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VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

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VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT No. 39

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REVISION 0

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	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

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	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

LIST OF ACRONYMS.....3

EXECUTIVE SUMMARY.....5

1 INTRODUCTION.....8

2 COMPLIANCE SUMMARY.....9

3 FEBRUARY 2023 MONITORING EVENT 14

 3.2.1 *Groundwater Monitoring Wells* 15

 3.2.2 *Penrhyn Estuary Pore Water* 16

 3.2.3 *Surface Water*..... 16

4 GROUNDWATER TREATMENT PLANT ACTIVITIES 18

5 STRATEGY REVIEW WORKSHOP 20

6 COMMUNITY CONSULTATION 22

7 REFERENCES 24

ATTACHMENT A – ANNUAL MONITORING REPORT – FEBRUARY 2023 25

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

LIST OF ACRONYMS

ACRONYM	DEFINITION
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
ANZG	Australian and New Zealand Governments
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BAF	Biological Aerated Filter
BGC Project	Botany Groundwater Cleanup Project (hydraulic containment and treatment project as described in the EIS)
bgl	Below ground level
BIP	Botany Industrial Park
BP	Bundle piezometer
CFM	Chloroform (trichloromethane)
CHC	Chlorinated hydrocarbon
CHHRA	Consolidated Human Health Risk Assessment
cis-1,2-DCE	cis-1,2-dichloroethene
CLC	Community Liaison Committee
CoPC	Chemical of potential concern
CPRC	Community Participation and Review Committee
CTC	Carbon tetrachloride (tetrachloromethane)
DNAPL	Dense non-aqueous phase liquid
DoD	Department of Defence
EDC	Ethylene dichloride (1,2-dichloroethane)
EIS	Environmental Impact Statement
EP&A Act	Environment Planning and Assessment Act
EPA	Environment Protection Authority
EPL	Environment Protection Licence
GEEA	Groundwater Extraction Exclusion Area
GIR	Groundwater Injection and Recovery
GRAMP	Groundwater Remediation and Management Plan
GTP	Groundwater Treatment Plant
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HHRA	Human Health Risk Assessment
IMC	Independent Monitoring Committee
IPART	Independent Pricing and Regulatory Tribunal
ISCO	In Situ Chemical Oxidation
JBS&G	JBS&G Australia Pty Ltd, an environmental consultancy
KBR	Kellogg, Brown and Root Pty Ltd, an engineering contractor
KMH	KMH Consulting Pty Ltd, an independent compliance auditor
LOR	Laboratory Limit of Reporting
MoU	Memorandum of Understanding
NCUA	Notice of Clean Up Action
NHMRC	National Health and Medical Research Council
NRAR	Natural Resources Access Regulator
NSW	New South Wales
OBLC	Orica Botany Liaison Committee
PCA	Primary Containment Area

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

ACRONYM	DEFINITION
PCE	Perchloroethylene (tetrachloroethene)
PRP	Pollution Reduction Program
QRA	Qualitative Risk Assessment
RAP	Remedial Action Plan
REF	Review of Environmental Factors
RO	Reverse osmosis
RWG	Regulatory Working Group
SCA	Secondary Containment Area
SCW	Scheduled Chemical Waste
SEPP	State Environmental Planning Policy
SESLHD	South-eastern Sydney Local Health District
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
TfNSW	Transport for NSW
TO	Thermal Oxidiser
TOC	Total Organic Carbon
TWA TLV	Time Weighted Average Threshold Limit Value
TWSA	Trade Waste Service Agreement
USEPA	United States Environment Protection Agency
VC	Vinyl chloride (chloroethene)
VMP	Voluntary Management Proposal
VOC	Volatile organic compound
VSD	Variable speed drive

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

EXECUTIVE SUMMARY

This document is the 39th Progress Report submitted in accordance with the Voluntary Management Proposal (VMP) under the *Contaminated Land Management Act 1997* and includes progress on the revised Groundwater Remediation and Management Plan (GRAMP) (Orica, 2020a). It provides a progress update on groundwater monitoring, Groundwater Treatment Plant (GTP) performance, related environmental management activities and community outreach initiatives. Unless stated otherwise, the reporting interval covered by this report is 1 October 2022 to 31 March 2023, however, if more recent and relevant information is available it is also included.

Voluntary Management Proposal

A revised VMP was approved by NSW EPA on 29 April 2020. This report is the seventh Progress Report prepared under the 2020 VMP.

The February 2023 Biannual Groundwater and Surface Water Monitoring Event was carried out in accordance with the 2020-2024 Program.

Hydraulic Monitoring

Assessment of hydraulic data for the February 2023 monitoring event, with consideration of the six-step evaluation approach adopted by JBS&G (2019), indicates that, despite the extreme rainfall events over the previous monitoring periods and although some inconsistencies were noted, effective hydraulic containment of the target capture zones was achieved at Botany Industrial Park (BIP), Primary Containment Area (PCA) and to a lesser extent at the Secondary Containment Area (SCA) during the monitoring period and, overall, the Botany Groundwater Cleanup (BGC) Project remedy objectives were met during this period.

Effective hydraulic containment at BIP, and within key portions of the target capture zones at PCA and SCA was evidenced by the achievement of target water levels and/or reverse hydraulic gradients immediately downgradient of the containment lines for the monitoring period.

