BHP

Orebody 29/30/35 Water (PFAS) Management Plan

November 2024

Document amendment record

Version	Version description	Key changes	Date
Version 0	Draft version for Traditional Owner review	Original document	21 August 2024
Version 1	Final version as part of the EPA referral of the Orebody 29/30/35 Significant Amendment	Minor editorial amendments and clarifications following Traditional Owner review	19 November 2024

Abbreviations and Definitions

Term	Meaning
BHP	BHP Iron Ore Pty Ltd
BWT	Below Water Table
ANZECC & ARMCANZ	Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)
CEO	Chief Executive Officer
CS Act	*Contaminated Sites Act 2003*
DWER	Department of Water and Environmental Regulation
DWG	Drinking Water Guideline
ECL	Environmental Concern Level
EIL	Ecological Investigation Levels
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EPWRMP	Eastern Pilbara Water Resource Management Plan
FTS	Fluorotelomer Sulfonic Acid
GIS	Geographic Information System
GL/a	Gigalitres per annum
HEPA	Heads of EPA
LOR	Limits of Reporting
LC	Lethal Concentration
MAR	Managed Aquifer Recharge
MS	Ministerial Statement
Mtpa	Million tonnes per annum
NEMP	National Environmental Management Plan
NHMRC	National Health and Medical Research Council
OB	Orebody
PDWSA	Public Drinking Water Supply Area
PFAS	per- and poly-fluoro alkyl substances
PFHxS	Perfluoro hexane sulfonate

Term	Meaning
PFOA	Perfluoro octanoate
PFOS	Perfluoro octane sulfonate
RIWI Act	*Rights in Water and Irrigation Act 1914*
SPL	Species Protection Level
TARP	Trigger and Response Plan
TEC	Threatened Ecological Community
UCL	Upper Confidence Level
WA	Western Australia
WPMP	Water (PFAS) Management Plan
WTP	Wastewater Treatment Plant

Contents

Tables

Figures

Executive summary

Orebody 29/30/35 Water (PFAS) Management Plan	
Proposal name	Orebody 29/30/35 Significant Amendment
Proponent name	BHP Iron Ore Pty Ltd
Ministerial Statement	XXXX
Purpose of the EMP	To meet the requirements of Ministerial Statement XXXX Condition B1-4 (Inland Waters Environment Management Plan)
Key environmental factors and EMP outcome	**Inland Waters** 1) Per- and Poly-fluoro Alkyl Substances (PFAS) concentrations in the combined surplus dewatered groundwater from Orebody 29/30/35 discharged to Ophthalmia Dam and in surface water within Ophthalmia Dam will remain below 30% of the human health (drinking water) guideline value and 10% of the ecological 95% guideline value in the PFAS National Environment Management Plan (NEMP) (HEPA 2020).
Condition clauses	Condition B1 Inland Waters (B1-3 and B1-4).
Key components of the plan	Outcomes-based components, including early warning, trigger and threshold criteria for water quality (PFAS concentrations) in: • combined Orebody 29/30/35 dewatered groundwater discharge prior to discharge to Ophthalmia Dam • surface water in Ophthalmia Dam.
Proposed construction date	Not applicable. Orebody 29/30/35 is in operation
EMP required pre-construction?	Not applicable. Orebody 29/30/35 is in operation.

1 Context, scope and rationale

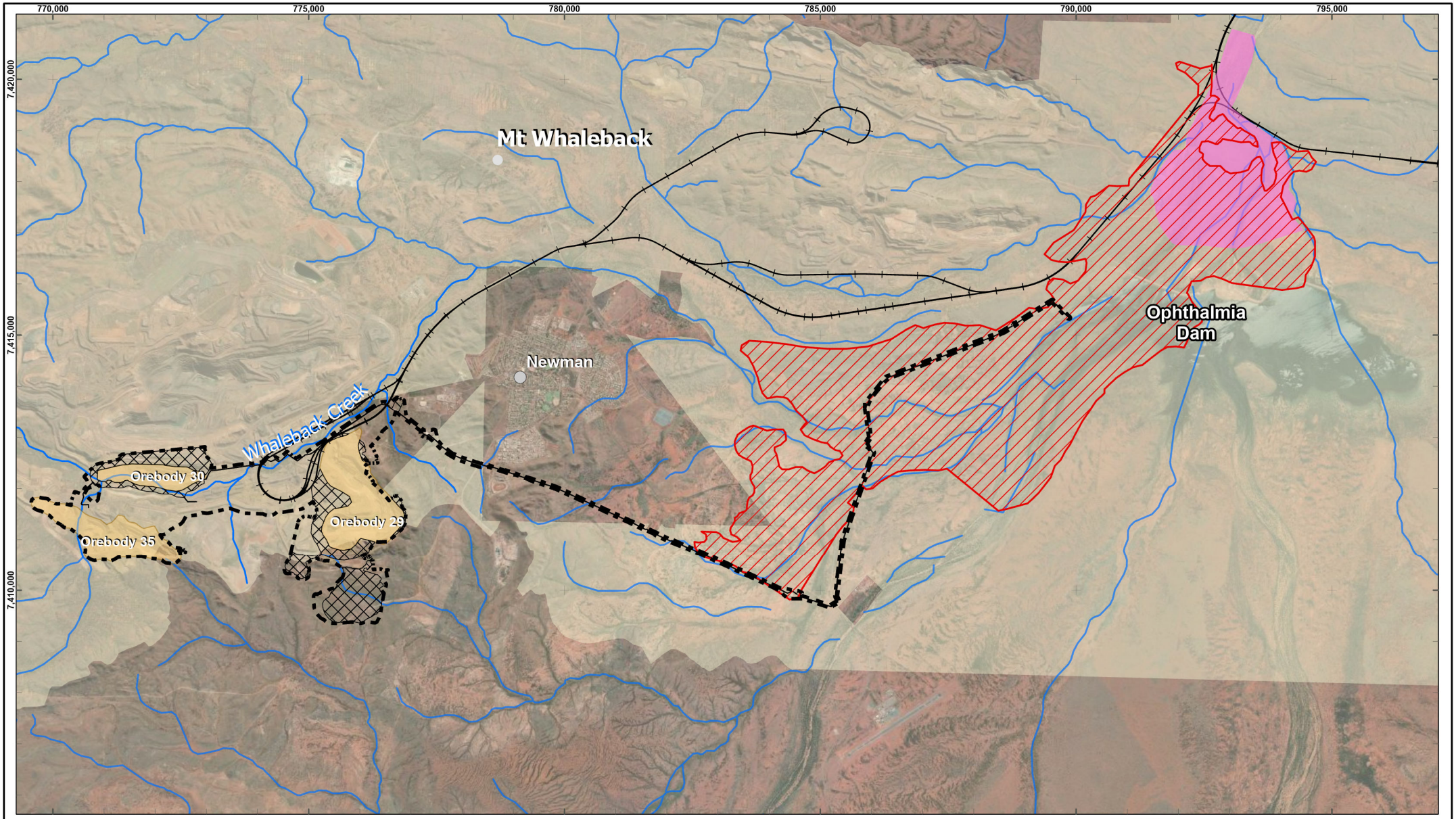
BHP Iron Ore Pty Ltd (BHP) has prepared this Water (PFAS) Management Plan (WPMP) to meet the requirements under Part IV of the *Environmental Protection Act 1986* (EP Act). The plan is submitted as a draft with the referral documentation for the Orebody 29/30/35 Significant Amendment (BHP 2024a). The intent for the WPMP is to meet the requirements of Ministerial Statement XXXX (MSXXXX) Condition B1-4 Inland waters environmental management plan.

BHP has prepared this WPMP to be consistent with the *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (hereafter, the Instructions) (EPA 2024d).

1.1 Proposal

The Proposal includes an increase in the rate of groundwater abstraction for mine dewatering at Orebody 29/30/35 from the authorised extent of 8 gigalitres per annum (GL/a) under MS963 to 24.5 GL/a. This change in groundwater abstraction will also result in an associated increase to the discharge of surplus water to Ophthalmia Dam from the authorised extent of 8 GL/a under MS963 to 20.8 GL/a. The Proposal also includes the construction and operation of a new surplus water pipeline from Orebody 29/30/35 to Ophthalmia Dam, expansion of mine pits and additional Overburden Storage Areas and a ramp.

The Proposal is part of the larger Mt Whaleback mining operations (which includes the Mt Whaleback mine), located in the Eastern Pilbara region of Western Australia (Figure 1).



- BHP rail
- Watercourse
- Ministerial Statement 963
- Newman Priority 1 PDWSA
- Development Envelope
- Indicative Footprint
- Threatened Ecological Community
- Ethel Gorge primary habitat monitoring zone

N

0 1 2 3 4 5
KILOMETRES

GDA 1994 MGA ZONE 50

BHP

PUBLIC

OREBODY 29/30/35 WATER (PFAS) MANAGEMENT PLAN

Proposal Location

RESOURCE ENGINEERING - IRON ORE

SCALE @ A4:	1:100,000	PREPARED:	GEOMATICS	FIGURE:	1
DATE:	31/10/2024	REQUESTOR:	ENV. APPROVALS	NO:	929/077F

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1.2 Key environmental factors

The key environmental factor relevant to this WPMP is Inland Waters, specifically in relation to the potential for direct and indirect impacts to groundwater from per-and poly-fluoro alkyl substances (PFAS) in groundwater at Orebody 29/30/35 and surface water in Ophthalmia Dam, which recharges the Ethel gorge aquifer which supports the Ethel Gorge aquifer Stygobiont Threatened Ecological Community (Ethel Gorge TEC).

Table 1 describes the activities, values and potential impacts on the key environmental factors addressed in this WPMP.

