MAULES CREEK COAL MINE

WHC_PLN_MCC_WATER MANAGEMENT PLAN_OVERVIEW

Edition	Rev.	Comments	Author	Authorised By	Date
1	0.	Initial Draft WMP	WRM	Daniel Martin	September 2013
1	1	Final Draft incorporating client comments	WRM	Craig Simmons	December 2013
1	2	Revisions addressing regulator comments	WRM	Craig Simmons	April 2013
1	3	Address SEWPaC Comments	WRM	Craig Simmons	May 2013
1	4		WRM	Daniel Martin/ Authorised By DPE	March 2014
2	0	Draft for stakeholder consultation following the 2013 Annual Review	WRM/AGE	Daniel Martin	October 2014
2	1	Administrative update	WHC	WHC/ Approved DPE 21/3/19	2019
3	0	Update incorporating Regulator comments	Resource Strategies	WHC/ Approved DPE 6/4/23	March 2023
3	1	Update to include Regulator Comments	WHC/Hydrobalance	WHC	24 March 2025

CONTENTS

1 INTRODUCTION

The Maules Creek Coal Mine (MCCM) is located in the Gunnedah Coal Basin, approximately 18 km north-east of Boggabri in New South Wales (NSW) (Figure 1). The MCCM is currently owned by Maules Creek Coal Pty Limited (MCCPL), a joint venture between Aston Coal 2 Pty Limited (75%) (a wholly owned subsidiary of Whitehaven Coal), ITOCHU Coal Resources Australia Maules Creek (15%) and J-Power (10%).

Project Approval (PA) 10_0138 was granted to Aston Coal 2 Pty Limited by the Planning Assessment Commission of NSW, as delegate of the Minister for Planning and Infrastructure under section 75J of the Environmental Planning and Assessment Act 1979 (EP&A Act) on 23 October 2012. PA 10_0138 allows for the development of a 21 year open cut coal mining operation and associated surface infrastructure, extracting coal at up to 13 Million tonnes per annum of run of mine (ROM) coal.

The MCCM PA 10_0138 has been modified on eight occasions briefly described as follows:

- Mod 1: to include the construction of and operation of the high voltage transmission lines and associated switching station in addition to a minor extension of an 11 kilovolt transmission line.
- Mod 2: to include a revised optimised design, alignment and arrangement of an existing approved water pipeline to the Naomi River and the rearrangement of the associated pump installation.
- Mod 3: to revise traffic management conditions and allow for a shuttle bus service to facilitate transportation and construction of local employees to the site.
- Mod 5: to include the continued use of Olivedene Water Supply and associated infrastructure.
- Mod 6: to include the continued use of the existing water supply pipeline and associated infrastructure.
- Mod 7: to amend the final landform design and enable changes to water management infrastructure.
- Mod 8: to include the disposal of end of life mine tyres and operation of mobile crushing units.
- Mod 9: to refine the biodiversity offset strategy and to specify commitments under the strategy.

1.1 PURPOSE AND SCOPE

This Water Management Plan (WMP) has been developed by Whitehaven Coal to satisfy the requirements of Condition 40, Schedule 3 of PA 10_0138.

This WMP applies to all employees and contractors of Whitehaven Coal that are responsible for the management of water within the project boundary of the MCCM. Water management at MCCM will continue in accordance with this WMP for the remainder of the currently approved mine life until 31 December 2034. As required under Condition 5 schedule 2, MCCM will continue to comply with the WMP (excluding mining operations) beyond the mine life until rehabilitation works have been completed to the satisfaction of both the Secretary and Resources Regulator.

The WMP provides details of the management of surface water and groundwater related impacts associated with the construction and operation of the MCCM. This includes, but not limited to, the management of sediment, the site water balance, water intake in accordance with licences and flooding.

The WMP will be reviewed and revised (to the satisfaction of the Planning Secretary) in accordance with the requirements of Schedule 5, Condition 5 of PA 10_0138.

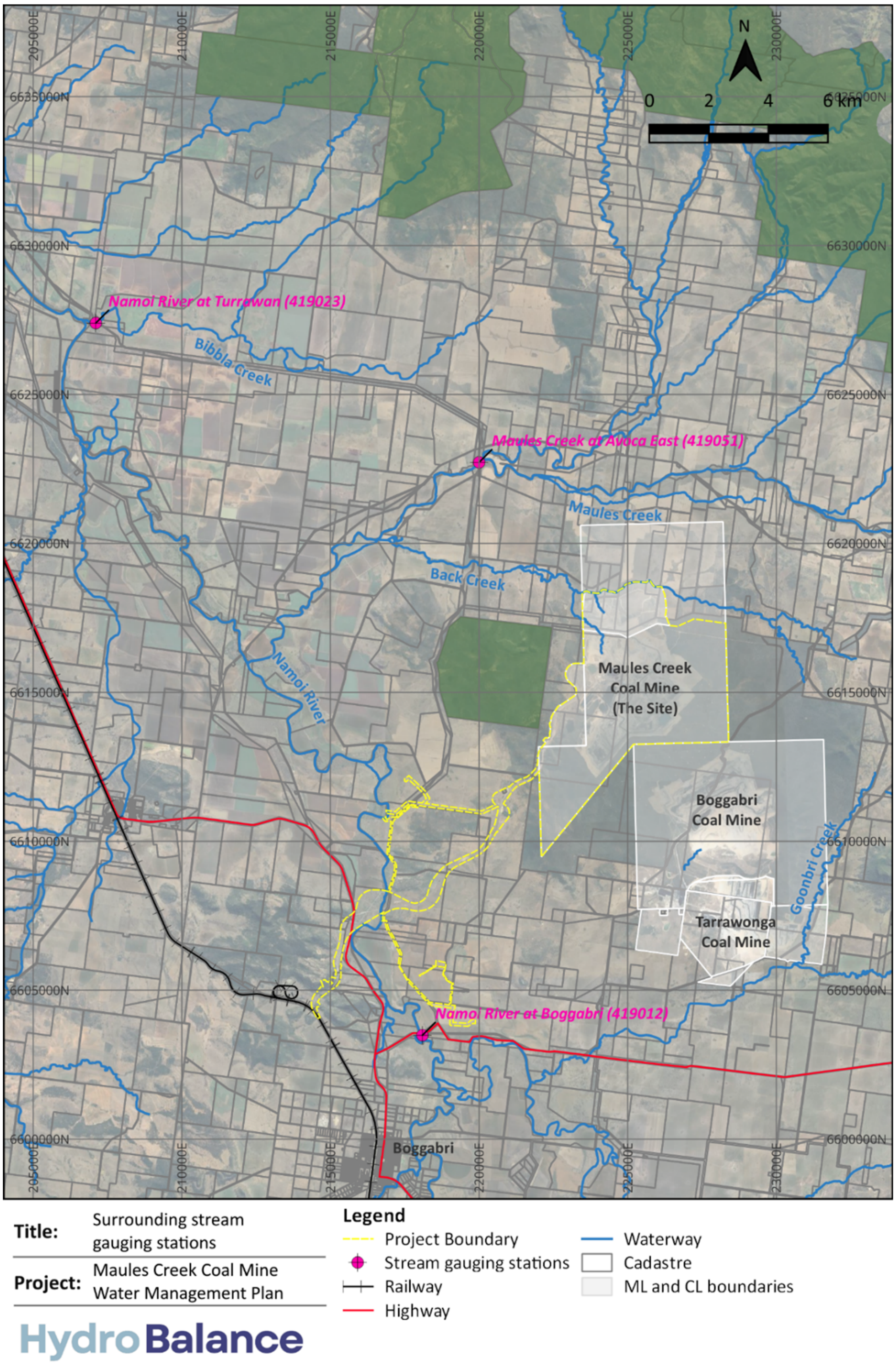


Figure 1 Locality Map

1.2 PREVIOUS VERSIONS

The WMP was first reviewed and approved in 2013 to satisfy the requirements of PA 10_0138. Since the implementation of the WMP, PA 10_0138 has been modified on five occasions. These modifications however did not require revisions of the WMP. In March 2019 the WMP was revised to incorporate necessary administrative updates. The WMP was updated again in March 2023 to reflect the changes to the water management system at the time, including the implementation of the eastern clean water management system and the highwall dams.

1.3 CURRENT VERSION

The current version of the WMP has been revised to align with ongoing development of the mine and maintain a high standard of water management protocols, procedures and practice at MCCM.

1.4 STRUCTURE OF THE WATER MANAGEMENT PLAN

The WMP comprises the following documentation in accordance with Condition 40 Schedule 3 of PA 10_0138 (further detailed in Table 1):

- An overarching WMP (this document)
- Site Water Balance (SWB) (Appendix A);
- Surface Water Management Plan (SWMP) (Appendix B); and
- Groundwater Management Plan (GWMP) (Appendix C).

Table 1

WMP Documentation

Document	Description/Scope
WMP	Describes the statutory obligations to the WMP (section 2) and provides an overview of the MCCM Water Management System (section 3). Section 4 outlines the review and improvement of environmental performance while section 5 describes the management and reporting of incidents, complaints and non-compliances.
Appendix A – Site Water Balance	Details the inputs and outputs of the mine water management system. This includes details of the site water management system and describes storage and use of water to maintain safe and optimal operations in accordance with existing water access licences (WALs), Environmental Protection Licence (EPL) 20221 and Australian New Zealand Guidelines (2018) ANZG.
Appendix B – Surface Water Management Plan	Provides information on baseline surface water data, as well as design objectives, performance criteria, trigger levels and monitoring requirements for surface water management at the mine.
Appendix C – Groundwater Management Plan	Describes the management of groundwater at MCCM. This includes details of the GWMP, predicted impacts and compliance with relevant PA 10_0138 conditions.

1.5 CONSULTATION

Consultation has taken place with the NSW government in development of the various versions of the WMP, which have been reviewed by the Department of Climate Change, Energy, Environment and Water (DCCEEW) (formerly DPIE) on numerous occasions. Updates to prepare this current version of the WMP have been undertaken in consultation with representatives of the NSW Office of Environmental Heritage (OEH), DPE Water and North West Local Land Services (NWLLS) (formerly Namoi Catchment Management Authority).

2 STATUTORY OBLIGATIONS

The statutory obligations of MCCM relating to water management are contained in project-specific approvals, as well as relevant legislation. Project approvals relevant to water management at MCCM include:

- PA 10_0138 (as modified);
- Commonwealth Approval 2010/5566 (as modified);
- relevant licences and permits (including EPL 20221) and mining and coal leases (Mining Lease (ML) 1701, ML 1719, CL 375).

Water management must also comply with general legislative requirements under:

- EP & A Act;
- Protection of the Environment Operations Act 1997 (NSW);
- Water Management Act 2000 (WM Act).

2.1 PROJECT APPROVAL 10_0138

2.1.1 Water Management Plan Requirements

Table 2 describes the requirements under Condition 40, Schedule 3 of PA 10_0138 and indicates where these are addressed within this WMP.

Table 2
Water Management Requirements in PA 10_0138

Schedule 3	
40. The Applicant must prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must be prepared in consultation with BCS, DCCEEW Water and North West Local Land Services (LLS), by suitably qualified and experienced person/s whose appointment has been approved by the Secretary for approval prior to the commencement of construction. In addition to the standard requirements for management plans (see condition 3 of schedule 5), this plan must include:	
Condition	**WMP report section**
a. a Site Water Balance…	Appendix A
b. a Surface Water Management Plan…	Appendix B
c. a Groundwater Management Plan…	Appendix C
d. a Leard Forest Mining Precinct Water Management Strategy…	BTM Complex WMS

2.1.2 Management Plan (General) Requirements

Condition 3 of Schedule 5 of PA 10_0138 outlines the general management requirements that are relevant to this WMP.

Table 3
Water Management Requirements in Project Approval 10_0138

MCCM Project Approval 10_0138	Relevant WMP Section
3. The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	
a. detailed baseline data;	Appendix B & C
b. a description of: – the relevant statutory requirements (including any relevant consent, licence or lease conditions);	Section 2
– any relevant limits or performance measures/criteria;	Appendix B & C
– the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Appendix B & C
c. a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Section 3 and Appendix A, B & C.
d. a program to monitor and report on the: – impacts and environmental performance of the project; – effectiveness of any management measures (see c above);	Appendix B & C
e. a contingency plan to manage any unpredicted impacts and their consequences;	Appendix B & C
f. a program to investigate and implement ways to improve the environmental performance of the project over time;	Section 4 and Appendix B & C
g. a protocol for managing and reporting any: – incidents; – complaints; – non-compliances with statutory requirements; and – exceedances of the impact assessment criteria and/or performance criteria; and	Section 5
h. a protocol for periodic review of the plan.	Appendix B & C
36. The Applicant must ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of mining operations on site, to match its available water supply to the satisfaction of the Planning Secretary.	Appendix B
37. The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose water supply is adversely and directly impacted (other than an impact that is negligible) as a result of the project, in consultation with DPE Water, and to the satisfaction of the Planning Secretary. The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributed to the project. Equivalent water supply should be provided (at least on an interim basis) within 24 hours of the loss being identified. If the Proponent and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution. If the Proponent is unable to provide an alternative long-term supply of water, then the Proponent shall provide alternative compensation to the satisfaction of the Planning Secretary.	Appendix C
Surface Water Discharges 38. The Applicant must ensure that any surface water discharges of mine water from the site:	

a. are of equal or better quality than the receiving waters; and	Appendix A Section 6.1
b. comply with the discharge limits (both volume and quality) set for the project in any EPL.	Appendix B Section 5
Operating Conditions 39. The Proponent shall:	
c. ensure that coal reject or any potentially acid forming interburden materials are not emplaced at elevations within the pit shell or out of pit emplacement areas where they may promote acid or sulphate species generation and migration beyond the pit shell or out of pit emplacement areas;	Appendix B
(d) ensure that no water can drain from an out of pit emplacement area to any watercourse or to any land beyond the lease boundary;	Appendix A
(f) design, install and maintain any new infrastructure within 40 metres of watercourses in accordance with the guidance series for Controlled Activities on Waterfront Land (DPI Water, 2012 or latest version;	Section 2.4.6

2.2 EPBC ACT CONTROLLED ACTIONS DECISION

The Commonwealth Approval Environmental Protection and Biodiversity Conservation (EPBC) 2010/5566 for MCCM was granted on 11 February 2013. This has since been varied with latest notice of variation received on 24 March 2021. Conditions 20 to 23 of the Commonwealth Approval relate to water management. However, these conditions have not been varied since the original approval in 2013.

Table 4 details the surface water and groundwater management conditions of EPBC Approval 2010/5566.

Table 4
Water Management Requirements EPBC Approval

MCCM EPBC 2010/5566	Relevant WMP Section
20. The person taking the action must provide to the **Minister** for approval, the *surface and groundwater management plans* as identified in condition 40 of the NSW state government Project Approval dated 23 October 2012 (application number 10_0138). The *surface and groundwater management plans* must be approved by the **Minister** prior to commencement of construction.	Appendix B & C
21. The *surface and groundwater management plans* must be consistent with the **National Water Quality Management Strategy.**	Appendix B & C
22. The person taking the action must, prior to **commencement of construction** a description of in collaboration with the proponent to develop and operate the Boggabri Extension (EPBC 2009/5296) and any other approved mines within 20 kilometres (km) of the project area, provide written advice to the Minister demonstrating how the NSW government approved surface water and groundwater management plans (condition 20), addresses the cumulative impact of groundwater drawdown as a result of mining and how this may impact on the consequence health of the remnant native vegetation in the Leard State Forest, the Leard State Forest Conservation Area and surrounding areas. In particular the advice must address the following matters: a. Maximum amount of allowable drawdown in the alluvial aquifer. b. Drawdown in hard rock. c. Trigger levels pertaining to drawdown in the alluvial aquifer when corrective actions will be required to be undertaken. d. Identify the depth of root zone of the native vegetation. e. Monitoring to assess the ongoing quality and quantity of both surface and groundwater to identify impacts on the native vegetation.	Appendix C & BTM Complex WMS
23. The person taking the action must within 6 months of this approval, or such other timeframe specified by the **Minister**, provide to the **Minister** a report on: a. any updated modelling of surface and groundwater impacts that has been undertaken in preparing the *surface and groundwater* management plans. b. how the *surface and groundwater management* plans addressed groundwater and surface water impacts on matter of national environmental significance.	Addressed in separate document to SEWPaC (now DAWE)

2.3 LICENCES, PERMITS AND LEASES

Water management at MCCM is conducted in accordance with the following licences and permits as required under the *Water Management Act, 2000,* NSW *Protection of the Environmental Operations Act, 1997*, the NSW *Mining Act*:

- Water Access Licences (WALs).
- EPL 20221.
- ML 1701, ML 1719 and CL 375.
- Forward Plan

2.3.1 Water Access Licences

Existing MCCM WALs used to account for passive take into the mine workings are detailed in Table 5. Table 5 shows MCCM has sufficient WALS (with carry over) to account for the predicted maximum passive take over the LOM as per the BTM complex Groundwater Model.

Table 5
Maules Creek Current Water Access Licences – Passive take

Water Source	WAL No.	Total Entitlement (units)	Predicted Maximum take and year
Upper Namoi Zone 4, Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source	36548	36	144 ML - FY30
	27385	38	
	12613	50^	
Upper Namoi Zone 11, Maules Creek Groundwater Source	12479	78 (39)*	15 ML - FY35
Gunnedah – Oxley Basin MDB Groundwater Source (Gunnedah – Oxley Basin MDB [Other] Management Zone)	29467	306	956 ML - FY24
	36641	800	
	36576	600	

*shared with Tarrawonga Coal Mine (39 ML each mine), which has a predicted maximum take of 9 ML
Application to assign miscellaneous works approval with WaterNSW

Existing MCCM WALs used to account for licensed extraction from an approved river pump or bore are detailed in Table 6. In addition to these WALs, MCCM has obtained temporary trades (through water allocation assignment trading) to allow for additional Zone 4 and Zone 5 groundwater to be extracted from the Roma, Brighton and Olivedene bores. Temporary trades are common in Zone 4 (78 trades totalling 7,231 units in Financial Year (FY) 2019) and hence offer a reliable market for MCCM to obtain temporary allocation of groundwater to meet any additional demand.

