

APPENDIX

D

Summary of contamination issues Site F (Part of OneSteel Site)



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Geotechnics | Environment | Groundwater

Integrated Practical Solutions

Summary of Contamination Issues
Site F (Part of OneSteel Site)

Proposed Terminal 4 Project
Mayfield

Prepared for
Port Waratah Coal Services Limited

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Executive Summary

This report presents a summary of a contamination issues at Site F, located within the OneSteel site at Tourle Street, Mayfield, which forms part of the proposed Terminal 4 (T4) Project. The report was prepared for Port Waratah Coal Services Limited, and is based on a desktop review of information made available. Site F is proposed for construction of wharves and associated infrastructure on the southern side of the Hunter River (South Arm), during Stages 2 and 3 of the T4 Project.

The full T4 project area includes the former Kooragang Island Waste Emplacement Facility, Delta EMD waste disposal area and the Fines Disposal Facility, plus wharf areas on both sides of the Hunter River (South Arm), adjacent to Tourle Street Bridge. Assessments of contamination, groundwater and remediation options were undertaken for the main T4 project area on Kooragang Island, and are presented in separate reports. Site F comprises formerly reclaimed land that has been extensively filled with industrial wastes from former steel making activities.

The objectives of the assessment of Site F were to assess whether the identified site contamination required remediation or management in relation to the proposed T4 Project for:

- Protection of the environment; and
- Protection of human health.

The environmental values to be protected are the quality of ground and surface water interacting with the Hunter River that adjoins the T4 project area. Protection of human health from identified contamination is required during construction of the wharves and in the long-term operation of the wharves.

The site presents a number of environmental challenges which could be managed by implementing appropriate mitigation measures during staged construction of the T4 Project. The main contamination issues identified at Site F are:

- Elevated contaminant levels in soils due to extensive filling with industrial wastes, and leaks/spills associated with former site activities;
- Presence of a benzene plume and impacts on groundwater associated with extensive filling with industrial wastes, and leaks/spills from former site activities; and
- Potential migration of impacted groundwater towards the Hunter River.

The principal contaminants expected on Site F are benzene, polycyclic aromatic hydrocarbons (including naphthalene), metals, cyanide and ammonia, which are contaminants typically associated the long history of industrial steel making and processing operations. A confirmed area of benzene contamination of groundwater is present within the T4 project area, and is the subject of a Voluntary Proposal for ongoing monitoring under Section 19 of the CLM Act.

The following contamination issues have been identified within Site F which could, if not properly managed, impact on the development of the T4 Project:

- Localised disturbance of impacted soils within the benzene plume area due to piled foundations;
- Potential vapour intrusion associated with the transfer house development over the benzene plume area;

- Localised disturbance of soils along the riverfront for wharf construction, including soils in the vicinity of ammonia/hydrocarbon impact (Mill Scale storage area and pit); and
- Localised disturbances of near surface soils for the development of surface infrastructure (ie pavement, slabs, services etc).

Any disturbances of site soils during construction of the wharves and associated infrastructure will require appropriate management through implementation of a Construction Environmental Management Plan. Following construction, the area will be essentially capped to manage potential exposure to existing impacted materials by implementation of a Long-term Environmental Management Plan.

The mitigation measures anticipated to be applied to existing conditions at Site F and to the proposed T4 development within Site F have been assessed and are discussed in this report. The management strategies will be confirmed following site-specific investigations to assess risks posed to human health and to the environment. The strategies will then be documented in a Remediation Action Plan (RAP).

The contaminants identified on Site F are of the nature and extent that can be readily managed and/or remediated using commonly employed methods that have been assessed as being suitable to remediation works proposed on the parts of the T4 Project located on Kooragang Island. It is understood that development over Site F is not likely to commence until 2017. There is therefore sufficient time to undertake the relevant investigations and confirm remediation requirements.

In summary, the proposed T4 development within Site F can be undertaken in a manner which would reduce environmental risks and protect human health and the receiving environment of waters and sediments within the Hunter River.

Table of Contents

	Page
1. Introduction.....	1
1.1 Overview	1
1.2 Proposed Development	2
1.3 Purposes and Objectives of the Assessment.....	3
1.4 Environmental and Human Health Values	4
1.5 Environmental Strategy for the T4 Project	5
2. T4 Project Area Identification	5
3. Site F Description	6
3.1 Site F - OneSteel	6
3.2 Surrounding Environment	12
4. Background Information.....	13
4.1 Introduction.....	13
4.2 Review of Previous Investigations	16
4.2.1 Douglas Partners Geotechnical and Contamination Assessment	16
4.2.2 Site F 'Benzene Area'.....	16
4.2.3 Remainder of Site F Area	21
4.3 Mill Scale Transfer Storage Area and Pit	25
4.4 Summary of Previous Investigation Findings	26
4.5 Geology and Hydrogeology	28
4.5.1 Geology.....	28
4.5.2 Stratigraphy.....	28
4.5.3 Hydrogeology	29
4.6 EPA Notices	31
5. Assessment of Site Contamination	34
5.1 Guidelines, Regulation and Policy	34
5.1.1 Soil.....	34
5.1.2 Groundwater	35
5.1.3 Guideline Documents.....	40
5.2 Environmental Protection Licences.....	40
6. Contamination Issues and Implications.....	42
6.1 Extent of Contamination.....	42
6.2 Implications of Contamination.....	43

7.	Review of Remediation Options.....	44
8.	Conclusions.....	44
9.	References.....	45
10.	Limitations.....	47

Appendix A: About this Report

Appendix B: Drawing 7.01 – Site Location Plan

Drawing 7.02 – 1954 Aerial Photo

Drawing 7.03 – 1984 Aerial Photo

Drawing 7.04 – Proposed Development

Drawing 7.05 – Site F Layout

Abbreviations

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environmental and Conservation Council
AS	Australian Standard
ASS	Acid Sulphate Soil
BHP	Broken Hill Proprietary Company Limited
BHPB	BHP Billiton Pty Ltd
BTEX	Benzene, Toluene, Ethyl benzene, total Xylenes (monocyclic aromatic hydrocarbons)
C₆-C₉	Light hydrocarbon chain groups
C₁₀-C₁₄	Light hydrocarbon chain groups
C₁₅-C₂₈	Medium hydrocarbon chain groups
C₂₉-C₃₆	Heavy hydrocarbon chain groups
C₆-C₃₆	Sum of light, medium and heavy hydrocarbon chain groups
CLM Act	Contaminated Land Management Act 1997
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DNAPL	Dense Non-Aqueous Phase Liquid
DP	Douglas Partners Pty Ltd
DQO	Data Quality Objective
EIS	Environmental Impact Statement
EMD	Electrolytic Manganese Dioxide
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EPL	Environment Protection Licence
FDF	Fines Disposal Facility
ha	hectares
KI	Kooragang Island
KCT	Kooragang Coal Terminal
KIWEF	Kooragang Island Waste Emplacement Facility
LNAPL	Light Non-Aqueous Phase Liquid
m	metres
NCIG	Newcastle Coal Infrastructure Group
NEHF	National Environmental Health Forum
NHTG	Newcastle Harbour Tide Gauge
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAH	Polycyclic Aromatic Hydrocarbons

Abbreviations (Continued)

PASS	Potential Acid Sulphate Soil
pH	unit measurement of acidity/alkalinity
PWCS	Port Waratah Coal Services Limited
RL	Reduced Level (in metres to a specified datum)
SP1	Special Activities (Port and Industry) Zone
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
T4	Coal Export Terminal 4

Summary of Contamination Issues Site F (Part of OneSteel Site) Proposed Terminal 4 Project, Mayfield

1. Introduction

1.1 Overview

Port Waratah Coal Services Limited (PWCS) proposes to construct and operate a new coal export terminal at the Port of Newcastle, New South Wales (NSW). PWCS owns and operates the Kooragang Coal Terminal (KCT) at Kooragang Island and Carrington Coal Terminal (CCT) at Carrington, both in the Port of Newcastle. The proposal, known as the Terminal 4 Project (T4 Project), is essentially an extension to KCT. The T4 Project would provide additional port capacity required to accommodate the projected future growth in coal exports from the Hunter Valley and broader NSW.

The T4 Project is proposed to include new rail tracks, coal stockyard, conveyors and ancillary facilities on Kooragang Island, adjacent to KCT, and wharves, berths, ship loaders and ancillary facilities along the north and south banks will be constructed and operated within the Hunter River South Arm and along its northern and southern banks.

Approval for the T4 Project is being sought under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Commonwealth has accredited the Part 3A process as the appropriate Commonwealth assessment pathway for the T4 Project. An environmental assessment (EA) of the T4 Project is a requirement of the Part 3A approval process. Douglas Partners Pty Ltd (DP) has been engaged by PWCS to undertake components of the EA related to contamination, groundwater and remediation options assessments and to address the relevant Director General's Requirements (DGRs).

The overall T4 project area as shown on Drawing 7.01 in Appendix B comprises Sites A, B, C, D, E and F.

This report relates to the T4 project area that is located on the southern bank of the Hunter River on part of the OneSteel site at Mayfield, which is referred to as Site F. Development of Site F is proposed during Stage 2 and 3 of the T4 Project. Following completion of Stage 3, the proposed use of Site F comprises two berths and shiploaders.

This report presents the results of a review of contamination issues within, and in the vicinity of, Site F. It presents an assessment of contamination, groundwater and potential mitigation measures. This assessment has been based on the results of a number of previous contamination assessments conducted at Site F, and is based on reports made available by OneSteel which are listed in Section 4.1.

The reports have been reviewed to provide the following:

- An increased level of knowledge of the environmental condition of Site F;

- An assessment of the reliability of existing information; and
- An assessment of data gaps and proposed additional work required to fill in identified data gaps.

This approach of reviewing existing information and proposing supplementary assessment for Site F is considered appropriate since it utilises the existing information at Site F specific to the proposed development. It is noted that due to the staging of the T4 Project, no development will take place on Site F for several years, allowing time for appropriate assessments and remediation where required.

The assessment has been the subject of peer review by Dr Bill Ryall of Ryall Environmental Pty Ltd.

1.2 Proposed Development

The T4 Project is proposed to be located at the Port of Newcastle, in the Newcastle local government area, approximately 6 km north-west of the Newcastle central business district. The T4 project is primarily located on Kooragang Island (Sites A to E), adjacent to KCT and the Newcastle Coal Infrastructure Group (NCIG) coal terminal. Site F (within the OneSteel site) is located on the south bank of the Hunter River South Arm, at Mayfield North and includes a section of the Hunter River bed.

Mayfield North and the southern part of Kooragang Island, where the T4 Project area is located, are dominated by industrial, transport, distribution and port facilities, including KCT and NCIG. The nearest residential areas to Site F are Mayfield and Warabrook to the south and south-west.

Site F is predominately reclaimed land previously used for industrial purposes. It is a completely modified landscape dominated by bare ground with a battered revetment at the river edge which is primarily constructed from blast furnace slag. Although there is some remnant mangrove and saltmarsh vegetation along the northern bank of the Hunter River, there is minimal vegetation at the locations of the proposed wharves and berths on Site F.

The T4 Project is proposed to be developed progressively over an estimated 10 year timeframe in a nominal three stage program, in response to demand for increased coal export capacity. The maximum coal throughput capacity for the T4 Project will increase from 70 million tonnes per annum (Mtpa) in the first stage, to a nominal 120 Mtpa at full development. All coal will be received by rail, stockpiled and then shipped to market. The T4 Project components proposed for Site F include the following:

- Progressive construction and operation of coal conveyors, feeders and transfer stations to deliver coal from the stockpiles on the northern T4 Project Site to the wharves at Site F delivering coal to the shiploaders, via buffer bins; and
- Progressive construction and operation of wharf and berth facilities. At full development, two berths and shiploaders are proposed for Site F.

The conceptual layout of the proposed T4 Project is shown on Drawing 7.04 Appendix B, which is based on drawing *KL 323170_A - Site Overview.dwg*, overlain on a site aerial photograph. The salient features, which will be refined during detailed design, are:

- Up to seven coal stockpiles of up to 1428 m in length;

- Up to eight machinery berms to carry yard equipment such as stackers, reclaimers, stacker/reclaimers and conveyors;
- T4 railway lines, mainly located in the SP1 zone outside the existing rail lines, except for a section inside Site A at Deep Pond;
- Dump Station located in the SP1 zone, just north of the boundary between FDF Cells 1 and 2;
- Water treatment ponds located over Deep Pond; and
- Berths and shiploaders along the north and south banks of the South Arm of the Hunter River.