Table 1: Key environmental factors, values and activities

Key environmental factor	Environmental values	Proposal activities	Actual/Potential impacts
Inland Waters	Newman Water Reserve P1 Public Drinking Water Source Area (PDWSA) Ethel Gorge aquifer	Discharge of surplus dewatered groundwater to Ophthalmia Dam Managed Aquifer Recharge (MAR) system	**Direct impacts** Potential change to surface water quality in Ophthalmia Dam as a result of PFAS in surplus dewatered groundwater, discharged to the dam. Potential change to groundwater quality in the Ethel Gorge aquifer from groundwater recharge from Ophthalmia Dam.

1.3 Condition requirements

BHP has provided the proposed condition requirements of MSXXXX Condition B1-4 and Condition C3 relating to the WPMP in the components tables (see Section 2), which the Instructions allow for, if there are multiple conditions and/or condition clauses. The proposed conditions are provided in the Environmental Review Document (ERD) for the Proposal (BHP 2024a: Appendix 3).

Condition C1-6 of MSXXXX requires publication of EMPs. BHP will publish the endorsed WPMP on the BHP website and provide to DWER in a suitable electronic form for online publication, to meet the condition requirements.

1.4 Rationale and approach

As required by the Instructions, this section provides a description of the rationale and approach for the components in this WPMP.

Environmental baseline investigations at the Mt Whaleback mining operations, specifically near Orebody 29/30/35, have identified PFAS at concentrations above the Australian drinking water quality guideline value (DWG) but below the recreational use guideline value in the *PFAS National Environmental Management Plan 2.0* (PFAS NEMP) (HEPA 2020). Given there is the potential for PFAS to migrate (as a result of dewatering) from potential and known sources of PFAS that are present within and adjacent to Orebody 29/30/35, BHP has proposed a comprehensive monitoring and mitigation program in this WPMP. BHP has also phased out the usage of PFAS-containing compounds across all its operations and so the potential for the future introduction of PFAS-containing compounds and the subsequent release to the environment of PFAS through mining operations is considered to be very low.

This WPMP has been developed in accordance with the precautionary principle and includes criteria (early response indicators, triggers, and thresholds) for PFAS detections, and associated response actions, if required.

1.4.1 Management approach

BHP applied a risk-based approach to identify and prioritise the components of this WPMP. The purpose of the components is to protect the environmental values identified in Table 1. In developing the components, BHP has used available scientific information from recent investigations and studies and has applied learnings from the management of PFAS in groundwater at other BHP and/or third party mine sites.

1.4.1.1 Sub-regional and site level management

BHP uses a regional and site specific approach to manage the impacts of its operations on water-related environmental values. At the Pilbara scale, BHP applies a regional approach to water management, as outlined in the *Pilbara Water Resource Management Strategy* (BHP 2020), which feeds into regional and site level management.

BHP applies the following approach to EP Act Part IV EMPs for water management:

- Sub-regional level EMPs are developed to manage potential impacts to regional environmental values (e.g. Ethel Gorge TEC) from multiple BHP hubs.
- Site level EMPs are developed to manage potential impacts to local environmental values from one BHP mine/hub.

Both levels of EMPs are complemented by controls and monitoring in other statutory decision-making processes for water-related activities. This includes regulation administered by the DWER, through the EP Act Part V, *Rights in Water and Irrigation Act 1914* (RiWI Act) and the *Contaminated Sites Act 2003* (CS Act).

The water management framework for the Newman Hub is shown in Figure 2.

As outlined in Section 1.1, this WPMP addresses the management of PFAS water quality for the Orebody 29/30/35 Proposal. BHP has developed a site level water (PFAS) management plan because the risk posed by PFAS is different for different mines, and hence the criteria, monitoring and mitigation are different for different mines. Therefore, BHP has developed a staged approach to PFAS monitoring and management, where PFAS monitoring and mitigation is targeted at the site scale (i.e. at the mine site) and monitoring and management at the sub-regional scale (i.e. in Ophthalmia Dam) will only be required if certain PFAS levels are reached in the surplus dewatered groundwater discharge from a particular mine, prior to discharge to

Ophthalmia Dam. BHP notes that Part V regulates emissions and discharges, including substances that have the potential to contaminate surface and groundwater.

Other relevant Part IV EMPs for Orebody 29/30/35

The potential impacts on environmental values from the discharge of surplus water from Orebody 29/30/35 (and other BHP mines) to Ophthalmia Dam at the sub-regional level is addressed in the Eastern Pilbara Water Resource Management Plan (EPWRMP) (BHP 2024b).

1.4.1.2 Other regulation related to the WPMP

This WPMP does not duplicate monitoring and/or controls in other statutory decision-making processes for water-related activities in the Orebody 29/30/35 Development Envelope and in the Newman PDWSA (Figure 2). This includes regulation administered by the Department of Water and Environmental Regulation (DWER), through the EP Act Part V, RiWI Act and the CS Act.

Region

Pilbara Water Resource Management Strategy

Sub-region

Part IV EP Act: Eastern Pilbara Water Resource Management Plan

- Ethel Gorge TEC: Eastern Ridge MS1037 Condition 8, Pilbara Expansion Strategic Proposal MS1105 Condition 10, MSXXXX Condition B1 and B2 (*if approved*)

Newman town water supply

RiWI 5C Homestead Borefield GWL177235(2) and Ophthalmia Borefield GWL65219(12) and Operating Strategies

- Limit on rate of groundwater abstraction
- Monitoring at the source (production bores) – abstraction rate, volume, groundwater quality
- Monitoring along pathway – groundwater levels

Country Areas Water Supply Act 1947

- Specifies the geometry of proclaimed P1 and P3 areas;
- Manage land use activities within the P1 and P3 areas in accordance with WQPN 25;
- Catchment management, surveillance, & monitoring managed jointly between BHP and Water Corporation to correct or reduce external contamination risk.

Water Services Act 2013

- Provides framework to issue licence for the provision of water services (including drinking water);
- Licence requires risk management approach from source to consumption point including definition of treatment critical control points, monitoring, and response actions.
- Risk management approach includes source & catchment management;
- Requires MoU with WA DoH for the drinking water management system.

Site

This EMP

Whaleback including Orebody 29/30/35	Western Ridge	Eastern Ridge (including Orebody 32 BWT)
EP Act Part IV Orebody 29/30/35 MSXXXX (*if approved*) • Condition A1: Limitations and extents (dewatering abstraction rate, Ophthalmia Dam discharge rate) • Condition B1: Inland Waters – outcome to limit PFAS concentrations in in the combined surplus dewatered groundwater from Orebody 29/30/35 discharged to Ophthalmia Dam and in surface water within Ophthalmia Dam – implement **Orebody 29/30/35 Water (PFAS) Management Plan** to meet outcome	EP Act Part IV s45B Notice: Statement 1105 – No 2 • Authorised extents (dewatering abstraction rate, Ophthalmia Dam discharge rate) EP Act Part IV MS1105 (and s45B Notice: Statement 1105 – No 2) • Condition 10 Water Environmental Management Plan (Water (PFAS) Management Plan)	EP Act Part IV Eastern Ridge MS1037 • Authorised extents (dewatering abstraction rate, Ophthalmia Dam discharge rate) EP Act Part IV s45B Notice: Statement 1105 – No 1 • Authorised extents (dewatering abstraction rate, Ophthalmia Dam discharge rate) EP Act Part IV MS1105 (and s45B Notice: Statement 1105 – No 1) • Condition 10 Water Environmental Management Plan (Water (PFAS) Management Plan)
EP Act Part V L4503/1975/14 (*amend if approved*) • Limit on the rate of emissions (discharge to Ophthalmia Dam) • Specifies the location of emissions • Specifies monitoring: flow rate, volume and water quality (including PFAS, if required)	EP Act Part V licence (*new if approved*) • Limit on the rate of emissions (discharge to Ophthalmia Dam) • Specifies the location of emissions • Specifies monitoring: flow rate, volume and water quality (including PFAS, if required)	EP Act Part V L6942/1997/13 (*amend if OB32 BWT approved*) • Limit on the rate of emissions (discharge to Ophthalmia Dam) • Specifies the location of emissions • Specifies monitoring: flow rate, volume and water quality (including PFAS, if required)
RiWI 5C GWL65148(11) and Operating Strategy (*amend if approved*) • Limit on rate of groundwater abstraction • Monitoring at the source (dewatering bores) – abstraction rate, volume, groundwater levels and quality • Monitoring along pathway – groundwater levels	RiWI 5C GWL and Operating Strategy (*new if approved*) • Limit on rate of groundwater abstraction • Monitoring at the source (dewatering bores) – abstraction rate, volume, groundwater levels and quality • Monitoring along pathway – groundwater levels	RiWI 5C GWL182237(4) and Operating Strategy (*amend or new if OB32 BWT approved*) • Limit on rate of groundwater abstraction • Monitoring at the source (dewatering bores) – abstraction rate, volume, groundwater levels and quality • Monitoring along pathway – groundwater levels
Contaminated Sites Act • PFAS National Environmental Management Plan (HEPA 2020) • Contaminated Sites PFAS Interim Site Management Plan Whaleback (BHP 2023)	Contaminated Sites Act • PFAS National Environmental Management Plan (HEPA 2020)	Contaminated Sites Act • PFAS National Environmental Management Plan (HEPA 2020)

Figure 2: Newman Hub water management framework

1.4.2 Rationale

Table 2 provides the rationale for the WPMP components in Section 2, including:

- environmental outcomes
- study findings
- key assumptions and uncertainties
- rationale for choice of indicators.