Table 6
Maules Creek Current Water Access Licences – Extraction

Water Source	WAL No.	Total Entitlement (units)	Extraction location
Lower Namoi Regulator River Water Source (High Security)	13050	3,000	Namoi River - 90WA801901
Maule's Creek Water Source (Maule's Creek Tributaries Management Zone)	41585	30	HWD10 and HWD11
Upper Namoi Zone 4, Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source	12722	77	Roma Bore - 90CA807023
	12718	102	Brighton Bore - 90CA807012
Upper Namoi Zone 5, Namoi Valley (Gin's Leap to Narrabri) Groundwater Source	12811	135	Olivedene Bore - 90CA807230
	12791	112	
Upper Namoi Zone 11, Maules Creek Groundwater Source	12480	215	Not in use
	12491	77	
	12473	241	
	12482	77	
	12486	77	
	12489	28	
Maules Creek Unregulated Water Source (Maules And Horsearm Creeks Management Zone	32474	302	

2.4 OTHER LEGISLATION AND REQUIREMENTS

2.4.1 Water Management (WM) Act 2000

The WM Act 2000 provides for various types of approval for land-based activities that affect the quality and quantity of the State's water resources:

- Water use approval (section 89 of the WM Act) which authorises the use of water at a specific location for a particular use, for up to 10 years.
- Water management work approval (section 90 of the WM Act).
- Controlled activity approval (section 91 of the WM Act) which is a type of controlled activity approval that authorises the holder to conduct activities that affect an aquifer such as approval for activities that intersect groundwater, other than water supply bores and may be issued for up to 10 years.

Water access licences are required to be held under the relevant water sharing plan (WSP) for any water take that occurs as a result of the Project on the various water sources neighbouring the mine.

The WSPs relevant to MCCM include:

- Upper and Lower Namoi Regulated River Water Sources WSP (Namoi Regulated WSP);
- Namoi Unregulated and Alluvial Water Sources WSP 2012 (Namoi Unregulated WSP);
- Upper and Lower Namoi Groundwater Sources WSP (Namoi Groundwater WSP); and
- MDB Porous Rock Groundwater Sources WSP (MDB Porous Rock WSP).

2.4.2 Licensing of storages

Water captured by all storages at MCCM will be appropriately licensed under the *WM Act 2000* based on the location and purpose of each storage. Further details of site storages and their licence status is provided in Appendix A (SWB).

2.4.3 Maximum Harvestable Rights Dam Capacity

MCCM's maximum harvestable right dam capacity (MHRDC) has been assessed based on the project lease area.

The MHRDC is calculated by multiplying the project area (3,641 hectares (ha)) by the landholding area multiplier of 0.065 from the Water NSW Maximum Harvestable Right Calculator, giving a total MHRDC of 236.7 ML. The capacity of dams licensed under harvestable rights is provided in Appendix A (SWB).

2.4.4 National Water Quality Management Strategy/ANZG (2018) Guidelines

The National Water Quality Management Strategy is a national approach to protecting the nations water resources by maintaining and improving water quality, while supporting dependent aquatic and terrestrial ecosystems, agricultural and urban communities. In 2018 the Australian & New Zealand (2000) water guidelines were superseded by the ANZG (2018) as an online resource. These guidelines provide a framework for long-term management strategies that protect community values of waterways.

The ANZG (2018) guidelines have been considered, where applicable, in the SWB (Appendix A), Surface Water Management Plan (SWMP) (Appendix B), Groundwater Management Plan (GWMP) (Appendix C) and BTM Complex WMS.

2.4.5 Aquifer Interference Policy

The *Aquifer Interference Policy* (AIP) clarifies the requirements for obtaining water licenses for aquifer interference activities under NSW water legislation (i.e. WM Act 2000). It establishes and objectively defines considerations in assessing and providing advice on whether more than minimal impacts might occur to a key water-dependent asset. The AIP applies throughout the state of NSW and allows for take activities to be accounted for in the state water budget through the appropriate licencing of water taken by aquifer interference activities. The AIP also forms the basis of assessment at various stages of an assessment under the EP&A Act.

The AIP has been considered in the preparation of the SWB (Appendix A), SWMP (Appendix B), GWMP (Appendix C) and BTM Complex WMS.

2.4.6 Controlled Activities on Waterfront Land

According to the DPI fact sheet *Controlled activity approval exemptions,* Clause 42 and Clause 18 of Schedule 4 of the WM Act state any kind of controlled activity carried out in accordance with any lease, licence or permit under the Mining Act 1992 is exempt from the controlled activities approval. Despite this exemption, any ancillary activities that occur as part of the mining operation that are within 40 m of waterfront land will be undertaken in accordance with the guidelines.

3 WATER MANAGEMENT OVERVIEW

3.1 SURFACE DRAINAGE NETWORK

MCCM is located within the catchment of Back Creek, a tributary of Maules Creek, which in turn is a tributary of the Namoi River. The mine access road and rail corridor, located to the west of the mine, drain to minor tributaries of the Namoi River. Figure 2 shows site catchment boundaries, water storages and land use across the site for financial year 2023/2024 (FY24).

3.2 WATER MANAGEMENT SYSTEM AND SITE WATER BALANCE OVERVIEW

The water management strategy for the Mine is based on targeted management of water from different sources based on anticipated water quality. Water on the site is categorised as either:

- clean water – water from areas not disturbed by mining;
- mine water – groundwater inflows and surface runoff in mining areas that is likely to come into contact with coal; or
- sediment laden water – runoff from areas disturbed by stripping or placement of overburden material.

Details of site storages for the management clean water, mine water and sediment laden water, as well as a full water balance of the MCCM water management system, are provided in Appendix A. The main storages on the site include:

- Mine Water Dam which is the primary storage for recycled mine water that supplies the major site water demands;
- Raw Water Dam which is a holding dam for clean water imported to the site from external sources; and
- sediment dams which collect runoff from overburden emplacements and recycled to the Mine Water Dam for reuse on the site to reduce external water demands in accordance with DPE guidelines (DECC, 2008) and the project conditions of consent. In the event the water is not required, MCCM may treat and release to receiving watercourses (in accordance with EPL requirements).

Key water demands include:

- CHPP water usage;
- haul road dust suppression; and
- miscellaneous water usage (i.e. stockpile water usage and vehicle washdown).

The first priority source for meeting site demands is the Mine Water Dam which collects water from the following sources:

- Passive groundwater inflows to the open cut mine.
- Runoff captured from the footprint of the mine disturbance area in accordance with appropriate water acquisition rights.
- Fine rejects bleed water captured from the Fines Emplacement Area.

Where mine water stored on site cannot meet demands, external water is imported from the Namoi River. In the event no water is available in the Namoi River, MCCM will import water from the Olivedene, Roma and Brighton bores. All external water extractions will be undertaken in accordance with the associated approved water supply networks in accordance with water access licences.

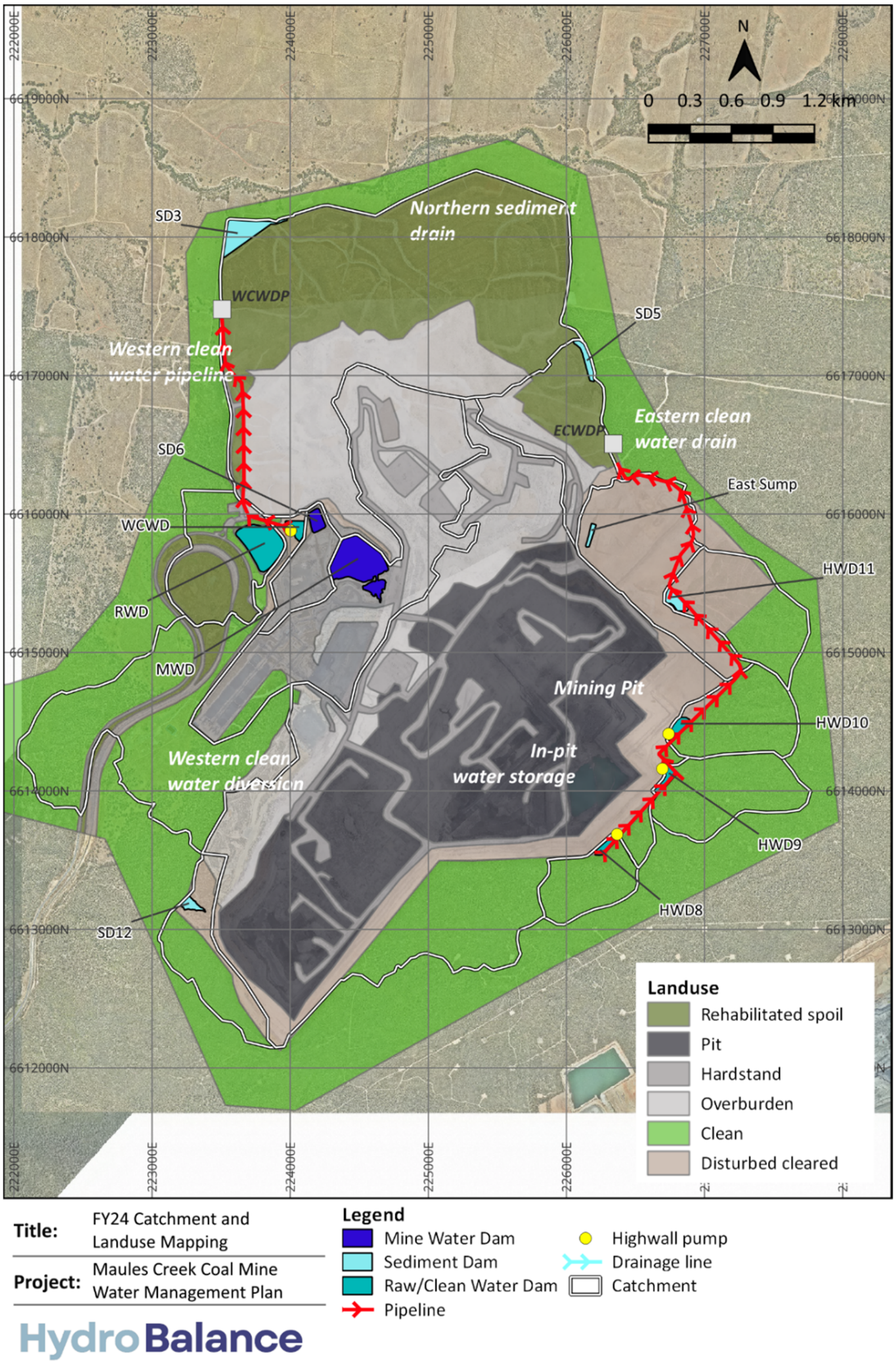


Figure 2 Site catchments, storages and land use – FY24

3.3 GROUNDWATER

Details of the groundwater system in the vicinity of MCCM are provided in the Groundwater Management Plan (GMP) (Appendix C).

3.4 BTM COMPLEX OVERVIEW

The BTM Water Management Strategy details the cumulative water management approach taken by the Boggabri, Tarrawonga and Maules Creek mines to monitor and collectively manage the surface water and groundwater impacts of their operations. The Water Management Strategy details the relevant water resources, the potential cumulative impacts on those water resources, and the cumulative water management protocols within the BTM Complex.

A brief overview of the Boggabri Coal Mine (BCM) and Tarrawonga Coal Mine (TCM) is provided below.

3.4.1 Boggabri Coal Mine

BCM is an existing open cut mine that consists of an open cut pit, overburden dump, infrastructure area including coal processing facilities, water management structures, and a rail spur. BCM obtained NSW State Government approval on 18 July 2012, and Commonwealth Government approval on 11 February 2013. These approvals (as modified) allow operations at BCM to extend until December 2033 at a rate of 8.6 Mtpa of ROM coal. The project approval for BCM provides for operation of existing ancillary equipment; construction and operation of a new coal handling and preparation plant (CHPP); 17 km rail spur line; bridges over the Namoi River and Kamilaroi Highway; a rail load-out facility located at the mine; upgrade of the overburden and coal extraction haulage fleet (with an option for a drag-line); upgrade of electricity transmission lines; and establishment of a water supply borefield and other ancillary infrastructure.

3.4.2 Tarrawonga Coal Mine

TCM is an existing open cut coal mine located immediately south of BCM. TCM initially had approval to extract 2 Mtpa of ROM coal until 2017. TCPL submitted an application in July 2011 under Part 3A of the *Environment Planning and Assessment Act, 1979* (EP&A Act) for an extension of open cut mining operations to 3 Mtpa of ROM coal for a further 17 years. This application was approved by the NSW State Government on 22 January 2013.

TCM have modified Project Approval 11_0047 on a number of occasions since then, with the most recent being in October 2023. Project Approval 11_0047 allow operations at TCM until 2030 at a rate of 3.5 Mtpa of ROM coal.

4 REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

4.1 ANNUAL REVIEW

In accordance with Schedule 5, Condition 4 of PA 10_0138, MCCM will submit by the end of March each year (or other such timing as agreed by the Planning Secretary) an Annual Review for the previous calendar year to the Planning Secretary of DPE, which will fulfil the reporting requirements listed in that condition. The review will include:

- Review of the monitoring results and complaints records of the development over the past year, which includes a comparison of these results against the:
  - relevant statutory requirements, limits or performance measures/criteria;
  - monitoring results of previous years; and
  - relevant predictions in the EIS.
- Validation of the calibration parameters of the water balance model to ensure that the model adequately simulates observed conditions on site;
- Identification of any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- Identification of any trends in the monitoring data over the life of the development;
- Identification of any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
- Description of measures that will be implemented over the next year to improve the performance of the water management system.

MCCM annual review documentation is publicly available on the MCCM website at https://whitehavencoal.com.au/our-business/our-assets/maules-creek-mine/ in accordance with Condition 12, Schedule 5 of PA 10_0138.

4.2 REVISION OF WMP

As detailed in Schedule 5, Condition 5 of PA 10_0138, the WMP will be reviewed and revised (to the satisfaction of the Secretary of the DPIH), within three months of the submission of the following documentation:

- Annual Review (Condition 4, Schedule 5);
- Incident Report (Condition 8, Schedule 5);
- Audit (Condition 10, Schedule 5); and
- Any modification to the conditions of the approval PA 10_0138.

As part of the WMP review process, MCCM will provide a report to the Minister (or their delegate) administering the EPBC Act 1999, on any updated water modelling that has been undertaken and how the WMP addresses groundwater and surface water impacts on matters of national environmental significance in accordance with approval EPBC 2010/5566 Condition 23.

5 REPORTING SYSTEMS

In accordance with Condition 3(g) Schedule 5 of PA 10_0138, MCCM has developed protocols for the management and reporting of any:

- incidents;
- complaints;
- non-compliances with statutory requirements; and
- exceedances of the impact assessment criteria and/or performance criteria.

These protocols are described in the Maules Creek Pollution Incident Response Management Plan.

In accordance with Schedule 5, Condition 8 of PA 10_0138, MCCM shall notify the Planning Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment at the earliest opportunity, and shall notify of any other incident as soon as practicable. The Planning Secretary will be notified in writing through the Major Projects Portal.

In the event of a non-compliance the Planning Secretary must be notified in writing via the Major Projects website within seven days after MCC becoming aware of any non-compliance. A non-compliance notification must identify the development and the application number for it, set out the condition of consent that the development is non-compliant with, the way in which it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance. A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

MCC will provide regular reporting on the environmental performance of the mine, this will occur through CCC reports and Annual Reviews on Whitehaven's website and any reporting arrangements in accordance with any plans or programs approved under the conditions of PA 10_0138.

MCCM will report on the operation of the clean water management system quarterly from June 2022, as per the Enforceable Undertaking entered into with NRAR. Documentation will be publicly available on the MCCM website at https://whitehavencoal.com.au/our-business/our-assets/maules-creek-mine/

6 REFERENCES

DECC, 2008 Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries, Department of Environment and Climate Change, June 2008.

APPENDIX A SITE WATER BALANCE

APPENDIX B SURFACE WATER MANAGEMENT PLAN

APPENDIX C GROUNDWATER MANAGEMENT PLAN

WHC_PLN_MCC_WATER MANAGEMENT PLAN_APPENDIX A_SITE_WATER_ BALANCE

CONTENTS

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the methodology and assumptions used to prepare an estimate of the Maules Creek Coal Mine (MCCM) site water balance for the financial years (FY) from 2024/25 (FY25) to 2026/27 (FY27). The GoldSim software was used to undertake a forecast simulation of the key inflows to and outflows from the site water management system.

Some components of the site water balance will vary substantially from year to year depending upon climatic conditions. The water balance simulation has assessed the performance of the mine water management system under the full range of historical climatic conditions. The presentation of results shows the range of likely values, based on the probability of different climatic conditions.

1.2 STRUCTURE OF THE SURFACE WATER BALANCE

This surface water balance (SWB) forms part of the Water Management Plan (WMP) for MCCM. The MCCM Water Management Plan comprises the following documents:

- An overarching WMP.
- Site Water Balance (this document) (Appendix A).
- Surface Water Management Plan (Appendix B).
- Groundwater Management Plan (Appendix C).

The following sections of the SWB describe:

- Statutory obligations under the project approval (Section 2).
- The site water management system, including adopted measures to minimise clean water use on the site (Section 3).
- The site water demands (Section 4).
- The sources of available water (Section 5).
- Surface water releases from the site water management system (Section 6).
- Climate data used for the surface water balance assessment (Section 7).
- Details of the water balance model and model results (Section 8).
- The process for review and validation of the water balance model (Section 9).
- Reporting procedures (Section 10).
- References (Section 11).

2 STATUTORY OBLIGATIONS

The Maules Creek Coal Project (PA 10_0138) was approved by the Minister for Planning and Infrastructure under Section 75J of the *Environmental Planning & Assessment Act 1979* (EP & A Act) on 23 October 2012.

Condition 40 (WMP) of Schedule 3 (Environmental Performance Conditions) of the approval requires the proponent to prepare and implement a WMP for the Project which includes a Site Water Balance. The requirements for the site water balance, and where each requirement is addressed in this document, is provided in Table 1.

