Marsden Point Refinery: **A Resource Consent Application to Renew 20 Resource Consents from the Northland Regional Council**

Prepared for: **ChanceryGreen on behalf of The New Zealand Refining Company Limited, trading as 'Refining NZ'**

Prepared by:
Gavin Kemble, *Director*
Bridgette Munro, *Chairperson*
Blair McLean, *Senior Planner*
George Sariak, *Planner*

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Volume 3i: Hydrogeological Model

REPORT

Tonkin+Taylor

GWS Limited

Marsden Point Refinery

Hydrogeological Conceptual Site Model

Prepared for
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Table of contents

1 Introduction 1
1.1 Background 1
1.2 Purpose/objective 1
1.3 Scope 2

2 Site overview 3
2.1 Description 3
2.1.1 Surface and groundwater infrastructure 3
2.2 Setting 4
2.2.1 Surrounding land use 4
2.2.2 Published geology 4
2.2.3 Hydrogeology 5
2.2.4 Coastal environment 5
2.3 Site history 6
2.3.1 Historic site uses and layout 6
2.3.2 Previous waste handling 8
2.4 Previous studies 8

3 Regulatory criteria 10
3.1 Ground contamination 10
3.1.1 Regional Plans 10
3.1.2 NES Soil 10
3.2 Groundwater take 10

4 Soil Contamination 12
4.1.1 Metals 12
4.1.2 Petroleum hydrocarbons 12
4.1.3 Volatile organic compounds 13
4.1.4 Polycyclic aromatic hydrocarbons (PAH) 13
4.1.5 Chlorinated solvents 13
4.1.6 Asbestos containing materials 13
4.1.7 PFAS 14
4.1.8 Transformer oils 14
4.1.9 Nutrients 15

5 Groundwater contamination 16
5.1 LNAPL 16
5.1.1 Characterisation 16
5.1.2 Distribution 17
5.1.3 Mobility 19
5.2 Dissolved phase 19
5.2.1 Petroleum hydrocarbons 19
5.2.2 Volatile organic compounds 19
5.2.3 PAHs 20
5.2.4 Phenols 20
5.2.5 Chlorinated solvents 20
5.2.6 Metals 20
5.2.7 Nutrients 23
5.2.8 PFAS 25

6 Hydrogeological site model 27
6.1 Geology and hydrogeology 27
6.2 Aquifer parameters 27

6.2.1 Hydraulic properties 27
6.2.2 Natural attenuation of hydrocarbons 30
6.3 Preferential pathways 30
6.4 Groundwater discharge zones 30
6.5 Efficacy of containment system 30
6.6 Summary of the current groundwater condition 31
7 Conceptual site model 32
7.1 Sources 32
7.1.1 Primary sources 32
7.1.2 Secondary sources 32
7.2 Transport mechanisms 32
7.3 Exposure pathways and receptors 33
8 Groundwater take 35
8.1 Purpose of use 35
8.2 Proposed take volume 35
8.2.1 Background to groundwater take 35
8.2.2 Well performance 36
8.2.3 Groundwater availability 38
8.2.4 Effects on other users 41
8.2.5 Effects on other aquifers 43
8.2.6 Effects on surface waters 43
8.2.7 Saline intrusion potential 43
8.2.8 Ground settlement effects 45
8.2.9 Nett positive benefits 45
8.2.10 Draft conditions 45
9 Conclusions 46
10 References 47
11 Applicability 49

Appendix A : Figures
Appendix B : Tables
Appendix C : T+T 2019a PFAS Sampling Report
Appendix D : T+T 2019b September 2019 GME Report
Appendix E : November 2019 Foreshore Sampling
Appendix F : LNAPL Graphs
Appendix G : Recovery well performance data
Appendix H : Water balance

Glossary

Specific terms	
Aquifer	A water bearing geological layer that is sufficiently permeable to contain or conduct significant amounts of water.
BTEX	Benzene, toluene, ethylbenzene, xylenes
Catalyst	A substance that increases the rate of a chemical reaction without being consumed by the reaction.
Fluvial	Formed by river processes.
Groundwater yield	The volume and rate of groundwater that can be extracted from a well or aquifer.
Hydraulic containment	The method of controlling groundwater movement by pumping.
Interceptor	An in-line wastewater or stormwater separation system that separates oil from water and sediment.
Intertidal	The area that is above water level and low tide and below water level at high tide.
Light non-aqueous phase liquid (LNAPL)	Hydrocarbons that are less dense than water and exist as a separate phase when in contact with water.
Littoral transport	The transport of sediment near the shoreline due to the action of breaking waves and the current.
NES Soil	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011
PAH	Polycyclic aromatic hydrocarbons
PFAS	Per- and polyfluoroalkyl substances
Smear zone	The area where soil contamination may exist within the range of fluctuating groundwater levels, such as if LNAPL were present.
Unconfined aquifer	An aquifer where the upper water interface is at atmospheric pressure, i.e. a water-table aquifer.

Executive Summary

- Refining NZ has monitored groundwater quality at the site since the early 1980s, with an increasing density of monitoring wells. There are currently 140 monitoring wells on the site that are periodically gauged for depth to water and depth to Light Non-Aqueous Phase Liquid (LNAPL), as well as four active recovery wells and one unused recovery well. Twenty-nine (29) perimeter wells are routinely monitored (based on 2017 – 2019 data), primarily for hydrocarbon contamination.
- Based on the 2019 data, the hydraulic containment system as it is currently operating is generally effective at containing LNAPL and dissolved phase hydrocarbons including Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX).
- With respect to exposure for human and ecological receptors from contact with contaminated receiving surface water and sediment, the only contaminants of concern found within the downgradient groundwater monitoring wells that exceeded the relevant criteria (or where the limits of reporting were above the relevant criteria) were metals (arsenic and zinc, on the foreshore) and PFAS (near the fire training ground). The presence of arsenic and zinc are considered to be reflective of natural conditions.
- The possible impact of dissolved PFAS in groundwater does not materially impact the conclusions of this hydrogeological assessment. The effects associated with discharges to the marine environment are being assessed by direct measurement of PFAS levels in the marine biota (Sharon De Luca). The implications for uptake by birds is being addressed by Graham Don, uptake by marine mammals by Dr Deanna Clement and uptake by humans by Dr Francesca Kelly.
- The Refinery site is presently permitted to take a total of 2,700 m^3/d under two separate resource consents. The history of the site dewatering and hydrocarbon recovery illustrates the need to have a flexible and pragmatic approach to the taking of groundwater by allowing the volume and location of the takes to be transferable within the site. As such, it is proposed that the water take volume under a new resource consent is general to the site and not specific to any particular recovery well (existing wells or as future needs require).
- The present regime of pumping is considered to be an appropriate and effective means of avoiding adverse effects associated with saline intrusion because outward hydraulic gradients are maintained. This is supported by the operational data and monitoring for the wells.
- It is, however, worth stating that in the context of planning provisions the prevention of saline intrusion is an objective designed to protect a freshwater resource (coastal aquifer) from becoming contaminated such that it cannot be used for other purposes. In the case of the aquifer system beneath the refinery, it is clear that the resource is already contaminated due to the presence of hydrocarbons in groundwater, and for this reason, the resource has little value for other purposes. Further, in the case of the Refinery, even if saline intrusion into the aquifer were to occur, seawater is enriched in electron acceptors that promote the natural attenuation of dissolved phase hydrocarbons. So, in this case, saline intrusion could be considered beneficial in that it would reduce the source of aquifer contamination. It should also be noted that saline intrusion, if it were to occur, is reversible so any effect can be considered transient in nature.

1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by The New Zealand Refining Company Ltd, trading as Refining NZ (Refining NZ) to prepare a hydrogeological conceptual site model report to support the application for renewal of existing resource consents for the Marsden Point Refinery site, Ruakaka (the Refinery, also referred to as the site) (**Figure 1** of **Appendix A**). The current resource consents are described in the Assessment of Environmental Effects (AEE) to which this report is attached.

This hydrogeological conceptual site model report has been prepared in accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 1 (MfE 2011a). The persons undertaking, managing, reviewing, and certifying this assessment are Suitably Qualified and Experienced Practitioners (SQEP), as required by the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES Soil) [New Zealand Government 2011] and defined in the NES Soil Users' Guide (MfE 2012).

This report was prepared in accordance with our proposal of 21 May 2019.

1.1 Background

Refining NZ operates New Zealand's only oil refinery (the Refinery) at Marsden Point on the southern headland of Whangarei Harbour. It is an independently operated "tolling" refinery, meaning that it owns neither the feed-stocks nor the finished products.

The Refinery receives over 40 million barrels of crude oil per year. The crude oil is sourced from a number of different locations and suppliers and is delivered to the Refinery via ship. The bulk of the products produced by the Refinery are distributed via dedicated coastal tankers or via the Refinery to Auckland Pipeline (RAP).

The Refinery has operated on the site since 1964 and during that time there have been various practices in terms of managing operations and the waste and sludge generated on site. The site also has a dedicated fire training ground which has been in use since the 1970s. As a result of losses to ground over the Refinery's operational period, soil and groundwater at the site have become contaminated.

Refining NZ has undertaken groundwater monitoring at the site since 1980. The long term monitoring programme shows that hydrocarbon contamination is present beneath the site, in the form of dissolved phase hydrocarbons and also light non-aqueous phase liquids (LNAPL). A series of wells are used within the site to recover hydrocarbon product and draw down the groundwater table to induce hydraulic containment.

Refining NZ hold a number of resource consents from Northland Regional Council (NRC) relating to the hydraulic containment system and the management of contaminants. The current resource consents are due to expire in May 2022.

1.2 Purpose/objective

In order to inform the AEE report being prepared in support of the renewal application, Refining NZ requires the development of an updated hydrogeological conceptual site model to detail the potential adverse effects associated with the presence and management of contamination at the Refinery.

Refining NZ has over the years gathered a large dataset on the site's contamination condition, its geological and hydrogeological setting, and the wider receiving environment. In the time since the

existing resource consents were obtained, significant additional information and data have been obtained by Refining NZ.

The purpose of this report is therefore to bring together the current knowledge of the site conditions to allow for an up-to-date assessment of the current and future potential effects on the environment. The findings of the assessment are used to consider what (if any) additional intervention or remediation is required to ensure the effects on the environment are acceptable.

1.3 Scope

The following scope of works was undertaken in developing the updated hydrogeological conceptual model for the site:

- Review of relevant existing reports and data sources as outlined in **Section 2.4** regarding contaminant sources, geological setting, hydrogeological conditions and the marine environment;
- Completion of one round of groundwater sampling in June 2019 to assess per- and polyfluoroalkyl substances (PFAS) contamination in the location of the current onsite fire training area;
- Completion of one round of groundwater sampling in September 2019 to provide recent data for potential contaminants that had either not been previously analysed or not analysed for some years;
- Evaluation of data obtained by Refining NZ from groundwater sampling on the Bream Bay beach adjacent to the site in November 2019;
- Assessment of recovery well performance based on data held in existing reports and recent monitoring data;
- Assessment of groundwater availability and yield in the context of the Marsden-Ruakaka coastal aquifer management area, again using data from existing reports and recent monitoring rounds;
- Assessment of effects on other groundwater users, other aquifers and surface waters;
- Quantitative assessment of saline intrusion potential and qualitative assessment of the consequence of saline intrusion occurring;
- Assessment of ground settlement potential;
- Assessment of positive benefits of the hydraulic containment system;
- Development of the hydrogeological conceptual site model; and
- Preparation of this report to support the AEE.

2 Site overview

2.1 Description

The site comprises 114 ha (**Figure 1**), legally described as *Part Section 10 Block VIII SD Ruakaka*. The site is bounded to the west by Port Marsden Highway and Mair Road, to the north by Ralph Trimmer Drive and the Whangarei Harbour, and to the east and south by Bream Bay.

The site is of flat topography at reduced level heights only a few metres above mean sea level (95.73 m reduced level [m RL], Refining NZ datum). To the east and south, hummocky sand dunes are present between the site boundary and the foreshore.

The operational refining facilities cover the majority of the site surface (**Figure 1** in **Appendix A**). The processing operations occur in a series of Process Blocks ('A'-'E') forming a T shape in the centre of the site. Tank compounds are located to the west, north and east of the Process Blocks. The tank compounds have perimeter bunds and dedicated stormwater control systems. The Refinery produces a number of products, which include gasoline, jet fuel A-1 / dual purpose kerosene, diesel, fuel oil, bitumen, sulfur and carbon dioxide. Product pipework is predominantly above ground.

The Refinery Jetty (consisting of a main jetty structure with access to three jetties) is located on the northeastern end of the point, with crude oil arriving to site by ship and pumped to storage facilities prior to processing.

Ancillary and supporting facilities for the Refinery operations are located in the northwest and include mechanical and maintenance services, offices, warehouses, staff amenities, a contractors' yard and laboratory. A visitor centre is also located in this area adjacent to the gate house and site entry point. The site is fully fenced. Access through the site is via a network of numbered roadways.

A fire training area (also referred to as a 'fire training ground' and 'fire training facility') is located on the eastern most point of the site and comprises a paved surface with training equipment in a central area.

The AEE outlines the current processing of crude oil that is undertaken at the Refinery. A detailed summary of the refining processes is not provided in this report. For the purposes of this report, it is important to note that crude and refined product storage, transfer and processing represent potential primary sources of contamination to groundwater.

2.1.1 Surface and groundwater infrastructure

Water management at the Refinery is of particular relevance to the hydrogeological conceptual site model. This section summarises the key water infrastructure which comprise part of the conceptual model.

There are two types of drainage system employed by the Refinery: the Continuously Oil Contaminated System ('the COC') and the Accidentally Oil Contaminated System ('the AOC'). The COC and AOC systems are described in detail in the AEE. A summary is provided here:

- The COC intercepts process water, stormwater and tank drainage water that is likely to be contaminated from a number of processing and treatment activities at the site. The COC system consists of five sewer networks and oil interceptors, oil sumps and pumps. The oil that is collected in the interceptors is directed back to the slops processing unit for recycling. The separated water is then pumped to the water treatment unit (the biotreater unit) for further treatment. Separated water from the interceptors (for rainfall events of up to 6 mm per hour [mm/hr]) is also pumped back to the biotreater for further treatment. Where rainfall intensity exceeds 6 mm/hr the treated water from the interceptors is discharged into the AOC system;

- The AOC system typically collects water that is unlikely to be contaminated by process activities or chemicals, but may, as a consequence of contact, be potentially contaminated. The AOC is effectively the stormwater system for the site. The reticulated stormwater network drains to the open channel drains within the site that all flow to the stormwater retention ponds and eventually discharge to the stormwater storage basin (also referred to as the SWB, or stormwater source basin). Stormwater from the SWB is pumped through a pipe along the No. 2 (western) Oil Jetty to an outfall. The stormwater discharge is tested for a range of water quality parameters in accordance with the consent conditions.

A hydraulic containment system has operated at the site since 1983 to manage hydrocarbon contamination of groundwater. The current extraction system comprises recovery wells RW15A, RW19B, RW22 and KIWI (RWSEQ) and operates continuously (refer **Figure 2** in **Appendix A** for well locations). Until 2017, recovery well RW02 in the northwest portion of the Refinery was also included in the containment system, but operation ceased as there was no longer an immediate need to provide containment and recovery in that portion of the site. RW02 is available to provide containment if required. Recovered product is pumped to the COC and slops system for separation and treatment. There was previously also a recovery system near the Control Room (within Block B, denoted 'C.R.' on **Figure 1** in **Appendix A**), within an area bounded by subsurface bentonite walls. The bentonite wells are understood to be partially degraded and recovery is not currently being undertaken from this system. The broader area, including the Control Room, is within the hydraulic capture of RW19B.

2.2 Setting

2.2.1 Surrounding land use

The surrounding environment comprises the marine environment of the Whangarei Harbour to the north and Bream Bay to the south and east. The mean high water mark (96.95 m RL) is located 15 to 40 m from the site boundary of the site to the north and east.

Northport is situated to the northwest of the site and a timber processing plant is located to the west of the refinery site. Refining NZ own land to the southwest of the site, with agricultural land use beyond. The nearest residential dwellings are approximately 900 m to the northwest on Albany Road.

2.2.2 Published geology

The location of the site in the context of the regional geology is presented on **Figure 2.1** with respect to the 1:250,000 geological map of Edbrooke and Brook (2009)[1]. The geology underlying the site is described as Holocene aged sediments of the Kariotahi Group, comprising loose to poorly consolidated sand in fixed parabolic and local transverse dunes with minor sand, mud and peat in interdune deposits.

Detailed site specific geological information is provided in **Section 6** of this report.

[1] Edbrooke, S.W.; Brook, F.J., 2009. Geology of the Whangarei area. Institute of Geological & Nuclear Sciences 1:250,000 Geological Map 2. Sheet 1. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand.

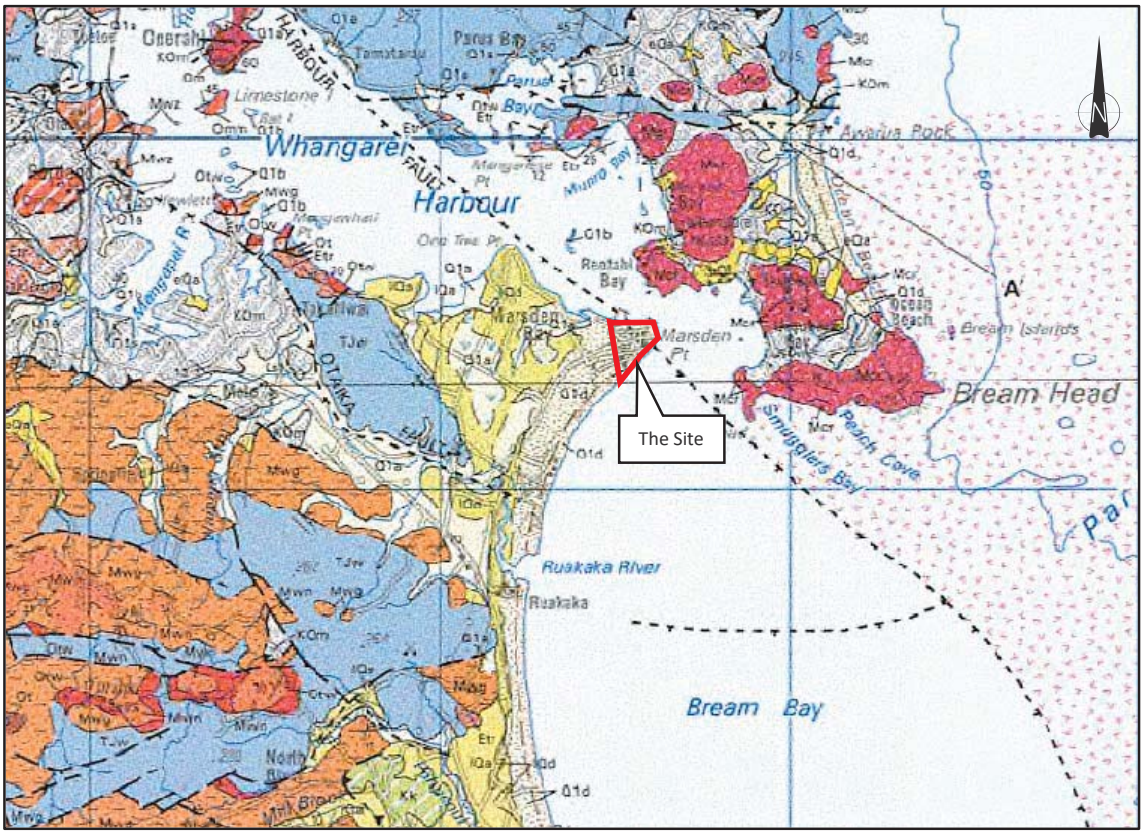

Figure 2.1 Regional published geology (Edbrooke and Brook, 2009)

2.2.3 Hydrogeology

The site is underlain by an unconfined sand aquifer which is part of the Marsden-Ruakaka aquifer system (based on the Geological and Natural Sciences [GNS] National Groundwater Atlas). Under natural groundwater flow conditions, groundwater would be expected to flow west to east, then to the north to Whangarei Harbour or northeast, east and southeast to Bream Bay, depending on location within the Refinery. However, current flow directions at the site are influenced by the groundwater hydraulic containment system that is operated by Refining NZ.

A plot of the March 2019 groundwater contours is shown in **Figure 3** in **Appendix A**. Based on the March 2019 water level data, the containment system is effective in capturing groundwater across the majority of the site. The zone of outward gradients (i.e. not within hydraulic containment) is shown in **Figure 4** in **Appendix A**. The in-well apparent LNAPL thickness contours and hydraulic containment are shown in **Figure 5** in **Appendix A**.

The hydrogeological setting of the site in detail and further information on flow direction, hydraulic conductivity, tidal influence and location of the saline interface are discussed in **Section 6.1**. The potential for preferential pathways for groundwater movement are discussed in **Section 6.3**. Two cross sections have been prepared which are presented in **Figures 7** and **8** in **Appendix A** and are discussed in **Section 6.1**.

2.2.4 Coastal environment

Whangarei Harbour is classified as a single spit enclosed estuary of fluvial origins. Its general location is stable, controlled by Whangarei Heads to the north and the large ebb delta to the south. The inlet is tide dominated with tidal flows significantly greater than littoral transport which results in a stable

inlet. Mair Bank is a 62 ha intertidal sandbank that extends east from Marsden Point and is fully submerged at high tide (T+T 2016).

The ecological values of the coastal environment near the site are described in the ecological assessment report (Boffa Miskell 2019).

2.3 Site history

This section presents a summary of the history of the site, which has principally been gathered from Refining NZ's records. The purpose of reviewing the site history is to understand historical and current potential sources of contamination. Given the history and uses of the site discussed below, there are a range of potential sources and contaminants. The potential contaminants are discussed in detail in **Sections 4** (Soil) and **5** (Groundwater) along with the available testing data.

Table 2.1: Site history overview

Date	Site use / activities
Pre-1960s	Farmland
1964	Refining operations commenced.
1980s	The Refinery underwent a major expansion (the Expansion) which included extension onto former farmland to the south. This resulted in the movement of some facilities and modifications to waste handling practices as described further in **Sections 2.3.1** and **2.3.2**. In 1983, the hydraulic containment system commenced operation.
Post-1980s	Upgrades and maintenance works have been undertaken over the last 30 years including demolition of tanks and infrastructure and construction of new infrastructure. In 1996, leaded petrol was banned by the New Zealand Government. Four tanks were removed from the Refinery's tetraethyl lead (TEL) compound following the cessation of adding lead compounds to petrol. Land farming (bioremediation of tank sludges) was undertaken on site until operations ceased in approximately 1996.

2.3.1 Historic site uses and layout

Prior to development, the site was used for farming. Refining NZ purchased the site in the early 1960s and commenced refinery operations in February 1964. The first fuel export occurred in June 1964. The original refinery was built in the northern portion of the site as a "hydroskimming" refinery, consisting of a distiller, octane platformer and associated secondary processes. The Refinery Jetty was also established in the 1960s.

In the mid-1980s, the Refinery underwent a major expansion (the Expansion) based upon a "hydrocracker" refinery with associated feedstock plant, utility and environmental facilities. As part of the Expansion the site extended to the south to cover the majority of the Marsden Point. It appears that the majority of the tanks that already were in use prior to the Expansion remained in place (i.e. were not removed), with others added over time from establishment of the facility through to the mid-1980s. The 170 km RAP from Marsden Point to the Wiri Oil terminal was commissioned during the Expansion. Some associated facilities were moved as the operations expanded; those potentially relevant with respect to ground contamination are listed below:

- The fire training area was previously located near the northern end of the site in what is now the Jet A-1 compound (refer the locations of T-122, T-123, T-124, T-129 and T-130 on **Figure 1**

in **Appendix A**). The former fire training area is also shown within a potential area of PFAS contamination in **Figure 6** in **Appendix A**. The fire station was also moved; the original fire station is now used as the present day workshop building, and the new fire station is located on the northern part of the site;

- The flare was originally located north of Road 5, and is now located in the southwest part of the site;
- The laboratory was originally in the centre of the site (in area of current Block A);
- The dangerous goods store was originally located near the former tetraethyl lead (TEL) compound west of Tanks 60 and 61. Four tanks within the former TEL compound were removed prior to 1999;
- There were originally three substations onsite. In the Expansion, some old substation buildings were demolished and replaced with more substantial substation buildings. A total of 10 substations were present by 1986, with one changing location between 1986 and 1997. It is understood that there are currently 19 substations in use at the site; and
- Sewage/leaching fields were removed in the Expansion. Fields were located near the old fire station, control room and office block. A sewage pit was also located in the present Block C area and was removed in the Expansion.

Prior to development, a historical land drain, known as the Bercich Drain after the original farming family, ran across the site from west to east. The drain was diverted to the south to allow for site development, with the initial diverted route reaching Bream Bay to the east of where the T-170 tanks are now located. Prior to the Expansion, the drain was diverted at the point where it entered the site. The historic location and the diverted routes of the drain are shown on **Figure 2.2**. Refining NZ has advised that when the drain was diverted, the redundant section of the drainage channel was filled with sand and brown rock and compacted to some degree (GHD/GWS, 2014).

Figure 2.2 Approximate location of Bercich Drain. Purple line shows the approximate drain alignment in 1942; the red line presents partial diversion of the route following site development; the green line presents the route diverted at the site boundary. Source: GHD/GWS 2014 and aerial photographs.

The hydraulic containment system ground began operation in 1983. Further background information regarding the containment system is included in **Section 2.1.1**. Up until 2017, recovery well RW02 in the northwest portion of the Refinery was also included in the containment system. There is currently no extraction being undertaken in the northwest portion of the Refinery due to the absence of LNAPL in the proximity of RW02.

Since the 1980s there has been a programme of upgrades and maintenance works across the facility. In 2012 an expansion of petrol-making facilities commenced (The New Venture – Te Mahi Hou project). This comprised:

- Integration of T7 and T9 compound; and
- Demolition of T10 and T12 and construction of Block E containing the continuous catalyst regeneration (CCR) unit.

In 2016 a buried revetment wall and foredune was constructed to the southeast of the butane spheres to protect a section of the coastline from erosion.

A sulfur solidification plant is currently under construction at the Refinery at the time of this report.

2.3.2 Previous waste handling

Historical waste management at the site included application of sludge to land. Small volumes of sludge were generated from tanks, interceptors and canals/drains and was buried onsite or transferred to sludge fields (also known as landfarms) where bioremediation practices were undertaken. Prior to the Expansion, leaded sludge was weathered on concrete slabs at various locations around the refinery site. These locations are shown as areas of lead contamination in **Figure 6** in **Appendix A** (plan provided by Refining NZ).

During the enabling works for the Expansion, some material that had been buried, weathered, or put in pits during the 1960s and 1970s was excavated and removed from site (see 'Coleman's Mountain' on **Figure 6** in **Appendix A**). After the Expansion, the sources of sludge increased, however, a sludge handling unit reduced the overall load on the landfarms. The locations of landfarms LF1 to LF4, which were established after the Expansion, are shown on **Figure 2**. Landfarms/sludge fields were previously located in numerous other locations across the Refinery. Landfarming ceased at the Refinery around 1996. These areas are shown as areas of potential metals and hydrocarbon contamination in Figure 6 (plan provided by Refining NZ).

2.4 Previous studies

Relevant previous studies that have been completed at the Refinery and used in the development of the hydrogeological conceptual site model are listed in **Table 2.2**.

Table 2.2: Previous studies

Title	Date	Author	Reference
Contamination source information			
Refining NZ – Fire Training Ground Investigation	June 2016	Refining NZ	Refining NZ 2016
Groundwater Monitoring Review – Marsden Point Oil Refinery	12 February 2016	AECOM New Zealand Ltd	AECOM 2016
Marsden Point Oil Refinery, Northland – Ground Contamination Soil Management Plan	July 2012	T+T	T+T 2012

Title	Date	Author	Reference
Marsden Point Oil Refinery – Compound T10 and T12 and former landfarm material characterisation	4 February 2013	T+T	T+T 2013b
Hydrogeological and geological information			
The New Zealand Refining Company Limited, Hydrogeological Characterisation	August 2014	GHD Ltd / GWS Ltd	GHD/GWS 2014
Control Room – Groundwater Hydraulic Assessment – Bentonite Wall Testing	17 March 2014	URS New Zealand Ltd	URS 2014
Previous resource consent application documents			
Application for resource consents (1997)	September 1997	Refining NZ	Refining NZ 1997
Resource Consent Applications and Assessment of Effects on the Environment, Earthworks for New Venture at Marsden Point	January 2013	T+T	T+T 2013a

3 Regulatory criteria

3.1 Ground contamination

3.1.1 Regional Plans

Discussion regarding the NRC Proposed Regional Plan [NRC 2019] (of which parts that are not under appeal are operative), the NRC Operative Regional Water and Soil Plan [NRC 2014], and consenting requirements is provided in the AEE.

Rule C.6.8.2 of the Proposed Regional Plan relates to passive discharges from contaminated land that are permitted activities. It is acknowledged that passive discharges at the site are **not** permitted under this Rule due to the presence of LNAPL which, although present, is managed via hydraulic containment. However, the permitted activity criteria under this Rule are referenced in later sections (in particular **Section 5**) of this report in regard to understanding the substantive effects of the ongoing (passive) discharges at the site.

3.1.2 NES Soil

The NES Soil regulates activities to be undertaken on potentially contaminated land and provides nationally consistent human health risk based criteria for the assessment of risks to human health.

The intention of the NES Soil is to enable safe use of contaminated land to ensure that contaminated land is appropriately assessed prior to development, and if necessary, the land is made safe for human activity. The NES Soil applies only when certain activities are to occur on the site generally associated with development, subdivision or change in land use. The NES Soil does not include criteria for environmental risk assessment.

Given that the purpose of this assessment is largely focused on fate and transport of contaminants in groundwater and potential impacts on environmental receptors, the NES Soil does not directly apply to the Proposal or to this assessment.

However, a number of guideline documents are brought into the NES Soil by reference which are relevant to this assessment. These include the MfE Contaminated Land Management Guidelines, including:

- Contaminated Land Management Guidelines No.5 – Site Investigation and Analysis of Soils (Revised 2011) [MfE 2011b]; and
- Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) (referred to as the Oil Industry Guidelines) [MfE 2011c].

The approach to the assessment was based upon the principles outlined in these guidelines.

3.2 Groundwater take

The relevant rules for the abstraction of groundwater in the Proposed Regional Plan are as follows:

- C.5.1.1 *Minor takes – permitted activity*;
- C.5.1.9 *Takes existing at the notification date of the plan – controlled activity*;
- C.5.1.11 *Takes existing at the notification date of the plan – discretionary activity*; and
- C.5.1.14 *Water take that will exceed an allocation limit – non-complying activity.*

In terms of volume, Rule C.5.1.1 (2)a specifies the permitted activity level for the total daily take to be 10 m^3.

The relevant rules for abstraction of groundwater in the Regional Soil and Water Plan are as follows:

- C25.1.1 *The taking and use of groundwater from an aquifer […]* (permitted activity); and
- C25.3.1 *The taking, use or diversion of groundwater from an aquifer […]* (discretionary activity).

In terms of volume, Rule C.5.1.1 a) specifies the permitted activity level for the total daily take to be 10 m^3 and a rate not exceeding 5 litres/second (L/s).

4 Soil Contamination

From the Refinery's data and anecdotal information held by long serving staff, Refining NZ has developed a plan of the known areas of subsurface contamination within the Refinery (**Figure 6** in **Appendix A**). This figure shows the known areas of likely subsurface contamination only, and because of the nature of site activities there is potential for other areas of the Refinery to contain contamination.

Within the known areas of likely contamination there are a range of known possible contaminants, all derived as part of the refining process. These are detailed in the following sections.

4.1.1 Metals

Metal contamination at the Refinery is generally derived from:

- Impurities released from the crude oil during its refining process, including arsenic, vanadium, iron, nickel and mercury;
- Garnet used in abrasive blasting contains metals from its source as well as contaminants from the blasting process;
- Spent catalyst contaminated by impurities in the crude oil including vanadium, cobalt and nickel;
- Sludge removed from leaded gasoline tanks contained high levels of organometallic forms of lead, such as tetraethyl lead. Organometallic lead can break down to elemental lead, which is less toxic, as part of the landfarming/bioremediation process. Tetraethyl lead is known to break down relatively quickly, with literature values for half-life in soil ranging from 7 hours to 47 days[2]. Leaded gasoline production ceased at the Refinery in the mid-1990s;
- Spent carbon storage; and
- Waste/slops storage and processing.

Known areas of potential metal contamination are shown on **Figure 6** in **Appendix A**, however others may exist. These generally relate to known areas of landfarms or waste disposal.

In the areas where metal contamination has been identified it is likely to be present in near surface soil around waste by-product storage areas. In these areas deeper contamination may also occur as a result of leaching and vertical migration of more soluble metals through the soil profile.

4.1.2 Petroleum hydrocarbons

Petroleum hydrocarbon residues are known to be present in soil and groundwater in areas of crude/product storage, refining processes and storage and processing of wastes. The presence of Light Non Aqueous Phase Liquids (LNAPL) at the groundwater table is well documented and is described in detail in **Section 5**.

Areas that are likely contain hydrocarbon contaminated soils are shown on **Figure 6** in **Appendix A**, however others may exist. Soil contamination by LNAPL will occur within the smear zone[3] above and below the groundwater table. Shallower areas of hydrocarbon contamination may be present in locations were spills or leaks have occurred, depending on the depth of release.

[2] Syracuse Research Corporation (1998) Chemical Fate Half-Lives for Toxics Release Inventory (TRI) Chemicals. Prepared for U.S. Environmental Protection Agency,

[3] The smear zone is the area where LNAPL has been smeared vertically across the aquifer material (in this case, soil) when groundwater levels have fluctuated.

4.1.3 Volatile organic compounds

Volatile compounds such as light fraction petroleum hydrocarbons, benzene, toluene, ethylbenzene, xylene and naphthalene are known to occur where petroleum hydrocarbons are recorded (**Figure 6** in **Appendix A**). Volatile organic compounds (VOCs) may occur in soil, groundwater, and as a gas phase within unsaturated soil.

An area of known benzene contamination has been mapped by Refining NZ in the centre-southeast of the site.

4.1.4 Polycyclic aromatic hydrocarbons (PAH)

PAH are present in the heavier end petroleum hydrocarbon fractions and as a by-product of the refining process. Available information for the Refinery indicates an area of PAH contamination exists associated with storage of spent carbon (**Figure 6** in **Appendix A**). It is possible other refinery process and waste processing areas may also contain PAH contamination in soil. More volatile PAH compounds such as naphthalene may also occur associated with VOC contamination as discussed in **Section 4.1.3**.

4.1.5 Chlorinated solvents

Tetrachloroethene (PCE, also known as perchloroethylene or perchloroethene) is stored and used in the Refinery's CCR unit located in Block E. PCE is stored in a purpose built vessel within a bunded area. During catalyst regeneration PCE is injected into the reactor from the vessel via an injection pump that is also located within the bunded area. The PCE storage vessel is periodically (every 8 to 10 weeks) topped up from a 200 L drum of PCE using a pump. PCE is converted to hydrochloric acid, water and carbon dioxide within the regenerator, with the hydrochloric acid sorbing onto the catalyst. Spent chloride removed from the catalyst is sorbed onto absorbent material comprised of zinc oxide, aluminium oxide and sodium carbonate components.

Prior to commissioning of the CCR unit PCE was used in a similar fashion within Block A for the old platformer unit which was replaced by the CCR unit. The PCE vessel was topped up once every 18 months using 8 to 10 drums of PCE.

RNZ advised that there are no recorded incidents in relation to spills of PCE. The management practices adhered to suggest that soil or groundwater contamination associated with use of PCE at the CCR unit or old platformer unit is unlikely to have occurred. Investigation of chlorinated solvents in soil or groundwater near the CCR unit or old platformer unit has not been undertaken for this assessment, however, these areas are within the area of hydraulic containment and are, therefore, not expected to impact the surrounding environment.

4.1.6 Asbestos containing materials

Refining NZ holds a register of asbestos containing materials (ACM) within the Refinery. Although a large component of the ACM historically present within the Refinery buildings and structures has been removed, some fibre cement cladding and insulation lagging remains. There is potential for asbestos contamination of soil to have resulted around areas of former or current asbestos product use (including disposal of wastes during construction, e.g. under building foundations), or where buildings containing asbestos have been demolished and demolition fill remaining in ground. Current asbestos product use at the site is limited and comprises some gaskets which are disposed of into dedicated bins when required.

An area of known asbestos contamination of soil has been identified by Refining NZ in Block B in the centre of the site (**Figure 6** in **Appendix A**).

The risk from asbestos relates to inhalation of airborne fibres. As asbestos does not have significant mobility in ground, and does not impact groundwater, the presence of asbestos has not been considered further in this assessment. Potential migration of asbestos in stormwater or surface water (originating from discharges to air) have also not been considered in this assessment.

4.1.7 PFAS

PFAS are a group of synthetic compounds that have been produced commercially since the 1950s – the most widely studied being perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexanesulfonic acid (PFHxS). PFAS compounds have been widely used for decades in consumer products such as carpeting, upholstery, and food paper wrappings; and in industrial applications such as metal plating and firefighting foams such as Aqueous Film Forming Foams (AFFFs) and fluoroprotein foams.

As PFAS are very persistent in the environment they can be found in air, water and soil and are known to bioaccumulate in some living organisms.

From 1964 to 1970, a protein firefighting foam comprised of rendered cattle horn and hoof (i.e. non-PFAS) was used at the Refinery. Firefighting foams containing PFOA were used at the Refinery in the area of the fire training area(s) from the 1970s until 2012. Foams containing ingredients that can break down into PFOA are understood to have been used after this time until recently having been phased out (Refining NZ 2016). Refining NZ holds no evidence that PFOS-containing firefighting foams were used at the site.

The firefighting foams were used during emergency situations and training events. Refining NZ has advised that emergency events requiring the use of foam have occurred in process areas in Blocks A, B and C. Generally, less than 300 L of foam concentrate (diluted to 1 or 3%) would have been used in each event.

Given the mobility of the compounds there is potential for PFAS contamination to spread widely from the area of intentional or accidental release into soil or stormwater at the fire training area and former fire training area, as well as into the stormwater system in Blocks A, B and C.

To provide an initial characterisation of PFAS contamination in the area of the current fire training area, Refining NZ completed a soil, water and sediment sampling exercise in June 2016. Areas of the highest expected impact were targeted by the sampling. Four soil sampling locations were selected around the central training area. Groundwater samples were collected from three groundwater monitoring wells inferred to be hydraulically adjacent or downgradient. One sample of sediment and one sample of surface water were collected from the stormwater drain closest to the area of use.

The results of Refining NZ's investigation indicated that concentrations of PFOA and PFOS in surface soil and sediment were below the assessment criteria relevant at the time of the investigation. The concentration of PFOA and PFOS in groundwater exceeded the adopted environmental protection criteria for fresh- and marine water at 99% protection level (relevant for surface water). Locations of potential PFAS contamination associated with firefighting training are shown on **Figure 6** in **Appendix A**.

A second round of groundwater monitoring and sampling for PFAS in the vicinity of the fire training area was completed by T+T in 2019. The findings of this assessment are discussed in **Section 5** (Groundwater Contamination).

4.1.8 Transformer oils

Polychlorinated biphenyls (PCBs) are a group of man-made chemicals that were widely used in industry from 1930 to the late 1970s, including in transformer oils. PCBs are environmentally persistent and have been demonstrated to cause a variety of adverse health effects. A programme

to withdraw PCBs from use in New Zealand was initiated in the mid-1980s and under the Hazardous Substances and New Organisms (HSNO) Act 1996 (as amended in 2003) PCBs are banned from importation, manufacture and use in New Zealand (with exemptions for small-scale research and laboratory use).

The Refinery has had numerous substations over its operational history as noted in **Section 2.3**, however, no leaks or fires involving these facilities are known to have occurred. It is understood that there are currently 19 substations in use at the site. Refining NZ has advised that:

- Transformers are located in sealed bunded areas;
- The majority of the transformers are from the Expansion and are understood to have used PCB-free oil from commissioning;
- Oil from the pre-Expansion transformers was replaced as required and is now PCB-free; and
- When oil replacement is required this is undertaken by an approved contractor.

Approximately 600 L of oil per year is used. On the basis of information provided by Refining NZ the likelihood of PCB contamination emanating from a pre-Expansion transformer is relatively low. PCBs, when lost to the environment, preferentially absorb to soil and are less likely to leach or migrate to groundwater than other chemicals.

4.1.9 Nutrients

Nitrate – phosphorus – potassium (NPK) fertiliser was historically applied to sludge in the landfarms. Soil samples collected from landfarm LF2 in 2009-2010 were not analysed for nutrients.

The presence of nitrogen in the crude products can result in the generation of process waters with elevated ammoniacal nitrogen concentrations (GHD/GWS 2014). Leaks from process water infrastructure may also potentially be a source of nitrogen.

5 Groundwater contamination

Refining NZ has monitored groundwater quality at the site since the early 1980s, with an increasing density of monitoring wells.

There are currently 140 monitoring wells on the site that are periodically gauged for depth to water and depth to LNAPL, as well as four active recovery wells and one unused recovery well. Twenty-nine (29) perimeter wells are routinely monitored (based on 2017 – 2019 data), primarily for hydrocarbon contamination. The well layout is presented in **Figure 2** in **Appendix A**.

In 2014, GHD and GWS completed a hydrogeological assessment focussing on the distribution, characterisation and mobility of LNAPL and dissolved phase hydrocarbons at the site. The assessment comprised the selection of relevant wells for spatially representative data collection, tidal assessment, permeability testing, product baildown testing, product physical analysis, collection of field parameters for groundwater quality, laboratory testing of groundwater samples, beach surveys (topographic, geophysical, and installation of temporary piezometers for the purpose of assessing groundwater quality at various heights in the beach profile). The findings of the report are relied upon for the assessment below.

In addition to the existing data from Refining NZ and GHD/GWS 2014, T+T conducted two groundwater monitoring events (GMEs) in 2019:

- June 2019: PFAS monitoring at the fire training ground (refer T+T 2019a, attached in **Appendix C**); and
- September 2019: monitoring of 28 perimeter wells and PF54 based on data gaps identified during preparation of the initial draft HCM report (refer T+T 2019b, attached in **Appendix D**).

In November 2019, Refining NZ undertook groundwater sampling from nine temporary wells along the Bream Bay foreshore to provide additional data for metals and nitrogen species closer to the receiving environment. Refer to **Appendix E** for an overview of the methodology, plan of indicative locations and laboratory report.

The findings from the 2019 GMEs are incorporated into the below assessment.

5.1 LNAPL

Hydrocarbon contamination in the form of LNAPL is present as a result of a number of leaks and spills over the operation of the facility. The distribution, type and behaviour of dissolved phase and LNAPL at the site was characterised by GHD/GWS in their 2014 report. A summary of the findings of the GHD/GWS 2014 report with regards to LNAPL at the site is provided below.

A discussion of the current LNAPL distribution based on 2019 data is included in **Section 5.1.2.2**.

5.1.1 Characterisation

Samples of LNAPL product were tested to assess the petroleum composition and physical properties of the LNAPL onsite.

GHD/GWS noted that the gas chromatography (GC) scans indicated that there are similarities between samples of LNAPL from within the same tank compounds. GHD/GWS noted the following:

- The tank compounds that included the 20s and 40s series tanks showed a dominant mid-range C_{15} to C_{22} hydrocarbon signature that was interpreted to be weathered products, as indicated by attenuation of the peaks as well as an increase in amorphous background. GHD/GWS concluded that these sources may relate to historic leakage;

- Wells on the outer edge of the 70s series tanks showed a dominant mid-range C_{15} to C_{22} hydrocarbon signature but with no C_{10} to C_{15} range hydrocarbons, again suggesting weathering. GHD/GWS postulated that this LNAPL may relate to historic leakage that has migrated to the current location; and
- LNAPL in the area of the 60s and 70s series tanks was notably unweathered and had common characteristics. GHD/GWS concluded the LNAPL in this location was from a common and relatively recent source. It was noted that the LNAPL recovered from recovery well RW19b is consistent with that from the groundwater in these areas.

5.1.2 Distribution

5.1.2.1 Historical (1997 and 2013)

The distribution of LNAPL at the site was plotted in the GHD/GWS 2014 study over two dates – 1997 and 2013. The plots are reproduced here as **Figure 5.1** and **Figure 5.2**. LNAPL thickness as presented in these figures is the measured in-well (or apparent) thickness of LNAPL. In-well LNAPL thickness, while easily obtained from well gauging, may not reflect the actual thickness in the formation due to factors including geology, changes in groundwater level, and well construction. It is also important to note that due to these factors in-well thickness is also not directly related to LNAPL mobility.

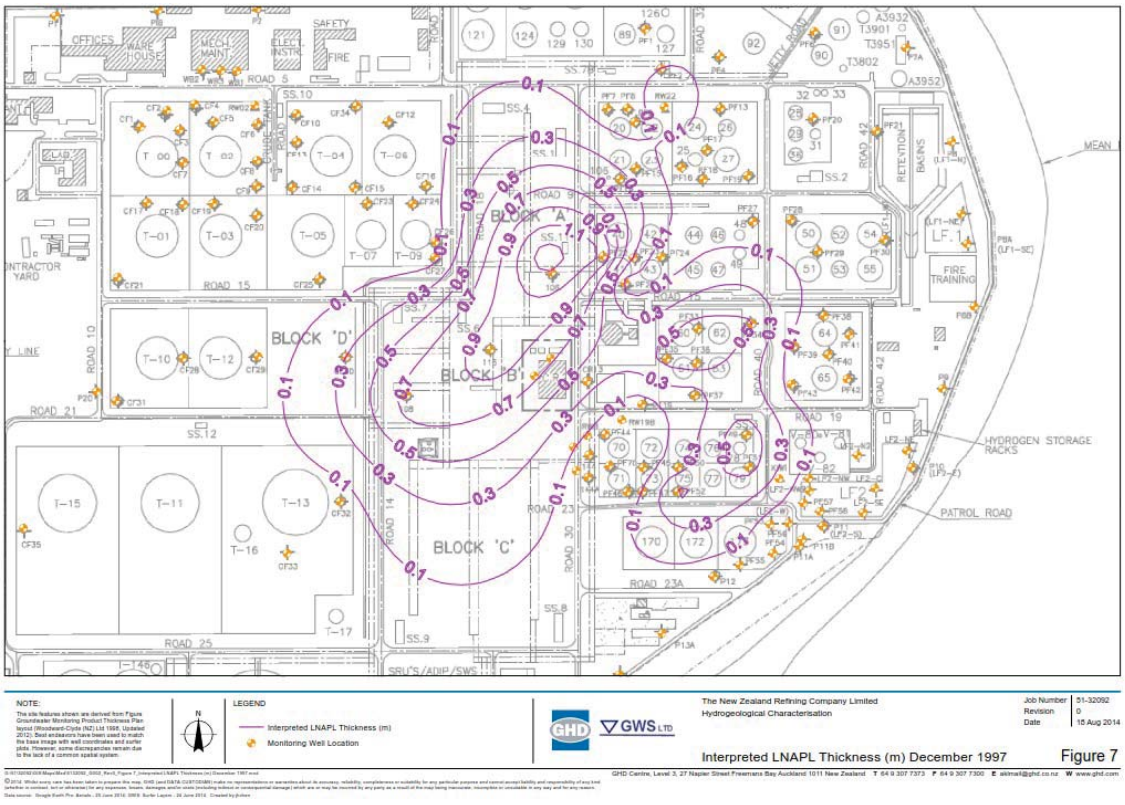

Figure 5.1 Plot of in-well LNAPL thickness in 1997 prepared by GHD/GWS in their 2014 report

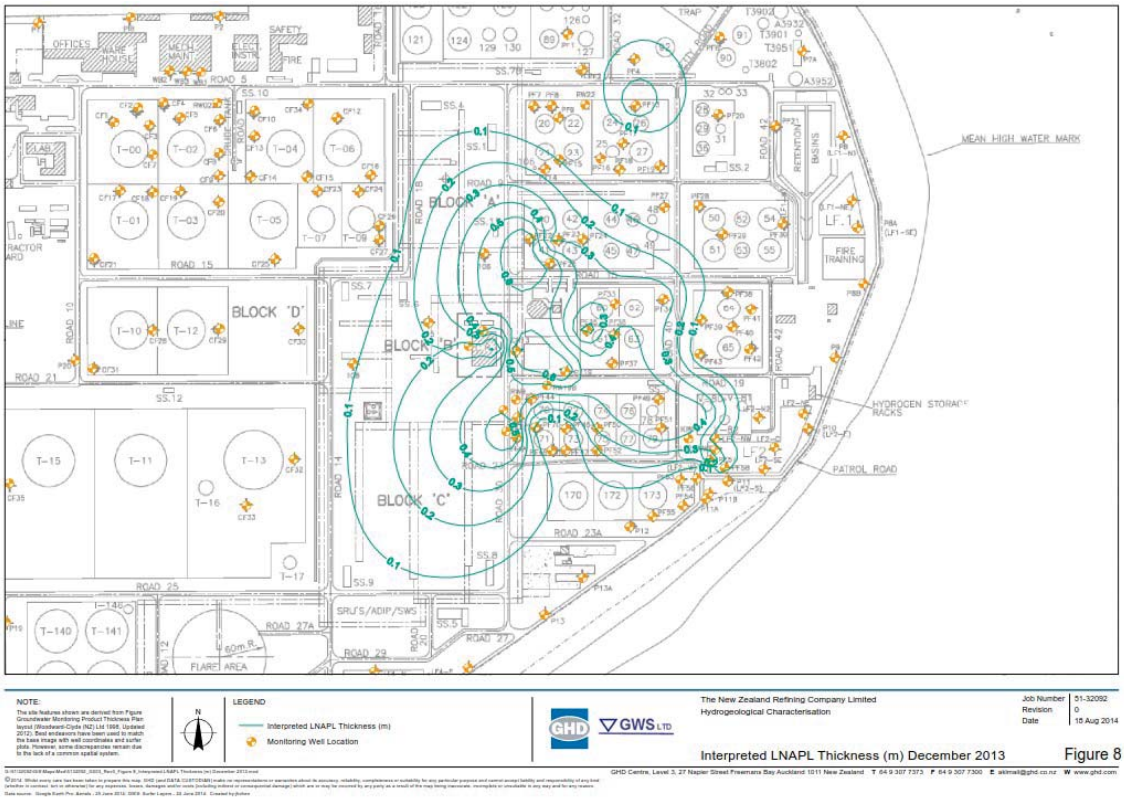

Figure 5.2 Plot of in-well LNAPL thickness in 2013 prepared by GHD/GWS in their 2014 report

The data assessment by GHD/GWS shows that the plume has reduced in size and in-well thickness since 1997. The plume also appears to have moved eastwards over the time period. The data suggests that no further sources of LNAPL appear to have occurred in the western part of the site.

