

	REPORT No: EN.1591.61.PR034	Rev: 0
GROUNDWATER CLEANUP PLAN PROGRESS REPORT NO. 24		

Orica Australia Pty Ltd  
16-20 Beauchamp Road  
Matraville NSW 2036 Australia  
Tel (02) 9352 2360  
Fax (02) 9352 2361

## GROUNDWATER CLEANUP PLAN PROGRESS REPORT No. 24

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### REVISION 0

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### REVISION HISTORY

REV	STATUS	DATE	PREPARED	CHECKED	AUTHORISED
0	Final	30 November 2009	S Corish	J Fairweather	B Crowe

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**LIST OF ACRONYMS**

<b>ACRONYM</b>	<b>DEFINITION</b>
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
ANZECC	Australia and New Zealand Environment and Conservation Council
BAF	Biological Aerated Filter
BEW	Botany Environment Watch
BEREPA	Botany and Eastern Region Environment Protection Agency
BGC Project	Botany Groundwater Cleanup Project (hydraulic containment and treatment project as described in the EIS)
BGL	Below ground level
BGP	Botany Groundwater Project (entire set of activities pertaining to Orica's contamination of the BIP and environs)
BIP	Botany Industrial Park
BP	Bundle piezometer
CFM	Chloroform (trichloromethane)
CHC	Chlorinated hydrocarbon
cis-1,2-DCE	cis-1,2-dichloroethene
CoBB	City of Botany Bay
COPC	Chemical of potential concern
CPRC	Community Participation and Review Committee
CTC	Carbon tetrachloride (tetrachloromethane)
CLC	Community Liaison Committee
DEC	Department of Environment and Conservation, incorporates the EPA and is now DECCW
DECC	Department of Environment and Climate Change, formerly DEC
DECCW	Department of Environment, Climate Change and Water, formerly DECC
DIPNR	Department of Infrastructure, Planning and Natural Resources (former NSW Government department, separated into DoP and DNR)
DNAPL	Dense non-aqueous phase liquid
DNR	Department of Natural Resources (formerly part of DIPNR and DWE, now the relevant the section is incorporated in the NSW Office of Water, which is part of DECCW)
DWE	Department of Water and Energy
DoD	Department of Defence
DoP	Department of Planning (formerly part of DIPNR)
EDC	Ethylene dichloride (1,2-dichloroethane)
EDO	Environmental Defender's Office
EIAD	Environmental Impact Assessment Document
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environmental Protection Licence
EP&A Act	Environment Planning and Assessment Act
GAC	Granular activated carbon
GCP	Groundwater Cleanup Plan
GEEA	Groundwater Extraction Exclusion Area
GIR	Groundwater Injection and Recovery

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<b>ACRONYM</b>	<b>DEFINITION</b>
GTA	General Terms of Approval
GTP	Groundwater Treatment Plant
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HHRA	Human Health Risk Assessment
IMC	Independent Monitoring Committee
ISCO	In Situ Chemical Oxidation
JBS	JBS Environmental Pty Ltd, an environmental consultancy
KBR	Kellogg, Brown and Root Pty Ltd, Engineering Contractor for many sub-projects of the BGP
KMH	KMH Consulting Pty Ltd, independent compliance auditor for the BGP
MoU	Memorandum of Understanding
NCUA	Notice of Clean Up Action
NHMRC	National Health and Medical Research Council
NSW	New South Wales
OEMP	Operational Environmental Management Plan
PCA	Primary Containment Area
PCE	Perchloroethylene (tetrachloroethene)
PFM	Planning Focus Meeting
PHA	Preliminary Hazard Analysis
PRP	Pollution Reduction Program
PVDF	Poly vinylidene fluoride
QRA	Qualitative Risk Assessment
RAP	Remedial Action Plan
REF	Review of Environmental Factors
RO	Reverse osmosis
RTA	Roads and Traffic Authority
RWG	Regulatory Working Group
SCA	Secondary Containment Area
SCW	Scheduled Chemical Waste
SEPP	State Environmental Planning Policy
SESPHU	South East Sydney Public Health Unit
SPC	Sydney Ports Corporation
SSU	Steam Stripping Unit
SWC	Sydney Water Corporation
TBA	To be advised
1,1,2,2-TeCA	1,1,2,2-Tetrachloroethane
1,1,2-TCA	1,1,2-Trichloroethane
1,2,4-TCB	1,2,4-Trichlorobenzene
1,2,4,5-TeCB	1,2,4,5-Tetrachlorobenzene
TCE	Trichloroethene
TO	Thermal Oxidiser
TOC	Total Organic Carbon
TWA TLV	Time Weighted Average Threshold Limit Value
TWSA	Trade Waste Service Agreement
URS	URS Australia Pty Ltd, Orica's principal environmental consultant on BGP
VC	Vinyl chloride (chloroethene)
VMP	Voluntary Management Plan
VOC	Volatile organic compound
VSD	Variable speed drive

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### **EXECUTIVE SUMMARY**

The NSW Environment Protection Authority (EPA), now part of the Department of Environment, Climate Change and Water (DECCW), issued Orica Australia Pty Ltd (Orica) with Notice of Clean Up Action (NCUA) No. 1030236 on 26 September 2003, under the Protection of the Environment Operations (POEO) Act 1997.

This document is the twenty-fourth report submitted in accordance to NCUA Condition 4G. The reporting interval for this report is 1 July to 30 September 2009, however if more recent and relevant information is available it is also included.

