel lay down area on the northern boundary of the site will be relocated off-site and the scrap steel storage area will be managed to maintain only a minimum working stock level.

- *Used sand stockpile*

  The existing used sand stockpile will be relocated to within the proposed mould pouring building. Both the sand and scrap areas will be appropriately contained within steel retaining walls.

- *Waste sand/dust bunkers*

The waste sand/dust bunker will be located outdoors on a concrete area and the sand/dust contained within steel retaining walls. Water sprays will be installed over the top of the stockpile to limit dust generation during loading and unloading and the bunker will have a roof and wall sheeting to reduce dust emissions during dry windy conditions.

The storage, construction and location of all dangerous goods stores will be compliant with the applicable Australian Standards. By complying with Australian Standards community requirements are inherently met. The proposed dangerous goods manifest for the upgraded facility is included below:

Class	PG	Maximum Quantity	Substances
3	II	1,100 L	Paints
3	III	5,700 L	Paints
4.3(6.1)	III	50,000 kg	Furnace consumables
6.1	III	40,000 L	Binder
8	III	8,000 L	Catalyst
2.1		3,000 L	Acetylene, LPG, aerosols
2.2		4,900 L	Argon, Carbon dioxide
2.2(5.1)		4,300 L	Oxygen
C1 Combustible Liquids		2,000 L	Diesel
C2 Combustible Liquids		5,000 L	Solvents

The potential for off-site impacts from dangerous goods storage has been assessed as part of the Risk Assessment Report prepared for the proposal. For this assessment the guideline "Multi-level Risk Assessment" (NSW Department of Urban Affairs and Planning, 1997) was used. This guideline provides a recognised method for determining if hazardous materials present on site are likely to pose a significant risk to surrounding land uses. The analysis undertaken in the Risk Assessment Report identified that, if managed in accordance with relevant standards and procedures as proposed, there will be no substances with the potential to cause off-site impacts.

The Metropolitan Fire Service has also confirmed that Bradken's proposed fire protection facilities associated with dangerous goods storage are adequate.

5.6.1.2 On-site Handling of Dangerous Goods

On-site handing and use of dangerous goods by Bradken employees is covered by the following directives, included in current procedures:

- clean up any spills immediately should they occur;
- wear appropriate personal protective equipment (PPE) when handling any chemicals and chemical containers;
- store all chemicals, paints, resins, oils etc. in specified areas at all times;
- all drums and containers used on site are to be clearly labelled;
- all empty containers are to be stored in the appropriate area;
- beverage containers are not to be used for storage of any chemicals, resins, paints or oils;
- bunded areas are to be kept free of sand and other debris;
- recyclable containers (odour sprays, etc) are to be returned to the store for recycling.

Control of chemical spills on site is currently handled by the site Emergency Response Team (ERT) in accordance with Bradken environmental procedures. The ERT receives regular training conducted by "The First Five Minutes" emergency response consultants. ERT procedures have been certified as part of the site's ISO 14001-2004, Environment Management Systems certification. These procedures will continue to be applicable after the upgrade.

In the case of minor spills (a spill where neither employees nor the environment are at risk) the following directives will be applied:

- know the chemical you are using, the required PPE and where the Material Safety Data Sheet (MSDS) is located;
- contain the spill using a suitable absorbent such as sand or sawdust; and
- clean up the spill immediately.

In the case of a significant spill (a spill where there is potential risk to employees and/or the environment) the following directives will be applied:

- warn all people in the vicinity that might be affected;
- notify the Emergency Response Co-ordinator, Environmental Officer and Manufacturing Manager. The Emergency Services and the EPA may also need to be notified;
- if necessary check the MSDS for instruction;
- wear the necessary PPE;
- remove all sources of ignition if the chemical is flammable;
- stop the leak at the source if possible;
- use spill absorbents to contain the spill and prevent the spill from spreading;
- take immediate action to contain the spill and ensure no liquid chemical in any quantity (small or large) enters the stormwater drains. Block the stormwater drains with foundry sand if required.
- take immediate steps to clean up the spill;
- dispose of contaminated absorbent, sand or spilt chemical after consultation with the Environmental Officer; and
- complete an incident report.

The Risk Assessment Report recommended reviewing the content and location of spill kits within the upgraded facility.

5.6.1.3 Transportation of Dangerous Goods

A summary of the current existing and proposed dangerous goods travelling to/from the site is provided at Appendix Y.

Transportation Routes

All trucks and tankers delivering dangerous goods will arrive at the site via the western length of Cromwell Road and enter the site, as currently, via the main gate (Gate B) on Cromwell Road. These goods are delivered from licensed warehousing and storage in the north western region of metropolitan Adelaide, typically along Grand Junction Road and South Roads.

Management of Off-site Accidents

Management of any off-site accidents (potentially chemical spills) is the responsibility of the contracted transportation company which holds its own licence to carry dangerous substances and will have the appropriate emergency response procedures in place. Bradken will only engage contractors who are appropriately licensed and have appropriate emergency response procedures in place. There have been no recorded incidents of this type during the last 12 years.

In the case of an emergency, the transportation company will request the assistance of the SA Metropolitan Fire Service who have access to the appropriate Material Safety Data Sheets and are aware of potential risks and how these risks are to be managed.

With appropriate emergency response, any potential adverse environmental effects (eg stormwater contamination, fire) will be greatly reduced.

Transport of Oversized Product

The proposed new 20 tonne arc furnace will provide capacity to produce single castings of up to 14 tonnes in weight. These larger castings will fit within the current net weight transport limits for semi trailers and will also fit the width and height limits in most cases.

Any casting that does not meet the dimension requirements for standard transportation will be transported in accordance with existing regulations for wide/high loads.

Bradken also has its own weighbridge on site which will be used to ensure individual trucks are not overloaded before despatch.

5.6.1.4 Fire Risk

The risk of fire was extensively investigated as part of the Risk Assessment process. Fire was an identified “hazard” guideword and systematically paired with each process undertaken in the upgraded facility to ensure that all potential scenarios were identified.

Four high to extreme fire risk scenarios were identified during the risk assessment. Actions were identified for each scenario resulting in the risk being eliminated or reduced to ALARP.

5.6.1.5 Cooling Tower Maintenance

Bradken operates all of its cooling towers to the specification set out in AS3666:2002 (parts 1, 2 and 3). These Australian Standards set the requirements for design, installation and commissioning; operation and maintenance; and performance based maintenance of cooling water systems.

Existing Cooling Towers

There are currently five cooling towers on site:

- Sand reclaim system cooling tower;
- Arc Furnace Transformer cooling tower;
- Two quench system cooling towers; and
- Arc Furnace cooling tower.

Water treatment maintenance of the cooling towers is currently contracted to Nalco Australia, a highly regarded and dependable supplier of cooling tower maintenance service in Adelaide and a world leader in water treatment and control. Nalco is ISO 9002 certified.

The water treatment maintenance program for each cooling tower is in accordance with AS3666, and is as follows:

- monthly inspection and servicing of the chemical dosing system;
- monthly testing and reporting of the water for pH, TDS, inhibitor and biocide;
- monthly total bacteria monitoring of the cooling water;
- three monthly Legionella testing by Gribbles Pathology for each tower;
- half yearly tower cleaning, where all towers are drained and cleaned with high pressure water to remove dirt and sludge. A tower clean certificate is supplied by Nalco for this work. Water drained during cooling tower cleaning is tested to ensure compliance with SA Water requirements and is disposed to sewer.

Further to this, the on-site Bradken fitters and electricians carry out weekly inspections and repairs as required to ensure that all cooling towers are maintained in good working order. This includes the water recirculation system and the mist eliminators.

Proposed Cooling Towers

The following changes to the existing cooling tower configuration are proposed:

- the current sand reclaim cooling tower will remain and an additional sand reclaim system cooling tower will be installed as part of the sand plant upgrade;

- the current arc furnace transformer cooling tower will be made redundant and a new larger cooling tower installed for the new arc furnace transformer;

- the existing arc furnace cooling tower will also be replaced and a new larger cooling tower installed to service the new 20 tonne arc furnace.

Each of these cooling towers will have an automatic water monitoring and chemical (biocide and inhibitor) addition system and each will be maintained in accordance with AS 3666 as indicated above for the existing cooling towers on site.

5.7 CONSTRUCTION AND OPERATIONAL EFFECTS

An increase in the capacity of a steel foundry has the potential to create adverse impacts to the surrounding environment such as those associated with increased noise, air emissions, odour, stormwater, and traffic. Bradken has put significant effort into ensuring that measures are taken either in the design of the upgrade or in the preparation of operating procedures to minimise potential adverse impacts.

The upgrade proposal has been “engineered” by a wide team of experienced personnel including foundry technical personnel, foundry engineering, consultant structural, process and mechanical engineers, occupational health and safety professionals, supplier representatives, building surveyors, planning professionals, contracts administrators, environmental scientists and risk management consultants.

Each person brings to the design process their own experience and learning in their area of expertise, which combined, allow identification of potential adverse impacts that have arisen in respect of similar manufacturing plants and solutions to avoid or mitigate these impacts.

Primary equipment suppliers are also pre-eminent in their fields with years of experience in manufacturing and in developing their equipment to a very high level of operational safety and environmental compliance.

The proposal has also been reviewed by the UK based Casting Technology International (CTI), a world renowned casting manufacturing, foundry and environmental consulting firm which has verified that the design represents “best available technology economically achievable”

5.7.1 Construction

As outlined previously, Appendix M contains a Construction Environmental Management Plan (CEMP) for the proposal.

The CEMP addresses the following matters:

- construction scheduling;
- construction hours of operation;
- operational control;
- legal and other regulatory requirements;
- organisational structure and responsibilities;

- training, awareness and competence;
- communication;
- complaints and incident management;
- key environmental issues management; and
- emergency response.

Under the heading of “Key Environmental Issues Management”, the CEMP outlines specific controls for the following issues:

- asbestos removal and other demolition;
- waste management and recycling;
- hazardous materials/dangerous goods management;
- noise and vibration;
- erosion and sediment control;
- access and traffic management;
- transport and storage of construction materials;
- dust/air management;
- lighting; and
- stormwater management

The CEMP, in conjunction with project specific Procedures and Checklists, forms the Environmental Management System for management and monitoring during construction. The CEMP also forms part of Bradken’s Environmental Strategy by setting specific goals and targets for construction activities.

5.7.1.1 Transitional Arrangements

In addition to the procedures outlined within the CEMP, the following transitional arrangements will be put in place for the commissioning of the proposed new furnace:

- upon completion of the electrical supply upgrade, the new furnace will be connected to the power supply but placed on stand by;

- the proposed new furnace will be commissioned and brought into trial operation;

- the old furnace will not be used for production purposes during the trial operation period, but will be kept connected and operable, so that it may be used in the event of malfunction or commissioning complications with the new furnace. The two furnaces will never be used simultaneously as the site does not have the capacity to process that volume of metal;

- after the trial period, when the new furnace is operating satisfactorily (which is likely to be several months after initial start-up) the old furnace will be decommissioned (ie the old furnace will be demolished and the cavity in the floor of the building will be filled, concreted and used as production storage space).

The construction phase of the proposal has been staged over a three year period to provide a relatively low level of construction impact on production. On average, there will be 15-30 construction employees on site at any one time during construction with a maximum of 44 during the peak construction period.

The environmental impact from the construction phase is expected to have only a minor effect on the current environmental base line for the site, and in some respects, may not be noticeable in a practical sense.

Production will continue at the current rate of 12,500 dressed tonnes per year until the new furnace is operational and the new foundry building with in-built fume extraction systems is in place. At that point, it will be possible to increase the site’s production rate to 16,500 dressed tonnes per year.

While the site is operating at 16,500 dressed tonnes per year, core and mould production will be converted from the current alkali phenolic resin binder system to the proposed Furane binder system.

After the new moulding line is installed and commissioned, production rates will be further increased in stages to 32,000 dressed tonnes per annum, which is expected to be reached approximately 3 years after the start of construction.

5.7.2 Operations

As outlined previously, Appendix N contains an Environmental Management and Monitoring Plan (EMMP) for the upgrade which covers the following topics:

- environmental policy objectives;
- approval and licensing requirements;
- environmental management structure and responsibility;
- reporting mechanisms;
- environmental training;
- emergency contacts and response; and
- implementation (including tables of specific management/monitoring practices for selected environmental issues).

Specific issues addressed by the EMMP implementation tables include:

- general site issues;
- solid waste management;
- liquid waste management;
- noise management;
- surface water management;
- ground water management;
- air quality;
- hazardous and dangerous substances;
- raw materials and finished product storage; and
- corrective action strategies.

Finalisation of the actions and responsibilities within the tables will be undertaken prior to construction activities commencing to enable inclusion of any relevant conditions of consent.

Operationally, the proposal reduces the existing environmental effects from the site (as discussed in previous sections of this report) and will therefore lead to an environmental gain relative to the existing base line.

5.7.3 Monitoring and Reporting

Details of construction and operational monitoring and reporting mechanisms are included in the CEMP and the Plan EMMP at Appendix M and N.

All personnel, from production operators, to supervisors, the Environmental Officer, the Plant Engineer and the Manufacturing Manager have responsibilities to report incidences of non-compliance or near-misses within Bradken's management structure.

In relation to environmental performance, Bradken's internal reporting requirements include:

- *Inspection Reports* - prepared weekly by the shift supervisor and detailing any occupational, health and safety, maintenance or environmental issues recognised within their work area;

- *Monthly Reports* - prepared by the Environmental Officer and identifying any significant environmental issues and progress with environmental projects during the month;

- *Annual Reports* - detailing significant environmental issues affecting the business and providing data for corporate environmental reporting such as National Pollutant Inventory reporting and strategic planning;

- *Complaint Reports* - prepared whenever external complaints are received; and

- *Incident Reports* - prepared in relation to all environmental incidents, spills, failure of equipment etc.

Bradken has specific internal monitoring programs in place in relation to:

- furnace fume extraction stacks;
- ladle wash baghouse stack;
- reclaimed sand dust collector vent stacks;
- paint booth stacks;
- arc air and scrap cutting stacks;
- welding extraction stack;
- waste water to sewer;
- storm water;
- solid wastes;
- boundary noise;
- ground water; and
- reclaimed sand.

Monitoring results are compared against statutory and regulatory guidelines, as well as Bradken's internal performance targets. Relevant monitoring results are also provided to the EPA in accordance with the facility's EPA licence, to SA Water in accordance with the Trade Waste Permit and the National Pollutant Inventory in accordance with the National Environment Protection (National Pollutant Inventory) Measure.

5.8 EFFECTS ON INFRASTRUCTURE REQUIREMENTS

5.8.1 Power

Electric power is presently supplied to the existing Bradken foundry site via ETSA Utilities infrastructure.

ETSA advises that a new dedicated transformer for the Bradken site will be required at the Kilburn substation together with a new 11kV power supply line in order to supply increased electrical demand generated by the proposed 20 tonne arc furnace.

The upgraded supply line is to be installed on existing power poles and underground as determined by ETSA to minimise visual impact.

5.8.2 Water

All water to the site, including process water, is supplied by SA Water through the metered supply system.

The existing facility uses approximately 6,600 kilolitres per year (or 0.53 kilolitres per tonne of product produced). Water consumption for the upgraded facility is projected to be approximately 13,200 kilolitres per year (or 0.41 kilolitres per tonne of product produced).

SA Water has confirmed that it can accommodate the requirements of the proposal without impacting upon existing users within the locality.

5.8.3 Gas

Natural Gas is currently supplied to the site by AGL. Existing annual gas consumption is estimated at 121,089 GJ. The upgraded facility is expected to use 310,000 GJ per annum.

AGL advises that there is sufficient capacity within the existing system to accommodate these additional requirements.

5.8.4 Sewerage

All wastewater generated at the site (except that which is lost to evaporation) is discharged to the existing SA Water Trade Waste system. This system will remain unchanged for the upgraded facility. Wastewater volumes will, however, increase proportionally with water use. The water balance model provided at Appendix V estimates that discharge to sewer is currently 3,900 KL/year (with the balance, 2,700 KL/year, lost to cooling tower evaporation and drift losses). This is projected to increase to 6,400KL/year for the upgraded plant (with the balance, 6,800 KL/year lost to cooling tower evaporation and drift losses).

SA Water advises that there is sufficient capacity in the existing sewerage system to accommodate the liquid waste volumes anticipated by the upgraded facility.

5.8.5 Emergency Services Access

Emergency Services vehicles are provided with access to the site via the two main site gates on Cromwell Road (Gates A and B) as well as via the “emergency only” access gate at the western end of Marmion Avenue.

A fire water booster station at the main gate and a new fire water ring main around the site will be installed to provide access to firewater throughout the site.

Preliminary meetings have been held with Katnich Dodd (Building Surveyors) and the Metropolitan Fire Service. Bradken understands from these discussions that the proposed upgrade to existing emergency services on the site is acceptable.

5.8.6 Road Infrastructure

Vehicles currently access the site from Cromwell Road via Churchill Road or Prospect Road. Modelling of vehicle numbers and queuing lengths has indicated that no changes to road infrastructure will be necessary to accommodate future traffic volumes associated with the upgrade.

6.0 CONSISTENCY WITH GOVERNMENT POLICY

The subject land is located within the City of Port Adelaide Enfield. The relevant planning policy documents are the Port Adelaide Enfield (City) Development Plan and the Planning Strategy for Metropolitan Adelaide (August 2006). Within the Port Adelaide Enfield Development Plan, the Council Wide provisions and, more particularly, the General Industry (1) Zone provisions apply.

6.1 DEVELOPMENT PLAN

The most pertinent provisions of the Port Adelaide Enfield (City) Development Plan provisions (1 June 2006 version) are listed at Appendix Z.

6.1.1 Development Plan Analysis

The subject land lies wholly within the General Industry (1) Zone of the Port Adelaide Enfield (City) Development Plan. Within the zone a 'Special Industry' is a non-complying kind of development (except where it involves alteration or expansion of an existing special industry on its existing site and located within Policy Area 46).

Foundries typically lie under the broad definition of "special industry". Therefore, if the proposed upgrade is to be defined as an alteration/expansion of an existing special industry on its existing site (and given that the site is not contained within Policy 46) the upgrade would be a non-complying kind of development within this part of the General Industry Zone.

The objectives of the Zone seek, primarily, light and general industries, road transport terminals, warehousing and storage. Adaptation and modification of existing special industry within Policy Area 46 (towards Cormack Road) is also supported.

There are no minimum side or rear set backs requirements for industrial developments within the zone.

The Council Wide provisions of the Development Plan specify a standard minimum front set back of eight metres for all development and 12 metres for industrial development to provide adequate space for car parking, access and manoeuvring of vehicles and landscaping at the front of buildings. The proposed building additions are sited no closer than 29m from the front property boundary, and are in line with the front set back of existing industrial buildings on the site.

The Development Plan also does not specify a maximum height for buildings within the General Industry (1) Zone. Instead, the provisions state that 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 (Cromwell Road) and extending across the allotment.

The subject land contains a number of larger buildings that are visually prominent within the immediate locality, particularly the processing buildings within the western portion of the land. These buildings have a maximum height of approximately 14.9 metres. The existing buildings, with a front set back of approximately 29 metres, therefore do not currently meet the front setback provision. The proposed foundry building, at 21.5m in height, will also be a prominent element within the locality. However, when considering the appropriateness of building design and appearance, consideration must also be given to the existing circumstances of the site in terms of overall building height, mass and proportion. In this instance, while the proposed foundry building will be tall, it is not unusually large (in terms of floor area) when compared with the scale of industrial buildings found throughout the wider locality (as can be seen on the locality plan provided at Appendix D) and will not be demonstrably out of place when compared with the existing development on the subject land. The visual impact of the proposed building additions is also limited to the immediate area, given the existing built up nature of the surrounding locality which effectively screens the buildings from most vantages. Additional landscape treatments and improvements to front fencing will also assist in obscuring views of the site generally when viewed from adjoining public roads.

Various expert reports have been prepared for the proposal to assess impacts such as noise, odour, dust and other air emissions, traffic, wastewater and stormwater generated by the proposal. These confirm that the upgrade, when compared with the current facility, will result in a net environmental gain and that the proposal will effectively manage, to an acceptable degree, off-site impacts so as to reduce current effects on owners/occupiers within the locality.

Noise levels generated by the upgrade will meet EPA requirements. Traffic routes and vehicle numbers have been assessed and reports have concluded that they are such that the increase in traffic is unlikely to result in any significant noticeable impact upon residents within the locality or impact unreasonably upon local road networks. Visual amenity is to be improved through a general site clean-up, comprehensive landscape improvements along the Cromwell Road frontage and eastern portion of the land and using an appropriate exterior colour palette for the proposed buildings. Air quality is to be improved from current levels and the upgrade has been designed to meet relevant EPA air quality guidelines. A stormwater management plan is to be implemented to improve water quality and prevent pollution.

The proposal is to utilise best practice technology and sound environmental management practices to minimise impact of operations on the environment.

The proposal will make a significant contribution toward the economic provisions of the Development Plan and adequately addresses the design, operational and performance measures of the Plan aimed at minimising adverse impacts on adjoining development.

The land is also adjacent land contained within the Residential Zone – Policy Area 44: Comprehensive Development Policy Area. This area is identified by the Development Plan as including Housing Trust residential estates of the 1950s and 1960s which primarily accommodate low-density, three bedroom, double unit houses – with many of these dwellings nearing the end of their economic life. The Zone therefore seeks to make more efficient use of the land in these areas, to improve housing and environmental quality and to encourage more diverse social mix by promoting private housing initiatives. Examples of the beginnings of this change are evident within the residential area to the east of the subject land. However, the character of housing in the locality generally, remains dominated by 1950s and 1960s style single storey duplex development.

The Development Plan recognises the dual responsibility involved in mitigation or management of interface effects aimed at protecting existing industry and maintaining resident amenity near industrial development. To this end, the Residential Zone includes residential design policies aimed at facilitating appropriate acoustic treatments for dwellings in locations where it is anticipated that there may be some acoustic impact from industrial development. It is also good planning practice (as supported by the Planning Strategy discussed below) to resist increases in residential densities close to existing industrial development, although it is noted that examples of this have occurred, particularly to the east of the subject land, in more recent years.

6.2 PLANNING STRATEGY

The Planning Strategy provides a physical framework to assist in reaching certain targets outlined in the South Australian Strategic Plan (2004). The Planning Strategy is also integrated with other State strategic planning documents.

The Planning Strategy for Metropolitan Adelaide includes broad key directions for the State together with more detailed policies to provide further guidance as to how to achieve those key directions. The following policies considered to be the most relevant:

Metropolitan Wide Policies

3.1 Water Resources

1. Ensure the most efficient use of water based on the principles of avoidance, reduction, re-use, recycle and appropriate disposal, to reduce Adelaide's dependence on water sourced from the Mount Lofty Ranges catchment and the River Murray.

2 Promote water sensitive urban design (WSUD) in Development Plans, the Building Code of Australia and development proposals to achieve multiple catchment water management objectives such as reducing runoff and flooding; protecting waterways and their biotic communities; conserving and harvesting water; and enhancing the amenity of urban environments.

3.4 Land Use and Transport Integration

1 Integrate transport and land use planning decisions to facilitate a safe, sustainable, efficient and effective transport network.

4 Encourage people to walk and cycle to destinations by providing suitable infrastructure and developing safe, attractive and convenient walking and cycling environments.

5 Facilitate an effective freight transport network which provides for more efficient freight logistics, channels heavy vehicle traffic onto designated routes, shifts more freight from road to rail, and is protected from encroachment by incompatible activities.

3.5 Energy Efficiency

1 Reduce energy requirements for transportation and buildings.

3 Increase efficiency of use of available energy infrastructure.

3.6 Integrated Waste Management

2 Gain the highest resource value from the waste stream.

3 Ensure urban design and buildings incorporate appropriate space, facilities, access and construction methods to manage waste in accordance with the Waste Management Hierarchy.

3.11 Health and Community Services

1 Create living environments with services and facilities to support healthy lifestyles and active communities.

3.12 Hazard Avoidance, Minimisation and Management

6 Protect land and groundwater from site contamination and encourage the progressive remediation of contaminated land where a risk to human health or the environment exists.

7 Improve environmental conditions and amenity in metropolitan Adelaide, particularly adjacent to primary freight routes and large industrial precincts.

Business and Industry

3.21 Industrial Land

3 Consolidate and strengthen key industrial areas to achieve operational advantages and the efficient provision of infrastructure.

4 Promote sustainable industrial practices, such as industrial ecology, and facilitate the co-location of businesses that can share their operations.

5 Manage and prevent conflicts between industry and other uses.

6.2.1 Planning Strategy Analysis

With respect to the Planning Strategy, the subject land is located within the "business and industry employment area" and also within a "significant employment node" as identified by map 11, item 3.20 of the Strategy. This location is generally identified by the Strategy as one of 7 key locations across Metropolitan Adelaide to drive business and industry employment. The proposed upgrade, involving direct investment of some $40 million dollars over three years and generating direct employment of 100 skilled and semi-skilled jobs in the region, makes a significant contribution towards meeting the State's "growing prosperity" targets.

In respect of the "detailed policies" identified above, the following is noted:

- the proposed upgrade maintains the existing stormwater retention basin on site which serves to minimise peak stormwater flows and provides opportunities for future re-use. Existing stormwater management practices are to be reviewed as part of the general upgrade of the facility in order to minimise negative effects on the quality of surface and groundwater resources.

- the proposal makes efficient use of existing transport infrastructure and its strategic transport links to the nearby secondary arterial roads of Churchill and Prospect Road.

- the site is easily and safely accessed by foot and opportunity exists for employees to cycle to work through the provision of secure bicycle parking facilities within the staff car parking area and showering facilities on site.

- the proposed upgrade results in the more efficient use of electricity and potential for less transport (per tonne of product) through more efficiency in sand reclamation and reuse.

- the proposal results in the expansion of value adding activities through the recycling of scrap metal sourced from manufacturers within the State.

- the proposal efficiently and economically utilises existing infrastructure supplied to the subject land.

- the upgraded facility seeks to more effectively manage interface issues to improve upon existing environmental performance.

- the proposal seeks to more effectively manage the environmental conditions of the facility via the Construction Environmental Management Plan (CEMP) and Environmental Management and Monitoring Plan (EMMP) prepared for the proposal.

6.3 OBJECTS OF THE ENVIRONMENT PROTECTION ACT

The Environment Protection Act 1993 is the principal legislation addressing environmental impacts in South Australia. The objects of the Act are set out in section 10 of the Act. The relevant objects of the Act include:

- to promote the following principles ("principles of ecologically sustainable development”):

  (i) that the use, development and protection of the environment should be managed in a way, and at a rate, that will enable people and communities to provide for their economic, social and physical well-being and for their health and safety while—

    (A) sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations; and

    (B) safeguarding the life-supporting capacity of air, water, land and ecosystems; and

    (C) avoiding, remedying or mitigating any adverse effects of activities on the environment;

  (ii) that proper weight should be given to both long and short term economic, environmental, social and equity considerations in deciding all matters relating to environmental protection, restoration and enhancement;”

- to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development; and, among other things,

- to ensure that all reasonable and practicable measures are taken to prevent, reduce, minimise and, where practicable, eliminate harm to the environment by programmes to encourage and assist action by industry, public authorities and the community aimed at pollution prevention, clean production and technologies, reduction, re-use and recycling of material and natural resources, and waste minimisation.

The proposed upgrade reflects and is consistent with these objects as the focus of the upgrade is the enabling of an increase in Bradken’s production capacity, which brings with it economic and social benefits to the State, with several improvements in the current environmental performance of the facility.

Features of the upgrade such as the proposed new resin binder system, fume collection system and baghouses were all selected to maximise improvements to environmental performance (particularly in relation to odour, particulates and air quality) while still enabling production rates to increase. Noise attenuation measures will be put in place to ensure that noise impacts after the upgrade will be no more than current levels, despite the increased activity on site.

6.4 LICENCE REQUIREMENTS UNDER THE ENVIRONMENT PROTECTION ACT

Schedule 1 of the Environment Protection Act 1993 sets out a list of ‘prescribed activities of environmental significance’. Bradken is currently authorised by the EPA via EPA Licence 13845 to carry out two of these activities at the Kilburn facility:

- ferrous and non-ferrous metal melting;
- activities producing Listed Waste.

The proposed upgrade relates to these activities, since one of the key features of the upgrade is the replacement of the existing EAF with a larger, more efficient furnace. The size, efficiency and design of the furnace affect the rates at which Bradken can melt metal to manufacture its products as well as the emissions from furnace operations. Further, the baghouse dust (particulate matter) collected by the furnace extraction system contains zinc and manganese, making the dust a Listed Waste for the purposes of the Act. Bradken’s EPA licence contains a number of conditions that regulate how Bradken is required to store, label, handle and transport Listed Waste to ensure that it does not cause harm to the environment.

6.5 SECTION 25 OF THE ENVIRONMENT PROTECTION ACT

Section 25 of the Environment Protection Act imposes a general environmental duty on all persons undertaking an activity that pollutes (or might pollute), which requires them to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

The section provides that in determining what measures are required to be taken in order to meet the duty, regard is to be had, amongst other things, to:

(a) the nature of the pollution or potential pollution and the sensitivity of the receiving environment; and

(b) the financial implications of the various measures that might be taken as those implications relate to the class of persons undertaking activities of the same or a similar kind; and

(c) the current state of technical knowledge and likelihood of successful application of the various measures that might be taken.

The proposed resin binder and design of the new foundry building are among best practice for steel foundries. The upgrade will bring the facility fully into compliance with relevant odour, particulate and air quality standards, in large part due to significant additional investment in environmental emission control technology. Further, the procedures set out in the EMMP and CEMP ensure that employees at all levels in the company take all reasonable and practicable measures to minimise the environmental impacts of the ways in which they carry out their duties.

6.6 POLICIES UNDER THE ENVIRONMENT PROTECTION ACT

Environment Protection Policies relevant to this proposal are:

- Environment Protection (Air Quality) Policy 1994;
- Environment Protection (Machine Noise) Policy 1994;
- Environment Protection (Industrial Noise) Policy 1994;
- Environment Protection (Waste Management) Policy 1994; and
- Environment Protection (Water Quality) Policy 2003.

These Policies contain both mandatory provisions as well as standards that may be enforced via EPA licence conditions or Environment Protection Orders. After the upgrade, the facility will be compliant with all relevant mandatory provisions of the Air Quality, Machine Noise, Industrial Noise and Waste Management Environment Protection Policies.

A small number of exceedences of the water quality criteria set out in the Environment Protection (Water Quality) Policy have been identified by recent groundwater and stormwater sampling. The Water Quality Policy provides a number of sets of criteria for the assessment of water quality impact on various protected environmental values. The exceedences of the water quality criteria identified in the recent investigation have been determined by reference to the most sensitive water quality parameters in the Water Quality Policy. These parameters are many orders of magnitude more sensitive than one would expect for the receiving environments for stormwater and groundwater under the site. Risk assessments have been undertaken to determine the extent to which the exceedences are of significance by reference to the water quality criteria for potable water (groundwater) and freshwater aquatic ecosystems (stormwater). The identified low level exceedences are consistent with the site's use as a foundry and are not regarded as significant by reference to those water quality criteria.

Following the upgrade, Bradken will have measures in place to minimise impacts on stormwater and aimed at improving stormwater quality to the extent that it will work towards meeting the water quality criteria for freshwater aquatic ecosystems under the Water Quality Policy.

Further, the upgrade has been designed and will be implemented so that the facility complies with all relevant non-mandatory Policy provisions, including the maximum noise levels set out in the Environment Protection (Industrial Noise) Policy 1994 and the draft Environment Protection (Noise) Policy 2004.

6.7 AIR EMISSIONS

Air emissions in South Australia are regulated by the EPA pursuant to the Environment Protection (Air Quality) Policy 1994. After the upgrade, the site will comply with all provisions of the Policy, including the maximum pollution levels to be emitted from point sources set out in Schedule 1 of the Policy.

The EPA has also issued guidelines for air quality impact assessment using design ground level pollutant concentrations (updated January 2006) which set out the EPA's preferred approach to calculating ground level concentrations resulting from emissions to atmosphere from a facility using computer modelling. The guidelines also set out design ground level concentrations ("DGLCs") against which the modelled ground level concentrations are compared to determine if there are potential adverse impacts from the facility's emissions. Modelling carried out in accordance with the guidelines has indicated that after the upgrade, ground level concentrations of all modelled substances emitted from the Bradken site should be below the DGLCs set out in the guidelines.

A consultation draft of EPA Guidelines for Separation Distances was issued in August 2000, but the draft Guidelines have not yet been finalised. The draft Guidelines list recommended separation distances between various industrial uses and sensitive land uses, which are designed to ensure that incompatible land uses are located far enough apart to enable industry to operate while at the same time avoiding air quality impacts on sensitive receptors. The express intention for use of the draft Guidelines was for the separation distances to only be used in the assessment of the siting of new industrial development, and to ensure that existing industrial activities in appropriate zones are protected from encroachment by residential and other sensitive land uses that would adversely affect industry viability. Given that the draft Guidelines are not intended to be applied retrospectively to existing industrial sites, this upgrade cannot be assessed against the recommended separation distances. Instead, Bradken has committed to invest in technology and processes that will minimise impacts and enable the site to operate while at the same time meeting all relevant EPA standards and guidelines for air emissions.

6.8 GREENHOUSE GAS EMISSIONS

The South Australian Government has proposed legislation in the form of the Climate Change and Greenhouse Emissions Reduction Bill 2006, which will set long-term targets for greenhouse gas emissions in the State. In particular, the Bill proposes a target for South Australia to reduce its greenhouse gas emissions by the end of 2050 to the extent that levels at that time will be equal to or less than 40% of 1990 levels.

The upgrade of the Kilburn site proposed by Bradken will improve the site's greenhouse gas efficiency from 2.0 t CO2-e/t dressed casting to 1.62 t CO2-e/t dressed casting, which compares favourably with foundry industry best practice.

South Australia is also a member of the National Emissions Trading Taskforce which recently released a discussion paper on a national emissions trading scheme. One aspect of the scheme is that emitters of greenhouse gases would report their emissions. Bradken's current and proposed record keeping procedures will adequately ensure that the relevant information about Bradken's emissions can be gathered and reported as appropriate.

6.9 WASTE MANAGEMENT

South Australia's Waste Strategy 2005-2010, prepared by ZeroWaste SA, sets out a number of goals and objectives for dealing with waste into the future in this State. These objectives include:

Less waste - achieving substantially less waste going to landfill in South Australia means that materials must be redirected towards more beneficial uses.

Effective systems - South Australia needs to establish, maintain and increase the capacity of recycling systems and re-processing infrastructure in metropolitan and regional areas.

The Bradken facility manufactures steel products from scrap steel. Its raw materials are a mixture of used steel parts returned by its customers and scrap (ie waste) steel from around the State and the country, obtained from scrap metal dealers such as Simsmetal. This waste material could be directed to landfill. However, Bradken's business is to melt it and remould it into useful products. The proposed upgrade will increase the capacity of the site to melt scrap steel. As such, the upgrade will have the effect of increasing South Australia's ability to recycle and reprocess waste materials that would otherwise go to landfill and turn them into beneficial products for customers in South Australia, Australia and around the world. This reinforces the waste hierarchy promoted by the State Waste Strategy.

Construction waste, and waste from earthworks or the demolition of existing buildings, plant and concrete foundations that is generated during the construction period will be reused on site or sent to one or more of the building materials recyclers located nearby in Wingfield so that it can be processed into a useful building or fuel material.

Further, the proposed new resin binder that will be introduced as part of the upgrade can be more efficiently cleaned from used foundry sand than the current resin binder used at the site. This means that for every casting, a significantly larger proportion of the sand than at present can be recycled back into the process and used for further casting. There will therefore be significantly less 'waste' sand generated by the process per tonne of metal cast. It is expected, in fact, that after the change in resin, the amount of new sand required each year (and therefore, the amount of waste sand that cannot be used for casting and must be sent off-site to other beneficial use or landfill) at the full expanded capacity of the site will be around the same as or slightly less than the current amount. As such, the proposed upgrade is consistent with the objectives of South Australia's Waste Strategy, and in particular, the waste hierarchy.

Finally, it is noted that waste must be managed in South Australia in accordance with the Environment Protection (Waste Management) Policy 1994. Relevantly, the Policy provides that a person who transports waste on or in a vehicle must take all reasonable and practicable steps to cover, contain or secure the waste to ensure that it remains on or in the vehicle throughout the course of transportation. Bradken does not carry out the transport of waste off-site itself as part of its normal operations. However, where waste is transported within the site, Bradken personnel comply with the requirements of the Policy.

7.0 AGREEMENTS/COMMITMENTS

Bradken commits to the following additional measures to further mitigate and manage the impacts of the proposed upgrade:

- undertaking a second round of groundwater testing/monitoring during the public exhibition period of the PER and providing the results of that monitoring as part of the Response Document;
- contributing (as agreed between Bradken and the relevant authority) to the cost of upgrading power supply to the land;
- discussing the potential need for an emu crossing on Cromwell Road with the City of Port Adelaide Enfield and contributing partial funding to such a crossing if considered necessary;
- landscaping and maintaining the verge in front of the Bradken property along Cromwell Road;
- working with the City of Port Adelaide Enfield to develop an employment strategy to target jobs growth for local residents;
- providing an increase in apprentice training positions and increased specific "on the job" training to provide increased opportunities for young workers;
- continuing to support the Kilburn Primary School with its building improvement program.

Appendix A

Construction Staging

CONSTRUCTION STAGING

QUARTER AFTER COMMENCEMENT	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Bradken Adelaide Foundry Upgrade Construction Staging													
Stage 1													
Demolish existing North-Eastern building		■	■										
Complete landscaping and signage				■									
Construct new furnace building (Stage 1)			■	■	■	■							
Upgrade site electrics and install transformer					■								
Install 20 tonne electric arc furnace (EAF)						■	■						
Install noise reduction equipment						■							
Install fume extraction equipment							■						
Stage 2													
Demolish existing South-Eastern building						■	■						
Extend new foundry building for moulding (Stage 2)							■	■					
Install Sand Reclaim plant								■	■				
Relocate Jobbing moulding into new building						■	■	■					
Install Fast Loop moulding system											■	■	■
Install mould cooling odour extraction												■	■
Extend Cleaning & Fettling building								■	■	■	■	■	
Install Cleaning & Fettling equipment											■	■	■

Appendix B

Development Act Provisions

Development Act 1993 – Relevant Provisions

PER Process – Specific Provisions, Section 46C

(1) This section applies if a PER must be prepared for a proposed development or project.

(2) The Minister will, after consultation with the proponent –

(a) require the proponent to prepare the PER; or

(b) determine that the Minister will arrange for the preparation of the PER.

(3) The PER must be prepared in accordance with guidelines determined by the Major Developments Panel under this subdivision.

(4) The PER must include a statement of –

(a) the expected environmental, social and economic effects of the development or project;

(b) the extent to which the expected effects of the development or project are consistent with the provisions of –

(i) any relevant Development Plan; and

(ii) the Planning Strategy; and

(iii) any matters prescribed by the regulations;

(c) if the development or project involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, the extent to which the expected effects of the development or project are consistent with –

(i) the objects of the *Environment Protection Act 1993*; and

(ii) the general environmental duty under that Act; and

(iii) relevant environment protection policies under that Act;

(ca) if the development or project is to be undertaken within the Murray-Darling Basin, the extent to which the expected effects of the development or project are consistent with –

(i) the objects of the *River Murray Act 2003*; and

(ii) the *Objectives for a Healthy River Murray* under that Act; and

(iii) the general duty of care under that Act;

(cb) if the development or project is to be undertaken within, or is likely to have a direct impact on, the Adelaide Dolphin Sanctuary, the extent to which the expected effects of the development or project are consistent with –

(i) the objects and objectives of the *Adelaide Dolphin Sanctuary Act 2005*; and

(ii) the general duty of care under that Act;

(d) the proponent's commitments to meet conditions (if any) that should be observed in order to avoid, mitigate or satisfactorily manage and control any potentially adverse effects of the development or project on the environment;

(e) other particulars in relation to the development or project required –

(i) by the regulations; or

(ii) by the Minister.

(5) After the PER has been prepared, the Minister –

(a) -

(i) must, if the PER relates to a development or project that involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, refer the PER to the Environment Protection Authority; and

(ia) must, if the PER relates to a development or project that is to be undertaken within the Murray-Darling Basin, refer the PER to the Minister for the River Murray; and

(ib) must, if the PER relates to a development or project that is to be undertaken within, or is likely to have a direct impact on, the Adelaide Dolphin Sanctuary, refer the PER to the Minister for the Adelaide Dolphin Sanctuary; and

(ii) must refer the PER to the relevant council (or councils), and to any prescribed authority or body; and

(iii) may refer the PER to such other authorities or bodies as the Minister thinks fit,

for comment and report within the time prescribed by the regulations; and

(b) must ensure that copies of the PER are available for public inspection and purchase (during normal office hours) for at least 30 business days at a place or places determined by the Minister and, by public advertisement, give notice of the availability of copies of the PER and invite interested persons to make written submissions to the Minister on the PER within the time determined by the Minister for the purposes of this paragraph.

(6) The Minister must appoint a suitable person to conduct a public meeting during the period that applies under subsection (5)(b) in accordance with the requirements of the regulations.

(7) The Minister must, after the expiration of the time period that applies under subsection (5)(b), give to the proponent copies of all submissions made within time under that subsection.

(8) The proponent must then prepare a written response to -

(a) matters raised by a Minister, the Environment Protection Authority, any council or any prescribed or specified authority or body, for consideration by the proponent; and

(b) all submissions referred to the proponent under subsection (7), and provide a copy of that response to the Minister within the time prescribed by the regulations.

(9) The Minister must then prepare a report (an *Assessment Report*) that sets out or includes -

(a) the Minister's assessment of the development or project; and

(b) the Minister's comments (if any) on –

(i) the PER; and

(ii) any submissions made under subsection (5); and

(iii) the proponent's response under subsection (8); and

(c) comments provided by the Environment Protection Authority, a council or other authority or body for inclusion in the report; and

(d) other comments or matter as the Minister thinks fit.

(10) The Minister must, by public advertisement, give notice of the place or places at which copies of the Assessment Report are available for inspection and purchase.

(11) Copies of the PER, the proponent's response under subsection (8), and the Assessment Report must be kept available for inspection and purchase at a place determined by the Minister for a period determined by the Minister.

(12) If a proposed development or project to which a PER relates will, if the development or project proceeds, be situated wholly or partly within the area of a council, the Minister must give a copy of the PER, the proponent's response under subsection (8), and the Assessment Report to the council.

Appendix C

Economic Analysis

Economic
ResearchConsultants

Economic Impact Assessment Analysis for Bradken Major Development PER

Prepared by Economic Research Consultants Pty Ltd*

20 August 2006

Executive Summary

Bradken Resources Pty Ltd ("Bradken") has proposed an investment of approximately $40 million to upgrade their steel foundry located at Kilburn, with the expectation of a consequent increase in operating employment of 100 people.

This investment will increase capacity of local production activity to 16,500 tonnes initially, increasing to 32,000 tonnes after three years. The major markets for increased outputs include the resource sector in South Australia, and castings for the ASC AWD contract.

This paper provides an assessment of the impacts of this proposal on net employment in the state of South Australian and in the north western Metropolitan region of Adelaide. Such an assessment is set within the context of the State Strategic Plan, which has as key objectives increases in employment and investment.

Bradken's current operations provide 180 employment opportunities for South Australians paying annual wages of almost $9 million. However, associated with operations there are also indirect impacts of the operations – related to the expenditure that occurs in the state in supporting the operations (ie purchase of supplies and the broader flow-on or down- stream effects. These impacts are modelled as effectively doubling the employment outcomes from a state perspective. It is estimated **that Bradken is currently responsible for creating total employment of over 330 people in the state and generating annual incomes (wage and salary in Bradken and a broader level of value added in the indirect effects) of $22 million**. From a north western region perspective it is estimated that Bradken is currently responsible for creating total employment for some 175 people and generating annual incomes of $11 million.

Bradken have provided information to suggest that without an upgrade, the Adelaide site will not be viable and most likely will be forced to close within the next five to ten years. The outcome of this perspective have been modelled as a direct decline in direct employment from the current levels to around 90 people (note that Bradken's

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* This analysis has been undertaken by Barry Burgan in his capacity as a Director of Economic Research Consultants. This study, while embodying the best efforts of the investigator, is but an expression of the issues considered most relevant, and neither the individual nor the associated organisations can be held responsible for any consequences that ensue from the use of the information herein

information suggests it could well be more significant than this, even to closure of the operations). Associated with the direct employment and expenditure outcomes, the modelling suggests that **under this base case of no investment in facilities, the economic outcomes for South Australia decline in total from 330 jobs for South Australian to 170 odd jobs, and incomes generated decline from $23 million to $12 million in South Australia.**

However the perspective if the investment were to be undertaken is quite different. Indeed the argument for undertaking the investment is that activity on site would increase substantially. Based on the forecasts of activity levels provided by Bradken, it is estimated/modelled that:

- The investment would generate a total of 95 person years of employment directly, and an additional 167 person years of employment through indirect impacts in the state. The present value of the outcomes in 2006 values (using a 5% real discount rate) for the state is estimated at $20 million. The majority of the activity will occur in 2008 and 2009.
- Direct employment in operations would increase to an estimated 281 in 2010, and direct wages and salaries would reach $17.6 million. Adding in the indirect impacts the modelling suggests that there will be an estimated total of 640 jobs and incomes within the state of $50 million associated with the proposal.

Therefore in conclusion the incremental increase in economic activity occurring if the investment is to occur (relative to the no investment case) is for the creation of 500 new jobs in the state from 2011 on, with incomes generated of almost $40 million per year. Over the period 2006-2015 the present value of this impact (in 2006, with 5% real discount rate) is almost $175 million. $63 million of this is wages and salaries paid at Bradken itself, while the balance is activity supported elsewhere in the economy. From a regional perspective the project is estimated for creating 213 new jobs annually from 2011 on, and generating new incomes in the state of $16 million. Over the period 2006 to 2015, the project is estimated as creating in the region new incomes with a value of $77 million (present value) – with $44 million of this incomes for residents employed at Bradken itself.

However the business case for this project also contends that the proposed upgrade will significantly assist Bradken to achieve environmental improvements for the area. Valuation of such outcomes would supplement the above benefits in a full cost benefit analysis context. In addition there is the possibility of what is called upstream effects, where Bradken's existence as a supplier adds value to their customers – and creates activities that would not otherwise occur. It is reasonable to expect that having a local supplier will add some value in operations, making an entity more competitive and enhancing the state's economic future in this context. It is reasonable to suggest that local companies supplied by Bradken will benefit in this way, providing additional value to the estimates above. Finally it is noted that there is insufficient information to assess inputs required from a State or Local Government perspective.

The assessment also requires consideration of relative outcomes of an alternative of relocating (eg to the Cast Metals precinct). From an operations perspective the major difference of this case would be the investment costs required, the underlying operating costs to achieve the same throughput, and perhaps even more importantly additional costs associated with relocation (eg suspension of activity during the move, costs and production issues while running two facilities). Based on Bradken's estimates, it is indicated that it would cost Bradken anything from $80 to $160 million extra to relocate to the Cast Metals Precinct – and this would mean an extra $5 million to $10 million per year in current dollar financing costs. The possible implications of these costs include either:

- Bradken's profitability would be reduced, indeed to such a level as Bradken's owners may choose to shut down the SA operation and integrate activity at an interstate operation.
- Bradken's competitiveness would be reduced, as prices would have to increase to cover up to around a 10% increase in costs. This would reduce Bradken's prospects in achieving the sales levels mooted in the proposal, and also increase costs for local activities currently supplied by Bradken.

At this point there is insufficient detail or certainty on these outcomes to model the relative impacts.

In comparison to this operating outcome, there are differential environmental impacts from an alternative location:

- Current impacts would be "removed" from the existing neighbourhood – but they would of course be replaced by the impacts of alternative uses (it is noted that all land uses have some degree of impact on each other). Those impacts will depend on possible land-uses of the area.
- The area already includes a mix of other industrial uses, and isolating the impact of Bradken's operations is difficult – therefore the existing issues remain and only the marginal impact of Bradken's operations would be removed.

Introduction

Background to current operations

Bradken Resources Pty Ltd ("Bradken") operates a steel foundry, located at Kilburn in Adelaide.

The foundry produces inputs into the mining industry – with customers nationally and internationally, and the manufacturing sector. The foundry has a current capacity of 12,500 tonnes per annum, with employment currently around 180.

Summary of the Bradken Proposal

Bradken has proposed an investment of approximately $40 million (of which $25 million will be spent locally) with the expectation of an increase in employment of 100 people.

This investment will increase capacity of the local production activity to 16,500 tonnes initially, increasing to 32,000 tonnes after three years. The major markets for increased outputs include the resource sector in South Australia, and castings for the ASC AWD contract.

As well as providing for an increase in output, the investment would allow for improvement of the way in which the entity interacts with its surrounding community, and an outcome would be a lowering of odour from the current level even with the expansion. Other environmental outcomes will also be possible through the investment. These are detailed in the Public Environmental Report prepared by Bradken.

Context of the analysis

The State strategic plan includes a range of targets and strategies to enable the State to improve on underlying levels of economic growth in the interest of the South Australian community. Some of the key targets include

- **Jobs:** Better the Australian average employment growth rate within 10 years
- **Unemployment:** Equal or better the Australian average within 5years
- **Economic growth**: Exceed the national economic growth rate within 10 years
- **Investment:** Match or exceed Australia's ratio of business investment as a percentage of the economy within 10 years.

An economic impact assessment undertakes a review of a project in the context of these targets, and therefore the main focus of economic impact assessments is the implications on the project for net jobs and incomes. However an economic impact assessment should also include consideration of the value community places on other outcomes including the value associated with affected land uses.

In order to assess the net impact, an evaluation must establish a base case - that is, what will happen in the absence of a project or policy, and compare it to the outcomes expected, given policy and the variations possible within that project. This analysis focuses on the creation of jobs and incomes as the key benefits of the proposal end compares that to the possible costs involved.

The economic activity and employment outcomes can be considered at three levels

- The direct employment and activity within the entity
- The indirect employment and activity in supplying companies
- The flow on all introduced employment impacts and lastly
- The upstream impacts for customers of the company

There are standard procedures and models for assessing these outcomes, and these will be employed in this model. Evaluation of the other aspects of project outcomes is more difficult, and will in large part be qualitative. Attached are the specific issues that are to be addressed in the analysis, and the following methodology to enable these issues to be addressed.

Assessment

Economic impact of current operations

As noted above, an entity has an impact on the economy in which it operates through the expenditures it makes within that community. Those expenditures are on labour, and on inputs into production. Table 1 provides a summary of the employment within Bradken's South Australian operations. Bradken provides 182 employment opportunities for South Australians paying annual wages of almost $9 million.

Table 1: Current Employment and Operating Expenditure Profile of Bradken

	2006
Employment	
Skilled	122
Semi-skilled	60
Unskilled	0
Total	182

Source: Bradken

This perspective is not sufficient to assess the importance of the operations however. In addition to their direct employment, Bradken creates employment in other entities, firstly those that directly supply its operations, and secondly the broader flow-on effects. Bradken has supplied information on expenditures and estimates of how much is purchased from local suppliers, and the assumptions re expenditure characteristics are provided in Table 2a and Table 2b. Note that expenditures have not been provided within this report due to commercial sensitivities. Table 2a provides the following parameters:

- The proportion of the expenditure type that occurs within the specified region. This has been estimated by Bradken, in that not all of the specified expenditure will occur in the given region – some will be imports – which provides no regional benefit.
- The second column entitled 'discount factor' is provided to recognise that without Bradken's operations in the state/region the inputs provided by the supplier to Bradken would in some cases still occur. Bradken is in a competitive industry and while it supplies local companies (and also exports) if it was to close there is no given reason to think that an alternative local company will take up any degree of its activity. However some of its supplies are provided by companies that would continue to produce in the absence of Bradken, and therefore the existence of Bradken does not create this activity in the region. So for example, one input into the production process is scrap metals. These scrap metals would still be produced within the state and would be sold elsewhere (possibly interstate) if Bradken was not operating. It is assumed that there is a benefit in the state of 20% due to Bradken purchasing these materials from local companies – through transport savings, savings on time, extra value in use etc (but the remaining 80% is not a benefit within the state and so is excluded). The argument for electricity and gas supplies is slightly different, in that the discount factor in this case allows for the high fixed cost nature of the industry, in that output in the state can be increased with only a marginal increase in inputs (economic models such as CGE models and Input-Output models typically work on average returns to scale, so this is a specific assumption to adjust for that factor).
- The third column is the way in which we provide an indicative estimate of the indirect economic effect – it uses multipliers or average industry ratios to provide estimates of the employment and income outcomes of the spend by Bradken on inputs into productions, and of further flow on effects. The use of such ratios in this way is a simplification in that it does not allow for macro-economic issues such as wage rate reductions or the impacts of welfare payment increases if unemployment increases, but these are unlikely to be significant in this instance.

Table 2a: Assumptions for calculating the impact of Bradken Expenditures – State Perspective

	Propn in State	Discount Factor	Multipliers Direct Value Added	Direct Employment	Indirect Value Added	Indirect Employment	Total Value Added	Total Employment
Labour	100%						0.574	6.241
Design and Development	75%		0.477	6.191	0.657	7.789	1.134	13.980
Construction of Buildings	100%		0.497	4.237	0.509	6.200	1.006	10.436
Plant and Equipment	50%		0.234	3.210	0.550	6.852	0.784	10.061
Scrap	100%	0.2	0.234	3.210	0.550	6.852	0.784	10.061
Alloys	0%	0.2	0.234	3.210	0.550	6.852	0.784	10.061
Gas & Electricity	100%	0.4	0.523	2.353	0.537	5.440	1.060	7.793
Sand	100%	0.2	0.551	1.941	0.419	4.900	0.970	6.841
Others	70%	0.9	0.477	6.191	0.657	7.789	1.134	13.980

Source: Proportion in state as estimated by Bradken. Assumptions re discount factor are internal and multipliers are taken from state tables as provided in Quantifying the Economic Contribution of Regional South Australia, a report prepared for Department of Trade and Economic Development, prepared by EconSearch Pty Ltd, 14 March 2005

Table 2b is the same table at the regional level. Note that there are no publicly (or privately) available current input output tables for the relevant region. There is a set of tables for North West Adelaide, but these date back to 1993, and the underlying economic structure has changed substantially in that time. Therefore it is indicatively assumed that the direct multipliers (industry ratios) are the same in the region as the state for a whole, while it is assumed that the indirect multipliers are half the state tables (in that there are greater leakages from the region than from the state).

Table 2b: Assumptions for calculating the impact of Bradken Expenditures – Regional Perspective

	Propn in Region	Discount Factor	Multipliers Direct Value Added	Direct Employment	Indirect Value Added	Indirect Employment	Total Value Added	Total Employment
Labour	70%							
Design and Development	15%		0.477	6.191058	0.329	3.895	0.806	10.086
Construction of Buildings	20%		0.497	4.236681	0.255	3.100	0.752	7.336
Plant and Equipment	20%		0.234	3.20955	0.275	3.426	0.509	6.635
Scrap	100%	0.2	0.234	3.20955	0.275	3.426	0.509	6.635
Alloys	0%	0.2	0.234	3.20955	0.275	3.426	0.509	6.635
Gas & Electricity	0%	0.4	0.523	2.352979	0.269	2.720	0.792	5.073
Sand	0%	0.2	0.551	1.941184	0.210	2.450	0.761	4.391
Others	20%	0.9	0.477	6.191058	0.329	3.895	0.806	10.086

Source: As Table 2a

Table 3 uses the information from tables 1 and 2 to estimate the impact that the operations of Bradken has on the state and on the north west Adelaide region, under the assumptions specified above. It is concluded that:

- Bradken directly employs 182 people and pays wages of almost $9 million, of which 70% occurs within the north west Adelaide region.

- The indirect impacts of the operations effectively almost double this impact from a state perspective, with Bradken responsible for creating employment for over 330 people in the state and generating incomes (wage and salary in Bradken and a broader level of value added in the indirect effects[1]) of $22 million. The indirect effects are much lower in the region itself (based on the assumptions used).

Table 3: Calculations of Broad Level Economic Impacts
Current Activity Level

	State Impact	Regional Impact
Direct Impact		
Wages and Salaries at Bradken	$8.88	$6.21
Employment at Bradken	182	127
Indirect Impact		
Value Added in Direct Suppliers	$3.65	$0.94
Employment in Direct Suppliers	40	12
Value Added in Further FlowOn	$9.92	$3.27
Employment in Further FlowOn	112	35
Total Impact		
Value Added	$22.45	$10.43
Employment	334	175

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Evaluation of the base case

The next step in the analysis is to model the economic impact of not upgrading at the current site – the base case is taken as no investment on the current site. The information provided suggest that competitiveness of the facility is likely to decline without some reinvestment, and therefore the level of activity is likely to fall somewhat without the project (ie the project is part and parcel of maintaining underlying competitiveness.

The Bradken information suggests that currently the current Kilburn site is:

- Capacity Constrained (12,500 TPA)
- Not cost competitive due to:
    - undersized and inefficient furnace
    - labour intensive processes across the plant
    - lacking economies of scale
- Has Safety and Environmental Compliance issues associated with old Plant and Equipment

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1 This study is providing an estimate of broader economic benefits, and as such it is considered that the other value added at Bradken itself is a private benefit and has been excluded from the value effect.

Bradken suggest that without an upgrade, the Adelaide site will not be viable and most likely will be forced to close within the next five to ten years. Note that this view has not been independently tested. This analysis is an assessment of the broader economic impacts of the Bradken case.

In undertaking the modelling, it has been conservatively set (relative to the statement above) with an assumption that without an upgrade the level of activity at the Bradken site will decline progressively from the current levels to around half of that by 2011, and that this will be sustained thereafter. Therefore it is indicatively modelled that the activity levels of Bradken will decline as follows:

Table 4: Projected Employment and Operating Expenditure Profile of Bradken – Base Case (no investment)

	2006	2007	2008	2009	2010	2011
Employment						
Skilled	122	122	97.6	78	70	63
Semi-skilled	60	60	48	38	35	31
Unskilled	0	0	0	0	0	0
Total	182	182	145.6	116	105	94
Wages paid	$8.88	$8.88	$7.10	$5.68	$5.11	$4.60

Source: Assumptions based on information provided by Bradken

Tables 4a and 4b translate the employment profiles and the associated expenditures on inputs into production[2] etc, to estimates of economic outcomes based on the assumptions in tables 2a and 2b. Associated with the direct employment and expenditure outcomes, the modelling suggests that economic outcomes for South Australia decline in total from 330 jobs for South Australian to 170 odd jobs, and incomes generated decline from $23 million to $12 million in South Australia without any investment being undertaken.

Table 4b shows the same outcomes at the regional level.

2 Again, the expenditure figures have been provided to inform the research, but have not been included in the report due to commercial sensitivity.

Table 4a: Projected Community Employment and Income Outcomes – Base Case (no investment) – State Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Base Case							
Direct Impact							
Wages and Salaries at Bradken	$8.88	$8.88	$7.10	$5.68	$5.11	$4.60	$49.27
Employment at Bradken	182	182	146	116	105	94	1203
Indirect Impact							
Value Added in Direct Suppliers	$3.65	$3.65	$2.92	$2.34	$2.10	$1.89	$20.29
Employment in Direct Suppliers	40	40	32	26	23	21	266
Value Added in Further FlowOn	$9.92	$9.92	$7.94	$6.35	$5.71	$5.14	$55.07
Employment in Further FlowOn	112	112	90	72	65	58	740
Total Impact							
Value Added	$22.45	$22.45	$17.96	$14.37	$12.93	$11.64	$124.62
Employment	334	334	267	214	192	173	2208

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Table 4b: Projected Community Employment and Income Outcomes – Base Case (no investment) – Regional Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Base Case							
Direct Impact							
Wages and Salaries at Bradken	$6.21	$6.21	$4.97	$3.98	$3.58	$3.22	$34.49
Employment at Bradken	127	127	102	82	73	66	842
Indirect Impact							
Value Added in Direct Suppliers	$0.94	$0.94	$0.75	$0.60	$0.54	$0.49	$5.23
Employment in Direct Suppliers	12	12	10	8	7	6	82
Value Added in Further FlowOn	$3.27	$3.27	$2.62	$2.10	$1.89	$1.70	$18.18
Employment in Further FlowOn	35	35	28	23	20	18	234
Total Impact							
Value Added	$10.43	$10.43	$8.34	$6.67	$6.01	$5.41	$57.89
Employment	175	175	140	112	101	91	1157

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Economic impact of Alternative Case 1

Modelling Description of Alternative Case 1

This section of the paper models the impacts of the investment proposed by Bradken. This entails expansion of activity at current site, and the impacts can be summarised as having 3 elements:

- The impacts of the investment expenditure.
- The impacts of the increased activity on site (both direct and indirect or downstream).
- Other impacts –including environmental and social, and upstream economic impacts.

Table 5 indicates the projected investment spend:

Table 5: Projected Investment Spend – Bradken Proposal

	2006	2007	2008	2009	2010	2011	Total
Design and Development	$0.00	$1.10	$1.10	$1.10	$0.40	$0.00	$3.70
Construction of Buildings	$0.00	$0.70	$3.70	$2.60	$0.60	$0.00	$7.60
Plant and Equipment	$0.00	$5.60	$11.40	$7.50	$4.20	$0.00	$28.70
Total capital	$0.00	$7.40	$16.20	$11.20	$5.20	$0.00	$40.00

Source: Information provided by Bradken ($million)

Table 6 provides the operating characteristics for the project in terms of the increase in activity as estimated by Bradken. This increase in activity is the basis of their proposal, the business case for the investment.

Table 6: Projected Operating Employment – Bradken Proposal

	2006	2007	2008	2009	2010	2011
Alternative 1						
Employment						
Skilled	122	122	122	157	180	180
Semi-skilled	60	60	60	77	101	101
Unskilled	0	0	0	0	0	0
Total	182	182	182	234	281	281
Wages paid	$8.88	$8.88	$8.88	$11.41	$17.62	$17.62

Source: Information provided by Bradken

Impacts at the State Level

As in the base case, the projected activity levels are modelled with the information as contained in Tables 2a and 2b to provide a community based perspective of economic outcomes.

Table 7a indicates the estimated outcomes from the investment spend itself. This investment is estimated to generate a total of 95 person years of employment directly, and an additional 167 person years of employment through indirect impacts in the state. The present value of the outcomes in 2006 values (using a 5% real discount rate) for the state is estimated at $20 million. The majority of the activity will occur in 2008 and 2009.

Table 7a: Projected Community Employment and Income Outcomes from Investment Activity– Alternative Case (investment proposal) – State Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Direct Construction Sector Impact							
Wages and Salaries in Construction	$0.00	$1.40	$3.57	$2.56	$0.93	$0.00	$7.55
Employment in Investment	0	17	39	28	11	0	95
Indirect Impact							
Value Added in FlowOn	$0.00	$2.44	$5.56	$3.93	$1.66	$0.00	$12.12
Employment in FlowOn	0	30	68	48	20	0	167
Total Impact							
Value Added	$0.00	$3.83	$9.13	$6.49	$2.59	$0.00	$19.67
Employment	0	47	107	76	32	0	262

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Table 7b illustrates the estimated community perspective of the economic outcomes from the operations of the Bradken with the activity levels facilitated by the investment. Under the proposal the direct employment levels reach an estimated 281 in 2010, and direct wages and salaries reach $17.6 million – with indirect impacts increasing the employment outcomes by a further 360 people and producing incomes in other economic entities with incomes of over $30 million per year by 2011. Therefore associated with the proposal will be an estimated total of 640 jobs and incomes within the state of $50 million.

Table 7b: Projected Community Employment and Income Outcomes from increased Operations– Alternative Case (investment proposal) – State Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Alternative 1							
Direct Impact							
Wages and Salaries at Bradken	$8.88	$8.88	$8.88	$11.41	$17.62	$17.62	$112.48
Employment at Bradken	182	182	182	234	281	281	2466
Indirect Impact							
Value Added in Direct Suppliers	$3.65	$3.65	$3.65	$4.60	$5.61	$9.40	$52.51
Employment in Direct Suppliers	40	40	40	51	62	103	750
Value Added in Further FlowOn	$9.92	$9.92	$9.92	$12.62	$17.52	$22.52	$133.90
Employment in Further FlowOn	112	112	112	142	197	256	1953
Total Impact							
Value Added	$22.45	$22.45	$22.45	$28.63	$40.75	$49.54	$298.90
Employment	334	334	334	427	540	640	5169

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Table 7c represents the key table in the analysis. It represents the incremental increase in economic activity occurring if the investment is to occur (relative to the no investment case). Using the assumptions described above and with the expectations of economic activity as described by Bradken, the project is responsible for the creation of 500 jobs in the state from 2011 on, with incomes generated of almost $40 million per year. Over the period 2006-2015 (which entails the construction period in (mainly 2008 and 2009), building up to full production potential by 2011 and 5 years of operation at this level) the present value in a 2006 context (5% real discount rate) is almost $175 million in a total perspective. $63 million of this is wages and salaries paid at Bradken itself, while the balance is activity supported elsewhere in the economy.

Table 7c: Projected Community Employment and Income Outcomes from increased Operations– Alternative Case (investment proposal) over the Base Case (no investment) – State Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Alternative 1 over Base Case							
Direct Impact							
Wages and Salaries at Bradken	$0.00	$0.00	$1.78	$5.73	$12.51	$13.02	$63.21
Employment at Bradken	0	0	36	118	176	187	1263
Indirect Impact							
Value Added in Direct Suppliers	$0.00	$0.00	$0.73	$2.26	$3.51	$7.50	$32.23
Employment in Direct Suppliers	0	0	8	25	39	83	484
Value Added in Further FlowOn	$0.00	$0.00	$1.98	$6.27	$11.81	$17.38	$78.84
Employment in Further FlowOn	0	0	22	71	132	198	1213
Total Impact							
Value Added	$0.00	$0.00	$4.49	$14.26	$27.82	$37.90	$174.28
Employment	0	0	67	213	347	467	2960

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Of the 187 jobs directly created at Bradken 117 jobs would be for skilled employees, while the balance of 70 would be semi-skilled. The indirect impacts will be a mix of professional (business services), skilled through to unskilled positions.

Impacts at the Regional Level

While the impacts of the project are widely spread, there is a focus in the region of Adelaide in which the project occurs (ie north western Adelaide).

Table 8a shows the impact of the investment activity with the north west region of Adelaide. Relative to the base case this is new activity and would not occur in the state without the project occurring. While the construction activity occurs in the region it is generally estimated that the workforce and suppliers to the activity will be drawn from all over the state.

Table 8a: Projected Community Employment and Income Outcomes from Investment Activity– Alternative Case (investment proposal) – Regional Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Direct Construction Sector Impact							
Wages and Salaries in Constructio	$0.00	$0.41	$0.98	$0.69	$0.28	$0.00	$2.11
Employment in Investment	0	5	11	8	4	0	28
Indirect Impact							
Value Added in FlowOn	$0.00	$0.40	$0.87	$0.60	$0.28	$0.00	$1.92
Employment in FlowOn	0	5	11	7	3	0	27
Total Impact							
Value Added	$0.00	$0.81	$1.85	$1.29	$0.57	$0.00	$4.02
Employment	0	10	22	15	7	0	55

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Table 8b shows the estimated contributions of the operations of Bradken on the regional economy if the project were to proceed.

Table 8b: Projected Community Employment and Income Outcomes from increased Operations– Alternative Case (investment proposal) – Regional Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Alternative 1							
Direct Impact							
Wages and Salaries at Bradken	$6.21	$6.21	$6.21	$7.99	$12.33	$12.33	$78.74
Employment at Bradken	127	127	127	164	197	197	1726
Indirect Impact							
Value Added in Direct Suppliers	$0.94	$0.94	$0.94	$1.18	$1.45	$2.42	$13.53
Employment in Direct Suppliers	12	12	12	16	19	32	230
Value Added in Further FlowOn	$3.27	$3.27	$3.27	$4.19	$6.17	$6.93	$42.76
Employment in Further FlowOn	35	35	35	45	66	75	595
Total Impact							
Value Added	$10.43	$10.43	$10.43	$13.36	$19.95	$21.69	$135.02
Employment	175	175	175	225	282	304	2552

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Again, from a regional perspective Table 8c is the key table in the analysis – it shows the estimated increase in economic activity in the region as a consequence of undertaking the project. In essence the project is estimated for creating 213 new jobs in the region annually from 2011 on, and generating new incomes in the state of $16 million. Over the period 2006 to 2015, the project is estimated as creating in the region new incomes with a value of $77 million (present value) – with $44 million of this incomes for residents employed at Bradken itself.

Table 8c: Projected Created Community Employment and Income Outcomes from increased Operations– Alternative Case (investment proposal) over Base Case (no investment) - Regional Perspective

	2006	2007	2008	2009	2010	2011	Sum/PV (5 yrs full op)
Alternative 1 over Base Case							
Direct Impact							
Wages and Salaries at Bradken	$0.00	$0.00	$1.24	$4.01	$8.75	$9.11	$44.25
Employment at Bradken	0	0	25	82	123	131	884
Indirect Impact							
Value Added in Direct Suppliers	$0.00	$0.00	$0.19	$0.58	$0.90	$1.93	$8.30
Employment in Direct Suppliers	0	0	2	8	12	25	149
Value Added in Further FlowOn	$0.00	$0.00	$0.65	$2.09	$4.28	$5.24	$24.58
Employment in Further FlowOn	0	0	7	23	46	57	361
Total Impact							
Value Added	$0.00	$0.00	$2.09	$6.69	$13.94	$16.28	$77.13
Employment	0	0	35	113	181	213	1394

Source: Calculations based on information above
(Wages and Salaries in $ million, employment in FTE's)

Other Outcomes of the Investment

Environmental Outcomes

While the economic outcomes as estimated above are significant, the context of the project is that the locality of the existing and upgraded operations incorporates some environmental issues. These are discussed in other supporting documents to the PER process, and so not discussed in detail here.

However a full economic study – a cost benefit analysis - would usually include comment on the impact of the project in terms of costs and benefits in this context.

The information is not available to allow modelling of such outcomes (such information would include identifying the specific effects – in general will include noise, odour and traffic congestion issues, and would require estimates of the number of entities and residences affected).

In considering the issue it is first noted that environmental issues are a consideration in the current operations. Bradken indicates that it is implementing an EPA-approved Environment Improvement Programme (EIP) at the site, which focuses on odour reduction.

However the business case for this project also contends that the proposed upgrade will form the second stage of the implementation, and will significantly assist Bradken to achieve its odour reduction objectives. The new foundry building will be fully enclosed and will incorporate advanced fume extraction and filtration equipment. The installation of the new furnace and associated equipment therefore are projected to result in an overall reduction of odour and air emissions from the site because it will replace buildings and plant that currently do give rise to some off-site effects.

Other Economic Outcomes

A further aspect of the analysis is the context of Bradken's customers. The business case for the project notes that much of the growth in Bradken's business is expected to come from activity in the state – including the resources sector and defence.

The flow through effects – impacts for suppliers etc as estimated above is typically called the downstream effects. In addition there is the possibility of what is called upstream effects, which means that Bradken's existence as a supplier adds value to their customers – and creates activities that would not otherwise occur. It is unlikely in this case that without Bradken, the activities described would not occur, but it is reasonable to expect that having a local supplier will add some value to the process, making it more competitive and enhancing the state's economic future in this context.

A final economic impact aspect is the implications for state and local government. In the case of state government there is the taxation implications of increased economic activity (ie GST payments, payroll tax, land tax etc). This is more limited from a local government perspective. At this stage of the analysis there is no information on specific costs that would be faced by either tier of government on the basis of the project.

Value of impacts under alternative case 2

The brief for this analysis required the consideration of the community benefits in the context of an alternative location, and specifically the relocation of operation to the cast metals precinct.

The cast metals precinct in Adelaide is an industrial area developed as a location for foundries and similar activities. It was developed as a response to two inter-related factors:

- The perceived importance of foundries in facilitating a manufacturing base to the South Australian economy. Tooling, and the activities of foundries is in many quarters seen as being of critical importance for the functioning of a manufacturing sector – it provides the basic product from manufacturing (at least metals manufacturing) to undertake their tasks. Further it provides a skill base for other manufacturing to use.
- The negative interaction of foundries and cast metals production with their surrounding environment – they are perceived as noisy, smelly and generally not fitting in with surrounding uses. It of course must be recognised that all land uses conflict to some degree with surrounding land uses (land use has by nature something of a public good context)

Therefore the alternative location of the cast metals precinct offers some advantages to Bradken – particularly giving an alternative to the ways in which current programs and the outcomes from the proposed project at the existing site would allow reduction of impacts on surrounding land uses – consistently with the objective of the cast metals precinct.

From an operations perspective the major differences perceived in this case will be the underlying investment costs required, the underlying operating costs to achieve the same throughput, the additional costs associated with relocation (eg suspension of activity during the move, costs while running two facilities). Bradken have estimated the cost of establishing within the cast metals precinct at $180 million. $10 million is in the purchase of land, and the balance in construction (note this includes $30 million of contingency).

It excludes estimates of the value of management time in managing the shift, and any costs involved in migrating between the two locations. Indeed the expectation is that through the attempt to run two separate sites simultaneously during the changeover, Bradken could have potential production disruptions to the point that they lose existing customers (on the basis of failing to meet their critical delivery requirements), some of those customers of which would also be the potential sources of future increased business and the basis on which the upgrade is based. The perspective is that this may indeed be a more serious issue than the cost differential itself.

Finally it excludes the value in the existing land – and therefore the offsetting sales price in the current location (which it is presumed would be primarily in the land itself as the buildings and plant are activity specific).

Detailed estimates of the cost construct (in the above context) are not available, and Bradken's estimates of location have not been independently assessed – but in short it would appear that it would cost Bradken anything from $80 to $160 million extra to relocate to the Cast Metals Precinct – and this would mean an extra $5 million to $10 million per year in financing costs (real costs only, nominal costs could be higher). Note that this compares to an operating spend which would reach of the order of $70 million by 2011 if market potential is met.

What then are the implications of this extra cost? There are two possible outcomes:

- Bradken's profitability would be reduced, indeed to such a level as Bradken's owners may choose to shut down the SA operation and integrate activity at an interstate operation.
- Bradken's competitiveness would be reduced, as prices would have to increase to cover up to around a 10% increase in costs (extra financing costs). This would reduce Bradken's prospects in achieving the sales levels mooted in the proposal, and also increase costs for local activities currently supplied by Bradken.

At this point there is insufficient detail or certainty on these outcomes to model the impacts, but either would significantly limit the outcomes estimate in Alternative 1.

In terms of relative impacts of environmental impacts:

- In a local context the current impacts would be "removed" from the area – but they would of course be replaced by the impacts of alternative uses (it is noted that all land uses have some degree of impact on each other). Those impacts will vary dependent on probable use of the area – would be limited if used for residential (except perhaps in the context of traffic) but may be significant if the alternative use is industrial.
- The areas includes a mix of other industrial uses, and isolating the impact of Bradken's operations is difficult – therefore the existing issues remain and only the marginal impact of Bradken's operations would be removed.

Appendix: Issues to be addressed in Economic Impact analysis for Bradken Major Development PER

5.1.3	Discuss alternative plant locations, such as the Cast Metals Precinct at Wingfield, with a comparative discussion of the social, economic, environmental, employment and infrastructure advantages and disadvantages of the location considered.
5.1.4	Assess the implications for site operations if the upgrading and expansion is not undertaken at the existing site.
5.2.1	Provide information on the economic benefits and costs of the proposal to the State and at local levels. This should include an explanation as to why the benefits could only be provided at the existing site, rather than at an alternative site.
5.2.2	Describe the direct and indirect consequences of the proposal not proceeding.
5.2.3	Describe, in quantitative as well as qualitative terms, the direct and indirect consequences associated with the proposed development and then its ongoing operation in the region, including the consequences for other local employers and companies.
5.2.4	Describe the flow-on effects to other local supply and service industries.
5.2.5	Quantify the employment that will be generated including opportunities for skilled, semi-skilled and unskilled employment and describe the nature and range of this employment.
5.2.6	Evaluate the potential for the project to attract and enhance business operations of other industries and commercial ventures.
5.2.7	Describe any public infrastructure requirements and detail any potential State or Local Government costs.

Appendix D

Locality Plan

Photo Source : Department for Environment & Heritage Environmental & Geographic Information, Survey 2005

Subject land

Gln(1) General Industry (1)

R Residential

0 80m

1:4000
September 2006
Reference F. 2168

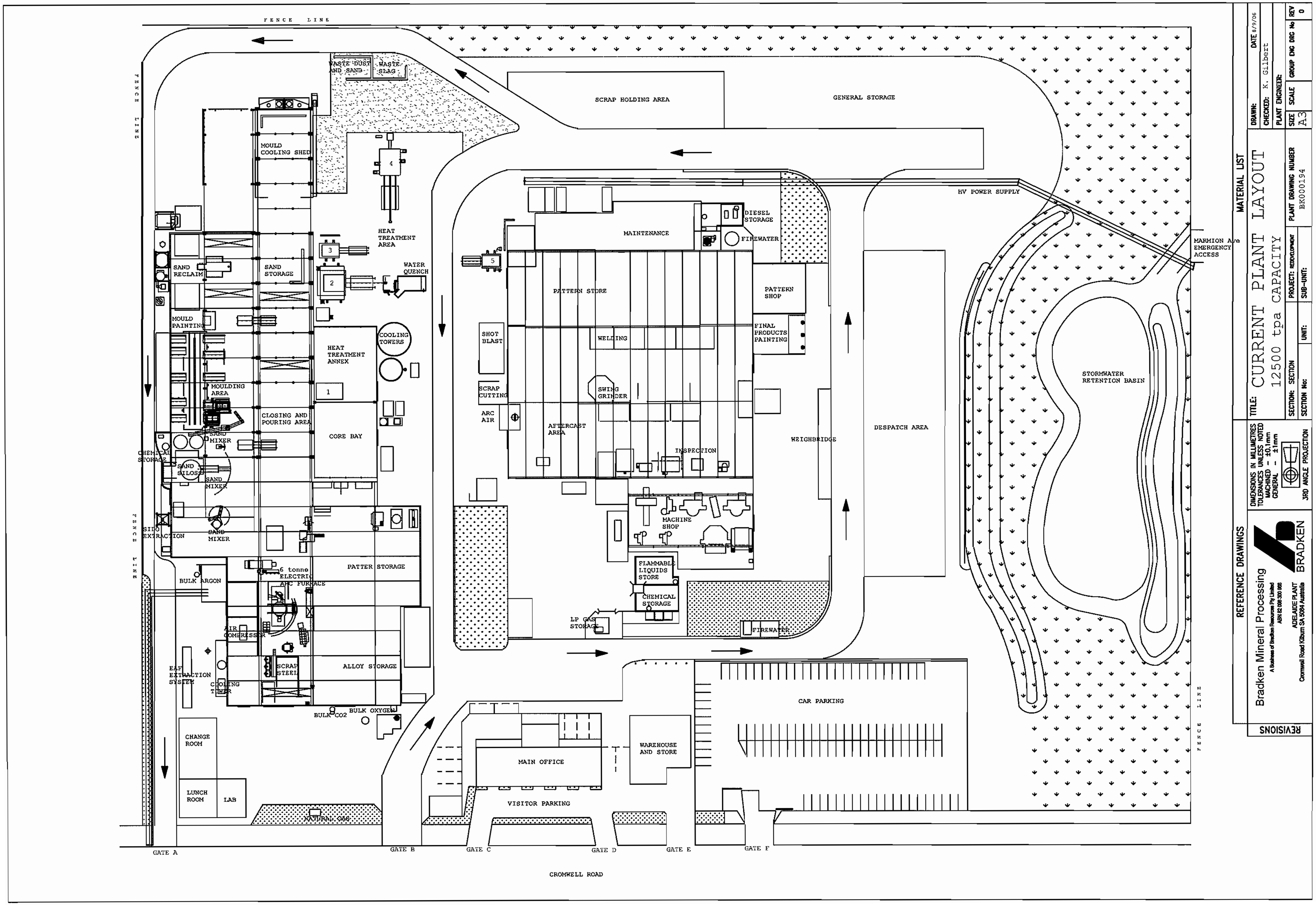
LOCALITY PLAN

Prepared By
ADELAIDE HILLS PRODUCTION DEPARTMENT

NOLAN RUMSBY PLANNERS

Appendix E

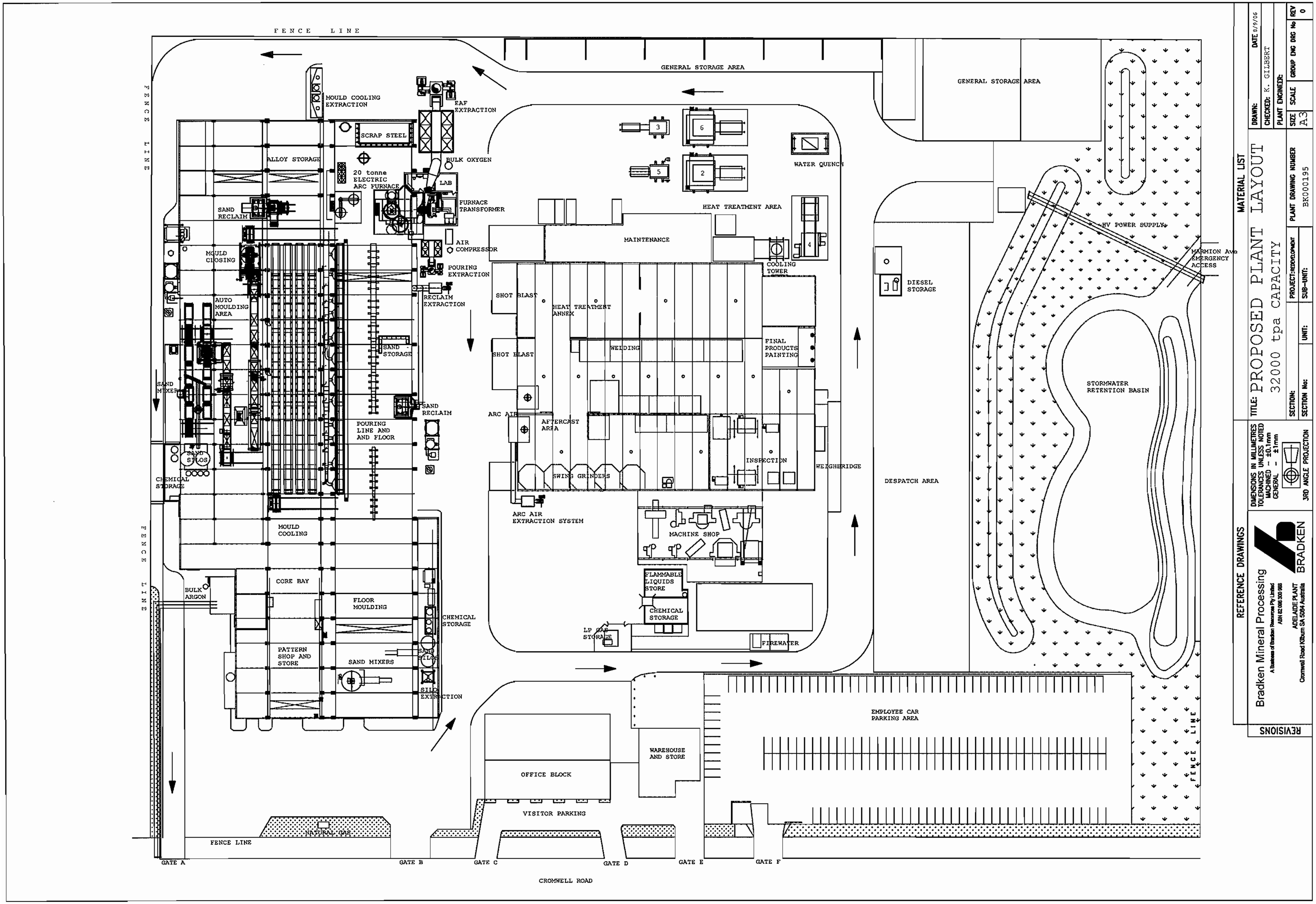
Existing Site Plans



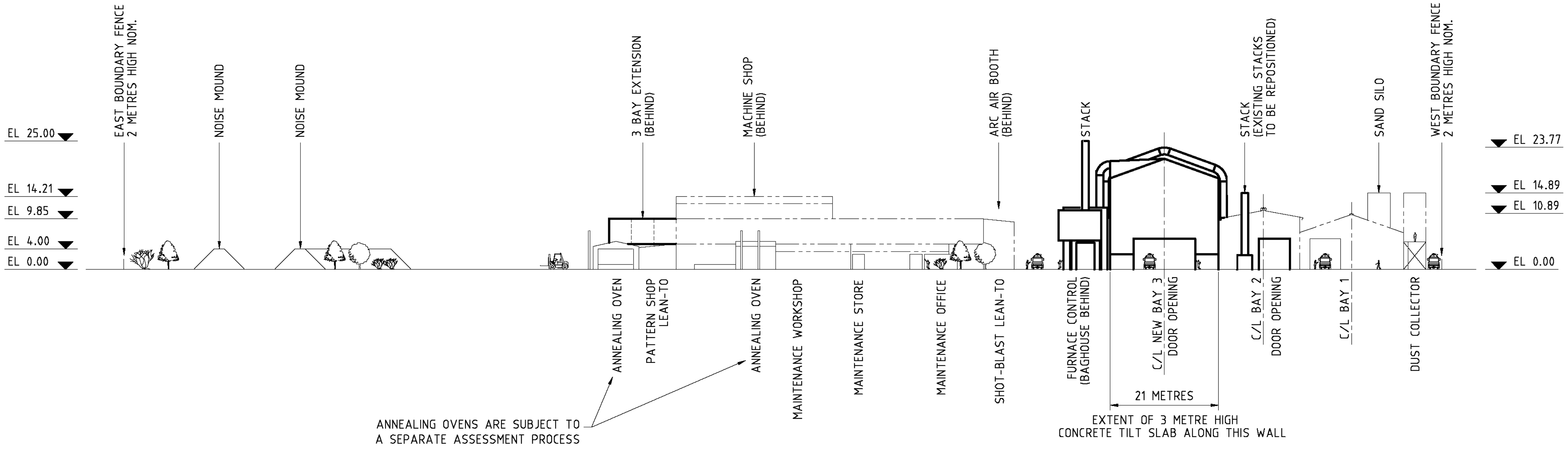
FENCE LINE
WASTE DUST AND SAND
WASTE SLAG
SCRAP HOLDING AREA
GENERAL STORAGE
MOULD COOLING SHED
HEAT TREATMENT AREA
WATER QUENCH
SAND RECLAIM
SAND STORAGE
MOULD PAINTING
HEAT TREATMENT ANNEX
COOLING TOWERS
MOULDING AREA
CLOSING AND POURING AREA
CORE BAY
SAND MIXER
CHEMICAL STORAGE
SAND SILOS
SILO EXTRACTION
PATTER STORAGE
6 tonne ELECTRIC ARC FURNACE
BULK ARGON
AIR COMPRESSOR
ALLOY STORAGE
SCRAP STEEL
EAF EXTRACTION SYSTEM
COOLING TOWER
BULK CO2
BULK OXYGEN
CHANGE ROOM
LUNCH ROOM
LAB
NATURAL GAS
MAINTENANCE
DIESEL STORAGE
FIREWATER
HV POWER SUPPLY
MARMION Ave EMERGENCY ACCESS
PATTERN STORE
PATTERN SHOP
FINAL PRODUCTS PAINTING
SHOT BLAST
WELDING
SCRAP CUTTING
ARC AIR
SWING GRINDER
AFTERCAST AREA
INSPECTION
WEIGHBRIDGE
DESPATCH AREA
STORMWATER RETENTION BASIN
MACHINE SHOP
FLAMMABLE LIQUIDS STORE
CHEMICAL STORAGE
LP GAS STORAGE
CAR PARKING
MAIN OFFICE
WAREHOUSE AND STORE
VISITOR PARKING
GATE A
GATE B
GATE C
GATE D
GATE E
GATE F
CROMWELL ROAD
REFERENCE DRAWINGS
REVISIONS
MATERIAL LIST
Bradken Mineral Processing
A Business of Bradken Resources Pty Limited
ADELAIDE PLANT
Cromwell Road Kilburn SA 5084 Australia
BRADKEN
DIMENSIONS IN MILLIMETRES
TOLERANCES UNLESS NOTED
MACHINED - ±0.1mm
GENERAL - ±1mm
3RD ANGLE PROJECTION
TITLE: CURRENT PLANT LAYOUT
12500 tpa CAPACITY
DRAWN:
CHECKED: K. Gilbert
PLANT ENGINEER:
DATE 8/9/06
SIZE A3
SCALE
GROUP ENG DRG No
REV 0
PLANT DRAWING NUMBER BK000194
PROJECT: REDEVELOPMENT
SUB-UNIT:
UNIT:
SECTION: SECTION
SECTION No:

Appendix F

Proposal Plans

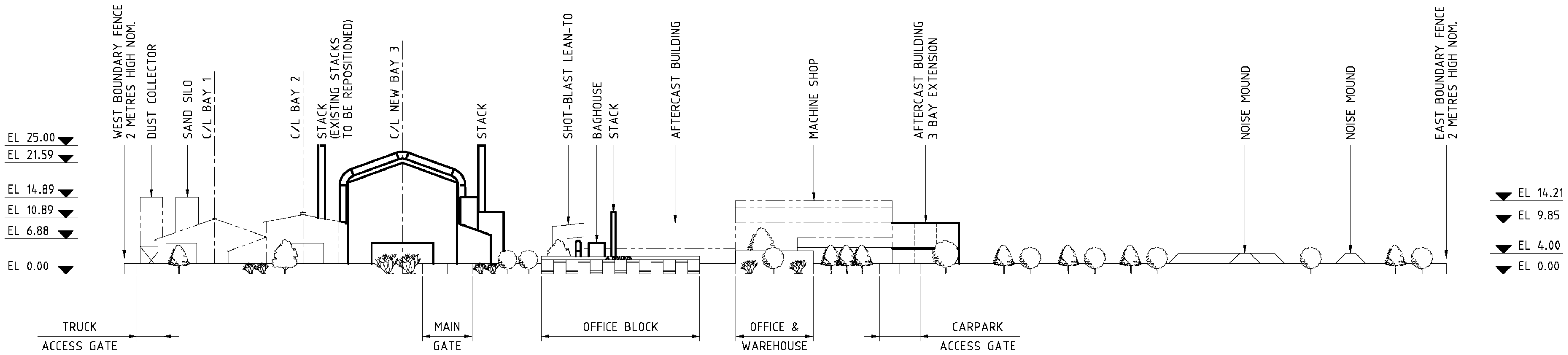

FENCE LINE
GENERAL STORAGE AREA
GENERAL STORAGE AREA
MOULD COOLING EXTRACTION
EAF EXTRACTION
SCRAP STEEL
ALLOY STORAGE
BULK OXYGEN
20 tonne ELECTRIC ARC FURNACE
LAB
FURNACE TRANSFORMER
SAND RECLAIM
AIR COMPRESSOR
MOULD CLOSING
POURING EXTRACTION
AUTO MOULDING AREA
RECLAIM EXTRACTION
SAND STORAGE
SAND MIXER
SAND RECLAIM
POURING LINE AND AND FLOOR
SAND SILOS
CHEMICAL STORAGE
MOULD COOLING
CORE BAY
BULK ARGON
FLOOR MOULDING
CHEMICAL STORAGE
PATTERN SHOP AND STORE
SAND MIXERS
SAND SILOS
SILO EXTRACTION
WATER QUENCH
HEAT TREATMENT AREA
MAINTENANCE
COOLING TOWER
DIESEL STORAGE
SHOT BLAST
HEAT TREATMENT ANNEX
SHOT BLAST
WELDING
FINAL PRODUCTS PAINTING
ARC AIR
AFTERCAST AREA
INSPECTION
WEIGHBRIDGE
SWING GRINDERS
ARC AIR EXTRACTION SYSTEM
MACHINE SHOP
FLAMMABLE LIQUIDS STORE
CHEMICAL STORAGE
LP GAS STORAGE
FIREWATER
DESPATCH AREA
HV POWER SUPPLY
MARMION Ave EMERGENCY ACCESS
STORMWATER RETENTION BASIN
EMPLOYEE CAR PARKING AREA
WAREHOUSE AND STORE
OFFICE BLOCK
VISITOR PARKING
NATURAL GAS
FENCE LINE
GATE A
GATE B
GATE C
GATE D
GATE E
GATE F
CROMWELL ROAD
MATERIAL LIST
TITLE: PROPOSED PLANT LAYOUT
32000 tpa CAPACITY
DRAWN:
DATE 8/9/06
CHECKED: K. GILBERT
PLANT ENGINEER:
SIZE A3
SCALE
GROUP ENG DRG No
REV 0
PLANT DRAWING NUMBER BK000195
PROJECT: REDEVELOPMENT
SUB-UNIT:
UNIT:
SECTION:
SECTION No:
DIMENSIONS IN MILLIMETRES
TOLERANCES UNLESS NOTED
MACHINED - ±0.1mm
GENERAL - ±1mm
3RD ANGLE PROJECTION
REFERENCE DRAWINGS
BRADKEN
Bradken Mineral Processing
A Business of Bradken Resources Pty Limited
ABN 82 098 300 988
ADELAIDE PLANT
Cromwell Road Kilburn SA 5084 Australia
REVISIONS

THIS SCALE FULL SIZE ON ORIGINAL DRAWING MILLIMETRES
0 20 40 60 80 100 140 160 180 200 220 240



NORTHERN ELEVATION

NORTHERN BOUNDARY FENCE NOT SHOWN HERE FOR CLARITY



SOUTHERN ELEVATION

THIS VIEW FROM CROMWELL ROAD

SCALE BAR = 10 METRES

NOTE:-
LIGHT LINES = EXISTING BUILDINGS & EQUIPMENT
BOLD LINES = NEW BUILDINGS & EQUIPMENT

ISSUED FOR REFERENCE 26/6/2006
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS:-
5777001 - DEMOLITION PLAN, SHEET 1
5777002 - DEMOLITION PLAN, SHEET 2
5777003 - DEMOLITION PLAN, SHEET 3
5777004 - NEW BUILDINGS PLAN
5777005 - NEW BUILDINGS ELEVATIONS, SHEET 1
5777006 - NEW BUILDINGS ELEVATIONS, SHEET 2
5777008 - FULL SITE ELEVATIONS, EAST & WEST

Bradken Mineral Processing
A Business of Bradken Resources Pty Limited
ABN 82 098 300 968
ADELAIDE PLANT
Cromwell Road Kilburn SA 5084 Australia
BRADKEN

DIMENSIONS IN MILLIMETRES
TOLERANCES UNLESS NOTED
MACHINED - ±0.1mm
GENERAL - ±1mm
3RD ANGLE PROJECTION

REV	GRID	DETAILS	BY	APP	DATE
A		ISSUED FOR REFERENCE	AM		26.6.06

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Newcastle, Australia
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FAX.(02) 4969-3530

ITEM	No. OFF	PART No.	DESCRIPTION	NOTE

DRAWN AM	DATE 26.6.06
CHKD GP	DATE 26.6.06
ENG. APP'D GP	DATE 26.6.06
CLIENT APP'D	DATE
CAD FILE No. 5777007-A-500	

BRADKEN MINERAL PROCESSING
ADELAIDE PLANT - KILBURN, SOUTH AUSTRALIA
2006 PLANT UPGRADE
FULL SITE ELEVATIONS - NORTH & SOUTH

SCALE	SHEET SIZE	DRAWING No.	REV
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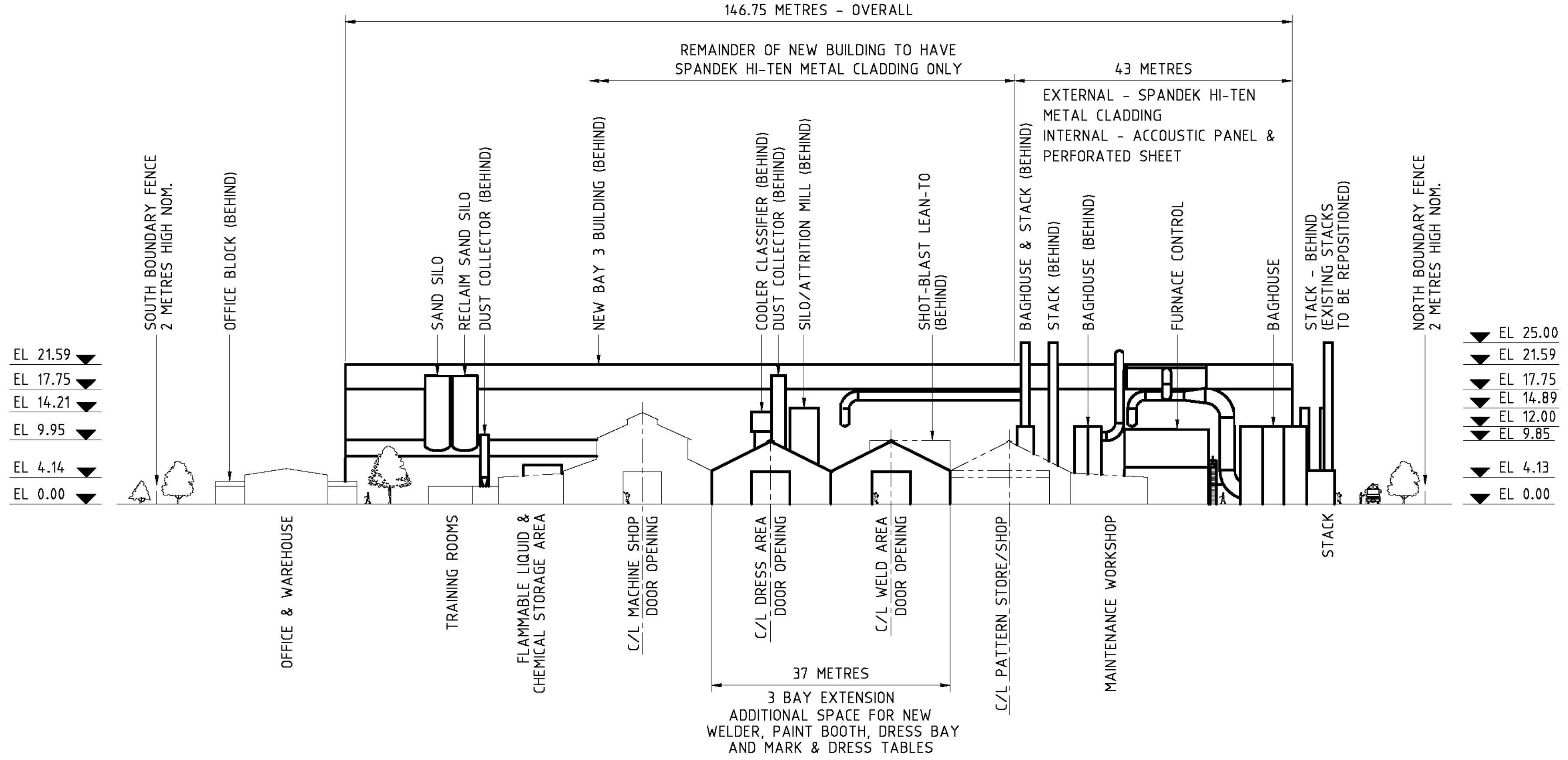
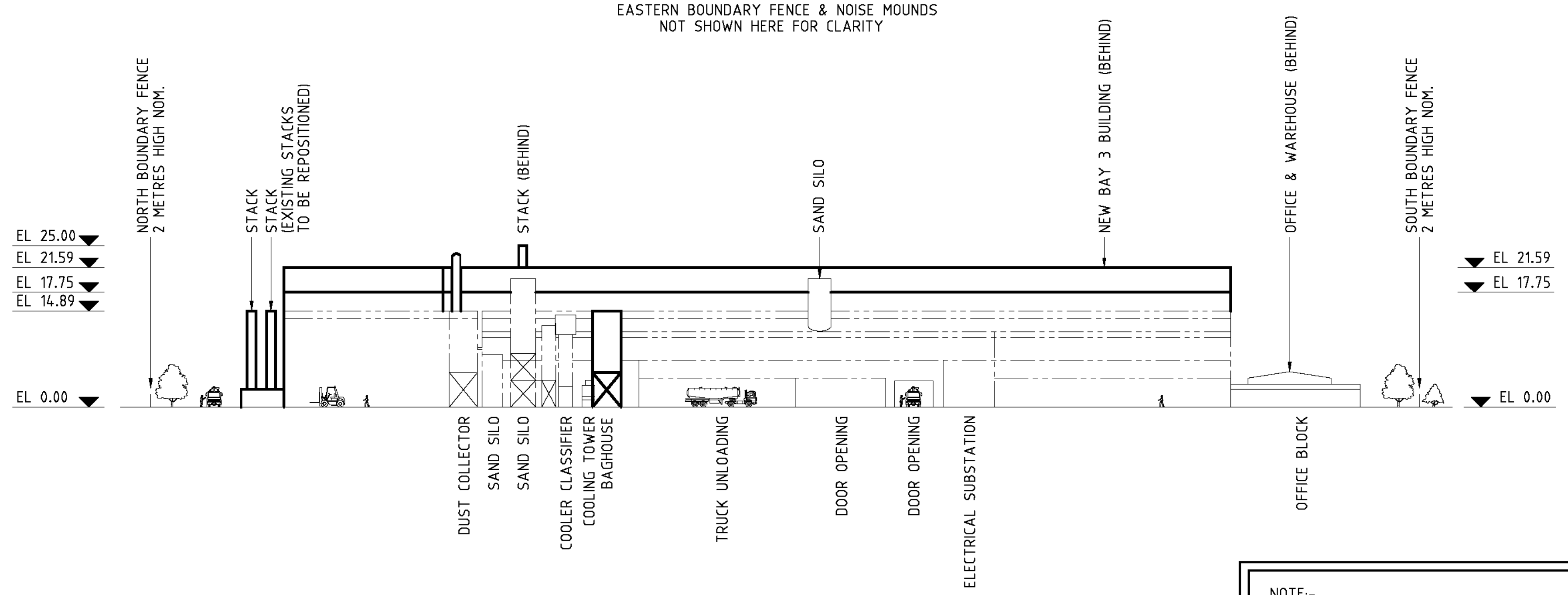


EASTERN ELEVATION

EASTERN BOUNDARY FENCE & NOISE MOUNDS
NOT SHOWN HERE FOR CLARITY



WESTERN ELEVATION

WESTERN BOUNDARY FENCE NOT SHOWN HERE FOR CLARITY

THIS SCALE FULL SIZE ON ORIGINAL DRAWING 240 MILLIMETRES

SCALE BAR
= 10 METRES

NOTE:-
LIGHT LINES = EXISTING BUILDINGS & EQUIPMENT
BOLD LINES = NEW BUILDINGS & EQUIPMENT

ISSUED FOR REFERENCE 26/6/2006
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS:-
5777001 - DEMOLITION PLAN, SHEET 1
5777002 - DEMOLITION PLAN, SHEET 2
5777003 - DEMOLITION PLAN, SHEET 3
5777004 - NEW BUILDINGS PLAN
5777005 - NEW BUILDINGS ELEVATIONS, SHEET 1
5777006 - NEW BUILDINGS ELEVATIONS, SHEET 2
5777007 - FULL SITE ELEVATIONS, NORTH & SOUTH

Bradken Mineral Processing
A Business of Bradken Resources Pty Limited
ABN 82 098 300 988
ADELAIDE PLANT
Cromwell Road Kilburn SA 5084 Australia
BRADKEN

DIMENSIONS IN MILLIMETRES
TOLERANCES UNLESS NOTED
MACHINED - ±0.1mm
GENERAL - ±1mm
3RD ANGLE PROJECTION

REV	GRID	DETAILS	BY	APP	DATE
A		ISSUED FOR REFERENCE	AM		26.6.06

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ITEM	No. OFF	PART No.	DESCRIPTION	NOTE

DRAWN AM	DATE 26.6.06
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ENG. APP'D GP	DATE 26.6.06
CLIENT APP'D	DATE
CAD FILE No. 5777008-A-500	

BRADKEN MINERAL PROCESSING
ADELAIDE PLANT - KILBURN, SOUTH AUSTRALIA
2006 PLANT UPGRADE
FULL SITE ELEVATIONS - EAST & WEST

SCALE	SHEET SIZE	DRAWING No.	REV
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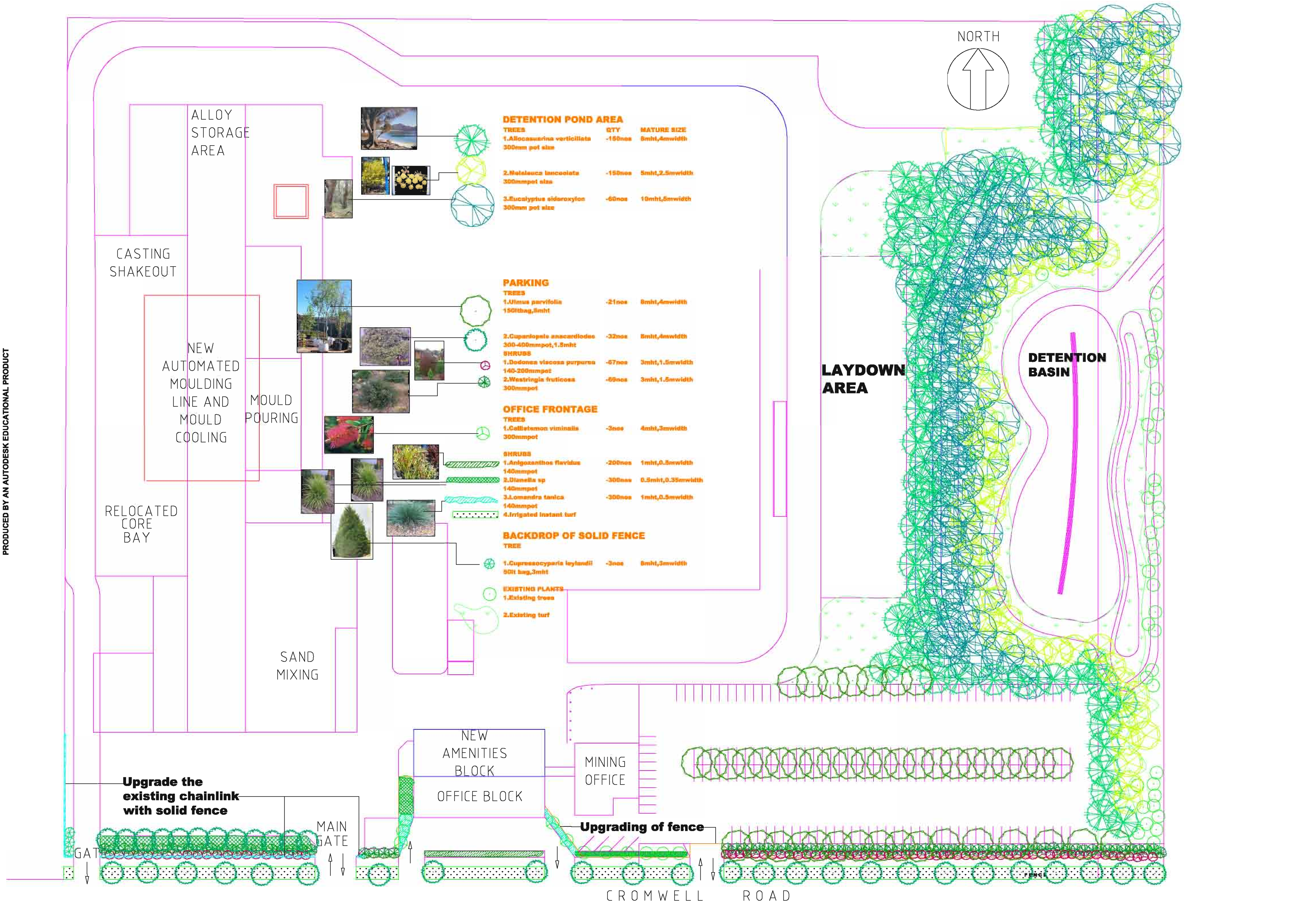
Appendix G

Landscaping Plan


NORTH
ALLOY STORAGE AREA
CASTING SHAKEOUT
NEW AUTOMATED MOULDING LINE AND MOULD COOLING
MOULD POURING
RELOCATED CORE BAY
SAND MIXING
NEW AMENITIES BLOCK
OFFICE BLOCK
MINING OFFICE
LAYDOWN AREA
DETENTION BASIN
Upgrade the existing chainlink with solid fence
Upgrading of fence
MAIN GATE
GATE
CROMWELL ROAD
DETENTION POND AREA
TREES QTY MATURE SIZE
1.Allocasuarina verticillata -150nos 8mht,4mwidth
300mm pot size
2.Melaleuca lancoalata -150nos 5mht,2.5mwidth
300mmpot size
3.Eucalyptus sideroxylon -60nos 10mht,5mwidth
300mm pot size
PARKING
TREES
1.Ulmus parvifolia -21nos 8mht,4mwidth
150ltbag,5mht
2.Cupaniopsis anacardiodes -32nos 8mht,4mwidth
300-400mmpot,1.5mht
SHRUBS
1.Dodonea viscosa purpurea -67nos 3mht,1.5mwidth
140-200mmpot
2.Westringia fruticosa -69nos 3mht,1.5mwidth
300mmpot
OFFICE FRONTAGE
TREES
1.Callistemon viminalis -3nos 4mht,3mwidth
300mmpot
SHRUBS
1.Anigozanthos flavidus -200nos 1mht,0.5mwidth
140mmpot
2.Dianella sp -300nos 0.5mht,0.35mwidth
140mmpot
3.Lomandra tanica -300nos 1mht,0.5mwidth
140mmpot
4.Irrigated instant turf
BACKDROP OF SOLID FENCE
TREE
1.Cupressocyparis leylandii -3nos 8mht,3mwidth
50lt bag,3mht
EXISTING PLANTS
1.Existing trees
2.Existing turf

Appendix H

Traffic Report

20060085LA8/PCS/PCS

18th October 2006

Mr Kevin Gilbert
Project Manager – Mineral Processing
Bradken
PO Box 131
ENFIELD PLAZA SA 5085

Dear Mr Gilbert

BRADKEN DEVELOPMENT – TRAFFIC ASSESSMENT

Introduction and Background

This report addresses the likely traffic implications associated with the proposed upgrading and expansion of the Bradken Foundry on Cromwell Road, Kilburn, as outlined in the Major Development Guidelines dated June 2006. This letter supersedes our letter dated 25th August 2006 (ref 20060085LA7) with additional detail of heavy vehicle numbers entering and exiting the Bradken site.