GHD/GWS concluded that based on the data, the contraction of the plume suggests an LNAPL migration rate of 10 m/year, towards the upper limit of the range interpreted from the mobility testing data. They concluded that this is likely to result from relatively high local LNAPL permeability and a steep hydraulic gradient caused by the pumping at extraction well RW19B.

5.1.2.2 Current (2019)

The plot of in-well apparent LNAPL thickness based on the March 2019 contours is presented in **Figure 5** in **Appendix A**. The apparent LNAPL thicknesses are generally greater compared to the December 2013 data, which is considered to be reflective of lower groundwater levels in summer resulting in greater apparent LNAPL thickness in the monitoring wells. Plots of in-well LNAPL thickness versus groundwater elevation for selected wells are included in **Appendix D**.

LNAPL was present at CF12 near T-06 in March 2019 which was not shown in the 1997 or 2013 plots. This area would previously have been within the containment of RW02. Based on the groundwater flow contours, groundwater at CF12 is inferred to flow east into the capture zone of RW22. Irrespective of the groundwater in this area of the site being within hydraulic containment, further groundwater investigation is planned to be undertaken by Refining NZ in this area.

The distribution of LNAPL is indicated to be within the area of hydraulic containment based on the March 2019 data (refer to **Figure 5** in **Appendix A**). The southern portion of Block C (where wells C1 and C2 have LNAPL), while indicated to be within containment, is close to the edge of the containment area. As part of the September 2019 GME (T+T 2019b), wells C1 and C2 were gauged

for LNAPL again and limited baildown tests were conducted. The gauging found smaller in-well LNAPL thicknesses than in March 2019, consistent with previous monitoring (conducted by RNZ) from 2016-18 which indicates a seasonal fluctuation of in-well LNAPL thickness in this area.

5.1.3 Mobility

GHD/GWS undertook baildown testing of LNAPL across the plume area as part of their assessment in 2013. It appears that LNAPL transmissivity was not calculated from the data obtained. Limited baildown tests were undertaken at C1 and C2 in September 2019, however, these tests were undertaken for observation purposes rather than calculation of transmissivity. With respect to permitted activity rule C.6.8.2 7) of the Proposed Regional Plan, as the LNAPL plume is within the area of hydraulic containment, the LNAPL is not considered to be an issue in regard to potential migration outside the area of containment.

5.2 Dissolved phase

Groundwater analytical results from December 2013 (GHD/GWS assessment) to November 2019 are presented in **Table 1** in **Appendix B** and are discussed in the following sections. The analytical results for the VOC and phenol suites are not shown in **Table 1** as all results were below the laboratory limits of reporting. A note as to whether each individual monitoring well is within or outside hydraulic containment is included in **Table 1**.

The permitted activity criteria in the NRC Proposed Regional Plan have been used in the assessment of the effects of dissolved phase contamination (where applicable) to assess the likely acceptability of these discharges (i.e., if groundwater concentrations are below the permitted activity criteria, stakeholders should have assurance that these discharges are likely to be acceptable).

5.2.1 Petroleum hydrocarbons

The distribution of dissolved phase hydrocarbons was found by GHD/GWS 2014 to generally correlate with presence of the LNAPL plume (refer **Section 5.1**), indicating the plume is the likely source. The laboratory testing of dissolved phase and LNAPL samples in each area generally matched for product type. GHD/GWS 2014 concluded that generally the concentrations of dissolved phase hydrocarbons in groundwater were relatively low suggesting a limited partitioning between the product sources and groundwater.

TPH concentrations in wells outside of hydraulic containment were below the limits of reporting in the most recent monitoring undertaken in 2018 and 2019, with the exception of 0.14 mg/L C_{15}-C_{20} reported for P8 in April 2019. This was not replicated in the monitoring round undertaken two weeks later. The distribution of total TPH concentrations (either C_7-C_{36} or C_7-C_{44}) based on the most recent results for each well (2018 – 2019 for perimeter wells and 2013 for other wells) are presented on **Figure 9** in **Appendix A**.

5.2.2 Volatile organic compounds

Elevated concentrations of BTEX were also recorded in groundwater samples analysed for the GHD/GWS 2014 assessment. Benzene concentrations were below the assessment criteria relevant for ecosystems except for samples from wells PF41 and PF45. These wells are located on the southeastern side of the site in an area also impacted by residual LNAPL and within hydraulic containment.

BTEX concentrations in wells outside of hydraulic containment were all below the limit of reporting in the most recent monitoring undertaken in 2018 and 2019, with the exception of PF54 located to the east of T-173. The most recent BTEX results for each well are presented on **Figure 10** in **Appendix A**. The results for the wells outside of hydraulic containment do not exceed the permitted

activity assessment criteria except for well PF54, where benzene and ethylbenzene concentrations in September 2019 exceeded the adopted drinking water criteria. The concentrations did not, however, exceed the ANZECC Guidelines (80% or 95% levels of protection).

5.2.3 PAHs

Three groundwater samples collected during Refining NZ's 2016 PFAS investigation of the fire training area were also analysed for PAHs. No PAHs were detected above the laboratory limits of reporting. As part of the September 2019 GME, perimeter wells and PF54 were sampled and tested for PAH. PAH were detected in samples from PF54 and P8b, however, concentrations did not exceed the relevant criteria.

5.2.4 Phenols

Halogenated and non-halogenated phenols were analysed for in the three samples collected from Refining NZ's 2016 PFAS investigation of the fire training area. No phenols were detected above the laboratory limits of reporting. As part of the September 2019 GME, perimeter wells were sampled and tested for phenols. Phenols were not detected in any of the samples.

5.2.5 Chlorinated solvents

Chlorinated solvents (as part of the VOCs suite) were analysed for in the three samples collected from Refining NZ's 2016 PFAS investigation of the fire training area. No chlorinated solvents were detected above the laboratory limits of reporting. It is understood that groundwater in the vicinity of the areas where PCE has been used in Block A and Block E have not been tested for chlorinated solvents, however, these areas are within the area of hydraulic containment and, on this basis, monitoring of the perimeter wells for chlorinated solvents is not considered necessary.

5.2.6 Metals

As part of the Refinery monitoring programme, groundwater samples from the perimeter wells are analysed for a suite of seven total heavy metals. A summary of total metals concentrations from the perimeter well monitoring over 2018-2019 is provided in **Table 5.1.** Total arsenic, copper, lead and zinc concentrations exceeded the ANZECC 2000 default guideline values at the 80% level of protection. The majority of the exceedances were at P8b (arsenic, copper, lead and zinc) with exceedances also noted at P3, P4, P5, P5a, P13a, P16 and P17 (arsenic) and P8a and P18 (copper and zinc).

Table 5.1: Total metals concentrations in groundwater 2018-2019 (perimeter wells)

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Arsenic (As)	<0.0011 – **0.027**	0.0023* (As III)	0.01
Cadmium (Cd)	<0.000053 – 0.0033	0.036	0.004
Chromium (Cr)	<0.00053 – 0.0059	0.085 (Cr VI)	0.05
Copper (Cu)	<0.00053 – **0.038**	0.008	1 (aesthetic) 2 (health)
Lead (Pb)	<0.00011 – **0.064**	0.012	0.01
Nickel (Ni)	<0.00053 – 0.42	0.56	0.08
Zinc (Zn)	<0.0011 – **0.45**	0.043	1.5 (aesthetic)

* ANZECC (2000) low reliability values
Bold – exceeds 80% protection level.

Underlined – exceeds drinking water standards.

The major toxic effect of metals comes from the dissolved fraction, therefore it is valid to filter samples and compare the filtered concentration to the guidelines. As part of the September 2019 GME, the perimeter wells and PF54 were sampled and analysed for a broader dissolved metals suite to cover other potential contaminants including cobalt, iron, manganese, mercury and vanadium.

A summary of September 2019 dissolved metals concentrations is provided in **Table 5.2** below. Dissolved phase concentrations of arsenic, copper, iron, manganese and zinc exceeded the ANZECC guideline values at the 80% level of protection. The highest concentration for each of arsenic, copper, iron, manganese and zinc were an order of magnitude higher than the ANZECC guideline values.

On comparison between the dissolved metals and the total metals data the following is noted:

- Dissolved nickel and lead concentrations were lower than historic total concentrations and were below the criteria;
- Dissolved arsenic and zinc concentrations were generally similar to historic total concentrations, and criteria exceedances were still observed. It is important to note that for arsenic the adopted ANZECC criterion is a low reliability value (i.e. not a default guideline value);
- Dissolved cadmium and chromium (total) concentrations were generally similar to historic total concentrations; and dissolved and total concentrations for both metals do not exceed the ANZECC 80% values;
- Dissolved copper concentrations were generally lower than the historic total values, however, two concentrations still exceeded the ANZECC 80% guideline;
- Dissolved iron concentrations were generally lower than the September 2019 total iron concentrations, and the number of exceedances of the ANZECC 80% guideline value was halved; and
- Dissolved zinc concentrations were generally similar to historic total concentrations, and exceedances of the ANZECC 80% guideline value were still observed.

Table 5.2: Dissolved metals concentrations in groundwater (wells outside or potentially outside of containment) September 2019

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Arsenic (As)	<0.001 – **0.022**	0.0023* (As III)	0.01
Cadmium (Cd)	<0.00005 – 0.00023	0.036	0.004
Chromium (Cr)	<0.0005 – 0.0046	0.085 (Cr VI)	0.05
Cobalt (Co)	<0.0002 – 0.0027	0.15	-
Copper (Cu)	<0.0005 – **0.026**	0.008	1 (aesthetic) 2 (health)
Iron (Fe)	<0.02 – **11.9**	0.3*	0.2 (aesthetic)
Lead (Pb)	<0.0001 – 0.00137	0.012	0.01
Manganese (Mn)	<0.0005 – **0.74**	0.08*	0.04 (aesthetic) 0.4 (health)
Mercury (Hg)	<0.00008	0.0014	0.007

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Nickel (Ni)	<0.0005 – 0.0176	0.56	0.08
Vanadium (V)	<0.001 – 0.0025	-	-
Zinc (Zn)	<0.0001 – **0.38**	0.043	1.5 (aesthetic)

* ANZECC (2000) low reliability values.
Bold – exceeds 80% protection level.
Underlined – exceeds drinking water standards.

Figures showing the distribution of dissolved arsenic, copper, iron, manganese and zinc concentrations above criteria are included as **Figure 11** to **Figure 15** in **Appendix A**. The distribution of metals shows elevated concentrations of metals are localised rather than encompassing broad areas. Four wells had exceedances of the ANZECC Guidelines at 80% protection for more than one dissolved metal analyte in the September 2019 GME:

- P8a (copper and zinc);
- P8c (iron, manganese, arsenic and copper);
- P18 (iron and manganese); and
- PF54 (iron and manganese).

The source(s) of the elevated metals in localised wells is not necessarily clear from the perimeter monitoring data. The following is noted:

- The highest dissolved iron concentration of 11.9 mg/L was reported for PF54 which was more than order of magnitude higher than any other well sampled. Benzene and ethylbenzene were detected at PF54. Production of ferrous iron from dissolution of naturally occurring iron oxides can occur in association with biodegradation of BTEX. The concentrations of other dissolved metals in PF54 were not significantly higher than the other wells sampled;
- All of the wells with more than one metal analyte exceedance are in relatively close proximity to landfarm locations, however, other wells also located near the landfarms with similar field pH and oxidation-reduction potential readings do not have exceedances of the guideline values. This indicates that elevated metals concentrations (if any) associated with the landfarms are likely to be discontinuous and limited in extent; and
- All of the wells with more than one metal analyte exceedances are within 100 m of the mean high water mark, however, the September 2019 field electrical conductivity (EC) data indicates total dissolved solids concentrations for all perimeter wells were less than 2,500 mg/L (i.e. fresh water), therefore influx of saline water does not appear to be the source. Indeed, the dissolved iron and manganese concentrations measured at the intertidal interface in the foreshore by GHD/GWS in 2013 were much lower than onsite concentrations and do not exceed the criteria.

Based on the above, it is interpreted that the majority of the metals exceedances are likely to be the result of local variations in the mineral composition of the aquifer material (i.e. naturally occurring). Those that are not naturally occurring, appear to be limited in extent. The dissolved iron concentration at PF54 is considered to be a by-product of natural attenuation of petroleum hydrocarbons. Given the localised nature of the exceedances, it is considered unlikely that the metals concentrations in groundwater will affect the marine environment. The results of the November 2019 groundwater sampling along the Bream Bay foreshore, summarised in **Table 5.3**, further supports this assertion.

Table 5.3: Dissolved metals concentrations in groundwater within Bream Bay foreshore, November 2019

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Arsenic (As)	<0.004 – **<u>0.013</u>**	0.0023* (As III)	0.01
Cadmium (Cd)	<0.0002 – 0.0014	0.036	0.004
Chromium (Cr)	<0.001 – 0.0021	0.085 (Cr VI)	0.05
Copper (Co)	<0.001 – 0.0012	0.008	1 (aesthetic) 2 (health)
Lead (Pb)	<0.001	0.012	0.01
Nickel (Ni)	<0.007	0.56	0.08
Zinc (Zn)	<0.012 – **0.066**	0.043	1.5 (aesthetic)

* ANZECC (2000) low reliability values.
Bold – exceeds 80% protection level.
<u>Underlined</u> – exceeds drinking water standards

Dissolved metals concentrations in groundwater samples collected from temporary wells GW01 to GW09 on the foreshore in November 2019 (**Appendix E**) were below the adopted criteria with the exception of arsenic and zinc. Manganese and iron were not analysed for in November 2019 on the basis the previous foreshore sampling in 2013 had shown all iron and manganese concentrations to be below the adopted criteria.

In the 2019 foreshore sampling, arsenic concentrations exceeded the ANZECC low reliability value of 0.0023 mg/L in eight of the nine locations. The drinking water standard of 0.01 mg/L was also exceeded in two locations. A grab sample of seawater (SW01 to SW09) was collected downgradient of each groundwater sampling location, and arsenic was not detected above the limit of reporting (0.004 mg/L). The spread of arsenic exceedances in the foreshore sampling is the result of applying the low reliability screening value, which is below the trace-level limit of reporting for saline samples. The exceedances of the drinking water standard were at GW03 and GW04. Arsenic concentrations at upgradient perimeter wells in this area were below the criteria in September 2019, indicating the foreshore exceedances are not related to the site. The maximum arsenic concentration in the foreshore sampling was of the same magnitude as the maximum perimeter monitoring well result, further indicating that concentrations are naturally occurring.

Zinc concentrations exceeded the ANZECC 80% guideline value at locations GW07, GW08 and GW09, located on the southern stretch of the beach. Zinc concentrations at perimeter wells upgradient of this area were all below the criteria in the September 2019 sampling, indicating that the foreshore exceedances are not related to the site. It is interpreted that the zinc concentrations at the foreshore, as for arsenic, are representative of naturally occurring concentrations. A grab sample of seawater (SW01 to SW09) was collected downgradient of each groundwater sampling location, and zinc was not detected above the limit of reporting (0.004 mg/L).

5.2.7 Nutrients

Nitrate (as nitrogen) and nitrite (as nitrogen) were analysed for in groundwater samples as part of the assessment of natural attenuation for GHD/GWS 2014. Elevated nitrate concentrations were observed to occur in groundwater at a number of wells surrounding the stormwater retention ponds and to the south and east of the butane spheres in the southeast quadrant. The highest reported concentration was 46 mg/L nitrate (as nitrogen) in P9. The sources of the nitrogen were speculated to be leakage from the stormwater detention ponds and the former landfarm (LF2) that existed to

the south and east of the butane spheres. Nitrate in groundwater can also be sourced from leaking septic tanks or sewage infrastructure and from fertiliser application in farming.

There are no ANZECC marine water ecosystem guideline values for nitrate (as nitrogen). The 80% protection level value for fresh water of 6.9 mg/L has been adopted as the permitted activity level for this assessment.

As part of GHD/GWS 2014, nitrate (as nitrogen) was also analysed for in six groundwater samples collected from the intertidal interface along the Bream Bay foreshore. Concentrations ranged from 1.2 mg/L to 6.7 mg/L and are below the adopted 80% guideline value. The highest concentrations (4.0 and 6.7 mg/L) were detected southeast of the T-170s and south of the butane spheres. The onsite concentrations in these areas ranged from 0.59 mg/L to 4.5 mg/L (PF54), suggesting that the nitrate concentrations detected on the foreshore may not be related to landfarm LF2. The nitrate concentration on the foreshore to the southeast of P9 (which had recorded the maximum concentration of 46 mg/L) was 1.2 mg/L.

Groundwater samples from a number of perimeter wells were also analysed for nitrate (as nitrogen) in July 1992. Concentrations were below the adopted guideline value of 6.9 mg/L apart from P14 located east of landfarm LF4 (31 mg/L).

As part of the September 2019 GME, groundwater samples from the perimeter wells and PF54 were analysed for nitrogen species (ammonia, nitrate and nitrite). A summary of the nitrogen species concentrations from September 2019 is provided in **Table 5.4**. Nitrate (as nitrogen) concentrations in six wells (P4, P9, P11b, P14, P16 and PF54) exceeded the adopted guideline value of 6.9 mg/L at the 80% level of protection. Well P8 was not sampled during the GME as the well requires maintenance (refer T+T 2019b). Nitrite and ammonia concentrations did not exceed the relevant criteria.

The distribution of nitrate concentrations in relation to criteria is shown in **Figure 16** of **Appendix A**. The exceedances appear to be generally associated with areas of landfarming. Nitrate (as nitrogen) concentrations of 1.52 mg/L and 2.2 mg/L were reported for samples from up hydraulic gradient wells P19 and P20, respectively, indicating that upgradient groundwater already contains some nitrate.

Table 5.4: Nitrogen concentrations in groundwater (wells outside or potentially outside of containment) 2019

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Nitrate (as N)	<0.002 – **13.9**	6.9[a]	11.3
Nitrite (as N)	<0.002 – 0.24	-	0.91
Ammonia (as N)	<0.01 – 0.88	7.3 (at pH 7)	-

a Freshwater grading value from NIWA (2013) *Updating nitrate toxicity effects on freshwater aquatic species.*
- no guideline value available
Bold – exceeds 80% protection level.
Underlined – exceeds drinking water standards.

Nitrogen species were also analysed for in groundwater samples collected from the intertidal foreshore along Bream Bay in November 2019. A summary of the concentrations is provided in **Table 5.5**. Concentrations of nitrite, nitrate and ammonia were all below the adopted criteria. These results indicate that the concentrations of nitrogen species are depleted along the groundwater flow path to a level that does not pose a risk to the marine environment. Nitrogen species concentrations in grab seawater samples collected downgradient of the temporary wells were predominantly below the limits of reporting and were all below the adopted criteria.

Table 5.5: Nitrogen concentrations in groundwater on Bream Bay foreshore, November 2019

Analyte	Range of recorded concentrations (mg/L)	ANZECC 2000 Guideline – 80% marine (mg/L)	Drinking Water Standards (mg/L)
Nitrate (as N)	<0.001 – 0.026	6.9[a]	11.3
Nitrite (as N)	<0.002 – 0.042	-	0.91
Ammonia (as N)	0.007 – 0.63	7.3 (at pH 7)	-

a Freshwater grading value from NIWA (2013) *Updating nitrate toxicity effects on freshwater aquatic species.*
- no guideline value available

5.2.8 PFAS

Following on from an initial characterisation of PFAS contamination in soil, sediment, surface water and groundwater by Refining NZ in June 2016 (**Section 4.1.7**) a second round of groundwater sampling was completed by T+T in June 2019. Groundwater samples were collected from three monitoring wells in the vicinity of the fire training area and a surface water/stormwater sample was collected from the drain to the west of the fire training area.

The letter report summarising the sampling approach, methodology and findings of the 2019 investigation are presented in **Appendix C** (T+T 2019b). In summary, the recent sampling indicated:

- Groundwater samples from P8a and P8b recorded concentrations for the sum of total PFOS and PFHxS above the interim guidance for drinking water. PFOA concentrations complied with all relevant criteria; and
- Groundwater sample P8c and surface water sample (NZR-SW) did not record PFOS, PFHxS or PFOA compounds above the laboratory limits of reporting. It is noted that the interim drinking water level for the sum of total PFOS and PFHxS and the 99% interim marine ecological protection value for PFOS were below the laboratory limits of reporting achieved. The limits of reporting were raised by the laboratory due to the concentrations of other PFAS compounds in the samples. In the 2016 sampling, concentrations of PFHxS (0.03 µg/L) and PFOA (0.13 µg/L) were detected in P8c that did not exceed the criteria.

A summary of the groundwater results is provided in **Table 5.6**. PFAS results for the monitoring wells are also shown on Cross Section A-A' and B-B' (**Figures 7** and **8** in **Appendix A**) where relevant.

Table 5.6: PFAS concentrations in P8a, P8b and P8c - 2016 and 2019

Analyte	Range of concentrations reported (µg/L)	ANZECC 2000 Guideline – 80% marine (µg/L)	ANZECC 2000 Guideline – 95% marine (µg/L)[a]	ANZECC 2000 Guideline – 99% marine (µg/L)[b]	Interim Guidance Value for Drinking Water (µg/L)	Recreational water guideline - (µg/L)[c]
Total PFHxS	<0.01 – 0.18	-	-	-	-	-
Total PFOS	<0.01 – **0.07**	31	0.13	0.00023	-	-
PFOS + PFHxS	0.035 – 0.22	-	-	-	0.07	2
PFOA	<0.1 – 0.56	1,824	220	19	0.56	10

a – For groundwater, 95% adopted for bioaccumulation for a highly disturbed system (i.e. increase level of protection from 80% to 95%)
b – For marine surface water receptor (slightly to moderately disturbed system), 99% recommended based on

bioaccumulation.
c- Australian Government National Health and Medical Research Council, 2019. *Guidance on Per and Polyfluoroalkyl substances (PFAS) in Recreational Water).*
- no guideline value available
Bold – exceeds 99% protection level.
Underlined – exceeds adopted drinking water value.

There were a number of PFAS detected in groundwater in 2016 and 2019 that do not currently have guideline values. Concentrations of PFCAs (which include PFOA) tended to be the highest. As other PFAS have been found to be present which can cause interference during laboratory testing, it may be difficult to achieve the limits of reporting for groundwater samples below the 99% marine guideline value (which is applicable to surface water, i.e. the marine environment). However, PFOS and PFOA concentrations in groundwater do not exceed the 95% or 80% marine guideline value.

The 2016 and 2019 PFOS+PFHxS and PFOA concentrations in groundwater and stormwater samples are all below the recreational guideline values recently published by the Australian Government (as of the time of the report, these guidelines are yet to have been accepted in New Zealand).

6 Hydrogeological site model

6.1 Geology and hydrogeology

GHD/GWS 2014 describes the geomorphology of Marsden Point in detail. The Refinery is located on a recent outer barrier sand dune system. The outer barrier formed as sands were deposited onshore during sea level rise 10,000 to 6,500 years before present. Over the past 6,500 years the sea level has fallen in the order of two metres and the barrier has prograded. Offshore sediment was reworked onshore by wave action, and aeolian (wind) processes formed hummocky dune structures.

GHD/GWS 2014 inferred mudstone, peat and coarse sand present at depths of 20 to 30 m bgl to represent the lower sea level prior to construction of the outer barrier.

GHD/GWS described the geology of the northern part of the site to comprise a thin layer of brown weathered sands that extend to 1 to 2 m bgl which then transition to grey unweathered sand. Shell deposits occur at around 5 m depth, below the groundwater depth of 2 to 3.5 m bgl and at or below the mean sea level.

In the central more elevated part of the site, GHD/GWS described brown sands extending to 2.5 to 3.5 m bgl before transitioning into grey sands. Shell deposits were noted above and below the weathering zone, supporting a highstand origin when the sea level was higher. Shell beds were noted above and below groundwater level and above mean sea level in the central part of the site. Along the southern boundary of the site, a thick sequence of brown sands extends to a depth of 5 to 6 m bgl after which grey sands and shell deposits are present. Shell deposits were below groundwater level and mean sea level.

The shelly beach deposits are considered to occur in elongated lenses running parallel to the shoreline that have formed through deposition. Where present below groundwater level and mean sea level, this provides a zone of coarse grained, high permeability material that could act as a preferential pathway for contaminant migration.

Shallow groundwater encountered at the site between depths of 1 m and 5.5 m bgl is unconfined. Aquifer parameters are discussed in **Section 6.2**.

Two cross sections have been prepared as part of this assessment. Cross Section A-A' (**Figure 7 Appendix A**) runs west to east through the centre of the site. Cross Section B-B' (**Figure 8 in Appendix A**) is a shorter west to east transect focussing on the fire training area. The cross sections are perpendicular to the expected orientation of the shell deposits, therefore they would not be considered to be laterally continuous on the west-east cross section. Shell fragments were noted below groundwater level in several logs reviewed for the cross sections (refer to notes on **Figures 7** and **8**). The extent of hydraulic containment is indicated on the cross sections.

6.2 Aquifer parameters

6.2.1 Hydraulic properties

6.2.1.1 Hydraulic gradient and flow direction

Under natural groundwater flow conditions, groundwater would be expected to flow west to east, then to the north to Whangarei Harbour or northeast, east and southeast to Bream Bay depending on location within the Refinery. The natural groundwater hydraulic gradient across the site is estimated to be between 0.001 and 0.002 (i.e. a fall of 1 to 2 m groundwater elevation over 1000 m).

In reality, the hydraulic containment system influences groundwater flow directions at the Refinery. The 2019 data (**Figure 4** in **Appendix A**) indicate that there is radial inflow to each of the four

recovery wells and that groundwater from the western portion of the site will follow the natural eastern hydraulic gradient before then entering the containment area. Around the periphery of the site there are outward flow gradients to Whangarei Harbour and Bream Bay. AECOM 2016 identified a seasonal effect on outward flow gradients based on the 2014 water level data. During times of lower groundwater levels, the divide between inward and outward gradients in the vicinity of the Kiwi recovery well was further inland. AECOM indicated that during these periods wells PF42, P9a, LF2-N2 and LF2-N1 were outside of the containment area.

The tidal assessment undertaken by GHD/GWS found amplitude changes from 0.03 to 0.18 m. The extent of tidal effects noted in the groundwater wells is shown in **Figure 6.1**. The area of greatest influence was at P10 near landfarm LF2 southeast of the butane spheres. Tidal effects may potentially have changed in this area following the 2016 construction of the revetment wall.

Tidal effects extrapolated between P7A and P9 indicate that there would be amplitude change of approximately 0.05 m in the vicinity of the fire training ground. This change in amplitude for wells P8b, P8b and P8c is unlikely to have an effect on the overall groundwater flow conditions.

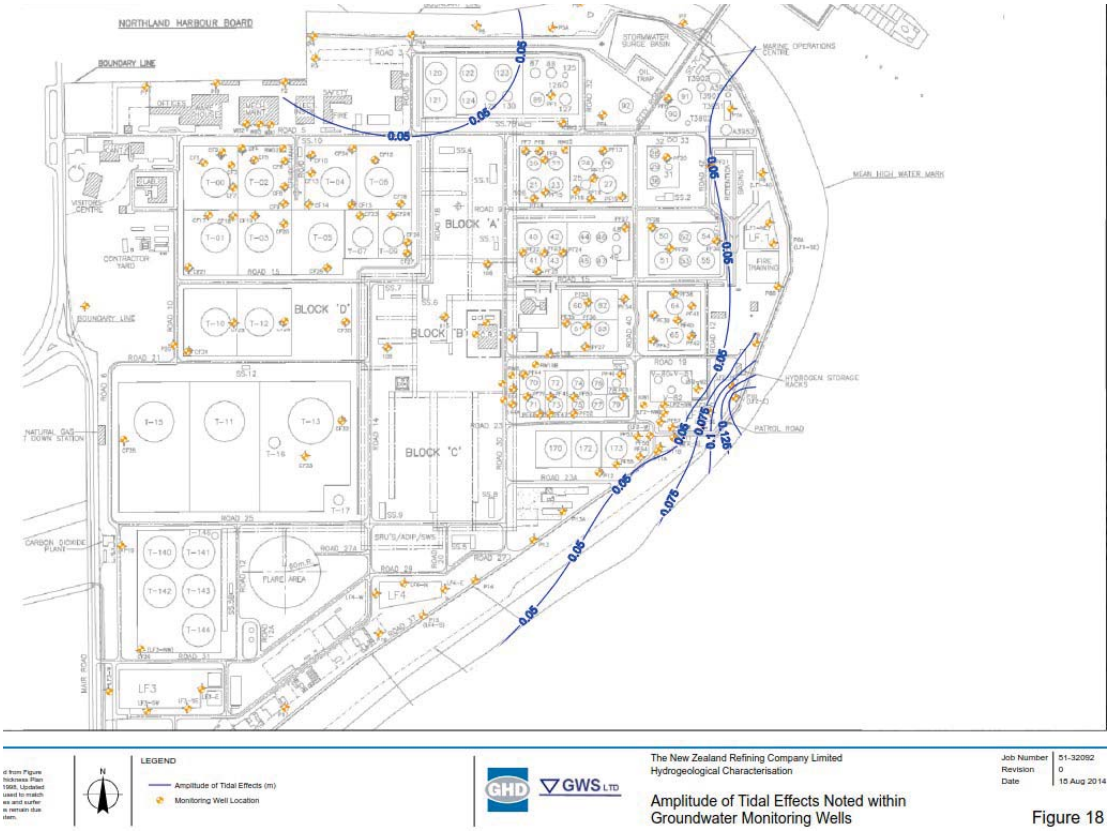

Figure 6.1: Tidal effects in monitoring wells (Source: GHD/GWS 2014).

6.2.1.2 Hydraulic conductivity

Rising head tests were conducted by GHD/GWS on 41 wells using a high volume Wilden pump to extract groundwater. Interpreted hydraulic conductivity ranged from 0.1 m/d to 30 m/d, with a geometric mean of 6 m/d. The plot of interpreted hydraulic conductivity is included as **Figure 6.2** (over page).

GHD/GWS noted that an area of higher hydraulic conductivity (inferred to be greater than 15 m/d) exists around and to the east of the Control Room. Another area of higher hydraulic conductivity (inferred to be greater than 20 m/d) was noted parallel to the southern foreshore.

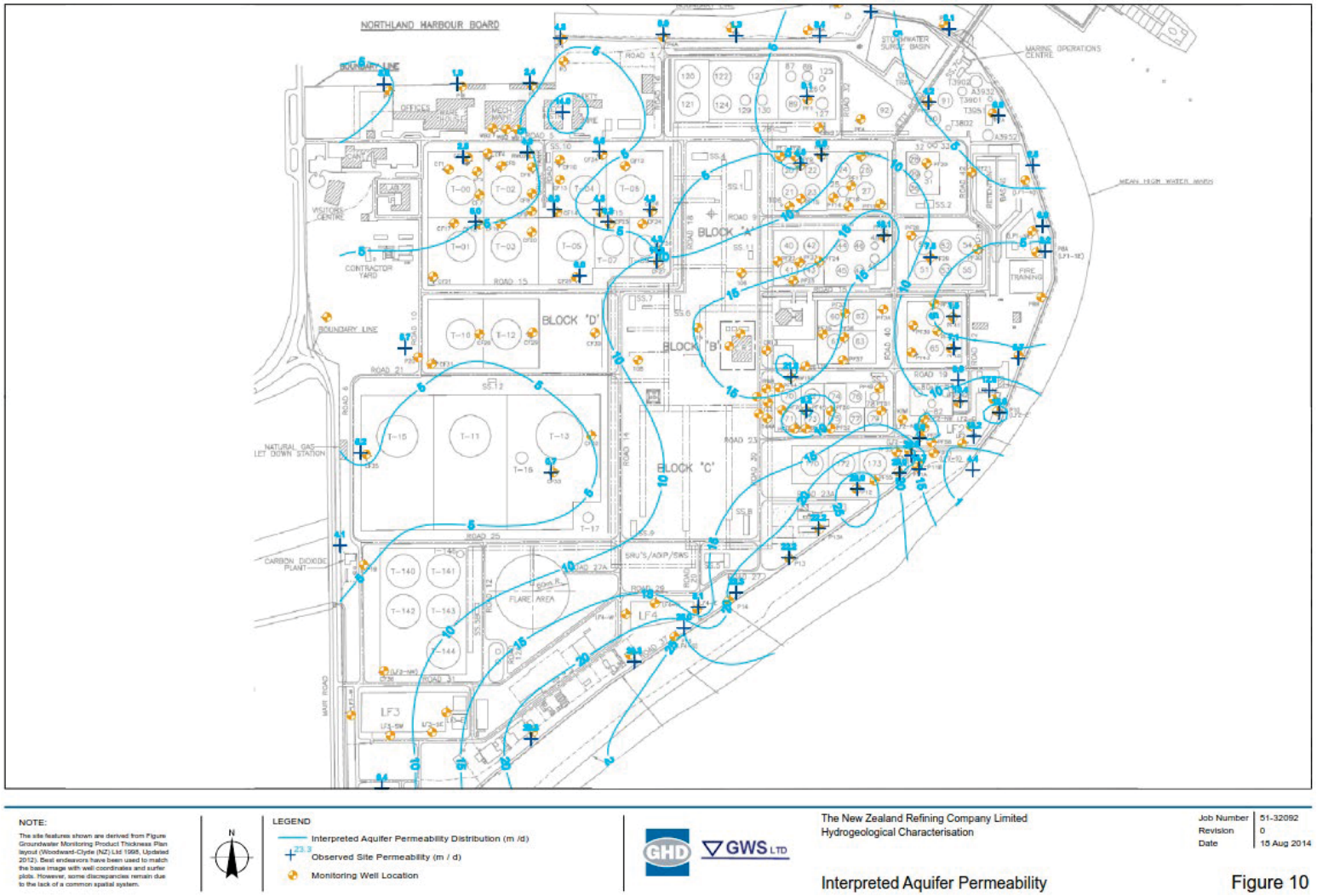

Figure 6.2 Interpreted hydraulic conductivity map, prepared by GHD/GWS 2014.

6.2.2 Natural attenuation of hydrocarbons

The natural attenuation assessment undertaken as part of GHD/GWS 2014 found that there is an abundance of terminal electron acceptors (TEAs) such as oxygen, nitrate and sulfate present in groundwater at the site that are able to promote the natural attenuation of petroleum hydrocarbons. Oxygen was considered to be naturally abundant in shallow groundwater with nitrate elevated in the east of the site and sulfate derived from more saline water elevated near the boundary. GHD/GWS considered it likely that both aerobic and anaerobic degradation processes were occurring given that hydrogen sulfide gas has been noted in wells near the site perimeter and in the crude tank farm.

6.3 Preferential pathways

The following potential preferential pathways for contaminant migration exist at the site:

- The trenches of the COC water and AOC water pipe networks and any trenches for underground product transfer (such as the RAP);
- The former Bercich Drain that was backfilled with sand and rock; and
- Coarse-grained shell beach deposits identified beneath the groundwater level. The connection between these higher permeability zones and the groundwater discharge points is not known, given the shell deposits are considered to run parallel to the shore.

The preferential pathways above are considered to potentially influence contaminant migration on the site but there is no direct connection between them and the marine environment. It should be noted that the hydraulic containment system would be expected to impact preferential pathways where they are in hydraulic connection to the surrounding groundwater.

6.4 Groundwater discharge zones

With the hydraulic containment system in operation, outward hydraulic gradients to Whangarei Harbour and Bream Bay exist around the periphery of the site (as shown in **Figure 3** in **Appendix A**), with groundwater otherwise contained by the system.

Shallow groundwater discharges onto the beach and into Whangarei Harbour and Bream Bay. As part of the GHD/GWS 2014 assessment, a well point groundwater survey was undertaken comprising seven transects onto the beach. The interface transition from groundwater to seawater was determined by electrical conductivity (EC). The saline interface was close to the eastern site boundary between the fire training area and landfarm LF2, which correlates to the area of tidal effects. In the northern and southern transects, the interface was closer to the mean high water mark.

Also as part of the GHD/GWS 2014 assessment, a number of parameters relating to the interaction of groundwater and the coastal saline interface were analysed including pH, electrical conductivity, bicarbonate, alkalinity, chloride, sulphate, and magnesium. All of these parameters increased at the coastline which is interpreted to be indicative of groundwater mixing at the saline interface beneath the Refinery perimeter boundary.

6.5 Efficacy of containment system

Based on the 2019 data, and as discussed in the previous sections, the hydraulic containment system as it is currently operating is generally containing LNAPL, dissolved phase hydrocarbons and BTEX. The system has the option of using RW02 as a recovery well in the future if needed, although we do not consider this necessary at present.

A summary of the current groundwater condition is provided in the following section.

6.6 Summary of the current groundwater condition

The current groundwater condition, based on the information detailed in **Section 5**, can be summarised as follows:

- LNAPL, sourced from historic losses at the site, is contained by the continuously operating hydraulic containment system. In-well LNAPL thicknesses vary depending on groundwater levels indicating that a smear zone is present related to seasonal groundwater highs and lows;
- Dissolved phase hydrocarbons, sourced from the LNAPL plume, are also contained by the system such that there are no exceedances of the ANZECC Guidelines for dissolved phase BTEX, PAH or phenol constituents in wells outside of the hydraulic containment area. This study has identified that benzene and ethylbenzene were present in groundwater at PF54, however, the concentrations did not exceed the ANZECC Guidelines. It is recommended that PF54 is added to the periodic monitoring schedule;
- While there is limited groundwater quality data for chlorinated solvents, if a loss of solvents had occurred historically, it would have been in an area where groundwater is captured by the containment system. Refining NZ is not aware of any losses of chlorinated solvents at the site. Chlorinated solvents were historically used in Block A (where there is an LNAPL plume) and are currently used within a bunded area in Block E. As these areas are within the area of hydraulic containment no further work is recommended at this stage;
- There are concentrations of dissolved metals (arsenic, copper, iron, manganese and zinc) in some of the groundwater wells outside of the containment area that exceed the ANZECC Guidelines. These exceedances appear to be localised on-site with the exception of arsenic and zinc which were also detected in groundwater samples collected from the Bream Bay foreshore. The concentrations of arsenic and zinc on the foreshore are considered to be representative of naturally occurring concentrations;
- There are concentrations of nitrate (as nitrogen) above the adopted guideline 80% value in six perimeter wells outside of hydraulic containment. The nitrate appears likely to be at least partially sourced from the former landfarms (where nitrate fertiliser was applied historically) and potentially from the stormwater retention basins. Sampling from the groundwater interface on the foreshore in 2013 indicated that nitrate was also present, but not at concentrations exceeding the adopted guideline value. Sampling of groundwater within the Bream Bay beach in 2019 confirmed that nitrogen species concentration at the foreshore are below the criteria and that the nitrate concentrations present at the site do not pose a risk to the marine environment; and
- PFAS have been detected in groundwater near the fire training ground. The reported concentrations did not exceed the ANZECC Guidelines 95% level of protection, but do exceed the 99% level of protection, in some cases because the laboratory level of detection was raised due to interference during laboratory testing from other PFAS. The initial PFAS assessment focussed on the potential worst-case location (the current fire training area where fluorinated firefighting foams may have been used for up to 30 years of firefighting training).

7 Conceptual site model

A conceptual model, as defined by MfE in the Contaminated Land Management Guidelines No. 5 (MfE 2011b) sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

7.1 Sources

The presence of contaminant sources on the site that have resulted in ground contamination are well documented in the site history and environmental data collected at the site.

7.1.1 Primary sources

The primary potential sources of contamination include the following:

- Tanks and associated refining operations;
- Product subsurface pipework;
- Current and former fire training areas and AFFF storage areas;
- Wastewater system (COC);
- Stormwater system (AOC) including the retention ponds and SWB;
- Former sludge landfarms;
- Buildings and structures containing ACM;
- Chemical storage including PCE in the CCR;
- Historical burial of sludge, lead scale and other wastes; and
- Historical sewage fields/pits.

7.1.2 Secondary sources

Secondary sources of contamination include:

- Contaminated soil that may leach mobile contaminants to groundwater. The identified soil contamination, as discussed in **Section 4,** includes metals, total petroleum hydrocarbons and benzene;
- LNAPL is a secondary source of ongoing dissolved phase contamination in groundwater and may itself impact upon receptors; and
- Dissolved phase groundwater contamination. The identified groundwater contamination as discussed in **Section 5** includes petroleum hydrocarbons, BTEX, metals, nitrate and PFAS.

7.2 Transport mechanisms

Transport mechanisms of groundwater contamination relevant to the site include:

- Migration of contaminants in groundwater and discharge to surface water;
- Migration of contaminants in groundwater and discharge/adsorption to sediment; and
- Volatilisation to soil gas/indoor or outdoor air.

7.3 Exposure pathways and receptors

The exposure pathways relevant to groundwater contamination at the site based on current use are summarised in **Table 7.1** along with the potential receptors.

Table 7.1: Pathway – Receptor Evaluation

Pathway	Potential Receptors	Complete Pathway?	Comments
Groundwater			
• Ingestion of groundwater	Onsite workers who may come into contact with groundwater	No	Exposure managed by existing GCMP
• Dermal absorption of contaminants in groundwater	Onsite workers	No	Exposure managed by existing GCMP
• Inhalation of volatile contaminants in indoor air	Onsite workers, visitors	No	Exposure managed by Control Room vapour barrier
• Inhalation of volatile contaminants in outdoor air	Onsite workers, visitors	No	Exposure managed by existing GCMP
Groundwater migration to receiving surface water (the marine environment) and sediment			
• Ingestion of surface water during primary or secondary contact recreation	Recreational users	Assessment being undertaken by Dr Francesca Kelly.	Hydraulic containment is effective at containing LNAPL, TPH, BTEX, PAH and phenols. The contaminants of concern outside of the containment area are PFAS, metals (arsenic, copper and zinc) and nitrate (as N). The groundwater and surface water sampling along the coast (analysed for metals and nutrients including nitrate) conducted by RNZ indicted that only arsenic and zinc were above the relevant criteria within the groundwater samples and these compounds are both considered to be at levels consistent with natural conditions. Both arsenic and zinc were below the limits of reporting in the surface water samples.
• Dermal absorption of contaminants in surface water	Recreational users		
• Direct contact with sediment	Recreational users		
• Contaminant uptake by marine biota	Marine biota, that may be consumed by other marine biota, birds and humans	Assessment of impact on marine biota being undertaken by Sharon De Luca (Boffa Miskell), and associated assessments of effects on avifauna (Graham Don, Bioresearches) and effects on marine mammals (Dr Deanna Clement, Cawthron). Assessment of impact on humans being undertaken by Dr Francesca Kelly.	

On the basis of this assessment, there are no complete exposure pathways for the onsite receptors given the management measures already applied at the site.

With respect to exposure for human and ecological receptors from contact with contaminated receiving surface water and sediment, the only contaminants of concern found within the downgradient groundwater monitoring wells that exceeded the relevant criteria (or where the limits of reporting were above the relevant criteria) were metals (arsenic and zinc, on the foreshore) and PFAS (near the fire training ground). The presence of arsenic and zinc are considered to be reflective of natural conditions.

The possible impact of dissolved PFAS in groundwater does not materially impact on the conclusions of this hydrogeological assessment. The effects associated with discharges to the marine environment are being assessed by direct measurement of PFAS levels in the marine biota (Sharon De Luca), and the implications for uptake by birds is being conducted by Graham Don, impact to marine mammals by Dr Deanna Clement and impact to humans by Dr Francesca Kelly. It is important to note that groundwater at the site is not the only potential source of contaminants that may end up in the receiving environment, as other potential sources of some contaminants exist such as stormwater discharge or infrastructure on the jetties, or offsite sources such as Northport and the Carter Holt Harvey timber processing plant.

8 Groundwater take

8.1 Purpose of use

The proposed groundwater take at the Refinery is no different from that which has been occurring under the existing resource consents, which is for the purpose of hydraulic containment of the shallow coastal groundwater system. Hydraulic containment of the site is a necessary and proactive management regime due to the presence of dissolved and LNAPL hydrocarbons within the groundwater system. Without hydraulic containment of the site, there is a potential risk of discharge of contaminants beyond the site boundary.

8.2 Proposed take volume

8.2.1 Background to groundwater take

Dewatering at the Refinery commenced in 1983 for the specific purpose of recovering LNAPL associated with groundwater around the control room. Initial pumped volumes of groundwater were in the order of 650 m^3/d. Dewatering continued in localised areas until 1990 when three permanent, large diameter wells were constructed (RW02, RW19B, and RW22). **Figure 2** in **Appendix A** shows the location of the recovery wells on the site. These wells were designed to both depress the water table with submersible pumps and recover oil via separate skimmer pumps. The operation of these wells became regulated in 1994 under the RMA and the site permit (NLD 94/7308/01) allowed a total daily abstraction of 2,000 m^3. The volume of groundwater taken from each well on a daily basis varied depending on the aquifer transmissivity and the need to recover LNAPL at a particular location. This remains the practice. The groundwater take is currently permitted under the site operations resource consent (CON20050831902) for the water take and land discharge, with Condition 21 of this consent requiring Refining NZ to “undertake such measures as are necessary to minimise the discharge of contaminants to ground within the Refinery site."

In 2009 a new recovery well was constructed in the southeast quadrant of the site to improve groundwater containment adjacent to the coastal margin. This new recovery well was named the Kiwi Well (also known as RWSEQ) and the operation of this well was permitted under a separate resource consent (CON20102502101) that allows a water take up to 700 m^3/d.

In 2014 another recovery well, named RW15, was constructed at the down hydraulic gradient end of the bulk fuel storage tanks to intercept hydrocarbons that were outside the radius of influence of the other recovery wells. This well is operated under the site operations resource consent. This is achieved by reducing the take from other recovery wells so that the total daily abstraction remains within the permitted 2,000 m^3/d site total. In particular, well RW02 is no longer operating (as of August 2017) as there is now no immediate need to provide containment and LNAPL recovery at that location (Crude Oil Farm).

In summary, the Refinery site is presently permitted to take a total of 2,700 m^3/d under two separate resource consents. The history of the site dewatering and hydrocarbon recovery illustrates the need to have a flexible and pragmatic approach to the taking of groundwater by allowing the volume and location of the takes to be transferable within the site. As such, it is proposed that the water take volume under a new resource consent is general to the site and not specific to any particular recovery well (existing wells or as future needs require).

8.2.2 Well performance

8.2.2.1 Water take volumes

An analysis of the past five years of operational data has been undertaken for all of the recovery wells on the site. The total groundwater usage is presented in **Figure 8.1 and Table 8.1** provides the details of groundwater abstraction from each of the recovery wells. Plots of abstraction volumes and water levels are included in **Appendix G** for each of the recovery wells.

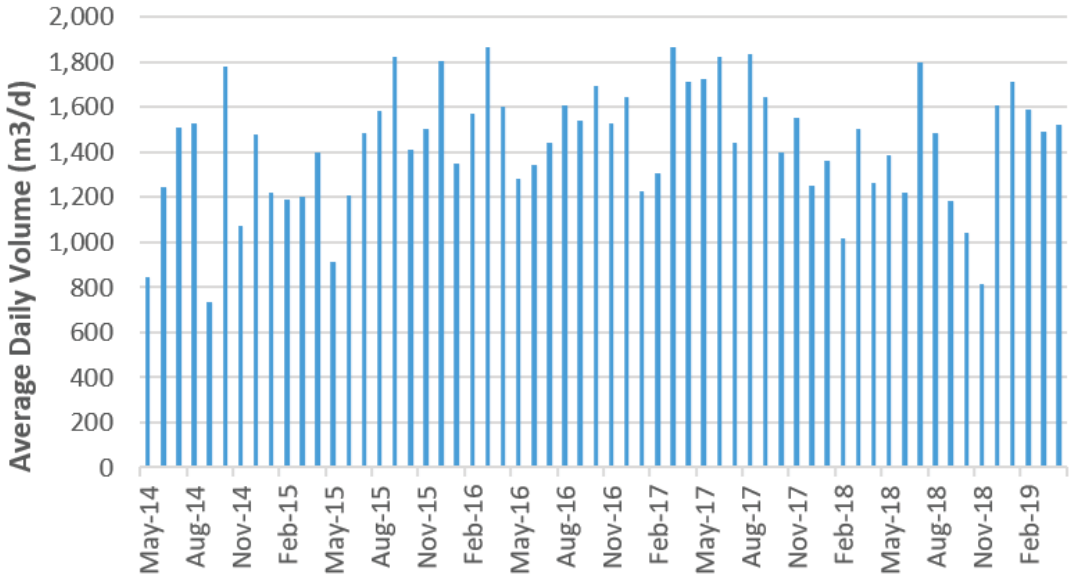

Figure 8.1: Average Monthly Groundwater Abstracted (m^3)

Table 8.1: Groundwater Take Volumes (m^3)

	RW02	RW15	RW22	RW19B	Kiwi	Combined [1]
Average Annual Total	67,785	38,862	169,584	259,584	68,465	531,234
Average Daily	224	123	616	796	224	1,436
Peak Daily	610	854	980	1,681	678	1,869

1. The combined is the annual average totals for those wells in operation at any given time between 2015 and 2018.

From **Figure 8.1** and **Table 8.1**, it can be seen that the total average and peak daily groundwater abstraction is within the 2,700 m^3/d consented total for the site. It can also be noted from **Table 8.1** that the peak daily abstraction has remained within the daily maximum allowed under their permits (2,000 m^3/d and 700 m^3/d respectively).