Table 1 Site Water Balance Requirements from PA 10_0138

Requirement for Site Water Balance	Section of SWB Where Addressed
• includes details of:	
– *sources and security of water supply, including contingency for future reporting periods;*	Section 5
– *water use on site;*	Section 4
– *water management on site;*	Section 3
– *any off-site water discharges;*	Section 6
– *reporting procedures, including the preparation of a site water balance for each calendar year;*	Section 10
– *a program to validate the surface water model, including monitoring discharge volumes from the site and comparison of monitoring results with modelled predictions; and*	Section 9
• describes the measures that would be implemented to minimise clean water use on site.	Section 3.5

3 WATER MANAGEMENT SYSTEM

3.1 SURFACE WATER MANAGEMENT OBJECTIVES

The proposed water management strategy for MCCM is based on targeted management of water from different sources based on anticipated water quality. Water on the site is categorised as either:

- clean water – water from areas not disturbed by mining;
- mine water – groundwater inflows and surface runoff in mining areas that is likely to come into contact with coal; or
- sediment laden water – runoff from areas disturbed by stripping or placement of overburden material.

The objectives of the water management system are to ensure:

- clean water runoff from undisturbed catchment areas is diverted away from the mining area, where possible and practical to do so;
- sediment laden runoff from disturbed areas is re-used in the water management system or released into the receiving environment if water quality meets Environmental Protection Licence (EPL) requirements;
- mine water (including water that accumulates within, or drains from, active mining areas, washdown bays, coal reject emplacement areas and Coal Handling and Preparation Plant (CHPP) infrastructure areas) and groundwater collected within open cut pits is contained and reused on-site;
- no discharge of mine water off-site; and
- on-site water demands are satisfied whilst minimising offsite water requirements.

3.2 WATER MANAGEMENT SYSTEM CONFIGURATION

Figure 1 shows a schematic representation of the water circuit for the MCCM water management system. Current and forecast site catchment areas, land use and water management infrastructure for FY25 to FY27 are shown in Figure 2 to Figure 4. Details of storages and their operating rules are provided in Section 3.3.1.

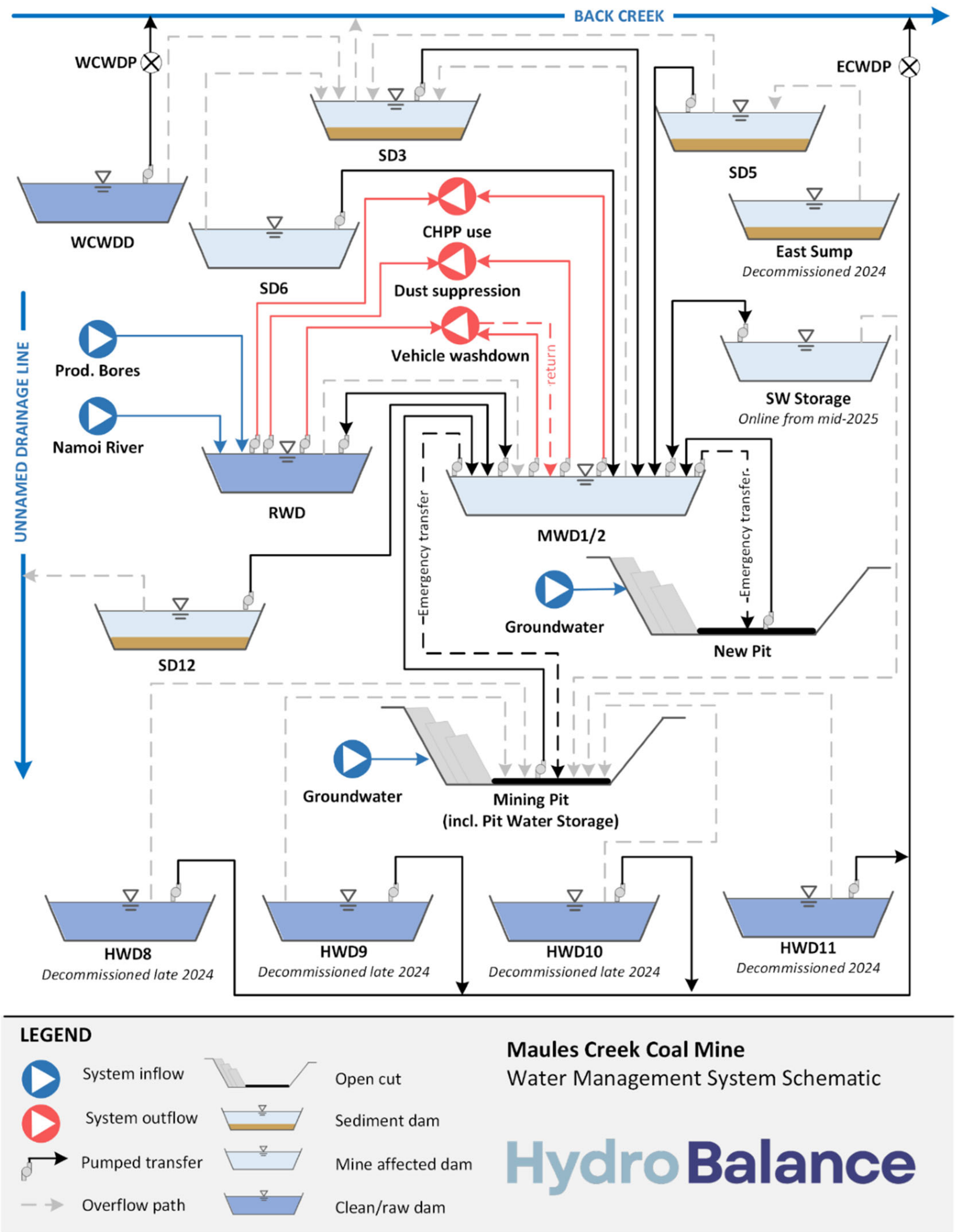


Figure 1 – Schematic of Mine Water Management System

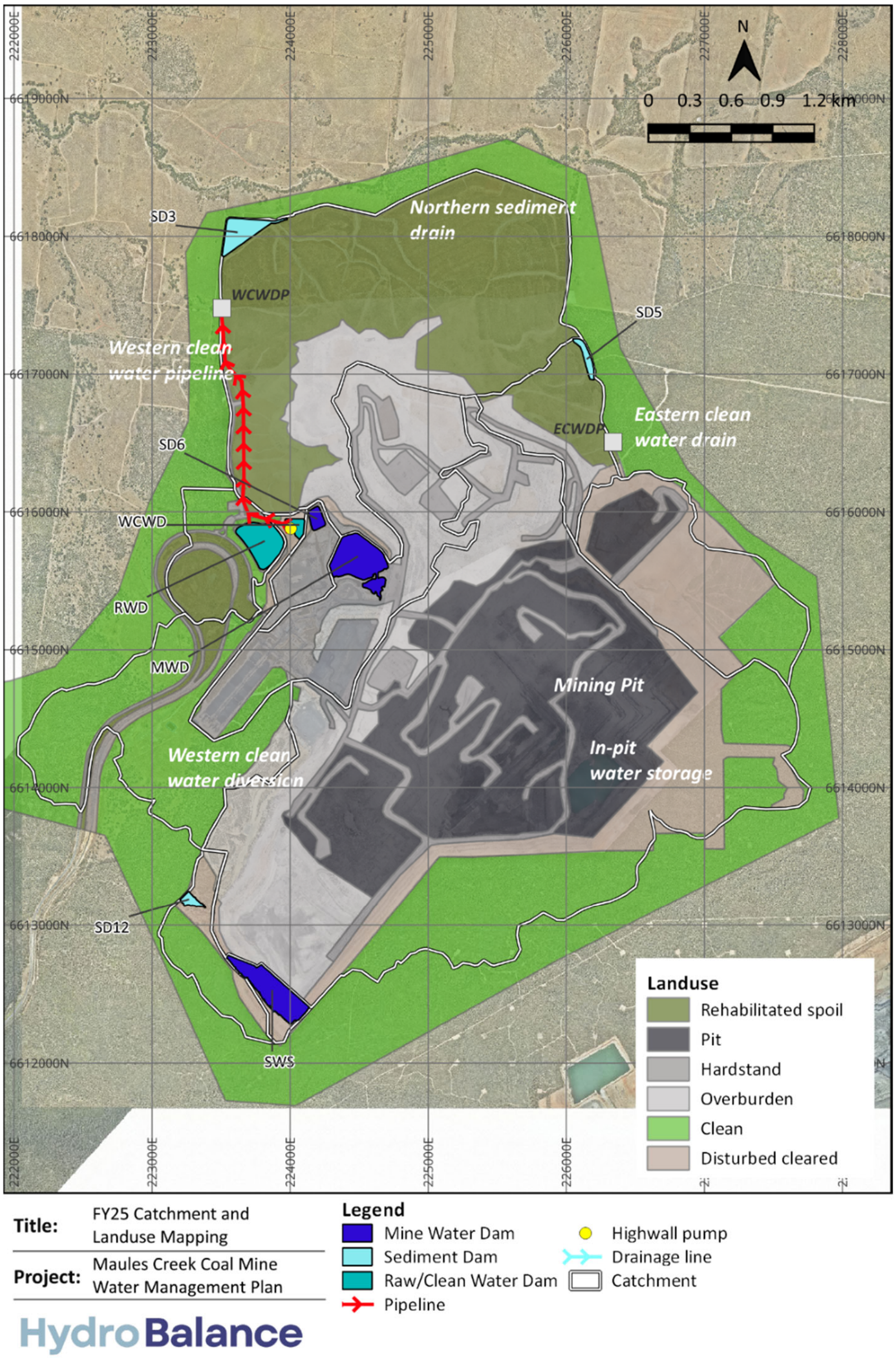


Figure 2 – Site catchments and land use, FY25

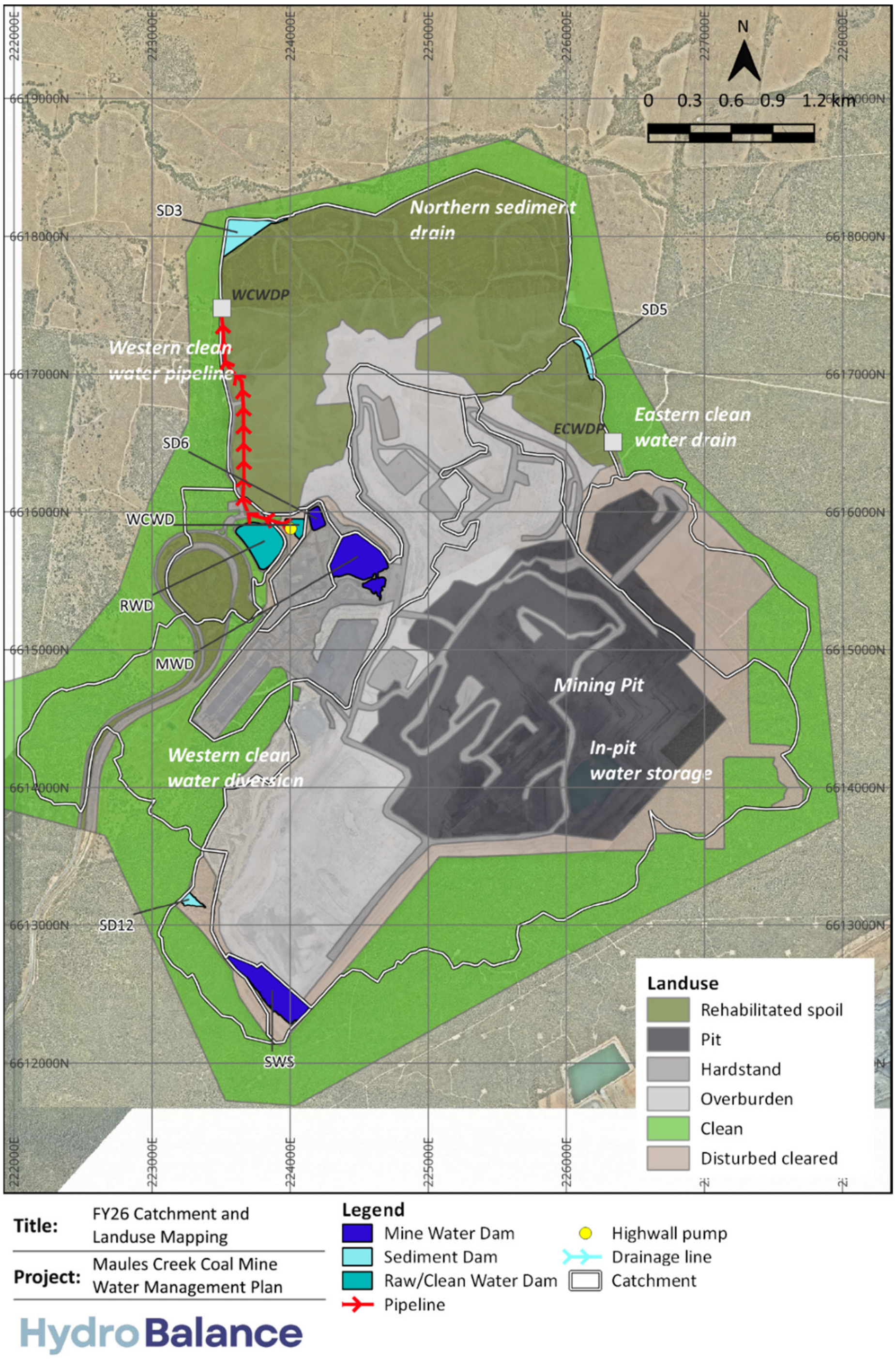


Figure 3 – Site catchments and land use, FY26

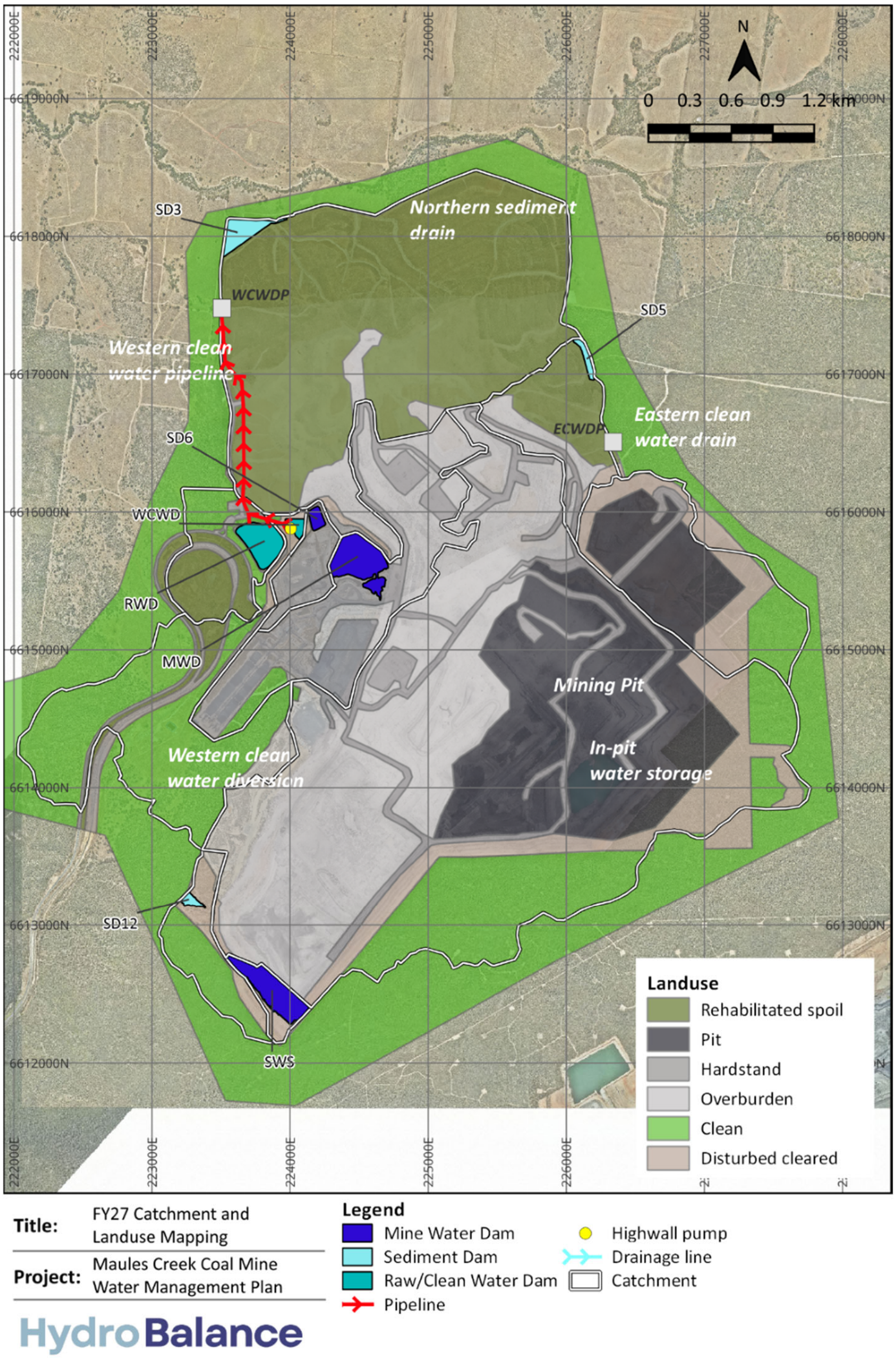


Figure 4 – Site catchments and land use, FY27

3.3 WATER MANAGEMENT INFRASTRUCTURE

3.3.1 Water Storages

The MCCM site water management system includes storages for management of:

- clean water – Raw Water Dam (RWD), highwall dams and Western Clean Water Diversion Dam (WCWD);
- mine water – Mine Water Dam (MWD), mining pit and Pit Water Storage; and
- sediment laden water – sediment dams (SD).

Details of site storages are shown in Table 2. Adopted storage characteristics for the RWD are shown in Table 3.

The water balance simulation assumed no off-site releases of water from sediment dams. Overflow of sediment dams to the receiving environment can still occur from SD3 and SD12 if rainfall exceeds the design standard, consistent with Condition L2.5 of EPL 20221.