Our assessment has been based on the data collection listed below and various discussions with staff at Bradken to clarify the transport efficiencies associated with the operation of the proposed new facilities.

- Traffic volume data was collected at two sites on Cromwell Road between Wednesday 26th April and Tuesday 9th May 2006. The data includes the number and type of vehicles, direction and time of travel, and vehicle speeds.
  - East of the junction with Blackburn Street
  - West of the junction with Nelson Street
- Manual counts were undertaken of traffic entering and leaving the Bradken site along the Cromwell Road frontage. The counts were undertaken on Tuesday 2nd May and Friday 5th May between the hours of 6:00am and 6:00pm. Recorded information includes :
  - The approach and departure direction of each vehicle
  - The type of each vehicle
  - The entrance / driveway used (6 driveways were monitored including the staff car park – refer attached diagram).
- On street parking surveys were also conducted along Cromwell Road (between Nelson Street and Blackburn Street) at 15 minute intervals on the same two days.

- Parking utilisation surveys were conducted within the on site staff car park on Wednesday 10th May, Thursday 11th May and Friday 12th May. The surveys were typically undertaken at 9:30am, 1:30pm, 3:00pm and 4:30pm.
- Traffic volume data was collected in Marmion Street, west of Tyne Avenue on 2nd and 3rd August 2006. The data includes the number and type of vehicles, direction and time of travel, and vehicle speeds.
- 4 hour turning counts were conducted concurrently at the junctions of Churchill Road/Cromwell Road and Prospect Road/Cromwell Road between 2:00pm – 6:00pm on 16th August 2006.

Existing Conditions and Traffic Generation

- The current average weekday daily traffic volume on Cromwell Road is 1,350 vpd (range 1,235-1,500). The existing volumes are therefore very close to the accepted threshold of 1,500 vpd for residential streets.
- The percentage of commercial vehicles (2 axle truck or larger) using Cromwell Road on weekdays is approximately 7-9% which is higher than normal for other residential streets.
- Existing 12 hour volumes in Cromwell Road (0600-1800) are 1,060-1,226 vehicles. Not surprisingly, most of the total daily traffic occurs between 0600-1800.
- Based on the manual count driveway surveys, the amount of traffic that can be attributed travelling to/from the Bradken site in the same 12 hour periods was approximately 300 vehicles (150 inbound and 150 outbound).
- Approximately 20% of traffic travelling to/from Bradken are commercial vehicles (2 axle truck or larger). Notwithstanding, the vast majority of commercial vehicles observed travelling to/from Bradken were either 2 or 3 axle rigid trucks. Articulated vehicles (semi-trailers) are a proportionally small component of the traffic generation of Bradken.
- Based on 12 hour volumes (0600-1800), the Bradken site generates 10.9-15.3% of volumes in Cromwell Road.
- On street parking demand is generally very light throughout the day. The most number of vehicles observed parked along Cromwell Road (between Nelson Street and Blackburn Road) was only 3, and there were frequently periods where no vehicles were parked on street.
- The existing staff car park area provides 101 parking spaces (not including a few informal parks on the unsealed area at the eastern end). At no stage did the car park reach capacity. The highest recorded occupancy rate was 85% when there were still 15 spaces available.
- There are very few delays or queuing experienced throughout the day at either the junction of Cromwell Road with Prospect Road or Churchill Road.

Future Traffic Generation

- The traffic generation of Bradken has been separated into three groups :
  - Production traffic (Gates A and B – traffic entering and leaving the main gate and the western most locked gate, that would be directly associated with the production of materials)
  - Visitor and administration traffic (Gates C and D – traffic using the entry / exit loop directly in front of the office building)
  - Staff traffic (Gates E and F – vehicles using the locked staff car park or small driveway between the staff car park and office building)
- Current traffic volumes to/from Bradken have been increased as follows :
  - Production traffic x 2.56
    This has been based on a directly proportional increase to production, that is 32,000 tonne p.a. / 12,500 tonne p.a.
  - Visitor / administration x 1.5
    While general admin and visitor traffic may increase, it is unlikely to be proportional to the increase in production. An allowance of 1.5 seems reasonable.
  - Staff traffic x 1.55
    This is a directly proportional increase relative to the increase in staff numbers as advised by Bradken, that is 283 / 182.
- On this basis, 12 hour traffic volumes in Cromwell Road will increase by 117-181 vehicles, as summarised in the attached spreadsheet and diagram.
- Estimated future 12 hour traffic volumes in Cromwell Road will be 1,177-1,407 vehicles. While the estimated increase in traffic volumes is around 11-15% of current 12 hour volumes, the result will render 24 hour volumes typically closer to the 1,500 vpd accepted threshold for residential streets. On some days this limit is likely to be exceeded (albeit just).

Discussion

Future Traffic Generation

As previously noted, the average weekday traffic volumes in Cromwell Road are 1,350 vpd which are within the acceptable threshold for a residential street. Weekend traffic volumes vary considerably from 780-850 vpd (29-30th April) to 1,050-1,330 vpd (6th-7th May). The variability of weekend traffic volumes is thought to be influenced by the scheduling of functions at the Canine Association facilities opposite the Bradken site.

The number of additional vehicle movements that can be expected from the increased production of the facility is not easy to estimate with any degree of confidence. We have based our assessment on the worse case scenario that vehicle trips associated with production will simply increase directly proportional to the overall increase in production (32,000 / 12,500 = 2.56).

However, this is likely to represent an overestimation of future production traffic movements as it does not include any efficiency gains through the new production process. For example, we understand that the new production process will significantly reduce the ratio of sand : steel through less sand being required per mould and a higher rate of recycling.

Under current production methods (12,500 tonne of steel produce p.a.), 19,250 tonne of sand is purchased p.a. and a similar amount of waste sand is taken from site p.a. Under the new production processes (32,000 tonne of product), 19,200 tonne of sand will be brought in and taken from site each year.

There may also be traffic efficiencies through improved loading of outgoing trucks. Due to current production rates, a high proportion of outgoing trucks leave the site under capacity. With improved production rates, it may be possible to increase the load of each truck.

As these possible improvements have been difficult to quantify we have based our assessment on production traffic increasing proportionally to the increase in product being produced, albeit that this may represent an over estimation.

On this basis, future traffic volumes are likely to increase by approximately 11-15% as a result of the proposed development, which will result in weekday total traffic volumes in the order of 1,500 vpd. These volumes must be considered the upper threshold for a residential street, particularly as the percentage of commercial vehicles is higher than other locations.

Arguably, the actual increase in traffic may not be noticeable in a practical sense. For example, about 25-40% of the increase will be attributed to additional staff numbers. Associated traffic movements will still be concentrated at the start and end of shift times.

The general increase in traffic movements associated with the production of the site will be spread throughout the day, typically between 7:00am and 4:00pm on weekdays.

We understand that there should be fewer operations at the site on Saturdays following the development, while actual staff numbers at the site over weekends should remain the same. Accordingly, there should be no change to existing traffic conditions on Saturday and Sundays, and in turn, there should be no influence on accessibility and safety of users of the adjacent Canine facilities.

The actual increase in traffic volumes is relatively modest (approximately 117-181 vpd), and these movements will be split between the eastern and western legs of Cromwell Road (to/from Churchill Road and Prospect Road).

It is also worth considering the proportion of trucks that currently enter and leave the Bradken site. Observational surveys classified vehicles entering and leaving Bradken as follows :

- Car / Wagon
- Ute Van Small Truck
- 2 Axle Truck
- 3+ Axle Rigid Truck
- Truck Trailer
- Semi Trailer

On average, 16 two axle trucks enter and leave the site each day, equating to 8-12% of all traffic generated to/from the site. With regard to heavier vehicles (3+ Axle Trucks and larger), these vehicles also represent 8-12% of all traffic generated to/from the site. That is, around 30-32 trucks (2 axle of more) enter and leave the site each weekday.

Applying the 2.56 multiple factor, the new production process may result in around 80 trucks (2 axle or more) entering and leaving the site each week day.

Alternative Access

All incoming materials and outgoings goods enter and leave the site via access driveways in Cromwell Road. 85-90% of traffic entering the main gate approaches from the west (Churchill Road). Conversely 67-77% of traffic leaving the main gate turns left and head east toward Prospect Road.

Staff traffic entering and leaving the staff car park is more evenly distributed with slightly more approaching and departing from the east and Prospect Road.

Overall, the traffic distribution associated with the existing Bradken site appears reasonably balanced between the eastern and western legs of Cromwell Road – that is to/from Prospect Road and Churchill Road. The future traffic growth associated with the development is likely to maintain this distribution.

Two alternative access arrangements have been identified (as shown below) :

- To the eastern boundary of the site using Marmion Street
- To the northern boundary of the site by constructing an extension to Mill Court

Marmion Street is a local residential street that has a terminating stub adjacent the Bradken site. The existing weekday traffic volumes in Marmion Street are only 204-239 vpd. Assuming the internal layout could be modified to suit, consideration could be given to utilizing Marmion Street as an alternative access to to/from the Bradken staff car park, either as an additional access (retaining the existing gate) or as a replacement access (closing the existing gate). Commercial vehicle access to the site via Marmion Street is not supported.

Existing volumes in/out of the staff car park are 138-177 (12 hours). If this volume increases proportionally (x 1.55), the amount of traffic entering and leaving the car park will be in the order of 214-274 vehicles.

If Marmion Street was developed as the only access to the staff car park, it would result in traffic volumes up to 500 vpd. While this volume is still below the acceptable environmental threshold for a residential street (1500 vpd), it would represent a proportionally significant increase in traffic in Marmion Street (approximate doubling). Traffic volumes in Cromwell Road would in turn reduce by 138-177 vehicles.

If Marmion Street was developed as an additional access to the staff car park, around 50-60% of staff might be expected to use this access in lieu of the existing gate in Cromwell Road, based on current distributions. Traffic volumes in Marmion Street would increase by 107-137 vehicles per day, and volumes in Cromwell Road would reduce very marginally.

Overall, there may not be a substantial benefit through the establishment of an alternative car park access via Marmion Street.

At face value, it would appear possible to extend Mill Court through the Council Depot to provide a new northern access to the Bradken site. This would obviously require the agreement of the Port Adelaide Enfield Council. Assuming the internal layout of Bradken could be modified to suit, the alternative access would provide a more appropriate access for commercial vehicles between the site and Grand Junction Road. The primary advantage of this option would be the removal of commercial vehicles from Cromwell Road. This would reduce traffic volumes, and in particular the percentage of commercial vehicles from Cromwell Road.

Notwithstanding, consideration would have to be given to the development of an improved right turn access between Grand Junction Road and Mill Court. The existing right turn lane is only approximately 25 metres in storage length whereas most right turn lanes provide at least 30 metres of storage. This is due to the proximity of a driveway for a property on the northern side of Grand Junction Road.

In this instance a longer right turn lane would almost certainly be needed to provide adequate storage for at least two articulated commercial vehicles (approximately 40 metres). The adjacent driveways and close proximity to the signalised intersection with Churchill Road may render the provision of a suitable turning lane difficult.

Junctions of Cromwell Road with Churchill Road and Prospect Road

Turning counts have been undertaken between 2:00pm and 6:00pm at both ends of Cromwell Road to determine the volume and direction of vehicles turning into/out of Prospect Road and Churchill Road.

The efficiency of each intersection was modelled using SIDRA 3 software. A base model was initially developed and calibrated to reflect observed conditions. Turning volumes were subsequently increased by 15% reflecting the anticipated increase in traffic attributed to the development.

Both intersections are currently performing well below capacity. The maximum observed queue for right turners into Cromwell Road was typically only 1 vehicle. Similarly there were very few delays / queues experienced by traffic turning into either Churchill Road or Prospect Road.

Future anticipated traffic volumes are not likely to significantly increase queues or delays in either the arterial roads. While queue lengths for drivers exiting Cromwell Road may increase up to 9 vehicles during peak afternoon conditions, there should be no need for additional right turn storage in Churchill Road or Prospect Road.

Car Parking

The existing car park provides 101 marked parking spaces, not including a few other parks located throughout the overall site. Parking utilisation surveys were conducted within the on site staff car park on Wednesday 10th May, Thursday 11th May and Friday 12th May.

The surveys were typically undertaken at 9:30am, 1:30pm, 3:00pm and 4:30pm. Additional verification surveys were also conducted at 2:00pm and 3:45pm on Thursday 11th May.

At no stage did the car park reach capacity. The highest rate of occupancy recorded was 85% (3:00pm on Wednesday and 2:00pm on Thursday) at which time there were still 15 parks available.

A comparison has been made between the estimated number of staff on site throughout the day (max number per shift less known absentees) in relation to the number of cars parked within the car park at different times of the day. The comparison demonstrated a typical 1:1 ratio, confirming that most staff currently drive to work and park on site.

Proposed shift times indicate that the largest contingent of staff on site will increase from 98 during the current day shift to 159 during the proposed day shift.

Increasing the size of the existing car park to around 170 car parks would preserve the existing parking ratio based on the maximum observed capacity of 85%. That is, the provision of 170 car parks would provide a surplus of 15% as per the existing surplus.

Adjacent Developments and Local Access

The Kilburn Primary School is located adjacent Montgomery Street, one street to the south of Cromwell Road. There is a pedestrian access path between Cromwell Road and the school, opposite Blackburn Street. Site observations between 2:45 – 3:45pm on a school day indicated that the path is used by a number of parents and children. In addition, several parents and children walk through the Canine Association car park between the school and Cromwell Road. Pedestrian movements were concentrated between 3:10 – 3:30pm. A 25km/h school zone applies to Cromwell Road in this area.

As a proportion of the potential increase in traffic movements associated with the Bradken development will be attributed to staff numbers, it would be desirable to manage the start/end of shift times to avoid conflict with school traffic (particularly around 3:20pm). In addition, the Port Adelaide Enfield Council could give consideration to the installation of a formal (Emu) pedestrian crossing adjacent the path.

Overall, local access should not be unduly affected by the additional traffic or through the provision of a larger on site car park. Traffic movements associated with the car park will (still) be concentrated at the start and end of shift times, particularly between 2:30-3:30pm at the conclusion of the day shift and commencement of the afternoon shift.

The current shift times (listed below) are not likely to change following the development.

Day shift	6:00-7:00am – 2:30-3:30pm
Afternoon shift	2:30-3:30pm – 10:30-11:30pm
Night Shift	11:30pm – 6:30am

Note that the change in shifts is spread over approximately 1 hour as production staff operates on two separate shifts (pre and post casting). Furthermore, administration staff operates on a 8:00am-4:30pm period. This benefits the necessary capacity of the car park as well as traffic movements to/from the site. The effect is a lessening of the "peak" concentration of movements at the change over of shifts.

Constructional Traffic

It is difficult to accurately quantify the amount of traffic that will be generated by the construction and upgrading of the proposed facilities. Variables include :

- The total estimate of goods / material delivered to site
- The total estimate of materials taken from site (demolition)
- The average amount of goods/materials per truck travelling to/from site

Based on data provided by Bradken with regard to the overall value of the project, and making some preliminary estimates for average truck loadings, an indication of the number of constructional truck that might be generated during the period of construction is 800 truck movements. This equates to around 6.4 per week (2.5 years and 50 weeks per annum), or approximately 1 per day on average.

However, it should also be noted that the amount of constructional traffic generated will vary from day to day depending on the actual work being undertaken. Bradken has advised that associated works will extend over 2.5 - 3 years. While the construction labour force will vary throughout the life of the project (between 4-45 staff), there will typically be an additional 15-30 people on site.

It is also important to note that these estimates are not additional to the future traffic generation of the facility (outlined above), as production can not reach capacity until after the development is complete.

Summary

This report outlines the anticipated traffic impacts associated with the proposed upgrading and expansion of the Bradken Foundry. While the proposed development will generate additional traffic, the actual increase in traffic volumes is relatively modest (approximately 117-181 vpd). These movements will be split between Churchill Road and Prospect Road and spread throughout the day. Accordingly, no infrastructure changes are anticipated for the arterial road network. Similarly, no changes are considered necessary to the local road network.

Yours faithfully
TONKIN CONSULTING

Paul Simons
Team Leader Roads and Traffic

SUMMARY OF CURRENT AND FUTURE TRAFFIC VOLUMES

TUESDAY 2nd MAY	
EAST OF BLACKBURN ST	**WEST OF NELSON ST**
Existing 12 hr volume = 1060	Existing 12 hr volume = 1057
Existing 12 hr traffic to/from Bradken = 116	Existing 12 hr traffic to/from Bradken = 144
Future 12 hr traffic to/from Bradken ~ 233	Future 12 hr traffic to/from Bradken ~ 265
Future est total 12 hr volume ~ 1177	Future est total 12 hr volume ~ 1178
Estimated increase in traffic ~ 117	Estimated increase in traffic ~ 121
% Increase (12 Hr) = 11%	% Increase (12 Hr) = 11.4%
FRIDAY 5th MAY	
EAST OF BLACKBURN ST	**WEST OF NELSON ST**
Existing 12 hr volume = 1226	Existing 12 hr volume = 1181
Existing 12 hr traffic to/from Bradken = 187	Existing 12 hr traffic to/from Bradken = 164
Future 12 hr traffic to/from Bradken ~ 368	Future 12 hr traffic to/from Bradken ~ 310
Future est total 12 hr volume ~ 1407	Future est total 12 hr volume ~ 1327
Estimated increase in traffic ~ 181	Estimated increase in traffic ~ 146
% Increase (12 Hr) = 14.8%	% Increase (12 Hr) = 12.4%

Existing 12 hour volumes determined from automated counts at two sites
Existing 12 hour traffic to/from Bradken determined from manual turning counts
Future 12 hour traffic to/from Bradken determined by factoring traffic increases as discussed above

Blackburn St
Nelson St
Gate A
Gate B
Gate C
Gate D
Gate E
Gate F
Cromwell Road

CURRENT AND FUTURE TRAFFIC GENERATION / TURNING COUNTS

FRIDAY 5TH MAY - TOTAL IN AND OUT

		Gate A							Gate B							Gate C						
		IN			OUT				IN			OUT				IN			OUT			2 W
		L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	
FRIDAY 5TH MAY	Car / Wagon	0	2	2	0	0	0	2	6	4	10	7	4	11	21	7	4	11	1	1	2	13
	Ute Van Small Truck	0	1	1	0	0	0	1	15	4	19	12	9	21	40	3	0	3	0	1	1	4
	2 Axle Truck	2	0	2	2	1	3	5	19	1	20	11	7	18	38	0	0	0	0	0	0	0
	3+ Axle Rigid Truck	0	0	0	1	0	1	1	11	0	11	8	1	9	20	0	0	0	0	0	0	0
	Truck Trailer	1	0	1	0	0	0	1	3	0	3	2	0	2	5	0	0	0	0	0	0	0
	Semi Trailer	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12 Hr Total	3	3	6	4	1	5	11	54	9	63	40	21	61	124	10	4	14	1	2	3	17

		Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
FRIDAY 5TH MAY	Car / Wagon	1	2	3	7	8	15	18	0	3	3	1	1	2	5	32	44	76	39	47	86	162	105	116
	Ute Van Small Truck	0	0	0	1	1	2	2	2	0	2	0	1	1	3	0	3	3	3	3	6	9	28	31
	2 Axle Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	21
	3+ Axle Rigid Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	10
	Truck Trailer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2
	Semi Trailer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	12 Hr Total	1	2	3	8	9	17	20	2	3	5	1	2	3	8	32	47	79	42	50	92	171	170	181
																							TOTAL	351

FRIDAY 5TH MAY - TOTAL IN AND OUT FROM CHURCHILL ROAD

		Gate A							Gate B							Gate C						
		IN			OUT				IN			OUT				IN			OUT			2 W
		L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	
FRIDAY 5TH MAY	Car / Wagon	0				0		0	6				4		10	7				1		8
	Ute Van Small Truck	0				0		0	15				9		24	3				1		4
	2 Axle Truck	2				1		3	19				7		26	0				0		0
	3+ Axle Rigid Truck	0				0		0	11				1		12	0				0		0
	Truck Trailer	1				0		1	3				0		8	0				0		0
	Semi Trailer	0				0		0	0				0		0	0				0		0
	12 Hr Total	3				1		4	54				21		75	10				2		12
	FUTURE 12 Hr							**10**							**192**							**18**

		Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
FRIDAY 5TH MAY	Car / Wagon	1				8		9	0				1		1	32				47		79	46	61
	Ute Van Small Truck	0				1		1	2				1		3	0				3		3	20	15
	2 Axle Truck	0				0		0	0				0		0	0				0		0	21	8
	3+ Axle Rigid Truck	0				0		0	0				0		0	0				0		0	11	1
	Truck Trailer	0				0		0	0				0		0	0				0		0	4	0
	Semi Trailer	0				0		0	0				0		0	0				0		0	0	0
	12 Hr Total	1				9		10	2				2		4	32				50		82	102	85
																							TOTAL	187
	FUTURE 12 Hr							**15**							**6.2**							**127**		**368.5**

FRIDAY 5TH MAY - TOTAL IN AND OUT FROM PROSPECT ROAD

		Gate A							Gate B							Gate C						
		IN			OUT				IN			OUT				IN			OUT			2 W
		L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	2 W	L	R	Tot	L	R	Tot	
FRIDAY 5TH MAY	Car / Wagon		2		0			2		4		7			11		4		1			5
	Ute Van Small Truck		1		0			1		4		12			16		0		0			0
	2 Axle Truck		0		2			2		1		11			12		0		0			0
	3+ Axle Rigid Truck		0		1			1		0		8			8		0		0			0
	Truck Trailer		0		0			0		0		2			2		0		0			0
	Semi Trailer		0		1			1		0		0			0		0		0			0
	12 Hr Total		3		4			7		9		40			49		4		1			5
	FUTURE 12 Hr							**18**							**125**							**7.5**

		Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
FRIDAY 5TH MAY	Car / Wagon		2		7			9		3		1			4		44		39			83	59	55
	Ute Van Small Truck		0		1			1		0		0			0		3		3			6	8	16
	2 Axle Truck		0		0			0		0		0			0		0		0			0	1	13
	3+ Axle Rigid Truck		0		0			0		0		0			0		0		0			0	0	9
	Truck Trailer		0		0			0		0		0			0		0		0			0	0	2
	Semi Trailer		0		0			0		0		0			0		0		0			0	0	1
	12 Hr Total		2		8			10		3		1			4		47		42			89	68	96
																							TOTAL	164
	FUTURE 12 Hr							**15**							**6.2**							**138**		**310.0**

Traffic to from Gates A and B factored by 2.56
Traffic to from Gates C and D factored by 1.5
Traffic to from Gates E and F factored by 1.55

CURRENT AND FUTURE TRAFFIC GENERATION / TURNING COUNTS

TUESDAY 2ND MAY - TOTAL IN AND OUT

		Gate A							Gate B							Gate C							Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
TUES 2ND MAY	Car / Wagon	0	1	1	0	0	0	1	4	2	6	3	2	5	11	3	2	5	1	1	2	7	0	5	5	2	1	3	8	0	1	1	5	0	5	6	29	46	75	35	23	58	133	93	73
	Ute Van Small Truck	0	0	0	0	0	0	0	13	1	14	12	5	17	31	2	0	2	0	0	0	2	1	0	1	0	2	2	3	0	1	1	0	0	0	1	0	1	1	3	1	4	5	19	23
	2 Axle Truck	1	0	1	0	0	0	1	11	0	11	7	3	10	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	10
	3+ Axle Rigid Truck	0	0	0	1	0	1	1	6	1	7	6	0	6	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
	Truck Trailer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Semi Trailer	0	0	0	1	0	1	1	8	0	8	7	0	7	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
	12 Hr Total	1	1	2	2	0	2	4	42	4	46	35	10	45	91	5	2	7	1	1	2	9	1	5	6	2	3	5	11	0	2	2	5	0	5	7	29	47	76	38	24	62	138	139	121
																																									TOTAL				**260**

TUESDAY 2ND MAY - TOTAL IN AND OUT FROM CHURCHILL ROAD

		Gate A							Gate B							Gate C							Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
TUES 2ND MAY	Car / Wagon	0				0		0	4				2		6	3				1		4	0				1		1	0				0		0	29				23		52	36	27
	Ute Van Small Truck	0				0		0	13				5		18	2				0		2	1				2		3	0				0		0	0				1		1	16	8
	2 Axle Truck	1				0		1	11				3		14	0				0		0	0				0		0	0				0		0	0				0		0	12	3
	3+ Axle Rigid Truck	0				0		0	6				0		6	0				0		0	0				0		0	0				0		0	0				0		0	6	0
	Truck Trailer	0				0		0	0				0		0	0				0		0	0				0		0	0				0		0	0				0		0	0	0
	Semi Trailer	0				0		0	8				0		8	0				0		0	0				0		0	0				0		0	0				0		0	8	0
	12 Hr Total	1				0		1	42				10		52	5				1		6	1				3		4	0				0		0	29				24		53	78	38
																																									TOTAL				**116**
	FUTURE 12 Hr							**2.6**							**133**							**9**							**6**							**0**							**82**		**232.8**

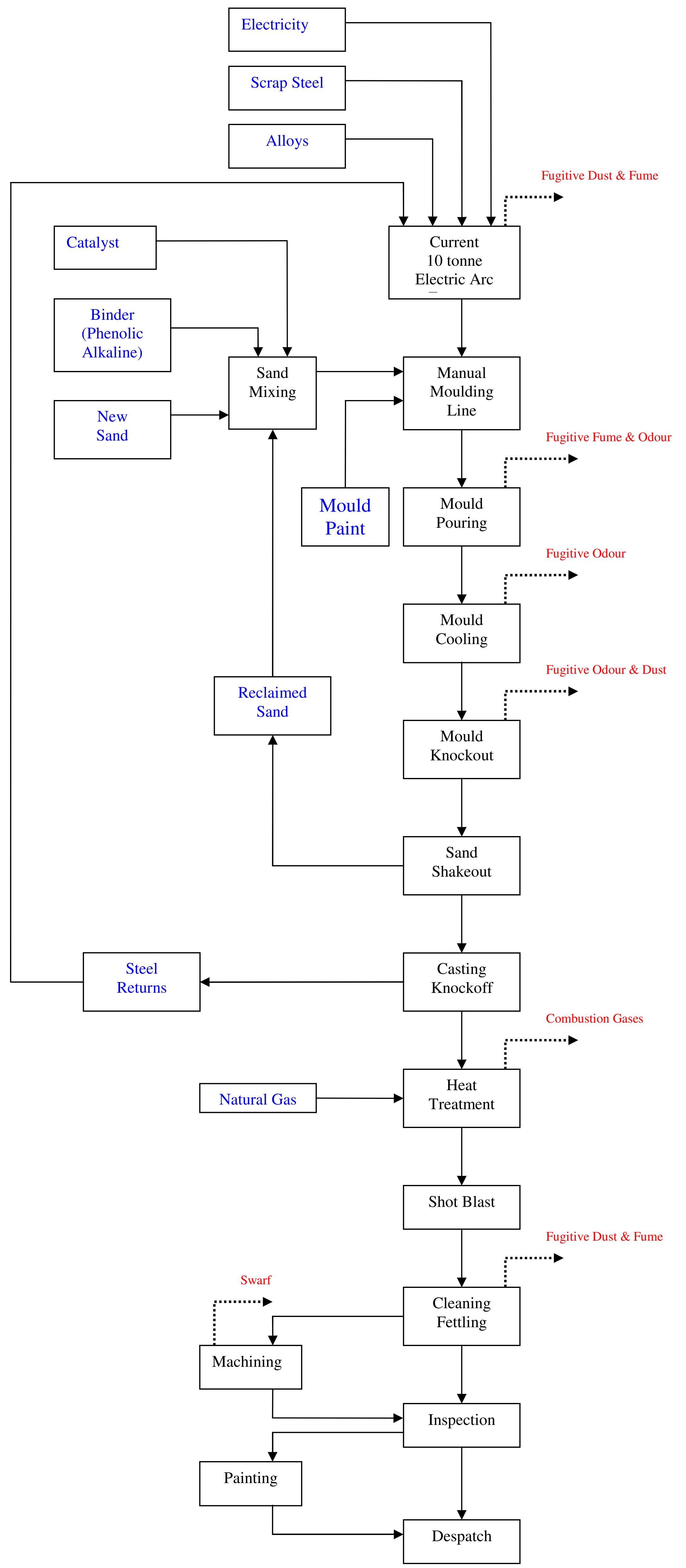
TUESDAY 2ND MAY - TOTAL IN AND OUT FROM PROSPECT ROAD

		Gate A							Gate B							Gate C							Gate D							Gate E							Gate F								
		IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W	IN			OUT			2 W		
		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		L	R	Tot	L	R	Tot		Total IN	Total OUT
TUES 2ND MAY	Car / Wagon		1		0			1		2		3			5		2		1			3		5		2			7		1		5			6		46		35			81	57	46
	Ute Van Small Truck		0		0			0		1		12			13		0		0			0		0		0			0		1		0			1		1		3			4	3	15
	2 Axle Truck		0		0			0		0		7			7		0		0			0		0		0			0		0		0			0		0		0			0	0	7
	3+ Axle Rigid Truck		0		1			1		1		6			7		0		0			0		0		0			0		0		0			0		0		0			0	1	7
	Truck Trailer		0		0			0		0		0			0		0		0			0		0		0			0		0		0			0		0		0			0	0	0
	Semi Trailer		0		1			1		0		7			7		0		0			0		0		0			0		0		0			0		0		0			0	0	8
	12 Hr Total		1		2			3		4		35			39		2		1			3		5		2			7		2		5			7		47		38			85	61	83
																																									TOTAL				**144**
	FUTURE 12 Hr							**7.7**							**100**							**4.5**							**11**							**11**							**132**		**265.1**

Traffic to from Gates A and B factored by 2.56
Traffic to from Gates C and D factored by 1.5
Traffic to from Gates E and F factored by 1.55

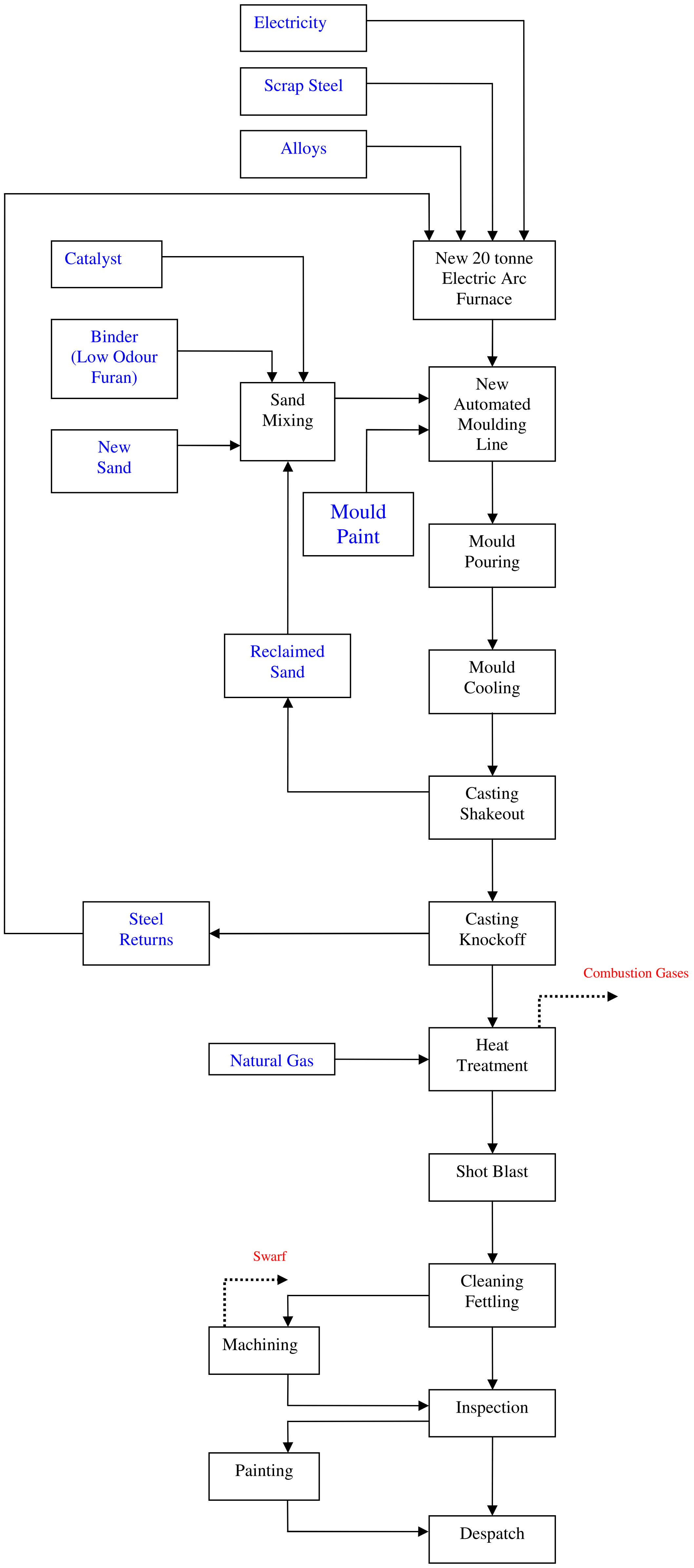
Appendix I

Process Flow Diagrams



Bradken Mineral Processing A business of Bradken Resources ABN: 82 098 300 988 Adelaide Plant Cromwell Rd Kilburn SA 5084 Australia	DRAWN BY: J. Gilbert CHECKED BY:	
TITLE: Bradken Process Flow Diagram 12500 tonnes per annum	DATE: 7-7-06	REV: C

953277



Bradken Mineral Processing
A business of Bradken Resources
ABN: 82 098 300 988
Adelaide Plant
Cromwell Rd Kilburn SA 5084 Australia

DRAWN BY: J. Gilbert

CHECKED BY:

TITLE: Bradken Process Flow Diagram
32000 tonnes per annum

DATE: 7-7-06

REV: C

953277

Appendix J

Binder Chemistry

Binder Chemistry

Foundries use moulds and cores made of sand to cast molten metal into desired shapes. The most commonly used sand is silica sand but in certain areas of the mould other sands (including chromite and zircon sands) are used to optimize casting quality. The sand is held in the shape of the mould or core by a binder.

Binders are mixed with the sand at low percentages by weight so they only form a very small portion of the mould volume. Ferrous foundries use various types of binders, including sodium silicate, oils, clay & starch and phenolic resins. Each of these binder systems has its own unique properties and foundry suppliers around the world are continually modifying these binders to improve the quality, safety and environmental aspects of their products.

Table 1 below shows the main constituents listed in the Material Safety Data Sheets (MSDSs) of the two resin binder systems being reviewed for the purposes of the Major Development. These are the current alkali phenolic binder and the proposed furfuryl alcohol binder.

Each binder supplier has their own proprietary mix of these constituents. Note, the constituents formaldehyde, phenol and urea are generally found in the binders in trace amounts of less than 1% as they are primarily bound up in the resin.

Table 1 – Foundry Sand Binder Constituents

	Alkali phenolic binder	Furfuryl alcohol binder
resin	Phenol/formaldehyde resin Urea/phenol/formaldehyde resin Sodium hydroxide Sodium phenoxide Potassium hydroxide Potassium phenoxide Formaldehyde water	Furfuryl alcohol Phenol/formaldehyde resin Urea/phenol/formaldehyde resin Formaldehyde Phenol Urea Bisphenol
Catalyst or reagent	Methyl formate Glyceryl triacetate Propylene carbonate	Toluene-4-sulphonic acid Lactic acid Sulphuric acid Ethane-1,2-diol

Both resin systems are in common use both industrially and domestically. Their uses include manufacture of molded plastics, adhesives, laminates, and fibre-reinforced polymers (FRPs).

ALKALI PHENOLIC RESIN BINDER

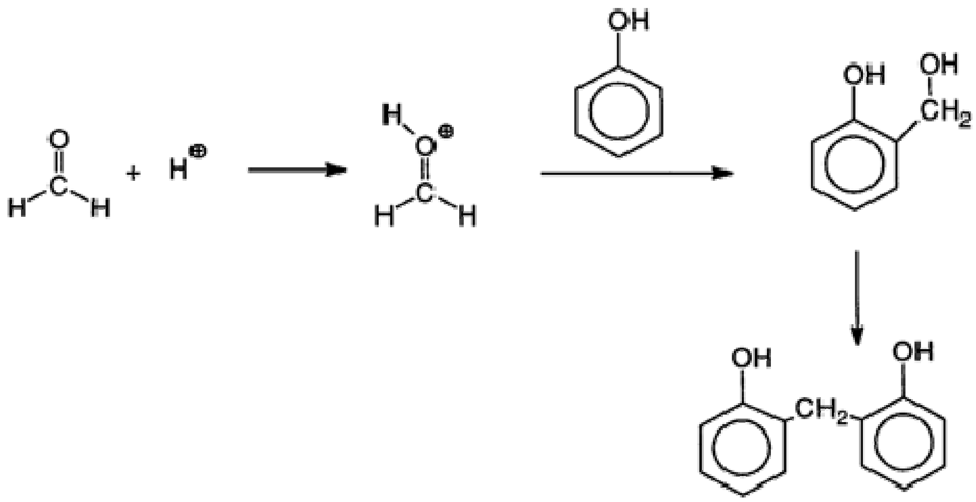
The following is a description of the chemistry for the alkali phenolic binder system. This is the system that is currently used at the Kilburn site.

Alkali phenolic resins are a base catalysed phenol formaldehyde resin. The resins are similar to the original Bakelite resin developed around 1905. The resin can be used to produce laminated boards and molded articles such as telephone parts, in adhesives, in paints, and for a multitude of other uses including foundry binders.

The ester hardened alkaline phenolic resins were developed for use in the foundry industry in the 1980s.

The alkali phenolic resin is formed from an elimination reaction of phenol with formaldehyde as shown in Figure 1.

Figure 1.



The resin is cross linked with alkali and an ester reagent to form the solid resin holding the sand grains together.

The following is an extract from "Third report of Institute Working Party T30 Mould and Core Production", The Foundryman, February 1994.

" ESTER HARDENED ALKALINE PHENOLIC RESINS

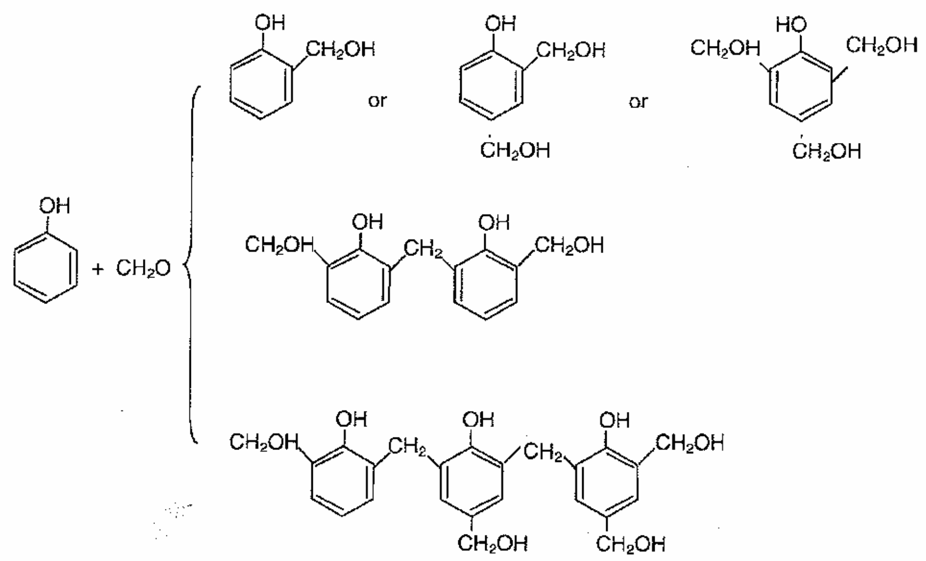
5.0 Ester hardened alkaline phenolic resins

The fact that alkaline phenolic resoles could be crosslinked to form a gel by the addition of an ester was discovered in the early 1950's but is was not until the early 1980's that these materials found application as environmentally improved foundry sand binders.

5.1 Basic Principle

The alkali in the phenolic resin reacts with the ester to form the alkali metal salt of the acid component of the ester releasing the alcohol component. Phenolic resin is released in a reactive form that polymerises (gels) at room temperature. Choice of alkali metal: Potassium (K) and Sodium (Na) give the best results. Lithium (Li) or Barium (Ba) can be used. The speed of gelation can be varied depending upon the rate of saponification of the ester by the alkali metal ion.

5.2 Chemistry



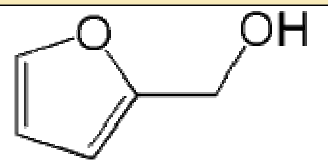
”

FURANE BINDER SYSTEM

The following is a description of the chemistry for the furfuryl alcohol or “Furane” binder system. This is the system that is proposed to be used at the Kilburn site as part of the site upgrade..

The Furane binder system is based on furfuryl alcohol. The term furane is a generic term used in the industry for the class of resins produced from furfuryl alcohol. Furane binders are not one of the furans or dioxins known as a Persistant Organic Pollutant.

Furfuryl alcohol



Chemical name	2-furanmethanol
Chemical formula	C_5H_6O
Molecular mass	98.10 g/mol
CAS number	[98-00-0]
Density	1.130 g/cm^3
Melting point	-29 °C
Boiling point	170 °C

Furfuryl alcohol is manufactured industrially by the catalytic reduction of furfural which is obtained from corncobs and sugar cane bagasse. Upon treatment with acids, it forms a resin.

It finds use as a solvent, but is primarily used as an ingredient in the manufacture of various chemical products such as foundry resins, adhesives, synthetic fibres, rubbers and wetting agents.

The following is an extract from “Third report of Institute Working Party T30 Mould and Core Production”, The Foundryman, February 1994.

“1.0 ***ACID SET FURAN BINDERS***

A group of versatile cold setting organic binders, all based on furfuryl alcohol and which occupy a prominent place in mould and core production techniques.

1.1 Basic Principles

There are three types of cold setting furan binders of commercial significance containing furfuryl alcohol contents ranging for 30% to 85%. The resins may be classified in chemical composition terms as follows:

1. *Urea formaldehyde/furfuryl alcohol UF/FA.*
2. *Phenol formaldehyde/furfuryl alcohol PF/FA.*
3. *Urea formaldehyde/phenol formaldehyde/furfuryl alcohol UF/PF/FA.*

Furfuryl alcohol/formaldehyde (FA/F) resins are rarely used as sole binders but are sometimes employed to enhance the properties of the above resins.

All types are polymerised by addition of acid and characteristically yield densely crosslinked structures with excellent bonding properties.

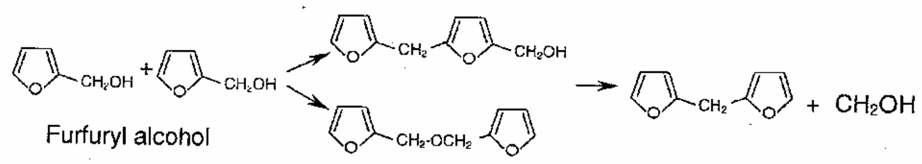
The acids used are:

1. *Phosphoric acid.*
2. *Aromatic sulphonic acids, commonly paratoluene sulphonic acid (PTSA) and more reactive types such as xylene sulphonic acid (XSA) and benzene sulphonic acid (BSA).*
3. *Blends of inorganics acids, commonly phosphoric and sulphuric acids and blends of sulphonic acids and sulphuric acid with relatively small proportions of the latter.*

1.2 Chemistry

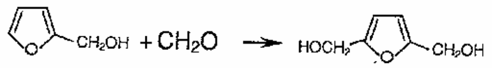
1.2.1 Furfuryl alcohol will self polymerise in the presence of acid catalysts via an extremely exothermic reaction. Polymerisation is effected by reaction between methylol (-CH2.OH) groups and methylol and active hydrogens as shown in Fig 1.

Figure 1.



Furfuryl alcohol also reacts with formaldehyde via an acid catalysed addition reaction as shown in Fig 2.

Figure 2.



Further reaction of methylol groups leads to polymer formation."

If you would like further information, please contact Greg Chaplin, Bradken Environmental Manager on (07) 3335 2226.

Appendix K

Existing Stormwater Quality Assessment

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

STORMWATER QUALITY 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

Written/Submitted by:

for

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1	ENVITHEB05076AA_R01_SW.doc	Final	12 October 2006	Coffey Environments Pty Ltd	CPC

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ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
C_6-C_{36}	Hydrocarbon chainlength fraction
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COC	Chain of Custody
ESA	Environmental Site Assessment
ID	Identification
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
OCP	Organochlorine Pesticide
OPP	Organophosphorous Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
Ppm	parts per million
ppmv	parts per million by volume

ABBREVIATIONS

QA	Quality Assurance
QC	Quality Control
RPD	Relative Percent Difference
SB	Soil Bore
SWL	Static Water Level
TPH	Total Petroleum Hydrocarbon
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 surface water (stormwater) at the Bradken Kilburn Foundry located on Cromwell Road, Kilburn, South Australia (the site). The work was completed in July 2006.

The project objectives were to provide a snapshot of stormwater quality from selected representative locations for the existing stormwater management infrastructure present at the site and to provide Bradken with general recommendations relating to options for continued monitoring of stormwater at the site.

The scope of works included stormwater sampling at five locations at the Bradken site, including the retention pond and the stormwater reticulation system within the site. Sample 1 and Sample 2 were collected from locations consistent with previous eastern retention pond samples. Sample 3 was collected from a location consistent with the south-west sump sample. The other samples were from within the manufacturing area of the site.

Analytes detected in samples were generally consistent with the use of the site as a foundry. Copper, lead, manganese, molybdenum and zinc were detected above the adopted Investigation Level (IL) in all samples. Chromium was detected in four of five samples above the adopted IL and nickel was detected in two of five samples above the adopted IL. In addition, it should be noted that TPH was identified at one location.

Only copper, lead and zinc levels were noted to be above the Aquatic Ecosystem criteria. This is consistent with the historical detection of lead and zinc in stormwater samples previously collected at the site. There were no other significant findings relating to the quality of stormwater sampled and analysed during this sampling event.

It is recommended that a stormwater management plan be developed by Bradken and implemented on a consistent basis. The stormwater management plan should address: sampling frequency, sampling locations and range of analysis to be completed and reported. In addition, the discharge standards, if any that Bradken must meet, will need to be clarified. The plan must address any changes to the site from the proposed upgrade.

It was noted during the field investigation that at the location where TPH was detected in the stormwater sump (Sample 3), along the western boundary, stormwater from this area flowed directly into this sump. This is a section of the site where trucks park and associated spills or leaks could be the source of the identified TPH. It is recommended that this issue be addressed by Bradken through some form of site management.

It was also noted during sampling that the stormwater reticulation system had a build up of sediments in the sampling locations, particularly the catch basins. These sediments could be a source of potential contaminants to stormwater, prior to discharge from the site. It is recommended that regular housekeeping be scheduled to minimise the build up of sediments in the stormwater reticulation system.

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 surface water (stormwater) at the Bradken Kilburn Foundry located on Cromwell Road, Kilburn, South Australia (the site). The work was completed in July 2006.

1.2 Objectives

The project objectives were to provide a snapshot of stormwater quality from selected representative locations for the existing stormwater management infrastructure present at the site and to provide Bradken with general recommendations relating to options for continued monitoring of stormwater at the site.

Coffey Environments understands that this report will form part of an application for planning approval for expansion works to be undertaken at the site. The findings of this report will address certain aspects of the "*Guidelines for the preparation of a Public Environmental Report for the Upgrading and expansion of a Foundry at Cromwell Road, Kilburn (PER)"*, Planning SA, June 2006.

1.3 Scope of Works

All works were undertaken in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (1999)*, highest industrial standards and Coffey Environments' standard work practices. Prior to work being completed, the South Australian Environmental Protection Authority Guidelines Environmental Management of Foundries, September, 2003 were reviewed.

The following work was completed:

- Collection of five stormwater samples (1 to 5) from the run-off in the western portion of the site and the existing stormwater retention pond along the eastern boundary. Sampling locations were selected based upon a balance of feasibility, given the limited rainfall and in an attempt to characterise the different areas of the site. Samples were specifically collected from the two locations where samples had been collected in the past at the site, to allow a degree of comparison;
- Analysis of these samples for a broad contaminant screen, which comprises a metals screen, cyanide, fluoride, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic hydrocarbons (PAH), organochloric pesticides (OCP), organophosphorous compounds (OPP), polychlorinated biphenyls (PCB), total phenols, halogenated volatiles (VHCs) and pH; and
- Documentation of all field work and development of this summary report.

2 BACKGROUND INFORMATION

The Bradken site is approximately 50,000 square metres in size. Approximately half of the site is built up or covered with an impervious surface, such as asphalt or concrete. Currently a portion of stormwater run-off is directed to an approximately 700 cubic metre retention pond along the eastern boundary of the site. This retention pond is designed to allow infiltration of the collected stormwater into the underlying shallow unconfined groundwater aquifer. The remaining stormwater run-off, largely from the western portion of the site, currently discharges to the roadside stormwater drains through a network of stormwater drains.

Figure 1 presents the site layout, along with the approximate location of the stormwater management infrastructure within the site.

Stormwater sampling was completed at the Bradken site in 1999, 2000, 2001, 2002 and 2005. Review of these laboratory reports indicates that in each year, two samples were collected. One from the eastern stormwater detention pond and one from the south-west sump, located prior to the discharge point from the site.

In 2005, aluminium and zinc were noted in samples at concentrations above the adopted IL, which are described in Section 6 of this report. Total petroleum hydrocarbons (TPH) C_{10} –C_{36} was noted in one sample and phenols were noted above the IL in the other sample.

Based upon stormwater sampling completed at the site to date by Bradken, the potential contaminants of concern are: aluminium, iron, zinc, lead, phenols, ammonia, oil and grease and TPH. These contaminants are all consistent with the current use of the site as a foundry.

It should be noted that some of the laboratory Limit of Reporting (LOR) for selected analytes exceeded the applicable IL, thus limiting the value of some of these conclusions.

The findings of stormwater sampling completed at the site have been incorporated into the design of the current scope of work.

2.1 Summary of Field Investigation

Samples were collected from the following locations:

- Sample 1 Southern portion of stormwater retention pond;
- Sample 2 Northern portion of the stormwater retention pond;
- Sample 3 Main stormwater discharge sump along western boundary;
- Sample 4 Stormwater sump between the After Cast Area and the Core Bay; and
- Sample 5 Eastern downspout of the Machining Shop.

The sampling locations are presented in Figure 1. Field Data Summary Sheets are presented in Appendix C.

The field activities conducted at the site are summarised in the following table.

Activity	Details
Date and Conditions of Field Investigation	14 July 2006 after a period of limited rainfall. This work was completed in the afternoon after two short periods of rainfall in the morning. Total rainfall for the 14 July was 0.4millimetres, measured at Kent Town, approximately 8 kilometres to the south of the site, according to the Australian Government, Bureau of Meteorology (refer Appendix A).
Sampling Method	Disposable bailers were used to obtain samples from all sampling locations that could not be accessed directly. Samples were collected directly into sampling containers where possible.
Sampling Completed	Collection of five stormwater samples and submission of samples to Amdel Environmental Laboratories, Cardiff NSW, a NATA Accredited Laboratory.
Decontamination Procedure	A disposable bailer was used at sampling locations, where samples could not be collected directly into the sample containers. As such, no decontamination was required during this project.
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 laboratory.

3 ADOPTED INVESTIGATION LEVELS

The adopted investigation levels (IL) for stormwater at the Bradken site are:

- South Australia Environment Protection Authority SA EPA (2003) *Environmental Protection (Water Quality) Policy*, Water Quality Criteria for Inland surface waters (being the most sensitive criteria for the Aquatic ecosystem (fresh), Recreation and aesthetics, Potable, Agriculture/aquaculture and Industrial protected environmental values;
- This criteria was chosen because there are no specific license conditions or policy provisions relating to stormwater at the Bradken site and any stormwater discharge will be to the onsite stormwater pond or the Port Adelaide Enfield Council stormwater system; and
- In addition, it is suggested that the *Environmental Protection (Water Quality) Policy*, Water Quality Criteria for Aquatic ecosystem (fresh) is the most practically appropriate set of criteria for the Bradken stormwater discharges to be compared against, given that the stormwater ultimately discharges to aquatic ecosystem environments that are not used for potable water supplies or agriculture/aquaculture. As such, a comparison of analytical results has also been made against these criteria.

4 SUMMARY OF ANALYTICAL FINDINGS

The following section summarizes the analytical findings for the sampling and analysis completed for this project. Selected results, along with a comparison to the adopted Investigation Level (IL) or potentially applicable criteria are presented in Table 1. Laboratory Reports and Chain of Custody (COC) documentation is provided in Appendix C.

When the results are compared against the adopted IL, copper, chromium, lead, manganese, molybdenum, nickel and zinc exceeded the adopted IL in at least one sample.

- Copper, lead, manganese, molybdenum and zinc were detected above the adopted IL in all samples.
- Copper detections ranged from 0.022 milligrams per litre (mg/L) to 0.089 mg/L, compared to the adopted IL of 0.01 mg/L.
- Lead concentrations ranged from 0.025 mg/L to 0.114 mg/L, compared to the adopted IL of 0.005 mg/L.
- Manganese concentrations ranged from 0.378 mg/L to 1.441 mg/L, compared to the adopted IL of 0.1 mg/L.
- Molybdenum concentrations ranged from 0.013 mg/L to 0.438 mg/L, compared to the adopted IL of 0.01 mg/L.
- Zinc concentrations ranged from 0.39 mg/L to 4.63 mg/L, compared to the adopted IL of 0.005 mg/L.
- Chromium was detected in four of the five samples at concentrations ranging from 0.025 mg/L to 0.085mg/L, compared to the adopted IL of 0.02 mg/L.
- Nickel was detected in two of the five samples at concentrations ranging from 0.031 mg/L to 0.032 mg/L, compared to the adopted IL of 0.02 mg/L.
- When the results are compared against the criteria in the Water Quality Policy for Aquatic ecosystems, copper, lead and zinc was noted to be above this criteria in all samples.

5 QUALITY ASSURANCE RESULTS

Certified laboratory reports for chemical analysis, laboratory quality assurance and quality control (QA/QC), including chain of custody and analysis request documentation have been provided to Bradken and are also provided in Appendix C.

Laboratory 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:

- E275993 Surrogate recovery for Benzo (b) & (k) fluroanthene fell outside the laboratory guideline limits; and
- E275993 Surrogate recovery for 1.1-Dicholorethane fell outside the laboratory guideline limits.

Benzo (b) & (k) fluroanthene and 1.1-Dicholorethane were not detected in any primary sample above the LOR. This low percentage of spike recovery is not expected to influence the conclusions of this report.

Results for one QA trip blank sample (QC1) are considered to be acceptable. No analytes were detected above the laboratory LOR in the trip blank.

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.

6 SUMMARY AND CONCLUSIONS

Stormwater sampling was completed at the Bradken site on 14 July 2006 from 5 locations, including the retention pond and the stormwater drainage system within the site. Sample 1 and Sample 2 were collected from locations consistent with previous eastern detention pond samples. Sample 3 is collected from a location consistent with the south west sump sample. The other samples were from within the manufacturing area of the site.

The stormwater sampling took place after limited rainfall, during a period of below average rainfall in the Adelaide Metropolitan region. Based upon information from the Australian Government, Bureau of Meteorology, rainfall in July was 34.2 millimetres, less than fifty percent of the average of 76.5 millimetres. It should be noted that the meteorological data used in this report was for Kent Town, almost 8 kilometres to the south of Kilburn, which was the best available data. Meteorology information provided by the Bureau of Meteorology is presented in Appendix B.

Analytes detected in samples were generally consistent with the use of the site as a foundry. Copper, lead, manganese, molybdenum and zinc were detected above the adopted IL in all samples. Chromium was detected in four of five samples above the adopted IL and nickel was detected in two of five samples above the adopted IL. Although the Water Quality Policy does not specify criteria for TPH, it should be noted that TPH was identified at one location.

Only copper, lead and zinc levels were noted to be above the Aquatic Ecosystem criteria. This is consistent with the historical detection of lead and zinc in stormwater samples previously collected at the site. There were no other significant findings relating to the quality of stormwater sampled and analysed during this sampling event.

7 DISCUSSION AND RECOMMENDATIONS

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

The sampling of stormwater at the site has previously been intermittent and limited to annual sampling at two locations for an inconsistent range of analysis. It is recommended that a stormwater management plan be developed by Bradken and implemented on a consistent basis. The stormwater management plan should address: sampling frequency, sampling locations and range of analysis to be completed and reported. In addition, the discharge standards, if any that Bradken must meet will need to be clarified. The plan must address any changes to the site from the proposed upgrade.

It should be noted that the use of the SA EPA (2003) *Environmental Protection (Water Quality) Policy, Water Quality Criteria, for Inland surface waters* as an adopted IL, should be considered as a screening criteria and may not be appropriate to the specific conditions at the Bradken site. These standards are appropriate for the evaluation of discharge directly into a water body used as a potable water supply or for aquaculture purposes. This is not the case at the Bradken site.

All stormwater from the site is contained within a stormwater detention basin or discharged to a council stormwater system, where it is commingled with other flows (diluted) prior to ultimate discharge to an aquatic ecosystem. It is recommended that this information be taken into consideration in the development of a stormwater management plan and appropriate contaminant discharge levels for the Bradken site.

It was noted during the field investigation that at the location, where TPH was detected in the stormwater sump (Sample 3), along the western boundary, stormwater from this area flowed directly into this sump. This is a section of the site where trucks park and associated spills or leaks could be the source of the identified TPH. It is recommended that this issue be addressed by Bradken through some form of site management.

In the retention basin, the elevation of surface water was approximately one metre above that of groundwater. This finding was based on field surveying of the elevation of the surface water, during the groundwater sampling completed in July as part of work for the PER and reported under separate cover. This suggests storage of surface water within the subsurface and localised mounding of surface water in this area. This information should be taken into consideration during the development of management options for stormwater at the site.

It was noted during sampling that the stormwater reticulation system had a build up of sediments in the sampling locations, particularly the catch basins. These sediments could be a source of potential contaminants to stormwater, prior to discharge from the site. It is recommended that regular housekeeping be scheduled to minimise the build up of sediments in the stormwater reticulation system.

All conclusions, findings and recommendations presented in this report are subject to the Coffey Environments, Statement of Limitations, which is attached.

8 STATEMENT OF LIMITATIONS

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

coffey environments
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.

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.

72510 / 07-06

Tables

Stormwater Quality Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

Table 1

Summary of Results of Stormwater Sampling Above Adopted Investigation Levels

Bradken Resources, July 14 2006

Analyte	**Adopted Investigation Level, Based on SA EPA Water Quality Policy Criteria (mg/l)**	**Sample 1 (mg/L)**	**Sample 2 (mg/L)**	**Sample 3 (mg/L)**	**Sample 4 (mg/L)**	**Sample 5 (mg/L)**	**Freshwater Aquatic ecosystem criteria (mg/L)**
Chromium	0.02	**0.025**	**0.039**	0.018	**0.032**	**0.085**	NA
Lead	0.005	**0.027**	**0.082**	**0.030**	**0.025**	**0.114**	0.005
Molybdenum	0.01	**0.026**	**0.013**	**0.102**	**0.438**	**0.054**	NA
Nickel	0.02	0.011	**0.032**	0.009	0.008	**0.031**	0.15
Zinc	0.005	**0.050**	**1.06**	**1.38**	**0.30**	**4.63**	0.05
Manganese	0.1	**0.513**	**1.010**	**0.521**	**0.378**	**1.441**	NA
Copper	0.01	**0.027**	**0.089**	**0.022**	**0.024**	**0.071**	0.01

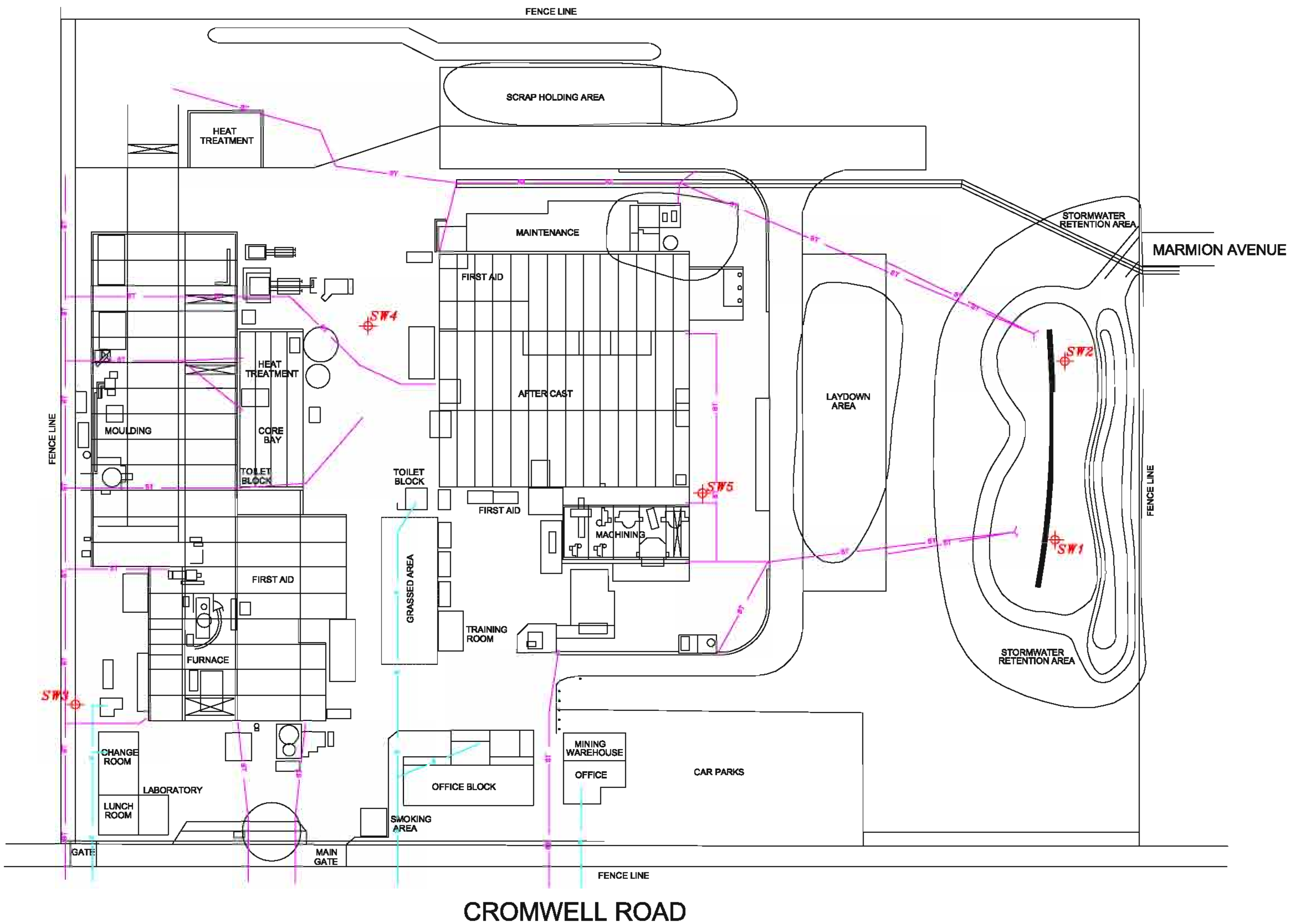
Notes:
The most protective water quality criteria has been selected as an adopted IL.
The Aquatic Ecosystem criteria has been included for reference as the most relevant criteria for stormwater.
Only analytes with detections in excess of the adopted IL have been included in this table.

Mg/L – milligrams per litre
NA - Not Applicable

Figures

Stormwater Quality Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

A3



LEGEND

- STORMWATER
- SEWER
- SW STORMWATER SAMPLING LOCATIONS

N

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

NOTE:
ALL LOCATIONS ARE APPROXIMATE.
DIMENSIONS IN METRES.

Coffey Environments Pty Ltd ©

Rev	Date	Revision Details	Drn
A	01.08.06	ESA ISSUE	GR

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES
27 Queen Street
Thebarton SA 5031
Ph: (08) 8443 5600
Fax: (08) 8443 8499

Client:
BRADKEN RESOURCES

Project:
BRADKEN STORMWATER SAMPLING

Location:
CROMWELL ROAD
KILBURN, SOUTH AUSTRALIA

Drawing Title:

STORMWATER SAMPLING LOCATIONS (14 JULY 2006)

Drawn GR	Signed	Date 01.08.06
Checked	Signed	Date

Project - Drawing No.	Figure No.	Rev.
J505076A-D01	1	A

THIS IS ONE INTERPRETATION ONLY
OTHER INTERPRETATIONS ARE POSSIBLE.

Appendix A
References

Stormwater Quality Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

REFERENCES

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

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Appendix B
Meteorology Information

Stormwater Quality Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

Adelaide, South Australia
July 2006 Daily Weather Observations

Observations are from Kent Town, about 2 km east of the city centre.

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Sa	11.6	12.7	2.4	0.2	0.0	NW	46	13:00	12.0	82	7	NNW	22	1012.6	12.0	91	7	NW	11	1011.7
2	Su	4.5	13.9	8.4	4.0	4.8	SE	28	11:18	8.6	95	4		Calm	1023.5	13.6	56	6	S	13	1022.9
3	Mo	4.3	14.0	0	0.8	4.8	SSW	20	14:39	7.7	88	1		Calm	1028.5	13.2	65	7	SW	13	1026.4
4	Tu	3.1	14.9	0	0.4	8.4	N	31	12:39	9.1	73	6	NNE	9	1027.4	14.5	60	1	NNW	13	1025.5
5	We	6.4	16.9	0	0.8	5.6	W	30	15:26	11.2	60	0	NNE	11	1028.8	16.4	57	7	NW	19	1026.8
6	Th	9.9	16.0	0.6	1.0	8.2	WSW	28	12:23	12.0	92	1		Calm	1031.9	14.4	55	4	W	20	1031.4
7	Fr	7.5	14.4	0	1.4		WSW	31	13:54	10.8	70	8	NNE	6	1032.4	12.8	71	7	WSW	13	1030.6
8	Sa	9.5	13.4	2.2	1.0		NW	28	13:46	10.4	83	7	NNE	11	1029.5	13.3	66		NW	17	1025.8
9	Su	7.2	15.4	0	1.2	8.2				9.4	62	4	N	17	1020.8	15.2	43	5	N	26	1015.1
10	Mo	9.2	18.8	0	2.2	1.0	N	39	05:36	12.6	39	6	N	17	1012.1	17.2	37	7	NNW	9	1007.3
11	Tu	9.3	16.2	5.4	1.0	2.8	SE	43	19:19	10.5	97	3	NNE	9	1015.1	13.8	68	7	SSW	6	1015.8
12	We	7.4	13.2	1.0	1.4	8.1	SSE	30	02:41	9.8	58	0	ESE	9	1026.5	11.9	46	6	SSE	15	1026.0
13	Th	3.0	14.3	0	1.8	6.0	ENE	31	10:06	9.5	66	7	NE	6	1029.2	13.5	49	7	ENE	17	1023.8
14	Fr	9.5	12.0	0.4	1.4	0.0	E	46	05:08	11.1	56	8	NE	4	1017.1	10.8	57	8	ESE	11	1011.5
15	Sa	7.8	12.8	0.8	0.8		SSW	44	05:13	10.0	90	8	SW	13	1011.2	11.7	89	8	S	13	1011.2
16	Su	9.9	13.4	3.2	0.0		SSW	44	13:21	11.3	85	6	SSW	15	1019.3	11.4	90		SSW	17	1018.3
17	Mo	11.0	15.2	5.6	1.8	5.4	SSE	57	15:33	12.1	89	5	S	13	1024.1	14.4	66	7	S	19	1024.2
18	Tu	8.0	14.5	0	1.8	4.2	SSE	39	13:30	11.0	66	7	SSW	4	1031.0	13.8	57	6	SSE	13	1029.8
19	We	5.8	15.5	0		7.3	SE	24	00:35	7.6	81	0	ESE	7	1033.0	14.8	53		S	9	1030.0
20	Th	2.2	14.4	0	3.0	9.4	ENE	26	11:01	8.7	66	0	ENE	13	1031.3	13.8	49	2	NE	11	1027.7
21	Fr	7.4	15.2	0	0.8	2.3	NNE	35	13:50	11.7	48	7	NE	13	1029.5	14.7	38	2	NNE	17	1026.5
22	Sa	5.9	17.0	0	1.6	2.2	N	17	13:40	10.0	72	7	N	7	1025.9	16.6	35		N	7	1022.6
23	Su	9.8	16.8	0.6	1.0	2.9	SW	22	16:20	11.2	87	6	SE	4	1023.2	15.9	55	3	N	6	1027.3

24	Mo	8.6	17.1	0	0.6	7.7	SE	26	13:35	11.8	76	4		Calm	1027.1	16.4	48	2	ENE	9	1024.2
25	Tu	5.0	17.0	0	1.8		NE	24	11:03	8.5	83	7		Calm	1027.1	15.8	47	7	NNE	11	1025.0
26	We	5.0	18.5	0	1.0	9.7	WNW	26	12:41	11.3	67	2		Calm	1027.3	18.0	30	1	WNW	11	1024.3
27	Th	6.7	18.1	0	1.4	4.6	NW	35	14:06	12.3	53	6	NNE	11	1021.6	16.6	41	6	NW	15	1017.4
28	Fr	11.4	18.0	0	1.8		N	50	15:18	14.1	44	6	NNE	20	1012.3	17.7	33	5	NNW	24	1007.3
29	Sa	9.3	14.3	1.4		2.5	WNW	44	12:31	11.5	81		NW	19	1016.6	12.1	79		W	13	1017.4
30	Su	8.4	16.1	0.6	1.2	3.2	NW	44	13:29	9.7	88	8	N	13	1020.1	14.5	67	7	WNW	24	1017.6
31	Mo	8.5	15.1	3.4	0.6	8.5	SW	33	13:38	11.6	71	2	SSW	7	1022.1	14.5	45	3	SW	13	1021.4
Statistics for July 2006																					
Mean		7.5	15.3		1.3	5.1				10.6	73	4		9	1023.8	14.4	56	5		14	1021.7
Lowest		2.2	12.0	0	0.0	0.0				7.6	39	0		Calm	1011.2	10.8	30	1	#	6	1007.3
Highest		11.6	18.8	8.4	4.0	9.7	SSE	57		14.1	97	8	NNW	22	1033.0	18.0	91	8	N	26	1031.4
Total				36.0	37.8	127.8															

IDCJDW5002.200607 Prepared at 13:28 GMT on Monday 14 August 2006

Source of data

Observations were drawn from Adelaide (Kent Town) {station 023090}.

Kent Town is a suburban site with good exposure. Climate averages are available for West Terrace as well as Kent Town.

You should read the **important information** in these notes.

Other formats

To **print** this page, get the PDF version (one page, 45 kb).

To use this page in a **spreadsheet**, get the plain text version (4 kb).

Other times and other places

The **last 13 months** of Daily Weather Observations for Adelaide, South Australia are also here on this web site:

Aug 06 Jul 06 Jun 06 May 06 Apr 06 Mar 06 Feb 06 Jan 06
Dec 05 Nov 05 Oct 05 Sep 05 Aug 05

Daily Weather Observations are also routinely prepared for hundreds of **other locations** in South Australia and across Australia. To get other months or places not on this web site, contact us.

Climate statistics

If you are after **long-term averages** relevant to Adelaide, South Australia, look at the tables for Adelaide (Kent Town) or Adelaide West Terrace.

Maps and tables of average conditions for locations across Australia are also available.

More information

If you are using these pages, you are deemed to have understood the **important information** in these notes. They cover how the data are obtained, how they are processed, and what each column means.

If you have **any questions** about this product, or you want any other weather or climate information, please contact us.

Appendix C
Laboratory Reports & Chain of Custody Documentation

Stormwater Quality Assessment
Bradken Kilburn Foundry
Cromwell Road, Kilburn, SA

amdel

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CERTIFICATE OF ANALYSIS

Contents :

Report No.	:	6E2277
Attention	:	Mr Colin Campbell
Client	:	Coffey Environments
	:	27 Queen Street
	:	THEBARTON
Samples	:	6
Reference/Order	:	J505076A/41431
Project	:	BRADKENFOUNDRY
Received Samples	:	18/07/06
Instructions	:	18/07/06
Date Reported	:	31/07/06

PLEASE SEE FOLLOWING PAGES FOR METHOD LISTING AND RESULTS

RESULTS

All samples were analysed as received. This report relates specifically to the samples as received. Results relate to the source material only to the extent that the samples as supplied are truly representative of the sample source. This report replaces any preliminary results issued. Note that for methods indicated with "#", NATA accreditation does not cover the performance of this service. Three significant figures (or 2 for < 10PQL) are reported for statistical purposes only. Where "Total" concentrations are reported for organic suites of compounds this is the summation of the individual compounds and the PQL is noted for reporting purposes only. This report has been authorized by the NATA signatories listed in the method descriptions section on the following page.

Anthony Crane

Anthony Crane
Operations Manager

Report No. : 6E2277 Cover Page 2

Please note: Where samples are collected/submitted over several days, the date on which the last samples were analysed or extracted is reported.
Unless Ferrous Iron is determined on site, the possibility of a ferrous-ferric ratio change may occur.

Method	Description	Extracted	Analysed	Authorised	
E0230	TPH C6-C9 by purge and trap	19/07/06	21/07/06	GTO	094
E0221F	TPH (C10-C36)	20/07/06	27/07/06	GTO	095
E0010	BTEX in Water	19/07/06	21/07/06	GTO	094
E4970	Total Metals by ICP-MS	21/07/06	21/07/06	APO	093
E4950	Mercury	20/07/06	20/07/06	APO	093
E0110	Polycyclic Aromatic Hydrocarbons	20/07/06	21/07/06	WME	095
E0142	Total Phenolics	21/07/06	21/07/06	AGR	101
E0270	Volatile Halogenated Compounds (P+T)	19/07/06	19/07/06	GTO	094
E0081	Organochlorine Pesticides and Total PCBs	20/07/06	24/07/06	WME	095
E2600	pH	20/07/06	20/07/06	AGR	101
E2450	Total Cyanide	19/07/06	19/07/06	AGR	101
E2500	Fluoride	24/07/06	24/07/06	DBL	101
E4820	Ferrous Iron	19/06/06	19/06/06	AGR	101
E0090	Organophosphorus Pesticides	20/07/06	24/07/06	WME	095
E2200	Anions by IC	25/07/06	25/07/06	DBL	101

NATA Signatories
(AGR) Alison Graham, (DBL) Dianne Blane, (DLU) Darrel Luck, (GTO) Greg Towers,
(MAV) Merrin Avery, (NCO) Nathan Cooper, (WME) Melanie Wade, (LSC) Lachlan Schwarz
(LSC) Laura Schofield, (APO) Annette Poulton

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E0230 TPH in Water by P&T/GC-MS (ug/L)						
C6-C9 Fraction	20	nd	nd	nd	nd	nd
E0221 TPH in Water (ug/L)						
C10-C14 Fraction	20	nd	nd	720	nd	nd
C15-C28 Fraction	100	nd	nd	1360	nd	nd
C29-C36 Fraction	100	nd	nd	715	nd	nd
E0010 BTEX (P&T) in Water (ug/L)						
Benzene	0.5	nd	nd	nd	nd	nd
Toluene	1	nd	nd	nd	nd	nd
Ethylbenzene	1	nd	nd	nd	nd	nd
m&p-Xylene	2	nd	nd	nd	nd	nd
o-Xylene	1	nd	nd	nd	nd	nd
4-Bromofluorobenzene-SURROGATE	1	71%	90%	112%	88%	89%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275998				
		QC1				
	Sample Id	14.7.06				
	PQL					
E0230 TPH in Water by P&T/GC-MS (ug/L)						
C6-C9 Fraction	20	nd				
E0221 TPH in Water (ug/L)						
C10-C14 Fraction	20	nd				
C15-C28 Fraction	100	nd				
C29-C36 Fraction	100	nd				
E0010 BTEX (P&T) in Water (ug/L)						
Benzene	0.5	nd				
Toluene	1	nd				
Ethylbenzene	1	nd				
m&p-Xylene	2	nd				
o-Xylene	1	nd				
4-Bromofluorobenzene-SURROGATE	1	87%				

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E4970 Total Recoverable Metals in Waters						
Arsenic	0.002	0.003	0.004	0.004	0.005	0.003
Cadmium	0.0005	nd	0.0005	nd	nd	0.0005
Chromium	0.005	0.025	0.039	0.018	0.032	0.085
Cobalt	0.005	nd	0.008	nd	nd	nd
Lead	0.002	0.027	0.082	0.030	0.025	0.114
Molybdenum	0.005	0.026	0.013	0.102	0.438	0.054
Nickel	0.005	0.011	0.032	0.009	0.008	0.031
Tin	0.010	nd	nd	nd	nd	nd
Selenium	0.005	nd	nd	nd	nd	nd
Zinc	0.010	0.50	1.06	1.38	0.39	4.63
Manganese	0.005	0.513	1.010	0.521	0.378	1.441
Antimony	0.010	nd	nd	nd	nd	nd
Beryllium	0.002	nd	nd	nd	nd	nd
Barium	0.005	0.049	0.179	0.054	0.026	0.045
Boron	0.010	0.05	0.07	0.06	0.11	0.04
Copper	0.005	0.027	0.089	0.022	0.024	0.071
E4950 Total Recoverable Mercury in Water						
Mercury	0.001	nd	nd	nd	nd	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275998				
		QC1				
	Sample Id	14.7.06				
	PQL					
E4970 Total Recoverable Metals in Waters						
Arsenic	0.002	nd				
Cadmium	0.0005	nd				
Chromium	0.005	nd				
Cobalt	0.005	nd				
Lead	0.002	nd				
Molybdenum	0.005	nd				
Nickel	0.005	nd				
Tin	0.010	nd				
Selenium	0.005	nd				
Zinc	0.010	nd				
Manganese	0.005	nd				
Antimony	0.010	nd				
Beryllium	0.002	nd				
Barium	0.005	nd				
Boron	0.010	nd				
Copper	0.005	nd				
E4950 Total Recoverable Mercury in Water						
Mercury	0.001	--				

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E0110 Priority PAH's in Water (ug/L)						
Naphthalene	1	nd	nd	nd	nd	nd
Acenaphthylene	1	nd	nd	nd	nd	nd
Acenaphthene	1	nd	nd	nd	nd	nd
Fluorene	1	nd	nd	nd	nd	nd
Phenanthrene	1	nd	nd	nd	nd	nd
Anthracene	1	nd	nd	nd	nd	nd
Fluoranthene	1	nd	nd	nd	nd	nd
Pyrene	1	nd	nd	nd	nd	nd
Benz(a)anthracene	1	nd	nd	nd	nd	nd
Chrysene	1	nd	nd	nd	nd	nd
Benzo(b) & (k)fluoranthene	2	nd	nd	nd	nd	nd
Benzo(a)pyrene	1	nd	nd	nd	nd	nd
Indeno(1.2.3-cd)pyrene	1	nd	nd	nd	nd	nd
Dibenz(a.h)anthracene	1	nd	nd	nd	nd	nd
Benzo(g.h.i)perylene	1	nd	nd	nd	nd	nd
Total USEPA Priority PAHs	1	nd	nd	nd	nd	nd
2-Fluorobiphenyl-SURROGATE	1	75%	71%	73%	79%	71%
Anthracene-D10-SURROGATE	1	80%	71%	71%	84%	79%
p-Terphenyl-D14-SURROGATE	1	78%	70%	75%	83%	80%
E0142 T.Phenolics as Phenol in Water(mg/L)						
Total Phenolics	0.02	nd	0.02	0.04	nd	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277
Client : Coffey Environments
Reference : J505076A/41431
Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E0270 VHCs in Water (ug/L)						
Vinyl chloride	5	nd	nd	nd	nd	nd
Chloroethane	5	nd	nd	nd	nd	nd
Trichlorofluoromethane	5	nd	nd	nd	nd	nd
1.1-Dichloroethene	5	nd	nd	nd	nd	nd
Methylene chloride	10	nd	nd	nd	nd	nd
trans-1.2-Dichloroethene	5	nd	nd	nd	nd	nd
1.1-Dichloroethane	5	nd	nd	nd	nd	nd
cis-1.2-Dichloroethene	5	nd	nd	nd	nd	nd
Chloroform	10	nd	nd	nd	nd	nd
1.1.1-Trichloroethane	5	nd	nd	nd	nd	nd
Carbon tetrachloride	5	nd	nd	nd	nd	nd
1.2-Dichloroethane	5	nd	nd	nd	nd	nd
Trichloroethene	5	nd	nd	nd	nd	nd
1.2-Dichloropropane	5	nd	nd	nd	nd	nd
Bromodichloromethane	5	nd	nd	nd	nd	nd
trans-1.3-Dichloropropylene	5	nd	nd	nd	nd	nd
cis-1.3-Dichloropropylene	5	nd	nd	nd	nd	nd
1.1.2-Trichloroethane	5	nd	nd	nd	nd	nd
Tetrachloroethene	5	nd	nd	nd	nd	nd
Dibromochloromethane	5	nd	nd	nd	nd	nd
Chlorobenzene	5	nd	nd	nd	nd	nd
Bromoform	5	nd	nd	nd	nd	nd
1.1.2.2-Tetrachloroethane	5	nd	nd	nd	nd	nd
1.3-Dichlorobenzene	5	nd	nd	nd	nd	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
1.4-Dichlorobenzene	5	nd	nd	nd	nd	nd
1.2-Dichlorobenzene	5	nd	nd	nd	nd	nd
1.1.1.2-Tetrachloroethane	5	nd	nd	nd	nd	nd
1.2.3-Trichlorobenzene	5	nd	nd	nd	nd	nd
1.2.4-Trichlorobenzene	5	nd	nd	nd	nd	nd
1.3-Dichloropropane	5	nd	nd	nd	nd	nd
2-Chlorotoluene	5	nd	nd	nd	nd	nd
4-Chlorotoluene	5	nd	nd	nd	nd	nd
Bromochloromethane	5	nd	nd	nd	nd	nd
Dibromomethane	5	nd	nd	nd	nd	nd
Hexachlorobutadiene	5	nd	nd	nd	nd	nd
Pentafluorobenzene-SURROGATE	1	95%	96%	94%	94%	94%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E0081 OC's & Total PCB's in Water (ug/L)						
HCB	1	nd	nd	nd	nd	nd
a-BHC	1	nd	nd	nd	nd	nd
g-BHC	1	nd	nd	nd	nd	nd
Heptachlor	1	nd	nd	nd	nd	nd
Aldrin	1	nd	nd	nd	nd	nd
b-BHC	1	nd	nd	nd	nd	nd
d-BHC	1	nd	nd	nd	nd	nd
Oxychlordane	1	nd	nd	nd	nd	nd
Heptachlor epoxide	1	nd	nd	nd	nd	nd
Endosulfan 1	1	nd	nd	nd	nd	nd
Chlordane-Trans	1	nd	nd	nd	nd	nd
Chlordane-Cis	1	nd	nd	nd	nd	nd
trans-Nonachlor	1	nd	nd	nd	nd	nd
DDE	1	nd	nd	nd	nd	nd
Dieldrin	1	nd	nd	nd	nd	nd
Endrin	1	nd	nd	nd	nd	nd
DDD	1	nd	nd	nd	nd	nd
Endosulfan 2	1	nd	nd	nd	nd	nd
DDT	1	nd	nd	nd	nd	nd
Endosulfan sulfate	1	nd	nd	nd	nd	nd
Methoxychlor	1	nd	nd	nd	nd	nd
Endrin Aldehyde	1	nd	nd	nd	nd	nd
Endrin Ketone	1	nd	nd	nd	nd	nd
Total Polychlorinated biphenyl	10	nd	nd	nd	nd	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = <PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

Job Number : 6E2277
Client : Coffey Environments
Reference : J505076A/41431
Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
2.4.5.6-TCMX-SURROGATE	1	92%	79%	80%	86%	91%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

Analyte	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E0090 OP Pesticides in Water (ug/L)						
Dichlorvos	10	nd	nd	nd	nd	nd
Mevinphos	10	nd	nd	nd	nd	nd
Ethoprop	10	nd	nd	nd	nd	nd
Phorate	10	nd	nd	nd	nd	nd
Demeton-s-methyl	10	nd	nd	nd	nd	nd
Diazinon	10	nd	nd	nd	nd	nd
Disulfoton	10	nd	nd	nd	nd	nd
Chlorpyrifos methyl	10	nd	nd	nd	nd	nd
Parathion methyl	10	nd	nd	nd	nd	nd
Ronnel	10	nd	nd	nd	nd	nd
Fenitrothion	10	nd	nd	nd	nd	nd
Malathion	10	nd	nd	nd	nd	nd
Fenthion	10	nd	nd	nd	nd	nd
Chlorpyrifos	10	nd	nd	nd	nd	nd
Merphos	10	nd	nd	nd	nd	nd
Stirophos	10	nd	nd	nd	nd	nd
Prothiofos	10	nd	nd	nd	nd	nd
Fensulfothion	10	nd	nd	nd	nd	nd
Ethion	10	nd	nd	nd	nd	nd
Bolstar	10	nd	nd	nd	nd	nd
Azinphos methyl	10	nd	nd	nd	nd	nd
Coumaphos	10	nd	nd	nd	nd	nd
Triphenyl Phosphate -SURROGATE	1	100%	87%	99%	93%	100%

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

Job Number : 6E2277

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

	Lab No	E275993	E275994	E275995	E275996	E275997
		SAMPLE_1	SAMPLE_2	SAMPLE_3	SAMPLE_4	SAMPLE_5
Analyte	Sample Id	14.7.06	14.7.06	14.7.06	14.7.06	14.7.06
	PQL					
E2600 pH in Water						
pH	0.1	7.7	8.0	7.9	8.5	7.6
E2450 Total Cyanide in Water						
Total Cyanide	0.005	nd	nd	nd	nd	nd
E2500 Fluoride in Water						
Fluoride	0.1	2.0	--	--	--	1.6
E4820 Ferrous Iron						
Iron(II)	0.05	nd	nd	0.35	nd	nd

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

amdel

AMDEL INTERNAL QUALITY CONTROL REVIEW.

Job No. 6E2277

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes and Laboratory Control Samples are included in this QC Report where applicable. Additional QC data may be available on request
2. Amdel QC Acceptance / Rejection Criteria is documented in AS-POL-002 and is available on request.
3. Proficiency trial results are available on request.
4. Actual PQLs are matrix dependent. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spike or surrogate recoveries.
6. Test samples duplicated or spiked, are from this job only and are identified in the following QC report.
7. SVOC analyses on waters are performed on homogenized, unfiltered samples, unless noted otherwise.
8. When individual results are qualified in the body of the report, refer to the qualifier descriptions on the following page.

Holding Times

Please refer to 'Sampling and Preservation Chart for Soils & Waters' for holding times. (Amdel from AS-FOR_ADM-020).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgement.
If the laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Chain of Custody and Sample Integrity	Yes/No/NA
Chain of Custody / instructions received with samples	Yes
Custody seals were received intact (if used)	NA
Chain of Custody completed and attached (if applicable)	Yes
Samples were received chilled or chilling in good condition	Yes
Samples received with other preservation appropriate for all tests	Yes
VOC/SVOC samples were received with Teflon lined lids	Yes
Samples received with Zero Headspace (if applicable)	Yes

Please refer to the following pages for the laboratory's Quality Control data.

Additional Comments

Anthony Crane

Anthony Crane
Operations Manager

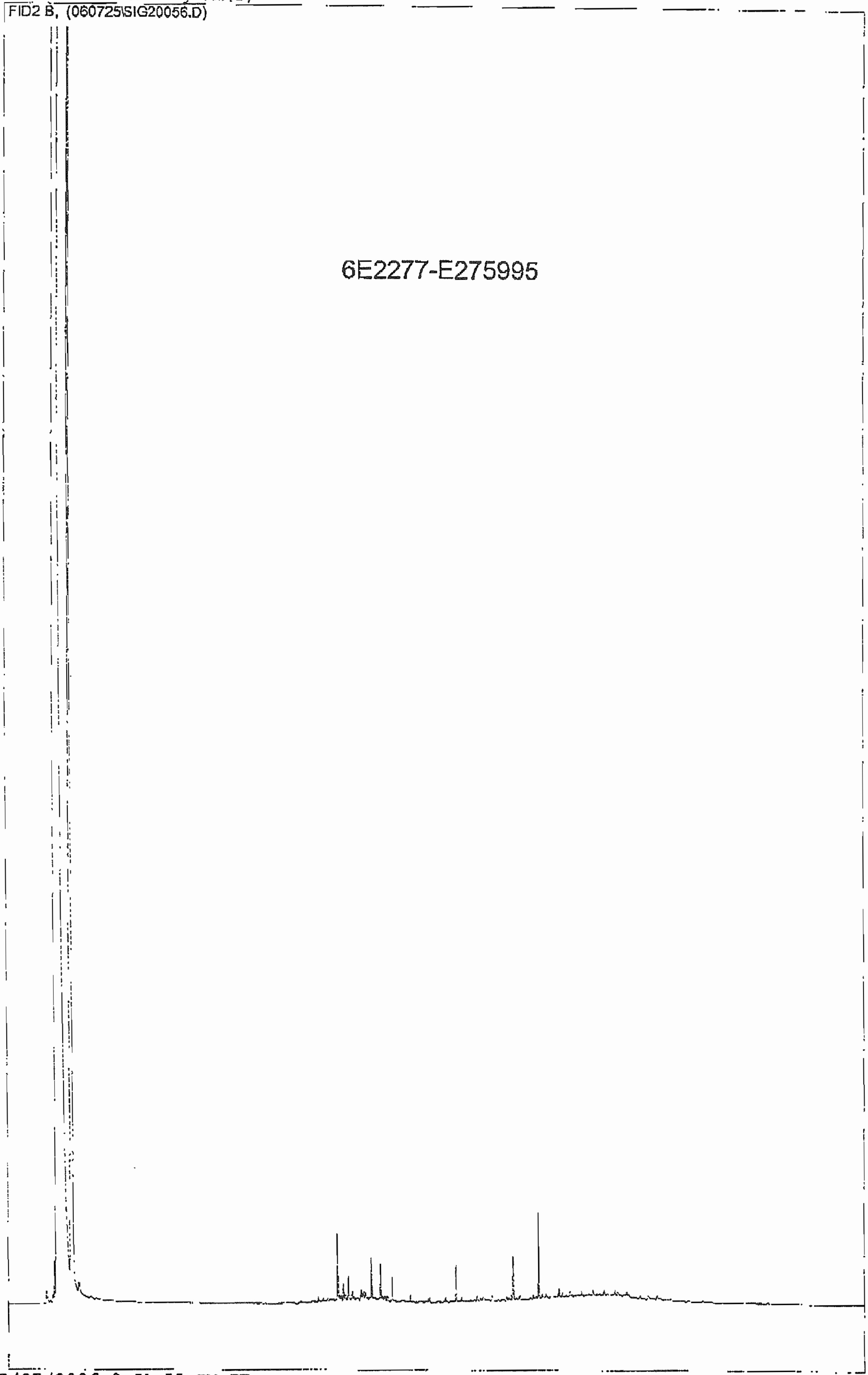
AMDEL STANDARD LABORATORY QUALIFIER CODES.

Job No. 6E2277

Qualifier Codes	Description
*	PQLs are raised due to matrix interference.
@	PQLs are raised due to insufficient sample provided for analysis.
$	The mass imbalance indicates the presence of other ions not measured as part of this procedure.
nd	<PQL
--	Not applicable
LNR	The sample was listed on the COC, but not received.
IS	Insufficient sample was supplied to conduct this analysis.
AN	The analysis indicates the presences of an analyte that has been 'tentatively' identified, and the associated numerical value represents it's approximate concentration.
A	Sample results are reported on an 'as received' basis (not moisture corrected).
B	The sample was not received in a suitable timeframe to allow completion within the recommended holding time.
C	This sample was received with headspace.
D	This sample was received with the incorrect preservation for this analysis.
E	The raw data indicates the absence of 0.055g of Copper Sulphate in the sample.
F	This sample contained significant amounts of solids and was therefore analysed by settling and decanting the aqueous phase to avoid including the solid in the analysis portion.
G	This test was performed outside the recommended holding time.
H	This sample contained significant material >5mm which was removed prior to analysis.
ISD	Insufficient sample was supplied to conduct duplicate analyses.
ISM	Insufficient sample was supplied to conduct matrix spike analyses.
W	The spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
J	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause.
K	The matrix spike concentration is less than five times the background concentration in the sample, and therfore the spike recovery can not be determined.
L	The surrogate recovery is outside of the recommended acceptance criteria, due to matrix interference.
M	The surrogate recovery is outside of the recommended acceptance criteria. Insuffìcent sample remains to perform re-analysis.
N	Results are expressed in mg/L (ppm) due to the high concentration of the analyte.
O	The results reported are 'recoverable organics' for this fraction, as the chromatogram and peak shape indicates the presence of a significant concentration of polar compounds.
P	The concentration reported is mainly due to a single peak.
Q	This samples contains volatile halogenated oxygenated or other compounds that are included and quantitated as part of TPH C6-9.
R	Theoretically the total result should be greater or equal to the dissolved concentration. However the difference reported is within the uncertainty of the individual tests.
S	The mass imbalance was equal to or less than 0.2 milli-equivalents.
T	During Kjeldahl digestion, nitrate (>10mg/L) can oxidise ammonia resulting in a negative TKN interference, which may have occurred for this sample.
U	Theoretically the TKN result should be greater or equal to ammonia concentration. However the difference reported is within the uncertainty of the individual tests.
V	This sample contained significant amounts of sediment which was included in the analysis portion as requested.
SUR	Surrogate recoveries could not be determined due to the dilution required to quantify the analyte.

Last updated: 19 May 2003

Current Chromatogram(s)



CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

41431 LIA

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

Coffey

- [x] 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) 6224 3822 Fax (03) 6224 3677, Suite 6, 221 Macquarie Street, Hobart TAS 7000
- [ ] Melbourne: Tel (03) 9819 0284 Fax (03) 9819 4079, 169 Burwood Road, Hawthorn VIC 3122
- [ ] Perth: Tel (08) 9481 4333 Fax (08) 9481 4122, Level 7, 220 George's Terrace, Perth WA 6000
- [ ] Sydney: Tel: (02) 9502 4844 Fax (02) 9502 2105, 17 Forrester Street, Kingsgrove NSW 2208
- [ ] Other:

Project No: JS05076A   Task No:
Project Name: Bradken Foundry   Laboratory: Andel
Samplers Name: Jess Miller   Project Manager: Colin Campbell
Special Instructions: Broad Contaminant Screen!! Metals and Ferrous Iron Are Not Filtered!!