Chemical Monitoring

The February 2023 sampling program represents a biannual monitoring event focused on assessment of volatile chlorinated hydrocarbon (CHC) concentrations in pore water, groundwater and surface water at Penrhyn Estuary and surface water at Springvale Drain and Floodvale Drain.

A parametric test has been used to identify increasing/decreasing trends in contaminant concentrations at sampling locations. The assessment of data trends for monitoring locations indicates that whilst there have been a number of increases (including historical maxima) and decreases in contaminant concentrations, the changes were either relatively small or are consistent with expected plume behaviour as a result of groundwater extraction from the three containment lines.

Reported CHC concentrations at BP01, BP117, MWF15, MWF17, MWF18 and MWF19 located downgradient of the SCA on the shoreline of Penrhyn Estuary can

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

be generally characterised by stable or decreasing trends in most CHC concentrations. However, increasing CHC contamination trends were noted at MWF15I for 1,2-dichloroethane (EDC) and vinyl chloride (VC); MWF15D for 1,2-dichloroethane (EDC) and trichloroethene (TCE); and MWF19D for VC. The concentrations of EDC at MWF15I and MWF15D represent historical maximum concentrations for those locations.

The increasing trends and historical maximum concentrations at MWF15 and MWF19 potentially represent limited migration of groundwater containing higher concentrations of dissolved phased CHCs from within the SCA. The previous two monitoring periods are characterised by extremely high rainfall, with the influence on potential groundwater migration further compounded by no groundwater extraction at the SCA associated with the scheduled GTP shutdowns throughout the monitoring period. Groundwater extraction within these portions of the SCA is expected to improve following the scheduled GTP maintenance shutdown completed in late March 2023. The contaminant trends within these portions of the SCA are considered in the ongoing refinement of the GTP operations and extraction well prioritisation within target capture zones. It should also be noted that the slow migration rates between the SCA and Penrhyn Estuary allow for potential recapture of CHCs that may migrate beyond the SCA during periods of poor hydraulic containment. Continued monitoring of these locations and surface water within Penrhyn Estuary downgradient is required to ensure the remedy objectives of the BGC at Penrhyn Estuary continue to be met.

In general, the February 2023 Penrhyn Estuary pore water data are consistent with previous monitoring rounds with the concentrations of the chemicals of potential concern generally reducing with decreasing depth towards the discharge interface.

The concentrations of the key contaminants of concern in pore water reported in the February 2023 monitoring round are less than the ANZG (2018) Trigger Values for all samples with the exception of VC at BP42 in the 2 m sample port. It is noted that VC concentrations at BP42 are historically highly variable, the concentrations are significantly lower than the historical maximum concentrations for those depths, and VC concentrations did not exceed the trigger values at the discharge interface (0.1 m sample) ports nor in nearby surface water samples.

No historical maximum concentrations for key contaminants were reported in samples collected from Penrhyn Estuary pore water during the February 2023 monitoring round.

The review of historical surface water monitoring data shows CHC concentrations have been generally consistent with, or less than, those reported in previous monitoring events. Comparison of the February 2023 surface water data with historical data shows CHC concentrations in Springvale Drain (in particular, EDC) have generally decreased several orders of magnitude compared to historical maximum concentrations. The decrease in EDC concentrations within surface water is attributable to the operation of the hydraulic containment system reducing groundwater levels and subsequently reducing groundwater seepage to Springvale

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

Drain. It is also noted that CHC concentrations in shallow groundwater have decreased significantly, further reducing groundwater CHC discharge to Springvale Drain. Similarly, concentrations of all CHCs in Floodvale Drain significantly decreased following the commencement of groundwater extraction and remain low.

The concentration of chloroform (CFM) at SW069 represented a historical maximum concentration, albeit marginally above the laboratory limit of reporting (LOR). It is noted that this location does not have an extensive monitoring history (sampling commenced in September 2020) and that the concentration of CFM remains low (0.002 mg/L compared to the ANZG criterion of 0.37 mg/L for CFM). No other historical maximum concentrations for key contaminants were reported during the February 2023 monitoring round.

Key contaminant concentrations reported in the February 2023 monitoring round were less than the relevant ANZG (2018) Trigger Values at all locations.

Human Health Risk Assessment

There are no data presented in the February 2023 monitoring round that affect the conclusions of the CHHRA (EnRiskS, 2018) in relation to the Penrhyn Estuary and Floodvale and Springvale Drains (i.e., provided groundwater is not extracted and used for any purpose, health risks associated with exposure to CoPC are low and acceptable).

GTP Operation

The GTP continues to operate effectively. There were two shutdowns of the GTP during the reporting period. There was a planned shutdown from 19th December 2022 until 9th January 2023. In March 2023, the annual shutdown occurred to carry out scheduled maintenance items and inspections of critical equipment. The plant restarted in early April.

On 6 April 2023 control of the GTP's operations and maintenance reverted from Ixom to Orica.

The approximate total volume of groundwater treated since pump and treat activities commenced in 2005, including this period, is 30,674 ML with approximately 741.1 ML treated during this reporting period.