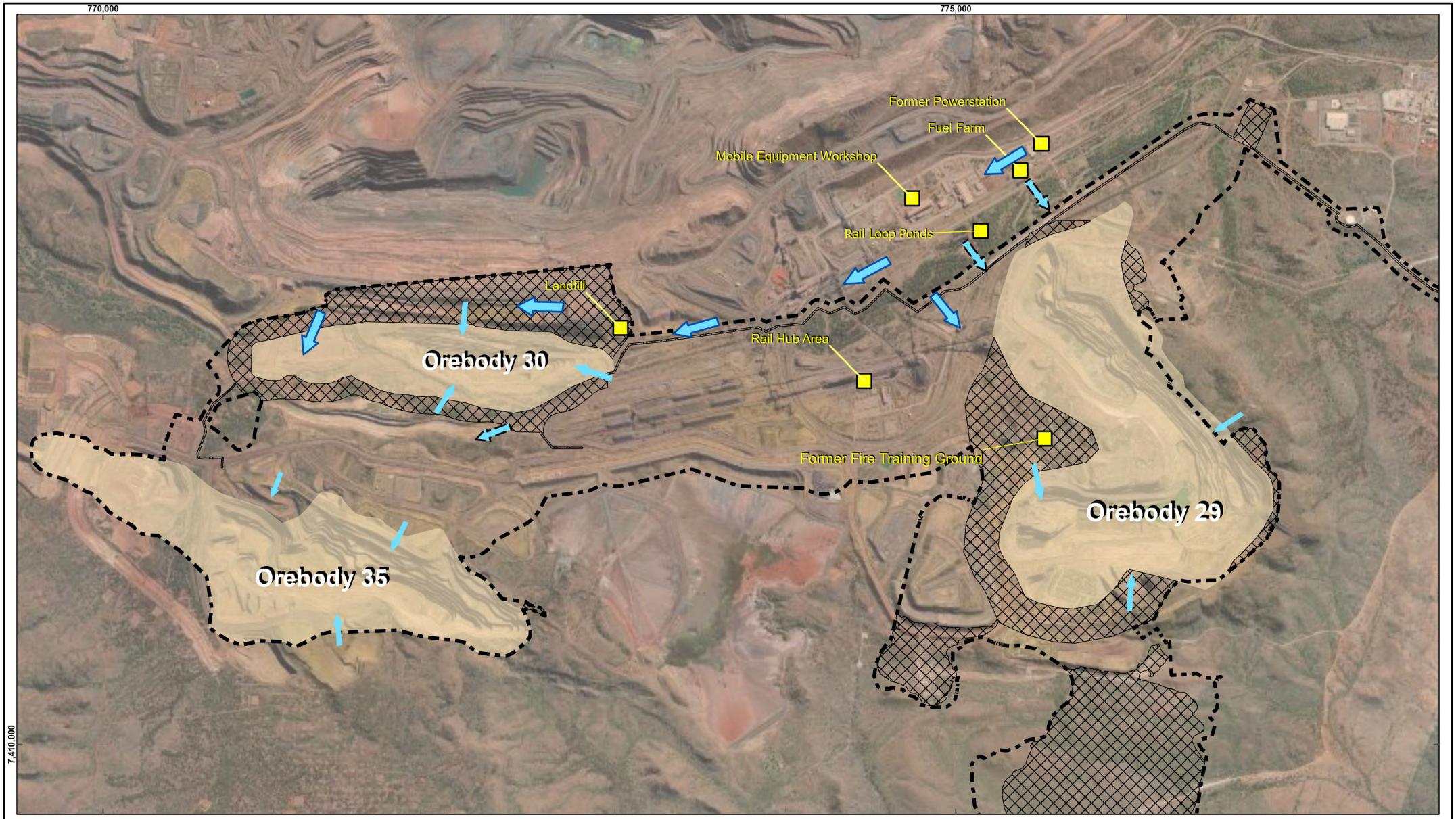
Detail on the multi-level monitoring approach is provided in Section 1.4.2.2.

Table 2: Rationale for EMP Components

Studies	Study findings	Key assumptions and uncertainties	Rationale for choice of components
Environmental values: Newman Water Reserve PDWSA, Ethel Gorge aquifer **Outcome:** PFAS concentrations in the combined surplus dewatered groundwater from Orebody 29/30/35 discharged to Ophthalmia Dam and in surface water within Ophthalmia Dam will remain below 30% of the human health (drinking water) guideline value and 10% of the ecological 95% guideline value in the PFAS NEMP (HEPA 2020).			
Baseline sampling for PFAS at Orebody 29/30/35 was conducted in April 2021 using existing groundwater wells. The studies used to develop the WPMP components related to groundwater are listed in Section 6, and key references are summarised below: CRC CARE (2022) *Stygofauna direct toxicity assessment.* Golder 2018-2021. *Multiple Detailed Site Investigation Reports for WB18, WB20, WB26 and Rail Loop Ponds.* ERM (2022) *Targeted Site Investigation – Factual Report. Mount Whaleback and Eastern Ridge Mine Sites.* *ERM (2023) Second Targeted Site Investigation – Factual Report. Mt Whaleback.* Tetratech (2023). *Surface Water and Drainage Channels – Newman Receiving Environment.* WSP Golder (2023). *Orebody 29/30/35/WR Dewatering and PFAS Mixing Assessment. 17 March 2023.* WSP (2024). *OB29 Hydraulic Test Analysis and Per- and Poly- Fluoroalkyl Substances (PFAS) Mixing Assessment, June 2024.*	Multiple contaminated site investigations and environmental assessments have been undertaken at known and potential PFAS source areas identified near Orebody 29/30/35 to inform PFAS distribution in groundwater. In addition, extensive investigations have been undertaken to assess PFAS concentrations in the receiving environments, specifically Ophthalmia Dam, Ethel Gorge aquifer and ephemeral streams inside and outside BHP mining tenure, etc. PFAS guideline values from the PFAS NEMP and average and maximum concentrations measured in Ophthalmia Dam are summarised in Table 3. **PFAS sampling in mine site groundwater** ***PFAS sampling in groundwater at identified PFAS sources (Golder 2018, 2019b, 2021a; ERM 2022, 2023):*** A summary of PFAS investigations undertaken at each of identified PFAS sources (Figure 3) as well as sitewide investigations that were undertaken to get a reasonable understanding of PFAS distribution in groundwater is presented below. *North of Orebody (OB) 29* The area north of OB29 contains a Fuel Farm, Former Power Station, Rail Loop Ponds and Mobile Equipment Workshop. Fire suppression foam was reportedly stored in the Fuel Farm and Former Power Station areas, as fuels were historically stored and/or dispensed in this area. The area also includes a former oil water separation pond. The Rail Loop Ponds site contains former oily wastewater evaporation ponds and wastewater treatment ponds, both of which are unlined. Extensive soil and groundwater investigations as well as remediation by low-permeability capping has been undertaken at the former evaporation ponds. This site is now subject to a site management plan under the CS Act (BHP 2023). The mobile equipment workshop is used for maintenance of heavy equipment and associated accessories, and it includes an oily wastewater treatment plant and a lined pond area. It is reported that fire extinguishers in mobile equipment have been replaced at the workshop and foam within some of the expired extinguishers may have been discharged into the oily wastewater treatment plant. PFAS concentrations in the groundwater north of OB29 exceeded the PFAS NEMP human health Australian drinking water guideline (DWG) value (0.07 µg/L) but were below the recreational use guideline value (2 µg/L) for Sum (PFOS+PFHxS) and exceeded the ecological 95% species protection level (SPL) guideline value (0.13 µg/L) for PFOS (Golder 2018, 2019b, 2021a; ERM 2022, 2023). PFOA was detected in a small subset of the wells at trace concentrations well below the DWG (0.56 µg/L) and 99% SPL (19 µg/L). The Sum (PFOS+PFHXs) concentrations in the groundwater abstraction bores located near OB29 were well below the NEMP human health drinking water quality guideline value of 0.07 µg/L. *West of OB29* The area west of OB29 contains a Former Fire Training Ground, Rail Hub Area, and Landfill. PFAS concentrations in groundwater in the Former Fire Training Ground area were relatively low considering the significant depth to groundwater in this area. PFAS concentrations only slightly exceeded the Australian DWG (0.07 µg/L) for Sum (PFOS+PFHxS). PFOS concentrations exceeded the 99% SPL (0.00023 µg/L) but were well below the 95% SPL (0.13 µg/L). The rail hub area is used for maintenance of rail equipment and historically some fire-fighting equipment was reportedly stored. An inert rubbish tip is located in the northeastern end of OB30. Sum PFOS+PFHxS concentrations in groundwater were below the Australian DWG (0.07 µg/L). PFOS concentrations exceeded the 99% SPL (0.00023 µg/L) but were well below the 95% SPL (0.13 µg/L). PFOA was detected in a small subset of the wells at trace concentrations well below the DWG (0.56 µg/L) and 99% SPL (19 µg/L). ***Site-wide PFAS sampling in groundwater (Golder 2019a, 2021b):*** A large number of new monitoring wells (compliant with DWER Contaminated Sites Guidelines (DWER 2021) were installed and sampled, along with existing monitoring wells, to get a reasonable distribution of PFAS concentrations in groundwater around OB29, OB30 and OB35, specifically between potential/known PFAS sources and the orebodies. Multiple rounds of sampling were completed to obtain a temporal understanding of PFAS concentrations. The results of these assessments provide a reasonable understanding of PFAS distribution and variability across the site and provides confidence that only low levels of PFAS exist onsite. Maximum Sum (PFOS+PFHxS) concentrations at Mt Whaleback were below the recreational use guideline value (2 µg/L) and only identified in small areas within known PFAS source areas. The data from these assessments	**Assumptions:** • PFAS containing compounds will not be used as part of the Orebody 29/30/35 operation. *Note: BHP phased-out PFAS usage at its Mt Whaleback operations in 2022* • Modelling conservatively assumes a 'constant source' scenario – i.e. PFAS concentrations in source will remain constant for the entire duration of the modelled dewatering simulation while the groundwater plume is allowed to deplete. This is considered conservative as PFAS concentrations in the source areas are expected to reduce over time. • Modelling conservatively excludes other PFAS attenuation mechanisms such as sorption, diffusion and degradation. **Uncertainties:** • Groundwater modelling has inherent uncertainties due to the complexity of the subsurface hydrogeology and groundwater flow paths. However, the model is considered robust because of the conservative approach taken in assumptions regarding excluding attenuating mechanisms. This is validated by the 7-month long OB29 pumping test, which showed that actual observed PFAS concentrations were much lower than modelled predictions. • Timing and sequencing of dewatering activities and abstraction rates between OB29 and OB30 will influence groundwater flow directions.	**Type of components** BHP has chosen outcome-based components as it is possible to measure PFAS concentrations in groundwater and surface water. **Risk-based approach** BHP has used a risk-based approach to identify the components, and has considered the following: • There are important water values that may be affected by water-related activities from the Orebody 29/30/35 Mine including: Newman Water Reserve Priority 1 PDWSA which includes the Ophthalmia Borefields and Ophthalmia Dam which recharges the Ethel Gorge aquifer (which supports the Ethel Gorge TEC. • There are known and potential sources of PFAS within and outside the Development Envelope which have been the subject of detailed site investigations in compliance with the CS Act. • There are existing low levels of PFAS in Ophthalmia Dam and the Ethel Gorge aquifer. • The modelling indicates that the proposed increase in dewatering at Orebody 29/30/35 may result in PFAS migrating to Orebody 29/30/35 dewatering bores but the PFAS concentrations in combined surplus groundwater are likely to remain within the current ambient PFAS concentration ranges in Ophthalmia Dam (except possibly some transient exceedances in the first one to two years of dewatering). However, PFAS concentrations will continue to remain well below the human health DWG value and 95% ecological SPL guideline value. **Rationale for choice of indicators** If surplus dewatered groundwater discharged to Ophthalmia Dam contains PFAS, it may impact on the quality of the surface water in the dam, which recharges the Ethel Gorge aquifer (which is within the Newman P1 PDWSA and supports the Ethel Gorge TEC). BHP has implemented multi-level PFAS monitoring at its Eastern operations, including Orebody 29/30/35 (see Section 1.4.2.2) to monitor and manage this risk. BHP has developed PFAS criteria for the combined surplus dewatered groundwater from Orebody 29/30/35, which is discharged to Ophthalmia Dam, to prevent the risk of unacceptable levels of PFAS being discharged to Ophthalmia Dam, as BHP can control the