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) 8M	PAH's	PHENOLS	OC's / OP's	Broad Contaminate	NOTES
6E275993	1	Kilburn	—	14/7	PM	water	5G, 4V, 4P	Std							X	
994	2			↓	↓		↓	↓							X	
995	3														X	
996	4														X	
997	5														X	
998	QC1						2G, 2V, 1P		X	X	X					

RECEIVED 18 JUL 2006

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]	Date: 14/7/06	Signature: [signature]	Date: 18/7/06
Company: Coffey Environments	Time: PM	Company: Andel – Cond. 72	Time: 12:30 pm
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. 6E22277

* **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

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E0230 TPH in Water by P&T/GC-MS (ug/L) (E275996)							
C6-C9 Fraction	200	200		104%			
E0221 TPH in Water (ug/L) (E275993)							
C10-C14 Fraction							
C15-C28 Fraction	5500	6780		123%			
C29-C36 Fraction							
E0010 BTEX (P&T) in Water (ug/L) (E275996)							
Benzene	10	10		102%			
Toluene	10	10		104%			
Ethylbenzene	10	10		100%			
m&p-Xylene	20	22		112%			
o-Xylene	10	11		113%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E0230 TPH in Water by P&T/GC-MS (ug/L)							
C6-C9 Fraction	200	200			104%		
E0221 TPH in Water (ug/L)							
C10-C14 Fraction							
C15-C28 Fraction	5500	6920			126%		
C29-C36 Fraction							
E0010 BTEX (P&T) in Water (ug/L)							
Benzene	10	11			107%		
Toluene	10	11			107%		
Ethylbenzene	10	11			106%		
m&p-Xylene	20	23			116%		
o-Xylene	10	12			117%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = <PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E0230 TPH in Water by P&T/GC-MS (ug/L) (E275995)								
C6-C9 Fraction	nd	nd						
E0221 TPH in Water (ug/L) (E275993)								
C10-C14 Fraction	nd	nd						
C15-C28 Fraction	nd	nd						
C29-C36 Fraction	nd	nd						
E0010 BTEX (P&T) in Water (ug/L) (E275995)								
Benzene	nd	nd						
Toluene	nd	nd						
Ethylbenzene	nd	nd						
m&p-Xylene	nd	nd						
o-Xylene	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

Job Number : 6E2277

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E0230 TPH in Water by P&T/GC-MS (ug/L)						
C6-C9 Fraction	20	nd				
E0221 TPH in Water (ug/L)						
C10-C14 Fraction	20	nd				
C15-C28 Fraction	100	nd				
C29-C36 Fraction	100	nd				
E0010 BTEX (P&T) in Water (ug/L)						
Benzene	0.5	nd				
Toluene	1	nd				
Ethylbenzene	1	nd				
m&p-Xylene	2	nd				
o-Xylene	1	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E4970 Total Recoverable Metals in Waters						
Arsenic	0.002	nd				
Cadmium	0.0005	nd				
Chromium	0.005	nd				
Cobalt	0.005	nd				
Lead	0.002	nd				
Molybdenum	0.005	nd				
Nickel	0.005	nd				
Tin	0.010	nd				
Selenium	0.005	nd				
Zinc	0.010	nd				
Manganese	0.005	nd				
Antimony	0.010	nd				
Beryllium	0.002	nd				
Barium	0.005	nd				
Boron	0.010	nd				
Copper	0.005	nd				
E4950 Total Recoverable Mercury in Water						
Mercury	0.001	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected Spike 1	Level Detected Spike 2	Recovery Details Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E4970 Total Recoverable Metals in Waters	(E275993)						
Arsenic	0.100	0.103		103%			
Cadmium	0.100	0.10		102%			
Chromium	0.100	0.105		105%			
Cobalt	0.100	0.103		103%			
Lead	0.100	0.098		98%			
Molybdenum	0.100	0.088		88%			
Nickel	0.100	0.102		102%			
Tin	0.100	W0.07					
Selenium	0.100	0.111		111%			
Zinc	0.100	K					
Manganese	0.100	0.102		102%			
Antimony	0.100	W0.20					
Beryllium	0.100	0.105		105%			
Barium	0.100	0.106		106%			
Boron	0.100	0.10		101%			
Copper	0.100	0.101		101%			
E4950 Total Recoverable Mercury in Water	(E275993)						
Mercury	0.010	0.011		110%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected Result1	Result2	Result3	Recovery Details Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E4970 Total Recoverable Metals in Waters							
Arsenic	0.100	0.096			96%		
Cadmium	0.100	0.098			98%		
Chromium	0.100	0.099			99%		
Cobalt	0.100	0.097			97%		
Lead	0.100	0.099			99%		
Molybdenum	0.100	0.091			91%		
Nickel	0.100	0.098			98%		
Tin	0.100	0.09			90%		
Selenium	0.100	0.103			103%		
Zinc	0.100	0.10			99%		
Manganese	0.100	0.098			98%		
Antimony	0.100	0.11			107%		
Beryllium	0.100	0.101			101%		
Barium	0.100	0.095			95%		
Boron	0.100	0.10			102%		
Copper	0.100	0.095			95%		
E4950 Total Recoverable Mercury in Water							
Mercury	0.010	0.010			100%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E4970 Total Recoverable Metals in Waters (E275993)								
Arsenic	0.004	0.003	0.004	28%				
Cadmium	nd	nd						
Chromium	0.025	0.025	0.025	0%				
Cobalt	nd	nd						
Lead	0.029	0.027	0.028	7%				
Molybdenum	0.027	0.026	0.027	3%				
Nickel	0.012	0.011	0.012	8%				
Tin	nd	nd						
Selenium	nd	nd						
Zinc	0.55	0.50	0.53	9%				
Manganese	0.530	0.513	0.522	3%				
Antimony	nd	nd						
Beryllium	nd	nd						
Barium	0.052	0.049	0.051	5%				
Boron	0.05	0.05	0.05	0%				
Copper	0.029	0.027	0.028	7%				
E4950 Total Recoverable Mercury in Water (E275993)								
Mercury	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E0110 Priority PAH's in Water (ug/L) (E275995,E275993)							
Naphthalene	10	8		83%			
Acenaphthylene	10	9		89%			
Acenaphthene	10	8		82%			
Fluorene	10	9		86%			
Phenanthrene	10	8		82%			
Anthracene	10	8		83%			
Fluoranthene	10	10		95%			
Pyrene	10	10		95%			
Benz(a)anthracene	10	10		98%			
Chrysene	10	18		180%			
Benzo(b) & (k)fluoranthene	20	11		56%			
Benzo(a)pyrene	10	10		96%			
Indeno(1.2.3-cd)pyrene	10	13		125%			
Dibenz(a.h)anthracene	10	13		129%			
Benzo(g.h.i)perylene	10	12		123%			
E0142 T.Phenolics as Phenol in Water(mg/L) (E275993)							
Total Phenolics	0.2	0.18		93%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E0110 Priority PAH's in Water (ug/L)							
Naphthalene	10	10			97%		
Acenaphthylene	10	10			99%		
Acenaphthene	10	10			99%		
Fluorene	10	10			99%		
Phenanthrene	10	10			99%		
Anthracene	10	10			99%		
Fluoranthene	10	10			100%		
Pyrene	10	10			101%		
Benz(a)anthracene	10	9			95%		
Chrysene	10	10			103%		
Benzo(b) & (k)fluoranthene	20	20			98%		
Benzo(a)pyrene	10	9			86%		
Indeno(1.2.3-cd)pyrene	10	10			100%		
Dibenz(a.h)anthracene	10	10			101%		
Benzo(g.h.i)perylene	10	12			116%		
E0142 T.Phenolics as Phenol in Water(mg/L)							
Total Phenolics	0.2	0.21			106%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = <PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E0110 Priority PAH's in Water (ug/L) (E275993)								
Naphthalene	nd	nd						
Acenaphthylene	nd	nd						
Acenaphthene	nd	nd						
Fluorene	nd	nd						
Phenanthrene	nd	nd						
Anthracene	nd	nd						
Fluoranthene	nd	nd						
Pyrene	nd	nd						
Benz(a)anthracene	nd	nd						
Chrysene	nd	nd						
Benzo(b) & (k)fluoranthene	nd	nd						
Benzo(a)pyrene	nd	nd						
Indeno(1.2.3-cd)pyrene	nd	nd						
Dibenz(a.h)anthracene	nd	nd						
Benzo(g.h.i)perylene	nd	nd						
E0142 T.Phenolics as Phenol in Water(mg/L) (E275993)								
Total Phenolics	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E0110 Priority PAH's in Water (ug/L)						
Naphthalene	1	nd				
Acenaphthylene	1	nd				
Acenaphthene	1	nd				
Fluorene	1	nd				
Phenanthrene	1	nd				
Anthracene	1	nd				
Fluoranthene	1	nd				
Pyrene	1	nd				
Benz(a)anthracene	1	nd				
Chrysene	1	nd				
Benzo(b) & (k)fluoranthene	2	nd				
Benzo(a)pyrene	1	nd				
Indeno(1.2.3-cd)pyrene	1	nd				
Dibenz(a.h)anthracene	1	nd				
Benzo(g.h.i)perylene	1	nd				
E0142 T.Phenolics as Phenol in Water(mg/L)						
Total Phenolics	0.02	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E0270 VHCs in Water (ug/L) (E275993)							
Vinyl chloride							
Chloroethane							
Trichlorofluoromethane							
1.1-Dichloroethene	25	21		85%			
Methylene chloride	25	20		71%			
trans-1.2-Dichloroethene	25	22		87%			
1.1-Dichloroethane	25	17		68%			
cis-1.2-Dichloroethene							
Chloroform	25	20		99%			
1.1.1-Trichloroethane	25	22		88%			
Carbon tetrachloride	25	23		92%			
1.2-Dichloroethane	25	26		102%			
Trichloroethene	25	24		97%			
1.2-Dichloropropane	25	26		102%			
Bromodichloromethane	25	25		102%			
trans-1.3-Dichloropropylene	25	22		87%			
cis-1.3-Dichloropropylene	25	22		90%			
1.1.2-Trichloroethane	25	25		100%			
Tetrachloroethene	25	22		88%			
Dibromochloromethane	25	24		95%			
Chlorobenzene	25	22		88%			
Bromoform	25	24		95%			
1.1.2.2-Tetrachloroethane	25	23		93%			
1.3-Dichlorobenzene	25	20		81%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
1.4-Dichlorobenzene	25	24		96%			
1.2-Dichlorobenzene	25	24		97%			
1.1.1.2-Tetrachloroethane							
1.2.3-Trichlorobenzene							
1.2.4-Trichlorobenzene							
1.3-Dichloropropane							
2-Chlorotoluene							
4-Chlorotoluene							
Bromochloromethane							
Dibromomethane							
Hexachlorobutadiene							

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E0270 VHCs in Water (ug/L)							
Vinyl chloride							
Chloroethane							
Trichlorofluoromethane							
1.1-Dichloroethene	25	22			87%		
Methylene chloride	25	20			92%		
trans-1.2-Dichloroethene	25	22			89%		
1.1-Dichloroethane	25	18			73%		
cis-1.2-Dichloroethene							
Chloroform	25	20			98%		
1.1.1-Trichloroethane	25	22			89%		
Carbon tetrachloride	25	23			90%		
1.2-Dichloroethane	25	25			99%		
Trichloroethene	25	25			98%		
1.2-Dichloropropane	25	26			104%		
Bromodichloromethane	25	25			100%		
trans-1.3-Dichloropropylene	25	23			93%		
cis-1.3-Dichloropropylene	25	24			95%		
1.1.2-Trichloroethane	25	26			103%		
Tetrachloroethene	25	23			93%		
Dibromochloromethane	25	24			98%		
Chlorobenzene	25	23			92%		
Bromoform	25	25			101%		
1.1.2.2-Tetrachloroethane	25	25			98%		
1.3-Dichlorobenzene	25	22			87%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = <PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected Result1	Result2	Result3	Recovery Details Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
1.4-Dichlorobenzene	25	26			103%		
1.2-Dichlorobenzene	25	26			103%		
1.1.1.2-Tetrachloroethane							
1.2.3-Trichlorobenzene							
1.2.4-Trichlorobenzene							
1.3-Dichloropropane							
2-Chlorotoluene							
4-Chlorotoluene							
Bromochloromethane							
Dibromomethane							
Hexachlorobutadiene							

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E0270 VHCs in Water (ug/L) (E275993)								
Vinyl chloride	nd	nd						
Chloroethane	nd	nd						
Trichlorofluoromethane	nd	nd						
1.1-Dichloroethene	nd	nd						
Methylene chloride	nd	nd						
trans-1.2-Dichloroethene	nd	nd						
1.1-Dichloroethane	nd	nd						
cis-1.2-Dichloroethene	nd	nd						
Chloroform	nd	nd						
1.1.1-Trichloroethane	nd	nd						
Carbon tetrachloride	nd	nd						
1.2-Dichloroethane	nd	nd						
Trichloroethene	nd	nd						
1.2-Dichloropropane	nd	nd						
Bromodichloromethane	nd	nd						
trans-1.3-Dichloropropylene	nd	nd						
cis-1.3-Dichloropropylene	nd	nd						
1.1.2-Trichloroethane	nd	nd						
Tetrachloroethene	nd	nd						
Dibromochloromethane	nd	nd						
Chlorobenzene	nd	nd						
Bromoform	nd	nd						
1.1.2.2-Tetrachloroethane	nd	nd						
1.3-Dichlorobenzene	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
1.4-Dichlorobenzene	nd	nd						
1.2-Dichlorobenzene	nd	nd						
1.1.1.2-Tetrachloroethane	nd	nd						
1.2.3-Trichlorobenzene	nd	nd						
1.2.4-Trichlorobenzene	nd	nd						
1.3-Dichloropropane	nd	nd						
2-Chlorotoluene	nd	nd						
4-Chlorotoluene	nd	nd						
Bromochloromethane	nd	nd						
Dibromomethane	nd	nd						
Hexachlorobutadiene	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E0270 VHCs in Water (ug/L)						
Vinyl chloride	5	nd				
Chloroethane	5	nd				
Trichlorofluoromethane	5	nd				
1.1-Dichloroethene	5	nd				
Methylene chloride	10	nd				
trans-1.2-Dichloroethene	5	nd				
1.1-Dichloroethane	5	nd				
cis-1.2-Dichloroethene	5	nd				
Chloroform	10	nd				
1.1.1-Trichloroethane	5	nd				
Carbon tetrachloride	5	nd				
1.2-Dichloroethane	5	nd				
Trichloroethene	5	nd				
1.2-Dichloropropane	5	nd				
Bromodichloromethane	5	nd				
trans-1.3-Dichloropropylene	5	nd				
cis-1.3-Dichloropropylene	5	nd				
1.1.2-Trichloroethane	5	nd				
Tetrachloroethene	5	nd				
Dibromochloromethane	5	nd				
Chlorobenzene	5	nd				
Bromoform	5	nd				
1.1.2.2-Tetrachloroethane	5	nd				
1.3-Dichlorobenzene	5	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
1.4-Dichlorobenzene	5	nd				
1.2-Dichlorobenzene	5	nd				
1.1.1.2-Tetrachloroethane	5	nd				
1.2.3-Trichlorobenzene	5	nd				
1.2.4-Trichlorobenzene	5	nd				
1.3-Dichloropropane	5	nd				
2-Chlorotoluene	5	nd				
4-Chlorotoluene	5	nd				
Bromochloromethane	5	nd				
Dibromomethane	5	nd				
Hexachlorobutadiene	5	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E0081 OC's & Total PCB's in Water (ug/L) (E275997)							
HCB							
a-BHC	10	10		95%			
g-BHC	10	10		95%			
Heptachlor	10	9		89%			
Aldrin	10	9		92%			
b-BHC	10	10		96%			
d-BHC	10	11		105%			
Oxychlordane							
Heptachlor epoxide	10	9		95%			
Endosulfan 1	10	10		96%			
Chlordane-Trans	10	10		98%			
Chlordane-Cis	10	10		98%			
trans-Nonachlor							
DDE	20	20		102%			
Dieldrin	10	10		99%			
Endrin	10	10		100%			
DDD	20	21		107%			
Endosulfan 2	10	10		100%			
DDT	20	22		112%			
Endosulfan sulfate	10	10		104%			
Methoxychlor	10	11		106%			
Endrin Aldehyde							
Endrin Ketone							

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E0081 OC's & Total PCB's in Water (ug/L)							
HCB							
a-BHC	10	9			94%		
g-BHC	10	9			94%		
Heptachlor	10	9			88%		
Aldrin	10	9			91%		
b-BHC	10	9			94%		
d-BHC	10	10			103%		
Oxychlordane							
Heptachlor epoxide	10	9			93%		
Endosulfan 1	10	10			95%		
Chlordane-Trans	10	10			96%		
Chlordane-Cis	10	10			96%		
trans-Nonachlor							
DDE	20	20			101%		
Dieldrin	10	10			99%		
Endrin	10	10			98%		
DDD	20	21			106%		
Endosulfan 2	10	10			101%		
DDT	20	21			106%		
Endosulfan sulfate	10	10			104%		
Methoxychlor	10	11			105%		
Endrin Aldehyde							
Endrin Ketone							

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E0081 OC's & Total PCB's in Water (ug/L) (E275993)								
HCB	nd	nd						
a-BHC	nd	nd						
g-BHC	nd	nd						
Heptachlor	nd	nd						
Aldrin	nd	nd						
b-BHC	nd	nd						
d-BHC	nd	nd						
Oxychlordane	nd	nd						
Heptachlor epoxide	nd	nd						
Endosulfan 1	nd	nd						
Chlordane-Trans	nd	nd						
Chlordane-Cis	nd	nd						
trans-Nonachlor	nd	nd						
DDE	nd	nd						
Dieldrin	nd	nd						
Endrin	nd	nd						
DDD	nd	nd						
Endosulfan 2	nd	nd						
DDT	nd	nd						
Endosulfan sulfate	nd	nd						
Methoxychlor	nd	nd						
Endrin Aldehyde	nd	nd						
Endrin Ketone	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E0081 OC's & Total PCB's in Water (ug/L)						
HCB	1	nd				
a-BHC	1	nd				
g-BHC	1	nd				
Heptachlor	1	nd				
Aldrin	1	nd				
b-BHC	1	nd				
d-BHC	1	nd				
Oxychlordane	1	nd				
Heptachlor epoxide	1	nd				
Endosulfan 1	1	nd				
Chlordane-Trans	1	nd				
Chlordane-Cis	1	nd				
trans-Nonachlor	1	nd				
DDE	1	nd				
Dieldrin	1	nd				
Endrin	1	nd				
DDD	1	nd				
Endosulfan 2	1	nd				
DDT	1	nd				
Endosulfan sulfate	1	nd				
Methoxychlor	1	nd				
Endrin Aldehyde	1	nd				
Endrin Ketone	1	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected Result1	Result2	Result3	Recovery Details Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E0090 OP Pesticides in Water (ug/L)							
Dichlorvos	100	100			109%		
Mevinphos	100	100			106%		
Ethoprop	100	100			100%		
Phorate	100	100			97%		
Demeton-s-methyl	100	100			104%		
Diazinon	100	100			97%		
Disulfoton	100	100			95%		
Chlorpyrifos methyl	100	100			107%		
Parathion methyl	100	100			106%		
Ronnel	100	120			112%		
Fenitrothion	100	100			109%		
Malathion	100	100			107%		
Fenthion	100	100			103%		
Chlorpyrifos	100	100			105%		
Stirophos	100	120			124%		
Prothiofos	100	100			101%		
Fensulfothion	100	100			100%		
Ethion	100	90			91%		
Bolstar	100	100			98%		
Azinphos methyl	100	120			125%		
Coumaphos	100	120			122%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = <PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E0090 OP Pesticides in Water (ug/L) (E275993)								
Dichlorvos	nd	nd						
Mevinphos	nd	nd						
Ethoprop	nd	nd						
Phorate	nd	nd						
Demeton-s-methyl	nd	nd						
Diazinon	nd	nd						
Disulfoton	nd	nd						
Chlorpyrifos methyl	nd	nd						
Parathion methyl	nd	nd						
Ronnel	nd	nd						
Fenitrothion	nd	nd						
Malathion	nd	nd						
Fenthion	nd	nd						
Chlorpyrifos	nd	nd						
Stirophos	nd	nd						
Prothiofos	nd	nd						
Fensulfothion	nd	nd						
Ethion	nd	nd						
Bolstar	nd	nd						
Azinphos methyl	nd	nd						
Coumaphos	nd	nd						

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

Job Number : 6E2277

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E0090 OP Pesticides in Water (ug/L)						
Dichlorvos	10	nd				
Mevinphos	10	nd				
Ethoprop	10	nd				
Phorate	10	nd				
Demeton-s-methyl	10	nd				
Diazinon	10	nd				
Disulfoton	10	nd				
Chlorpyrifos methyl	10	nd				
Parathion methyl	10	nd				
Ronnel	10	nd				
Fenitrothion	10	nd				
Malathion	10	nd				
Fenthion	10	nd				
Chlorpyrifos	10	nd				
Stirophos	10	nd				
Prothiofos	10	nd				
Fensulfothion	10	nd				
Ethion	10	nd				
Bolstar	10	nd				
Azinphos methyl	10	nd				
Coumaphos	10	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Matrix Spike(s)

Analyte	Spike Level	Level Detected		Recovery Details			
		Spike 1	Spike 2	Rec 1 (%)	Rec 2 (%)	Average (%)	RPD (%)
E2500 Fluoride in Water (E275993)							
Fluoride	1.0	1.0		108%			

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E2600 pH in Water							
pH	7.4	7.4			100%		
E2450 Total Cyanide in Water							
Total Cyanide	0.10	0.093			93%		
E2500 Fluoride in Water							
Fluoride	1.0	0.9			86%		
E4820 Ferrous Iron							
Iron(II)	0.4	0.39			98%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277

QAQC : Laboratory Duplicate(s)

Analyte	Dupl A	Dupl B	Average	RPD (%)	Dupl A	Dupl B	Average	RPD (%)
E2450 Total Cyanide in Water (E275993)								
Total Cyanide	nd	nd						
E2500 Fluoride in Water (E275993)								
Fluoride	2.2	2.0	2.2	9%				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

The number in brackets after the method header identifies the sample tested.

amdel

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E2450 Total Cyanide in Water						
Total Cyanide	0.005	nd				
E2500 Fluoride in Water						
Fluoride	0.1	nd				
E4820 Ferrous Iron						
Iron(II)	0.05	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

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NATA

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ANALYTICAL SERVICES DIVISION
ABN 30 008 127 802

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CENTRE NSW 2310

99 Mitchell Rd
CARDIFF NSW 2285
Telephone: (02) 4902 4800
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CERTIFICATE OF ANALYSIS

Cover Page 1

Contents :

Report No.	:	6E2277A
Attention	:	Mr Colin Campbell
Client	:	Coffey Environments
	:	27 Queen Street
	:	THEBARTON
Samples	:	1
Reference/Order	:	J505076A/41431
Project	:	BRADKENFOUNDRY
Received Samples	:	25/07/06
Instructions	:	25/07/06
Date Reported	:	27/07/06

PLEASE SEE FOLLOWING PAGES FOR METHOD LISTING AND RESULTS

RESULTS

All samples were analysed as received. This report relates specifically to the samples as received. Results relate to the source material only to the extent that the samples as supplied are truly representative of the sample source. This report replaces any preliminary results issued. Note that for methods indicated with "#", NATA accreditation does not cover the performance of this service. Three significant figures (or 2 for < 10PQL) are reported for statistical purposes only. Where "Total" concentrations are reported for organic suites of compounds this is the summation of the individual compounds and the PQL is noted for reporting purposes only. This report has been authorized by the NATA signatories listed in the method descriptions section on the following page.

Anthony Crane
Operations Manager

Report No. : 6E2277A

Please note: Where samples are collected/submitted over several days, the date on which the last samples were analysed or extracted is reported.
Unless Ferrous Iron is determined on site, the possibility of a ferrous-ferric ratio change may occur.

Method	Description	Extracted	Analysed	Authorised
E4950	Mercury	26/07/06	26/07/06	DLU 093

NATA Signatories
(AGR) Alison Graham, (DBL) Dianne Blane, (DLU) Darrel Luck, (GTO) Greg Towers,
(MAV) Merrin Avery, (NCO) Nathan Cooper, (WME) Melanie Wade, (LSC) Lachlan Schwarz
(LSC) Laura Schofield, (APO) Annette Poulton

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Job Number : 6E2277A

Client : Coffey Environments

Reference : J505076A/41431

Project : BRADKEN FOUNDRY

	Lab No	E275998				
		QC1				
Analyte	Sample Id	14.7.06				
	PQL					
E4950 Total Recoverable Mercury in Water						
Mercury	0.001	nd				

PQL = Practical Quantitation Limit
LNR = Samples Listed not Received
nd = < PQL
-- = Not Applicable

Soils : mg/kg (ppm) dry weight unless otherwise specified
Waters : mg/L (ppm) unless otherwise specified in Method Header
Leachates : mg/L (ppm) in leachate unless otherwise specified in Method Header

Refer to Amdel standard laboratory qualifier codes for comments.

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

41431

IT Environmental (Australia) Pty Ltd
ABN 89 003 931 052
www.itenviro.com.au
A subsidiary of Coffey International Limited

Coffey

- [x] 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) 6224 3822 Fax (03) 6224 3877 Suite 6, 221 Macquarie Street, Hobart TAS 7000
- [ ] Melbourne: Tel (03) 9819 0284 Fax (03) 9819 4079 169 Burwood Road, Hawthorn VIC 3122
- [ ] Perth: Tel (08) 9481 4333 Fax (08) 9481 4122 Level 7, 220 George's Terrace, Perth WA 6000
- [ ] Sydney: Tel: (02) 9502 4844 Fax (02) 9502 2105 17 Forrester Street, Kingsgrove NSW 2208
- [ ] Other:

Project No: JS05076A
Task No:
Project Name: Bradken Foundry
Laboratory: Andel
Samplers Name: Jess Miller
Project Manager: Collin Campbell
Special Instructions: Broad Contaminant Screen!!
Metals and Ferrous Iron Are Not Filtered!!

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) P/M	PAH's	PHENOLS	OC's / OP's	Broad Contaminant					NOTES
7599/3	1	Kilburn	–	14/7	PM	water	5G, 4V, 4P	Std							X					
9994	2	↓		↓	↓	↓	↓	↓							X					
9995	3														X					
996	4														X					
997	5														X					
998	QC1						2G, 2V, 1P		X	X	X									

RECEIVED 18 JUL 2006

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]	Date: 14/7/06	Signature: [signature]	Date: 18/7/06
Company: Coffey Environments	Time: PM	Company: Andel – Card.ff	Time: 12:30pm
Signature:	Date:	Signature:	Date:
Company:	Time:	Company:	Time:

Sample Receipt Advice: *(Lab Use Only)*
- All Samples Received in Good Condition .... [x]
- All Documentation is in Proper Order .... [x]
- Samples Received Properly Chilled .... [x]

Lab. Ref/Batch No. 6E2277A

*** 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

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AMDEL INTERNAL QUALITY CONTROL REVIEW.

Job No. 6E2277A

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes and Laboratory Control Samples are included in this QC Report where applicable. Additional QC data may be available on request
2. Amdel QC Acceptance / Rejection Criteria is documented in AS-POL-002 and is available on request.
3. Proficiency trial results are available on request.
4. Actual PQLs are matrix dependent. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spike or surrogate recoveries.
6. Test samples duplicated or spiked, are from this job only and are identified in the following QC report.
7. SVOC analyses on waters are performed on homogenized, unfiltered samples, unless noted otherwise.
8. When individual results are qualified in the body of the report, refer to the qualifier descriptions on the following page.

Holding Times

Please refer to 'Sampling and Preservation Chart for Soils & Waters' for holding times. (Amdel from AS-FOR_ADM-020).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgement.
If the laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Chain of Custody and Sample Integrity	Yes/No/NA
Chain of Custody / instructions received with samples	Yes
Custody seals were received intact (if used)	NA
Chain of Custody completed and attached (if applicable)	Yes
Samples were received chilled or chilling in good condition	Yes
Samples received with other preservation appropriate for all tests	Yes
VOC/SVOC samples were received with Teflon lined lids	NA
Samples received with Zero Headspace (if applicable)	NA

Please refer to the following pages for the laboratory's Quality Control data.

Additional Comments

Anthony Crane
Operations Manager

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AMDEL STANDARD LABORATORY QUALIFIER CODES.

Job No. 6E2277A

Qualifier Codes	Description
*	PQLs are raised due to matrix interference.
@	PQLs are raised due to insufficient sample provided for analysis.
$	The mass imbalance indicates the presence of other ions not measured as part of this procedure.
nd	<PQL
--	Not applicable
LNR	The sample was listed on the COC, but not received.
IS	Insufficient sample was supplied to conduct this analysis.
AN	The analysis indicates the presences of an analyte that has been 'tentatively' identified, and the associated numerical value represents it's approximate concentration.
A	Sample results are reported on an 'as received' basis (not moisture corrected).
B	The sample was not received in a suitable timeframe to allow completion within the recommended holding time.
C	This sample was received with headspace.
D	This sample was received with the incorrect preservation for this analysis.
E	The raw data indicates the absence of 0.055g of Copper Sulphate in the sample.
F	This sample contained significant amounts of solids and was therefore analysed by settling and decanting the aqueous phase to avoid including the solid in the analysis portion.
G	This test was performed outside the recommended holding time.
H	This sample contained significant material >5mm which was removed prior to analysis.
ISD	Insufficient sample was supplied to conduct duplicate analyses.
ISM	Insufficient sample was supplied to conduct matrix spike analyses.
W	The spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
J	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause.
K	The matrix spike concentration is less than five times the background concentration in the sample, and therfore the spike recovery can not be determined.
L	The surrogate recovery is outside of the recommended acceptance criteria, due to matrix interference.
M	The surrogate recovery is outside of the recommended acceptance criteria. Insufficent sample remains to perform re-analysis.
N	Results are expressed in mg/L (ppm) due to the high concentration of the analyte.
O	The results reported are 'recoverable organics' for this fraction, as the chromatogram and peak shape indicates the presence of a significant concentration of polar compounds.
P	The concentration reported is mainly due to a single peak.
Q	This samples contains volatile halogenated oxygenated or other compounds that are included and quantitated as part of TPH C6-9.
R	Theoretically the total result should be greater or equal to the dissolved concentration. However the difference reported is within the uncertainty of the individual tests.
S	The mass imbalance was equal to or less than 0.2 milli-equivalents.
T	During Kjeldahl digestion, nitrate (>10mg/L) can oxidise ammonia resulting in a negative TKN interference, which may have occurred for this sample.
U	Theoretically the TKN result should be greater or equal to ammonia concentration. However the difference reported is within the uncertainty of the individual tests.
V	This sample contained significant amounts of sediment which was included in the analysis portion as requested.
SUR	Surrogate recoveries could not be determined due to the dilution required to quantify the analyte.

Last updated: 19 May 2003

amdel

Job Number : 6E2277A

QAQC : Laboratory Control Sample(s)

Analyte	Level	Level Detected			Recovery Details		
		Result1	Result2	Result3	Rec 1 (%)	Rec 2 (%)	Rec 3 (%)
E4950 Total Recoverable Mercury in Water							
Mercury	0.010	0.011			110%		

PQL = Practical Quantitation Limit
-- = Not Applicable
nd = < PQL

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

amdel

Job Number : 6E2277A

QAQC : Method Blank(s)

ANALYTE	Sample ID PQL	Blank1	Blank2	Blank3	Blank4	Blank5
E4950 Total Recoverable Mercury in Water						
Mercury	0.001	nd				

PQL = Practical Quantitation Limit
nd = < PQL
-- = Not Applicable

(S) Soils : mg/kg (ppm) dry weight
(W) Waters : mg/L (ppm) unless otherwise specified

Appendix L

Stormwater Management Plan

Bradken Mineral Processing

Bradken Kilburn Foundry

Upgrading & Expansion Project: Stormwater Management Plan

Principal Contacts
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Ian Wishart

October 2006
Ref No 20060763RA1

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Table of Contents

Bradken Mineral Processing
Bradken Kilburn Foundry Upgrading and Expansion
Stormwater Management Plan

Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Issue to Client	TK	IW	DJ	25/10/06

1. Introduction

A major upgrading and expansion is proposed for the existing Bradken Foundry at Cromwell Road Kilburn. The proposed alterations will increase the amount of impervious area on site, thereby increasing stormwater runoff. This Report outlines the proposed method of management of the increase in runoff and proposes measures to improve the quality of discharge leaving the site.

2. Existing Drainage System

2.1 Background

Stormwater drainage arrangements for the existing site are shown on the drawing enclosed in Appendix A entitled "Stormwater Management Plan: Existing Site". The site is spilt into two distinct catchment areas: the southern and western portion of the site discharges into Cromwell Road, and the northern and eastern areas discharge into the retention basin located at the east edge of the site.

2.2 Cromwell Road Catchment

Approximately half of the existing impervious areas of the site discharges to Cromwell Road through a combination of piped and surface discharge. The main foundry building at the west of the site discharges to Cromwell Road via an underground drain that is connected directly into the upstream end of the City of Port Adelaide Enfield (Council) 375mm diameter drain. The yard areas to the west of the main building and some yard areas to the east also connect directly into this drain. The existing car park discharges to Cromwell Road via surface discharge. A number of smaller drains in the south western corner of the site discharge directly to the Cromwell Road kerb and gutter.

2.3 Marmion Avenue Catchment

The northern and eastern sections of the site currently discharge via two underground drains into a retention basin adjacent to the eastern boundary of the site. Based on field inspections the basin has an estimated capacity of 700m^3. The basin was constructed in the late 1990s and based on anecdotal evidence has never reached capacity since it was constructed indicating that the size of the basin, combined with the relatively high infiltration rate at the site is able to adequately deal with all rainfall events that have occurred in that time.

Hydrological modelling has confirmed that provided the basin is empty at the start of the event, little surface discharge will spill from the basin in a 5-year ARI event.

Should the basin fill to capacity, the basin would spill via surface flows into the western end of Marmion Avenue where it would be intercepted by the Council drainage system within Marmion Avenue, at the intersection with Nelson Street.

3. Drainage Requirements

As part of an assessment of a recent Development Application (for Heat Treatment System Upgrading and Noise Reduction Improvements, No. 040/1724/06) lodged by Bradken, Council requirements for discharge from the site have recently been stated as follows:

- "Discharge from the site to the NAE channel to be kept to below 50L/s for all events up to and including a 20yr ARI storm for durations up to 120 minutes
- For durations longer than 120 minutes site discharge must be detained/retained to prevent the peak flow rate in the NAE channel exceeding 25 m^3/s for the 20-year ARI event
- The 100-year ARI site discharge to the NAE channel to be no greater than existing flow rates."

As part of the assessment of this Development Application, Council had also required that a Stormwater Management Plan be provided, and an environmental assessment of the runoff entering the retention basin and impact for groundwater contamination be undertaken. An assessment of stormwater quality and groundwater monitoring was undertaken by Coffey Environments Pty Ltd in 2006, and the reports of these assessments were submitted by Bradken with their Stormwater Management Plan for the existing site (Ref No. BK3-E-019), to Council.

Bradken's Stormwater Management Plan for the existing site identified various actions to improve and safeguard the quality of stormwater, and many of these actions are now proposed to be implemented under this upgrading and expansion project.

It is understood that Council will require that the above discharge conditions are also applicable for the stormwater management plan for the proposed major upgrade and expansion of the Bradken site.

4. Proposed Stormwater Management Plan

This section outlines the proposed stormwater management plan for the upgrade and expansion of the Bradken site. Reference should be made to the drawing enclosed in Appendix B entitled “Stormwater Management Plan: Proposed Upgrading and Expansion Works” which outlines all of the proposed works.

Hydrological calculations for the existing and upgraded site are summarised within Appendix C.

4.1 Cromwell Road Catchment

4.1.1 Discharge Rates

The portion of the existing Bradken site draining to Cromwell Road is essentially fully developed. The size and amount of impervious area draining to Cromwell Road will essentially remain unchanged under the proposed upgrading and expansion project, and will therefore meet Council requirements of not increasing the rate of discharge to Cromwell Road.

It is proposed to connect large portions of the main foundry building roof to storage tanks for reuse of rainwater on site for process purposes (e.g. cooling towers). These tanks would result in a net reduction in flows discharged to Cromwell Road.

The majority of the southern and western area of the site will connect directly into the upstream end of the underground Council drainage system at the south western corner of the Bradken site. Some discharge (from the car park and adjacent hard stand areas) will be discharged to the kerb and gutter via a pump system.

4.1.2 Water Quality

All paved surfaces, including the car park will be treated by new proprietary oil and grit separators before discharging into Cromwell Road. The devices will be sized to treat the 1 in 3 month design flow rate.

Due to there being no adjacent underground drainage system, the eastern oil and grit separator (at the south western corner of the car park) will be pumped into Cromwell Road. It will then run down Cromwell Road within the kerb and gutter and enter the side entry pit at the south western corner of the Bradken site.

The western oil and grit separator will connect directly into the underground Council drainage system. Any spill from the rainwater tank to the east of the main building will by-pass the oil and grit separator, as roof runoff is considered to be clean and will not require treatment prior to discharge.

4.2 Marmion Avenue Catchment

4.2.1 Discharge Rate

The proposed upgrading and alterations to the site will increase the impervious area draining to the retention basin from 1.62 hectares to 1.9 hectares (17% increase), while the pervious area will subsequently decrease to 0.8 hectares. Roof runoff from the 0.35 hectare eastern building will be directed to tanks for reuse for process purposes (e.g. quench makeup and cooling tower). This will partially mitigate the reduction in the increase in impervious area.

Council require that the peak 100-year ARI discharge rate from the site does not exceed that from the existing site (115L/s). To achieve this condition the capacity of the basin would need to be increased by 200kL to 900kL. This would be achieved through additional excavation.

Council also require the peak flow from short duration (less than 2 hour) 20-year ARI storms be limited to less than 50L/s. This requirement will be met as the volume of runoff generated by the 2-hour storm is less than the expanded capacity (900kL) of the basin and therefore there will be negligible runoff from the site.

Council's final requirement is that discharge from the site does not result in a peak flow rate within the NAE channel exceeding 25m^3/s in the 20-year ARI event for events exceeding 2 hours in duration. As the critical time of concentration for the NAE catchment is less than 2 hours there is a large reduction (~3m^3/s) in the peak flow rate within the NAE channel for events exceeding this duration (North Arm East Catchment Drainage Study, BC Tonkin & Associates, 1995). Therefore the small discharge from the site (less than 0.05m^3/s) will ensure that the peak flow rate is kept to below 25m^3/s.

All modelling assumes that the basin is empty at the start of the event. This is based on observations from Bradken that infiltration rates from the basin are high, with the basin levels dropping steadily following any rainfall. Bradken have advised that the basin has not spilled since it was constructed in the late 1990s. The actual infiltration rate will require verification as part of the detailed design process. Assessments of soil maps indicate that some sandy soils are located in the area. Sandy soils are known to exhibit high rates of infiltration.

An alternative to increasing the volume of the retention basin is to construct a piped outfall from the basin directly into the NAE channel. The preferred route for this drain is along the southern boundary of the Council depot site to the north of the Bradken site (refer Appendix B). This option would require the acquisition of a drainage easement. A pipe 375mm in diameter would be sufficient to ensure that there is no increase in peak flow from the site during the 100-year ARI rainfall event while still meeting the 20-year ARI limitations detailed in Section 3. The invert of the pipe would be set approximately 400mm below the level that water spills into Marmion Avenue. The invert of the new pipe will therefore be located towards the top of the retention basin. As a result the majority of the basin's retention volume would be retained.

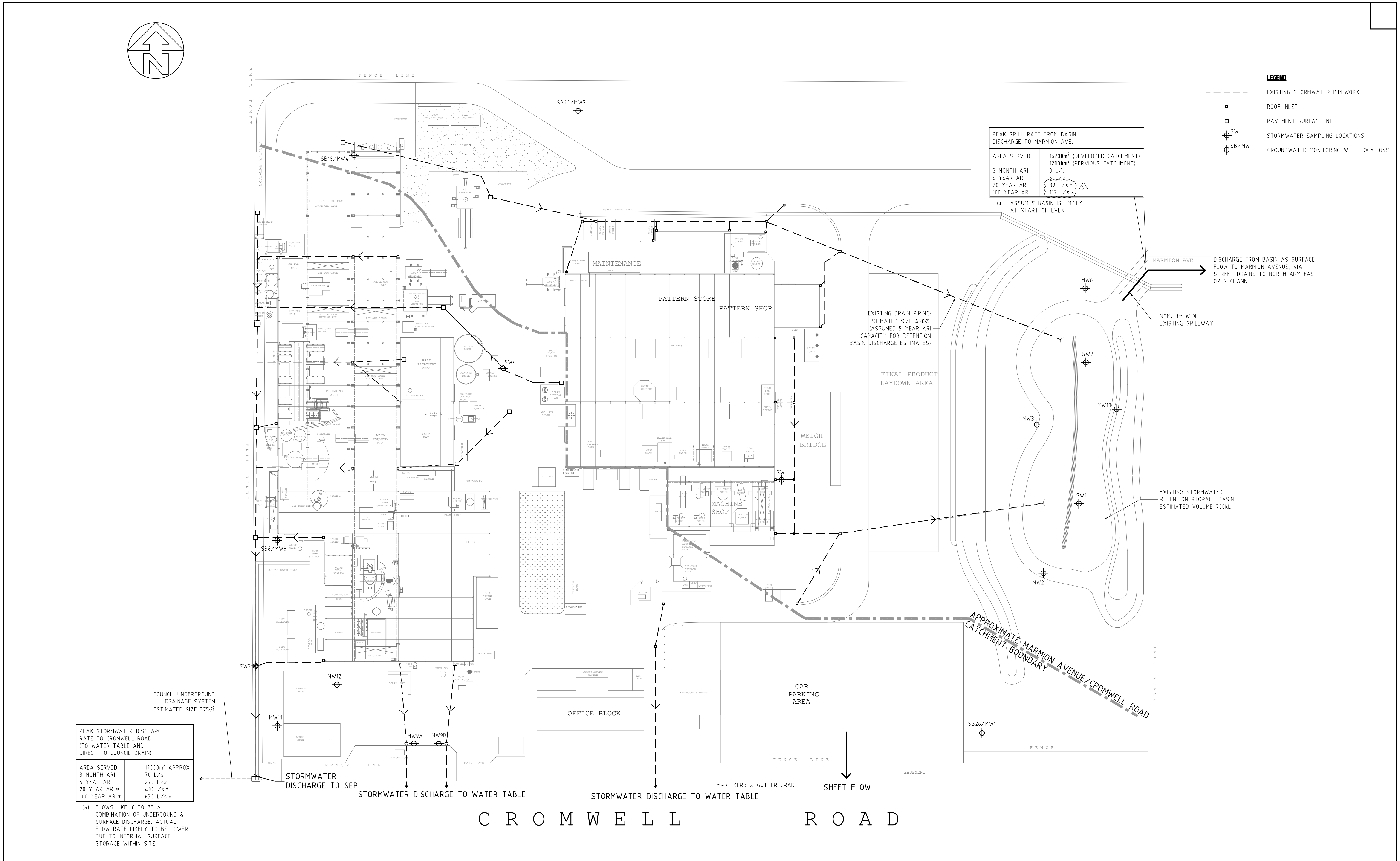
4.2.2 Water Quality

All paved areas will be treated by proprietary oil and grit separators before discharging into the retention basin. Any overflow from the tank on the eastern building will by-pass the oil and grit separators as the roof water is considered to be clean and not requiring treatment.

The basin will provide significant additional water quality improvement through the processes of siltation and vegetative filtering. Sediment build up would require periodic removal.

Appendix A

Drawing: Stormwater Management Plan: Existing Site



REVISION	AMENDMENT / REASON FOR ISSUE	APPROVED	DATE
2	FLOWS REVISED	TK	18/10/06
1	ISSUED	TK	10/10/06

NOTES:

ALL LEVELS TO A.H.D.

100mm ON ORIGINAL DRAWING

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- CIVIL INFRASTRUCTURE
- STRUCTURAL
- ENVIRONMENTAL
- WATER RESOURCES
- STORMWATER MANAGEMENT
- ROAD SAFETY & TRAFFIC
- BUILDING SURVEYING
- SPATIAL INFORMATION
- ELECTRICAL, MECHANICAL AND AUTOMOTIVE

SCALE: 1:1000 SHEET SIZE A3
DESIGNED: IW DRAWN: RM
PROJECT MANAGER: TK SENIOR DRAFTER:
SURVEYED: SURVEY DATE:
APPROVED:
DATE:

BRADKEN MINERAL PROCESSING

80 CROMWELL ROAD KILBURN SA

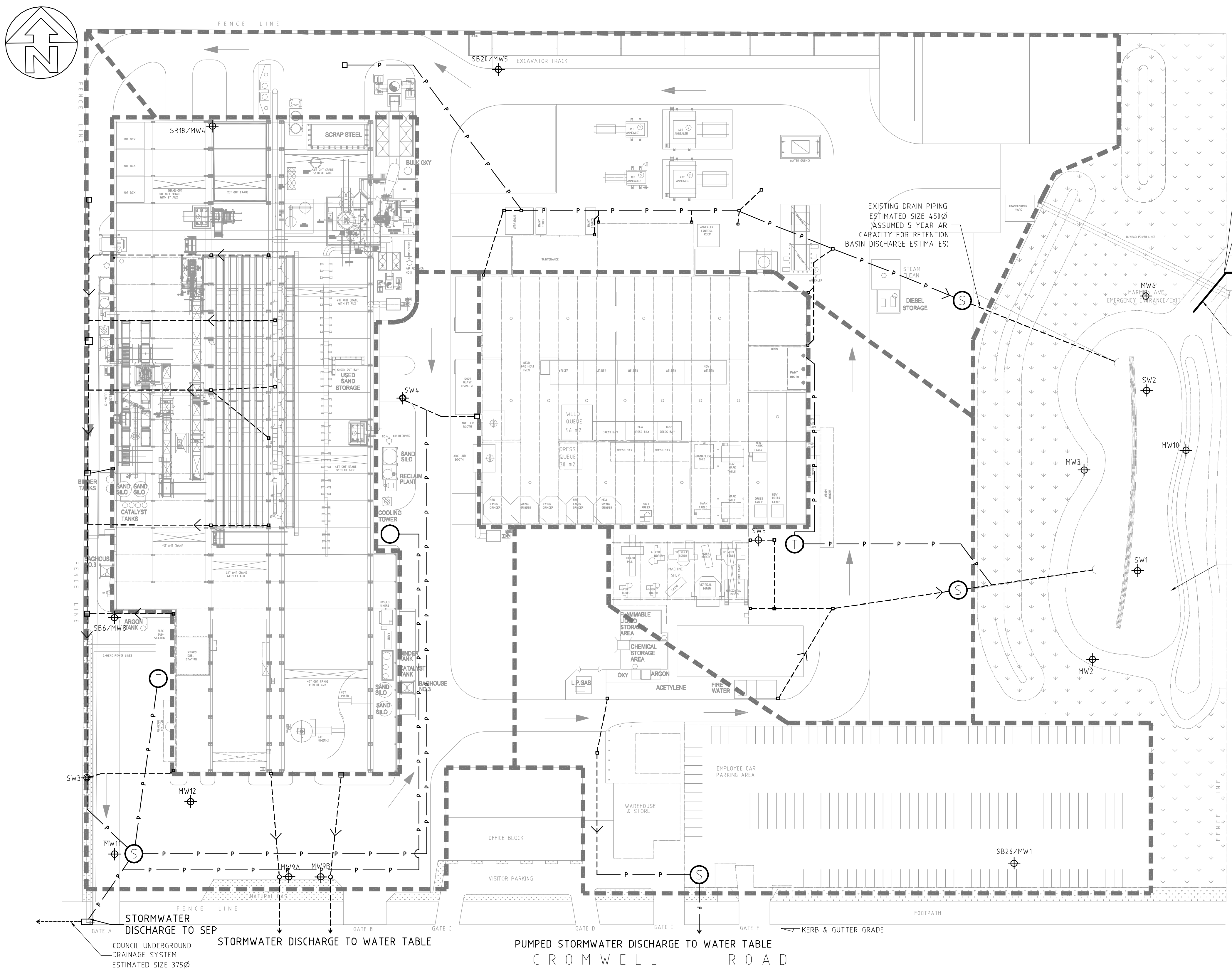
EXISTING SITE STORMWATER MANAGEMENT PLAN

CAD REFERENCE: 20060302_M01_10.dwg
XREFS: x20060302_xplan.dwg

SHEET NUMBER 1 of 1 | JOB NUMBER 2006.0302 | REVISION 2

Appendix B

Drawing: Stormwater Management Plan: Proposed Upgrading and Expansion Works



LEGEND

- EXISTING STORMWATER PIPEWORK RETAINED
- NEW STORMWATER PIPEWORK
- CATCHMENT AREA BOUNDARY PER OIL/GRIT SEPARATOR
- ROOF INLET
- PAVEMENT SURFACE INLET
- SW – STORMWATER SAMPLING LOCATIONS
- SB/MW – GROUNDWATER MONITORING WELL LOCATIONS
- T – NEW TANK (FOR HARVEST & REUSE OF ROOF WATER)
- S – NEW OIL/GRIT SEPARATOR

PEAK SPILL RATE FROM BASIN DISCHARGE TO MARMION AVE.

AREA SERVED	19000m² (DEVELOPED CATCHMENT) 8000m² (PERVIOUS CATCHMENT)
3 MONTH ARI	0 L/s
5 YEAR ARI	0 L/s
20 YEAR ARI	31 L/s *
100 YEAR ARI	115 L/s *

(*) ASSUMES BASIN IS EMPTY AT START OF EVENT

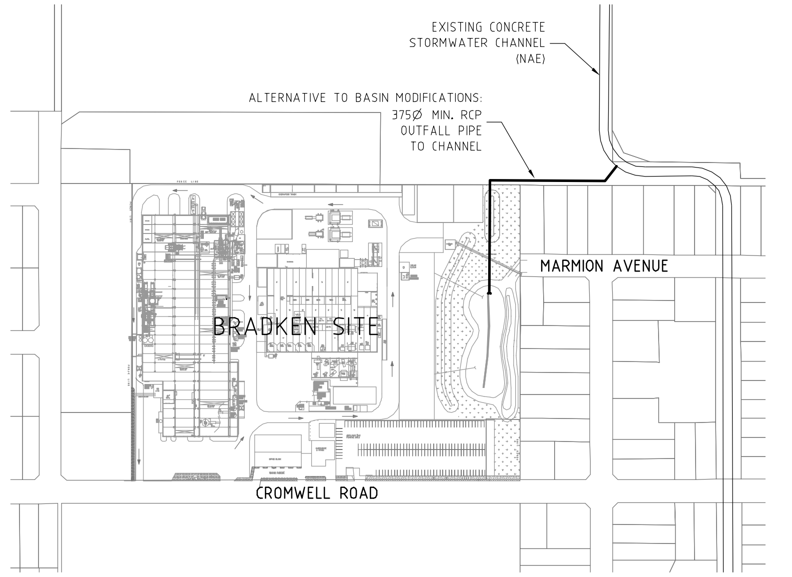
PEAK STORMWATER DISCHARGE RATE TO CROMWELL ROAD (TO WATER TABLE AND DIRECT TO COUNCIL DRAIN)

AREA SERVED	19000m² APPROX.
3 MONTH ARI	70 L/s
5 YEAR ARI	270 L/s
20 YEAR ARI*	400L/s*
100 YEAR ARI*	630 L/s *

(*) FLOWS LIKELY TO BE A COMBINATION OF UNDERGOUND & SURFACE DISCHARGE. ACTUAL FLOW RATE LIKELY TO BE LOWER DUE TO INFORMAL SURFACE STORAGE WITHIN SITE

STORMWATER PLAN

SCALE 1:1000



POTENTIAL BASIN OUTFALL PIPE ALIGNMENT

SCALE 1:5000

REVISION	AMENDMENT / REASON FOR ISSUE	APPROVED	DATE
1	ISSUED WITH SMP REPORT	TK	26/10/06

NOTES:

ALL LEVELS TO A.H.D.

100mm ON ORIGINAL DRAWING — DO NOT SCALE

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- CIVIL INFRASTRUCTURE
- STRUCTURAL
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- WATER RESOURCES
- STORMWATER MANAGEMENT
- ROAD SAFETY & TRAFFIC
- BUILDING SURVEYING
- SPATIAL INFORMATION
- ELECTRICAL, MECHANICAL AND AUTOMOTIVE

SCALE: AS NOTED — SHEET SIZE: A3
DESIGNED: TK — DRAWN: RM
PROJECT MANAGER: TK — SENIOR DRAFTER:
SURVEYED: — SURVEY DATE:
APPROVED:
DATE:

BRADKEN MINERAL PROCESSING

80 CROMWELL ROAD KILBURN SA

STORMWATER MANAGEMENT PLAN: PROPOSED UPGRADING & EXPANSION WORKS

CAD REFERENCE: 20060763_per_SWMP.DWG
XREFS: -

SHEET NUMBER	JOB NUMBER	REVISION
1 of 1	2006.0763	1

Appendix C

Hydrological Calculations

```
ILSAX INPUT DATA

BRADKEN FOUNDRY.  EXISTING SITE
NOTE  Job # - 2006.0763
NOTE: AAA DRAINS TO BASIN AND DISCHARGE TO MARMION AVENUE

AAA 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.60 85 12.0 0 15 27.0 0.0

AAA 002 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.22 0 35.0 0 100 50.0 0.0

NOTE: DETENTION BASIN MINIMAL DISCHARGE PRIOR TO 700m3 STORAGE

AAA 003 -1 -1
10 0 1.0 1.0 0 -1
5
0.000  0.0  0.000
1.000  50     0.003
2.000  700.0  0.004
3.0 780 0.20
4.000  860.0  0.40
0.0
0.00 100 0.0 0 0 0.0 0.0

AAA 003 0 -1
3 0 200 0.20 0.012 1 600 2.000 36.00 1.00 0 1.0 0 -1 0
0.00 100 0.0 0 0 0.0 0.0

OUT

NOTE: AAB IS CROMWELL ROAD CATCHMENT

AAB 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
2.2 85 12.0 0 15 27.0 0.0

AAB 001 0 -1
3.0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

OUT
END
```

1.6 ha developed catchment

ILSAX OUTPUT DATA (20-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY: EXISTING SITE

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA 001	.306	.306	.000	.306	610.	.311
AAA 002	.014	.289	.000	.289	610.	.311
AAA 003	.000	.287	.000	.287	610.	.000
AAA 003	.000	.039	.000	.039	610.	.311
AAB 001	.421	.421	.000	.421	686.	.425
AAB 001	.000	.394	.000	.394	686.	.425

END

39L/s PEAK DISCHARGE
FROM EXISTING BASIN
IN 20-YR ARI EVENT

ILSAX OUTPUT DATA (100-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY: EXISTING SITE

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA 001	.458	.458	.000	.458	762.	.563
AAA 002	.045	.458	.000	.458	762.	.563
AAA 003	.000	.438	.000	.438	762.	.000
AAA 003	.000	.115	.000	.115	762.	.563
AAB 001	.629	.629	.000	.629	838.	.725
AAB 001	.000	.629	.000	.629	838.	.725

END

PEAK FLOW TO MARMION AVE 115 L/s

629 L/s DISCHARGE TO CROMWELL ROAD

1.9 ha developed area

```
ILSAX INPUT DATA

BRADKEN FOUNDRY. INCREASED BASIN CAPACITY
NOTE  Job # - 2006.0763
NOTE: AAA DRAINS TO BASIN AND DISCHARGE TO MARMION AVENUE

AAA 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.9 85 12.0 0 15 27.0 0.0

AAA 002 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.8 0 35.0 0 100 50.0 0.0

NOTE: DETENTION BASIN EXPANDED TO 900m3 BEFORE SPILL

AAA 003 -1 -1
10 0 1.0 1.0 0 -1
5
0.000  0.0  0.000
1.000  50     0.003
2.000  900.0  0.004
3.0 980 0.20
4.00  1060.0  0.40
0.0
0.00 100 0.0 0 0 0.0 0.0

AAA 003 0 -1
3 0 200 0.20 0.012 1 600 2.000 36.00 1.00 0 1.0 0 -1 0
0.00 100 0.0 0 0 0.0 0.0

OUT
NOTE: AAB DRAINS TO CARPARK INTERCEPTOR

AAB 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.66 85 12.0 0 15 27.0 0.0

AAB 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAC DRAINS TO WESTERN INTERCEPTOR

AAC 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.14 85 12.0 0 15 27.0 0.0

AAC 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAD DRAINS TO CROMWELL ROAD VIA TANK SPILLAGE

AAD 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.35 85 12.0 0 15 27.0 0.0

AAD 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAB 003 COMBINED DISCHARGE TO CROMWELL ROAD

ADD AAC TO AAB
ADD AAD TO AAB

AAB 003 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

OUT
END
```

ILSAX OUTPUT DATA (20-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY: INCREASED BASIN CAPACITY

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA 001	.363	.363	.000	.363	686.	.425
AAA 002	.009	.361	.000	.361	686.	.425
AAA 003	.000	.340	.000	.340	686.	.000
AAA 003	.000	.031	.000	.031	686.	.425
AAB 001	.126	.126	.000	.126	600.	.297
AAB 002	.000	.125	.000	.125	600.	.297
AAC 001	.218	.218	.000	.218	600.	.297
AAC 002	.000	.217	.000	.217	600.	.297
AAD 001	.067	.067	.000	.067	600.	.297
AAD 002	.000	.067	.000	.067	600.	.297
AAB 003	.000	.390	.000	.390	686.	.425

END

PEAK DISCHARGE
FROM BASIN 31L/S

ILSAX OUTPUT DATA (100-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY: INCREASED BASIN CAPACITY

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA 001	.543	.543	.000	.543	762.	.563
AAA 002	.029	.543	.000	.543	762.	.563
AAA 003	.000	.518	.000	.518	762.	.000
AAA 003	.000	.114	.000	.114	762.	.563
AAB 001	.189	.189	.000	.189	600.	.297
AAB 002	.000	.189	.000	.189	600.	.297
AAC 001	.326	.326	.000	.326	686.	.425
AAC 002	.000	.326	.000	.326	686.	.425
AAD 001	.100	.100	.000	.100	600.	.297
AAD 002	.000	.100	.000	.100	600.	.297
AAB 003	.000	.600	.000	.600	838.	.725

END

114L/s BELOW 115L/s FROM EXISTING SITE

600L/s SIMILAR TO 629L/s FROM EXISTING SITE

1.9 ha developed area

```
ILSAX INPUT DATA

BRADKEN FOUNDRY.  PIPED DISCHARGE OPTION
NOTE  Job # - 2006.0763
NOTE: AAA DRAINS TO BASIN

AAA 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.9 85 12.0 0 15 27.0 0.0

AAA 002 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.8 0 35.0 0 100 50.0 0.0

NOTE: EXISTING DETENTION BASIN WITH 375MM PIPE DISCHARAGE COMMENCING AT 450m3 OF
STORAGE

AAA 003 -1 -1
10 0 1.0 1.0 0 -1
5
0.000  0.0  0.000
1.000  50     0.003
1.5     450     0.004
2.000  700.0  0.09
3.0 780 0.29
4.00  860.0  0.49
0.0
0.00 100 0.0 0 0 0.0 0.0

AAA 003 0 -1
3 0 200 0.20 0.012 1 600 2.000 36.00 1.00 0 1.0 0 -1 0
0.00 100 0.0 0 0 0.0 0.0

OUT

NOTE: AAB DRAINS TO CARPARK INTERCEPTOR

AAB 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.66 85 12.0 0 15 27.0 0.0

AAB 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAC DRAINS TO WESTERN INTERCEPTOR

AAC 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
1.14 85 12.0 0 15 27.0 0.0

AAC 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAD DRAINS TO CROMWELL ROAD VIA TANK SPILLAGE

AAD 001 0 -1
3 0 100.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.35 85 12.0 0 15 27.0 0.0

AAD 002 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

NOTE: AAB 003 COMBINED DISCHARGE TO CROMWELL ROAD

ADD AAC TO AAB
ADD AAD TO AAB

AAB 003 0 -1
3 0 50.0 0.2 0.012 1 600 0.0 0.00 0 0 1.0 0 -1 0
0.0 100 12.0 0 15 27.0 0.0

OUT
END
```

ILSAX OUTPUT DATA (20-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY; PIPED DISCHARGE OPTION (20-YEAR ARI OUTPUT)

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA 001	.363	.363	.000	.363	686.	.425
AAA 002	.009	.361	.000	.361	686.	.425
AAA 003	.000	.340	.000	.340	686.	.000
AAA 003	.000	.045	.000	.045	686.	.425
AAB 001	.126	.126	.000	.126	600.	.297
AAB 002	.000	.125	.000	.125	600.	.297
AAC 001	.218	.218	.000	.218	600.	.297
AAC 002	.000	.217	.000	.217	600.	.297
AAD 001	.067	.067	.000	.067	600.	.297
AAD 002	.000	.067	.000	.067	600.	.297
AAB 003	.000	.390	.000	.390	686.	.425

END

PEAK DISCHARGE
FROM BASIN 45L/S

ILSAX OUTPUT DATA (100-YEAR ARI PEAK FLOW RATES)

BRADKEN FOUNDRY: PIPED DISCHARGE OPTION

PEAK FLOWS AMONG RUNOFFS FROM 22 RAINFALL PATTERNS
(The following lines give Branch and Reach names;
Maximum surface flow arriving at an entry point or pit,
Maximum flow in the pit before routing through downstream reach,
Maximum surface overflow and Total flows to this point (m3/s);
Pipe Diameter or Normal Depth (open sections) (mm) & Capacity (m3/s).
Other information is given for non-circular reaches
- refer to the program code for details.)

AAA	001	.543	.543	.000	.543	762.	.563
AAA	002	.029	.543	.000	.543	762.	.563
AAA	003	.000	.518	.000	.518	762.	.000
AAA	003	.000	.094	.000	.094	762.	.563
AAB	001	.189	.189	.000	.189	600.	.297
AAB	002	.000	.189	.000	.189	600.	.297
AAC	001	.326	.326	.000	.326	686.	.425
AAC	002	.000	.326	.000	.326	686.	.425
AAD	001	.100	.100	.000	.100	600.	.297
AAD	002	.000	.100	.000	.100	600.	.297
AAB	003	.000	.600	.000	.600	838.	.725

END

94L/S BELOW
115L/S FROM
EXISTING SITE

600L/S SIMILAR TO
629L/S FROM EXISTING
SITE

Appendix M

Construction Environmental Management Plan

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

KILBURN FOUNDRY

Bradken Mineral Processing

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

KILBURN FOUNDRY

Bradken Mineral Processing

Prepared For:

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Report Details:

File Name: 5777 Construction Environment Plan Final Rev 1

This report has been collated and prepared by:

______________________ 30/10/6

Gordon Paterson **Date**
Project Engineer

This report has been checked and authorised by:

______________________ 30/10/6

Steven Smith **Date**
General Manager - Operations

October, 2006
5777 Construction Environment Plan Final Rev 1
Job No: 5999
Folder No: 5777

TABLE OF CONTENTS

1. INTRODUCTION

This document is the Construction Environmental Management Plan (CEMP) for the Bradken Mineral Processing, Kilburn Adelaide Foundry upgrade.

In order to mitigate construction impacts, the CEMP addresses the environmental control requirements applied during the construction phase and is based on AS/NZS ISO14001:2004 'Environmental management systems – Specification with guidance for use'. The CEMP, in conjunction with project specific Procedures and Checklists, forms the Environmental Management System for this project.
Bradken is certified to the international standard for environmental management *AS/NZS ISO 14001:2004: Environmental management systems*.

The CEMP will also form part of Bradken's Environmental Strategy by setting specific goals and targets for the construction activities.

The issues and requirements within this document are developed by understanding the typical requirements and key impacts of large construction projects on adjacent communities and other stakeholders. As such, the CEMP represents a methodology to control and monitor typical adverse impacts which may arise during a facility upgrade.

2. OBJECTIVES

2.1 Project Objectives

Bradken Resources Pty Limited (Bradken), a division of Bradken Limited is proposing to undertake a project to upgrade their existing foundry operation at Kilburn, South Australia. The project will include replacement of the existing 10 tonne Electric Arc Furnace (EAF), construction of a new foundry building and installation of a fast loop moulding system.

Bradken has recognised an economic need to upgrade the Kilburn foundry. The upgrade will enable Bradken to maintain supply of quality metal castings to its current customers and provide it with the ability to secure further contracts within the mining and minerals processing industry.

A parallel driving objective of the proposed upgrade is to further address the environmental aspects associated with the foundry operation to ensure that it improves environmental performance and reduces emissions in line with environmental goals.

2.2 CEMP Objectives

This CEMP has four principle objectives:

- To ensure that environmental management is adequate and implemented during construction.
- To clarify the roles of Bradken Project Management Team and relevant Contractors' staff in ensuring compliance with requirements.
- To provide guidelines to minimise plant disruptions during construction.
- To provide guidelines for safe construction while the facility is operational.

These objectives will be achieved by:

- Meeting the Bradken site environmental goals and targets
- Ensuring specific procedures are available to counter any likely environmental effects from construction activities.
- Providing Project Team members and Contractors with suitable induction and training in awareness and knowledge of environmental issues.
- By assigning responsibilities and providing sufficient resources to carry out the CEMP.
- Ensuring construction work is carried out in accordance with all relevant legislation and codes of practice.
- By communicating with the construction team, site workforce and wider community on the environmental affects and controls to be expected during construction.
- By monitoring environmental performance and applying appropriate controls where required, meeting the necessary standards.

3. SCOPE OF WORKS

The proposed upgrade of the foundry will result in an increase in production from 12,500 tonnes to 32,000 tonnes per annum. The production increase will be achieved through the replacement of the existing 10 tonne Electric Arc Furnace (EAF) with a new 20 tonne EAF and the installation of a fast loop moulding and cooling system. In addition to the increase in production a number of environmental improvements are proposed to improve the amenity and environmental values of the surrounding land.

The upgrade will require the construction of additional buildings and the demolition of older buildings.

The project will involve the following activities:

- Construction of industrial buildings including establishment of foundations.
- Installation of large scale plant and equipment.
- Removal of existing asbestos roof sheeting.
- Demolition of buildings.
- Upgrading of Fire Systems.
- Removal of concrete and bitumen

In parallel ETSA Utilities will project manage and install new switch stations and decommission old switch stations as well as provide underground power for the new furnace.

4. LOCATION

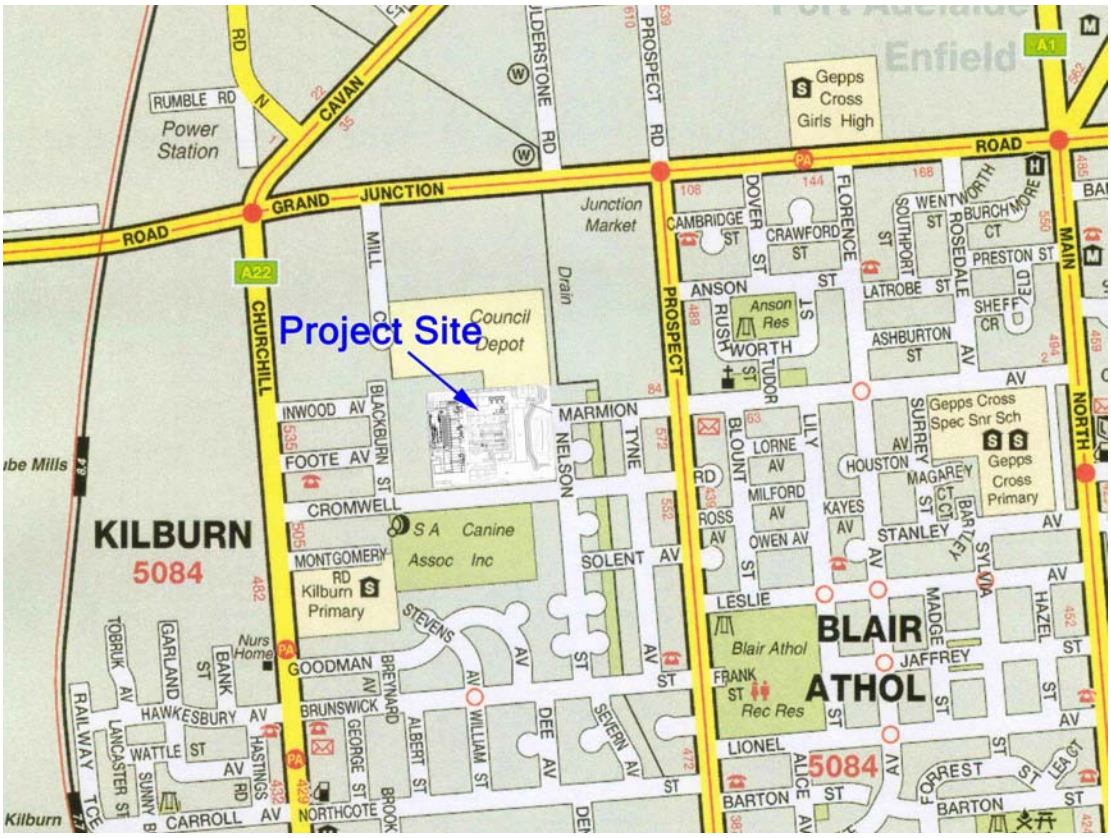
Bradken is the owner of the site of the existing foundry, which is where the proposed development will take place, no expansion into neighbouring land is proposed. The site has a street address of 32-36 Cromwell Road, Kilburn . The subject land is situated within the General Industry (1) Zone of the Port Adelaide Enfield (City) Development Plan. The site has an approximate area of 5 hectares. Figure 1 shows the location of the Bradken site.

The Bradken facility is bordered by a number of different land uses including the existing industrial complex of Plastics Granulation Services, which is situated immediately to the north and west of the site. The Enfield Community Food Centre is situated on the southwestern corner of Cromwell Road and Blackburn Street. The council works depot, which is located to the north of the site, is still owned by the council. There are residences adjacent to the eastern boundary of the subject land, this being that part of the site which holds the storm water basin and noise attenuation mound. All buildings and foundry operations are concentrated in the centre and western portion of the site.

There is also residential development further to the west of the plant, situated on the opposite side of Blackburn Street. To the south on the other side of Cromwell Road is a large oval and open grounds associated with the offices of the South Australian Canine Association.

The wider industrial environment is concentrated to the west and north of the proposed development site. Railway maintenance facilities, transport operations and a waste management facility are located to the west of Churchill Road and medium to heavy industry such as furniture manufacturing, metal galvanising, and the Master Butchers Co-op are locate to the north of the site.

Figure 1: Locality Map



Source: UBD *2005*

5. CONSTRUCTION SCHEDULE

It is intended to phase in the upgrade construction over a period of approximately 3 years. This will in effect reduce the impact of the construction works by reducing the numbers of men and equipment on site at any one time. Reduction in plant output will be planned during the major construction periods of phase 1 and 2. The indicative schedule for the various phases of the construction is shown in Table 1.

Table 1: INDICATIVE WORKS SCHEDULE

Phase	Construction Works	Start Date (approx)	Finish Date (approx)
1	Erect new furnace building Install 20t EAF. Decommission current EAF.	6 months after commencement	18 months after commencement
2	Construct new moulding and pouring floor	18 months after commencement	24 months after commencement
3	Extend After Cast buildings and purchase equipment	24 months after commencement	34 months after commencement
4	Install automated fast loop line	22 months after commencement	38 months after commencement

6. CONSTRUCTION WORKING HOURS

Normal construction working hours at the site will be between 7:00am and 7:00pm Mondays to Fridays and 7:00am to 1:00pm on Saturdays.

Work will not normally be carried out on Saturdays after 1:00pm, Sundays or Public holidays.

However, activities may be required to be carried out outside these limits due to:

- Deliveries of special items as directed by the RTA.
- Early starts for concrete pours in hot weather
- Medical or environmental emergency.

If work is necessary outside these limits, all reasonable and practicable measures will be taken to minimise noise resulting from the work and to minimise its impact. Particular noise minimisation measures are set out in section 14.4 of this CEMP.

7. OPERATIONAL CONTROL

The effects that the construction activities will have on the environment will be assessed using Bradken's "Environmental Aspects & Impact Assessment" procedure 2 BK SP ENV200.

The purpose of this procedure is to identify the significant environmental aspects and impacts to allow appropriate responses to be assessed and action taken where necessary.

The key environmental issues associated with the construction work are expected to be:

- Asbestos Removal and other Demolition
- Waste Management and Recycling
- Hazardous Materials
- Noise and Vibration
- Erosion and Sedimentation Control
- Access and Traffic
- Transport and Storage of Construction Materials
- Hazards and Risk Management
- Utilities and Services
- Dust / Air Management
- Lighting
- Stormwater

These aspects shall have controls and documented procedures applied to them as set out in Bradken's "Environmental Operational Control" procedure 2 BK SP ENV 320.

In particular:

- Contractors working on site are to be advised of the relevant requirements, procedures, work instructions and regulations required to comply with during construction
- Suppliers are to be advised of the relevant requirements, procedures, regulations and work instructions that they will need to comply with regarding the furnishing of equipment or supplies

7.1 Construction during Facility Operations

Bradken intends to remain operational during construction, but with reduced output during those periods. Bradken intend to ensure safety of personnel and equipment through:

- The isolation of construction work;
- Appropriate traffic management as per Section 14.8;
- Appropriate project management as per Section 9;
- Site training of staff and contractors as per Section 10;
- Construction risk assessments and communication as per Section 11; and
- Appropriate production planning

8. LEGAL AND OTHER REQUIREMENTS

8.1 Legal Compliance

Bradken's "Environmental Legal Compliance" procedure 2 BK SP ENV 220 shall be used to:

- Ensure all construction activities comply fully with all relevant statutory requirements and;
- Ensure that relevant personnel on site are aware of their responsibilities with regards to such environmental regulations and the need to comply

It is expected that the construction activities to be carried out, as part of the proposed works, shall be required to comply with at least the following provisions:

8.1.1 State Legislation and Regulations

- Environmental Protection Act 1993
- Occupational Health, Safety and Welfare Regulations 1995
- Environment Protection (General) Regulations 1994
- Environment Protection (Air Quality) Policy 1994
- Environment Protection (Water Quality) Policy 2003
- Environment Protection (Industrial Noise) Policy 1994
- Environment Protection (Machine Noise) Policy 1994
- Environment Protection (Waste Management) Policy 1994
- Environment Protection (Burning) Policy 1994
- Waterworks Act 1932
- Sewerage Act 1929
- Sewerage Regulations 1996

8.1.2 Australian Standards

- AS/NZS ISO 14001:1996 – Environmental management systems – Specification with guidance for use.
- AS 2436 – Guide to noise control on construction, maintenance and demolition sites.
- AS1216.1 – Hazardous Substances

8.1.3 State Government Publications

- Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry (SA)
- Code of Practice for the Control of Workplace Hazardous Substances (SA)
- NOHSC 2002-2005 Code of Practice for the Safe Removal of Asbestos (SA)

8.1.4 Other Requirements

- Bradken's "Environmental Regulations" procedure 2 BK SP ENV 100.

9. ORGANISATION STRUCTURE AND RESPONSIBILITIES

9.1 Organisation

The Project organisation chart in Appendix I of this Plan shows the interrelationships between the various project related functions.

9.2 Roles and Responsibilities

9.2.1 General Responsibilities

All Project team members and Contractors have a duty to, where practical, prevent or minimize environmental effects.

They also have a responsibility to:

- Comply with all statutory requirements.
- Conform to the procedures set out in this CEMP and any other relevant Bradken procedures.
- Successfully undertake all inductions and training required by this CEMP and other Bradken requirements.
- Report promptly to their supervisor any potential or actual environmental effect, incident or accident.

The duties and responsibilities of all Project Management staff are defined in Position Descriptions, a copy of which is held by the staff member. The duties and responsibilities with respect to environmental management are described below:

9.2.2 Manufacturing Manager

9.2.2.1 Description/Authority

The Site Manufacturing Manager is responsible for all environmental matters, (including the implementation and effectiveness of the CEMP).

9.2.2.2 Organisational Status

The Site Manufacturing Manager reports to the General Manager.

9.2.2.3 Responsibilities

The Site Manufacturing Manager shall be responsible for the environmental aspects of the construction activities, which include but are not limited to:

- Managing all environmental issues.
- Ensuring all staff are aware of the environmental legislation and regulations.
- Delegating environmental responsibility and authority.
- Reporting any non-compliance to senior management and the Environmental manager.
- Ensuring that environmental aspects and impacts assessment are carried out.

- Setting and approving environmental targets and allocating resources to achieve the agreed environmental targets.
- Ensuring all staff and contractors are aware of and trained in environmental matters.

9.2.3 Project Manager

9.2.3.1 Description/Authority

The Project Manager has overall authority in the determination of all matters affecting the implementation and operation of the project.

9.2.3.2 Organisational Status

The Project Manager reports to the Bradken Manufacturing Manager.

9.2.3.3 Responsibilities

The Project manager is responsible for:

- Preparation of CEMP and approval by Bradken Management;
- Maintaining controlled copy of CEMP;
- Update CEMP as required;
- Ensuring the construction works maintain compliance with all statutory requirements and approvals;
- Identifying resources and equipment for environmental purposes;
- Ensuring the provision of training to improve awareness/knowledge of environmental issues;
- Incorporating environmental management practices in project planning;
- Ensuring project operations are performed in accordance with specified requirements;
- Reviewing the effectiveness of the system for continuous improvement.

9.2.4 Project Environmental Officer (PEO)

9.2.4.1 Description/Authority

The PEO is responsible for implementing the CEMP and will be the authority for the project on environmental matters. The PEO has the authority to direct all activities to comply with the CEMP.

9.2.4.2 Organisational Status

The PEO has line responsibility to the Project Manager and has functional control over project staff during their performance of inspection duties.

9.2.4.3 Responsibilities

The Project Environmental Officer is responsible for:

- Developing, implementing and maintaining the CEMP to meet the requirements of the project;
- Advising Construction Management on environmental issues;

- Ensuring licence compliance;
- Assigning project staff to perform verification duties;
- Ensuring non-conformance is reported and ensuring that corrective action taken is effective;
- Implementing construction environmental training;
- Reviewing inspection reports and ensuring any actions required are initiated;
- Ensuring subcontractors fulfill their environmental obligations;
- Attending meetings called to discuss environmental issues;
- Assisting with the updating of the CEMP;
- Reviewing and authorising environmental procedures, forms and checklists;
- Liaison with the environmental representatives from the client and community groups;
- Assisting in the auditing/assessment of suppliers/subcontractors;
- Preparing and submitting monthly environmental management system reports to the Project Manager and Bradken senior management.

9.2.5 Construction Manager

9.2.5.1 Description/Authority

The Construction Manager is responsible for directing and co-coordinating the project labour force, including subcontractors, in the daily execution of the work in compliance with environmental requirements.

9.2.5.2 Organisational Status

The Construction Manager reports to the Project Manager.

9.2.5.3 Responsibilities

The Construction Manager is responsible for:

- Ensuring that environmental controls are established and maintained as per the CEMP;
- Ensuring that environmental protection requirements are communicated to all personnel and subcontractors under their control;
- Performing verification of environmental measures as requested by the PEO and in accordance with relevant project procedures;
- Identifying and reporting environmental non-conformance to the senior management;
- Rectifying work to comply with environmental requirements;
- Conducting regular environmental audits;
- Advising the PEO of any changes which that may affect the environmental performance of the works;
- Conducting risk assessments within their own area;
- Identifying the aspects and impacts of activities of work in their area;

- Managing the environmental performance and training of all contractors working in their area;
- Ensuring the contractors are aware of their environmental responsibilities.

9.2.6 Contractors

9.2.6.1 Responsibilities

All contractors and employees of contractors are required to:

- Report all environmental incidents or hazards to the Bradken contract superintendent or his representative;
- Carry out their duties in a manner that does not risk harm or nuisance to the environment or neighbours;
- Comply fully with Bradken policies and procedures;
- Conduct risk assessments within their own area;
- Identify the aspects and impacts of activities of work in their area;
- Manage the environmental performance and training of all contractors working in their area.

10. TRAINING, AWARENESS AND COMPETENCE

The Bradken Environmental Officer or delegate shall identify the overall environmental training needs for the Project staff and contractors.

This shall include as a minimum:

- An awareness of the environmental issues of their work area;
- An awareness of the Bradken Environmental Management System;
- An awareness of the Bradken Policy, Goals and Environmental Regulations plus the various procedures that apply to the construction site;
- An understanding of what to do in the event of an environmental emergency;
- The safe and legal disposal/recycling practices for the wastes generated.

Contractor competence shall be demonstrated by successful completion of induction training.

Staff competence shall be demonstrated by the successful completion of the probationary period.

Training shall be carried out under Bradken's "Environmental Training" procedure 2 BK SP ENV 250.

11. COMMUNICATION

11.1 Internal Communication

Internal communication of environmental issues within the Project organisation shall be carried out in accordance with the Bradken "Internal Environmental Communications" procedure 2 BK SP ENV 260.

A summary of this is set out in Table 2 below.

11.1.1 Responsibilities

The Manufacturing manager is responsible for managing internal communications whereby environmental issues are brought to the attention of those responsible.

The Construction Manager is responsible for ensuring that:

- Information obtained from the Manufacturing Manager and PEO is distributed to all staff and contractors;
- Information on environmental performance and incidents are passed on to Senior Management.

The Project Environmental Officer is responsible for assisting the Manufacturing Manager manage the internal communication system and ensuring that relevant information is disseminated to appropriate people.

Table 2: Internal Communication Methods

Method	Frequency	Participants	Formal record
General Site Inductions	On commencement and annually	All	Training records
Contractor construction site induction	On commencement and annually	All	Training records
Contractor selection meetings	As required	Project and Contractors Supervision and Management	Meeting Minutes
Risk assessments	As required	As required	Risk Assessment
Incident reports	As required	As required	Incident report
Job start meetings	Daily	Project and Contractors team members	Site diary
Contractor Progress meetings	Weekly	Project and Contractors Supervision and Management	Meeting Minutes
Project meetings	Monthly	Bradken and Project Management	Meeting Minutes
Monthly Environmental report	Monthly	Senior Management	Report

11.2 External Communication

Bradken shall manage all external communication in accordance with "External Environmental Communications" procedure 2 BK SP ENV 270.

11.2.1 Responsibilities

The Manufacturing Manager is responsible for

- Dealing with external environmental communications so that environmental issues are brought to the attention of those responsible;
- Ensuring all environmental communications with external interested parties are dealt with in a timely manner;
- Keeping records of all communications.

The Project Environmental Officer is responsible for:

- Assisting the Manufacturing Manager in setting up and implementing the external communication system;
- Assisting the Manufacturing Manager in dealing with external communications in a timely and appropriate manner.

12. COMPLAINTS AND INCIDENT MANAGEMENT

12.1 Complaints

All environmental complaints will be investigated using Bradken's "Environmental Complaint Reporting" procedure 2 BK SP ENV 280.

The purpose of this procedure is to ensure that environmental complaints are reported and corrective actions that have taken to prevent re-occurrence in the future have been recorded.

The Manufacturing Manager is responsible for dealing with all complaints and collecting all relevant data.

The Project Environmental Officer is responsible for assisting the Manufacturing Manager in dealing with the complaint and keeping records of the communications.

12.2 Incident Management

Environmental incident management will be handled using the Bradken "Incident Reporting and Investigation" procedure BK OHS 0601.

13. ENVIRONMENTAL MONITORING, AUDITING AND REPORTING

13.1 Monitoring

Bradken "Environmental Monitoring" procedure BK SP ENV 330 will be used to establish and maintain procedures to monitor and measure the construction activities that can have a significant impact on the environment.

Details of expected monitoring procedures required are included in Section 14

13.2 Records

Adequate records shall be kept by the Project Management group to demonstrate compliance to Legislative requirements and this CEMP. This shall include as a minimum the following:

- Daily Site Inspections as part of Site Supervisors OH&S checks;
- Weekly Site Inspections by the Project Manager;
- Sound measurement readings;
- Meeting minutes;
- Training records;
- Permits and approvals;
- Incident reports;
- Material MSDSs;
- Waste materials removed from site.

These records shall be maintained under the Bradken "Document and Record Control" procedure 2 BK SP ENV 300.

13.3 Audits

Audits will be carried out at two levels as set out in Bradken's "Environmental Auditing" policy 2BK SP ENV 350.

The first level is a Work Area Safety audit where environmental issues will be considered as part of the Housekeeping-Safety-Environment checklist. See procedure 2BK SP OHS Housekeeping.

Corrective actions on environmental issues shall be implemented in the same manner as those for safety issues.

The second level will be carried out as part of the sites Quality Assurance auditing procedures.

13.4 Reports

The Project Manager shall provide monthly reports on the environmental performance against the CEMP.

This will detail any non-conformances as well corrective measures.

14. KEY ENVIRONMENTAL ISSUES MANAGEMENT

14.1 Asbestos Removal and Other Demolition

14.1.1 Sources

Demolition of the existing furnace area will involve the handling and disposal of an existing asbestos roof.

Demolition of existing flooring and hard stand areas may reveal previously unidentified contamination hotspots.

14.1.2 Controls

The following measures will protect workers and the environment during demolition:

- Removal of asbestos roof sheeting or other asbestos products will be compliant with the SA Occupational Health Safety and Welfare Act, 1986 and the Code of Practice for Asbestos Removal; and
- A suitably qualified contractor shall submit an asbestos removal and disposal plan to Workplace Services. No work shall commence until approval to proceed has been received.
- Historical impacts to soil from unknown substances may be detected during demolition. A discovery will be treated as an incident triggering investigation under EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure." This will necessarily involve soil sampling and testing to determine the nature of the impact. It will also involve the carrying out of corrective actions, such as remediation, as appropriate.

14.2 Waste Management and Recycling

The primary principles of Avoidance, Reduce, Reuse, Recycle and Acceptable Disposal will be applied to the demolition and construction activities.

14.2.1 Sources

- Excavation materials for building foundations;
- Existing concrete floors and foundations;
- Redundant building steelwork, roof and wall sheeting;
- Miscellaneous building materials;
- Waste water from construction activities;
- Packaging materials;
- Office and domestic waste.

14.2.2 Controls

- Work Instruction BK3-E-001 General Environmental Rules;
- Work Instruction BK3-E-015 Disposal of Empty Spray cans;

- Where ever possible bulk excavation material will be reused on site. Bradken will confirm the suitability of material for reuse on site prior to reuse;
- Surplus excavation material and concrete will be made available as clean fill where appropriate;
- Waste demolition materials will be separated and stored in suitable containers for recycling;
- General wastewater from construction activities will be contained within the existing storm water runoff retention system;
- Liquid wastes shall be processed through the existing Bradken system. (See BK3-E-009 Disposal of Liquid Wastes);
- Packaging materials, office waste and domestic waste will be processed through the existing Bradken waste management streams. (See BK3-E-010 Disposal of General Wastes).
- Contractors will be required to manage their waste streams as part of their contract. Details of which will become part of their Contract Conditions.
- All waste that is disposed of off-site will be transported to a licensed facility in accordance with EPA requirements.

14.3 Hazardous Materials/Dangerous Goods

All Hazardous/Dangerous materials brought onto the construction site shall be handled by Bradken's existing on-site procedures.

14.3.1 Sources

- Diesel and petrol fuels;
- Paints and thinners;
- Sealants, glues and grouts;
- Oils, lubricants and greases; and
- Refractory materials

14.3.2 Controls

- Work Instruction BK3-E-007 Clean-up of General Spillage;
- Work Instruction BK3-E-009 Disposal of Liquid Wastes;
- All materials to be used on site shall have an MSDS submitted to Project Management for approval, prior to the materials arriving on site.
- Based on the MSDS, procedures shall be prepared for the safe storage, handling and disposal if required.
- Special procedures shall be prepared for the storage and handling of fuels on site, for off-road vehicle refuelling.
- Hazardous materials handling procedures shall be discussed at Job-Start meetings to ensure team members are familiar with requirements.
- Spill kits shall be made available on site in areas of potential risk.

14.4 Noise and Vibration

14.4.1 Sources

Noise and vibration may be created by the use of equipment at various times during the construction of the facility. The principal contributors to this will be:

- Contractors' vehicles normally at the start and finish of each day.
- Rock breakers and jackhammers during demolition of redundant concrete foundations and flooring.
- Piling equipment for pile construction;
- Earth moving and compaction equipment during the construction of foundations and floors.
- Concrete delivery trucks during construction of foundations and floors.
- Cranes and Elevating Work Platforms during erection of steel work and cladding.
- General daily construction activities;
- Equipment commissioning

14.4.2 Controls

- Work Instruction BK3-E-005 Environmental Noise Control
- Management of construction hours in accordance with EPA guidelines;
- Scheduling of noisy machines such as jackhammers after 9:00am;
- Locating noisy equipment so that the impact on neighbouring premises is minimised;
- Between work periods, builders will shut down, or throttle to a minimum machines such as backhoes, cranes, bobcats, loaders and generators;
- All equipment will be properly maintained, with special attention to mufflers and other noise control devices. Equipment failing to meet acceptable noise levels will not be used.
- Special noise minimisation requirements will be put into any Tender Contract Conditions;
- Local residents to be pre warned of any relatively high construction noise activities.

14.5 Erosion and Sedimentation Control

14.5.1 Sources

The principal sources for erosion and sedimentation will be:

- Exposed foundations for building footings and floors in the period between demolition of existing and construction of new foundations and floors.
- Stockpiled excavation materials

14.5.2 Controls

- Management of excavated material and waste;

- Diversion of affected storm and waste water to the existing holding pond prior to disposal as required.
- Spray stockpiles with water during periods of wind to prevent dust generation.
- Cleaning of earth moving equipment prior to leaving site if required.
- Minimising time excavations are exposed to weather

Note: Water used for spraying stockpiles and wheel wash will be sourced from the mains water supply until stormwater reuse can be implemented.

14.6 Access and Traffic

14.6.1 Sources

Traffic movements generated by the construction activities will include:

- Contractors vehicles at the commencement and completion of work each day;
- Material deliveries at infrequent and random times during the construction phase;
- Deliveries of concrete during concrete pours. Can be frequent for a short period of time usually in the mornings;
- Deliveries of large pieces of equipment at very infrequent and random times during the construction phase;
- Transport of off-road machinery by low loader at infrequent and random times during the early stages of construction;
- Mobile Cranes for erection of steelwork and equipment at infrequent and random times;

14.6.2 Controls

- Preparation of a Traffic Management Plan in conjunction with contractors and suppliers;
- Off-site storage and lay down areas to ensure just-in-time deliveries to site;
- Minimising traffic impacts through the planning of materials deliveries;

14.7 Transport and Storage of Construction Materials

Construction materials will be delivered to site using trucks via the main gate on Cromwell Road.

Concrete will be sourced from external suppliers to avoid impacts on Bradken's neighbours that will arise if a temporary concrete batching plant were established on the site. Suppliers in the nearby Wingfield area will be preferred in order to minimise the distance that concrete must be transported on the road network. Temporary truck washdown areas will be established on site on an as-needs basis.

Once delivered to site, construction materials will be stored on the concrete lay down area located near the northern boundary of the site. Standard stormwater collection and control procedures will be put in place to prevent contamination of run-off.

14.8 Hazards and Risk Management

A formal risk assessment will be carried out for all hazardous construction tasks and any environmental effects will be considered during this process. Any significant hazards or risks found will be managed as part of the Project Management process.

If required, additional procedures will be prepared and added to the CEMP.

14.9 Utilities and Services

Sources of risk to the environment could come from breakages to service lines during construction whether inadvertent or not.

These will be controlled by Bradken's "Permit to Work" or "Excavation Permit" system as required.

14.10 Dust / Air Management

14.10.1 Sources

The principal sources of dust generation will come from:

- Excavation activities during dry windy conditions;
- Presence of excavated material stockpiles;
- Traffic movements over disturbed earthworks;
- Earth and dust contaminated trucks leaving site;

14.10.2 Controls

- Work Instruction BK3-E-013 Control of Fugitive Dust, Fume, Noise and Odour;
- Exposed earthworks and stockpiles will be watered in dry and windy conditions;
- Earthworks will be exposed for minimum periods;
- Trucks transporting materials off site will be cleaned down if required.
- All loose loads of materials will be covered as appropriate;

Note: Water used for dust management purposes will be sourced from the mains water supply until stormwater reuse can be implemented.

14.11 Fugitive emissions

14.11.1 Sources

Construction of the new foundry buildings will involve either full or partial demolition of the existing foundry buildings. During this construction period, it is intended that production operations will continue. Fugitive emissions may escape from these demolition areas and areas under construction.

14.11.2 Controls

In order to manage the escape of fugitive emissions from partially or fully demolished buildings, Bradken proposes the following production sequence:

- The existing core production equipment currently located inside the north eastern annex of the main foundry building will be relocated inside the main foundry building.
- The north eastern annex will be demolished following the removal of the core production equipment. The existing roof of the annex is asbestos, therefore; the roof will be isolated from surrounding areas prior to demolition. A partition wall will be built between the annex and the main foundry building to isolate the asbestos removal work from foundry employees. This partition will also provide a barrier to fugitive emissions.
- Following the removal of the north eastern annex, the area will be cleaned and levelled. Construction emissions will be controlled as per the CEMP.
- The construction of the northern end of the proposed new furnace building, including civil works and installation of the new EAF (Stage 1) will then commence. Existing production will be disrupted during this period as forklifts and product movements will need to go around the construction area. Construction of Stage 1 will continue for 12 months.
- The new EAF will not be commissioned until after the extraction and noise attenuation equipment for the new EAF have first been commissioned. Once the new EAF is operational, production from the old EAF will be reduced and transferred to the new EAF.
- The south eastern annex of the main foundry building will then be demolished. The existing roof of the annex is asbestos, therefore; the roof will be isolated from surrounding areas prior to removal. A partition wall will be built between the annex and the main foundry building to isolate the asbestos removal work from foundry employees. This partition will also provide a barrier to fugitive emissions.
- With the south eastern annex removed, the area will be cleaned and levelled. Construction emissions will be controlled as per the CEMP.
- Construction of the southern end of the new furnace building (Stage 2) will have no impact on site emissions.
- Following completion of Stage 2, existing equipment and new moulding equipment will be installed into this new building. All equipment will be commissioned following the commissioning of the required environmental control equipment.

14.12 Lighting

14.12.1 Sources

- Lighting is required for periods of low light, indoor construction activities, and for evening work. Lighting is used for construction activities, personnel security and safety, and equipment security and safety during non working hours.

14.12.2 Controls

Construction lighting is intended to be minimised through the following:

- Construction Risk Assessments
- Consultations with neighbours as required

- The 4m high noise attenuation barrier on the Eastern boundary will act as a light barrier.
- Construction work hours are typically during periods of good natural light.
- All hazardous work will be undertaken during the day
- Equipment lay down and storage areas to be chosen with consideration for minimisation of light leaving the site.

14.13 Stormwater

14.13.1 Sources

The principal impacts to stormwater will come from:

- Exposed foundations for building footings and floors in the period between demolition of existing and construction of new foundations and floors;
- Stockpiled excavation materials;
- Waste water from construction activities; and
- Litter.

14.13.2 Controls

In addition to the other measures set out in this CEMP:

- Contractors and construction crews will be made aware of the Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry (SA)
- Construction work will be carried out in accordance with the Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry as far as reasonably practicable.
- The area of exposed soil at any one time will be minimized.
- Rainwater runoff near the construction area will be diverted so that it does not run through the construction site.
- Liquid wastes will be properly disposed of in compliance with the Trade Waste Discharge Permit as detailed in Work Instruction BK-E-009.
- Measures will be in place to ensure that no chemicals, oils or other foreign substances are washed into the stormwater system. Specific actions are detailed in Work Instruction BK3-E-001.
- Hardstand areas will be regularly cleaned to minimise solid particles entering the stormwater system during rainfall events.
- Monthly reports identifying any significant water related issues during that month will be compiled.
- Incident reports will be complied if required in accordance with EMS procedure BK OHS 0601 “Incident Reporting and Investigation Procedure.”

15. EMERGENCY RESPONSE

Any emergency during construction will be handling by the existing Bradken site "Occupational Health and Safety Emergency Plan"

The environment aspects of these procedures are set out in Bradken "Environmental Emergency Planning" procedure 2 BK SP ENV 310.

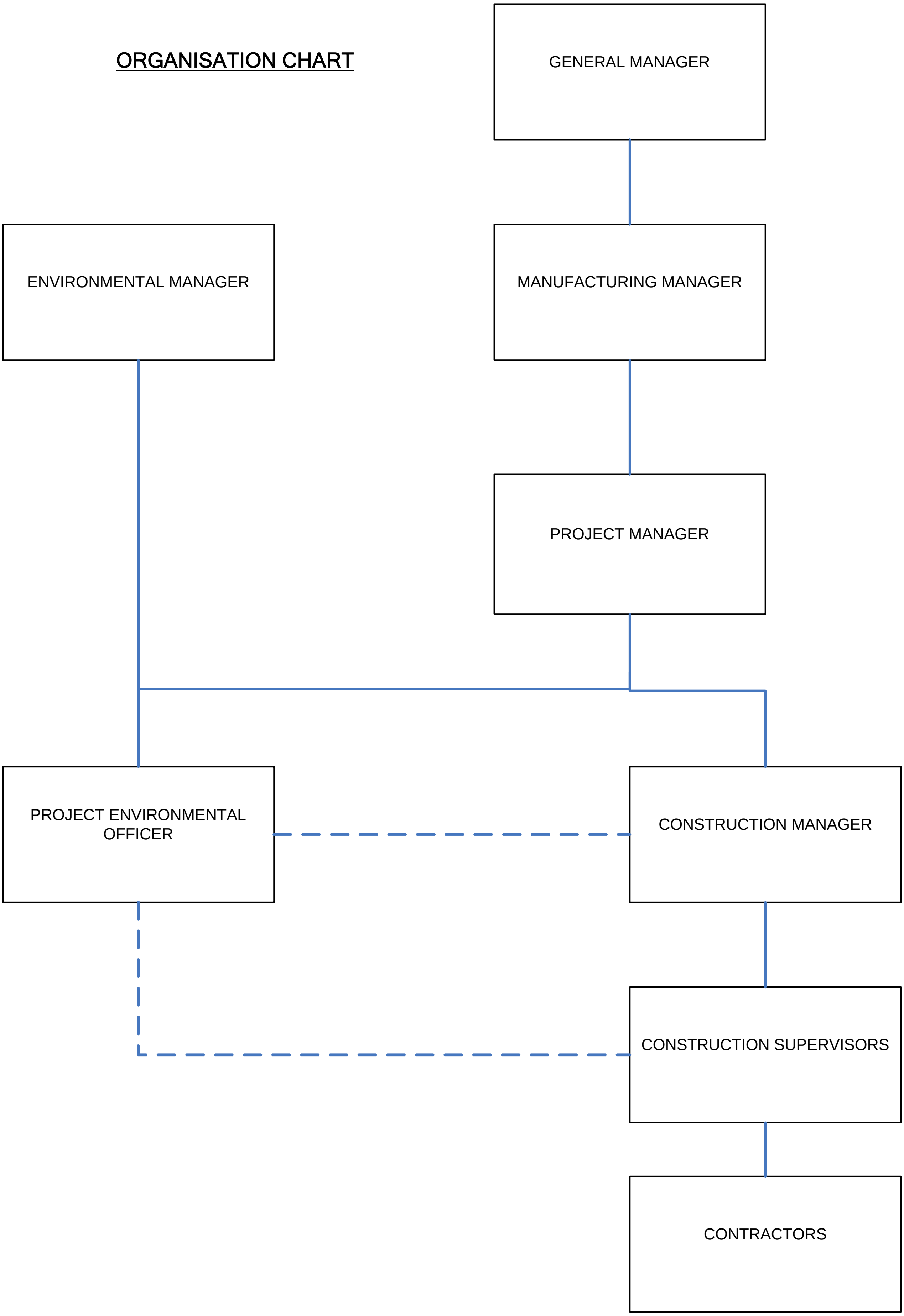
16. MANAGEMENT REVIEW

Management review of the CEMP shall be carried out as part of the normal Bradken "Environmental Management Review" procedure 2 BK SP ENV 360.

Appendix I

Organisation Chart

ORGANISATION CHART



Appendix II

Bradken Referenced Policies and Procedures

APPENDIX II

REFERENCE BRADKEN POLICIES AND PROCEDURES

2 BK SP ENV 010	Environmental Strategy
2 BK SP ENV 100	Environmental Regulations
2 BK SP ENV 200	Environmental Aspects & Impact Assessment
2 BK SP ENV 210	Environmental Risk Assessment
2 BK SP ENV 220	Environmental Legal Compliance
2 BK SP ENV 230	Environmental Goals, Targets & Improvement Plans
2 BK SP ENV 240	Environmental Responsibilities
2 BK SP ENV 250	Environmental Training
2 BK SP ENV 260	Internal Environmental Communications
2 BK SP ENV 270	External Environmental Communications
2 BK SP ENV 280	Environmental Complaint Reporting
2 BK SP ENV 282	Environmental Complaint form
2 BK SP ENV 290	Annual Environmental Report
2 BK SP ENV 300	Environmental Document & Record Control
2 BK SP ENV 310	Environmental Emergency Planning
2 BK SP ENV 320	Environmental Operations Control
2 BK SP ENV 330	Environmental Monitoring
2 BK SP ENV 350	Environmental Auditing
2 BK SP ENV 360	Environmental Management Review
BK3-E-001	General Environmental Rules
BK3-E-005	Environmental Noise Control
BK3-E-008	Handling and Disposal of Asbestos, Kaowool and PCB
BK3-E-009	Disposal of Liquid Wastes
BK3-E-010	Disposal of General Wastes
BK3-E-012	EPA Licence Conditions
BK3-E-013	Control of Fugitive Dust, Fume, Noise and Odour
BK3-E-014	Environmental Emergency Response Plan
BK3-E-015	Disposal of Empty Spray Cans
BK3-E-016	Control of Wooden Pallets

Appendix III

Bradken ISO 14001 Accreditation

Environmental System

Certified
Environmental
Management

CERTIFICATE OF REGISTRATION

BRADKEN PTY LTD

Cromwell Road,KILBURN,SA,5084,Australia

complies with the requirements of

ISO 14001:2004

Environmental management systems - Specification with guidance for use

for the following capability

The registration covers the Environmental Management System for the manufacture of steel and iron castings for the mining, quarrying, transportation and general engineering industries. The registration does not cover sales.

Registered by:

SAI Global Certification Services Pty Ltd (ACN 108 716 669) 286 Sussex Street Sydney NSW 2000 Australia with SAI Global Limited ("SAI Global") and subject to the SAI Global Terms and Conditions for Certification. While all due care and skill was exercised in carrying out this assessment, SAI Global accepts responsibility only for proven negligence. This certificate remains the property of SAI Global and must be returned to SAI Global upon its request.

Certificate No: C10126
Issue Date: 11 April 2006

Certified Date: 18 June 1999
Expiry Date: 15 September 2007

Alex Ezrakhovich
General Manager Certification
for and on behalf of
SAI Global

Authorised Local Signatory, SAI Global

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SAI Global is Accredited by the Joint Accreditation System of Australia and New Zealand. Acc No.Z1581 99AS

IQNet MEMBER

The ANAB accreditation mark that appears on this electronic certificate is the new ANAB mark that, effective 1 January 2005, replaces the ANSI-RAB NAP mark. However, for any certificate issued prior to 1 January 2005, the accreditation mark on the original certificate is the ANSI-RAB NAP mark.

Appendix IV

Bradken Environmental Policy

Adelaide Foundry
Environmental Policy Statement

This Environmental Statement applies to the Bradken Mineral Processing Adelaide Foundry and supplements the Bradken Environmental Policy. The Adelaide site produces steel castings for the mining, mineral processing and general industries.

The Adelaide Foundry is committed to conducting our steel casting business in an environmentally sound manner; in particular we are committed to:

- Compliance - Ensuring that the Adelaide foundry has the management systems and operating procedures, which will ensure compliance with the spirit of the law, as well as with applicable statutory requirements, and identify, control and monitor the environmental risks associated with the operation.
- Careful Practices - Adopting practices, which minimise any adverse environmental impact of this site, and aiming to achieve a high standard of environmental care. This includes practices to minimise the impact of nuisance noise and dust issues.
- Communication - Maintaining open and constructive communication with government, industry bodies and the community on environmental issues, and contributing to the development of national policies and regulations.
- Information - Providing employees and customers with information about the environmental impact of products and services, and ensuring that suppliers and contractors are aware of the environmental policy and are encouraged to apply a comparable standard of environmental care.
- Efficiency - Requiring all areas of its businesses to continually improve production methods and processes to make the most efficient use of resources, minimise waste and emission, and reduce any adverse environmental impact by utilising responsible pollution control practices. There is a focus on the beneficial reuse of wastes in environmentally acceptable ways and adopting “cleaner production” methods that eliminate wastes at the source.

DARREN ELLIOTT
MANUFACTURING MANAGER

Appendix N

Environmental Management and Monitoring Plan

Draft Environmental Management and Monitoring Plan

Adelaide Foundry

Bradken Resources

Draft Environmental Management and Monitoring Plan

Adelaide Foundry

Bradken Resources

Prepared For:

Bradken Resources Pty Ltd

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Report Details:

File Name: 5777 EMMP Rev 5.doc

This report has been collated and prepared by:

Susan Kay Environmental Scientist	**Date**

This report has been checked and authorised by:

Jeremy Pola Senior Environmental Scientist	**Date**

October, 2006
Draft Report
Job No: 5999
Folder No: 5777

TABLE OF CONTENTS

1. INTRODUCTION

Bradken Resources Pty Ltd recently recognised an economic need to upgrade their Adelaide foundry at Kilburn, South Australia. The proposed upgrade of the foundry will include an increase in production to 32 000 tonnes per annum of high quality steel casting. The production increase will be achieved through the installation of a 20 tonne EAF and "Fast-Loop" moulding and cooling system. To facilitate the increase in production a number of environmental improvements are proposed to ensure that the amenity and environmental values of the surrounding land uses are maintained.

This document is the Environmental Management and Monitoring Plan (EMMP) and will ensure that appropriate environmental management practices are developed for the ongoing operation of the upgraded facility.

1.1 Project Description

Bradken is the owner of the Adelaide site known as Lot 32-36 Cromwell Road, Kilburn and is situated within the General Industry (1) zone under the *Port Adelaide Enfield (City) Development Plan 2005* (**Figure 1**).

The site has an approximate area of 5 hectares.

The plant is bordered by a number of different land uses including the existing industrial complex of Plastics Granulation Services, which is situated immediately to the north and west of the site. The Enfield Community Food Centre is situated on the south-western corner of Cromwell Road and Blackburn Street and the Council works depot is located to the north of the site.

Residential development is also within the locality, and is situated on the opposite side of Blackburn Street, to the west of the plant and on Nelson Street to the east. A large oval and open grounds associated with the offices of the South Australian Canine Association is situated on the opposite side of Cromwell Road, south of the plant.

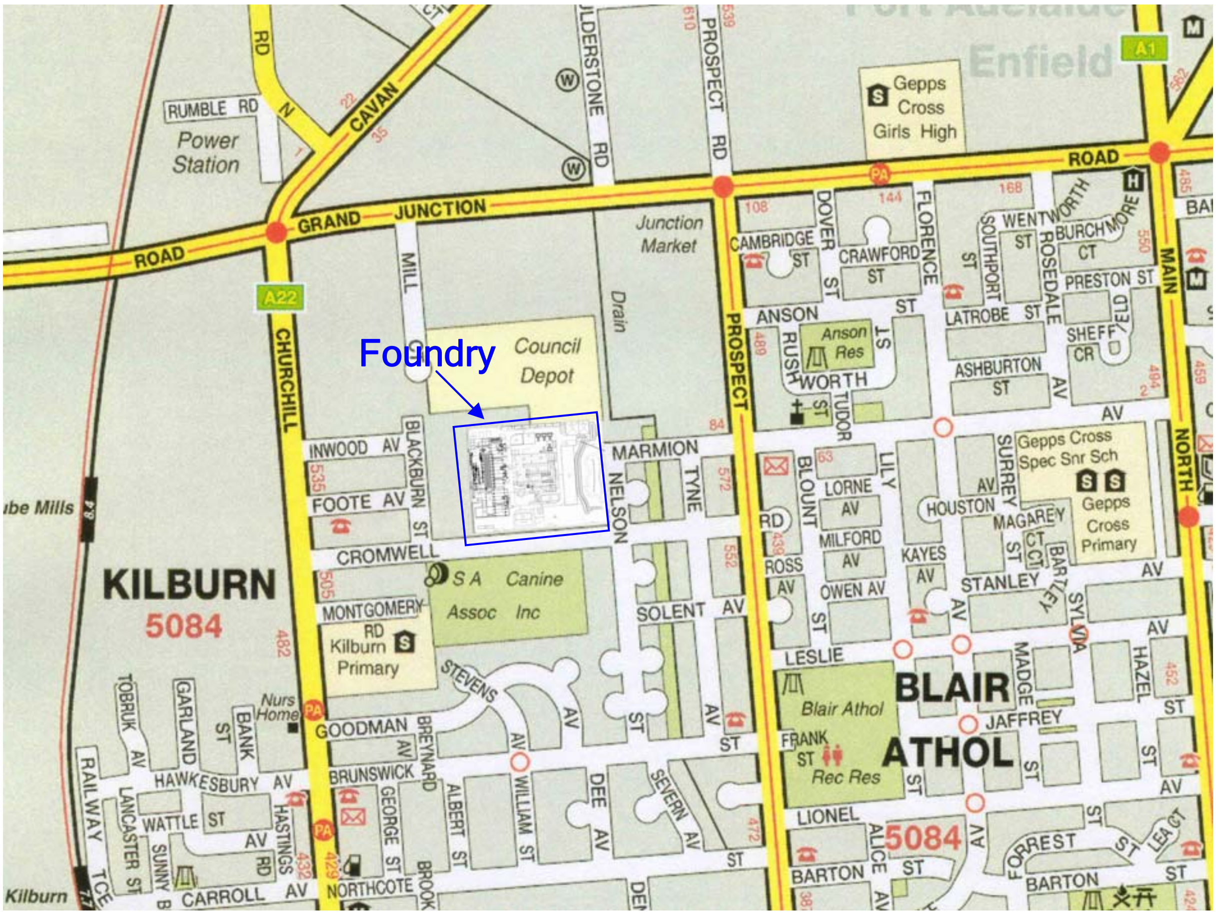

Figure 1: Foundry Location

Source: UBD,2005

1.2 Operation Activities

The basic steps in a typical foundry process are listed below and outlined in Figure 2. Figure 2 also indicates the potential sources of particulate and other air emissions resulting from the foundry process.