Table 2 MCCM Water Storages

Storage	Minimum Capacity (Megalitres (ML))	Spills To	Comments	Operating rules
MWD [a]	526	Low spot in the landform which cannot drain offsite	Excluded works storage Accepts mine water from the pit and CHPP. Captures runoff from the CHPP infrastructure area.	Supplies water management system demands at the highest priority. Transfer to Pit Water Storage when MWD reaches MOV[c] of 340 ML.
Pit Water Storage	1,200[e]	Mining Pit	Excluded works storage Supplementary storage for mine affected water.	Transfers to and from MWD to meet site demands.
RWD	328	Low spot in the landform which cannot drain offsite	Excluded works storage Storage dam for Namoi River and bore water supply. Supplementary storage for mine affected water to reduce reliance on external water	Supplies water management system demands at the lowest priority.
Western Clean Water Diversion Dam (WCWD)	15	Low spot in the landform which cannot drain offsite	Captures runoff from the upstream clean water catchment area	Water released off-site to Back Creek.

Storage	Minimum Capacity (Megalitres (ML))	Spills To	Comments	Operating rules
SD3	169	Off site	Excluded works storage Captures runoff from the OEA.	Water released off-site if water quality meets EPL criteria[d]. Otherwise dewatered to MWD.
SD5	18	SD3	Excluded works storage Captures runoff from the OEA.	Dewatered to MWD.
SD6	25	Low spot in the landform which cannot drain offsite	Excluded works storage Captures runoff from haul road area during operations, and Mine Infrastructure Area (MIA) .	Dewatered to MWD.
SD12	26	Off site	Excluded works storage Captures runoff from the overburden emplacement areas (OEA).	Dewatered to MWD

[a] Combined capacity of MWD1 and MWD2

[b] MWD and RWD are designed to not spill based on the current water balance modelling, however an emergency spillway is required for dam safety purposes

[c] MOV = maximum operating volume

[d] Water balance assessment assumed no off-site release

[e] MOV displayed, the actual capacity of Pit Water Storage varies as mining progresses

Table 3 RWD Storage Characteristics

RL (mAHD)	Volume (ML)	Area (ha)	Comment
303.0	0	0.1	
304.0	3	1.4	
305.0	31	3.8	
306.0	76	5.5	
306.1	82	5.6	Commence pumping from river
307.0	137	6.4	
308.0	205	7.1	
308.5	243	7.5	Cease pumping from river
309.0	280	7.9	
309.2	296	8.1	

309.6	328	8.3	Spillway level

3.3.2 Dam Licensing

Water captured by all storages at MCCM will be appropriately licensed under the Water Management Act 2000 (*WM Act 2000*) based on the location and purpose of each storage. The various licence categories for storages are shown in Table 4.

In addition to the categories in Table 4, some dams are categorised as "Diversion Only". These dams function as part of a clean water diversion system. They are designed to not take water from the environment but may not meet the definition of a Harvestable Rights dam or Excluded Works. The storage capacity of such dams provides temporary attenuation of inflows to match the capacity of a pumped or gravity diversion system.

Within the Project Boundary, there are numerous minor dams, such as old farm dams and construction-phase sediment basins, that do not form part of the water management system. The locations of all dams within the Project Boundary are shown in Figure 5. Capacities of minor dams have been estimated from surface area and approximate depth.

Details regarding the dams which fall under each of the licence categories is provided in the following sub-sections.

Table 4 – Licence Categories for Site Water Use and Storage

Licence category	Reference	Conditions
Water Access Licence (WAL)	Section 56 *WM Act 2000*	Approval for water supply works and/or water use from *WaterNSW*
Harvestable right	Section 53 *WM Act 2000*	Dam located on a minor stream[1]. Total of all harvestable rights dams not to exceed 10% of the average regional run-off calculated from landholding area multiplier.
Mixed Rights	New South Wales (NSW) Government Gazette No. 40, Schedule 3, p1630	A dam from which water is taken as a harvestable right, as well as for other water rights. Runoff captured calculated on the average regional run-off calculation assuming 100% capture.
Excluded work	Water Management (General) Regulation 2018 – Schedule 1	Dam for control of erosion, flood detention or capture of drainage consistent with best management practice to prevent the contamination of a water source. Located on a minor stream[1].
Exempt	NSW Farm Dams Policy	Pre-1999, less than 7 ML

[1] A minor stream is a first or second order stream

Clean water compliance

MCCM compliance of clean water take is summarised in Table 5, which shows:

- MCCM has a Harvestable Rights Allowance of 236.7 ML for its project boundary (3,641 ha)
- MCCM has a total Harvestable Rights dam capacity of 12.1 ML (Table 6)
- The available Harvestable Rights allowance for site is 220.3 ML
- The Mixed Rights allowance for MCCM is 172.8 ML (224.6 ML divided by 1.3)
- The annual Mixed Rights volume captured by MCCM Mixed Rights dams is 4.6 ML (Table 7)
- There is 168.2 ML of available Mixed Rights. Water captured by WCWD, HWD8 or HWD9 which is not diverted will be deducted from the available mixed rights and reported on in the Annual Return.

MCCM has contiguous landholdings outside of the project boundary which it can rely on for additional Harvestable Rights allowance if required.

Table 5: MCCM clean water compliance summary

Summary	
Maximum Harvestable Rights Allowance (ML):	236.7
Harvestable Rights Dam Capacity (ML):	12.1
Available Harvestable Rights Allowance (ML):	224.6
Mixed Rights Allowance (ML):	172.8
Mixed Rights Used By Site (ML):	4.6
Available Mixed Rights (ML):	168.2
Additional contiguous land required to comply (ha):	0.0

Excluded Works Exemption

MCCM has 9 excluded works dams and the active mining pit. Dams covered under the excluded works exemption may have clean catchments which are neither possible nor practical to divert in accordance with best management practice.

Harvestable Rights Dams

Harvestable rights dams capture clean water from overland flow and minor streams within the project boundary. MCCM currently has seven harvestable rights dams including five farm dams which were built prior to the mine. These farm dams are not used to supply water for the mining operation. Seven additional harvestable rights dams were decommissioned in 2022/23 to allow the clean catchment to drain to the environment, as per the approved WMP Addendum B. Table 6 shows the existing harvestable rights dams at MCCM and their storage capacity.

Table 6: Harvestable Rights Dams

Storage	Dam Capacity (ML)	Comment
Upper Turtle	4.0	Farm Dam/Discharges offsite
Lower Turtle	2.9	Farm Dam/Discharges offsite
FD01	0.5	Farm Dam/Discharges offsite
FD02	0.4	Farm Dam/Discharges offsite
FD03	0.8	Farm Dam/Discharges offsite
MC16	1.4	Discharges to WCWD
SD11	2.1	Discharges offsite
TOTAL	**12.1**	

Mixed Rights dams

Table 7 summarises the Mixed Rights dam at MCCM, which is RWD2. Mixed Rights dams have a component of their catchment which is natural and therefore captures clean water. The annual average runoff captured by RWD2, assuming 100% of runoff is captured, is 4.6 ML compared to the Mixed Rights allowance of 171.2 ML.

Table 7 Mixed Rights Dams

Dam	Natural Catchment (ha)	Annual runoff (ML)
RWD2	7.02	4.6
Total	**7.02**	**4.6**

Clean Water Diversions

Table 8 summarises the clean water diversions at MCCM. Any water captured by these dams that is not diverted will be account for in the following way:

- WCWD, HWD8 and HWD9 will be accounted for against the annual available mixed rights allowance of 166.5 ML and reported in the Annual Return.
  - HWD8 and HWD9 will be decommissioned in 2024
- HWD10 is located on a non-minor stream. Water which is not diverted will be accounted for against WAL41585 which has annual allocation of 30 ML (up to 60 ML with carryover).
  - HWD10 will be decommissioned in 2024
- HWD11 was decommissioned in early 2024.

The volume of water diverted by these storages, and any water retained on site is reported quarterly on the Whitehaven website.

Table 8 Clean Water Diversions

Dam	Natural Catchment (ha)	Storage Volume (ML)	Stream type	Water which is not diverted will be accounted for against
WCWD	92.4	15	Minor	Mixed rights allowance
HWD8	26.8	8	Minor	Mixed rights allowance
HWD9	48.1	16	Minor	Mixed rights allowance
HWD10	39.7	20	Non-Minor	WAL41585 - 30 ML
Total	207	59		

HWD = Highwall Dam

Dams on Non-minor Streams

Table 9 summarises the dams on non-minor streams within the MCCM project boundary. FD2, FD12 and FD20 are farm dams built prior to the mine and prior to 1999. These dams are less than 7 ML and therefore exempt under the NSW Farm Dam policy. These dams are located outside of the mines project approval boundary, but within the mines ML. MCCM does not extract any water from these dams for the operation.

SD7 and MC10 were decommissioned in 2022/23 as part of an enforceable undertaken entered into with NRAR and approved in the WMP Addendum B.

Table 9 Dams on Non-minor Streams

Dams	Dam Capacity (ML)	Built prior to 1999	Action
FD2	1.9	Yes	Complies with NSW Farm Dam Policy
FD12	0.44	Yes	Complies with NSW Farm Dam Policy
FD20	1.77	Yes	Complies with NSW Farm Dam Policy

3.3.3 Drains and Pipelines

The site water management system includes the following key drains and pipelines designed to contain runoff from operational areas in accordance with PA condition 39 d, as shown in Figure 2 to Figure 4:

- Northern Sediment Drain – drains sediment laden runoff from northern out-of-pit overburden emplacement to SD3.
- Western Clean Water Diversion – collects runoff from undisturbed catchments to the south and west of the coal stockpile area and drains to the Western Clean Water Diversion Dam.
- Eastern Clean Water Pipeline – clean water pipeline that connects the highwall dams and discharges clean water from the dams to Back Creek tributaries east of the mine.
- Western Clean Water Pipeline – discharges from the Western Clean Water Diversion Dam to a tributary of Back Creek west of the mine.
- Northern Clean Water Drain – drains undisturbed catchment runoff to the Western Clean Water Diversion Dam.
- Eastern Clean Water Drain – remnants of the historical highwall diversion drain which is progressively being mined through as the pit advances eastwards.

3.3.4 Clean Water Management System

Details of the clean water management system are provided in Section 4.3 of the Surface Water Management Plan (Appendix B of the WMP).

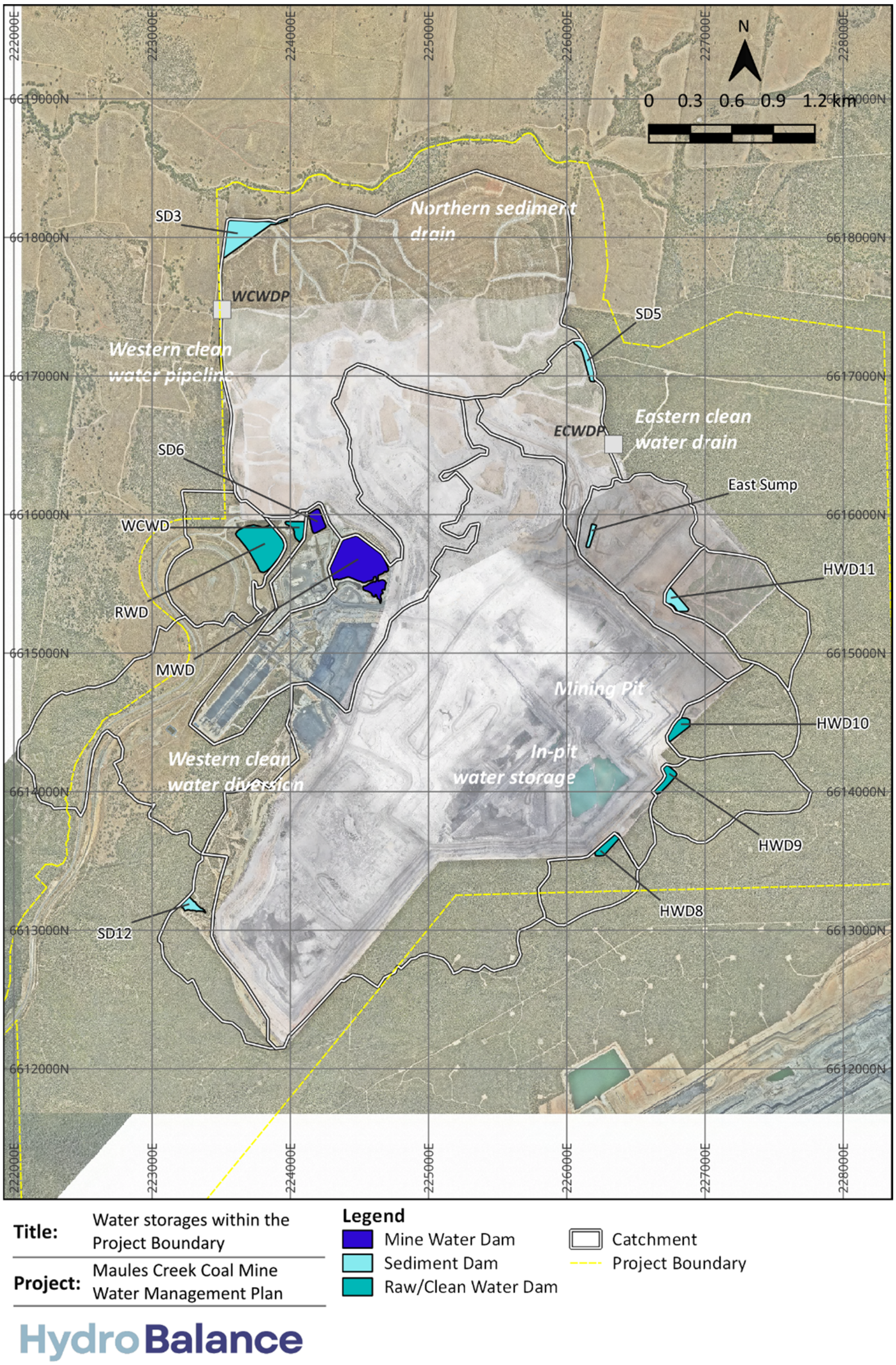


Figure 5 – Locations of dams within Project Boundary

3.4 POTABLE WATER

Potable water is either trucked to site as required or treated to potable standards onsite and stored in water tanks supplying the main office and workshop areas. Potable water is used for drinking and shower purposes within the main office, bathhouse and adjacent workshop areas.

The volumes of potable water used on the site are negligible compared to process water use and hence potable water use is not included in the site water balance.

3.5 MEASURES IMPLEMENTED TO MINIMISE CLEAN WATER USE

Use of clean water on the site is minimised by implementing the following measures:

- Operating the MWD to ensure no spills of mine water to the receiving environment. This ensures maximum recycled water is available on site for reuse.
- Using mine water and sediment laden water to supply site demands as first priority. Water from clean water sources is taken only to supplement any deficit in water availability from the mine water system in compliance with Water Access License conditions or Harvestable Rights.
- Recycle water from the CHPP to re-use in the mine water management system.

4 WATER DEMANDS

4.1 OVERVIEW

The modelled water demands from the mine water management system include:

- coal processing demand from the CHPP;
- dust suppression (dominated by haul road watering); and
- vehicle washdown and stockpile use.

4.2 COAL HANDLING AND PREPARATION PLANT

The adopted forecast annual run-of-mine (ROM) and production tonnages are shown in Table 10.

The recorded CHPP water usage over 2023 was 3,774 ML for an annual ROM tonnage of 11.6 million tonnes. This results in a gross CHPP consumption rate of 325 litres/ROM tonne (L/ROM tonne).

An analysis of site data from the Year 2019 annual review indicates that approximately 70% of the water that is supplied to the CHPP is recycled within the CHPP/belt filter press circuit. Therefore, the estimated net CHPP consumption rate is 127 L/ROM tonne representing approximately 30% of gross CHPP water use.

This estimated net consumption rate has been applied to the forecast ROM tonnages, and the resulting forecast net CHPP water usage is provided in Table 10.

Table 10 Water Management Requirements in Project Approval 10_0138

Year	ROM Tonnage (Mtpa)	Bypass Tonnage (Mtpa)	Feed Tonnage (Mtpa)	Net Usage (ML/yr)
FY25	11.36	2.36	11.33	1,439
FY26	11.68	2.03	11.70	1,485
FY27	11.65	1.78	11.54	1,465

4.3 DUST SUPPRESSION

Haul road dust suppression rates have been estimated using daily rainfall and evaporation data sourced from the SILO database and the predicted haul road length. The haul road length determined from aerial photography is approximately 24 kilometres (km). This is expected to remain the same through to FY27.

The following rules were used to determine the applied dust suppression rate on any given day:

- For a dry day (zero rainfall), the haul road watering rate is equal to the daily evaporation rate.

- For a rain day when rainfall is less than the daily evaporation rate, the watering rate is reduced and is only required to make up the remaining depth to the daily evaporation rate.
- For a rain day when rainfall exceeds the daily evaporation rate, no haul road watering is required.
- It was assumed that 27.5 metres of the haul road width would be watered twice per day; and
- A seasonal factor was applied to the wet season and dry season daily estimates to account for seasonal variation in the use of dust suppressant emulsions:
  - Wet season (October to March) application factor: 0.75
  - Dry season (April to September) application factor: 1.05

Figure 6 shows the average estimated monthly haul road dust suppression and recorded water cart volumes for 2016 through to 2023 which were drought years, allowing MCCM to plan for the highest rates of dust suppression. This figure shows that the adopted procedure for estimating dust suppression rates provides a reasonable match to the recorded data on a monthly scale. The adopted consumption rates for FY25 to FY27 are summarised in Table 11.