The estimated total mass of chlorinated hydrocarbons destroyed in the thermal oxidiser, including this period, is 1,578 tonnes with approximately 10.4 tonnes destroyed during this reporting period.

Community Consultation

Two ordinary meetings of the Orica Botany Liaison Committee (OBLC) were held during the reporting period: on 8 November 2022 and 14 March 2023. The next scheduled meeting is to be held on 11 July 2023.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

1 INTRODUCTION

The NSW Environment Protection Authority (EPA) 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*.

Following effective completion of the principal NCUA actions and consultation with the Community Liaison Committee (CLC) and Orica, NSW EPA determined that the project would be best managed by a Voluntary Management Proposal (VMP) under the *Contaminated Land Management Act 1997*. An initial VMP was approved on 5 November 2010 (Approval No. 20101714), which replaced the NCUA as the regulating tool following the NCUA being revoked on 3 December 2010. A revised VMP was approved on 13 August 2015 (Approval No. 20151711). On 19 May 2020 that VMP was replaced with a revised VMP (Approval No. 20201704).

A revised Groundwater Remediation and Management Plan (GRAMP) (Orica, 2020a) was submitted as an attachment to the 2020 VMP; it outlines the monitoring requirements as per the referenced Groundwater Treatment Plant (GTP) – Groundwater and Surface Water Monitoring Program (Golder, 2017). The GTP monitoring program includes three types of monitoring events: biannual, annual and biennial (in order of sampling program magnitude). In accordance with the review schedule in the VMP, the monitoring program was reviewed and revised in 2020. The 2020-2024 Groundwater and Surface Water Monitoring Program (Golder, 2020) was submitted to NSW EPA in August 2020.

The February 2023 monitoring event is the fifth to be carried out under the 2020-2024 monitoring program (Golder, 2020). As specified in that monitoring program, the February 2023 round is a biannual monitoring event.

This document is the 39th report submitted in accordance with the initial and replacement VMPs and includes progress on the GRAMP (Orica, 2020a). It is the seventh report prepared under the 2020 VMP. It provides a progress update on groundwater, pore water and surface water monitoring, hydraulic monitoring, GTP performance, related environmental management activities and community outreach initiatives. The reporting interval for this report is 1 October 2022 to 31 March 2023, however, if more recent and relevant information is available, it is also included.

Previous reports are available at the relevant section of the website (<https://www.orica.com/Locations/Australia--Pacific-and-Indonesia/Australia/Botany-Remediation-Projects/Projects/Groundwater-Cleanup/Publications--Reports---Reviews/progress-reports#.YZWV2NBBw2x>) and a distribution list is provided at the beginning of this document.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

2 COMPLIANCE SUMMARY

2.1 Voluntary Management Proposal

The objectives of the 2020 VMP are as follows:

- To protect human health and the environment via hydraulic containment of the chlorinated hydrocarbon contaminant plumes and source areas (as outlined in the GRAMP) (Orica, 2020a). In the case of Penrhyn Estuary and Botany Bay, the hydraulic containment works will prevent contaminant migration to these receptors via groundwater or surface water in order to achieve protection for slightly to moderately disturbed ecosystems using the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018);
- To monitor the nature and extent of the contamination to identify any potential exposures to the contamination that require management; and
- To investigate potential technologies to remediate source zones and plumes.

To achieve these objectives Part 3 of the VMP establishes a clear set of undertakings relating to each of the following components of the project:

- Maintenance and optimisation of hydraulic containment;
- Source area management;
- Contingency measures for the GTP;
- Community consultation;
- Chemical monitoring programs for groundwater and surface water (from which the data are used in assessment of risk to human health and the environment);
- Assessment of risk to human health and the environment (including additional monitoring programs for relevant environmental media); and
- Reporting requirements.

The groundwater contamination issues will require long-term management beyond the expiry date of this VMP. At that time, the objectives and management approach will be reviewed and modified as required.

The 2017-2020 Groundwater and Surface Water Monitoring Program (Golder, 2017) was accepted by NSW EPA in May 2017. It was updated in August 2020. The 2020-2024 Groundwater and Surface Water Monitoring Program (Golder, 2020) was initially adopted for the biannual monitoring event in February 2021 and will be implemented thereafter until the monitoring program is next updated.

REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39	

A summary of the compliance status against VMP requirements is provided below.