The proposed T4 Project would be developed in stages. The initial stage is proposed to include the construction of four coal stockpiles, three berths and associated infrastructure on Kooragang Island. Development of Site F is proposed to be undertaken in Stages 2 and 3 of the overall T4 Project. It is understood that Stage 2 construction is not likely to commence until 2017, subject to demand for increased coal export capacity.

Wharves M8 and M9 and associated conveyors are proposed for construction adjacent to and within the Hunter River as part of Stages 2 and 3 of the T4 Project.

A sheet piled wall along the fender line is proposed for wharf construction; therefore, no bulk excavation of the existing bank will be required for construction. The transfer house for conveyors located adjacent to the existing batter east of the Tourle Street bridge (ie western end of Site F riverfront) will be supported on piled foundations. Bulk excavation of the riverfront batter is also not required for development.

Further details on the proposed T4 Project are provided in the EA.

1.3 Purposes and Objectives of the Assessment

The assessment was required for the following reasons:

- The proposed T4 Project would be a significant development that could have potential impacts on the environment unless managed appropriately;
- Characterisation of the soil and groundwater contamination at the T4 Project site would be required so that the potential impacts could be assessed; and
- Assessment of the appropriate mitigation measures would be required and implemented to effectively manage site contamination and potential off-site groundwater migration.

The proposed development presents an opportunity to implement strategies that manage and mitigate on-site and off-site risks associated with the presence of existing contaminants on Site F.

The overall objective of the assessment was to aid the environmental assessment of the T4 Project so that it could be constructed and operated in a manner that would:

- Protect the environment; and
- Protect human health.

Site F, and the Mayfield OneSteel site as a whole, comprises formerly reclaimed land that has been extensively filled with materials including gravel, brecketts, blast furnace slag, brick, refractory, iron ore and coal washery reject and various other wastes from steel making operations. The site was formerly owned by BHP Billiton for steelmaking operations, therefore, as a result of filling and former site operations, there is a potential for contaminants in soil and groundwater to be present at the site.

The specific objectives of the assessment were as follows:

- Identify potential contamination issues arising from the T4 Project;
- Assess the appropriate mitigation strategies to manage these issues (remediation and/or management); and
- Confirm that the remediation works can be undertaken in a sustainable manner that meets the objectives of policies and guidelines endorsed by NSW Office of Environment and Heritage (OEH)¹.

1.4 Environmental and Human Health Values

The Hunter River (South Arm) located immediately to the north of Site F at Mayfield, is the primary environmental value requiring protection during and following Stage 2 and 3 construction of the southern wharves of the T4 Project.

The potential risk to this environmental receptor and its ecological attributes is the potential for contaminant migration through groundwater movements.

Human health would also require protection during construction of the southern wharves and subsequently during their operation. The main modes of protection would be:

- Construction: minimisation of exposure of workers to contaminants (through implementation of an environmental management plan); and
- Operation: prevention of access to contaminants by humans (through capping of the site).

The protection of these environmental and human health values can be achieved through consideration of the relevant policies and guidelines endorsed by the NSW Office of Environment and Heritage (OEH), by implementation of Data Quality Objectives (DQOs), and with reference to the National Water Quality Management Strategy *Guidelines for Groundwater Protection in Australia* (NWQMS, September 1995).

¹ NSW Office of Environment and Heritage (OEH) has replaced the former NSW Department of Environment (DEC), NSW Department of Environment and Climate Change (DECC) and NSW Department of Environment, Climate Change & Water (DECCW). NSW Environment Protection Authority (EPA) is currently part of NSW OEH. NSW EPA, NSW DEC and NSW DECC have each made guidelines endorsed by s.105 of the Contaminated Land Management Act 1997.

1.5 Environmental Strategy for the T4 Project

The primary objective of the assessment of remediation options for the T4 Project is to protect from unacceptable impacts the off-site receiving environment, including adjacent landholdings and the South Arm of the Hunter River. The secondary objective is to implement a land use option which effectively minimises exacerbation, and reduces the long-term risks posed by the contaminant legacies on the site, minimises the requirement for maintenance to protect environmental values, supports project approvals and minimises PWCS liability.

Development of the T4 Project provides an opportunity for PWCS to contribute to the responsible development of an area of Newcastle which is recognised as a heavily contaminated site. Specifically, the historical use of Site F, including the formation of the area from the historical filling using waste products from steel making, along with subsequent site use as part of the former Steelworks, has rendered the site contaminated. Understanding the contamination risks, and identifying mitigation measures to prevent or minimise potential impact, would facilitate safe use of the site and protection of the environment.

2. T4 Project Area Identification

The T4 project area consists of six parcels of land, four of which are within the former Kooragang Island Waste Emplacement Facility (KIWEF), designated Sites A, B, C and D (as shown on Drawing 7.01). The fifth parcel of land comprises the SP1 (Special Activities) zone (Site E), located to the west and north of the existing railway line which is 100m wide. The SP1 zone is essentially low-lying wetlands. The sixth parcel of land (Site F) comprises part of the existing OneSteel site adjacent to the Hunter River (South Arm) where Wharves M8 and M9 are proposed.

The assessment of contamination at Sites A to E and mitigation options are presented in separate reports (Refs 1 and 2), and these sites are not discussed further in this report.

The location and extent of these sites are shown on Drawing 7.01, and identified in Table 1.

Table 1: T4 Project Area Identification

Site	Name	Lot and DP	Area (ha)
A	KIWEF (north-west)	Lot 9, Lot 10 and Lot 11 DP 1119752	96.7
B	KIWEF (south-east) - River Waterfront / Cormorant Road	Lot 21 DP 1155723	37.6
C	Delta EMD Waste Disposal Site	Lot 121 DP 874949	25.4
D	PWCS Fines Disposal Facility	Lot 11 DP 841542	45.1
E	SP1 Special Activities - Rail and Dump Station	Part Lot 1 DP 126347	41.3
F	OneSteel - river waterfront (proposed wharves), south bank, internal roads	Part Lot 222 DP 1013964	9.2

3. Site F Description

3.1 Site F - OneSteel

Site F includes a section of the Hunter River, the southern bank of the Hunter River (South Arm) and a portion of the Mayfield OneSteel site spanning a length of about 850 m. It is described in Section 1.2, and shown on Drawing 7.04 in Appendix B.

The Site F area extends south to Industrial Drive generally along existing roads as follows:

- North to south adjacent to Tourle Street;
- East to west along George Bishop Drive; and
- North to south along Woodstock Street.

The extension to Industrial Drive is for the purpose of road access as indicated on the proposed development layout included as Drawing 7.04 in Appendix B.

An unsealed road along the riverbank (referred to as River Road) is located along the Site F northern boundary.

The proposed M8 and M9 wharf location extends along the northern boundary of River Road and the Hunter River (south arm) from the Tourle Street Bridge in the west to the proposed swing basin to the east of Site F. It is noted that Site F does not include the swing basin area.

A landscape mound is located immediately south of River Road, and is generally vegetated by grass / shrubs. A localised stand of trees is present within the fill mound at the eastern extent of the proposed wharves, as shown in Figure 1.



Figure 1: River Road looking east (December 2011)

An open, unlined stormwater drain (known as Drain 19) containing dense vegetation bisects the central area of Site F.



Figure 2: Open drain in the central portion of Site F, looking north (December 2011)

An access road oriented north-south from River Road was observed to the west of the open drain.

A network of groundwater monitoring wells are located along River Road, as shown on Drawing 7.05 in Appendix B.

Numerous monitoring wells were observed at the western portion of River Road near the Tourle Street Bridge, which are associated with the known benzene plume in groundwater in the area (refer to Section 4.2 for more information).



Figure 3: Groundwater monitoring wells at the western end of River Road, looking east (December 2011)

A decommissioned booster sludge pump was observed at the western end of River Road (Figure 4).



Figure 4: Booster sludge sump pump at the western end of River Road, looking south-west (December 2011)

The north-western portion of Site F, bounded by the open drain to the east and George Bishop Road to the south, was under lease to a transport company (Toll Transport). The area was unsealed and contained two large workshops along the western boundary, as well as some smaller sheds (Figure 5).



Figure 5: Leased western portion of Site F, looking south from monitoring well E-29 (December 2011)

Several shipping containers were present within the leased area, as were numerous trucks and trailers. Two diesel fuel bowlers and an aboveground tank were present at the south-western corner of the northern-most workshop (Figure 6) (ie south of Site F).



Figure 6: Diesel bowlers and aboveground tank in western portion of Site F, looking north to north-east (December 2011)

The north-eastern portion of the leased area was fenced with temporary fencing. Steel and sections of rail track were stored in this area.



Figure 7: Fenced north-western area of the site, looking west across the open drain (December 2011)

The area west of the open drains, and south of Site F was general unsealed and utilised for storage of various equipment and materials. A typical storage area south of Site F is shown in Figure 8.



Figure 8: Reel storage area in south, looking west (December 2011)

The area immediately east of the open drain in the central-northern portion of Site F comprised coal reject at the surface and had sparse grass coverage. A grass-covered stockpile was observed adjacent to the drain. Numerous open-ended metal boxes were stored in the northern portion of this area (Figure 9).



Figure 9: Coal reject-capped area showing metal boxes, looking south (December 2011)

Stockpiles of orange filter cake (Figure 10) and black mill scale (Figure 11) were observed in the northern area of Site F, to the west of the area leased by Steelstone.



Figure 10: Stockpiles of orange filter cake, looking south (December 2011)



Figure 11: Stockpiles of black mill scale, looking north (December 2011)

A localised surface water pond was observed north of the filter cake and mill scale stockpiles in the northern portion of Site F (Figure 12).



Figure 12: Surface water pond north of filter cake and mill scale stockpiles, looking north (December 2011)

Numerous stockpiles containing a variety of material, including slag, bitumen, concrete steel and demolition waste was observed south of the eastern portion of Site F (Figure 13).



Figure 13: Stockpiles of waste material located south of the eastern portion of Site F, looking north (December 2011)

It is understood that the stockpiled materials are associated with the Steelstone recycling and processing facility located within and south of the eastern portion of Site F.

Large stockpiles of crushed concrete were observed in the north-eastern portion of Site F (Figure 14).



Figure 14: Stockpiled materials, looking south from the bund along River Road (December 2011)

Figure 15 below shows the Site F riverfront batter generally comprising slag fill materials.



Figure 15: Site F Batter with the Hunter River – looking east (December 2011)

3.2 Surrounding Environment

The land adjoining and surrounding Site F comprises the South Arm of the Hunter River to the north and industrial development, as follows:

- East and South of proposed M8 and M9 wharves: existing Mayfield OneSteel industrial site (including OneSteel Bar Mill, Toll Transport and Steelstone);

- East of Woodstock Street: QR National, Oceanic Aluminium, Koppers and several other commercial/industrial developments;
- West of Woodstock Street: Sandvik, Hymix, Mayfield Concrete Plant;
- South of George Bishop Drive: Lot 223 (currently vacant commercial/industrial land) and Gateway Medical Kooragang, Hunter Health Care Group, Biospecialities Australia and several other commercial developments;
- West: Tourle Street followed by the former Delta EMD plant and the Steel River Industrial Estate; and
- South of Industrial Drive: residential development.

4. Background Information

4.1 Introduction

Numerous environmental investigations have been conducted at the OneSteel site, including investigations within the Site F area. The results of a number of investigations relevant to Site F were made available by OneSteel as part of the current assessment of Site F.

A list of the reviewed reports is provided in Table 2 below. The results of the reports are discussed in Section 4.2 below.