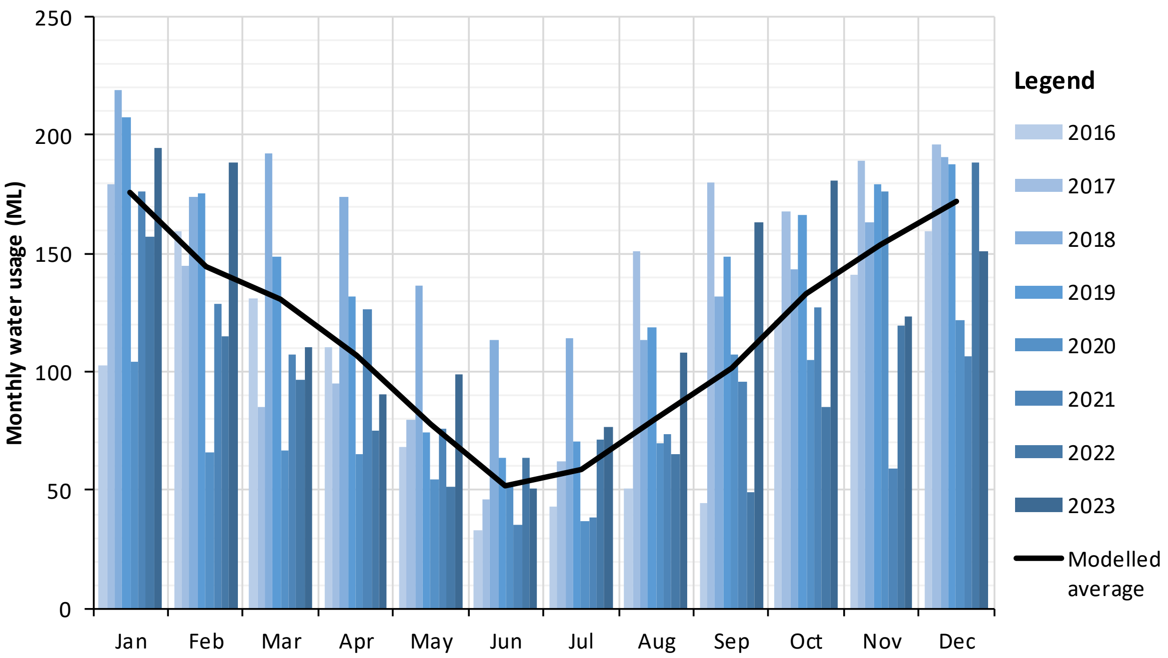


Figure 6 - Comparison of Estimated and Actual Haul Road Dust Suppression Rates

Operational water use is not heavily dependent on climate. The monthly operation water use was estimated as the average of usage data (MIA supply flowmeter) recorded between 2016 and 2023. The average monthly operational water use is summarised in Table 11.

Table 11 Adopted Monthly Dust Suppression and Operations Usage

Month	Average Haul Road Dust Suppression (ML/month)	Average Operational Use (ML/month)
January	176	6.7
February	144	7.4
March	131	9.7
April	107	11.1
May	78	9.3
June	52	5.2
July	59	4.8
August	80	3.5
September	101	6.0
October	133	7.2
November	153	7.6
December	172	7.4
Annual	**1,386**	**86**

4.4 VEHICLE WASHDOWN AND STOCKPILE USE

Consistent with the Year 2023 Annual Review, a vehicle washdown usage of 3 ML/year (8 kilolitres per day (kL/day)) was adopted. The vehicle washdown supply will be returned to MWD, with only minor losses due to evaporation.

4.5 DEMAND SUMMARY

Table 12 provides a summary of total annual CHPP net demand and other demands for the water balance simulation period (FY25 to FY27). The monthly variation in total demand for FY25 is shown in Figure 7.

Table 12 Summary of Estimated Annual Water Demands, FY25 – FY27

Year	Net CHPP (ML)	Other (ML)	Total (ML)
FY25	1,439	1,475	2,914
FY26	1,485	1,475	2,960
FY27	1,465	1,475	2,940

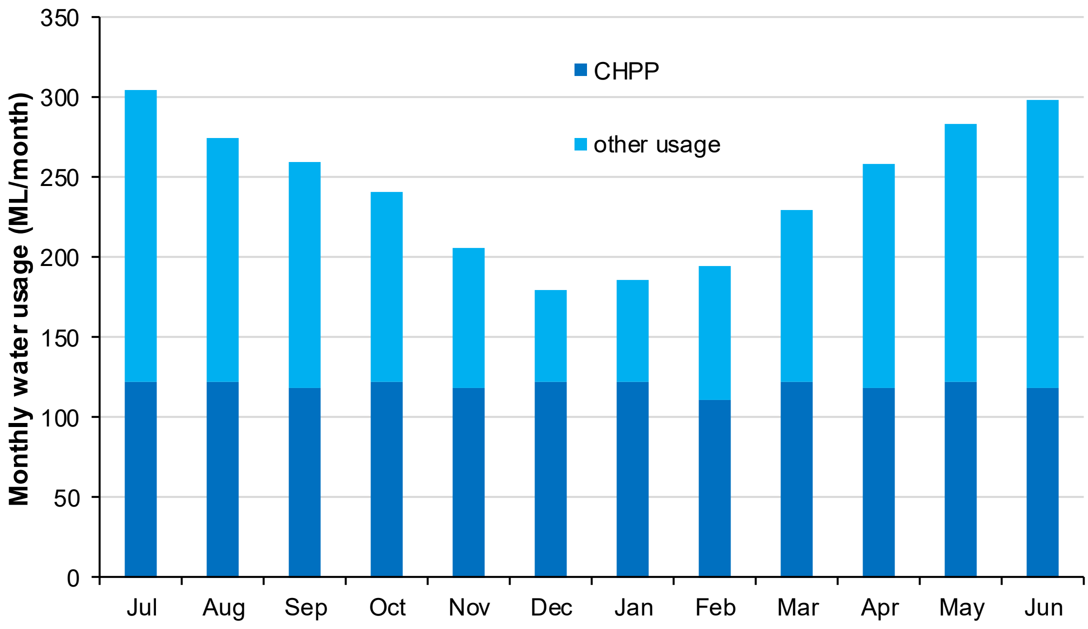


Figure 7 – Forecast Monthly Water Demand, FY25

5 WATER SOURCES

5.1 GROUNDWATER INFLOWS

The following groundwater inflows to the mining pit were adopted based on groundwater model predictions from the BTM complex groundwater model (AGE, 2021):

- FY25: 1.39 ML/d.
- FY26: 1.37 ML/d.
- FY27: 1.38 ML/d.

5.2 CATCHMENT RUNOFF

5.2.1 Rainfall Runoff Model

The Australian Water Balance Model (AWBM) (Boughton, 2004) was used to estimate daily runoff from daily rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff.

The AWBM uses a group of connected conceptual storages (three surface water storages and one ground water storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evapotranspiration. Simulated surface runoff occurs when the storages fill and overflow. Figure 8 shows a conceptual configuration of the AWBM model.

The AWBM model uses daily rainfalls and estimates of catchment evapotranspiration to calculate daily values of runoff using a daily balance of soil moisture. The model has a baseflow component which simulates the recharge and discharge of a shallow subsurface store. Runoff depth calculated by the AWBM model is converted into runoff volume by multiplying by the contributing catchment area. The model parameters define the storage depths, the proportion of the catchment draining to each of the storages, and the rate of flux between them.

Catchment runoff was modelled using the AWBM rainfall-runoff model. Catchments across the site have been characterised into the following land use types:

- Natural (undisturbed catchments, fully rehabilitated spoil and pre-strip areas).
- Compacted (haul roads, pit floor, mine infrastructure).
- Spoil (unrehabilitated overburden emplacement areas).
- Rehabilitated spoil (rehabilitated spoil, high gradient slopes).

The adopted rainfall runoff parameters are summarised in Table 13. The 'natural' parameters have been calibrated against recorded runoff collected by the highwall dams between April and October 2022. The remaining parameters have been validated against data from site observations (see Section 9).

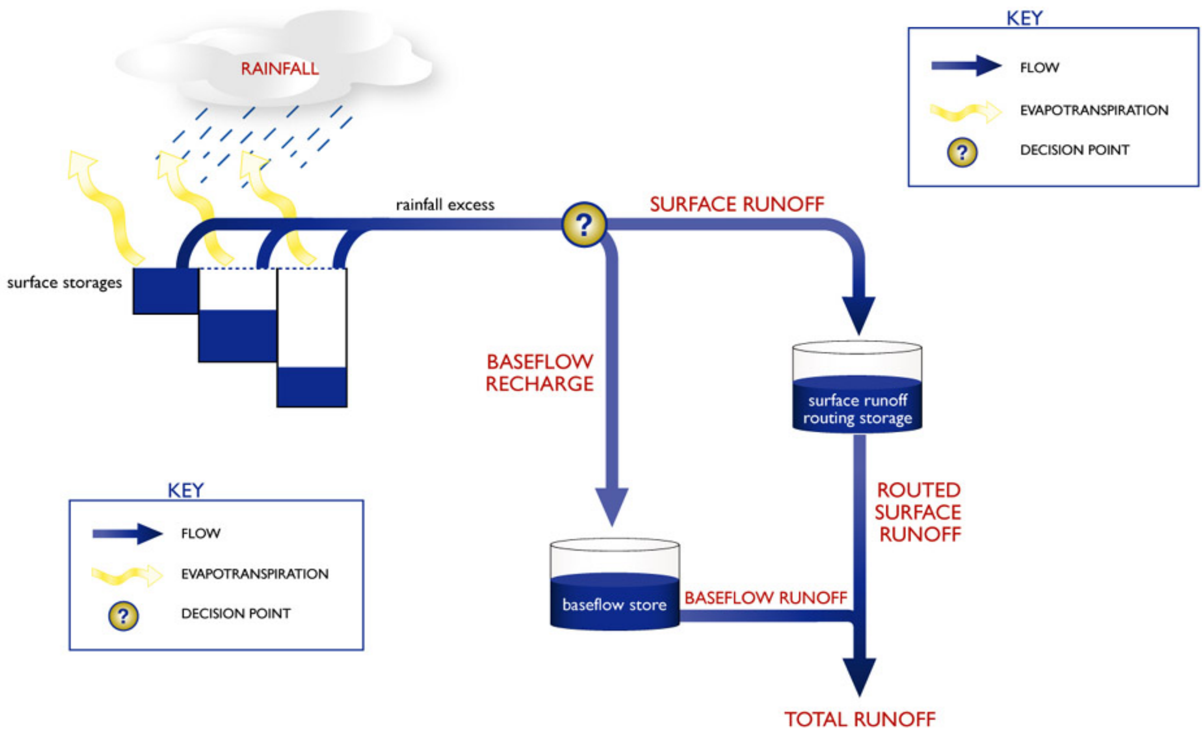


Figure 8 – AWBM Model Configuration

Table 13 Adopted AWBM Parameters for the MCCM Water Balance

Parameter	Natural	Compacted	Spoil	Rehabilitated Spoil
C1 (mm)	25.5	2	15	15
C2 (mm)	98.2	10	50	50
C3 (mm)	477.7	30	110	183
A1	0.069	0.33	0.1	0.1
A2	0.282	0.33	0.3	0.3
A3	0.649	0.33	0.6	0.6
BFI	0	0	0.2	0.2
Kbase	0	0	0	0.9
Ksurf	0.3	0	0	0

mm = millimetres

5.2.2 Catchment Areas

Figure 2 to Figure 4 show the adopted catchments and land use for FY25 to FY27. Catchment areas for each storage are shown in Table 14.

Table 14 Adopted Catchment Areas

Dam	FY25 Catchment (ha)	FY26 Catchment (ha)	FY27 Catchment (ha)
East Pit	197.1	197.1	197.1
New Pit	133.2	133.2	133.1
MWD	195.7	191.7	166.0
Mining Pit	738.9	738.9	738.9
RWD	58.3	58.3	58.3
SD12	42.4	42.4	42.4
SD3	418.4	422.4	448.0
SD5	65.2	65.2	64.7
SD6	25.0	25.0	25.0
WCWD	177.9	177.9	177.9
Total	**2,052**	**2,052**	**2,052**

5.3 EXTERNAL WATER SUPPLIES

Site water demands can be supplemented by external sources if sufficient water is not available on site to meet demands. External water sources that can supplement site water supply are:

- High security allocation from the Namoi River pipeline.
- Groundwater bores:
  - Olivedene (Zone 5).
  - Brighton (Zone 4).
  - Roma (Zone 4).

Water required from external sources is obtained under Water Access Licences (WALs). Table 15 shows the WALs associated with the Water Supply Works Approval 90WA801901 from which MCCM can draw water. A combined allocation of 4,704 ML is available annually to MCCM under these WALs, which is sufficient to supply the projected raw water demand (assuming each source has water available).

In addition to these WALs, MCCM has obtained temporary trades (through water allocation assignment trading) to allow for additional Zone 4 groundwater to be extracted from the Roma, Brighton and Olivedene bores. Temporary trades are common in Zone 4 (78 trades totalling 7,231 units in FY2019) and hence offer a reliable market for MCCM to obtain temporary allocation of groundwater to meet any additional demand.

To replicate the uncertainty of flows within the Namoi River, it was assumed that water could only be extracted from the Namoi River 4 months per year. This replicated block releases from Lake Keepit which is how the dam is operated in dry periods.

As a water supply contingency measure, water may be obtained from Boggabri Coal Mine (BCM), which has in the past had excess water on site. Approximately 410 ML from BCM was transferred to MCCM in the second half of 2019.

Table 15 MCCM WALs

Site	Water Source	WAL Number	Volume Available (units)
Roma	Upper Namoi Zone 4 Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source	12722	77
Brighton	Upper Namoi Zone 4 Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source	12718	102
Olivedene	Upper Namoi Zone 5 Namoi Valley (Gin's Leap to Narrabri) Groundwater Source	12811	135
Olivedene	Upper Namoi Zone 5 Namoi Valley (Gin's Leap to Narrabri) Groundwater Source	12791	112
Regulated River (High Security)	Lower Namoi Regulated River Water Source	13050	3,000

External water imports over the simulation period (FY25 to FY27) were modelled based on the rules outlined in Table 16.

Table 16 MCCM Water Importation Rules

Source	Importation Rules	Maximum Daily Rate (ML/d)	Annual extraction limit (ML)
Namoi River pipeline	Namoi River importation linked to annual cumulative rainfall deficit (CRD). • CRD>20 mm, access at any time • CRD<20 mm and >-130 mm, access 4 months of the year • CRD<-130 mm and >-238 mm, access 4 months of the year and a max 1,000 ML/a extraction limit. • CRD< -238 mm, access 1 month of the year and a max 250 ML/a extraction limit. Imported when the inventory of the three major storages (RWD, MWD and Pit Water Storage) falls below 1,000 ML	30	3,000
Roma bore	Cannot be imported simultaneously with Namoi River water. Imported when the inventory of the three major storages (RWD, MWD and Pit Water Storage) falls below 700 ML	5	1,200
Brighton bore	Cannot be imported simultaneously with Namoi River water. Imported when the inventory of the three major storages (RWD, MWD and Pit Water Storage) falls below 600 ML	3	204
Olivedene bore	Cannot be imported simultaneously with Namoi River water. Imported when the inventory of the three major storages (RWD, MWD and Pit Water Storage) falls below 600 ML	1	300
BCM pipeline	***Not modelled***		

6 OFF-SITE RELEASES

6.1 MINE WATER

In accordance with mine Project Approvals (Schedule 3 - Condition 38), mine water discharges from site can only occur if:

- The water is equal to or better quality than the receiving environment
- The discharge complies with the discharge limits in Condition L2.5 of EPL 20221

The project is based on a zero-discharge basis for mine water. However, in the event of very wet conditions occurring at the mine, mine water may be treated and discharged if it complies with the EPL.

The Mine Water Dam is not able to spill off lease due to topography and the out of pit emplacement. No uncontrolled discharges of mine water have ever occurred from the mine.

6.2 SEDIMENT LADEN WATER

The water balance assessment assumed no release of water from sediment dams. Overflow of sediment dams to the receiving environment can still occur from SD3 if rainfall exceeds the design standard, in accordance with Condition L2.5 of EPL 20221.In the event of very wet conditions occurring at the mine, dirty water may be treated and discharged in accordance with Condition L2.5 of EPL 20221.

6.3 CLEAN WATER

6.3.1 Highwall Dams

Undisturbed catchment inflows upslope of the Mining Pit highwall are captured by highwall dams HWD8, HWD9 and HWD10. The catchment runoff collected by the highwall dams is pumped to Back Creek via LDP45. Further detail of the highwall dam strategy is provided in Section 4.3 of the Surface Water Management Plan (Appendix B of the WMP). These dams will be decommissioned in FY24.

6.3.2 Western Clean Water Diversion Dam

WCWD collects undisturbed runoff via the Western Clean Water Diversion. Clean water collected in WCWD is pumped off-site into a tributary of Back Creek, via the Western Clean Water Pipeline and LDP46 (see Figure 2 to Figure 4), at a maximum rate of 400 Litres per second (L/s). Further detail of the clean water management strategy is provided in Section 4.3 of the Surface Water Management Plan (Appendix B of the WMP).

7 CLIMATE DATA

Long term daily rainfall and evaporation data for MCCM was obtained from the SILO database (https://www.longpaddock.qld.gov.au/silo/) for the period January 1889 to January 2024 (135 years). Average monthly rainfall and evaporation are shown in Figure 9. Morton's lake evaporation was adopted to represent evaporation for the simulation of the site water balance.