For the purpose of this application, new limits are proposed for abstraction volumes. These volumes are based on proven volumes from the existing network of recovery wells, with additional provision made for two additional recovery wells in the future to enhance hydraulic containment.

The historic average annual take for the site is 531,234 m^3 based on four bores being in operation at any one time i.e. prorate of 132,809 m^3 per annum per well. Assuming six wells are in operation in the future this would equate to an annual take of 796,851 m^3 that will be sought under this consent.

This annual allocation is less that that presently assumed by NRC for the site of 986,175 m^3/year, therefore making additional groundwater available for other users.

The daily maximum historic abstraction has been 1,869 m^3 based on four bores being in operation at any one time i.e. prorate of 468 m^3 per day per well. Assuming six wells are in operation in the future this would equate to a daily maximum take of 2,804 m^3. This is only nominally greater that that presently allowed under the two groundwater take consent of 2,700 m^3/d.

The proposed groundwater abstraction limits for this consent application are therefore 796,850 m^3 annually, with a maximum daily take of 2,800 m^3. As discussed in Section 8.2.1, this proposed water take volume is general to the site and not specific to any particular recovery well (consistent with the approach of the legacy consent).Hydrocarbon recovery

The volume of LNAPL recovered from the wells is presented in **Figure 8.2** and **Table 8.2** provides the details of groundwater abstraction from each of the recovery wells. Plots of recovered LNAPL volumes and thickness are included in **Appendix G** for each of the recovery wells.

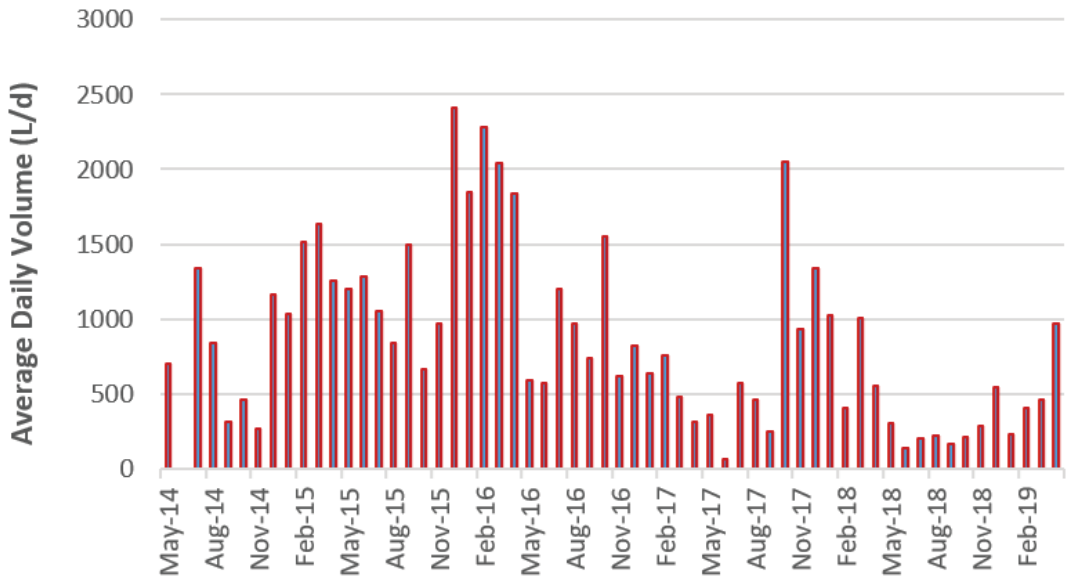

Figure 8.2: Average Monthly LNAPL Recovered (L)

Table 8.2: **LNAPL Recovered (L)**

	RW19B	**RW15**	**Kiwi**
Average Annual Total	188,131	112,273	101,912
Average Daily	514	307	244
Peak Daily	7,648	1,155	1,691

In summary, the data show that RW19B continues to recover the majority of the LNAPL, however, the volumes are noted to be diminishing over the past five years. RW15 is noted to have recovered relatively high volumes of LNAPL in the first 12 months of operation, with recovery since 2016 being seasonally dependent. Similarly, the Kiwi Well had an initial 24 months of high rates of LNAPL recovery and for the past few years recovery has become seasonally dependent. Recovery records

and full site gauge data indicates a retraction of the LNAPL plume from this area in general due to recovery efforts.

The observation that LNAPL recovery is seasonally dependent at the Refinery site has been well established over the years of operating the wells. This effect is considered to be caused by the long term lowering of groundwater levels due to pumping that has resulted in the LNAPL-water interface being smeared as it migrates downwards. This means that during winter months when high groundwater levels occur the hydrocarbon is trapped and is immobile beneath the water table. In summer months when groundwater levels drop the hydrocarbons become mobile and recoverable again.

8.2.2.2 Monitoring

Under the existing site operations resource consent (CON20050831902) the requirements for the water take monitoring include recording groundwater abstraction volumes. For the land discharge consent monitoring consists of; recording volumes of hydrocarbon recovered, quarterly full site gaugings and monthly perimeter well monitoring (headspace, groundwater level, and water quality). The results of this monitoring are reported to the NRC on a monthly basis.

In summary, the monitoring undertaken shows that the site is compliant with its resource consents.

The Kiwi Well resource consent to take groundwater (CON20102502101) has conditions that require the weekly measurement of; the volume of groundwater abstracted, groundwater levels (pumping well and P11), LNAPL recovered, and chloride levels at P11. The condition of consent has limits for; water volume taken (<700 m^3/d), groundwater level at P11 (>96.3 m RL), and chloride concentration at P11 (<250 g/m^3). Since pumping commenced at the Kiwi Well the effects have remained within the compliance limits set. The exception to this was in 2016 when the revetment wall was constructed to protect a section of the coastline from erosion. This section of coastline is in the same general location as the Kiwi Well, and very near P11. Construction of the coastal revetment wall required dewatering to allow construction of the wall foundations, and this was done via well points. This dewatering was permitted under resource consent AUT.036495.05.01 that allowed for a short term take of up to 3,200 m^3/d. As a consequence of this dewatering, the groundwater level and chloride trigger levels were temporarily exceeded at P11 between May and July 2016, requiring a response by the Refinery under the Kiwi Well resource consent conditions. The dewatering associated with the construction of the revetment wall ceased after a few months and the groundwater system returned to pre-existing conditions. No adverse effects occurred as a consequence of this temporary trigger level exceedance and the NRC were notified of this incident having occurred. No enforcement action was undertaken by the regulators.

8.2.2.3 Well maintenance

It has been noted that biofouling of the pumps can occur in the recovery wells, resulting in reduced production over time. This is typically localised to the south-eastern part of the site where the microbiological activity is at its greatest. As a result, the pumps at the Kiwi Well and RW15 are periodically lifted to undertake maintenance. The Refinery now self-monitor the recovery well's Specific Capacity on a regular basis, and this information is used as guidance as to when well and pump maintenance may be required.

8.2.3 Groundwater availability

8.2.3.1 Regional allocation

The Refinery site is located within the Marsden-Ruakaka aquifer system. This catchment has a groundwater allocation limit of 3,769,116 m^3/year, of which 3,162,886 m^3/year is typically taken. A

balance of 606,203 m^3/year is, therefore, available for allocation to new groundwater takes. The existing groundwater take at the Refinery is included within the allocated volume.

The effect on the resource from the proposed groundwater take by the Refinery is considered less than minor given that the aquifer is not fully allocated and there remains groundwater available for allocation.

8.2.3.2 Site sustainable yield

An assessment of sustainable yield has been undertaken at a site-wide scale to assist in evaluating the potential for effects to results from the proposed groundwater take. This has included a water balance that has calculated volumes of surface water runoff reporting to the site drainage system and is based on the measured area of impervious cover over the site. The balance of the site is considered the area of soakage and aquifer recharge due to rainfall. The groundwater throughflow across the western site boundary was also included in the water balance as aquifer recharge, and this was based on the observed hydraulic gradients between well pairs. After accounting for the aquifer recharge inputs, the measured abstraction volumes from the recovery wells have been deducted. The net balance of the recharge and abstraction is the remaining aquifer outflow and this is used as a measure of the sustainability of abstraction.

The average annual water balance over the past five years for the site is presented in **Table 8.3**. Further details of the water balance are included in **Appendix H.** In summary, these calculations indicate that around 30% of rainfall will leave the site via the surface water drainage network, with 70% going to ground and potentially contributing to groundwater recharge. A schematic figure conceptualising the water balance is presented in Figure 8.3: Conceptual Water Balance Figure 8.3.

Table 8.3: Site Water Balance

Rainfall Rate	1.255	*m/year*
Site Area	1,226,750	m^2
Rainfall	1,539,755	m^3/year
Impervious Site Area	387,580	m^2
Permeable Site Area	839,170	m^2
Runoff (33%)	486,471	m^3/year
Soakage (67%)	982,756	m^3/year

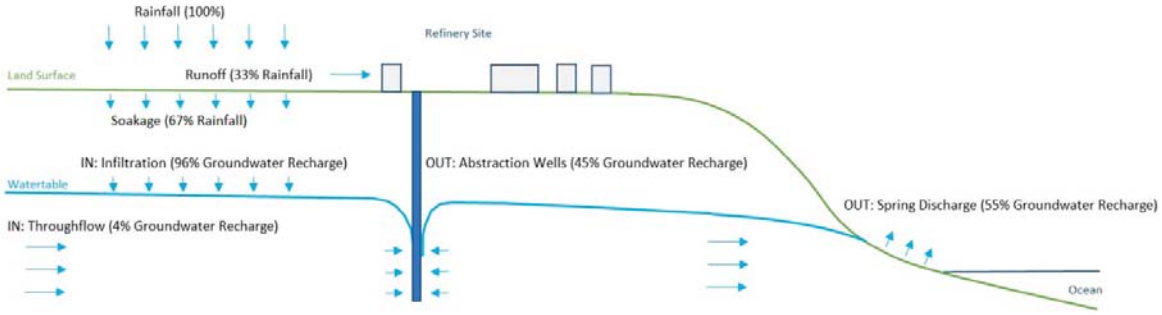

Figure 8.3: Conceptual Water Balance

It is noted that the pervious areas of the site consist of either; bare sand, gravel hardstand over sand, or vegetation over sand (limited area). As a consequence of the nature of this cover, and due to the high surface infiltration rates (up to 15 mm/hr), most of the rainfall enters the groundwater system. No overland flow is observed on the bare ground due to rainfall at the Refinery site. So, while the calculations indicate the potential soakage volume going to ground (987,756 m^3/year), for the purposes of this assessment we have considered only a portion of this (factor of 0.9) as contributing to groundwater recharge to allow for losses due to shallow soil evaporation and evapotranspiration.

In addition to the rainfall recharge to groundwater, some added contribution to groundwater recharge at the site comes from throughflow across the western site boundary. **Table 8.4** below shows the annual average water balance for the shallow system that includes the recharge and discharge volumes within the area of the site. **Figure 8.4** shows the water balance components over the five years of data analysed.

Table 8.4: Average Annual Groundwater Balance

Rainfall Recharge (96% of total recharge)	947,956	*m^3/year*
Groundwater Throughflow (4% of total recharge)	34,800	*m^3/year*
Total IN	982,756	*m^3/year*
Groundwater Abstraction (54%)	531,234	*m^3/year*
Groundwater Outflow (46%)	451,521	*m^3/year*
Total OUT	982,756	*m^3/year*

In summary, the groundwater balance indicates that at a site wide scale, rainfall is the main recharge mechanism for the aquifer and groundwater abstraction is the dominant proportion of the discharge. Groundwater outflow is, typically, in the order of 30% of the water balance but ranges from 20% to 40% based on the five years of data analysed for this assessment. This volume of groundwater outflow (i.e. discharge along the coastline) from the Refinery site is, therefore, sufficient to mitigate the ingress of seawater into the aquifer. These calculations support the monitoring observations at the site that the present rates of ground abstraction are sustainable, without causing saline intrusion. This is discussed further below.

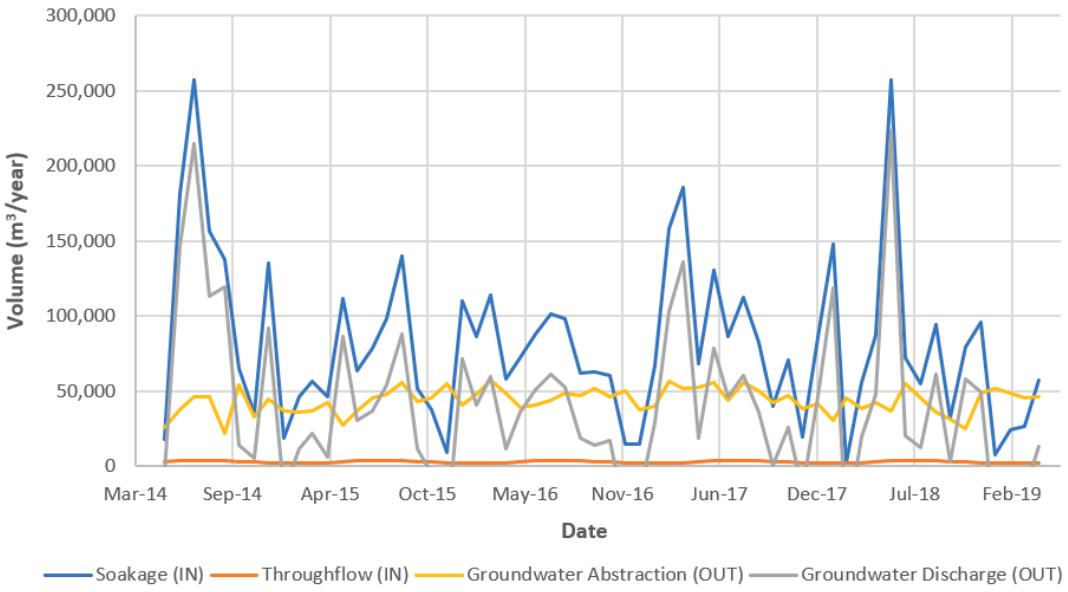

Figure 8.4: Groundwater Balance over Time

8.2.3.3 Assessment of reasonable and efficient use

Under the NRC proposed Regional Plan it is necessary to evaluate the proposed take as being reasonable and efficient use of the groundwater resource.

We consider that the groundwater take is reasonable in the context of the Refinery operations in that if the take were not to occur, there would be a discharge of hydrocarbons into the receiving environment.

We consider the groundwater take to be efficient in that only the volume of groundwater needed to be taken is abstracted to create hydraulic containment of the parts of the site that require it to prevent an off site discharge from occurring.

8.2.3.4 Additional recovery wells

As indicated previously, Refining NZ operates the containment and recovery system by pumping at locations and at rates that manage the potential for an off-site discharge occurring in a fairly dynamic and responsive manner based on monitoring observations. To this end, it is highly likely that Refining NZ will construct additional recovery wells as needed to achieve their objectives of recovering as much LNAPL as possible. While the exact locations of these wells have yet to be determined, it is most likely that they will be positioned within the eastern half of the site, downgradient of areas where refined (more mobile) bulk product storage occurs nearer the coastline (e.g. there is localised LNAPL beneath Block C). The western half of the site is, typically, used for the bulk storage of crude oil and residues which are far less mobile and are distant from the coast, and as such it is unlikely additional hydrocarbon recovery would be necessary for these areas. If additional wells are constructed, it is proposed that the recovery system would continue to operate within the maximum daily yield limit of up to 2,700 m^3/d, under the proposed take consent.

8.2.4 Effects on other users

The radius of influence of the recovery wells is limited in lateral extent, given the relatively high transmissivity and unconfined nature of the aquifer system. For the highest rate abstraction well (RW19B) the theoretical radius of influence is in the order of 500 m to 600 m and this is consistent

with the observed radial extent of drawdown shown in **Figure 2** in **Appendix A**, which is based on measured groundwater levels. In summary, the drawdown effect from the existing recovery wells does not extend beyond the site boundary and cannot affect other groundwater users. The NRC database does not indicate the presence of any wells used for groundwater supply within the Marsden Point area with the exception of two bores located at the BOC plant on Mair Road, some 800 to 1000 m distance from the existing recovery wells. Details of these neighbouring bores are included in Table 8.5below.

Table 8.5: Neighbouring bore details

Bore ID	Max Pump Rate [1]		Ground Level	Casing Depth	Bore Depth	Pump Cut-out	Water Level		Pump Submergence
	(m^3/hr)	(m^3/d)	(m RL)	(m bgl)	(m bgl)	(m bgl)	(m bgl)	(m RL)	(m)
LOC.316701(A)	1	24	4.5	30.0	33.0	28.5	2.4	2.1	26.1
LOC.316701(B)	1	24	4.5	10.0	13.5	8.5	1.0	3.5	7.5

In order to assess the effects of the existing and proposed groundwater abstraction from the recovery wells, a cumulative drawdown assessment has been undertaken. The methodology used has been to apply a Theis algorithm (1935) to assess the level of drawdown at the BOC bores created by each well after 365 days continuous abstraction based on its distance, pumping rate and aquifer transmissivity at its location. For the purpose of the proposed recovery wells, the distance is based on the closest practical location at which abstraction might occur to maintain hydraulic containment, which is 300 m from the BOC wells. Table 8.6below provides the inputs and predicted drawdown levels from each of the bores and their cumulative total.

Table 8.6: Predicted drawdown

Bore ID	Distance to BOC	Q	T	Drawdown
	m	m3/d	m2/d	m
RW02	800	224	75	0.06
RW22	1175	616	150	0.08
RW19B	900	796	225	0.20
RW15	1075	123	225	0.02
Kiwi	1045	224	150	0.04
Proposed 1	300	225	150	0.27
Proposed 2	300	225	150	0.27
Total Drawdown				**0.95**

This assessment is considered conservative in that it does not account for rainfall recharge that would reduce these drawdown levels. Given that there is a 1.0 to 1.5 m natural hydraulic gradient across the site, it is not expected that any off-site drawdown occurs from the existing wells (supported by the piezometric surface map), nor if the proposed wells were to be located with 300 m setback from the western site boundary. The effects due to groundwater abstraction within the Refinery site are, therefore, expected to be indiscernible on the BOC bores and not expected to inhibit their operation and ability to take groundwater.

In summary, we consider the potential for other groundwater users to be affected by the proposed groundwater take to be less than minor.

8.2.5 Effects on other aquifers

The proposed groundwater take is from the coastal unconfined sand aquifer and this is the uppermost aquifer. While there is bedrock at some 30 m depth beneath the site, this is not considered to be a viable source of groundwater due to its low yield and poor quality. Any groundwater recharge from the shallow aquifer into a deeper system is expected to be minimal and the taking of shallow groundwater is not expected to affect groundwater levels in the deeper aquifer.

For the reasons stated, we consider the effects to other aquifers from the proposed take is expected to be less than minor.

8.2.6 Effects on surface waters

There are no permanent freshwater surface water bodies in the Marsden Point area, and consequently, the effects to surface waters from the proposed groundwater take are expected to be less than minor.

8.2.7 Saline intrusion potential

The recovery wells at the Refinery have been in operation for many years and the management philosophy to create hydraulic containment of the site is to maintain heads above sea level at the perimeter wells to ensure a groundwater divide and an outward gradient are maintained. This philosophy also assists in preventing saline intrusion from occurring. Figure 3 provides a plan of the interpreted potentiometric surface and shows the zone where outward hydraulic gradients exist. Over the past 10 years, there have been two new recovery wells constructed (Kiwi Well and RW15) that are downgradient of the bulk storage tanks and are, therefore, closer to the coastline than the other recovery wells. The Kiwi Well is 130 m from the mean sea level (95.73 m RL) and, as such, has been monitored with additional criteria to manage the saline interface due to pumping. This has required monitoring of chloride concentrations at the pumping well and at the perimeter well P11 (<250 mg/L chloride limit), as well as monitoring of the groundwater level at P11 relative to a trigger level (96.3 m RL, being 0.1 m below the summer low level).

The Kiwi Well operated successfully without any incidence of elevated chloride or breach of groundwater trigger level for seven years. Between May and July 2016, however, both the chloride and groundwater level at P11 exceeded the resource consent limits. **Figure 8.4** shows the monitoring results during this period. Note that the concentration of chloride at the Kiwi Well during this time reached 2,234 mg/L. As discussed previously, this was due to the cumulative effects of the Kiwi Well pumping and dewatering associated with the construction of the revetment wall to protect the site from coastal erosion. The dewatering for the seawall construction required some 1,200 m^3/d to be pumped immediately adjacent to the coastline and this resulted in the exceedance of the limits at P11 based on the resource consent conditions for the Kiwi Well. Once the dewatering ceased, groundwater levels and quality returned to conditions that are more typical for the area.

Ultimately, no adverse effects were observed in association with this exceedance, and this experience has been valuable in understanding the threshold of pumping at which point saline intrusion can occur, and based on the monitoring results to date, it would seem the balance is well maintained based on the pumping rates employed at the Kiwi Well under usual circumstances. Excessive pumping at this location could, in all reasonable likelihood, result in saline intrusion occurring at that particular location. Given the Kiwi Well is the most coastal of the recovery wells,

the risk of saline intrusion occurring due to the pumping at the other recovery wells is considered to be much lower.

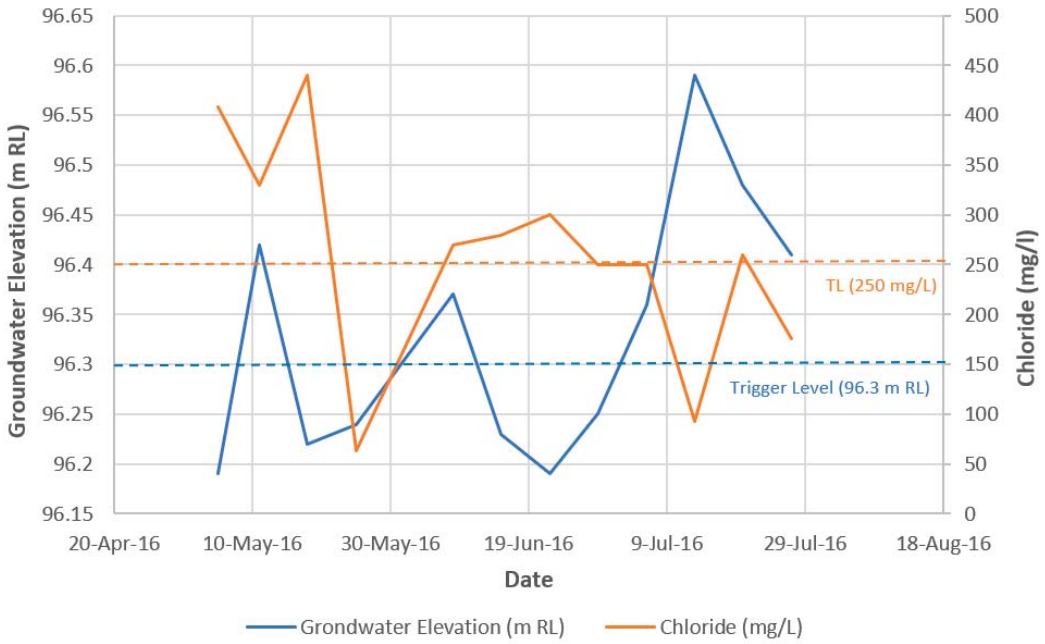

Figure 8.5: Groundwater Elevation and Chloride Concentration at P11

In summary, the present regime of pumping is considered to be an appropriate and effective means of avoiding adverse effects associated with saline intrusion because outward hydraulic gradients are maintained. This is supported by the operational data and monitoring for the wells.

It is, however, worth stating that in the context of planning provisions (Objective F.1.1 and Policy H.4.4 of the Proposed Northland Regional Plan) the prevention of saline intrusion is an objective designed to protect a freshwater resource (coastal aquifer) from becoming contaminated such that it cannot be used for other purposes. In the case of the aquifer system beneath the refinery, it is clear that the resource is already contaminated due to the presence of hydrocarbons in groundwater, and for this reason, the resource has little value for other purposes. Further, in the case of the Refinery, even if saline intrusion into the aquifer were to occur, seawater is enriched in electron acceptors that promotes the natural attenuation of dissolved phase hydrocarbons. So, in this case, saline intrusion could be considered beneficial in that it would reduce the source of aquifer contamination. It should also be noted that saline intrusion, if it were to occur, is reversible so any effect can be considered transient in nature.

Given the proposed duration of the consent, it can be expected that some increase in sea level could occur (approx. 0.2 m) during this time that might impact on the operation of the containment system. Put simply, an increase in head at the coastline would steepen the hydraulic gradients within the cone of depression at wells within reasonable proximity. This would result in the need to abstract nominally more groundwater. In addition, the toe of the saltwater interface would migrate further inland, increasing the risk of saline intrusion occurring. Given the small increase in head expected, any changes in groundwater level and increased pumping volume are expected to be small and can be adequately managed within the allocation volumes sought and the saline intrusion risk managed through the proposed monitoring. In summary, the likelihood of saline intrusion occurring due to the proposed groundwater take is considered to be low and manageable, and the effects of

saline intrusion, if it were to occur, are not expected to impact on the potable groundwater resource and are expected to provide positive environmental benefits.

8.2.8 Ground settlement effects

Lowering of the groundwater level in compressible soils can result in compaction of the pore structure and result in ground settlement effects. Where building structures or plant infrastructure are present within the zone of influence of dewatering, damage can result from ground settlement due to dewatering should it occur.

No detailed geotechnical assessment of settlement has been undertaken as part of this assessment. However, based on the fact that dewatering has been undertaken at the site recovery wells for decades with no ground settlement having been observed that is directly attributable to the dewatering. This is attributed to the limited presence and thickness of compressible soils beneath the Marsden Point site and as such the potential for ground settlement to occur due to the ongoing pumping of the recovery wells is expected to be less than minor.

8.2.9 Nett positive benefits

The hydraulic containment provided by the groundwater take is considered overall to be a positive effect as it prohibits the movement of the hydrocarbon products into the marine environment and enables the recovery of LNAPL, thereby reducing the source of contamination over time.

8.2.10 Draft conditions

We recommend the conditions of consent be developed and agreed with NRC in relation to the following parameters

- Water use;
- Verification of water meter/device accuracy;
- Groundwater level readings; and
- Trigger level conditions for groundwater level and electrical conductivity at the site perimeter.

9 Conclusions

The overall conclusions of this report are as follows:

- Refining NZ has monitored groundwater quality at the site since the early 1980s, with an increasing density of monitoring wells. There are currently 140 monitoring wells on the site that are periodically gauged for depth to water and depth to LNAPL, as well as four active recovery wells and one unused recovery well. Twenty-nine (29) perimeter wells are routinely monitored (based on 2017 – 2019 data), primarily for hydrocarbon contamination;
- Based on the 2019 data, the hydraulic containment system as it is currently operating is generally effective at containing LNAPL, dissolved phase hydrocarbons, including dissolved phase BTEX;
- With respect to exposure for human and ecological receptors from contact with contaminated receiving surface water and sediment, the only contaminants of concern found within the downgradient groundwater monitoring wells that exceeded the relevant criteria (or where the limits of reporting were above the relevant criteria) were metals (arsenic and zinc, on the foreshore) and PFAS (near the fire training ground). The presence of arsenic and zinc are considered to be reflective of natural conditions;
- The possible impact of dissolved PFAS in groundwater does not materially impact on the conclusions of this hydrogeological assessment. The effects associated with discharges to the marine environment are being assessed by direct measurement of PFAS levels in the marine biota (Sharon De Luca), and the implications for uptake by birds is being conducted by Graham Don, marine mammals by Dr Deanna Clement and humans by Dr Francesca Kelly;
- The Refinery site is presently permitted to take a total of 2,700 m^3/d under two separate resource consents. The history of the site dewatering and hydrocarbon recovery illustrates the need to have a flexible and pragmatic approach to the taking of groundwater by allowing the volume and location of the takes to be transferable within the site. As such, it is proposed that the water take volume under a new resource consent is general to the site and not specific to any particular recovery well (existing wells or as future needs require);
- The present regime of pumping is considered to be an appropriate and effective means of avoiding adverse effects associated with saline intrusion because outward hydraulic gradients are maintained. This is supported by the operational data and monitoring for the wells; and
- It is, however, worth stating that in the context of planning provisions the prevention of saline intrusion is an objective designed to protect a freshwater resource (coastal aquifer) from becoming contaminated such that it cannot be used for other purposes. In the case of the aquifer system beneath the refinery, it is clear that the resource is already contaminated due to the presence of hydrocarbons in groundwater, and for this reason, the resource has little value for other purposes. Further, in the case of the Refinery, even if saline intrusion into the aquifer were to occur, seawater is enriched in electron acceptors that promotes the natural attenuation of dissolved phase hydrocarbons. So, in this case, saline intrusion could be considered beneficial in that it would reduce the source of aquifer contamination. It should also be noted that saline intrusion, if it were to occur, is reversible so any effect can be considered transient in nature.

10 References

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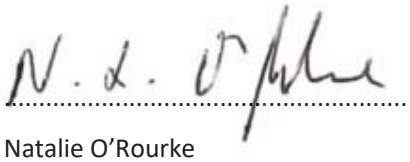
11 Applicability

This report has been prepared for the exclusive use of our client The New Zealand Refining Company Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report in support of an application for resource consent and that Northland Regional Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:



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Natalie O'Rourke

Contaminated Land Consultant

Authorised for Tonkin & Taylor Ltd by:

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Sarah Schiess

Technical Director

GWS Ltd

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Chris Simpson

Hydrogeologist

LKH/NAOR/CRJS
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Appendix A: Figures

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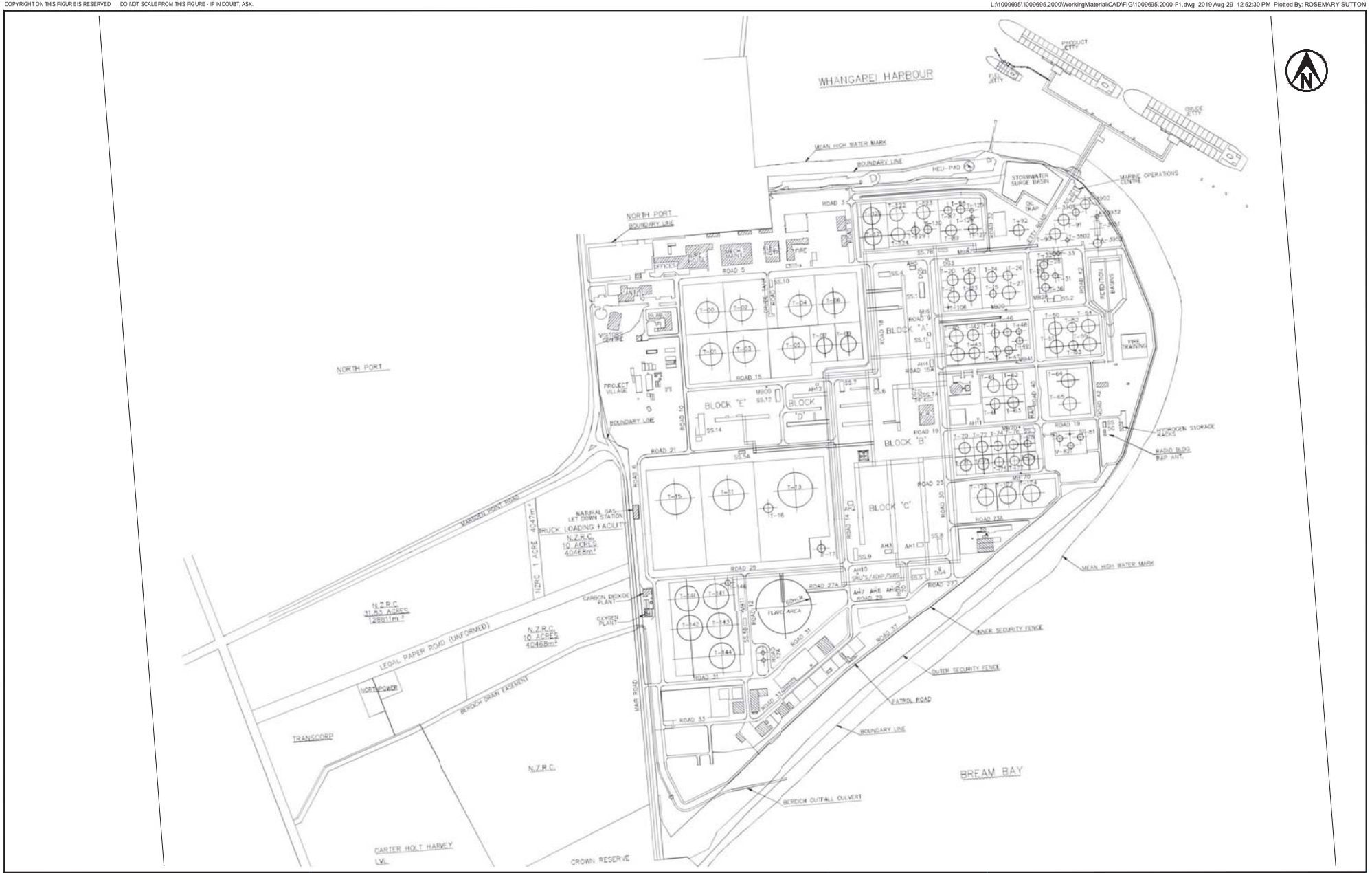

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SCALE 1:7500

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Base drawing supplied by RNZ "Full Site Plot Plan"

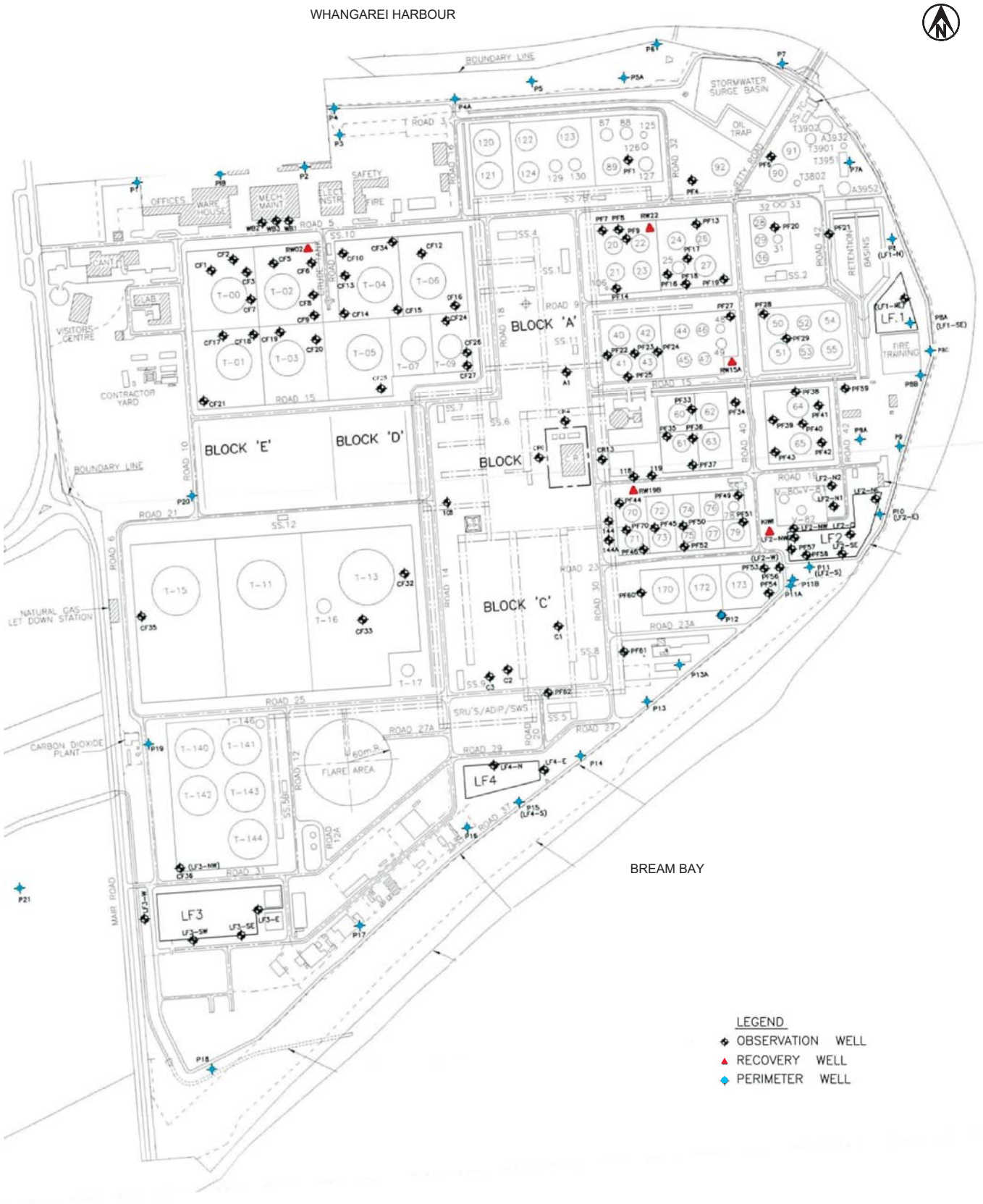
PROJECT No.	1009695.2000	
DESIGNED	NOR	Aug.19
DRAWN	RBS	Aug.19
CHECKED		
APPROVED		DATE

CLIENT **NEW ZEALAND REFINING COMPANY LIMITED**

PROJECT **REFINING NZ RE-CONSENTING**

TITLE MARSDEN POINT, WHANGAREI
Site Plan

SCALE (A3) 1:7500 FIG No. Figure 1 REV 1



Base plan supplied by GWS, July 2019.

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PROJECT No.	1009695.2000	
DESIGNED	NOR	Aug.19
DRAWN	RBS	Aug.19
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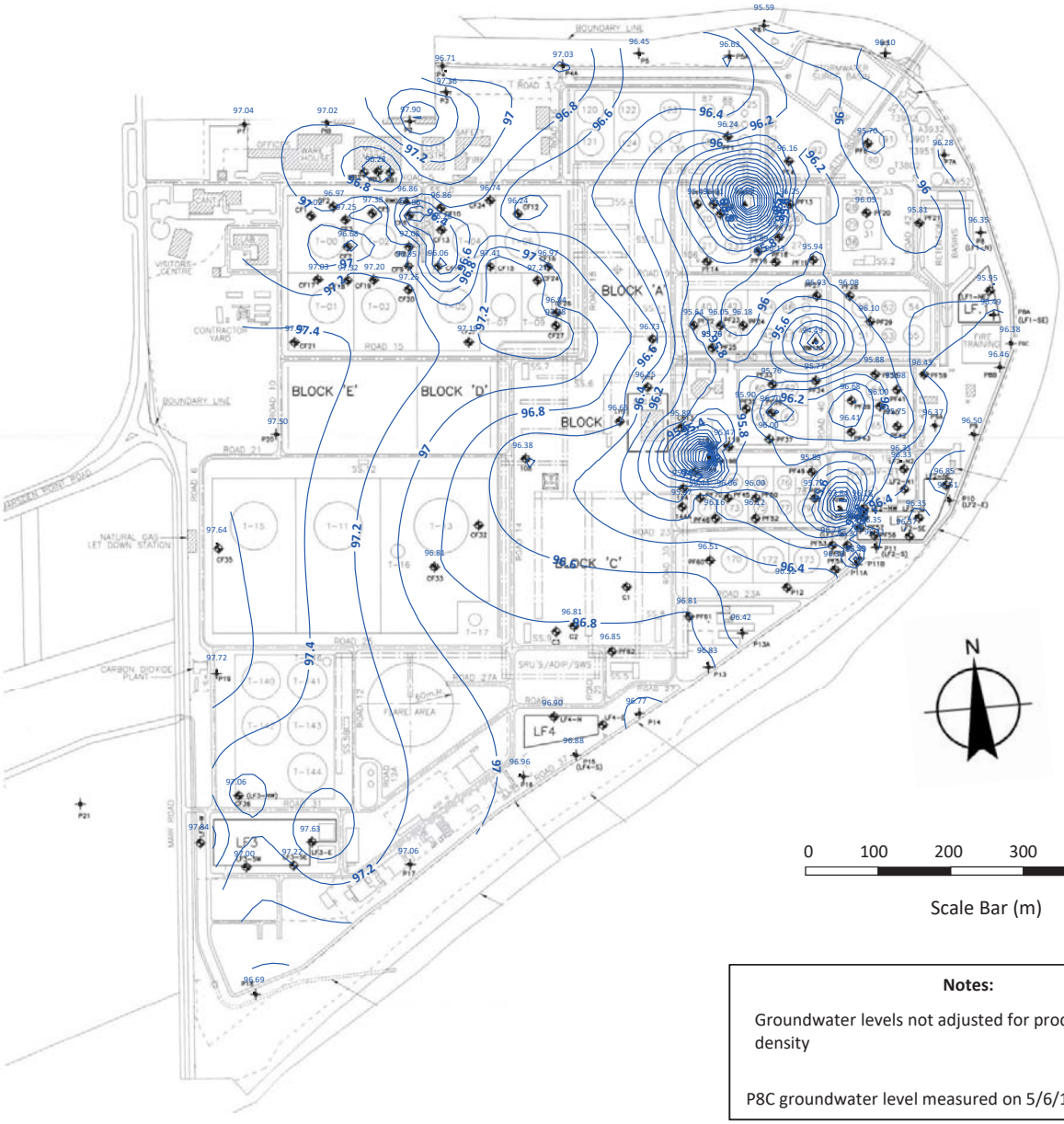
CLIENT **NEW ZEALAND REFINING COMPANY LIMITED**

PROJECT **REFINING NZ RE-CONSENTING**

TITLE MARSDEN POINT, WHANGAREI
Monitoring Well Location Plan

SCALE (A3) 1:5000 FIG No. Figure 2 REV 1



Notes:

Groundwater levels not adjusted for product thickness or density

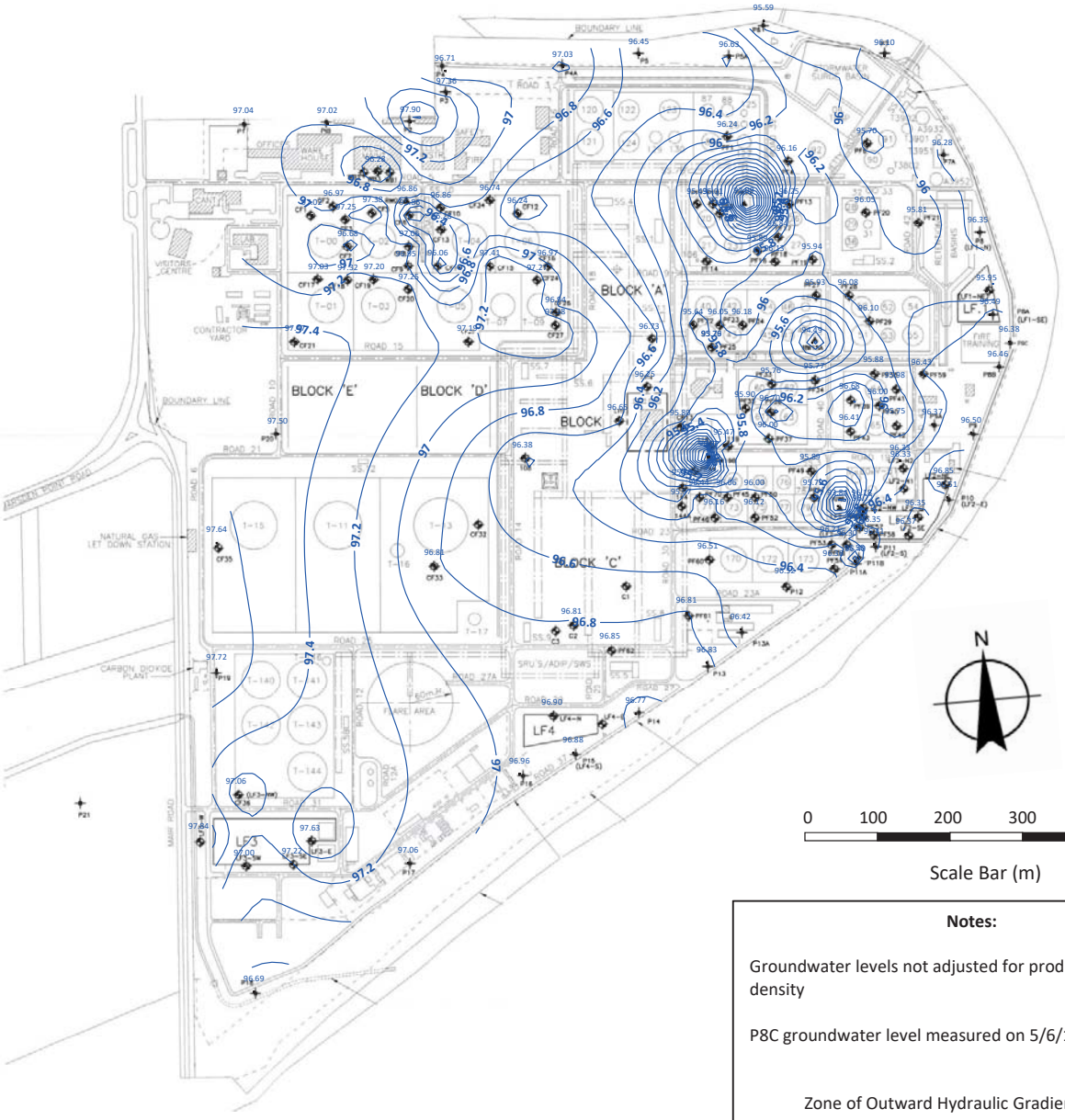
P8C groundwater level measured on 5/6/19

Figure 3: Groundwater Levels (mRL RNZ Datum) 3 March 2019

Tonkin+Taylor

Client: Refining NZ
Project: Consent Renewals
Project Number: 1009695.2000
Revision: Rev4
Date: 19/7/19

GWS Limited



Notes:

Groundwater levels not adjusted for product thickness or density

P8C groundwater level measured on 5/6/19

Zone of Outward Hydraulic Gradient

Figure 4: Hydraulic Containment and Groundwater Levels (mRL RNZ Datum)
3 March 2019

Tonkin+Taylor

Client: Refining NZ
Project: Consent Renewals
Project Number: 1009695.2000
Revision: Rev1
Date: 30/7/19

GWS Limited

Figure 5: In-well Apparent LNAPL Thickness and Hydraulic Containment
3 March 2019

Tonkin+Taylor

Client: Refining NZ
Project: Consent Renewals
Project Number: 1009695.2000
Revision: Rev1
Date: 30/7/19

GWS Limited

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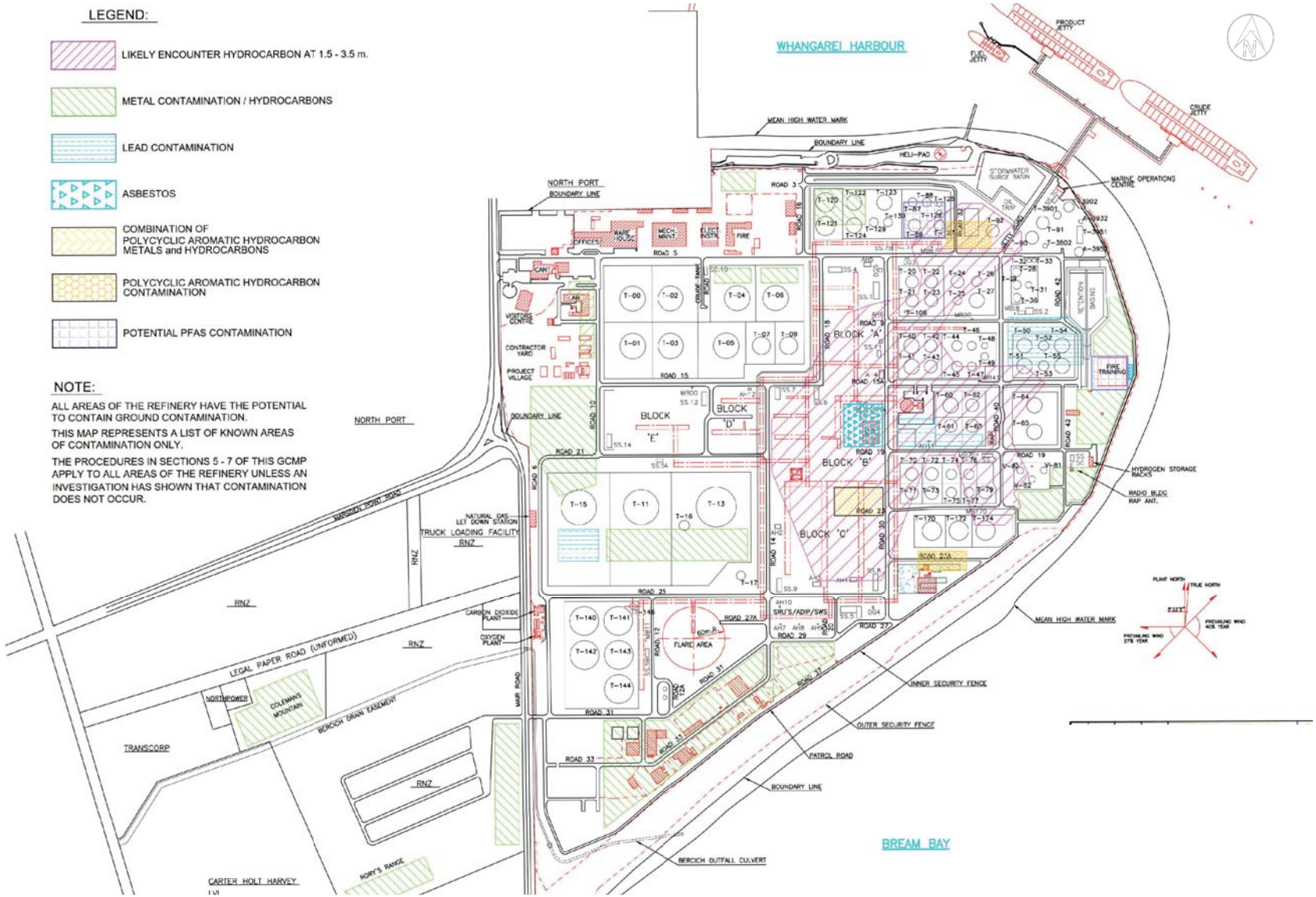

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SCALE 1:7500

0 100 200 300 400 500 (m)

Base drawing supplied by RNZ "Known Ground Contamination Soil Management Plan" Dwg T3030756, Rev B.