1. Raw material handling and preparation;
2. Metal melting;
3. Mould and core production; and
4. Casting and finishing.

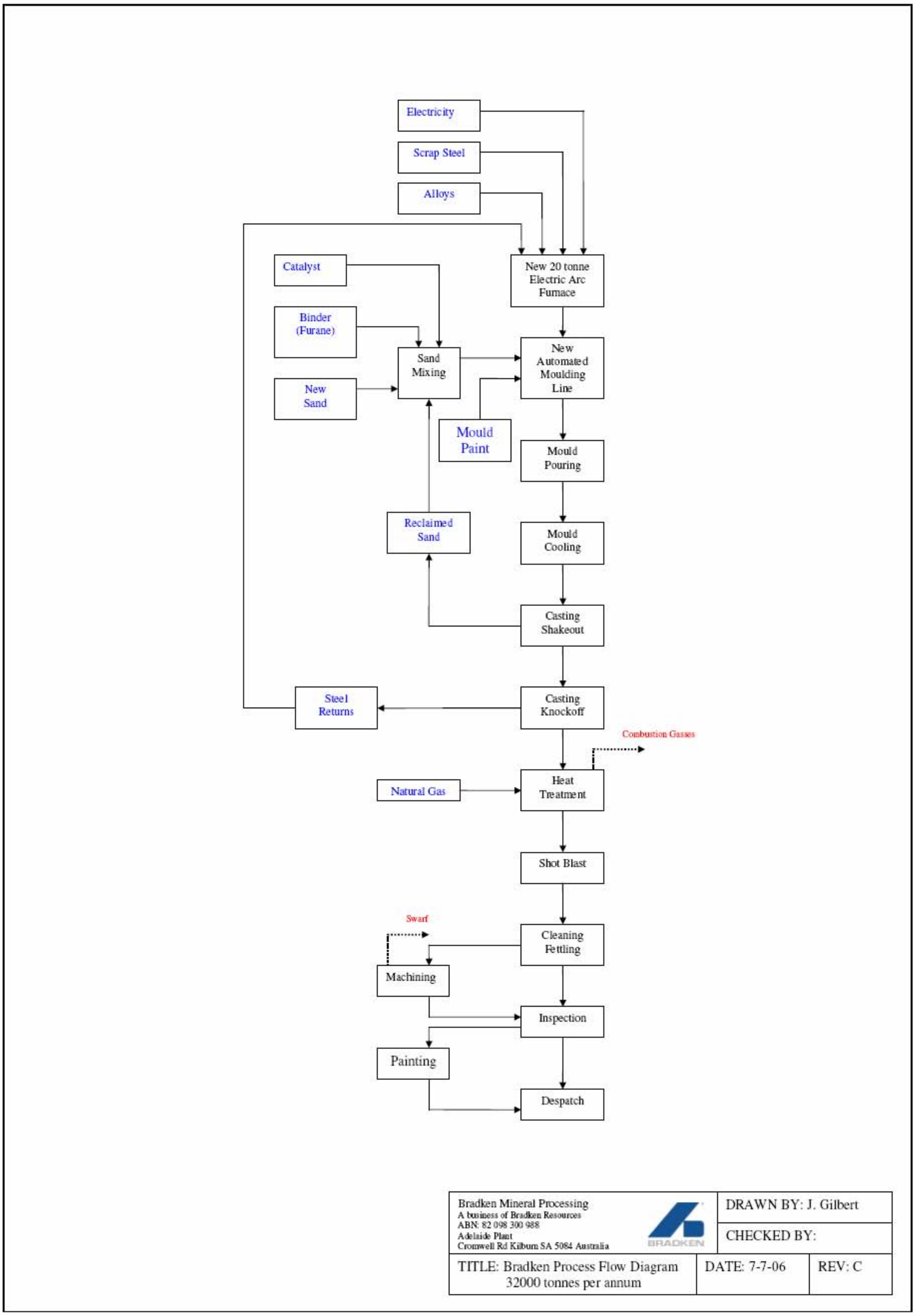

Figure 2: Foundry Process and Emissions Diagram

The foundry workforce consists of 180 employees working three 8-hours shifts per day seven days per week.

2. EMMP OBJECTIVES

The EMMP provides a framework for managing and/or mitigating the environmental impacts for the life of the facility, and also makes provision for auditing the effectiveness of the proposed environmental protection measures and procedures.

2.1 Environmental Policy

The Adelaide foundry's existing environmental policies and Bradken's corporate Environmental Management System (EMS) are the basis of this EMMP. The foundry process and procedures for handling, treatment and disposal of waste will not significantly change following the foundry upgrade, and as such the existing policies and procedures remain relevant.

The Adelaide foundry has developed an Environmental Policy Statement outlining their commitment to operating in an environmentally sound manner. In particular, the statement affirms Bradken Adelaide's commitment to:

- **Compliance -** Ensuring that the Adelaide foundry has the management systems and operating procedures, which will ensure compliance with the spirit of the law, as well as with applicable statutory requirements, and identify, control and monitor the environmental risks associated with the operation.
- **Careful Practices -** Adopting practices, which minimise any adverse environmental impact of this site, and aiming to achieve a high standard of environmental care. This includes practices to minimise the impact of nuisance noise and dust issues.
- **Communication -** Maintaining open and constructive communication with government, industry bodies and the community on environmental issues, and contributing to the development of national policies and regulations.
- **Information -** Providing employees and customers with information about the environmental impact of products and services, and ensuring that suppliers and contractors are aware of the environmental policy and are encouraged to apply a comparable standard of environmental care.
- **Efficiency -** Requiring all areas of its businesses to continually improve production methods and processes to make the most efficient use of resources, minimise waste and emission, and reduce any adverse environmental impact by utilising responsible pollution control practices. There is a focus on the beneficial reuse of wastes in environmentally acceptable ways and adopting "cleaner production" methods that eliminate wastes at the source.

Bradken's site specific Work Instructions detail responsibility and instruction for dealing with a variety of environmental issues in a manner which fulfils the Environmental Policy Statement.

Key elements of the Work Instructions are detailed in Section 8 of this EMMP.

3. APPROVAL AND LICENSING REQUIREMENTS

3.1.1 Environmental Protection Act 1993

The *Environment Protection Act, 1993* is the principal legislation addressing pollution in South Australia. In particular, Section 25 imposes the general environmental duty on all persons undertaking an activity that pollutes (or might pollute) to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

Metal melting is a *Prescribed Activity of Environmental Significance* under Schedule 1 of the Act. Foundries with a capacity to melt in excess of 500 kilograms of metal per production cycle require authorisation in the form of a licence.

The current foundry operation is licensed under Part 6 of the *Environment Protection Act 1993* for the following activities:

- 2(7) Ferrous and Non-ferrous Metal Melting
- 3(4) Activities Producing Listed Waste

Environment protection legislation also includes Environment Protection Policies (EPPs), which outline guidelines and mandatory requirements for the protection of a particular aspect of the environment. Policies relevant to this development are:

- Environment Protection (Air Quality) Policy 1994;
- Environment Protection (Machine Noise) Policy 1994;
- Environment Protection (Industrial Noise) Policy 1994;
- Environment Protection (Waste Management) Policy 1994; and
- Environment Protection (Water Quality) Policy 2003.

3.1.2 EPA Licence (EPA 13845)

Work Instruction BK3-E-012 details the primary conditions of the EPA licence issued to Bradken Adelaide.

The site Environmental Officer is responsible for ensuring all EPA licence conditions are met and that the licence is renewed and fees paid prior to the expiry date.

3.2 Trade Waste Discharge Permit

The South Australian Water Corporation has granted a Trade Waste Discharge Permit to Bradken for the Adelaide Foundry to discharge trade wastewater into SA Water's sewer. The conditions of this permit are listed in Work Instruction BK3-E-004.

3.3 Environmental Improvement Program (EIP)

Bradken has prepared a voluntary Environmental Improvement Program (EIP) to address odour complaints and assumed health issues arising from the emissions from the foundry. The EIP has been developed with the aim of achieving compliance with the standards in the EPA Guideline "Odour Assessment using Odour Source Modelling".

Following the upgrade of the foundry operation it is predicted that offsite odour impacts from the operation will be greatly reduced and the majority of actions identified in the EIP will be completed. However, it has been recognised that implementation of the EIP is an on-going process and may continue beyond the completion of the foundry upgrade.

3.4 Bradken Environmental Management System

Bradken has developed a corporate level Environmental Management System (EMS). The EMS provides the means to identify, manage and monitor environmental risk associated with the company's activities, products and services. The system focuses on pollution prevention, resource management and continuous improvement of environmental performance. Key elements of the EMS are incorporated into this EMMP.

3.5 Site Specific Environmental Policies

Bradken Adelaide's existing site specific environmental Work Instructions form the basis of the EMMP. Key elements of the Work Instructions are included in Section 8 of this EMMP. The Work Instructions relate to:

- BK3-E-001 General Environmental Rules
- BK3-E-002 Disposal of Furnace Baghouse Dust
- BK3-E-003 Monitoring of Baghouse Performance
- BK3-E-004 Environmental Sampling and Monitoring
- BK3-E-005 Environmental Noise Control
- BK3-E-006 Disposal and Recycling of Containers, Waste Oils, Swarf and other Chemicals
- BK3-E-007 Clean-up of General Spillage
- BK3-E-008 Handling and Disposal of Asbestos, Kaowool and PCB
- BK3-E-009 Disposal of Liquid Wastes
- BK3-E-010 Disposal of General Wastes
- BK3-E-011 Disposal of Solid Production Wastes
- BK3-E-012 EPA Licence Conditions
- BK3-E-013 Control of Fugitive Dust, Fume, Noise and Odour
- BK3-E-014 Environmental Emergency Response Plan
- BK3-E-015 Disposal of Empty Spray Cans
- BK3-E-016 Control of Wooden Pallets

4. ENVIRONMENTAL MANAGEMENT STRUCTURE AND RESPONSIBILITY

Bradken's existing environmental Work Instructions detail the roles and responsibilities of personnel accountable for environmental management. An organisational chart will be contained in **Appendix I**. The identified roles and responsibilities are listed below.

4.1 Manufacturing Manager

4.1.1 Description

The site Manufacturing Manager holds overall responsibility for all site matters, ensuring that the commitments made during the development process and consequently in the EMMP are supported and achieved.

4.1.2 Organisational Status

The Manufacturing Manager reports to the General Manager.

4.1.3 Responsibilities

The Manufacturing Manager is responsible for:

- Developing and maintaining a culture of environmental responsibility at the Adelaide foundry;
- Supporting the implementation of the EMMP; and
- Reporting any non-compliance to senior management.

4.2 Plant Engineer

4.2.1 Description

The Plant Engineer has overall authority in all site matters and has ultimate responsibility for the development and implementation of the EMMP.

4.2.2 Organisational Status

The Plant Engineer reports to the Manufacturing Manager.

4.2.3 Responsibilities

The Plant Engineer is responsible for:

- Ensuring the content and implementation of the EMMP is consistent with commitments made during the development process and the Bradken EMS;
- Reviewing and approving monthly and annual environmental reports;
- Developing and maintaining a culture of environmental responsibility at the Adelaide foundry;
- Approving environmental targets and allocating resources to achieve the agreed environmental targets;
- Approving corrective environmental actions; and
- Reporting any issues of non-compliance to the Manufacturing Manager.

4.3 Bradken Environmental Officer

4.3.1 Description

The Environmental Officer is responsible for the implementation of the EMMP and is the authority for the foundry on all environmental matters. The Environmental Officer has the authority to direct all activities to comply with the EMMP.

4.3.2 Organisational Status

The Environmental Officer has responsibility to the Manufacturing Manager and has functional control over staff during their performance of inspection duties.

4.3.3 Responsibilities

The Environmental Officer is responsible for:

- Developing, implementing and maintaining the EMMP as a relevant, living document;
- Maintaining appropriate licences and approvals and ensuring compliance, as specified in environmental policy BK3-E-012 "EPA Licence Conditions";
- Maintaining and enforcing Bradken's environmental Work Instructions;
- Developing and implementing regular environmental staff training;
- Advising management, staff and contractors on day-to-day environmental issues;
- Liaison with residents and community groups in relation to environmental issues;
- Reviewing inspection reports and ensuring any actions required are initiated;
- Environmental auditing of suppliers and contractors;
- Preparing monthly EMS reports to Bradken senior management; and
- Reporting incidences of environmental non-compliance to senior management.

4.4 Supervisors

4.4.1 Description

Supervisors are responsible for ensuring that their operators receive appropriate training and comply with environmental Work Instructions. Supervisors are required to take any appropriate immediate corrective action to minimise and or eliminate adverse environmental impacts.

4.4.2 Organisational Status

Supervisors have direct responsibility to the Manufacturing Manager and have functional control over Production Operators.

4.4.3 Responsibilities

Supervisors are responsible for:

- Undertaking weekly inspection reports as part of regular shift duties and reporting any areas of environmental concern to the Environmental Officer;
- Possessing a working knowledge of Bradken's environmental Work Instructions and managing shift operations accordingly;
- Possessing an awareness of the EMMP;
- Identifying resources and training opportunities to assist in environmental compliance and reporting these to the Environmental Officer;
- Encouraging a culture of environmental awareness and responsibility on the foundry floor; and
- Reporting any incidences of non-compliance to the Environmental Officer in a timely manner.

4.5 Production Operators

4.5.1 Description

Production Operators are responsible for complying with relevant aspects of environmental Work Instructions. Operators are authorised to take any appropriate immediate corrective action to minimise or eliminate adverse environmental impacts.

4.5.2 Organisational Status

Production Operators have direct responsibility to their shift Supervisors.

4.5.3 Responsibilities

Production Operators have the following responsibilities:

- Awareness of Bradken's environmental policies and EMMP;
- Successfully undertake all environmental inductions and training as required; and
- Report any environmental incidences, including 'near-misses' to their Supervisor in a timely manner.

4.6 All Staff and Employees

All staff and employees are responsible for:

- Carrying out duties in a manner that does not risk harm or nuisance to the environment or neighbours;
- Complying with Bradken policies, procedures, Work Instructions and regulations.

4.7 Contractors

All contractors and employees of contractors employed on any Bradken operation are required to:

- Report on all environmental incidents to the Bradken representative responsible for that work. If the person is not available, report the matter to the nearest Bradken Supervisor;
- Carry out their duties in a manner that does not risk harm or nuisance to the environment or neighbours;
- Comply with Bradken's policies or procedures;
- Comply with the Bradken Environmental Emergency Procedures and instructions;
- Report all environmental incidents or hazards to the contract superintendent or their representative;
- Remove all wastes produced by their activities from the site at their expense, unless otherwise agreed in writing by site management.

It is the responsibility of the Bradken officer supervising the contractors to advise them of their environmental responsibilities. The *Contractor Permit to Work* form is used to ensure contractors comply with requirements.

5. REPORTING

Bradken undertakes the following reports to detail their environmental performance:

- Inspection Reports;
- Monthly Reports;
- Annual Reports;
- Complaint Reports; and
- Incident Reports.

5.1 Inspection Reports

Inspection reports are undertaken weekly by the shift supervisor. The inspection reports detail any occupational, health and safety, maintenance or environmental issues recognised within their work area. All areas of environmental concern identified by the weekly reports are relayed to the Environmental Officer for action.

5.2 Monthly Reports

The monthly report is compiled by the Environmental Officer identifying any significant environmental issues and progress with environmental projects during the month. The report is submitted to the Bradken Environmental Manager who will produce a summary of identified issues across all sites for presentation to Bradken senior management.

5.3 Annual Reports

Annual reporting is undertaken to ensure the Board, Managing Director and the Bradken Environmental Manager are formally and fully informed of significant environmental issues affecting the business and to provide data for the corporate environmental reporting and strategic planning.

The annual report is completed to a template EMS procedure 2 BK SP ENV 292 'Annual Environmental Report Form' to ensure consistency across the various Bradken sites. It is in the form of a questionnaire with the following information collected:

- An assessment of the development and effectiveness of the site's EMS;
- National Pollutant Inventory data;
- Greenhouse gas emission data;
- Legislative and licence compliance assessments;
- Environmental improvement project reports;
- Community and environmental authority contacts and issues; and
- Resource and waste management.

The Manufacturing Manager has overall responsibility for ensuring the timely and accurate completion of the annual report.

5.4 Complaint Reports

Complaint reports ensure environmental complaints are reported and recorded and that corrective actions are put in place to prevent re-occurrence in the future. The format for complaint reports is generic across all Bradken sites. The complaint report template and detailed instructions for completing the report are contained in Bradken's EMS procedure BK ENV 270 'External Environmental Communications'.

5.5 Incident Reports

All environmental incidents, spills, failure of equipment etc. are to be reported using the procedure and forms described in EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure".

5.6 Document and Record Control

The procedure for document and record control is detailed in EMS procedure 2 BK SP ENV 300 "Environmental Document & Record Control".

The Bradken Environmental Manager controls corporate EMS documents, while the site specific Work Instructions are controlled by the Adelaide Environmental Officer.

5.7 Communication Protocols

5.7.1 Internal Communications

Internal environmental communications between various levels and functions of the organisation should be undertaken according to EMS procedure 2 BK SP ENV 260 "Internal Environmental Communications".

5.7.1.1 Responsibilities

The Manufacturing Manager is responsible for managing internal communications whereby environmental issues are brought to the attention of those accountable.

The Environmental Officer is responsible for assisting the Manufacturing Manager in managing internal environmental communications and ensuring that relevant information received is disseminated to the workforce.

Supervisors are responsible for ensuring that:

- Information obtained from the Manufacturing Manager and Environmental Officer is disseminated to all employees under their supervision, where applicable; and
- Information on environmental performance, incidents etc. in their areas is passed on to site senior management.

The records of the environmental communications, reports and meetings are to be regarded as controlled environmental records and must be kept.

5.7.2 External Communications

The procedure for external environmental communications is described in EMS procedure 2 BK SP ENV 270 “External Environmental Communications”. The procedure outlines the method for receiving, documenting and responding to external parties interested in Bradken’s environmental issues.

5.7.2.1 Responsibilities

The Manufacturing Manager is responsible for:

- Dealing with external environmental communications so that environmental issues are brought to the attention of those accountable;
- Ensuring all environmental communications with external interested parties are dealt with in a timely manner;
- Keeping records of all communications.

The Environmental Officer is responsible for:

- Assisting the Manufacturing Manager in setting up and implementing the external communication system;
- Assisting the Manufacturing Manager in dealing with external communications in a timely manner.

6. ENVIRONMENTAL TRAINING

All employees at Bradken undergo general environmental awareness training, and outlining their responsibilities under Bradken’s EMS. Training ensures that all employees understand their obligations to exercise due diligence for environmental matters. Environmental training for all employees is carried out in accordance with EMS procedure 2 BK SP ENV 250 and includes:

- An awareness of the environmental issues of their work areas;
- An awareness of the Bradken EMS and their responsibilities;
- An awareness of the Bradken Policy, Goals and Environmental Regulations plus the various procedures and works instruction that apply in their work areas;
- An understanding of what to do if a possible environmental emergency occurs in their work areas;

- The safe and legal disposal/recycling practices for the wastes generated in their work areas.

At the Adelaide foundry this training also incorporates the site specific Work Instructions and targeted environmental training for personnel working in areas of environmental concern. This training will be extended to incorporate site specific requirements under the EMMP.

Training requirements should be reviewed regularly. EMS procedure 2 BK SP ENV 250 outlines instances where training systems may require modification or training needs reviewed. Adelaide's Environmental Officer in consultation with shift supervisors and senior management has the authority to modify or upgrade Adelaide's training content as required.

Staff competence shall be demonstrated by the successful completion of the probationary period. Contractor competence shall be demonstrated by successful completion of the induction training.

All training records are a controlled environmental record and are to be kept by Adelaide's Human Resources Officer.

7. EMERGENCY CONTACTS AND RESPONSE

Emergencies will be handled by the existing "Occupational Health and Safety Emergency Plan" for the Adelaide foundry, which will be revised to reflect the upgraded facility.

An Environmental Emergency Response Plan currently exists for the Adelaide foundry to ensure the impact of environmental emergencies are minimised and pollution is prevented. The plan is detailed in Work Instruction BK3-E-014 and includes:

- Response personnel responsibilities;
- The location of spill containment kits and fire fighting equipment;
- Steps to follow to minimise damage and control an emergency situation; and
- Instructions for notifying government agencies and emergency services.

Emergency procedures are displayed in prominent positions within the site working area, and contain important telephone numbers and contact details for emergency services.

8. EMMP IMPLEMENTATION

This section provides individual sub-plans outlining the specific management practices for the following issues:

- General Site Issues;
- Solid Waste Management;
- Liquid Waste Management;
- Noise Management;
- Surface Water Management;
- Ground Water Management
- Air Quality;
- Hazardous and Dangerous Substances;
- Raw Materials and Finished Product Storage; and
- Corrective Action Strategies.

Table 1: General Site Issues

Actions	Responsibility
Objective: To ensure that Bradken Adelaide has the management systems and operating procedures which enable duty of care provisions and other environmental commitments to be achieved.	
Legislation: All relevant environmental legislation	
Actions	**Responsibility**
Conduct site induction training for all personnel. Training to advise of sensitive work areas, explain the requirements of Work Instruction BK3-E-001 (General Environmental Rules), outline an individual's responsibilities and inform them of the emergency response work procedure. Evidence of training is to be available prior to commencing work on site.	Environmental Officer
Ensure emergency procedures (detailed in Work Instruction BK3-E-014) are displayed in a prominent position within the foundry.	Plant Engineer
Measurement / Monitoring	
Actions	**Responsibility**
Conduct audits of the corporate EMS and site Work Instructions in accordance with ISO 14001 Environment Management Systems, ISO 9001 Quality Assurance System Procedures and site specific.	Environmental Officer & Quality Systems Officer
Conduct audits of the EMMP. These will involve reviewing all documents, records and monitoring results to ensure compliance with the EMMP.	Environmental Officer
Reporting / Review	
Actions	**Responsibility**
Conduct weekly inspection reports to ensure that environmental issues are identified and actions developed.	Supervisors
Compile monthly reports identifying any significant environmental issues and progress with environmental projects of that month.	Environmental Officer
Compile and submit an annual report to ensure the Board, Managing Director and the Bradken Environmental Manager are formally and fully informed each year of significant environmental issues affecting the business and to provide data for the corporate environmental reporting requires. The annual report is completed to a template EMS procedure 2 BK SP ENV 292 'Annual Environmental Report Form' to ensure consistency across the various Bradken sites.	Manufacturing Manager
Ensure all external environmental complaints are recorded according to EMS procedure 2 BK SP ENV 280 "Environmental Complaint Reporting".	Environmental Officer
Ensure all outcomes identified from inspection and auditing are managed through the corrective action process as part of the continuous improvement framework.	Environmental Officer

Table 2: Solid Waste Management

Objective: To ensure all areas of the business continually improve production methods and processes to make the most efficient and sustainable use of resources, minimise waste and emissions and reduce any adverse environmental impact by implementing sound waste management practices.

Legislation:

Environmental Protection Act, 1993

Environment Protection (Waste Management) Policy, 1994

Compliance Criteria

EPA Guideline - Used foundry sand (UFS) – classification and disposal (EPA 329/03, September 2003)

Actions	Responsibility
Ensure furnace baghouse dust (which may contain low levels of dioxins formed in furnace operations) is collected, stored and handled in accordance with Work Instruction BK3-E-002. - Furnace baghouse dust shall be collected directly from the screw conveyor and collected in one tonne bulka bags. - Bulka bags are to be securely fastened to the outlet of the conveyor using support chains to ensure correct filling and avoid spillage. - Full bags are to be labelled 'Arc Furnace Baghouse Dust', shrink wrapped and removed by forklift to the furnace baghouse dust holding area, for storage under a tarpaulin to await dispatch.	Supervisor
Ensure furnace baghouse dust is disposed of in accordance with EPA guideline (EPA415/02) Waste Transport Certificate.	Environmental Officer
Ensure general wastes produced on site are handled and disposed of in a way that minimises potential environmental impacts and complies with Work Instruction BK3-E-010. - General waste is to be placed immediately into bins. No waste is to be stored on the floor within work areas. - Ensure bins, skips and bulka bags are emptied well before they overflow. - Separate waste in accordance with Work Instruction BK3-E-010 to ensure proper disposal. - No waste material is to be burnt or buried on site.	Supervisors
Ensure disposal of empty spray cans (including those used for painting and dye) is in accordance with Work Instruction BK3-E-015.	Supervisors
Ensure correct and responsible handling, storage, disposal and spill containment of solid wastes in accordance with Work Instruction BK3-E-007. - Consult the MSDS prior to initiating clean-up. - Minor spills should be contained using absorbent material and the appropriate PPE. - Significant spills require notification to the Emergency Response Co-ordinator, Environmental Officer and Manufacturing Manager. - Immediate action must be taken to contain the spill and ensure no foreign matter enters the stormwater drains.	Supervisors

Solid Waste Management (continued)

Actions	**Responsibility**
Ensure production wastes produced on the site are handled and disposed of in a way that minimises environmental impacts and complies with Work Instruction BK3-E-011. Production wastes include: - Waste foundry sand; - Sand reclamation plant baghouse dust; - Shot blast baghouse dust; - Furnace slag and waste refractory and ceramics; - Mixer washing sand and core bay sand; - Sand pebbles from reclamation plant; and - Dust from road sweeper. - Production wastes must be stored and handled to minimise dust and eliminate release to the environment. - Any spills must be cleaned up immediately.	Supervisor
Ensure asbestos, Kaowool and PCBs are handled and disposed of in accordance with Work Instruction BK3-E-008.	Environmental Officer
Compile incident reports following environmental non-compliance in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."	Environmental Officer
Waste minimisation and recycling actions include: - Wooden pallets are to be sorted, stored separately and recycled. - Empty 200 litre drums are to be collected and stored for recycling. - Used foundry sand is put through an attrition mill to return the sand to its normal size fraction. The sand is then returned to the silo for further use in moulds. Up to 90% of foundry sand can be recycled.	Supervisor

Measurement / Monitoring

Action	**Responsibility**
Ensure all listed wastes are recorded when leaving the site, detailing transporter, volume, type of wastes and disposal method and location.	Environmental Officer
Ensure solid wastes are sampled and tested to enable classification of the waste.	Environmental Officer

Waste	Sample Method	Test Parameters	Frequency
Furnace baghouse dust	Sample at date of test Composite	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same.	Annual
Ladle wash Baghouse dust	Sample at date of test Composite	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same.	Annual
Sand reclamation baghouse dust	Sample at date of test, composite from all three baghouses	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same and Phenol.	Annual
Shot blast baghouse dust	Sample at date of test Composite	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same.	Annual
Waste sand in stockpile	Sample at date of test Composite	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same and Phenol.	Annual
Furnace slag	Sample at date of test Composite	Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn, Mn and TCLP for same.	Two yearly

Solid Waste Management (continued)

Reporting / Review	
Actions	**Responsibility**
Review Waste Transport Certificate.	Environmental Officer
Compile monthly reports identifying any significant waste related issues during that month.	Environmental Officer

Table 3: Liquid Waste Management

Objective: To ensure all areas of the business continually improve production methods and processes to make the most efficient and sustainable use of resources, minimise waste and emissions and reduce any adverse environmental impact by implementing sound waste management practices.	
Legislation: *Environmental Protection Act, 1993* Environment Protection (Waste Management) Policy, 1994	
Compliance Criteria Trade Waste Permit	
Actions	**Responsibility**
Ensure quench water is disposed of in accordance with the Trade Waste Permit and Work Instruction BK3-E-002. - Ensure SA Water is advised 5 days before a clean is planned.	Supervisor
Ensure oily water from sumps and compressor condenser are pumped to the oil/water separator.	Supervisor
No other liquid wastes are to be disposed of without consultation with the Environmental Officer.	Supervisor
Ensure correct and responsible handling, storage, disposal and spill containment of chemicals, resins and paints in accordance with Work Instruction BK3-E-007. - Consult the MSDS prior to initiating clean-up. - Minor spills should be contained using absorbent material and the appropriate PPE. - Significant spills require notification to the Emergency Response Co-ordinator, Environmental Officer and Manufacturing Manager. - Immediate action must be taken to contain the spill and ensure no liquid chemical enters the stormwater drains.	Supervisor
Compile incident reports following environmental non-compliance in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."	Environmental Officer
Waste minimisation and recycling actions include: - Waste oil is appropriately stored, labelled and collected for recycling. - Paint thinners are transferred to 200 litre drums, labelled and collected for recycling.	Supervisor
Measurement / Monitoring	
Action	**Responsibility**
Ensure liquid waste is disposed of in accordance with the Trade Waste Permit and Work Instruction BK3-E-002.	Environmental Officer

Liquid Waste	Sample Method	Test Parameters	Frequency
Quench tank water	200ml sample collected before draining tanks	TDS, pH, oil, grease and metals	Annually before tank clean
Discharge from furnace cooling tower pit	200ml sample from pit discharge	As above	As above
Discharge from reclaim cooling tower pit	200ml sample from cooling pit tower	As above	As above
Discharge from transformer cooling tower	200ml sample from overflow pipe	As above	As above

Reporting / Review	
Actions	**Responsibility**
Review Trade Waste Permit to ensure relevance to upgraded facility.	Environmental Officer
Compile monthly reports identifying any significant waste related issues of that month.	Environmental Officer

Table 4: Noise Management

Objective: To minimise environmental noise from equipment and processes and intrusion of sensitive receivers.	
Legislation: *Environmental Protection Act, 1993* Environment Protection (Industrial Noise) Policy, 1994. Environment Protection (Machine Noise) Policy, 1994.	
Compliance Criteria	
Source Location	**Indicative Noise Factor (dB(A))** **Day** **Night**
Applicable Noise Level	58 50
Actions	**Responsibility**
Ensure equipment operation is undertaken in a way which is sensitive to surrounding sensitive receivers. Restrictions exist on the operating hours of: - Excavator Rock Breaker (operation not before 8am Monday – Saturday or 10am Sunday and public holidays or after 10pm on any day); - Arc Furnace (operation not before 8am Sunday and public holidays); - Sand Reclaim Plant (operation not before 6am Monday – Saturday or 8am Sunday or public holidays). - Equipment with an operating noise in excess of 80dB(A) (operation in the open not before 7am Monday to Saturday or 10am Sunday and public holidays); - Loud Speaker (operation not before 7am on any day or after 8pm). - Machine Shop (doors to be closed between 7pm and 7am each at a minimum). - Where cutting noise during machining beings to 'ring' at a level above the background noise level, work must be halted and immediate action taken to reduce the noise. - Truck movements in and out of the factory shall be restricted to between 7am and 7pm each day. - The main foundry southern doors and eastern doors on the aftercast building are to be kept closed between 7am and 7pm each day.	Supervisor
Compile incident reports following environmental non-compliance in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."	Environmental Officer
Measurement / Monitoring	
Actions	**Responsibility**
Noise monitoring is undertaken on a regular basis to verify the facility is operating within the allowable noise levels. Monitoring should dictate improvements to the operation to minimise excessive noise.	Environmental Officer
Ensure all noise complaints are recorded and actioned.	Environmental Officer
Reporting / Review	
Actions	**Responsibility**
Compile monthly reports identifying any significant noise related issues during that month.	Environmental Officer
Ensure all noise complaints are a recorded and actioned.	Environmental Officer

Table 5: Surface Water Management

Objective: To ensure all areas of the business continually improve production methods and processes to make the most efficient and sustainable use of resources, minimise waste and emissions and reduce any adverse environmental impact by utilising responsible pollution control practices.			
Legislation: *Environmental Protection Act, 1993*			
Compliance Criteria Environment Protection (Water Quality) Policy, 2003 Work Instruction BK3-E-004			
Actions			**Responsibility**
Ensure regular cleaning of hardstand areas to minimise solid particles entering the stormwater system during rainfall events.			Supervisors
Store chemicals, oils or fuels in their appropriate containers and bunded areas to ensure they are not released into the stormwater system.			Supervisors
Ensure bunded areas remain free of sand and excess rainwater at all times.			Supervisors
Maintenance and cleaning of vehicles and other equipment is to be carried out in the wash bay area.			Supervisors
Equipment containing chemicals, oils or fuel shall not be placed near stormwater drains.			Supervisors
Spills must not be washed into the stormwater system.			Supervisors
Compile incident reports following environmental non-compliance in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."			Environmental Officer
Measurement / Monitoring			
Actions			**Responsibility**
Ensure stormwater is sampled and tested and the results are assessed against allowable levels.			Supervisors
Stormwater	Sample Method	Test Parameters	Frequency
In retention basin (east)	200ml sample taken from basin and placed into plastic sample container.	TDS, pH, Na, K, Mg, Cl, Cr, F, Fe, Mn, Mo, Co, Ni, phenols, hydrocarbons.	Once a year at first flush in Autumn.
In south western sump	As above	As above	As above
Reporting / Review			
Actions			**Responsibility**
Compile monthly reports identifying any significant water related issues of that month.			Environmental Officer

Table 6: Groundwater Management

Objective: To ensure all areas of the business continually improve production methods and processes to make the most efficient and sustainable use of resources, minimise waste and emissions and reduce any adverse environmental impact on groundwater by utilising responsible pollution control practices.	
Legislation: *Environmental Protection Act, 1993*	
Compliance Criteria Environment Protection (Water Quality) Policy, 2003 Work Instruction BK3-E-004	
Actions	**Responsibility**
Store chemicals, oils and fuels in their appropriate containers and bunded areas to ensure they are not able to enter the groundwater.	Supervisors
Spills are to be cleaned up immediately.	Supervisors
Compile incident reports following environmental non-compliance in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."	Environmental Officer
Environmental Safeguards	
Operational footprint is entirely hardstand.	
Measurement / Monitoring	
Actions	**Responsibility**
Ensure groundwater is monitored from the five on site bores for the presence of hydrocarbons, BTEX and heavy metals.	Environmental Officer
Reporting / Review	
Actions	**Responsibility**
Compile monthly reports identifying any significant groundwater related issues of that month.	Environmental Officer

Table 7: Air Quality

Objective: To ensure all areas of the business continually improve production methods and processes to make the most efficient and sustainable use of resources, minimise air emissions and reduce any adverse environmental impact by utilising responsible pollution control practices.	
Legislation: *Environmental Protection Act, 1993* Environment Protection (Air Quality) Policy, 1994. National Environment Protection (Ambient Air Quality) Measure.	
Compliance Criteria	
Stack emission criteria detailed in Work Instruction BK3-E-004 and outlined below.	
Substance	**Criteria**
TSP	100 mg/m^3
PM_{10}	N/A
CO	1g/m^3
NOX	0.35 mg/m^3
Ambient Air (Design Ground Level Concentrations((DGLC) outlined below.	
Substance	**Criteria**
PM_{10}	50 µg/ m^3 (24 hr average)
SO_2	0.45 mg/ m^3 (1 hr average)
NOx	0.113 mg/ m^3 (1 hr average)
CO	29 mg/ m^3 (1 hr average)
Actions	**Responsibility**
Minimise dust generation by: - Applying water sprays to the waste foundry sand pile before and after truck loading and during times of high winds. - Ensuring trucks hose down their loads as required. - Keeping all bulk waste sand awaiting disposal within the sand retaining wall area. - Ensuring any spills of new sand are cleaned up before the delivery truck departs. - Regular sweeping of hardstand areas. - Cleaning the scrap cutting booth area at least weekly to minimise dust build up. - Cleaning the paint mixing and core bay flow coat system weekly. - Cleaning the arc air booth at least weekly.	Supervisors
Minimise fume generation by: - Ensuring the furnace roof is returned to the furnace as soon as possible after charging with scrap to re-establish positive fume extraction. - Ensuring fume extraction is in operation on the furnace prior to oxy blowing of the furnace. - Undertaking oxy lancing of ladles in the dedicated ladle wash station with the hood in place and the fan turned on. - Ensuring fume extraction equipment is used at all times to collect welding fumes. - Ensuring that the fume extraction to the arc air is turned on before the arc air starts and the doors to the arc air booth are closed at all times (if reasonably practicable). - Not undertaking spray painting in open areas during periods of high/gusty wind.	

Air Quality (continued)

Actions	**Responsibility**
Minimise odour generation by: - Operating the pouring, knockout and cooling extraction systems unit before and during the pouring of each heat and during and knockout process. - Ensuring all furnace feed is free of paint, oil or other contaminants. - Ensuring that no painted casting or other coated items are heat treated. Keeping the main western and southern doors to the foundry building closed at all times (if reasonably practicable).	

Measurement / Monitoring

Actions	**Responsibility**
Monitor furnace baghouse and stack discharge every four hours for visible solid particles and or reduced extraction flow. In the event of a failure the furnace will be shut down as soon as practicable until repairs have been completed.	Supervisor
The sand reclamation extraction system is to be monitored during operation, with maintenance informed of any work required.	Supervisor
Air emission sources are to be sampled and tested in accordance with the following criteria:	Environmental Officer

Emission Source	Sample Method	Test Parameters	Frequency
Furnace baghouse stack	Review of continuous particle monitoring, and isokinetic.	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Daily review of continuous monitoring and every four years for isokinetic.
Sand reclaimer No. 1 baghouse stack	Review of continuous particle monitoring, and isokinetic.	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Daily review of continuous monitoring and every four years for isokinetic.
Sand reclaimer No. 2 baghouse stack	Review of continuous particle monitoring, and isokinetic.	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Daily review of continuous monitoring and every four years for isokinetic.
Sand reclaimer No. 3 baghouse stack	Review of continuous particle monitoring, and isokinetic.	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Daily review of continuous monitoring and every four years for isokinetic.
Ladle wash Baghouse stack	Particulate flow (TSP) monitor from Runcorn and isokinetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Annual TSP Every four years for isokinetic
Shot blast baghouse	Particulate flow (TSP) monitor from Runcorn and isokinetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Annual TSP Every four years for isokinetic
Spray paint booth stack	Particulate flow (TSP) monitor from Runcorn and isokinetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Annual TSP Every four years for isokinetic
Arc air and scrap cutting stacks	Particulate flow (TSP) monitor from Runcorn and isokinetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn.	Annual TSP Every four years for isokinetic
Welding fume extraction stack	Particulate flow (TSP) monitor from Runcorn and isokinetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn. Fluoride.	Annual TSP Every four years for isokinetic

Air Quality (continued)

Pattern shop dust collected stack	Particulate flow (TSP) monitor from Runcorn and isokenetic	TSP, flow velocity, NOx, CO, PAH, O_2, particulate analysis for metals including Mn. Fluoride.	Annual TSP Every four years for isokinetic
Heat treatment furnace #1	Isokinetic in stack	NOX, CO, O2	Every two years
Heat treatment furnace #2	Isokinetic in stack	NOX, CO, O2	Every two years
Heat treatment furnace #3	Isokinetic in stack	NOX, CO, O2	Every two years
Heat treatment furnace #4	Isokinetic in stack	NOX, CO, O2	Every two years
Heat treatment furnace #5	Isokinetic in stack	NOX, CO, O2	Every two years

Reporting / Review

Actions	Responsibility
Maintain logbook (accessible to EPA) containing weekly records of fabric filters on site.	Supervisors
Compile monthly reports identifying any significant air quality or odour related issues of that month.	Environmental Officer
Compile incident reports if required in accordance with EMS procedure BK OHS 0601 "Incident Reporting and Investigation Procedure."	Environmental Officer
Ensure all air quality complaints are appropriately recorded and addressed.	Environmental Officer

Table 8: Hazardous and Dangerous Substances

Objective: To ensure that the storage and handling of hazardous and dangerous substances does not result in any adverse environmental impacts.

Legislation: *Dangerous Substances Act, 1979*
Licence to keep a Dangerous Substance
Annual Licence (Petroleum Products Regulation)

Compliance Criteria

Applicable Australian Standards

Applicable Work Instructions

Actions	Responsibility
Ensure all dangerous goods or hazardous substances are stored in compliance with the applicable Australian Standards. *AS:1596* – The storage and handling of LP Gas *AS:1894* – The storage and handling of non-flammable cryogenic and refrigerated liquids *AS:1940* – The storage and handling of flammable and combustible liquids *AS:2430* – Classification of hazardous areas *AS:4332* – The storage and handling of gases in cylinders	Manufacturing Manager

Measurement / Monitoring

Actions	Responsibility
Ensure handling and storage of hazardous and dangerous substances is compliant with the appropriate Australian Standards and relevant Work Instructions.	Environmental Officer

Reporting / Review

Actions	Responsibility
Ensure the appropriate MSDSs are easily accessible and are updated as required.	Environmental Officer
Ensure Licence to keep a Dangerous Substance is updated to reflect changes in the volume or types of dangerous substances.	Environmental Officer
Ensure site Dangerous Goods Manifest is updated as required reflecting changes in the volume or types of dangerous or hazardous substances.	Environmental Officer
Ensure Work Instructions are updated as required to recognise any issues associated new dangerous or hazardous substances.	Environmental Officer
Ensure all storage and handling of dangerous goods and hazardous substances are managed in accordance with the relevant standards.	Environmental Officer

Table 9: Raw Materials and Finished Product

Objective: To ensure that the storage and handling of raw materials and finished product does not result in any adverse environmental impacts.

Legislation: *Dangerous Substances Act, 1979*
Licence to keep a Dangerous Substance
Annual Licence (*Petroleum Products Regulation Act, 1995*)

Compliance Criteria

Applicable Australian Standards
Work Instructions

Actions	Responsibility
Ensure all dangerous goods or hazardous substances are stored in compliance with the applicable Australian Standards.	Manufacturing Manager
Ensure all raw materials and finished product are handled and stored in compliance with the applicable Work Instructions.	Supervisors

Environmental Safeguards	Responsibility
Sand: Delivery trucks are directed to a truck unloading bay within the site, where sand is pneumatically conveyed directly from the truck to sand silos. The conveyor is enclosed to prevent sand escaping to the environment. The unloading bay is bunded to prevent spills to the environment.	Supervisors
Chemicals: Deliveries of small volumes are unloaded on a hardstand and transported by forklift to the chemical stores. All access routes used by forklifts are hardstand. Materials are generally received shrink wrapped to minimise the potential for spillage. Deliveries of large volumes are directed to the truck unloading bund within the site where chemicals are piped directly into storage tanks.	Supervisors
Scrap Metal: Received directly into a scrap receival bay which is roofed and enclosed to minimise impacts from noise and dust.	Supervisors
Finished Product: Handled where possible within buildings and is stored on a hardstand area prior to dispatch.	Supervisors

Reporting / Review

Actions	Responsibility
Ensure the appropriate MSDSs are easily accessible and are updated as required.	Environmental Officer
Ensure Licence to keep a Dangerous Substance is updated to reflect changes in the volume or types of dangerous substances.	Environmental Officer
Ensure site Dangerous Goods Manifest is updated as required reflecting changes in the volume or types of dangerous or hazardous substances.	Environmental Officer
Ensure Work Instructions are updated as required to recognise any issues associated new dangerous or hazardous substances.	Environmental Officer
Ensure Work Instructions are updated as required to recognise any issues associated with new raw materials or finished products.	Environmental Officer

Table 10: Corrective Action Strategies

Objective: To ensure all outcomes identified from inspection, auditing and monitoring are managed through the corrective action process as part of the continuous improvement framework.	
Legislation: *Environmental Protection Act, 1993*	
Compliance Criteria Environmental Protection Policies EPA licence	
Actions	**Responsibility**

All non-compliances and incidents will be systematically investigated to determine potential causes.
- Mechanical failures will be rectified as soon as practicable.
- Procedural short-comings will be investigated and existing training and Work Instructions will be modified as required.
- Non-compliances will require:
  - A preliminary investigation to quantify the impact;
  - A detailed investigation of potential causes;
  - A works/training programme to mitigate impacts; and
  - A remediation programme if required.
	Manufacturing Manager

Measurement / Monitoring	
Actions	**Responsibility**
Undertake risk assessments of project design to ensure risks and short-comings of the project are identified prior to construction and commissioning.	Manufacturing Manager
Ensure current environmental procedures are adequate and effective by undertaking regular internal audits.	Environmental Officer
Ensure current contracting arrangements are suitable and compliant with relevant legislation.	Environmental Officer
Reporting / Review	
Actions	**Responsibility**
Ensure monitoring programs are able to be adapted to incorporate new systems or additional information.	Environmental Officer
Ensure Work Instructions and the EMMP are updated to reflect any outcomes identified by monitoring and auditing.	Environmental Officer

Appendix O

Construction Labour

CONSTRUCTION LABOUR - NUMBER OF EMPLOYEES

Months after commencement of project	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Mechanical trades						1	8	6	11	10					2	10	8	26	12	6		9	5					20	27	26	2
Mechanical trades, piping												2	1															3	3	3	1
ETSA						8	10																								
Electrical trades						2	12	8	1							3	2	11	13	10	4	2	1					3	4	4	1
Electrical trades, Bradken													1	1																	
Civil, concrete trades				4	4	5						5	3		19	5				1	2	2	1	9	16	17	18	4			
Mechanical trades, Bradken	1	2										4	1																		
Asbestos remover	3	1										4	3										2	2							
Builder		2	4	8	11	12							1	6	8	8	8	8	7	5											
Grand Total	**10**	**12**	**12**	**21**	**25**	**39**	**42**	**27**	**26**	**25**	**16**	**32**	**28**	**26**	**49**	**47**	**40**	**68**	**56**	**47**	**32**	**40**	**37**	**40**	**46**	**48**	**50**	**63**	**68**	**68**	**40**

Appendix P

Air Quality Modelling

Air Quality Modelling

Kilburn Upgrade

Bradken Adelaide

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Report Details:

File Name: 56315501 Final Jan 2007

Air Quality Modelling

Kilburn Upgrade

Bradken Adelaide

This report has been collated and prepared by:

January 2007

Jeremy Pola — **Date**
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January 2007
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APPENDICES

1. INTRODUCTION

Advitech Pty Limited was engaged by Bradken Resources Pty Ltd (Bradken) to undertake air quality modelling of the Kilburn foundry to support the preparation of a Public Environmental Review (PER) for the upgrade of the foundry which will include expansion to an annual capacity of 45 000 tonnes of cast metal per annum.

This report details the results of air quality modelling for the existing operational scenario (16 500 tonnes of cast metal to produce 12 500 dressed tonnes) and the proposed future operational scenario of 45 000 tonnes cast tonnes (32 000 dressed tonnes). Both the existing and future scenarios have been modelled to enable the environmental impact of the proposed development to be assessed.

It should be noted that this report was prepared by Advitech Pty Limited for Bradken ("the customer") in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

2. DESIGN CRITERIA

The SA EPA guideline *Air quality impact assessment using design ground level pollutant concentrations (DGLCs) 2006*, details the design criteria for specific atmospheric pollutants.

Table 1 outlines the specific pollutants that were assessed in the air quality modelling presented in this report.

Table 1: Design ground level concentrations

Substance	Criteria (Toxicity)	Units	Averaging Period
Ammonia[1]	0.6	mg/m^3	3-minute
Nitrogen Oxides[1] (metro) (NOx)	0.113	mg/m^3	1-hour
Sulphur Dioxide[1] (SO_2)	0.45	mg/m^3	1-hour
Phenol[1]	0.13	mg/m^3	3-minute
Cresol	NC	mg/m^3	3-minute
Formaldehyde[1]	0.04	mg/m^3	3-minute
Acrolein[1]	0.00077	mg/m^3	3-minute
Benzene[1]	0.053	mg/m^3	3-minute
Ethylbenzene[1]	14.5	mg/m^3	3-minute
Styrene[1]	6.97	mg/m^3	3-minute
Toluene[1]	12.3	mg/m^3	3-minute
Xylene[1]	11.4	mg/m^3	3-minute
Cyclohexanone[1]	3.2	mg/m^3	3-minute
Ethyl Acetate[1]	23.6	mg/m^3	3-minute
Isopropylbenzene[1]	8.1	mg/m^3	3-minute
Methylethylketone[1]	16	mg/m^3	3-minute
Methylisobutylketone[1]	6.7	mg/m^3	3-minute
Butyl acetate[1]	23.8	mg/m^3	3-minute
Anthracene	NC	mg/m^3	3-minute
Benzo (a) pyrene[1]	0.00073	mg/m^3	3-minute
Fluorene[1]	NC	mg/m^3	3-minute
Naphthalene[5]	1.73	mg/m^3	3-minute
Phenanthrene	NC	mg/m^3	3-minute
Pyrene	NC	mg/m^3	3-minute
Cyanide[1]	0.17	mg/m^3	3-minute
Carbon Monoxide[1] (CO)	29	mg/m^3	1-hour
Hydrogen Sulphide[1] (H_2S)	0.47	mg/m^3	3-minute
Dioxin[4]	0.0037	ng/m^3	3-minute
Odour[2] (99.9th %ile)	2	ODU	3-minute
PM_{10}[3]	50	$\mu g/m^3$	1-day
$PM_{2.5}$ (annual)[3]	25	$\mu g/m^3$	1-day
$PM_{2.5}$ (one day)[3]	8	$\mu g/m^3$	1-year
Butanol[1]	5.1	mg/m^3	3-minute

Substance	Criteria (Toxicity)	Units	Averaging Period
Acetaldehyde[1]	5.9	mg/m^3	3-minute
Furfural	NC	mg/m^3	3-minute
Propanaldehyde	NC	mg/m^3	3-minute
Butanaldehyde	NC	mg/m^3	3-minute
Pentanaldehyde	NC	mg/m^3	3-minute
Benzaldehyde	NC	mg/m^3	3-minute
Glutaraldehyde	NC	mg/m^3	3-minute
Acenaphthene	NC	mg/m^3	3-minute
Acenaphthylene	NC	mg/m^3	3-minute
Benz (a) anthracene	NC	mg/m^3	3-minute
Benzo (b) fluoranthene	NC	mg/m^3	3-minute
Fluoranthene	NC	mg/m^3	3-minute
Chrysene	NC	mg/m^3	3-minute
Dimethylphenols	NC	mg/m^3	3-minute
1,3,5 Trimethylbenzene	NC	mg/m^3	3-minute

Sources:
[1] SA EPA Guidelines Air Quality Impact Assessment.
[2] SA EPA Guidelines Odour Assessment.
[3] National Environment Protection (Ambient Air Quality) Measure.
[4] National Dioxins Program - National Action Plan for addressing Dioxins in Australia.
[5] 3 minute average derived from TWA of 52 mg/m^3 published by the Australian Safety and Compensation Council (1995).
NC = No criteria specified in SA EPA Guidelines Air Quality Impact Assessment

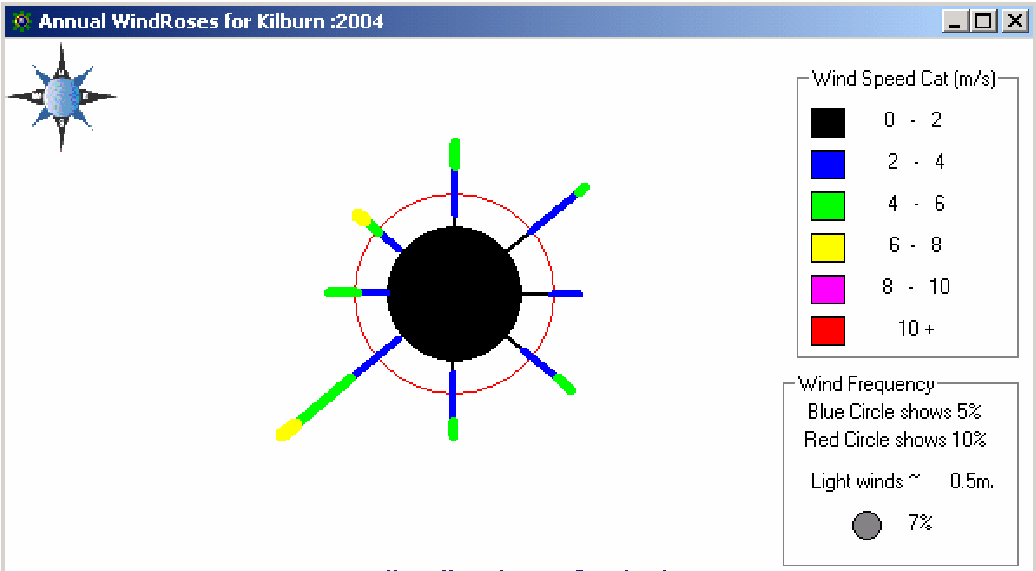
3. METEOROLOGY

Meteorological data representative of the Kilburn site was obtained from the following sources:

- **Kent Town** AWS data Bureau of Meteorology South Australian Regional Office; and
- **Adelaide Airport,** cloud data and vertical temperature profiles. National Climate Centre, Bureau of Meteorology, Melbourne.

Figure 1 shows the frequency of wind direction for the 2004 calendar year. Winds from the south west are predominant and are a feature of the summer months. Winds from the north to north east feature during the winter months.

Figure 1: Annual Wind Rose for Kilburn 2004



Percentage Frequency distribution of Winds

Speed Cat/Dir	NE	E	SE	S	SW	W	NW	N	Total Speed Freq
0 - 2	4.9	3.3	3.7	3.8	1.7	0.8	1.4	3.8	23%
2 - 4	7.8	3.6	5.1	6.5	7.5	3.7	3.5	6.7	44%
4 - 6	1.9	1.0	2.8	2.2	8.0	3.6	2.7	3.6	26%
6 - 8	0.2	0.1	0.7	0.2	2.1	0.9	1.1	0.6	6%
8 - 10	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	1%
10 +	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	%
Total Dir Freq	15%	8%	12%	13%	20%	9%	9%	15%	

The Meteorological Summary Report is included in Appendix V to this report.

4. DISPERSION MODELLING METHODOLOGY

4.1 Ausplume

Dispersion modelling was undertaken using the AUSPLUME version 6. Ausplume was considered to be the appropriate model for the air quality assessment as the site is located in an area of relatively flat terrain with good dispersion characteristics. The site is not affected by shoreline fumigation or complex terrain that may influence dispersion of pollutants.

Meteorological data for Kilburn was compiled from Bureau of Meteorology sources at Kent Town and Adelaide Airport. Kent Town is located approximately 8 kilometres to the south east of the Bradken site. The meteorological data set covers the 12 months from January 2004 to December 2004.

Model sensitivity was assessed using meteorological files supplied by the SA EPA from the Netley and Edinburgh monitoring sites. Due to the absence rainfall data in the Netley and Edinburgh meteorological data it was not possible to prepare a comparative model for particulate matter as the original model employed wet deposition.

A number of substances were selected to undergo comparative modelling using the three meteorological input files. **Table 2** to **Table 6** summarise the results of the analysis. The correlation was undertaken between the Kilburn 2004 result and each of the Netley and Edinburgh results.

The sensitivity analysis was undertaken to confirm model suitability prior to actual stack testing results being obtained using proxy input values for the concentrations of each substance at stack exit. As such, the comparative GLC values presented in Tables 2 to 6 do not correspond to the modelling inputs and results presented elsewhere in this report.

Table 2: Comparative Nitrogen Oxides GLC Analysis (mg/m^3)

Substance	Percentile						Correlation
	0.01	0.1	0.5	0.9	0.99	1	
Kilburn 2004	0.081	0.083	0.088	0.101	0.108	0.109	1
Netley 2003	0.081	0.082	0.090	0.109	0.131	0.133	0.97
Edinburgh 2000	0.088	0.088	0.092	0.101	0.108	0.108	0.98

Table 3: Comparative Sulphur Dioxide GLC Analysis (mg/m^3)

Substance	Percentile						Correlation
	0.01	0.1	0.5	0.9	0.99	1	
Kilburn 2004	0.14	0.14	0.15	0.18	0.23	0.23	1
Netley 2003	0.14	0.14	0.16	0.20	0.23	0.24	0.99
Edinburgh 2000	0.13	0.13	0.14	0.17	0.21	0.23	0.99

Table 4: Comparative Benzene GLC Analysis (mg/m^3)

Substance	Percentile						Correlation
	0.01	0.1	0.5	0.9	0.99	1	
Kilburn 2004	0.106	0.107	0.116	0.141	0.174	0.180	1
Netley 2003	0.117	0.119	0.134	0.167	0.194	0.196	0.99
Edinburgh 2000	0.095	0.095	0.104	0.135	0.164	0.183	0.99

Table 5: Comparative Dioxins GLC Analysis (ng/m^3)

Substance	Percentile						Correlation
	0.01	0.1	0.5	0.9	0.99	1	
Kilburn 2004	0.000006	0.000006	0.000006	0.00001	0.000009	0.000015	1
Netley 2003	0.000006	0.000006	0.000007	0.000008	0.000010	0.000011	0.84
Edinburgh 2000	0.000005	0.000005	0.000005	0.000006	0.000008	0.000008	0.73

The lower correlation result for dioxin presented in **Table 5** was the result of a comparatively higher peak (100th percentile) result being predicted using the Adelaide 2004 meteorological input file. This peak value occurs within the site boundary and remains below the design criteria.

Table 6: Comparative Odour GLC Analysis (ODU)

Substance	Percentile						Correlation
	0.01	0.1	0.5	0.9	0.99	1	
Kilburn 2004	0.5	0.5	0.5	0.7	0.9	1.0	1
Netley 2003	0.5	0.5	0.6	0.8	0.9	1.0	0.95
Edinburgh 2000	0.4	0.4	0.5	0.6	0.8	0.9	0.98

The data presented in **Table 2** to **Table 6** compares the top 100 concentrations for each of the modelled substances. With the exception of odour, all modelled substances are presented as the100th percentile concentration. Odour is required to be assessed as the 99.9th percentile concentration, for this reason the odour data presented in **Table 6** will differ from the reported maximum compliance concentration in **Table 13**.

5. METHODOLOGY AND ASSUMPTIONS

5.1 Modelling Methodology

Figure 2 provides a process flow outline the basic modelling methodology. Detailed model assumptions and methodology are provided in **section 5.2.**

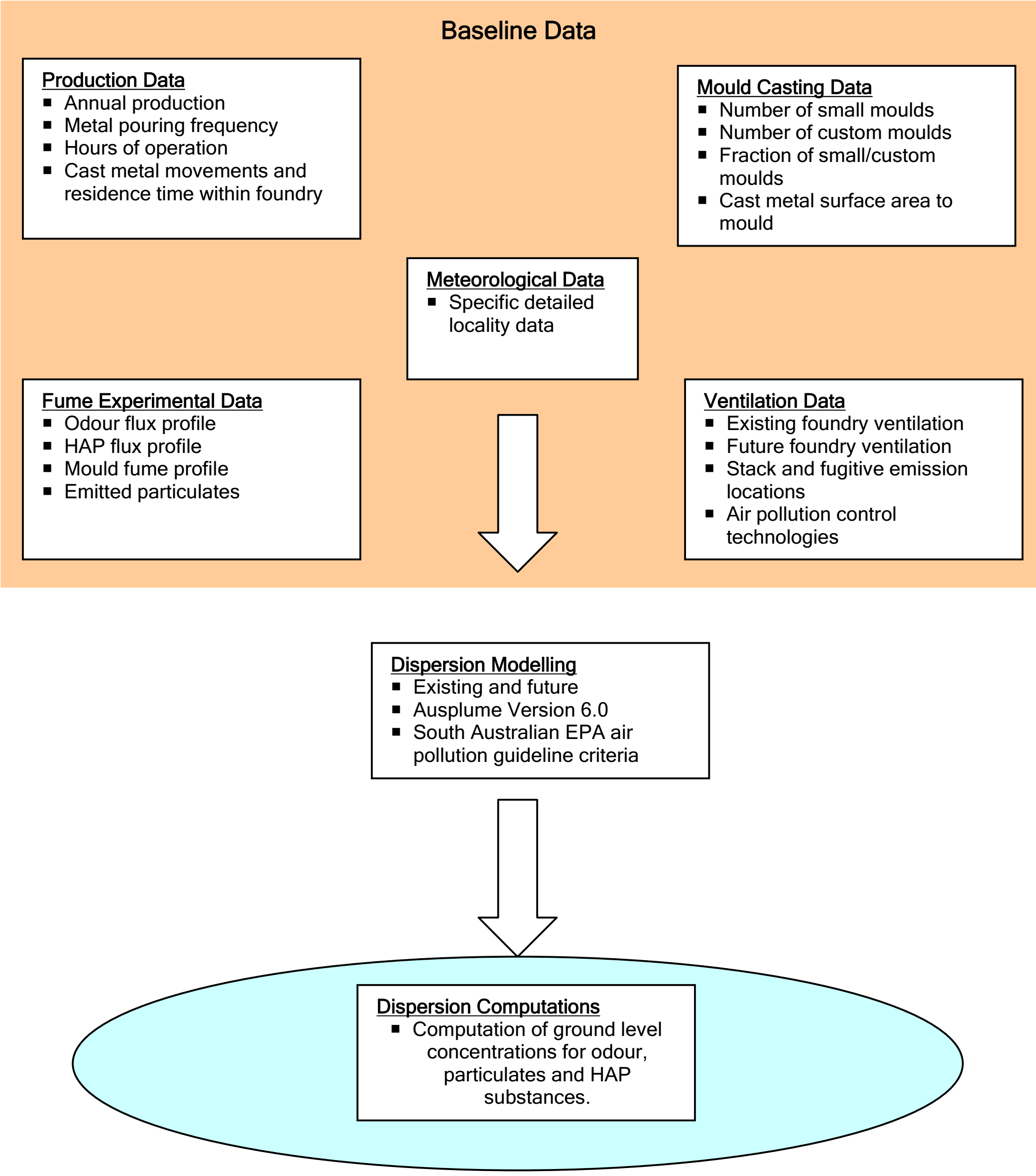


Figure 2: Modelling Flow Chart

5.2 Model Assumptions

5.2.1 General

- The topography surrounding the foundry at Kilburn is flat.
- Default options within the Ausplume model are used.
- Pasquill-Gifford curves are used for horizontal dispersion curves.
- Pasquill-Gifford curves are used for vertical dispersion curves.
- Enhanced plume spreads for buoyancy are enabled for both the horizontal and vertical dimensions.
- Pasquill-Gifford formulae are adjusted for roughness height.
- All modelled emissions, either time-of-hour dependent or constant with time, are modelled over a one-year period.
- The Australian Map Grid (AMG) projection was used for mapping contours.
- Fumes from cast moulds cease after 24 hours from pouring.
- The fast loop cooling small mould conveyor extracts 95% of fume emissions to the COOLS1 stack. The remaining 5% escapes the fast loop cooling small mould conveyor as fugitive emissions from the foundry building.
- Fugitive emissions are released uniformly along the roof ridge vent line of the existing and future foundry buildings. Fugitive emissions are assumed to be well mixed with ambient air within the building before they are discharged from the roof ridge vent at a height of 14 m.
- PM_{10} emissions are directly proportional to casting production. Original data is based on the foundry's annual production of 16 500 tonne/year and scaled to 45 000 tonne/year.
- The existing EAF ventilation system collects 90% of particulates. The remaining 10% of particulates is released as a fugitive emission.
- The existing foundry fugitive emissions (PF&EAF and KNOCK) have been modelled with a:
  - Release height = 14 m;
  - Initial vertical spread = 4 m; and
  - Initial horizontal spread = 29 m.
- The future foundry fugitive emissions (COOL) have been modelled with a:
  - Release height = 14 m;
  - Initial vertical spread = 4 m; and
  - Initial horizontal spread = 17 m.
- Odour fluxes are scaled based on large custom mould casting surface areas. This would represent the worst-case odour flux from both custom and small moulds. A scaling factor of 5.2 is applied for both large custom moulds and smaller standard moulds. For the conversion from a 600 kg experimental mould to an 8 000 kg mould the surface area scale factor is determined to be 5.2.
- Odour capture efficiency from the fast loop pour conveyor of 65% is assumed. The remaining odour is collected and mixed with the custom floor odour emissions and ventilated by the roof ventilation system.
- The fast loop pouring conveyor is completely cleared of cooling moulds at the end of each production day.

- The fast loop capture conveyor ventilation system is turned off at the end of a 16 hour (day) shift.
- An air pollution control factor of 75% has been applied to AS2 source to achieve the design criteria for acrolein and odour.
- An air pollution control factor of 95% has been applied to the COOLS1, P-Line and P+C sources to achieve the design criteria for acrolein, benzene and odour.
- An air pollution control factor of 85% has been applied to the FUG source to facilitate achieving the design criteria for fugitive odour in the future modelling scenario.
- A wet scavenger rate coefficient of 1.9 x 10^{-4} hr.s^{-1}.mm^{-1} for $PM_{2.5}$ particles is assumed (User's Guide for the Industrial Source Complex (ISC3) Dispersion of Model Algorithms U.S. Environmental Protection Agency).
- A wet scavenging rate coefficient of 6.8 x 10^{-4} hr.s^{-1}.mm^{-1} for PM_{10} particles is assumed (User's Guide for the Industrial Source Complex (ISC3) Dispersion of Model Algorithms U.S. Environmental Protection Agency).
- Emission concentrations derived from laboratory analysis data where the result was below the Practical Quantitation Limit (PQL), were assumed to be equal to the PQL.

5.2.2 Casting Operations

- The existing foundry produces 16 500 tonne / year of cast product.
- Fugitive emissions of odours and particulates generated from within the existing foundry building rely on natural ventilation processes.
- The anticipated future foundry production is to increase to 45 000 tonne / year.
- The future proposed foundry building relies on mechanical ventilation, natural ventilation and pollution control technology to collect and remove odours and particulates from within the foundry building.
- The EAF is always fully charged with molten metal. The capacity of the ladle bucket while fully charged is 20 tonnes.
- The periods of time between EAF pours for existing production and future production are 4.7 hours and 1.7 hours respectively.
- Molten metal is cast either into standard cast moulds or into larger custom cast moulds. The mass of molten metal poured into each mould has been derived from the report "Foundry Expansion Requirements Analysis" (Advitech Pty Limited, January 2006).
- For the existing and future foundry production, 60 wt% is cast into standard cast moulds while 40 wt% is cast into larger custom cast moulds.

5.2.3 Particulate Modelling

Assumptions used in the computation of ground level concentration for particulate matter pollutants using the Ausplume computer model are listed below:

- All baghouses are operated at an efficiency of 99%. Particulate solid emissions have a density equivalent to 2 560 kg/m^3. The aerodynamic diameter of particles passing through the baghouse is either 10 µm or 2.5 µm. The wet depletion option is selected for estimating both the GLC and rate of dust deposition of particulate matter and total particulates.
- The National Environment Protection (Ambient Air Quality) Measure PM_{10} and $PM_{2.5}$ standard was applied.

- The background particulate matter (TSP, 10μm or 2.5μm) was assumed to be zero.
- Particulate matter data and stack configuration was sourced from the report "Miscellaneous Stack Emission Testing from the Kilburn Plant, South Australia" (Axiom Air, May 2004).
- 32% of PM_{10} particulate materials are assumed to consist of $PM_{2.5}$ (US EPA AP42).
- Fugitive particulate emissions from foundry operations are modelled as a volume source.

5.2.4 Odour Modelling

Assumptions used in the computation of ground level concentration for odour using the Ausplume computer model are listed below:

- Future fugitive odour emissions from foundry operations escape through existing roof penetrations. Given the existing and proposed future foundry layout, fugitive emissions escape at a height of 14 metres.
- Fugitive odour emissions from foundry operations are modelled as a volume source, with volume source characteristics as outlined in section 5.2.1.

5.2.5 Hazardous Air Pollutant (HAP) Modelling

Assumptions used in the computation of ground level concentration for HAPs using the Ausplume computer model are listed below:

- An averaging time of 3 minutes and the 100^{th} percentile concentration is applied for the calculation of ground level concentrations of specified HAPs.
- The emission of HAPs from the existing and proposed future foundry has been determined by accounting for the number of cooling moulds (small and large custom) at any time during normal operation. A 24 hour weighted average HAP emission is determined for each mould. The total HAP emission (existing) is the sum of HAPs from cooling moulds.
- 90 wt% of emitted dioxin is exhausted through the EAF baghouse stack (AS4). The remaining fraction is emitted as fugitive emission from the foundry building. In the future scenario the dioxin will be emitted through the P+C stack.
- HAP emissions are emitted from the future foundry casting floor through the fast loop conveyor (P-Line) and overhead roof ventilation (P+C) system. A rolling 24 hour average volume is assumed.
- Fugitive HAP emissions are modelled as a volume source.

5.3 Data Sources and Emission Inputs

5.3.1 Data Sources

Model input data for the suite of hazardous air pollutants, carbon monoxide, oxides of nitrogen, sulphur dioxide and odour released from moulds was sourced from binder emission trials of the existing (alkali phenolic) and future (furane) resin undertaken at the Bradken Henderson foundry in Western Australia.

Emission data for particulates and odour from the existing process was sourced from environmental monitoring reports prepared by Axiom Air and Enviroscan.

5.3.2 Emission Inputs

Calculation of emission inputs for each substance or compound was undertaken by conversion of the raw emission concentration result (mass per volume of air) in to an emission rate (mass per time). The basic premise of the conversion requires the measurement and understanding of the physical characteristics of the emission source (e.g. the velocity, temperature, source diameter).

In most circumstances the emission of a substance or compound is not constant with time, particularly in the case of emissions from the pouring and cooling of moulds. The timeframe from the pouring of a mould to the knocking out of that mould has been applied within the model as 24 hours. Within this 24 hour period the emission rate will varying significantly from the peak at pouring (approximately 0.5-1.0 hours), through the cooling phase (approximately 23 hours) within which there is a very sharp decay of the emission rate, to a second peak at knockout (0.5 hours).

Where the emission rate is not constant with time, a time weighted average (TWA) has been calculated to enable an emission profile to be constructed. To construct the emission profile a logarithmic interpolation was applied to the discrete emission results obtained over the pouring, cooling and knockout process to arrive at an hourly time weighted average for a typical 24 hour period. It is this TWA that has been applied in the model to represent the emission of each relevant substance or compound emitted from the pouring, cooling and knockout of casting moulds.

5.4 Emission Control

The air quality model indicates that it is necessary to apply traditional dispersion techniques such as increased stack height and exit velocity and/or pollution abatement technology to certain stacks to optimise dispersion of substances from the foundry process.

Emission abatement technologies facilitate the removal of a specific substance or group of substances. The most common and widely understood control mechanisms are focused around the removal of particulate matter from emission streams, and are typically baghouse or cartridge filters.

Control technologies for reducing gaseous pollutants in foundry emission streams also exist. Compounds such as odour, VOCs, PAHs, carbon monoxide, sulphur dioxide and oxides of nitrogen are generally present in emission streams in relatively low concentrations but can still exceed the design ground level concentration criteria. Removal of these compounds from emission streams can potentially be achieved by the following methods, dependant upon the characteristics of the specific emission stream and facility.

- Absorption by a liquid solution;
- Condensation of pollutants by cooling the gas stream;
- Adsorption on a porous adsorbent; and
- Chemical conversion of pollutants into benign compounds

In the planning and assessment phase of the project it has been necessary to specify for the air model, the required efficiency of the emission control technology and the physical nature of the emission sources to achieve optimum dispersion characteristics and ground level concentrations. It is not necessary to assess individual control technologies at this stage and as such only generic efficiencies have been applied. During the detailed design phase it will be necessary to evaluate the available technologies to select the most suitable system to achieve the GLC predictions presented in this report.

5.5 Background Concentrations

Background concentrations of individual modelled substances have not been applied in the air model. With the exception of particulate matter, oxides of nitrogen and SO_2 background concentrations are not available for the majority of modelled substances.

5.6 Sensitivity Analysis

Analysis of the sensitivity of the existing model (16 500 tonnes / year) and future model (45 000 tonnes / year, furane binder) scenarios has been conducted to determine the impact of variable volume and stack source characteristics. Odour has been used as the compound to assess the model's sensitivity to these variables. **Table 7**, **8** and **9** detail the results of this analysis.

5.6.1 Fugitive Emissions

Table 7 shows the sensitivity of the model to varying horizontal and vertical plume spread parameters.

The model is not significantly sensitivity to the variation in the vertical plume spread parameter as demonstrated with the 4 m and 1 m vertical spread parameters for both the existing and future modelling scenarios.

Sensitivity of the model to the horizontal spread parameter is more significant as demonstrated by the existing model scenario. The 9 m and 5 m (PF+EAF and KNOCK) horizontal spread parameters assume no horizontal spread of the plume as it rises from the emission source to the point of release at the roof of the building. This is the theoretical worst case and not considered representative of actual conditions with the foundry building.

The actual horizontal and vertical plume spread parameters used in the models are derived from the building dimensions as being one quarter the length and height of the building over which the emission is emitted.

Table 7: Volume Source Characteristics

Foundry	Horizontal Spread (m)	Vertical Spread (m)	Predicted Highest Odour (OU)
Existing	29	4	10.3
	29	1	9.3
	9 (PF+EAF) 5 (KNOCK)	4	17.2
	9 (PF+EAF) 5 (KNOCK)	1	14.7
Future	17	4	1.57
	17	1	1.51

Table 8: Future Model Sensitivity – Fugitive Odour

Scenario		99.9^{th} Percentile Odour GLC (ODU)
1	5% Fugitive (Cool Conveyor)	1.57
2	10% Fugitive (Cool Conveyor)	1.99
3	15% Fugitive (Cool Conveyor)	2.55

The sensitivity of the future model to fugitive emissions from the Cool Conveyor enclosure is summarised in **Table 8**. The predictions presented in **Table 8** have assumed a pollution control technology reduction factor of 85%. The comparison between scenario 1 and 2 presented in **Table 8** indicates that the model is slightly sensitive to the variations in fugitive odour emissions.

The assessment of the proportion of fugitive emissions from the Cooling Conveyor enclosure indicates that the future model is relatively sensitive to this parameter. The predictions presented in this assessment have assumed a fugitive loss from the enclosure of five percent.

5.6.2 Point Source Characteristics

Table 9 provides a summary of the predicted glc for odour (without additional pollution control technology) from the three primary point sources (COOLS1, P-Line and P+C) under varying stack heights and exit velocities to assess the sensitivity of the dispersion model to these parameters. Scenario 1, 2 and 3 indicate that the model is not particularly sensitive to stack height changes up to 50 metres as presented in **Table 9.**

Scenario 1 and 4 and scenario 2 and 5 presented in **Table 9** demonstrate the models sensitivity to increasing the exit velocity from the three primary point sources. This indicates that the model is not particularly sensitive to the exit velocity from the three primary point sources.

Table 9: Future Model Sensitivity – Stack Height and Velocity

Scenario		99.9^{th} Percentile Odour GLC (ODU)
1	25 m Stack height COOLS1, P-Line and P+C	35.8
2	40 m Stack height COOLS1, P-Line and P+C	22.4
3	50 m Stack height COOLS1, P-Line and P+C	22.2
4	25 m Stack height + 20 m/s exit velocity COOLS1, P-Line and P+C	30.6
5	40 m Stack height + 20 m/s exit velocity COOLS1, P-Line and P+C	22.2

6. MODEL INPUT DATA

6.1 Sources

Tables 10 and **11** detail the emission sources that have been used in both the existing (E) and future (F) dispersion modelling, including the physical characteristics of the source.

Table 10: Source Characteristics

AUSPLUME Source Identifier	Source Description	Emission Height (metres)	Stack Diameter (metres)	Temperature (^oC)	Exit Velocity (m/s)
AS1 (E&F)	Silo Dedust Bag Filter Stack	9	0.6	38	5.6
AS2 (E&F)	Shake-out Baghouse Filter Stack	12	1.06	34	10
AS3 (E&F)	Sand Cooler Baghouse Filter Stack	12	0.2	53	45
AS4 (E)	Furnace Baghouse Filter Stack	19	1.03	54	16
AS4 (F)	Furnace Baghouse Filter Stack	25	2	80	27
AS5 (F)	Silo Dedust Bag Filter Stack	9	0.6	38	5.6
AS6 (F)	Sand Cooler Baghouse Filter Stack	12	0.2	53	45
ARC (E)	ARC Air Baghouse Filter Stack	12	1.25	18	13.4
ARC 2 (F)	ARC Air Baghouse Filter Stack	12	1.25	18	13.4
PATTER (E&F)	Pattern Shop Baghouse Filter Stack	8	0.45	20	26.6
LADLE (E&F)	Ladle Wash Baghouse Filter Stack	15	0.95	24	6.7
SHOT (E&F)	Shot Blast Stack	11	0.47	27	25.5
SHOT2 (F)	Shot Blast Stack	11	0.47	27	25.5
COOLS1 (E)	Cooling Room Stack	12	1.25	44	10.5
COOLS2 (E)	Cooling Room Stack	12	1.25	42	9.4
COOLS1 (F)	Cooling Floor Conveyor Stack	25	1.4	40	20
P-LINE (F)	Pouring Conveyor Baghouse Filter Stack	25	1.8	40	12.9
P+C (F)	Pouring Floor Baghouse Filter Stack	25	1.4	40	13.5

AUSPLUME Source Identifier	Source Description	Emission Height (metres)	Stack Diameter (metres)	Temperature (°C)	Exit Velocity (m/s)
WELD (E&F)	Weld Bay Extraction Exhaust	10	0.6	36	4.3
OXY (E&F)	Oxy LPG Cutting Exhaust Stack (North)	10	1.25	38	12
10TA (E&F)	10 tonne annealing oven	12	0.25	600	13.9
10TB (E&F)	10 tonne annealing oven	12	0.25	600	13.9
40TA (E&F)	40 tonne annealing oven	7	0.60	600	6.8
40TB (E&F)	40 tonne annealing oven	7	0.60	600	6.8
40TC (F)	40 tonne annealing oven	7	0.60	600	6.8
40TD (F)	40 tonne annealing oven	7	0.60	600	6.8

Source: Axiom Air, May 2004

(E) = Existing

(F) = Future

Table 11: Volume Source Characteristics

AUSPLUME Source Identifier	Height (metres)	Horizontal Spread (metres)	Vertical Spread (metres)
PF + EAF (E)	14	29	4
KNOCK (E)	14	29	4
Cool (F)	14	17	4

(E) = Existing

(F) = Future

6.2 Source Emission Data

Table 12 to **Table 15** detail the pollutant emission rates for each modelled source for the existing and future operating scenarios.

Table 12: Emission Rates (existing)

AUSPLUME Source Identifier	Source Description	PM_{10} (kg/hr)	$PM_{2.5}$ (kg/hr)	Dioxins (ng/hr)	Odour (OUV/second)
AS1	Silo Dedust Bag Filter Stack	1.44E-02	4.62E-03		72
AS2	Shake-out Baghouse Filter Stack	2.59E-03	8.29E-04		360 #
AS3	Sand Cooler Baghouse Filter Stack	1.72E-03	5.50E-04		378
AS4	Furnace	2.00E-02 #	6.38E-03 #	126 #	520 #
ARC	ARC Air Baghouse Filter Stack	1.17 * *	3.74E-01 * *		-
PATTER	Pattern Shop Baghouse Filter Stack	1.14E-02 #	3.66-03 #		
LADLE	Ladle Wash Baghouse Filter Stack	1.42E-02 #	4.55E-03 #		-
SHOT	Shot Blast Stack	5.92E-02 #	1.89E-02 #		-
COOLS1	Mould Cooling Stack	1.05E-01	3.36E-02		4300
COOLS2	Mould Cooling Stack	1.05E-01	3.36E-02		4300
WELD	Weld Bay Extraction Exhaust	5.94E-02 # #	1.9E-02 #		62 # #
OXY	Oxy LPG Cutting Exhaust Stack (North)	1.02E-01 # #	3.27E-02 #		530 # #
PF + EAF	Furnace Building	2.20E-01	7.04E-02	1390 #	6070-14000 *
KNOCK	Knockout	6.50E-01	2.08E-01		5750 #

# indicates sources with constant emissions for the period 0601-2200 hours, zero at other times.

indicates sources with constant emissions for the period 0601-1400 hours, zero at other times.

* higher value is for emissions from 0601-2200 hours, lower value applies at other times

* * indicates sources with constant emissions every second hour for the period 0601-2200 hours, zero at other times.

Table 13: Emission Rates (future)

AUSPLUME Source Identifier	Source Description	PM_{10} (kg/hr)	$PM_{2.5}$ (kg/hr)	Dioxins (ng/hr)	Odour (OUV/second)
AS1	Silo Dedust Bag Filter Stack	2.11E-02	6.76E-03	-	72
AS2	Shake-out Baghouse Filter Stack	3.80E-03	1.22E-03	-	380 #
AS3	Sand Cooler Baghouse Filter Stack	2.52E-03	8.06E-04	-	378
AS4	Furnace Baghouse Filter Stack	1.51E-01 #	4.83E-02 #	340 #	520 #
AS5	Silo Dedust Bag Filter Stack	2.11E-02	6.75E-03	-	72
AS6	Shake-out Baghouse Filter Stack	2.52E-03	8.06E-04	-	378
ARC 2	ARC Air Baghouse Filter Stack	3.43E-02	1.10E-02	-	-
PATTER	Pattern Shop Baghouse Filter Stack	1.67E-02 #	5.34E-03 #	-	-
LADLE	Ladle Wash Baghouse Filter Stack	2.08E-02 #	6.70E-03 #	-	-
SHOT	Shot Blast Stack	4.34E-02 #	1.39E-02 #	-	-
SHOT 2	Shot Blast Stack(2)	4.34E-02 #	1.39E-02 #	-	-
COOLS1	Cooling Floor Conveyor Stack	5.13E-01	1.64E-01	-	6550
P-LINE	Pouring Conveyor Baghouse Filter Stack	9.05E-03	2.90E-03	-	3330
P+C	Pouring Floor Baghouse Filter Stack	2.30E-02 #	7.36E-03 #	3820 #	2030-3820 *
WELD	Weld Bay Extraction Exhaust	8.71E-02 ##	2.79E-02 ##	-	62 ##
OXY	Oxy LPG Cutting Exhaust Stack (North)	1.98E-01 ##	6.34E-02 ##	-	530 ##
COOL	Furnace Building	5.70E-02 #	1.82E-02 #	-	-
FUG	Fugitive Odour (cooling line)	-	-	-	1040

# indicates sources which have a constant emission profile for the period 0601-2200 hours (with the exception of odour which is variable).

indicates sources which have a constant emission profile for the period 0601-1400 hours.

* higher value is for emissions from 0601-2200 hours, lower value applies at other times

Table 14: Emission Rates (Existing Alkali Phenolic) kg/hr

Substances	CoolS1/CoolS2 #	10TA-B	40TA-B	PF&EAF
Ammonia	6.38E-02	--	--	5.01E-02 ##
NOx	2.14E-02	8.40E-02	1.28E-01	1.68E-02 ##
SO_2	3.78E-03	--	--	2.96E-03 ##
Phenol	4.78E-02	--	--	3.72E-02 ##
Cresol	7.11E-02	--	--	5.58E-02
Formaldehyde	8.12E-02	--	--	6.37E-02 ##
Acrolein	2.04E-03	--	--	1.60E-03 ##
Benzene	2.56E-01	--	--	2.08E-01 ##
Ethylbenzene	1.89E-02	--	--	1.48E-02 ##
Styrene	1.30E-03	--	--	1.02E-03 ##
Toluene	1.04E-01	--	--	2.26E-02 ##
Xylene	9.31E-02	--	--	7.31E-02 ##
Cyclohexanone	7.41E-04	--	--	5.82E-04 ##
Ethyl Acetate	5.12E-02	--	--	4.02E-02 ##
Isopropylbenzene	6.24E-04	--	--	4.89E-04 ##
Methylethylketone	5.11E-03	--	--	4.01E-03 ##
Methylisobutylketone	2.56E-03	--	--	2.01E-03 ##
Butyl acetate	1.24E-03	--	--	9.76E-04 ##
Anthracene	9.73E-04	--	--	3.82E-04
Benzo (a) pyrene	1.20E-05	--	--	9.55E-06 ##
Fluorene	7.30E-04	--	--	2.86E-04
Naphthalene	6.07E-03	--	--	4.77E-03 ##
Phenanthrene	7.54E-04	--	--	2.96E-04
Pyrene	7.30E-05	--	--	2.87E-05
Cyanide	2.43E-02	--	--	1.91E-02 ##
CO	1.12E+01	--	--	8.75E+00 ##
H_2S	nd	--	--	nd
Butanol	2.98E-03	--	--	1.17E-03
Acetaldehyde	1.64E-01	--	--	6.45E-02
Furfural	3.35E-04	--	--	1.30E-04
Propanaldehyde	7.55E-02	--	--	2.96E-02
Butanaldehyde	7.60E-02	--	--	2.98E-02
Pentanaldeyhde	2.27E-03	--	--	8.90E-04
Benzaldehyde	1.89E-03	--	--	7.40E-04
Glutaraldehyde	8.10E-04	--	--	3.20E-04
Acenaphthene	4.37E-04	--	--	1.70E-04
Acenaphthylene	1.28E-04	--	--	5.00E-05

Substances	CoolS1/CoolS2 #	10TA-B	40TA-B	PF&EAF
Benz (a) anthracene	2.04E-05	--	--	2.00E-05
Benzo (b) fluoranthene	5.16E-04	--	--	4.00E-06
Fluoranthene	1.58E-04	--	--	6.00E-05
Chrysene	1.59E-05	--	--	1.00E-05
Dimethylphenols	1.49E-01	--	--	5.85E-02
1,3,5-Trimethylbenzene	6.51E-02	--	--	2.55E-02

nd = Not Detected

= Emission rate is for each individual source. Emission rate is constant over the 24 hour period.

= Emission rate is expressed as the period (daily) mass emission rate. Model input emission rates are variable over the 24 hour period. The factors for the hourly emission rate relative to the daily average are: 0001-0700 hours x0.67; 0701-1100 hours x0.95; 1101-1600 hours x1.14; 1601-2000 hours x1.34; 2001-2200 hours x1.42; 2201-2300 hours x0.95; 2301-2400 hours x0.67.

Table 15: Emission Rates (Future Furane) kg/hr

Substances	AS2 #	CoolS1	P+C	P-Line	10TA-B	40TA-D	Cool
Ammonia	5.77E-02	3.40E-02	6.87E-03	9.78E-03	--	--	1.80E-03
NOx	1.08E-01	1.78E-01	3.57E-02	5.08E-02	8.40E-02	1.28E-01	9.35E-03
SO2	2.22E+00	1.94E-01	3.90E-02	5.08E-02	--	--	1.02E-02
Phenol	1.01E-02	4.84E-02	9.72E-03	1.38E-02	--	--	2.55E-03
Cresol	1.62E-02	3.04E-02	6.11E-03	8.70E-03	--	--	1.60E-03
Formaldehyde	1.21E-01	1.20E-01	2.41E-02	3.43E-02	--	--	6.33E-03
Acrolein	2.70E-03	2.81E-04	5.65E-05	8.05E-05	--	--	3.00E-04
Benzene	2.26E-03	5.78E-02	1.16E-02	1.65E-02	--	--	6.10E-02
Ethylbenzene	6.74E-03	2.09E-02	4.20E-03	5.98E-03	--	--	1.10E-03
Styrene	7.41E-03	1.06E-02	2.13E-03	3.02E-03	--	--	5.60E-04
Toluene	2.16E-01	5.85E+00	1.17E+00	1.67E+00	--	--	3.08E-01
Xylene	2.17E-02	3.53E-01	7.09E-02	1.01E-01	--	--	1.86E-02
Cyclohexanone	6.74E-03	7.06E-03	1.42E-03	2.02E-03	--	--	3.71E-04
Ethyl Acetate	5.80E-03	1.14E-01	2.28E-02	3.25E-02	--	--	5.98E-03
Isopropylbenzene	8.09E-03	7.06E-02	1.42E-02	2.02E-02	--	--	3.71E-03
Methylethylketone	3.17E-02	5.06E-02	1.02E-02	1.44E-02	--	--	2.66E-03
Methylisobutylketone	6.74E-03	7.06E-03	1.42E-03	2.02E-03	--	--	3.70E-04
Butyl acetate	7.41E-03	7.06E-03	1.42E-03	2.02E-03	--	--	3.70E-04
Anthracene	nd	1.10E-04	2.00E-05	3.00E-05	--	--	1.00E-05
Benzo (a) pyrene	nd	2.90E-05	1.70E-06	2.70E-06	--	--	1.50E-06
Fluorene	4.04E-04	3.80E-04	8.00E-05	1.10E-04	--	--	2.00E-05
Naphthalene	9.03E-03	8.58E-03	1.72E-03	2.45E-03	--	--	4.50E-04
Phenanthrene	4.00E-04	3.80E-04	8.00E-05	1.10E-04	--	--	2.00E-05
Pyrene	6.70E-05	5.70E-05	1.00E-05	2.00E-05	--	--	3.37E-06
Cyanide	5.73E-02	5.44E-02	1.09E-02	1.55E-02	--	--	2.86E-03
CO	3.32E+01	3.15E+01	6.32E+00	9.00E+00	--	--	1.66E+00
H2S	1.14E-01	1.08E-01	2.17E-02	3.09E-02	--	--	5.68E-03
Butanol	6.14E-03	2.09E-03	1.20E-04	1.90E-04	--	--	1.90E-04
Acetaldehyde	1.50E-01	1.61E-01	9.33E-03	1.47E-02	--	--	8.47E-03
Furfural	nd	1.13E-03	7.00E-05	1.00E-04	--	--	6.00E-05
Propanaldehyde	1.00E-02	2.09E-02	1.21E-03	1.91E-03	--	--	1.10E-03
Butanaldehyde	3.26E-02	1.12E-01	6.52E-03	1.03E-02	--	--	5.92E-03
Pentanaldeyhde	nd	1.12E-02	6.50E-04	1.02E-03	--	--	5.90E-04
Benzaldehyde	5.14E-03	2.25E-02	1.30E-03	2.05E-03	--	--	1.18E-03
Glutaraldehyde	2.08E-03	2.25E-03	1.30E-04	2.00E-04	--	--	1.20E-04
Acenaphthene	nd	6.00E-05	3.20E-06	5.10E-06	--	--	2.90E-06
Acenaphthylene	nd	1.44E-04	8.30E-06	1.31E-05	--	--	7.60E-06

Substances	AS2 #	CoolS1	P+C	P-Line	10TA-B	40TA-D	Cool
Benz (a) anthracene	nd	2.90E-05	1.70E-06	2.70E-06	--	--	1.50E-06
Benzo (b) fluoranthene	nd	2.90E-05	1.70E-06	2.70E-06	--	--	1.50E-06
Fluoranthene	nd	5.60E-05	3.20E-06	5.10E-06	--	--	2.90E-06
Chrysene	nd	2.90E-05	1.70E-06	2.70E-06	--	--	1.50E-06
Dimethylphenols	7.14E-03	1.24E-02	7.20E-04	1.13E-03	--	--	6.50E-04
1,3,5-Trimethylbenzene	nd	1.14E-02	6.60E-04	1.04E-03	--	--	6.00E-04

nd = Not Detected

AS2 emission profile is for the hours from 0601 to 2200.

7. MODELLING RESULTS

7.1 Results Summary – Design Ground Level Concentrations (DGLC)

Table 16 presents the maximum (100th percentile) predicted GLC for each listed substance and the 99.9th percentile GLC for odour for each of the following operating scenarios.

- Existing (Alkali Phenolic binder, 16 500 tonnes cast metal)
- Future (Furane binder, 45 000 tonnes cast metal)

Table 16: Predicted GLC for Existing and Future Furane Scenarios

Substance	Maximum Predicted GLC		Criteria (Toxicity)	Units	Averaging Period
	Existing	Future			
Ammonia	0.0197	0.00823	0.6	mg/m^3	3-minute
NOx	0.0502	0.0464	0.113	mg/m^3	1-hour
SO_2	0.000972	0.304	0.45	mg/m^3	1-hour
Phenol	0.0146	0.00263#	0.13	mg/m^3	3-minute
Cresol	0.0181	0.00276#	NC	mg/m^3	3-minute
Formaldehyde	0.0225	0.0183	0.04	mg/m^3	3-minute
Acrolein	0.000563#	0.00039#	0.00077	mg/m^3	3-minute
Benzene	0.0733[1]	0.0139	0.053	mg/m^3	3-minute
Ethylbenzene	0.00522	0.00133#	14.5	mg/m^3	3-minute
Styrene	0.000359#	0.00119#	6.97	mg/m^3	3-minute
Toluene	0.0232	0.262	12.3	mg/m^3	3-minute
Xylene	0.0258	0.0159	11.4	mg/m^3	3-minute
Cyclohexanone	0.000205#	0.00103#	3.2	mg/m^3	3-minute
Ethyl Acetate	0.0142#	0.0051#	23.6	mg/m^3	3-minute
Isopropylbenzene	0.000173#	0.00339#	8.1	mg/m^3	3-minute
Methylethylketone	0.00141#	0.0052#	16	mg/m^3	3-minute
Methylisobutylketone	0.000708#	0.00103#	6.7	mg/m^3	3-minute
Butyl acetate	0.000344#	0.00111#	23.8	mg/m^3	3-minute
Anthracene	0.000223	5.07×10^{-6}#	NC	mg/m^3	3-minute
Benzo (a) pyrene	3.34×10^{-6}	1.07×10^{-6}#	0.00073	mg/m^3	3-minute
Fluorene	0.000167	0.0000723#	NC	mg/m^3	3-minute
Naphthalene	0.00168	0.00136	1.73	mg/m^3	3-minute
Phenanthrene	0.000173	0.0000603#	NC	mg/m^3	3-minute
Pyrene	0.0000168	0.0000104#	NC	mg/m^3	3-minute
Cyanide	0.00673#	0.00861#	0.17	mg/m^3	3-minute
CO	2.87	4.91	29	mg/m^3	1-hour
H_2S	NR	0.0171	0.47	mg/m^3	3-minute
Dioxin	0.00022	0.000169	0.0037	ng/m^3	3-minute
Odour[2]	10.3[1]	1.57	2	ODU	3-minute
PM_{10}	42	13.5	50	$\mu g/m^3$	1-day

Substance	Maximum Predicted GLC		Criteria (Toxicity)	Units	Averaging Period
	Existing	Future			
$PM_{2.5}$	11.4	4.25	25	µg/m^3	1-day
$PM_{2.5}$	2	1.43	8	µg/m^3	1-year
Butanol	0.000653#	0.000856#	5.1	mg/m^3	3-minute
Acetaldehyde	0.0377	0.0219	5.9	mg/m^3	3-minute
Furfural	0.0000768#	0.0000416#	NC	mg/m^3	3-minute
Propanaldehyde	0.0173	0.00161#	NC	mg/m^3	3-minute
Butanaldehyde	0.0174#	0.00590#	NC	mg/m^3	3-minute
Pentanaldehyde	0.000521#	0.000413#	NC	mg/m^3	3-minute
Benzaldehyde	0.000433	0.00108	NC	mg/m^3	3-minute
Glutaraldehyde	0.000186#	0.000304#	NC	mg/m^3	3-minute
Acenaphthene	0.0001	2.18 x10^{-6}#	NC	mg/m^3	3-minute
Acenaphthylene	0.0000293	5.29 x10^{-6}#	NC	mg/m^3	3-minute
Benz (a) anthracene	5.46 x10^{-6}	1.07 x10^{-6}#	NC	mg/m^3	3-minute
Benzo (b) fluoranthene	1.05 x10^{-4}	1.07 x10^{-6}#	NC	mg/m^3	3-minute
Fluoranthene	0.0000378	2.05 x10^{-6}#	NC	mg/m^3	3-minute
Chrysene	3.89 x10^{-6}	1.07 x10^{-6}#	NC	mg/m^3	3-minute
Dimethylphenols	0.0342	0.00111#	NC	mg/m^3	3-minute
1,3,5 Trimethylbenzene	0.0149#	0.000418#	NC	mg/m^3	3-minute

[1] - indicates maximum predicted GLC is above criteria.

[2] – Maximum GLC is the 99.9th percentile value.

- Result derived from input data that was < analytical detection limit.

NC = No criteria specified in SA EPA Guidelines Air Quality Impact Assessment

NR = No result, substance not detected in emission analysis

7.1.1 Contour Plots

Figure 3 to **Figure 10** show comparative predicted GLCs for each operating scenario for the following primary air quality criteria:

- Odour
- Fine Particulates - PM_{10}, $PM_{2.5}$

A complete presentation of contour plots for all substances and operating scenarios is presented in **Appendix I** to **Appendix IV.**

Figure 3: Predicted odour GLC from existing operation (ODU).
(3 minute averaging period, 99.9th percentile)

The predicted 99.9th percentile odour GLC for the existing operating scenario is 10.3 ODU compared to the design criteria of 2.0 ODU.

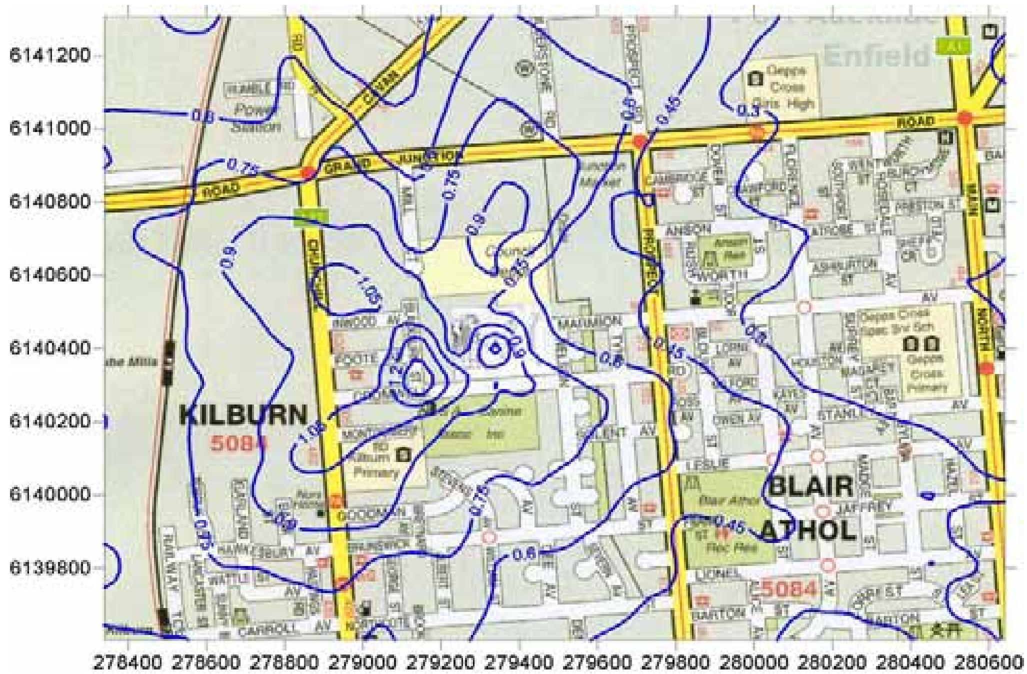


Figure 4: Predicted odour GLC from future operation (ODU).
(3 minute averaging period, 99.9th percentile)

The predicted 99.9th percentile odour GLC for the future operating scenario is 1.57 ODU compared to the design criteria of 2.0 ODU.

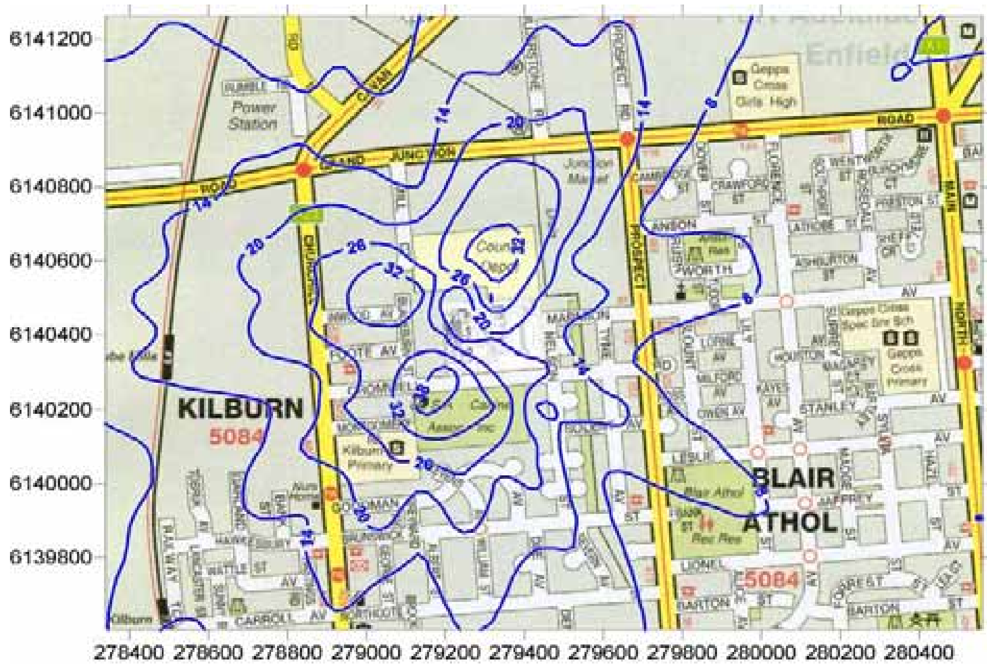


Figure 5: Predicted PM_{10} GLC from existing operation ($\mu g/m^3$).
(24 hour averaging period, 100^{th} percentile)

The maximum predicted PM_{10} GLC for the existing operating scenario is 42 $\mu g/m^3$ compared to the design criteria of 50 $\mu g/m^3$.

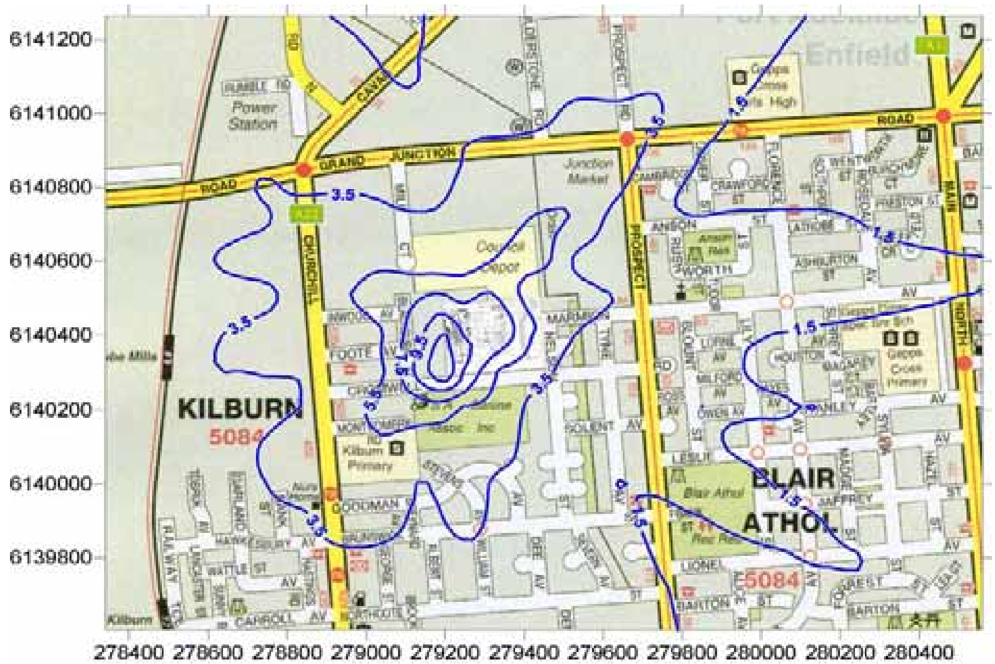


Figure 6: Predicted PM_{10} GLC from future operation ($\mu g/m^3$).
(24 hour averaging period, 100^{th} percentile)

The maximum predicted PM_{10} GLC for the future operating scenario is 13.5 $\mu g/m^3$ compared to the design criteria of 50 $\mu g/m^3$.

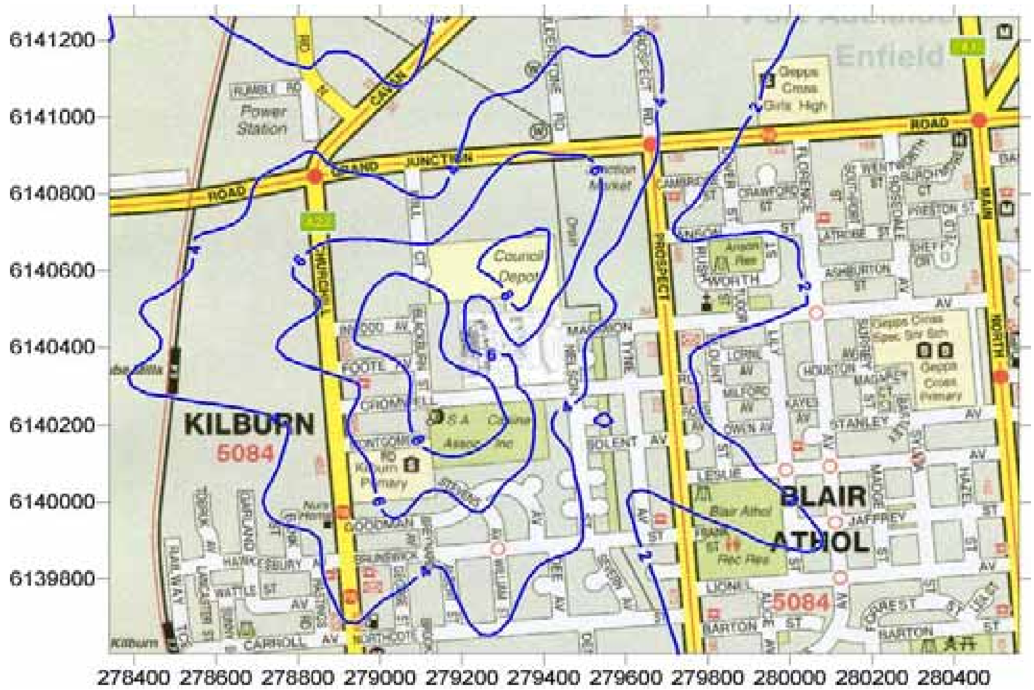


Figure 7: Predicted $PM_{2.5}$ GLC from existing operation ($\mu g/m^3$).
(24 hour averaging period, 100th percentile)

The maximum predicted $PM_{2.5}$ GLC (24 hour average) for the existing operating scenario is 11.4 $\mu g/m^3$ compared to the design criteria of 25 $\mu g/m^3$.

Figure 8: Predicted $PM_{2.5}$ GLC from future operation ($\mu g/m^3$).
(24 hour averaging period, 100th percentile)

The maximum predicted $PM_{2.5}$ GLC (24 hour average) for the future operating scenario is 4.25 $\mu g/m^3$ compared to the design criteria of 25 $\mu g/m^3$.

Figure 9: Predicted $PM_{2.5}$ GLC from existing operation ($\mu g/m^3$).
(Annual averaging period, 100th percentile)

The maximum predicted $PM_{2.5}$ GLC (annual average) for the existing operating scenario is 2 $\mu g/m^3$ compared to the design criteria of 8 $\mu g/m^3$.