Table 2: Documents provided by OneSteel

Author	Date	Title	Document Reference	Ref	Subject Area
CH2MHill	Oct 2000	<i>Investigation of Benzene in Groundwater at the North-western Corner of the Newcastle Rod and Bar Site</i>	110166	3	Benzene area
CH2MHill	July 2001	<i>Characterisation Investigations at the Benzene Impacted Area, OneSteel Lot 222, July 2001</i>	110292.003	4	Benzene area
CH2MHill	Apr 2002	<i>Letter report: Benzene Impacted Area, OneSteel Lot 222 - Biological Indicator and Contaminant Stratification Investigation in Groundwater Wells</i>	110294	5	Benzene area
RCA	August 2002	<i>Soil Contamination Assessment, OneSteel Market Mills Newcastle</i>	2939-004/1	6	
Contamination Management Pty Ltd	August 2002	<i>Summary Site Audit Report, Benzene Impacted Area, OneSteel Newcastle</i>	0124	7	Benzene area
CH2MHill	Dec 2002	<i>OneSteel Rod, Bar & Mills and Industrial Park - Lot 222 Newcastle Final Assessment Report for the Voluntary Investigation - Lot 222 Characterisation Studies from Feb 2000 to Sept 2002</i>	110293.08	8	Lot 222
CH2MHill	Dec 2002	<i>Figures - AutoCAD and PDF, OneSteel Rod, Bar & Mills and Industrial Park - Lot 222 Newcastle & Final Assessment Report for the Voluntary Investigation - Lot 222 Characterisation Studies from Feb 2000 to Sept 2002</i>	110293.09	9	Lot 222
Contamination Management Pty Ltd	20 Feb 2003	<i>Summary Site Audit Report, Lot 222 OneSteel, Newcastle</i>	123	10	Lot 222
Contamination Management Pty Ltd	20 Feb 2003	<i>Letter Report: RE: Migration of contaminants within the clay layer at the "Benzene Impacted Area", OneSteel Site, Newcastle</i>	124	11	Benzene area

Table 2: Documents provided by OneSteel (continued)

Author	Date	Title	Document Reference	Ref	Subject Area
RCA	May 2003	<i>Environmental Site Assessment, Steelstone Services Lease Area, OneSteel, Mayfield. Prepared for Hunter Bulk Materials</i>	3032-002/1	12	Lot 222
RCA	December 2003	<i>Contamination Assessment, OneSteel Lease Area Mayfield, Prepared for Steelstone Services Pty Ltd</i>	3733-002/0	13	Lot 222
CH2MHill	Jun 2004	<i>Groundwater Monitoring Program - Sampling and Reporting of Foreshore Wells within the Benzene Impacted Area</i>	312749	14	Benzene area
HLA Envirosiences	August 2004	<i>Summary Site Audit Report, Stage 3 Investigation, Benzene Impacted Area</i>	S4020301-SSAR_3Aug04	15	Benzene area
CH2MHill	August 2006	<i>EPA Environment Protection Licence Groundwater Quality Monitoring – OneSteel Site, Industrial Drive Mayfield</i>	311750	16	Lot 222
RCA	December 2006	<i>Groundwater Monitoring Report- August 2006 Lot 223 Mayfield</i>	5340a-001/1	17	Lot 223
CH2MHill	September 2007	<i>EPA Environmental Protection Licence Groundwater Quality Monitoring – OneSteel, Industrial Drive Mayfield</i>	355481	18	Lot 222
CH2MHill	October 2007	<i>Environment Protection Licence 11149 – Changes to Zn and Fe Discharge Limits for the Rod and Bar Mills</i>	365121	19	Lot 222
RCA	September 2008	<i>Environmental Protection Licence Groundwater Quality Monitoring, OneSteel Rod, Bar and Wire Site, Mayfield</i>	6775-701/2	20	Lot 222
RCA	April 2009	<i>Voluntary Investigation Groundwater Monitoring Program, Benzene Impacted Area Lot 222 OneSteel Site Mayfield</i>	6775-702/3	21	Benzene area

4.2 Review of Previous Investigations

4.2.1 Douglas Partners Geotechnical and Contamination Assessment

Douglas Partners has undertaken a geotechnical and environmental assessment for the T4 Project (DP Report 49533.02-03, dated 31 March 2011) which comprised the sampling and testing of soils/sediments in the South Arm of the Hunter River adjacent to Site F. Sampling locations close to the Site F river bank, however, were limited in number (five).

Sediment samples were tested for a range of potential contaminants, including heavy metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX), ammonia and cyanide. Selected samples were also tested for the presence of acid sulphate soils. Current and previous investigations have shown that some contamination is present within the river sediment, however, exceedences of relevant guideline criteria are few and appear to be localised.

The river sediments were identified to be potential acid sulphate soils (PASS).

DP has also undertaken numerous geotechnical investigations in the vicinity of the Site F, the results of which have been utilised to formulate the expected stratigraphy of the site.

4.2.2 Site F 'Benzene Area'

An area of elevated benzene dissolved in groundwater, generally referred to as 'the benzene area', is located in the north-western portion of Site F within Lot 222 DP 1013964.

Elevated benzene concentrations were initially observed in groundwater in natural sediments within Bore E1 (as indicated on Drawing 7.05, Appendix B) in the north-western portion of Site F in March 2000. Initial sampling was conducted as part of ongoing groundwater monitoring for Environmental Protection Licence requirements. Benzene concentrations in the order of 20 000 µg/L were initially encountered in groundwater samples from Bore E1.

Subsequent investigations were undertaken to assess the potential source and extent of groundwater contamination, the reliability of the investigations and the potential for off-site migration.

Further details of the assessment of the benzene area within Site F are presented below.

Initial Investigations – Benzene Area

Initial investigations within the benzene area within Site F generally comprised the following:

- Trench excavation and groundwater sampling of existing wells to identify potential sources of benzene contamination;
- Additional groundwater well installation to further identify potential sources and extent of the benzene plume; and
- Fingerprint analysis to identify the possible activities that contributed to the benzene contamination.

Trench excavation and sampling of surrounding groundwater wells indicated that the source of the benzene in groundwater was not in the vicinity of the original elevated results in Bore E1. Additional wells were therefore installed in an attempt to identify a potential source of the benzene plume and to identify the possible extent of the plume. Additional groundwater well investigation and groundwater sampling indicated the highest concentration of benzene in groundwater (approximately 180 000 µg/L) was located in the vicinity of Bore E19, which was located approximately 25 m west of the original benzene exceedence in Bore E1.

Approximately 10 mm thickness of floating product was also observed during initial sampling of Bore E20, which is located approximately 25 m west of the assumed plume source. The approximate extent of the benzene plume is shown in Figure 16 below (extracted from Ref 3, Oct 2000).

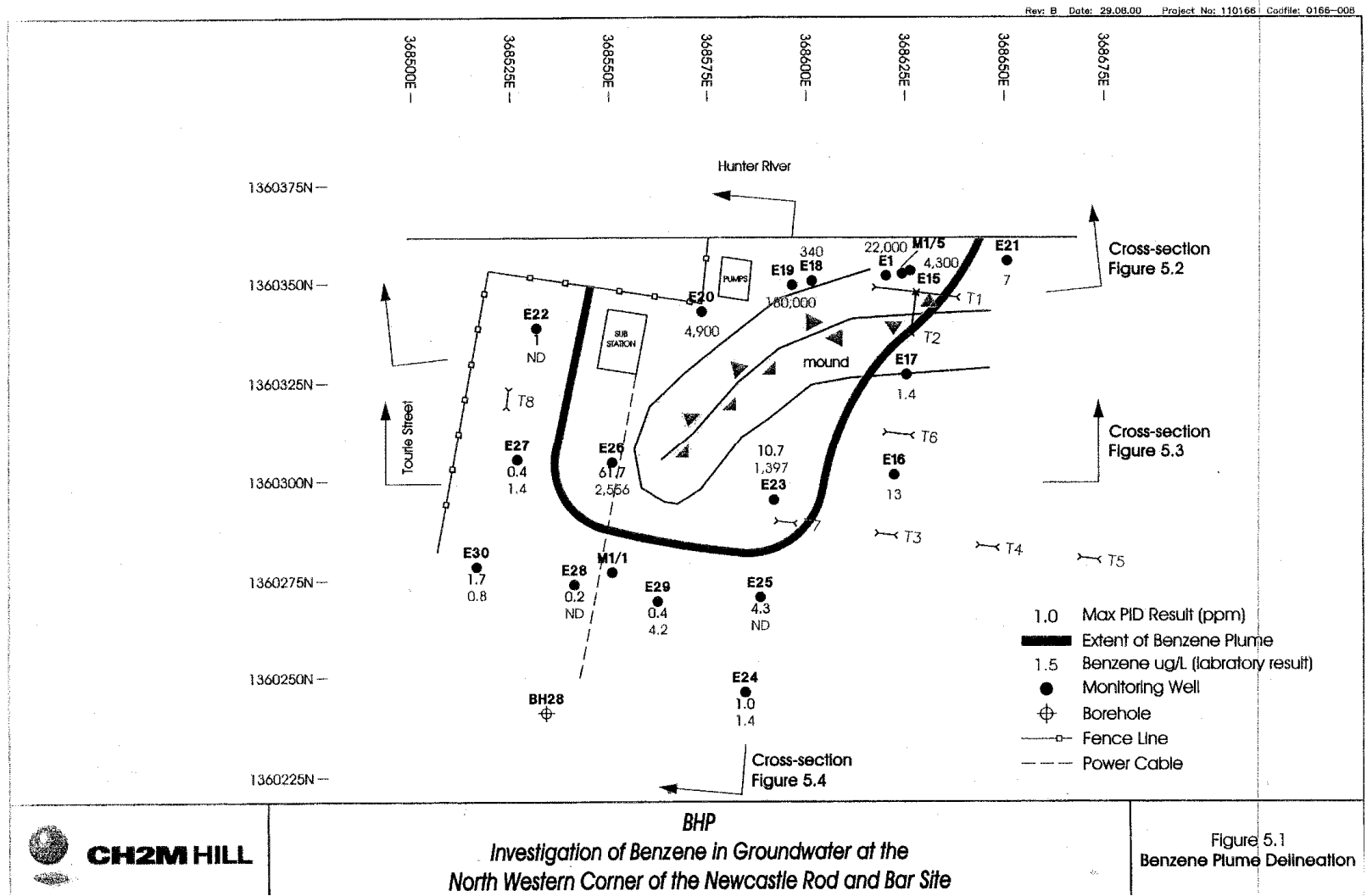


Figure 16: Approximate Location and Extent of the Benzene Plume in the North-Western Portion of Site F (source - Ref 3, Oct 2000)

At the time of the initial assessment in October 2000, the benzene plume was assessed as being approximately 75 m wide at the northern extent, adjacent to the south arm of the Hunter River, and extending approximately 75 m to the south of the river where the plume had a width of approximately 60 m. Initial reporting indicated that the plume was located at the top of the semi-confined to confined aquifer, comprising silty clays and fine sands. Groundwater was assessed to flow to the north to north-east at a gradient of between 0.0003 to 0.2 and a permeability of 0.39 to 1.14 m/day.

Fingerprinting analysis of samples collected from Bore E19 indicated that the benzene plume contaminants were possibly sourced from coke oven residues and gas mains residues that may have been disposed in the area.

Subsequent Investigations of the Benzene Area

Following initial investigations to assess the presence and extent of the benzene area, additional assessments were undertaken to further characterise the benzene contamination as follows:

- Further soil excavation and testing to assess the potential for a benzene source within sediments;
- Further fingerprint and leachability analysis;
- Groundwater depth, tidal and electrical conductivity gauging to assess groundwater flow, mounding of groundwater, and tidal/flushing effects;
- Assessment of the reliability of the installed groundwater wells; and
- Installation of additional groundwater wells to assess off-site migration.

Additional subsurface investigation in the north-western portion of the benzene area within the 'lower tier' of the area (ie the area at the edge of the benzene plume adjacent to the river) indicated the presence of hydrocarbon contaminated clay filling intermixed with slag fill, and also the possible presence of floating product sourced from deeper sediments (i.e. groundwater from the base of excavated test pit approximately 7 m below surface levels). Leachability testing of lower tier contaminated soils in both salt water and deionised water indicated leachable concentrations of PAH, benzene and phenols. Fingerprint analysis of floating product within Bore E20 also indicated potential contamination sources as sludge from a decanter tank or contaminated absorber oil from the benzene stripping process (coke oven by-product plant).

Assessment of groundwater flows and movements were conducted within the benzene area to identify the possible cause of groundwater mounding (i.e. localised higher groundwater levels) and the potential for groundwater movement and mixing and the effect of tides. The groundwater flow assessment indicated the following:

- Groundwater mounding (located in the vicinity of Bores E20 and E26 in the western portion of the benzene area) may have been caused by increased infiltration from a surface depression and rainfall infiltration over an underground service trench;
- Chemical sampling of groundwater indicated no obvious correlation of PAH and BTEX results with tide levels;
- There was a minor potential for river water and groundwater mixing at peak high tide levels;
- There was an intimate connection and response in estuarine well levels and tide fluctuations, however there was limited tidal/fill aquifer interactions;

- There was some evidence of mixing between fill and estuarine aquifers in Bore E18 and E19, as evidenced by a decrease in electrical conductivity at peak high tides (however, it is noted that the placement of screened sections in monitoring wells at these locations may have influenced the results);
- The likely migration pathway of dissolved phase contamination into the Hunter River is via the estuarine aquifer, with mixing at the fresh water/salt water interface; and
- The impact of contaminated groundwater on the Hunter River was mitigated by the presence of the clay layer between fill and estuarine aquifers, the gentle groundwater gradient and the potential for biodegradation of contaminants.