Cond.	Summary of Requirement	Status	Reference Documents / Comments
P1	Maintain effective hydraulic containment of contaminants of concern at the Primary Containment Area (PCA) Containment Line.	Ongoing compliance	Summary of hydraulic containment of PCA provided in Section 3.1 and Attachment A of this report.
P1	Maintain effective hydraulic containment of contaminants of concern at the Secondary Containment Area (SCA) Containment Line.	Ongoing compliance	Summary of hydraulic containment of SCA provided in Section 3.1 and Attachment A of this report.
P1	Maintain effective hydraulic containment of contaminants of concern at the Botany Industrial Park (BIP) Containment Line commensurate with the available GTP treatment capacity and operational performance.	Ongoing compliance	Summary of hydraulic containment of BIP provided in Section 3.1 and Attachment A of this report.
P2	Conduct ongoing review of developments in remediation technologies and techniques for treatment of Dense Non-Aqueous Phase Liquid (DNAPL), sorbed mass and dissolved phase chlorinated hydrocarbon (CHC) contamination, and their practical applicability to the Botany Groundwater Cleanup Project.	Work in progress	On 2 and 3 March 2020 Orica conducted the fifth Botany Groundwater Strategy Review Workshop to discuss remediation strategy with a range of respected overseas and local experts. The inaugural Workshop was held in December 2007, the second in February 2011, the third in February 2014 and the fourth in February 2017.
P2	Convene a Strategy Review Workshop every four years to which it will invite a minimum of three international experts in the field.	Work in progress	A workshop was held on 2 and 3 March 2020. A summary report of the outcomes of the review was issued on 30 April 2020.
P2	Provide an annual report to EPA that would assess the practical application and effectiveness of appropriate technologies in relation to the remediation. Every four years, this would also include a detailed summary of the outcomes of the Strategy Review Workshop.	Ongoing compliance	The 17 th DNAPL and Groundwater Technology Annual Review Report for 2022 was issued on 24 February 2023.
P4	Continue and strengthen community/stakeholder relationships that help to build awareness and transparency of the contamination, contamination risk, risk management and remediation process.	Ongoing compliance	Meeting minutes from the meetings of the Orica Botany Liaison Committee (OBLC), newsletters and newspaper columns are included as part of the community/stakeholder program.
P4	Create a better understanding of public perceptions, information needs and community responses regarding current and emerging Botany Groundwater Cleanup (BGC) Project	Ongoing compliance	

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

Cond.	Summary of Requirement	Status	Reference Documents / Comments
	<p>issues so that these can be anticipated and addressed.</p> <p>Orica will inform the community of developments in the Orica BGC Project through:</p> <p>a) Regular OBLC meetings (nominally three times a year unless otherwise agreed to by OBLC members); and</p> <p>b) Maintenance of an internet website providing information related to the BGC Project, which will provide access to copies of current reports prepared under this VMP. Reports older than three years may be archived from the website and be made available on request.</p>		<p>a) The OBLC meets nominally three times per year (see Section 6.1)</p> <p>b) https://www.orica.com/Locations/Asia-Pacific/Australia/Botany/Botany-Transformation-Projects/Groundwater-Cleanup#YZWakdBBw2w</p>
P5	<p>Orica will conduct chemical and hydraulic monitoring of groundwater and chemical monitoring of surface water to measure the effectiveness of hydraulic containment activities, to identify changes in the magnitude and extent of the contamination and to allow for the ongoing assessment of risks to human health and the environment.</p> <p>Orica will conduct groundwater monitoring in accordance with revised <i>Groundwater Treatment Plant Groundwater and Surface Water Monitoring Program 2020 – 2024</i> (Golder, 2020), noting that the frequency and scope of the monitoring program will be reviewed periodically. The next scheduled review will occur in May 2024.</p>	Ongoing compliance	<p>The current revised monitoring program <i>Groundwater Treatment Plant Groundwater and Surface Water Monitoring Program 2020 – 2024</i> (Golder, 2020) was submitted to NSW EPA in August 2020 and has been adopted thereafter.</p> <p>A detailed assessment of hydraulic containment at BIP, PCA and SCA was undertaken by JBS (2012) using the United States Environment Protection Agency approach presented in <i>A Systematic Approach for the Evaluation of Capture Zones at Pump and Treat Systems</i> (USEPA, 2008). The assessment was updated by JBS&G and submitted to NSW EPA for review in September 2018. Following comments from NSW EPA, a revised report was prepared and submitted to NSW EPA in November 2019 (JBS&G, 2019). The revised report has been used for assessment of hydraulic containment in the February 2023 monitoring event report (Attachment A).</p>
P6	<p>Orica will implement a suitable monitoring program for the assessment of risk to human health, which is primarily based on groundwater and surface water monitoring. In addition, as described in the GRAMP, there are certain groundwater level and contaminant concentration conditions that will trigger the collection of additional soil</p>	Ongoing compliance	<p>All reports now submitted to NSW EPA include relevant appraisal of potential risk to human health and hence identify any requirement to update the CHHRA. The CHHRA has been updated and revised a number of times over the years. The latest draft-final version of the CHHRA (EnRiskS, 2022) was submitted to the NSW EPA on 29 July 2022. This assessment</p>

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

Cond.	Summary of Requirement	Status	Reference Documents / Comments
	vapour, flux emission and ambient air data. The trigger values are set out in the Consolidated Human Health Risk Assessment (EnRiskS, 2018) (CHHRA). The scope of this monitoring program will be subject to regular review and possible modification with EPA consent.		provided an update of the 2017 CHHRA, incorporating data and information relevant to the nature and presence of contamination to February 2022, review and update of information and values used to characterise the toxicity of the chemicals of potential concern and the quantification of risk. The CHHRA has been independently reviewed and the recommendations have been forwarded to EnRiskS for their consideration.
P6	At the end of February every year, should data collected in the previous 12 months determine that risk profiles have changed, an annual Addendum will be issued summarising the changes to the risk profiles outlined in the CHHRA. If the risk profiles have not been altered significantly no addendum will be issued.	Ongoing compliance	No addendum was required to be issued in February 2023 as the risk profiles had not been altered significantly. The next review of the risk profiles is scheduled to be completed in February 2024.
P6	Every four years, the entire CHHRA will be revised to take into account more recent consolidated monitoring data and changes to relevant exposure scenarios, toxicological data and risk calculation methods. The next revision will be completed in July 2026. Orica will have this document reviewed by an independent expert.	Work in progress	The 2022 revision of the CHHRA was completed in July 2022. An independent expert reviewed the CHHRA in April 2023 and concluded that the CHHRA utilised scientifically valid and robust approaches and assumptions and was completed in accordance with relevant state and national guidance. The independent reviewer has provided some recommendations to EnRiskS for their consideration. The next revision will be completed in July 2026.