PROJECT No.	1009695.2000		
DESIGNED	NOR	Oct.19	
DRAWN	RBS	Oct.19	
CHECKED			
APPROVED	DATE		

CLIENT **NEW ZEALAND REFINING COMPANY LIMITED**

PROJECT **REFINING NZ RE-CONSENTING**

TITLE MARSDEN POINT, WHANGAREI
Site Contamination Plan

SCALE (A3) 1:7500 FIG No. Figure 6 REV 1

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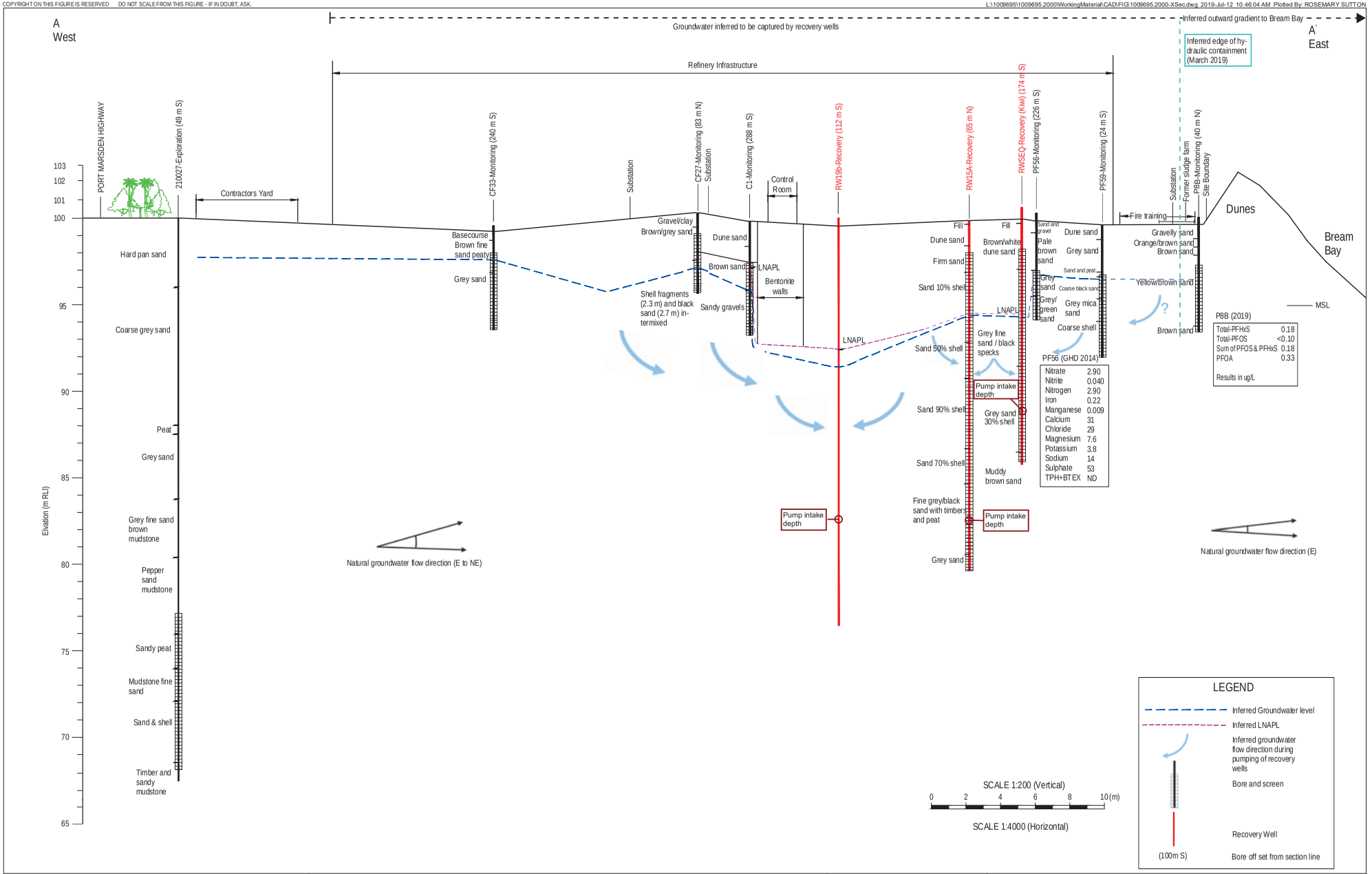

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PROJECT No.	1009695.2000	
DESIGNED	KP	Jul.19
DRAWN	RBS	Jul.19
CHECKED		
APPROVED		DATE

CLIENT **NEW ZEALAND REFINING COMPANY LIMITED**

PROJECT **REFINING NZ RE-CONSENTING**

TITLE MARSDEN POINT, WHANGAREI
Cross Section A - A'

SCALE (A3) AS SHOWN FIG No. Figure 7 REV 2

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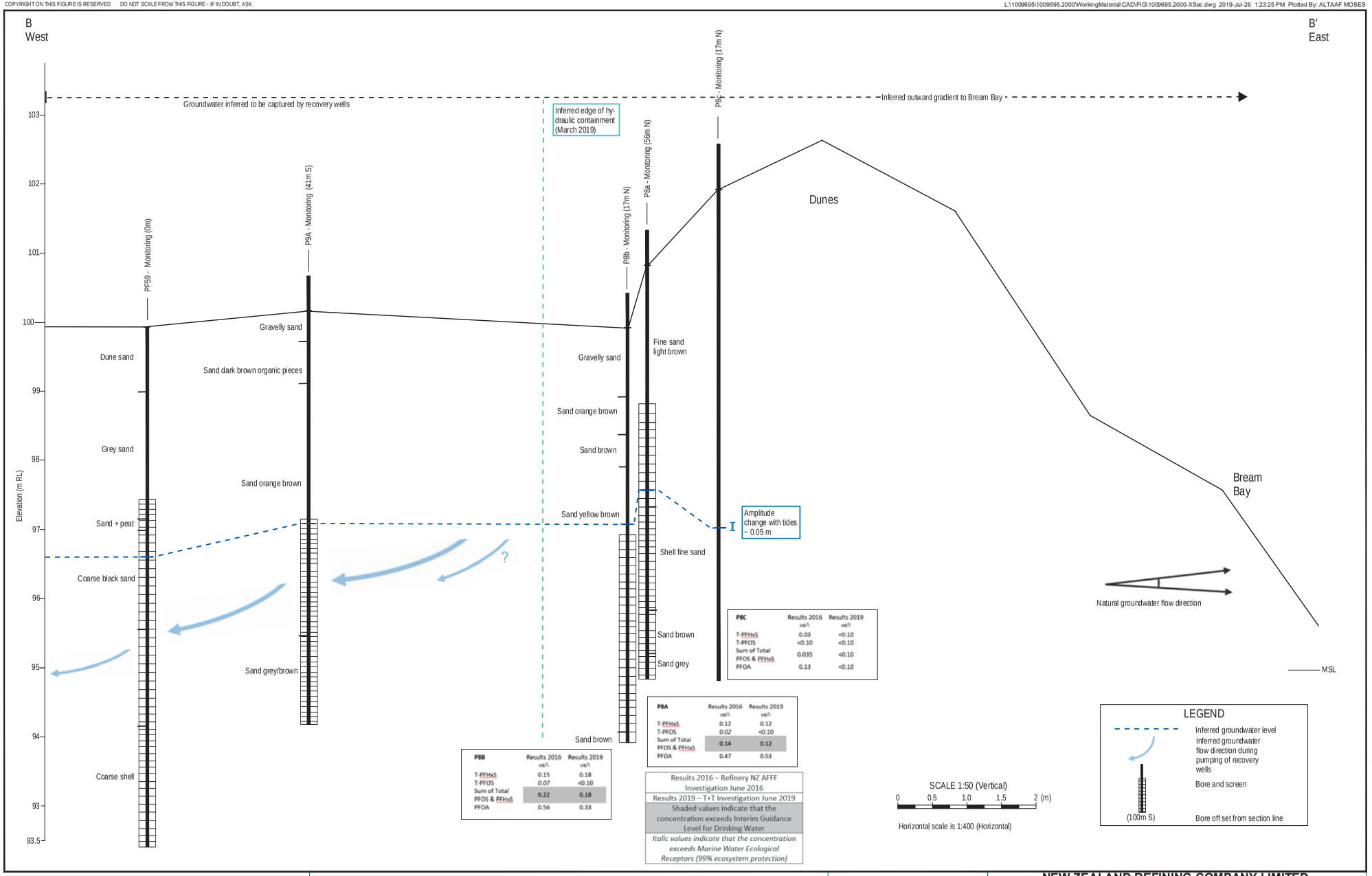

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PROJECT No.	1009695.2000	
DESIGNED	KP	Jul.19
DRAWN	RBS	Jul.19
CHECKED		
APPROVED		DATE

CLIENT NEW ZEALAND REFINING COMPANY LIMITED

PROJECT REFINING NZ RE-CONSENTING

TITLE MARSDEN POINT, WHANGAREI
Cross Section B - B'

SCALE (A3) AS SHOWN FIG No. Figure 8 REV 2

P6
P7
P4
P4a
P5
P5a
P3
PF1
P7a
P1
P2
CF34
P8
PF17
PF18
PF27
PF29
P8 a
P8 b
PF41
P9
LF2N2
P20
PF45
LF2NE
PF56
LF2C
PF54
P12
P13 a
P13
P14
P19
P15
P16
P17
P18
0
250
500 m
Total TPH concentration (mg/L) (2018-19 data for perimeter wells, 2013 for other wells)
No detection
Detected <5.0
5 - 20
>20 - 100
>100

PF1 (Dec 2013)
Benzene - 0.003
Toluene - 0.004
Ethylbenzene - 0.034
m&p-xylene - 0.038
o-xylene - 0.002
Total xylenes - 0.04
PF17 (Dec 2013)
Benzene - 0.001
Toluene - <0.001
Ethylbenzene - 0.028
m&p-xylene - 0.007
o-xylene - <0.001
Total xylenes - 0.007
CF34 (Dec 2013)
Benzene - <0.001
Toluene - <0.001
Ethylbenzene - 0.6
m&p-xylene - 1.7
o-xylene - <0.001
Total xylenes - 1.7
PF41 (Dec 2013)
Benzene - 1.3
Toluene - 2.3
Ethylbenzene - 1.1
m&p-xylene - 9.3
o-xylene - 3.2
Total xylenes - 12.5
PF18 (Dec 2013)
Benzene - <0.001
Toluene - 0.001
Ethylbenzene - <0.001
m&p-xylene - <0.002
o-xylene - <0.001
Total xylenes - <0.003
PF54 (Sep 2019)
Benzene - 0.45
Toluene - <0.001
Ethylbenzene - 0.003
m&p-xylene - 0.004
o-xylene - <0.001
PF45 (Dec 2013)
Benzene - 1.2
Toluene - 9.4
Ethylbenzene - 1.8
m&p-xylene - 6.3
o-xylene - 2.9
Total xylenes - 9.2
P1
P2
P3
P4
P5
P5a
P6
P7
P7a
P8
P9
P10
P11
P12
P13
P13 a
P14
P15
P16
P17
P18
P19
P20
CF34
PF1
PF17
PF18
PF20
PF27
PF29
PF41
PF42
PF45
PF54
PF56
LF1NE
LF2N2
LF2NE
LF2C
0
250
500 m
BTEX (mg/L)
No detection
Detection

P6
P7
P5
P5a
P4A
P4
P7A
P1
P1B
P2
BH8A
BH8C
BH8B
P9A
P9
P20
P10
P12
P11B
P13A
P13
P19
P14
P16
P15
P17
P18
0
250
500 m
Dissolved arsenic concentrations (mg/L)
No detection
Detected below ANZECC criteria (<0.0023)
Exceeds ANZECC low reliability values (>0.0023)
Exceeds Drinking Water Standards and ANZECC (>0.01)

P6
P7
P5
P5a
P4A
P4
P7A
P1
P1B
P2
BH8A
BH8C
BH8B
P9A
P9
P20
P10
P12
P11B
P13A
P13
P19
P14
P16
P15
P17
P18
0
250
500 m
Dissolved copper concentrations (mg/L)
No Detection
Detected below criteria (<0.008)
Exceeds ANZECC 80% - marine (>0.008)
Exceeds Drinking Water Standards and ANZECC (>1)

P6
P7
P5
P4A
P5a
P4
P7A
P1
P1B
P2
BH8A
BH8C
BH8B
P9A
P9
P20
P10
P11
P11B
P12
PF54
P13
P13A
P19
P14
P16
P15
P17
P18
0
250
500 m
Dissolved iron concentrations (mg/L)
No detection
Detected below criteria (<0.2)
Exceeds drinking water standards (>0.2)
Exceeds ANZECC low reliability values (>0.3)

P6
P7
P5
P5a
P4A
P4
P7A
P1
P1B
P2
BH8A
BH8C
BH8B
P9A
P9
P20
P10
P11B
P12
PF54
P13
P13A
P19
P14
P16
P15
P17
P18
0
250
500 m
Dissolved manganese concentrations (mg/L)
No detection
Detected below criteria (<0.04)
Exceeds drinking water standards (>0.04)
Exceeds ANZECC low reliability values (>0.08)

P1
P1B
P2
P4
P4A
P5
P5a
P6
P7
P7A
BH8A
BH8C
BH8B
P9A
P9
P10
P11B
P12
P13A
P13
P14
P15
P16
P17
P18
P19
P20
0
250
500 m
Dissolved zinc concentrations (mg/L)
No detection
Detected below criteria (<0.043)
Exceeds ANZECC 80% - marine (>0.043)
Exceeds Drinking Water Standards and ANZECC 80% - marine (>1.5)

P6
P7
P5
P5a
P4A
P4
P7A
P1
P1B
P2
BH8A
BH8C
BH8B
P9A
P9
P20
P10
P11B
P12
PF54
P13A
P13
P19
P14
P16
P15
P17
P18
0
250
500 m
Nitrate as Nitrogen (mg/L)
No detection
Detected below criteria (<6.9)
Exceeds ANZECC 80% - marine (>6.9)
Exceeds Drinking Water Standards and ANZECC 80% - marine (>11.3)

Appendix B: Tables

						Total Metals										Dissolved Metals														
						Iron (T)	Mercury (T)	Tin (T)	Arsenic (T)	Cadmium (T)	Chromium (T)	Copper (T)	Lead (T)	Nickel (T)	Zinc (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Total Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)						0.0004			0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023								
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)						0.0014			0.036	0.085	0.008	0.012	0.56	0.043	0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023								
	Drinking Water Standards				Health		0.007		0.01	0.004	0.05	2	0.01	0.08				0.4	0.007			0.01	0.004	0.05	2	0.01	0.08	
					Aesthetic	0.2						1			1.5		0.2	0.04							1			1.5
Location	Field ID	Within containment?	Data Source	Lab Report No.	Date																									
CF34	CF34	Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	11.2	0.64	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.23	0.11	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	Perimeter monitoring	1314580	19-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2C		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.19	0.073	-	-	-	-	-	-	-	-	-	-
LF2C	LF2C	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2N2	LF2N2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.07	0.001	-	-	-	-	-	-	-	-	-	-
LF2NE	LF2NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.98	0.040	-	-	-	-	-	-	-	-	-	-
LF2SE	LF2SE	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1852610	29-Sep-17	-	-	-	0.076	0.00029	0.0068	0.0122	0.02	0.0036	0.134	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	< 0.0011	< 0.000053	0.00054	< 0.00053	< 0.00011	< 0.00053	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	2.70	-	-	-	-	-	-	-	-	-	< 0.0002	0.05	0.0052	< 0.00008	-	< 0.0010	0.001	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0023
P10		N	GHD/GWS 2014		2-Dec-13	-	-	-	<0.0011	<0.000053	0.00058	0.00084	<0.00011	<0.00053	0.0027	-	0.04	1.29	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1787828	31-May-17	-	-	-	< 0.0011	< 0.000053	< 0.00053	0.00112	< 0.00011	0.0007	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	< 0.0021	< 0.00011	< 0.0011	< 0.0011	< 0.00021	< 0.0011	< 0.021	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	< 0.0011	< 0.000053	0.00064	< 0.00053	< 0.00011	< 0.00053	0.0012	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	0.081	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0011	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0014	0.0022	< 0.00010	0.003	0.0084
P11	P11	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.001	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	< 0.0011	< 0.000053	< 0.00053	< 0.00053	< 0.00011	< 0.00053	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	< 0.0011	< 0.000053	< 0.00053	0.00071	0.0016	< 0.00053	0.0021	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1919841/1937630	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1994035	31-May-18	-	-	-	< 0.0011	< 0.000053	0.00058	0.00084	< 0.00011	< 0.00053	0.0027	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	1.55	-	-	-	-	-	-	-	-	-	0.0008	1.05	0.036	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0034
P11 b	P11 b	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1766379	26-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	< 0.0011	< 0.000053	< 0.00053	0.00098	0.00033	0.00162	0.0164	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	< 0.021	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0029
P116	P116	?	Perimeter monitoring		No Date	-	-	-	< 0.0011	< 0.000053	< 0.00053	< 0.00053	< 0.00011	< 0.00053	0.0027	-	-	-	-	-	-	-	-	-	-	-	-	-
P12		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.07	0.018	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1429976	20-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	0.0029	< 0.000053	0.00135	< 0.00053	0.00019	< 0.00053	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	0.0017	< 0.000053	0.00103	0.0067	0.0016	0.00145	0.23	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	< 0.0011	< 0.000053	0.00061	< 0.00053	< 0.00011	< 0.00053	0.193	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	0.24	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0072	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.27
P13	P13	N	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	< 0.0011	< 0.000053	< 0.00053	< 0.00053	0.00014	< 0.00053	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	0.25	-	-	-	-	-	-	-	-	-	< 0.0002	0.03	0.0029	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	< 0.0005	< 0.00010	< 0.0005	0.0023

						Total Metals										Dissolved Metals											
						Iron (T)	Mercury (T)	Tin (T)	Arsenic (T)	Cadmium (T)	Chromium (T)	Copper (T)	Lead (T)	Nickel (T)	Zinc (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Total Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)						0.0004			0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)						0.0014			0.036	0.085	0.008	0.012	0.56	0.043	0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	Drinking Water Standards				Health		0.007		0.01	0.004	0.05	2	0.01	0.08				0.4	0.007			0.01	0.004	0.05	2	0.01	0.08	
					Aesthetic	0.2						1			1.5		0.2	0.04							1			1.5
P13 a		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.33	0.044	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1368346	23-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	0.0065	< 0.000053	0.00176	< 0.00053	0.00012	0.00072	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	0.0055	< 0.000053	0.0018	< 0.00053	0.00025	0.00057	0.0044	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	0.0066	< 0.000053	0.0028	< 0.00053	< 0.00011	< 0.00053	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	1.78	-	-	-	-	-	-	-	-	-	< 0.0002	0.12	0.0116	< 0.00008	-	< 0.0010	0.005	< 0.00005	0.0016	< 0.0005	0.00028	< 0.0005	0.0017
P14	P14	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	< 0.0011	< 0.000053	0.00062	< 0.00053	< 0.00011	< 0.00053	0.0026	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	< 0.0011	< 0.000053	0.00058	< 0.00053	< 0.00011	< 0.00053	0.0041	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	< 0.0011	< 0.000053	0.00082	< 0.00053	< 0.00011	< 0.00053	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	0.073	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0064	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	< 0.0005	< 0.00010	< 0.0005	0.002
P14 BL	P14 BL	?	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1801598/1802537	30-Jun-17	-	-	-	< 0.0011	< 0.000053	0.00063	0.00066	< 0.00011	< 0.00053	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	< 0.0011	< 0.000053	< 0.00053	< 0.00053	< 0.00011	< 0.00053	0.0013	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	< 0.0011	< 0.000053	0.00095	< 0.00053	< 0.00011	< 0.00053	< 0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	0.21	-	-	-	-	-	-	-	-	-	< 0.0002	0.05	0.0008	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	< 0.0005	0.00012	< 0.0005	0.0039
P16	P16	N	Perimeter monitoring		5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	0.0054	< 0.000053	0.0029	0.00113	0.00014	< 0.00053	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	0.0018	< 0.000053	0.002	0.00072	< 0.00011	< 0.00053	0.0075	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	0.027	< 0.000053	0.0031	0.00085	0.00030	< 0.00053	0.0066	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	3	-	-	-	-	-	-	-	-	-	< 0.0002	0.21	0.026	< 0.00008	-	< 0.0010	0.001	< 0.00005	0.0007	< 0.0005	< 0.00010	< 0.0005	0.0026
P17	P17	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1751238	31-Mar-17	-	< 0.00008	< 0.00053	0.005	< 0.000053	0.00147	< 0.00053	0.0002	< 0.00053	0.0024	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	0.0042	< 0.000053	< 0.00053	< 0.00053	< 0.00011	< 0.00053	0.0019	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	0.0040	< 0.000053	0.0059	< 0.00053	< 0.00011	< 0.00053	< 0.011	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	1.36	-	-	-	-	-	-	-	-	-	< 0.0002	0.16	0.0007	< 0.00008	-	0.0016	0.0026	< 0.00005	0.0046	< 0.0005	< 0.00010	< 0.0005	< 0.0010
P18	P18	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1787828	31-May-17	-	-	-	0.027	0.00021	0.0071	0.026	0.0023	0.0056	0.115	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1973686	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1974037	30-Apr-18	-	-	-	< 0.0011	0.000085	0.00118	0.0054	0.00014	0.0075	0.069	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	2074265	31-Oct-18	-	-	-	< 0.0011	0.00038	< 0.00053	0.0116	< 0.00011	0.025	0.31	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	1.46	-	-	-	-	-	-	-	-	-	0.0027	0.33	0.6	< 0.00008	-	< 0.0010	< 0.0010	0.0001	< 0.0005	0.0021	< 0.00010	0.0045	0.039
P19	P19	P	Perimeter monitoring	1333050	29-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1816937	27-Jul-17	-	-	-	< 0.021	< 0.0011	< 0.011	< 0.011	< 0.0021	< 0.011	0.032	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1994035	31-May-18	-	-	-	0.0015	< 0.000053	0.0024	0.00173	0.00011	< 0.00053	0.0048	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	5.6	-	-	-	-	-	-	-	-	-	0.0004	0.29	0.0125	< 0.00008	-	< 0.0010	0.0019	< 0.00005	0.002	0.001	< 0.00010	< 0.0005	0.0056
P1b	P1b	P	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	1.35	-	-	-	-	-	-	-	-	-	< 0.0002	0.14	0.0084	< 0.00008	-	< 0.0010	< 0.0010	0.00022	0.0014	0.001	0.00011	< 0.0005	0.008
P2	P2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.09	0.005	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Total Metals										Dissolved Metals												
						Iron (T)	Mercury (T)	Tin (T)	Arsenic (T)	Cadmium (T)	Chromium (T)	Copper (T)	Lead (T)	Nickel (T)	Zinc (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Total Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)						0.0004			0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)						0.0014			0.036	0.085	0.008	0.012	0.56	0.043	0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	Drinking Water Standards				Health		0.007		0.01	0.004	0.05	2	0.01	0.08				0.2	0.04	0.007			0.01	0.004	0.05	2	0.01	0.08	
					Aesthetic	0.2						1			1.5			0.2	0.04						1			1.5
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	0.073	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0017	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	0.0031	0.00034	0.0008	0.029
P20	P20	Y	Perimeter monitoring	1290129	18-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	< 0.021	< 0.0011	< 0.011	< 0.011	< 0.0021	< 0.011	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2074265	31-Oct-18	-	-	-	0.0013	0.000121	0.00165	0.0007	0.0092	< 0.00053	0.0169	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	1.02	-	-	-	-	-	-	-	-	-	< 0.0002	0.07	0.032	< 0.00008	-	< 0.0010	< 0.0010	0.00028	0.0016	0.0005	0.0003	0.0008	0.091
P3	P3	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	0.0067	< 0.000053	0.00066	< 0.00053	0.00017	< 0.00053	0.0013	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	0.0019	< 0.000053	< 0.00053	< 0.00053	0.00014	< 0.00053	0.0011	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	0.0017	< 0.000053	0.00057	< 0.00053	0.00015	< 0.00053	0.0048	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	0.0095	< 0.000053	0.00072	< 0.00053	0.00065	< 0.00053	0.030	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	0.82	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.027	< 0.00008	-	< 0.0010	0.0015	< 0.00005	0.0005	< 0.0005	< 0.00010	< 0.0005	0.0022
P4a	P4a	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1509744	26-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	< 0.0011	0.000071	0.00075	0.0044	0.0027	0.00189	0.0164	-	-	-	-	-	-	-	-	-	-	-	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	0.29	-	-	-	-	-	-	-	-	-	< 0.0002	0.05	0.029	< 0.00008	-	< 0.0010	0.0012	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0057
P5	P5	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.015	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1787828	31-May-17	-	-	-	0.0044	0.000183	0.00054	0.0013	0.00125	0.00062	0.0116	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1993978/1994035	31-May-18	-	-	-	0.0042	< 0.000053	< 0.00053	0.00091	< 0.00011	< 0.00053	0.0014	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	0.24	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0019	0.0038	< 0.00005	< 0.0005	0.0006	< 0.00010	< 0.0005	< 0.0010
P5a	P5a	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	0.0069	< 0.000053	0.00163	0.0021	0.0034	0.00066	0.0146	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	0.0029	< 0.000053	0.00067	0.00088	0.00016	< 0.00053	0.0013	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	0.177	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0025	0.0027	< 0.00005	< 0.0005	0.0008	< 0.00010	< 0.0005	0.0103
P6	P6	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.002	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	< 0.0011	< 0.000053	< 0.00053	0.00088	< 0.00011	< 0.00053	0.0066	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	< 0.0011	< 0.000053	< 0.00053	0.00078	< 0.0011	< 0.00053	0.0043	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	0.24	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0016	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0014
P7	P7	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.001	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1378318	27-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	0.0049	< 0.000053	0.0049	0.0068	0.0042	0.00127	0.041	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	0.044	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0007	< 0.00008	-	0.0017	0.0019	< 0.00005	0.0006	0.0006	0.00019	0.0006	0.012
P7a	P7a	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	<0.0005	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	< 0.0011	< 0.000053	0.00115	0.00101	0.00097	< 0.00053	0.0103	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	< 0.0011	< 0.000053	0.00059	< 0.00053	< 0.00011	< 0.00053	0.0016	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7A	N	September 2019 GME	2239932.4	10-Sep-19	0.055	-	-	-	-	-	-	-	-	-	< 0.0002	0.03	0.0015	< 0.00008	-	0.0021	0.001	< 0.00005	0.0008	0.0009	0.00014	< 0.0005	0.0115
P8	P8	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.003	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1247311	10-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Total Metals										Dissolved Metals												
						Iron (T)	Mercury (T)	Tin (T)	Arsenic (T)	Cadmium (T)	Chromium (T)	Copper (T)	Lead (T)	Nickel (T)	Zinc (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Total Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)						0.0004			0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)						0.0014			0.036	0.085	0.008	0.012	0.56	0.043	0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	Drinking Water Standards				Health		0.007		0.01	0.004	0.05	2	0.01	0.08				0.4	0.007			0.01	0.004	0.05	2	0.01	0.08	
					Aesthetic	0.2						1			1.5		0.2	0.4							1			1.5
P8	P8	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1314580	21-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1447364	3-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1560600	31-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1766393	28-Feb-17	-	-	-	< 0.0021	< 0.00011	< 0.0011	0.0019	0.00147	< 0.0011	0.0178	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	< 0.0053	< 0.00027	< 0.0027	< 0.0027	< 0.00053	< 0.0027	< 0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	< 0.0053	< 0.00027	< 0.0027	< 0.0027	< 0.00053	< 0.0027	< 0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	LF1-SE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.270	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1236128	10-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	FTG GW02	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0001	-	-	0.002	0.0003	<0.001	0.009	<0.001	0.012	0.33
P8 a	P8 a	N	Perimeter monitoring	1603955	17-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1751238	31-Mar-17	-	< 0.00008	< 0.00053	< 0.0011	0.00114	< 0.00053	0.068	< 0.00011	0.067	0.69	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1834620	30-Aug-17	-	-	-	< 0.0011	0.00114	0.00068	0.2	< 0.00011	0.074	0.83	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	< 0.0011	0.00040	< 0.00053	0.024	< 0.00011	0.0128	0.45	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	BH8 a	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	0.29	-	-	-	-	-	-	-	-	-	0.0003	< 0.02	0.034	< 0.00008	-	0.0011	< 0.0010	0.00052	0.0008	0.026	< 0.00010	0.0176	0.38
P8 b	FTG GW01	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0001	-	-	<0.001	0.0024	<0.001	0.014	0.001	0.01	0.13
P8 b	P8 b	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	0.0056	0.0033	0.0041	0.038	0.064	0.042	0.136	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	BH8 b	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	0.136	-	-	-	-	-	-	-	-	-	0.0011	< 0.04	0.085	< 0.00008	-	< 0.002	< 0.002	0.00014	< 0.0010	0.0028	< 0.0002	0.0044	0.014
P8 BL	P8 BL	?	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 c	FTG GW03	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0001	-	-	0.03	<0.0002	0.04	0.005	0.043	0.004	0.23
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	1.22	-	-	-	-	-	-	-	-	-	0.0025	0.97	0.74	< 0.00008	-	0.002	0.022	0.00017	0.0006	0.0102	0.00137	0.0033	0.02
P8 c	BH8 c	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.002	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	< 0.021	< 0.0011	< 0.011	0.156	< 0.0021	< 0.011	< 0.021	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	0.0036	0.00025	0.00154	0.0057	0.00157	0.0013	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	< 0.0011	< 0.000053	0.00065	0.00058	< 0.00011	< 0.00053	0.0012	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	0.199	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.001	< 0.00008	-	0.0011	< 0.0010	< 0.00005	< 0.0005	0.0006	< 0.00010	< 0.0005	0.0041
P9 a	P9 a	P	Perimeter monitoring	1816911	28-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9 a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	0.134	-	-	-	-	-	-	-	-	-	< 0.0002	< 0.02	0.0009	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	0.0005	0.00046	< 0.0005	0.0033
PF1		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	1.16	0.240	-	-	-	-	-	-	-	-	-	-
PF17		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF18		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF20		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.02	0.001	-	-	-	-	-	-	-	-	-	-
PF20	PF20	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF21	PF21	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF27		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.98	0.280	-	-	-	-	-	-	-	-	-	-
PF29		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.07	0.064	-	-	-	-	-	-	-	-	-	-
PF41		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	17.2	0.280	-	-	-	-	-	-	-	-	-	-
PF42		P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	1.49	0.019	-	-	-	-	-	-	-	-	-	-
PF45		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF54		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.23	0.008	-	-	-	-	-	-	-	-	-	-
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	10.9	-	-	-	-	-	-	-	-	-	0.002	11.9 #1	0.195	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	< 0.0005	< 0.00010	0.0016	0.0098
PF56		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.22	0.009	-	-	-	-	-	-	-	-	-	-
PF59	PF59	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF6		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	0.03	0.023	-	-	-	-	-	-	-	-	-	-

						Total Metals										Dissolved Metals											
						Iron (T)	Mercury (T)	Tin (T)	Arsenic (T)	Cadmium (T)	Chromium (T)	Copper (T)	Lead (T)	Nickel (T)	Zinc (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Total Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)						0.0004			0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)						0.0014			0.036	0.085	0.008	0.012	0.56	0.043	0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043
	Low reliability values					0.3		0.01	0.0023								0.3	0.08		0.01		0.0023						
	Drinking Water Standards				Health		0.007		0.01	0.004	0.05	2	0.01	0.08				0.4	0.007			0.01	0.004	0.05	2	0.01	0.08	
					Aesthetic	0.2						1			1.5		0.2	0.04							1			1.5
A3 - temporary well	A3	N/A - foreshore	GHD/GWS 2014	1218298.1	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.04	0.0015	-	-	-	-	-	-	-	-	-
B1 - temporary well	B1	N/A - foreshore	GHD/GWS 2014	1218298.2	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.003	-	-	-	-	-	-	-	-	-
C1 - temporary well	C1	N/A - foreshore	GHD/GWS 2014	1218298.4	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.04	0.0032	-	-	-	-	-	-	-	-	-
D1 - temporary well	D1	N/A - foreshore	GHD/GWS 2014	1218298.6	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.04	0.0018	-	-	-	-	-	-	-	-	-
E1 - temporary well	E1	N/A - foreshore	GHD/GWS 2014	1218752.1	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.003	-	-	-	-	-	-	-	-	-
F1 - temporary well	F1	N/A - foreshore	GHD/GWS 2014	1218752.3	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.003	-	-	-	-	-	-	-	-	-
G1 - temporary well	G1	N/A - foreshore	GHD/GWS 2014	1218752.5	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.003	-	-	-	-	-	-	-	-	-
Beach 01	GW01	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.007	0.025
Beach 02	GW02	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.0014	0.0012	< 0.0010	< 0.0010	< 0.007	0.014
Beach 03	GW03	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	0.0008	0.0021	< 0.0010	< 0.0010	< 0.007	0.012
Beach 04	GW04	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013	< 0.0002	< 0.0010	0.001	< 0.0010	< 0.007	0.014
Beach 04	GW05	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.004	< 0.0002	0.0021	< 0.0010	< 0.0010	< 0.007	0.03
Beach 05	GW06	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.007	< 0.0002	0.0013	0.0012	< 0.0010	< 0.007	0.032
Beach 06	GW07	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.007	0.05
Beach 07	GW08	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.007	< 0.0002	< 0.0010	0.0011	< 0.0010	< 0.007	0.059
Beach 08	GW09	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.004	< 0.0002	0.0012	< 0.0010	< 0.0010	< 0.007	0.066

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

						BTEX						Total Petroleum Hydrocarbons												MNA Suite																			
						Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene	C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)	Total Kjeldahl Nitrogen (TKN)	Total Nitrogen	Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Hardness (CaCO3)	Anions (Total) [meq/L]	Cations (Total) (F) [meq/L]	Calcium (F)	Chloride (F)	Magnesium (F)	Potassium (F)	Sodium (F)	Sulfate as SO4 (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)					0.7																		3.91 (at pH 7)	2.4 a																
	Low reliability values						0.18	0.005	0.075	0.35																																
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)					0.7 c																		7.3 (at pH 7)	6.9 a																
	Low reliability values						0.33	0.005	0.15	0.64																																
	Drinking Water Standards				Health	0.01	0.8	0.3			0.6														11.3	0.91															
					Aesthetic		0.03	0.002			0.02																						200				250			200	250
Location	Field ID	Within containment?	Data Source	Lab Report No.	Date																																				
CF34	CF34	Y	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	0.6	1.7	<0.001	1.7	1.7	-	0.9	-	-	<0.4	-	-	-	-	2.6 (C7-C36)	-	-	0.04	0.085	0.13			119	145	91	2.9	2.9	30	14	3.8	2.5	14	5
LF1-NE	LF1-NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.87	0.051	0.92			230	280	104	5.7	5.4	33	21	5	4.1	74	24
LF1-NE	LF1-NE	N	Perimeter monitoring	1314580	19-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
LF2C		N	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	<0.7 (C7-C36)	-	-	0.78	0.007	0.79			27	33	94	3.7	3.4	28	53	5.6	3.4	33	76
LF2C	LF2C	N	Perimeter monitoring	1460335	31-Jul-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	0.13	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
LF2N2	LF2N2	P	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	<0.7 (C7-C36)	-	-	1.57	0.011	1.59			16	20	9	3.0	2.9	1	79	1.7	8.7	58	16
LF2NE	LF2NE	N	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	<0.7 (C7-C36)	-	-	0.5	0.019	0.52			43	52	24	9.9	10.4	2	240	4.6	10.7	220	112
LF2SE	LF2SE	N	Perimeter monitoring	1460335	31-Jul-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	0.12	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1482125	28-Sep-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1494697	23-Oct-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1509744	30-Nov-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1519250	22-Dec-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1528309	22-Jan-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1544809	26-Feb-16	0.0072	< 0.0010	0.0041	0.008	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1303576	23-Jul-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1467358	24-Aug-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1528309	22-Jan-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1852610	29-Sep-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	0.42	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1956498	29-Mar-18	< 0.0010	< 0.0010	0.0011	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1973686/1974037	30-Apr-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.3	< 0.002	2.3			-	-	-	-	-	-	-	-	-	-	-	-
P10		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59	0.002	0.59			260	310	610	13.9	13.5	230	55	8.4	5.4	25	340
P10	P10	N	Perimeter monitoring	1368346	22-Dec-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.17	0.18	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1378318	23-Jan-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.14	0.18	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1659269	30-Sep-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1787828	31-May-17	< 0.0010	0.005	< 0.0010	0.003	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1801598	30-Jun-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2041344	30-Aug-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2169749	30-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.26	< 0.002	1.26			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.77	0.01	1.78			37	45	44	2.8	2.7	8	51	5.5	1.7	42	25
P11	P11	N	Perimeter monitoring	1348963	7-Nov-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1389799	24-Feb-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1460335	31-Jul-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1751238	31-Mar-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1919841/1937630	31-Jan-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1993978	31-May-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	2104516	31-Dec-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	1.17	0.004	1.18			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1277675	19-May-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1401329	20-Mar-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1625296	29-Jul-16	< 0.0010	0.0033	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1766379	26-Apr-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.2	-	-	< 0.4	-	-	-	-	< 0.7 (C7 - C36)	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902082	27-Dec-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	9.4	0.005	9.4			-	-	-	-	-	-	-	-	-	-	-	-
P116	P116	?	Perimeter monitoring		No Date	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.6	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.10	0.032	1.13			79	97	168	5.3	5.3	55	25	7.6	4.1	42	141
P12	P12	N	Perimeter monitoring	1257728	1-Apr-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1429976	20-May-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1519250	22-Dec-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1544809	26-Feb-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1641438	31-Aug-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1939711/1937630	28-Feb-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2091767	30-Nov-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2113920	23-Jan-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring		28-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.58	< 0.002	0.58			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1303576	23-Jul-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1494697	28-Oct-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1603955	20-Jun-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1699761	16-Dec-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1711586	20-Jan-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2008304	27-Jun-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	4.3	< 0.002	4.3			-	-	-	-	-	-	-	-	-	-	-	-

						BTEX						Total Petroleum Hydrocarbons												MNA Suite																	
						Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene	C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)	Total Kjeldahl Nitrogen (TKN)	Total Nitrogen	Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Hardness (CaCO3)	Anions (Total) [meq/L]	Cations (Total) (F) [meq/L]	Calcium (F)	Chloride (F)	Magnesium (F)	Potassium (F)	Sodium (F)	Sulfate as SO4 (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)					0.7																		3.91 (at pH 7)	2.4 a															
	Low reliability values						0.18	0.005	0.075	0.35																															
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)					0.7 c																		7.3 (at pH 7)	6.9 a															
	Low reliability values						0.33	0.005	0.15	0.64																															
	Drinking Water Standards				Health	0.01	0.8	0.3			0.6														11.3	0.91														
					Aesthetic		0.03	0.002			0.02																						200				250			200	250
P13 a		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	<0.002	<0.002			34	42	48	1.7	1.7	12	19	4.3	3.1	15	25
P13 a	P13 a	N	Perimeter monitoring	1227609	21-Jan-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.2	-	-	< 0.4	-	-	-	-	-	< 0.7 (C7 - C36)	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1368346	23-Dec-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1509744	30-Nov-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	0.20	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1519250	22-Dec-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	0.39	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1560600	30-Mar-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1671121	27-Oct-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1731881	27-Feb-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902082	27-Dec-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2025814	31-Jul-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2163361	16-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.021	0.065	0.002	0.067			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1247311	11-Mar-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1378318	23-Jan-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1595572	31-May-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	0.13	-	0.29	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1751238	31-Mar-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1870883/ 1870248	30-Oct-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2025814	31-Jul-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2169749	30-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	13.2	< 0.002	13.2			-	-	-	-	-	-	-	-	-	-	-
P14 BL	P14 BL	?	Perimeter monitoring	1247311	11-Mar-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1247311	11-Mar-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1444515	26-Jun-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1577176	29-Apr-16	< 0.0010	< 0.0010	0.0027	0.003	< 0.0010	-	< 0.10	-	0.26	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1801598/1802537	30-Jun-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2041344	30-Aug-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2113920	23-Jan-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	5.9	< 0.002	5.9			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring		5-Aug-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1482125	28-Sep-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1625296	29-Jul-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1834620	29-Aug-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2059139/2058712	28-Sep-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2074265	30-Oct-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.018	13.9	0.015	13.9			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1309496	5-Aug-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1494697	28-Oct-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	0.31	< 0.10	-	< 0.10	0.11	0.16	-	0.42	-	1.0	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1603955	20-Jun-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1751238	31-Mar-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2059139/2058712	28-Sep-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2163361	16-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.53	0.005	1.53			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1368346	22-Dec-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1419300	28-Apr-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1560600	30-Mar-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1787828	31-May-17	< 0.0010	0.0086	0.0014	0.005	0.0025	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1816937	27-Jul-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1973686	30-Apr-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	2074265	31-Oct-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.023	3.1	< 0.002	3.1			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1333050	29-Sep-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1460337	22-Jul-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1625296	29-Jul-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1731881	27-Feb-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1993978	31-May-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	2104516	31-Dec-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.52	< 0.002	1.53			-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1309496	5-Aug-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1519250	22-Dec-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1659269	30-Sep-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1888326	30-Nov-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.1	< 0.002	2.1			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)	-	0.48	<0.002	0.49			27	33	31	1.1	1	11	10	1.2	1.3	9	10
P2	P2	P	Perimeter monitoring	1277675	19-May-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1303576	23-Jul-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1419300	28-Apr-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1641438	31-Aug-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1902082	27-Dec-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	2091767	30-Nov-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	<0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-

						BTEX						Total Petroleum Hydrocarbons												MNA Suite																			
						Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene	C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)	Total Kjeldahl Nitrogen (TKN)	Total Nitrogen	Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Hardness (CaCO3)	Anions (Total) [meq/L]	Cations (Total) (F) [meq/L]	Calcium (F)	Chloride (F)	Magnesium (F)	Potassium (F)	Sodium (F)	Sulfate as SO4 (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)					0.7																		3.91 (at pH 7)	2.4 a																
	Low reliability values						0.18	0.005	0.075	0.35																															
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)					0.7 c																		7.3 (at pH 7)	6.9 a																
	Low reliability values						0.33	0.005	0.15	0.64																															
	Drinking Water Standards				Health	0.01	0.8	0.3			0.6														11.3	0.91															
					Aesthetic		0.03	0.002			0.02																						200					250			200	250
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	5.8	< 0.002	5.8			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1290129	18-Jun-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1401329	20-Mar-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1528309	22-Jan-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1816937	27-Jul-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2008304	27-Jun-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2074265	31-Oct-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.2	< 0.2	-	< 0.2	< 0.2	< 0.2	-	< 0.4	-	< 1.5	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.026	2.2	< 0.002	2.2			-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1482125	28-Sep-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1690894	30-Nov-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1888326	30-Nov-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	2104516	31-Dec-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1348963	7-Nov-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1467358	24-Aug-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1699761	16-Dec-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1870883/ 1870248	30-Oct-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1956498	29-Mar-18	< 0.0010	< 0.0010	0.0011	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1973686/ 1974037	30-Apr-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	2169749	30-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	9.4	0.24	9.6			-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1348963	7-Nov-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1509744	26-Nov-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1577176	29-Apr-16	< 0.0010	< 0.0010	0.0022	0.003	< 0.0010	-	< 0.10	-	0.23	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1731881	27-Feb-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1919316/1919841	31-Jan-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.188	0.027	< 0.002	0.028			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	0.023	0.13			230	280	240	5.8	5.7	87	25	6.9	1.8	18	24
P5	P5	N	Perimeter monitoring	1333050	30-Sep-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1494697	23-Oct-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1690894	30-Nov-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1787828	31-May-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1801598	30-Jun-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1993978/ 1994035	31-May-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	2074265	30-Oct-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.9	< 0.002	1.9			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1333050	30-Sep-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1401329	20-Mar-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1595572	31-May-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1852610	29-Sep-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1956498	29-Mar-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	6.5	0.008	6.5			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.3	0.162	4.5			300	360	310	7.1	7.1	106	22	11.8	2.2	17	14
P6	P6	N	Perimeter monitoring	1277675	19-May-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1429976	21-May-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1641438	31-Aug-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1834620	29-Aug-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2008304	27-Jun-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.6	< 0.002	2.6			-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.56	<0.002	0.56			210	260	220	5.2	5.3	75	24	8.7	2.1	18	12
P7	P7	N	Perimeter monitoring	1378318	27-Jan-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1671121	27-Oct-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1852610	29-Sep-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	2091767	30-Nov-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3.5	< 0.002	3.5			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.80	0.107	4.90			185	220	230	6.9	7.3	82	78	5.5	4.1	61	29
P7a	P7a	N	Perimeter monitoring	1290129	19-Jun-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1509744	30-Nov-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1659269	30-Sep-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1711586	20-Jan-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	2041344	30-Aug-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7A	N	September 2019 GME	2239932.4	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.9	0.006	2.9			-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	0.104	7.7			173	210	330	21	17.9	82	520	30	11.7	250	86
P8	P8	N	Perimeter monitoring	1227609	16-Jan-14	0.0075	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.2	-	-	< 0.4	-	-	-	-	-	< 0.7 (C7 - C36)	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1236128	11-Feb-14	0.0056	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1247311	10-Mar-14	0.0044	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.117	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1257728	1-Apr-14	0.0048	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.20	< 0.10	< 0.10	-	< 0.15	-	< 0.7	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1290129	19-Jun-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.13	< 0.10	< 0.10	-	< 0.15	-	< 0.8	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-