An investigation of the integrity and reliability of groundwater monitoring wells within the Site F area was undertaken in 2002 as part of assessment of the benzene area. Investigations across the benzene area had suggested that the potential benzene contamination source was confined to the clay layer between the fill and underlying natural sediments. It was noted, however that the majority of the installed wells up to that time were screened across the potentially contaminated clay layer, which highlighted whether the wells were providing results representative of the estuarine groundwater. As a result, an attempt to characterise the depth of groundwater contamination was undertaken by conducting stratified sampling within three wells within the benzene area (Bores E15, E19 and E26), in which groundwater samples were collected at specific depths below the clay layer using a Micropurge sampling system.

It was reported that the stratification sampling indicated that contaminant migration is likely to have occurred from the contaminated clay layer into the underlying estuarine aquifer by diffusion through the clay layer and dispersion/advection through the estuarine sands. It was recommended that subsequent well installation in the estuarine aquifer to comprise well screening starting directly below the clay layer.

Following investigation within the benzene area, an assessment of potential off-site migration of contaminants in groundwater was conducted. The investigation comprised installation of angled foreshore groundwater monitoring wells at the northern boundary of Lot 222 (i.e. northern boundary of Site F) in 2002. Several rounds of subsequent groundwater monitoring were conducted to assess the potential for off-site migration of contaminants (generally comprising BTEX, TRH, PAH and metals) and to aid in the assessment as to whether the benzene area could be considered to be a significant risk of harm. Assessment of biodegradation indicators was also conducted as part of the monitoring program to provide an indication of possible biological activity which may attenuate potential contaminant concentrations in groundwater over time.

The results of monitoring of the foreshore groundwater monitoring wells indicated some exceedences of adopted groundwater trigger levels for TRH, PAH and metals. BTEX concentrations were generally within the adopted criteria. Subsequent sampling rounds generally indicated falling concentrations of most organic analytes, with the majority of analytes either below the adopted groundwater trigger levels or below laboratory detection limits. Metals, TRH and some PAHs were consistently reported over several rounds of monitoring of the foreshore wells. Elevated TRH and PAH concentrations were attributed to remnant contamination from filling operations within the benzene area, as opposed to the site use at the time of sampling. Elevated metal contaminants were attributed to regional groundwater quality and were not sourced on Site F.

The results of monitoring of biological parameters to assess natural attenuation suggested that natural attenuation monitoring was considered to be a practical management strategy for remediation of groundwater contamination within the benzene area.

In September 2007 OneSteel submitted a Voluntary Investigation Proposal (VIP) to the EPA for the benzene area. Additional groundwater monitoring and monitoring of seeps along the Hunter River foreshore was subsequently conducted within the benzene area and the adjacent foreshore wells as part of the VIP. The concentrations of key contaminants and natural attenuation parameters were assessed.

The results of the VIP assessment indicated that contamination, generally in the form of PAH, benzene, TRH and phenols, is present in the estuarine aquifer, and that, as previously indicated, the contamination source is within the clay layer between the upper fill aquifer and the estuarine aquifer. The VIP assessment also indicated that contaminant concentrations in the foreshore wells (i.e. at the northern extent of the benzene area) are consistently low and in most cases are below adopted trigger levels (with the exception of TRH).

Groundwater seeps within the Hunter River foreshore were highlighted as a potential secondary off-site migration mechanism (ie after migration of contaminants via the estuarine aquifer). The results of contamination testing of five groundwater seeps from the river foreshore in the vicinity of the benzene area indicated some elevated concentrations of metals, TRH and some PAH components. The report noted that although some elevated contaminant concentrations were encountered in seeps, dilution and dispersion of contaminants would occur within the Hunter River, minimising the risk of human health and environmental impact. It was recommended, however, that further evaluation of seeps is conducted to assess impacts at high and low tide and during periods of high and low rainfall, as well as assessing groundwater properties within the fill aquifer adjacent to the riverbank.

The VIP investigation also concluded that biodegradation of contaminants is taking place in at least some areas of the benzene plume.

4.2.3 Remainder of Site F Area

Several reports within Lot 222, DP 1013964 (outside the benzene area) were provided by OneSteel which have relevance to Site F. The additional reports contained information regarding the following:

- Near-surface soil contamination from previous site activities (Steelstone site within/adjacent to the Site F area, manganese stockpile area adjacent to Site F);
- Surface soil, surface water and groundwater assessments/summaries on Lot 222 (within and adjacent to Site F);
- Ongoing groundwater monitoring as part of Environment Protection Licence requirements on Lot 222 (within and adjacent to Site F); and
- Groundwater monitoring on adjacent sites.

Near-Surface Soils

An assessment of potential manganese contamination in near-surface soils was undertaken within Lot 222, immediately south of Site F, in 2002 to investigate whether concentrations of manganese in near surface soils were within acceptable limits following the removal of a manganese ore stockpile. The health-based soil criteria adopted for the site was calculated specifically for the site based on the results of a previous assessment of risk. The site-specific health-based soil quality criteria was calculated to be 300 000 mg/kg manganese. All samples tested were within the site specific health-based criteria, therefore the area was considered suitable for ongoing industrial use.

Two additional assessments were conducted in the Steelstone Services lease area immediately south-east of Site F. The assessments generally comprised sampling and analysis of near-surface soils, background soils and surface water from on-site retention ponds. The results of the investigations generally concluded that it was unlikely that the operations at the Steelstone site had contributed to soil or groundwater contamination.

A targeted surface soil assessment was undertaken on portions of Lot 222 with the objective of assessing the risk to human health risk (by dermal and ingestion pathways) of near-surface soils across Lot 222. Near-surface soil testing conducted within and adjacent to Site F generally indicated concentrations in soil below the adopted site specific health-based criteria, with the exception of PAH species at two locations, one within the western portion of Site F, and one to the south-east of site F.

Surface Waters

Sampling and analysis of surface waters has previously been conducted within Site F, specifically within a surface water drain which runs north-south through the centre of Site F, known as Drain 19. The catchment of Drain 19 includes the Site F area as well as areas of Lot 222, adjacent industrial lots to the south of Lot 222, and parts of Mayfield to the south. Drain 19 flows to the north through Site F into the Hunter River.

Sampling has previously been conducted within Drain 19 in periods following rainfall and in dry periods to assess surface water quality entering the Hunter River. Sampling was conducted at four locations within the drain.

The results of analysis of surface water samples from Drain 19 identified elevated concentrations of metals, ammonia, PAH and TRH. Contaminant loads entering the river have been reported as not being significant due to several factors, including potential up-slope factors, possible impact from base flow from the fill aquifer into Drain 19, discharge contaminant concentrations being less than the adopted trigger values, or discharge concentrations being less than the up-stream contamination concentrations in the Hunter River.

Groundwater within Lot 222

Groundwater monitoring has been conducted at Lot 222 and surrounds (including within the Site F area) as part of Voluntary Investigation Proposals / Voluntary Investigation Agreements / Environmental Protection Licence (EPL) agreements. Several groundwater monitoring wells installed within the fill and estuarine aquifers are sampled as part of ongoing monitoring within Site F. The assessment of these wells is separate to investigations within the benzene area.

Table 3 below summarises the groundwater monitoring wells sampled as part of the EPL assessments that are located within Site F, and the list of analytes that exceeded the adopted criteria following analysis of samples from 2006 to 2008 (the most recent information made available). The identified well locations are shown on Drawing 7.05 in Appendix B.

Table 3: EPL 11149 Groundwater Monitoring within Site F

Groundwater Monitoring Well	2006 EPL Exceedences	2007 EPL Exceedences	2008 EPL Exceedences
W6F	Ammonia, TRH, Phenanthrene, Anthracene	Ammonia, TRH, Phenanthrene, Anthracene	Ammonia, TRH, Anthracene, Phenanthrene
W6E	Copper	Copper, TRH	Zinc, TRH, Anthracene, Benzo(a)pyrene
W7F	Ammonia, TRH, Arsenic	Ammonia, TRH, Arsenic	Ammonia, TRH
W7E	Ammonia	Ammonia, TRH	Zinc, Ammonia, TRH
W8F	Arsenic, Ammonia, TRH	Ammonia	Chromium, TRH
W8E	Ammonia	Ammonia, TRH	Ammonia, TRH
M2/1W	No exceedences	No exceedences	Zinc, Anthracene, Benzo(a)pyrene
E13	Ammonia, TRH	Chromium, Zinc, Ammonia, TRH	Ammonia, TRH
F2	No exceedences (well dry)	No exceedences (well dry)	No exceedences (well dry)
F12	Ammonia	No exceedences	Ammonia

The above results suggest groundwater contaminants of concern within Site F (excluding the benzene area) include ammonia, metals, TRH and PAH

Figure 17 below (extracted from Ref 18, September 2007), shows the existing groundwater monitoring well network at the site.

OneSteel Lots 222, 224 and 225 Newcastle
Groundwater Monitoring Well Locations

CH2MHILL

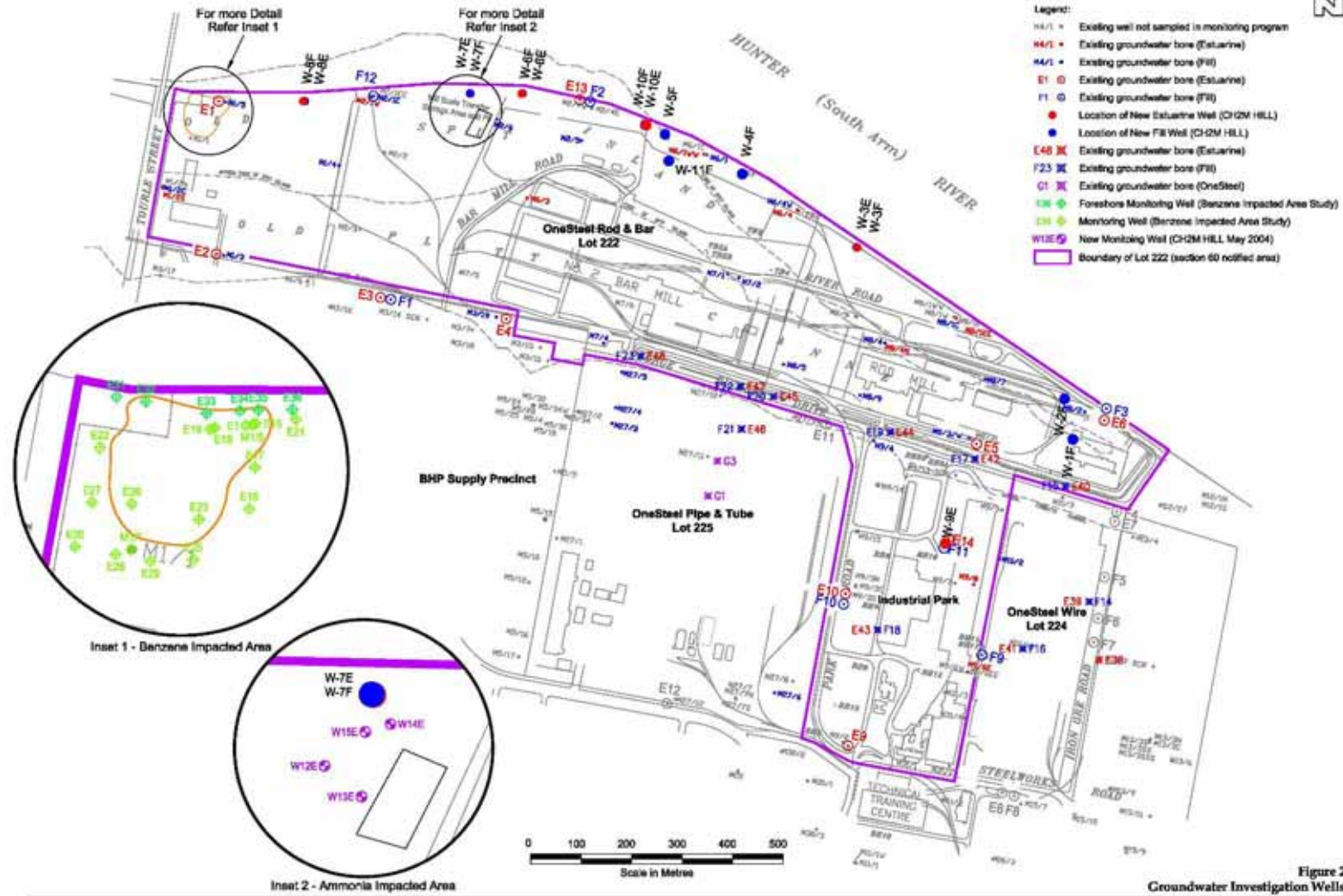


Figure 17: Existing Groundwater Monitoring Well Network (Ref 18, September 2007)

Groundwater on Adjacent Sites

Groundwater monitoring has occurred in the past on Lot 223, DP 1013964, which is located to the south of Lot 222. The northern boundary of Lot 223 is approximately 300 m to 500 m south of the Site F area.