2.2 Environment Protection Licence No. 2148 (EPL 2148)

The GTP's operational environmental performance is regulated under the *POEO Act* as part of Orica's licence for its activities at Botany Industrial Park via EPL 2148. Orica reports compliance against EPL 2148 requirements via the submission of the annual return to NSW EPA up until now in September each year. On 19 May 2017 NSW EPA agreed to amend the licence fee period commencement date to 1 July, which brings forward the annual return submission date to late August. This followed a request by Orica to align the data collection period for EPL 2148 with the GTP's licences under the *Water Industry Competition Act 2006*.

No substantive amendments to EPL 2148 were made during the reporting period.

One technical non-conformance was recorded for the reporting period 1 October 2022 to 31 March 2023. Under Condition M2.3 of EPL 2148, the licensee is required

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

to collect a grab sample at Point 14 monthly during discharge of excess Treated Water. This did not occur in March 2023. The GTP's annual maintenance period started on 24 February and ended on 27 March with the first Treated Water discharge at Point 14 taking place on 30 March at around 7 pm. Key Treated Water customers were offline, so there was a greater than usual reliance at this point in time on this system for managing excess Treated Water. Testing was undertaken on the Point 14 system late on 30 March to identify whether there may have been any issues coming back online after the month-long shutdown. An issue was found which brought the testing to an end. The following day, 31 March, the issue was resolved, however, the Treated Water quality exceeded the discharge limits specified in Condition L2.4 (high pH) and could not be discharged at any time that day. This meant that a sample from Point 14 could not be collected for the month of March. NSW EPA was advised.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

3 FEBRUARY 2023 MONITORING EVENT

Orica engaged WSP Australia Pty Ltd (WSP) to complete a monitoring event in February 2023 in accordance with the 2020-2024 Groundwater and Surface Water Monitoring Program (Golder, 2020).

The February 2023 monitoring event was a biannual monitoring event and was the 39th monitoring event undertaken in accordance with the requirements of the VMP, which requires Orica to implement a comprehensive monitoring program within the Groundwater Extraction Exclusion Area (GEEA).

Groundwater level and groundwater and surface water chemical monitoring for volatile CHCs are undertaken biannually to measure effectiveness of containment and for ongoing assessment of potential risks to human health and the environment.

Groundwater, pore water and surface water samples are collected for volatile CHC analysis from the GEEA and Penrhyn Estuary, and surface water samples from Springvale Drain and Floodvale Drain.

Interpretation of chemical data is limited to significant changes in water quality that are identified during monitoring rounds. Parametric tests are used to identify increasing/decreasing trends in contaminant concentrations at sampling locations. Measured concentrations are also compared against those considered in the Consolidated Human Health Risk Assessment (CHHRA) (EnRiskS, 2018).

Hydraulic containment at the SCA, PCA and BIP is assessed every six months.

Results and discussions are provided in the WSP Golder report *Groundwater Treatment Plant – February 2023 Biannual Groundwater and Surface Water Monitoring Report*. This report is bound separately as Attachment A. The remainder of this section has been extracted from the WSP report to summarise the monitoring event findings.

3.1 Hydraulic Monitoring

A detailed assessment of hydraulic containment at BIP, PCA and SCA was undertaken by JBS (2012) using the United States Environment Protection Agency approach presented in *A Systematic Approach for the Evaluation of Capture Zones at Pump and Treat Systems* (USEPA, 2008). The assessment was updated in 2019 (JBS&G, 2019) incorporating more recent data and modelled capture targets. This monitoring report uses the updated (2019) version as the basis for assessment of hydraulic containment performance.

The JBS&G (2019) evaluation uses multiple lines of evidence within the six 'steps' framework to assess hydraulic containment. It concludes that the remediation objective of the BGC Project (i.e. *"to achieve protection for slightly to moderately disturbed ecosystems using the Australian and New Zealand Guidelines for Marine and Fresh Water (ANZG, 2018)"*) in surface water at Penrhyn Estuary is being achieved. It provides a framework for assessment of key metrics for evaluation of the success of hydraulic containment during ongoing monitoring.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

Assessment of hydraulic data for the February 2023 monitoring event, with consideration of the six-step evaluation approach adopted by JBS&G (2019), indicates that, although effective hydraulic containment of the target capture zones was inconsistent at Botany Industrial Park (BIP), Primary Containment Area (PCA) and at the Secondary Containment Area (SCA) during the monitoring period, overall, the Botany Groundwater Cleanup (BGC) Project remedy objectives were met.

The effects of reduced groundwater extraction due to the GTP shutdowns in September 2022 and December 2022 were compounded by extremely high rainfall during the monitoring period.