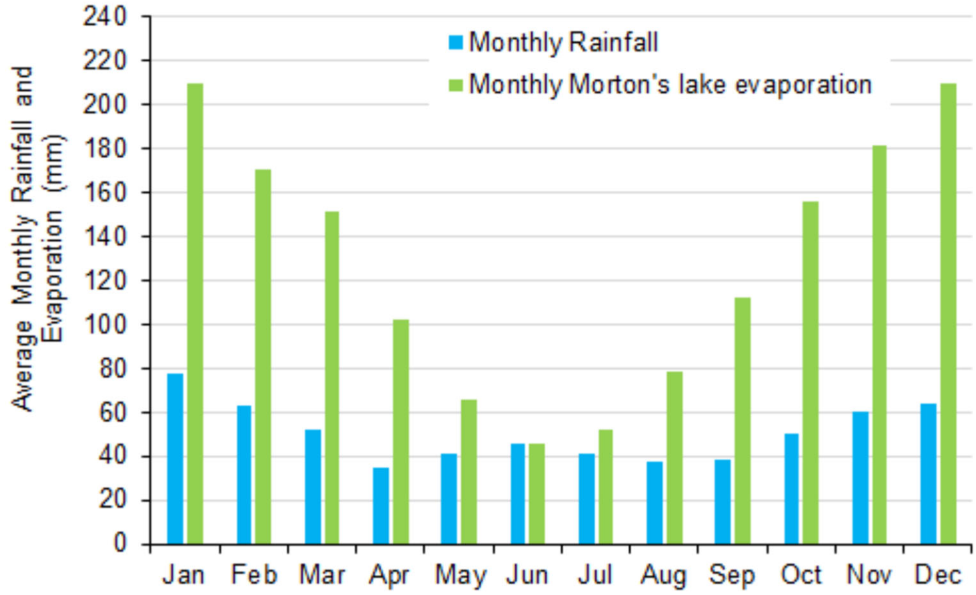


Figure 9 - Average Monthly Rainfall and Evaporation from SILO Database

8 WATER BALANCE MODEL

8.1 OVERVIEW

The GoldSim water balance model was used to undertake a forecast simulation of the MCCM site water balance under varying climatic conditions over the three-year period FY25 to FY27. The model simulates all major components of the water management system on a daily time step. The simulated inflows and outflows included in the model are provided in Table 17.

Climatic conditions were represented by extracting two-year periods of rainfall from the historical rainfall record which goes back to 1889. Each three-year climate sequence represented by the model is referred to as a “realisation”. The first realisation used recorded rainfall data from 1889 to 1891. The second realisation used data from 1890 to 1892, and so on. The historical rainfall record (1889 to 2024) provides 132 realisations.

Table 17 Simulated Inflows and Outflows to Mine Water Management System

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	CHPP demand
Groundwater inflows	Dust suppression demand
Raw water supply	Vehicle wash down
	Offsite spills from storages

The GoldSim model was used to assess the performance of the proposed water management system, including:

- mine water storage inventory;
- raw water requirements from an external source;
- uncontrolled spills from site dams; and
- the overall water balance within the water management system.

Figure 1 shows the conceptualisation of the mine water management system adopted for the water balance model. Note that the coal process water circuit was not explicitly modelled. However, the estimated net water demand from the CHPP was included in the model (refer Table 10).

It is important to note that there is inherent uncertainty with respect to some components of the water balance (e.g. catchment yield/rainfall runoff, mining area groundwater inflows). Best estimates of these parameters have been adopted and these estimates will continue to be checked and refined against on-site observations as operations progress.

8.2 FORECAST SIMULATION RESULTS INTERPRETATION

In interpreting the results of a forecast simulation, it should be noted that the results provide a statistical analysis of the water management system's performance over the 3-year forecast period, based on 132 realisations with different climatic sequences.

The model results are presented as a probability of exceedance. For example, the 10th percentile represents 10% probability of exceedance and the 90th percentile results represent 90% probability of exceedance. The is an 80% chance that the result will lie between the 10th and 90th percentile traces.

Whether a percentile trace corresponds to wet or dry conditions depend upon the parameter being considered. For site water storage, where the risk is that available capacity will be exceeded, the lower percentiles correspond to wet conditions. For example, there is only a small chance that the 1 percentile storage volume will be exceeded, which would generally correspond to very wet conditions.

For external site water supply volumes (for example), where the risk is that insufficient water will be available, there is only a small chance that more than the 1 percentile water supply volume would be required. This would generally correspond to very dry climatic conditions.

It is important to note that a percentile trace shows the likelihood of a particular value on each day and does not represent continuous results from a single model realisation. For example, the 50th percentile trace does not represent the model time series for median climatic conditions.

8.2.1 Overall Water Balance

Water balance results from the 132 modelled realisations are presented in Table 18, averaged over each year. The results presented in Table 18 are the average of realisations and will include wet and dry periods distributed throughout the forecast period.

Rainfall yield for each year is affected by the variation in climatic conditions within the adopted climate sequence. It should be recognised that the following components of the water balance are subject to climatic variability:

- Rainfall runoff.
- Evaporation.
- Dust suppression water use.
- Imported water requirement.
- Site releases/spills.

Hence, actual values of these components of the water balance will vary from year to year and may be outside the range of simulated results.

The results show that, on average:

- The average annual external water demand supplied from external licensed sources ranges between approximately 234 ML/year and 726 ML/year.
- Evaporation from dam water surfaces ranges between approximately 298 ML/year and 344 ML/year.
- No overflows of mine water occurred in the simulation period.
- Combined runoff and direct rainfall contribute between 1,949 ML/year and 2,183 ML/year.

Table 18 Annual Water Balance – All Realisations (Averaged)

	Annual Water Balance (ML/period)		
	FY25	FY26	FY27
Water Inputs			
Direct Rainfall + Catchment Runoff	2,183	2,064	1,949
Raw Water (external source)	234	648	726
Groundwater Inflow	507	500	504
Total Inputs	**2,924**	**3,211**	**3,179**
Water Outputs			
Evaporation from Dams and Ponds	344	304	298
Dust Suppression Demand	1,390	1,391	1,393
CHPP Makeup Demand	85	85	85
Construction Water Use	1,439	1,485	1,465
MWD Spills	0	0	0
SD Overflows (off-site)	29	40	38
Clean Off-Site Release	0	0	0
Total Outputs	**3,286**	**3,305**	**3,279**
Change in Stored Volume	**-362**	**-94**	**-100**

8.2.2 Mine Site Storage Inventory

Figure 10 and Figure 11 show the predicted probability of the modelled out-of-pit and in-pit storage volume over the 3-year forecast period. A build-up of water in the active open cut generally occurs when the out of pit storages are too full to accept additional pit water. The primary out-of-pit storages are MWD and Pit Water Storage. MWD is made up of two separate dams and has a full supply capacity of 526 ML. The MOV of the MWD is set at 340 ML to prevent uncontrolled spills. When the stored volume in the MWD is below 340 ML, water can be pumped in from the active pits. If MWD stored capacity exceeds 340 ML, water will need to be managed within the pit. Pit Water Storage has an assumed MOV of 1,200 ML. Therefore, the combined MOV of MWD and Pit Water Storage is 1,540 ML.

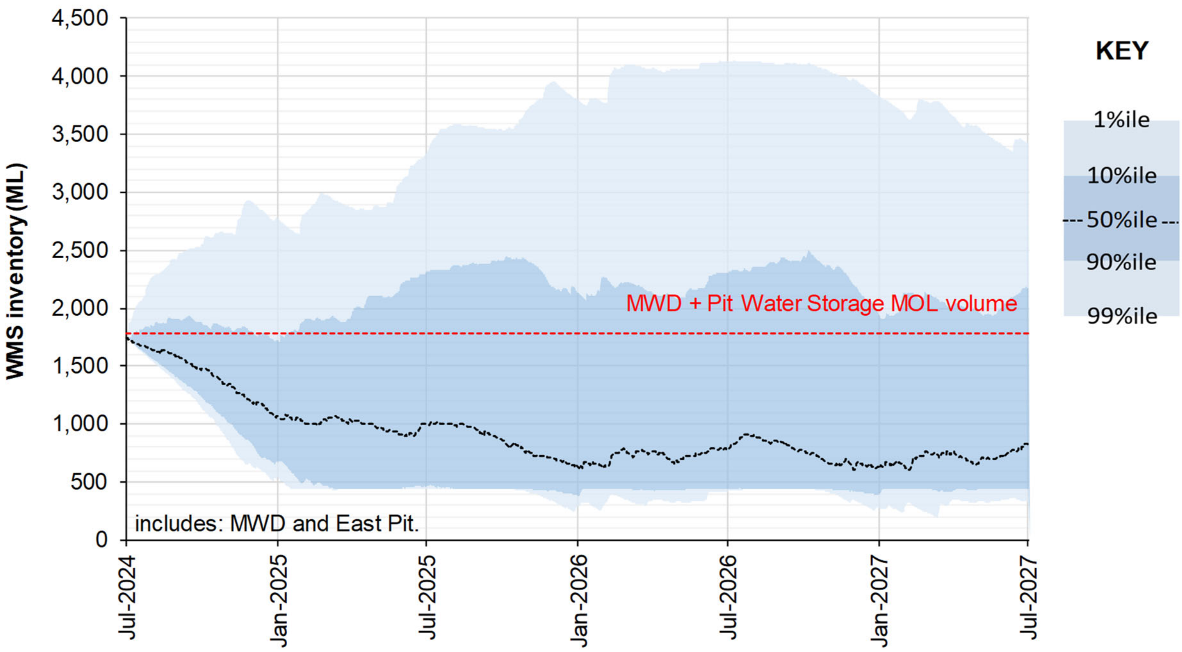


Figure 10 - Forecast MWD and Pit Water Storage Combined Inventory

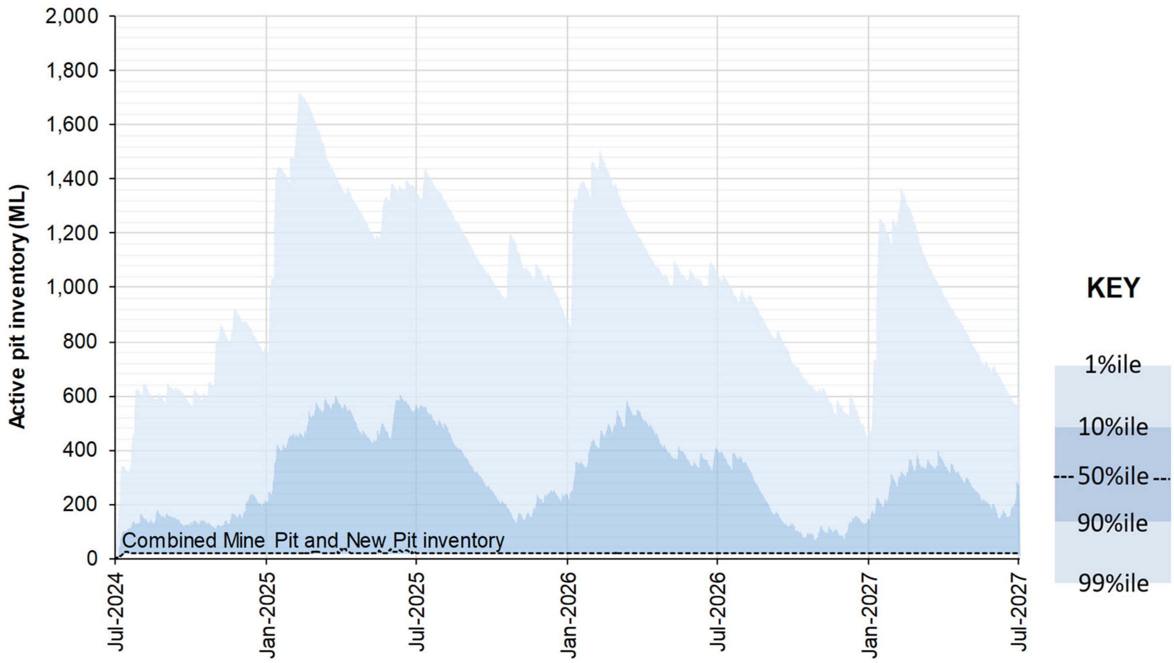


Figure 11 - Forecast In-pit Inventory

The water balance model results show that:

- The MWD and Pit Water Storage do not empty over the simulation period due to the external water supply.
- The 50th percentile combined MWD and Pit Water Storage volume fluctuates between 700 ML and 1,000 ML after January 2025. This suggests that water will be held in Pit Water Storage for median conditions, as the MWD MOV will be exceeded.
- There is a 50% chance that there will be no significant accumulated water (i.e. >150 ML) in the pit over the 3-year forecast period.
- There is at least a 10% chance that:
  - MWD and Pit Water Storage will be maintained around or just above the combined MOV over the next 3 years; and
  - the active pit water volume will exceed 600 ML over the next 3 years.
- There is a 1% chance that:
  - the combined MWD and Pit Water Storage inventory will exceed 4,000 ML at some point over the next 3 years; and
  - the active pit water volume will exceed 1,700 ML over the next 3 years.

8.2.3 External Water Requirements

When considering external water requirements, the probabilities have been inverted to indicate the risk of requiring at least the specified volume of water from an external source. Hence, for investigation of external water supply, the 1st percentile represents very dry conditions which provide an indication of the likely upper limit of required water volumes.

When the site mine water supplies are exhausted, site demands (CHPP and dust suppression) draw upon the RWD. Once the MWD drops below a low trigger level, water will be demanded from external sources, as per the rules outlined in Section 5.3. Figure 12 shows the external water requirements from the Namoi River pipeline and the borefields. The following is of note:

- For the Namoi River pipeline source:
  - during 90th percentile wet climates, Namoi River water will not be required to supply operational demands over the 3-year forecast period;
  - there is a 50% chance that an annual volume of at least between 100 and 252 ML per year of Namoi River water will be required to supply operational demands over the 3-year forecast period; and
  - during 10th percentile dry climates, an annual volume of between 230 and 758 ML per year of Namoi River water will be required to supply operational demands over the 3-year forecast period.
- For the borefield (including the Roma, Brighton and Olivedene bores) source:
  - during 90th percentile wet climates, bore water will not be required to supply operational demands over the 3-year forecast period;

  - there is a 50% chance that an annual volume of at least between 0 and 245 ML per year of bore water will be required to supply operational demands over the 3-year forecast period; and
  - during 10th percentile dry climates, an annual volume of between 470 and 1,212 ML per year of Namoi River water will be required to supply operational demands over the 3-year forecast period.
- External water requirements from the Namoi River and from the borefield would not exceed the respective allocations for any of the climatic conditions assessed, therefore complying with license conditions.

Figure 12 shows the project complies with PA condition 36 and has sufficient water for the operation. In the event there is not sufficient water, MCCM will scale its operation to match supply, through reduced operation or increased bypass.

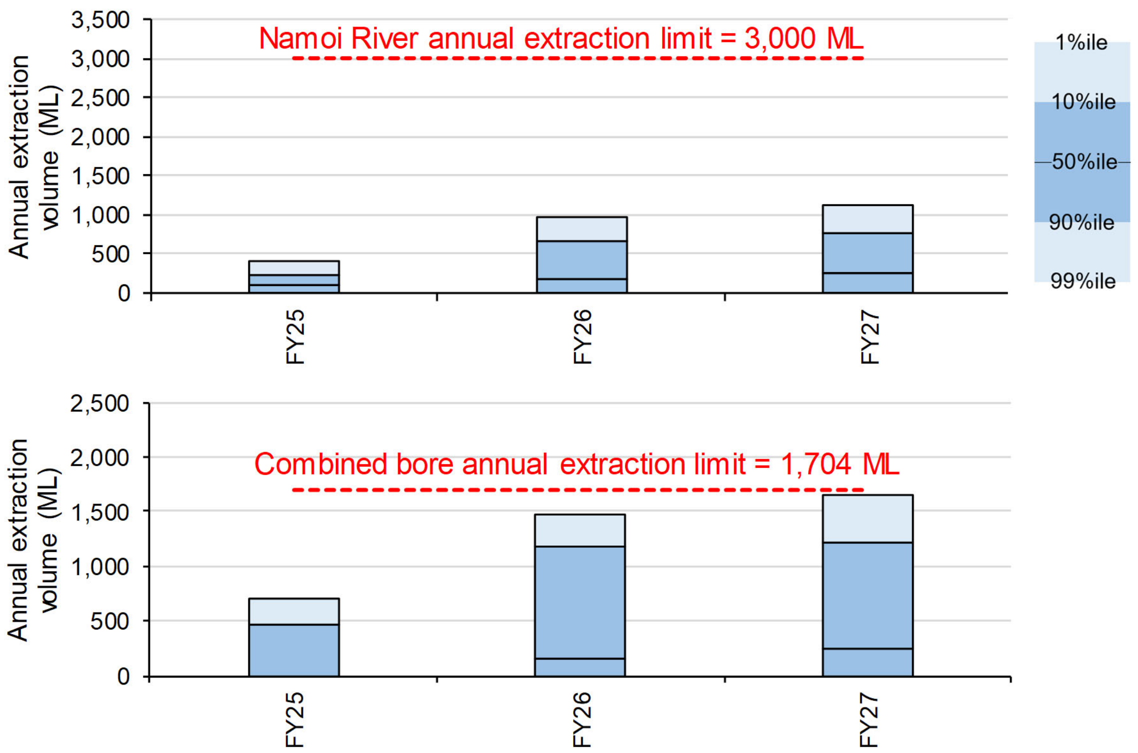


Figure 12 - Forecast Total Annual External Water Supply, Namoi River & Bores

8.2.4 Uncontrolled Spills

Table 19 shows the predicted spills from key site storages over the 3-year forecast period for the median as well as the 90th (dry) and 10th (wet) percentile confidence limits. The results show:

- There are no spills from MWD or RWD under all realisations.
- SD3 would spill only 8 days per year during wet (10th percentile) climatic conditions, with an average spill volume of 9.3 ML per event.
- SD12 would spill for only 1 day per year during wet (10th percentile) climatic conditions, with an average spill volume of 3.8 ML event.

Table 19 Predicted Spills from Key Site Storages Over 3 Year Forecast Simulation

Dam	Probability Percentile	Ave. No. of spill days per year	Ave. spill volume per spill day (ML)
MWD	10	0	0
	50	0	0
	90	0	0
RWD	10	0	0
	50	0	0
	90	0	0
SD3	10	8	9.3
	50	0	0
	90	0	0
SD12	10	1	3.8
	50	0	0
	90	0	0

8.2.5 Adaptive Management of Mine Water Balance

The model results presented above represent the application of the adopted mine water management system rules over the mine life, regardless of climatic conditions. In reality, there are numerous options for adaptive management of the mine water management system to accommodate climatic conditions. For example, when excess water is available on site, it may be possible to increase the application of water for dust suppression. These alternative management approaches would be used to reduce the risks to operations associated with climatic variability.