						BTEX						Total Petroleum Hydrocarbons											MNA Suite																			
						Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene	C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)	Total Kjeldahl Nitrogen (TKN)	Total Nitrogen	Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Hardness (CaCO3)	Anions (Total) [meq/L]	Cations (Total) (F) [meq/L]	Calcium (F)	Chloride (F)	Magnesium (F)	Potassium (F)	Sodium (F)	Sulfate as SO4 (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)					0.7																	3.91 (at pH 7)	2.4 a																
	Low reliability values						0.18	0.005	0.075	0.35																															
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)					0.7 c																	7.3 (at pH 7)	6.9 a																
	Low reliability values						0.33	0.005	0.15	0.64																															
	Drinking Water Standards				Health	0.01	0.8	0.3			0.6														11.3	0.91														
					Aesthetic		0.03	0.002			0.02																					200					250			200	250
P8	P8	N	Perimeter monitoring	1309496	5-Aug-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.15	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1314580	21-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1389799	24-Feb-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	0.13	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1419300	28-Apr-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1444515	26-Jun-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1447364	3-Jul-15	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	0.15	< 0.10	< 0.10	-	0.20	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1460337	22-Jul-15	0.0035	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1467358	24-Aug-15	0.0017	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1482125	28-Sep-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	0.13	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1544809	26-Feb-16	0.22	0.0038	0.063	0.113	< 0.0010	-	0.16	-	0.19	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1560600	31-Mar-16	0.112	0.0036	0.069	0.101	< 0.0010	-	0.12	-	0.13	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1577176	29-Apr-16	0.047	0.002	0.047	0.059	< 0.0010	-	0.14	-	0.2	< 0.10	-	0.15	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1595572	31-May-16	0.045	0.0016	0.031	0.013	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1671121	27-Oct-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1699761	16-Dec-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1766393	28-Feb-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	1870883/ 1870248	30-Oct-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring	2163361	16-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	0.14	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8	P8	N	Perimeter monitoring		28-Apr-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8 a	LF1-SE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	0.01	<0.002	0.01			260	320	450	13.1	12.5	146	56	20	7.1	77	300
P8 a	P8 a	N	Perimeter monitoring	1227609	21-Jan-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.2	-	-	< 0.4	-	-	-	-	-	< 0.7 (C7 - C36)		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1236128	10-Feb-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	0.12	< 0.10	< 0.10	< 0.10	-	< 0.7		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1429976	21-May-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	0.12	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1444515	26-Jun-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8 a	FTG GW02	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1603955	17-Jun-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	0.11	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	1834620	30-Aug-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8 a	P8 a	N	Perimeter monitoring	2059139/2058712	28-Sep-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8 a	BH8 a	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-			-	-	-									
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		< 0.010	2.1	< 0.002	2.1			-	-	-	-	-	-	-	-	-	-	-
P8 b	FTG GW01	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	-	-			-	-	-									
P8 b	P8 b	N	Perimeter monitoring	1919316/1919841	31-Jan-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P8 b	BH8 b	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-			-	-	-									
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		0.186	0.62	0.002	0.62			-	-	-	-	-	-	-	-	-	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1227609	16-Jan-14	<0.0010	<0.0010	<0.0010	<0.002	<0.0010	-	< 0.10	-	< 0.2	-	-	< 0.4	-	-	-	-	-	< 0.7 (C7 - C36)		-	-	-			-	-	-									
P8 BL	P8 BL	?	Perimeter monitoring	1236128	11-Feb-14	<0.0010	<0.0010	<0.0010	<0.002	<0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7		-	-	-			-	-	-									
P8 c	FTG GW03	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	-	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	-	-			-	-	-									
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		0.018	< 0.002	< 0.002	< 0.002			-	-	-	-	-	-	-	-	-	-	-
P8 c	BH8 c	N	T+T PFAS 2019	19-129345	5-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	46	<0.2	46			106	130	250	7	6.3	74	34	15.8	2.6	28	31
P9	P9	N	Perimeter monitoring	1236128	11-Feb-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1257728	1-Apr-14	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1389799	24-Feb-15	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.7		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1528309	22-Jan-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.15	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1690894	30-Nov-16	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1711586	20-Jan-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.10	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1816937	27-Jul-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	1939711/1937630	28-Feb-18	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	Perimeter monitoring	2113920	23-Jan-19	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		< 0.010	10.8	< 0.002	10.8			-	-	-	-	-	-	-	-	-	-	-
P9 a	P9 a	P	Perimeter monitoring	1816911	28-Jul-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	< 0.2	-	< 0.8		-	-	-			-	-	-									
P9 a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		< 0.010	3.8	0.005	3.8			-	-	-	-	-	-	-	-	-	-	-
PF1		Y	GHD/GWS 2014		2-Dec-13	0.003	0.004	0.014	0.038	0.002	0.04	0.3	-	0.3	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)			<0.002	<0.002	<0.002			144	175	113	3.5	3.4	38	19	4.1	4.5	22	4
PF17		Y	GHD/GWS 2014		2-Dec-13	0.001	<0.001	0.028	0.007	<0.001	0.007	<0.1	-	1.9	-	-	3.2	-	-	-	-	-	5 (C7-C36)		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF18		Y	GHD/GWS 2014		2-Dec-13	<0.001	0.001	<0.001	<0.002	<0.001	<0.001	<0.1	-	<0.2	-	-	1	-	-	-	-	-	1 (C7-C36)		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF20		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	11.3	0.003	11.3			73	89	97	3.8	3.5	28	30	6.7	4.5	34	34
PF20	PF20	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	1.67	-	6.2	3.4	1.22	1.27	1.73	-	14.2		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF21	PF21	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	< 0.10	-	< 0.10	< 0.10	-	0.12	< 0.10	< 0.10	< 0.10	< 0.15	-	< 0.8		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF27		Y	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.1	-	0.3	-	-	4.4	-	-	-	-	-	4.7 (C7-C36)		-	<0.002	<0.002	0			182	220	159	4.1	3.9	53	14	6.4	3.4	14	1
PF29		Y	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.1	-	29	-	-	73	-	-	-	-	-	101 (C7-C36)		-	<0.002	<0.002	<0.002			59	72	50	1.4	1.4	12	7	4.5	2.3	7	0.5
PF41		Y	GHD/GWS 2014		2-Dec-13	1.3	2.3	1.1	9.3	3.2	12.5	11.4	-	12.8	-	-	<0.4	-	-	-	-	-	24 (C7-C36)		-	0.01	0.015	0.02			132	161	136	9.3	9.6	29	240	15.5	11.5	137	<0.5
PF42		P	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	0.7	0.002	0.7			43	52	13	1.2	1.3	3	7	1.6	6.1	19	6
PF45		Y	GHD/GWS 2014		2-Dec-13	1.2	9.4	1.8	6.3	2.9	9.2	14.4	-	5.6	-	-	<0.4	-	-	-	-	-	20 (C7-C36)		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF54		N	GHD/GWS 2014		2-Dec-13	0.007	<0.001	0.004	<0.002	<0.001	<0.003	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	4.50	0.047	4.50			49	60	67	2.6	2.6	16	25	6.4	2.2	27	30
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	0.45	< 0.0010	0.003	0.004	< 0.0010	-	< 0.06	<0.2	-	-	< 0.4	-	-	-	-	-	<0.7	-		0.88	7.3	0.032	7.3			-	-	-	-	-	-	-	-	-	-	-
PF56		Y	GHD/GWS 2014		2-Dec-13	<0.001	<0.001	<0.001	<0.002	<0.001	<0.003	<0.1	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)		-	2.90	0.046	2.90			45	55	109	3.0	2.9	31	29	7.6	3.8	14	53
PF59	PF59	Y	Perimeter monitoring	1816937	27-Jul-17	< 0.0010	< 0.0010	< 0.0010	< 0.002	< 0.0010	-	< 0.06	-	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.2	-	< 0.8		-	-	-	-			-	-	-	-	-	-	-	-	-	-	-
PF6		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	0.74	0.039	0.78			190	230	168	4.6	4.8	49	18	10.8	4.7	30	12

BTEX

Location	Well ID	Containment	Source	Lab Ref	Date	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)					0.7					
	Low reliability values						0.18	0.005	0.075	0.35	
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)					0.7 c					
	Low reliability values						0.33	0.005	0.15	0.64	
	Drinking Water Standards				Health	0.01	0.8	0.3			0.6
					Aesthetic		0.03	0.002			0.02
A3 - temporary well	A3	N/A - foreshore	GHD/GWS 2014	1218298.1	18-Dec-13	-	-	-	-	-	-
B1 - temporary well	B1	N/A - foreshore	GHD/GWS 2014	1218298.2	18-Dec-13	-	-	-	-	-	-
C1 - temporary well	C1	N/A - foreshore	GHD/GWS 2014	1218298.4	18-Dec-13	-	-	-	-	-	-
D1 - temporary well	D1	N/A - foreshore	GHD/GWS 2014	1218298.6	18-Dec-13	-	-	-	-	-	-
E1 - temporary well	E1	N/A - foreshore	GHD/GWS 2014	1218752.1	19-Dec-13	-	-	-	-	-	-
F1 - temporary well	F1	N/A - foreshore	GHD/GWS 2014	1218752.3	19-Dec-13	-	-	-	-	-	-
G1 - temporary well	G1	N/A - foreshore	GHD/GWS 2014	1218752.5	19-Dec-13	-	-	-	-	-	-
Beach 01	GW01	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 02	GW02	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 03	GW03	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 04	GW04	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 04	GW05	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 05	GW06	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 06	GW07	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 07	GW08	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-
Beach 08	GW09	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-

Total Petroleum Hydrocarbons

Location	C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)
A3 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
B1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
C1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
D1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
E1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
F1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
G1 - temporary well	<0.10	-	<0.2	-	-	<0.4	-	-	-	-	-	<0.7 (C7-C36)
Beach 01	-	-	-	-	-	-	-	-	-	-	-	-
Beach 02	-	-	-	-	-	-	-	-	-	-	-	-
Beach 03	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	-	-	-	-	-	-	-	-	-	-	-	-
Beach 05	-	-	-	-	-	-	-	-	-	-	-	-
Beach 06	-	-	-	-	-	-	-	-	-	-	-	-
Beach 07	-	-	-	-	-	-	-	-	-	-	-	-
Beach 08	-	-	-	-	-	-	-	-	-	-	-	-

MNA Suite

Location	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)	Total Kjeldahl Nitrogen (TKN)	Total Nitrogen	Alkalinity (as CaCO3)	Bicarbonate (as HCO3)	Hardness (CaCO3)	Anions (Total) [meq/L]	Cations (Total) (F) [meq/L]	Calcium (F)	Chloride (F)	Magnesium (F)	Potassium (F)	Sodium (F)	Sulfate as SO4 (F)
ANZECC 2000 95% marine	3.91 (at pH 7)	2.4 a															
Low reliability values																	
ANZECC 2000 80% marine	7.3 (at pH 7)	6.9 a															
Low reliability values																	
Drinking Water Standards – Health		11.3	0.91														
Drinking Water Standards – Aesthetic									200				250			200	250
A3 - temporary well	-	2.2	<0.002	2.2			330	390	144	29	25	12.9	670	27	29	490	154
B1 - temporary well	-	6.7	0.003	6.7			380	460	179	43	38	13.8	1080	35	38	770	220
C1 - temporary well	-	4	<0.11	4			162	-	3500	-	-	240	9800	710	260	6400	1720
D1 - temporary well	-	1.2	<0.11	1.2			149	-	4500	-	-	300	12400	920	300	7800	2100
E1 - temporary well	-	2.2	<0.002	2.2			350	410	230	41	36	16	1040	45	42	710	220
F1 - temporary well	-	2	<0.002	2			360	430	210	41	39	27	1030	34	30	780	220
G1 - temporary well	-	2.5	<0.002	2.5			300	350	350	41	37	36	1070	63	41	660	220
Beach 01	0.032	< 0.0010	< 0.0010	-	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-
Beach 02	0.007	< 0.0010	< 0.0010	-	< 0.2	< 0.3	-	-	-	-	-	-	-	-	-	-	-
Beach 03	0.048	0.0011	0.0014	-	0.2	0.2	-	-	-	-	-	-	-	-	-	-	-
Beach 04	0.091	0.0016	0.0021	-	0.3	0.3	-	-	-	-	-	-	-	-	-	-	-
Beach 04	0.25	0.0012	0.0018	-	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-
Beach 05	0.25	0.0028	0.0034	-	0.7	0.7	-	-	-	-	-	-	-	-	-	-	-
Beach 06	0.63	0.0052	0.006	-	1.3	1.3	-	-	-	-	-	-	-	-	-	-	-
Beach 07	0.008	0.026	0.042	-	0.4	0.4	-	-	-	-	-	-	-	-	-	-	-
Beach 08	0.051	0.0029	0.0035	-	0.3	0.3	-	-	-	-	-	-	-	-	-	-	-

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

						Per- and Polyfluorinated Alkyl Substances (PFAS)																															
						Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid (PFBA)	di-PFHxS	mono-PFHxS	L-PFHxS	Perfluorohexanesulfonic acid (PFHxS)	di-PFOS	mono-PFOS	L-PFOS	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (PFOSA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl-perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTS)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTS)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTS)	PFHpS	Sum PFHxS+PFOS
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)														0.00000023 b					0.019 b																
	Low reliability values																																				
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)														0.031					1.824																
	Low reliability values																																				
	Drinking Water Standards				Health															0.00056																0.00007
					Aesthetic																																
Location	Field ID	Within containment?	Data Source	Lab Report No.	Date																																
CF34	CF34	Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	Perimeter monitoring	1314580	19-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2C		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2C	LF2C	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2N2	LF2N2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2NE	LF2NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2SE	LF2SE	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1919841/1937630	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1766379	26-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P116	P116	?	Perimeter monitoring		No Date	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1429976	20-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Per- and Polyfluorinated Alkyl Substances (PFAS)																													
						Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid (PFBA)	di-PFHxS	mono-PFHxS	L-PFHxS	Perfluorohexanesulfonic acid (PFHxS)	di-PFOS	mono-PFOS	L-PFOS	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (PFOSA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl-perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTS)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTS)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTS)	PFHpS	Sum PFHxS+PFOS
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)														0.00000023 b					0.019 b															
	Low reliability values																																		
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)														0.031					1.824															
	Low reliability values																																		
	Drinking Water Standards				Health															0.00056															0.00007
					Aesthetic																															
P13 a		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1368346	23-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14 BL	P14 BL	?	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1801598/1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring		5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1973686	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	2074265	31-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1333050	29-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Per- and Polyfluorinated Alkyl Substances (PFAS)																														
						Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid (PFBA)	di-PFHxS	mono-PFHxS	L-PFHxS	Perfluorohexanesulfonic acid (PFHxS)	di-PFOS	mono-PFOS	L-PFOS	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (PFOSA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl-perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTS)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTS)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTS)	PFHpS	Sum PFHxS+PFOS
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)														0.00000023 b					0.019 b															
	Low reliability values																																			
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)														0.031					1.824															
	Low reliability values																																			
	Drinking Water Standards				Health															0.00056															0.00007
					Aesthetic																															
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1290129	18-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2074265	31-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1509744	26-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1993978/1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1378318	27-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7A	N	September 2019 GME	2239932.4	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1247311	10-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Per- and Polyfluorinated Alkyl Substances (PFAS)																												
						Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid (PFBA)	di-PFHxS	mono-PFHxS	L-PFHxS	Perfluorohexanesulfonic acid (PFHxS)	di-PFOS	mono-PFOS	L-PFOS	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (PFOSA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl-perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTS)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTS)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTS)	PFHpS	Sum PFHxS+PFOS
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)														0.0000023 b					0.019 b														
	Low reliability values																																		
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)														0.031					1.824														
	Low reliability values																																		
	Drinking Water Standards				Health															0.00056														0.00007
					Aesthetic																														
P8	P8	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1314580	21-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1447364	3-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1560600	31-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1766393	28-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	LF1-SE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1236128	10-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	FTG GW02	N	Refining NZ 2016	504911	16-Jun-16	0.00001	0.00093	-	-	-	0.00012	-	-	-	0.00002	<0.00001	0.017	0.0088	0.0045	0.00047	0.00027	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005	<0.00005	<0.00005	0.00001	0.011	0.00002	-	-
P8 a	P8 a	N	Perimeter monitoring	1603955	17-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1834620	30-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	BH8 a	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	0.0074	<0.00010	<0.00010	0.00012	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.033	0.015	0.0038	0.00053	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	NR	<0.00010	<0.00010	<0.00010	<0.00010	0.016	<0.00010	0.000	0.00012
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	FTG GW01	N	Refining NZ 2016	504911	16-Jun-16	0.00006	0.00009	-	-	-	0.00015	-	-	-	0.00007	<0.00001	0.00074	0.0015	0.0004	0.00056	0.00005	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005	<0.00005	<0.00005	<0.00001	0.0081	0.00006	-	-
P8 b	P8 b	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	BH8 b	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	0.00062	<0.00010	<0.00010	0.00018	0.00018	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0024	0.0017	0.00097	0.00033	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	NR	<0.00010	<0.00010	<0.00010	<0.00010	0.00077	<0.00010	0.000	0.00018
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 c	FTG GW03	N	Refining NZ 2016	504911	16-Jun-16	<0.00001	0.00033	-	-	-	0.00003	-	-	-	<0.00001	<0.00001	0.0032	0.0027	0.00082	0.00013	0.00010	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005	<0.00005	<0.00005	<0.00001	0.0017	0.00006	-	-
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 c	BH8 c	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	NR	<0.00010	<0.00010	<0.00010	<0.00010	0.0003	<0.00010	0.0001	<0.00010
P9	P9	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9 a	P9 a	P	Perimeter monitoring	1816911	28-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9 a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF1		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF17		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF18		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF20		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF20	PF20	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF21	PF21	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF27		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF29		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF41		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF42		P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF45		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF54		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF56		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF59	PF59	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF6		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						Per- and Polyfluorinated Alkyl Substances (PFAS)																														
						Perfluorobutanesulfonic acid (PFBS)	Perfluorobutanoic acid (PFBA)	di-PFHxS	mono-PFHxS	L-PFHxS	Perfluorohexanesulfonic acid (PFHxS)	di-PFOS	mono-PFOS	L-PFOS	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (PFOSA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl-perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTS)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTS)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTS)	PFHpS	Sum PFHxS+PFOS
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)														0.00000023 b					0.019 b															
	Low reliability values																																		
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)														0.031					1.824															
	Low reliability values																																		
	Drinking Water Standards				Health															0.00056															0.00007
					Aesthetic																															
A3 - temporary well	A3	N/A - foreshore	GHD/GWS 2014	1218298.1	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B1 - temporary well	B1	N/A - foreshore	GHD/GWS 2014	1218298.2	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1 - temporary well	C1	N/A - foreshore	GHD/GWS 2014	1218298.4	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D1 - temporary well	D1	N/A - foreshore	GHD/GWS 2014	1218298.6	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E1 - temporary well	E1	N/A - foreshore	GHD/GWS 2014	1218752.1	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F1 - temporary well	F1	N/A - foreshore	GHD/GWS 2014	1218752.3	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1 - temporary well	G1	N/A - foreshore	GHD/GWS 2014	1218752.5	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 01	GW01	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 02	GW02	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 03	GW03	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	GW04	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	GW05	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 05	GW06	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 06	GW07	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 07	GW08	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 08	GW09	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

						PFAS cont.								Polycyclic Aromatic Hydrocarbons																	
						PFNS	NEtFOSA-M	NMeFOSA-M	NEtFOSE-M	NMeFOSE-M	d5-n-EtFOSAA (surr.) %	13C-PFHxA (surr.) %	13C8-PFOS (surr.) %	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)															0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																														
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)															0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																														
	Drinking Water Standards				Health													0.0007													
					Aesthetic																										
Location	Field ID	Within containment?	Data Source	Lab Report No.	Date																										
CF34	CF34	Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF1-NE	LF1-NE	N	Perimeter monitoring	1314580	19-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2C		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2C	LF2C	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2N2	LF2N2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2NE	LF2NE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LF2SE	LF2SE	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P001	P001	?	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P10		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P11	P11	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1460335	31-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1919841/1937630	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P11 b	P11 b	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1766379	26-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11 b	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P116	P116	?	Perimeter monitoring		No Date	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1429976	20-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1888449	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P13	P13	N	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-

						PFAS cont.								Polycyclic Aromatic Hydrocarbons																	
						PFNS	NEtFOSA-M	NMeFOSA-M	NEtFOSE-M	NMeFOSE-M	d5-n-EtFOSAA (surr.) %	13C-PFHxA (surr.) %	13C8-PFOS (surr.) %	Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b&j]fluoranthene	Benzo[g,h,i]perylene	Benzo[k]fluoranthene	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)															0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																														
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)															0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																														
	Drinking Water Standards				Health													0.0007													
					Aesthetic																										
P13 a		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1368346	23-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13 a	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P14	P14	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1378318	23-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2025814	31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P14 BL	P14 BL	?	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1247311	11-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	1801598/1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P16	P16	N	Perimeter monitoring		5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1802537	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P17	P17	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1494697	28-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1603955	20-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P18	P18	N	Perimeter monitoring	1368346	22-Dec-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1560600	30-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1973686	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	Perimeter monitoring	2074265	31-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P19	P19	P	Perimeter monitoring	1333050	29-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1625296	29-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1993978	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P1b	P1b	P	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1519250	22-Dec-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1b	P1b	P	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	< 0.000008	-	-
P2	P2	P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1303576	23-Jul-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	1902082	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	P2	P	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						PFAS cont.								Polycyclic Aromatic Hydrocarbons																	
						PFNS	NEtFOSA-M	NMeFOSA-M	NEtFOSE-M	NMeFOSE-M	d5-n-EtFOSAA (surr.) %	13C-PFHxA (surr.) %	13C8-PFOS (surr.) %	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(bk)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)															0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																														
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)															0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																														
	Drinking Water Standards				Health													0.0007													
					Aesthetic																										
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P20	P20	Y	Perimeter monitoring	1290129	18-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	Perimeter monitoring	2074265	31-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P3	P3	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	1888326	30-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P3	P3	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	1973686/1974037	30-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	Perimeter monitoring	2169749	30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P4a	P4a	N	Perimeter monitoring	1348963	7-Nov-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1509744	26-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1731881	27-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4a	P4a	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P5	P5	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1494697	23-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1787828	31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1801598	30-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	1993978/1994035	31-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	Perimeter monitoring	2074265	30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P5a	P5a	N	Perimeter monitoring	1333050	30-Sep-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1401329	20-Mar-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	1956498	29-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P6	P6	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1277675	19-May-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1641438	31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	1834620	29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2008304	27-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	Perimeter monitoring	2104516	31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P7	P7	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1378318	27-Jan-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	1852610	29-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	Perimeter monitoring	2091767	30-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P7a	P7a	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1509744	30-Nov-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1659269	30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	1902095	27-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7a	N	Perimeter monitoring	2041344	30-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P7a	P7A	N	September 2019 GME	2239932.4	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P8	P8	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1247311	10-Mar-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1290129	19-Jun-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						PFAS cont.								Polycyclic Aromatic Hydrocarbons																	
						PFNS	NEtFOSA-M	NMeFOSA-M	NEtFOSE-M	NMeFOSE-M	d5-n-EtFOSAA (surr.) %	13C-PFHxA (surr.) %	13C8-PFOS (surr.) %	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)															0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																														
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)															0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																														
	Drinking Water Standards				Health													0.0007													
					Aesthetic																										
P8	P8	N	Perimeter monitoring	1309496	5-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1314580	21-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1419300	28-Apr-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1447364	3-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1460337	22-Jul-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1467358	24-Aug-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1482125	28-Sep-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1544809	26-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1560600	31-Mar-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1577176	29-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1595572	31-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1671121	27-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1699761	16-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1766393	28-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	1870883/1870248	30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring	2163361	16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8	P8	N	Perimeter monitoring		28-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	LF1-SE	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1227609	21-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1236128	10-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1429976	21-May-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1444515	26-Jun-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	FTG GW02	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	55	87	44	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	82	77
P8 a	P8 a	N	Perimeter monitoring	1603955	17-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1751238	31-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	1834620	30-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	P8 a	N	Perimeter monitoring	2059139/2058712	28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	BH8 a	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	<0.00010	0.0002	<0.00010	<0.00010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P8 b	FTG GW01	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	56	119	28	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	71	67
P8 b	P8 b	N	Perimeter monitoring	1919316/1919841	31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	BH8 b	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	<0.00010	0.0002	<0.00010	<0.00010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	0.000018	0.000038	0.000046	0.00006	0.000014	0.00002	< 0.000008	0.000071	0.00001	0.000038	< 0.00004	< 0.000008	0.000114	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1227609	16-Jan-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 BL	P8 BL	?	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P8 c	FTG GW03	N	Refining NZ 2016	504911	16-Jun-16	-	-	-	-	-	52	90	34	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	62	59
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	-	-	-	-	-	-	-	-	< 0.00008 #2	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P8 c	BH8 c	N	T+T PFAS 2019	19-129345	5-Jun-19	<0.00010	<0.00010	0.0002	<0.00010	<0.00010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1236128	11-Feb-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1257728	1-Apr-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1389799	24-Feb-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1528309	22-Jan-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1690894	30-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1711586	20-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	1939711/1937630	28-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	Perimeter monitoring	2113920	23-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P9 a	P9 a	P	Perimeter monitoring	1816911	28-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P9 a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
PF1		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF17		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF18		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF20		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF20	PF20	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF21	PF21	Y	Perimeter monitoring	1314580	20-Aug-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF27		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF29		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF41		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF42		P	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF45		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF54		N	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	-	-	-	-	-	-	-	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.0036	0.000017	< 0.000008	-	-
PF56		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF59	PF59	Y	Perimeter monitoring	1816937	27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PF6		Y	GHD/GWS 2014		2-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

						PFAS cont.								Polycyclic Aromatic Hydrocarbons																	
						PFNS	NEtFOSA-M	NMeFOSA-M	NEtFOSE-M	NMeFOSE-M	d5-n-EtFOSAA (surr.) %	13C-PFHxA (surr.) %	13C8-PFOS (surr.) %	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water under pNRP)															0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																														
	ANZECC 2000 80% marine (applicable within 50 m of the source under pNRP)															0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																														
	Drinking Water Standards				Health													0.0007													
					Aesthetic																										
A3 - temporary well	A3	N/A - foreshore	GHD/GWS 2014	1218298.1	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B1 - temporary well	B1	N/A - foreshore	GHD/GWS 2014	1218298.2	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1 - temporary well	C1	N/A - foreshore	GHD/GWS 2014	1218298.4	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D1 - temporary well	D1	N/A - foreshore	GHD/GWS 2014	1218298.6	18-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E1 - temporary well	E1	N/A - foreshore	GHD/GWS 2014	1218752.1	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F1 - temporary well	F1	N/A - foreshore	GHD/GWS 2014	1218752.3	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G1 - temporary well	G1	N/A - foreshore	GHD/GWS 2014	1218752.5	19-Dec-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 01	GW01	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 02	GW02	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 03	GW03	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	GW04	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 04	GW05	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 05	GW06	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 06	GW07	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 07	GW08	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beach 08	GW09	N/A - foreshore	Nov 2019 sampling	2271800	7-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

Appendix C: T+T 2019a PFAS Sampling Report

Tonkin+Taylor

Job No: 1009695.2000
11 July 2019

Refining New Zealand
by email: Riaan.Elliot@refiningnz.com

Attention: Riaan Elliot

Dear Riaan

Refining New Zealand PFAS Groundwater Preliminary Assessment

1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Refining New Zealand (Refining NZ, the client) to undertake groundwater and surface water sampling at the Fire Fighting Training Area at the Marsden Point Refinery.

It is understood that the results of this sampling will contribute to the Assessment of Environmental Effects (AEE) relating to the discharge of groundwater and surface water from this area on downgradient receptors.

This investigation was undertaken in accordance with our proposal dated 21 May 2019.

2 Sampling Procedures

2.1 Groundwater Sampling

Groundwater sampling was undertaken by T+T on 5 June 2019 and was undertaken following "clean hands"/"dirty hands" protocols in general accordance with the Ministry for the Environment (MfE) (2018) *Sampling and Analysis of Per and Poly-fluorinated Substances* Draft Guideline. Refer to **Figure 1**, **Appendix A** for well locations.

The following procedures were followed during groundwater sampling:

- To minimise cross contamination, the groundwater samples were obtained prior to the collection of the surface water sample. Groundwater samples were obtained from least likely to be contaminated to the most contaminated well, assumed to be in the following order:
  1 GW03/BH8c;
  2 GW01/BH8b;
  3 GW02/BH8a;
- The wells were purged using a peristaltic pump following low-flow procedures. Water quality measurements (temperature, conductivity, pH, dissolved oxygen and turbidity) were measured during purging and samples were obtained once field parameters had stabilised and at least three sample train volumes had been removed from the monitoring wells;
- Samples were collected directly into laboratory prepared bottles, and were double bagged prior to being placed into a laboratory supplied chilly bin;

Tonkin & Taylor Ltd | Harbour Tower, Level 4, 2 Hunter Street, Wellington 6011, New Zealand | PO Box 2083, Wellington 6140
P +64-4-381 8560 F +64-9-307 0265 E wlg@tonkintaylor.co.nz

- The dip meter, YSI ProDSS and flow through cell were decontaminated between sample locations using Type 1 rinsate water and Decon 90;
- All samples were submitted to AsureQuality for the PFAS suite analysis. Note that samples were originally submitted for ultra-trace (parts per trillion) analysis, however, due to the high analyte concentrations present this level of reporting was unable to be achieved by the laboratory. Consequently, for some of the criteria, the laboratory level of reporting for total PFOS and the sum of total PFOS & PFHxS is higher than relevant criteria (see **Section 3.1** and **3.2**).

2.2 Surface Water Sampling

The surface water sample was obtained from the open stormwater drain to the west of the fire training area (refer to **Figure 1**, **Appendix A**) using a grab sampler. The sample was collected mid-stream without disturbing sediment. The water sample was collected into an unpreserved triple-rinsed laboratory supplied bottle before being transferred into laboratory supplied PFAS sampling bottles.

Water quality measurements (including temperature, conductivity, pH, dissolved oxygen and turbidity) were obtained subsequent to the surface water sample being collected.

2.3 Data Quality

A quality assurance and quality control (QA/QC) programme was implemented as part of field procedures, which included:

- Decontaminating sampling equipment between sample locations;
- Transportation of samples with accompanying Chain of Custody documentation;
- Compliance with laboratory holding times;
- Collection of the following QA/QC samples:
  - One duplicate sample from BH8a;
  - One rinsate sample obtained following decontamination of the dip meter;
  - One field blank sample.

The duplicate sample results correlated well with the primary sample results with all relative percentage differences being less than 10%.

Additional samples for QA/QC were obtained during the sampling event and were held at the laboratory pending a review of the initial results.

Both blank samples recorded analyte concentrations below the laboratory level of detection.

3 Results

3.1 Evaluation Criteria

Section C.6.8.2 3) of Northland Regional Council's (NRC) Proposed Regional Plan[1] states that:

> *"in groundwater the concentration of a contaminant at the property boundary or within 50 horizontal metres of the contaminant source (whichever is less), does not exceed:*

[1] NRC 2019. Proposed Regional Plan for Northland Decisions Version – 4 May 2019.

> *a) the relevant contaminant concentrations in the Drinking Water Standards for New Zealand 2005 (revised 2008), and*
>
> *b) the relevant contaminant concentrations measured as dissolved concentrations in Table 3.4.1 in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 (ANZECC 2000) at the level of 80 percent protection of species, except for benzene which is to be applied at a level of 1 milligram per litre (95 percent protection of species)."*

Therefore, the analytical results have been compared to the Australian Department of Health (2017) *Health based guidance values for PFAS for use in site investigations in Australia* (accepted by the Ministry of Health in 2017 as interim guidance levels) and the Draft Australian and New Zealand Water Quality Guidelines (ANZG) reported in MfE (2019) *PFAS investigation, response and funding guidance*.

Section C.6.8.2 4) of the NRC Proposed Regional Plan states that:

> *"in surface water, the concentration of a contaminant, at the property boundary or within 50 horizontal metres of the contaminant source (whichever is less), or immediately adjacent to any surface water or coastal water, does not exceed the relevant contaminant concentrations measured as dissolved concentrations in Table 3.4.1 in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 (ANZECC 2000) at the level of 95 percent protection of species"*

For comparative purposes, the analytical results for groundwater and surface water (collected from the stormwater drain) have been compared to the Draft ANZG at the 99% level of protection (recommended for slightly to moderately disturbed ecosystems as PFAS have been shown to bioaccumulate and biomagnify in wildlife).

3.2 Analytical Results

A summary of analytical results from the sampling are presented in **Table 1, Appendix B**, alongside a comparison of the relevant acceptance criteria and 2016 results provided by Refining NZ. Laboratory transcripts are appended in **Appendix C**.

- Groundwater samples BH8a and BH8b collected in 2019 recorded concentrations for the sum of total PFOS and PFHxS above the interim guidance for drinking water. PFOA concentrations complied with all relevant criteria.
- Groundwater sample BH8c and the surface water sample (NZR-SW) did not record PFOS, PFHxS or PFOA compounds above the laboratory level of detection in the 2019 sampling. It is noted that the interim drinking water level for the sum of total PFOS and PFHxS and the 99% interim marine ecological protection value for PFOS are below the laboratory levels of detection achieved.

4 Conclusions

Tonkin & Taylor Ltd (T+T) was engaged by Refining New Zealand to undertake groundwater and surface water sampling at the Fire Fighting Training Area at the Marsden Point Refinery.

Groundwater and surface water sampling was undertaken on 5 June 2019 and was undertaken following "clean hands"/"dirty hands" protocols in general accordance with the MfE (2018) *Sampling and Analysis of Per and Poly-fluorinated Substances* Draft Guideline.

PFAS compounds were detected in two of the three groundwater samples (BH8a and BH8b). The reported concentrations of total PFOS and PFHxS in the samples exceeded the interim drinking water guidelines.

No PFAS compounds were detected above the laboratory level of detection in the groundwater sample from BH8c or the surface water sample.

5 Applicability

This report has been prepared for the exclusive use of our client Refining New Zealand, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on discrete data from boreholes and surface water. The nature and continuity of groundwater away from the sampling locations could vary.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
pp	.....
Melody Robyns	Sarah Schiess
Contaminated Land Consultant	Project Director

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Appendix A: Figures

DRAFT

Refining NZ
Port Marsden Highway, Ruakaka, Northland 0171, Private Bag 9024, Whangarei 0148, New Zealand
Telephone: +64 9 432 5100 Email: corporate@refiningnz.com www.refiningnz.com

Appendix B: Analytical Results

Table 1 - Analytical Results [1]

Sample ID	Interim Guidance Level for Drinking Water [2]	Marine Water Ecological Receptors (80% ecosystem protection) [3]	Marine Water Ecological Receptors (99% ecosystem protection) [4]	BH8a/GW02		BH8b/GW01		BH8c/GW03		NZR-SW/SW01	
Laboratory Reference				-	19-129345-1	-	19-129345-2	-	19-129345-3	-	19-129345-4
Date				16/06/2016	5/06/2019	16/06/2016	5/06/2019	16/06/2016	5/06/2019	15/06/2016	5/06/2019
Analytes											
Total Perfluorohexanesulfonic acid (T-PFHxS)	-	-	-	0.12	0.12	0.15	0.18	0.03	<0.10	<0.01	<0.10
Total Perfluorooctanesulfonic acid (T-PFOS)	-	31	0.00023	*0.02*	<0.10	*0.07*	<0.10	<0.01	<0.10	<0.01	<0.10
Sum of Total PFOS & PFHxS [5]	0.07	-	-	0.14	0.12	0.22	0.18	0.035	<0.10	<0.02	<0.10
Perfluorooctanoic acid (PFOA)	0.56	1,824	19	0.47	0.53	0.56	0.33	0.13	<0.10	0.03	<0.10

Notes:

1. All results in ug/L.
2. Australian Department of Health 2017 as reported in Ministry for the Environment. 2019. *PFAS investigation, response and funding guidance.* Wellington: Ministry for the Environment.
3. Draft ANZG as reported in MfE 2019. Applicable to groundwater based on NRC Proposed Regional Plan.
4. Draft ANZG as reported in MfE 2019. Applicable to surface water and coastal water based on NRC Proposed Regional Plan.
5. Where individual compounds are below the detection limit, a value of half the detection limit has been used.

0.14	Shaded values indicate that the concentration exceeds guidance level for drinking water.
0.02	Italic values indicate that the concentration exceeds 99% ecosystem protection level.

Appendix C: Laboratory Transcripts

AsureQuality Limited | 1C Quadrant Drive | Waiwhetu | Lower Hutt 5010 | Wellington | New Zealand
PO Box 31242 | Lower Hutt 5040 | Wellington | New Zealand
t. +64 4 570 8800 | e. cswellington@asurequality.com | w. www.asurequality.com
Global Experts in Food Assurance

Certificate of Analysis

Submission Reference: 1009695-2000
Amended Report

Melody Robyns
Tonkin & Taylor Ltd - Auckland
PO Box 5271
Auckland 1141
New Zealand

Report Issued: 10-Jul-2019 **AsureQuality Reference: 19-129345** **Sample(s) Received:** 07-Jun-2019 08:00

Temp. on Receipt: 14.5 °C

Comments

Amended Report: Unrelated QC results removed.

Results

The tests were performed on the samples as received.

Customer Sample Name: BH8a **Lab ID:** 19-129345-1

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	7.4	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	33	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	15	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	3.8	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	0.53	µg/L	AsureQuality Method (LC-MS/MS)

AsureQuality has used reasonable skill, care, and effort to provide an accurate analysis of the sample(s) which form(s) the subject of this report. However, the accuracy of this analysis is reliant on, and subject to, the sample(s) provided by you and your responsibility as to transportation of the sample(s). AsureQuality's standard terms of business apply to the analysis set out in this report.

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	16	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	59	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	59	%	AsureQuality Method (LC-MS/MS)
M8PFOS	56	%	AsureQuality Method (LC-MS/MS)
M4PFBA	80	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	65	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	55	%	AsureQuality Method (LC-MS/MS)
MPFHpA	56	%	AsureQuality Method (LC-MS/MS)
M8PFOA	57	%	AsureQuality Method (LC-MS/MS)
M9PFNA	60	%	AsureQuality Method (LC-MS/MS)
M6PFDA	58	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	63	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	57	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	26 (R)	%	AsureQuality Method (LC-MS/MS)
MPFOSA	59	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	56	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	57	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	57	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	59	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	61	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	59	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	56	%	AsureQuality Method (LC-MS/MS)

R = Recovery outside method limits

Customer Sample Name: BH8b **Lab ID:** 19-129345-2

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference

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Report Number 1550645 cancels Report Number 1532984.

Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level

Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	0.18	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	0.18	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	0.18	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	0.62	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	2.4	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	1.7	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	0.97	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	0.33	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	0.77	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	60	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	62	%	AsureQuality Method (LC-MS/MS)
M8PFOS	58	%	AsureQuality Method (LC-MS/MS)
M4PFBA	78	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	67	%	AsureQuality Method (LC-MS/MS)

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Test	Result	Unit	Method Reference
M5PFHxA	61	%	AsureQuality Method (LC-MS/MS)
MPFHpA	59	%	AsureQuality Method (LC-MS/MS)
M8PFOA	62	%	AsureQuality Method (LC-MS/MS)
M9PFNA	67	%	AsureQuality Method (LC-MS/MS)
M6PFDA	61	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	60	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	57	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	37	%	AsureQuality Method (LC-MS/MS)
MPFOSA	62	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	55	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	56	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	62	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	61	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	60	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	59	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	60	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	59	%	AsureQuality Method (LC-MS/MS)

Customer Sample Name: BH8c **Lab ID:** 19-129345-3

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)

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Test	Result	Unit	Method Reference
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	0.30	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	60	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	60	%	AsureQuality Method (LC-MS/MS)
M8PFOS	59	%	AsureQuality Method (LC-MS/MS)
M4PFBA	80	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	68	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	60	%	AsureQuality Method (LC-MS/MS)
MPFHpA	59	%	AsureQuality Method (LC-MS/MS)
M8PFOA	64	%	AsureQuality Method (LC-MS/MS)
M9PFNA	67	%	AsureQuality Method (LC-MS/MS)
M6PFDA	61	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	61	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	60	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	53	%	AsureQuality Method (LC-MS/MS)
MPFOSA	62	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	56	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	58	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	62	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	62	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	61	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	60	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	61	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	56	%	AsureQuality Method (LC-MS/MS)

Customer Sample Name: NZR-SW **Lab ID:** 19-129345-4

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)

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Test	Result	Unit	Method Reference
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	59	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	60	%	AsureQuality Method (LC-MS/MS)
M8PFOS	55	%	AsureQuality Method (LC-MS/MS)
M4PFBA	78	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	65	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	56	%	AsureQuality Method (LC-MS/MS)
MPFHpA	58	%	AsureQuality Method (LC-MS/MS)
M8PFOA	59	%	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
M9PFNA	65	%	AsureQuality Method (LC-MS/MS)
M6PFDA	59	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	60	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	57	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	36	%	AsureQuality Method (LC-MS/MS)
MPFOSA	60	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	54	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	55	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	59	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	61	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	55	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	58	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	58	%	AsureQuality Method (LC-MS/MS)

Customer Sample Name: Dipmeter **Lab ID:** 19-129345-5

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	58	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	62	%	AsureQuality Method (LC-MS/MS)
M8PFOS	57	%	AsureQuality Method (LC-MS/MS)
M4PFBA	79	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	65	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	58	%	AsureQuality Method (LC-MS/MS)
MPFHpA	56	%	AsureQuality Method (LC-MS/MS)
M8PFOA	59	%	AsureQuality Method (LC-MS/MS)
M9PFNA	63	%	AsureQuality Method (LC-MS/MS)
M6PFDA	60	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	62	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	54	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	28 (R)	%	AsureQuality Method (LC-MS/MS)
MPFOSA	59	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	53	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	54	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	58	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	58	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	56	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	57	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	56	%	AsureQuality Method (LC-MS/MS)

R = Recovery outside method limits

Customer Sample Name: Field blank **Lab ID:** 19-129345-6

Sample Condition: Acceptable **Sampled Date**: 05-Jun-2019

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	59	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	60	%	AsureQuality Method (LC-MS/MS)
M8PFOS	58	%	AsureQuality Method (LC-MS/MS)
M4PFBA	80	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	68	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	59	%	AsureQuality Method (LC-MS/MS)
MPFHpA	58	%	AsureQuality Method (LC-MS/MS)
M8PFOA	57	%	AsureQuality Method (LC-MS/MS)
M9PFNA	61	%	AsureQuality Method (LC-MS/MS)
M6PFDA	60	%	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
M7PFUnDA	64	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	56	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	28 (R)	%	AsureQuality Method (LC-MS/MS)
MPFOSA	60	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	57	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	56	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	61	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	59	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	60	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	59	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	56	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	59	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	57	%	AsureQuality Method (LC-MS/MS)

R = Recovery outside method limits

Customer Sample Name: Duplicate of 19-129345-1 **Lab ID:** 19-129345-7

Sample Description: BH8a duplicate

Sample Condition: Acceptable

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	0.12	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	7.3	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	33	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	15	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	4.0	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	0.55	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	15	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	58	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	60	%	AsureQuality Method (LC-MS/MS)
M8PFOS	57	%	AsureQuality Method (LC-MS/MS)
M4PFBA	77	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	62	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	56	%	AsureQuality Method (LC-MS/MS)
MPFHpA	55	%	AsureQuality Method (LC-MS/MS)
M8PFOA	55	%	AsureQuality Method (LC-MS/MS)
M9PFNA	61	%	AsureQuality Method (LC-MS/MS)
M6PFDA	61	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	59	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	58	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	37	%	AsureQuality Method (LC-MS/MS)
MPFOSA	59	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	55	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	56	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	59	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	60	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	58	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	58	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	56	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	59	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	52	%	AsureQuality Method (LC-MS/MS)

QC Results

Blank

Relates to sample(s) 19-129345-1, 19-129345-2, 19-129345-3, 19-129345-4, 19-129345-5, 19-129345-6, 19-129345-7

Test	Result	Unit	Method Reference
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
Perfluoroalkylsulfonic acids			
PFPrS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFBS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
di-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFHxS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFHxS (3)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
di-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
mono-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
L-PFOS (5)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Total PFOS (7)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Sum PFHxS+PFOS (1)	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluoroalkylcarboxylic acids			
PFBA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFPeA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHxA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFHpA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFOA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFNA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFUnDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFDoDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTrDA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
PFTeDA	NR	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamides			
PFOSA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NEtFOSA-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSA-M	<0.20	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoacetic acids			
NEtFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSAA	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Perfluorooctanesulfonamidoethanols			
NEtFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
NMeFOSE-M	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Telomere Sulfonic acids			
4:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
6:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
8:2 FTS	<0.10	µg/L	AsureQuality Method (LC-MS/MS)
Internal Standards			
M3PFBS	108	%	AsureQuality Method (LC-MS/MS)
M3PFHxS	109	%	AsureQuality Method (LC-MS/MS)
M8PFOS	106	%	AsureQuality Method (LC-MS/MS)
M4PFBA	96	%	AsureQuality Method (LC-MS/MS)
M5PFPeA	104	%	AsureQuality Method (LC-MS/MS)
M5PFHxA	108	%	AsureQuality Method (LC-MS/MS)

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Report Number 1550645 cancels Report Number 1532984.

Test	Result	Unit	Method Reference
MPFHpA	107	%	AsureQuality Method (LC-MS/MS)
M8PFOA	110	%	AsureQuality Method (LC-MS/MS)
M9PFNA	120	%	AsureQuality Method (LC-MS/MS)
M6PFDA	110	%	AsureQuality Method (LC-MS/MS)
M7PFUnDA	111	%	AsureQuality Method (LC-MS/MS)
MPFDoDA	108	%	AsureQuality Method (LC-MS/MS)
MPFTeDA	109	%	AsureQuality Method (LC-MS/MS)
MPFOSA	108	%	AsureQuality Method (LC-MS/MS)
DNEtFOSA	105	%	AsureQuality Method (LC-MS/MS)
DNMeFOSA	105	%	AsureQuality Method (LC-MS/MS)
DNEtFOSAA	110	%	AsureQuality Method (LC-MS/MS)
DNMeFOSAA	106	%	AsureQuality Method (LC-MS/MS)
DNEtFOSE	111	%	AsureQuality Method (LC-MS/MS)
DNMeFOSE	112	%	AsureQuality Method (LC-MS/MS)
M4:2FTS	104	%	AsureQuality Method (LC-MS/MS)
M6:2FTS	105	%	AsureQuality Method (LC-MS/MS)
M8:2FTS	105	%	AsureQuality Method (LC-MS/MS)

Analysis Summary

Wellington Laboratory

Analysis	Method	Accreditation	Authorised by
Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level			
DX-PFCS01, 05-HIGHLEVEL	AsureQuality Method (LC-MS/MS)	IANZ	Amelie Sellier

di-PFHxS (1) = Concentration determined using a branched di-PFHxS isomer standard (399>80 transition)

mono-PFHxS (1) = Concentration determined using a branched mono-PFHxS isomer standard (399>80 transition)

L-PFHxS (1) = Concentration determined using the linear PFHxS isomer standard (399>80 transition)

Total PFHxS (3) = The numerical sum of di-PFHxS (1), mono-PFHxS (1), and L-PFHxS (1)

di-PFOS (5) = Concentration determined using a branched di-PFOS isomer standard (499>80 transition)

mono-PFOS (5) = Concentration determined using a branched mono-PFOS isomer standard (499>80 transition)

L-PFOS (5) = Concentration determined using the linear PFOS isomer standard (499>230 transition)

Total PFOS (7) = The numerical sum of di-PFOS (5), mono-PFOS (5), and L-PFOS (5)

Sum PFHxS+PFOS (1) = The numerical sum of Total PFHxS (3) and Total PFOS (7)

For all Totals, where a component is detected below the LOR, the value of zero is used in the calculation of the sum. The result represents the lower-bound concentration present in the sample.

Reported results are corrected for internal standard recovery

Results that are prefixed with '<' indicate the lowest level at which the analyte can be reported, and that in this case the analyte was not observed above this limit.

NR = Not Reportable

Amelie Sellier

Scientist

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Report Number 1550645 cancels Report Number 1532984.

Accreditation

Appendix

Analyte LOR Summary

Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level - AsureQuality Method (LC-MS/MS)

Analyte	LOR
Perfluoroalkylsulfonic acids	
PFPrS	0.10 µg/L
PFBS	0.10 µg/L
PFPeS	0.10 µg/L
di-PFHxS (1)	0.10 µg/L
mono-PFHxS (1)	0.10 µg/L
L-PFHxS (1)	0.10 µg/L
Total PFHxS (3)	0.10 µg/L
PFHpS	0.10 µg/L
di-PFOS (5)	0.10 µg/L
mono-PFOS (5)	0.10 µg/L
L-PFOS (5)	0.10 µg/L
Total PFOS (7)	0.10 µg/L
Sum PFHxS+PFOS (1)	0.10 µg/L
PFNS	0.10 µg/L
PFDS	0.10 µg/L
Perfluoroalkylcarboxylic acids	
PFBA	0.10 µg/L
PFPeA	0.10 µg/L
PFHxA	0.10 µg/L
PFHpA	0.10 µg/L
PFOA	0.10 µg/L
PFNA	0.10 µg/L
PFDA	0.10 µg/L
PFUnDA	0.10 µg/L
PFDoDA	0.10 µg/L
PFTrDA	0.10 µg/L
PFTeDA	NR µg/L
Perfluorooctanesulfonamides	
PFOSA	0.10 µg/L
NEtFOSA-M	0.10 µg/L
NMeFOSA-M	0.10 µg/L
Perfluorooctanesulfonamidoacetic acids	
NEtFOSAA	0.10 µg/L
NMeFOSAA	0.10 µg/L
Perfluorooctanesulfonamidoethanols	
NEtFOSE-M	0.10 µg/L
NMeFOSE-M	0.10 µg/L
Telomere Sulfonic acids	
4:2 FTS	0.10 µg/L
6:2 FTS	0.10 µg/L
8:2 FTS	0.10 µg/L

Analyte Definitions

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Poly- and Perfluorinated Alkyl Substances (PFAS) in Water - High Level - AsureQuality Method (LC-MS/MS)

Analyte	Full Name
Perfluoroalkylsulfonic acids	
PFPrS	Perfluoro-1-propanesulfonic acid
PFBS	Perfluoro-1-butanesulfonic acid
PFPeS	Perfluoro-1-pentanesulfonic acid
di-PFHxS (1)	Total Perfluorodimethylbutane sulfonic acids
mono-PFHxS (1)	Total Perfluoromethylpentane sulfonic acids
L-PFHxS (1)	Linear Perfluorohexanesulfonic acid
PFHpS	Perfluoro-1-heptanesulfonic acid
di-PFOS (5)	Total Perfluorodimethylhexane sulfonic acids
mono-PFOS (5)	Total Perfluoromethylheptane sulfonic acids
L-PFOS (5)	Linear Perfluorooctanesulfonic acid
PFNS	Perfluoro-1-nonanesulfonic acid
PFDS	Perfluoro-1-decanesulfonic acid
Perfluoroalkylcarboxylic acids	
PFBA	Perfluoro-n-butanoic acid
PFPeA	Perfluoro-n-pentanoic acid
PFHxA	Perfluoro-n-hexanoic acid
PFHpA	Perfluoro-n-heptanoic acid
PFOA	Perfluoro-n-octanoic acid
PFNA	Perfluoro-n-nonanoic acid
PFDA	Perfluoro-n-decanoic acid
PFUnDA	Perfluoro-n-undecanoic acid
PFDoDA	Perfluoro-n-dodecanoic acid
PFTrDA	Perfluoro-n-tridecanoic acid
PFTeDA	Perfluoro-n-tetradecanoic acid
Perfluorooctanesulfonamides	
PFOSA	Perfluoro-1-octanesulfonamide
NEtFOSA-M	N-ethylperfluoro-1-octanesulfonamide
NMeFOSA-M	N-methylperfluoro-1-octanesulfonamide
Perfluorooctanesulfonamidoacetic acids	
NEtFOSAA	N-ethylperfluoro-1-octanesulfonamidoacetic acid
NMeFOSAA	N-methylperfluoro-1-octanesulfonamidoacetic acid
Perfluorooctanesulfonamidoethanols	
NEtFOSE-M	2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol
NMeFOSE-M	2-(N-methylperfluoro-1-octanesulfonamido)-ethanol
Telomere Sulfonic acids	
4:2 FTS	1H,1H,2H,2H-perfluoro-1-hexanesulfonic acid
6:2 FTS	1H,1H,2H,2H-perfluoro-1-octanesulfonic acid
8:2 FTS	1H,1H,2H,2H-perfluoro-1-decanesulfonic acid
Internal Standards	
M3PFBS	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid
M3PFHxS	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid
M8PFOS	Perfluoro-1-[13C8]octanesulfonic acid
M4PFBA	Perfluoro-n-[1,2,3,4-13C4]butanoic acid
M5PFPeA	Perfluoro-n-[1,2,3,4,5-13C5]pentanoic acid
M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid
MPFHpA	Perfluoro-n-[-1,2,3,4-13C4]heptanoic acid
M8PFOA	Perfluoro-n-[13C8]octanoic acid
M9PFNA	Perfluoro-n-[13C9]nonanoic acid
M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid
M7PFUnDA	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid
MPFDoDA	Perfluoro-n-[1,2-13C2]dodecanoic acid

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Analyte	Full Name
MPFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid
MPFOSA	Perfluoro-1-[13C8]octanesulfonamide
DNEtFOSA	N-ethyl-D5-perfluoro-1-octanesulfonamide
DNMeFOSA	N-methyl-D3-perfluoro-1-octanesulfonamide
DNEtFOSAA	N-ethyl-D5-perfluoro-1-octanesulfonamidoacetic acid
DNMeFOSAA	N-methyl-D3-perfluoro-1-octanesulfonamidoacetic acid
DNEtFOSE	2-(N-ethyl-D5-perfluoro-1-octanesulfonamido)ethan-D4-ol
DNMeFOSE	2-(N-methyl-D3-perfluoro-1-octanesulfonamido)ethan-D4-ol
M4:2FTS	1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-hexane sulfonic acid
M6:2FTS	1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-octane sulfonic acid
M8:2FTS	1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-decane sulfonic acid

LOR = Limit of Reporting LOD = Limit of Detection NR = Not Reportable

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Appendix D: T+T 2019b September 2019 GME Report

Tonkin+Taylor

Job No: 1009695.2000
9 October 2019

Refining New Zealand
by email: Riaan.Elliot@refiningnz.com

Attention: Riaan Elliot

Dear Riaan

Marsden Point Refinery September 2019 Groundwater Monitoring Event

1 Introduction

Tonkin & Taylor Ltd (T+T) was engaged by Refining New Zealand (Refining NZ, the client) to undertake a groundwater monitoring event (GME) of the perimeter wells and PF54 at the Marsden Point Refinery. The purpose of the GME was to collect further information to reduce the data gaps identified during preparation of the draft hydrogeological conceptual site model (HCM) report.