Orica engaged URS to complete a quarterly monitoring event in September 2009 in accordance with the agreed monitoring plan. Results and discussions were provided in the URS report *Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, September 2009*.

### **Hydraulic Containment**

- The inferred contours and patterns of shallow and deep groundwater flow infer that hydraulic containment was achieved at SCA and PCA during the monitoring period.
- Elevated groundwater levels were observed at the SCA in intermediate monitoring wells east of MWF01. Investigations of the cause of the increased levels have been inconclusive at this stage but additional works are ongoing to more fully understand the issue. The increased levels have not resulted in a loss of hydraulic containment but corrective action is required to ensure that the water levels are lowered in the medium term.
- Hydraulic containment was achieved at the central and southern portions of the BIP containment line in the shallow and deep aquifers. Containment was not regularly achieved at the northern portion of the BIP containment line during the monitoring period due to capacity constraints at the GTP. However, this section of the line has lower groundwater contaminant concentrations, and groundwater flow from this area is towards the central portion of the line and groundwater that migrates past the BIP containment line is effectively captured at the PCA.
- Water levels at regional monitoring wells show no discernible water level impact due to hydraulic containment thus indicating a limited potential to affect infrastructure and licensed groundwater users.

### **Chemical Monitoring Results**

While there were various increasing and decreasing trends in CHC concentrations within the Northern, Southern and Central Plumes, the overall inferred CHC distributions as represented by the contours and cross sections are largely similar to those presented previously. The main overall changes in contaminant distribution in September 2009 were as follows:

- Decreasing trends in CHC concentrations within the Southern Plumes between PCA and SCA;

- Stable or increasing trends for some CHCs in deeper groundwater in the Southern Plumes at Southlands;
- Decreasing trends in CHC concentrations within the Central Plume at Southlands;
- Continuing migration of the leading edge of the Central Plume in the vicinity of Botany Road. The leading edge of the Central Plume will be captured at the SCA and will not discharge into Penrhyn Estuary or Botany Bay;
- Increasing concentrations of CHCs at the leading edge of the Northern Plumes at depth, which were in contrast to the stable or decreasing trends in shallow groundwater;
- The decreasing trends in groundwater concentrations of CHCs within the Central Plume on Southlands and at the periphery of the Southern Plumes south of the PCA, are likely to be related to migration of the plume and changing plume dynamics due to groundwater extraction – i.e. pumping at the PCA and SCA has changed groundwater flow directions so that relatively cleaner groundwater is being drawn in towards the plumes from the northwest (Block 2 PCA) and east (eastern edge of Southern Plumes).
- Many of the increases and decreases in CHC concentrations in the Northern, Southern and Central Plumes are likely related to the re-distribution of contaminants due to hydraulic containment. Groundwater flow in areas of flat hydraulic gradients is very slow which implies that contaminant concentrations are unlikely to change in the short to medium term. Variability in CHC concentrations in these areas (and others) can be expected;
- The estimated average concentration for the entire aquifer within PCA has decreased from approximately 550 mg/L in July 2002 to approximately 201 mg/L in September 2009, equivalent to a decrease of approximately 63%. This decrease is reflected in the significant decrease in the average total CHC concentration at the PCA extraction wells from 850 mg/L in June 2005 to 160 mg/L in September 2009;
- Semi-volatile CHC concentrations in groundwater were generally consistent with historical data. HCBd was detected at a low concentration at WG23S and elevated HCBd concentrations were reported at BP61 at depth.

### **Penrhyn Estuary and Surface Waters**

- The change in concentrations of volatile CHCs at BP01, BP115 and MWF15 represent the redistribution of contaminants in groundwater that had passed Foreshore Road prior to commencement of hydraulic containment at the SCA in late-2004.
- Concentrations of the key contaminants at the pore water discharge interface were less than the ANZECC (2000) Trigger Values for all sample locations in Penryhn Estuary.

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- In general, volatile CHC concentrations measured in pore water within Penrhyn Estuary are similar to, or lower than, historical concentrations.
- The concentrations of volatile CHCs in surface waters were less than the respective ANZECC (2000) Trigger Values.
- Semi-volatile CHCs were not detected above the laboratory limit of reporting in Penrhyn Estuary pore water samples collected at low tide and surface water samples.

### **Implications for Human Health Risk Assessment**

- With respect to the western margin of the Northern Plumes, the additional data presented in the September 2009 quarterly monitoring report does not affect the conclusions of the HHRA and Addendum.
- The additional data presented in the September 2009 Quarterly Monitoring Report does not alter the conclusions of the HHRA with respect to existing commercial/industrial workers in areas above the main plumes.
- Data collected from Springvale Drain does not suggest the requirement for more frequent monitoring of ambient air concentrations (currently included in Orica's 15 monthly air sampling program) adjacent to the drain.
- Data collected to September 2009 does not change the conclusions presented within the HHRA associated with exposures within the inner and outer Penrhyn Estuary. That is, given the conservative nature of the range of assumptions and the safety factors applied to toxicity values, the risks to human health for all exposure scenarios are considered to be low. However, the assessment has identified worst-case exposure scenarios (particularly within the inner estuary) where the calculated risks exceed the target values.