Results summaries were limited for the previous groundwater assessment on Lot 223, however, it is noted that exceedences of the adopted TRH, PAH and metals criteria were observed on the adjacent Lot 223, including exceedences adjacent to the Southern boundary of Lot 222. The regional groundwater flow regime for both the fill and estuarine aquifers is to the north, indicating that groundwater from the adjacent Lot 223 is flowing onto Lot 222 and Site F. The results of EPL groundwater monitoring on the southern boundary of Lot 222 (i.e. to the south of Site F) have also indicated the presence of elevated hydrocarbon contamination.

4.3 Mill Scale Transfer Storage Area and Pit

The following information was provided by OneSteel personnel in relation to the Mill Scale Transfer Storage Area and Pit, located within the eastern portion of Site F, as shown on Drawing 7.05 in Appendix B. The Mill Scale Transfer Storage Area is used for temporary storage of “mill scale” (oxidised steel). Mill scale was originally delivered in a slurry form, which contained elevated ammonia, that resulted in localised ammonia impact on groundwater.

The current procedure for mill scale storage comprises dewatering (removal of up to 95% water) prior to temporary storage in stockpiles overland. The ‘mill scale’ is then sold for beneficial use (recycling).

A significantly lower volume of mill scale has been temporarily stored since 2008 (ie since shutdown of the Bar Mill). Mill scale generated by the Rod Mill is currently stored temporarily in this area.

The pit located within the “mill scale” area (known as 245 road pit), was utilised for the collection of runoff from the mill scale stockpiles, and for maintenance/cleaning of equipment and processing/handling of wastes (ie “dirty work”) associated with former steelworks activities. The pit was not lined and was a couple of metres deep. It is understood that previous investigations within the area identified ammonia and hydrocarbon impact in groundwater.

The volume of mill scale temporarily stored in this area has reduced significantly, together with a significant reduction in the water content of mill scale due to dewatering. In addition, “dirty work” is no longer conducted within 245 road pit, so the potential for additional impact on groundwater has been significantly reduced.

Effluent Treatment Plant (ETP) Filter Cake is temporarily stockpiled east of the Mill Scale Area adjacent to the Site F boundary prior to disposal to a licensed facility (Refer to Photo 10 and orange area on Drawing 7.05). The filter cake comprises an orange metal hydroxide dust, with elevated total lead concentrations and low leachability characteristics. The material is currently stored on-ground immediately south west of the Mill Scale area. It was also stored further west within the Site F area in the early 2000's as shown on Drawing 7.05 in Appendix B.

Various materials were stored in the vicinity of Site F, including slag, manganese (additive in steel making), coal and washery reject, metal spares / equipment, metal scrap, rail dolomite (used in lime kiln to product burnt lime).

4.4 Summary of Previous Investigation Findings

Based on the available information, a summary of maximum groundwater and soil concentrations within Site F are presented in Table 4 below.

Table 4: Maximum Observed Concentrations in Groundwater and Soil in Target Areas

Contaminant	Groundwater						Soil		
	ANZECC Criteria	Benzene Area	Benzene Area - Seeps	Benzene Area – Foreshore	Mill Scale Area	Site F - General	Commercial/Industrial Landuse Criteria	Benzene Area	Site F - General
TRH (C ₆ -C ₃₆)	NC	197.72	0.985	1.246	3.19	3.92	1000	-	-
Benzo(a)pyrene	0.0001 ^L	-	0.00116	-	-	0.00026	5	251	-
Naphthalene	0.05	55.3	-	0.205	-	-	NC	32900	-
Phenanthrene	0.0006 ^L	0.013	-	0.0028	-	0.0013	NC	-	-
Anthracene	0.00001 ^L	0.0009	-	0.0037	-	0.0002	NC	-	-
Fluoranthene	0.001 ^L	0.0054	-	-	-	-	NC	-	-
Total PAH	-	83.007	0.12045	-	-	-	100	44759	-
Ammonia	0.91	-	-	-	23.2	6.7	NC	-	-
Benzene	0.5	147	-	-	-	-	1	5100	-
Toluene	0.18 ^L	1	-	-	-	-	1.4/130 ¹	570	-
Ethylbenzene	0.08 ^L	1	-	-	-	-	3.1/50 ¹	-	-
Xylene	NC	2.02	-	-	-	-	14/25 ¹	97	-
Phenols	0.4	2.04	-	-	-	-	42500	-	-
Arsenic	0.0023 ^L	-	-	-	0.009	0.005	500	-	-
Cadmium	0.0007	0.0321	-	0.032	-	-	100	-	-
Chromium	0.0044	-	-	0.027	-	0.008	500	-	-
Copper	0.0013	0.006	-	0.038	0.002	0.002	5000	-	-
Lead	0.0044	-	-	-	-	-	1500	-	90
Mercury	0.0001	-	-	0.0004	-	-	75	-	-
Nickel	0.007	-	-	0.009	-	-	3000	-	-
Zinc	0.015	1.92	0.03	0.25	0.028	0.03	35000	-	-
Manganese	0.08 ^L	4.08	1.170	1.92	0.399	-	7500	-	87000
Iron	NC	-	2.37	-	-	-	NC	-	-
Aluminium	0.0005	-	-	-	-	-	NC	-	12000
Vanadium	0.1	-	-	-	-	-	NC	-	350

Notes to Table 4:

All results in mg/L (Groundwater), and mg/kg (Soil)

ANZECC Criteria – Trigger levels from Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) – (Ref 24)

Commercial/Industrial Landuse Criteria – Guidelines for the NSW Site Auditor Scheme 2nd Edition April 2006 (Ref 22), NSW EPA Guidelines for Assessing Service Station Sites, December 1994 (Ref 26)

L – Low Reliability ANZECC Trigger Level

1 – Human health based protection level

Based on information made available at the time of preparing this report.

On the basis of the above reviews, the main areas of contamination that could impact development over Site F are as follows:

- Groundwater benzene plume area and associated seeps;
- Ammonia and hydrocarbon impact associated with the mill scale area and pit;
- Filter cake storage areas within and adjacent to Site F;
- General site fill materials comprising steelworks wastes; and
- General groundwater and surface water quality within and migrating towards Site F.

4.5 Geology and Hydrogeology

4.5.1 Geology

Site F is located on the lower reaches of the Hunter River. The site was formed by the reclamation of former mudflats within features known as Platts Channel and Spit Island. Drawing 7.03 in Appendix B shows the landform in 1954 (aerial photo) prior to any substantial reclamation, with the T4 project area boundaries.

Reference to the 1:100 000 scale regional geology map for Newcastle (Newcastle Coalfield Regional Geology, Sheet 9321, NSW Department of Mineral Resources) indicates that the geology at the site comprises Permian aged Tomago Coal Measures overlain by Quaternary alluvium. The Tomago Coal Measures comprise shale, siltstone, sandstone, conglomerate and coal. No recorded geological faults have been identified directly beneath Site F.

As discussed in Section 1.5, the site contains extensive fill materials resulting from the reclamation of the area using steel making wastes and from dredging activities.

The acid sulphate soil risk map for Newcastle indicates that there is a high probability of occurrence of acid sulphate soils within bottom sediments of the Hunter River. The land area associated with the Site F development is indicated as disturbed terrain due to reclamation.

4.5.2 Stratigraphy

The following section describes the general stratigraphy at Site F based on previous site investigations. DP has adopted similar terminology for the various soil units, as defined in various investigations for the T4 Project, for purposes of continuity and consistency.

Unit 1: Filling

Review of historical information indicates that Site F has been filled, with current surface levels in the range 5 m to 7 m NHTG. Experience on adjacent sites indicates that fill material may have included dredged sand, blast furnace slag, fly ash and coal washery reject, and various other steel making wastes.

The base level of the fill is generally in the range 1.0 NHTG to 2.0 NHTG and therefore the thickness of the fill is likely to be in the range 3 m to 6 m.

Unit 2: Upper Soft Soil

The filling is generally underlain by a soft to firm compressible natural clay unit, designated Unit 2. The thickness of the unit typically varies from approximately 1 m to 4 m.

Unit 3: Lower Sand

The Unit 2 clay is underlain by sand. On adjacent sites this unit can vary from several metres, to up to approximately 30 m thick.

Unit 4: Deep Clay

The dense sand is generally underlain by a "deep clay" unit which generally comprises stiff medium to high plasticity clay and occasionally lower plasticity sandy clay. In places, deep clay contains interbeds of dense to very dense sand and gravel layers.

Unit 5: Bedrock

The alluvial soils are underlain by bedrock comprising siltstone, sandstone and coal.

4.5.3 Hydrogeology

Aquifers

Groundwater beneath Site F is generally present in two principal aquifers: an upper unconfined aquifer within the Unit 1 fill strata (known as the Fill Aquifer), and a semi-confined aquifer within the Unit 3 estuarine sediments (known as the Estuarine Aquifer). Unit 2 soft natural clays are expected to form a 'leaky' aquitard that separates these aquifers.

The aquifers and aquitard are described in the sub-sections below.

Fill Aquifer (Unit 1 Filling)

A Fill Aquifer (Unit 1) is expected to be present at the surface and therefore would be unconfined. A Fill Aquifer is expected to be present across the extent of Site F and is likely to continue to the south, to the mapped southern extent of the disturbed ground, a distance of about 300 m to 600 m, as well as for several kilometres to the east and west following the southern bank of the Hunter River.

The Fill Aquifer is expected to be recharged primarily by rainfall. Groundwater flow within the aquifer is expected to be primarily sub-horizontal, generally from south to north, discharging to the Hunter River, however, some vertical leakage would be expected to occur through the underlying 'leaky' clay aquitard.

Within Site F, groundwater is expected to inflow from the south, along the southern boundary and discharge to the Hunter River along the northern boundary of the site. Rainfall recharge as well as some leakage to the underlying aquifer will occur across the site, probably with an overall slight net increase in horizontal flow at the northern boundary compared to the inflow at the southern boundary.

Clay Aquitard (Unit 2 Clay)

The Unit 2 clay is expected to form an aquitard between the Fill and Estuarine Aquifers. The permeability of the aquitard is generally relatively low, however, still sufficient to allow some vertical flow from the Fill Aquifer to the underlying Estuarine Aquifer. In places the Unit 2 Aquitard is known to be absent (for example at the main part of the T4 project area on Kooragang Island to the north) and it is possible that the Aquitard may be absent on part of Site F.

Estuarine Aquifer (Unit 3 Sand)

The Estuarine Aquifer is generally confined, which means that there is no free water table within the layer, and the phreatic surface (the height at which a water table would form in a bore connected only to the Estuarine Aquifer) would be above the base of the overlying clay aquitard. The phreatic surface, however, is generally below the water table in the Fill Aquifer, thereby allowing vertical flow from the Fill Aquifer to the underlying Estuarine Aquifer. The sand within the Estuarine Aquifer is characterised by generally moderate to high permeability.

The overall extent of the Estuarine Aquifer would be expected to be similar to the fill aquifer, extending about 300 m to 700 m to the south as well as to the east and west.

This Estuarine Aquifer is expected to be recharged primarily by leakage from the Fill Aquifer above. Groundwater flow within the aquifer is expected to be primarily sub-horizontal, generally from south to north, discharging to the Hunter River.

Within Site F, groundwater is expected to inflow from the south, along the southern boundary and discharge to the Hunter River beyond the northern boundary of the site.