Studies	Study findings	Key assumptions and uncertainties	Rationale for choice of components
	were used to generate PFAS concentration contour plots, which were used as inputs to the groundwater modelling assessments discussed below. **PFAS sampling in receiving environment** ***Ophthalmia Dam (Tetratech 2023)*** The Ophthalmia Dam system constructed in 1981 comprises the dam (approximately 16 km^2 and 23 GL capacity), infiltration basins and recharge ponds. The Ophthalmia Dam system serves as a managed aquifer recharge system and currently receives surplus mine water from below water table (BWT) dewatering at BHP's Eastern Pilbara mines (Orebody 29/30/35, Eastern Ridge, Jimblebar and Orebody 31). The dam also receives ephemeral surface water flows from across the Fortescue River catchment, including some of BHP mine sites as well as the Newman Township, the Newman Airport and other non-BHP operations. Tetra Tech Coffey was engaged to undertake a program of sediment, surface water and groundwater sampling to assess the presence of PFAS in locations receiving water from BHP's Eastern Pilbara mines. The sampling included three (3) rounds of monitoring within Ophthalmia Dam using unmanned aerial vehicles (UAV) to collect surface water from 19 locations across the entire dam in 2022. The 95% upper confidence level (UCL) average of PFOS, Sum (PFOS+PFHxS) and PFOA concentration within Ophthalmia Dam was estimated to be 0.001 µg/L, 0.001 µg/L and 0.0003 µg/L, respectively, with a maximum concentration of 0.0054 µg/L, 0.0062 µg/L and <0.001 µg/L, respectively. PFOA was predominantly detected below the laboratory limits of reporting (LOR) of 0.0005 µg/L and therefore the average was calculated by assuming that the actual concentrations were half the LOR (i.e. 0.00025 ug/L, which was then rounded to 0.0003 ug/L). As noted, ambient PFOS concentrations in Ophthalmia Dam was above the PFAS NEMP ecological 99% SPL but the Sum (PFOS+PFHxS) concentration was well below the Australian DWG value. The results of the post-rain sampling events indicated minor increases in PFAS concentrations within the dam, which suggests that there is a PFAS contribution from surface water flows from upstream areas, which include mining and non-mining sources which include but are not necessarily limited to Newman Township and Newman Airport. The surface water sampling was repeated in 2023 and 2024, which indicated a similar range in PFAS concentrations within Ophthalmia Dam. **Ethel Gorge aquifer (Tetratech 2023)** The Ethel Gorge aquifer is a shallow alluvial aquifer which extends to the north and west of Ophthalmia Dam. The primary pathways for PFAS to reach this aquifer is through infiltration of PFAS-containing surface water from Ophthalmia Dam and the Recharge Ponds. As noted in the earlier section, the 95% UCL average PFOS concentration within Ophthalmia Dam is 0.001 µg/L with a maximum concentration recorded of 0.0054 µg/L. Similarly, the 95% UCL average PFOS concentration within the Recharge Ponds is 0.0005 µg/L with a maximum concentration recorded of 0.001 µg/L. Other minor pathways include infiltration from surface water creeks within the TEC footprint. On this basis, the concentrations of PFAS compounds are considered to remain consistent with the range of PFAS concentrations observed in these surface water bodies. Sampling of existing groundwater monitoring wells in the Ethel Gorge aquifer within the core stygofauna habitat area was undertaken by Tetratech Coffey in 2022. The PFOS concentrations observed in the Ethel Gorge TEC groundwater monitoring bores were similar, but below the maximum concentrations observed in Ophthalmia Dam. The 95% UCL average PFOS concentration within the Ethel Gorge TEC core habitat area is 0.0009 µg/L with a maximum concentration recorded of 0.0046 µg/L. The 95% UCL average PFOA concentration within the Ethel Gorge TEC core habitat area is 0.001 µg/L with a maximum concentration recorded of 0.007 µg/L. **Stygofauna PFAS Direct toxicity assessment (CRC Care 2022)** BHP engaged CRC Care to undertake an independent study to investigate the toxicity of PFAS to stygofauna. Stygofauna sampling was conducted in March 2021 and 17 groundwater samples were analysed to evaluate the species abundance of stygofauna. A total of 252 individual specimens were identified across nine different families. Copepods were used for toxicity testing because cyclopoid copepod, *Diacyclops humphreysi*, was found in abundance and was the predominant species identified in the wells sampled within the Ethel Gorge TEC. The ecotoxicity testing involved the assessment of mortality of stygofauna species *Diacyclops humphreysi*, at varying PFOS concentrations ranging from 0.05 to 1,000 µg/L and a control (0 µg/L). The study investigated the toxic effects of PFOS on stygofauna species because the PFAS NEMP ecological freshwater species protection guideline values are for this PFAS compound. The study found that the stygofauna species can tolerate a range of PFAS concentrations. Based on the toxicity studies, the LC_{50} (i.e. lethal concentration to 50% of the stygofauna population) was estimated to be 237 +/- 48 µg/L PFOS. The LC_{10} (i.e. lethal concentration to 10% of the stygofauna population) was estimated to be 139 µg/L. These lethal concentrations are		quality of the combined dewatered groundwater. BHP has also included PFAS criteria in surface water quality within Ophthalmia Dam to verify outcomes and inform response actions. BHP has conservatively based the PFAS criteria on existing ambient low PFAS concentrations in Ophthalmia Dam and a percentage of the human health (drinking water) and ecological species protection guideline values in the PFAS NEMP (Version 2.0), which provides nationally agreed guidance (by all heads of EPAs) on the management of PFAS contamination in the environment (HEPA 2020). The relevant guideline values and indicators used in this WPMP are summarised in Section 1.4.2.1 (Table 3). The guideline values in the PFAS NEMP are currently being reviewed and Version 3.0 of this document is being updated following public review and consultation and is planned to be finalised during 2024 (DCCEEW 2024). The National Health and Medical Research Council (NHMRC) is also conducting an independent review of the health-based guideline values for PFAS in the *Australian Drinking Water Guidelines* (2011) and anticipates that the review will be completed by late 2025 (NHMRC 2024). Following any updates of these documents and relevant guideline values, BHP will review and if applicable, will update the criteria in the WPMP.