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## 1 INTRODUCTION

The NSW Environment Protection Authority (EPA), now part of the Department of Environment, Climate Change and Water (DECCW), issued Orica Australia Pty Ltd (Orica) with Notice of Clean Up Action (NCUA) No. 1030236 on 26 September 2003, under the Protection of the Environment Operations (POEO) Act 1997. Since then the DECCW has issued three variation notices as follows:

<b>Notice under Protection of the Environment Act 1997</b>	<b>Date Issued</b>
Notice of Cleanup Action (NCUA) No. 1030236	26 September 2003
<i>Variation NCUA No. 1033107</i>	17 February 2004
<i>Variation NCUA No. 1042957</i>	7 December 2004
<i>Variation NCUA No. 1052882</i>	2 February 2006

Condition 3 of the NCUA requires Orica to submit a Groundwater Cleanup Plan (GCP) by 31 October 2004 for consideration by the EPA. Condition 3 defines the issues to be addressed in the GCP within timeframes defined in Condition 4. Condition 3(e) defines requirements for a comprehensive monitoring plan, the results of which were to be reported to the EPA (under Condition 4G) on a quarterly basis.

This document is the twenty fourth report submitted in accordance with NCUA Condition 4G. The reporting interval for this report is 1 July to 30 September 2009, however if more recent and relevant information is available it is also included.

Previous reports are available at the relevant section of the website [www.oricabotanytransformation.com](http://www.oricabotanytransformation.com) and a distribution list is provided at the beginning of this document.

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## 2 COMPLIANCE SUMMARY

### 2.1 Notice of Clean Up Action (NCUA)

A summary of the compliance status against current NCUA (including variation notices) condition requirements is provided below. DECCW has advised that the regulation of the Botany Groundwater Cleanup (BGC) Project is currently being reviewed to take into account cleanup progress and recent developments. Orica made a submission to DECCW to outline a proposed way forward and DECCW has agreed that the NCUA can be replaced by a Voluntary Management Plan (VMP). Orica has prepared a draft VMP for review by DECCW (refer Section 2.4).

Cond.	Summary of Requirement	Status	Reference Documents / Comments
3A	Commence preparation of GCP by 30/09/2003	<b>Achieved</b>	Commenced on 26/09/2003
3B	Prepare and submit GCP by 31/10/2003 covering matters listed	<b>Achieved</b>	GCP submitted 31/10/2003. EPA authorisation of GCP on 17/02/2004 by Variation Notice No.1033107.
4A	Commence implementation of GCP by 16/03/2004	<b>Achieved</b>	Work commenced immediately after submission of GCP, in anticipation of its approval.
4B	Commence containment works within primary containment area within 14 days of receipt of all approvals and complete such work within 90 days.	<b>Achieved</b>	Extraction commenced 28/10/2004. Orica letter of 29/10/2004, DECCW letter 10/11/2004.
4BA	At least once every 3 months during GCP implementation report on effectiveness of hydraulic containment works.	<b>Ongoing compliance</b>	Most recent data provided in Section 3.1 of this report.
4C	Complete identification of the locations of the DNAPL sources by 31 May 2004.	<b>Ongoing compliance</b>	Significant DNAPL investigations completed to date and discussed in previous GCP Progress reports. No further work in this reporting period.
4D	Complete containment of DNAPL sources by 30/11/2004.	<b>Achieved</b>	Orica submission regarding compliance submitted 30/11/2004. DEC letter of 06/01/2005 has stated in-principle acceptance and requested further information. Orica submitted requested information on 27/01/2005. DEC provided letter of compliance on 07/09/2005.
4D	Remove DNAPL sources to the maximum extent practicable by 31 October 2005.	<b>Achieved</b>	Progress included in Section 4.3 of this report.
4E	Reduce the concentrations within the primary containment area to the maximum extent practicable by 31/10/2005, with an 80% target on July 2002 levels.	<b>Achieved</b>	Letter of compliance (to maximum extent practicable requirements of the Condition) received on 1 February 2006.
4F	Establish a secondary containment area by 31/10/2004.	<b>Achieved</b>	Commenced extraction 29/10/2004. Orica letter of 29/10/2004, DEC letter of 10/11/2004 (confirmed in DEC letter of 06/01/2005).
4G	Implement monitoring program and	<b>Ongoing</b>	Summary of monitoring program

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
	report at the end of February, May, August and November of each year.	compliance	results for this reporting period provided in Section 3 of this report. Details are provided in Attachment A.
5	Remedial measures to ensure groundwater and surface water flows into Botany Bay and Penrhyn Estuary achieve ANZECC Guidelines for slightly to moderately disturbed ecosystems.	Work in progress	Discussion on latest findings provided in Section 3 and Attachment A of this report.
6	Emission controls from works and measures required by the NCUA strictly controlled through adoption of best practice. Works and operations to be carried out in a controlled and competent manner.	Ongoing monitoring being performed	A discussion on GTP emission compliance provided in Section 5.2 of this report.
7	Orica to make all reasonable attempts to obtain consent for work on premises not occupied by Orica and related companies. Notify EPA within 7 days if refusal to grant access.	<b>Ongoing compliance</b>	Ongoing access to third party premises sought as required.
7A	Updating of GCP to take account of developments.	<b>Ongoing compliance</b>	The GCP remains relevant in terms of the overall groundwater containment and remedial strategy. The strategy is currently under review (see comments on 7E). The Groundwater and Surface Water Monitoring Plan was agreed for 2006 and a revised Plan was submitted and agreed with former DEC (now DECCW) for 2007. In June 2008 Orica, in conjunction with its consultants, submitted a proposal for monitoring from late 2008 to 2010 (URS, 2008). DECCW has agreed to the revised program. A revised Groundwater Remediation and Management Plan (GRAMP) has been submitted for review by DECCW as part of a Voluntary Management Proposal (VMP) (see Section 2.4). If accepted, the GRAMP will replace the current GCP.
7B	Orica to monitor groundwater in any other area likely to have been, or to be, impacted by the contaminants.	<b>Ongoing compliance</b>	The most recent residential bore monitoring round took place in early November 2009.. results will be reported in the next quarterly progress report.
7C	7B monitoring is to: a) Determine the spatial distribution of the contaminants; and b) Monitor changes in the spatial contamination and distribution of the contaminants.	<b>Ongoing compliance</b>	Refer to comments on 7B.
7D	Monitoring results to be provided to the EPA as soon as possible after	<b>Ongoing compliance</b>	Important results are provided to DECCW as soon as possible. The