9 WATER BALANCE MODEL REVIEW AND VALIDATION

The site water balance model has been reviewed and validated on an ongoing basis over the life of the mine to ensure that the model adequately simulates observed conditions on site. The model and site monitoring data is reviewed as part of the Annual Review each year and the performance of the water management system is tracked by site personnel and reported monthly by the WHC Group Manager Water through Monthly Water Report which tracks:

- Site inventory compared to WBM forecast;
- Dam inventory and TARP levels;
- External water sources and license compliance; and
- Site discharges and water use.

The data from the monthly report is used to update future models and track actual vs forecast in order to take action to address changes in the water management system.

Figure 13 shows a comparison of simulated and recorded site water inventory for 2022 to 2024 which demonstrates that the model provides a good representation of the site water balance.

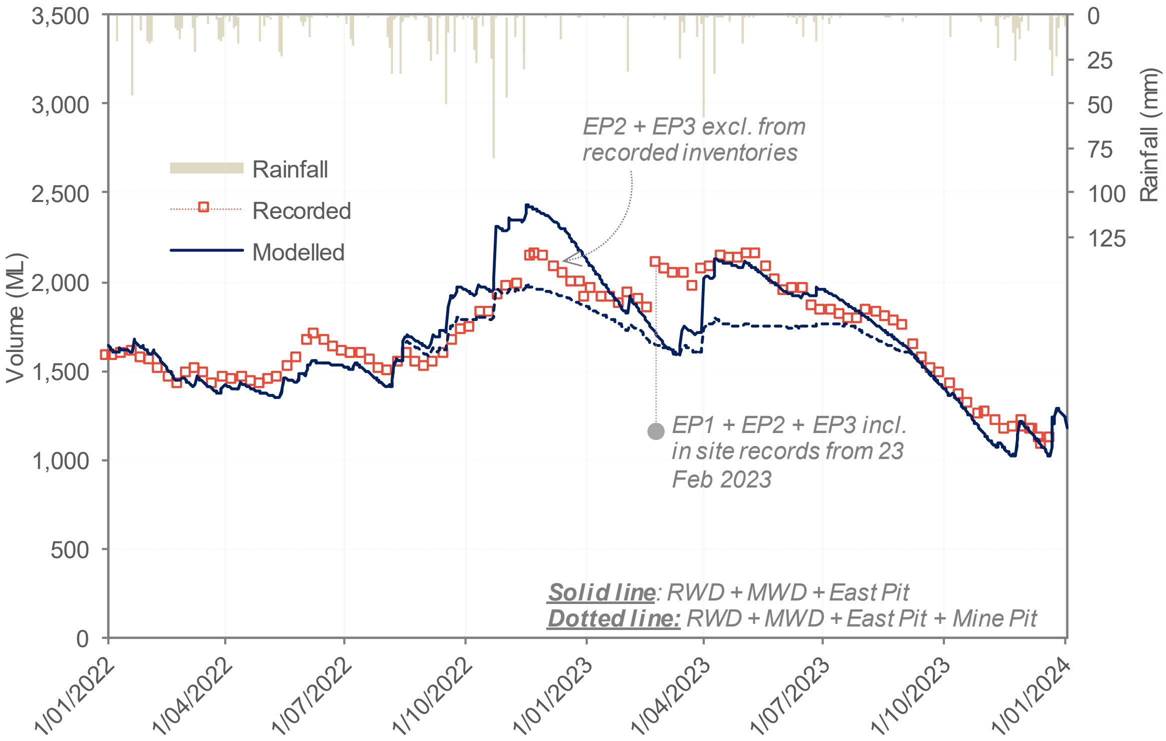


Figure 13 – Water Balance Model Validation for 2022 and 2024 Comparing Simulated (Blue) and Recorded (Red) Site Water Inventory

10 REPORTING PROCEDURES

In accordance with Schedule 5, Condition 4 of PA 10_0138, MCCM will submit by the end of March each year (or other such timing as agreed by the Director-General) an Annual Review for the previous calendar year to the Director-General of the Department of Planning, Industry & Environment. The Annual Review will include:

- validation of the calibration parameters of the water balance model to ensure that the model adequately simulates observed conditions on site; and
- a site water balance for each calendar year.

11 REFERENCES

Boughton, 2004 'The Australian water balance model, Environmental Modelling and Software', vol. 19, pp. 943-956.

WHC_PLN_MCC_WATER MANAGEMENT PLAN_APPENDIX_B_SURFACE_WATER _MANAGEMENT_PLAN

CONTENTS

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the Surface Water Management Plan (SWMP) for MCCM. The SWMP includes baseline surface water data, a description of the surface water management system on the site, design objectives and performance criteria for various aspects of surface water management, and details of the surface water monitoring program.

1.2 STRUCTURE OF THE SURFACE WATER MANAGEMENT PLAN

This SWMP forms part of the Water Management Plan for MCCM. The MCCM Water Management Plan comprises the following documents:

- An overarching Water Management Plan.
- Site Water Balance (Appendix A).
- SWMP (this document) (Appendix B).
- Groundwater Management Plan (Appendix C).

The following sections of the SWMP describe:

- Statutory obligations under the project approval (Section 2).
- Baseline surface water data (Section 3).
- The surface water management system on the site (Section 4).
- Surface water impact trigger levels and response plan (Section 5).
- The surface water monitoring programme (Section 6).
- Reporting procedures (Section 7).
- References (Section 8).

2 STATUTORY OBLIGATIONS

The Maules Creek Coal Project (Project Approval (PA) 10_0138) was approved by the Minister for Planning and Infrastructure under Section 75J of the *Environmental Planning & Assessment Act 1979* (EP & A Act) on 23 October 2012.

Condition 40 (WMP) of Schedule 3 of the Project approval (Environmental Performance Conditions) requires the proponent to prepare and implement a WMP for the Project which includes a SWMP. The requirements for the SWMP, and where each requirement is addressed in this document, are provided in Table 1.

Table 1 Surface Water Management Plan requirements from Project Approval 10_0138

Requirement for site water balance	Section of SWMP where addressed
• Detailed baseline data on surface water flows and quality in the water-bodies that could potentially be affected by the project;	Section 3.2 & 3.3
• Detailed baseline data on hydrology across the downstream drainage system of the Namoi River floodplain from the mine site to the Namoi River;	Section 3.2 & 3.3
• A detailed description of the water management system on site, including the:	
– clean water diversion systems;	Section 4.3 (see also Site Water Balance – Appendix A of WMP)
– erosion and sediment controls (dirty water system);	Section 4.9
– mine water management systems;	Section 4.2 (see also Site Water Balance – Appendix A of WMP)
– discharge limits in accordance with EPL requirements;	Section 5
– water storages;	Section 4.2 (see also Site Water Balance – Appendix A of WMP)
– mine access road and Maules Creek rail spur line.	Section 4.4
• Detailed plans, including design objectives and performance criteria for:	
– design and management of final voids;	Section 4.7
– design and management for the emplacement of reject materials, sodic and dispersible soils and acid or sulphate generating materials;	Section 4.6
– design and management for construction and operation of the rail spur line and mine access road;	Section 4.4
– reinstatement of drainage lines on the rehabilitated areas of the site; and	Section 4.5
– control of any potential water pollution from the rehabilitated areas of the site.	Section 4.5
• Performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the project:	
– the water management system;	Section 4.9 & 5
– downstream surface water quality;	Section 4.10
– downstream flooding impacts, including flood impacts due to the construction and operation of the rail spur line and mine access road, and flooding along Back Creek; and	Section 5
– stream and riparian vegetation health, including the Namoi River	Section 3.5 & 6.4
• A program to monitor:	
– the effectiveness of the water management system; and	Section 6
– surface water flows and quality in the watercourses that could be affected by the project; and	Section 6
– downstream flooding impacts.	Section 6
• Reporting procedures for the results of the monitoring program.	Section 7
• A plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project.	Section 5

3 BASELINE DATA

3.1 DRAINAGE NETWORK

MCCM is located within the catchment of Back Creek, a tributary of Maules Creek, which in turn is a tributary of the Namoi River. The mine access road and rail corridor, located to the west of the mine, drain to minor tributaries of the Namoi River. Figure 1 shows the location of the mine and receiving watercourses.

The Namoi River to Boggabri has a catchment area of 22,600 square kilometres (km^2). Flow in the river has been regulated by releases from Keepit Dam, located about 56 kilometres (km) west of Tamworth, since the dam's completion in 1960. Keepit Dam has a storage capacity of 425,510 ML.

Maules Creek is ephemeral in the upper catchment. Historical data from the Dam Site gauge (data from 1968 to 1992, catchment area = 171 km^2) shows that the creek flows for only about 60% of the time. Further downstream along Maules Creek at the Avoca East gauge (catchment area = 673 km^2), the creek flows about 80% of the time. Analysis of recorded streamflow data for the two gauging stations indicates volumetric runoff coefficients (proportion of rainfall that becomes surface runoff) of approximately 5%.

3.2 SITE CATCHMENTS

Figure 2**Error! Reference source not found.** shows site catchment boundaries, water storages and land use across the site for 2024 financial year (FY). Further details of catchment and land use changes due to mine progression over coming years are provided in the Site Water Balance (Appendix A to the WMP).

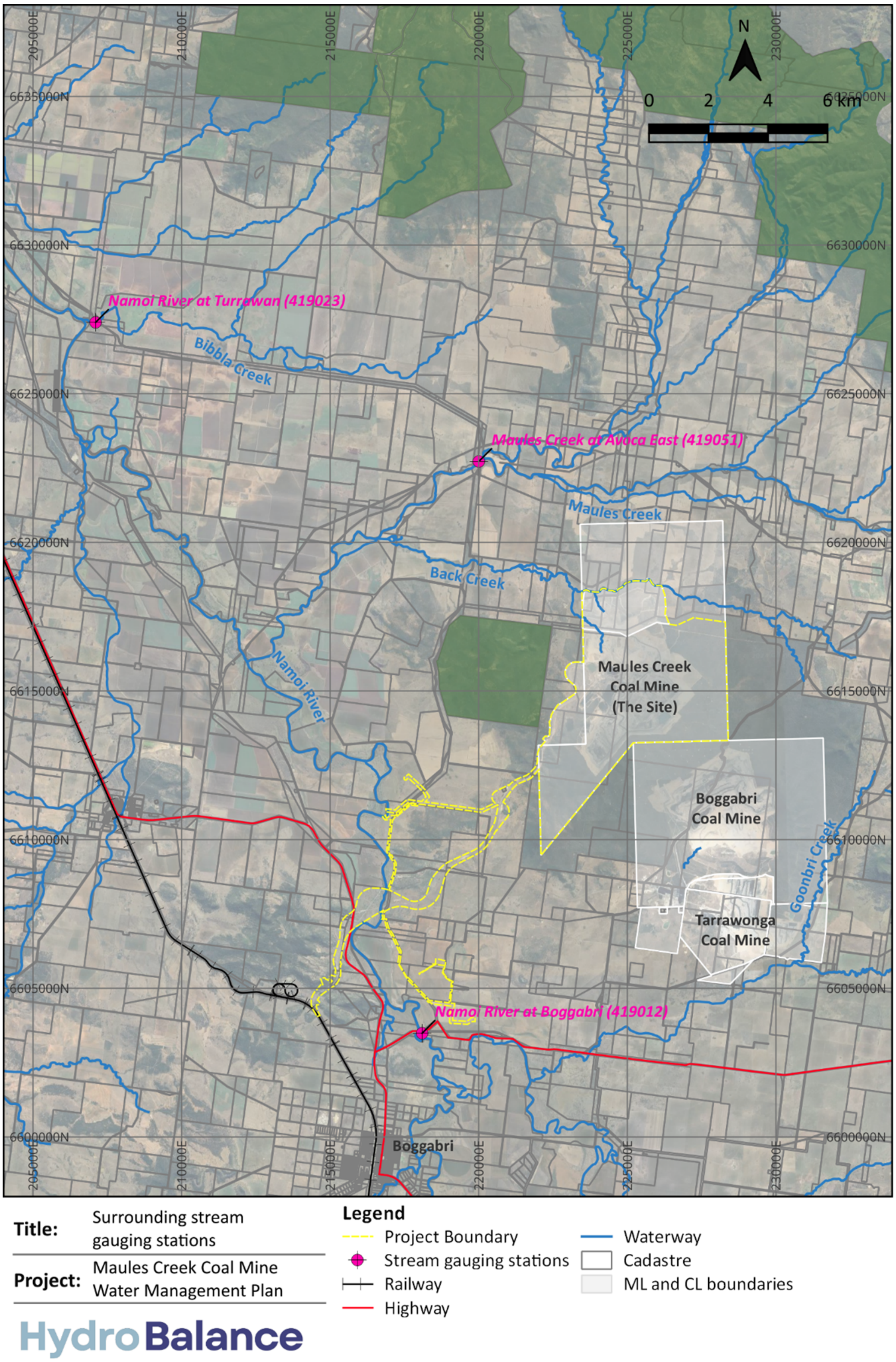


Figure 1 Stream Gauge Locations on Receiving Watercourses

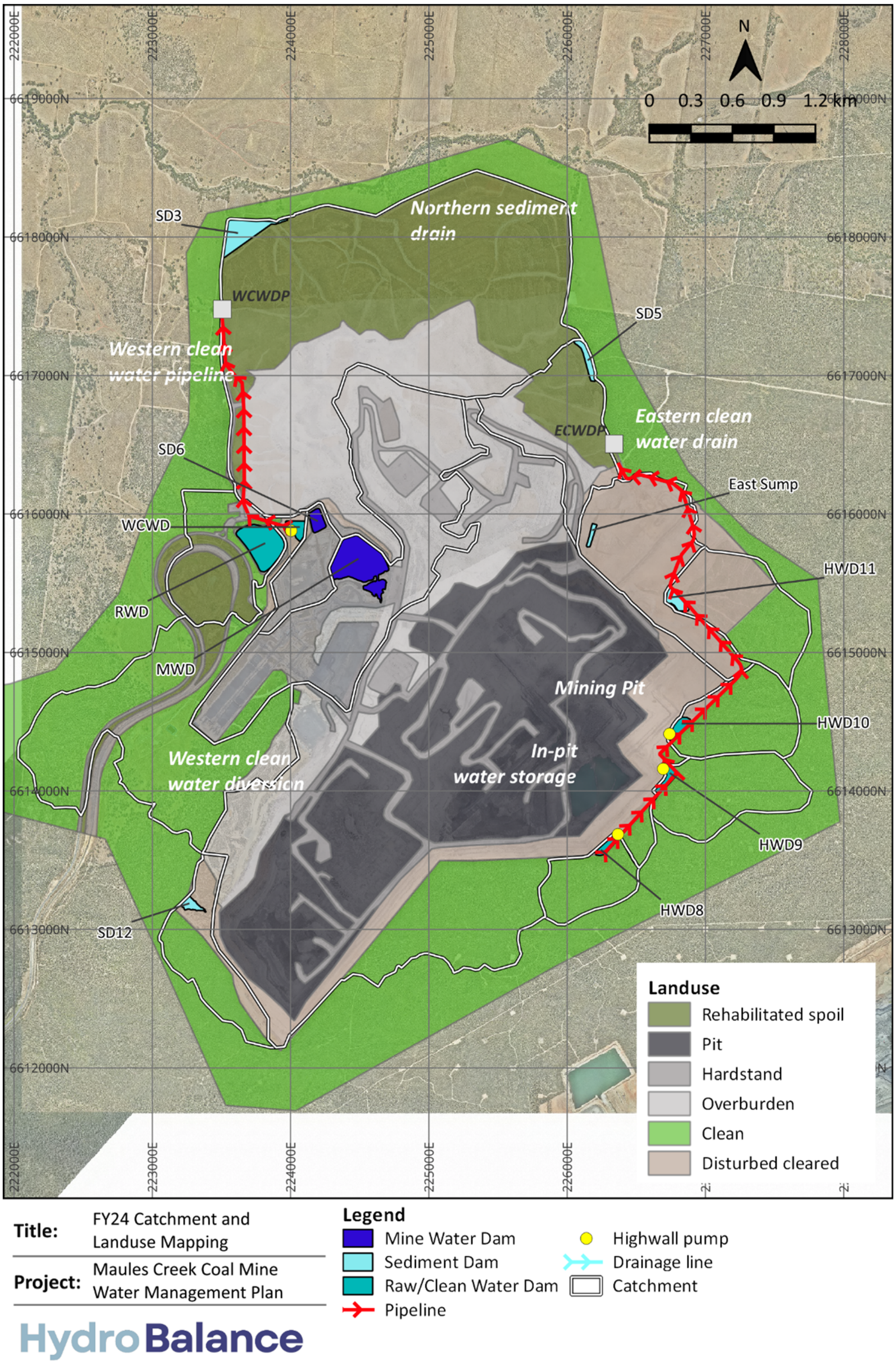


Figure 2 Site Catchments, Storages and Land Use – FY24

3.3 STREAMFLOW

Figure 1 shows the locations of streamflow gauges on receiving watercourses. Gauge details are provided in Table 2.

Figure 3 to Figure 8 show a time series of daily flow and ranked daily flow (data taken from http://www.bom.gov.au/waterdata/) for the Boggabri and Turrawan gauges in the Namoi River and the Maules Creek gauge at Avoca East.