Effective hydraulic containment at BIP, and within key portions of the target capture zones at PCA and SCA was evidenced by the achievement of target water levels and/or reverse hydraulic gradients immediately downgradient of the containment lines for the monitoring period.

3.2 Chemical Monitoring

The February 2023 sampling program represents a biannual monitoring event focused on assessment of volatile chlorinated hydrocarbon (CHC) concentrations in pore water, groundwater and surface water at Penrhyn Estuary and surface water at Springvale Drain and Floodvale Drain. Groundwater sampling was undertaken at key locations downgradient of the SCA in order to supplement the dataset that will be used to assess contaminant trends in the annual/biennial monitoring reports.

A parametric test has been used to identify increasing/decreasing trends in contaminant concentrations at sampling locations.

3.2.1 Groundwater Monitoring Wells

Reported CHC concentrations at BP01, BP117, MWF15, MWF17, MWF18¹ and MWF19 located downgradient of the SCA on the shoreline of Penrhyn Estuary can be generally characterised by stable or decreasing trends in most CHC concentrations. However, increasing CHC contamination trends were noted at MWF15I for EDC and VC, MWF15D for EDC and TCE, and MWF19D for VC. Location MWF19S, denoted with an analytical increasing trend, was the result of elevated laboratory limits of reporting in recent monitoring data which are not considered to actually represent an increasing trend. The concentrations of EDC at MWF15I and MWF15D represent historical maximum concentrations for those locations.

The increasing trends and historical maximum concentrations at MWF15 and MWF19 potentially represent limited migration of groundwater containing higher concentrations of dissolved phased CHCs from within the SCA. The previous two

¹ The nested monitoring wells MWF18R have been integrated into the ongoing program to replace sampling previously conducted from MWF18, which were destroyed by adjacent third-party earthworks in 2022.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

monitoring rounds were characterised by extremely high rainfall, with the influence on potential groundwater migration further compounded by no groundwater extraction at the SCA associated with the scheduled GTP shutdowns during the monitoring period. Groundwater extraction within these portions of the SCA is expected to improve following the scheduled GTP maintenance shutdown completed in late March 2023.

An increasing CHC concentration trend was noted from the 3.5 m port at BP117 for CTC, however, this was due to an increase in the LOR. No detections above the LOR for BP117 in the 3.5 m port have been reported since sampling commenced in 2010. Although CHC concentrations have historically been highly variable at BP01 (adjacent to BP117), the February 2023 concentration data were generally consistent with, or less than, those reported in previous monitoring events, and shows decreasing trends in these ports. No historical maximums were detected at BP01 or BP117 during this biannual monitoring round.

Further evaluation of long-term contaminant trends and plume hydrodynamics will be undertaken as part of the annual and biennial monitoring events.

3.2.2 Penrhyn Estuary Pore Water

In general, the February 2023 data are consistent with previous monitoring rounds with the concentrations of the chemicals of concern generally decreasing with decreasing depth towards the discharge interface.

Key contaminant concentrations reported in the February 2023 monitoring round were less than the relevant ANZG (2018) Trigger Values at all sampled pore water monitoring locations with the exception of VC at BP42 in the 2.0 m sample port. It was noted that VC concentrations at BP42 are historically highly variable and that the February 2023 result is lower than the historical maximum concentration at this depth and location.

It should also be noted that the concentration of VC in the shallower 0.1 m and 0.5 m ports and adjacent surface water monitoring location SW069 did not exceed the trigger value.

No historical maximum concentrations for key contaminants were reported during the February 2023 monitoring round.

3.2.3 Surface Water

The review of historical surface water monitoring data shows CHC concentrations have been generally consistent with, or less than, those reported in previous monitoring events. Comparison of the February 2023 surface water data with historical data shows CHC concentrations in Springvale Drain (in particular EDC) have generally decreased several orders of magnitude compared to historical maximum concentrations. The decrease in EDC concentrations within surface water is attributable to the operation of the hydraulic containment system reducing groundwater levels and subsequently reducing groundwater seepage to Springvale Drain, as well as the non-detections or low detections of CHC concentrations in

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

shallow groundwater. Similarly, concentrations of all CHCs in Floodvale Drain significantly decreased following the commencement of groundwater extraction and remain low.

The concentration of CFM at SW069 represented an historical maximum concentration, albeit marginally above the laboratory limit of reporting (LOR). It was noted that this location does not have an extensive monitoring history (sampling commenced in September 2020) and that the concentration of CFM remains low (0.002 mg/L compared to the ANZG criterion of 0.37 mg/L for CFM). No other historical maximum concentrations for key contaminants were reported during the February 2023 monitoring round.

Key contaminant concentrations reported in the February 2023 monitoring round were less than the relevant ANZG (2018) Trigger Values at all locations.

3.3 Implications for Human Health Risk Assessment

A review of Springvale Drain surface water data collected in accordance with the CHHRA (EnRiskS, 2018) did not indicate potential issues during the monitoring period with respect to workplace inhalation exposures adjacent to Springvale Drain. Water levels at MWB03S, which is located close to Springvale Drain where it flows under McPherson Street, exceeded the risk review trigger level for a cumulative period of 111 days during the monitoring period. As a result of this risk review trigger, additional surface water sampling rounds were conducted at key locations within Springvale Drain during the period of elevated water levels. Whilst concentrations of some CHCs increased relative to recent monitoring events, all concentrations were significantly lower than those historically reported. Similarly, the reported concentrations for the additional surface water sampling were less than the ANZG (2018) Trigger Values and concentrations considered in the CHHRA (EnRiskS, 2018).