Studies	Study findings	Key assumptions and uncertainties	Rationale for choice of components
	approximately six orders of magnitude (i.e. million times) above the PFAS levels detected in the Ethel Gorge TEC. The study report has been peer reviewed by national and international independent subject matter experts and was confirmed to have followed Australian Standards for toxicity assessments. The toxicity testing was scored against the ANZECC & ARMCANZ guidelines. The total score was 81.9% indicating high quality of data from this study. Following on from the study, BHP has initiated further work with CRC Care, which includes expanding the toxicity assessment program to include a broader and more diverse suite of stygofauna species collected from additional locations within the Ethel Gorge TEC. **PFAS Groundwater modelling and mixing assessments** ***Orebody 29/30/35 Modelling assessment (WSP Golder 2023):*** The risk of PFAS migrating from known/potential PFAS sources at the Mt Whaleback mine to Orebody 29/30/35 was evaluated using groundwater modelling. A subsurface mixing assessment approach was used to estimate the PFAS concentrations in Orebody 29/30/35 dewatering bores and combined dewatering discharges from each of the orebodies (OB29, OB30 and OB35) over a pumping period up to 2056. The modelling incorporated all available PFAS data from existing groundwater monitoring bores as well as targeted site investigations undertaken in and around Orebody 29/30/35. The modelling assessment indicated that during the initial two years of dewatering, transient detections of PFOS at levels above the 99% ecological protection guideline value may be observed in the combined dewatered groundwater from OB29 and OB30. The PFOS concentrations are predicted to be well below the 95% ecological SPL value. The estimated Sum (PFOS+PFHxS) concentrations in dewatered groundwater from OB29 or OB30 are also predicted to transiently increase in the initial two (2) years of dewatering but remain below the Australian DWG value. The maximum predicted concentrations were lower than 30% of DWG. After the initial two year of dewatering, the PFAS concentrations are predicted to rapidly decrease to below detectable levels. PFAS concentrations in dewatered groundwater from OB35 and Western Ridge are predicted to be non-detect. BHP's view is that PFAS concentrations in 'combined' surplus water from Orebody 29/30/35 and/or Western Ridge will be much lower than the predicted concentrations in dewatered groundwater from the individual orebodies. Although the PFAS concentrations in the 'combined' surplus water that will be discharged to Ophthalmia Dam will depend on timing and sequencing of dewatering activities, it is expected that the PFAS concentrations will be well within the current ambient PFAS concentration ranges in the receiving environment (i.e. Ophthalmia Dam and Ethel Gorge Aquifer) and ongoing dewatering discharges are unlikely to alter the existing water quality within the receiving environment. ***OB29 Hydraulic Test Analysis and PFAS Mixing Assessment (WSP 2024)*** BHP undertook a 7-month long aquifer pumping test at OB29 between June 2023 and January 2024. WSP was engaged to complete groundwater elevation and water quality monitoring, analyse the data and update the conceptual site model and hydrogeological understanding. Based on this information, WSP updated the groundwater model and conducted a PFAS mixing assessment to evaluate the validity of the methodology to predict PFAS concentrations in dewatering bores. The pumping test was undertaken in three dewatering bores, HWHB0051P (located in the northeastern corner of OB29) and HWHB0057P and HWHB0060P, both located in the mid-western edge of OB29. Observed Sum (PFOS+PFHxS) concentrations in all dewatering bores were below the Australian DWG value. Observed PFOS concentrations exceeded the 99% SPL guideline value in 2 of 3 dewatering bores but were well below the 95% SPL guideline value. Simulated PFAS concentrations in the three dewatering bores exceeded the actual PFAS observations. PFAS concentrations in combined surplus groundwater from the pumping trial also remained well within the current ambient PFAS concentration ranges in Ophthalmia Dam. The following main conclusions are drawn: • The pumping trial improved the understanding of aquifer connectivity between OB29 and potential/known PFAS source areas, which are primarily located north of OB29. The analysis of measured groundwater levels indicated that there is hydraulic connection between OB29 and the PFAS source areas to the north of OB29. This helped verify the groundwater modelling outcomes. • The PFAS mixing assessment methodology overestimated the prediction of PFAS concentrations in dewatering bores, as the observed PFAS concentrations were consistently lower than the predicted PFAS concentrations. • Although the methodology is not a formal contaminant fate and transport model, its results are considered suitable to provide predictions of PFAS concentrations in dewatered groundwater from OB29.		



- Known and Potential PFAS Sources
- Indicative Footprint
- Development Envelope
- Ministerial Statement 963
- Indicative Groundwater Flow Direction

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OREBODY 29/30/35 WATER (PFAS) MANAGEMENT PLAN

Orebody 29/30/35 orebodies and PFAS sources

RESOURCE ENGINEERING - IRON ORE

SCALE @ A4:	1:30,000	PREPARED:	GEOMATICS	FIGURE:	3
DATE:	31/10/2024	REQUESTOR:	ENV. APPROVALS	NO:	929/071E

Document Path: Y:\Jobs\A501_A1000\A929\3Project\A929_071_E_OB29_30_35_PFAS_WMP_PotentialLocations_RevA.aprx

1.4.2.1 PFAS guideline values and indicators

The relevant guideline values (PFAS NEMP) and indictors (Ophthalmia Dam PFAS concentrations) discussed in this WPMP and used to develop the criteria in this WPMP are summarised in Table 3.

Table 3: PFAS guideline values and indicators

Source	Description	PFAS species	Value (µg/L)
Human health			
PFAS NEMP 2.0	Drinking water quality guideline value	Sum (PFOS+PFHxS)	0.07
		PFOA	0.56
	Recreational water quality guideline value	Sum (PFOS+PFHxS)	2
BHP monitoring	Average concentration in Ophthalmia Dam	Sum (PFOS+PFHxS)	0.001
		PFOA	0.00025[1]
	Maximum concentration in Ophthalmia Dam	Sum (PFOS+PFHxS)	0.0062
		PFOA	0.001
Ecological			
PFAS NEMP 2.0	Freshwater 99% species protection - high conservation value systems guideline value	PFOS	0.00023
		PFOA	19
	Freshwater 95% species protection - slightly to moderately disturbed systems guideline value	PFOS	0.13
BHP monitoring	Average concentration in Ophthalmia Dam	PFOS	0.001
		PFOA	0.00025[1]
	Maximum concentration in Ophthalmia Dam	PFOS	0.0054
		PFOA	0.001

Notes:

1. Average concentration assumed to be half the LoR of 0.0005 µg/L

1.4.2.2 Multi-level monitoring approach

BHP proposes to implement a multi-level PFAS monitoring approach (Figure 4) to proactively monitor PFAS migration towards OB29/30/35 and minimise the risk of dewatered groundwater from Orebody 29/30/35 containing unacceptable levels of PFAS being discharged to Ophthalmia Dam.

BHP will develop an internal operational monitoring plan and associated Trigger and Response Plan (TARP) for Level 1 and Level 2 monitoring of groundwater in the mine area. The Level 1 and Level 2 monitoring and TARP will provide early warning and response actions to minimise PFAS concentrations in surplus water discharged to Ophthalmia Dam. The Level 1 and 2 monitoring and related actions are not included in this WPMP; however, will inform the Level 3 and Level 4 monitoring for the combined dewatered groundwater and surface water in Ophthalmia Dam (and associated indicators, response actions and reporting) proposed for this WPMP (Table 4).

The levels and approaches for monitoring are described below:

Level 1: Pathway groundwater monitoring

Monitoring of groundwater from monitoring wells (including sentinel wells closest to the dewatering bores) between known/potential PFAS sources and Orebody 29/30/35 (Figure 5) will serve as an early warning of PFAS migration. Monitoring results will be compared against historical trends, groundwater modelling predictions and internal operational early warning levels, to inform response actions.

Level 2: Monitoring of groundwater from Orebody 29/30/35 dewatering bores

If Level 1 groundwater monitoring indicates PFAS has moved close to Orebody 29/30/35 dewatering bores, then monitoring of Orebody 29/30/35 dewatering bores will be undertaken. Monitoring results will be compared against internal operational early warning levels to inform response actions.

Level 3: Monitoring of combined dewatered groundwater prior to discharge to Ophthalmia Dam

The combined dewatered groundwater from Orebody 29/30/35 is blended water from some or all Orebody 29/30/35 dewatering bores before it is discharged to Ophthalmia Dam. This data is considered representative of surplus discharge water quality from Orebody 29/30/35. Regular monitoring of the combined dewatered groundwater from Orebody 29/30/35 will be undertaken and the frequency will be increased if Level 2 monitoring indicates PFAS is present in dewatering bores above internal operational early warning levels. Monitoring results will be compared against the WPMP criteria (Table 4) to inform response actions.

Level 4: Monitoring of surface water Quality in Ophthalmia Dam

If Level 3 monitoring indicates PFAS is present above Level 3 early response indicators in the combined dewatered groundwater, then additional monitoring of surface water at multiple locations within Ophthalmia Dam will be undertaken. Monitoring results will be compared against the WPMP criteria (Table 4) to inform response actions.