This investigation was undertaken in accordance with our proposal dated 21 May 2019 and subsequent variation dated 30 August 2019.

2 Methodology

2.1 Groundwater sampling

The GME was undertaken by T+T between 9 and 12 September 2019. A total of 29 wells were sampled. The list of wells sampled in the GME is provided in **Appendix A.** Refer to **Figure 1**, **Appendix B** for well locations.

The following procedures were followed during groundwater sampling:

- The depth to light non-aqueous phase liquid (LNAPL) (if any) and groundwater was gauged prior to sampling using an oil/water interface probe;
- Wells were purged using a peristaltic pump following low-flow procedures. Water quality measurements (temperature, conductivity, pH, dissolved oxygen and turbidity) were measured during purging and samples were obtained once field parameters had stabilised and at least three sample train volumes had been removed;
- Samples were collected directly into laboratory prepared bottles, or field filtered using laboratory provided filter kits where required;
- The interface probe, YSI ProDSS multiparameter water quality meter and flow through cell were decontaminated between sample locations using Type 1 rinsate water and Decon 90; and
- All samples were submitted to Hills Laboratories under chain of custody for analysis. Samples from the perimeter wells were analysed for polycyclic aromatic hydrocarbons (PAH), phenols,

Tonkin & Taylor Ltd | Harbour Tower, Level 4, 2 Hunter Street, Wellington 6011, New Zealand | PO Box 2083, Wellington 6140
P +64-4-381 8560 F +64-9-307 0265 E wlg@tonkintaylor.co.nz

dissolved metals[1] (field filtered) and nitrogen species[2]. The sample from PF54 was analysed for total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX), dissolved metals and nitrogen species.

Groundwater samples were not collected from well P3 (removed from the sampling plan at Refining NZ's request due to logistical constraints) and P8 (as the screen was inferred to be partially blocked by sediment).

2.2 Limited baildown testing

The following work was undertaken for the limited baildown testing:

- The depth to LNAPL and groundwater were gauged for C1-C3 using an interface probe. The baildown test then proceeded at C2;
- LNAPL was removed from the well as quickly as possible using a bailer;
- LNAPL recovery was measured at set time intervals until 80% of original LNAPL thickness had returned to the well;
- Due to the low initial LNAPL thickness in C2 a limited baildown test was also conducted at C1. However, as the well diameter of C1 was 104 mm rather than 50 mm like C2, the bailer was less effective at removing LNAPL for the test; and
- The LNAPL recovered from the testing was stored in a purge container to be later disposed of by Refining NZ.

2.3 Data quality

A quality assurance and quality control (QA/QC) programme was implemented as part of field procedures, which included:

- Decontaminating sampling equipment between sample locations;
- Transportation of samples with accompanying chain of custody documentation;
- Compliance with laboratory holding times; and
- Collection of the following QA/QC samples:
  - Two duplicate samples were collected from BH8a and P1B respectively;
  - Daily rinsate blanks were collected from the interface probe from each sampling team; and
  - One trip blank sample from the day that PF54 was sampled.

The duplicate samples showed good correlation with the majority of results having relative percentage differences (RPDs) being less than 30%. RPDs above 50% were calculated from the dissolved iron, lead and manganese species between samples DUP01 and P1B. The elevated RPDs do not affect the interpretation of the primary results.

Additional samples for QA/QC were obtained during the sampling event and were held at the laboratory pending a review of the initial results. No further analysis was requested of these samples.

Samples from rinsate blanks 7 and 8 returned trace detections of nitrogen species with rinsate 8 also having trace detections of zinc. These trace detections are within the laboratories limit of

[1] Based on the potential contaminants of concern identified in the HCM, the dissolved metals suite is to include arsenic, cadmium, chromium, copper, lead, nickel, zinc, cobalt, vanadium, mercury, manganese and speciated iron.
[2] Nitrite, nitrate, ammonia

uncertainty and are unlikely to have had an effect on other samples collected on the day. It is not uncommon for low detections of zinc to be present in Type 1 water.

The trip blank was prepared at the site at the beginning of the day on 11 September and was kept with the other groundwater samples. Toluene was detected in the trip blank, however, toluene was not detected in the rinsate blank sample Rinsate 6. Based on this, it is unlikely that the detection in the trip blank was a result of toluene contamination in the Type 1 water. Toluene was also not detected in the groundwater sample from PF54.

3 Results

3.1 Field observations

3.1.1 Groundwater sampling

- No LNAPL was detected in the perimeter monitoring wells or PF54;
- Varying degrees of orange-brown precipitate and orange-brown staining were observed during sampling in all of perimeter wells with the exception of wells located in the northern to north-western area of the Refinery; and
- Based on the total depth measured of well P8 and the likely well construction, it is considered likely that the well screen has been partially blocked by sediment. Well P8 was not sampled.

3.1.2 Limited baildown testing

- No LNAPL was detected in C3. C2 and C1 had LNAPL thicknesses measured at 7 cm (0.07 m) and 70.5 cm (0.705 m) respectively; and
- LNAPL was observed to be black with low viscosity. A distinct hydrocarbon odour was noted from the LNAPL and wells C1 and C2.

3.2 Analytical results

A summary of analytical results from the sampling are presented in **Table 1, Appendix B**, alongside a comparison of the relevant acceptance criteria identified in the draft HCM report. Laboratory transcripts are appended in **Appendix C**. The following is noted:

- Concentrations of dissolved iron, manganese, arsenic, cobalt, total chromium (one sample only), copper and zinc exceeded the drinking water guidelines[3] and/or ANZECC Guidelines[4] for 80% and 95% species protection;
- PAHs were detected in groundwater samples from PF54 and P8b, however, concentrations did not exceed the screening criteria;
- BTEX were detected in the sample from PF54. TPH (C_7-C_{36}) was not detected. The reported concentrations of benzene and ethylbenzene are above relevant drinking water guidelines, but do not exceed the ANZECC Guidelines;
- Nitrate concentrations above adopted ecological screening criteria for 95% and/or 80% species protection were detected in approximately half of the groundwater samples tested. Nitrate concentrations at above relevant drinking water guidelines were detected in samples from perimeter monitoring wells P14 and P16 respectively; and
- Phenols were not detected in the groundwater samples from the perimeter wells (and are therefore not shown in Table 1).

[3] Ministry of Health. 2018. Drinking-water Standards for New Zealand 2005 (revised 2018). Wellington: Ministry of Health
[4] Australian and New Zealand Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia (ARMCANZ). 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Further discussion of the results in the context of the HCM will be provided in the upcoming revision of the HCM report.

3.3 Limited baildown testing

The findings from the limited baildown testing are summarised in the below table. The in-well LNAPL thickness recovered to 80% of the pre-test thickness within 5 minutes for well C1 and within 20 minutes for well C2. The results for C1 suggest that insufficient LNAPL was able to be removed from the filter pack during bailing, which was due to the larger diameter well. The results for C2 indicate that the LNAPL could be mobile which is consistent with historical testing by RNZ, however, given the relatively large bore diameter (~300 mm for a 50 mm casing) it is also possible that the limited baildown test was not able to fully purge LNAPL from the filter pack before starting recovery measurements. Irrespective of this, insufficient LNAPL thickness was present in well C2 to calculate LNAPL transmissivity from the baildown test.

Well	Initial LNAPL thickness (m)	LNAPL volume removed (L)	Time elapsed for 80% recovery (min)
C1	0.705	2.0	5
C2	0.07	0.05	20

4 Recommendations for well network maintenance

Based on the GME, we have the following recommendations:

- Monitoring well P8 should be redeveloped using a downhole or aboveground pump to remove sediment from the bottom of the well and well screen; and
- Water purged from groundwater wells during routine sampling should be disposed of into the onsite stormwater treatment system (or similar treatment), not to ground.

5 Conclusions

T+T has completed a GME of 28 perimeter wells and PF54 at the Marsden Point Refinery. Groundwater sampling was undertaken between 9 and 12 September 2019 using low-flow sampling techniques. The analytical results show concentrations of various dissolved metals and nitrate above the ANZECC Guidelines in the perimeter wells. Organic compounds were not detected in the groundwater samples, except for BTEX and PAH in PF54 and PAH in P8b. The reported concentrations of BTEX and PAH do not exceed the ANZECC Guidelines.

Further discussion of the results from this GME in the context of the HCM will be provided in the upcoming revision of the HCM report.

6 Applicability

This report has been prepared for the exclusive use of our client Refining New Zealand, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on discrete data from boreholes. The nature and continuity of groundwater away from the sampling locations could vary.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

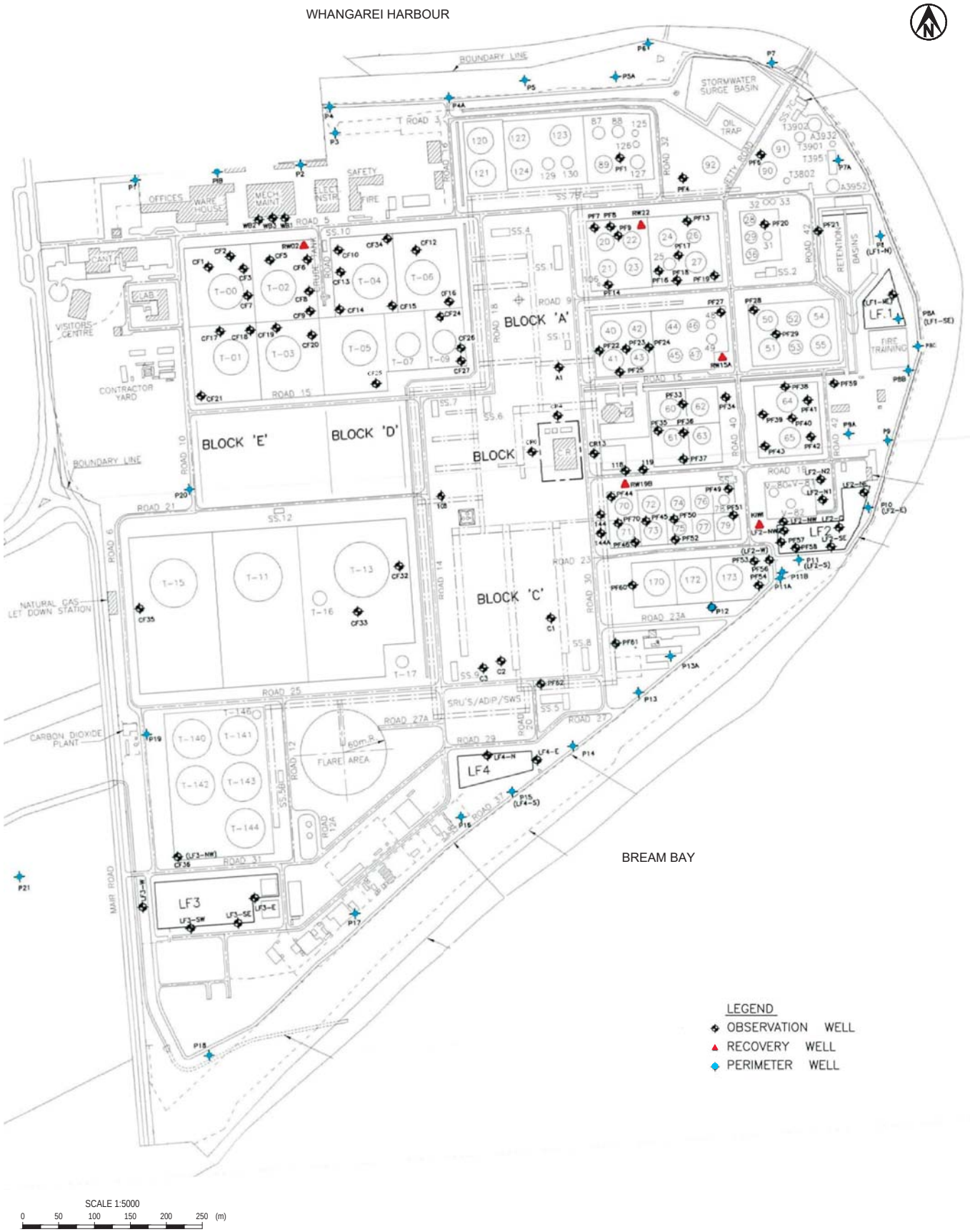
Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Xiao Jin Contaminated Land Consultant	Sarah Schiess Project Director

XIJI
\\ttgroup.local\corporate\christchurch\tt projects\1009695\1009695.2000\4000 groundwater monitoring\issueddocuments\20191009_gme letter.docx

Appendix A: List of wells sampled

#	Well	Notes
1	P1	
2	P10	
3	P11	
4	P11 b	
5	P12	
6	P13	
7	P13 a	
8	P14	
9	P15	
10	P16	
11	P17	
12	P18	
13	P19	
14	P1b	
15	P2	
16	P20	
17	P3	Not sampled – logistical constraints
18	P4	
19	P4a	
20	P5	
21	P5a	
22	P6	
23	P7	
24	P7a	
25	P8	Not sampled – screen inferred to be partially blocked
26	P8 a	
27	P8 b	
28	P8 c	
29	P9	
30	P9 a	
31	P54	

Appendix B: Figures



Base plan supplied by GWS, July 2019.

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L:\1009695\1009695.2000\WorkingMaterial\CAD\FIG\1009695.2000-F2.dwg 2019-Aug-29 12:52:48 PM Plotted By: ROSEMARY SUTTON

Tonkin+Taylor

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PROJECT No.	1009695.2000	
DESIGNED	NOR	Aug.19
DRAWN	RBS	Aug.19
CHECKED		
APPROVED		DATE

CLIENT **NEW ZEALAND REFINING COMPANY LIMITED**

PROJECT **REFINING NZ RE-CONSENTING**

TITLE MARSDEN POINT, WHANGAREI
Monitoring Well Location Plan

SCALE (A3) 1:5000 FIG No. Figure 1 REV 1

Appendix C: Analytical Results

Tonkin+Taylor

Table 1: September 2019 Groundwater Results

							Total Metals	Dissolved Metals												BTEX					
							Iron (T)	Cobalt (F)	Iron (F)	Manganese (F)	Mercury (F)	Tin (F)	Vanadium (F)	Arsenic (F)	Cadmium (F)	Chromium (F)	Copper (F)	Lead (F)	Nickel (F)	Zinc (F)	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	Total Xylene
Guidelines	ANZECC 2000 95% marine (applicable for surface water)							0.001			0.0004				0.0055	0.0044	0.0013	0.0044	0.07	0.015	0.7					
	Low reliability values						0.3		0.3	0.08		0.01		0.0023								0.18	0.005	0.075	0.35	
	ANZECC 2000 80% marine (applicable within 50 m of the source under NRP)							0.15			0.0014				0.036	0.085	0.008	0.012	0.56	0.043	0.7 c					
	Low reliability values						0.3		0.3	0.08		0.01		0.0023								0.33	0.005	0.15	0.64	
	Drinking Water Standards					Health				0.4	0.007			0.01	0.004	0.05	2	0.01	0.08		0.01	0.8	0.3			0.6
						Aesthetic	0.2		0.2	0.04							1			1.5		0.03	0.002			0.02
Location	Field ID	Within	Data Source	Lab Report No.	Date																					
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19		2.70	< 0.0002	0.05	0.0052	< 0.00008	-	< 0.0010	0.001	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0023	-	-	-	-	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19		0.081	< 0.0002	< 0.02	0.0011	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0014	0.0022	< 0.00010	0.003	0.0084	-	-	-	-	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19		1.55	0.0008	1.05	0.036	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0034	-	-	-	-	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19		< 0.021	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0029	-	-	-	-	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19		0.24	< 0.0002	< 0.02	0.0072	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.27	-	-	-	-	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19		0.25	< 0.0002	0.03	0.0029	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	< 0.0005	< 0.00010	< 0.0005	0.0023	-	-	-	-	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19		1.78	< 0.0002	0.12	0.0116	< 0.00008	-	< 0.0010	0.005	< 0.00005	0.0016	< 0.0005	0.00028	< 0.0005	0.0017	-	-	-	-	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19		0.073	< 0.0002	< 0.02	0.0064	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	< 0.0005	< 0.00010	< 0.0005	0.002	-	-	-	-	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19		0.21	< 0.0002	0.05	0.0008	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	< 0.0005	0.00012	< 0.0005	0.0039	-	-	-	-	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19		3	< 0.0002	0.21	0.026	< 0.00008	-	< 0.0010	0.001	< 0.00005	0.0007	< 0.0005	< 0.00010	< 0.0005	0.0026	-	-	-	-	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19		1.36	< 0.0002	0.16	0.0007	< 0.00008	-	0.0016	0.0026	< 0.00005	0.0046	< 0.0005	< 0.00010	< 0.0005	< 0.0010	-	-	-	-	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19		1.46	0.0027	0.33	0.6	< 0.00008	-	< 0.0010	< 0.0010	0.0001	< 0.0005	0.0021	< 0.00010	0.0045	0.039	-	-	-	-	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19		5.6	0.0004	0.29	0.0125	< 0.00008	-	< 0.0010	0.0019	< 0.00005	0.002	0.001	< 0.00010	< 0.0005	0.0056	-	-	-	-	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19		1.35	< 0.0002	0.14	0.0084	< 0.00008	-	< 0.0010	< 0.0010	0.00022	0.0014	0.001	0.00011	< 0.0005	0.008	-	-	-	-	-	-
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19		0.073	< 0.0002	< 0.02	0.0017	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	0.0031	0.00034	0.0008	0.029	-	-	-	-	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19		1.02	< 0.0002	0.07	0.032	< 0.00008	-	< 0.0010	< 0.0010	0.00028	0.0016	0.0005	0.0003	0.0008	0.091	-	-	-	-	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19		0.82	< 0.0002	< 0.02	0.027	< 0.00008	-	< 0.0010	0.0015	< 0.00005	0.0005	< 0.0005	< 0.00010	< 0.0005	0.0022	-	-	-	-	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19		0.29	< 0.0002	0.05	0.029	< 0.00008	-	< 0.0010	0.0012	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0057	-	-	-	-	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19		0.24	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0019	0.0038	< 0.00005	< 0.0005	0.0006	< 0.00010	< 0.0005	< 0.0010	-	-	-	-	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19		0.177	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0025	0.0027	< 0.00005	< 0.0005	0.0008	< 0.00010	< 0.0005	0.0103	-	-	-	-	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19		0.24	< 0.0002	< 0.02	< 0.0005	< 0.00008	-	0.0016	< 0.0010	< 0.00005	< 0.0005	< 0.0005	< 0.00010	< 0.0005	0.0014	-	-	-	-	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19		0.044	< 0.0002	< 0.02	0.0007	< 0.00008	-	0.0017	0.0019	< 0.00005	0.0006	0.0006	0.00019	0.0006	0.012	-	-	-	-	-	-
P7A	P7A	N	September 2019 GME	2239932.4	10-Sep-19		0.055	< 0.0002	0.03	0.0015	< 0.00008	-	0.0021	0.001	< 0.00005	0.0008	0.0009	0.00014	< 0.0005	0.0115	-	-	-	-	-	-
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19		0.29	0.0003	< 0.02	0.034	< 0.00008	-	0.0011	< 0.0010	0.00052	0.0008	0.026	< 0.00010	0.0176	0.38	-	-	-	-	-	-
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19		0.136	0.0011	< 0.04	0.085	< 0.00008	-	< 0.002	< 0.002	0.00014	< 0.0010	0.0028	< 0.0002	0.0044	0.014	-	-	-	-	-	-
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19		1.22	0.0025	0.97	0.74	< 0.00008	-	0.002	0.022	0.00017	0.0006	0.0102	0.00137	0.0033	0.02	-	-	-	-	-	-
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19		0.199	< 0.0002	< 0.02	0.001	< 0.00008	-	0.0011	< 0.0010	< 0.00005	< 0.0005	0.0006	< 0.00010	< 0.0005	0.0041	-	-	-	-	-	-
P9a	P9A	P	September 2019 GME	2239932.7	10-Sep-19		0.134	< 0.0002	< 0.02	0.0009	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0006	0.0005	0.00046	< 0.0005	0.0033	-	-	-	-	-	-
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19		10.9	0.002	11.9 #1	0.195	< 0.00008	-	< 0.0010	< 0.0010	< 0.00005	0.0005	< 0.0005	< 0.00010	0.0016	0.0098	0.45	< 0.0010	0.003	0.004	< 0.0010	-

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

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Table 1: September 2019 Groundwater Results

						Total Petroleum Hydrocarbons												Nitrogen Species			
						C7 - C9	C10 - C14	C10 - C11	C12 - C14	C15-C36	C15 - C20	C21 - C25	C26 - C29	C30 - C36	C30 - C44	Total Hydrocarbons (C7-C36)	Total Hydrocarbons (C7-C44)	Total Ammoniacal-N	Nitrate (as N)	Nitrite (as N) (F)	Nitrogen (Total Oxidised) (F)
Guidelines	ANZECC 2000 95% marine (applicable for surface water)																	3.91 (at pH 7)	2.4 a		
	Low reliability values																				
	ANZECC 2000 80% marine (applicable within 50 m of the source under NRP)																	7.3 (at pH 7)	6.9 a		
	Low reliability values																				
	Drinking Water Standards				Health														11.3	0.91	
					Aesthetic																
Location	**Field ID**	**Within**	**Data Source**	**Lab Report No.**	**Date**																
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.3	< 0.002	2.3
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.26	< 0.002	1.26
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.027	1.17	0.004	1.18
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	9.4	0.005	9.4
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.58	< 0.002	0.58
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	4.3	< 0.002	4.3
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.021	0.065	0.002	0.067
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	13.2	< 0.002	13.2
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	5.9	< 0.002	5.9
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.018	13.9	0.015	13.9
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.53	0.005	1.53
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.023	3.1	< 0.002	3.1
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.52	< 0.002	1.53
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.1	< 0.002	2.1
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	5.8	< 0.002	5.8
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.026	2.2	< 0.002	2.2
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	9.4	0.24	9.6
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.188	0.027	< 0.002	0.028
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	1.9	< 0.002	1.9
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	6.5	0.008	6.5
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.6	< 0.002	2.6
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3.5	< 0.002	3.5
P7A	P7A	N	September 2019 GME	2239932.4	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.9	0.006	2.9
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.1	< 0.002	2.1
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.186	0.62	0.002	0.62
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	0.018	< 0.002	< 0.002	< 0.002
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	10.8	< 0.002	10.8
P9a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3.8	0.005	3.8
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	< 0.06	<0.2	-	-	< 0.4	-	-	-	-	-	<0.7	-	0.88	7.3	0.032	7.3

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

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Table 1: September 2019 Groundwater Results

						Polycyclic Aromatic Hydrocarbons																	
						Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	p-Terphenyl-d14 (surr.)	2-Fluorobiphenyl (surr.)
Guidelines	ANZECC 2000 95% marine (applicable for surface water)							0.00001 b		0.0001 b						0.001 b			0.07	0.0006 b			
	Low reliability values																						
	ANZECC 2000 80% marine (applicable within 50 m of the source under NRP)							0.007		0.0007						0.002			0.12	0.008			
	Low reliability values																						
	Drinking Water Standards				Health					0.0007													
					Aesthetic																		
Location	Field ID	Within	Data Source	Lab Report No.	Date																		
P1	P1	P	September 2019 GME	2240519.6	12-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P10	P10	N	September 2019 GME	2239932.1	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P11	P11	N	September 2019 GME	2239932.2	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P11 b	P11B	N	September 2019 GME	2240788.1	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P12	P12	N	September 2019 GME	2240788.2	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P13	P13	N	September 2019 GME	2240788.4	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P13 a	P13A	N	September 2019 GME	2240788.3	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P14	P14	N	September 2019 GME	2240788.5	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P15	P15	N	September 2019 GME	2240788.6	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P16	P16	N	September 2019 GME	2240788.7	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P17	P17	N	September 2019 GME	2240788.8	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P18	P18	N	September 2019 GME	2240788.9	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P19	P19	P	September 2019 GME	2240788.1	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P1B	P1B	P	September 2019 GME	2239092.2	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P2	P2	P	September 2019 GME	2239092.3	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P20	P20	Y	September 2019 GME	2240788.11	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P4	P4	N	September 2019 GME	2239092.4	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P4A	P4A	N	September 2019 GME	2239092.5	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P5	P5	N	September 2019 GME	2239092.6	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P5a	P5a	N	September 2019 GME	2240519.4	12-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P6	P6	N	September 2019 GME	2240519.3	12-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P7	P7	N	September 2019 GME	2240519.5	12-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P7A	P7A	N	September 2019 GME	2239932.4	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P8 a	BH8A	N	September 2019 GME	2239092.1	9-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P8 b	BH8B	N	September 2019 GME	2239932.5	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	0.000018	0.000038	0.000046	0.00006	0.000014	0.00002	< 0.000008	0.000071	0.00001	0.000038	< 0.00004	< 0.000008	0.000114	-	-
P8 c	BH8C	N	September 2019 GME	2239932.3	10-Sep-19	< 0.00008 #2	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P9	P9	N	September 2019 GME	2239932.6	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
P9a	P9A	P	September 2019 GME	2239932.7	10-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.00004	< 0.000008	< 0.000008	-	-
PF54	PF54	N	September 2019 GME	2240788.12	11-Sep-19	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.0036	0.000017	< 0.000008	-	-

Notes:
All units mg/L unless otherwise noted
Within containment: Y - Yes, P - Possibly, N - No
Grey text - below limit of reporting
a Hickey, C.W. (2013) *Updating nitrate toxicity effects on freshwater aquatic species*
b 99% level of protection adopted for bioaccumulation
c 95% level of protection as per proposed Regional Plan
#1 Dissolved fraction reported as greater than total, but noted by laboratory as within variation of analytical methods.
#2 Detection limit raised due to interference in the chromatography.

Appendix D: Laboratory Transcripts

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2239092 SPv1
Contact:	Natalie O'Rourke	**Date Received:**	11-Sep-2019
	C/- Tonkin & Taylor	**Date Reported:**	17-Sep-2019
	PO Box 5271	**Quote No:**	101070
	Auckland 1141	**Order No:**	1009695.2000
		Client Reference:	1009695.2000
		Submitted By:	Xiao Jin

Sample Type: Aqueous

Sample Name:		BH8A 09-Sep-2019	P1B 09-Sep-2019	P2 09-Sep-2019	P4 09-Sep-2019	P4A 09-Sep-2019
Lab Number:		2239092.1	2239092.2	2239092.3	2239092.4	2239092.5
Individual Tests						
Dissolved Cobalt	g/m³	0.0003	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Iron	g/m³	< 0.02	0.14	< 0.02	< 0.02	0.05
Total Iron	g/m³	0.29	1.35	0.073	0.82	0.29
Dissolved Manganese	g/m³	0.034	0.0084	0.0017	0.027	0.029
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Vanadium	g/m³	0.0011	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	0.188
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	0.24	< 0.002
Nitrate-N	g/m³	2.1	2.1	5.8	9.4	0.027
Nitrate-N + Nitrite-N	g/m³	2.1	2.1	5.8	9.6	0.028
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	0.0015	0.0012
Dissolved Cadmium	g/m³	0.00052	0.00022	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	0.0008	0.0014	0.0005	0.0005	< 0.0005
Dissolved Copper	g/m³	0.026	0.0010	0.0031	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	0.00011	0.00034	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	0.0176	< 0.0005	0.0008	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	0.38	0.0080	0.029	0.0022	0.0057
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008

ilac-MRA IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		BH8A 09-Sep-2019	P1B 09-Sep-2019	P2 09-Sep-2019	P4 09-Sep-2019	P4A 09-Sep-2019
Lab Number:		2239092.1	2239092.2	2239092.3	2239092.4	2239092.5
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Phenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample Name:		P5 09-Sep-2019	Dup01 09-Sep-2019	Dup02 09-Sep-2019	Rinsate 02 09-Sep-2019	
Lab Number:		2239092.6	2239092.7	2239092.8	2239092.10	
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	0.0003	< 0.0002	-	-
Dissolved Iron	g/m³	< 0.02	0.06	0.31	-	-
Total Iron	g/m³	0.24	0.32	1.72	-	-
Dissolved Manganese	g/m³	< 0.0005	0.041	0.031	-	-
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	-	-
Dissolved Vanadium	g/m³	0.0019	0.0011	< 0.0010	-	-
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	< 0.010	-	-
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	-	-
Nitrate-N	g/m³	1.90	1.98	2.1	-	-
Nitrate-N + Nitrite-N	g/m³	1.90	1.98	2.1	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	0.0038	< 0.0010	< 0.0010	-	-
Dissolved Cadmium	g/m³	< 0.00005	0.00052	0.00023	-	-
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	0.0013	-	-
Dissolved Copper	g/m³	0.0006	0.032	0.0010	-	-
Dissolved Lead	g/m³	< 0.00010	< 0.00010	0.00021	-	-
Dissolved Nickel	g/m³	< 0.0005	0.0179	< 0.0005	-	-
Dissolved Zinc	g/m³	< 0.0010	0.39	0.0065	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	-	-	-	< 0.00010	-
Acenaphthylene	g/m³	-	-	-	< 0.00010	-
Anthracene	g/m³	-	-	-	< 0.00010	-
Benzo[a]anthracene	g/m³	-	-	-	< 0.00010	-
Benzo[a]pyrene (BAP)	g/m³	-	-	-	< 0.00010	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	-	-	-	< 0.00010	-
Benzo[g,h,i]perylene	g/m³	-	-	-	< 0.00010	-
Benzo[k]fluoranthene	g/m³	-	-	-	< 0.00010	-
Chrysene	g/m³	-	-	-	< 0.00010	-
Dibenzo[a,h]anthracene	g/m³	-	-	-	< 0.00010	-
Fluoranthene	g/m³	-	-	-	< 0.00010	-
Fluorene	g/m³	-	-	-	< 0.0002	-
Indeno(1,2,3-c,d)pyrene	g/m³	-	-	-	< 0.00010	-
Naphthalene	g/m³	-	-	-	< 0.0005	-
Phenanthrene	g/m³	-	-	-	< 0.0004	-
Pyrene	g/m³	-	-	-	< 0.0002	-

Sample Type: Aqueous						
Sample Name:		P5 09-Sep-2019	Dup01 09-Sep-2019	Dup02 09-Sep-2019	Rinsate 02 09-Sep-2019	
Lab Number:		2239092.6	2239092.7	2239092.8	2239092.10	
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	-	-
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	-
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Phenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	-	-

Analyst's Comments

It has been noted that the method performance for 2-nitrophenol for Phenol analysis is not acceptable therefore we are unable to report this compound at this present time.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-8
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m³	10
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.000005 g/m³	1-8
Acetylated Phenols in Water samples by Liq/liq	Liquid / liquid extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	0.00005 g/m³	1-8
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-8
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-8
Dissolved Cobalt	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0002 g/m³	1-8
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m³	1-8

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m^3	1-8
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-8
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	1-8
Dissolved Vanadium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-8
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-8
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-8
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-8
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-8

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2240519 SPv1
Contact:	Natalie O'Rourke	**Date Received:**	12-Sep-2019
	C/- Tonkin & Taylor	**Date Reported:**	20-Sep-2019
	PO Box 5271	**Quote No:**	101070
	Auckland 1141	**Order No:**	1009695.2000
		Client Reference:	1009695.2000
		Submitted By:	Rebecca van der Krogt

Sample Type: Aqueous

Sample Name:		Rinsate 7 12-Sep-2019	Rinsate 8 12-Sep-2019	P6 12-Sep-2019	P5a 12-Sep-2019	P7 12-Sep-2019
Lab Number:		2240519.1	2240519.2	2240519.3	2240519.4	2240519.5
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Iron	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total Iron	g/m³	< 0.021	< 0.021	0.24	0.177	0.044
Dissolved Manganese	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0007
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Vanadium	g/m³	< 0.0010	< 0.0010	0.0016	0.0025	0.0017
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	0.008	< 0.002
Nitrate-N	g/m³	0.003	< 0.002	2.6	6.5	3.5
Nitrate-N + Nitrite-N	g/m³	0.003	0.002	2.6	6.5	3.5
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	0.0027	0.0019
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005	0.0008	0.0006
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00019
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006
Dissolved Zinc	g/m³	< 0.0010	0.0016	0.0014	0.0103	0.0120
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		Rinsate 7 12-Sep-2019	Rinsate 8 12-Sep-2019	P6 12-Sep-2019	P5a 12-Sep-2019	P7 12-Sep-2019
Lab Number:		2240519.1	2240519.2	2240519.3	2240519.4	2240519.5
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Phenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00010	< 0.00005	< 0.00005	< 0.00010
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample Name:		P1 12-Sep-2019				
Lab Number:		2240519.6				
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	-	-	-	-
Dissolved Iron	g/m³	0.05	-	-	-	-
Total Iron	g/m³	2.7	-	-	-	-
Dissolved Manganese	g/m³	0.0052	-	-	-	-
Dissolved Mercury	g/m³	< 0.00008	-	-	-	-
Dissolved Vanadium	g/m³	< 0.0010	-	-	-	-
Total Ammoniacal-N	g/m³	< 0.010	-	-	-	-
Nitrite-N	g/m³	< 0.002	-	-	-	-
Nitrate-N	g/m³	2.3	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	2.3	-	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	0.0010	-	-	-	-
Dissolved Cadmium	g/m³	< 0.00005	-	-	-	-
Dissolved Chromium	g/m³	< 0.0005	-	-	-	-
Dissolved Copper	g/m³	< 0.0005	-	-	-	-
Dissolved Lead	g/m³	< 0.00010	-	-	-	-
Dissolved Nickel	g/m³	< 0.0005	-	-	-	-
Dissolved Zinc	g/m³	0.0023	-	-	-	-
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	-	-	-	-
Acenaphthylene	g/m³	< 0.000008	-	-	-	-
Anthracene	g/m³	< 0.000008	-	-	-	-
Benzo[a]anthracene	g/m³	< 0.000008	-	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	-	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.000008	-	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.000008	-	-	-	-
Chrysene	g/m³	< 0.000008	-	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.000008	-	-	-	-
Fluoranthene	g/m³	< 0.000008	-	-	-	-
Fluorene	g/m³	< 0.000008	-	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	-	-	-	-
Naphthalene	g/m³	< 0.00004	-	-	-	-
Phenanthrene	g/m³	< 0.000008	-	-	-	-
Pyrene	g/m³	< 0.000008	-	-	-	-

Sample Type: Aqueous						
Sample Name:		P1 12-Sep-2019				
Lab Number:		2240519.6				
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m^3	< 0.00005	-	-	-	-
4-Chloro-3-methylphenol	g/m^3	< 0.00005	-	-	-	-
2-Chlorophenol	g/m^3	< 0.00005	-	-	-	-
2,4-Dichlorophenol	g/m^3	< 0.00005	-	-	-	-
2,6-Dichlorophenol	g/m^3	< 0.00005	-	-	-	-
2,4-Dimethylphenol	g/m^3	< 0.00005	-	-	-	-
3-Methylphenol (m-cresol)	g/m^3	< 0.00005	-	-	-	-
2-Methylphenol (o-Cresol)	g/m^3	< 0.00005	-	-	-	-
4-Methylphenol (p-Cresol)	g/m^3	< 0.00005	-	-	-	-
Pentachlorophenol (PCP)	g/m^3	< 0.00010	-	-	-	-
Phenol	g/m^3	< 0.00005	-	-	-	-
2,3,4,6-Tetrachlorophenol (TCP)	g/m^3	< 0.00010	-	-	-	-
2,4,5-Trichlorophenol	g/m^3	< 0.00005	-	-	-	-
2,4,6-Trichlorophenol	g/m^3	< 0.00005	-	-	-	-

Analyst's Comments

It has been noted that the method performance for 2-nitrophenol for Phenol analysis is not acceptable therefore we are unable to report this compound at this present time.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m^3	1-6
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.000005 g/m^3	1-6
Acetylated Phenols in Water samples by Liq/liq	Liquid / liquid extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	0.00005 g/m^3	1-6
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-6
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-6
Dissolved Cobalt	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0002 g/m^3	1-6
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-6
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m^3	1-6
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-6
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	1-6
Dissolved Vanadium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-6
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-6
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-6
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-6
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-6

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2240788 SPv1
Contact:	Natalie O'Rourke	**Date Received:**	13-Sep-2019
	C/- Tonkin & Taylor	**Date Reported:**	25-Sep-2019
	PO Box 5271	**Quote No:**	101070
	Auckland 1141	**Order No:**	1009695.2000
		Client Reference:	1009695.2000
		Submitted By:	Rebecca van der Krogt

Sample Type: Aqueous

Sample Name:		P11B 11-Sep-2019	P12 11-Sep-2019	P13A 11-Sep-2019	P13 11-Sep-2019	P14 11-Sep-2019
Lab Number:		2240788.1	2240788.2	2240788.3	2240788.4	2240788.5
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Iron	g/m³	< 0.02	< 0.02	0.12	0.03	< 0.02
Total Iron	g/m³	< 0.021	0.24	1.78	0.25	0.073
Dissolved Manganese	g/m³	< 0.0005	0.0072	0.0116	0.0029	0.0064
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Vanadium	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	0.021	< 0.010	< 0.010
Nitrite-N	g/m³	0.005	< 0.002	0.002	< 0.002	< 0.002
Nitrate-N	g/m³	9.4	0.58	0.065	4.3	13.2
Nitrate-N + Nitrite-N	g/m³	9.4	0.58	0.067	4.3	13.2
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	0.0050	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	0.0016	0.0006	0.0006
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	0.00028	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	0.0029	0.27	0.0017	0.0023	0.0020
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		P11B 11-Sep-2019	P12 11-Sep-2019	P13A 11-Sep-2019	P13 11-Sep-2019	P14 11-Sep-2019
Lab Number:		2240788.1	2240788.2	2240788.3	2240788.4	2240788.5
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Phenol	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample Name:		P15 11-Sep-2019	P16 11-Sep-2019	P17 11-Sep-2019	P18 11-Sep-2019	P19 11-Sep-2019
Lab Number:		2240788.6	2240788.7	2240788.8	2240788.9	2240788.10
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	< 0.0002	< 0.0002	0.0027	0.0004
Dissolved Iron	g/m³	0.05	0.21	0.16	0.33	0.29
Total Iron	g/m³	0.21	3.0	1.36	1.46	5.6
Dissolved Manganese	g/m³	0.0008	0.026	0.0007	0.60	0.0125
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Vanadium	g/m³	< 0.0010	< 0.0010	0.0016	< 0.0010	< 0.0010
Total Ammoniacal-N	g/m³	< 0.010	0.018	< 0.010	0.023	< 0.010
Nitrite-N	g/m³	< 0.002	0.015	0.005	< 0.002	< 0.002
Nitrate-N	g/m³	5.9	13.9	1.53	3.1	1.52
Nitrate-N + Nitrite-N	g/m³	5.9	13.9	1.53	3.1	1.53
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	0.0010	0.0026	< 0.0010	0.0019
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	< 0.00005	0.00010	< 0.00005
Dissolved Chromium	g/m³	0.0005	0.0007	0.0046	< 0.0005	0.0020
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005	0.0021	0.0010
Dissolved Lead	g/m³	0.00012	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	0.0045	< 0.0005
Dissolved Zinc	g/m³	0.0039	0.0026	< 0.0010	0.039	0.0056
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008

Sample Type: Aqueous						
Sample Name:		P15 11-Sep-2019	P16 11-Sep-2019	P17 11-Sep-2019	P18 11-Sep-2019	P19 11-Sep-2019
Lab Number:		2240788.6	2240788.7	2240788.8	2240788.9	2240788.10
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Phenol	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00010	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample Name:		P20 11-Sep-2019	PF54 11-Sep-2019	Trip blank 11-Sep-2019	Rinsate 6 11-Sep-2019	
Lab Number:		2240788.11	2240788.12	2240788.13	2240788.15	
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	0.0018	-	-	-
Dissolved Iron	g/m³	0.07	11.9 #1	-	-	-
Total Iron	g/m³	1.02	10.9	-	-	-
Dissolved Manganese	g/m³	0.032	0.195	-	-	-
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	-	-	-
Dissolved Vanadium	g/m³	< 0.0010	< 0.0010	-	-	-
Total Ammoniacal-N	g/m³	0.026	0.88	-	-	-
Nitrite-N	g/m³	< 0.002	0.032	-	-	-
Nitrate-N	g/m³	2.2	7.3	-	-	-
Nitrate-N + Nitrite-N	g/m³	2.2	7.3	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	-	-	-
Dissolved Cadmium	g/m³	0.00028	< 0.00005	-	-	-
Dissolved Chromium	g/m³	0.0016	0.0005	-	-	-
Dissolved Copper	g/m³	0.0005	< 0.0005	-	-	-
Dissolved Lead	g/m³	0.00030	< 0.00010	-	-	-
Dissolved Nickel	g/m³	0.0008	0.0016	-	-	-
Dissolved Zinc	g/m³	0.091	0.0098	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	-	0.45	< 0.0010	< 0.0010	-
Toluene	g/m³	-	< 0.0010	0.0063	< 0.0010	-
Ethylbenzene	g/m³	-	0.0030	< 0.0010	< 0.0010	-
m&p-Xylene	g/m³	-	0.004	< 0.002	< 0.002	-
o-Xylene	g/m³	-	< 0.0010	< 0.0010	< 0.0010	-
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	-	-	-
Acenaphthylene	g/m³	< 0.000008	< 0.000008	-	-	-
Anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-
Chrysene	g/m³	< 0.000008	< 0.000008	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-

Sample Type: Aqueous						
Sample Name:		P20 11-Sep-2019	PF54 11-Sep-2019	Trip blank 11-Sep-2019	Rinsate 6 11-Sep-2019	
Lab Number:		2240788.11	2240788.12	2240788.13	2240788.15	
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Fluorene	g/m³	< 0.000008	< 0.000008	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	-	-	-
Naphthalene	g/m³	< 0.00004	0.0036	-	-	-
Phenanthrene	g/m³	< 0.000008	0.000017	-	-	-
Pyrene	g/m³	< 0.000008	< 0.000008	-	-	-
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00007	-	-	-
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	-	-	-
2-Chlorophenol	g/m³	< 0.00005	< 0.00007	-	-	-
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	-	-	-
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	-	-	-
Phenol	g/m³	< 0.0005	< 0.0007	-	-	-
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00005	-	-	-
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	-	< 0.06	< 0.06	< 0.06	-
C10 - C14	g/m³	-	< 0.2	< 0.2	< 0.2	-
C15 - C36	g/m³	-	< 0.4	< 0.4	< 0.4	-
Total hydrocarbons (C7 - C36)	g/m³	-	< 0.7	< 0.7	< 0.7	-

Analyst's Comments

It has been noted that the method performance for 2-nitrophenol for Phenol analysis is not acceptable therefore we are unable to report this compound at this present time.

#1 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-12
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m³	12-13, 15
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.000005 g/m³	1-12
Acetylated Phenols in Water samples by Liq/liq	Liquid / liquid extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	0.00005 g/m³	1-12
Total Petroleum Hydrocarbons in Water	Solvent extraction, GC-FID analysis. Headspace GC-MS analysis for C7-C9 carbon band.	0.06 - 0.7 g/m³	12-13, 15
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-12
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-12
Dissolved Cobalt	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0002 g/m³	1-12
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m³	1-12
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m³	1-12

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-12
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	1-12
Dissolved Vanadium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-12
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-12
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-12
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-12
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-12

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2239932 SPv1
Contact:	Natalie O'Rourke	**Date Received:**	12-Sep-2019
	C/- Tonkin & Taylor	**Date Reported:**	25-Sep-2019
	PO Box 5271	**Quote No:**	101070
	Auckland 1141	**Order No:**	1009695.2000
		Client Reference:	1009695.2000
		Submitted By:	Xiao Jin

Sample Type: Aqueous

Sample Name:		P10 10-Sep-2019	P11 10-Sep-2019	BH8C 10-Sep-2019	P7A 10-Sep-2019	BH8B 10-Sep-2019
Lab Number:		2239932.1	2239932.2	2239932.3	2239932.4	2239932.5
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	0.0008	0.0025	< 0.0002	0.0011
Dissolved Iron	g/m³	< 0.02	1.05	0.97	0.03	< 0.04
Total Iron	g/m³	0.081	1.55	1.22	0.055	0.136
Dissolved Manganese	g/m³	0.0011	0.036	0.74	0.0015	0.085
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Vanadium	g/m³	< 0.0010	< 0.0010	0.0020	0.0021	< 0.002
Total Ammoniacal-N	g/m³	< 0.010	0.027	0.018	< 0.010	0.186
Nitrite-N	g/m³	< 0.002	0.004	< 0.002	0.006	0.002
Nitrate-N	g/m³	1.26	1.17	< 0.002	2.9	0.62
Nitrate-N + Nitrite-N	g/m³	1.26	1.18	< 0.002	2.9	0.62
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	0.022	0.0010	< 0.002
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	0.00017	< 0.00005	0.00014
Dissolved Chromium	g/m³	0.0014	< 0.0005	0.0006	0.0008	< 0.0010
Dissolved Copper	g/m³	0.0022	< 0.0005	0.0102	0.0009	0.0028
Dissolved Lead	g/m³	< 0.00010	< 0.00010	0.00137	0.00014	< 0.0002
Dissolved Nickel	g/m³	0.0030	< 0.0005	0.0033	< 0.0005	0.0044
Dissolved Zinc	g/m³	0.0084	0.0034	0.020	0.0115	0.014
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.00008 #1	< 0.000008	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000018
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000038
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000046
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000060
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000014
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000020
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000071
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000010
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000038
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000114

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		P10 10-Sep-2019	P11 10-Sep-2019	BH8C 10-Sep-2019	P7A 10-Sep-2019	BH8B 10-Sep-2019
Lab Number:		2239932.1	2239932.2	2239932.3	2239932.4	2239932.5
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Phenol	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample Name:		P9 10-Sep-2019	P9A 10-Sep-2019	Rinsate 4 10-Sep-2019		
Lab Number:		2239932.6	2239932.7	2239932.9		
Individual Tests						
Dissolved Cobalt	g/m³	< 0.0002	< 0.0002	-	-	-
Dissolved Iron	g/m³	< 0.02	< 0.02	-	-	-
Total Iron	g/m³	0.199	0.134	-	-	-
Dissolved Manganese	g/m³	0.0010	0.0009	-	-	-
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	-	-	-
Dissolved Vanadium	g/m³	0.0011	< 0.0010	-	-	-
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	-	-	-
Nitrite-N	g/m³	< 0.002	0.005	-	-	-
Nitrate-N	g/m³	10.8	3.8	-	-	-
Nitrate-N + Nitrite-N	g/m³	10.8	3.8	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	-	-	-
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	-	-	-
Dissolved Chromium	g/m³	< 0.0005	0.0006	-	-	-
Dissolved Copper	g/m³	0.0006	0.0005	-	-	-
Dissolved Lead	g/m³	< 0.00010	0.00046	-	-	-
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	-	-	-
Dissolved Zinc	g/m³	0.0041	0.0033	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene	g/m³	-	-	< 0.00010	-	-
Acenaphthylene	g/m³	-	-	< 0.00010	-	-
Anthracene	g/m³	-	-	< 0.00010	-	-
Benzo[a]anthracene	g/m³	-	-	< 0.00010	-	-
Benzo[a]pyrene (BAP)	g/m³	-	-	< 0.00010	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	-	-	< 0.00010	-	-
Benzo[g,h,i]perylene	g/m³	-	-	< 0.00010	-	-
Benzo[k]fluoranthene	g/m³	-	-	< 0.00010	-	-
Chrysene	g/m³	-	-	< 0.00010	-	-
Dibenzo[a,h]anthracene	g/m³	-	-	< 0.00010	-	-
Fluoranthene	g/m³	-	-	< 0.00010	-	-
Fluorene	g/m³	-	-	< 0.0002	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	-	-	< 0.00010	-	-
Naphthalene	g/m³	-	-	< 0.0005	-	-
Phenanthrene	g/m³	-	-	< 0.0004	-	-
Pyrene	g/m³	-	-	< 0.0002	-	-

Sample Type: Aqueous						
Sample Name:		P9 10-Sep-2019	P9A 10-Sep-2019	Rinsate 4 10-Sep-2019		
Lab Number:		2239932.6	2239932.7	2239932.9		
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	-	-	-
Acenaphthylene	g/m³	< 0.000008	< 0.000008	-	-	-
Anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-
Chrysene	g/m³	< 0.000008	< 0.000008	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	-	-	-
Fluoranthene	g/m³	< 0.000008	< 0.000008	-	-	-
Fluorene	g/m³	< 0.000008	< 0.000008	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	-	-	-
Naphthalene	g/m³	< 0.00004	< 0.00004	-	-	-
Phenanthrene	g/m³	< 0.000008	< 0.000008	-	-	-
Pyrene	g/m³	< 0.000008	< 0.000008	-	-	-
Acetylated Phenols in Water samples by Liq/liq						
4-Chloro-2-methylphenol	g/m³	< 0.00005	< 0.00005	-	-	-
4-Chloro-3-methylphenol	g/m³	< 0.00005	< 0.00005	-	-	-
2-Chlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,4-Dichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,6-Dichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,4-Dimethylphenol	g/m³	< 0.00005	< 0.00005	-	-	-
3-Methylphenol (m-cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
2-Methylphenol (o-Cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
4-Methylphenol (p-Cresol)	g/m³	< 0.00005	< 0.00005	-	-	-
Pentachlorophenol (PCP)	g/m³	< 0.00010	< 0.00010	-	-	-
Phenol	g/m³	< 0.0005	< 0.0005	-	-	-
2,3,4,6-Tetrachlorophenol (TCP)	g/m³	< 0.00005	< 0.00005	-	-	-
2,4,5-Trichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-
2,4,6-Trichlorophenol	g/m³	< 0.00005	< 0.00005	-	-	-

Analyst's Comments

It has been noted that the method performance for 2-nitrophenol for Phenol analysis is not acceptable therefore we are unable to report this compound at this present time.