As a result of this assessment, the elevated groundwater levels (and the associated potential for shallow groundwater to discharge into Springvale Drain) do not impact the conclusions of the CHHRA (EnRiskS, 2018).

Contaminant concentrations for the February 2023 monitoring program were less than the relevant ANZG (2018) Trigger Values and less than the values considered in the CHHRA (EnRiskS, 2018) at all surface water sampling locations.

There are no data presented in the February 2023 monitoring round that affect the conclusions of the CHHRA (EnRiskS, 2018) in relation to Penrhyn Estuary, Springvale and Floodvale Drains (i.e., provided groundwater is not extracted and used for any purpose, health risks associated with exposure to chemicals of potential concern (CoPC) are low and acceptable).

4 GROUNDWATER TREATMENT PLANT ACTIVITIES

4.1 GTP Performance

Overall, the GTP continues to operate effectively. There were two shutdowns of the GTP during the reporting period. There was a planned shutdown from 19 December 2022 until 9 January 2023. In March 2023, the annual shutdown occurred to carry out scheduled maintenance items and inspections of critical equipment. The plant restarted in early April.

There were no process trips during the reporting period. Operations have not been adversely affected by COVID-19.

A summary of indicative GTP operational performance figures for 1 October 2022 to 31 March 2023 is provided below:

Average volumetric rate of groundwater treated (1 October 2022 to 31 March 2023)	4.1 ML/d ²
Approximate total volume of groundwater treated since pump and treat activities commenced in 2005 (at 31 March 2023)	30,674 ML
Volume of groundwater treated during the period 1 October 2022 to 31 March 2023	741.1 ML
Estimated total mass of CHCs destroyed in the thermal oxidiser (at 31 March 2023)	1,578 tonnes
Estimated mass of CHCs destroyed in the thermal oxidiser during the period 1 October 2022 to 31 March 2023	10.4 tonnes

In the past several years, GTP operations – and the volumes of groundwater treated in it – have been relatively steady. As the mass of dissolved-phase CHCs in the aquifer has been depleted, the average concentration of groundwater being pumped to the GTP has decreased. The daily mass of CHCs destroyed has gradually declined due to the reduction in CHC concentrations in extracted groundwater; it was approximately 78 kg per day during the reporting period (taking into account the GTP shutdowns).

On 6 April 2023 control of the GTP's operations and maintenance reverted from Ixom to Orica.

² Excluding the offline time for the December 2022 and March 2023 shutdowns, the average volumetric rate of groundwater treated during the reporting period was 5.5 ML/d.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

4.2 Thermal Oxidiser and Dioxin Air Emissions

Stack emissions testing was undertaken in December 2022 and February 2023, with all results below the relevant licence limits.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

5 STRATEGY REVIEW WORKSHOP

Condition P2 of the 2020 VMP states that Orica will:

- "Conduct ongoing review of developments in remediation technologies and techniques for treatment of Dense Non-Aqueous Phase Liquid (DNAPL), sorbed mass and dissolved phase CHC contamination, and their practical applicability to the Botany Groundwater Cleanup Project.
- Convene a Strategy Review Workshop every four years to which it will invite a minimum of three international experts in the field. The EPA will be consulted on the selection of the experts prior to the experts being engaged. The review process will involve consideration by the experts of the annual reports prepared by Orica (see bullet point below) and worldwide developments in technology in order to assess whether any current or emerging technologies (including developments in technology and its applications) are likely (individually or in combination) to provide a practicable solution and justify the conduct of field trials of those technologies. Appropriate representatives of the Independent Monitoring Committee (IMC) (as agreed with the Orica Botany Liaison Committee (OBLC) – refer P4) and the EPA will be invited to attend the workshop. The outcome of the Remediation Strategy Review Workshop will be considered in determining whether field trials of one or more remediation technologies should be conducted.
- Provide an annual report to the EPA that would assess the practical application and effectiveness of appropriate technologies in relation to the remediation. Every four years, this would also include a detailed summary of the outcomes of the Strategy Review Workshop (refer R3)."

The fifth Botany Groundwater Strategy Review Workshop was held on 2 and 3 March 2020. A report on the Workshop was issued to the EPA on 30 April 2020.

Updates on work arising from the 2017 Workshop actions (Orica, 2017) were presented to the 2020 Workshop participants (Orica, 2020b). In particular, Geosyntec Consultants issued a report and gave a presentation on the outcomes of their column studies and related DNAPL characterisation and contaminant mass transport work. Their work included assessment of additional groundwater data from the March and September 2019 monitoring events. The report indicated there is clear evidence of natural attenuation in the aquifer due to biological and abiotic degradation processes, and sorption and diffusion into low-permeability layers, which varies both laterally and vertically in the aquifer beneath and downgradient of the BIP.