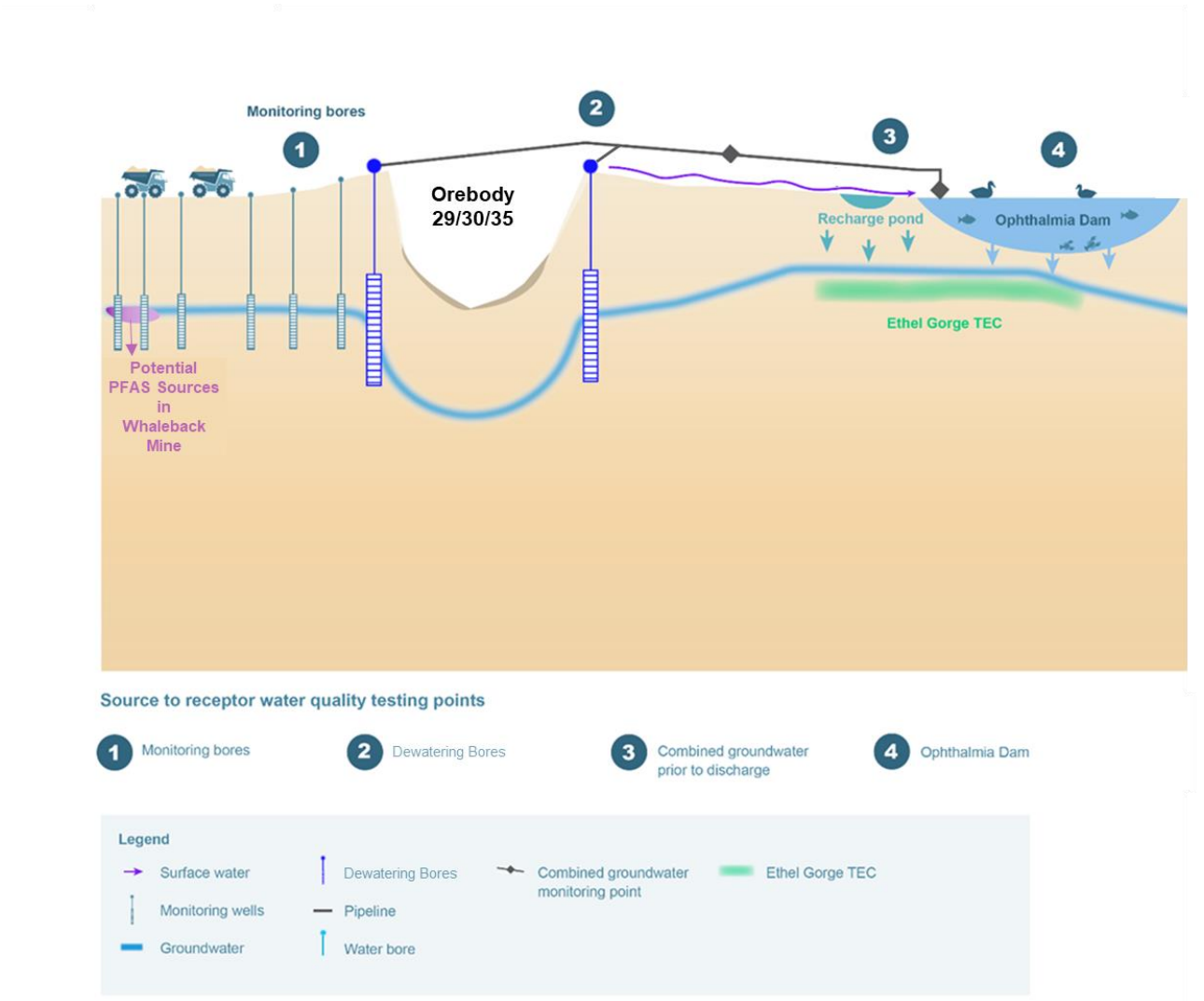
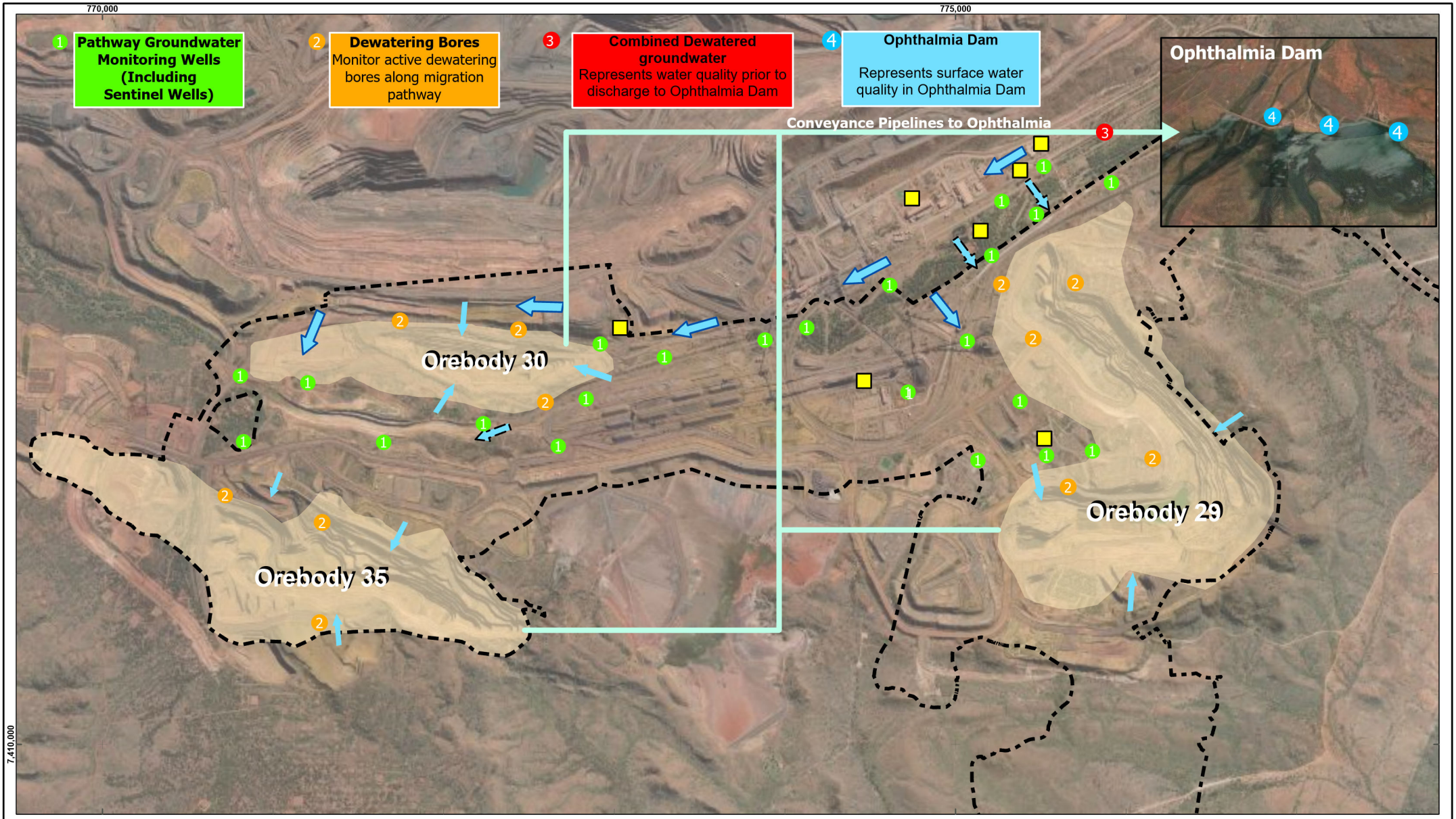


Figure 4: Conceptual site model showing PFAS monitoring levels



Development Envelope
Ministerial Statement 963
Known and Potential PFAS Sources
Indicative Groundwater Flow Direction

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OREBODY 29/30/35 WATER (PFAS) MANAGEMENT PLAN

Multi-level monitoring approach and indicative monitoring locations

RESOURCE ENGINEERING - IRON ORE

SCALE @ A4:	1:30,000	PREPARED:	GEOMATICS	FIGURE:	5
DATE:	31/10/2024	REQUESTOR:	ENV. APPROVALS	NO:	929/072E

Document Path: Y:\Jobs\A501_A1000\A929\3Project\A929_072_E_OB29_30_35_PFAS_WMP_MonitoringLocations_RevA.aprx

2 EMP Components

BHP has provided detail of the EMP components in Table 4, as per the preferred approach outlined in the Instructions. BHP has not used the ‘Schedule’ approach (which the Instructions state may be used), as this EMP (WPMP) covers only one operation. BHP may adopt the ‘Schedule’ approach in future for this WPMP, should additional activities, operations or Ministerial Statements apply.

Table 4: Outcome-based components

Purpose: To meet the requirements of Condition B1-4 and Condition C3 of Ministerial Statement XXXX.

Rationale: Limit PFAS concentrations in combined dewatered groundwater from Orebody 29/30/35 to maintain the water quality in Ophthalmia Dam

EPA Factor and objective:	**Inland waters –** to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
Environmental outcomes	PFAS concentrations in the combined surplus dewatered groundwater from OB29/30/35 discharged to Ophthalmia Dam and in surface water within Ophthalmia Dam will remain below 30% of the human health (drinking water) guideline value and 10% of the ecological 95% guideline value published in the PFAS NEMP 2.0 (HEPA 2020).
Key environmental values:	Newman Water reserve P1 PDWSA Ethel Gorge aquifer
Key impacts and risks:	If Orebody 29/30/35 dewatering intercepts PFAS, there is the risk of surplus water discharge to Ophthalmia Dam increasing PFAS concentrations in Ophthalmia Dam and the Ethel Gorge aquifer.