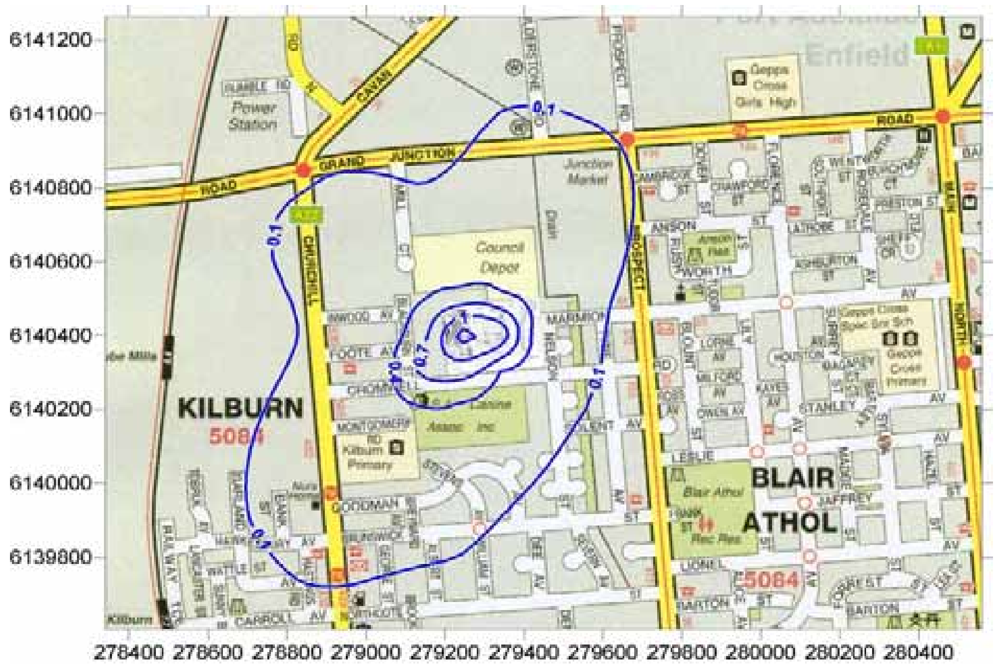


Figure 10: Predicted $PM_{2.5}$ GLC from future operation ($\mu g/m^3$).
(Annual averaging period, 100th percentile)

The maximum predicted $PM_{2.5}$ GLC (annual average) for the future operating scenario is 1.43 $\mu g/m^3$ compared to the design criteria of 8 $\mu g/m^3$.

7.2 Results Summary – Health Risk Assessment

Table 17 presents the maximum predicted GLC for each listed substance for each of the future furane operating scenario with a 24 hour and annual averaging period applied. The 24 hour and annual averaging periods have been modelled to provide data to assist in the preparation of a health risk assessment by a third party. No discussion or analysis of modelling results presented in **Section 6.2** is provided in this report.

Table 17: Predicted GLC for Future Scenario

Substance	24 hour averaging period	Annual averaging period	Units
Ammonia	0.00168	0.000519	mg/m^3
NOx	0.0134	0.00411	mg/m^3
SO_2	0.0486	0.0157	mg/m^3
Phenol	0.000974#	0.000253#	mg/m^3
Cresol	0.000789#	0.000225#	mg/m^3
Formaldehyde	0.00424	0.00128	mg/m^3
Acrolein	0.0000629#	0.000019#	mg/m^3
Benzene	0.00236	0.000468	mg/m^3
Ethylbenzene	0.000464#	0.000125#	mg/m^3
Styrene	0.000306#	0.0000903#	mg/m^3
Toluene	0.100	0.0237	mg/m^3
Xylene	0.00618	0.00149	mg/m^3
Cyclohexanone	0.000241#	0.0000723#	mg/m^3
Ethyl Acetate	0.00197#	0.000472#	mg/m^3
Isopropylbenzene	0.0013#	0.000324#	mg/m^3
Methylethylketone	0.0014#	0.000406#	mg/m^3
Methylisobutylketone	0.000241#	0.0000723#	mg/m^3
Butyl acetate	0.000255#	0.0000769#	mg/m^3
Anthracene	0.00000185#	0.000000413#	mg/m^3
Benzo (a) pyrene	0.000000378#	0.0000000701#	mg/m^3
Fluorene	0.000017#	0.00000561#	mg/m^3
Naphthalene	0.00031	0.0000935	mg/m^3
Phenanthrene	0.0000138#	0.00000417#	mg/m^3
Pyrene	0.00000229#	0.000000696#	mg/m^3
Cyanide	0.00197#	0.000593#	mg/m^3
CO	1.14	0.344	mg/m^3
H_2S	0.00391	0.00118	mg/m^3
Butanol	0.00015#	0.0000464#	mg/m^3
Acetaldehyde	0.0049	0.0014	mg/m^3
Furfural	0.0000148#	0.00000274#	mg/m^3
Propanaldehyde	0.00045#	0.000118#	mg/m^3
Butanaldehyde	0.00204#	0.000491#	mg/m^3
Pentanaldehyde	0.00125#	0.000196#	mg/m^3

Substance	24 hour averaging period	Annual averaging period	Units
Benzaldehyde	0.000382	0.0000888	mg/m^3
Glutaraldehyde	0.0000859#	0.0000263#	mg/m^3
Acenaphthene	0.000000773#	0.000000141#	mg/m^3
Acenaphthylene	0.00000183#	0.00000034#	mg/m^3
Benz (a) anthracene	0.000000378#	0.0000000701#	mg/m^3
Benzo (b) fluoranthene	0.000000378#	0.0000000701#	mg/m^3
Fluoranthene	0.000000773#	0.000000141#	mg/m^3
Chrysene	0.000000378#	0.0000000701#	mg/m^3
Dimethylphenols	0.000288#	0.000078#	mg/m^3
1,3,5 Trimethylbenzene	0.000148#	0.00002741#	mg/m^3
Dioxin	0.0000466	0.0000117	ng/m^3
PM_{10}	13.5	4.46	$\mu g/m^3$
$PM_{2.5}$	4.25	1.43	$\mu g/m^3$

- Result derived from input data that was < analytical detection limit.

For the purposes of the health risk assessment, carbon monoxide (CO) was also modelled for the future furane operating scenario over an 8 hour averaging period, giving a maximum predicted GLC of 1.78 mg/m^3.

7.2.1 Contour Plots

Contour plots for each substance and operating scenario presented in **Table 16** are provided in **Appendix III** to **Appendix IV.**

8. DISCUSSION AND CONCLUSION

Ausplume modelling of primary air pollutants and chemical constituents from both the alkali phenolic and furane binders was undertaken to enable assessment of the air quality impacts of the proposed foundry upgrade at the Bradken Adelaide foundry. Comparative models were prepared for the existing (alkali phenolic) and future (furane) operating scenarios to identify both the absolute and relative merits of each scenario.

Predicted GLCs for the primary air pollutants, odour and fine particulates, show a significant improvement (>50%) under the future (furane) operating scenario when compared to the existing situation. In addition the future scenario readily achieves the design ground level concentration criteria, with margins between 21-99.6% below the criteria.

The results of the modelling indicate that the predicted ground level concentration for each modelled substance for the future (furane) operating scenario realises a significant overall environmental improvement on the existing situation and readily achieve the SA EPA design ground level concentration criteria.

Central to achieving the future predicted ground level concentration for each substance is the application of emission control technology to a number of emission sources. The sources are, the pouring line ventilation (P-Line stack), fast-loop mould cooling conveyor ventilation (COOLS1 stack), custom cast floor ventilation (P+C stack) and the fast-loop mould shakeout (AS2 stack).

In conclusion, based on representative site emission data, the planned upgrade of the foundry will result in a significant net environmental benefit under the future (furane) operating scenario.

Appendix I

Contour Plots - Existing
(Alkali Phenolic)

Figure 1: Predicted odour GLC from existing operation (ODU).
(3 minute averaging period, 99.9th percentile)

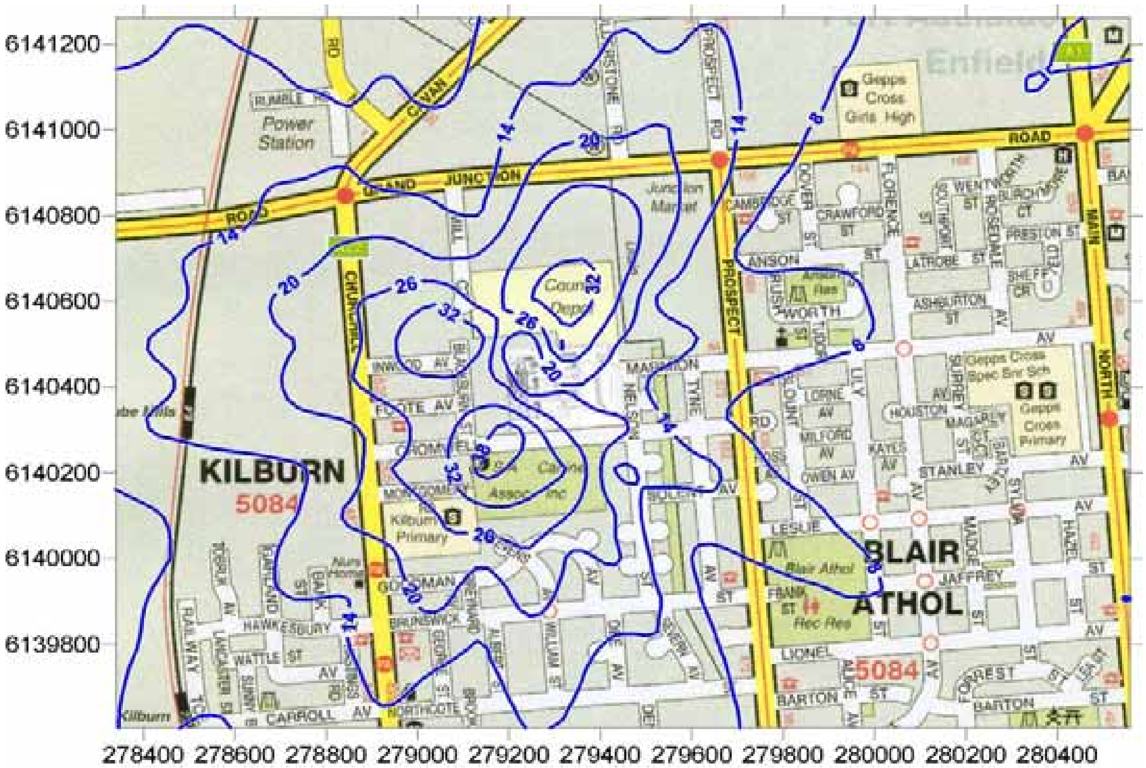


Figure 2: Predicted PM_{10} GLC from existing operation (µg/m^3).
(24 hour averaging period, 100th percentile)

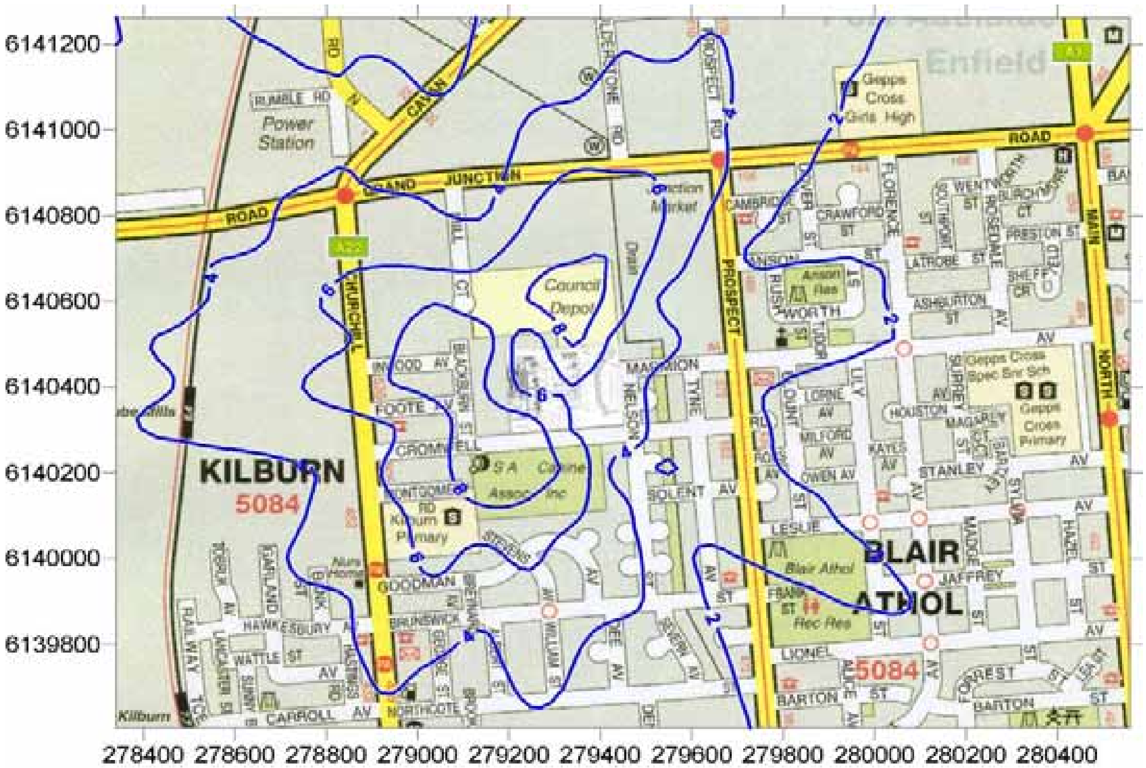


Figure 3: Predicted $PM_{2.5}$ GLC from existing operation ($\mu g/m^3$).
(24 hour averaging period, 100th percentile)

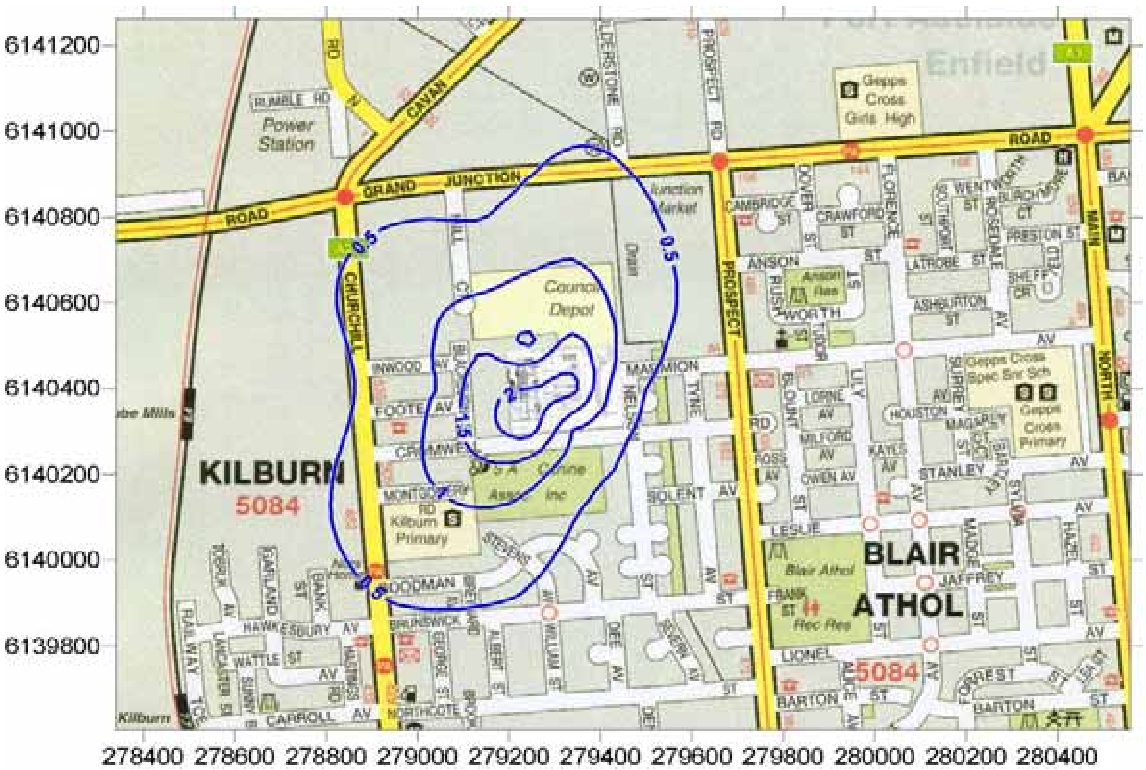


Figure 4: Predicted $PM_{2.5}$ GLC from existing operation ($\mu g/m^3$).
(Annual averaging period, 100th percentile)

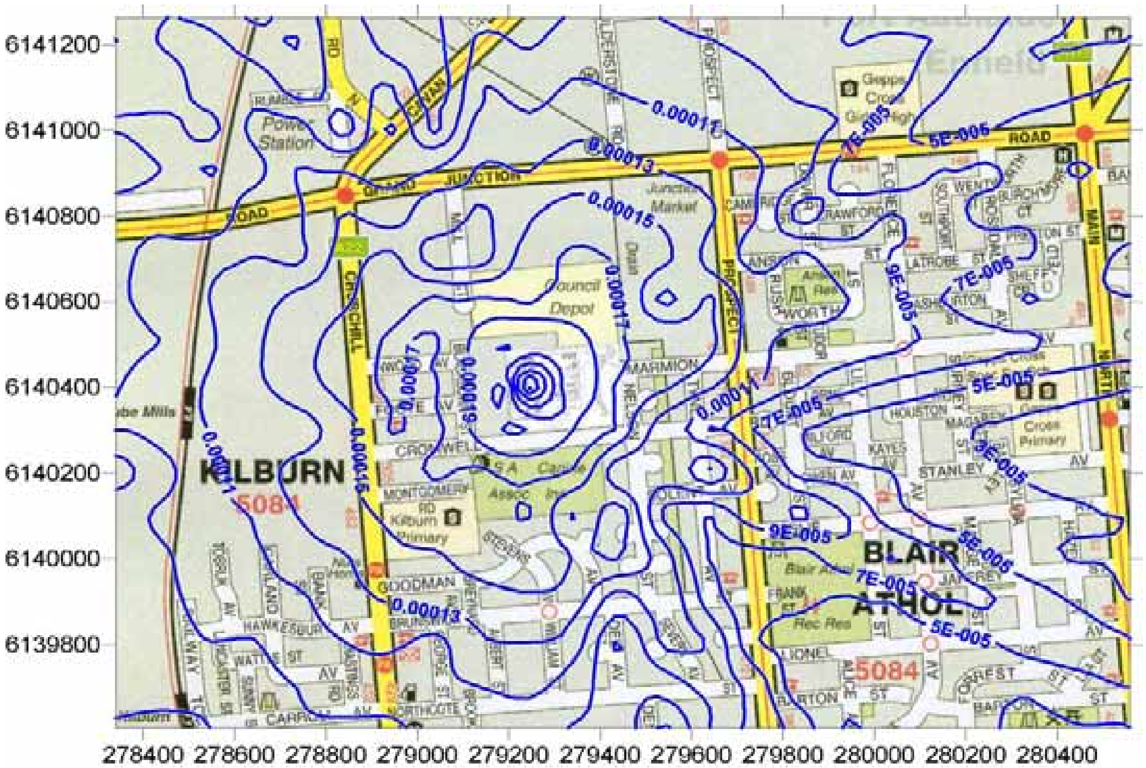


Figure 5: Predicted dioxin GLC from existing operation (ng/m^3).
(3 minute averaging period, 100th percentile)

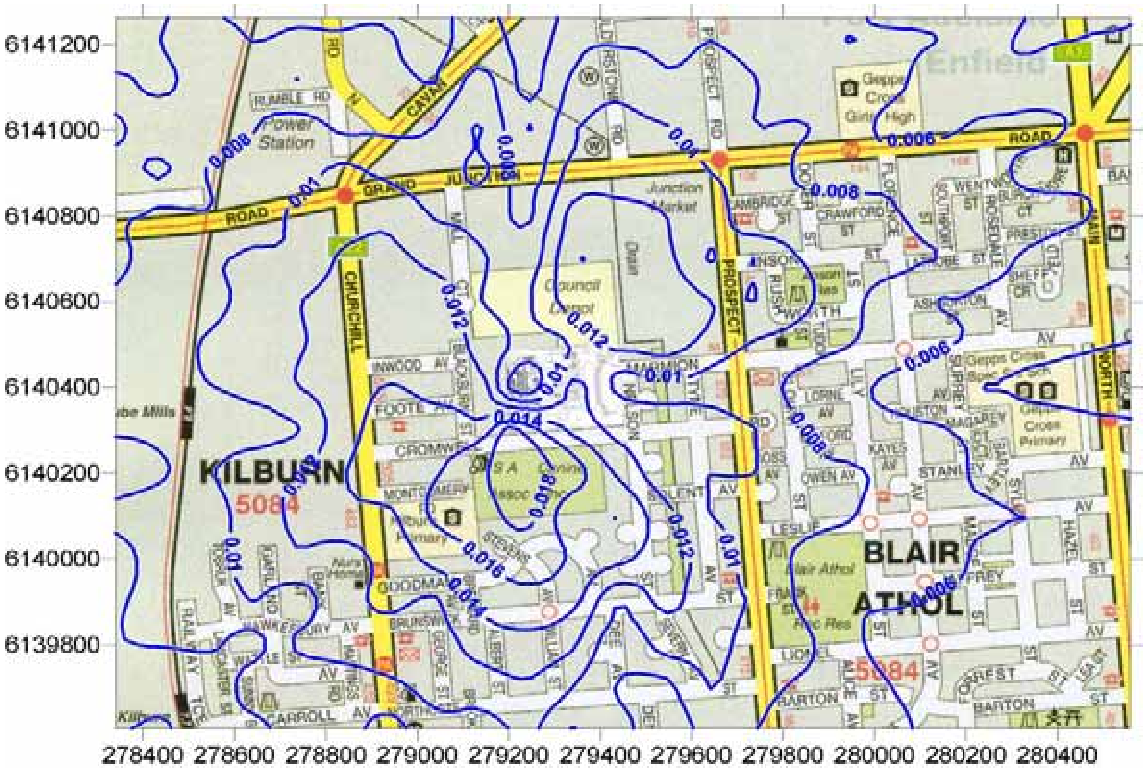


Figure 6: Predicted ammonia GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

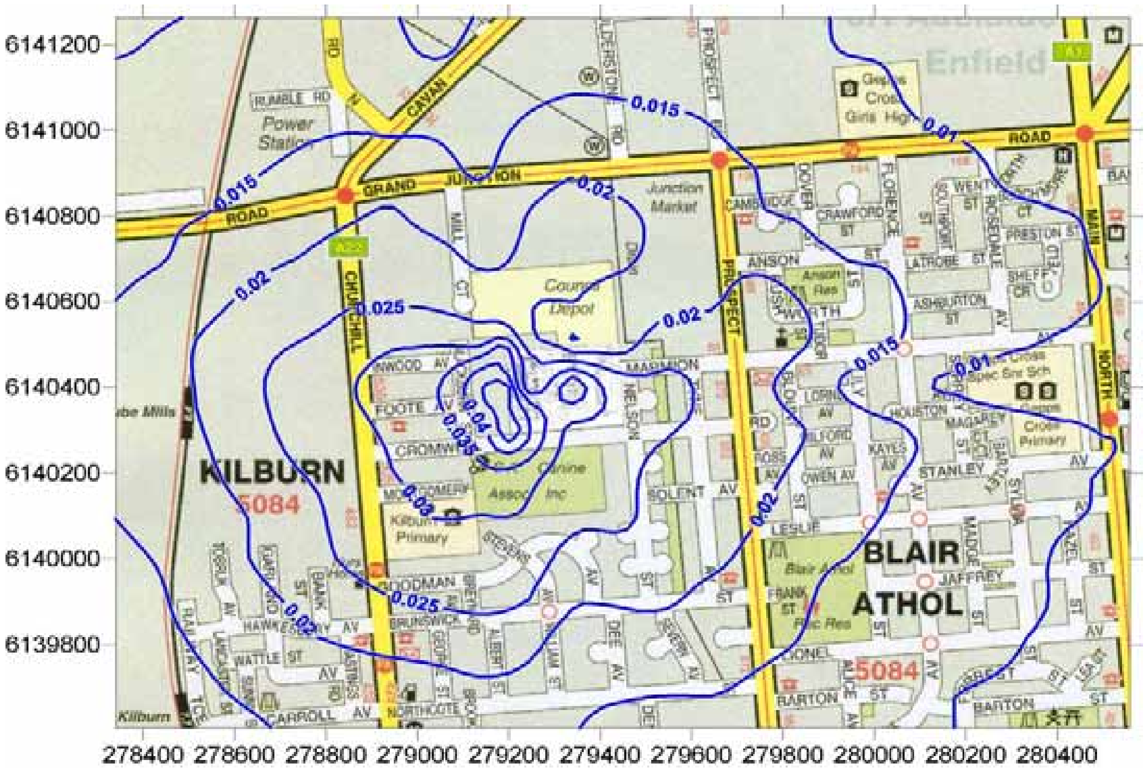


Figure 7: Predicted nitrogen oxides GLC from existing operation (mg/m^3). (1 hour averaging period, 100th percentile)

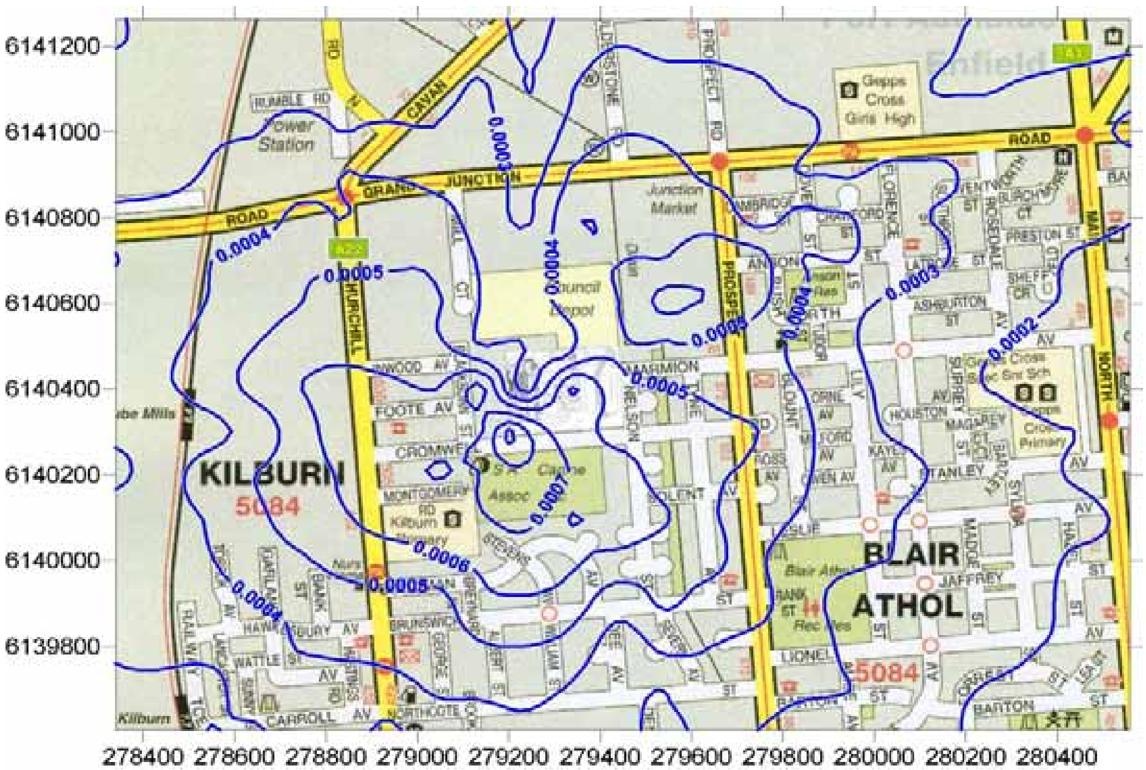


Figure 8: Predicted sulphur dioxide GLC from existing operation (mg/m^3). (1 hour averaging period, 100th percentile)

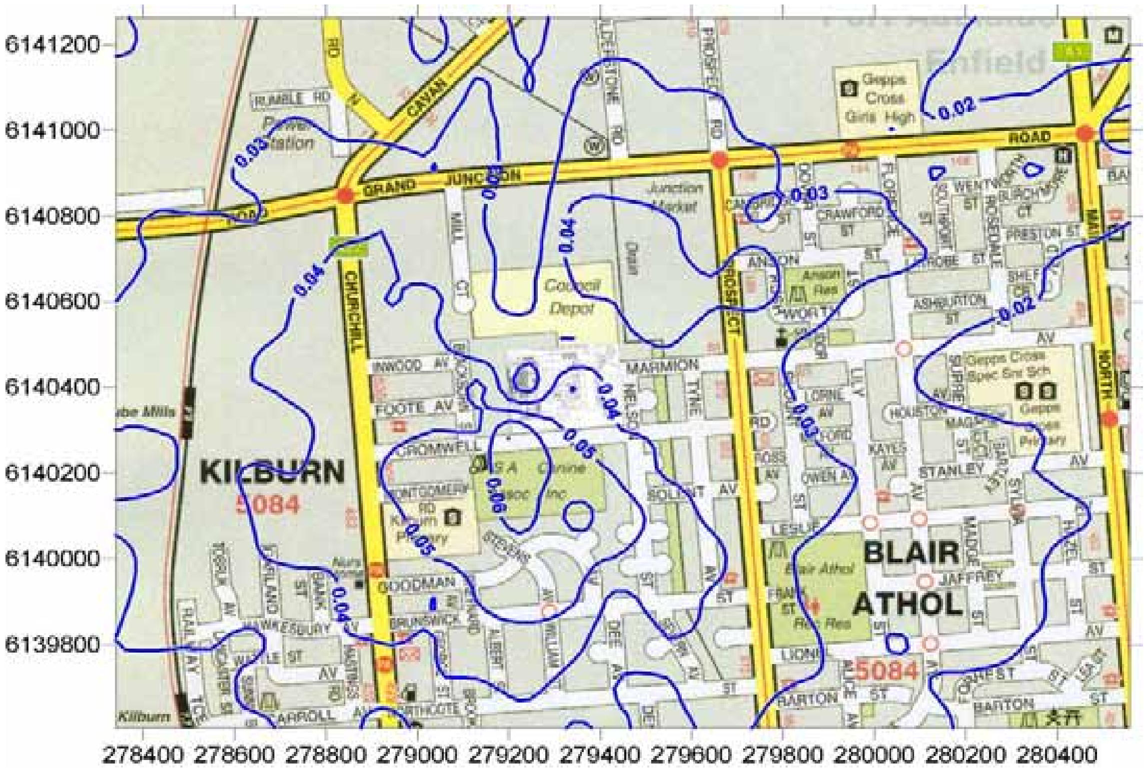


Figure 9: Predicted benzene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

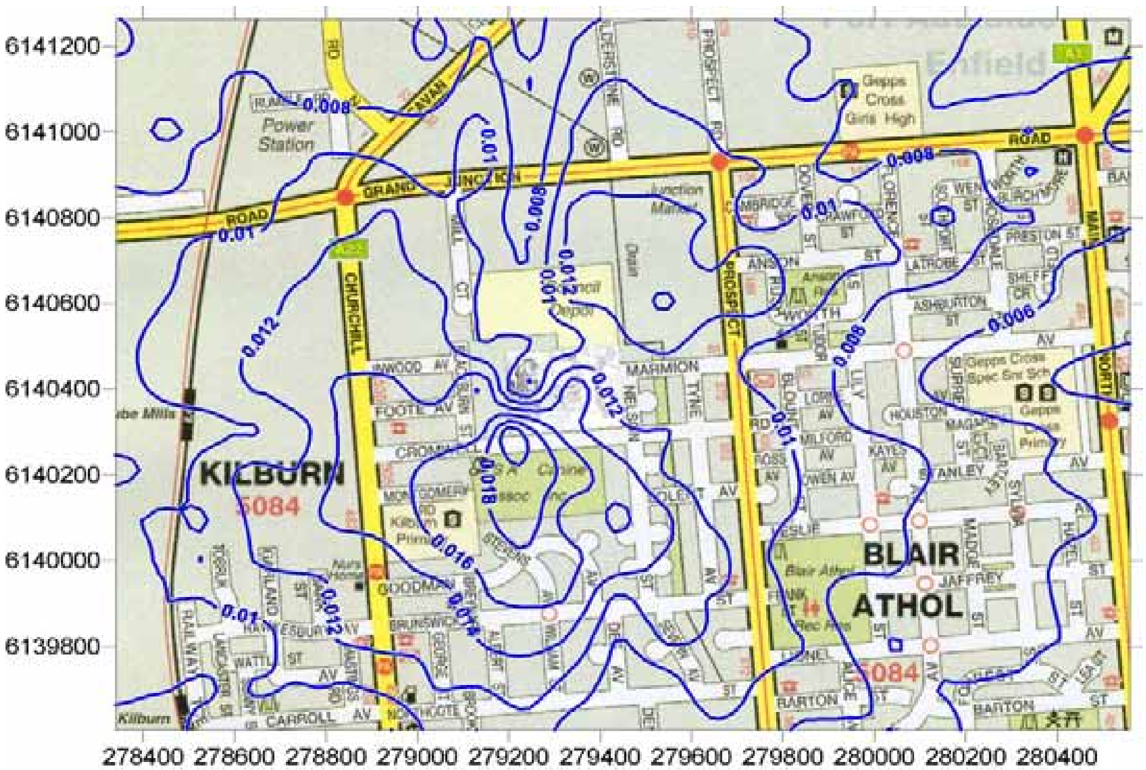


Figure 10: Predicted formaldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 11: Predicted cyanide GLC from existing operation (mg/m^3).
(3 minute averaging period, 100^{th} percentile)

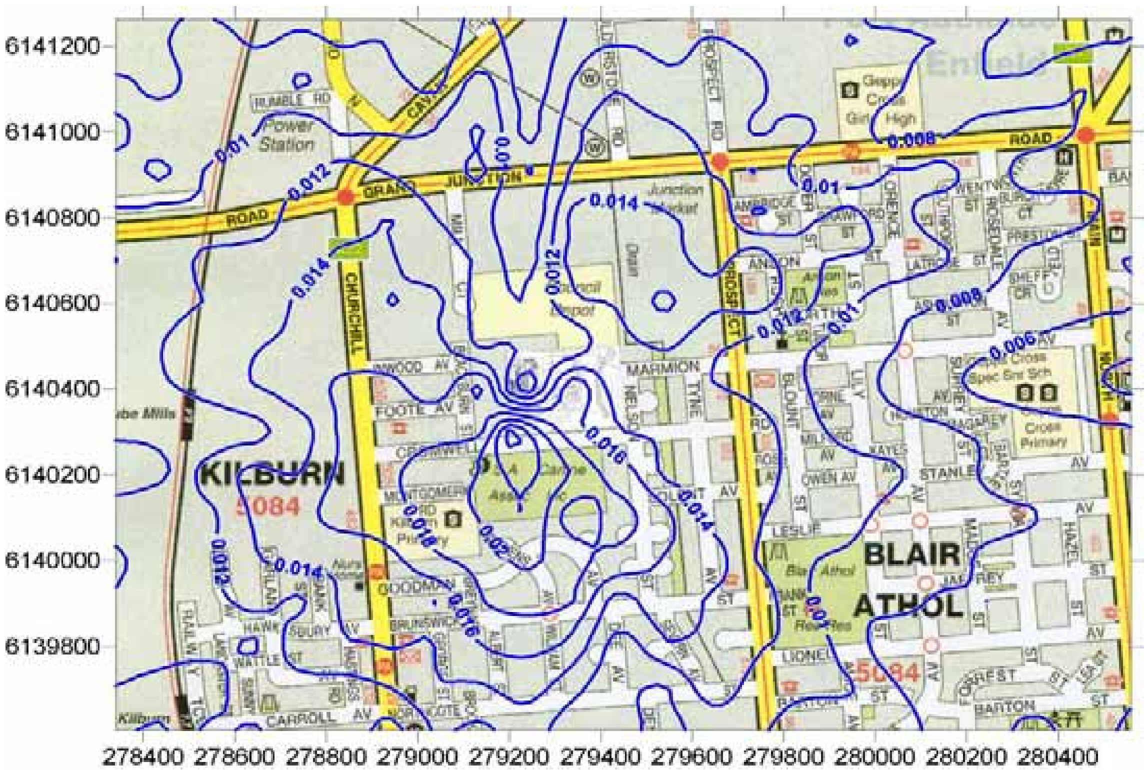


Figure 12: Predicted total xylene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100^{th} percentile)

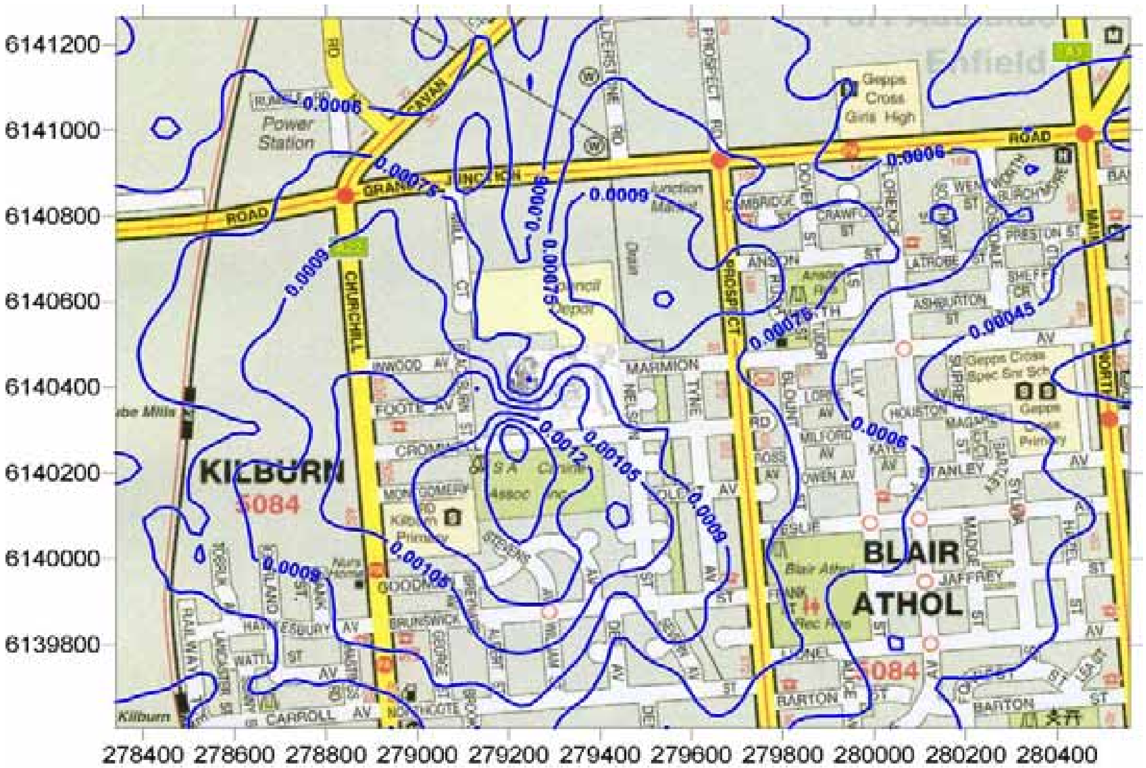


Figure 13: Predicted naphthalene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

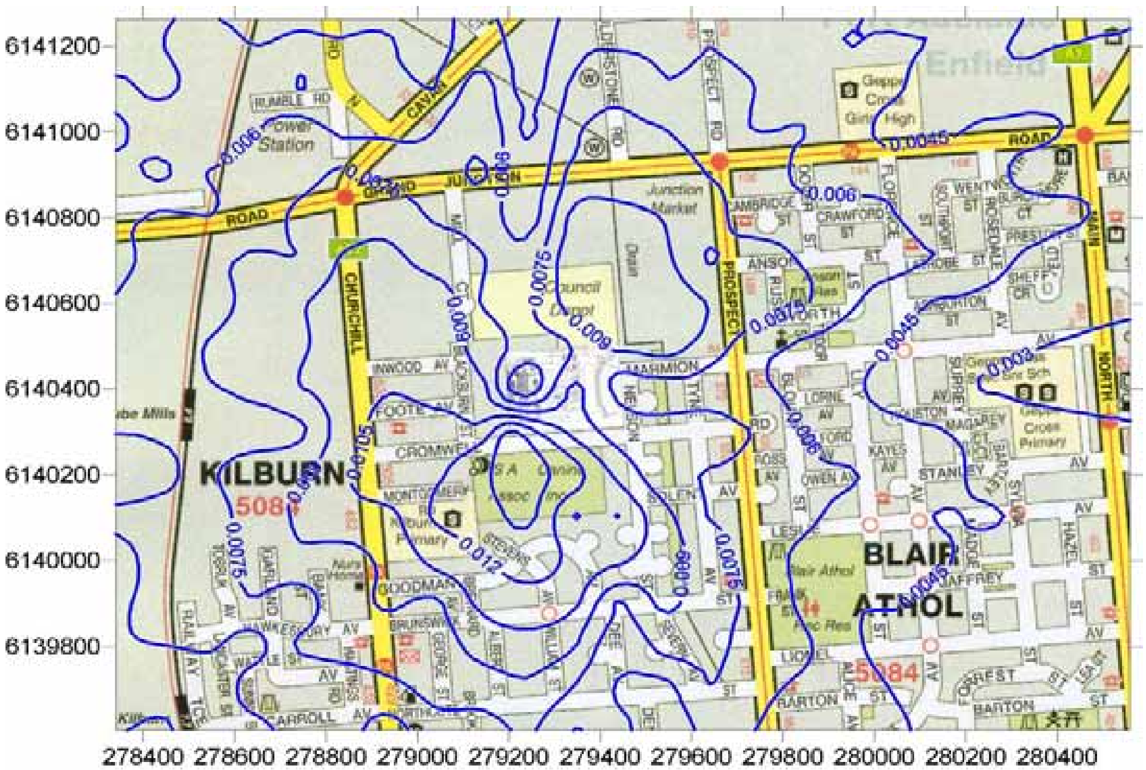


Figure 14: Predicted phenol GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

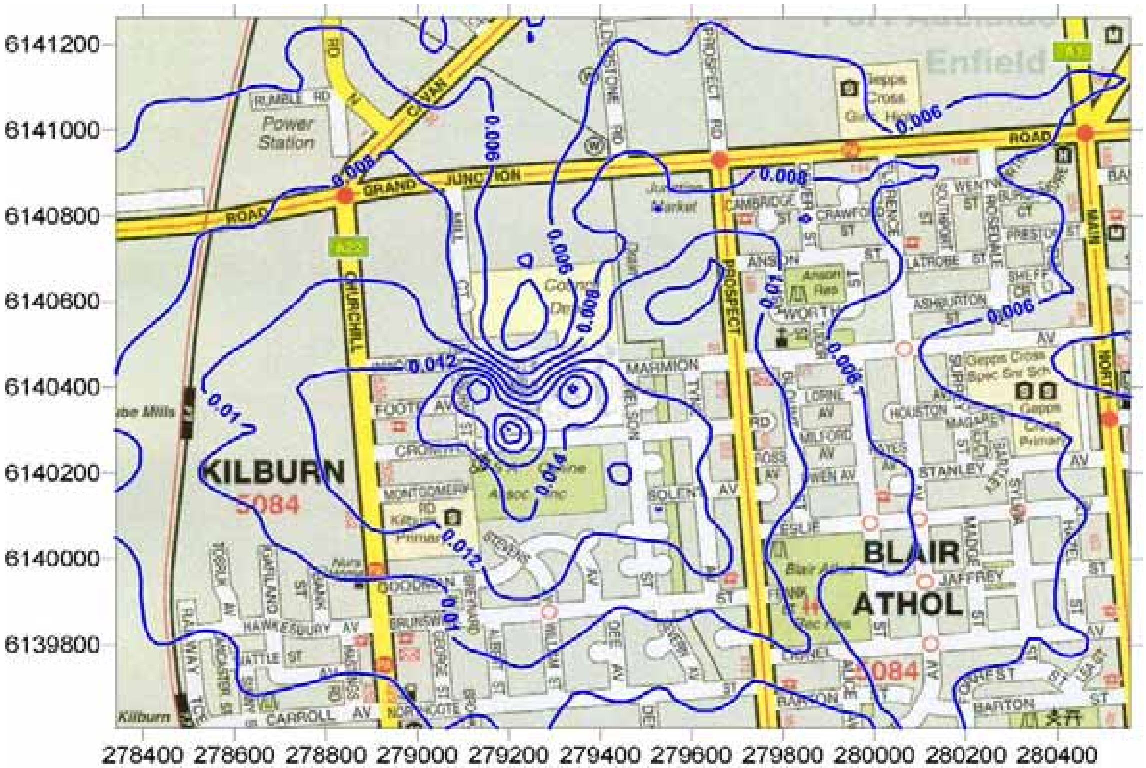


Figure 15: Predicted toluene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

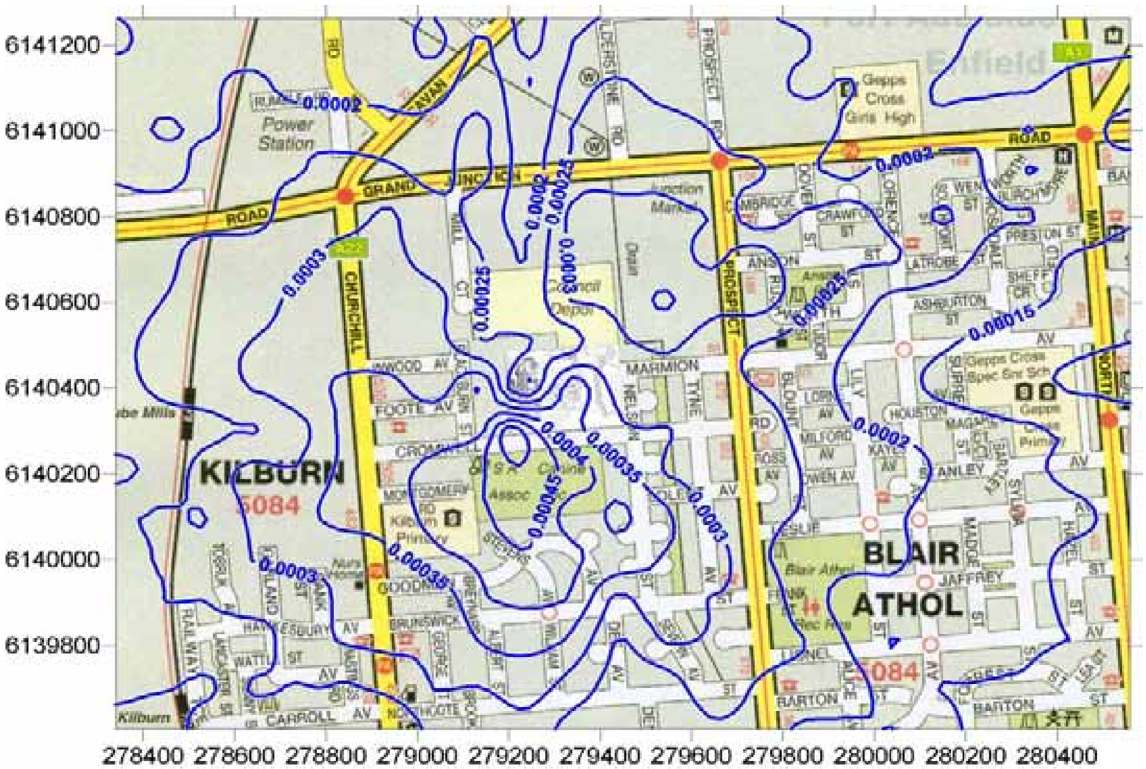


Figure 16: Predicted acrolein GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

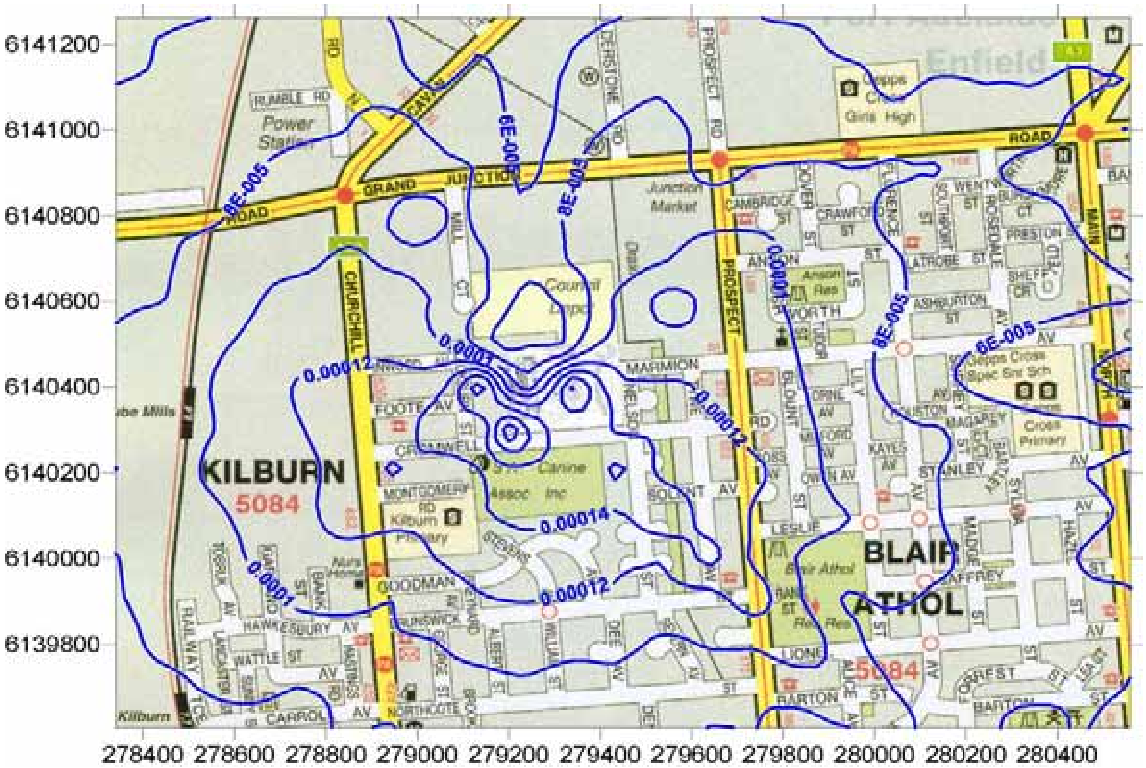


Figure 17: Predicted anthracene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

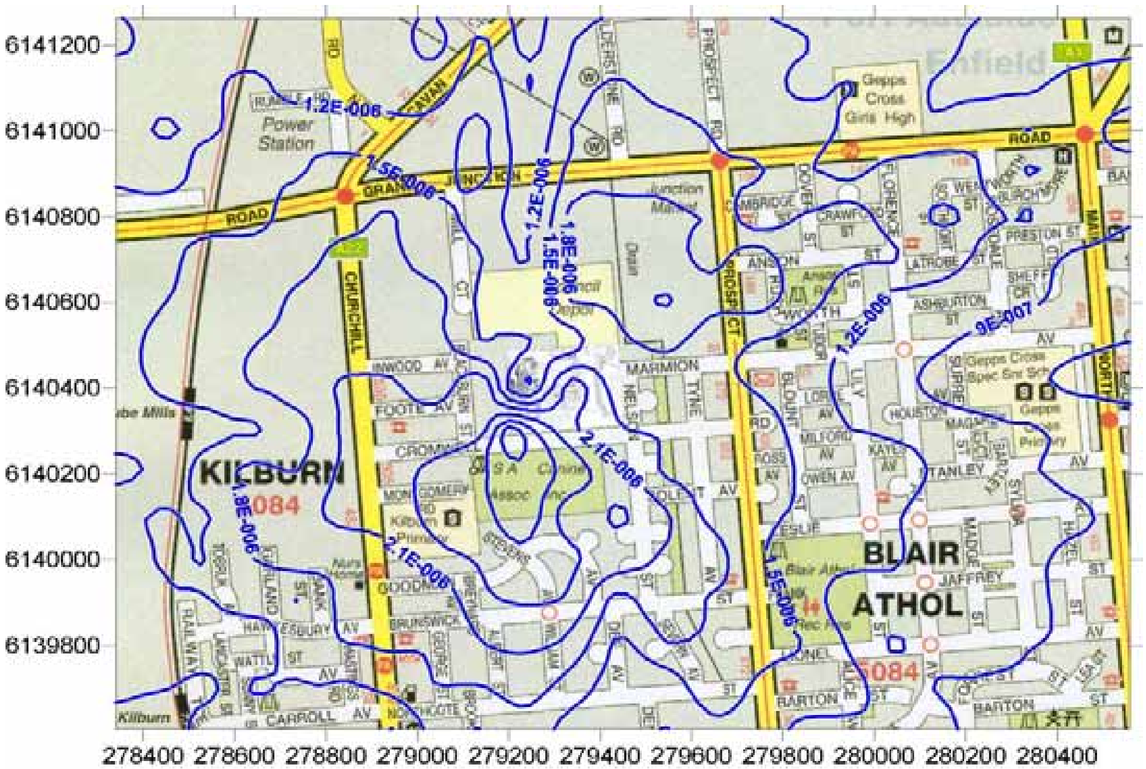


Figure 18: Predicted benzo (a) pyrene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

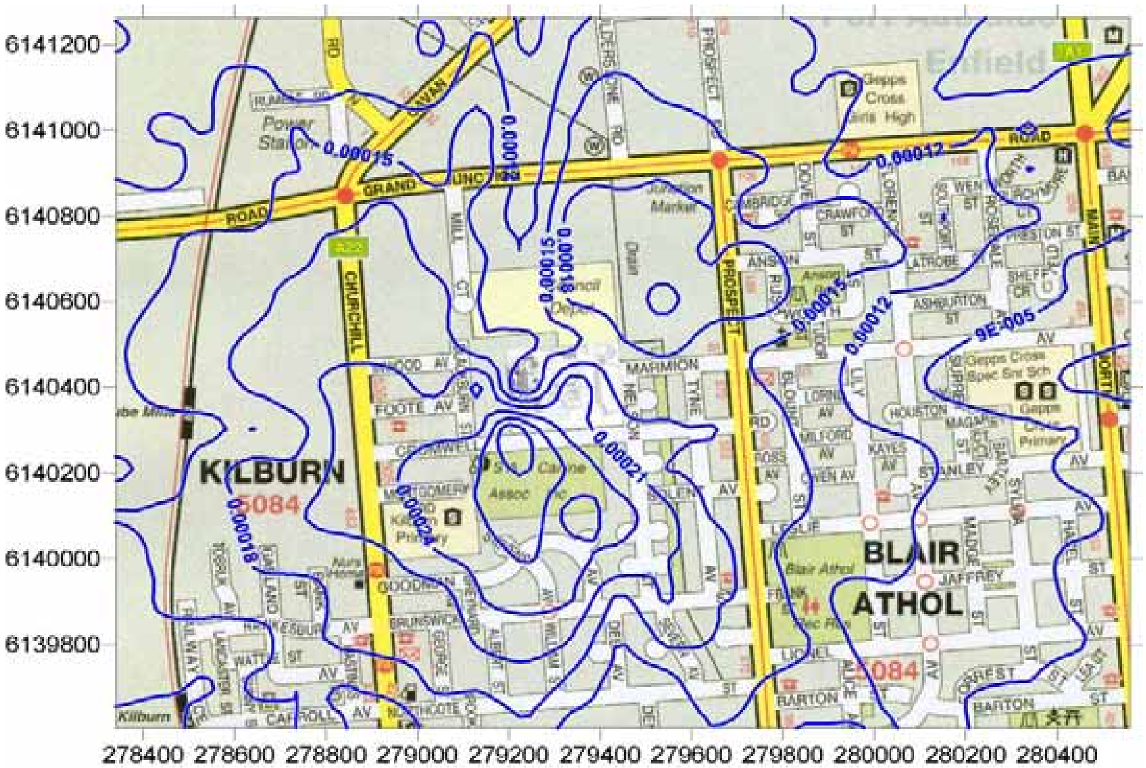


Figure 19: Predicted butyl acetate GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

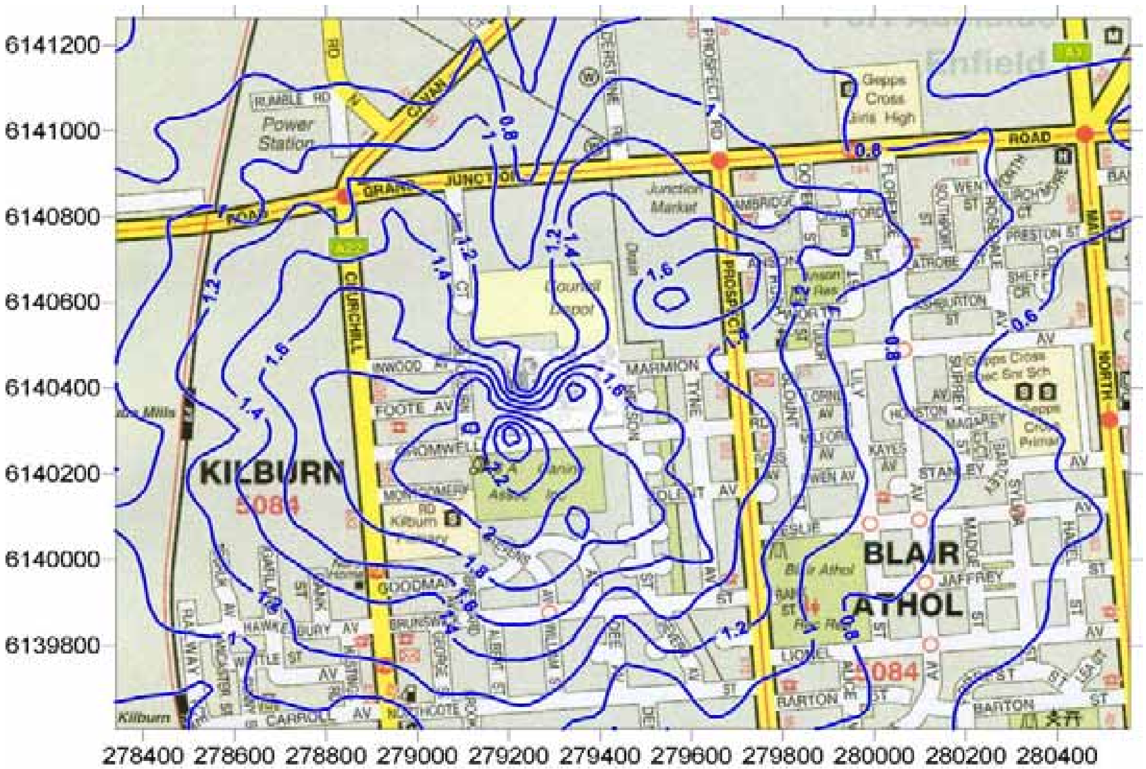


Figure 20: Predicted carbon monoxide GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

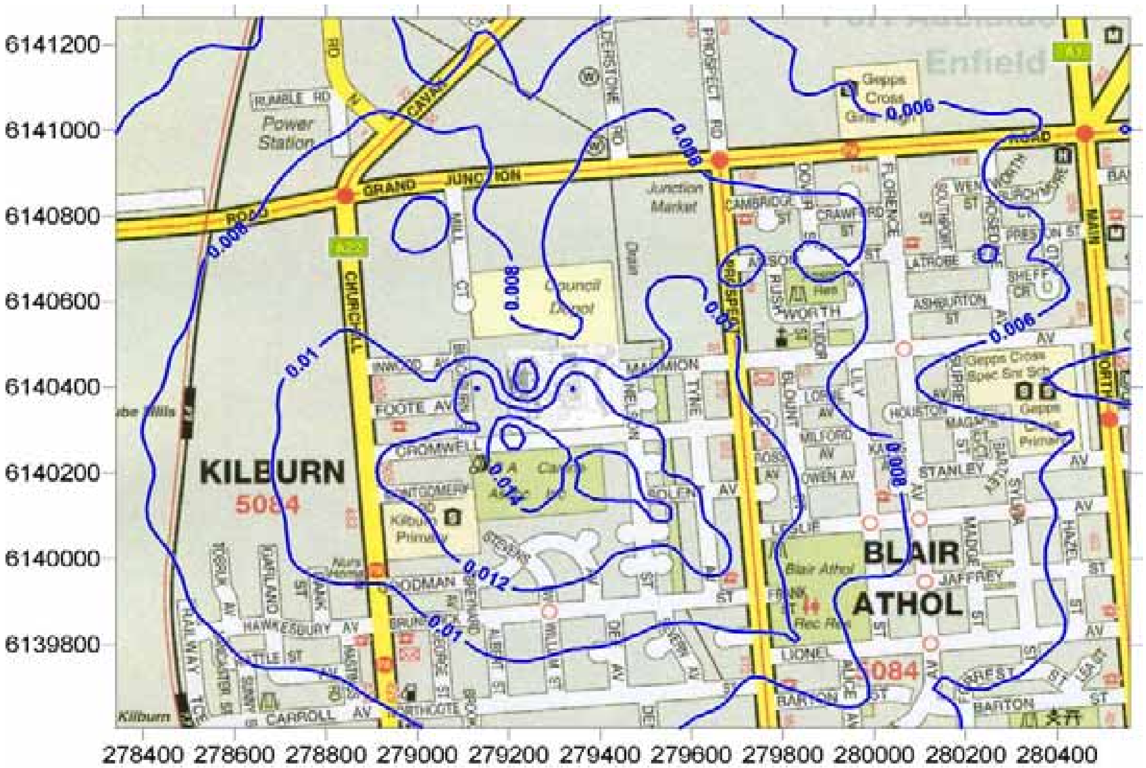


Figure 21: Predicted cresol GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

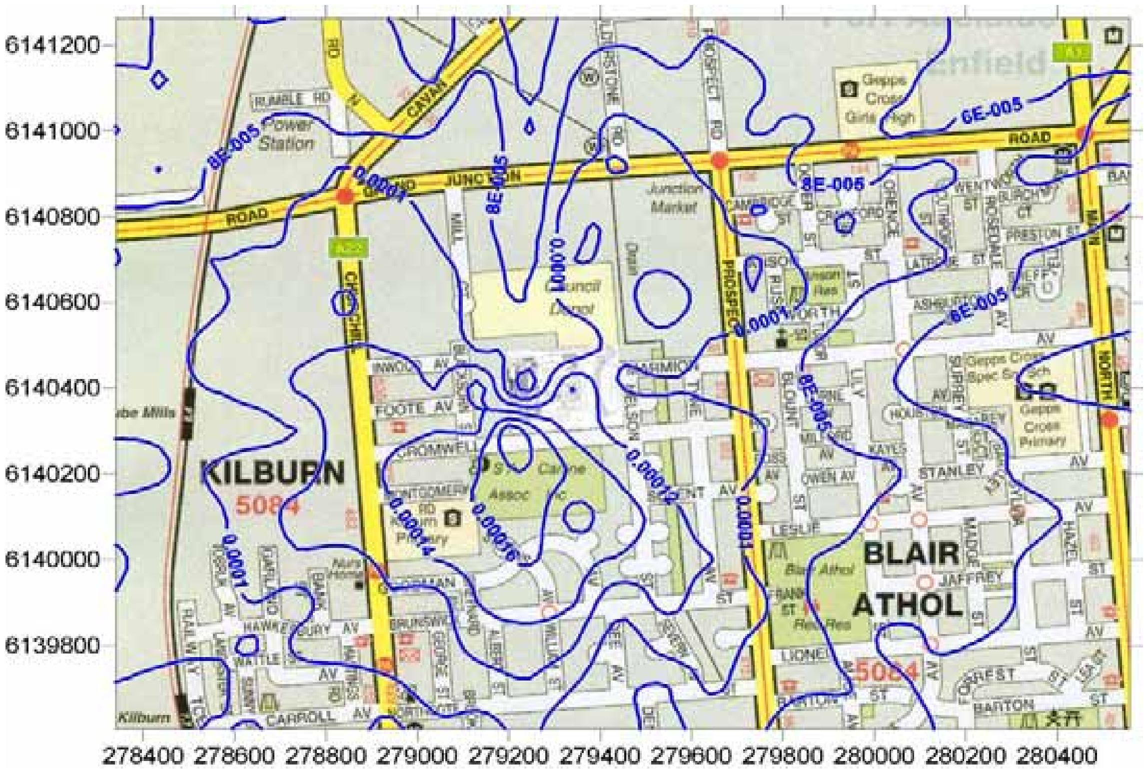


Figure 22: Predicted cyclohexanone GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

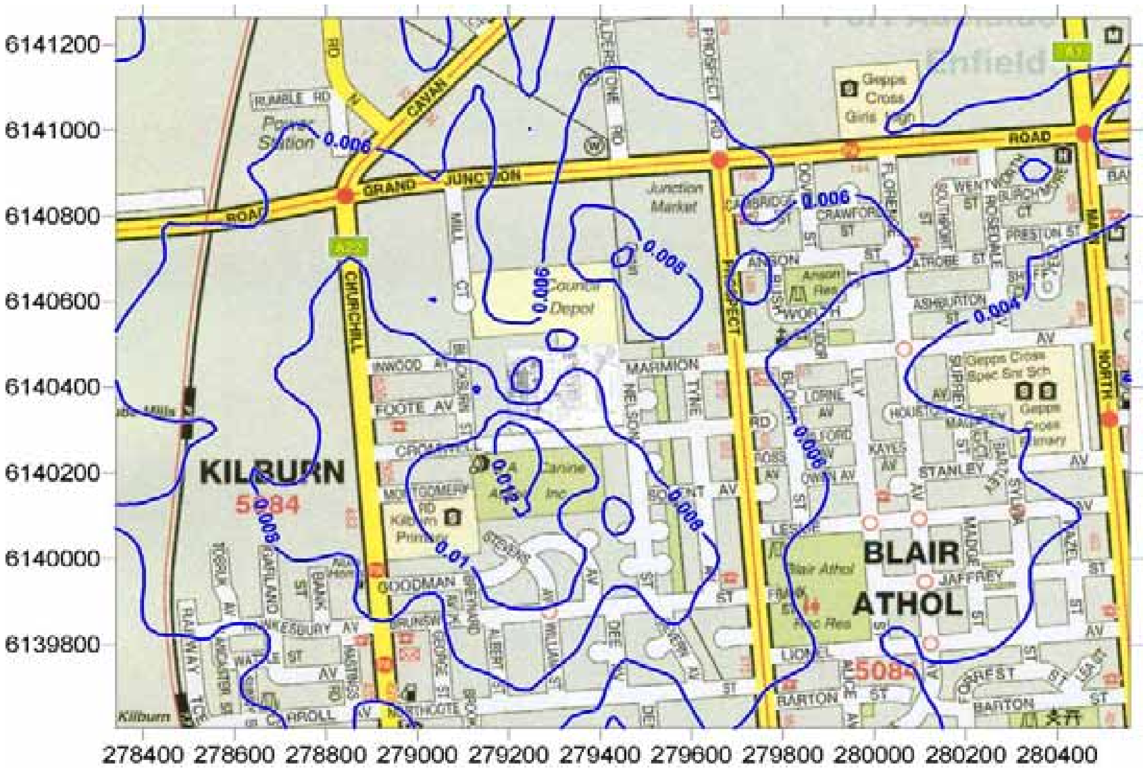


Figure 23: Predicted ethyl acetate GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

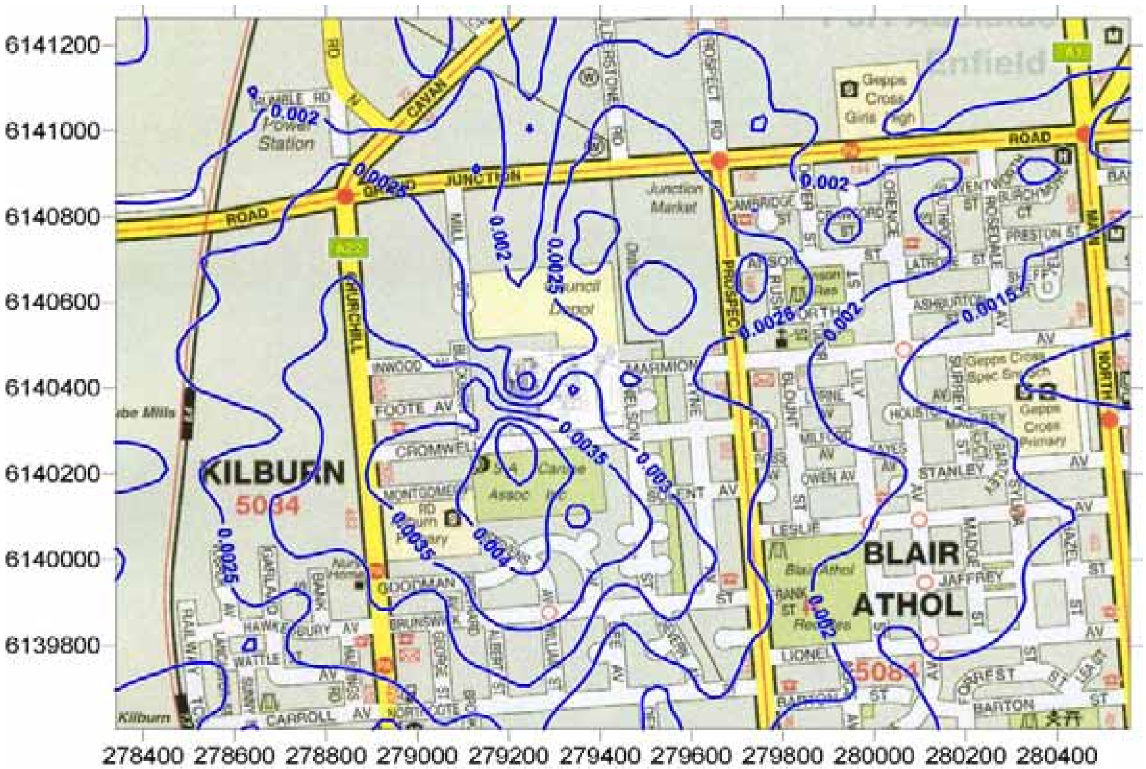


Figure 24: Predicted ethyl benzene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 25: Predicted fluorene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

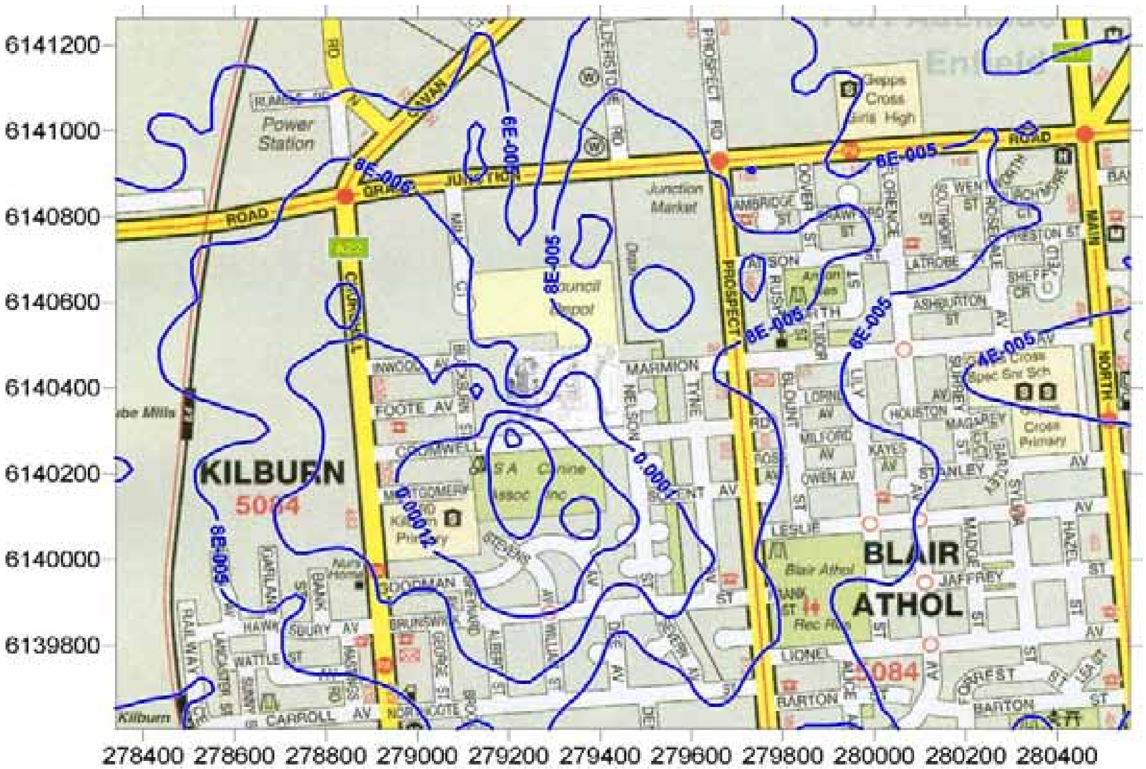


Figure 26: Predicted isopropylbenzene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 27: Predicted methylethylketone GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

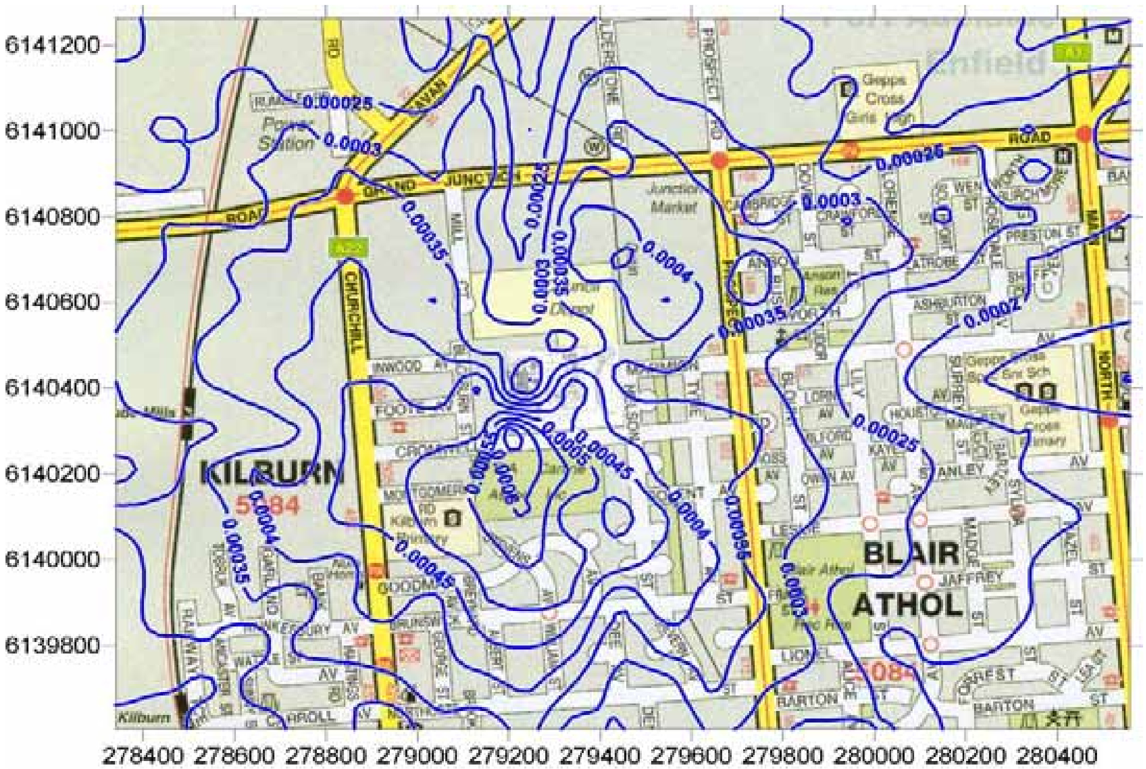


Figure 28: Predicted methylisobutylketone GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

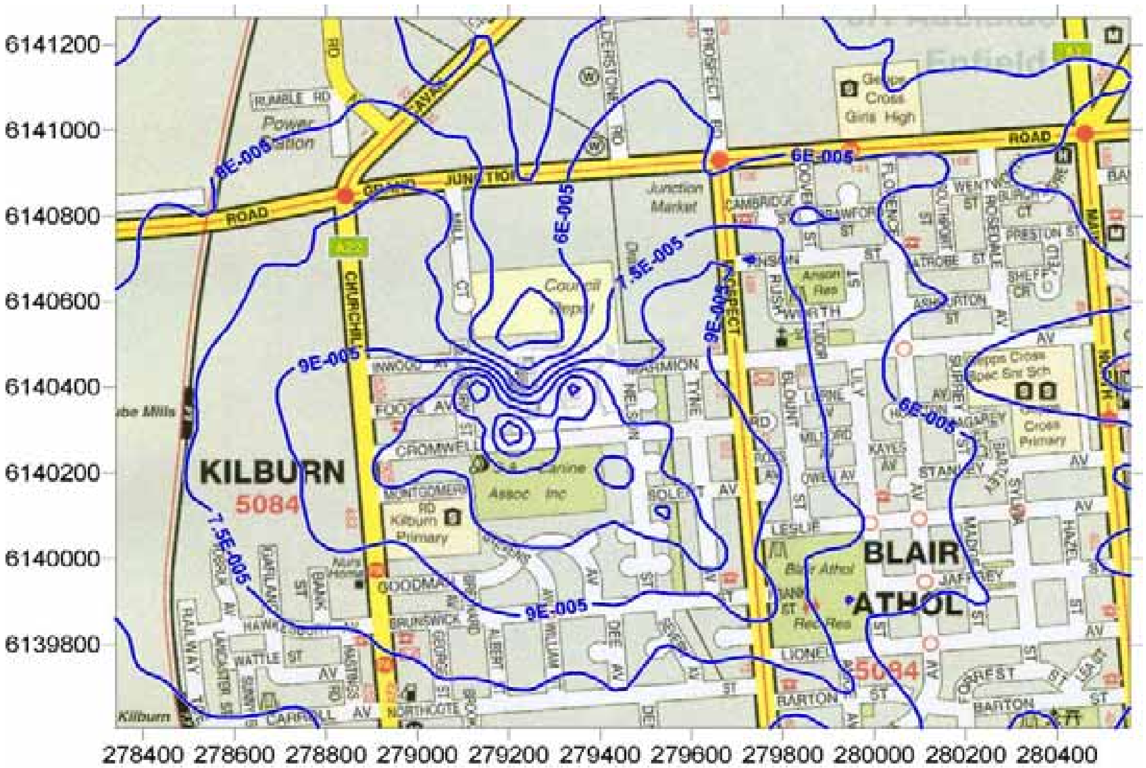


Figure 29: Predicted phenanthrene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

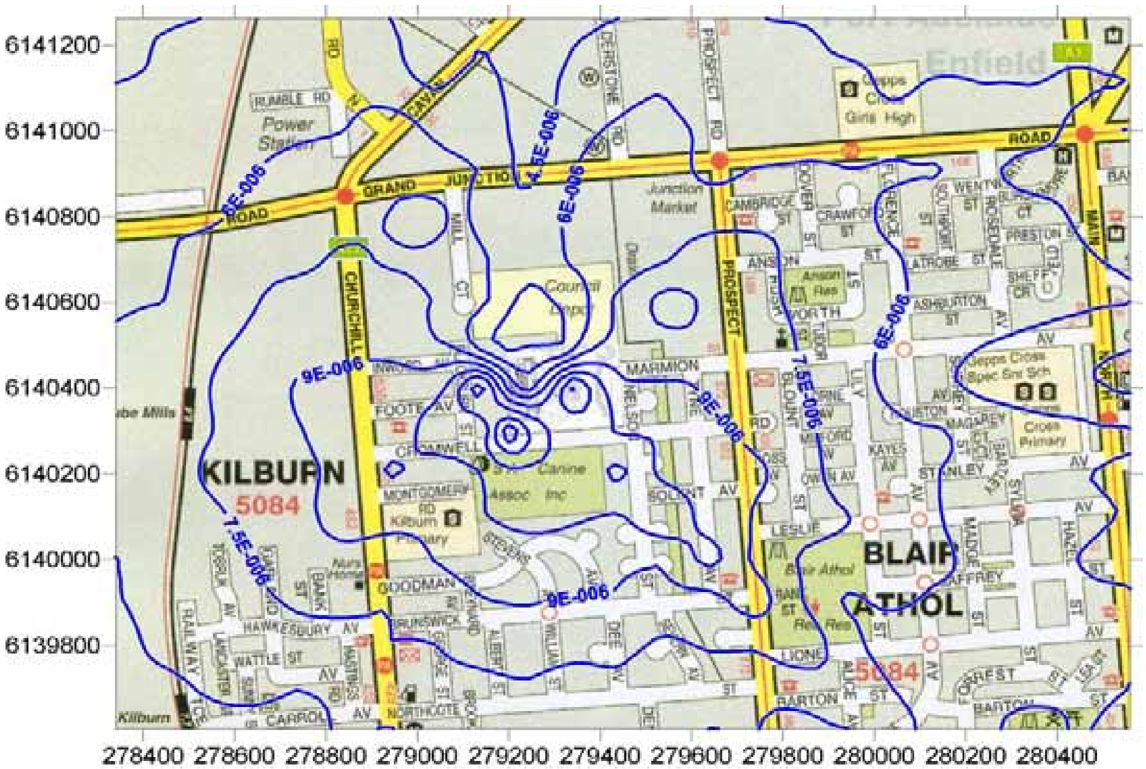


Figure 30: Predicted pyrene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 31: Predicted styrene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

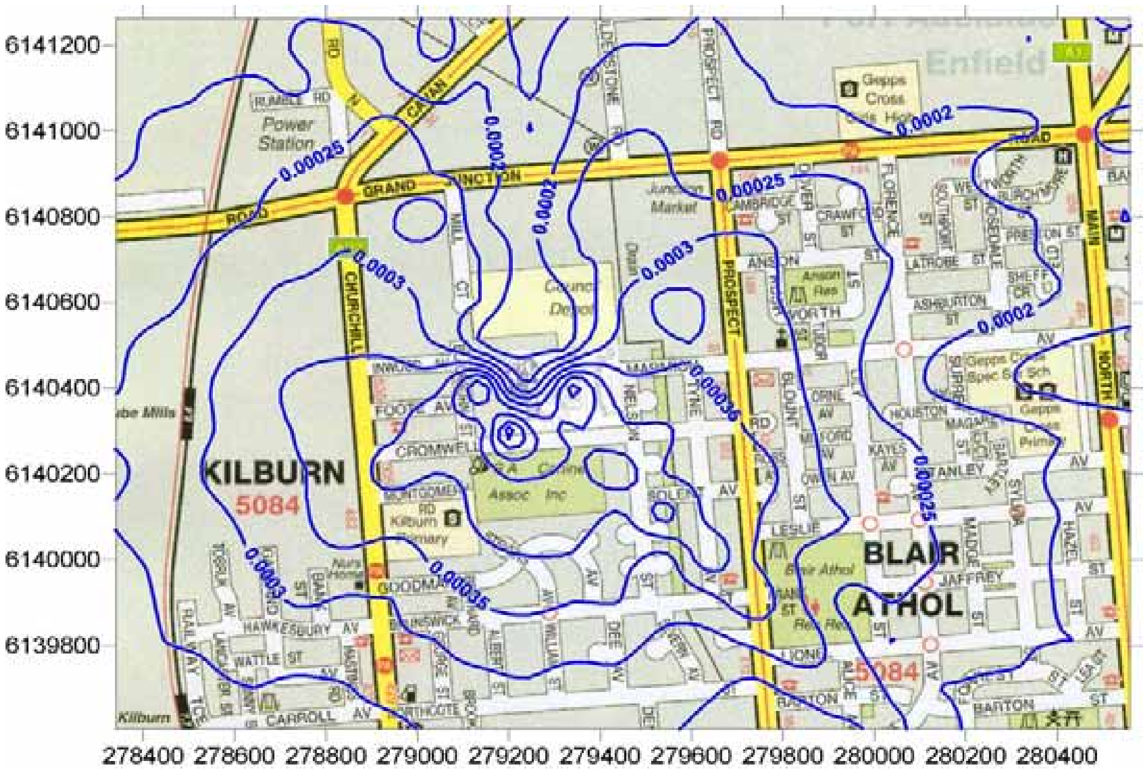


Figure 32: Predicted butanol GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

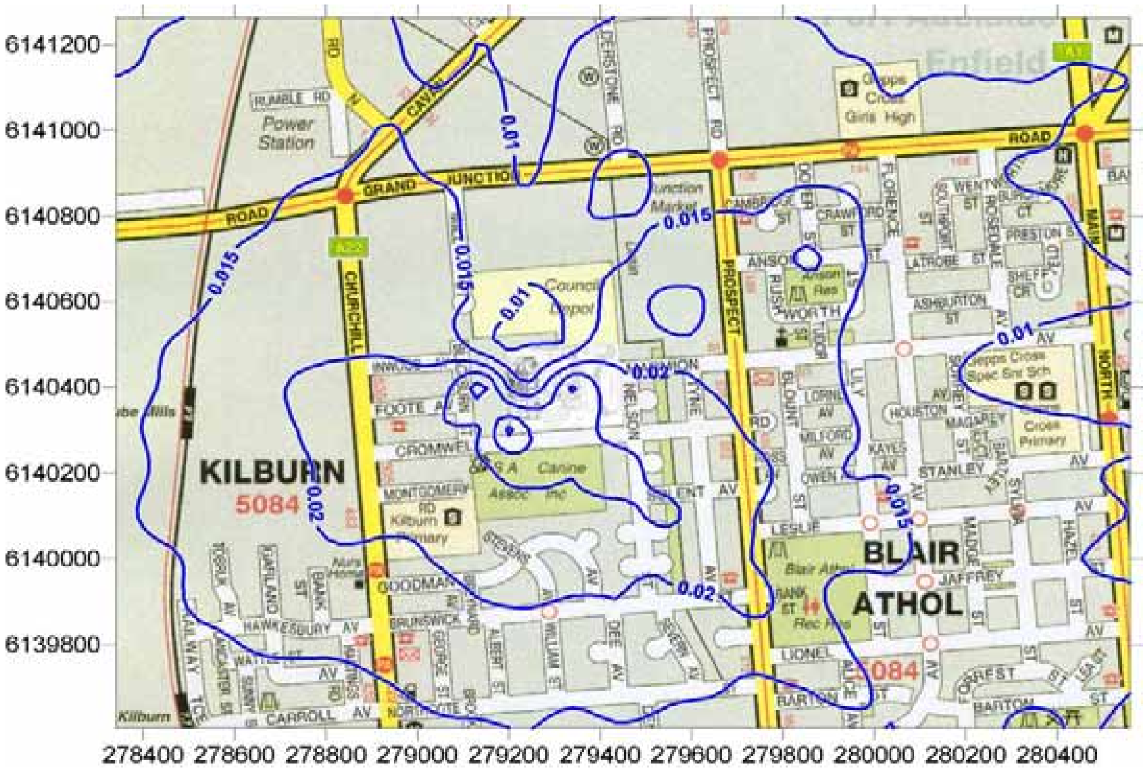


Figure 33: Predicted acetaldehyde GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

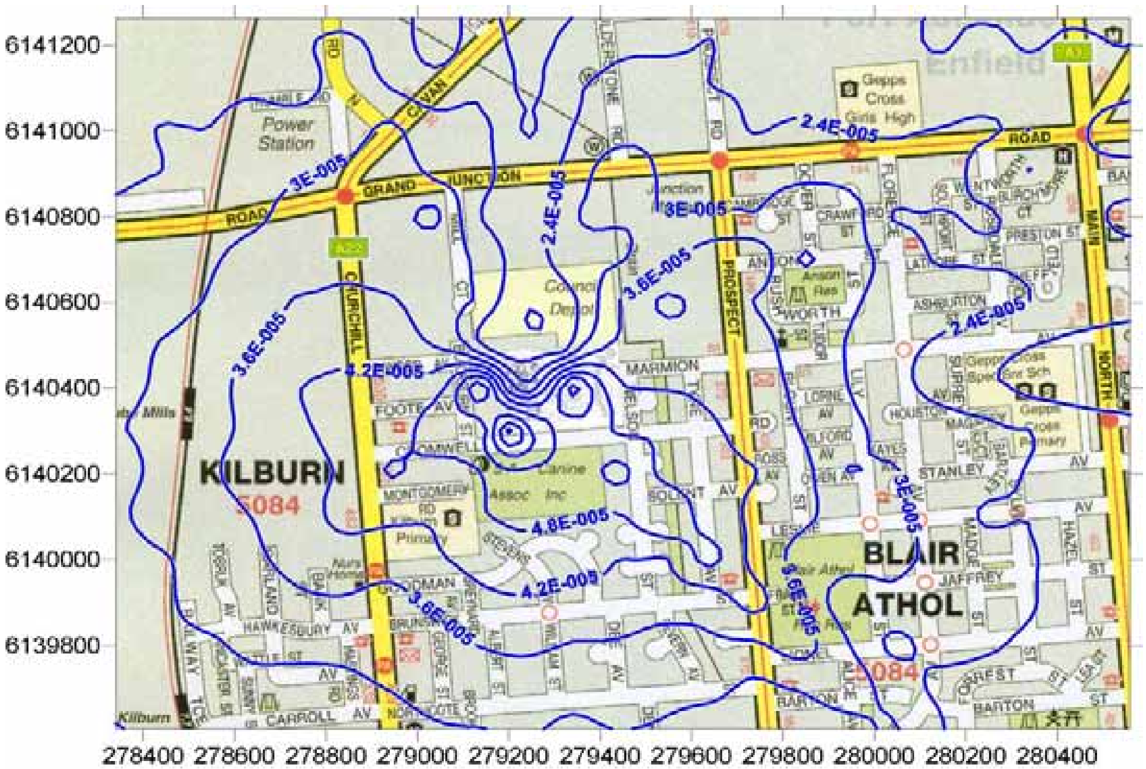


Figure 34: Predicted furfural GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

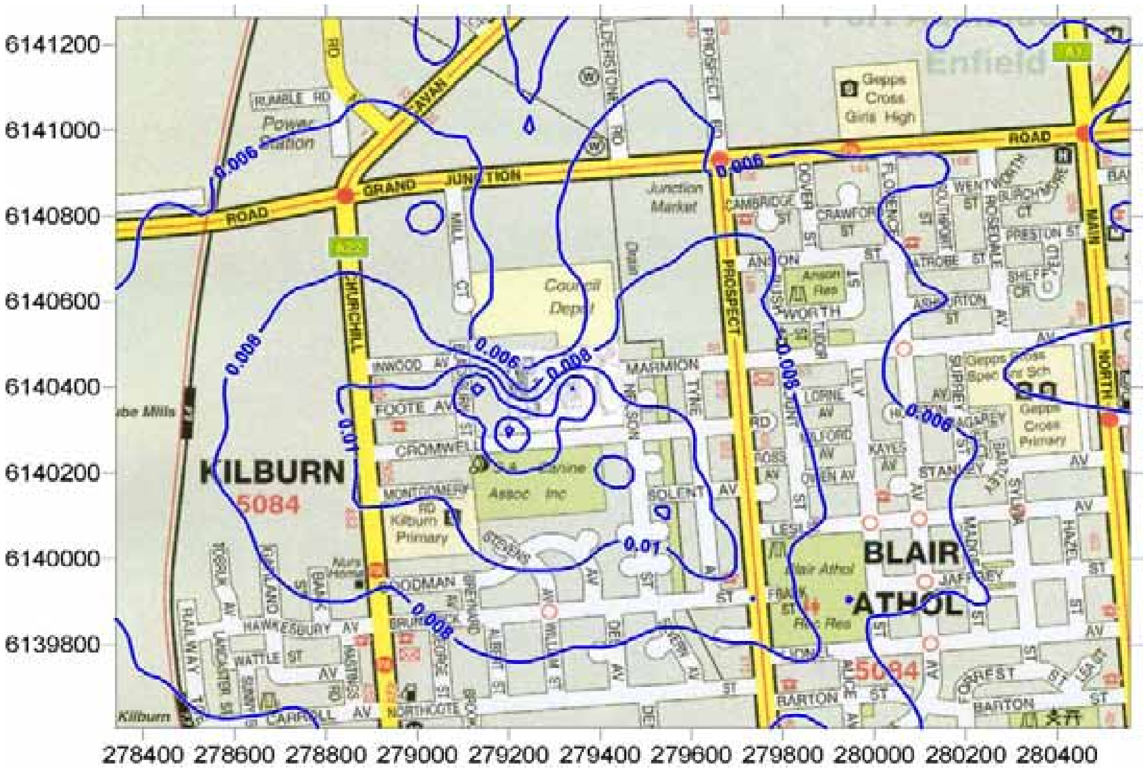


Figure 35: Predicted propanaldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

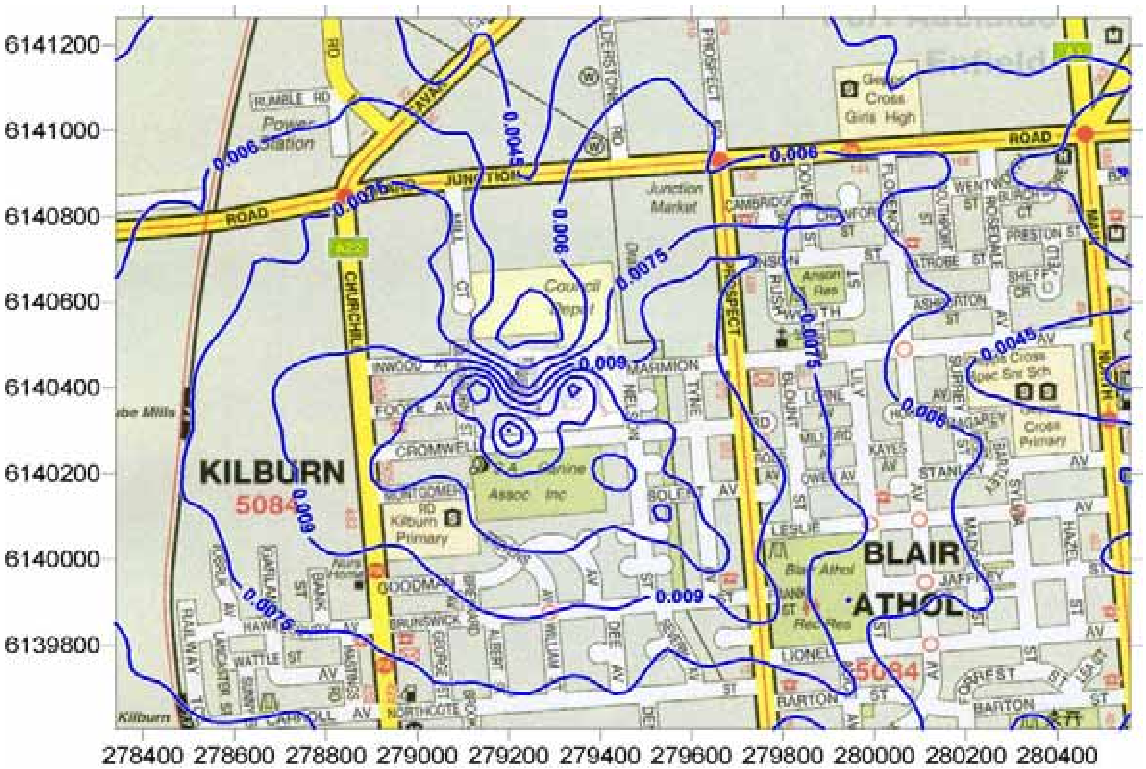


Figure 36: Predicted butanaldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 37: Predicted pentanaldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

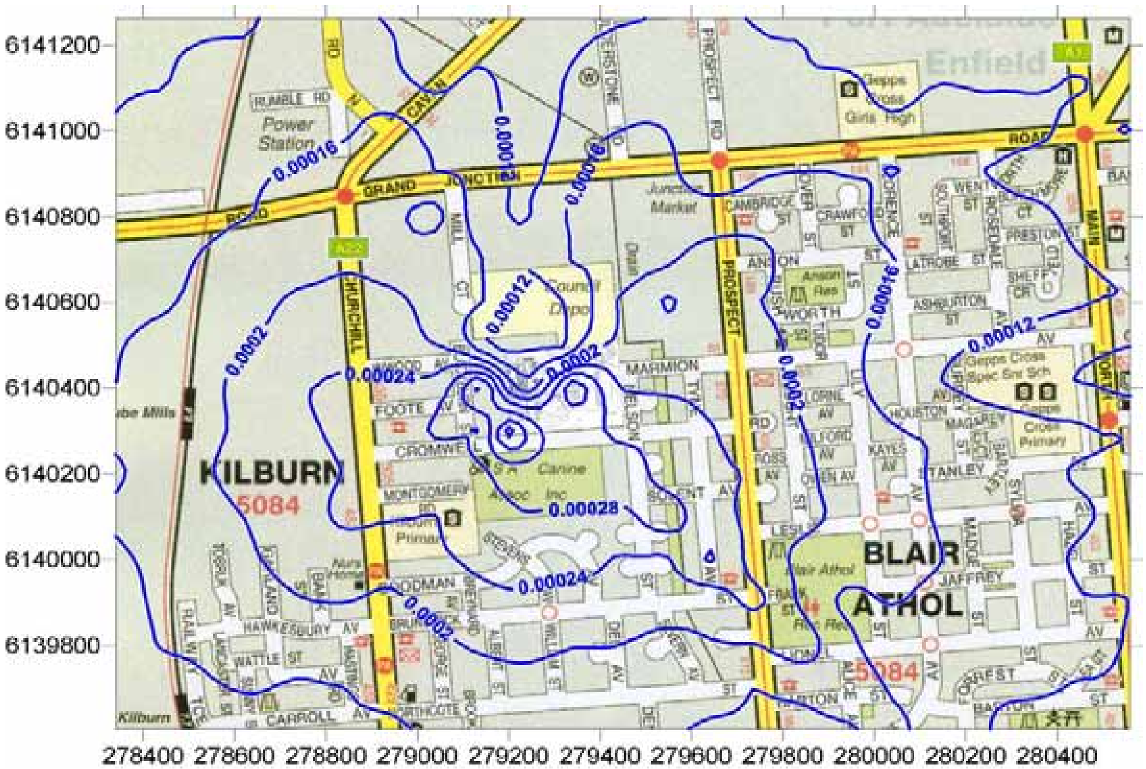


Figure 38: Predicted benzaldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 39: Predicted glutaraldehyde GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

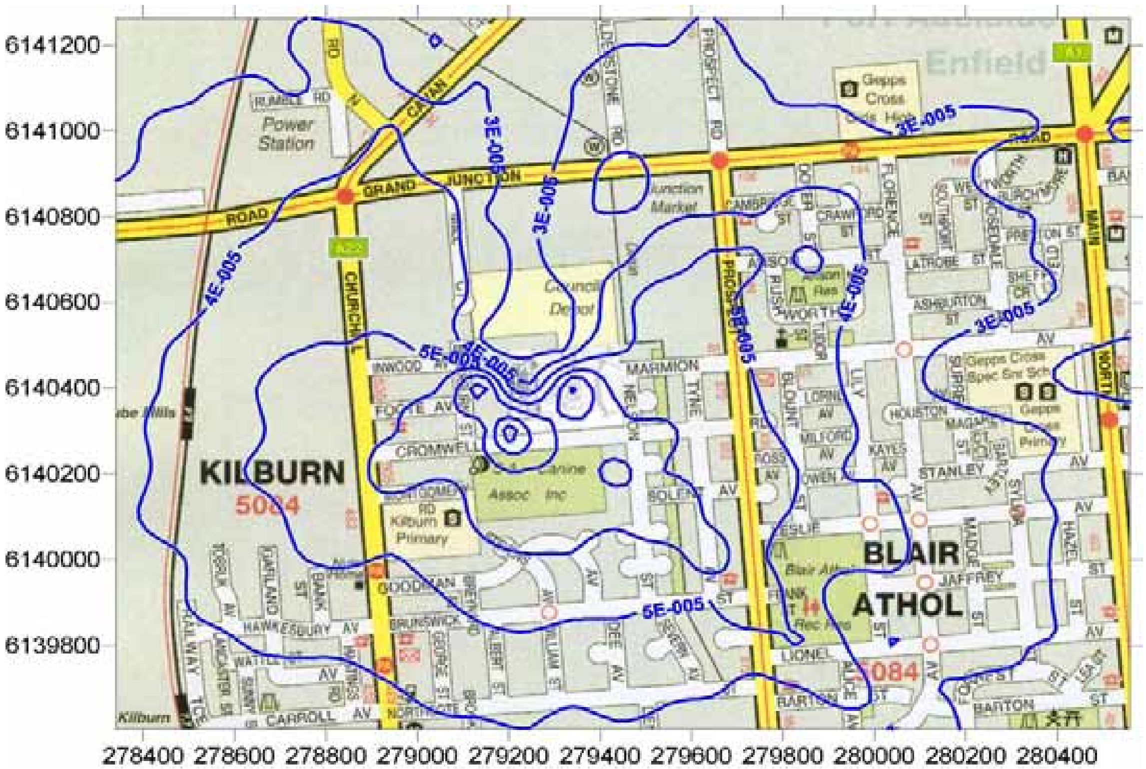


Figure 40: Predicted acenaphthene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

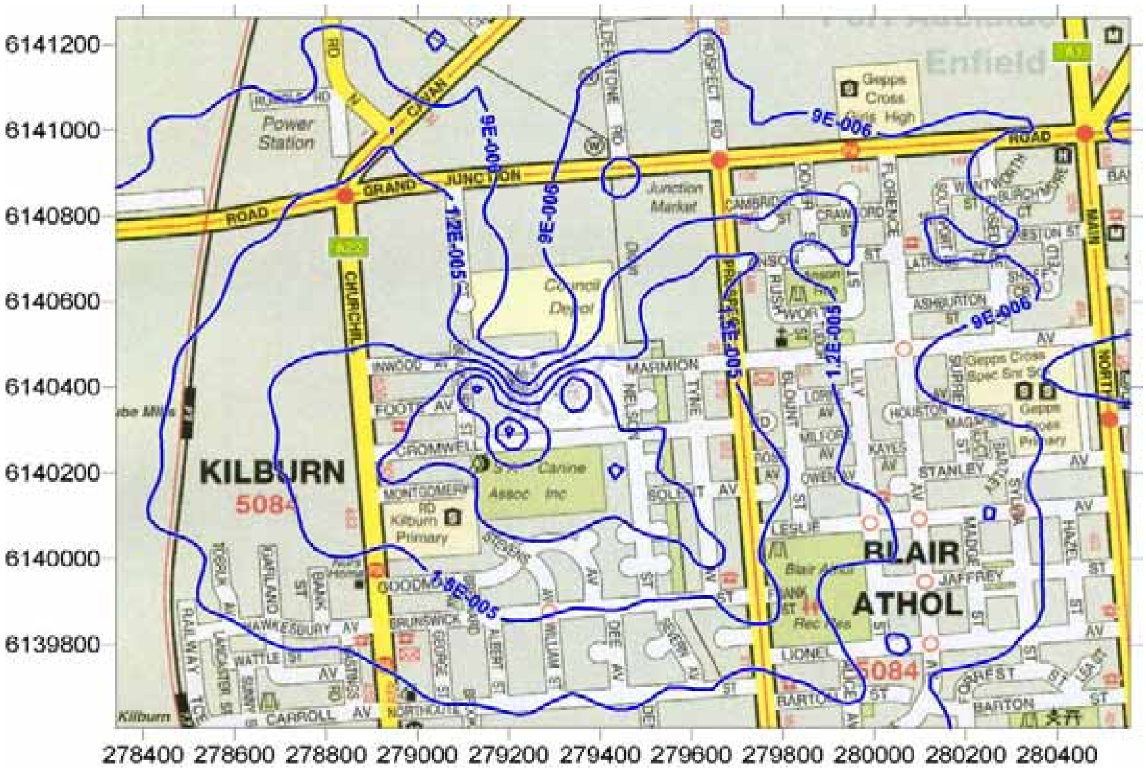


Figure 41: Predicted acenaphthylene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

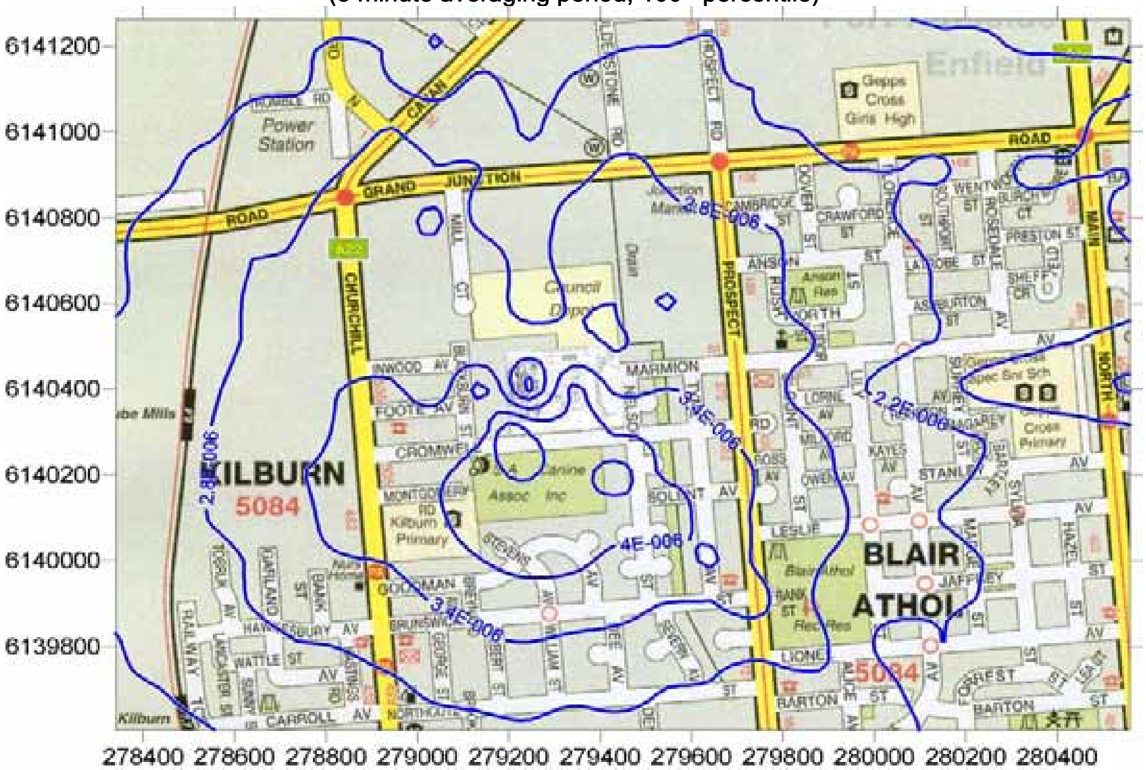


Figure 42: Predicted benz (a) anthracene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 43: Predicted benzo (b) fluoranthene GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