General Conceptual Groundwater Flow Model

The conceptual groundwater flow model can be summarised as follows:

- Groundwater flows into Site F from the south within both the Fill and Estuarine Aquifers;
- Rainfall infiltrates vertically into the Fill Aquifer;
- Sub-horizontal flow occurs in the Fill Aquifer, draining towards the revetment along the south bank of the Hunter River;
- Vertical percolation occurs through a Clay Aquitard from the Fill Aquifer to the Estuarine Aquifer; and
- Sub-horizontal flow occurs within the Estuarine Aquifer, draining to the bed of the Hunter River to the north of Site F.

4.6 EPA Notices

A review of publicly available information was undertaken for the Mayfield OneSteel site. The public register of EPA notices indicated three notices have been issued for the OneSteel Mayfield site under the *Contaminated Land Management Act 1997*. These notices are listed and summarised in Table 5 below.

Table 5: EPA Notices for Site F

Notice No.	Date	Title	Site Identification
15008*	14/6/2001	Declaration of Investigation Area	Lot 222 DP 1013964 (Rod and Bar Mills); Hunter River bed sediments which fall within 120 m of the land-based boundary of the Rod and Bar Mills
16003	22/6/2005	Notice to end declaration	Lot 222 DP 1013964 (Rod and Bar Mills); Hunter River bed sediments which fall within 120 m of the land-based boundary of the Rod and Bar Mills
19033	31/10/2007	Agreement not to Issue Order During Compliance with a Voluntary Proposal	Part Lot 222 DP 1013964 comprising an area of 8,200 m ² delineated by the Benzene Impact Area in Figure 1 of the notice

Notes to Table 5:

* notice was ceased on 22 June 2005 in accordance with Notice 16003 and Section 16 of the Contaminated Land Management Act 1997, however, Declaration Investigation Area 15008 is still in force as it applies to the benzene impacted areas in the northwest of Lot 222 and the sediments adjacent to the OneSteel site

EPA Notice 15008 – Declaration of Investigation Area, dated 14 June 2001

The EPA declared Lot 222 DP 1013964, known as the Rod and Bar Mills, and the bed sediments within 120 m from the boundary to be an investigation area. The substances believed to be contaminating the site comprise Petroleum Hydrocarbons including BTEX, PAHs, metals, cyanides and ammonia. The agreement notes these contaminants are typically associated with a long history of industrial steel processing operations at rod and bar mills. It also notes the confirmed presence of benzene contamination and reported seeps into the Hunter River.

The notice applied to the whole of the OneSteel site (Lot 222 DP1013964) which was considered to have a “significant risk of harm”. The notice does not include any borehole data or test results.

EPA Notice 16003 – Notice to End Investigation, dated 22 June 2005

Contamination Investigations conducted at the site between 2001 and 2004 were reviewed by the EPA and as a result Notice 16003 ended the declaration for most of Lot 222 which was considered to no longer present a “significant risk of harm”. Notice 16003 excludes both the Benzene Area in the northwest portion of the site and the Hunter River bed sediments adjacent to the site within 120 metres from the northern site boundary which remains as an investigation area covered by License 15008. The notice does not include any borehole data or test results. A plan showing the extent of the Benzene Area is shown in Figure 18 below.

EPA Notice 19033 – Agreement not to Issue Order during Compliance with a Voluntary Proposal, dated 31 Oct 2007

Notice 19033 relates to the Benzene Area and includes OneSteel’s “Revised Voluntary Investigation Proposal” dated September 2007. The purpose of the proposal was to assess the natural attenuation of the Benzene Impacted Area and confirm there has been no significant off site impact. It further notes that the remainder of the site (Lot 222) was previously covered by a separate Voluntary Investigation Proposal, subsequently ended by notice 16003 above.

Section 1.4 of this agreement notes “groundwater in the estuarine aquifer within the Benzene Impacted Area is contaminated with benzene and PAHs including naphthalene. There is currently no significant offsite migration of contaminants into the Hunter River as demonstrated by the relevant background reports”.

The voluntary proposal included groundwater sampling and testing of the following analytes:

- Selected Inorganics (Total Iron, Ferrous Iron, Manganese, Copper, Zinc);
- Total Petroleum Hydrocarbons (TPH C₆-C₃₆);
- Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX);
- Ultra Trace Polycyclic Aromatic Hydrocarbons (PAHs);
- Ultra Trace Phenols;
- Major Cations and Anions with calculation of Ion Balance;
- Nitrate and Nitrite;
- Sulphate;
- Dissolved Carbon Dioxide, Hydrogen Sulphide and Methane; and
- Anilines and Benzidines (including Dibenzofuran).

A detailed review of seeps observed along the foreshore boundary of the Benzene Area, including field observations and analytical testing, were also proposed.

The target completion date for this assessment was 30 June 2008, however no notice of assessment results have been made available on the Record of EPA Notices.

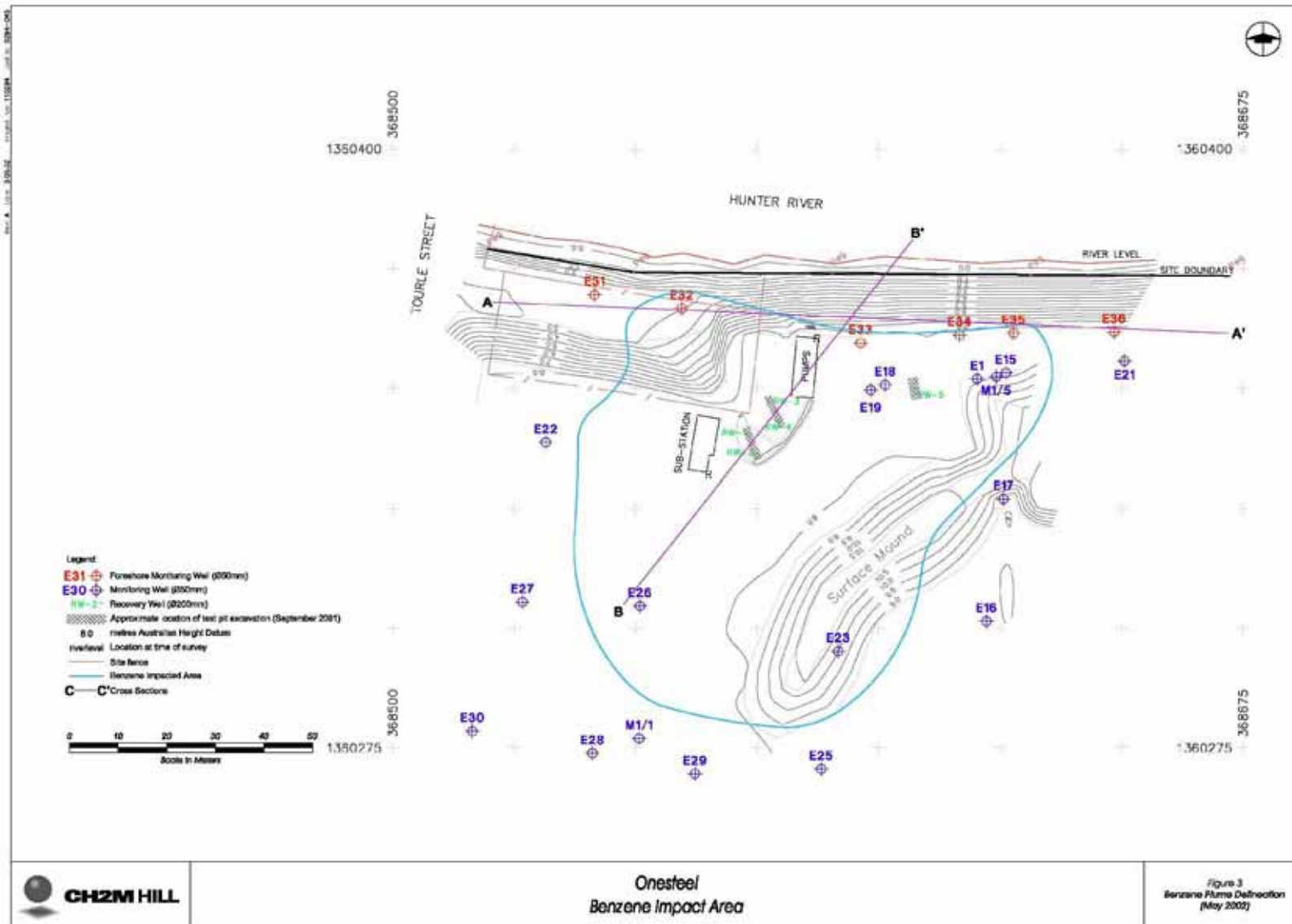


Figure 18: Benzene Impacted Area

5. Assessment of Site Contamination

5.1 Guidelines, Regulation and Policy

5.1.1 Soil

The policy adopted by NSW EPA for the remediation of soil follows the policy adopted by ANZECC/NHMRC (1992) and is set out in section 4.3.2, 4.3.3 and 4.3.4 of the NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme (2nd edition)* (Ref 22). Although this guideline addresses actions site auditors must follow, it is understood that the actions represent the policy of NSW EPA that would be expected to be applied to remediation works at Site F.

The parts of the guideline considered relevant to remediation of contamination at Site F are summarised below.

The site remediation policy (Section 4.3.2 of Ref 22) states that:

“...soil remediation and management is implemented in the following preferred order:

- *On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;*
- *Off-site treatment of the excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;*
- *Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill;*
- *Consolidation and isolation of the soil on-site by containment within a properly designed barrier.*

If remediation is likely to cause a greater adverse effect than leaving the site undisturbed, remediation should not proceed”.

The policy regarding on-site containment and capping (Section 4.3.3 of Ref 22) states:

“...such options should be considered only where other preferred approaches from the ANZECC/NHMRC remediation hierarchy, outlined in Section 4.3.2, are not applicable.

The capping and/or containment strategy must be appropriate for the contaminants of concern. Before endorsing any capping and/or containment proposal site auditors must check that it:

- *Maximises the long-term stability of the capping and/or containment system(s) and any proposed structures above it (from an engineering perspective) and, where applicable, minimises the potential for leachate formation and/or volatilization;*
- *Does not include the erection of structures on the capped and/or contained area that may result in a risk of harm to public health or the environment;*

- *Recommends a notification mechanism to ensure that the capped and/or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier, such as recommending placing a notation or covenant on the property title or a notation on a s.149 certificate or issuing a notice or placing a covenant on the title to land under the CLM Act to require maintenance of remediation action under the Act⁹.*

Section 4.3.4 of Ref 22 deals with contamination at depth, and states that as a general principle, contamination at a site must be remediated to meet the appropriate clean-up criteria through the full depth of contamination and that:

“Clean-up criteria for contaminated soils at depth may differ from the criteria for shallow soils due to differences in exposure opportunities. However, the inhalation of volatile contaminants and the need to protect groundwater require consideration, irrespective of depth. Where clean-up criteria for contaminated soils at depth are different from those for shallower soils, an auditor must consider, in the site audit report, the need for any ongoing management of the contamination at depth in addition to any requirements for managing shallow soil contamination. An auditor must document in their report the rationale supporting the conclusion on this issue”.

Irrespective of the depth of contamination, it is undesirable to leave contamination that may pose an unacceptable human health or environmental risk *in situ* unless the following issues are satisfactorily addressed:

- Investigation has demonstrated that the remaining contamination would not affect the groundwater quality and that any contaminant vapours would not migrate to the surface and pose a risk to human health;
- An environmental management plan has been developed, would be implemented, and can be enforced under relevant laws to ensure that, if the contaminated soil is disturbed, it would be handled in an appropriate manner to avoid any increase in potential risks to human health or the environment; and
- The local planning authority is notified that contamination remains at depth on the site, together with its location, nature and extent, details of the environmental management plan and any other regulatory requirements that relate to the contamination, thus allowing the local authority to record this information, as it considers appropriate, in its property information system for the site, such as s.149 certificates⁹.

5.1.2 Groundwater

The framework for managing groundwater in NSW is summarised in NSW DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination* (Ref23). The sections of these guidelines that are considered to apply to the contamination at a site are discussed below.