MSXXXX Condition clauses - Outcome-based components			
Indicators: • **Trigger criteria** • **Threshold criteria**	**Response actions:** • **Trigger level actions** • **Threshold contingency actions**	**Monitoring** **(including timing / frequency of monitoring)**	**Reporting**
Condition B1-4 The proponent must implement the Orebody 29/30/35 Water (PFAS) Management Plan, with the purpose of ensuring the environmental outcomes in condition B1-3 are achieved, monitored and substantiated.			
Condition C3-1 The environmental management plan required under condition B1-4, must contain provisions which enable the substantiation of whether the relevant outcomes of those conditions are met, and must include: (1) **threshold criteria** that provide a limit beyond which the environmental outcomes are not achieved; (2) **trigger criteria** that will provide an early warning that the environmental outcomes are not likely to be met;	**Condition C3-1** The environmental management plan required under condition B1-4, must contain provisions which enable the substantiation of whether the relevant outcomes of those conditions are met, and must include: (7) contingency measures which will be implemented if threshold criteria or trigger criteria are met; **Condition C3-2** Without limiting condition C3-1, failure to achieve an environmental outcome, or the exceedance of a **threshold criteria**, regardless of whether threshold contingency measures have been or are being implemented, represents a non-compliance with these conditions. **Condition D1-1** If the proponent becomes aware of a potential non-compliance, the proponent must: (2) implement contingency measures; (3) investigate the cause; (4) investigate environmental impacts; (5) advise rectification measures to be implemented; (6) advise any other measures to be implemented to ensure no further impact;	**Condition C3-1** The environmental management plan required under condition B1-4, must contain provisions which enable the substantiation of whether the relevant outcomes of those conditions are met, and must include: (3) monitoring parameters, sites, control/reference sites, methodology, timing and frequencies which will be used to measure **threshold criteria** and **trigger criteria**. Include methodology for determining alternative monitoring sites as a contingency if proposed sites are not suitable in the future;	**Condition C3-1** The environmental management plan required under condition B1-4, must contain provisions which enable the substantiation of whether the relevant outcomes of those conditions are met, and must include: (8) reporting requirements. **Condition D1-1** If the proponent becomes aware of a potential non-compliance, the proponent must: (1) report this to the CEO within seven (7) days; (7) advise timeframe in which contingency, rectification and other measures have and/or will be implemented; and (8) provide a report to the CEO within twenty-one (21) days of being aware of the potential non-compliance, detailing the measures required in conditions D1-1(2) to D1-1(7) above. **Condition D2-1** The proponent must provide an annual Compliance Assessment Report to the CEO for the purpose of determining whether the implementation conditions are being complied with. **Condition D2-4** Each annual Compliance Assessment Report must: (1) state whether each condition of this Statement has been complied with, including: (b) achievement of environmental outcomes; (d) requirements to implement the content of environmental management plans; (e) monitoring requirements; (f) implement **contingency measures**; (g) requirements to implement adaptive management; and (h) reporting requirements. (2) include the results of any monitoring (inclusive of any raw data) that has been required under Part C in order to demonstrate that the limits in Part A, and any outcomes or any objectives are being met; (3) provide evidence to substantiate statements of compliance, or details of where there has been a non-compliance; (4) include the corrective, remedial and preventative actions taken in response to any potential non-compliance;

MSXXXX Condition clauses - Outcome-based components			
Indicators: • **Early response indicators** • **Trigger criteria** • **Threshold criteria**	**Response actions:** • **Early response actions** • **Trigger level actions** • **Threshold contingency actions**	**Monitoring** **(including timing / frequency of monitoring)**	**Reporting**
Level 3: Combined Orebody 29/30/35 dewatered groundwater monitoring point (prior to discharge to Ophthalmia Dam)			
Early response indicators: • PFAS concentrations exceed the historical 95% upper confidence level (UCL) ***average concentration in Ophthalmia Dam*** (or) the laboratory limits of reporting (LOR), whichever is higher: ○ Sum (PFOS + PFHxS) ≥ 0.001 µg/L ○ PFOA ≥ 0.0005 µg/L (LOR) ○ PFOS ≥ 0.001 µg/L **Trigger criteria:** • PFAS concentrations exceeds the historical ***maximum concentrations in Ophthalmia Dam*** (Tetratech 2023). ○ Sum (PFOS + PFHxS) ≥ 0.0062 µg/L ○ PFOA ≥ 0.001 µg/L ○ PFOS ≥ 0.0054 µg/L **Threshold criteria:** • PFAS concentrations exceeds any of the criteria below. ***Human health: 30% of PFAS NEMP 2.0 drinking water quality guideline value*** ○ Sum (PFOS + PFHxS) ≥ 0.021 µg/L ○ PFOA ≥ 0.17 µg/L ***Ecological: 10% of PFAS NEMP 2.0 95% species protection guideline value*** ○ PFOS ≥ 0.013 µg/L	**Early response actions:** Response actions to the early response indicator exceedances include any or all of the following, but are not limited to: • Resampling within 1 month to verify and confirm exceedance of early response indicator and ensure it is not related to sampling and analysis errors or cross-contamination. • Complete a minimum 3 rounds of 'monthly' monitoring and assess whether detections consistently exceed early warning criteria ○ if early warning criteria exceedance detections are consistent, then identify the dewatering bore(s) that may be resulting in these exceedances – to inform future response actions ○ if exceedances are not replicated during follow-on monitoring rounds, revert to routine monitoring frequency • Implement Level 4 monitoring of surface water quality within Ophthalmia Dam and continue until combined groundwater PFAS concentration is below the early response indicator. **Trigger level actions:** Response actions to trigger criteria exceedances include any or all of the following, but are not limited to: • Resampling within 2 weeks to verify exceedance of trigger criteria and ensure it is not related to sampling and analysis errors or cross-contamination. • Complete a minimum 3 rounds of 'monthly' monitoring and assess whether detections consistently exceed trigger levels. ○ if trigger level exceedances detections are consistent, implement the following responses: - turn down or turn off the impacted dewatering bore(s) that may be causing the exceedance, where geotechnically safe to do so *(geotechnical safety assessment undertaken as part of Level 2 internal operational TARP)* and/or increase extraction from unimpacted dewatering bores until combined groundwater PFAS concentration is below trigger criteria (or) - re-direct water from the impacted dewatering bore(s) for mining re-use, where acceptable, until combined groundwater PFAS concentration is below trigger criteria *(onsite reuse assessment undertaken as part of Level 2 internal operational TARP)* (and) - continue monthly monitoring of combined dewatered groundwater to assess improvements to discharge quality. ○ if exceedances are not replicated during follow-on monitoring rounds, revert to routine monitoring frequency. • Implement Level 4 monitoring of surface water quality within Ophthalmia Dam, if not already initiated. **Threshold contingency actions:** Response actions to threshold criteria exceedances include any or all of the following, but are not limited to: • Resampling within 1 week to verify exceedance of threshold criteria and ensure it is not related to sampling and analysis errors or cross-contamination. • Implement Level 4 monitoring of surface water quality within Ophthalmia Dam, if not already initiated. • If threshold criteria exceedance detections are confirmed, implement the following responses:	**Parameters:** PFAS (µg/L) **Sampling Methodology:** Consistent with DWER Contaminated sites guidelines **Analytical Method:** EP231 (ultra-trace, or equivalent suitable to meet lowest guideline value) **Frequency:** Quarterly or monthly if criteria are exceeded **Location(s):** Combined dewatered groundwater monitoring point (blended groundwater from OB29/30/35 operating dewatering bores)	**Annual reporting** Report against the requirements of Condition D2-4, in the Annual Compliance Assessment Report required by Condition D2-1 (included as part of the Annual Environmental Report), including: • Achievement of environmental outcomes against the trigger and threshold criteria and implementation of contingency measures (response actions), if trigger and/or threshold criteria were exceeded. • Monitoring results to demonstrate environmental outcomes have been met. • If the threshold criterion was exceeded during the reporting period (representing a potential non-compliance), include the corrective, remedial and preventative actions taken (including the threshold contingency actions). **Exception reporting** If there has been a confirmed exceedance of a Level 3 trigger and/or threshold criteria: • Notify Superintendent within 72 hours of BHP identifying an exceedance of a trigger criterion. • Notify Superintendent and General Manager within 24 hours of BHP identifying an exceedance of a threshold criterion (potential non-compliance). • Notify KNAC of threshold exceedances at the Nyiyaparli Implementation Committee meetings. • As required by Condition D1-1: ○ notify the CEO of DWER in writing within 7 days of being aware of the potential non-compliance (exceedance of a threshold criterion) ○ provide a report to the CEO within 21 days of being aware of the potential non-compliance, detailing the measures required in conditions D1-1(2) to D1-1(7).