#1 Due to some interference found in the chromatography, the detection limit was raised. Hence the higher detection limit reported.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-7
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m³	9
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.000005 g/m³	1-7
Acetylated Phenols in Water samples by Liq/liq	Liquid / liquid extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	0.00005 g/m³	1-7
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-7
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-7
Dissolved Cobalt	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0002 g/m³	1-7

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-7
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m^3	1-7
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1-7
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	1-7
Dissolved Vanadium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-7
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-7
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-7
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-7
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix E: November 2019 Foreshore Sampling

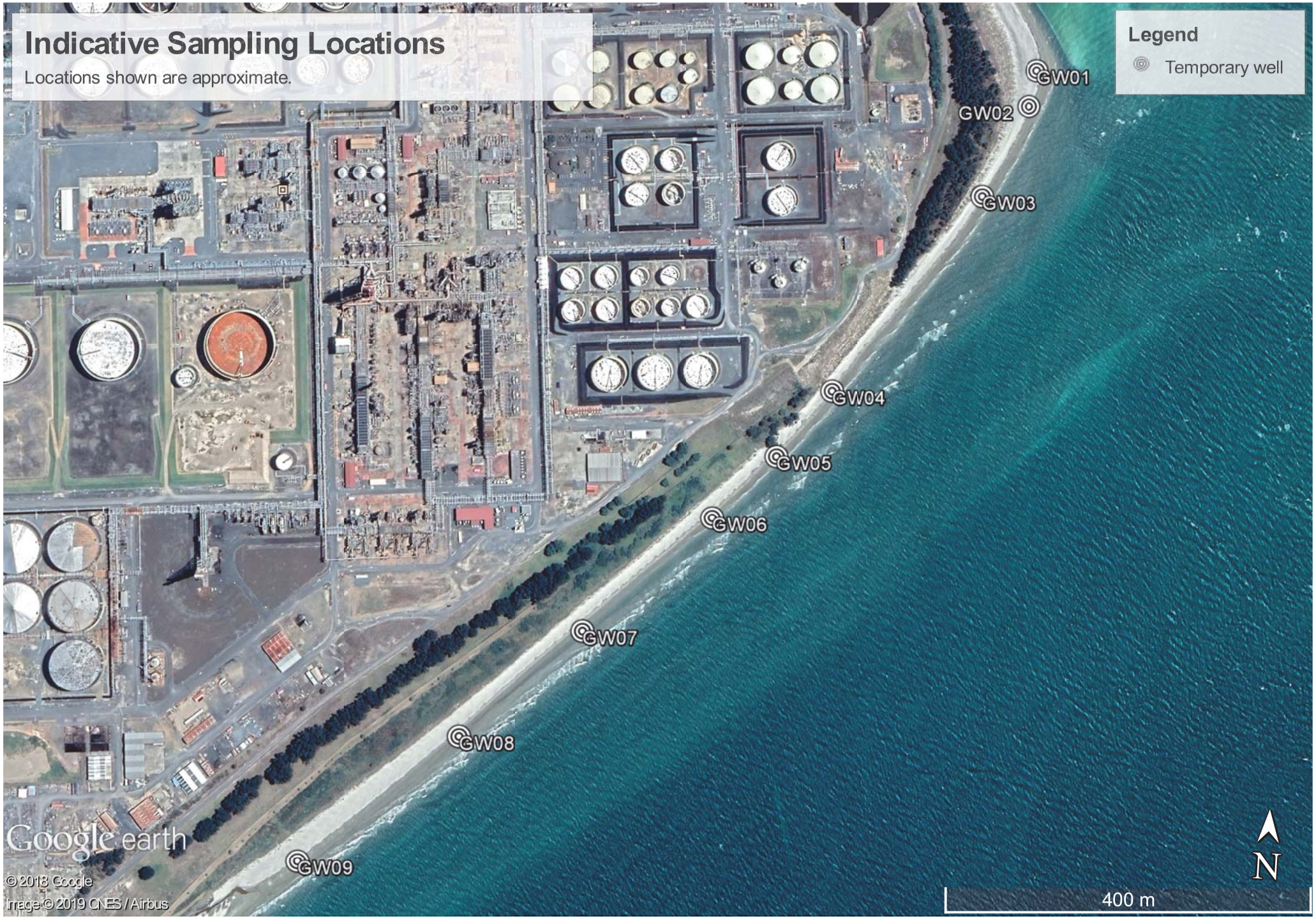
E1 Methodology

Groundwater sampling from temporary wells on the Bream Bay foreshore was undertaken by Refining New Zealand on 7 November 2019. Nine temporary wells (GW01 to GW09) were installed in the indicative locations shown on the attached plan. The indicative sampling locations were oriented downgradient of perimeter wells with groundwater exceedances of metals and/or nitrogen species. The actual locations on the beach were based on the tide and observations of groundwater seeps. Sampling was undertaken either side of low tide.

There general methodology comprised:

- A hole was excavated and a temporary piezometer (25 mm diameter PVC with 1 m slotted screen and 0.5 m blank) emplaced into the hole;
- The standing water temporary well was removed using a Wilden pump;
- Samples were collected from the recharging water using a peristaltic pump; and
- A grab sample of seawater downgradient of each location was also collected.

All samples were submitted to Hill Laboratories for analysis of dissolved metals and nitrogen species.


Indicative Sampling Locations
Locations shown are approximate.
Legend
Temporary well
GW01
GW02
GW03
GW04
GW05
GW06
GW07
GW08
GW09
Google earth
© 2018 Google
Image © 2019 CNES / Airbus
N
400 m

Hill Laboratories
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R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	NZ Refining Company	**Lab No:**	2271800	SPv2
Contact:	Andy McCall	**Date Received:**	08-Nov-2019	
	C/- NZ Refining Company	**Date Reported:**	27-Nov-2019	**(Amended)**
	Private Bag 9024	**Quote No:**	102330	
	Whangarei 0140	**Order No:**	228568	
		Client Reference:		
		Submitted By:	Andy McCall	

Sample Type: Saline

Sample Name:		SW01 07-Nov-2019 10:12 am	SW02 07-Nov-2019 10:31 am	SW03 07-Nov-2019 10:45 am	SW04 07-Nov-2019 10:57 am	SW05 07-Nov-2019 11:07 am
Lab Number:		2271800.1	2271800.2	2271800.3	2271800.4	2271800.5
Individual Tests						
Dissolved Arsenic	g/m³	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Dissolved Cadmium	g/m³	< 0.0002	0.0007	< 0.0002	< 0.0002	< 0.0002
Dissolved Chromium (III)*	g/m³	< 0.0015	< 0.0015	< 0.0015	< 0.0015	0.0014
Hexavalent Chromium*	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Chromium	g/m³	0.0013	0.0012	< 0.0010	< 0.0010	0.0014
Dissolved Copper	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Lead	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Nickel	g/m³	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Dissolved Zinc	g/m³	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Total Nitrogen*	g/m³	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Total Ammoniacal-N	g/m³	0.011	0.010	0.023	0.030	0.032
Nitrite-N	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Nitrate-N	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Nitrate-N + Nitrite-N	g/m³	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0010
Total Kjeldahl Nitrogen (TKN)*	g/m³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2

Sample Name:		SW06 07-Nov-2019 11:16 am	SW07 07-Nov-2019 11:26 am	SW08 07-Nov-2019 11:37 am	SW09 07-Nov-2019 11:48 am	GW01 07-Nov-2019 10:12 am
Lab Number:		2271800.6	2271800.7	2271800.8	2271800.9	2271800.21
Individual Tests						
Dissolved Arsenic	g/m³	< 0.004	< 0.004	< 0.004	< 0.004	0.010
Dissolved Cadmium	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Chromium (III)*	g/m³	< 0.0015	< 0.0015	< 0.0015	< 0.0015	-
Hexavalent Chromium*	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Dissolved Chromium	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Copper	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Lead	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Nickel	g/m³	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Dissolved Zinc	g/m³	< 0.004	< 0.004	< 0.004	< 0.004	0.025
Total Nitrogen*	g/m³	< 0.3	< 0.3	< 0.3	< 0.3	0.5
Total Ammoniacal-N	g/m³	0.028	0.040	0.016	0.015	0.032
Nitrite-N	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Nitrate-N	g/m³	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0010
Nitrate-N + Nitrite-N	g/m³	< 0.0010	< 0.0010	0.0018	< 0.0010	< 0.0010
Total Kjeldahl Nitrogen (TKN)*	g/m³	< 0.2	< 0.2	< 0.2	< 0.2	0.5

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Saline						
Sample Name:		GW02 07-Nov-2019 10:31 am	GW03 07-Nov-2019 10:45 am	GW04 07-Nov-2019 10:57 am	GW05 07-Nov-2019 11:07 am	GW06 07-Nov-2019 11:16 am
Lab Number:		2271800.22	2271800.23	2271800.24	2271800.25	2271800.26
Individual Tests						
Dissolved Arsenic	g/m³	0.005	0.011	0.013	< 0.004	0.007
Dissolved Cadmium	g/m³	0.0014	0.0008	< 0.0002	< 0.0002	< 0.0002
Dissolved Chromium	g/m³	0.0012	0.0021	< 0.0010	0.0021	0.0013
Dissolved Copper	g/m³	< 0.0010	< 0.0010	0.0010	< 0.0010	0.0012
Dissolved Lead	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Nickel	g/m³	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Dissolved Zinc	g/m³	0.014	0.012	0.014	0.030	0.032
Total Nitrogen*	g/m³	< 0.3	0.2	0.3	0.5	0.7
Total Ammoniacal-N	g/m³	0.007	0.048	0.091	0.25	0.25
Nitrite-N	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Nitrate-N	g/m³	< 0.0010	0.0011	0.0016	0.0012	0.0028
Nitrate-N + Nitrite-N	g/m³	< 0.0010	0.0014	0.0021	0.0018	0.0034
Total Kjeldahl Nitrogen (TKN)*	g/m³	< 0.2	0.2	0.3	0.5	0.7

Sample Name:		GW07 07-Nov-2019 11:26 am	GW08 07-Nov-2019 11:37 am	GW09 07-Nov-2019 11:48 am	GW10 07-Nov-2019 9:15 am	GW11 07-Nov-2019 1:00 pm
Lab Number:		2271800.27	2271800.28	2271800.29	2271800.30	2271800.31
Individual Tests						
Dissolved Arsenic	g/m³	0.006	0.007	< 0.004	< 0.004	< 0.004
Dissolved Cadmium	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Chromium	g/m³	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0010
Dissolved Copper	g/m³	< 0.0010	0.0011	< 0.0010	< 0.0010	< 0.0010
Dissolved Lead	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Nickel	g/m³	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Dissolved Zinc	g/m³	0.050	0.059	0.066	< 0.004	0.006
Total Nitrogen*	g/m³	1.3	0.4	0.3	< 0.3	< 0.3
Total Ammoniacal-N	g/m³	0.63	0.008	0.051	< 0.005	< 0.005
Nitrite-N	g/m³	< 0.0010	0.0165	< 0.0010	< 0.0010	< 0.0010
Nitrate-N	g/m³	0.0052	0.026	0.0029	< 0.0010	< 0.0010
Nitrate-N + Nitrite-N	g/m³	0.0060	0.042	0.0035	< 0.0010	< 0.0010
Total Kjeldahl Nitrogen (TKN)*	g/m³	1.3	0.4	0.3	< 0.2	< 0.2

Sample Type: Aqueous						
Sample Name:		GW01 07-Nov-2019 10:12 am	GW02 07-Nov-2019 10:31 am	GW03 07-Nov-2019 10:45 am	GW04 07-Nov-2019 10:57 am	GW05 07-Nov-2019 11:07 am
Lab Number:		2271800.10	2271800.11	2271800.12	2271800.13	2271800.14
Individual Tests						
Dissolved Chromium (III)*	g/m³	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Hexavalent Chromium	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Nitrogen	g/m³	0.36	< 0.11	0.17	0.30	0.49
Total Ammoniacal-N	g/m³	0.16 #1	0.13 #1	0.081	0.098	0.21
Nitrite-N	g/m³	< 0.02 #2	< 0.02 #2	< 0.02 #2	< 0.02	< 0.02 #2
Nitrate-N	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Nitrate-N + Nitrite-N	g/m³	< 0.02 #2	< 0.02 #2	< 0.02 #2	< 0.02	< 0.02 #2
Total Kjeldahl Nitrogen (TKN)	g/m³	0.35	< 0.10 #3	0.16	0.29	0.48
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dissolved Cadmium	g/m³	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Dissolved Chromium	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Copper	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Lead	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dissolved Nickel	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Zinc	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Sample Type: Aqueous						
Sample Name:		GW06 07-Nov-2019 11:16 am	GW07 07-Nov-2019 11:26 am	GW08 07-Nov-2019 11:37 am	GW09 07-Nov-2019 11:48 am	GW10 07-Nov-2019 9:15 am
Lab Number:		2271800.15	2271800.16	2271800.17	2271800.18	2271800.19
Individual Tests						
Dissolved Chromium (III)*	g/m³	< 0.06	< 0.06	< 0.06	< 0.06	< 0.0012
Hexavalent Chromium	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Nitrogen	g/m³	0.44	0.93	0.37	0.24	< 0.11
Total Ammoniacal-N	g/m³	0.34	0.67	0.031	0.051	< 0.010
Nitrite-N	g/m³	< 0.02	< 0.02 #2	< 0.02 #2	< 0.02	< 0.002
Nitrate-N	g/m³	< 0.02	< 0.02	0.03	< 0.02	< 0.002
Nitrate-N + Nitrite-N	g/m³	< 0.02	< 0.02 #2	0.05 #2	< 0.02	< 0.002
Total Kjeldahl Nitrogen (TKN)	g/m³	0.44	0.92	0.32	0.23	< 0.10
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.0010
Dissolved Cadmium	g/m³	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00005
Dissolved Chromium	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.0005
Dissolved Copper	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.0005
Dissolved Lead	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.00010
Dissolved Nickel	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.0005
Dissolved Zinc	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.0010

Sample Name:		GW11 07-Nov-2019 1:00 pm				
Lab Number:		2271800.20				
Individual Tests						
Dissolved Chromium (III)*	g/m³	< 0.0012	-	-	-	-
Hexavalent Chromium	g/m³	< 0.0010	-	-	-	-
Total Nitrogen	g/m³	< 0.11	-	-	-	-
Total Ammoniacal-N	g/m³	< 0.010	-	-	-	-
Nitrite-N	g/m³	< 0.002	-	-	-	-
Nitrate-N	g/m³	< 0.002	-	-	-	-
Nitrate-N + Nitrite-N	g/m³	< 0.002	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	< 0.10	-	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	-	-	-	-
Dissolved Cadmium	g/m³	< 0.00005	-	-	-	-
Dissolved Chromium	g/m³	< 0.0005	-	-	-	-
Dissolved Copper	g/m³	< 0.0005	-	-	-	-
Dissolved Lead	g/m³	< 0.00010	-	-	-	-
Dissolved Nickel	g/m³	< 0.0005	-	-	-	-
Dissolved Zinc	g/m³	< 0.0010	-	-	-	-

Analyst's Comments

#1 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NH4N analysis.

#2 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NOxN /NO2N analysis.

#3 It has been noted that the result for Total Ammoniacal-N was greater than that for Total Kjeldahl Nitrogen, but within the analytical variation of these methods.

Amended Report: This certificate of analysis replaces an earlier report issued on 18 Nov 2019 at 11:54 am
Reason for amendment: Samples GW01 - GW11 have been re-analysed as saline samples to achieve lower detection limits at the request of the client.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Saline

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	1-31
Filtration for dissolved metals analysis*	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23rd ed. 2017.	-	1-31
Dissolved Arsenic	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.004 g/m^3	1-9, 21-31
Dissolved Cadmium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0002 g/m^3	1-9, 21-31
Dissolved Chromium (III)*	Calculation: Total dissolved chromium - chromium (VI).	0.0010 g/m^3	1-20
Hexavalent Chromium*	Diphenylcarbazide colorimetry. Discrete Analyser. APHA 3500 Cr B (modified from manual analysis) 23rd ed. 2017.	0.0010 g/m^3	1-20
Dissolved Chromium	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-9, 21-31
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-9, 21-31
Dissolved Lead	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1-9, 21-31
Dissolved Nickel	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.007 g/m^3	1-9, 21-31
Dissolved Zinc	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.004 g/m^3	1-9, 21-31
Total Nitrogen*	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3.	0.05 g/m^3	1-31
Total Ammoniacal-N	Saline sample. Phenol/hypochlorite colorimetry. Flow injection analyser. (NH4-N = NH4+-N + NH3-N). APHA 4500-NH_3 H 23rd ed. 2017.	0.005 g/m^3	1-9, 21-31
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.0010 g/m^3	1-9, 21-31
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-31
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.0010 g/m^3	1-9, 21-31
Total Kjeldahl Nitrogen (TKN)*	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-31

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.00005 - 0.0010 g/m^3	10-20
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	10-20
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	10-20
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	10-20

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Appendix F: LNAPL Graphs

F1 Relationship between LNAPL thickness and groundwater elevation

Groundwater elevations and in-well LNAPL thickness were reviewed for recent (2016-2019) data for four selected wells located near the edges of the LNAPL plume (i.e. wells less likely to be acutely affected by pumping at the recovery wells). The selected wells were C1, CR4, PF22 and PF23. Graphs of groundwater elevations versus LNAPL thickness are presented in **Figure Appendix F.1** to **Figure Appendix F.4**.

In-well LNAPL thickness is positively correlated to lower groundwater elevations in wells C1, CR4 and PF23 (i.e. in-well LNAPL thicknesses are greater when the groundwater elevation is lower). This is indicative of the presence of a smear zone which is consistent with the previous understanding of the site (GHD/GWS 2014). The data for PF22 only showed a weak correlation between LNAPL thickness and groundwater elevation indicating that this well may be influenced by other factors.

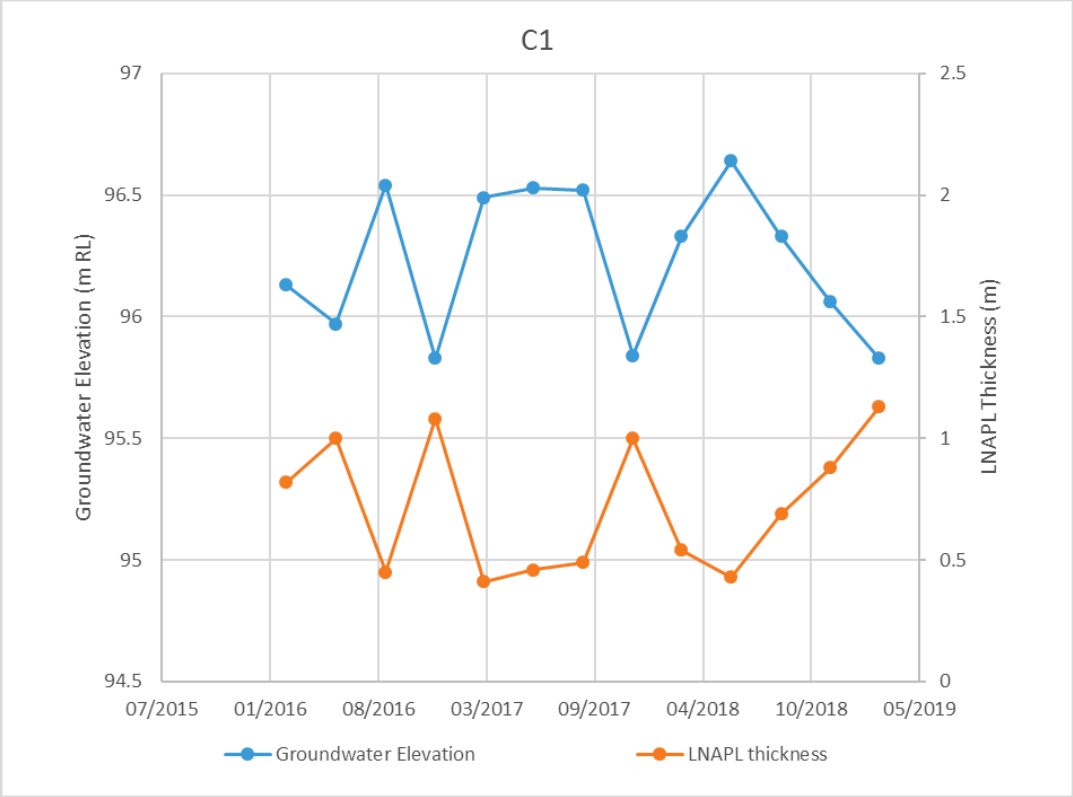

Figure Appendix F.1: C1 groundwater elevation vs LNAPL thickness

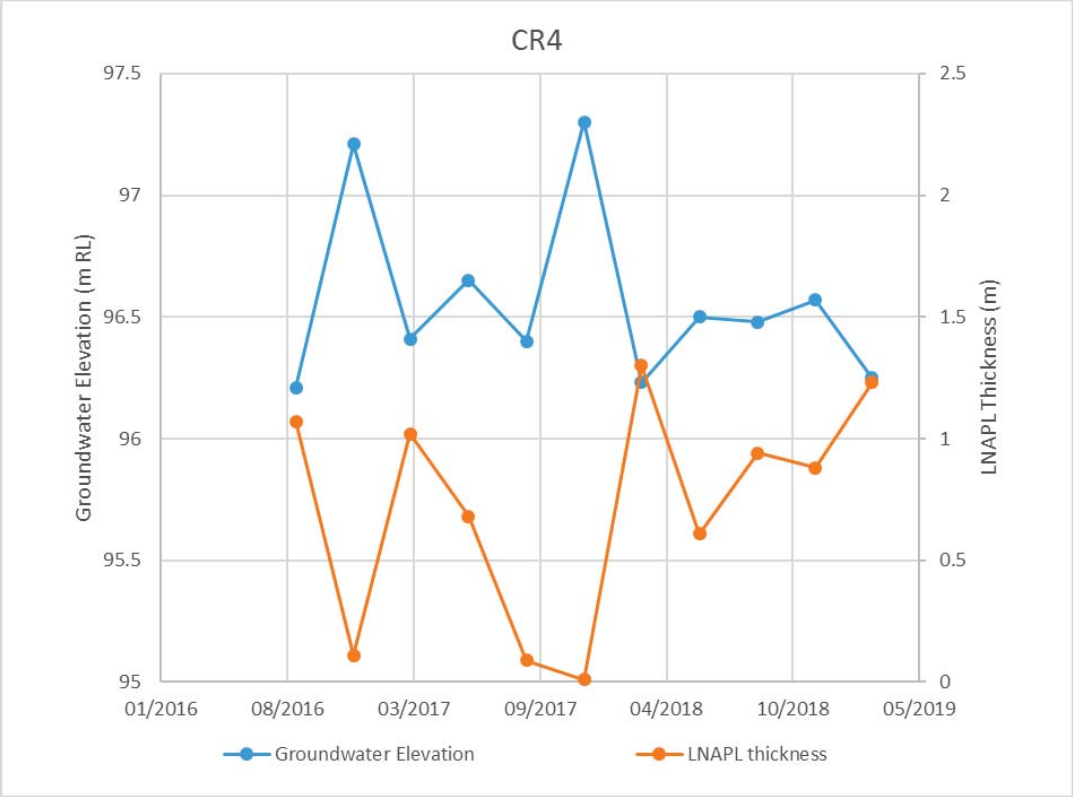

Figure Appendix F.2: CR4 groundwater elevation vs LNAPL thickness

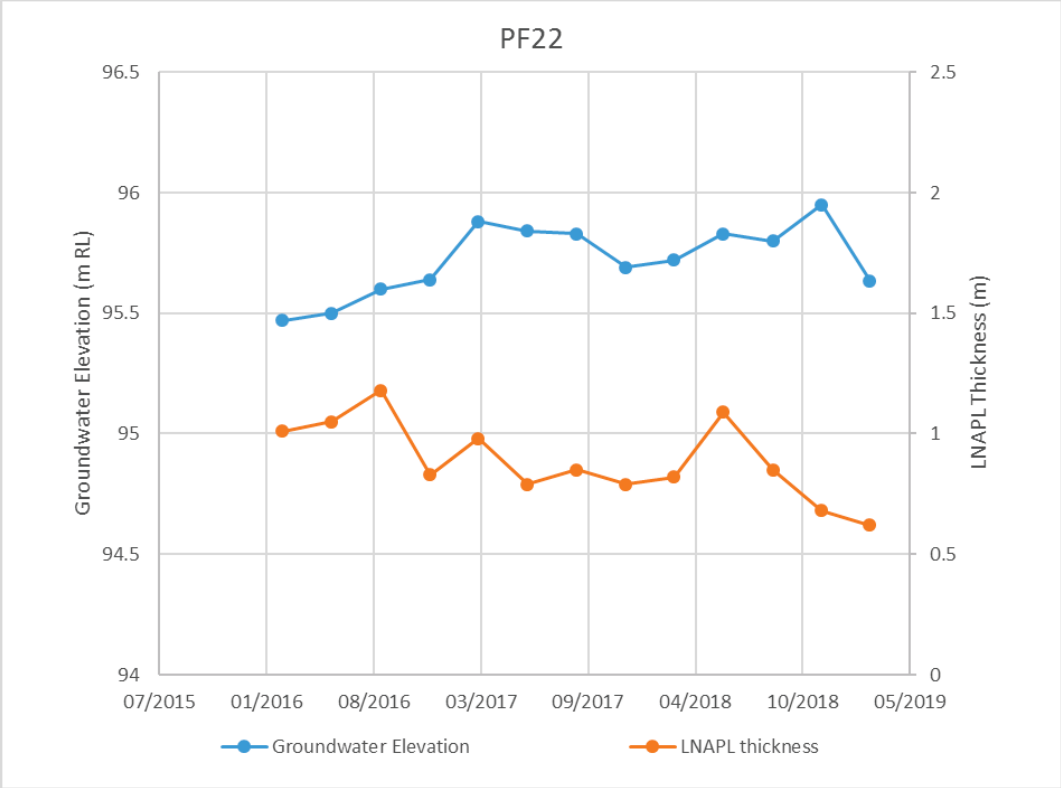

Figure Appendix F.3: PF22 groundwater elevation vs LNAPL thickness

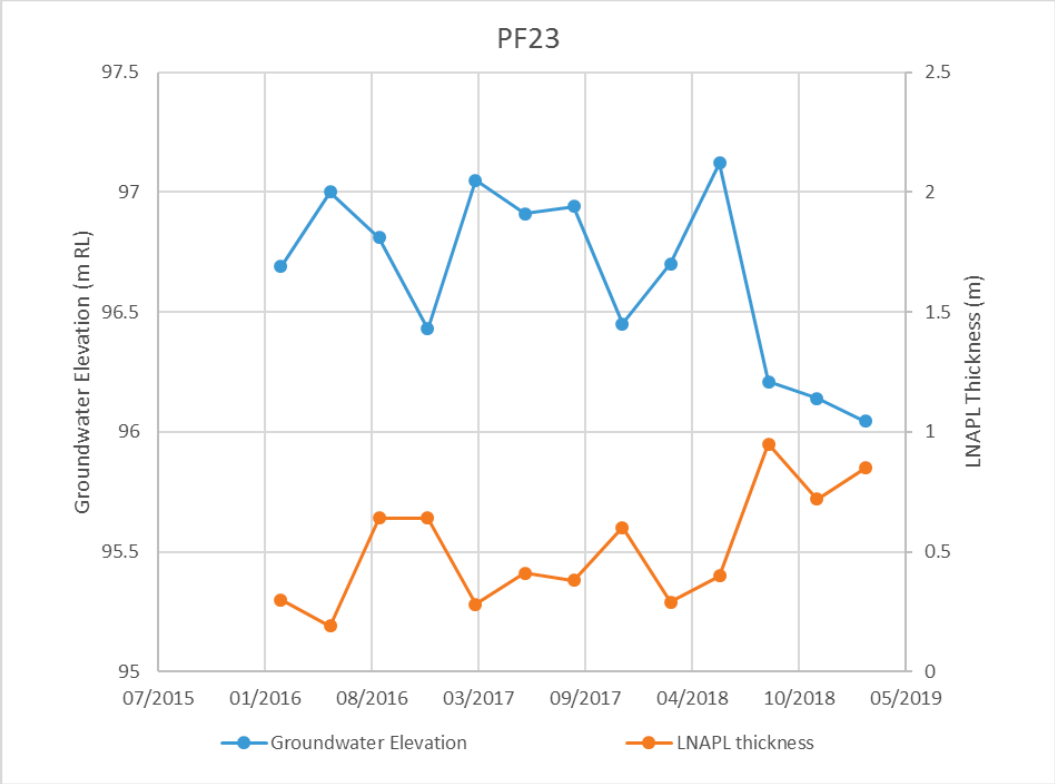

Figure Appendix F.4: PF23 groundwater elevation vs LNAPL thickness.