Section 1.3 Framework for groundwater management in NSW:

“Legislation and published policies in NSW have articulated key principles for assessing and managing groundwater contamination. These include the principles of ecologically sustainable development, which require the effective integration of economic, social and environmental considerations in decision-making. This can be achieved by implementing:

- *The precautionary principle;*
- *Intergenerational equity;*
- *Conservation of biological diversity and ecological integrity;*
- *Improved valuation, pricing and incentive mechanisms for environmental factors (including the concept of 'polluter pays').*

The groundwater policies set out in 1.3.3 encourage ecologically sustainable development to:

- *Slow and halt, or reverse, any degradation of groundwater resources;*
- *Ensure long-term sustainability of the ecological support;*
- *Characteristics of groundwater systems;*
- *Maintain the full range of beneficial uses of these systems;*
- *Maximise economic benefit to the region, state and nation.*

The policies set out basic principles that should guide the management of groundwater in NSW. In relation to groundwater contamination, these include:

- *Preventing groundwater pollution so future remediation is not required;*
- *Managing all groundwater systems so their most sensitive identified beneficial use (or environmental value) is maintained;*
- *Recognising the cumulative impacts of human activities on groundwater quality;*
- *Replacing processes and practices that degrade groundwater systems, either directly or indirectly, with ecologically sustainable alternatives;*
- *Requiring developments to minimise adverse impacts on the environment by preventing pollution of, or changes in, groundwater quality;*
- *Applying the precautionary principle to protect groundwater dependent ecosystems where scientific knowledge is lacking;*
- *Affording town water supplies special protection against contamination;*
- *Rehabilitating degraded groundwater systems, where practical, to minimise the impacts of contamination on groundwater dependent ecosystems, and to restore the ecosystem support;*
- *Characteristics of groundwater systems.*

DEC would consider the above principles of ecologically sustainable development when exercising functions under the CLM Act, and others managing contaminated groundwater must also implement these principles. These guidelines establish a decision-making framework for addressing groundwater contamination that is consistent with these principles".

Section 3.5.1 "Non-aqueous Phase Liquids" of the Groundwater Guidelines addresses the presence and remediation of these compounds as follows:

“Non-aqueous phase liquids (NAPLs) in the subsurface provide an ongoing source of contamination. NAPLs that are in contact with groundwater constitute groundwater contamination. Where light NAPLs (LNAPLs) or dense NAPLs (DNAPLs) are present in the subsurface, they must be removed or treated as much as practicable. Particular care, however, is required in the assessment and clean-up of DNAPL contamination to prevent mobilisation or an increased rate of dissolution.

Where complete removal or treatment of the NAPL is impracticable, as may be the case with some DNAPLs in complex geological media, ongoing monitoring and management of the contamination is required as a minimum for as long as necessary, to ensure the protection of human and ecological health. Sources and plumes would need to be contained to the maximum extent practicable, and remediation to address the dissolved-phase contaminants may also be required.

A strategy for controlling NAPL contamination should have the following objectives:

- To ensure the protection of human and ecological health;*
- To control further migration of contaminants from subsurface NAPLs to the surrounding groundwater (source control);*
- To reduce NAPL mass to the extent practicable (source removal or treatment).*

It is recognised that clean-up of NAPL contamination can be difficult. For instance, there can be high costs and uncertain benefits in aggressive source zone treatment of some NAPLs. Therefore, the remedial objective for some sites with recalcitrant sources of NAPL may be to contain the source material and prevent or minimise further contaminant migration. Nonetheless, presumptions about the practicability of source zone remediation must keep pace with emergent technology; it should not automatically be assumed that source zone remediation is not feasible. Any assessment that source removal of NAPL contaminants is impracticable should be clearly documented”.

Section 3.6 “*Plume containment*” of the Groundwater Guidelines addresses the requirement to contain plumes of contaminated groundwater as follows:

“In responding to groundwater contamination, one goal is to contain the extent of the contaminant plume, that is, to prevent or minimise further plume migration while other management actions are taking place. Plume containment, as the sole long-term response to groundwater contamination, is generally only acceptable when cleaning up contaminated groundwater is not practicable.

Proponents of long-term containment must demonstrate they have adequately considered all risks posed by the groundwater contamination. Systems must be developed to monitor the effectiveness of the containment in the long term, and contingency plans must be developed if monitoring data shows that the containment is not effective. In this context, the responsibilities for, and resourcing of, long-term management and contingency plans need to be addressed”.

Section 4.3 “Clean-up to the extent practicable” of the Groundwater Guidelines considers the situation where it is considered impracticable to remediate groundwater to restore the protection of all environmental values, this is required to be demonstrated to NSW OEH. Section 4.3 addresses the situation where restoring environmental values is impracticable, which is termed “clean-up to the extent practicable” (CUTEP) as follows:

“Where DEC has decided to regulate the management of contaminated groundwater under Part 3 of the CLM Act, DEC must be satisfied with any remediation plan or proposal for a voluntary remediation agreement. In this context, DEC would consider what is practicable and may seek independent expert verification of any supporting claims. In some cases, it may not be practicable to continue cleaning up the groundwater to the point where all its environmental values are restored. In such instances, when regulating the remediation, DEC may consider proposed interim clean-up goals in consultation with stakeholders.

4.3.1 Demonstrating restoring environmental values is impracticable

If a proponent considers that clean-up to restore the protection of environmental values is impracticable in the future, this must be clearly demonstrated to DEC. The evaluation of practicability should be documented against each factor listed below:

- *Technical capability to achieve the clean-up;*
- *Clean-up costs;*
- *The value of the groundwater resource;*
- *Threats the contamination poses to human or ecological health.*

Proposed clean-up measures should correlate with the value of the groundwater resource and the severity of the contamination. Further, any proposal for the clean-up that argues impracticability must include an acknowledgement that the long-term objective is to restore the protection of all relevant environmental values, and ultimately achieve natural background quality. In such cases, ongoing management and monitoring of the groundwater may be required to ensure the protection of human and ecological health.

In considering the nature of the remediation required for a site, DEC may consider what actions are practicable. If it is impracticable to clean up groundwater to a concentration needed to restore the protection of environmental values, DEC may accept that clean-up to the extent practicable has occurred and that, subject to appropriate ongoing management of exposures to the contaminants and periodic review, further clean-up is not required. However, acute risks from the contamination, such as risks from short-term exposure or a risk of explosion from the accumulation of vapours, must be resolved without delay.

In all cases where clean-up to restore environmental values cannot be achieved:

- *It is still necessary to clean up to the extent practicable, to minimise the impact on environmental values;*
- *Human and ecological health must be protected;*
- *Plume containment should be implemented to prevent the plume from spreading;*
- *Ongoing groundwater monitoring may be required;*

- *The possibility of cleaning up the groundwater contamination should be periodically reassessed to account for emerging technologies;*
- *Provisions are required for long-term resourcing and responsibility for any ongoing management strategy;*
- *Information must be recorded and disseminated.*

In considering the practicability of cleaning up the groundwater contamination, DEC would take into account technical, logistical and financial considerations.

Before DEC agrees to the proposal, it may seek input from DNR on the current and realistic future uses of the groundwater and the implications that residual contamination may have for groundwater resource management. DNR would consider the information provided in a groundwater management plan where long-term restrictions on groundwater use are required.

Where DEC agrees that clean-up to the extent practicable has occurred, this does not remove the proponent's responsibility for ongoing management of the residual contamination. The remediation proposal should be accompanied by:

- *A commitment to ongoing monitoring and re-evaluation of the practicability of clean-up. A satisfactory monitoring and reporting program must be implemented to continually evaluate the contamination;*
- *A groundwater management plan (GMP) that specifies measures which would be implemented to mitigate risks to human and ecological health (see 5.3.2);*
- *Acknowledgement that future management including clean up action may be required by the government to ensure the protection of human and ecological health;*
- *Provision for long-term resourcing and responsibility for any ongoing management strategy.*

Any ongoing management actions may be enforceable through statutory means such as a regulatory instrument issued under the CLM or POEO Act⁹.

It is likely that NSW OEH and other stakeholders would expect that remediation of contamination that is acting or has potential to act as a source of contamination of groundwater and surface water would be remediated or managed so that contamination of groundwater does not occur. Remediation or management is therefore required to be in accordance with the policy and guidelines referred to above.

It is expected that Non-aqueous Phase Liquids (NAPLs) - both Light Non-aqueous Phase Liquids (LNAPLs) and Dense Non-aqueous Phase Liquids (DNAPLs) would be required to be managed or remediated so that they do not pose an unacceptable risk to contaminate groundwater or surface water.

It is also expected that substances that have a high potential to contaminate groundwater, such as benzene, aqueous sludges, oil sludges, tar waste and waste oil would be expected to be managed and/or remediated as part of the T4 Project development, including on Site F. Each of the potential contaminants, if present on the T4 project area, would be required to be addressed in the groundwater assessment program if they pose a potential risk to groundwater quality or surface water quality.

5.1.3 Guideline Documents

Assessment of site contamination has been undertaken with consideration of the following NSW OEH (EPA) recommended guidelines:

- ANZECC (2000) “*Australian and New Zealand Guidelines for Fresh and Marine Water Quality*” (Ref 24);
- NSW DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination* (Ref 23);
- NSW DECCW (2009) “*Waste Classification Guidelines, Part 1: Classifying Waste*”, December 2009 (Ref 25);
- NSW EPA (1994) – Guidelines for Assessing Service Station Sites, December 1994 (Ref 26);
- NSW EPA (2000) “*Guidelines for Consultants Reporting on Contaminated Sites*” (Ref 27);
- NSW DEC (2006) “*Guidelines for the NSW Site Auditor Scheme, 2nd edition*” (Ref 22), which contain National Environmental Health Forum (NEHF) levels for various beneficial use scenarios including: low density residential (A), high density residential (D), recreational (E) and commercial/industrial (F). These criteria are applicable where aesthetic and ecological concerns are not an issue.

5.2 Environmental Protection Licences

In accordance with the *Protection of the Environment Operations Act 1997*, the POEO Register contains details of EPLs which are publicly available. The OneSteel site is currently the subject of an EPL issued by OEH. The licence prescribes the permitted waste disposal activities, environmental monitoring and reporting requirements. Of particular interest are the groundwater and surface water monitoring requirements and notices of any breaches of licence conditions. Table 6 lists the relevant licence, permitted waste and number of water monitoring locations for Site F.

Table 6: Environment Protection Licences (Archive date 5 July 2011)

Licence No	Date of Most Recent Variation	Licensee	Site Identification	Permitted Waste	Number of Required Water Monitoring Locations
11149	5/7/2011	OneSteel Wire Pty Ltd	OneSteel – Newcastle Market Mills, Industrial Drive, Mayfield	Mill Scale (General Solid Waste) General or Specific Exempted Waste	36 Groundwater 3 Discharge points

EPL 11149 applies for the following activities:

- Metallurgical activities;
- Waste storage;
- Waste processing (non-thermal treatment);

- Other types of waste;
- Metal processing;
- Metal coating;
- Metal waste generation; and
- Scrap metal processing.

Three discharge points (Points 1, 39 and 40) are required to be tested for the following analytes:

- pH,
- Temperature;
- Oil and Grease;
- Nitrogen (Ammonia);
- Total Suspended Solids;
- Phosphate;
- Total Iron;
- Total Zinc;
- Total Copper;
- Total Manganese;
- Total Lead; and
- Chromium (hexavalent).

As part of the licence conditions, there is a requirement to monitor concentrations of pollutants in groundwater at well locations specified in the licence. Groundwater parameters to be monitored comprise:

- TPH;
- BTEX;
- PAHs;
- Heavy Metals (Cadmium, Chromium (hexavalent), Copper, Manganese (dissolved), Lead (dissolved), Zinc (dissolved) and Mercury (dissolved));
- Ammonia as N;
- Phenols; and
- Cyanide.

OEH requires an annual report presenting the monitoring results, along with a comparison with previous monitoring and the relevant ANZECC 2000 water quality guidelines.

The licence also states a record of contaminated soils must be established and maintained on the site, which includes a map showing locations of soil disturbance or other materials below the ground that may expose contamination. Precautions must be taken to prevent unauthorised persons from accessing soil below the ground that is contaminated or disturbing contamination below the ground surface. Any authorised disturbance needs to be monitored and recorded in detail as specified in the licence.

A review of the results of some groundwater monitoring undertaken as part of the licence conditions at the site is presented in Section 4.2.