MSXXXX Condition clauses - Outcome-based components			
Indicators: • **Early response indicators** • **Trigger criteria** • **Threshold criteria**	**Response actions:** • **Early response actions** • **Trigger level actions** • **Threshold contingency actions**	**Monitoring** **(including timing / frequency of monitoring)**	**Reporting**
	○ turn down or turn off the impacted dewatering bore(s) that may be causing the exceedance, where geotechnically safe to do so *(geotechnical safety assessment undertaken as part of Level 2 internal operational TARP)* and/or increase extraction from unimpacted dewatering bores until combined groundwater PFAS concentration is below trigger criteria (or) ○ re-direct water from the impacted dewatering bore(s) for mining re-use, where acceptable, until combined groundwater PFAS concentration is below trigger criteria *(onsite reuse assessment undertaken as part of Level 2 internal operational TARP)* (and) • implement monthly monitoring of combined dewatered groundwater, if not already initiated, to assess improvements to discharge quality. • If it is not feasible or safe to turn off or turn down impacted dewatering bores (or) if onsite reuse for mining is not practical, then implement management/ remediation strategies that are practicable to reduce PFAS concentrations, until the combined groundwater PFAS concentration is below the threshold criteria.		
Level 4: Surface water within Ophthalmia Dam			
Trigger criteria: • Average PFAS concentrations exceeds any of the criteria below. Historical ***maximum concentrations in Ophthalmia Dam*** (Tetratech 2023)***:*** ○ Sum (PFOS + PFHxS) ≥ 0.0062 µg/L ○ PFOA ≥ 0.001 µg/L ○ PFOS ≥ 0.0054 µg/L **Threshold criteria:** • Average PFAS concentrations exceeds any of the criteria below. ***Human health: 30% of PFAS NEMP 2.0 drinking water quality guideline value*** *(based on Water Corporation's PFAS trigger for drinking water catchments)* ○ Sum (PFOS + PFHxS) ≥ 0.021 µg/L ○ PFOA ≥ 0.17 µg/L ***Ecological: 10% of PFAS NEMP 2.0 95% species protection guideline value*** ○ PFOS ≥ 0.013 µg/L	**Trigger level actions:** Response actions to the trigger criteria exceedances include any or all of the following, but are not limited to: • Resampling within 2 weeks to verify exceedance of trigger criteria and ensure it is considered project attributable. i.e. exceedance is due to dewatering discharges from Orebody 29/30/35 and not surface water runoff sources from in and around Ophthalmia Dam or other cross-contamination. • Complete a minimum 3 rounds of 'monthly' monitoring and assess whether detections consistently exceed trigger levels. ○ if trigger level exceedances detections are consistent, implement the following responses: - turn down or turn off impacted production bore that may be causing the exceedance, where geotechnically safe to do so *(geotechnical safety assessment undertaken as part of Level 2 internal operational TARP)*, until Ophthalmia Dam surface water PFAS concentration is below trigger criteria (or) - re-direct water from the impacted dewatering bore (s) for mining re-use, where acceptable, (*onsite reuse assessment undertaken as part of Level 2 internal operational TARP*) until Ophthalmia Dam surface water PFAS concentration is below trigger criteria (and) - continue monthly monitoring to assess improvements to surface water quality. ○ If exceedances are not replicated during follow-on monitoring rounds, revert to routine monitoring or more frequent monitoring as required by Level 3 response actions. • If it is not feasible or safe to turn off or turn down impacted dewatering bores (or) if onsite reuse for mining is not practical, then implement management/ remediation strategies that are practicable to reduce PFAS concentrations in the combined groundwater until the Ophthalmia Dam surface water PFAS concentration is below the trigger criteria. BHP may implement additional response actions depending on the particular circumstances. **Threshold contingency actions:** Response actions to threshold criteria exceedances include any or all of the following, but are not limited to:	**Parameters:** PFAS (µg/L) **Sampling Methodology:** Consistent with DWER Contaminated sites guidelines **Analytical Method:** EP231 (ultra-trace, or equivalent suitable to meet lowest guideline value) **Frequency:** Triggered by Level 3 and/or Level 4 monitoring response actions. *(Note: routine quarterly monitoring of surface water within Ophthalmia Dam is undertaken by BHP Non Process Infrastructure team as part of the drinking water catchment management program)* **Location(s):** Three representative and accessible surface water sample locations from within Ophthalmia Dam	**Annual reporting** Report against the requirements of Condition D2-4, in the Annual Compliance Assessment Report required by Condition D2-1 (included as part of the Annual Environmental Report), including: • Achievement of environmental outcomes against the trigger and threshold criteria and implementation of contingency measures (response actions), if trigger and/or threshold criteria were exceeded. • Monitoring results to demonstrate environmental outcomes have been met. • If the threshold criterion was exceeded during the reporting period (representing a potential non-compliance), include the corrective, remedial and preventative actions taken (including the threshold contingency actions). **Exception reporting** If there has been a confirmed exceedance of a Level 4 trigger and/or threshold criteria: • Notify Superintendent within 72 hours of BHP identifying an exceedance of a trigger criterion. • Notify Superintendent and General Manager within 24 hours of BHP identifying an exceedance of a threshold criterion (potential non-compliance). • Notify KNAC of threshold exceedances at the Nyiyaparli Implementation Committee meetings. • As required by Condition D1-1: ○ notify the CEO of DWER in writing within 7 days of being aware of the potential non-compliance (exceedance of a threshold criterion) ○ provide a report to the CEO within 21 days of being aware of the potential non-compliance, detailing the measures required in conditions D1-1(2) to D1-1(7).

MSXXXX Condition clauses - Outcome-based components			
Indicators: • **Early response indicators** • **Trigger criteria** • **Threshold criteria**	**Response actions:** • **Early response actions** • **Trigger level actions** • **Threshold contingency actions**	**Monitoring** **(including timing / frequency of monitoring)**	**Reporting**

	• Resampling within 1-week to verify exceedance of threshold level and ensure it is considered project attributable. i.e. exceedance is due to dewatering discharges and not surface water runoff sources from in and around Ophthalmia Dam or other cross-contamination.
	  ○ If threshold criteria exceedance detections are confirmed, implement the following responses:
	  - turn down or turn off impacted production bore(s) that may be causing the exceedance, where geotechnically safe to do so *geotechnical safety assessment undertaken as part of Level 2 internal operational TARP*), until Ophthalmia Dam surface water PFAS concentration is below trigger criteria (or)
	  - re-direct water from the impacted production bore (s) for mining re-use, where acceptable, until Ophthalmia Dam surface water concentration is below trigger criteria *(onsite reuse assessment undertaken as part of Level 2 internal operational TARP)* (and)
	  - continue monthly monitoring to assess improvements to discharge quality and surface water quality.
	  ○ If exceedances are not replicated during follow-on monitoring rounds, revert to routine monitoring or more frequent monitoring if required by Level 3 response actions.
	• If it is not feasible or safe to turn off or turn down impacted dewatering bores (or) if onsite reuse for mining is not practical, then implement management/ remediation strategies that are practicable to reduce PFAS concentrations in the combined groundwater until the Ophthalmia Dam surface water PFAS concentration is below the trigger criteria.		

3 Adaptive management and review of the EMP

3.1 Adaptive management approach

BHP applies an adaptive management framework for implementing management measures identified in this WPMP, which is consistent with the Instructions. Adaptive management is a structured, iterative process to decision making. The framework embeds a cycle of monitoring, reporting and implementing change where required. It allows an evaluation of the management and mitigation measures so that they are progressively improved and refined, or alternative solutions adopted, to ensure that environmental objectives and outcomes in the plan are achieved. The key steps of the adaptive management approach are outlined in Figure 6.

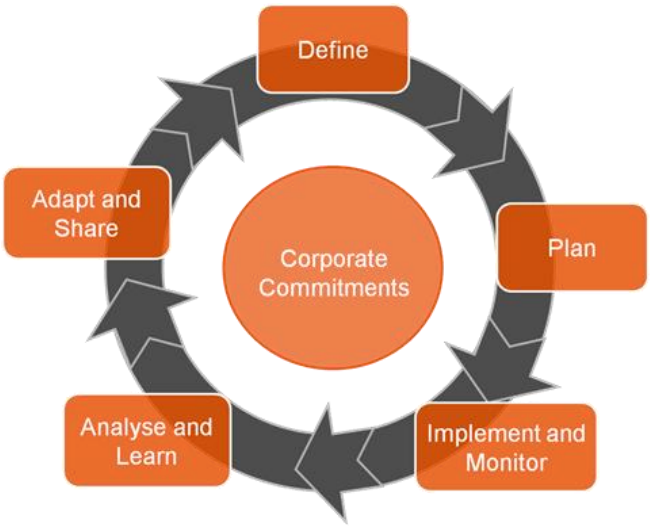

Figure 6: BHP's adaptive management approach

Where the WPMP is a requirement of a Ministerial Statement (MS) condition, BHP notes that if it chooses to amend an WPMP component in Table 4 based on information gained through adaptive management, it must seek formal approval from the Department of Water and Environmental Regulation (DWER).

3.2 Review and revision of this EMP

BHP will review this EMP (WPMP) (and revise it if required), to ensure that it achieves the identified environmental objectives and meets MS conditions. A review may arise from the following:

- where required by a MS condition
- if initiated by BHP as part of the adaptive management process and/or
- if triggered by a MS condition (e.g. for exceedance of a threshold criteria).

Changes to the endorsed version of the EMP may arise from the following:

- BHP reviews the EMP if the EPA or relevant government agencies develop new, or amend existing guidance or policy
- BHP adds components when a new operation (or amendment to an existing operation) is proposed.
- BHP adds or amends components when new proposals are approved and conditioned through Part IV of the EP Act or due to a change to MS conditions.

- the CEO of DWER directs BHP to revise the EMP
- the CEO of DWER confirms by notice in writing that it has been demonstrated that the relevant requirements for the EMP have been met, or are able to be met under another statutory decision-making process, in which case the implementation of the EMP is no longer required.

As provided for in proposed Condition C1-3 of MSXXXX (BHP 2024a), BHP may make minor revisions to this EMP (i.e. excluding changes to components in Table 3) without seeking endorsement from DWER. If BHP makes minor revisions to this EMP, BHP will provide the revised EMP with an explanation and justification of the minor revisions, according to the requirements in proposed Condition C1-4. In accordance with proposed Condition C1-1(1), BHP must implement the most recent version of the confirmed EMP.

4 Stakeholder consultation

BHP discussed the Proposal including the water-related aspects, with the Nyiyaparli Traditional Owners, through Karlka Nyiyaparli Aboriginal Corporation (KNAC) during the May 2024 Social Surroundings engagement. BHP provided a draft version (0) of this WPMP to KNAC with the draft Environmental Review Document (referral supplementary report) for the Proposal. In response to KNAC's request, BHP has added a new table (Table 3) in the WPMP of the relevant guideline values (PFAS NEMP) and indicators (Ophthalmia Dam PFAS concentrations) discussed in the WPMP. KNAC also raised concerns about the need for remedial actions if there are threshold exceedances. BHP clarified that in the unlikely situation that thresholds of the dewatered groundwater and/or of Ophthalmia Dam surface water are exceeded, the threshold contingency actions in the WPMP include implementing remediation strategies to reduce PFAS concentrations.

BHP will consult with government agencies (including decision-making authorities), local authorities, groups and individuals, where relevant, in relation to the revision of this WPMP.

5 Changes to an EMP

There are no changes as this WPMP (Rev 1) is the original version.

6 References

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