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
	results become available to Orica.		quarterly progress reports are the primary mode of reporting monitoring data.
7E	Orica must consider best practice technology in the remediation of DNAPL and groundwater containing dissolved phase contamination.	<b>Ongoing compliance</b>	DNAPL overseas mission completed in April 2005. Orica representatives attended the Battelle conference on "Remediation of Chlorinated and Recalcitrant Compounds" in Monterey, California in May 2008. Orica held a workshop at Botany in December 2007 to discuss remediation strategy with a range of respected overseas and local experts. A submission and presentation was made to the DECCW and the Botany Groundwater Community Liaison Committee (CLC) in September 2008. A community workshop was held on 31 March 2009. The revised remediation strategy has been included in proposed VMP and supporting documents (see Section 2.4).
7F	Orica must provide an annual written report to DECCW on actions required by 7E. First report to be provided no later than 28 February 2006.	<b>Ongoing compliance</b>	Annual detailed update provided in the February Progress Report each year.
7G	Orica must review the need to revise the HHRA in light of relevant monitoring data.	<b>Ongoing compliance</b>	See 7H
7H	All reports submitted to DECCW must include an assessment of the potential risk to human health.	<b>Ongoing compliance</b>	All reports now submitted to DECCW include relevant appraisal of potential risk to human health and hence identify any requirement to update the Consolidated HHRA.
7I	By 30 April 2006, Orica must prepare and submit to DEC, a monitoring plan for all necessary input parameters to the HHRA.	<b>Achieved</b>	Plan submitted on 30 April 2006.
7J	Orica must provide copies of reports issued under 7F and 7H to DWE, SESPHU, NSW Health, and City of Botany Bay (CoBB) Council within 7 days of submission to DECCW.	<b>Ongoing compliance</b>	Ongoing compliance
7K	Orica must inform the community of developments by: a) A community forum agreed to by the DECCW. b) Provision of a quarterly newsletter to people residing within a 1 km radius of BIP. c) Maintenance of a website in which copies of relevant reports are posted.	<b>Ongoing compliance</b>	a) The CLC meets quarterly b) See Section 6.1. c) <a href="http://www.oricabotanytransformation.com">www.oricabotanytransformation.com</a>
8	Works and measures under voluntary agreement must not compromise the	<b>Ongoing compliance</b>	Orica has since discontinued bioremediation trials because sufficient

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
	efficacy of measures under the notice.		data had been obtained to assess the efficacy of bioremediation, and the PCA interim hydraulic containment was interfering with the flow of groundwater through the trials area. Orica proposed and DECCW agreed to defer installation of a zero valent iron permeable reactive barrier wall.
8A	Provide additional information as detailed to DEC by 16/03/2004.	<b>Achieved</b>	Issued by Orica 16/03/2004, received by DEC 17/03/2004 due to courier error. Additional information on PCA extraction design progressively provided in accordance with Orica's response of 16/03/2004.

## 2.2 Environmental Protection Licence No. 2148 (EPL2148)

Orica reports compliance against EPL2148 requirements via the submission of the annual return in September each year to DECCW. The following matters are noted in relation to the licence conditions for the GTP for the reporting period:

- Progress Report for Condition U3, the treated water discharge temperature reduction strategy, was submitted to DECCW on 27 August 2009.
- The 2008-09 Annual Return was submitted on 16 September 2009.
- Orica understands that DECCW is currently processing a licence variation to:
  - include contaminated groundwater as a scheduled activity, as it is now listed as such under the Protection of the Environment Operations Act, 1997; and
  - require implementation of Orica's proposed approach to reduce the temperature of the GTP excess treated water discharge (i.e. installation of a shroud over the above ground pipe to reduce solar radiant heating).
- Orica has reviewed monitoring data results from Point 9 (discharge to air from the GTP stack) and Point 11/14 (excess treated water discharge to waters) over recent years and submitted a request to DECCW for reduced monitoring frequencies for a number of parameters at these points in light of consistently demonstrable compliance.

## 2.3 Other Licences and Statutory Approvals

A summary of recent compliance activity regarding other approvals relevant to the project is provided in the table below.