6. Contamination Issues and Implications

6.1 Extent of Contamination

Based on EPA Notices 15008, 16003 and 19033, historical industrial landuse and the review of the supplied reports, Site F contains soil, groundwater and surface water contamination to various degrees as follows:

- Soils:
 - Elevated contaminant levels due to extensive filling with industrial wastes, and possible leaks / spills associated with former site activities;
 - Possible contamination within natural clay sediments within Site F, likely to be a result of placement of wastes from previous coking activities at the site; and
 - Possible near-surface soil impacts associated with former site uses (stockpiling of wastes).
- Groundwater:
 - Presence of a benzene plume which is regulated under EPL11149;
 - Possible floating product within the benzene plume;
 - Presence of ammonia and hydrocarbon impact in groundwater associated with the Mill Scale storage area and pit;
 - Impacts on groundwater within Site F associated with extensive filling with industrial wastes, leaks/spills from former site activities and regional groundwater quality;
 - Potential migration of contaminated groundwater from sites adjacent to Site F; and
 - Potential migration of impacted groundwater towards the Hunter River, as evidenced by the reported historical seeps (benzene plume area).
- Surface Water:
 - Presence of impacts on surface waters associated with stockpiles and buried industrial wastes; and
 - Potential migration of impacted waters towards the Hunter River via stormwater drains.

Contamination issues have also been identified within the previously investigated Kooragang Island T4 project area to the north of Site F. Identified contamination issues at the T4 project area include soil and groundwater impact associated with historical site filling, historical use of the area for waste disposal and industrial use. Given the similar historical use of Site F, similar potential contamination is present within Site F.

The principal contaminants within Site F are benzene, PAHs (including naphthalene), petroleum hydrocarbons, phenols, metals, cyanide and ammonia. Based on knowledge of historical filling of the site, historical industrial activity and similar site activity to adjacent sites with identified contamination issues, the possibility of additional organic and inorganic contaminants within Site F cannot be discounted.

6.2 Implications of Contamination

The potential for site disturbance due to the T4 Project at Site F is predominantly associated with sheet piled wall construction at the riverfront, piled foundations for various infrastructure, and near surface development of pavements, slabs etc. Bulk excavations for wharf construction are not proposed. In addition, bulk excavations are not proposed in the vicinity of the benzene area, nor the mill scale area that is known to contain elevated ammonia and hydrocarbon impact.

Piled foundations for the transfer station which is proposed within the benzene plume area (refer to Drawing 7.05 in Appendix D) may generate minor quantities of impacted spoil, depending on the method of piling.

Due to the presence of elevated volatile contamination within the benzene plume area, the risk of vapour intrusion is required to be considered during design construction and operation of the proposed facility. Further investigations are required to determine the nature and extent of vapour intrusion risks associated with the benzene plume area (if any).

Large scale disturbance of soil is not anticipated due to the absence of bulk excavation for wharf construction. All materials excavated during construction can be appropriately managed to minimise the risk to human health and the environment, during and following construction activities.

During works proposed to be conducted on Site F, localised remediation/removal of near surface soils (i.e. filter cake, mill scale, and other stockpiled industrial wastes) will be required, together with capping and management of existing waste fill materials at the site.

In summary, the following implications of contamination have been identified for the T4 development with Site F:

- Localised disturbance of impacted soils within the benzene plume area due to piled foundations;
- Potential vapour intrusion associated with the transfer house development over the benzene plume area;
- Localised disturbance of soils along the riverfront for wharf construction, including soils in the vicinity of ammonia/hydrocarbon impact (Mill Scale storage area and pit); and

- Localised disturbances of near-surface soils for the development of surface infrastructure (ie pavement, slabs, services etc).

Any disturbances of site soils will require management according to normally implemented practices during construction. Following construction, the area will be essentially capped to manage potential exposure to existing impacted materials, which will be managed by implementation of a Long-term Environmental Management Plan.

7. Review of Remediation Options

To facilitate construction of the T4 Project on Site F, it is anticipated that management of soils, groundwater and surface water will be implemented as follows:

- Where possible, avoid or minimise disturbance of areas of known contamination (e.g. bulk excavations are not proposed for wharf construction, or development of the transfer house within the benzene plume area);
- Manage potential vapour intrusion risks through engineering design and monitoring for the benzene plume area. Subject to the results of further investigations within the benzene plume area, passive or active management of potential vapours may be required for the construction of the proposed transfer house in this location;
- Appropriate management of all materials disturbed / excavated during construction (via an Excavated Material Management Plan);
- Capping of site soils through the construction of the facility; and
- Long term management of site soils, groundwater, and surface water, including on-going groundwater monitoring by implementation of a Long-term Environmental Management Plan.

The management strategies will be confirmed following site-specific investigations to address human health and environmental risks associated with existing site conditions and the proposed T4 development within Site F. The strategies will then be documented in a Remediation Action Plan (RAP).

8. Conclusions

Site F presents a number of environmental challenges associated with contamination of soil and groundwater which are able to be managed effectively by implementing appropriate readily available and robust remediation measures during construction of the T4 Project. The soil, groundwater and surface water contamination issues identified on Site F can be remediated to the extent required to allow construction of facilities on Site F by implementation of appropriate Construction Environmental Management Plans during construction activities, and management of any residual contamination by implementation of a Long-term Environmental Management Plan during the operation of the completed stages of the T4 Project.

As part of the Long-term Environmental Management Plan, a groundwater monitoring program will be implemented to address existing EPL conditions, and general groundwater quality associated with Site F. The EMPs are an important element of the adopted remediation procedures to ensure that the effectiveness of the remediation works are monitored and maintained during operation of Site F, as part of the T4 Project.

To address site specific issues and to formulate the proposed remediation strategies required for the construction of facilities on Site F, the following program is proposed:

- Additional subsurface investigation across Site F, comprising collection of soil samples and installation of additional groundwater monitoring wells in the fill and estuarine aquifers;
- Analysis of soil and groundwater samples for a range of targeted organic and inorganic contaminants;
- Assessment of vapour intrusion risks associated with development within the benzene plume area;
- Classification of soils for disposal and/or reuse;
- Assess the nature and extent of contamination specific to Site F and confirm suitable remediation management options; and
- Preparation of an RAP.

Further site-specific investigation relating to risks posed by development on Site F is required. It is understood that development over Site F is not likely to commence until 2017, due to staging of construction for the T4 Project. There is therefore sufficient time to undertake the relevant investigations and confirm remediation requirements.

Based on the review of available information and the understanding of potential contamination and remediation options, it is expected that the proposed T4 Project within Site F could be undertaken in a manner which would reduce environmental risks, and protect human health and the receiving environment (i.e. Hunter River) using one of or a combination of remedial methods that have been assessed as being suitable to be employed on the parts of the T4 Project located on Kooragang Island.

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10. Limitations

DP has prepared this report for the T4 Project in accordance with DP's proposal NCL100317 Rev 1 dated 26 July 2010 and Consultancy Agreement with PWCS dated 4 August 2010. The report is provided for the exclusive use of PWCS for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results of previous investigations referred to in the report are considered to be indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences.

DP's advice is based upon the review of EPA Notices 15008, 16003 and 19033, and the supplied reports. Specific subsurface investigation was not conducted for the above assessment.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawing 7.01 – Site Location Plan
Drawing 7.02 – 1954 Aerial Photo
Drawing 7.03 – 1984 Aerial Photo
Drawing 7.04 – Proposed Development
Drawing 7.05 – Site F Layout

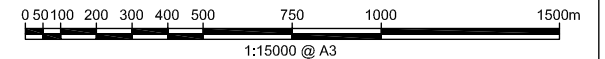


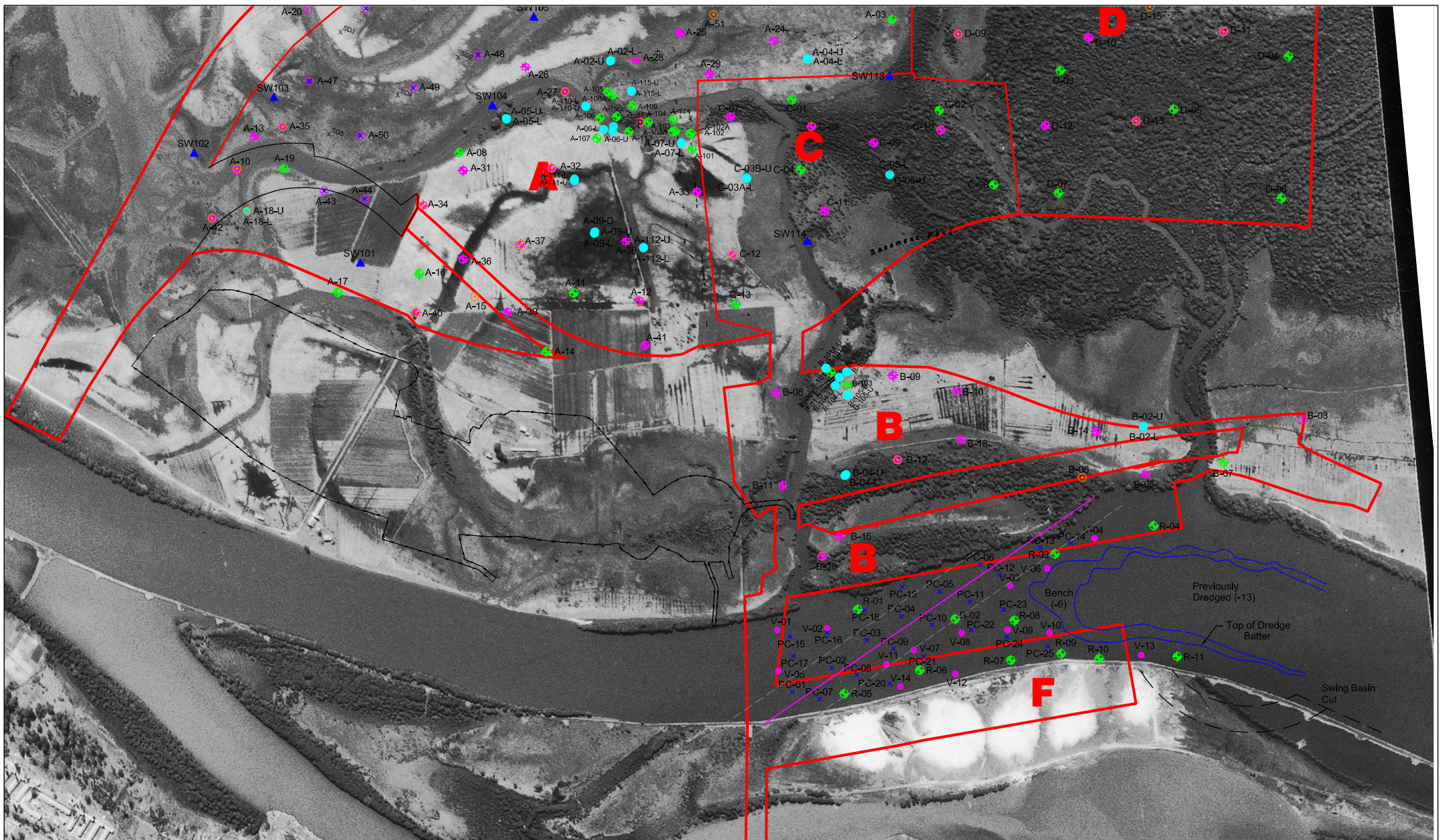
LEGEND

- Approximate T4 Project Area
- B Site Designation
- K5 Area Number
- 1 Pond Number
- Cell 2 FDF Cell Number

Drawing based on Aerial Photograph dated 17.09.11

* - Indicates naming convention adopted for the purposes of the T4 Project investigation



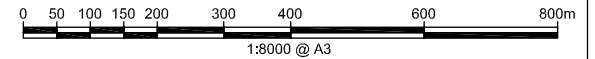


LEGEND

- NCIG RAILWAY EASEMENT
- 2009 SURFACE CONTOUR (m AHD)
- ▭ BOUNDARY OF T4 SITE

CURRENT TESTS

- TEST BORE LOCATION
- TEST BORE AND WELL LOCATION
- CPT (Standard)
- CPTu (Piezocone)
- VIBROCORE
- TEST PIT
- PUSH CORE
- APPROXIMATE SURFACE WATER SAMPLE LOCATION



DRAWING ADAPTED FROM SURVEY PLAN BY CONNELL HATCH REF NO: HW00-00-C-61-600 DATED 29/03/06 AND SURVEY FROM PWCS REF KOORAGANG RAIL 0.5m CONTOURS 2009/04, AND 1954 AERIAL PHOTO NSW 252-5069



CLIENT: Port Waratah Coal Services Limited	
OFFICE: Newcastle	DRAWN BY: PLH
SCALE: 1:8000@A3	DATE: 31.01.2012

TITLE: 1954 Aerial Photo - T4 Project Area Summary of Contamination Issues - Site F Proposed Terminal 4 Project, Mayfield
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PROJECT No: 49533.02
DRAWING No: 7.02
REVISION: 3