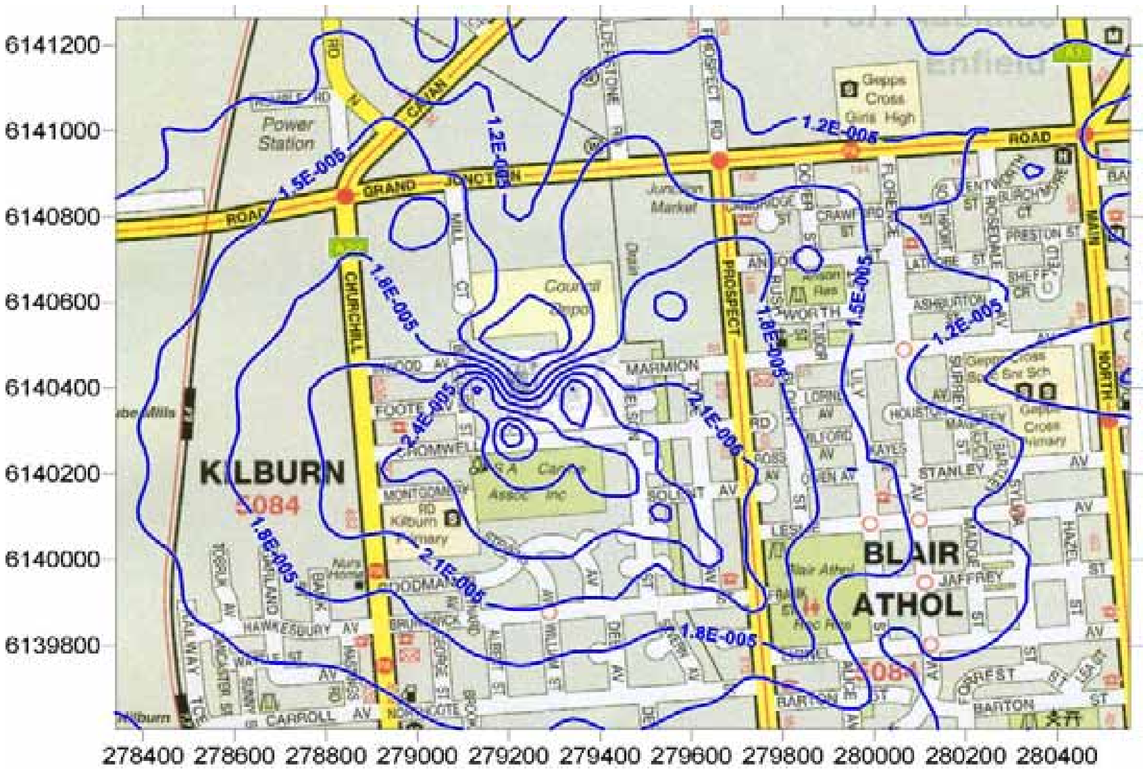


Figure 44: Predicted fluoranthene GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

Figure 45: Predicted chrysene GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

Figure 46: Predicted dimethylphenols GLC from existing operation (mg/m^3).
(3 minute averaging period, 100th percentile)

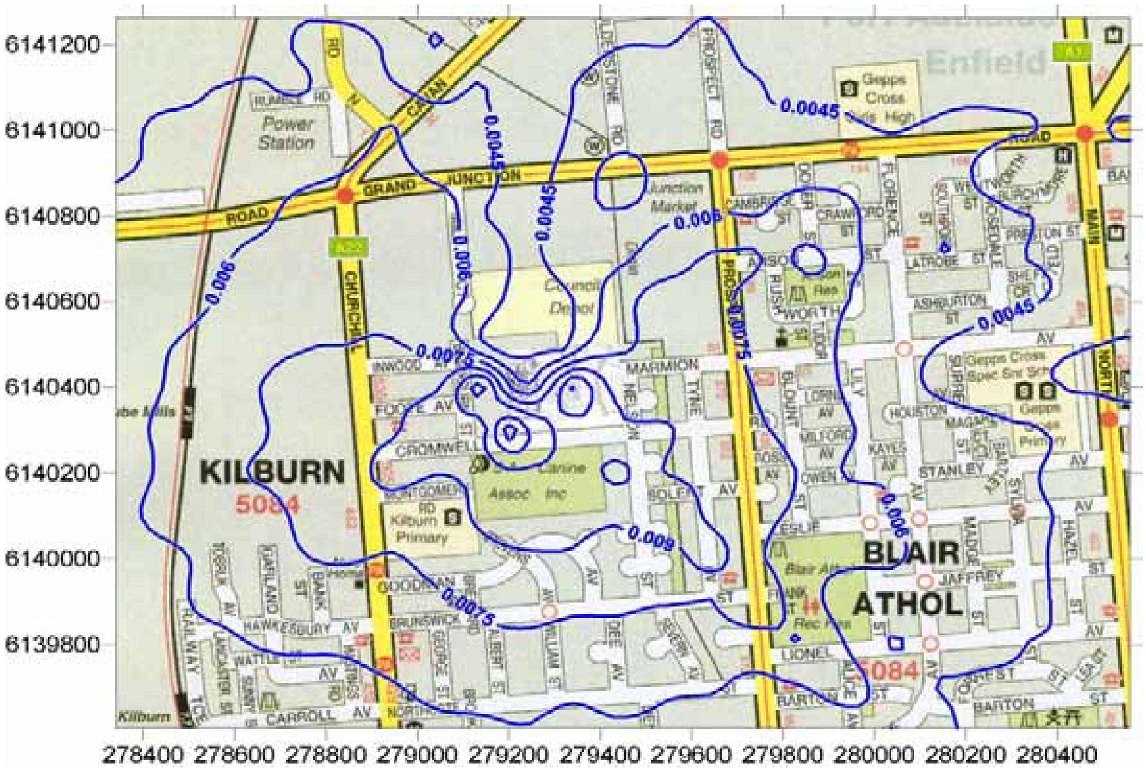


Figure 47: Predicted 1,3,5-trimethylbenzene GLC from existing operation (mg/m^3). (3 minute averaging period, 100th percentile)

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Appendix II

Contour Plots - Future

(Furane)

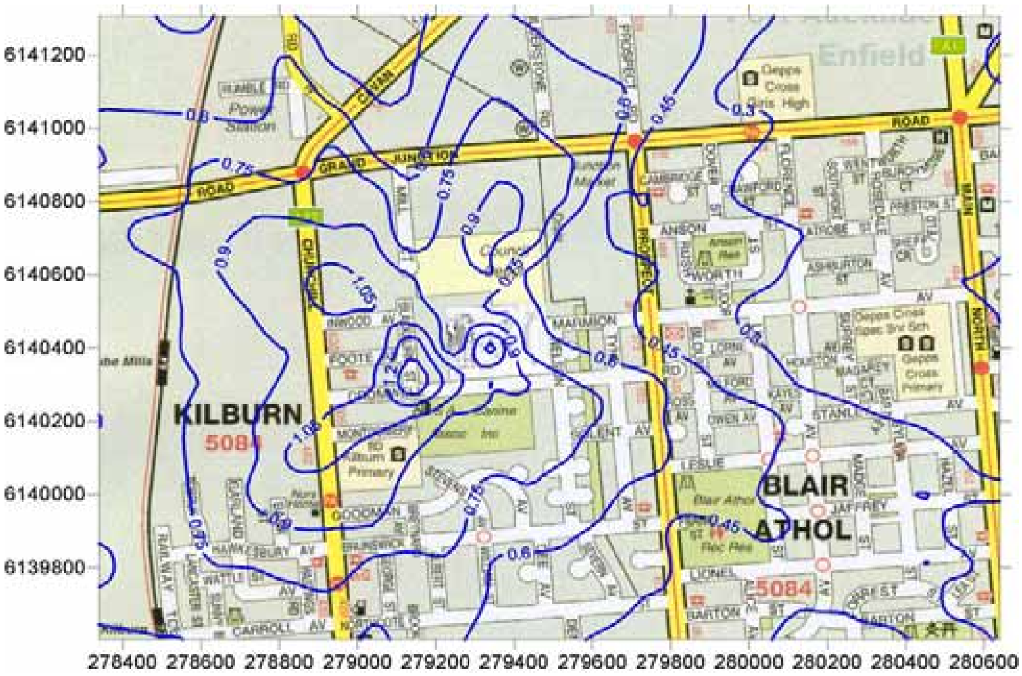


Figure 1: Predicted odour GLC from future (furane) operation (ODU). (3 minute averaging period, 99.9th percentile)

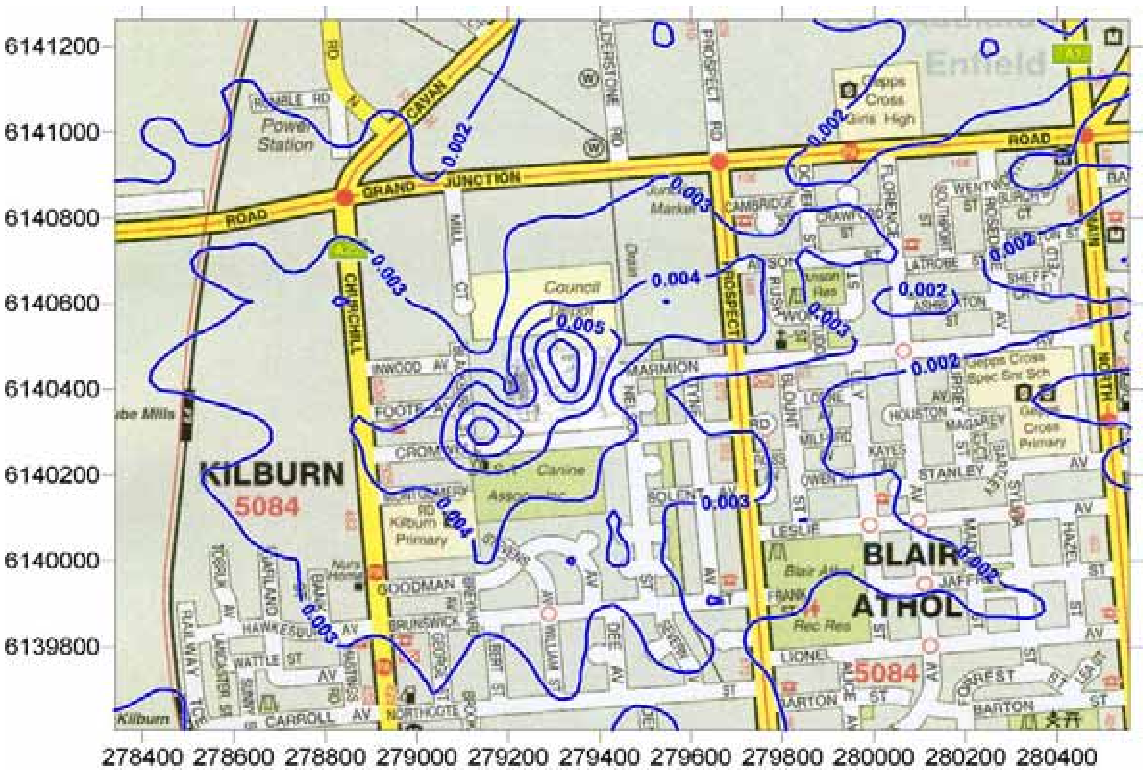


Figure 2: Predicted ammonia GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

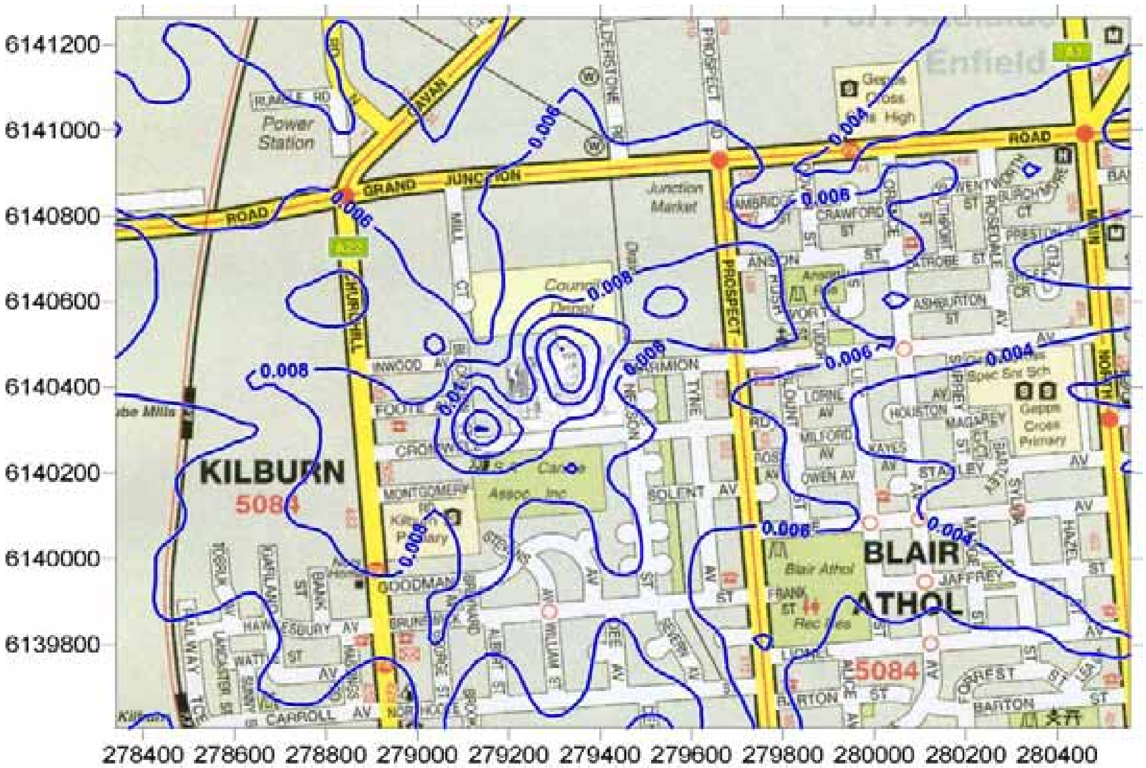


Figure 3: Predicted hydrogen sulphide GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

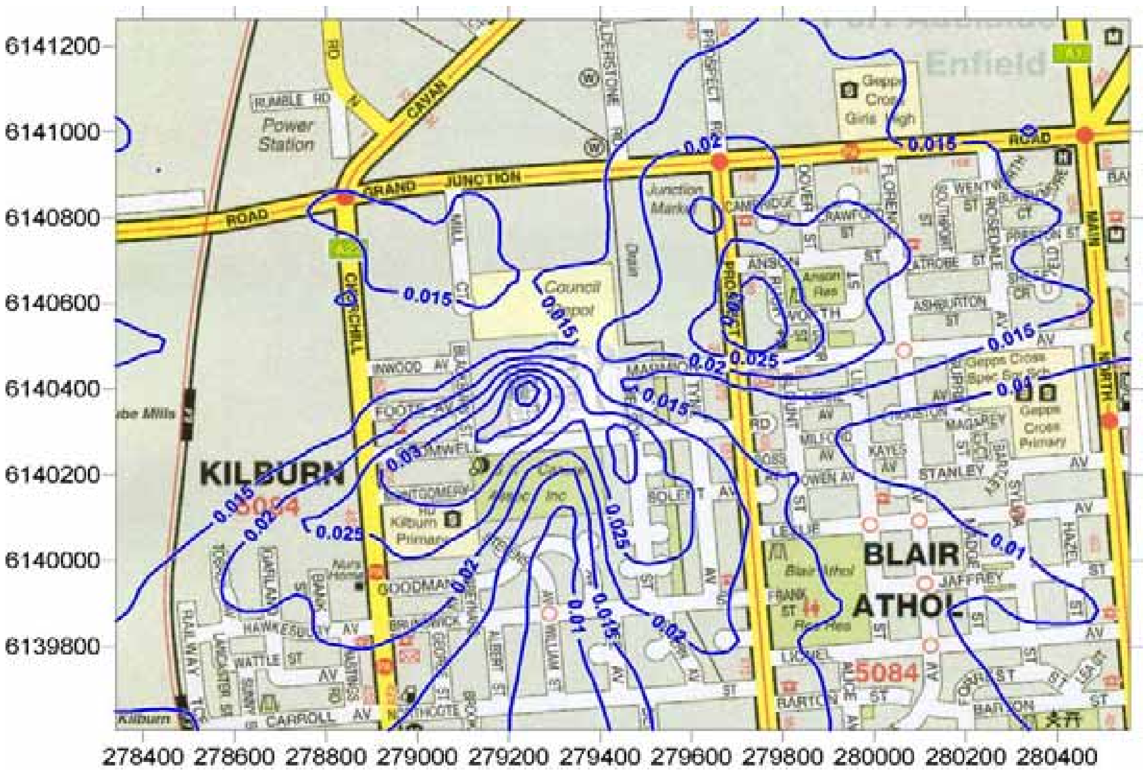


Figure 4: Predicted nitrogen oxides GLC from future (furane) operation (mg/m3). (1 hour averaging period, 100th percentile)

Figure 5: Predicted PM10 GLC from future (furane) operation (ug/m3).
(24 hour averaging period, 100th percentile)

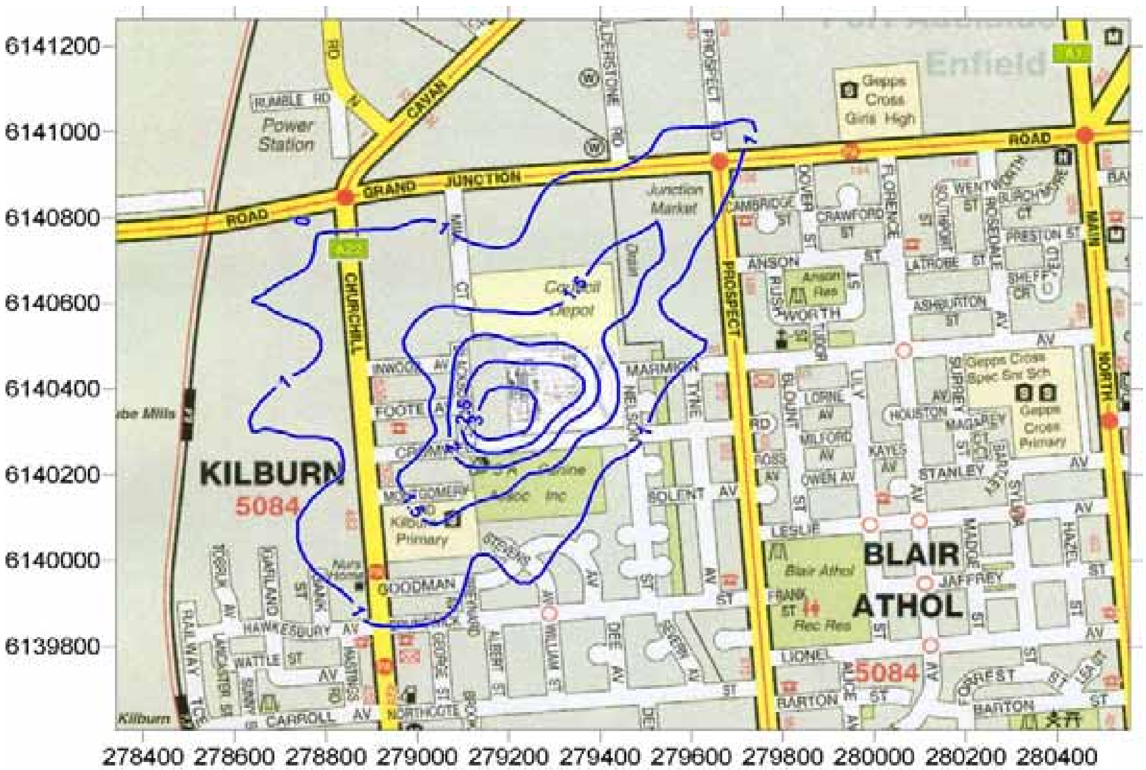


Figure 6: Predicted PM2.5 GLC from future (furane) operation (ug/m3).
(24 hour averaging period, 100th percentile)

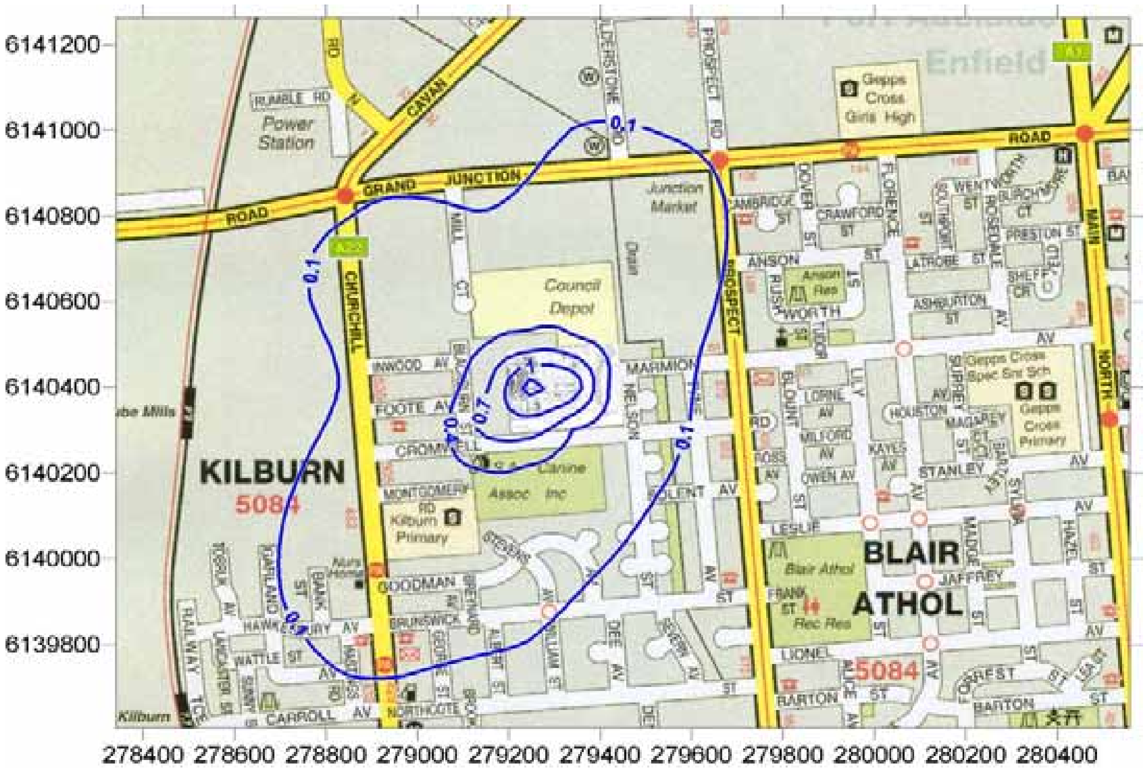


Figure 7: Predicted PM2.5 GLC from future (furane) operation (ug/m3).
(annual averaging period, 100th percentile)

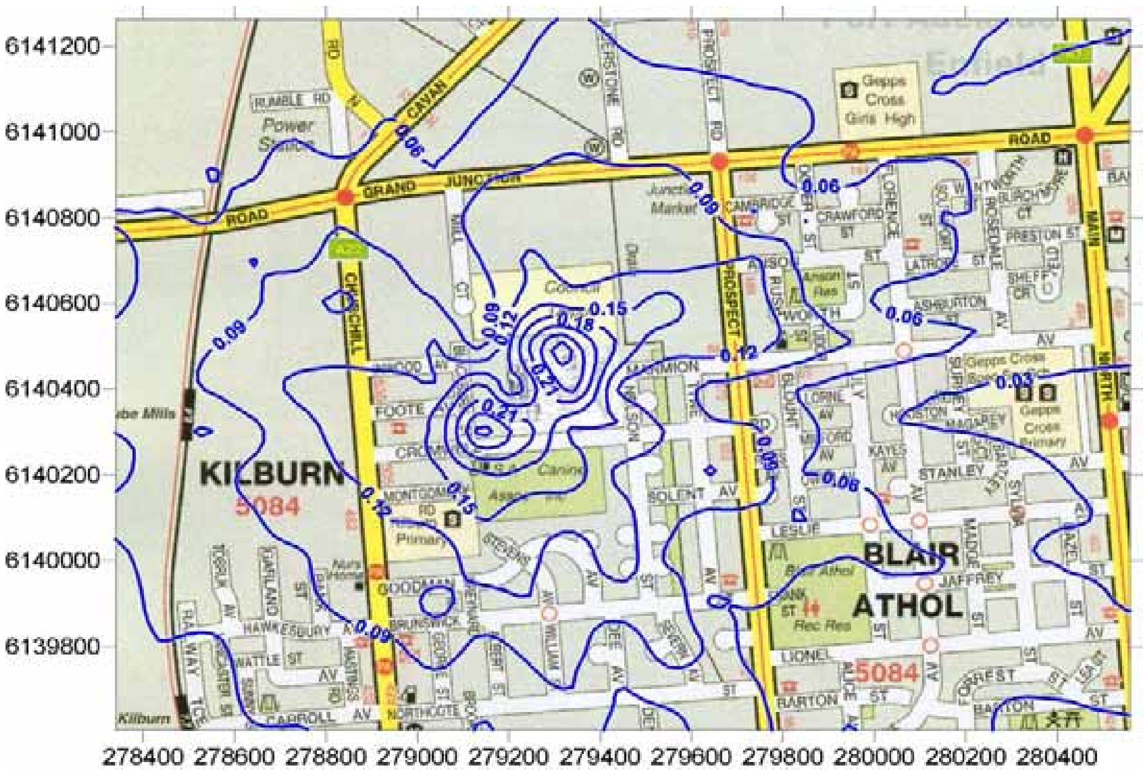


Figure 8: Predicted sulphur dioxide GLC from future (furane) operation (mg/m3).
(1 hour averaging period, 100th percentile)

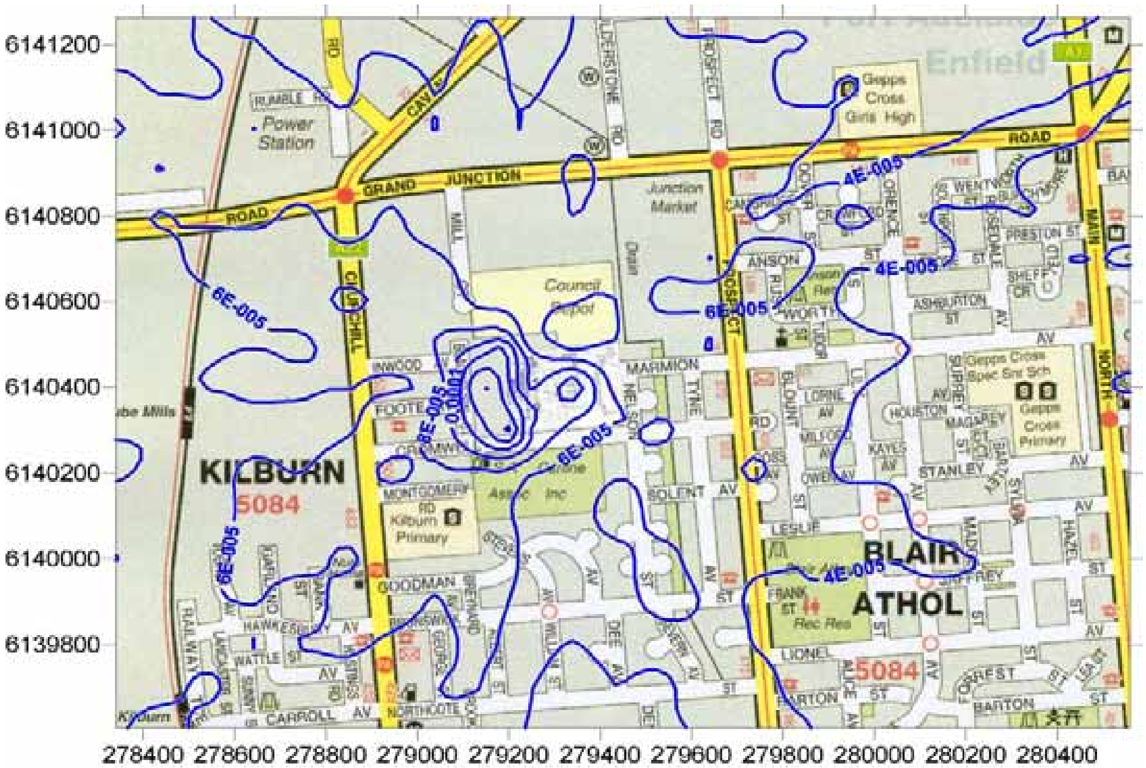


Figure 9: Predicted dioxin GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

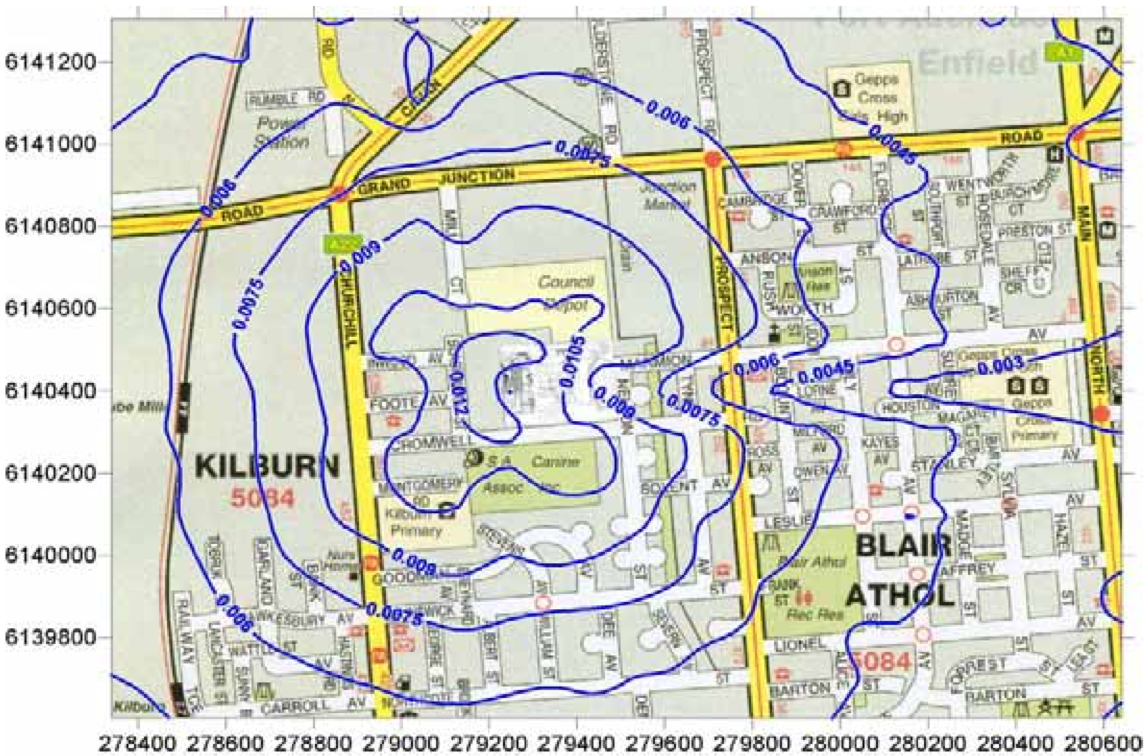


Figure 10: Predicted benzene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

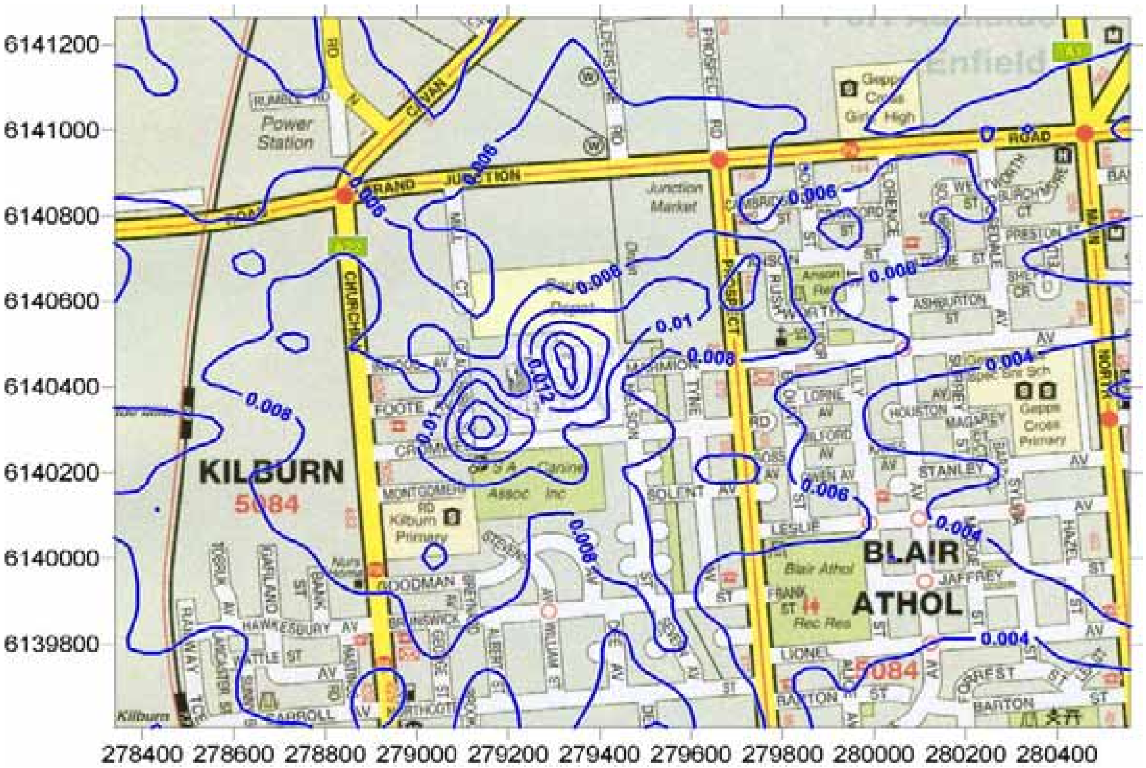


Figure 11: Predicted formaldehyde GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

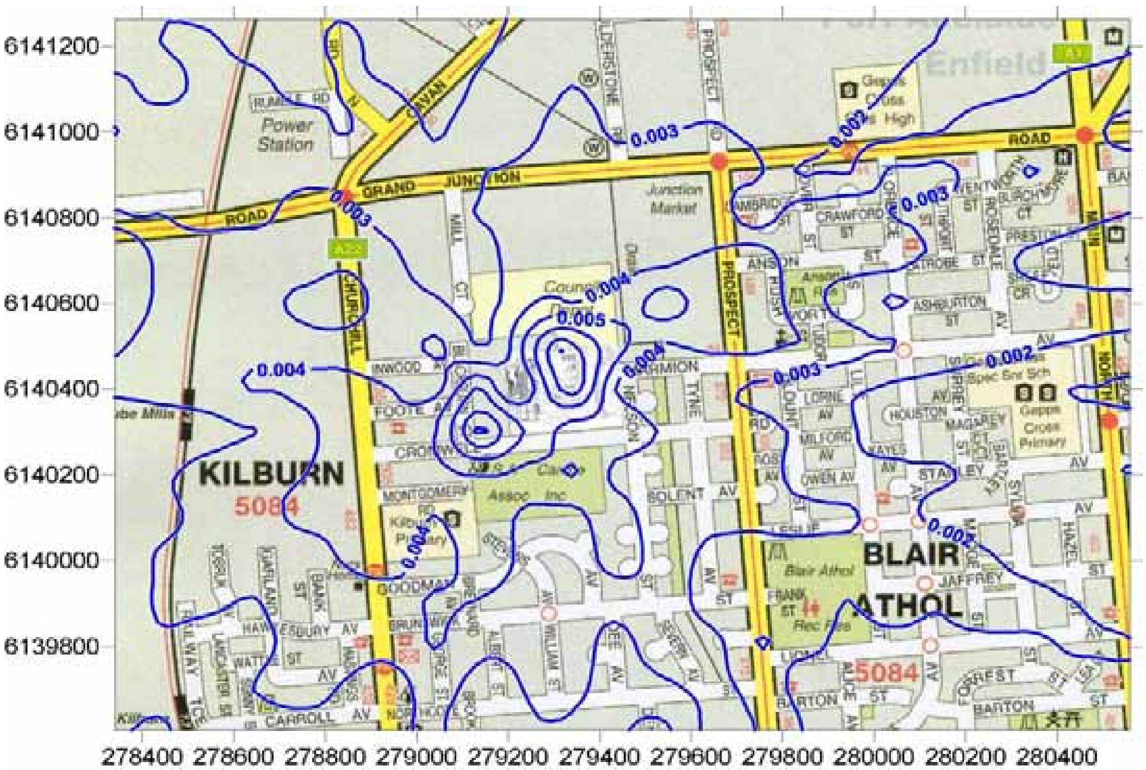


Figure 12: Predicted cyanide GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

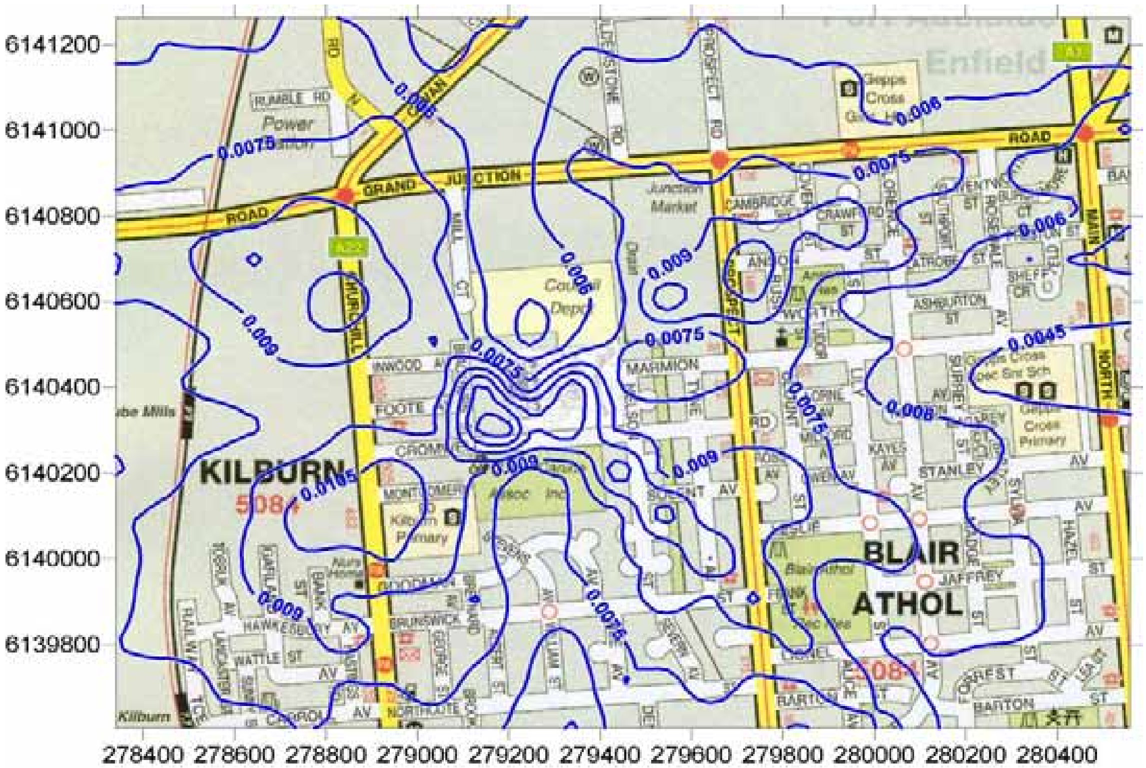


Figure 13: Predicted total xylene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

Figure 14: Predicted naphthalene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

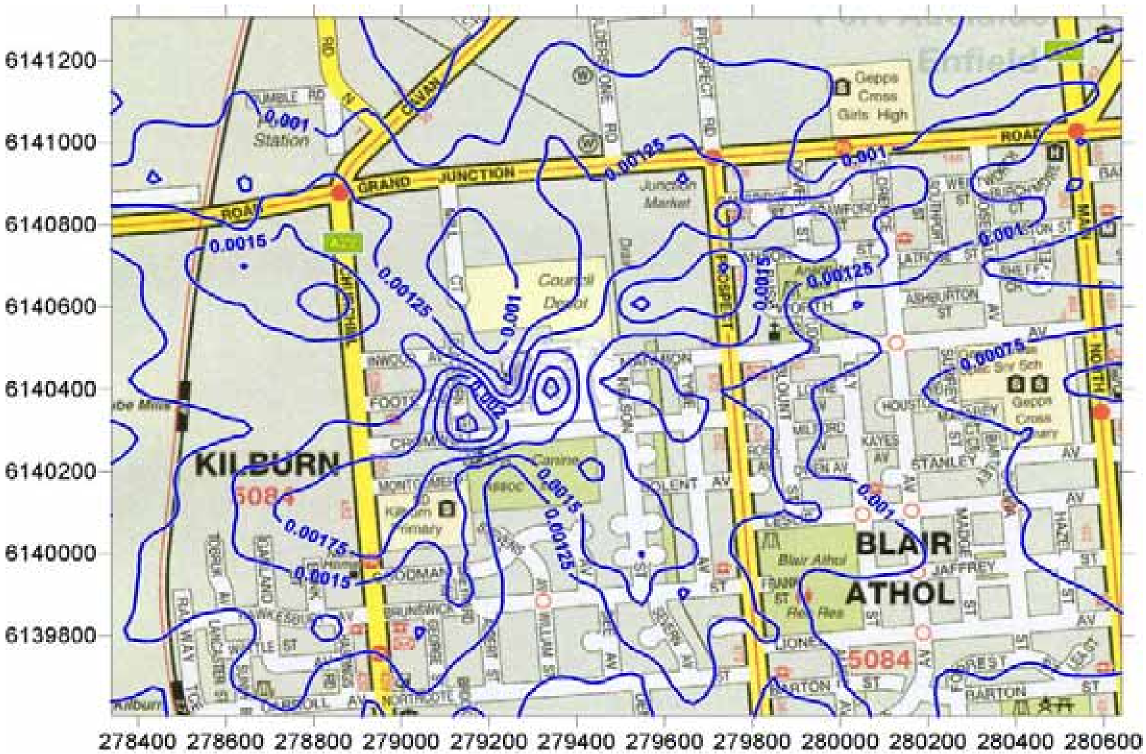


Figure 15: Predicted furane based phenol GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

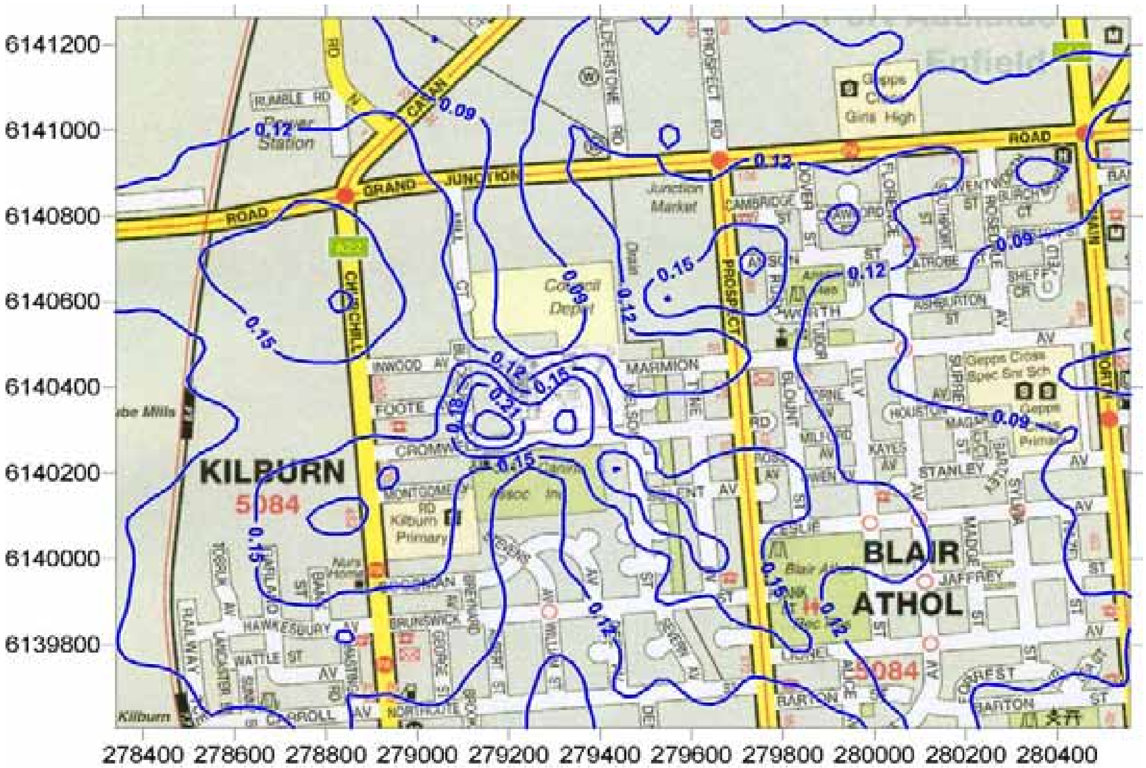


Figure 16: Predicted toluene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

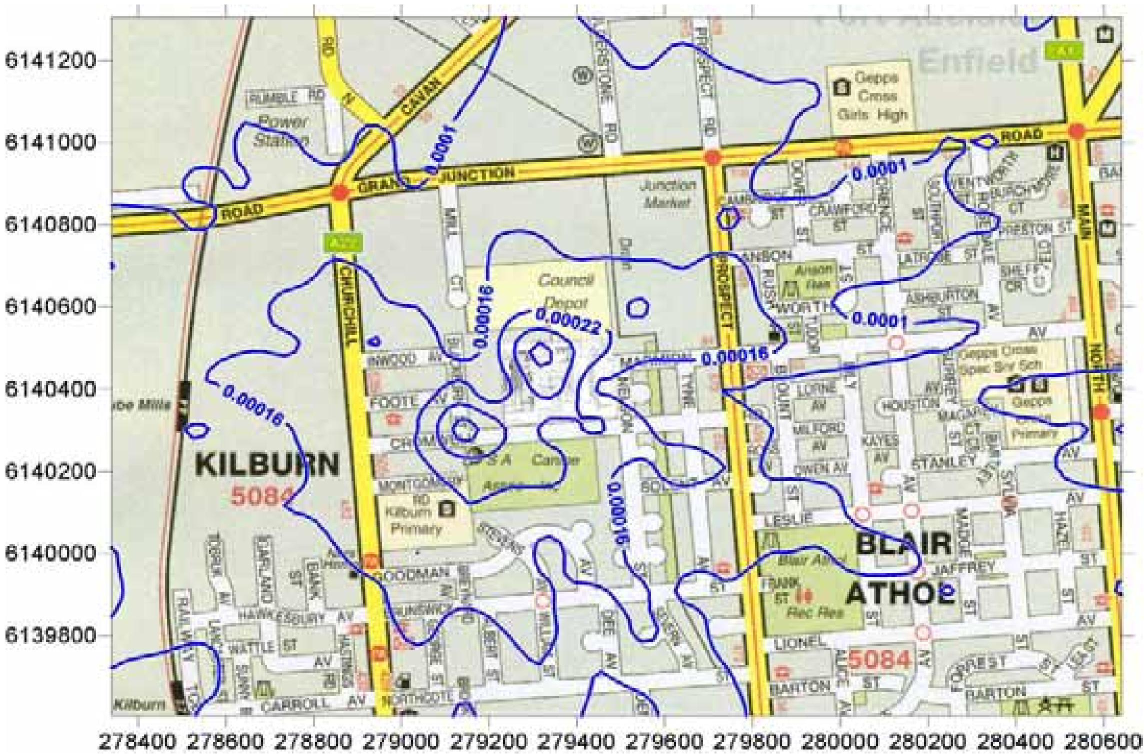


Figure 17: Predicted acrolein GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

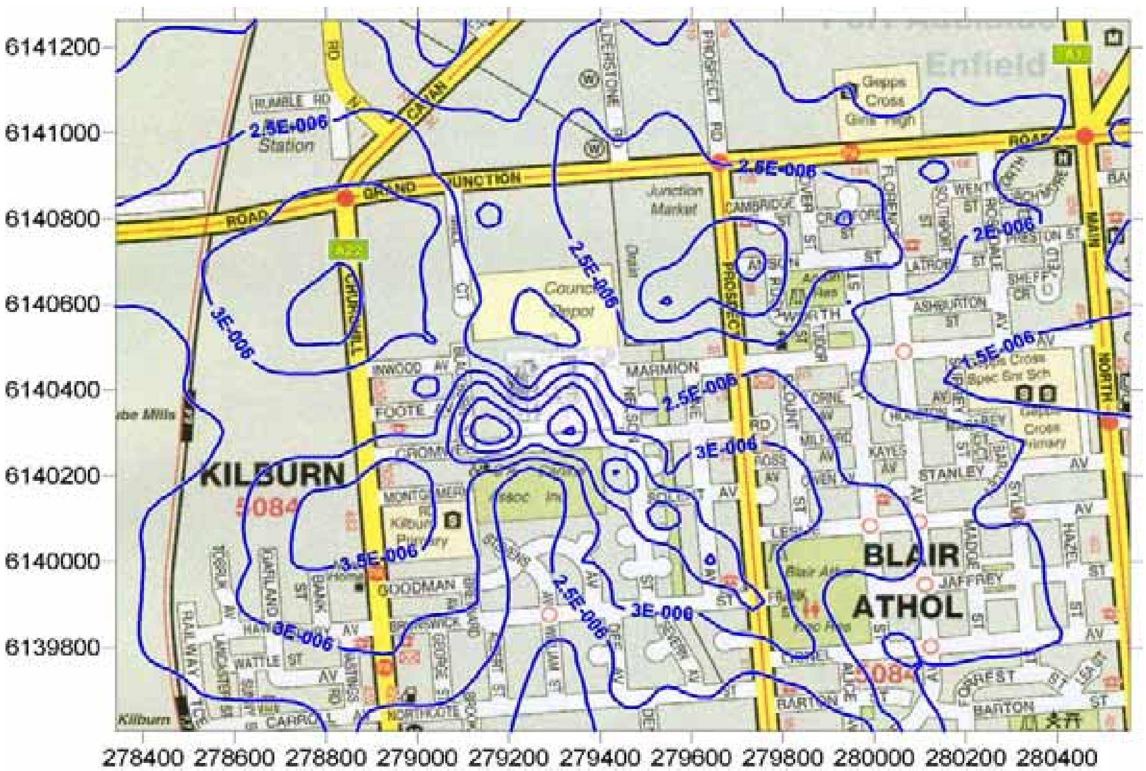


Figure 18: Predicted anthracene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

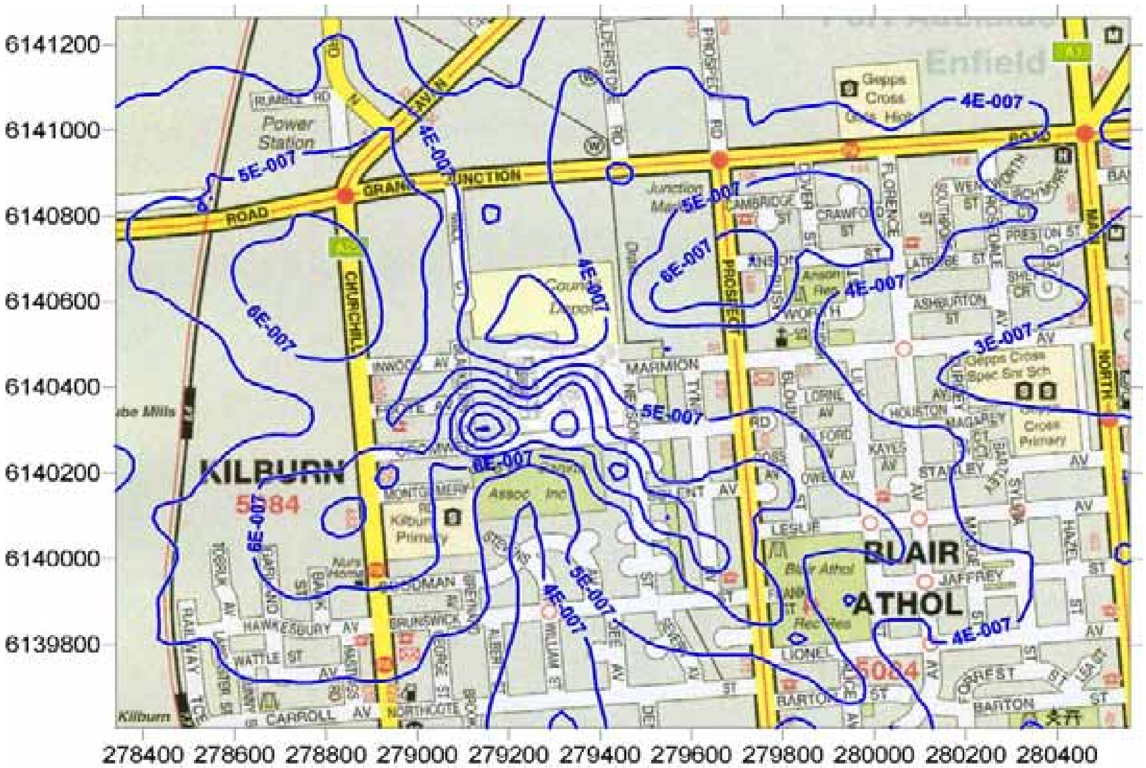


Figure 19: Predicted benzo (a) pyrene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

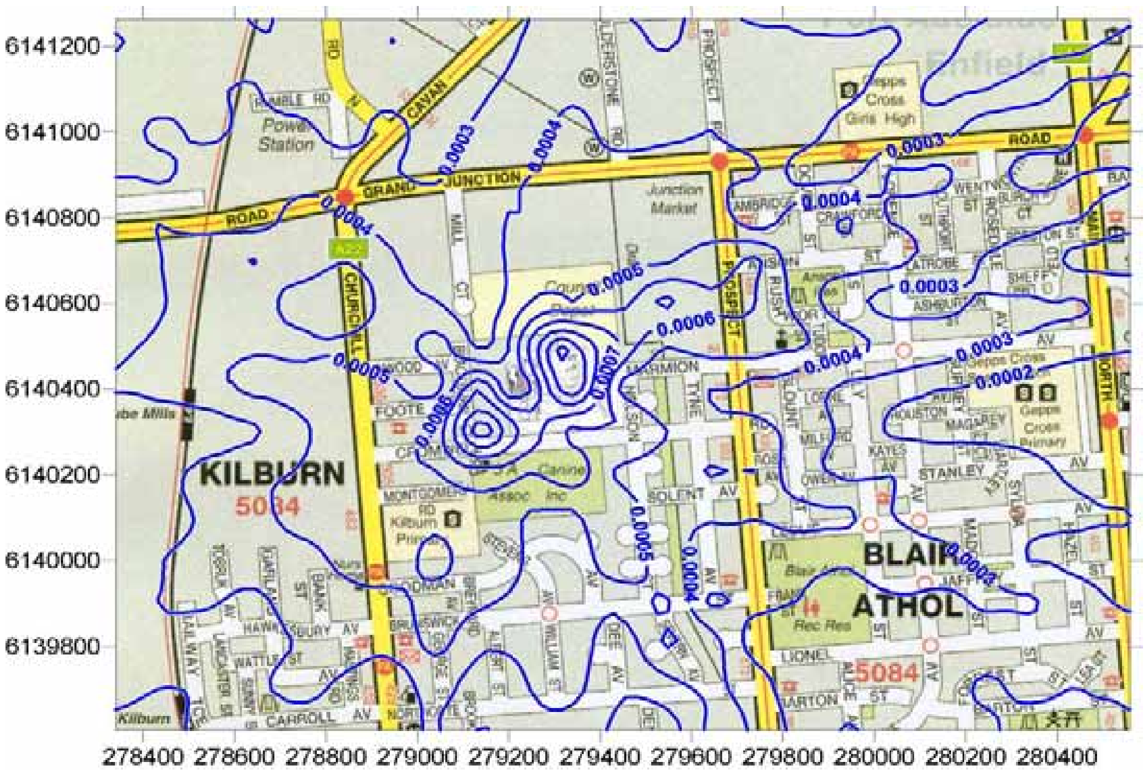


Figure 20: Predicted butyl acetate GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

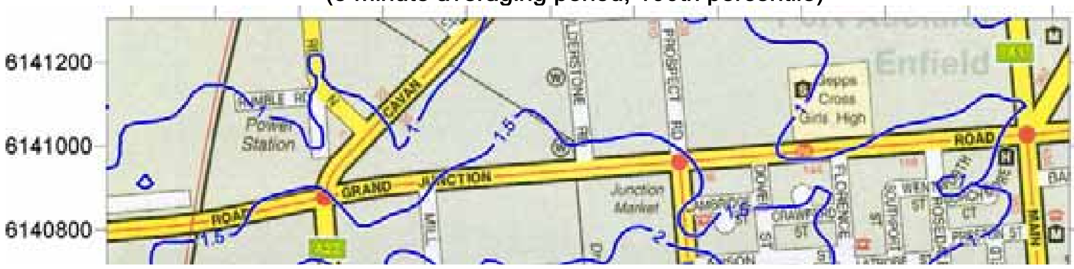


Figure 21: Predicted carbon monoxide GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

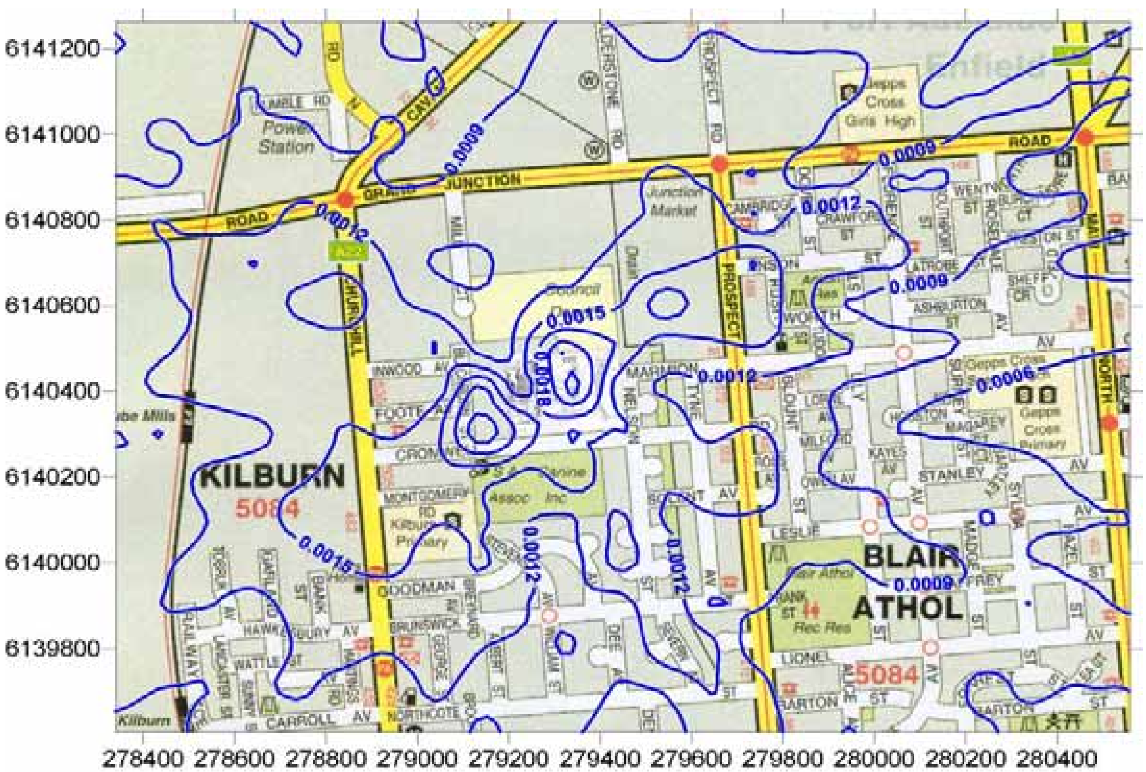


Figure 22: Predicted cresol GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

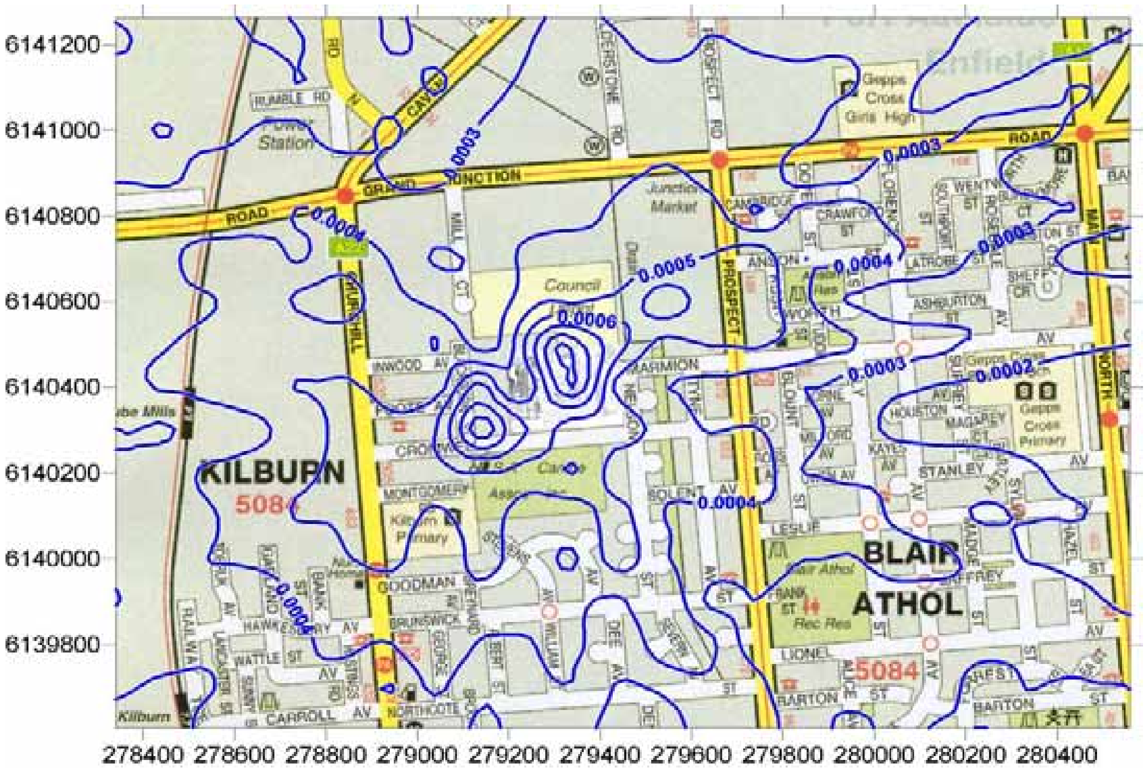


Figure 23: Predicted cyclohexanone GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

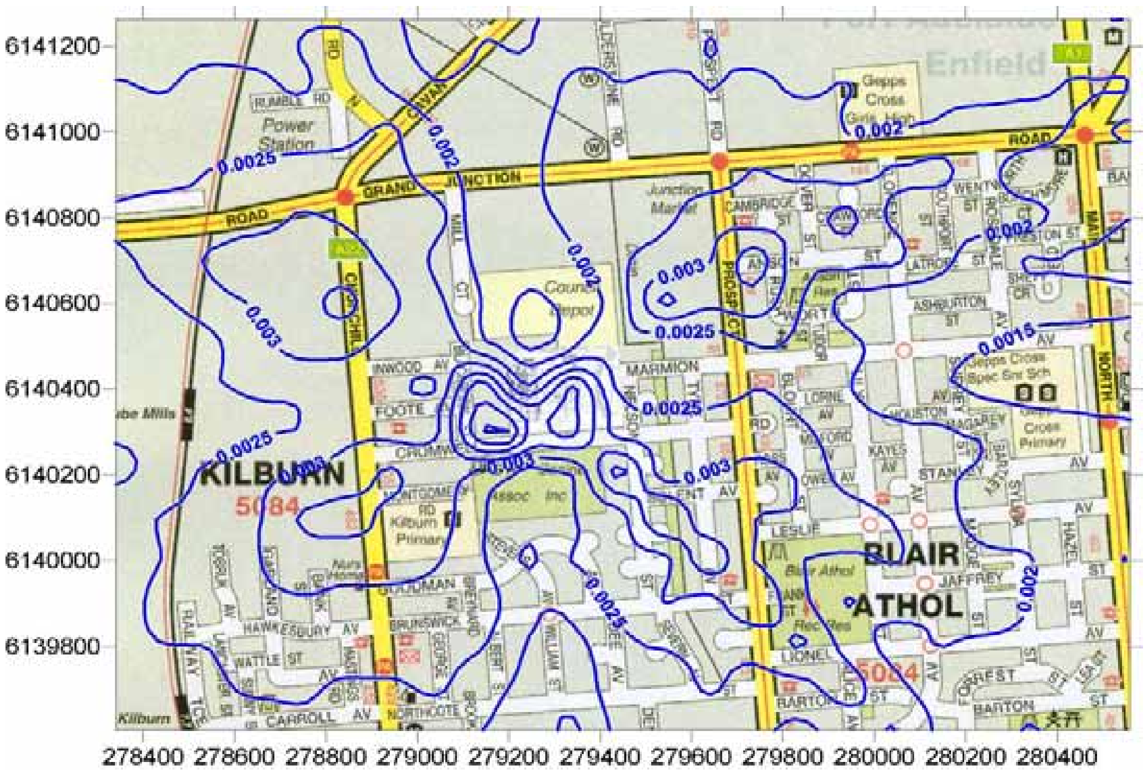


Figure 24: Predicted ethyl acetate GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

Figure 25: Predicted ethyl benzene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

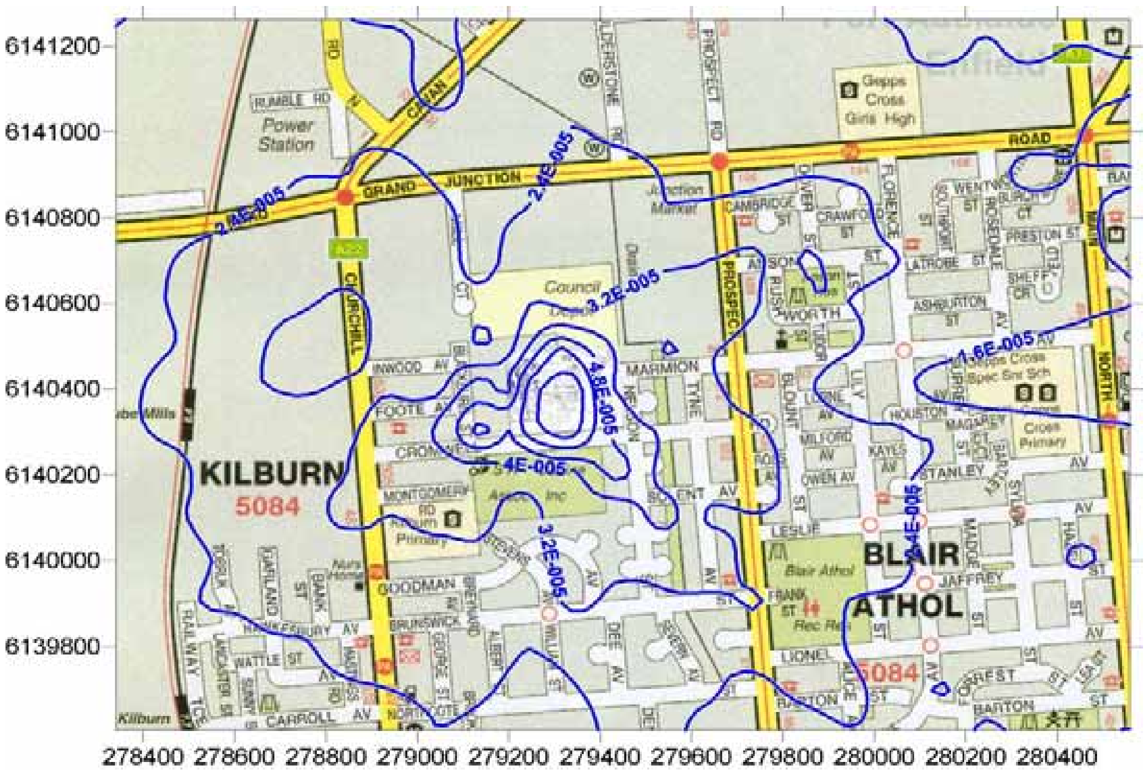


Figure 26: Predicted fluorene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

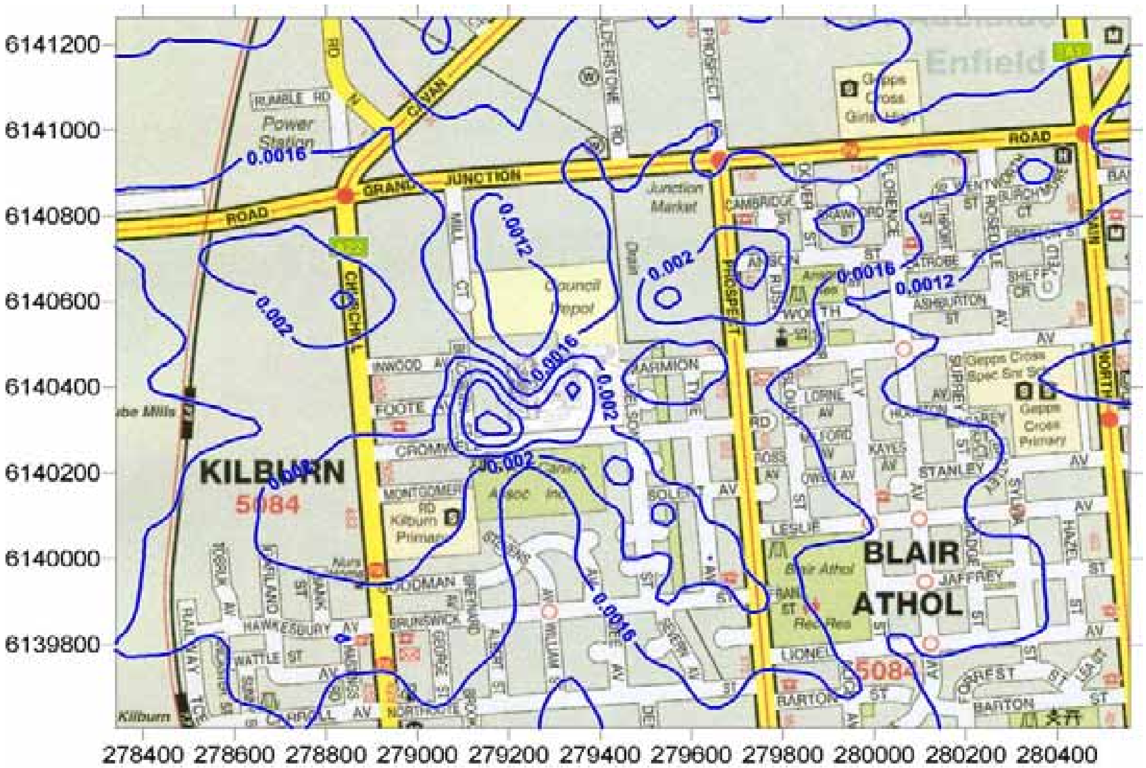


Figure 27: Predicted isopropylbenzene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

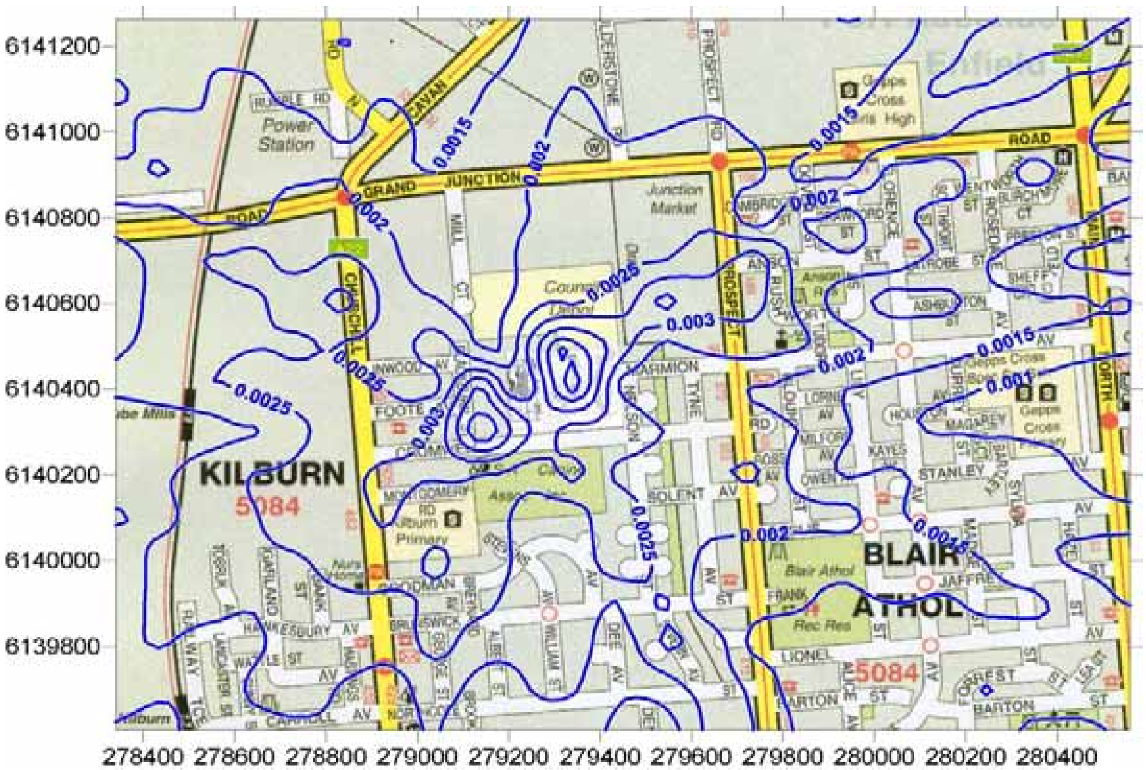


Figure 28: Predicted methylethylketone GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

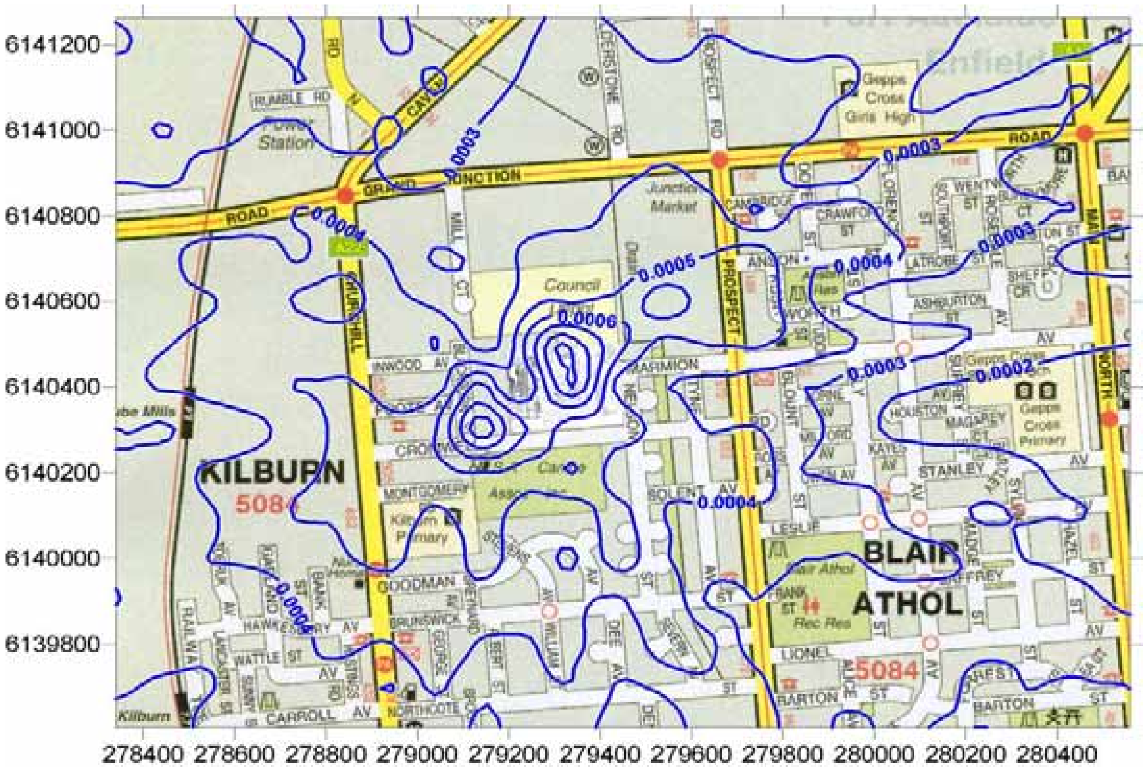


Figure 29: Predicted methylisobutylketone GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

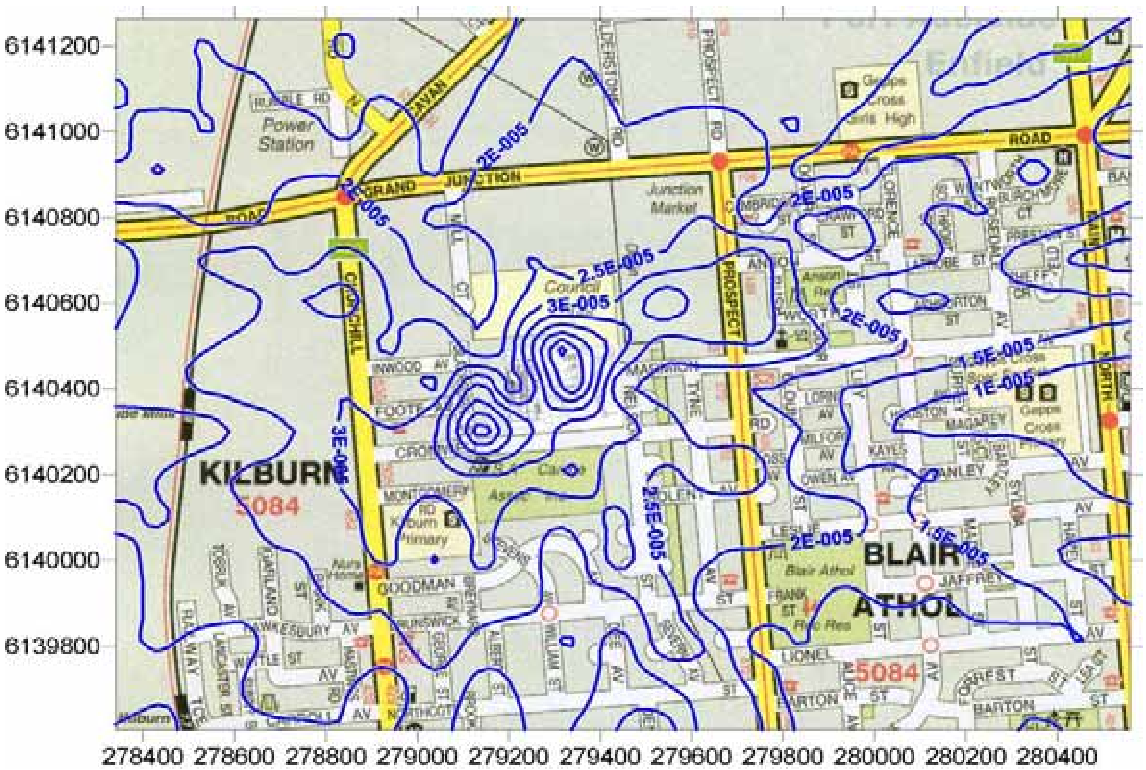


Figure 30: Predicted phenanthrene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

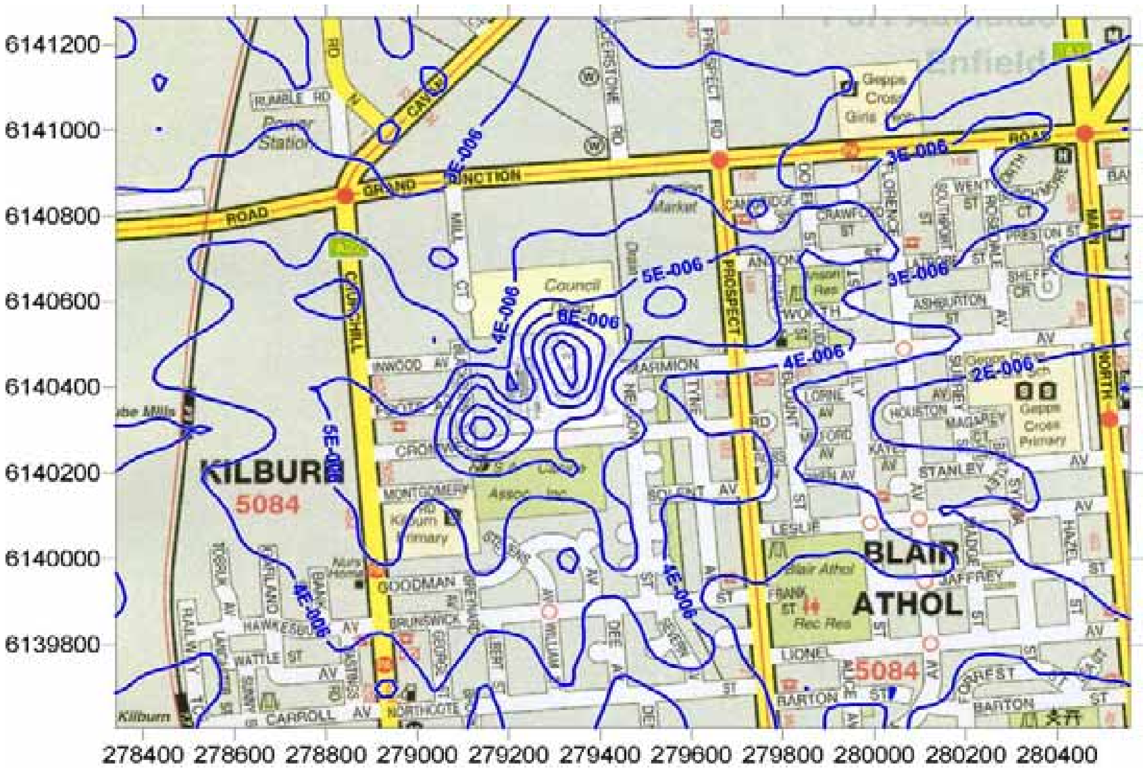


Figure 31: Predicted pyrene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

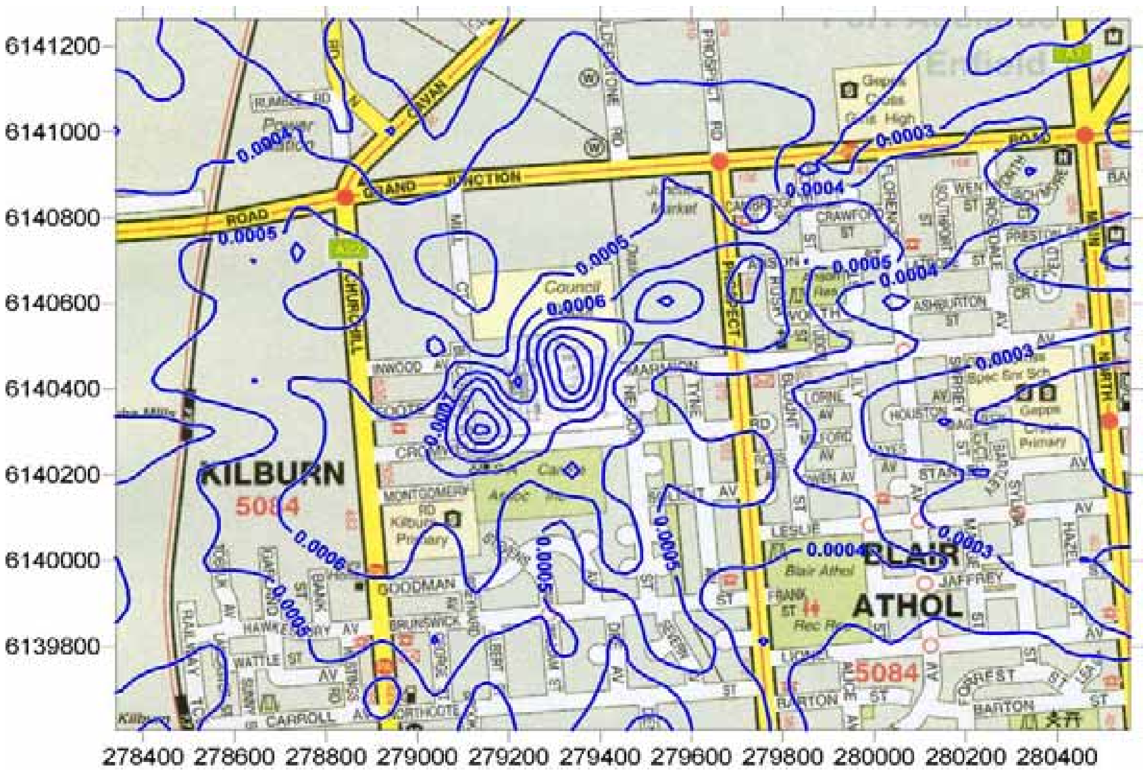


Figure 32: Predicted styrene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

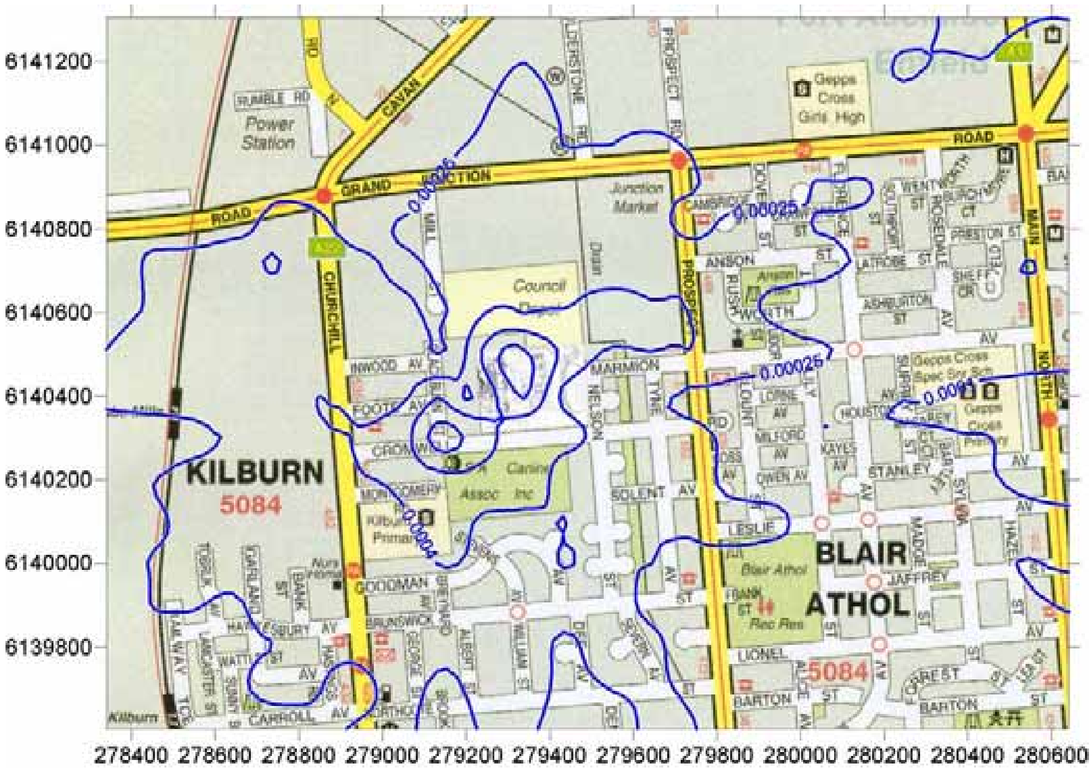


Figure 33: Predicted butanol GLC from future (furane) operation (ODU).
(3 minute averaging period, 100th percentile)

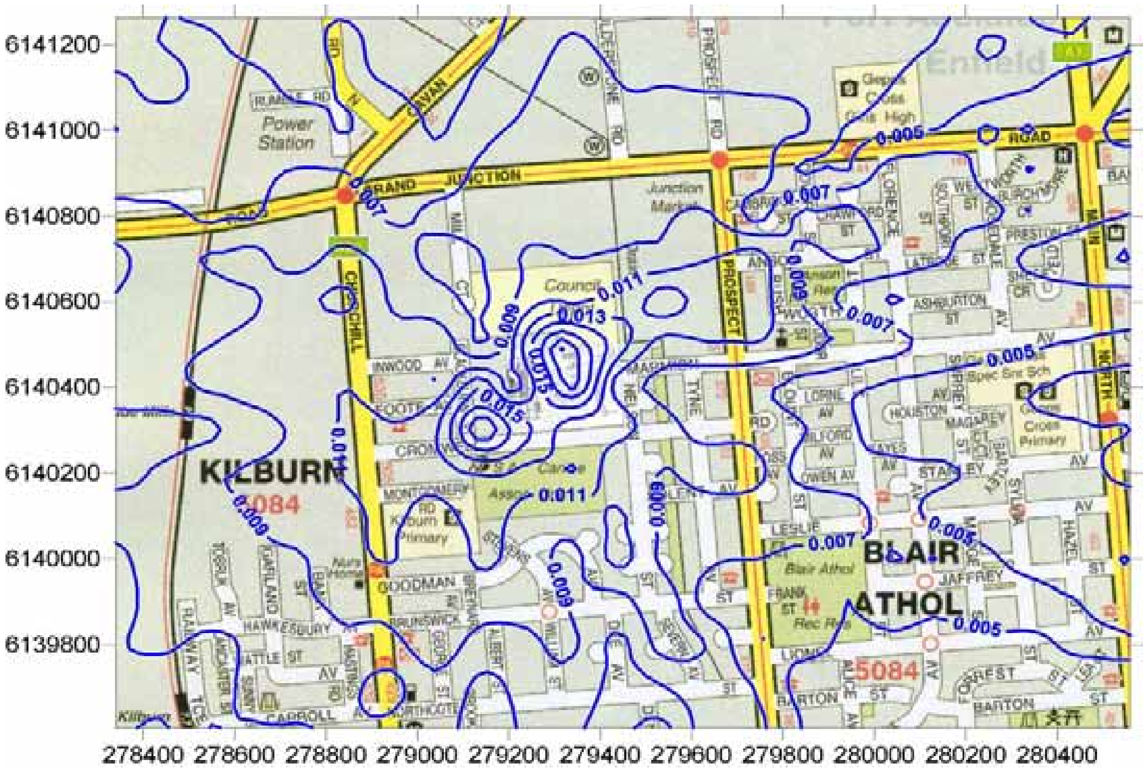


Figure 34: Predicted acetaldehyde GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

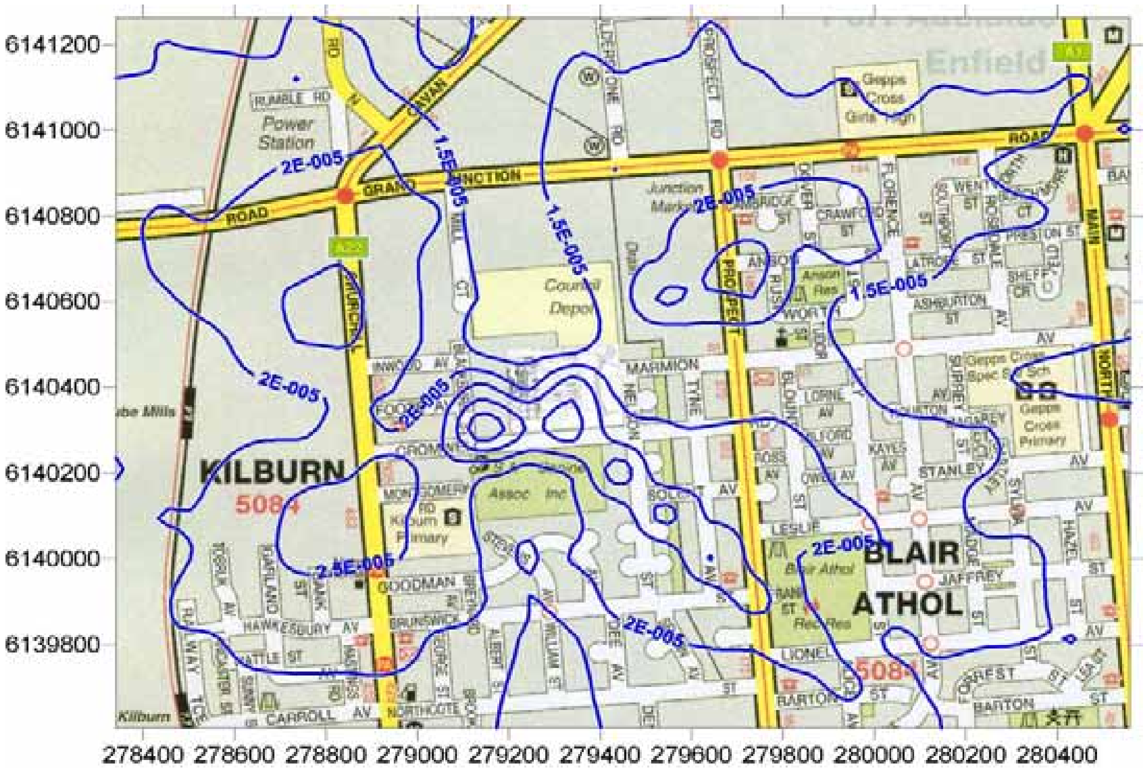


Figure 35: Predicted furfural GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

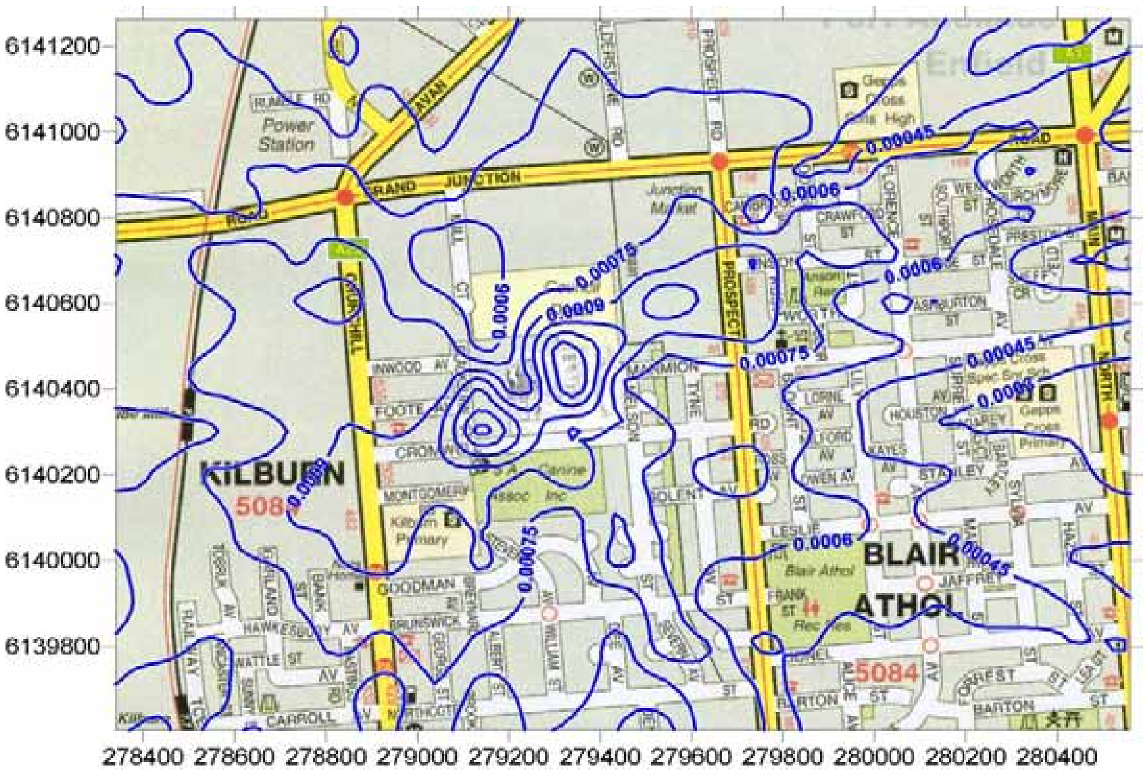


Figure 36: Predicted propanaldehyde GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

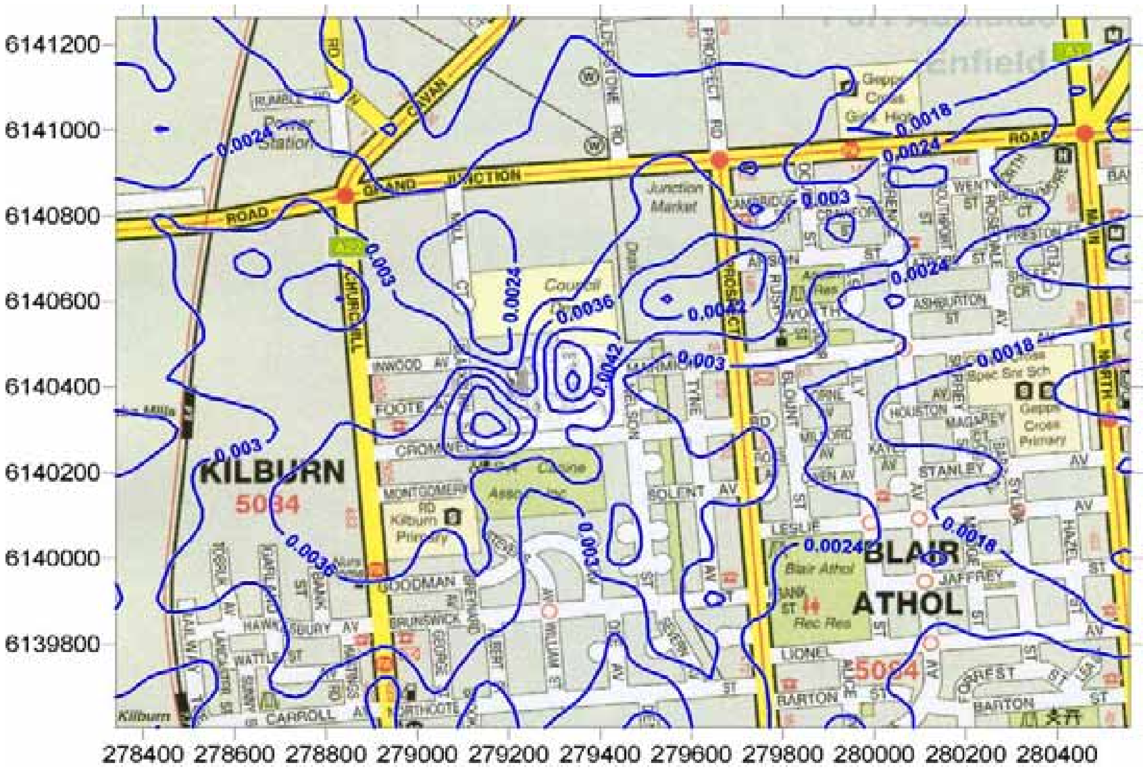


Figure 37: Predicted butanaldehyde GLC from future (furane) operation (ug/m3).
(3 minute averaging period, 100th percentile)

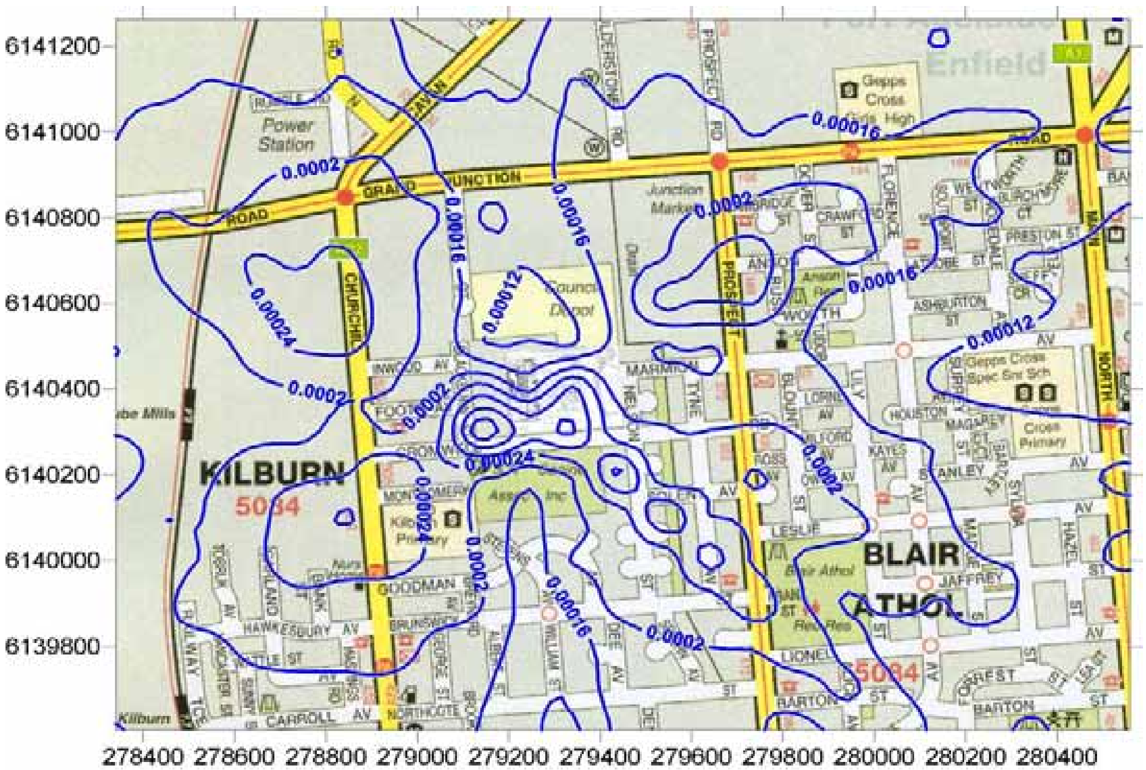


Figure 38: Predicted pentanaldehyde GLC from future (furane) operation (ug/m3).
(3 minute averaging period, 100th percentile)

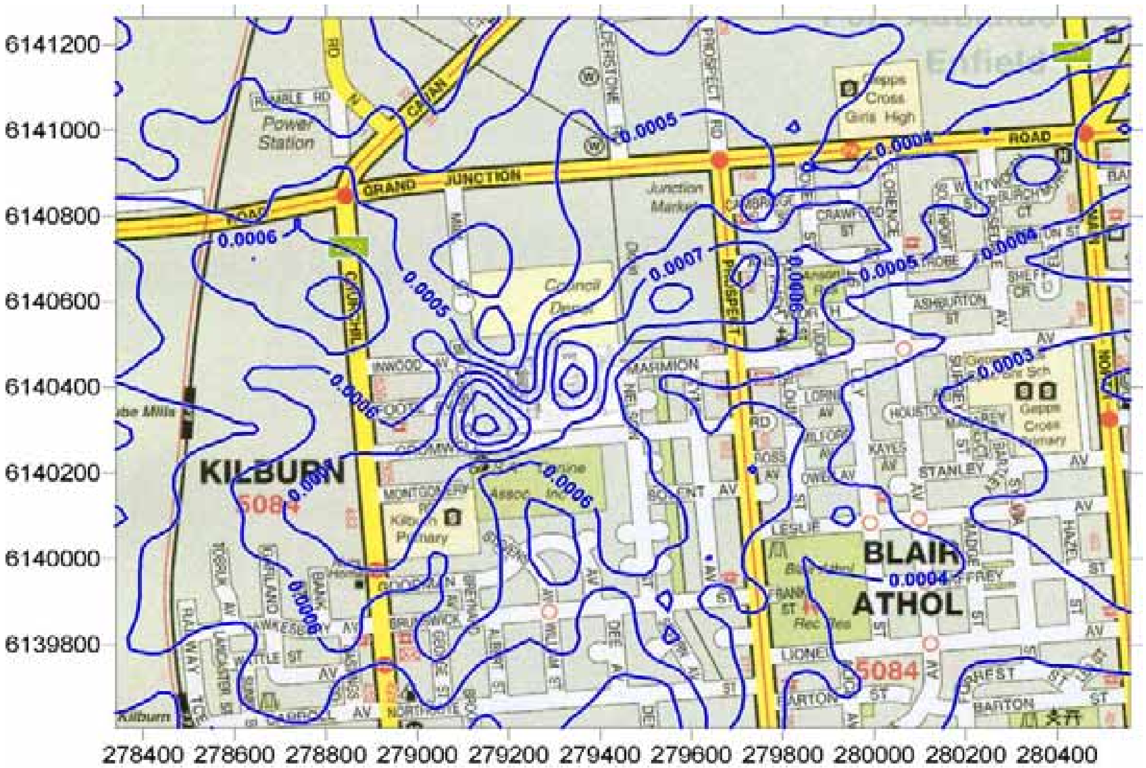


Figure 39: Predicted benzaldehyde GLC from future (furane) operation (ug/m3).
(3 minute averaging period, 100th percentile)