Licence / Statutory Approval	Comments
Conditions under Part V of the Water Act	<ul style="list-style-type: none"> <li>• Groundwater and surface water monitoring conducted during this reporting period was undertaken in accordance with the program developed in response to condition E5.1.3 of EPL2148. A summary of the results is provided in Section 3 of this report.</li> <li>• Orica submitted production bore applications to DWE (now the</li> </ul>

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Licence / Statutory Approval	Comments
	NSW Office of Water) in mid 2008 and awaits a response.
Conditions from Department of Planning	<ul style="list-style-type: none"> <li>These conditions require that Orica maintain a register of accidents, incidents and potential incidents with actual or potential significant off-site impacts on people, property, or the biophysical environment. Orica maintains an incident register for the GTP in the internal Safety Health and Environment Incident Management database.</li> </ul>
Network Operator and Retail Supplier licence under the Water Industry Competition Act, 2006.	<ul style="list-style-type: none"> <li>An application for a combined Network Operator and Retail Supplier licence under the Water Industry Competition Act, 2006 is to be submitted to the Independent Pricing and Regulatory Tribunal of NSW by 8 August 2010.</li> </ul>

Other matters of note in the reporting period include:

- As noted in Progress Report No. 21, Orica has identified an opportunity to treat contaminated stormwater, liquids and activated carbon from Stores G & H of the HCB Waste Repackaging operation at the GTP. These proposals were presented to the February 2009 Community Participation and Review Committee (CPRC) meeting and the March 2009 CLC meeting. Orica met with the Department of Planning (DoP) and DECCW to discuss the possible means for seeking approval for this proposal on 4 May 2009. Orica has since discussed the possible approvals and assessment approach with DoP (which has also consulted with DECCW) and is waiting for written advice from DoP regarding the way forward.

## 2.4 Ongoing regulation

Since late 2008, Orica and DECCW have been reviewing the regulatory regime for the Botany Groundwater Cleanup Project. It was agreed that the NCUA issued in 2003 required revision or replacement with another regulatory instrument.

Following consultation with the Community Liaison Committee (CLC) and Orica, DECCW determined that the project is best managed by a Voluntary Management Proposal (VMP) under the Contaminated Land Management Act 1997.

Orica submitted a VMP in late October 2009. the purpose of which was to establish a clear set of undertakings relating to each part of the project including:

- Maintenance and optimisation of hydraulic containment;
- Chemical and hydraulic monitoring programs for groundwater, surface water, air and other relevant environmental media;
- Assessment of risk to human health and the environment;
- Source area management;
- Contingencies for the GTP; and
- Community consultation.

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Orica notes that the existing NCUA is referenced in Schedule 1 to State Environmental Planning Policy 55 – Remediation of Land, and that DoP and DECCW have discussed the need for an amendment to this SEPP following implementation of the VMP to provide the ongoing statutory approvals framework for work conducted in accordance with the VMP.

### 3 QUARTERLY MONITORING EVENT

NCUA Condition 3B(e) requires Orica to implement a comprehensive monitoring program within the defined area (formerly named as the Groundwater Protection Zone 1 by the then DIPNR (now the NSW Office of Water), and now referred to as the Groundwater Exclusion Extraction Area [GEEA]) to:

- monitor changes in concentrations of the substances in the contaminant plumes;
- monitor changes in the spatial distribution of contaminant plumes in the sub-surface;
- gauge groundwater levels to assess effectiveness of hydraulic containment; and
- monitor concentrations in groundwater and surface water discharges to Botany Bay and Penrhyn Estuary for comparison against the Australian and New Zealand Guidelines for Marine and Fresh Water (ANZECC, 2000) trigger values for protection of slightly to moderately disturbed ecosystems.

Orica and DEC (now DECCW) subsequently agreed the content and scope of the *GTP Groundwater and Surface Water Monitoring Plan* (URS, 2005b). On an annual basis DECCW and Orica meet to discuss the effectiveness of the monitoring program and revise monitoring requirements as appropriate. In June 2008 Orica submitted its proposal for monitoring from late 2008 to 2010 (URS, 2008).

Orica engaged URS to complete a quarterly monitoring event in September 2009 in accordance with the agreed monitoring plan. The September 2009 monitoring event was a biennial (two-yearly) event, which entails the most comprehensive monitoring program in terms of number of sample locations, range of analyses and interpretation of the data. Results and discussions were provided in the URS report *Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, September 2009*. This report is bound separately as Attachment A. The remainder of this section has effectively been transcribed from the URS report to summarise the monitoring event.

#### 3.1 Hydraulic Monitoring

- The inferred contours and patterns of shallow and deep groundwater flow infer that hydraulic containment was achieved at SCA and PCA during the monitoring period.
- Elevated groundwater levels were observed at the SCA in intermediate monitoring wells east of MWF01. Investigations of the cause of the increased levels have been inconclusive at this stage but additional works are ongoing to more fully understand the issue. The increased levels have not resulted in a loss of hydraulic containment but corrective action is required to ensure that the water levels are lowered in the medium term.
- Hydraulic containment was achieved at the central and southern portions of the BIP containment line in the shallow and deep aquifers. Containment was not regularly achieved at the northern portion of the BIP containment line during the monitoring period due to capacity constraints at the GTP. However, this section of the line has lower groundwater contaminant concentrations, and groundwater

flow from this area is towards the central portion of the line and groundwater that migrates past the BIP containment line is effectively captured at the PCA.

- Water levels at regional monitoring wells show no discernible water level impact due to hydraulic containment thus indicating a limited potential to affect infrastructure and licensed groundwater users.