Over the two days of the 2020 Workshop presentations were made by:

- Orica personnel and environmental consultants to provide background to the Orica Botany Groundwater Project and updates since the previous workshop;
- A representative from NSW EPA to provide the Regulator's perspective; and
- The three international experts to provide their views on the current remediation strategy and achievements of the BGC Project to date, observations from comparable sites overseas, updates on available and

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

emerging cleanup technologies, and views on whether any changes to the strategy would be warranted.

Attendees of the Workshop then participated in a facilitated discussion of recent developments and application of cleanup technologies, and what – if any – could be the best alternative strategies for long-term management and remediation.

The primary conclusions for the 2020 Workshop are:

- The existing remedial strategy (hydraulic containment effected through large-scale ‘pump and treat’ of groundwater) is appropriate, effective and concluded to remain the most viable option for containment and source reduction through the foreseeable future;
- No recent remediation technology developments, or complementary technologies, are identified at this time that would merit exploration of their applicability to the BGC Project; and
- The review of source zone remediation options indicates uncertain performance relative to the current situation and high cost.

Notwithstanding the above outcomes, it was also noted that:

- Flushing and mass extraction alone (i.e., without natural attenuation) will not likely achieve remediation end goals in the short or medium term;
- In situ degradation is contributing to faster decay of the plumes and sources; while
- The mechanisms of ‘back-diffusion’ and desorption create secondary sources which impact long-term persistence of plumes and plume response to GTP pumping.

Accordingly, a series of actions were captured in the context of moving towards an enhanced project direction aimed to:

- Optimise GTP performance in key areas of the plumes where practical and cost beneficial;
- Continue to investigate and enumerate existing back-diffusion/desorption and natural attenuative processes with the goal of defining a transition condition that could allow for cessation of operating the GTP;
- Continue to evaluate options to enhance natural attenuative processes to accelerate the rate of cleanup progress; and
- Continue to evaluate timing, metrics and potential effects on the receiving environment of shutting down the ‘pump and treat’ system

while maintaining the ‘pump and treat’ system for the medium to long term.

A special meeting was held on 4 March 2020 to allow community members of the OBLC to discuss the outcomes of the Strategy Review Workshop with the three international experts, IMC hydrogeologist Dr Denis O’Carroll and James Stening.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

6 COMMUNITY CONSULTATION

This section provides an update in response to Condition P4 of the VMP, which specifies how Orica must inform the community of developments in the BGC Project. It provides information regarding the consultation activities undertaken by Orica to share information and obtain community feedback on the BGC Project.

6.1 Orica Botany Liaison Committee (OBLC)

Two ordinary meetings of the Orica Botany Liaison Committee (OBLC) were held during the reporting period: on 8 November 2022 and 14 March 2023. The next scheduled meeting is to be held on 11 July 2023.

6.2 Independent Monitoring Committee (IMC)

An IMC Task was assigned to Dr Denis O'Carroll, IMC hydrogeologist:

- To review the updated mass estimate report and comment at the next scheduled OBLC meeting on its relationship to the Conceptual Site Model (CSM), noting this does not need to occur until the mass estimates have been completed by external consultants.

6.3 Communication Tools

The following table provides an overview of activity this reporting period (or more recently) for the routine BGC Project communication tools used by Orica.

Communication Tool	Activity This Reporting Period Related to the BGC Project
BGC Project pages on https://www.orica.com/Locations/Asia-Pacific/Australia/Botany/Botany-Transformation-Projects/Groundwater-Cleanup#.X8QZoGgzYuU	Information uploaded: <ul style="list-style-type: none"> • November 2022 and March 2023 OBLC meetings' agendas and briefing papers. • November 2022 OBLC meeting minutes and presentations. • October 2022 Orica VMP Progress Report no. 38. • DNAPL and Groundwater Remediation Technology Annual Review No. 17.
Local newspapers	Column published in the <i>St George Leader</i> on 2 November 2022 and 8 March 2023 ³ ,

³ The *Southern Courier* and *St George Leader* are now only published online. As the *Southern Courier* is only available through paid subscription, column advertisements for the BGC Project are now only published in the *St George Leader* and is also distributed via Orica's database of subscribers.

	REPORT No.: EN.1591.61.PR095	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 39		

Communication Tool	Activity This Reporting Period Related to the BGC Project
	and emailed to Orica's database of subscribers.
Email enquiries	No feedback received specific to the BGC Project.
Feedback facility on the Orica website	No feedback received specific to the BGC Project.
1800 Number Calls	No feedback received specific to the BGC Project.
Site tours	22 March 2023 - Chemical Engineering students from University of New South Wales (UNSW) visited the Groundwater Treatment Plant.

6.4 Community Investment

The Orica Botany Community Investment Program opened in March and applications need to be submitted by the end of May 2023.

	REPORT No. : EN.1591.61.PR093	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 38		

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	REPORT No. : EN.1591.61.PR093	Rev: 0
VOLUNTARY MANAGEMENT PROPOSAL PROGRESS REPORT NO. 38		

ATTACHMENT A – ANNUAL MONITORING REPORT – FEBRUARY 2023

Groundwater Treatment Plant – February 2023 Biannual Groundwater and Surface Water Monitoring Report. WSP Australia Pty Ltd. 28 April 2023. *Separately provided report.*