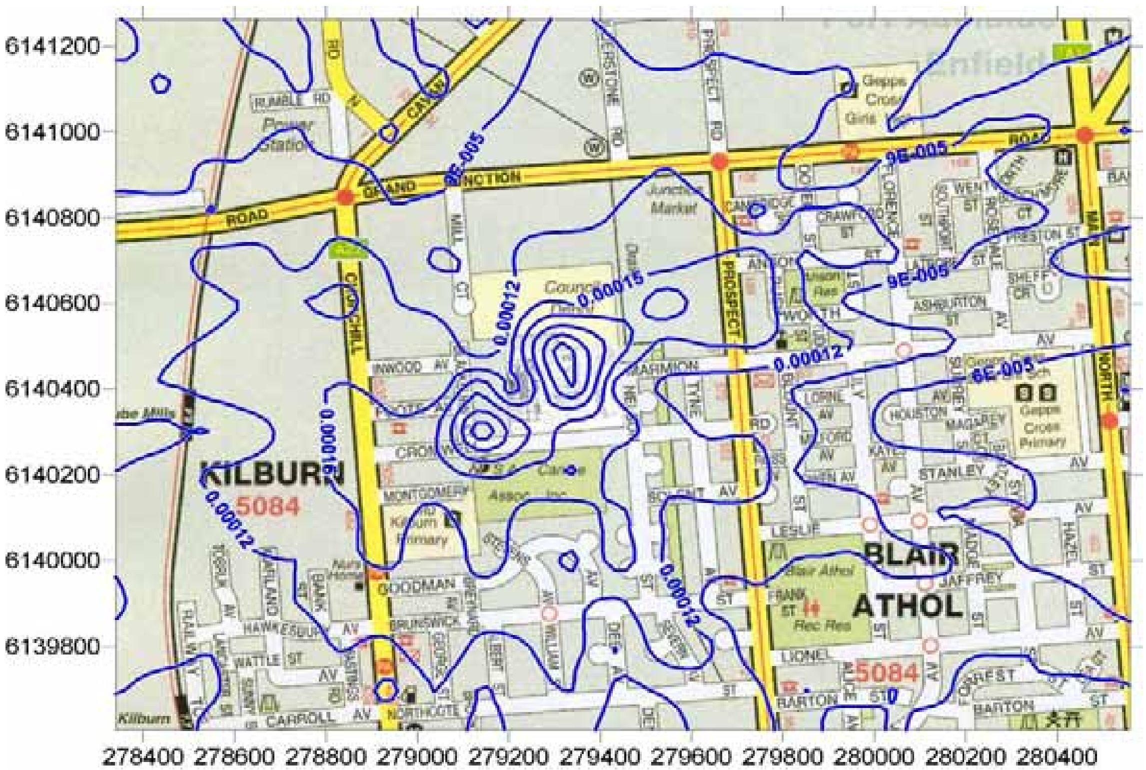


Figure 40: Predicted glutaraldehyde GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

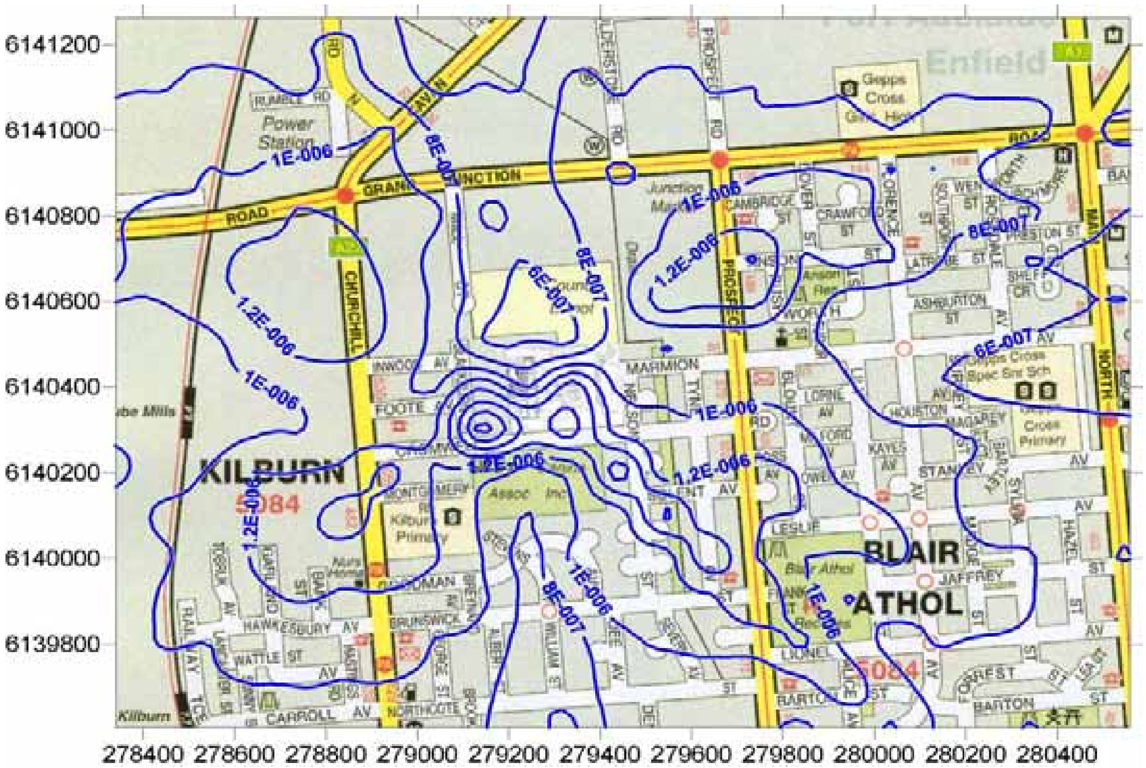


Figure 41: Predicted acenaphthene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

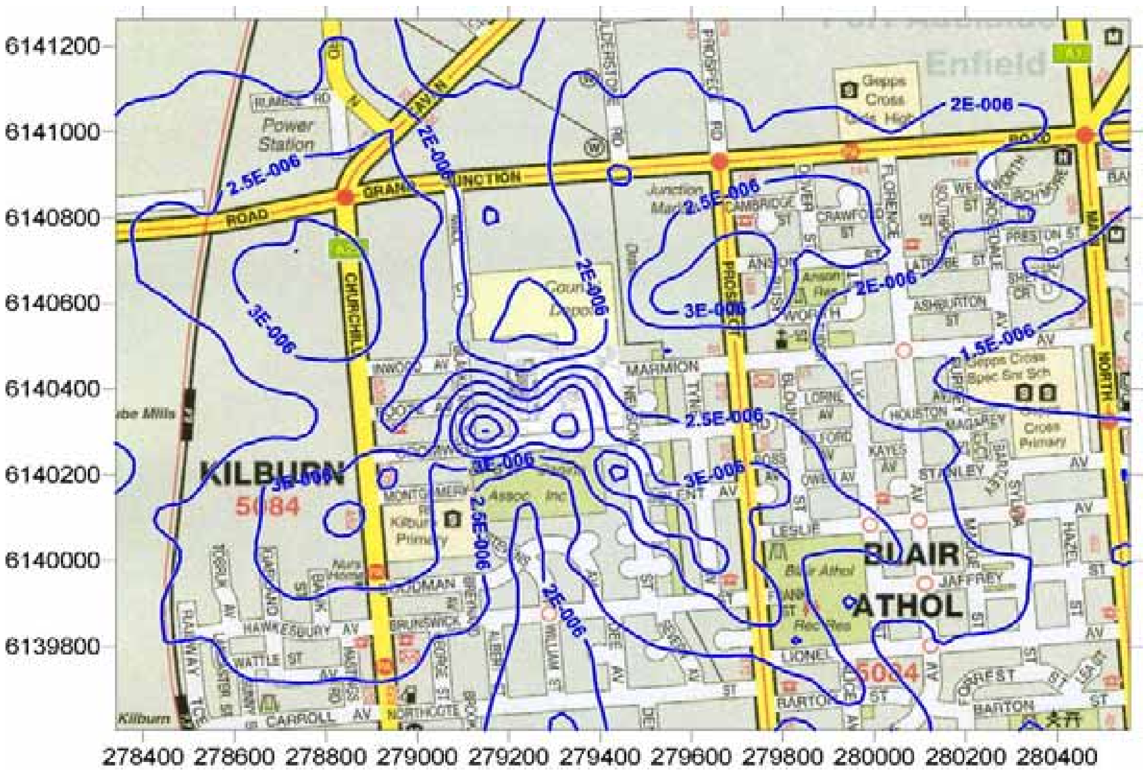


Figure 42: Predicted acenaphthylene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

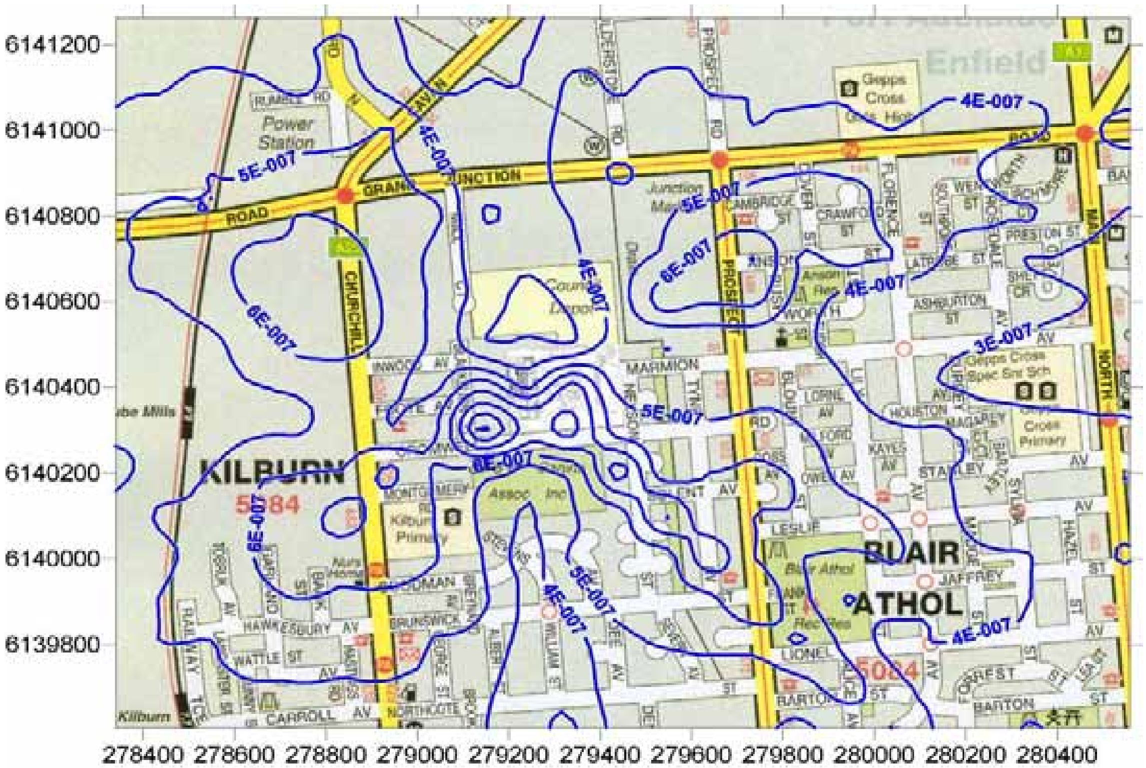


Figure 43: Predicted benz (a) anthracene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

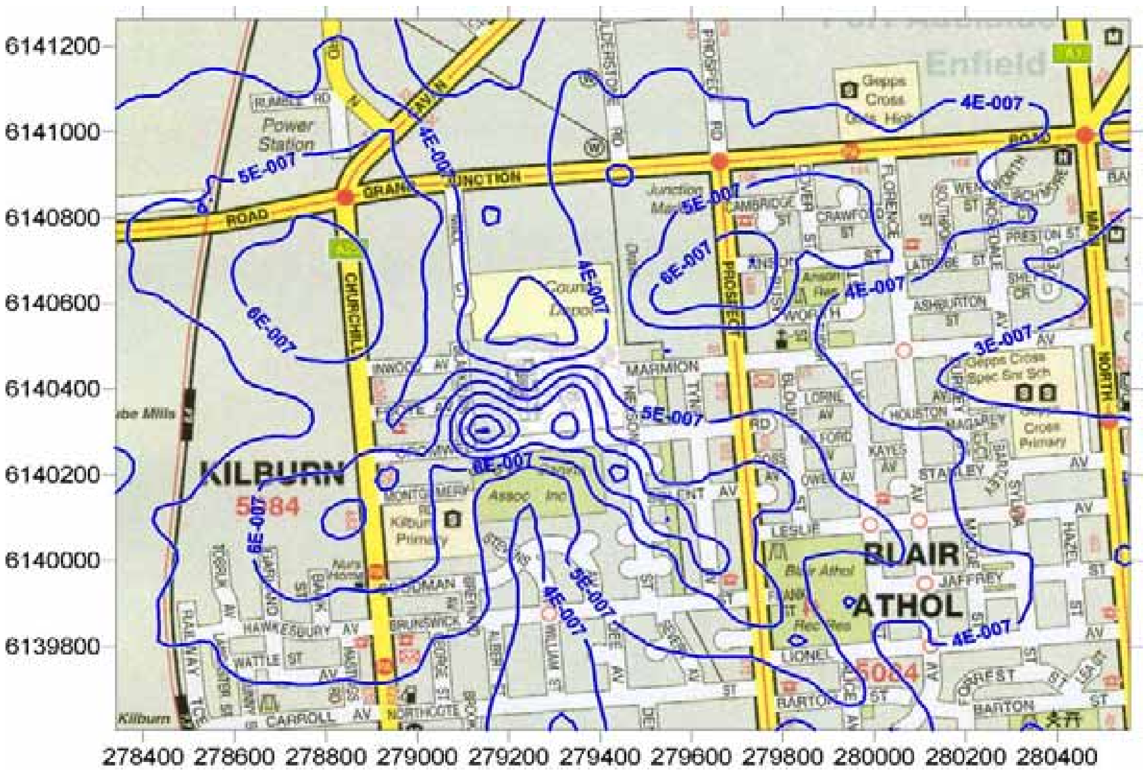


Figure 44: Predicted benzo (b) fluoranthene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

Figure 45: Predicted total fluoranthene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

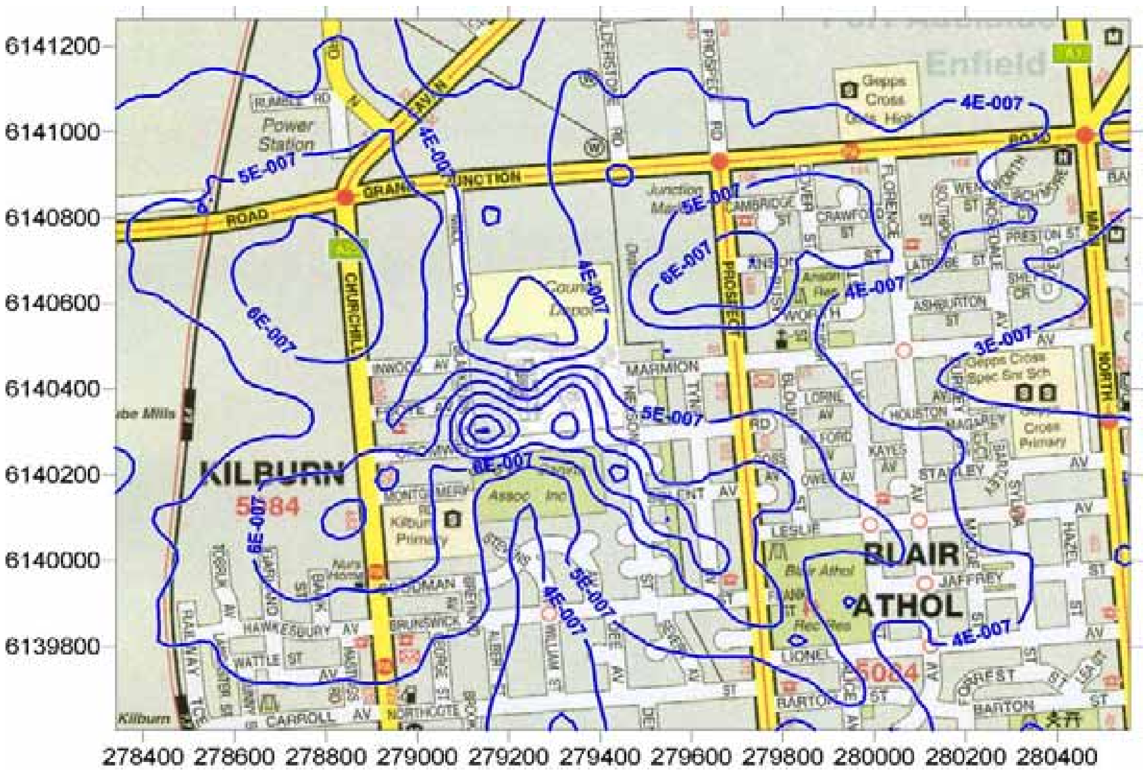


Figure 46: Predicted chrysene GLC from future (furane) operation (mg/m3).
(3 minute averaging period, 100th percentile)

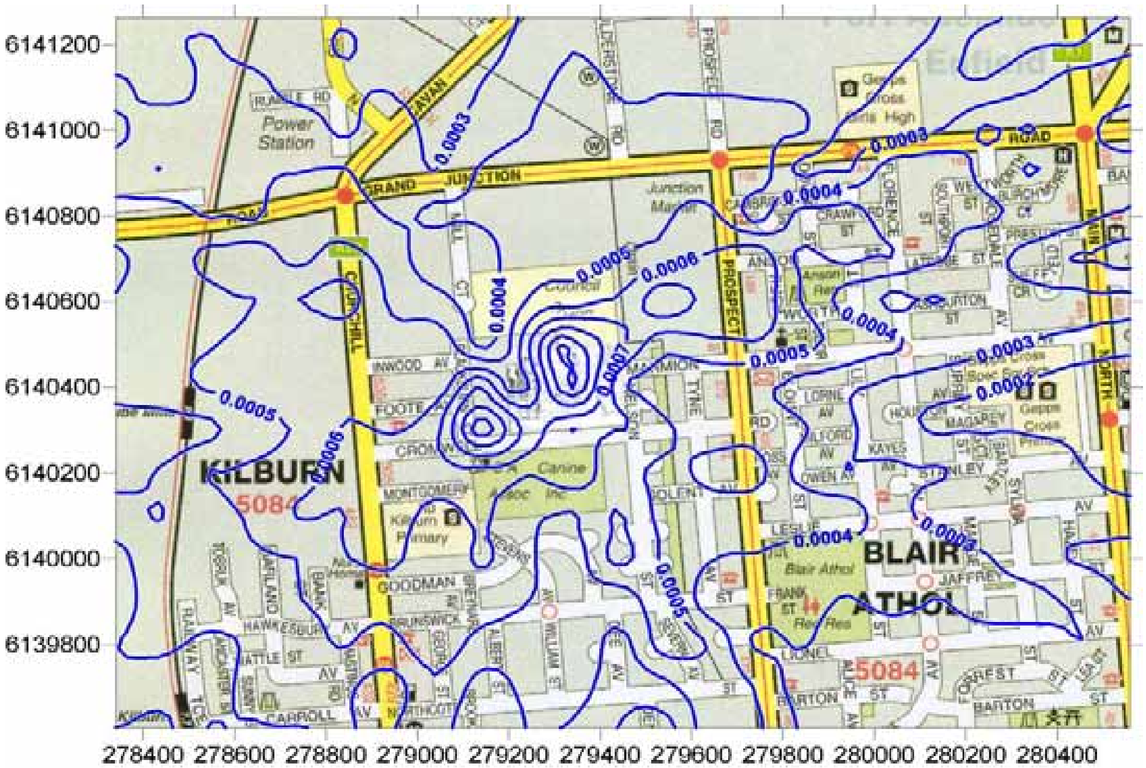


Figure 47: Predicted dimethylphenols GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

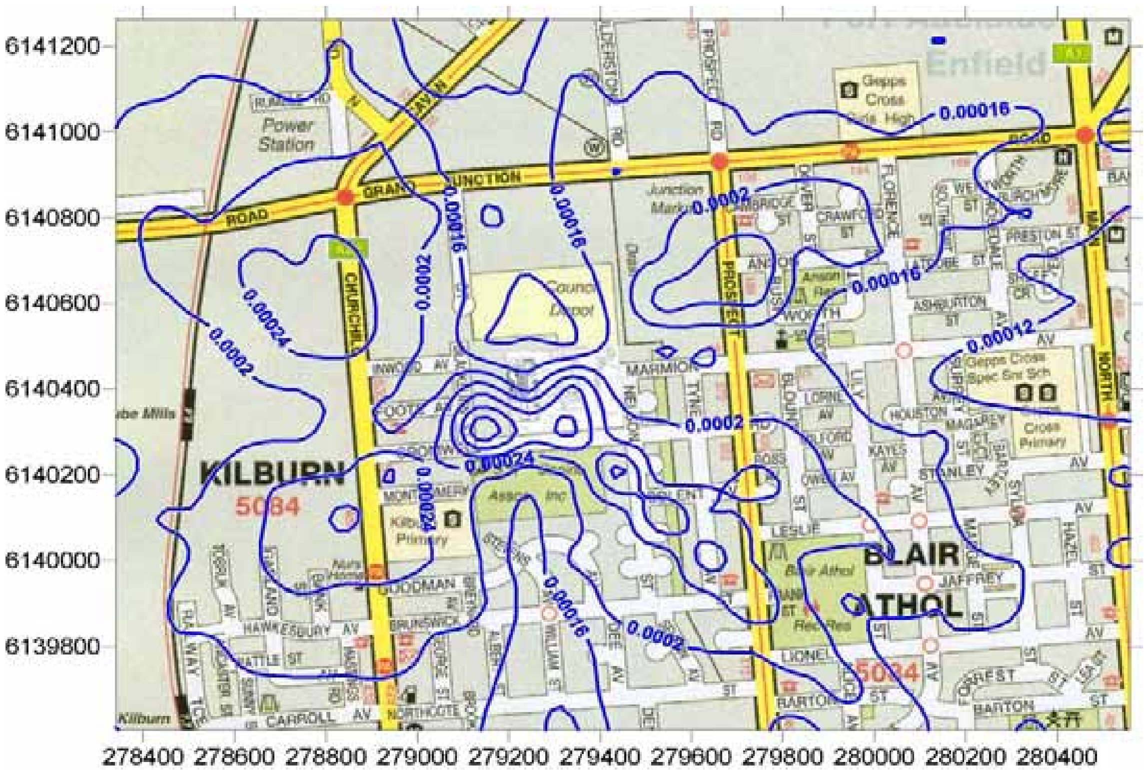


Figure 48: Predicted 1,3,5-trimethylbenzene GLC from future (furane) operation (mg/m3). (3 minute averaging period, 100th percentile)

Appendix III

Contour Plots - Future 24 hr (Furane)

Figure 1: Predicted ammonia GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

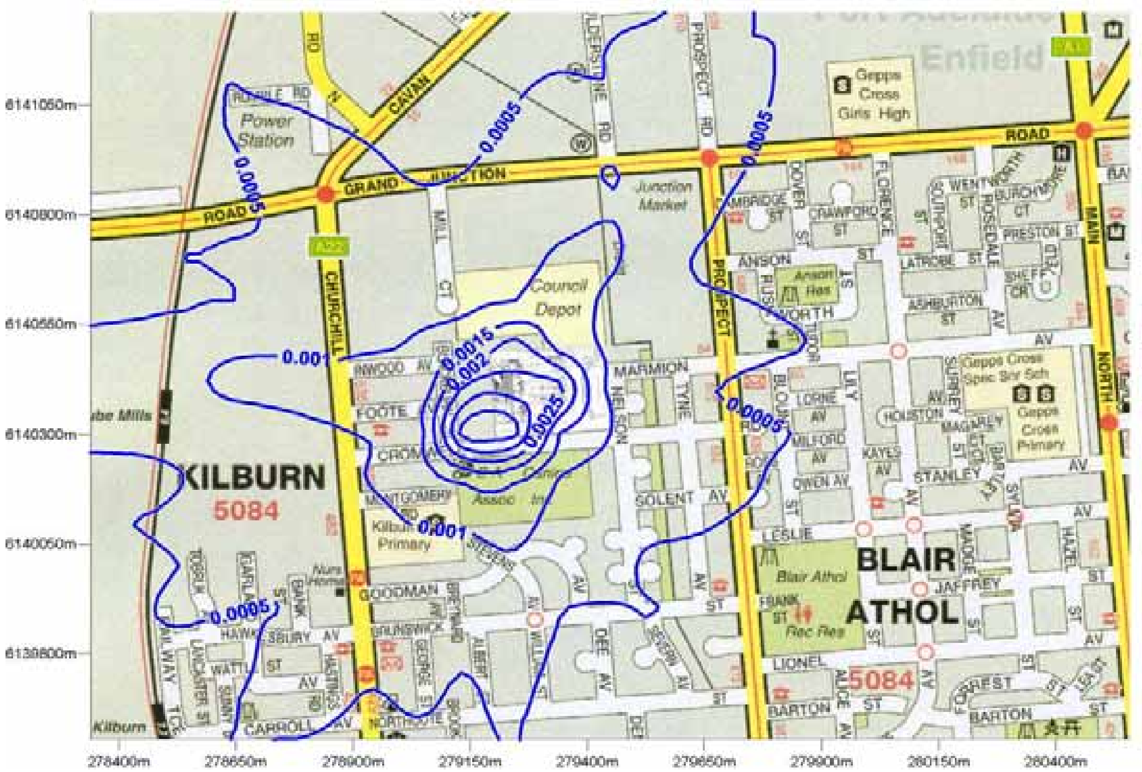


Figure 2: Predicted hydrogen sulphide GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 3: Predicted PM10 GLC from future (furane) operation (ug/m^3).
(24 hour averaging period, 100th percentile)

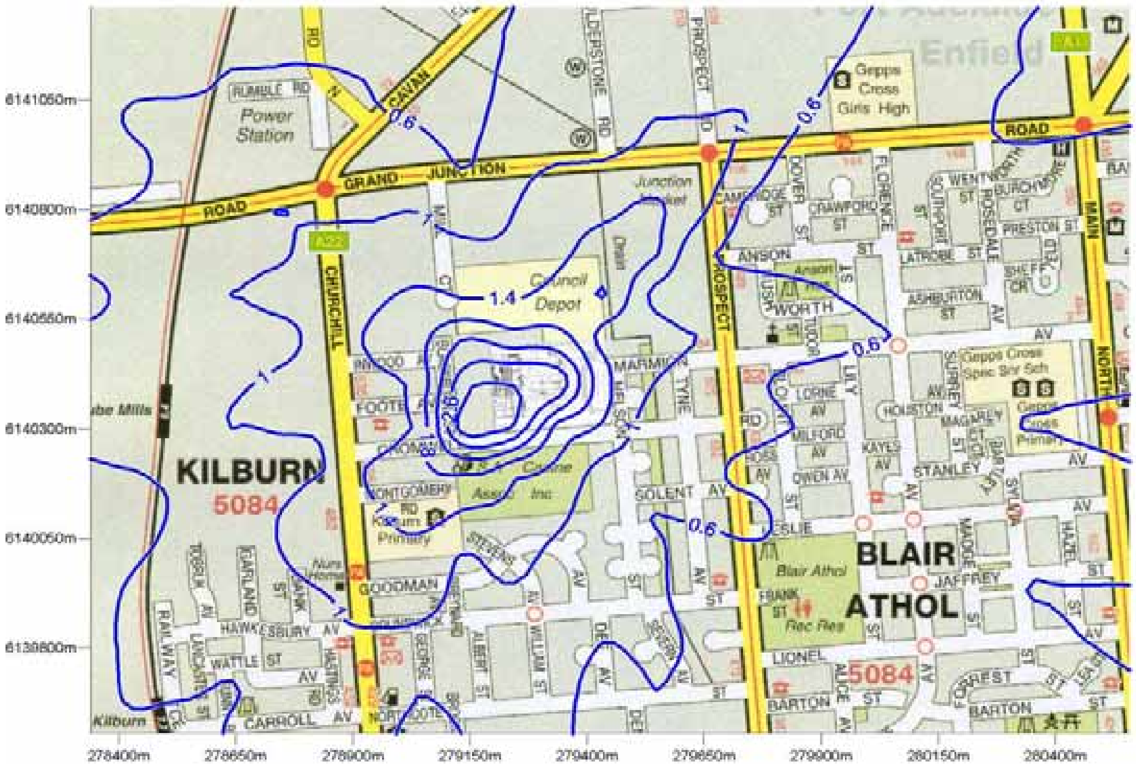


Figure 4: Predicted PM2.5 GLC from future (furane) operation (ug/m^3).
(24 hour averaging period, 100th percentile)

Figure 5: Predicted nitrogen oxides GLC from future (furane) operation (ug/m^3).
(24 hour averaging period, 100th percentile)

Figure 6: Predicted sulphur dioxide GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 7: Predicted dioxin GLC from future (furane) operation (ng/m^3).
(24 hour averaging period, 100th percentile)

Figure 8: Predicted benzene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 9: Predicted formaldehyde GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 10: Predicted cyanide GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 11: Predicted total xylene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 12: Predicted naphthalene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 13: Predicted phenol GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 14: Predicted toluene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

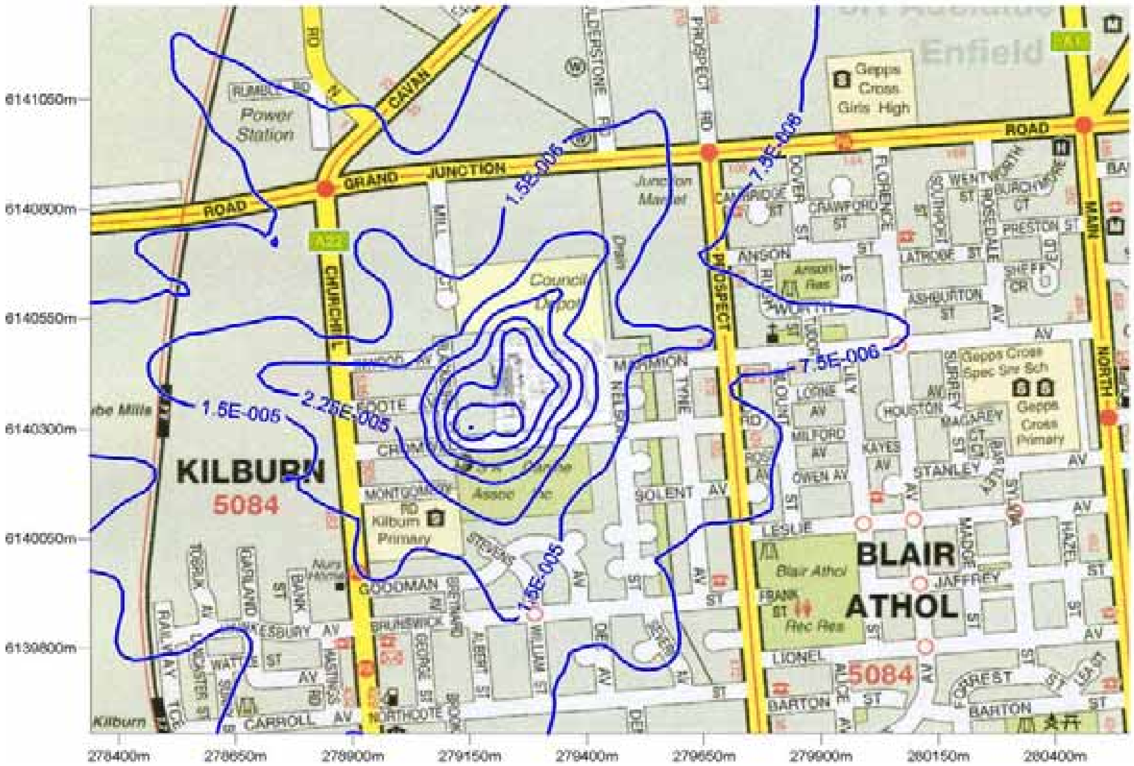


Figure 15: Predicted acrolein GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

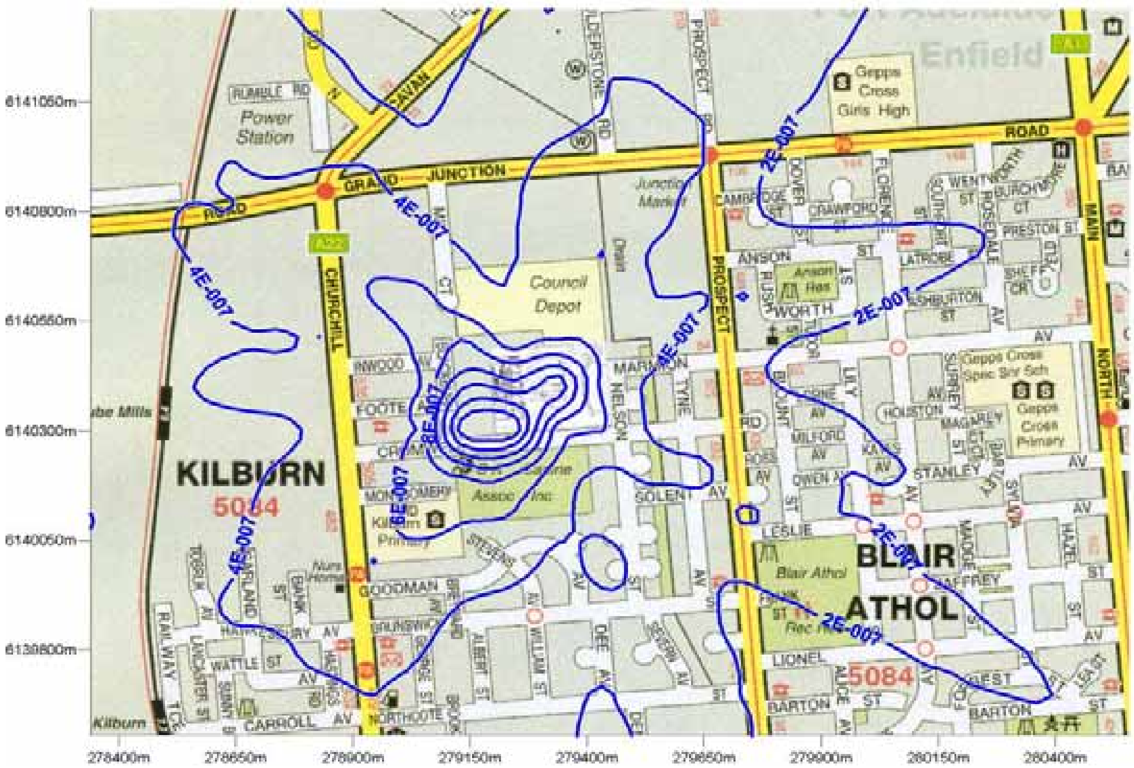


Figure 16: Predicted anthracene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

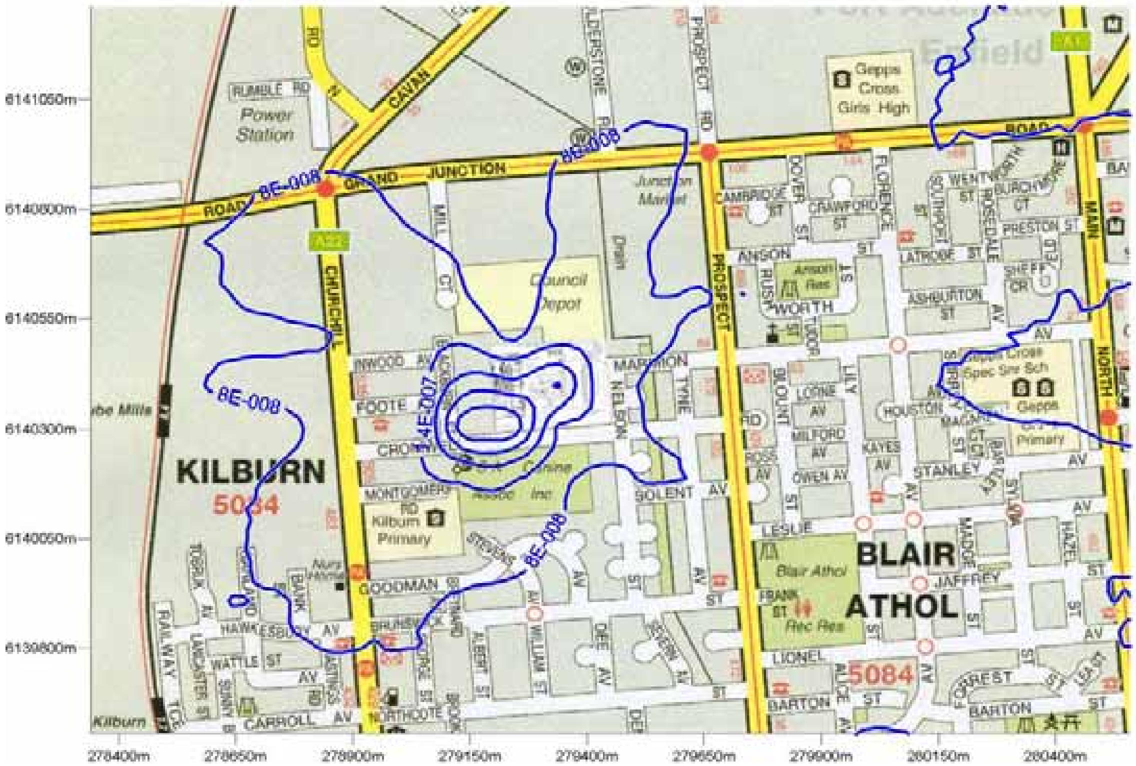


Figure 17: Predicted benzo (a) pyrene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

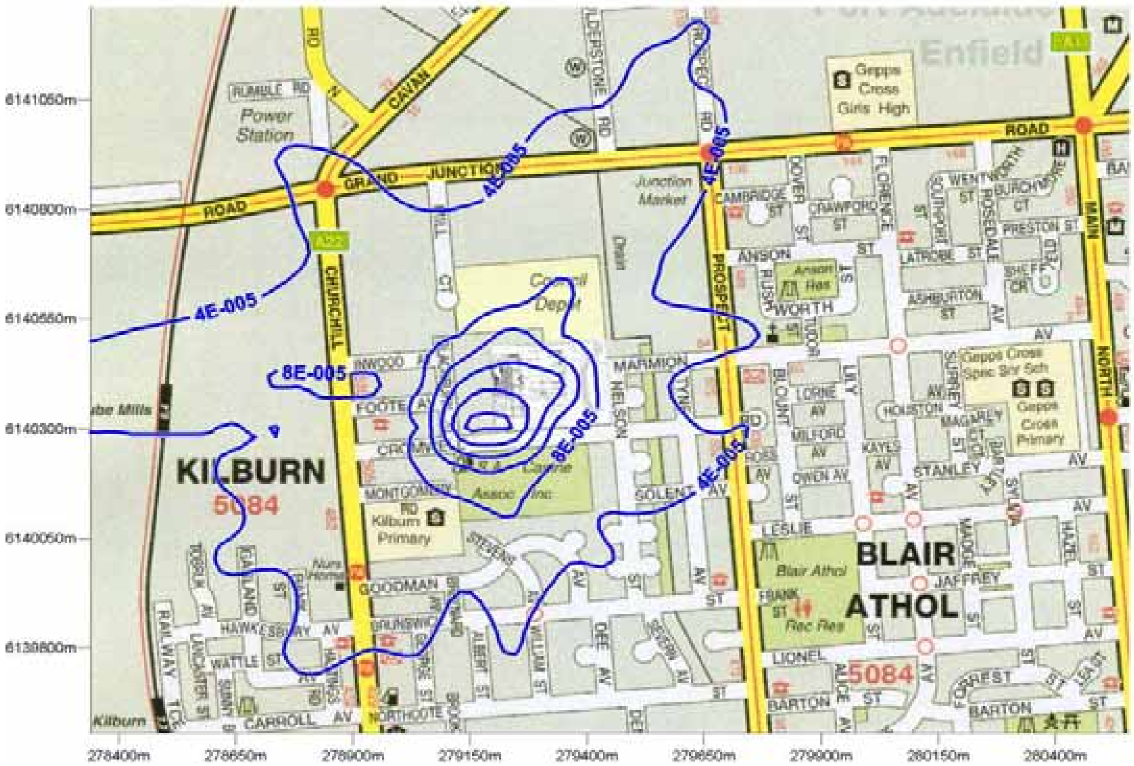


Figure 18: Predicted butyl acetate GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 19: Predicted carbon monoxide GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 20: Predicted cresol GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 21: Predicted cyclohexanone GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

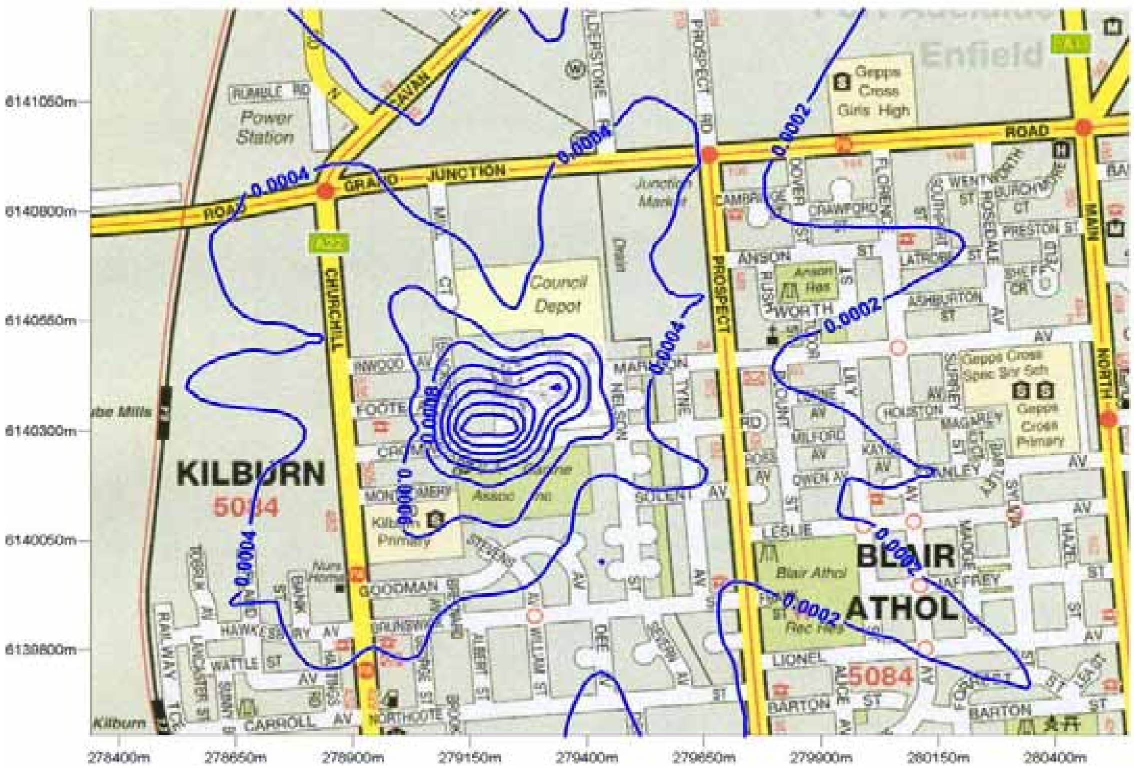


Figure 22: Predicted ethyl acetate GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 23: Predicted ethyl benzene GLC from future (furane) operation (mg/m³). (24 hour averaging period, 100th percentile)

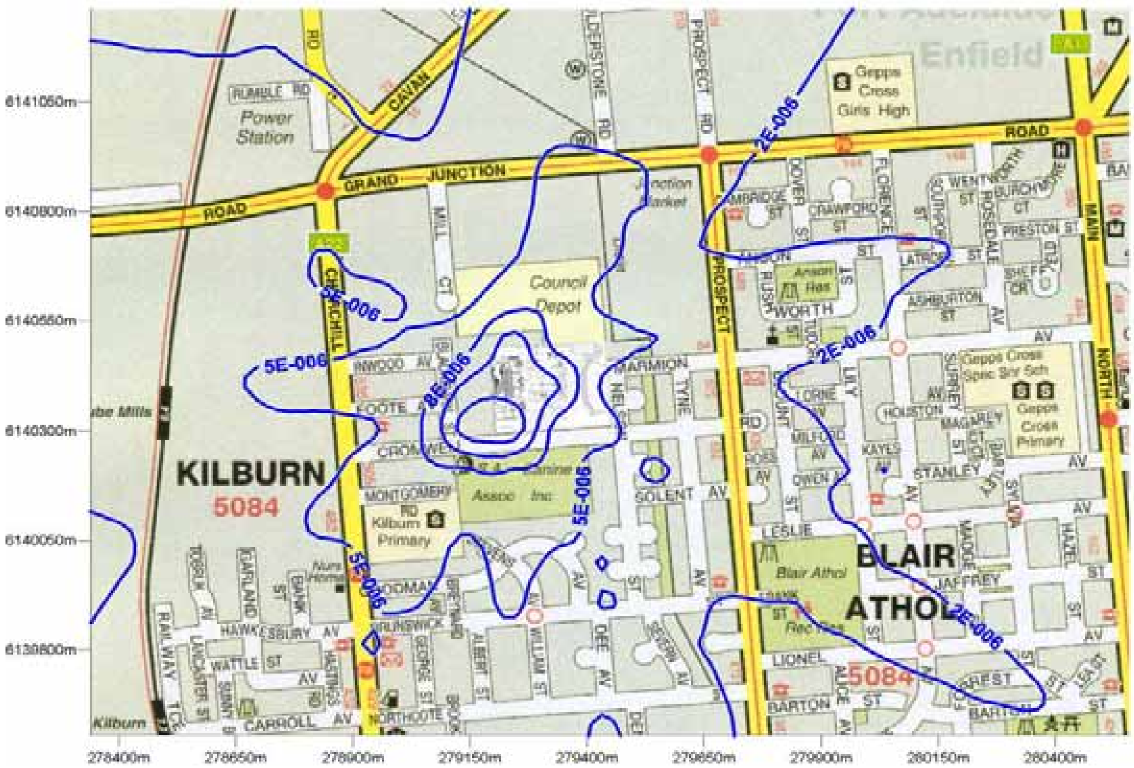


Figure 24: Predicted fluorene GLC from future (furane) operation (mg/m³). (24 hour averaging period, 100th percentile)

Figure 25: Predicted isopropylbenzene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 26: Predicted methylethylketone GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 27: Predicted methylisobutylketone GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

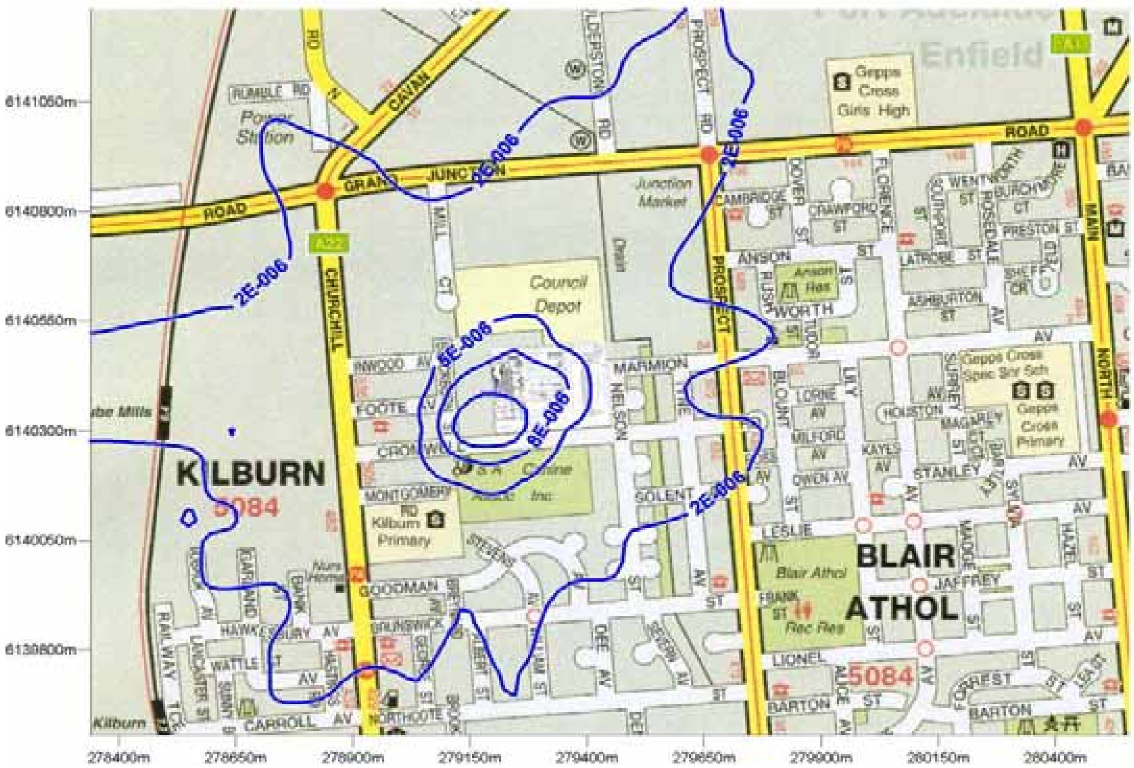


Figure 28: Predicted phenanthrene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 29: Predicted pyrene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 30: Predicted styrene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 31: Predicted butanol GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 32: Predicted acetaldehyde GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

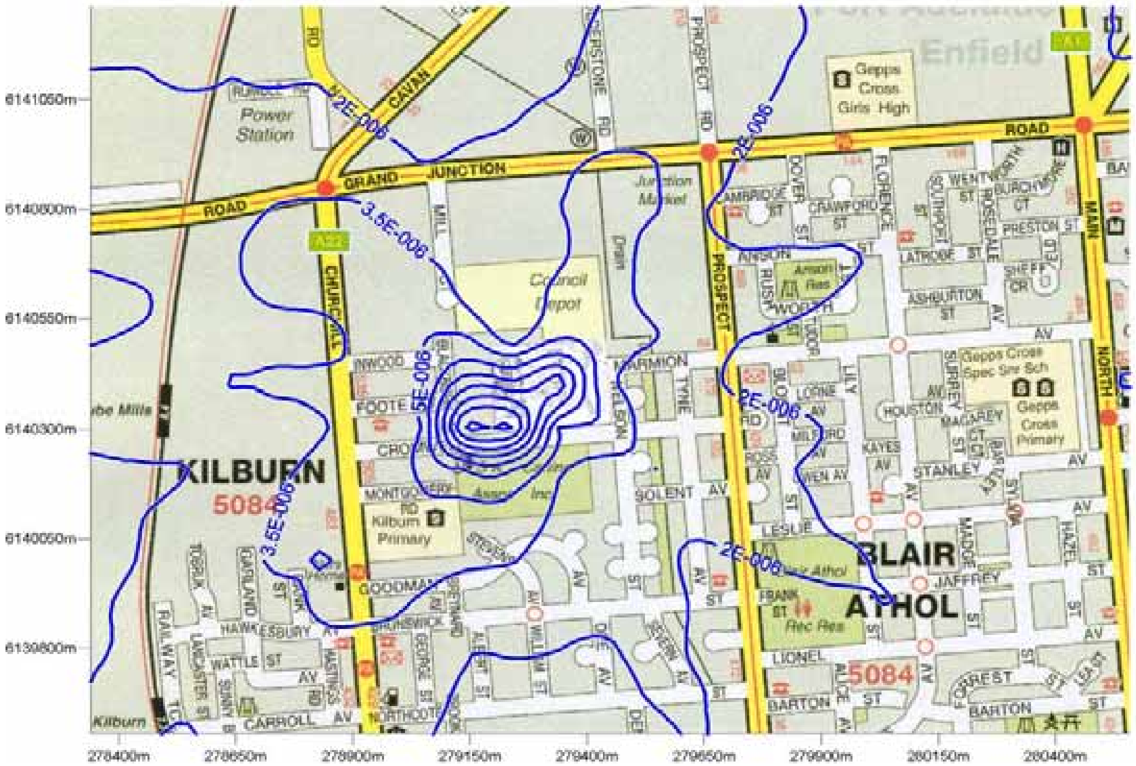


Figure 33: Predicted furfural GLC from future (furane) operation (ug/m^3).
(24 hour averaging period, 100th percentile)

Figure 34: Predicted propanaldehyde GLC from future (furane) operation (ug/m^3).
(24 hour averaging period, 100th percentile)

Figure 35: Predicted butanaldehyde GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 36: Predicted pentanaldehyde GLC from future (furane) operation (ng/m^3).
(24 hour averaging period, 100th percentile)

Figure 37: Predicted benzaldehyde GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

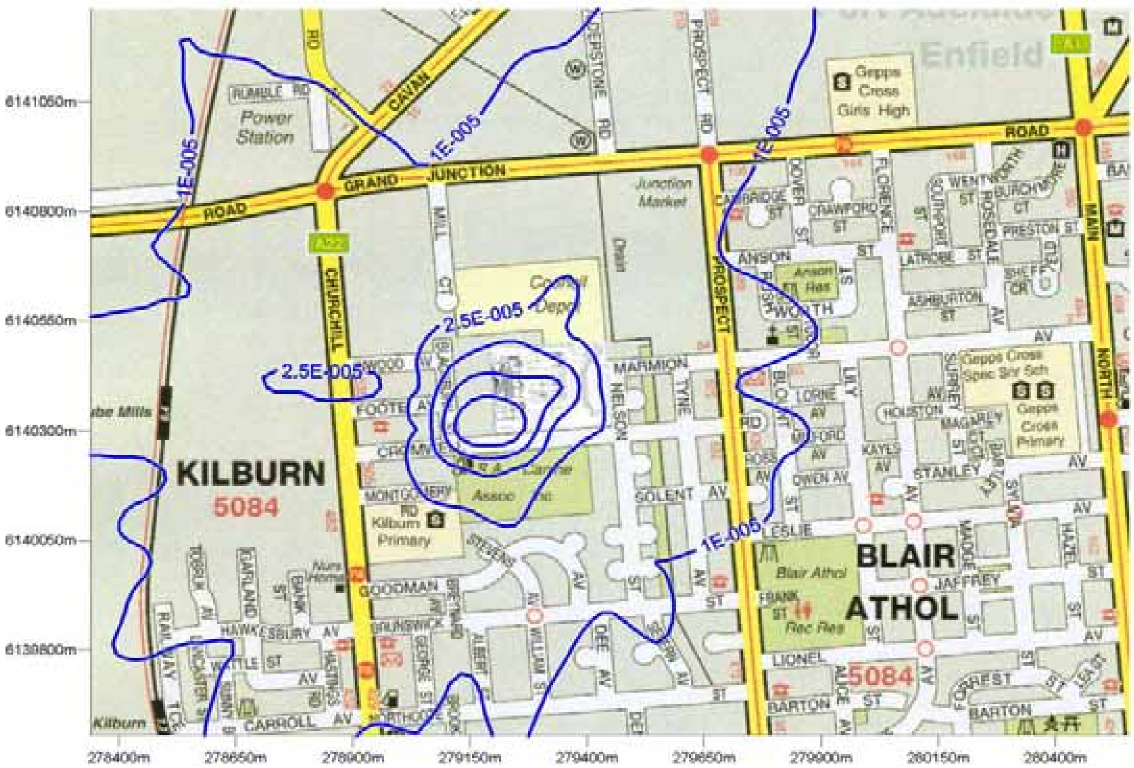


Figure 38: Predicted glutaraldehyde GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

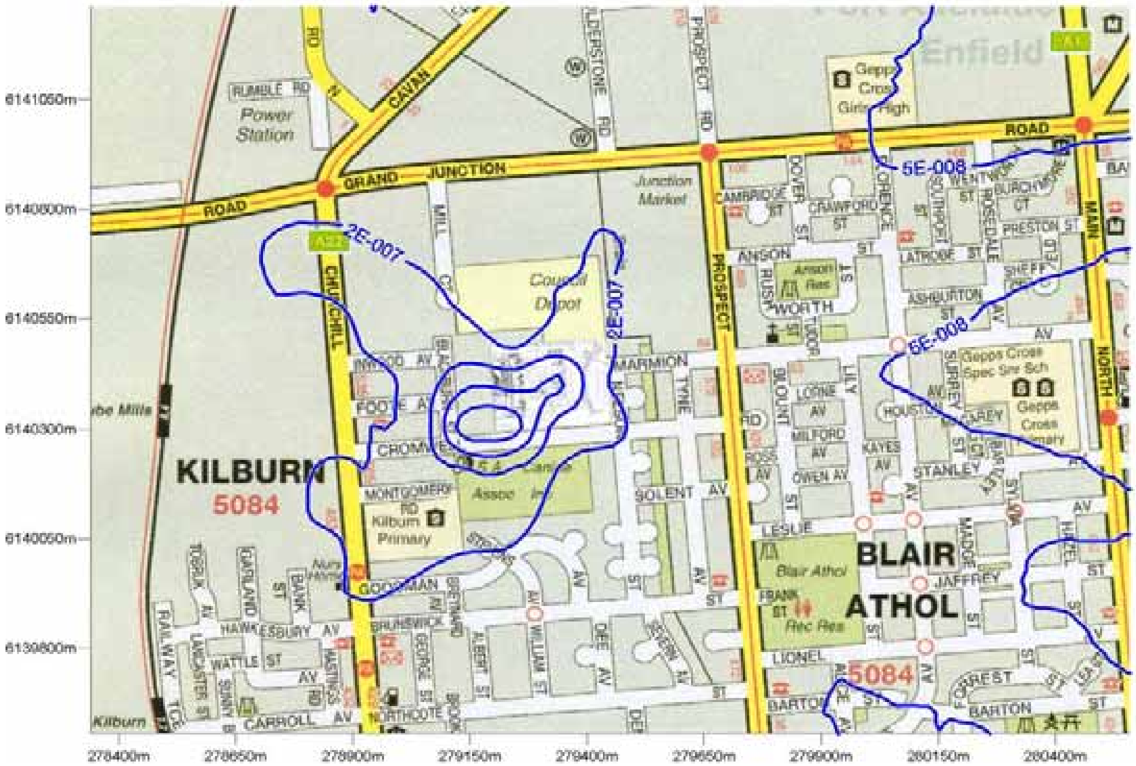


Figure 39: Predicted acenaphthene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 40: Predicted acenaphthelyne GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 41: Predicted benz (a) anthracene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

Figure 42: Predicted benzo (b) fluoranthene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

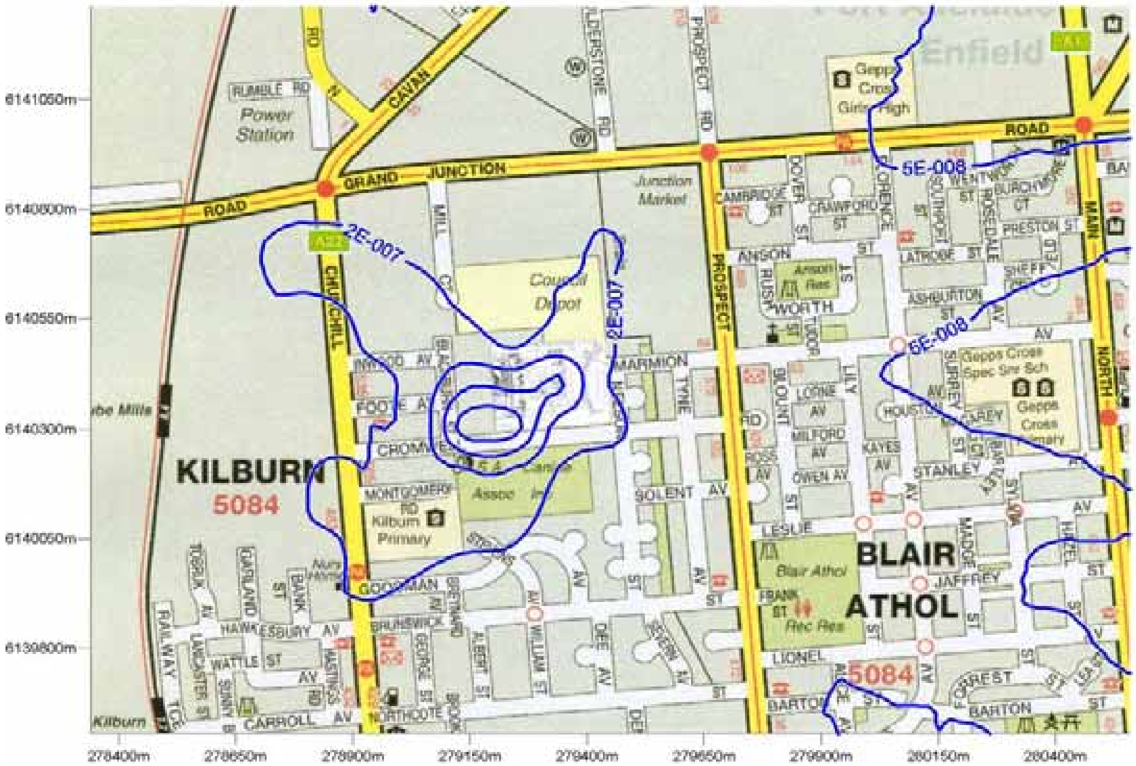


Figure 43: Predicted fluoranthene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 44: Predicted chrysene GLC from future (furane) operation (mg/m^3). (24 hour averaging period, 100th percentile)

Figure 45: Predicted dimethylphenols GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

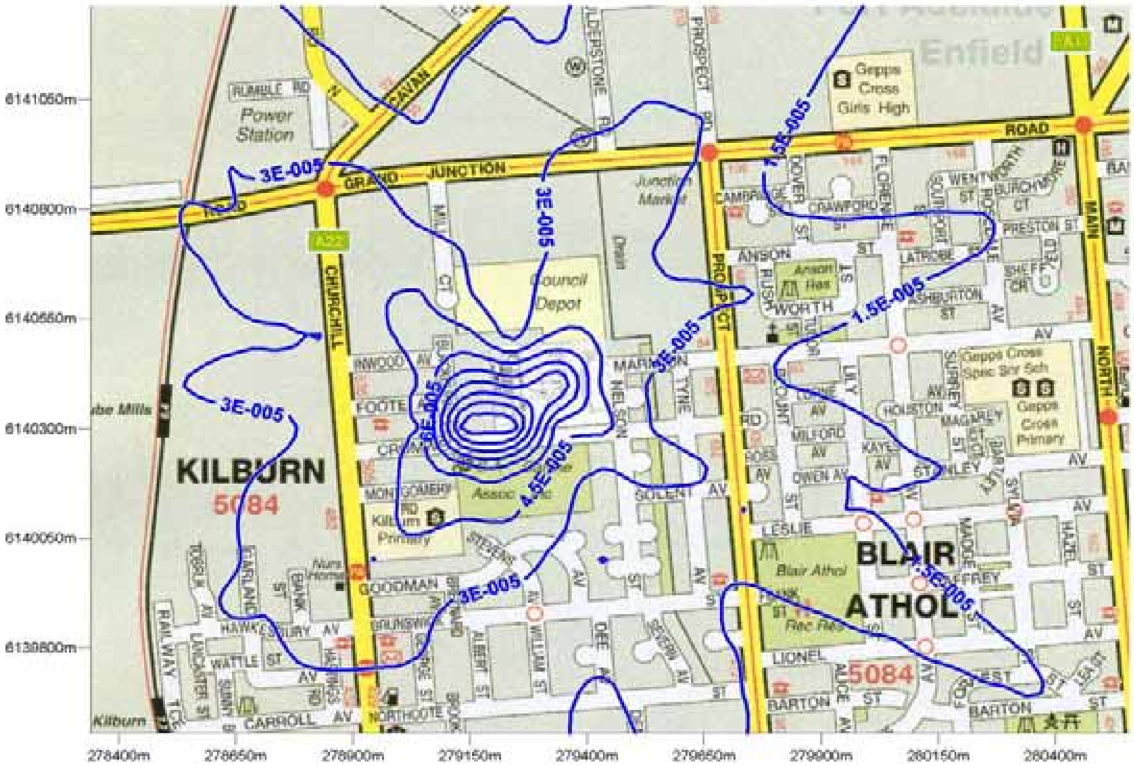


Figure 46: Predicted 1,3,5-trimethylbenzene GLC from future (furane) operation (mg/m^3).
(24 hour averaging period, 100th percentile)

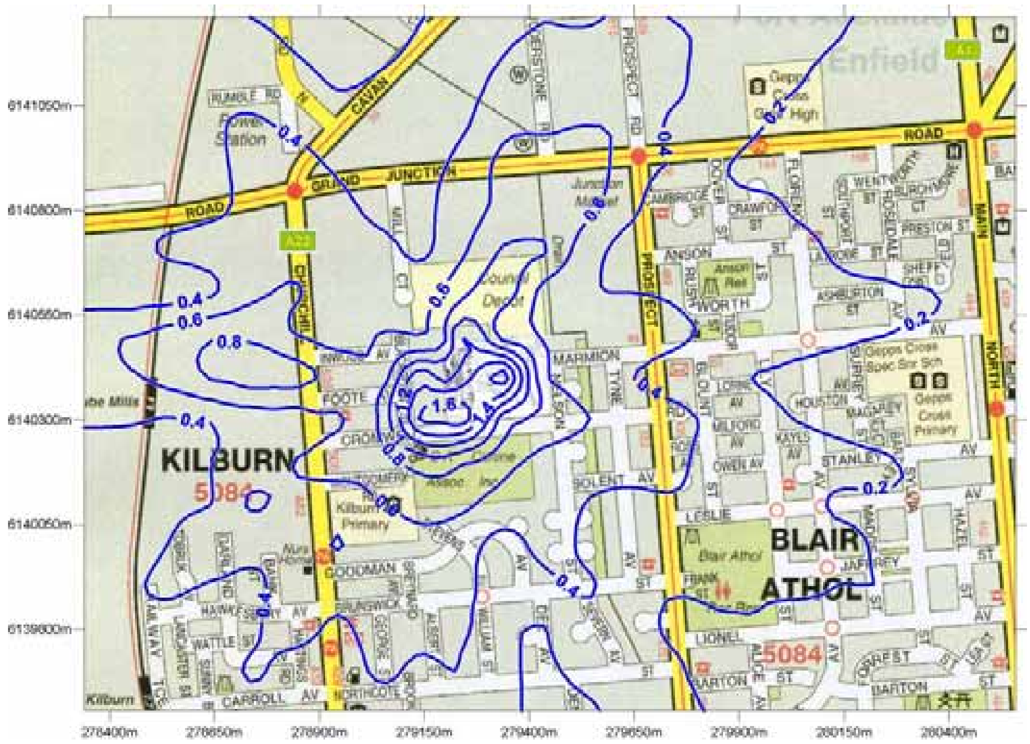


Figure 47: Predicted CO GLC from future operation (mg/m^3).
(8 hour averaging period, 100th percentile)

Appendix IV

Contour Plots - Future Annual (Furane)

Figure 1: Predicted ammonia GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

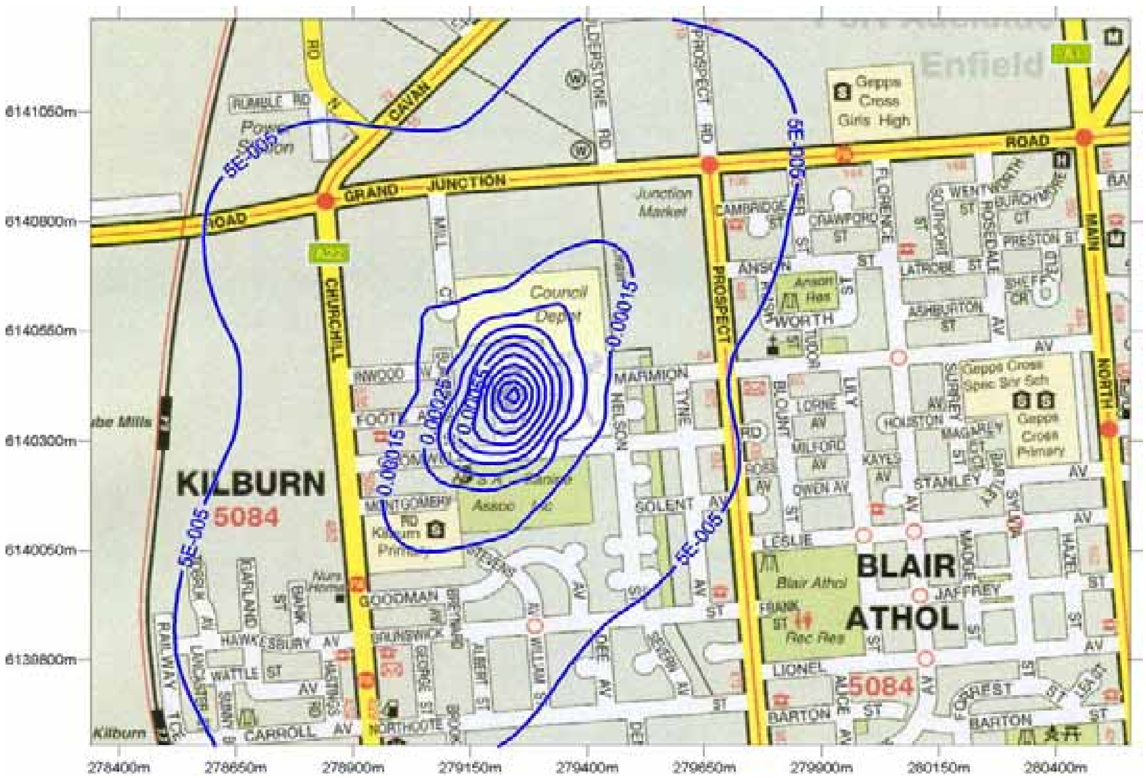


Figure 2: Predicted hydrogen sulphide GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

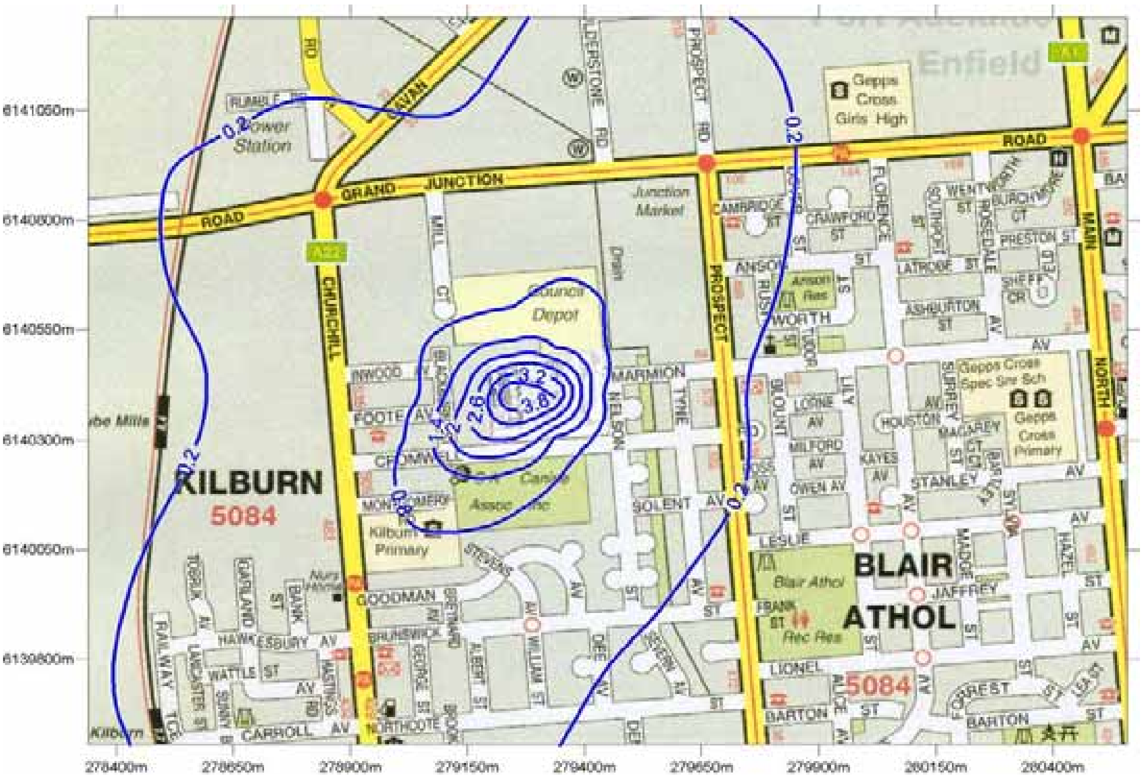


Figure 3: Predicted PM10 GLC from future (furane) operation (ug/m^3).
(Annual averaging period, 100th percentile)

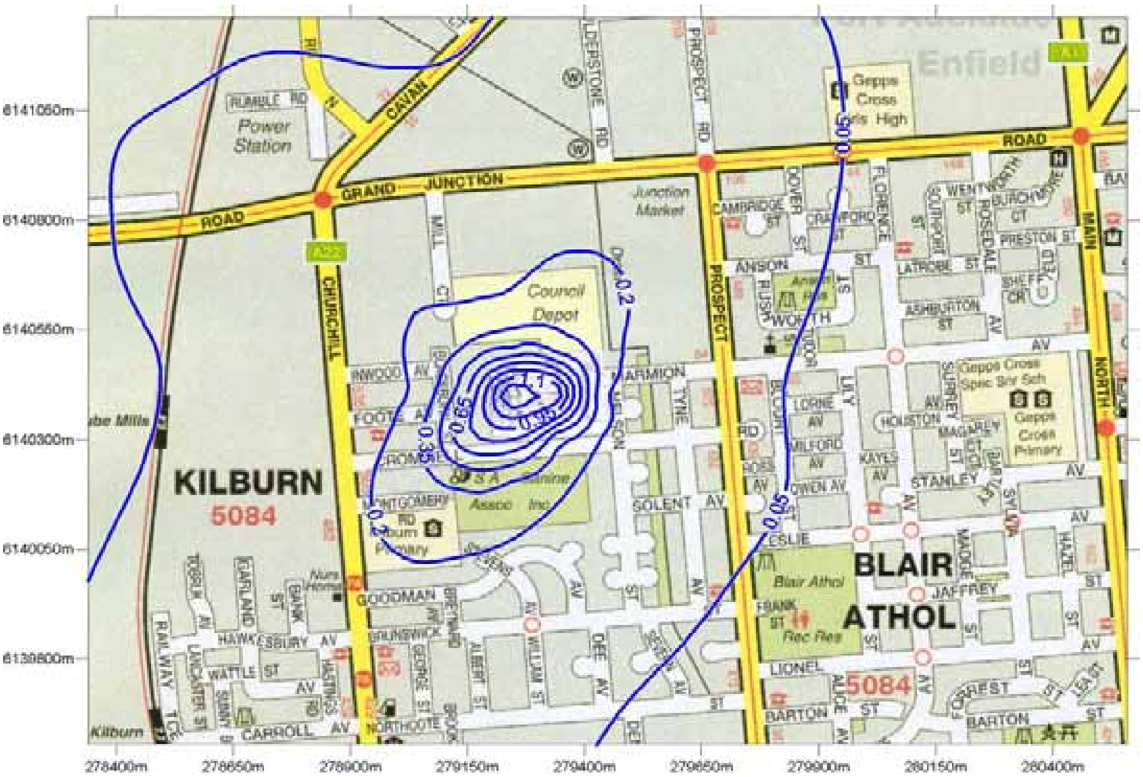


Figure 4: Predicted PM2.5 GLC from future (furane) operation (ug/m^3).
(Annual averaging period, 100th percentile)

Figure 5: Predicted nitrogen oxides GLC from future (furane) operation (ug/m^3). (Annual averaging period, 100th percentile)

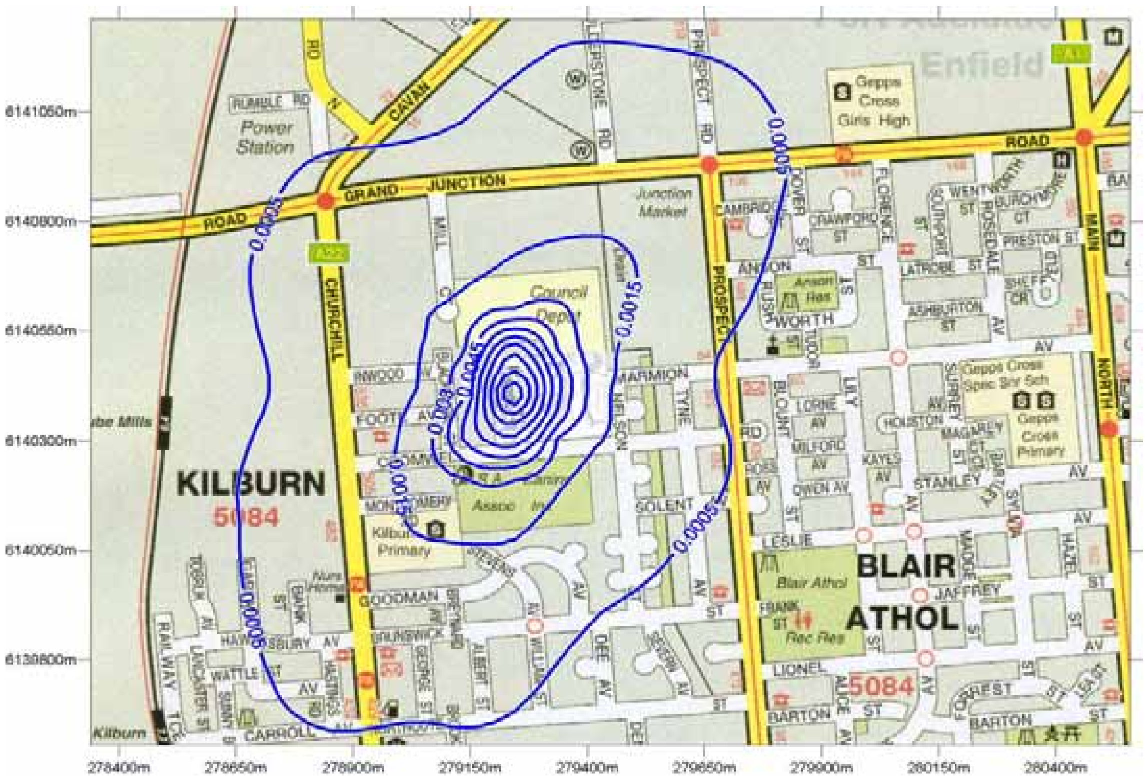


Figure 6: Predicted sulphur dioxide GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

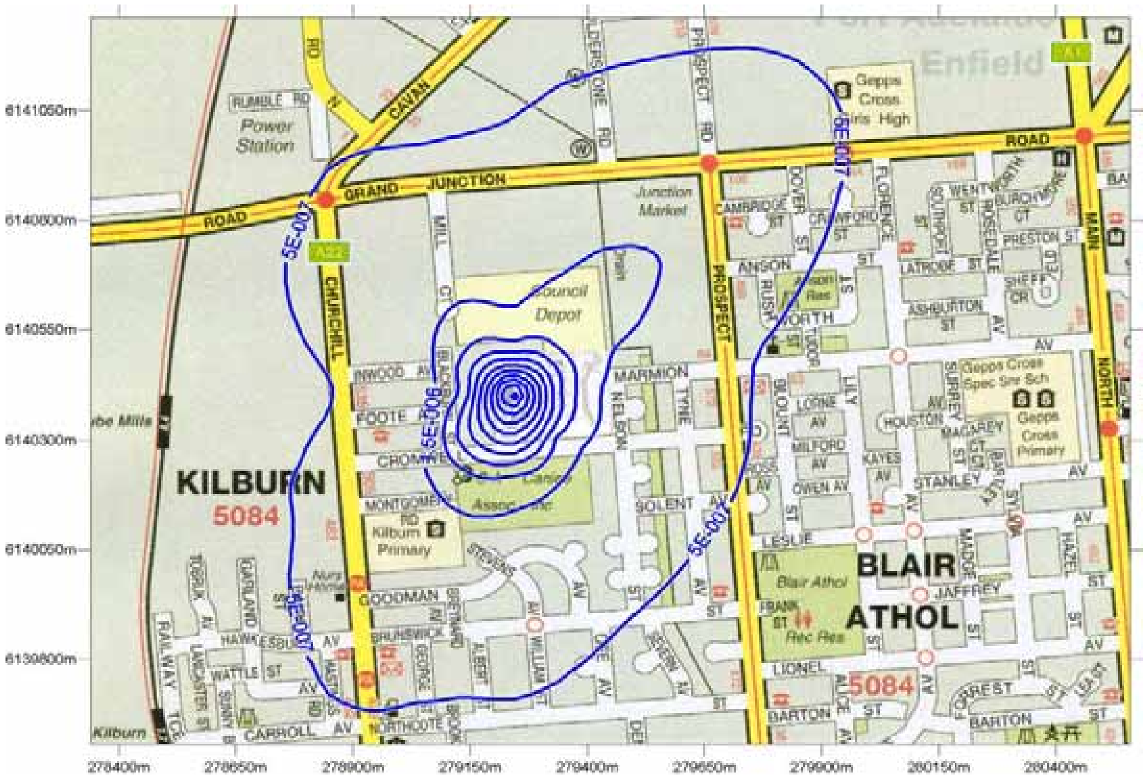


Figure 7: Predicted dioxin GLC from future (furane) operation (ng/m^3). (Annual averaging period, 100th percentile)

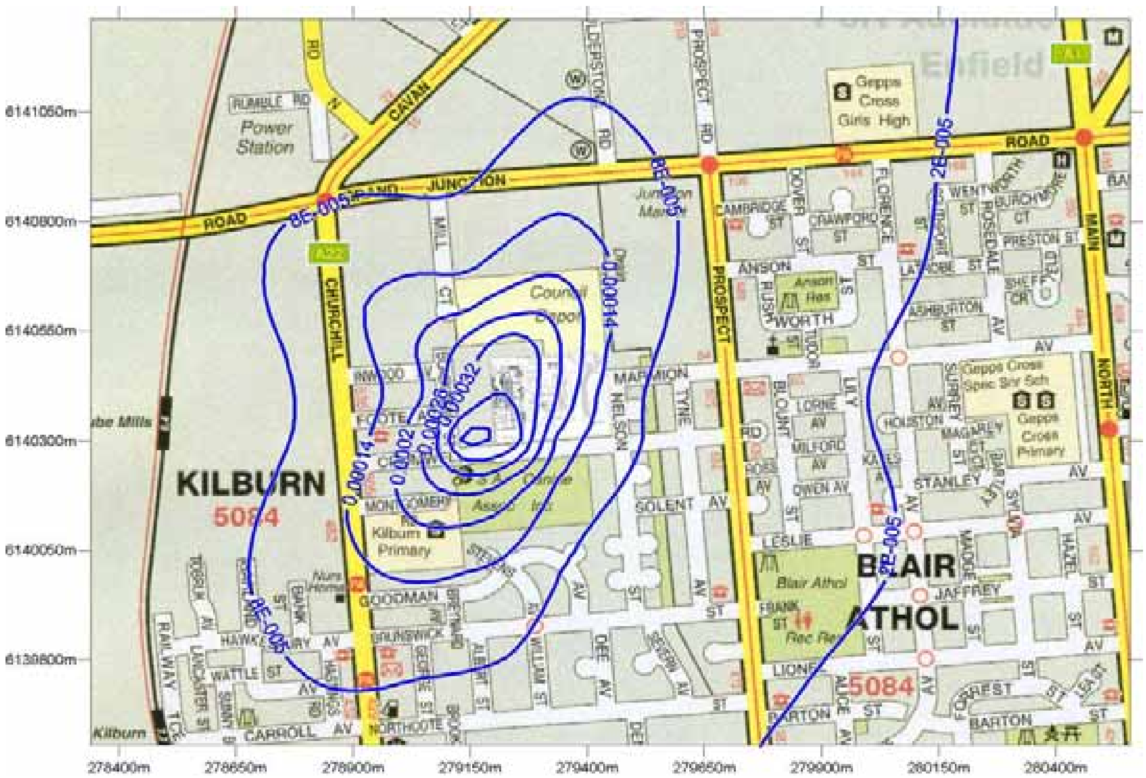


Figure 8: Predicted benzene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

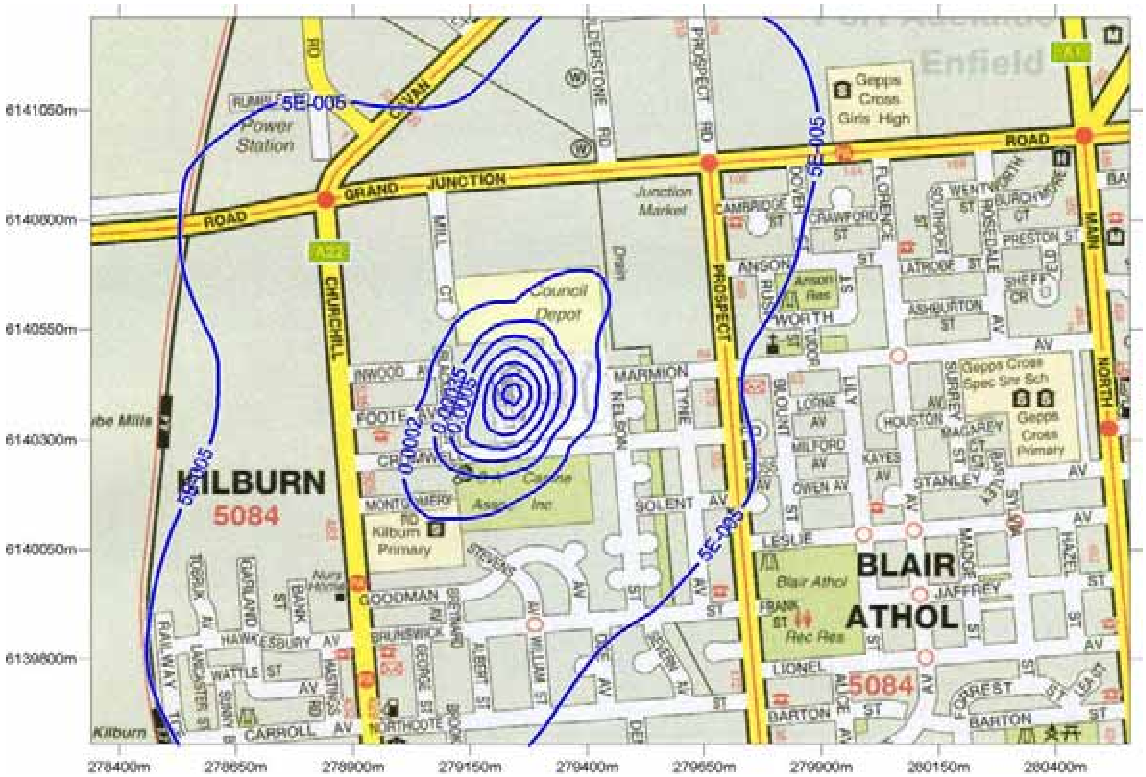


Figure 9: Predicted formaldehyde GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

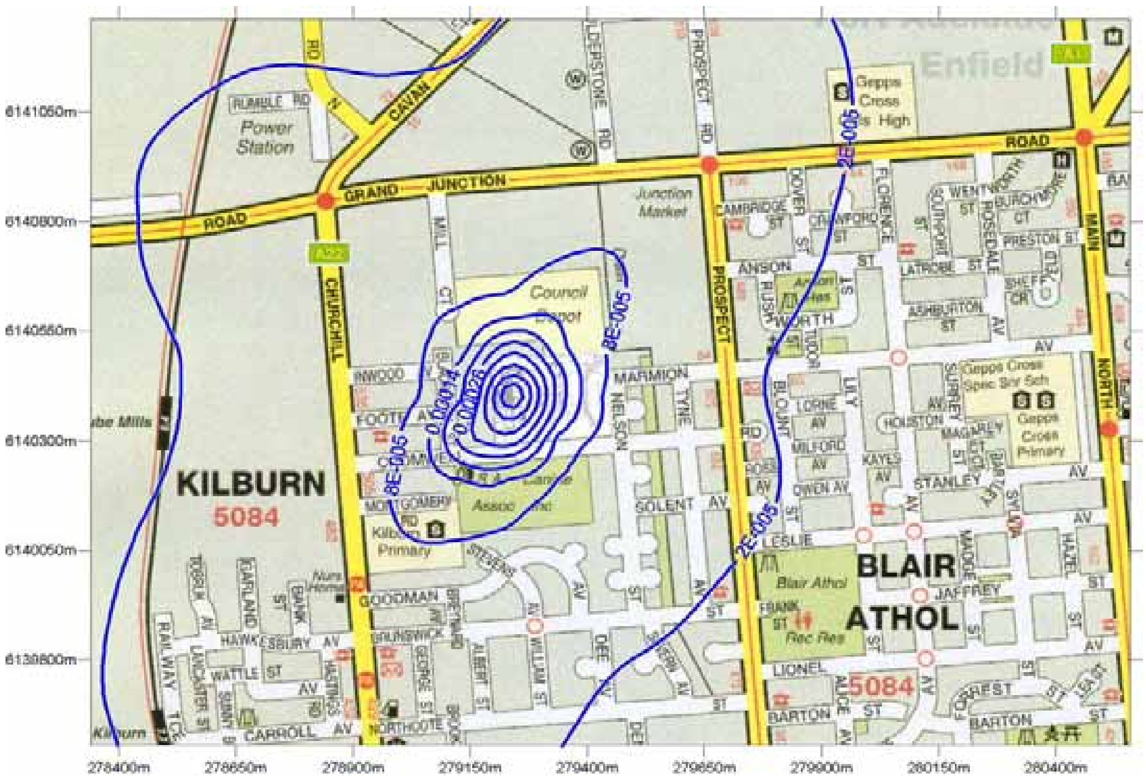


Figure 10: Predicted cyanide GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 11: Predicted total xylene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

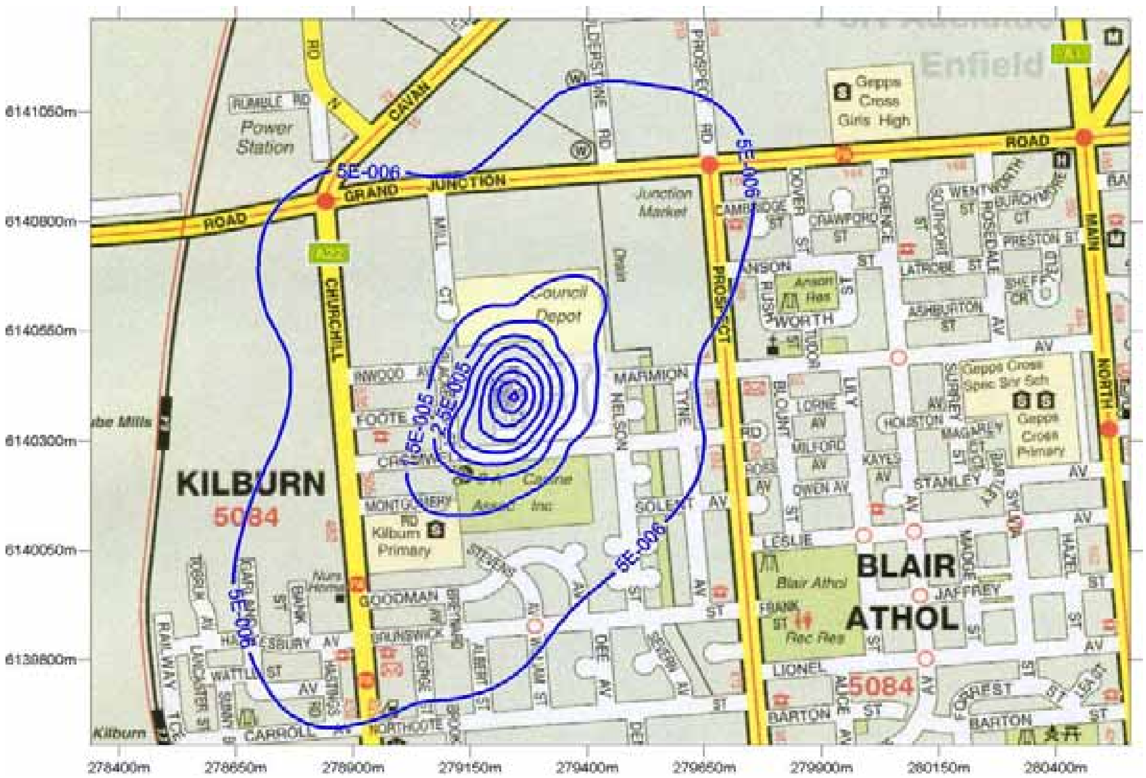


Figure 12: Predicted naphthalene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

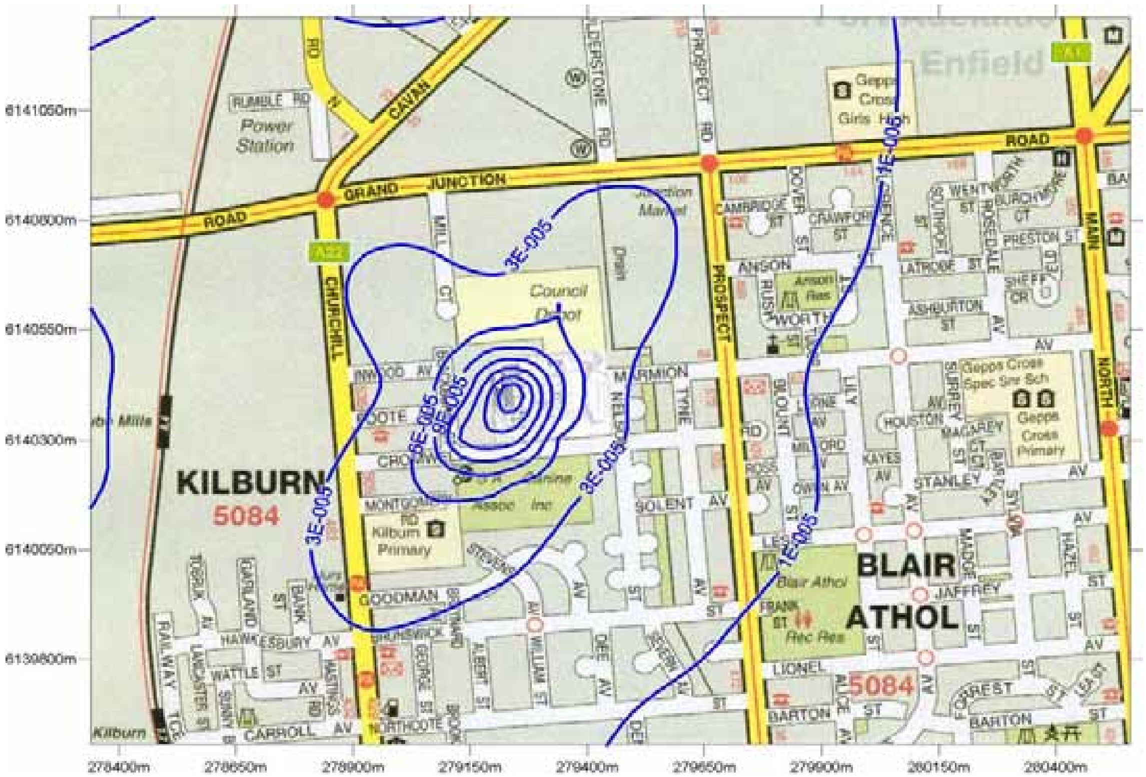


Figure 13: Predicted phenol GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

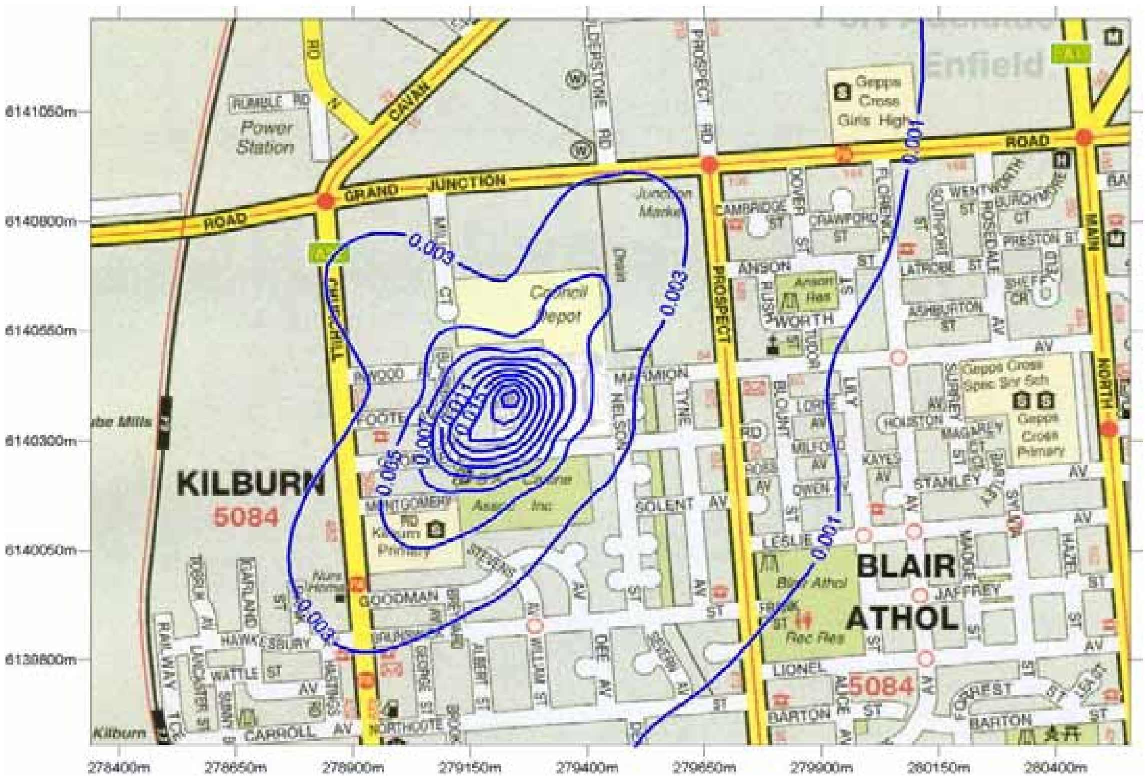


Figure 14: Predicted toluene GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

Figure 15: Predicted acrolein GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

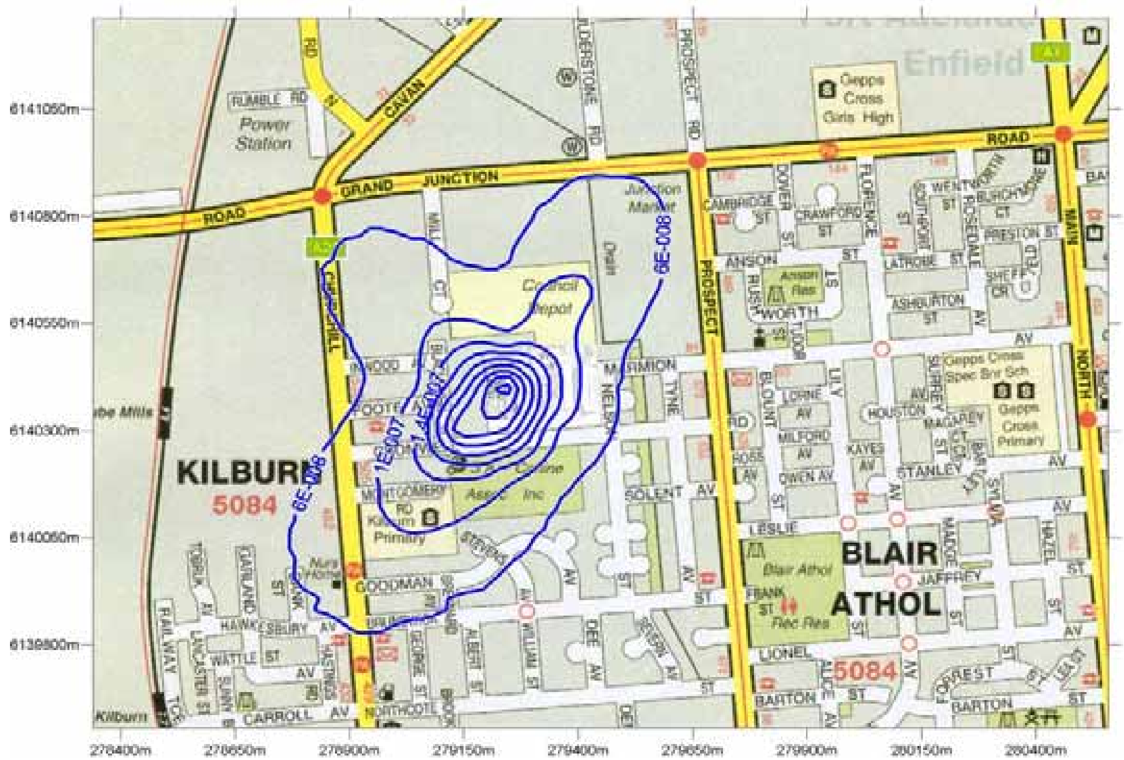


Figure 16: Predicted anthracene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

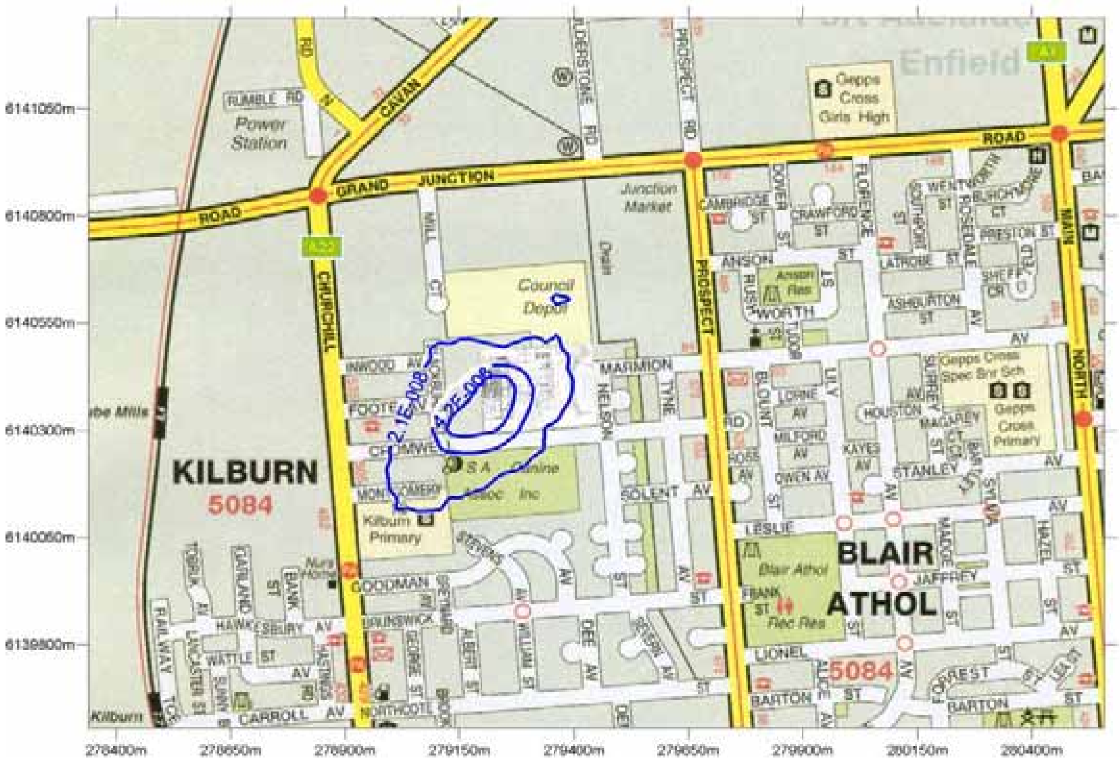


Figure 17: Predicted benzo (a) pyrene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

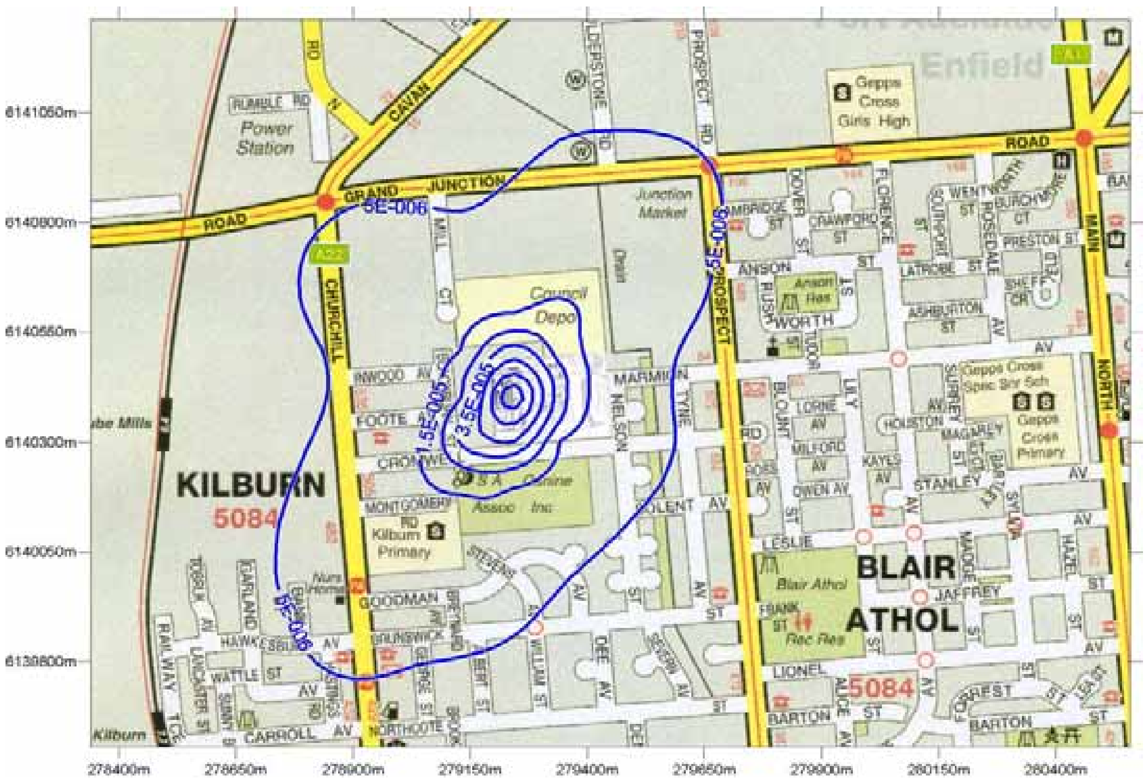


Figure 18: Predicted butyl acetate GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 19: Predicted carbon monoxide GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100[th] percentile)