### **Chemical Monitoring**

While there were various increasing and decreasing trends in CHC concentrations within the Northern, Southern and Central Plumes, the overall inferred CHC distributions as represented by the contours and cross sections are largely similar to those presented previously. The main overall changes in contaminant distribution in September 2009 were as follows:

- Decreasing trends in CHC concentrations within the Southern Plumes between PCA and SCA;
- Stable or increasing trends for some CHCs in deeper groundwater in the Southern Plumes at Southlands;
- Decreasing trends in CHC concentrations within the Central Plume at Southlands;
- Continuing migration of the leading edge of the Central Plume in the vicinity of Botany Road. The leading edge of the Central Plume will be captured at the SCA and will not discharge into Penrhyn Estuary or Botany Bay;
- Increasing concentrations of CHCs at the leading edge of the Northern Plumes at depth, which were in contrast to the stable or decreasing trends in shallow groundwater;
- The decreasing trends in groundwater concentrations of CHCs within the Central Plume on Southlands and at the periphery of the Southern Plumes south of the PCA, are likely to be related to migration of the plume and changing plume dynamics due to groundwater extraction – i.e. pumping at the PCA and SCA has changed groundwater flow directions so that relatively cleaner groundwater is being drawn in towards the plumes from the northwest (Block 2 PCA) and east (eastern edge of Southern Plumes).
- Many of the increases and decreases in CHC concentrations in the Northern, Southern and Central Plumes are likely related to the re-distribution of contaminants due to hydraulic containment. Groundwater flow in areas of flat hydraulic gradients is very slow which implies that contaminant concentrations are unlikely to change in the short to medium term. Variability in CHC concentrations in these areas (and others) can be expected;
- The estimated average concentration for the entire aquifer within PCA has decreased from approximately 550 mg/L in July 2002 to approximately 201 mg/L in September 2009, equivalent to a decrease of approximately 63%. This decrease is reflected in the significant decrease in the average total CHC concentration at the PCA extraction wells from 850 mg/L in June 2005 to 160 mg/L in September 2009;

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- Semi-volatile CHC concentrations in groundwater were generally consistent with historical data. HCBd was detected at a low concentration at WG23S and elevated HCBd concentrations were reported at BP61 at depth.

### **Penrhyn Estuary and Surface Waters**

- The change in concentrations of volatile CHCs at BP01, BP115 and MWF15 represent the redistribution of contaminants in groundwater that had passed Foreshore Road prior to commencement of hydraulic containment at the SCA in late-2004.
- Concentrations of the key contaminants at the pore water discharge interface were less than the ANZECC (2000) Trigger Values for all sample locations in Penrhyn Estuary.
- In general, volatile CHC concentrations measured in pore water within Penrhyn Estuary are similar to, or lower than, historical concentrations.
- The concentrations of volatile CHCs in surface waters were less than the respective ANZECC (2000) Trigger Values.
- Semi-volatile CHCs were not detected above the laboratory limit of reporting in Penrhyn Estuary pore water samples collected at low tide and surface water samples.

### **Implications for Human Health Risk Assessment**

- With respect to the western margin of the Northern Plumes, the additional data presented in the September 2009 quarterly monitoring report does not affect the conclusions of the HHRA and Addendum.
- The additional data presented in the September 2009 Quarterly Monitoring Report does not alter the conclusions of the HHRA with respect to existing commercial/industrial workers in areas above the main plumes.
- Data collected from Springvale Drain does not suggest the requirement for more frequent monitoring of ambient air concentrations (currently included in Orica's 15 monthly air sampling program) adjacent to the drain.
- Data collected to September 2009 does not change the conclusions presented within the HHRA associated with exposures within the inner and outer Penrhyn Estuary. That is, given the conservative nature of the range of assumptions and the safety factors applied to toxicity values, the risks to human health for all exposure scenarios are considered to be low. However, the assessment has identified worst-case exposure scenarios (particularly within the inner estuary) where the calculated risks exceed the target values.

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#### 4 OTHER ENVIRONMENTAL ACTIVITIES

Other groundwater and surface water monitoring and data acquisition activities that have been undertaken in this reporting period pursuant to, or that have relevance to, the agreed monitoring plan and conditions of the NCUA are detailed below.

##### 4.1 Air Monitoring and Human Health Risk Assessment

It was reported in Progress Report No. 6 that the draft *Consolidated Human Health Risk Assessment 2005* (URS, 2005c) was prepared by URS and submitted to the DEC on 31 March 2005 with copies provided also to NSW Health and Prof. Brian Priestly (Monash University) from the Australian Centre for Human Health Risk Assessment for independent review. Following a request from the DEC, the draft report was released publicly.

Prof. Priestly completed the independent review and provided comments in a letter to the DEC on 11 May 2005. The comments were overwhelmingly positive and strongly supported the findings of the risk assessment.

Since 1995 air emission monitoring has conducted on a nominally 15-month cycle (targeting different seasons every year). Sampling locations are on and off the BIP and are usually adjacent to shallow groundwater-monitoring points. Some air monitoring locations – such as the Car Park Waste Encapsulation – are not directly relevant to the Botany Groundwater Project.

Preliminary results from the June/July 2009 event indicated the following:

- The surface flux emissions and soil gas data collected in 2009 did not change the outcome of the assessment of risks associated with the vapour migration pathway for workers, recreational users and residents within the off-site areas above the groundwater plumes presented in the Consolidated HHRA (URS, 2005c). The potential presence of HCBd in emissions at AS09 requires further assessment in the next 15-monthly sampling round with both Summa canisters and PUF/XAD-2 samplers.
- The ambient air and surface water data collected adjacent to Springvale Drain in 2009 did not change the outcome of the assessment of exposure and risks to workers within the MCS and Discovery Cove. In addition the data collected in 2009 supports the conclusion that the operation of the GTP and associated groundwater extraction has effectively reduced CHC concentrations within the vicinity of Springvale Drain (particularly in the areas currently occupied at MCS and Discovery Cove).