Appendix G: Recovery well performance data

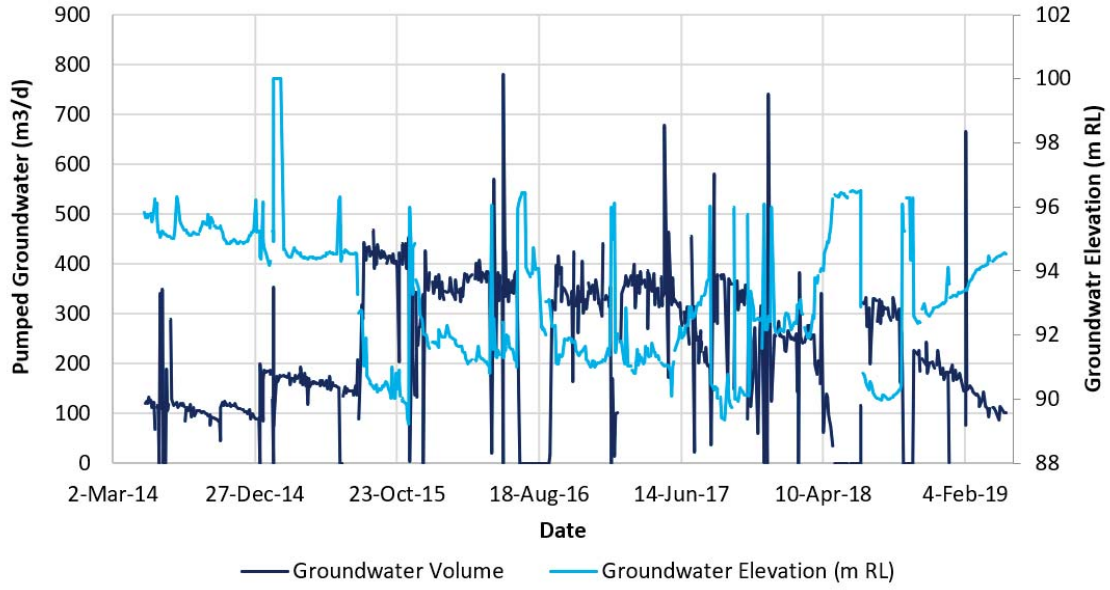

Figure Appendix G.1: Kiwi Well - Groundwater Elevation vs Groundwater Pumped

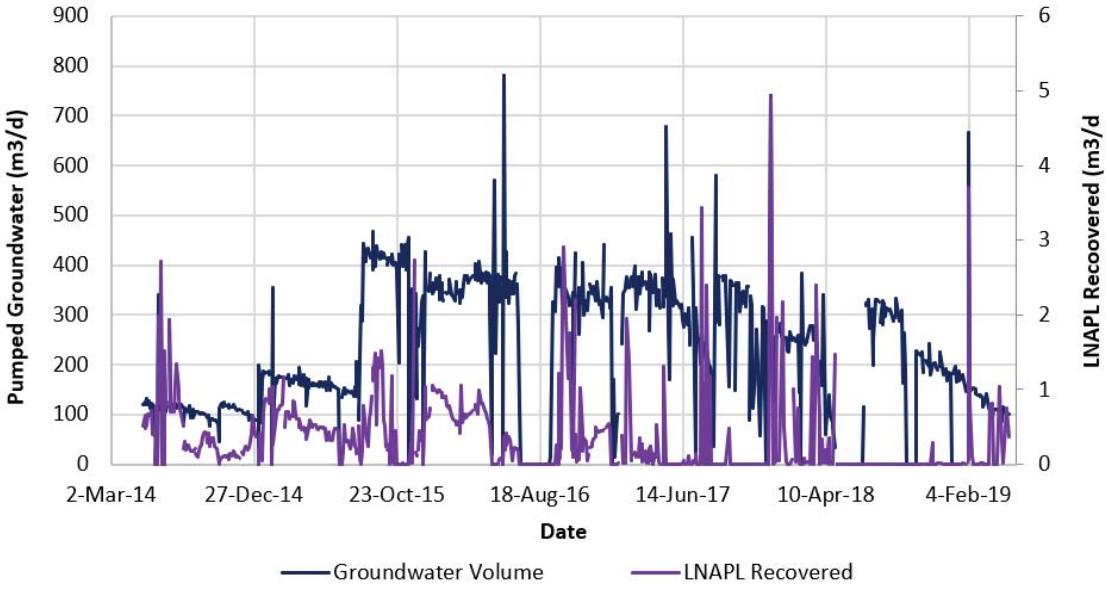

Figure Appendix G.2: Kiwi Well - Groundwater Pumped vs LNAPL Recovered

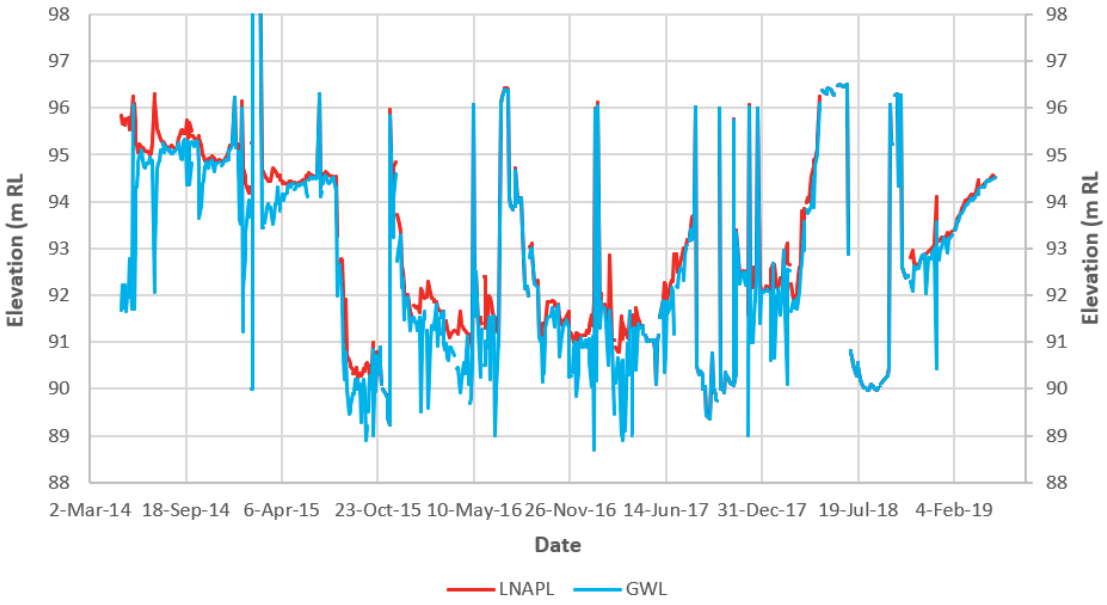

Figure Appendix G.3: Kiwi Well – LNAPL Elevation vs Groundwater Elevation

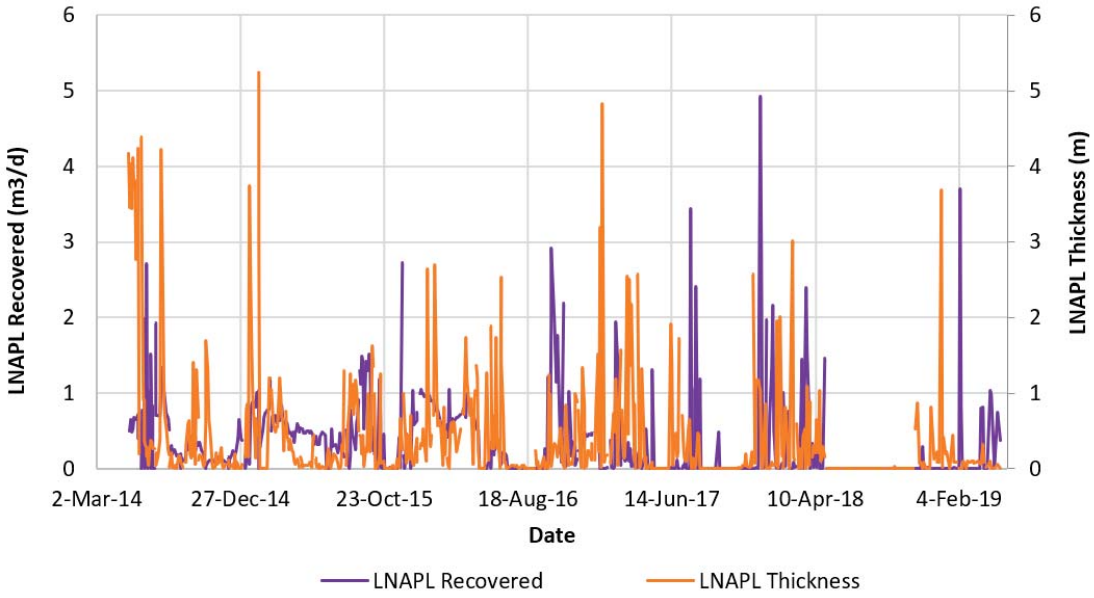

Figure Appendix G.4: Kiwi Well - LNAPL Recovered vs LNAPL Thickness

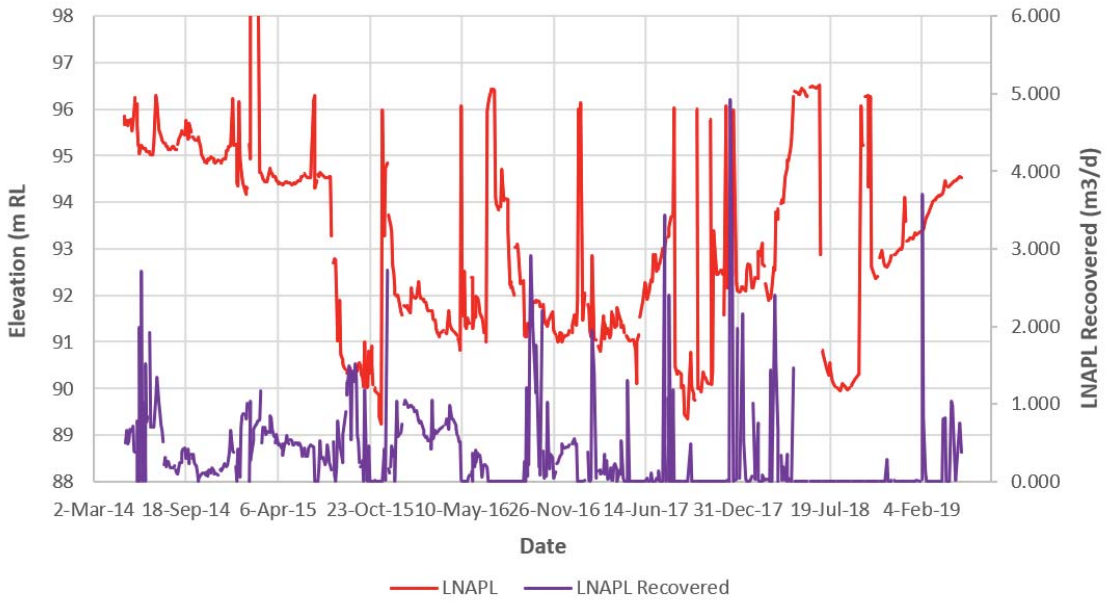

Figure Appendix G.5: Kiwi Well - LNAPL Recovered vs LNAPL Elevation

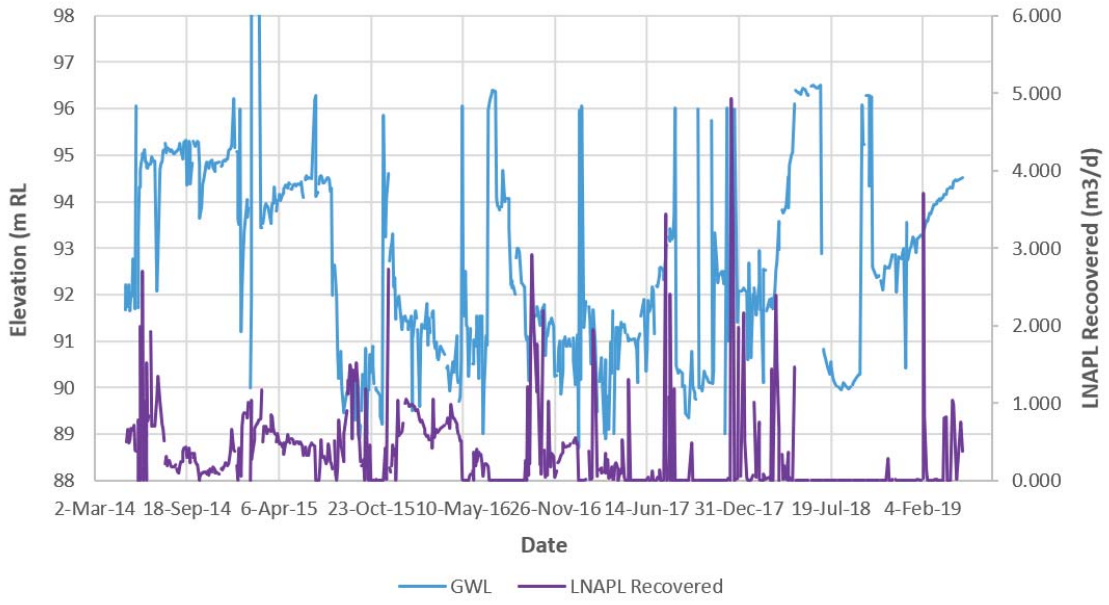

Figure Appendix G.6: Kiwi Well - LNAPL Recovered vs GWL Elevation

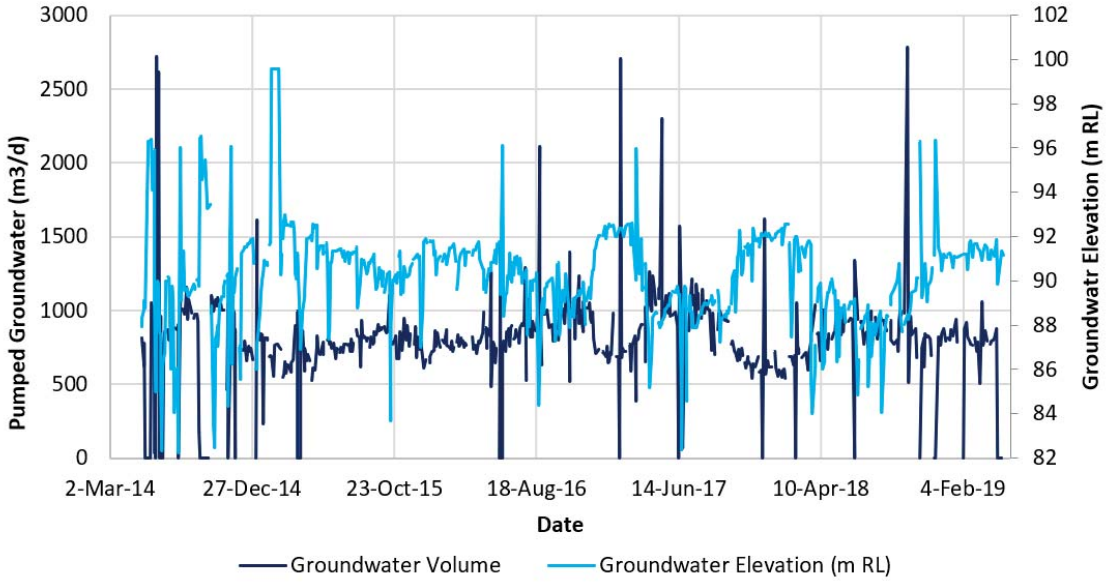

Figure Appendix G.7: RW19B - Groundwater Elevation vs Groundwater Pumped

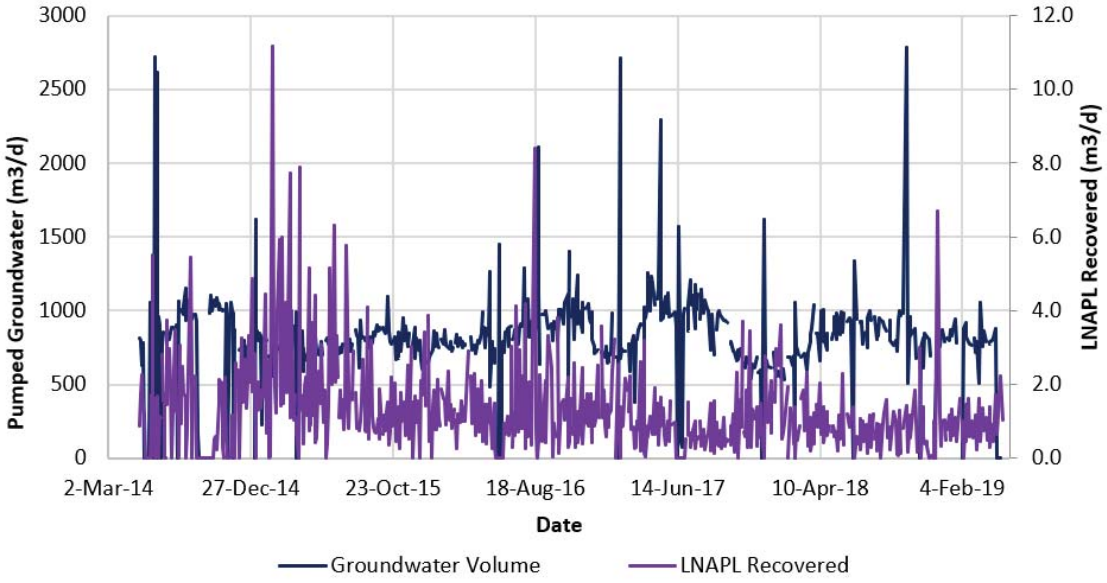

Figure Appendix G.8: RW19B - Groundwater Pumped vs LNAPL Recovered

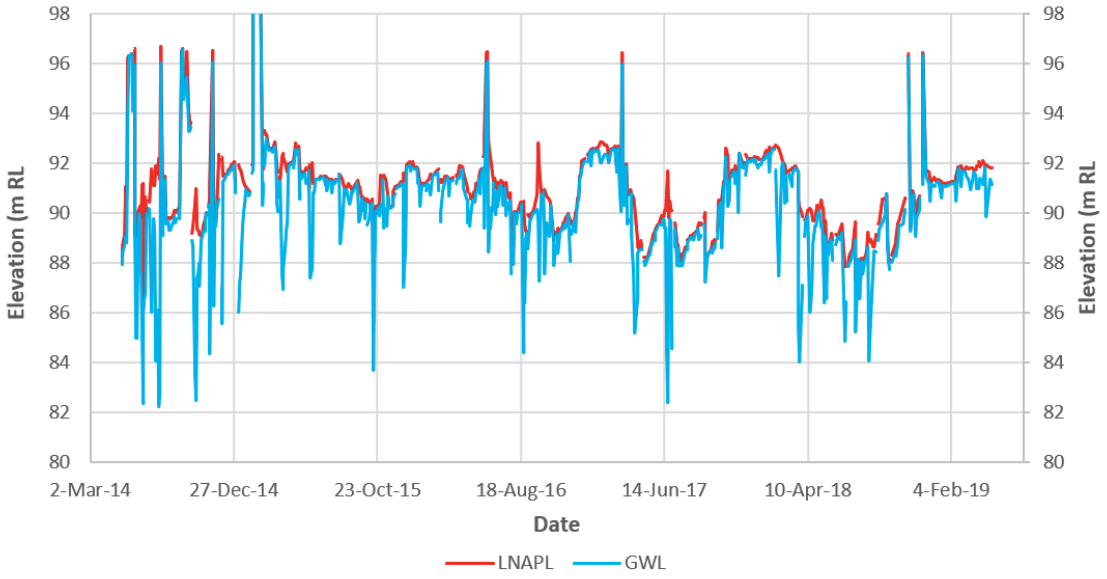

Figure Appendix G.9: RW19B – LNAPL Elevation vs Groundwater Elevation

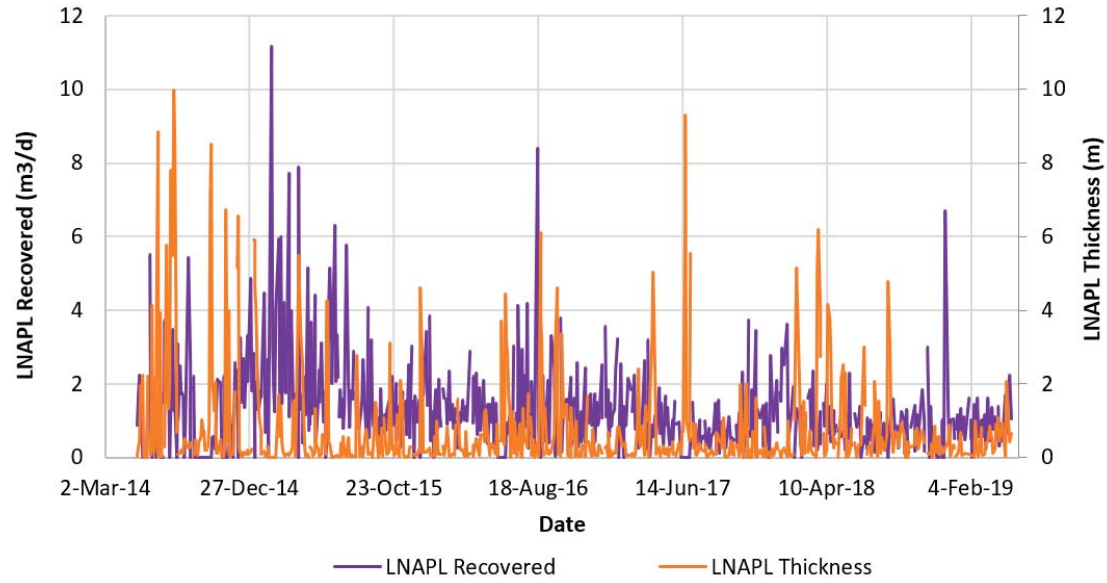

Figure Appendix G.10: RW19B - LNAPL Recovered vs LNAPL Thickness

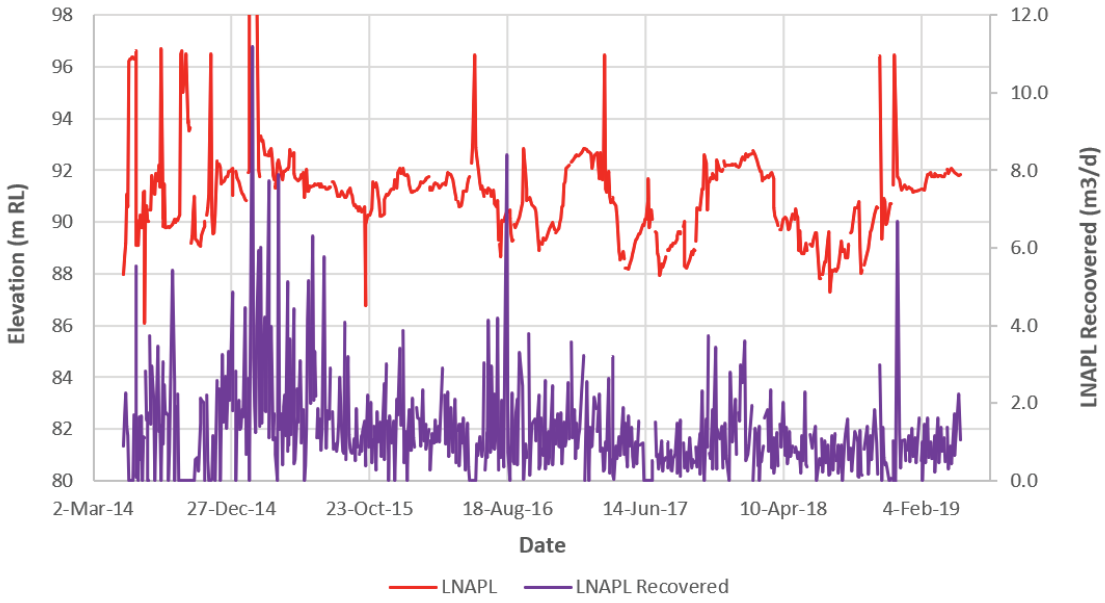

Figure Appendix G.11: RW19B - LNAPL Recovered vs LNAPL Elevation

Figure Appendix G.12: RW19B - LNAPL Recovered vs GWL Elevation

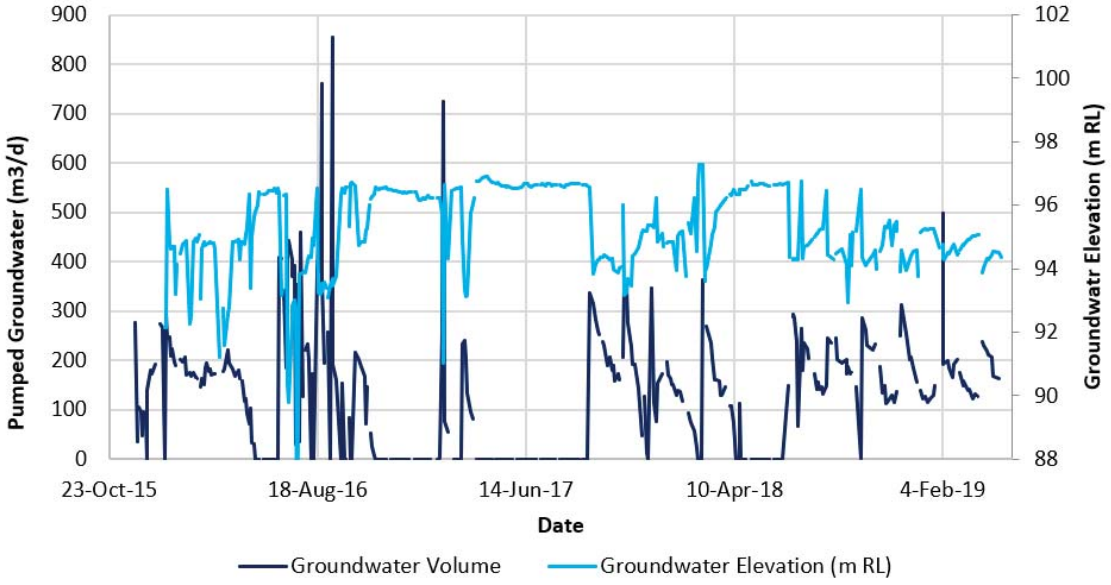

Figure Appendix G.13: RW15A - Groundwater Elevation vs Groundwater Pumped

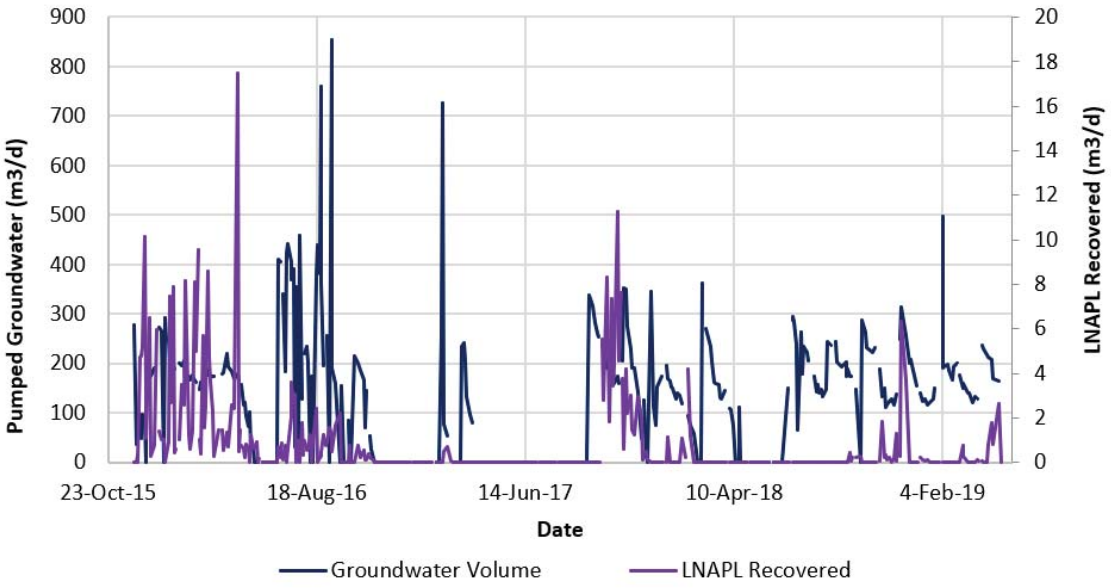

Figure Appendix G.14: RW15A - Groundwater Pumped vs LNAPL Recovered

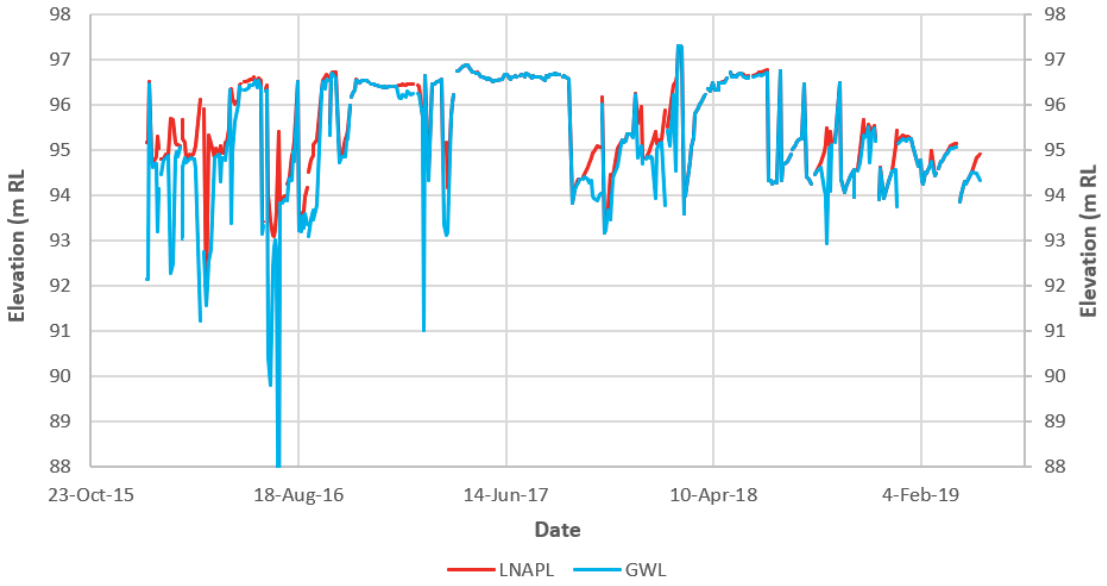

Figure Appendix G.15: RW15A – LNAPL Elevation vs Groundwater Elevation

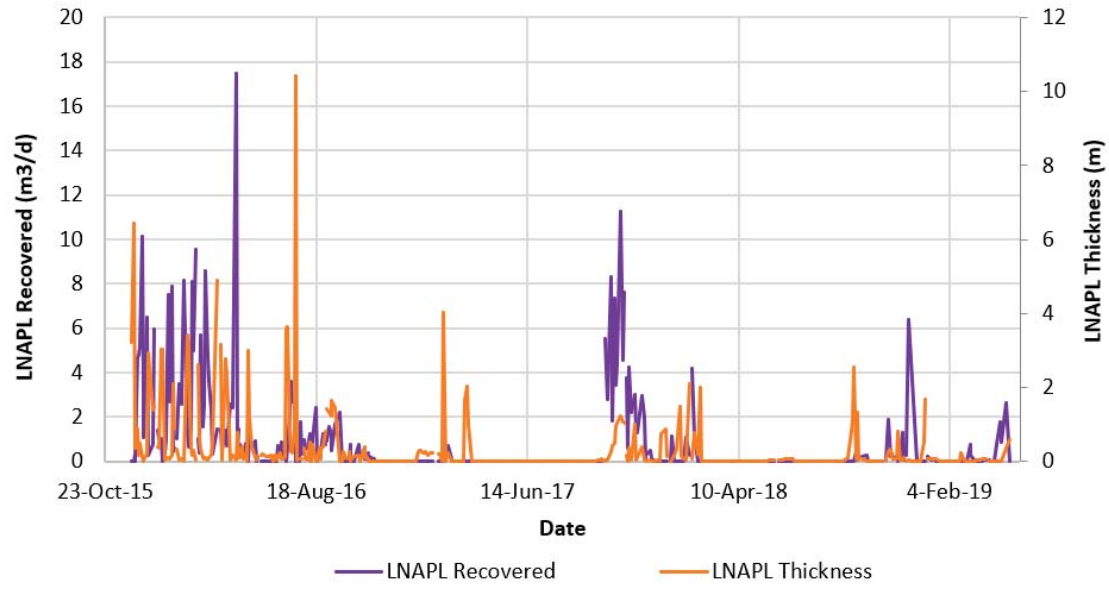

Figure Appendix G.16: RW15A - LNAPL Recovered vs LNAPL Thickness

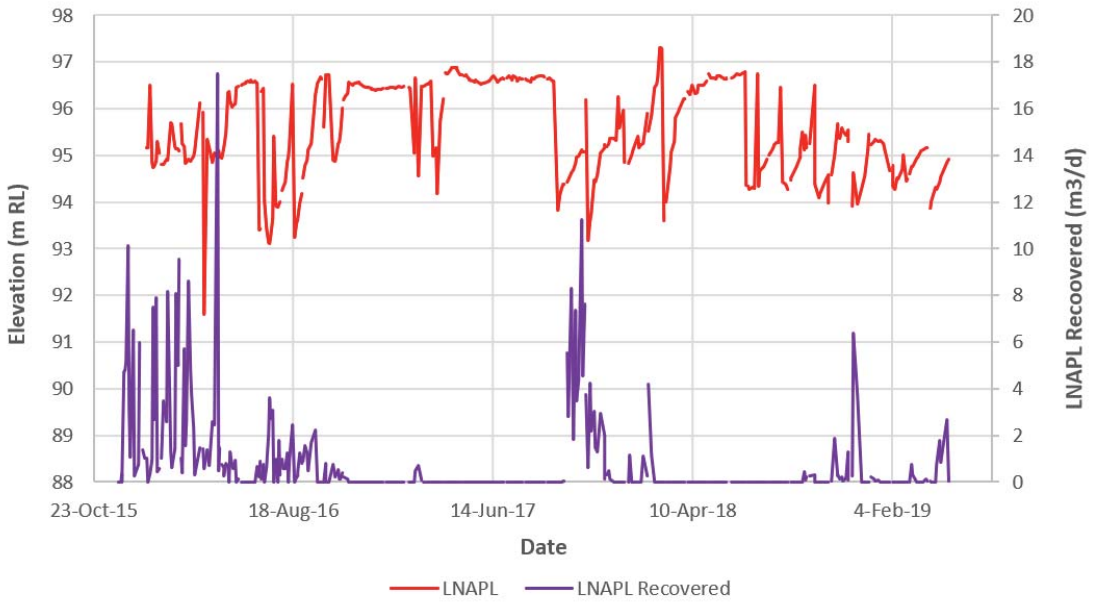

Figure Appendix G.17: RW15A - LNAPL Recovered vs LNAPL Elevation

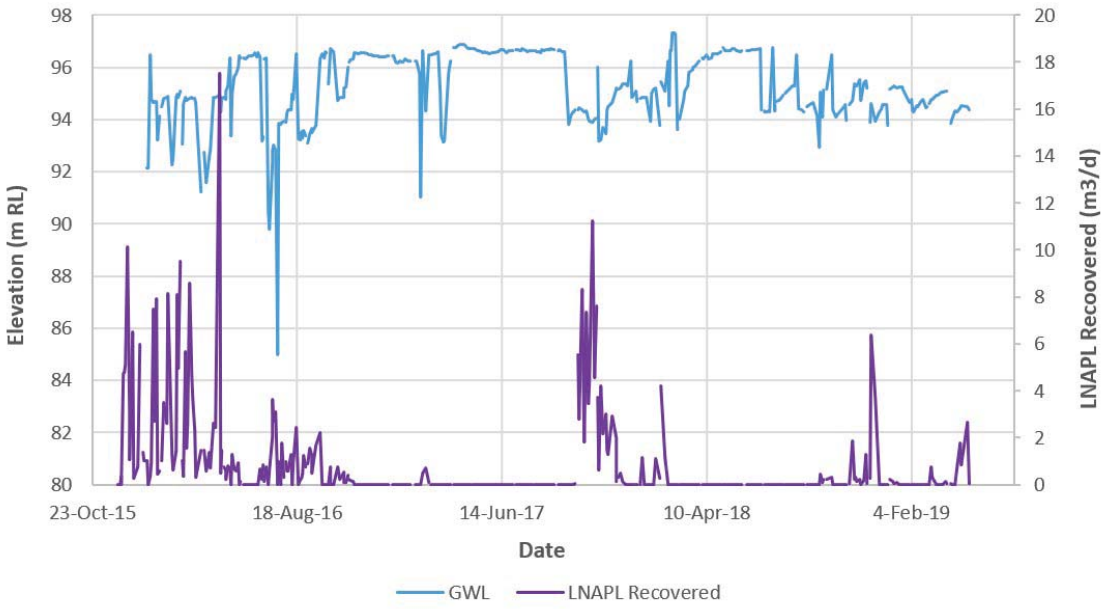

Figure Appendix G.18: RW15A - LNAPL Recovered vs GWL Elevation

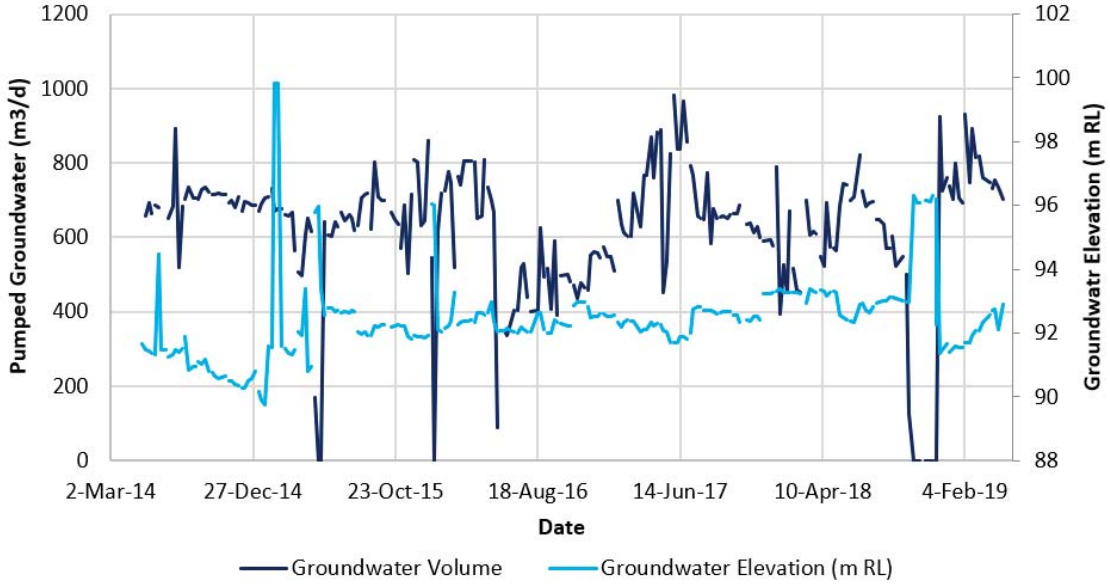

Figure Appendix G.19: RW22 - Groundwater Elevation vs Groundwater Pumped

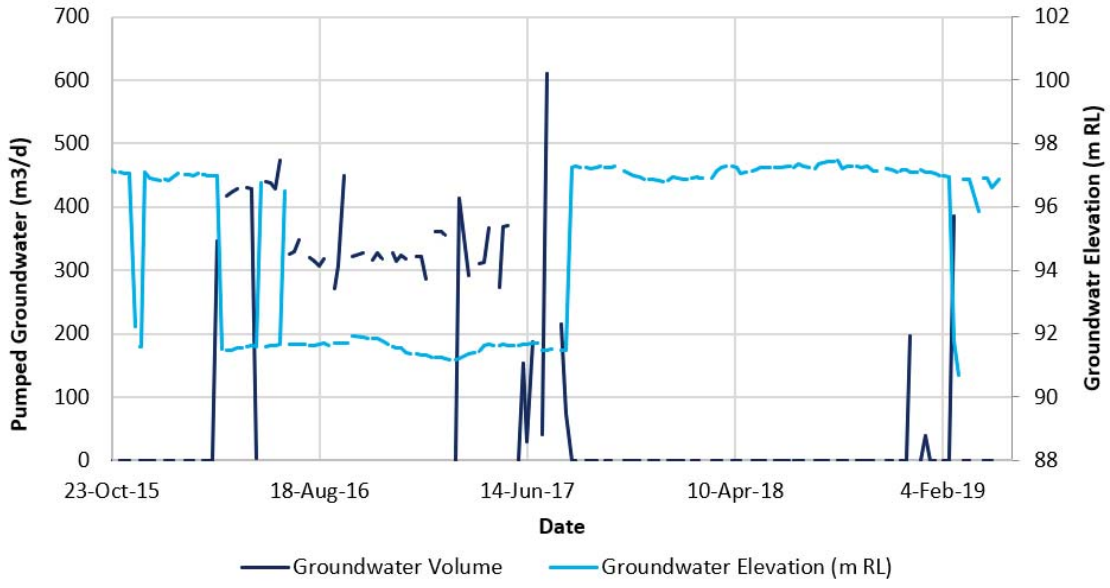

Figure Appendix G.20: Groundwater Elevation vs Groundwater Pumped

	Kiwi			RW22			RW19B			RW15			RW02			GW TOTAL	
	HC (L)	HC (m3)	GW(m3/m)	HC (L)	HC (m3)	GW(m3/m)	HC (L)	HC (m3)	GW(m3/m)	HC (L)	HC (m3)	GW(m3/m)	HC (L)	HC (m3)	GW(m3/m)	m3/month	m3/d
May-14	13353	13	2708	0	0	14121	8221	8	8930				0	0	6852	25,759	845
Jun-14	20476	20	2777	0	0	14311	233272	233	20866				0	0	6656	37,954	1,244
Jul-14	24011	24	3418	0	0	19715	16991	17	22857				0	0	9328	45,990	1,508
Aug-14	5696	6	2989	0	0	15028	20083	20	28551				0	0	6898	46,568	1,527
Sep-14	9533	10	2730	0	0	15290	0	0	4324				0	0	7393	22,344	733
Oct-14	4148	4	3031	0	0	20050	9949	10	31155				0	0	10199	54,236	1,778
Nov-14	2590	3	2605	0	0	14610	5718	6	15567				0	0	7847	32,782	1,075
Dec-14	8890	9	2931	0	0	19315	26507	27	22920				0	0	9867	45,166	1,481
Jan-15	14696	15	3913	0	0	14736	16818	17	18561				0	0	7288	37,210	1,220
Feb-15	17379	17	4252	0	0	14152	28818	29	17930				0	0	7252	36,334	1,191
Mar-15	18905	19	4818	0	0	13340	30864	31	18514				0	0	0	36,672	1,202
Apr-15	13621	14	4560	0	0	16550	24796	25	21501				0	0	0	42,611	1,397
May-15	13376	13	4479	0	0	4486	23277	23	18872				0	0	2465	27,837	913
Jun-15	8268	8	3112	0	0	13129	30888	31	20652				0	0	0	36,893	1,210
Jul-15	8950	9	4490	0	0	18070	23251	23	22749				0	0	0	45,309	1,486
Aug-15	11102	11	10233	0	0	15682	14448	14	22285				0	0	0	48,200	1,580
Sep-15	30630	31	11701	0	0	20357	14997	15	23578				0	0	53	55,636	1,824
Oct-15	6913	7	10611	0	0	8985	13400	13	23430				0	0	0	43,026	1,411
Nov-15	16252	16	8973	0	0	13333	13369	13	23470				0	0	2	45,776	1,501
Dec-15	14860	15	8986	0	0	21425	15893	16	20597	42774	43	4027	0	0	1	55,035	1,804
Jan-16	23287	23	8463	0	0	9358	10624	11	17941	22419	22	5296	0	0	0	41,058	1,346
Feb-16	17440	17	9296	0	0	12996	12020	12	20797	40115	40	4848	0	0	0	47,937	1,572
Mar-16	18787	19	9882	0	0	21347	12279	12	21079	31246	31	4687	0	0	2428	56,995	1,869
Apr-16	18987	19	9408	0	0	15470	9969	10	19357	27135	27	4591	0	0	9309	48,826	1,601
May-16	2420	2	7889	0	0	9510	9794	10	20022	5904	6	1655	0	0	5600	39,076	1,281
Jun-16	6660	7	10036	0	0	10200	9001	9	18682	1761	2	2042	0	0	12457	40,960	1,343
Jul-16	514	1	1059	0	0	10422	20342	20	24198	15873	16	8374	0	0	7026	44,053	1,444
Aug-16	0	0	0	0	0	13466	20793	21	28123	8750	9	7386	0	0	8815	48,975	1,606
Sep-16	3366	3	7339	0	0	9703	12093	12	25878	7218	7	4010	0	0	6631	46,930	1,539
Oct-16	35231	35	9301	0	0	10382	9111	9	28192	2879	3	3740	0	0	6811	51,615	1,692
Nov-16	7750	8	8960	0	0	10137	10962	11	27226	307	0	219	0	0	7061	46,542	1,526
Dec-16	11291	11	9839	0	0	14957	13681	14	25274	0	0	0	0	0	8661	50,070	1,642
Jan-17	4681	5	5177	0	0	12267	14782	15	19893	0	0	0	0	0	7077	37,337	1,224
Feb-17	11264	11	7219	0	0	12346	10715	11	17597	1288	1	2620	0	0	7185	39,782	1,304
Mar-17	3869	4	10674	0	0	18461	9533	10	22442	1289	1	5244	0	0	7838	56,821	1,863
Apr-17	2941	3	8424	0	0	17580	6764	7	26128	0	0	0	0	0	6863	52,132	1,709
May-17	1319	1	9390	0	0	13062	9777	10	30124	0	0	0	0	0	7183	52,576	1,724
Jun-17	545	1	8585	0	0	23630	1496	1	23446	0	0	0	0	0	2440	55,661	1,825
Jul-17	11634	12	5055	0	0	14557	5814	6	24421	0	0	0	0	0	4558	44,033	1,444
Aug-17	7209	7	8446	0	0	18693	6939	7	28756	0	0	1	0	0	2108	55,896	1,833
Sep-17	2886	3	7940	0	0	13742	4602	5	23702	49	0	4845	0	0	0	50,229	1,647
Oct-17	0	0	9262	0	0	8768	10852	11	19500	51576	52	5207	0	0	0	42,737	1,401
Nov-17	0	0	5847	0	0	17421	10634	11	17716	17826	18	6304	0	0	0	47,288	1,550
Dec-17	30414	30	6029	0	0	11766	9951	10	16911	619	1	3445	0	0	0	38,151	1,251
Jan-18	11403	11	7048	0	0	14065	17339	17	16410	2504	3	4081	0	0	0	41,604	1,364
Feb-18	4183	4	5818	0	0	6374	6964	7	16723	1173	1	2093	0	0	0	31,008	1,017
Mar-18	22154	22	6804	0	0	12806	8591	9	21036	0	0	5246	0	0	0	45,892	1,505
Apr-18	8220	8	2827	0	0	12246	8769	9	22325	0	0	1172	0	0	0	38,570	1,265
May-18	0	0	0	0	0	18029	9278	9	24285	0	0	0	0	0	0	42,314	1,387
Jun-18	0	0	231	0	0	15529	4286	4	21171	14	0	299	0	0	0	37,230	1,221
Jul-18	0	0	8663	0	0	15204	6202	6	25180	0	0	5894	0	0	0	54,941	1,801
Aug-18	0	0	0	0	0	16312	6779	7	24369	0	0	4675	0	0	0	45,356	1,487
Sep-18	0	0	0	0	0	11318	4345	4	20121	741	1	4636	0	0	0	36,075	1,183
Oct-18	0	0	0	0	0	891	6261	6	24937	296	0	5959	0	0	0	31,787	1,042
Nov-18	1204	1	4994	0	0	0	3218	3	16480	4301	4	3375	0	0	0	24,849	815
Dec-18	61	0	4478	0	0	17511	6596	7	20929	10075	10	6174	0	0	1970	49,092	1,610
Jan-19	117	0	4765	0	0	20289	6788	7	23377	291	0	3737	0	0	0	52,168	1,710
Feb-19	5831	6	3876	0	0	17946	6703	7	21997	9	0	4677	0	0	2699	48,496	1,590
Mar-19	5814	6	3179	0	0	16540	7166	7	21782	1233	1	3943	0	0	0	45,444	1,490
Apr-19	16235	16	2807	0	0	15932	7284	7	22086	6072	6	5534	0	0	0	46,359	1,520

Figure Appendix G.21: Summary of Groundwater Pumped and Hydrocarbons Recovered by Month

Appendix H: Water balance

H1 Methodology

An assessment of the water balance at the Refinery site has been undertaken as a means of assessing the effects of the existing groundwater abstraction relative to recharge rates and groundwater throughflow. This assessment then allows the determination of groundwater outflows at the coastline that determine the likely risk of saline intrusion and the yield that be sustainably taken from the site. The water balance has been undertaken on a monthly basis given that the water meters on the abstraction bores are generally read on a fortnightly basis.

The methodology has been firstly to calculate the total area of the site that has impervious cover that is connected to the sites reticulated stormwater network. This area is shown in red in the **Figure Appendix H.1** below. The balance of the site is then assumed to be subject to rainfall infiltration via soakage and this area is considered to constitute groundwater recharge given that no overland surface water flows are observed at the site except under extreme rainfall conditions. An allowance has been made to account for less recharge entering the groundwater system due to soil evaporative losses which is assumed to be 10% based on published information that relates soil evaporation to pan evaporation. This relationship is shown in **Figure Appendix H.2**. Assuming a pan factor of 0.7 for total evaporative loss, the relationship shows that soil evaporation is in the order of 1/10 of this, or 0.07. Rounding this to 0.1, the water balance calculations then assume 10% of the rainfall is lost due to soil evaporation and 90% goes to soakage and aquifer recharge.

Groundwater throughflow has been included in the water balance calculations by assessing the hydraulic gradient between well CF53 and CF33 (locations shown on **Figure B3**) from water level measurements made during the quarterly full site gauging. The hydraulic gradients were then used in Darcy calculations to determine the amount of throughflow across the site's western boundary. These calculations are provided in **Figure Appendix H.4**

The water balance than has two components to the groundwater input; rainfall recharge and throughflow. The groundwater outputs for the water balance are abstraction from the recovery wells and groundwater discharge at the coastline. The abstracted volumes of groundwater are known from pumping records and so the groundwater discharge can be calculated from the total input less the amount abstracted. The results of the water balance are included in **Figure Appendix H.5** to **Figure Appendix H.10**.

Figure Appendix H.1: Areas within the Refinery Site connected to reticulated stormwater (387,580 m^2)

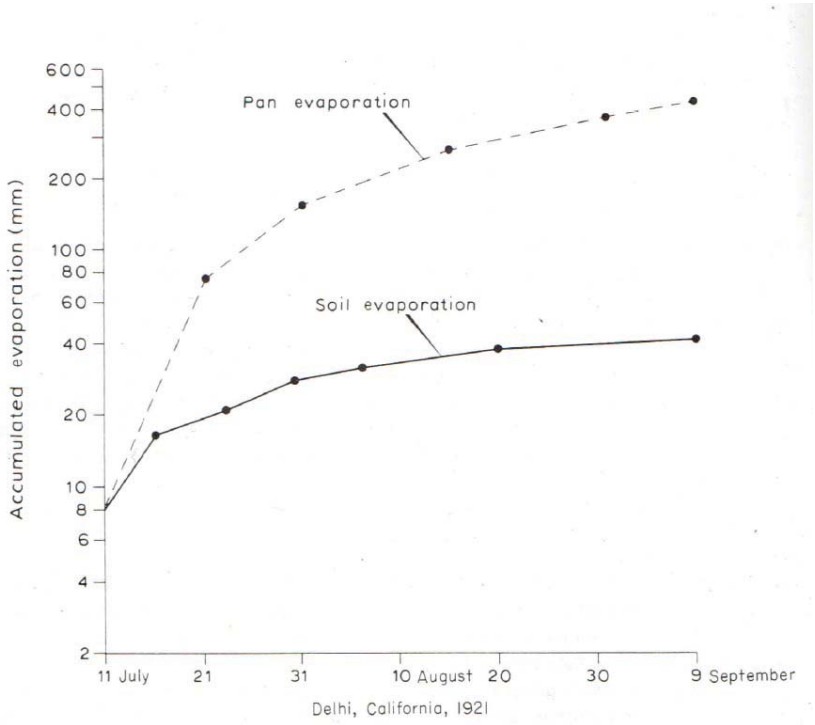

Figure Appendix H.2: Relationship between Soil Evaporation and Pan Evaporation (Veihmeyer and Brooks, 1954)

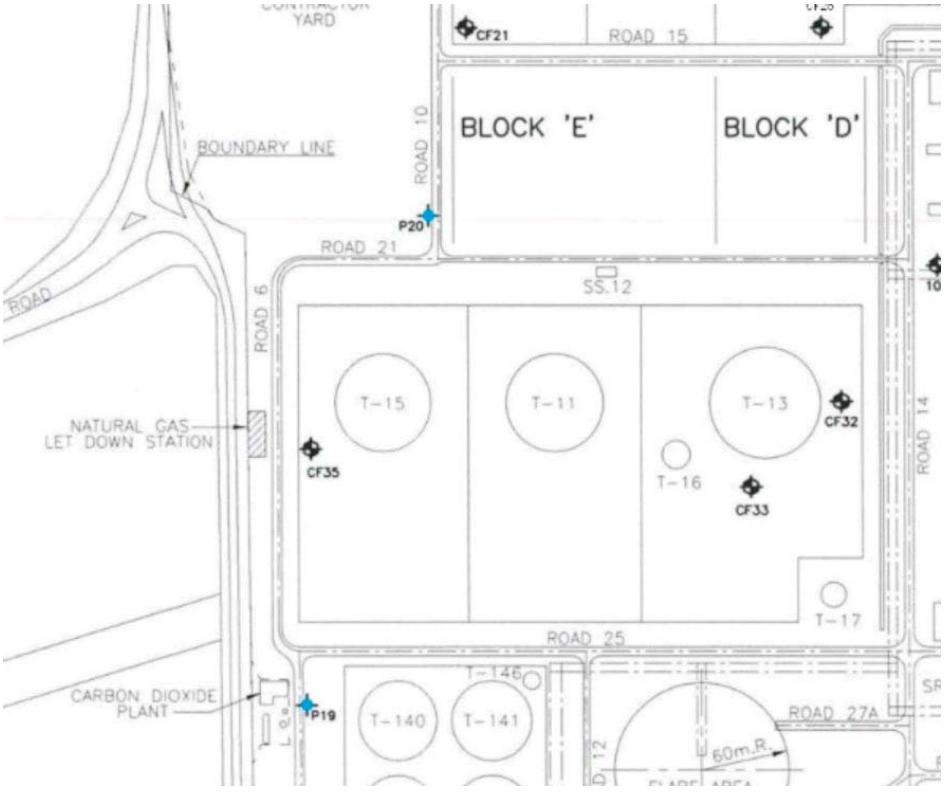

Figure Appendix H.3: Location of Wells CF35 and CF33

Well Name	1/03/2016	dist (m)	1/06/2016		1/09/2016		1/12/2016	
	GW RL	305	GW RL	305	GW RL	305	GW RL	305
CF33	96.91		97.35		97.37		96.99	
CF35	97.8	0.89	97.8	0.45	97.83	0.46	98.03	1.04
	i	0.00292		0.00148		0.00151		0.00341
	K (m/d)	0.86400		0.86400		0.86400		0.86400
	A (1,400m x 20m)	28000		28000		28000		28000
	Q m3/d	**71**		**36**		**36**		**82**
	m3/month	**2153**		**1089**		**1113**		**2516**

Well Name		dist (m)	1/06/2017		1/09/2017		1/12/2017	
	GW RL	305	GW RL	305	GW RL	305	GW RL	305
CF33			97.22		97.25		96.88	
CF35			98.68	1.46	98.71	1.46	97.85	0.97
	i			0.00479		0.00479		0.00318
	K (m/d)			0.86400		0.86400		0.86400
	A (1,400m x 20m)			28000		28000		28000
	Q m3/d			**116**		**116**		**77**
	m3/month			**3532**		**3532**		**2347**

Well Name	1/03/2019	dist (m)	1/06/2018		1/09/2018		1/12/2017	
	GW RL	305	GW RL	305	GW RL	305	GW RL	305
CF33	96.84		97.4		97.33		97.03	
CF35	97.68	0.84	98.88	1.48	98.83	1.5	98.64	1.61
	i	0.00275		0.00485		0.00492		0.00528
	K (m/d)	0.86400		0.86400		0.86400		0.86400
	A (1,400m x 20m)	28000		28000		28000		28000
	Q m3/d	**67**		**117**		**119**		**128**
	m3/month	**2032**		**3580**		**3629**		**3895**

	March	2000	June	3500	Sept	3600	Dec	2500

J	2333
F	2167
M	**2000**
A	2500
M	3000
J	**3500**
J	3533
A	3567
S	**3600**
O	3233
N	2867
D	**2500**

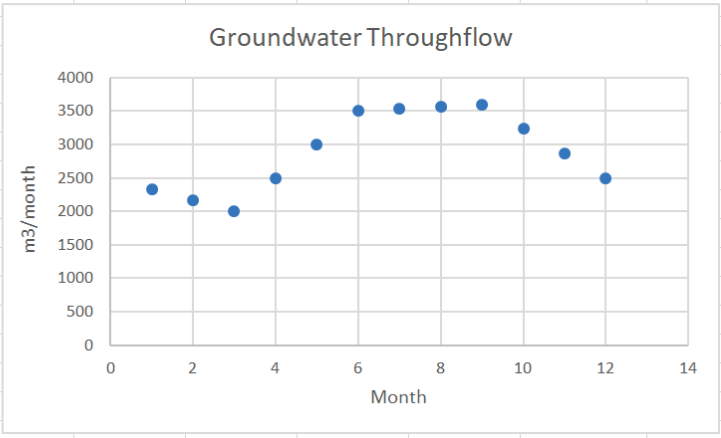

Figure Appendix H.4: Groundwater Throughflow Across the Western Site Boundary

		IN	IN	GW TOTAL IN	
		Soakage	**Throughflow**		**Storm Water**
Site Area	1,226,750	839,170			387,580
Soakage Factor		0.9			1
	Rainfall				
Date	*mm/month*	*m3/month*	*m3/month*	*m3/month*	*m3/month*
May-14	23.8	17,975	3,000	20,975	9,224
Jun-14	239.0	180,505	3,500	184,005	92,632
Jul-14	340.8	257,390	3,533	260,924	132,087
Aug-14	206.8	156,186	3,567	159,753	80,152
Sep-14	182.6	137,909	3,600	141,509	70,772
Oct-14	86.0	64,952	3,233	68,185	33,332
Nov-14	46.6	35,195	2,867	38,061	18,061
Dec-14	178.6	134,888	2,500	137,388	69,222
Jan-15	24.6	18,579	2,333	20,913	9,534
Feb-15	61.2	46,221	2,167	48,388	23,720
Mar-15	75.2	56,795	2,000	58,795	29,146
Apr-15	61.8	46,675	2,500	49,175	23,952
May-15	147.4	111,324	3,000	114,324	57,129
Jun-15	84.4	63,743	3,500	67,243	32,712
Jul-15	104.0	78,546	3,533	82,080	40,308
Aug-15	130.4	98,485	3,567	102,052	50,540
Sep-15	185.8	140,326	3,600	143,926	72,012
Oct-15	68.6	51,810	3,233	55,044	26,588
Nov-15	50.0	37,763	2,867	40,629	19,379
Dec-15	12.6	9,516	2,500	12,016	4,884
Jan-16	145.6	109,965	2,333	112,298	56,432
Feb-16	114.8	86,703	2,167	88,870	44,494
Mar-16	151.4	114,345	2,000	116,345	58,680
Apr-16	77.2	58,306	2,500	60,806	29,921
May-16	95.4	72,051	3,000	75,051	36,975
Jun-16	117.0	88,365	3,500	91,865	45,347
Jul-16	134.6	101,657	3,533	105,190	52,168
Aug-16	130.2	98,334	3,567	101,901	50,463
Sep-16	81.8	61,780	3,600	65,380	31,704
Oct-16	83.2	62,837	3,233	66,070	32,247
Nov-16	80.2	60,571	2,867	63,438	31,084
Dec-16	20.2	15,256	2,500	17,756	7,829
Jan-17	20.2	15,256	2,333	17,589	7,829
Feb-17	88.4	66,764	2,167	68,931	34,262
Mar-17	209.0	157,848	2,000	159,848	81,004
Apr-17	245.8	185,641	2,500	188,141	95,267
May-17	90.4	68,275	3,000	71,275	35,037
Jun-17	173.0	130,659	3,500	134,159	67,051
Jul-17	115.0	86,854	3,533	90,387	44,572
Aug-17	149.2	112,684	3,567	116,250	57,827
Sep-17	109.6	82,776	3,600	86,376	42,479
Oct-17	53.2	40,179	3,233	43,413	20,619
Nov-17	93.6	70,692	2,867	73,558	36,277
Dec-17	25.8	19,486	2,500	21,986	10,000
Jan-18	113.8	85,948	2,333	88,281	44,107
Feb-18	195.8	147,879	2,167	150,045	75,888
Mar-18	3.2	2,417	2,000	4,417	1,240
Apr-18	73.4	55,436	2,500	57,936	28,448
May-18	115.4	87,156	3,000	90,156	44,727
Jun-18	340.6	257,239	3,500	260,739	132,010
Jul-18	95.4	72,051	3,533	75,584	36,975
Aug-18	72.4	54,680	3,567	58,247	28,061
Sep-18	124.6	94,105	3,600	97,705	48,292
Oct-18	42.4	32,023	3,233	35,256	16,433
Nov-18	105.6	79,755	2,867	82,621	40,928
Dec-18	127.2	96,068	2,500	98,568	49,300
Jan-19	10.2	7,704	2,333	10,037	3,953
Feb-19	32.4	24,470	2,167	26,637	12,558
Mar-19	35.2	26,585	2,000	28,585	13,643
Apr-19	75.8	57,248	2,500	59,748	29,379

Figure Appendix H.5: Groundwater Inputs and Stormwater Output by Month

	Rainfall (mm)	IN Soakage (m3)	IN Throughflow (m3)	GW TOTAL IN (m3)	SW Discharge (m3)
2015	1,006	759,785	34,800	794,584	389,905
2016	1,232	930,170	34,800	964,969	477,344
2017	1,373	1,037,113	34,800	1,071,913	532,225
2018	1,410	1,064,756	34,800	1,099,556	546,410
Average	1,255	947,956	34,800	982,756	486,471
Proportion		96%	4%		

Figure Appendix H.6: Groundwater Inputs and Stormwater Output Annual Summary

	OUT **Groundwater Take**	OUT **GW Discharge**	**GW TOTAL OUT**
Date	*m3/month*	*m3/month*	*m3/month*
May-14	25,759	-4,784	20,975
Jun-14	37,954	146,051	184,005
Jul-14	45,990	214,934	260,924
Aug-14	46,568	113,185	159,753
Sep-14	22,344	119,165	141,509
Oct-14	54,236	13,949	68,185
Nov-14	32,782	5,279	38,061
Dec-14	45,166	92,222	137,388
Jan-15	37,210	-16,297	20,913
Feb-15	36,334	12,054	48,388
Mar-15	36,672	22,123	58,795
Apr-15	42,611	6,564	49,175
May-15	27,837	86,487	114,324
Jun-15	36,893	30,350	67,243
Jul-15	45,309	36,771	82,080
Aug-15	48,200	53,852	102,052
Sep-15	55,636	88,290	143,926
Oct-15	43,026	12,018	55,044
Nov-15	45,776	-5,147	40,629
Dec-15	55,035	-43,019	12,016
Jan-16	41,058	71,240	112,298
Feb-16	47,937	40,933	88,870
Mar-16	56,995	59,350	116,345
Apr-16	48,826	11,980	60,806
May-16	39,076	35,975	75,051
Jun-16	40,960	50,905	91,865
Jul-16	44,053	61,137	105,190
Aug-16	48,975	52,926	101,901
Sep-16	46,930	18,450	65,380
Oct-16	51,615	14,455	66,070
Nov-16	46,542	16,896	63,438
Dec-16	50,070	-32,314	17,756
Jan-17	37,337	-19,748	17,589
Feb-17	39,782	29,149	68,931
Mar-17	56,821	103,027	159,848
Apr-17	52,132	136,009	188,141
May-17	52,576	18,699	71,275
Jun-17	55,661	78,498	134,159
Jul-17	44,033	46,354	90,387
Aug-17	55,896	60,354	116,250
Sep-17	50,229	36,147	86,376
Oct-17	42,737	676	43,413
Nov-17	47,288	26,270	73,558
Dec-17	38,151	-16,165	21,986
Jan-18	41,604	46,677	88,281
Feb-18	31,008	119,037	150,045
Mar-18	45,892	-41,475	4,417
Apr-18	38,570	19,366	57,936
May-18	42,314	47,842	90,156
Jun-18	37,230	223,509	260,739
Jul-18	54,941	20,643	75,584
Aug-18	45,356	12,891	58,247
Sep-18	36,075	61,630	97,705
Oct-18	31,787	3,469	35,256
Nov-18	24,849	57,772	82,621
Dec-18	49,092	49,476	98,568
Jan-19	52,168	-42,131	10,037
Feb-19	48,496	-21,859	26,637
Mar-19	45,444	-16,859	28,585
Apr-19	46,359	13,389	59,748

Figure Appendix H.7: Groundwater Output by Month

	OUT	OUT	GW TOTAL OUT
	Groundwater Take (m3)	GW Discharge (m3)	(m3)
2015	510,539	284,045	794,584
2016	563,037	401,932	964,969
2017	572,643	499,270	1,071,913
2018	478,718	620,838	1,099,556
Average	531,234	451,521	982,756
Proportion	54%	46%	

Figure Appendix H.8: Groundwater Output Annual Summary

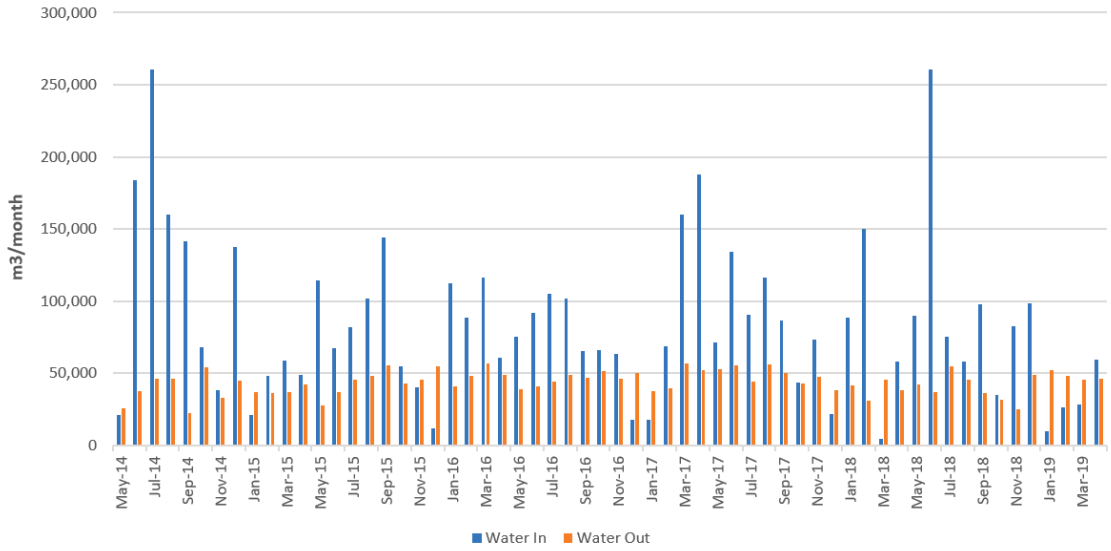

Figure Appendix H.9: Monthly Water Balance

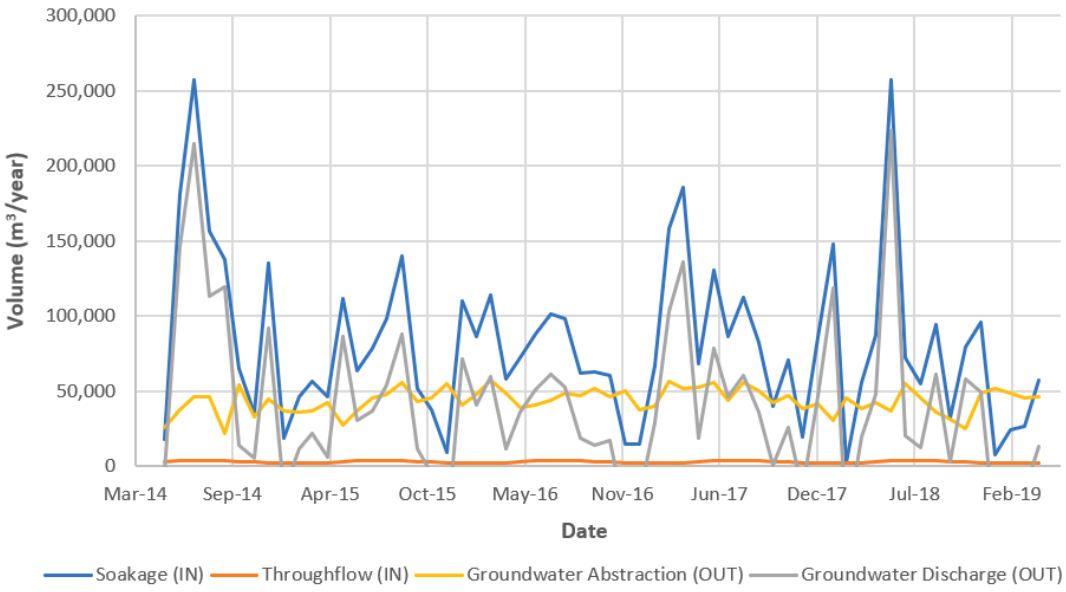

Figure Appendix H.10: Water Balance Component

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