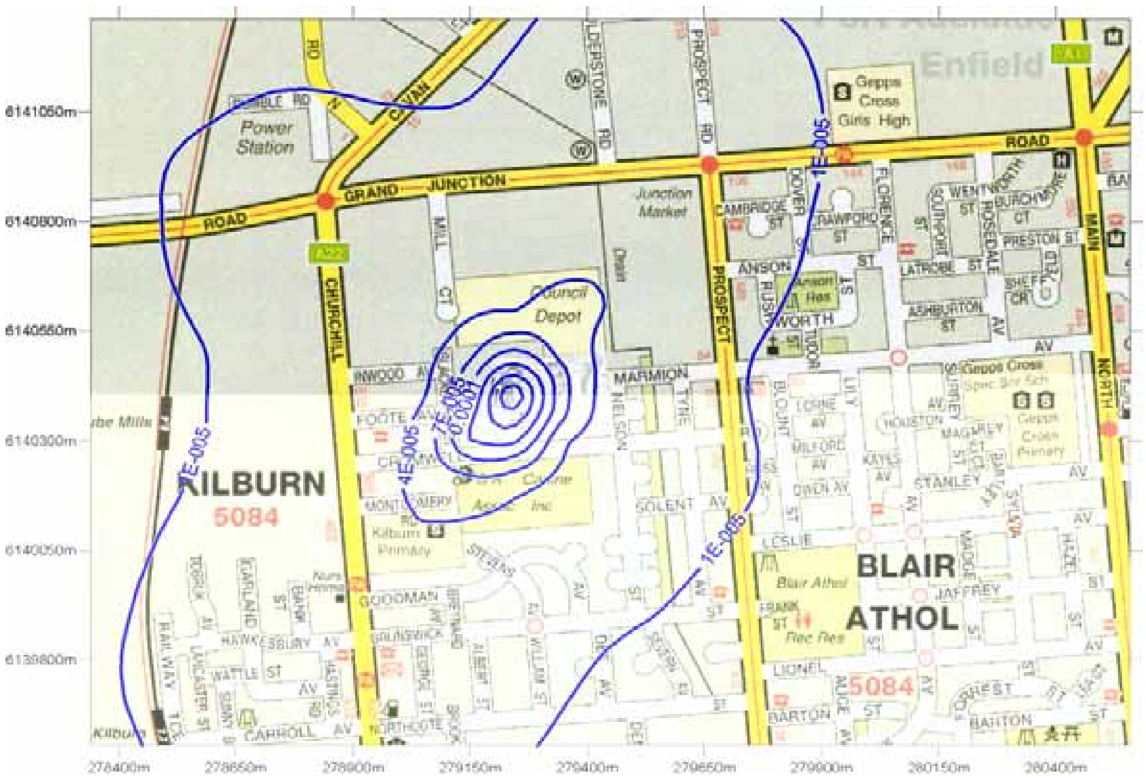


Figure 20: Predicted cresol GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100[th] percentile)

Figure 21: Predicted cyclohexanone GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

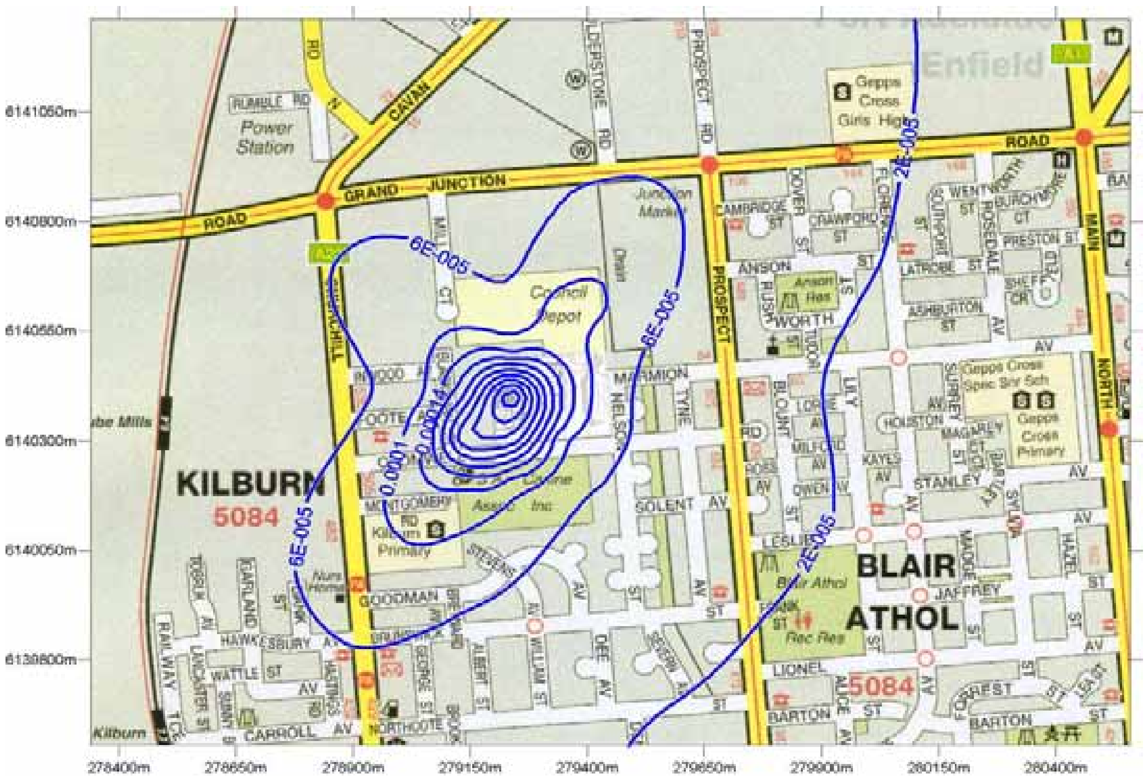


Figure 22: Predicted ethyl acetate GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 23: Predicted ethyl benzene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

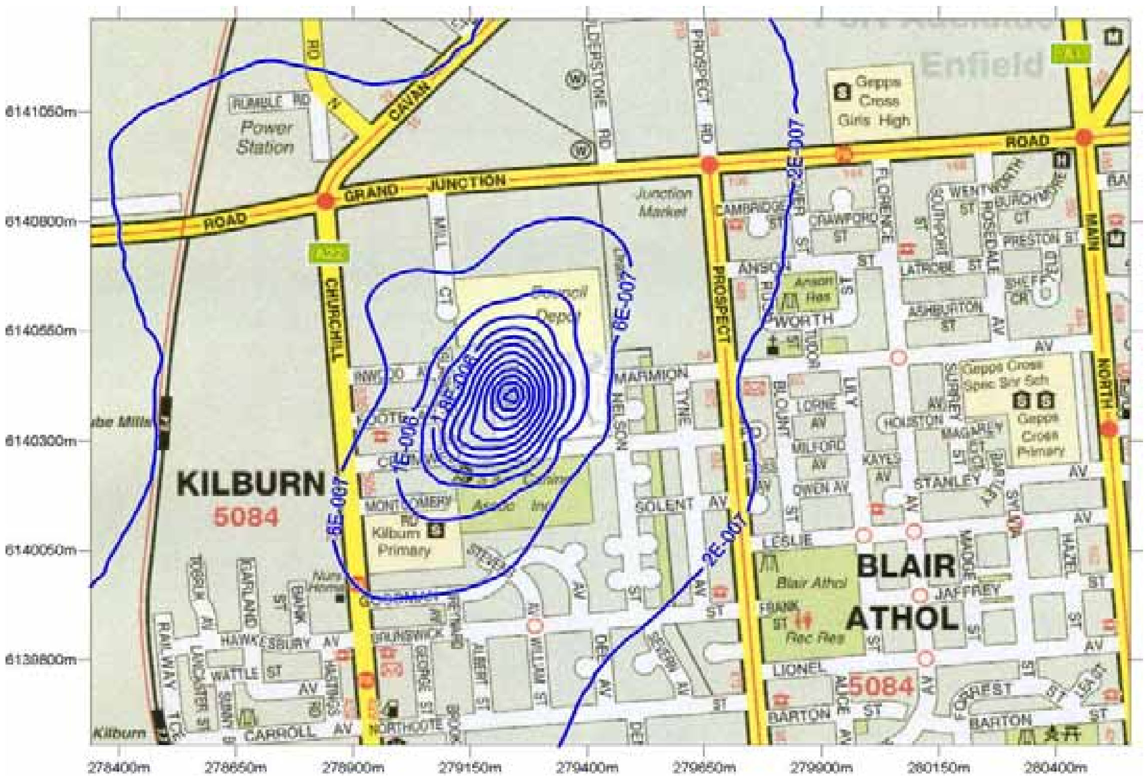


Figure 24: Predicted fluorene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 25: Predicted isopropylbenzene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

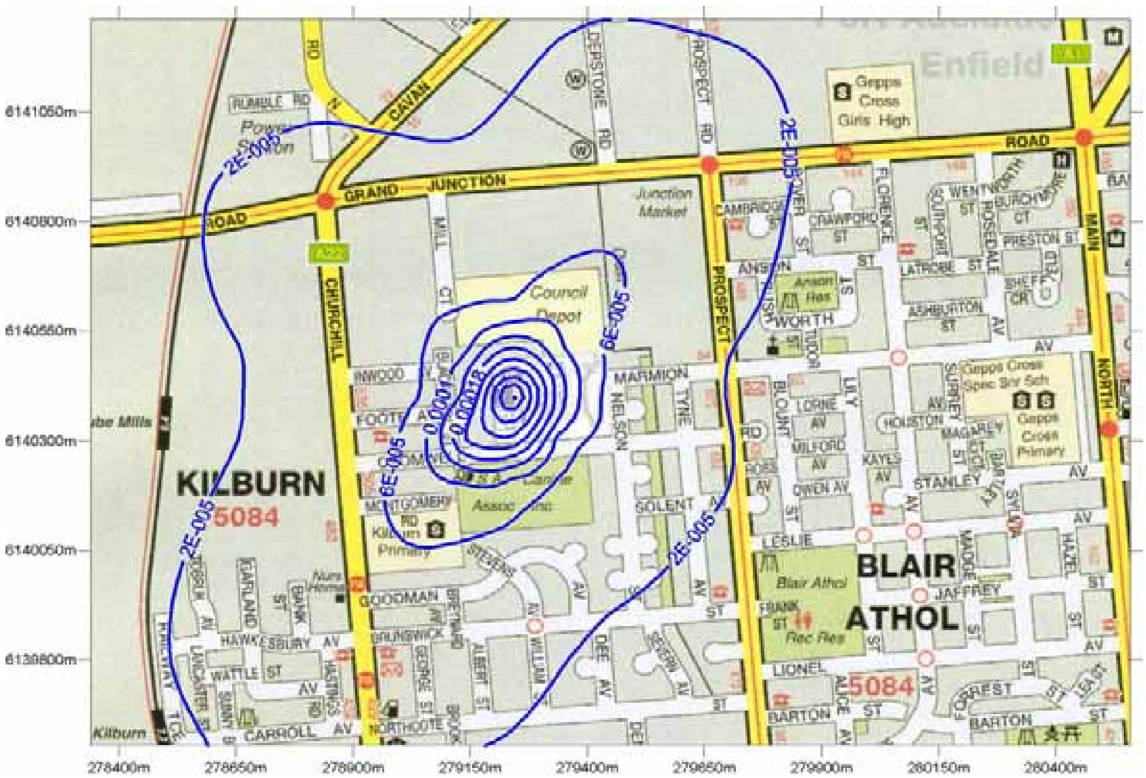


Figure 26: Predicted methylethylketone GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 27: Predicted methylisobutylketone GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

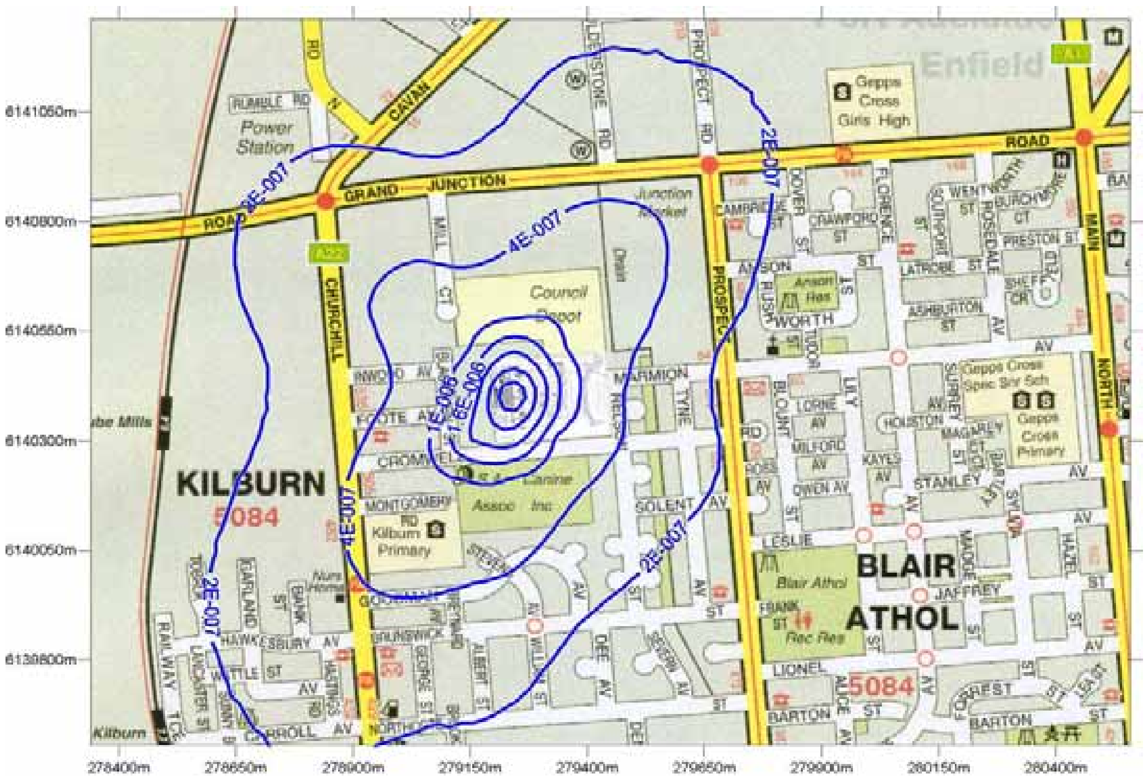


Figure 28: Predicted phenanthrene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 29: Predicted pyrene GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

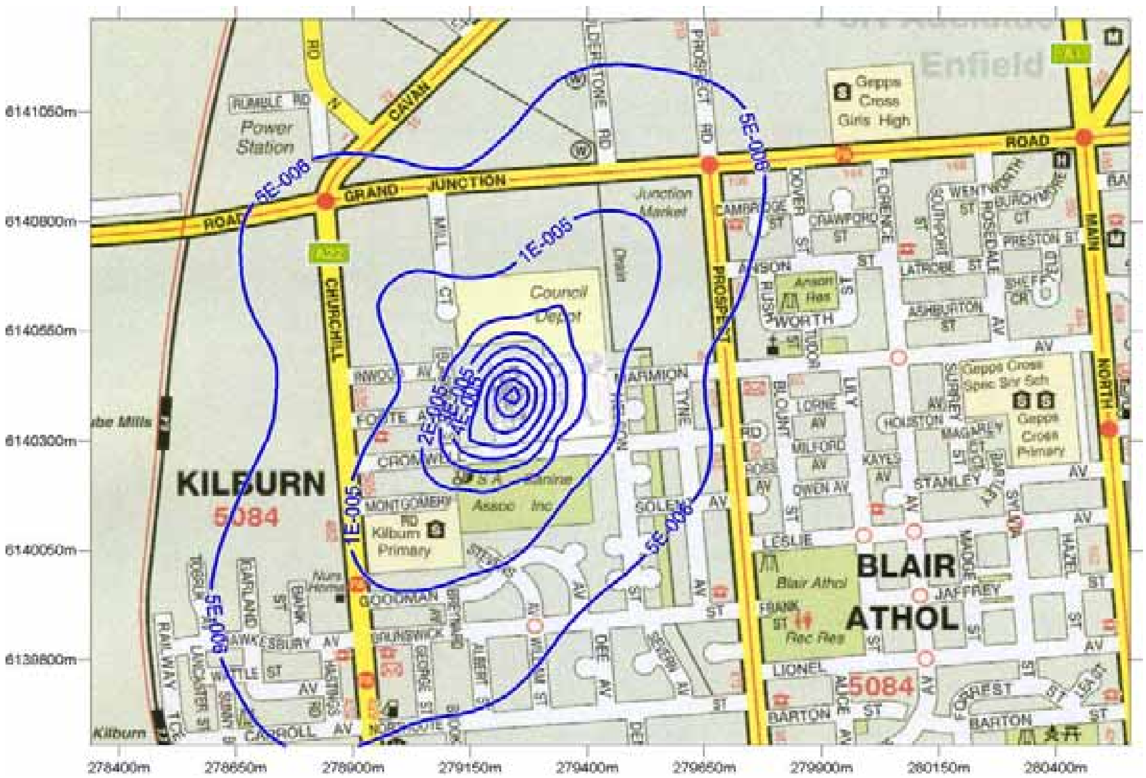


Figure 30: Predicted styrene GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

Figure 31: Predicted butanol GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

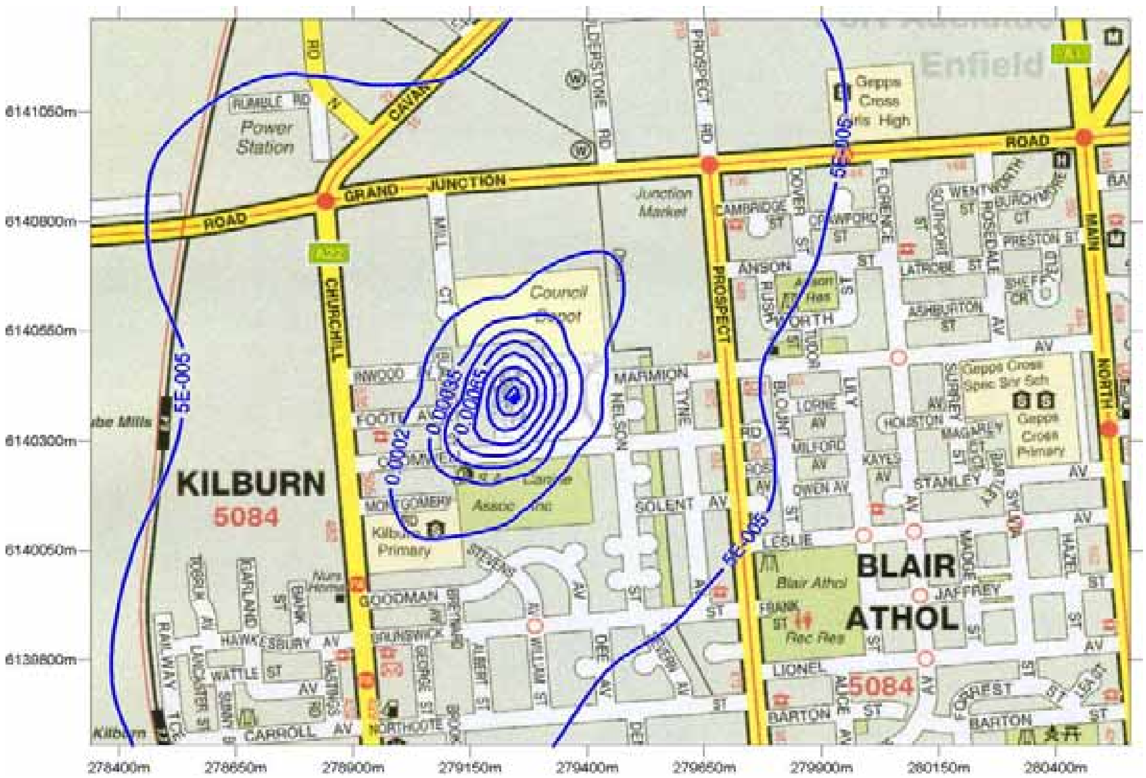


Figure 32: Predicted acetaldehyde GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 33: Predicted furfural GLC from future (furane) operation (ug/m^3).
(Annual averaging period, 100th percentile)

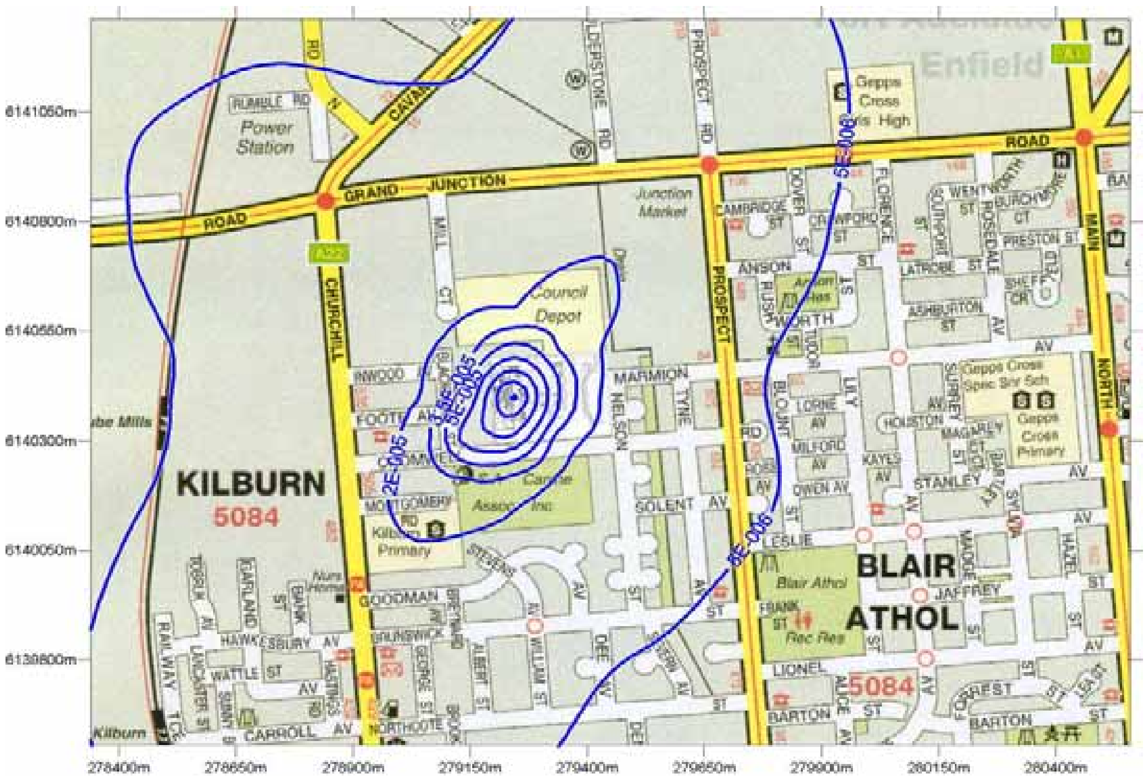


Figure 34: Predicted propanaldehyde GLC from future (furane) operation (ug/m^3).
(Annual averaging period, 100th percentile)

Figure 35: Predicted butanaldehyde GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 36: Predicted pentanaldehyde GLC from future (furane) operation (ng/m^3). (Annual averaging period, 100th percentile)

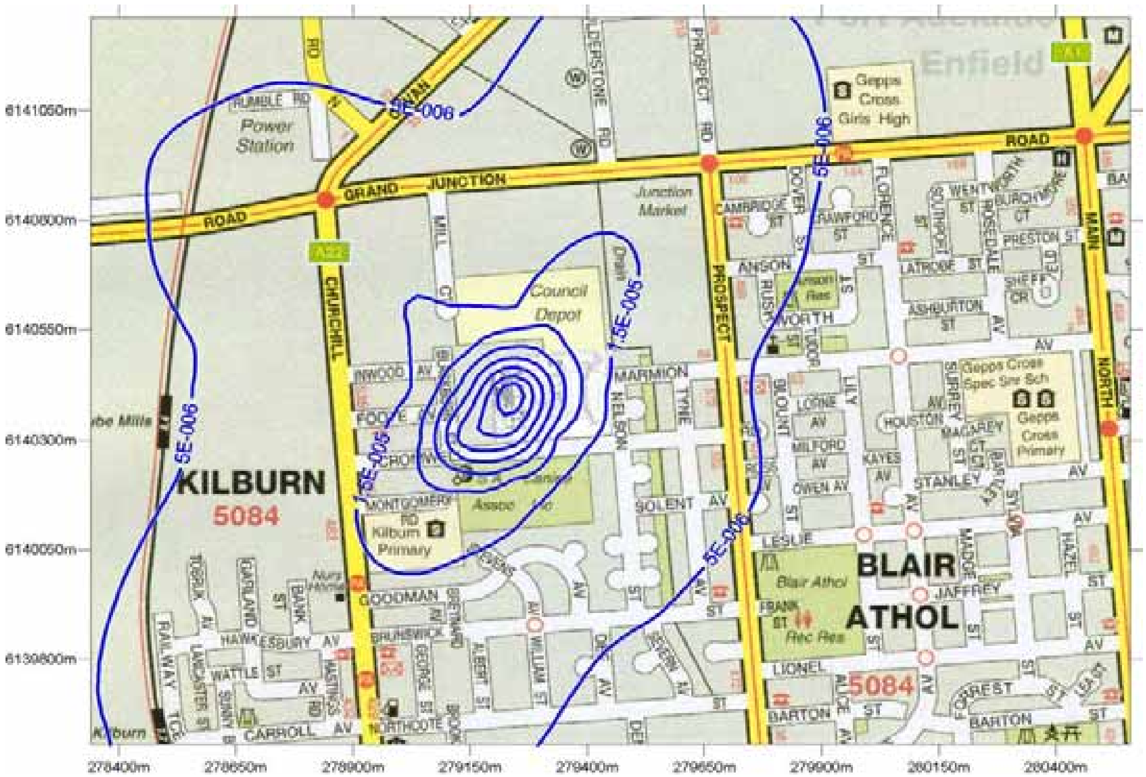


Figure 37: Predicted benzaldehyde GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

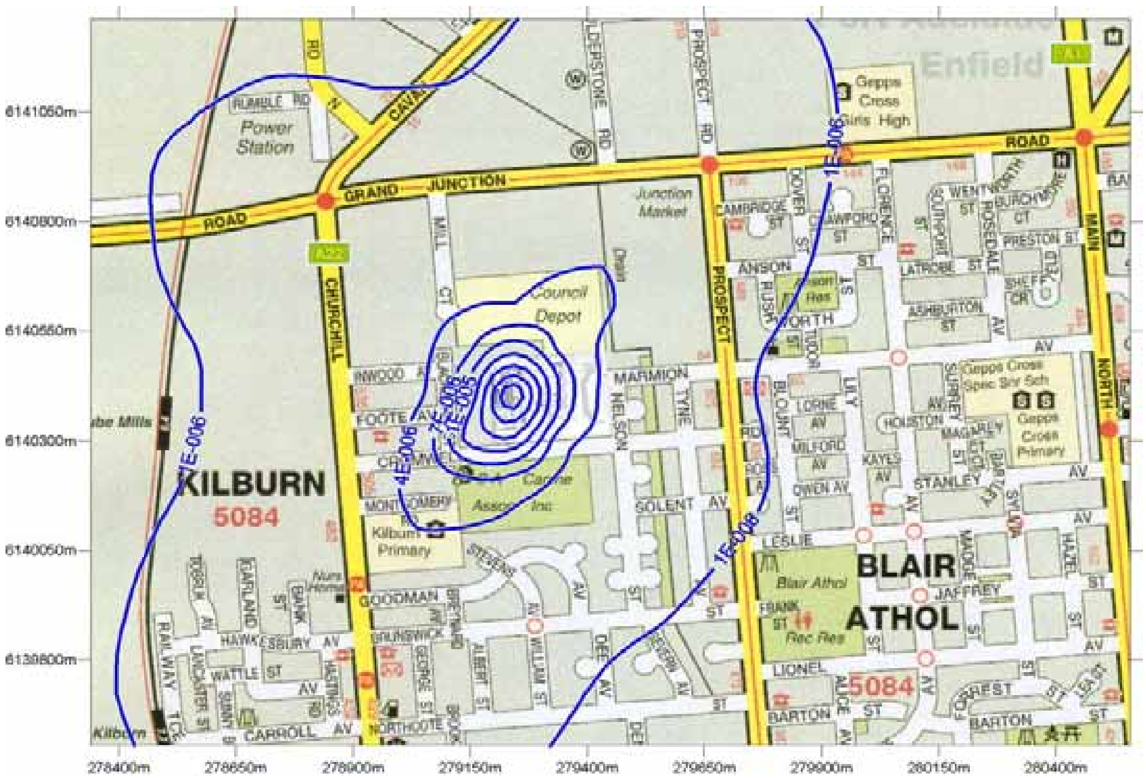


Figure 38: Predicted glutaraldehyde GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 39: Predicted acenaphthene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

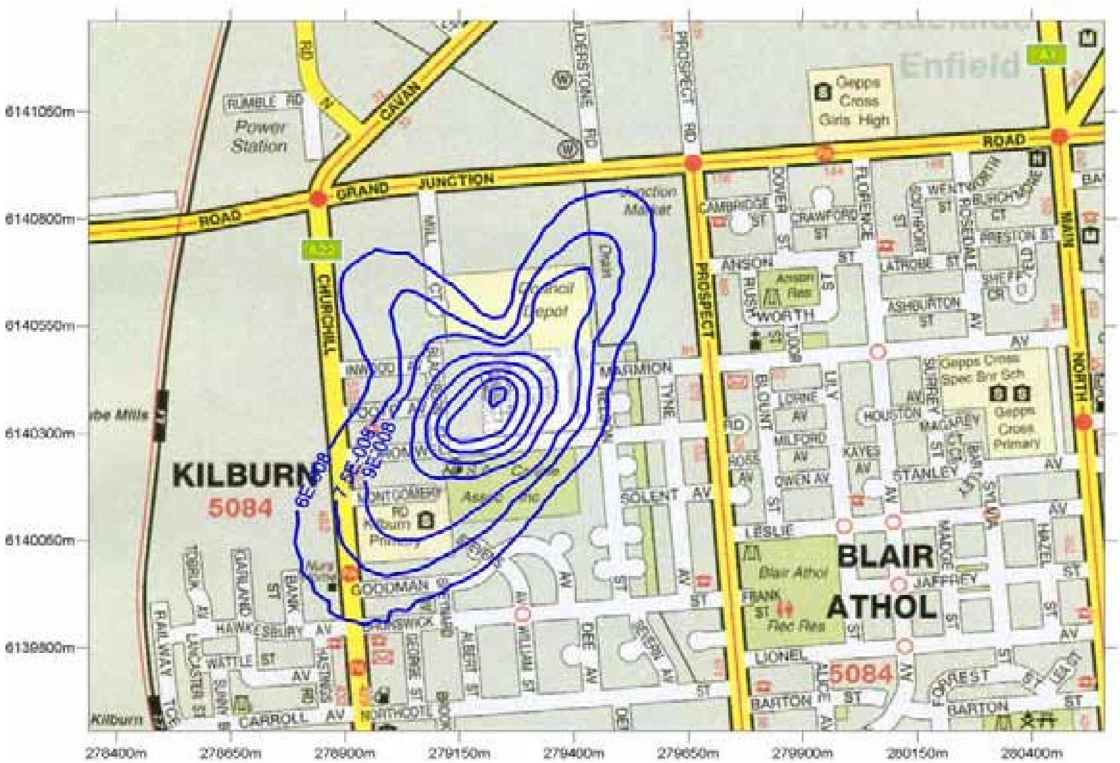


Figure 40: Predicted acenaphthylene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 41: Predicted benz (a) anthracene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

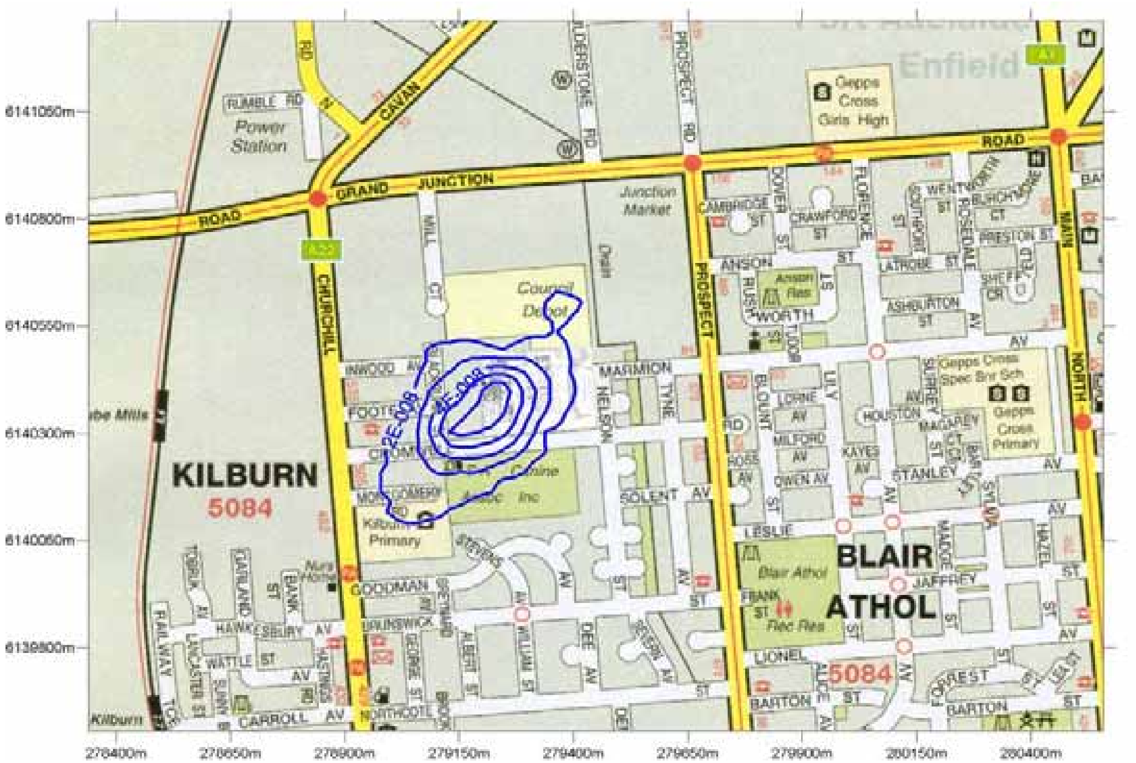


Figure 42: Predicted benzo (b) fluoranthene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Figure 43: Predicted fluoranthene GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

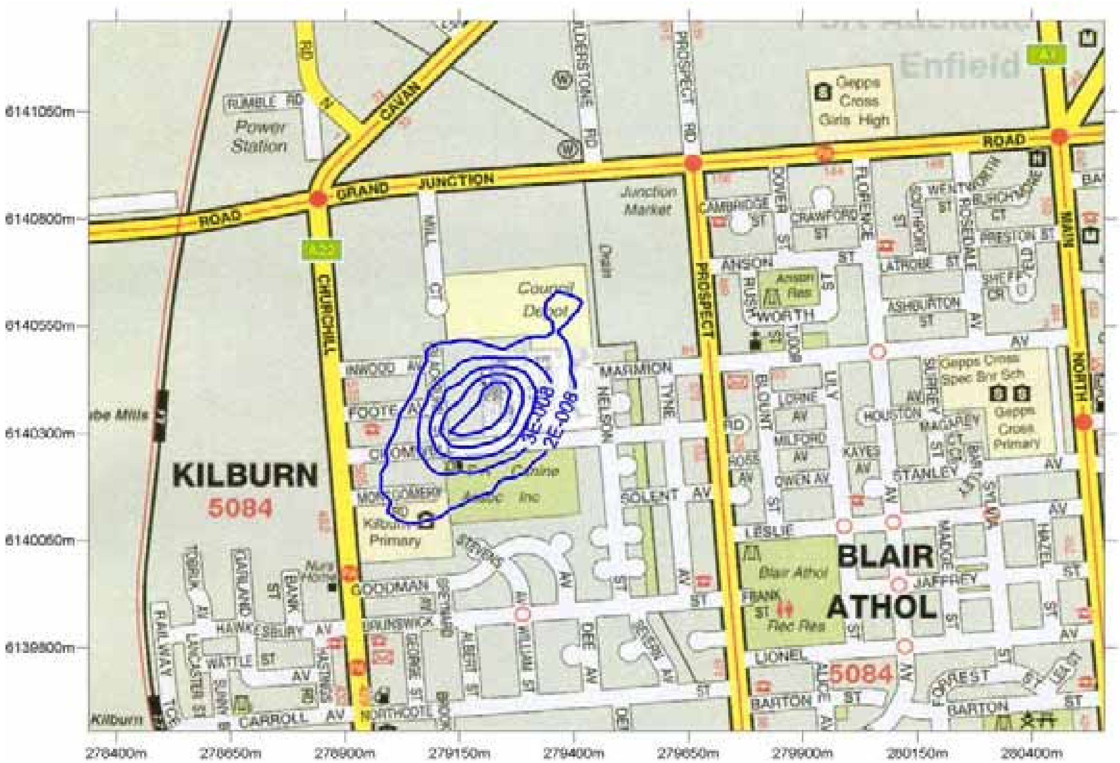


Figure 44: Predicted chrysene GLC from future (furane) operation (mg/m^3).
(Annual averaging period, 100th percentile)

Figure 45: Predicted dimethylphenolsGLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

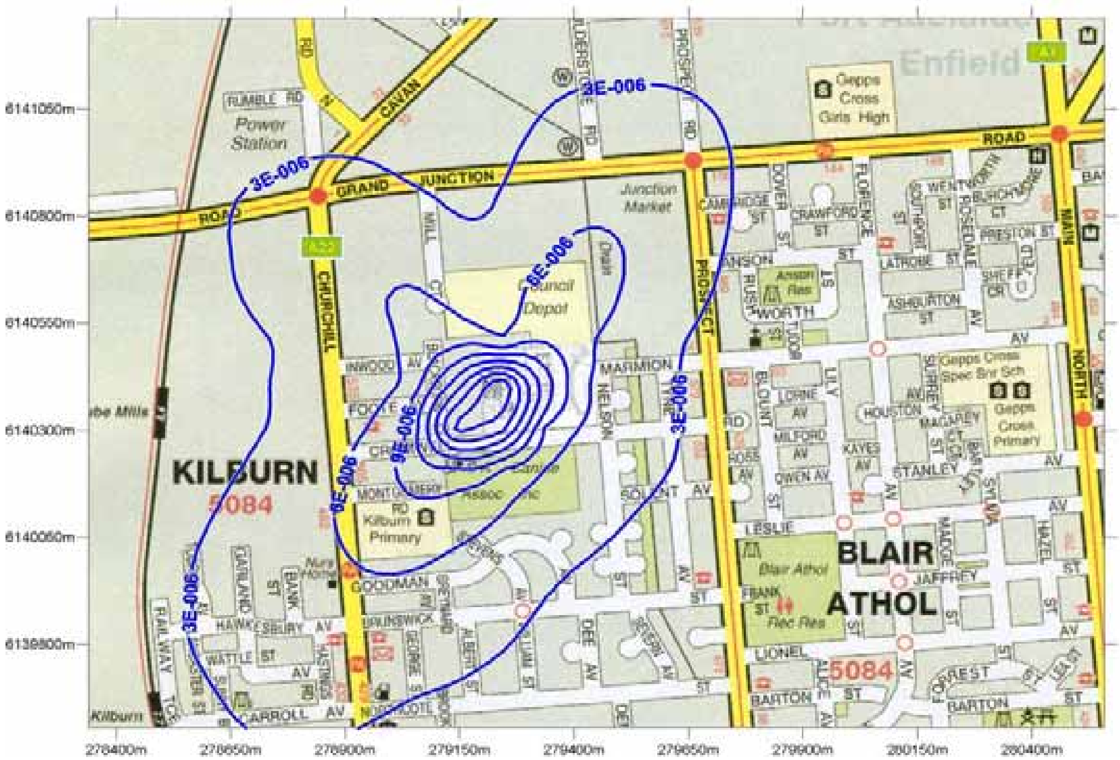


Figure 46: Predicted 1,3,5-trimethylbenzene GLC from future (furane) operation (mg/m^3). (Annual averaging period, 100th percentile)

Appendix V

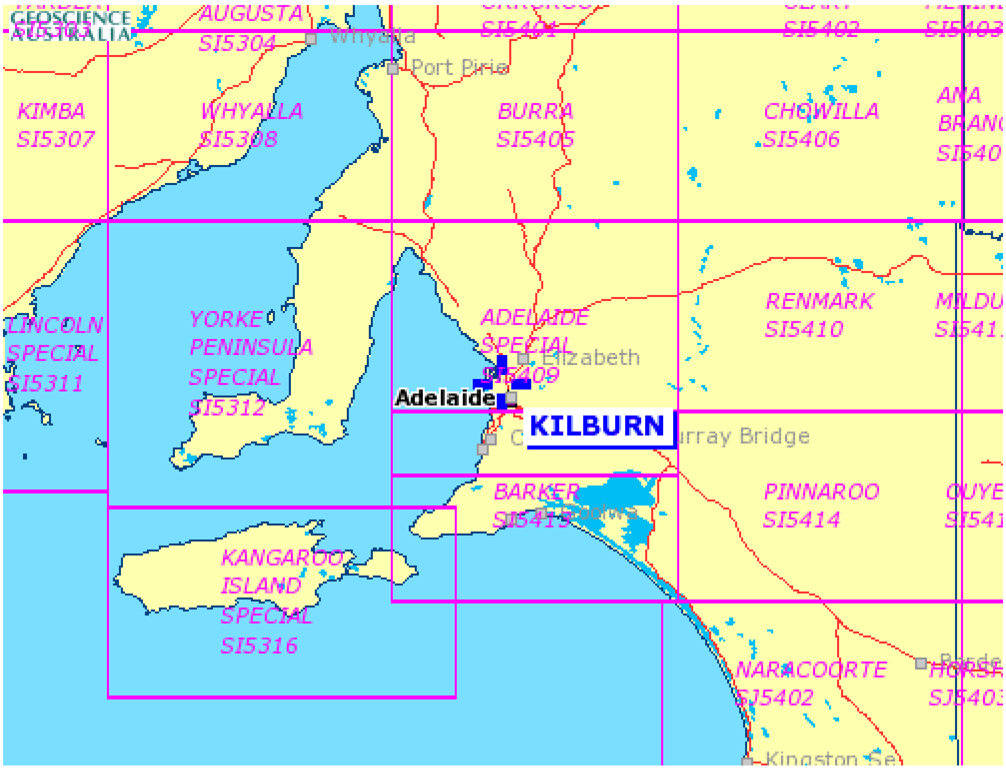
Meteorological
Summary Report

Report on

KENT TOWN-South Australia (for Kilburn)
Input Metrological data file
For

AUSPLUME

(Victoria, Regulatory Pollution Dispersion Model)



Exclusively Prepared for

Advitech Australia Pty Ltd

By pDs MultiMedia and Consultancy service

AUSPLUME input Meteorological Data File

Kilburn (South Australia)

Locality

Site Information:

Longitude	138.62
Latitude	-34.92
Land use	Urban
Surface Roughness	0.4 m
Anemometer Height	10m

Data Source

1. Kent Town AWS Data- Bureau of Meteorology South Australian Regional Office.
2. Adelaide Airport Cloud data and Vertical temperature Profiles –National Climate Centre- Bureau of Meteorology, Melbourne.

Multimedia & Consultancy pDs Consultancy

pdsmet@tpg.com.au

Input Information

- Onsite (Kent Town) parameters

    a. Wind speed (m/s)
    b. Wind direction
    c. Ambient Temperature (C)
    d. Dewpoint Temperature
    e. Surface Pressure
    f. 3 Hourly Cloud cover
    g. Hourly Rainfall

  Wind was measured at 10m (Anemometer Height)

- Offsite (Adelaide Airport) parameters

  Adelaide Airport

    a. Vertical temperature profiles; Temperature, Dewpoint (2 profiles per day)

DATA HANDELLING

QA/QC on Bureau of Meteorology Raw data

Kent Town AWS

- Check for the completeness of 24 hour data sets
- Suspected wind stalls (both wind direction and speed) removed and filled with interpolated data.
- Small gaps filled with previous or following data
- Wind direction found to be stored to the nearest 10 degrees
    - Last digit of Wind Direction randomised (± 5)

- Pressure, Dewpoint Temperature and cloud amount were checked for unusual values
- Hourly accumulation of rainfall records at Kent Town were processed to get rainfall rate (mm/hour). This records were merged with the Kent Town other records.

Adelaide Vertical Temperature Profiles

- Gaps in vertical temperature profiles (twice daily) were filled with previous or following day data for the completeness.

Secondary parameters

Vertical Stability

Solar Radiation for day time and Modified Pasquill Stability Class outlined in the reference, Davis and Singh, Jl of Hazardous Materials, 11 was used to determine night-time stability class. Solar radiation was theoretically calculated using off site cloud observations.

Table 1 for daytime and part of Table 2 for night-time were used.

Table 1: Stability Classification for Daytime Using Solar Radiation and Wind Speed

	Solar Radiation (W/m^2)			
Wind Speed(m/s)	≥925	≥675	≥175	< 175
< 2	A	A	B	D
< 3	A	B	C	D
< 5	B	B	C	D
< 6	C	C	D	D
≥ 6	C	D	D	D

Table 2: Modified Pasquill stability calsses

Surface Wind Speed m/s at 10m	Daytime incoming solar radiation				Within 1 h before sunset or after sunrise	Night-time cloud amount(Oktas)		
	Strong (>600)	Moderate (300-600)	Slight (<300)	Overcast		0-3	4-7	8
≤ 2	A	A-B	B	C	D	F	F	D
≤ 3	A-B	B	C	C	D	F	E	D
≤ 5	B	B-C	C	C	D	E	D	D
≤ 6	C	C-D	D	D	D	D	D	D
> 6	C	D	D	D	D	D	D	D

Mixing height

Definition:

The mixing height, the depth of the surface mixed layer is the height of the atmosphere above the ground, which is well mixed due either to mechanical turbulence or convective turbulence. The air layer above this height is stable.

The mixing height was determined by using the methodology of Benkley and Schulman (Journal of Applied Meteorology, Volume 18, 1979,pp 772-780). Adelaide upper air observation containing temperature and moisture profiles were used to determine daytime mixing height.

Surface wind speeds and roughness were used to calculate the depth of the mechanically forced boundary layer during the night time

$MixH_m = 0.185 * Ustar/Cterm$

Where $Ustar = .35 * Usfc / Ln\ (Ht_{anemo}/Z_0)$

$Cterm$ = Coriolis Term $= 2\ \Omega\ \mathrm{Sin}(\phi)$

Where Ω is the angular velocity of the earth
ϕ is the latitude

Ht_{anemo} = Anemometer Height, Z_0 is the roughness

Height of the convective boundary layer was determined using daytime temperature sounding (Vertical temperature and dewpoint profiles) in between sunrise and sunset. Evening or nighttime sounding for the same day was used to compensate daytime sounding to calculate convective mixing height at different daylight hours (Temperature difference at 700 hPa layer was used to allow advection). Larger value of the mechanical turbulence or convective turbulence was taken as Mixing height for the daylight hours.

Standard Analysis

Data Coverage

Summer :90 days
Autumn :92
Winter :92
Spring :91

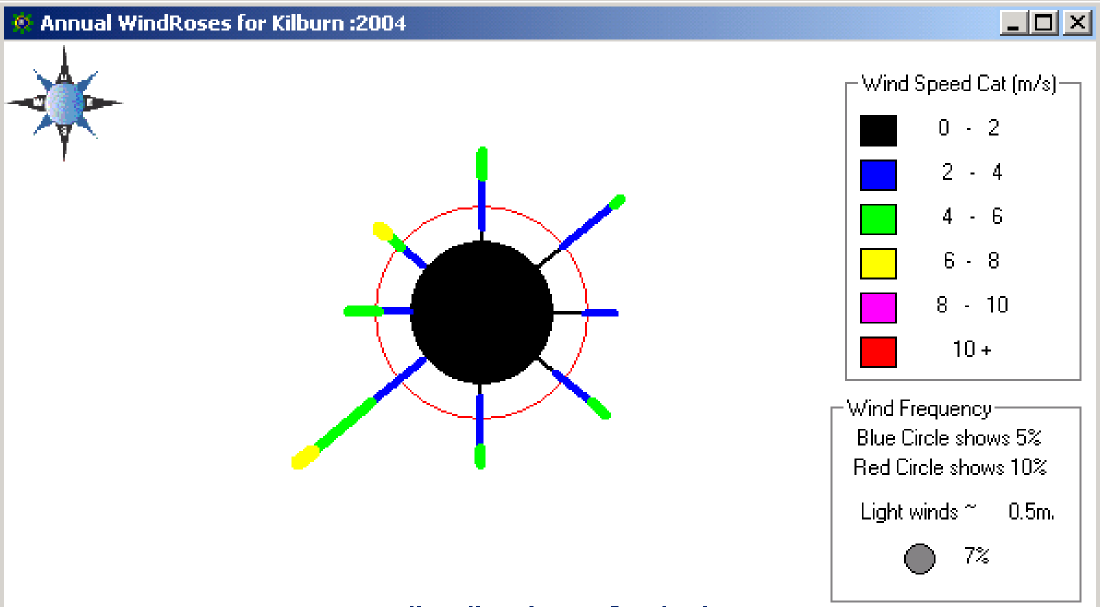
Number of days covered :365 % Coverage :99%

All seasons (summer, autumn and spring) were well represented. 365 days available in the year 2004. Data coverage from 01 Jan 2004 to 30 Dec 2004.

Stability Distribution

Stability Category	% Distribution	Avg Wind Speed	Avg Temperature	Avg Mixing Height
A	2 %	1.8	22.3	887
B	8 %	3.1	22.5	1137
C	16 %	3.8	19.7	1162
D	36 %	4.2	16.6	1041
E	13 %	3.1	16.1	732
F	25 %	1.5	13.7	380

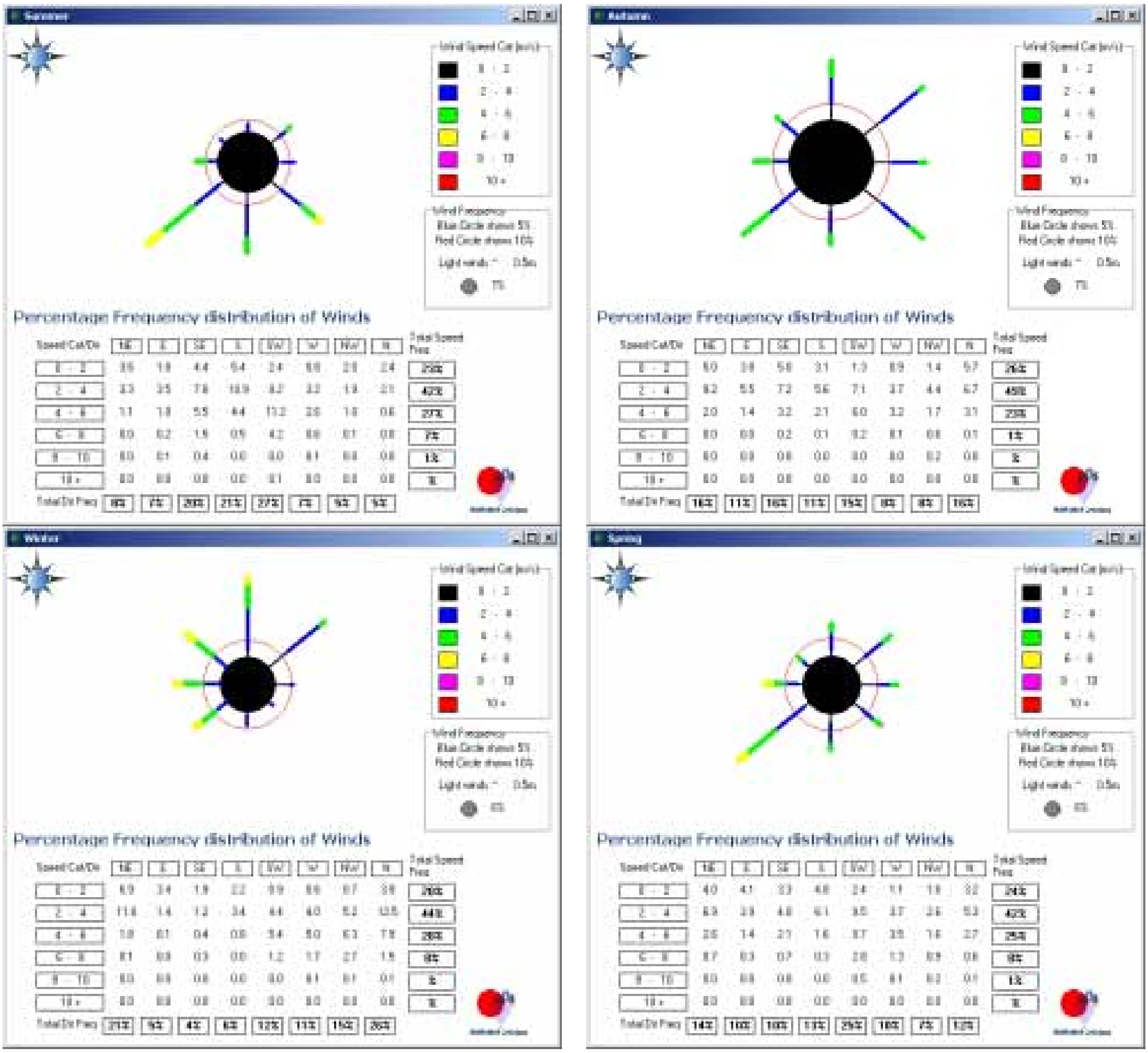
Annual Wind Roses



Percentage Frequency distribution of Winds

Speed Cat/Dir	NE	E	SE	S	SW	W	NW	N	Total Speed Freq
0 - 2	4.9	3.3	3.7	3.8	1.7	0.8	1.4	3.8	23%
2 - 4	7.8	3.6	5.1	6.5	7.5	3.7	3.5	6.7	44%
4 - 6	1.9	1.0	2.8	2.2	8.0	3.6	2.7	3.6	26%
6 - 8	0.2	0.1	0.7	0.2	2.1	0.9	1.1	0.6	6%
8 - 10	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	1%
10 +	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	%
Total Dir Freq	15%	8%	12%	13%	20%	9%	9%	15%	

Seasonal Wind Roses



Input Meteorological data file has got about 7 % of light winds: speed less than or equal to 0.5 ms^{-1}.

Statistics of Kilburn (SA) input Meteorological data file-2004

Stability	Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
A	Max of Temp	30.0	37.0	28.0	26.0				16.0	17.0	24.0	33.0	30.0	30.0
	Min of Temp	17.0	19.0	17.0	21.0				16.0	11.0	14.0	11.0	15.0	17.0
	Average of Temp	22.3	27.9	21.4	23.0				16.0	14.5	19.8	20.2	21.5	22.3
	Max of WS	2.6	2.6	2.6	1.5				1.0	1.5	2.6	2.6	2.6	2.6
	Min of WS	1.0	0.5	0.5	1.0				1.0	0.5	0.5	0.5	0.5	1.0
	Average of WS	2.0	1.8	1.5	1.3				1.0	1.3	1.9	1.8	1.8	2.0
	Max of MixH	1726	2090	1572	1186				595	895	1689	2603	1601	1726
	Min of MixH	332	308	406	472				595	535	370	362	217	332
	Average of MixH	1011	790	907	732				595	698	929	1048	759	1011
B	Max of Temp	38.0	41.0	38.0	29.0	21.0	14.0	13.0	21.0	29.0	29.0	36.0	36.0	38.0
	Min of Temp	16.0	16.0	15.0	14.0	11.0	12.0	10.0	9.0	11.0	14.0	12.0	15.0	16.0
	Average of Temp	23.1	26.4	23.2	22.2	15.6	13.0	11.4	14.5	18.4	20.6	22.5	24.7	23.1
	Max of WS	4.6	4.6	4.6	4.6	1.5	1.5	1.5	4.6	4.6	4.6	4.6	4.6	4.6
	Min of WS	0.5	0.5	0.5	0.5	0.5	1.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5
	Average of WS	3.3	3.1	2.8	2.6	1.3	1.5	1.4	2.5	3.3	3.4	3.3	3.6	3.3
	Max of MixH	2137	2412	2773	1795	1409	824	969	1680	1874	2308	2756	2738	2137
	Min of MixH	181	211	242	383	399	657	373	399	374	376	435	180	181
	Average of MixH	1121	1021	1034	989	678	741	635	1029	1114	1257	1290	1371	1121
C	Max of Temp	39.0	42.0	39.0	31.0	21.0	23.0	18.0	24.0	29.0	36.0	37.0	38.0	39.0
	Min of Temp	15.0	16.0	15.0	12.0	12.0	10.0	9.0	9.0	10.0	13.0	10.0	14.0	15.0
	Average of Temp	22.2	28.8	24.4	20.8	16.6	14.5	13.0	14.8	16.0	21.4	22.3	23.5	22.2
	Max of WS	6.7	6.7	8.7	5.7	5.7	5.7	5.7	5.7	5.7	8.7	7.7	7.7	6.7
	Min of WS	1.0	0.5	2.1	0.5	1.5	2.1	2.1	1.5	1.5	2.1	1.0	0.5	1.0
	Average of WS	4.1	3.6	3.8	3.4	3.5	3.6	3.9	3.8	3.5	4.0	4.1	4.1	4.1
	Max of MixH	2194	2257	2408	1867	1694	1447	1682	2310	1876	2458	2452	2813	2194
	Min of MixH	421	197	482	441	473	531	471	537	399	471	501	598	421
	Average of MixH	1268	1177	1295	1108	1009	963	1078	1132	1074	1264	1239	1349	1268
D	Max of Temp	39.0	44.0	39.0	30.0	23.0	23.0	21.0	26.0	28.0	37.0	37.0	39.0	39.0
	Min of Temp	12.0	13.0	11.0	9.0	6.0	4.0	4.0	3.0	5.0	8.0	7.0	10.0	12.0
	Average of Temp	19.5	24.0	20.3	17.9	14.6	13.2	12.0	12.9	13.6	17.8	18.6	19.8	19.5
	Max of WS	10.3	9.3	8.2	8.7	8.2	9.3	7.7	9.7	8.2	9.8	9.3	9.8	10.3
	Min of WS	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Average of WS	4.5	3.9	3.9	3.5	3.8	4.5	3.9	4.3	3.8	4.3	4.8	4.3	4.5
	Max of MixH	2423	2101	1951	2140	1694	2053	2360	2204	1950	2303	2529	2884	2423
	Min of MixH	121	121	121	211	217	242	121	121	121	121	181	121	121
	Average of MixH	1154	984	970	905	928	1095	978	1057	941	1106	1178	1099	1154
E	Max of Temp	35.0	36.0	38.0	28.0	18.0	20.0	16.0	24.0	26.0	27.0	35.0	35.0	35.0
	Min of Temp	14.0	14.0	14.0	10.0	6.0	7.0	5.0	7.0	7.0	9.0	9.0	14.0	14.0
	Average of Temp	19.1	24.0	20.3	17.5	13.2	11.9	10.4	11.4	13.5	16.4	19.1	20.1	19.1
	Max of WS	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
	Min of WS	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Average of WS	3.5	3.3	3.5	2.9	2.9	3.1	2.6	2.8	2.7	3.2	3.5	3.3	3.5

	Max of MixH	1238	1208	1171	1111	1111	1238	1171	1178	1111	1147	1268	1178	1238
	Min of MixH	411	374	411	374	411	374	344	344	344	374	435	405	411
	Average of MixH	846	769	803	670	670	744	633	665	632	765	840	779	846
F	Max of Temp	34.0	34.0	36.0	29.0	19.0	17.0	16.0	19.0	24.0	26.0	35.0	34.0	34.0
	Min of Temp	12.0	13.0	9.0	8.0	5.0	4.0	3.0	4.0	5.0	8.0	7.0	11.0	12.0
	Average of Temp	17.2	20.9	16.4	15.1	10.9	9.9	8.2	10.1	10.6	13.9	15.7	17.8	17.2
	Max of WS	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
	Min of WS	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Average of WS	1.4	1.5	1.6	1.4	1.6	1.7	1.2	1.4	1.3	1.4	1.7	1.6	1.4
	Max of MixH	749	906	809	779	719	779	688	779	779	809	966	779	749
	Min of MixH	121	121	121	121	121	121	121	121	121	121	121	121	121
	Average of MixH	370	382	413	358	405	427	324	376	332	372	448	410	370

Important Notes:

1. Sensitivity of Anemometers (not known) may not be up to air quality standard.
2. Zero wind speed is allowed, which may not be acceptable to older versions of *AUSPLUME.*

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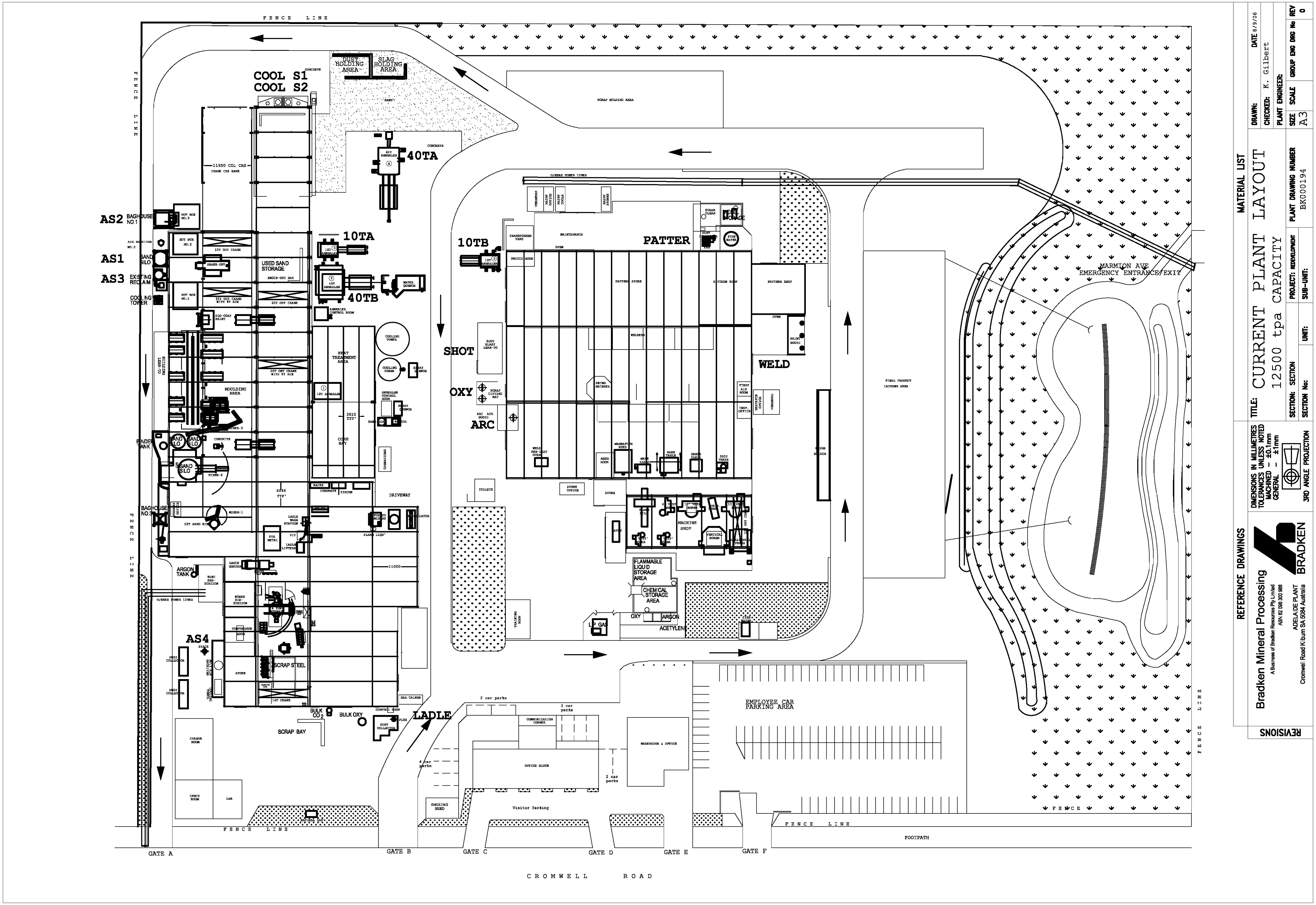
Appendix VI

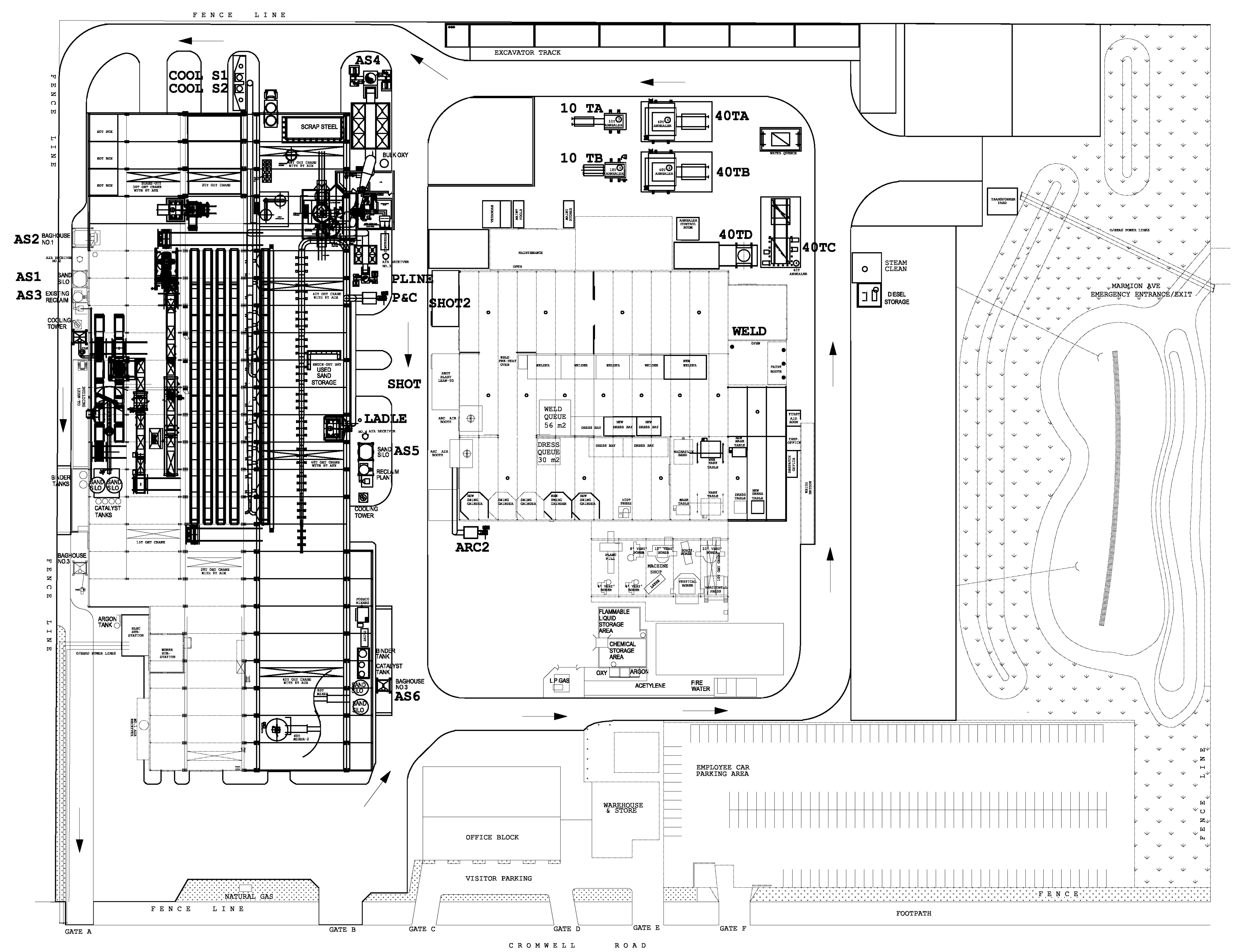
Emission Sources
Existing



FENCE LINE
COOL S1
COOL S2
DUST HOLDING AREA
SLAG HOLDING AREA
SCRAP HOLDING AREA
40TA
10TA
40TB
10TB
AS2
AS1
AS3
AS4
BAGHOUSE NO.1
BAGHOUSE NO.3
SAND SILO
EXISTING RECLAIM
COOLING TOWER
USED SAND STORAGE
MOULDING AREA
HEAT TREATMENT AREA
CORE BAY
MIXER-1
MIXER-2
MIXER-3
ARGON TANK
BINDER TANK
SCRAP STEEL
SCRAP BAY
BULK CO2
BULK OXY
LADLE
DRIVEWAY
O/HEAD POWER LINES
SHOT
OXY
ARC
PATTER
WELD
MAINTENANCE
PATTERN STORE
PATTERN SHOP
MACHINE SHOP
FLAMMABLE LIQUID STORAGE AREA
CHEMICAL STORAGE AREA
LP GAS
OXY
ARGON
ACETYLENE
FINAL PRODUCT LAYDOWN AREA
MARMION AVE EMERGENCY ENTRANCE/EXIT
EMPLOYEE CAR PARKING AREA
OFFICE BLOCK
WAREHOUSE & OFFICE
Visitor Parking
CHANGE ROOM
LUNCH ROOM
LAB
FOOTPATH
GATE A
GATE B
GATE C
GATE D
GATE E
GATE F
CROMWELL ROAD
MATERIAL LIST
REFERENCE DRAWINGS
REVISIONS
TITLE: CURRENT PLANT LAYOUT 12500 tpa CAPACITY
DRAWN:
DATE 8/9/06
CHECKED: K. Gilbert
PLANT ENGINEER:
SIZE A3
SCALE
PLANT DRAWING NUMBER BK000194
REV 0
PROJECT: REDEVELOPMENT
DIMENSIONS IN MILLIMETRES TOLERANCES UNLESS NOTED MACHINED - ±0.1mm GENERAL - ±1mm
3RD ANGLE PROJECTION
Bradken Mineral Processing
A Business of Bradken Resources Pty Limited ABN 82 098 300 988
ADELAIDE PLANT Cromwell Road Kilburn SA 5084 Australia
BRADKEN

Appendix VII

Emission Sources
Future



MATERIAL LIST

DRAWN:

DATE 8/9/06

CHECKED: K. GILBERT

PLANT ENGINEER:

TITLE: PROPOSED PLANT LAYOUT
32000 tpa CAPACITY

SIZE A3

SCALE

GROUP DWG DRG No

REV 0

PLANT DRAWING NUMBER BK000195

PROJECT: REDEVELOPMENT

SUB-UNIT:

SECTION:

UNIT:

SECTION No:

DIMENSIONS IN MILLIMETRES
TOLERANCES UNLESS NOTED
MACHINED - ±0.1mm
GENERAL - ±1mm

3RD ANGLE PROJECTION

REFERENCE DRAWINGS

BRADKEN

Bradken Mineral Processing
A Business of Bradken Resources Pty Limited
ABN 82 098 300 988

ADELAIDE PLANT
Cromwell Road Kilburn SA 5084 Australia

REVISIONS

Appendix Q

Noise Modelling Report

BRADKEN – NOISE MODELLING

1. BACKGROUND

A noise model was prepared for the Bradken Adelaide facility using the Environmental Noise Model (ENM) software package. Noise measurements and modelling were undertaken in accordance with the *Environment Protection (Industrial Noise) Policy 1994, Environment Protection (Machine Noise) Policy 1994 and the Draft Environment Protection (Noise) Policy 2004*.

Representative noise sources data was obtained from measurements undertaken during November 2005, manufacturer data and from the existing site noise model prepared by SONUS Pty Ltd.

2. NOISE CRITERIA

The project specific noise criteria are currently specified in the *Environment Protection (Industrial Noise) Policy 1994*. Schedule 2 of the Policy details the maximum noise levels and is reproduced below in **Table 1**.

Table 1: Maximum Noise Levels

Source Location	7 am – 10 pm	10 pm – 7 am
	L_{Aeq} dB(A)	
Rural or predominantly rural	47	40
Urban residential	52	45
Urban residential with some commerce, or with a school, hospital or the like	55	45
Urban residential with some manufacturing industry, or with some place of public assembly or licensed premises	58	50
Predominantly commercial	65	60
Predominantly industrial	70	70

The maximum noise levels presented in **Table 1** are based on the location of the industrial noise source. The Bradken facility is located in a General Industry zone under the Port Enfield Council Development Plan, and as such the noise source location could be described as "predominantly industrial". The maximum noise level for this source would therefore be 70 dB(A).

However, the intent of the General Environmental Duty outlined in Section 25 of the *Environment Protection Act* states the following.

- A person must not undertake an activity that pollutes, or might pollute the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

- In determining what measures are required to be taken under subsection (1), regard is to be had, amongst other things, to:
  - *the nature of the pollution or potential pollution and the sensitivity of the receiving environment...*

Therefore it may be reasonable to consider the receiving environment in setting a maximum noise level. The sensitive receivers are the residential properties to the west and east of the site. These receivers would be classified as "Urban residential with some manufacturing industry, or with some place of public assembly or licensed premises" and the applicable maximum noise level would be night time 50 dB(A) and day time 58 dB(A).

The *Draft Environment Protection (Noise) Policy 2004* attempts to address the difference between source and receiver by introducing the following clause:

> *"If the land uses principally promoted by the relevant Development Plan provisions for the noise source and those principally promoted by the relevant Development Plan provisions for the noise-affected premises do not all fall within a single land use category, the indicative noise level for the noise source is the average of the indicative noise factors for the land use categories within which those land uses fall."*

Table 2 details the "indicative noise factor" as reproduced from Part 5 of the Draft Policy.

Table 2: Maximum Noise Levels

Source Location	Indicative Noise Factor (dB(A))	
	Day	Night
Rural/Rural Living	47	40
Residential	52	45
Light Industry/Intensive Primary Production	57	50
Commercial	62	50
General Industry	65	55
Special Industry	70	60

Under the draft policy the applicable maximum noise level would be the average of the indicative noise factors for the General Industry and Residential source locations. Using this method the applicable maximum noise level would be, night time 50 dB(A) and day time 58 dB(A).

3. MODELLING

3.1 Assumptions

The following assumptions have been made in respect to the noise model:

- Acoustic attenuation has been applied to each of the 40 t Annealing Ovens to result in a total noise reduction of 6 dB.
- In the night time model, external operation of trucks and forklifts has been removed with the exception of the heat treatment forklift.
- Source data relating to new equipment is based on representative noise sources obtained from other heavy industries as actual source data was not available for this proposed equipment. It should be noted that the selection of future equipment should achieve noise levels equal to or less than those used in the model.
- Building opening will be kept closed during the night time period to minimise the impact of noise sources.
- A 4.5 m high noise mound is in place on the eastern boundary.
- The proposed new foundry building is constructed of a insulated panel structure consisting of a sheet metal external face and perforated internal sheet metal, sandwiching 100 mm of glass wool or equivalent insulating material.

3.2 Modifying Factors

The *Environment Protection (Industrial Noise) Policy 1994* makes provision for the adjustment of the measured (or predicted) noise level to account for both tonal and impulsive characteristics of the noise source.

Adjustments to the measured noise level may be applied as follows:

1. Tonal component: Where the alleged excessive noise:
    a) contains a perceptible tonal component adjustment to the measured noise level must be made in accordance with item 1(a) of Schedule 5;
    b) exhibits frequency and or amplitude modulation an adjustment to the measured noise level must be made in accordance with item 1(b) of Schedule 5.
2. Impulse component: Where the alleged excessive noise contains an impulse component, an adjustment to the measured noise level must be made in accordance with item 2 of Schedule 5.

Schedule 5 is as follows:

Adjustments to measured noise level in dB(A)
Characteristics of alleged excessive noise Adjustment dB(A)

1. Tonal components
    a) Perceptible tonal component ....+5
    b) Frequency and/or amplitude modulation ....+5
2. Impulse component/Impulsive noise ....+5

3.3 Noise sources

Table 3 outlines the primary noise source inputs used in the noise model. Not all noise sources are continuous and will have varying frequencies of operation. To account for this the sound power level of non-continuous time based sources have been adjusted to provide a time weighted sound power level.

Table 3: Representative Noise Sources

Source	SWL dB(A)
Oxy Cutting	105.8
Quench Tank + Cooling Tower	100.5
EAF	106.4
Furnace Baghouse	95.8
Pattern Shop Baghouse	92.8
Excavator	92.2
Forklift	90.5
Scrap Steel Delivery	94.8
40 t Annealing Oven	98.0
Gas Filling	103.7
Furnace Compressor	90.7
Shakeout Chamber	91.8
Shakeout Baghouse	95.1
Furnace Cooling Tower	93.5
Arc Air Booth	93.2
Shot Blast Chamber	84.8
Welding Bay Extraction Fan	89.8
Sand Silo Baghouses	97.8
Sand Truck	75.3
Overhead Crane	89.9
Grinding Bay	93.7
Machine Shop	86.3

3.4 Noise Predictions

The predicted noise levels for the adjacent sensitive receivers are presented in **Table 4** and **Table 5**. The predicted noise levels presented below are inclusive of a 5 dB penalty applied for the character of the noise.

Table 4: Predicted Noise Levels (Westerly)

Receiver Location	L_{Aeq} (dB(A))	
	Day	Night
Criteria	**58**	**50**
(R1) Former Council Depot	53	49
(R2) Blackburn Street (north)	45	45
(R3) Blackburn Street (south)	43	43
(R4) Nelson Street (north)	51	49
(R5) Nelson Street (south)	50	46
(R6) Tyne Avenue	51	49
(R7) Stevens Avenue	42	38

Table 5: Predicted Noise Levels (Neutral)

Receiver Location	L_{Aeq} (dB(A))	
	Day	Night
Criteria	**58**	**50**
(R1) Former Council Depot	54	50
(R2) Blackburn Street (north)	48	48
(R3) Blackburn Street (south)	45	45
(R4) Nelson Street (north)	48	45
(R5) Nelson Street (south)	46	42
(R6) Tyne Avenue	43	40
(R7) Stevens Avenue	44	39

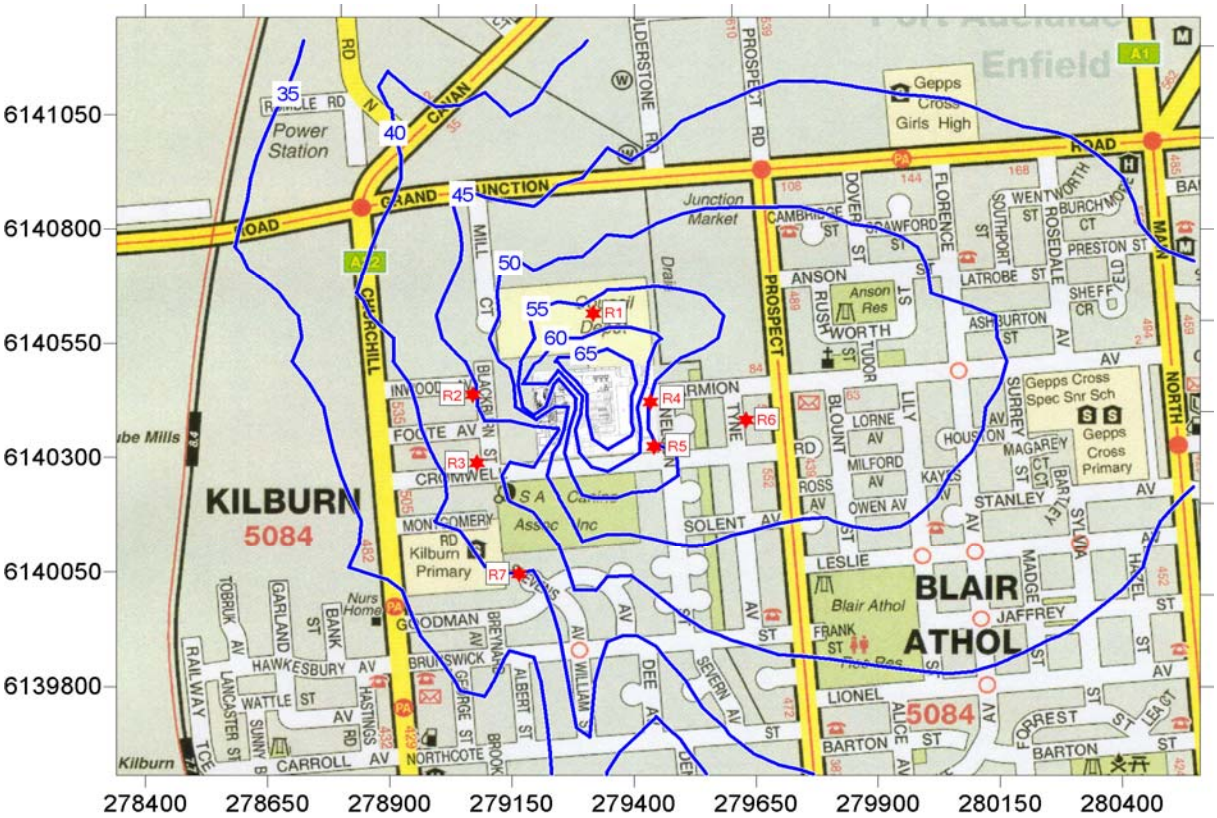


Figure 1: Day Time Noise Prediction Contours dB(A) (westerly wind)

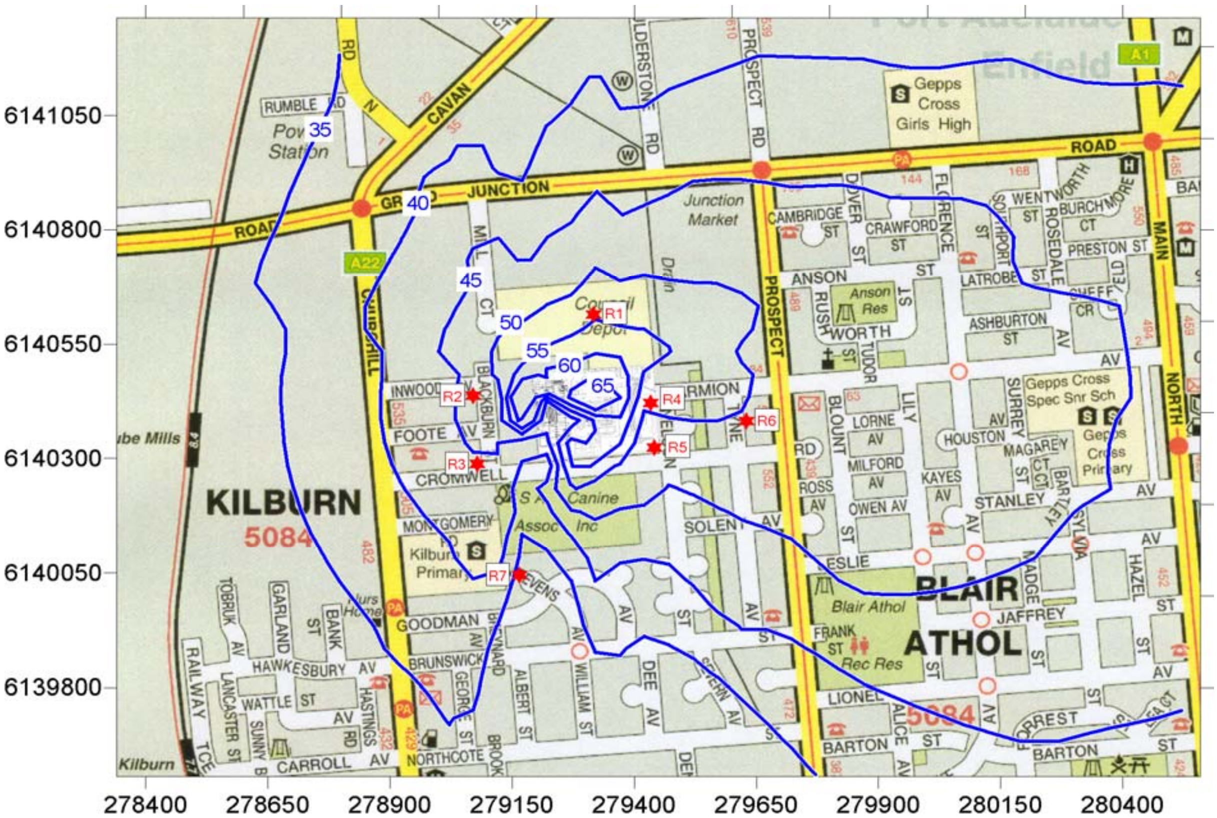


Figure 2: Night Time Noise Prediction Contours dB(A) (westerly wind)

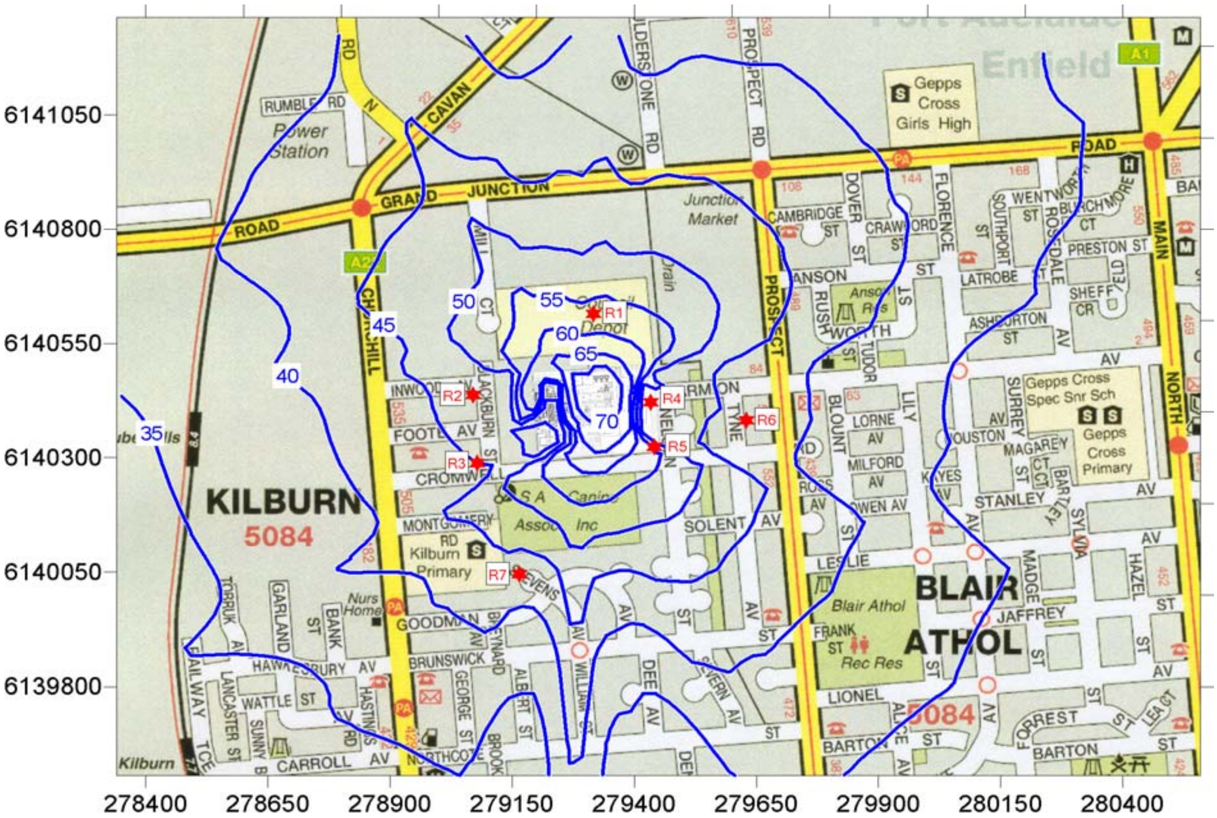


Figure 3: Day Time Noise Prediction Contours dB(A) (neutral conditions)

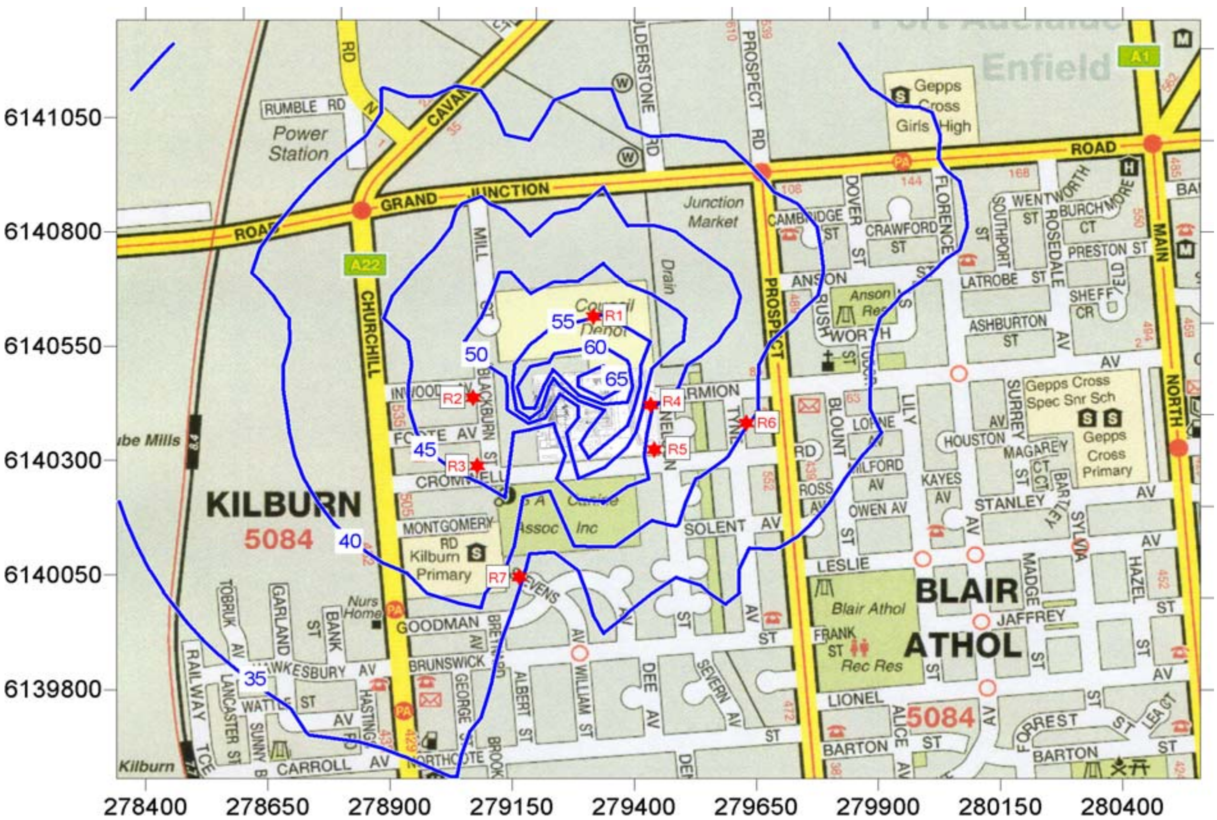


Figure 4: Night Time Noise Prediction Contours dB(A) (neutral conditions)

Appendix R

Health Risk Assessment

Appendix S

Photomontages

Cromwell Road (Blackwood Street Corner) Looking East - Existing

Cromwell Road (Blackwood Street Corner) Looking East - Proposed

Cromwell Road Looking West - Existing

Cromwell Road Looking West - Proposed

Foote Avenue Looking East - Existing

Foote Avenue Looking East - Proposed

Marmion Avenue - Existing

Marmion Avenue - Proposed

Opposite Cromwell Road Looking North - Existing

Opposite Cromwell Road Looking North - Proposed

Appendix T

Sonus Acoustic Report (Car Park)

Sonus Pty Ltd
280 Melbourne St
NORTH ADELAIDE SA 507
Phone: 8361 7844
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0410 920 122
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Bradken Foundry
80 Cromwell Road
KILBURN SA 5084

S2048C2

Attention: Mr John Gilbert

20 October 2006

Dear John,

BRADKEN FOUNDRY – EMPLOYEE CARPARK EXTENSION
ENVIRONMENTAL NOISE ASSESSMENT

This report summarises the environmental noise assessment of the proposed employee carpark extension.

The assessment has been based on Bradken Mineral Processing Drawing BK000195.

Environmental Noise Criteria

The *Environment Protection (Industrial Noise) Policy 1994* and the World Health Organisation recommendations relating to sleep disturbance have been used to objectively assess the noise associated with the proposal to extend the existing carpark.

Environment Protection (Industrial Noise) Policy

The Environment Protection (Industrial Noise) Policy is designed for resolving existing complaint situations. In development situations, a more stringent criterion is appropriate and it is common practice to require a noise level which is 5 dB(A) below the requirements of the policy to be achieved.

The Environment Protection (Industrial Noise) Policy defines the maximum allowable noise levels for particular areas as follows:

Description of area in which the noise source is situated	Maximum permissible noise levels dB(A)	
	7.00am-10.00 pm	10.00pm-7.00 am
Rural or predominantly rural	47	40
Urban residential	52	45
Urban residential with some commerce, or with a school, hospital or the like	55	45
Urban residential with some manufacturing industry, or with some place of public entertainment or place of public assembly or a licensed premise	58	50
Predominantly commercial	65	60
Predominantly industrial	70	70

The site is best classified as "Urban residential with some manufacturing industry", with application of this classification providing maximum allowable noise levels of 58 dB(A) during the day, and 50 dB(A) at night. As the carpark is proposed to be used after 10pm, it is the night-time criterion of 50 dB(A), which is most relevant.

When measuring noise levels for comparison with the policy, penalties for the character of the noise can be applied. A 5 dB(A) penalty is applied for each of the characteristics of tone, fluctuation and impulsiveness. Given the fluctuation in noise from the carpark, an adjustment for the character of the noise has been applied.

Therefore, the applicable criterion for night time operation with the adjustments for its fluctuating characteristic and new development status becomes 40 dB(A).

Sleep Disturbance Criteria

Many studies have been undertaken to give some indication of the noise level inside a bedroom that would result in sleep disturbance. The World Health Organisation (WHO) has developed guidelines[1] for community noise in specific environments.

The WHO suggests that the equivalent noise level (L_{eq}) inside bedrooms should be limited to 30dB(A) and the maximum noise level (L_{max}) should be limited to 45 dB(A). The equivalent noise level is effectively the average over a period of time, and the maximum represents the highest individual event during that period.

It is normal practice when considering internal noise levels from an external source to assume that windows may be partially open. This allows people to open windows on warm nights. Based on the windows being partially open, the WHO suggests that to achieve the internal levels described above, the equivalent (L_{eq}) and maximum (L_{max}) noise levels outside a bedroom window should be limited to 45 dB(A) and 60 dB(A) respectively.

The most stringent criteria based on the above becomes an equivalent noise level (L_{eq}) of 40 dB(A) and a maximum noise level (L_{max}) of 60 dB(A) to be achieved at the nearest dwelling.

Assessment

The noise at adjacent residences from activity in the extended car park has been estimated based on the measured noise associated with use of the current Bradken carpark in addition to other data collected from a range of similar carpark sites.

The predicted noise includes voices, vehicle movement into and out of individual carparks and car doors closing. The predicted noise assumes that all cars within the total capacity of the proposed carpark have changed over in a one hour period.

[1] Berglund, Lindvall and Schwela, 1999, "Guidelines for Community Noise"

Based on the above, a fence of a minimum height of 2.1 metres, constructed from "Colorbond" sheet steel sealed at all joins and at the junction with the ground, is required at the eastern edge of the carpark extension to comply with the objective criteria. The fence is to extend from the southern boundary to either of the existing earth mounds.

With the proposed fence in place, it is predicted that the equivalent noise (L_{eq}) from the extended carpark, when measured at the closest residence, will be approximately 35 dB(A). This level is 5dB(A) below the criterion based on the Environment Protection (Industrial Noise) Policy and 10dB(A) below the equivalent noise level criterion recommended by the World Health Organisation (WHO) for sleep disturbance. In addition, the maximum instantaneous (L_{max}) noise outside of the windows of adjacent residences is predicted to be substantially less than the maximum noise level criterion of 60dB(A) recommended by the WHO.

Conclusion

An assessment of the impact of the noise from the proposed extension of the carpark has been made.

The noise from use of the proposed carpark during the night will be suitably controlled by the construction of a fence on the proposed carpark extension's eastern edge that extends to either of the existing earth mounds on the site.

With the fence in place, the noise is predicted to achieve the requirements of the World Health Organisation sleep disturbance guidelines and the criterion based on a level 5 dB(A) below the Environment Protection (Industrial Noise) Policy.

It is concluded that, with the construction of fencing in accordance with this report, the proposed carpark extension will not adversely impact the amenity of the locality by way of noise.

If you have any questions or require clarification, please call me.

Yours faithfully
Sonus Pty Ltd

Jason Turner
Associate

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

Written/Submitted by:

for

Mark Keppel
Environmental Geologist

Reviewed/Approved by:

Colin Campbell
Senior Project Manager

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ENVITHEB05076AA_R02_GW.doc

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1	ENVITHEB05076AA_R02_GW.doc	Final	10 October 2006	Coffey Environments Pty Ltd	
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1	ENVITHEB05076AA_R02_GW.doc	Final	12 October 2006	Coffey Environments Pty Ltd	CPL

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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.

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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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.

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

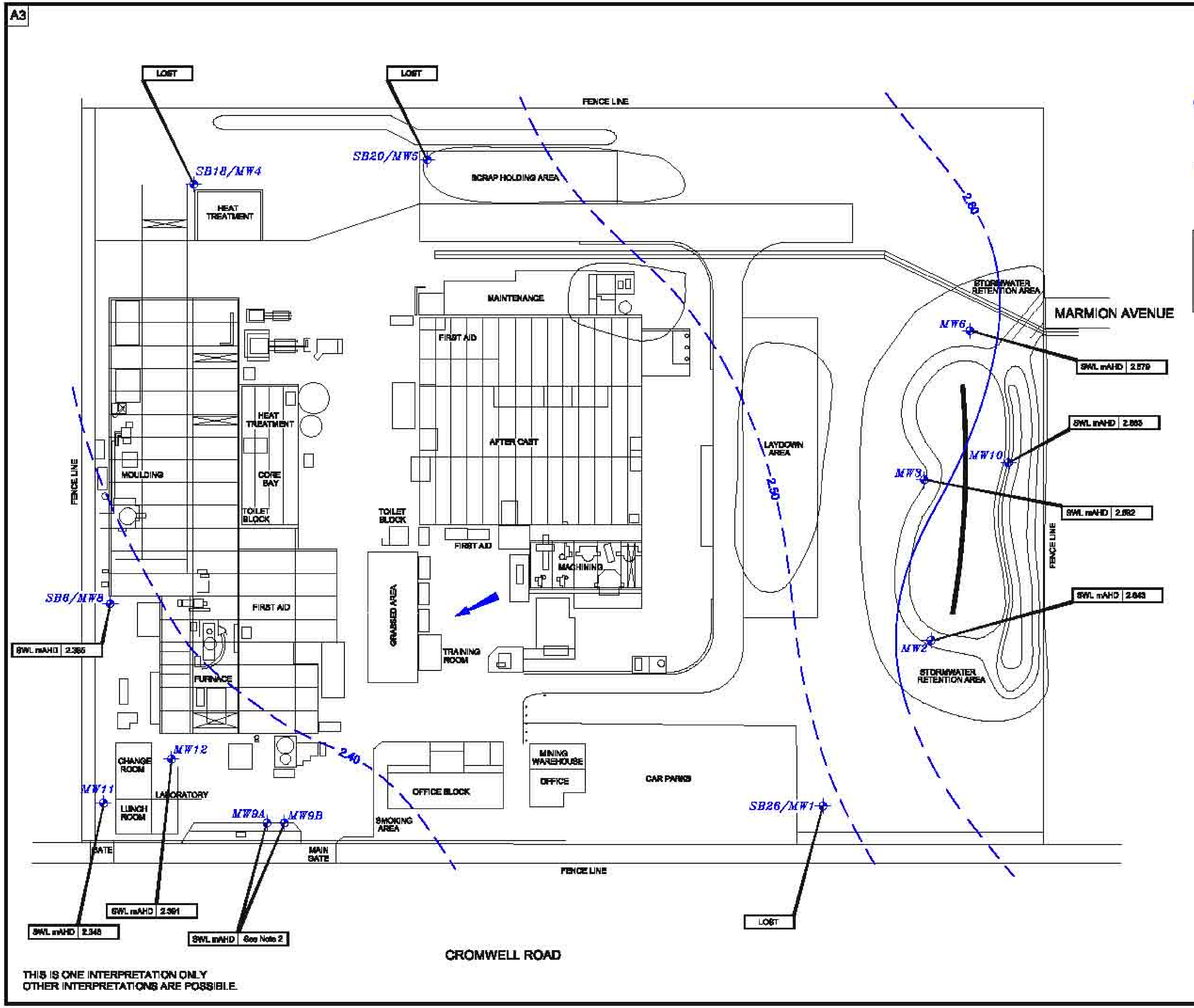
Bradken Resources, August 1 and 2 2006

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



N

LEGEND

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

NOTE:

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

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

NOTE:
ALL LOCATIONS ARE APPROXIMATE.
DIMENSIONS IN METRES.

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

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES
27 Queen Street
Thebarton SA 5031
Ph: (08) 8443 5000
Fax: (08) 8443 6489

Client:
BRADKEN RESOURCES

Project:
BRADKEN GROUNDWATER SAMPLING

Location:
CROMWELL ROAD
KILBURN, SOUTH AUSTRALIA

Drawing Title:

HYDROGEOLOGICAL INFORMATION (1 AUGUST 2006)

Drawn	Signed	Date
GR		01.08.06
Checked	Signed	Date

Project - Drawing No.	Figure No.	Rev.
J505076A-D01	1	B

Appendix A
References

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

REFERENCES

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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

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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:

Jayana Dadallage B.Sc.(Chemistry) Senior Analyst - Volatiles	Leanne Murray PhD (Organic Chemistry) Production Manager	Kumara Dadallage B.Sc. Teamleader - Volatiles
Alex Petridis Master of Science (Chemistry) Senior Analyst - Semivolatiles	Mark Herbstreit B.App.Sci. Senior Analyst - Metals	Helen Lei B.App.Sci. (Biochemistry) Senior Analyst - Waters

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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

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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

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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
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

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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*
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

Results

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	0608003/001 MW2 1/08/06 3/08/06	0608003/002 MW3 1/08/06 3/08/06	0608003/003 MW6 1/08/06 3/08/06	0608003/004 MW8 1/08/06 3/08/06	0608003/005 MW9A 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

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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
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

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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
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

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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
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

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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	-

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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 3/08/06 3/08/06	0608003Q013 Spike Recovery Lab Control 4/08/06 4/08/06	0608003Q014 Duplicate 0608003/010 4/08/06 4/08/06	0608003Q015 Spike Recovery 0608003/010 4/08/06 4/08/06	0608003Q016 Duplicate 0608003/010 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	-	-	-

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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	-	-	-

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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*	*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

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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

Report No: 171381

	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

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
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	-

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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

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Quality Results

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	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

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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.

02/08 2006 16:50 FAX 0884436499 IT ENVIRONMENTAL 002

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

Quality Endorsed Company — Coffey

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☐ **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: J505076A
Task No:
Project Name: Bradken Kilburn GME
Laboratory: Amdel
Samplers Name: Monique Jensen
Project Manager: Colin Campbell
Special Instructions: Please fax back COC's upon receipt
Please provide electronic tables

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	PAH's	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	↓								✓	

RELINQUISHED BY:		RECEIVED BY:	
Signature: M Jensen	Date: 2/8/06	Signature: [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:	J505076A
Date:	1/8/06
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			
	~~MW4~~							
11:12.	MW12			3.055	4.205			Bailer in Well.
11:15.	MW11			2.885	3.665			"
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)

PROJECT NAME: ____________ PROJECT NUMBER: J505076A

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		16.51		
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))

coffey environments

GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: ____________________ PROJECT NUMBER: J505076A

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]~~ 1.5	~~[illegible]~~	635		8.33		445		17.24		purged WQP
														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))

coffey environments

GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: ____________________ PROJECT NUMBER: J505076A

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		7.39		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 5076A

DATE: 2/8/06

ARR: ______ am/pm

DEP: ______ am/pm

OPERATOR: ______

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

SURVEY MARK: ______

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			2/8/06 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		~~[illegible]~~ 5059		15.	Sampled AM.
								Post											
~~[illegible]~~								Pre											
								Post											
MW6		12:00	5.105		3.330			2/8/06 Pre	18.41		[illegible]	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~~					
MW 10 (6L)		12:45	5.340		4.459			2/8/06 Pre	18.27		1.4		455	7.75		2185		6 L	
								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

coffey environments

GROUNDWATER SAMPLING FORM (A)

PAGE ____ OF ____

PROJECT NAME: ______________________ PROJECT NUMBER: JS05076A

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))

coffey environments

GROUNDWATER SAMPLING FORM (A)

PROJECT NAME: Bradken

PROJECT NUMBER: J505076A

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 ☐ WAERRA ☐ 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 CO_2 & H_2O	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) L	0	Furnace baghouse dust collected (tonnes)	0	
limestone (assisting in removing impurities from the molten metal)	0			
Fluorospar (calcium fluoride CaF_2)(assisting in removing impurities from the molten metal)	0	Slag collected (tonnes)	1,946	Note: the limestone will initially decompose to form CO_2 & CaO [$caCO_3$ => CO_2 = 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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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	1100L	Miscellaneous containers		2000L	No
Paints	3	II	5700L	Miscellaneous containers	80 metres	2000L	No
Furnace Consumables	4.3		45.2 tonnes			1 tonne	**Yes**
Binder	6.1b	III	40000L	Above ground tank		2500L	**Yes**
Catalyst	8	III	8000L	Above ground tank		50000L	No
Acetylene	2.1		>500L	Above ground tank		5000L	No
Aerosols	2.1		>10L	Aerosol cans			
LPG	2.1		2500L	Above ground tank		16000L	No
Argon and Carbon dioxide	2.2		4900L	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	

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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

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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

Bradken Project Management Team

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