The draft report is being reviewed by Orica and will be submitted to DECCW shortly.

##### 4.2 Residential Monitoring

Monitoring of selected residential bores in the Groundwater Extraction Exclusion Area (GEEA) for volatile chlorinated hydrocarbons (vCHCs) occurred again in early November 2009. Results will be provided in the next Progress Report.

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### 4.3 DNAPL Source Area Depletion Projects

In accordance with Condition 7E of the NCUA, Orica is required to stay abreast of relevant DNAPL remedial technologies and apply them as practicable. Orica is required to submit an annual report pursuant to this condition at the end of February every year. The 2009 report was provided as an attachment in GCP Progress Report No. 21. The next report will be due at the end of February 2010.

### 4.4 Groundwater Injection and Recovery

Groundwater Injection and Recovery (GIR) System is designed to reinject extracted groundwater into the aquifer upgradient of the containment lines on BIP if the GTP is unable to treat groundwater for an extended period of time.

Orica received a variation to EPL2148 from DECCW, and a trial injection licence from DWE (now the NSW Office of Water).

At the time of writing the initial stages of the Trial Injection for GIR have been completed. A brief summary of key findings is provided below:

- The trial injection well was highly efficient and injection rates averaging approximately 150 m<sup>3</sup>/day were maintained throughout the trial;
- Based on the observed monitoring well water levels, the trial has demonstrated that the proposed full-scale GIR system is worth pursuing; however
- The rates and duration of injection were limited due to clogging of the pre-injection filter and reducing capacity within the well over time. The clogging is believed to be biological in nature.

In order to maximise effectiveness Orica will need to minimise the clogging so as to extend the rates and duration of the injection. Orica proposes an extension of the trial prior to the implementation of the full-scale system. The trial will focus on the use of anti-fouling agents and injection well maintenance techniques.

Orica is currently discussing the trial outcomes and the next stage of work with DECCW.

### 4.5 Springvale Drain Infilling

Previous GTP reports have detailed the monitoring of chlorinated solvent vapours in air close to Springvale Drain caused by the influx on contaminated groundwater into the drain. Accordingly it was observed that reducing the groundwater level at Southlands (through pumping at the BIP and PCA containment lines) has decreased groundwater levels and hence decreased CHC concentrations in the surface water in Springvale Drain.

The monitoring also determined that the realignment channel located in Southlands contains concentrations of contaminants far greater than the main channel. Consequently, as a precautionary measure to protect against possible elevated concentrations of CHCs in air close to the realignment channel, it is prudent to infill this channel. The channel is not a natural feature, but was created by the sediment remediation works performed by Orica in the late 1990s.

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Orica applied to the NSW Office of Water for a permit under Part 3 Chapter 3 of the *Water Management Act, 2000*. The NSW Office of Water has advised Orica that the works may proceed.

The previous Progress Report indicated these works would be completed by the end of the 2009 calendar year, however works have been delayed due the availability of civil contractors and are now scheduled to be completed in early 2010.

#### **4.6 Maximising Hydraulic Containment**

In Progress Report No. 21 it was explained that Orica had commenced an assessment to determine the maximum sustainable volume of groundwater the aquifer could provide to the GTP from the existing groundwater extraction network. One component of the assessment<sub>5</sub> was an investigation of the effects of additional extraction beyond containment requirements on the built environment (ie buildings and structures).

In October 2009, the assessment assessment was completed by Pell Sullivan Meynink (PSM). The report concluded the following:

- Extraction up to approximately 7 ML/d of groundwater from the existing network will not present any significant risks of settlement.
- Extraction beyond 7ML/d may present a risk of subsidence, particularly on the BIP. Further detailed investigations would be required to establish the feasibility of extracting at rates exceeding this value.

As a result of information presented in the subsidence report Orica will continue to only extract what is required for containment alone, and does not currently aim to treat more than 7ML/d.

Should Orica decide in future to extract more than 7 ML/day, further assessment of the subsidence risks and possible environmental impacts would be necessary.

In addition to the subsidence assessment, some groundwater modelling was also undertaken. Orica consulted with Ian Acworth (IMC member) and Noel Merrick with respect to the approach and scope of that work. A significant recalibration of the model was completed using data collected since the last model was created. This model will be a very useful tool for future works onsite. One application may include the optimisation of the containment lines.

Orica will debrief Ian Acworth, Noel Merrick and the NSW Office of Water (formerly DWE) in due course.

## 5 GROUNDWATER TREATMENT PLANT OPERATION

### 5.1 GTP Performance

A summary of the GTP operational performance for 1 July to 30 September 2009 is provided below:

Average volumetric rate of groundwater treated 1 July 2009 to 30 September 2009	4.83 ML/d
Total volume of groundwater treated since pump and treat activities commenced in 2005 (at 30 September 2009).	6,080 ML
Total mass of CHCs destroyed in the thermal oxidiser (at 30 September 2009).	730 tonnes

Since commencement of operations in 2006, there have been significant improvements to the treatment process resulting in gradual increases in the daily treatment volumes. In this reporting period, the daily treatment volumes regularly exceeded 6 ML/d. If maintained, this is sufficient to contain groundwater at PCA and SCA as required by the NCUA, reduce influx of groundwater into Springvale Drain and contain high concentration source areas on BIP.

### 5.2 Thermal Oxidiser and Dioxin Air Emissions

All stack testing emission results were within licence limits.

### 5.3 Beneficial Reuse of Treated Water

Orica continues to provide treated water from the GTP for industrial reuse at the BIP and adjacent industry. As noted in Section 4.6, Orica intends to maximise groundwater at 7ML/d. However, opportunities for feeding water from other sources for water treatment and recycling will be considered on an individual basis.

### 5.4 Planned GTP Shutdown

The annual shutdown of the GTP for repairs and preventative maintenance was underway at the time of writing.

### 5.5 Containment Line Infrastructure

Ongoing maintenance works are occurring on the SCA, PCA and BIP containment lines. The works consist primarily of cleaning and minor inspection and repair works. In the short term this will require the barricades on Foreshore Road to remain in place. In early 2010, the barricades will be moved to the western end of the line to facilitate the regular cleaning and maintenance associated with a pump and treat system. The issue of longer term access to the SCA line is currently being assessed by Orica.

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## 6 COMMUNITY CONSULTATION

This section provides a consolidated update in response to Condition 7K of the NCUA, which specifies how Orca must inform the community of developments in the remediation of groundwater, and provides information regarding the wider consultation activities that are undertaken by Orca to obtain community feedback regarding the BGC Project. Orca supports a two-way communication process with the local community and this section incorporates feedback received from the community during the reporting period.

### 6.1 Community Liaison Committee

A quarterly Community Liaison Committee (CLC) meeting was held on 15 September 2009. The following table summarises key matters raised at the meeting, and actions taken or planned as a result. It should be noted that this information has been summarised from draft minutes not yet endorsed by the CLC.

Matter Raised by CLC	Action Taken or Planned
Improved communication regarding upcoming works at the SCA at Foreshore Road and concerns with long-term use of temporary barriers.	Orca will report back at the December CLC meeting.
Members decided to keep all current Independent Monitoring Committee (IMC) members, and also to further consider potential new members with expertise in areas such as communications and sustainability.	Orca to renew contracts with all current IMC members. Further discussions regarding seeking other expertise to be held at the December CLC meeting.
Community members of the CLC wish to consider undertaking a review of the current communication approach and identify ways that the CLC can generate interest in the project in the wider community, especially within younger generations.	Further discussions to be held at the December CLC meeting, including the possibility of seeking advice from a communications specialist.
A request for further information on GTP operational capacity constraints.	Orca to provide an update at the December CLC meeting.

#### **CLC Newsletter**

CLC Newsletter No. 34 was distributed to approximately 5,500 homes and businesses within the Botany, Banksmeadow, Hillsdale, Matraville and Pagewood areas in September 2009, after being reviewed by the CLC. Additional copies are also distributed to City of Botany Bay and Rockdale Councils, Botany and Rockdale Council Libraries and Bexley Community Centre.

CLC Newsletter No. 34 included updates on groundwater treatment and containment, a summary of the September 2009 CLC meeting, results of the May 2009 Residential Bore Monitoring Program, and an update on Groundwater Injection & Recovery.

### 6.2 Communication Tools

#### **Website**

The following BGC Project material has been posted on the website during the reporting period:

- Groundwater Cleanup Plan Progress Report No. 23;

- CLC newsletter No. 34;
- The Briefing Paper and presentations for the September 2009 CLC meeting;
- Recent newspaper columns;
- Report by Prof Priestly on IMC Task 24; and
- Report on March 2009 Groundwater Strategy Review Community Workshop.

There were 2,900 visits to the Botany Transformation Projects website from 20 August to 12 November 2009, of which 1,146 visits were to BGC Project pages and 126 visits to Treated Water Recycling Program pages.

### **E-mail Enquiry**

There was one website email enquiry regarding the now complete Rainwater Tank Rebate program in this reporting period. No emails were received via the CLC feedback facility.

### **Newspaper Columns**

Three newspaper columns were published in the *Southern Courier* since the last quarterly Progress Report. A column was also published in the *St George and Sutherland Shire Leader* in September 2009.

### **1800 Number**

The Botany Industrial Park operates a free-call number – 1800 025 138, where enquiries to Orica are directed. Of the calls received during this reporting period, only one related to the BGC Project and this concerned the November residential bore testing.

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## 7 REFERENCES

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Orica Australia Pty Ltd (Orica, 2003). *Groundwater Cleanup Plan*. EN1591-00-10-001, Rev 0. October 2003.

URS (2005a) Orica Botany Environmental Survey, Stage 4 – *Remediation. Groundwater Cleanup Plan (GCP) Quarterly Groundwater and Surface Water Monitoring Report - December 2004*. Doc. No. R021\_A, 15 February 2005.

URS (2005b) Orica Botany Environmental Survey, Stage 4 – Remediation. *Groundwater Treatment Plant – Groundwater and Surface Water Monitoring Plan*. Document Number R013\_A. 17 May 2005.

URS (2005c) Orica Botany Environmental Projects. *Consolidated Human Health Risk Assessment 2005*. Document Number R022\_D. August 2005.

URS (2006) Orica Botany Environmental Projects. *Addendum to Consolidated Human Health Risk*. Doc. No. R022\_D, August 2005.

URS (2008) *Proposed Amendment to the GTP Groundwater and Surface Water Monitoring Program, 2008-2010*. WCIE 4396. 6 June 2008.

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**ATTACHMENT A – QUARTERLY MONITORING REPORT – SEPTEMBER 2009.**

Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, September 2009. URS Australia Pty Ltd. November 2009.  
*Separately bound report.*