Table 2 Available streamflow data

Stream	Gauge name	Gauge number	Catchment area (km^2)	Period of record
Namoi River	Boggabri	419012	22,600	1955 -
Namoi River	Turrawan	419023	24,500	1995 -
Maules Creek	Avoca East	419051	673	1972 -

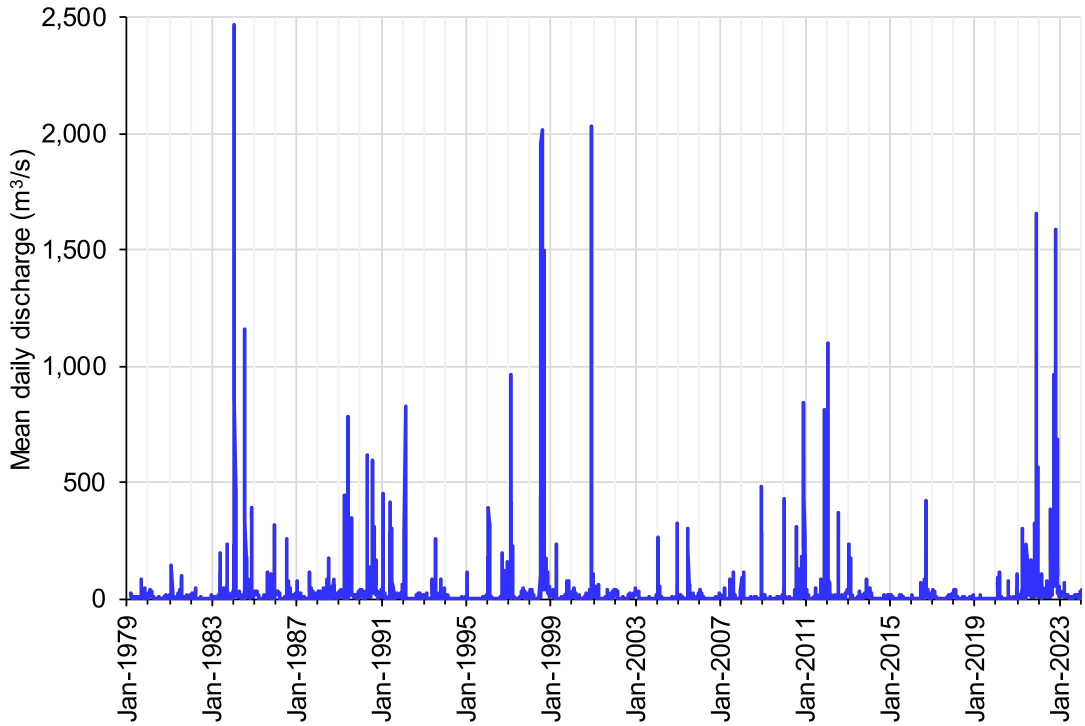


Figure 3 Daily Mean Discharge, Namoi River at Boggabri (Gauge No. 419012)

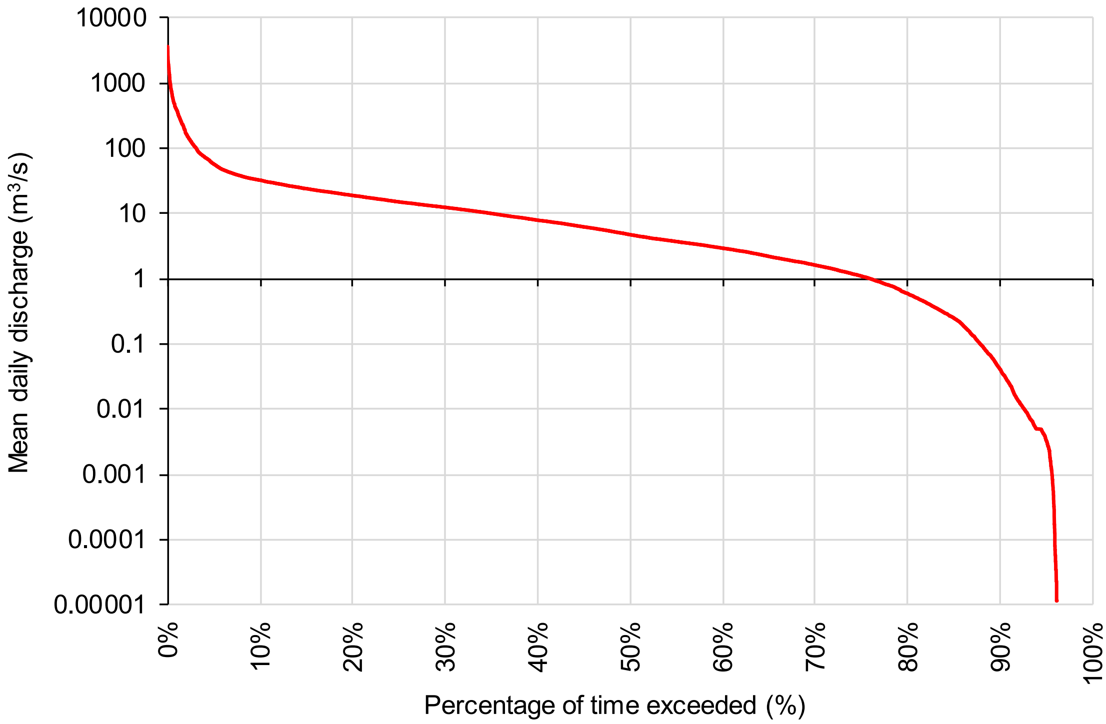


Figure 4 Ranked Flow Plot, Namoi River at Boggabri (Gauge No. 419012)

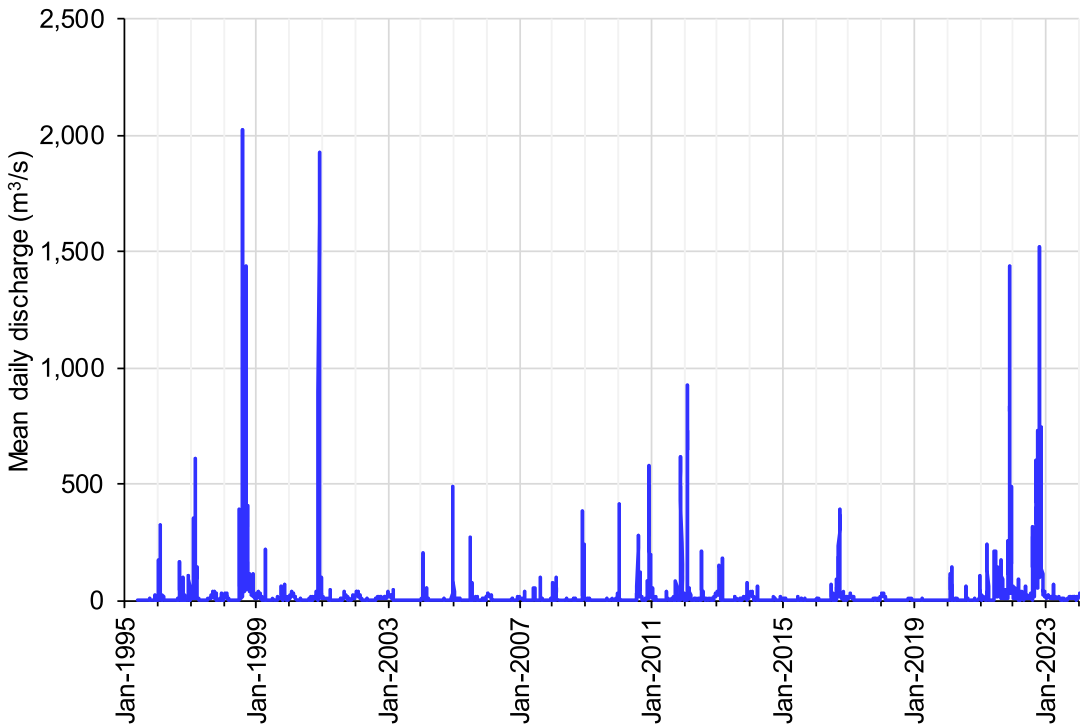


Figure 5 Daily Mean Discharge, Namoi River at Turrawan (Gauge No. 419023)

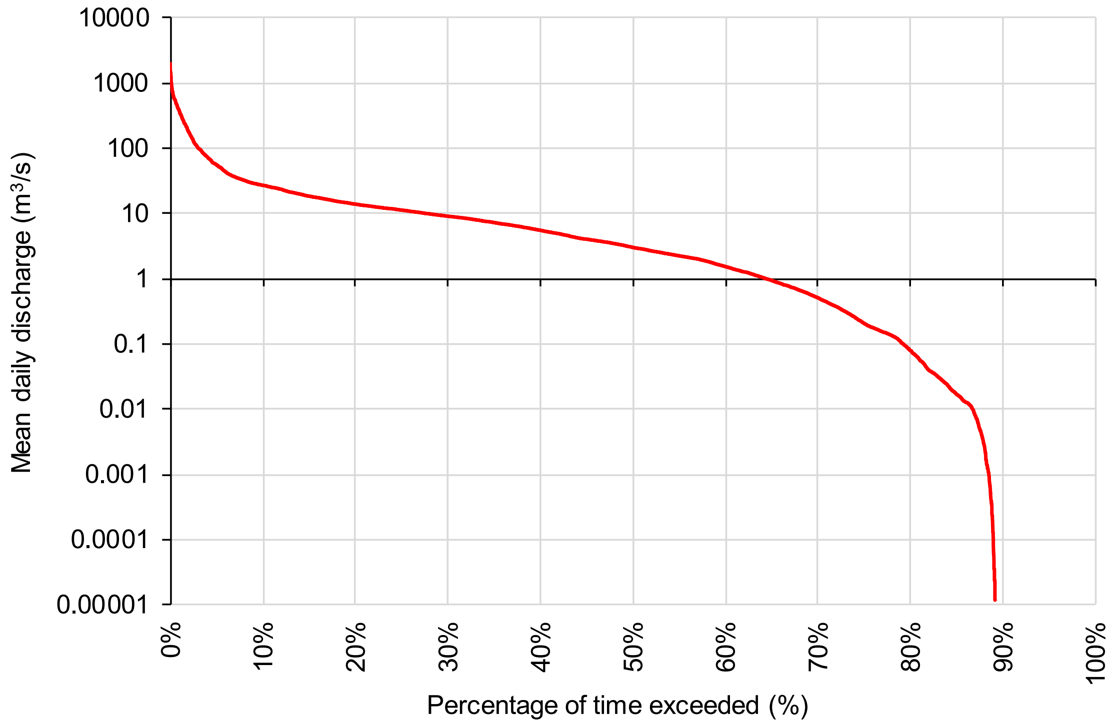


Figure 6 **Ranked Flow Plot, Namoi River at Turrawan (Gauge No. 419023)**

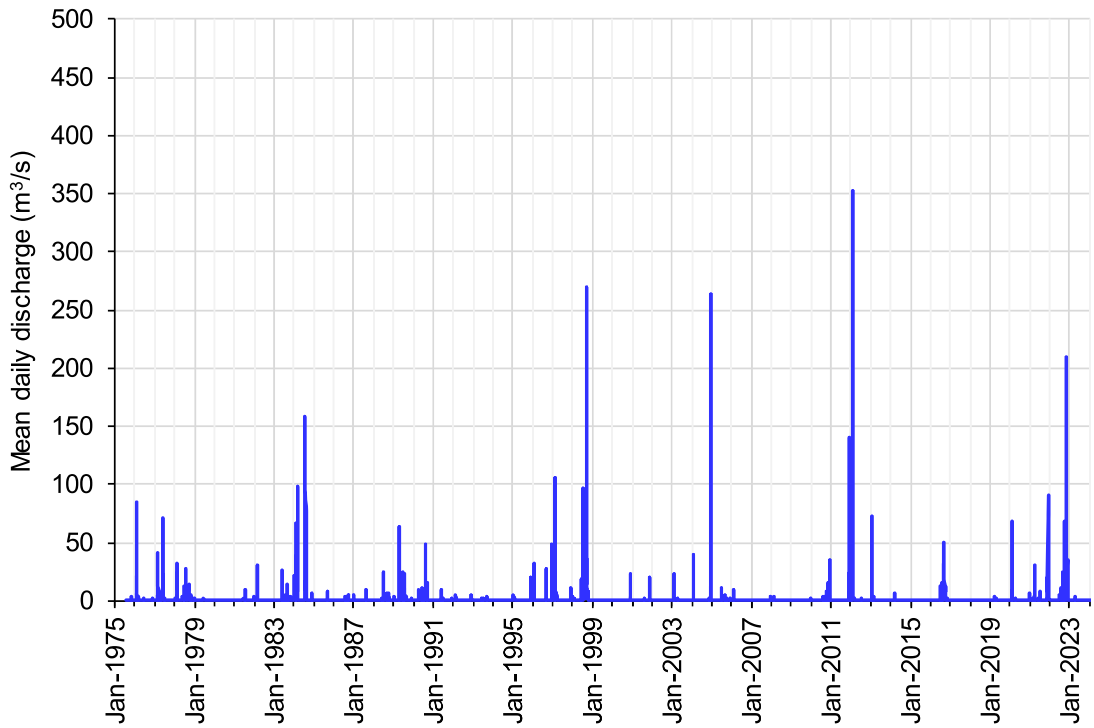


Figure 7 **Daily Mean Discharge, Maules Creek at Avoca East (Gauge No. 419051)**

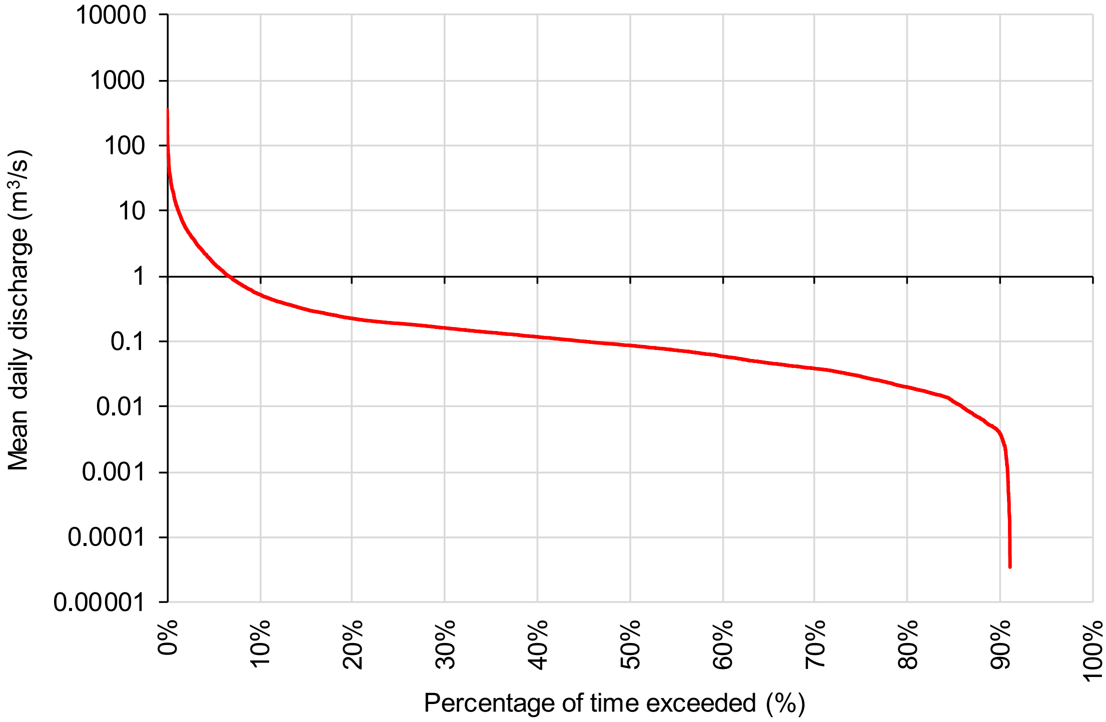


Figure 8 Ranked Flow Plot, Maules Creek at Avoca East (Gauge No. 419051)

3.4 SURFACE WATER QUALITY

A summary of the surface water quality sampling results over the last five years for Namoi River, Maules Creek and Back Creek is provided in Table 3 for pH, electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS). The locations of surface water sampling are shown in Figure 9.

3.4.1 Namoi River

Water quality is sampled at four locations in the Namoi River, identified as SW5, SW6, SW7 and SW8. SW8 is located downstream of the confluence with Maules Creek. The remaining Namoi River monitoring locations are located upstream of the Maules Creek confluence and therefore is not affected by MCCM releases. Figure 10 shows the pH, EC, TDS and TSS readings respectively for the Namoi River monitoring locations between 2019 and 2023.

pH

pH readings range between 7.70 and 8.41 (20^{th} and 80^{th} percentiles) for SW5, SW6 and SW7 and between 7.94 and 8.29 (20^{th} and 80^{th} percentiles) for SW8. The pH at SW5, SW6 and SW7, which are located upstream of the Maules Creek confluence (and hence would not be impacted by releases from the site storages) is similar to values at SW8, located downstream of the Maules Creek confluence. There is no discernible trend in pH at these locations over the last five years.

EC

EC readings range between 309 and 598 microSiemens per centimetre (µS/cm) (20th and 80th percentiles) for SW5, SW6 and SW7 and between 301 and 657 µS/cm (20th and 80th percentiles) for SW8. EC at SW5, SW6 and SW7 is typically slightly higher than at SW8. The EC values fluctuate significantly between wet and dry seasons over the last five years.

TDS

TDS readings range between 244 and 366 milligrams per litre (mg/L) (20th and 80th percentile) for SW5, SW6 and SW7 and between 249 and 389 mg/L (20th and 80th percentile) for SW8. The TDS values fluctuate significantly between wet and dry seasons over the last five years.

TSS

TSS readings range between 29 and 115 mg/L (20th and 80th percentile) for SW5, SW6 and SW7 and between 37 and 134 mg/L (20th and 80th percentile) for SW8. The TSS values fluctuate significantly between wet and dry seasons over the last five years.

3.4.2 Maules Creek

Water quality is sampled at two locations in Maules Creek, identified as SW1 and SW2. Figure 11 shows the pH, EC, TDS and TSS readings respectively for Maules Creek monitoring locations between 2019 and 2023.

pH

pH readings range between 7.14 and 7.70 (20th and 80th percentiles) for SW1 and SW2. There is no discernible trend in pH at these locations over the last five years.

EC

EC readings range between 343 and 525 µS/cm (20th and 80th percentiles) for SW1 and SW2. There is no discernible trend in EC at these locations over the last five years.

TDS

TDS readings range between 235 and 337 mg/L (20th and 80th percentile) for SW1 and SW2. There is no discernible trend in TDS at these locations over the last five years.

TSS

TSS readings range between 5 and 34 mg/L (20th and 80th percentile) for SW1 and SW2. There is a noticeable upwards trend in TSS in 2019, which coincides with the historical drought conditions. The TSS from 2020 is notably reduced following the February rainfall event.

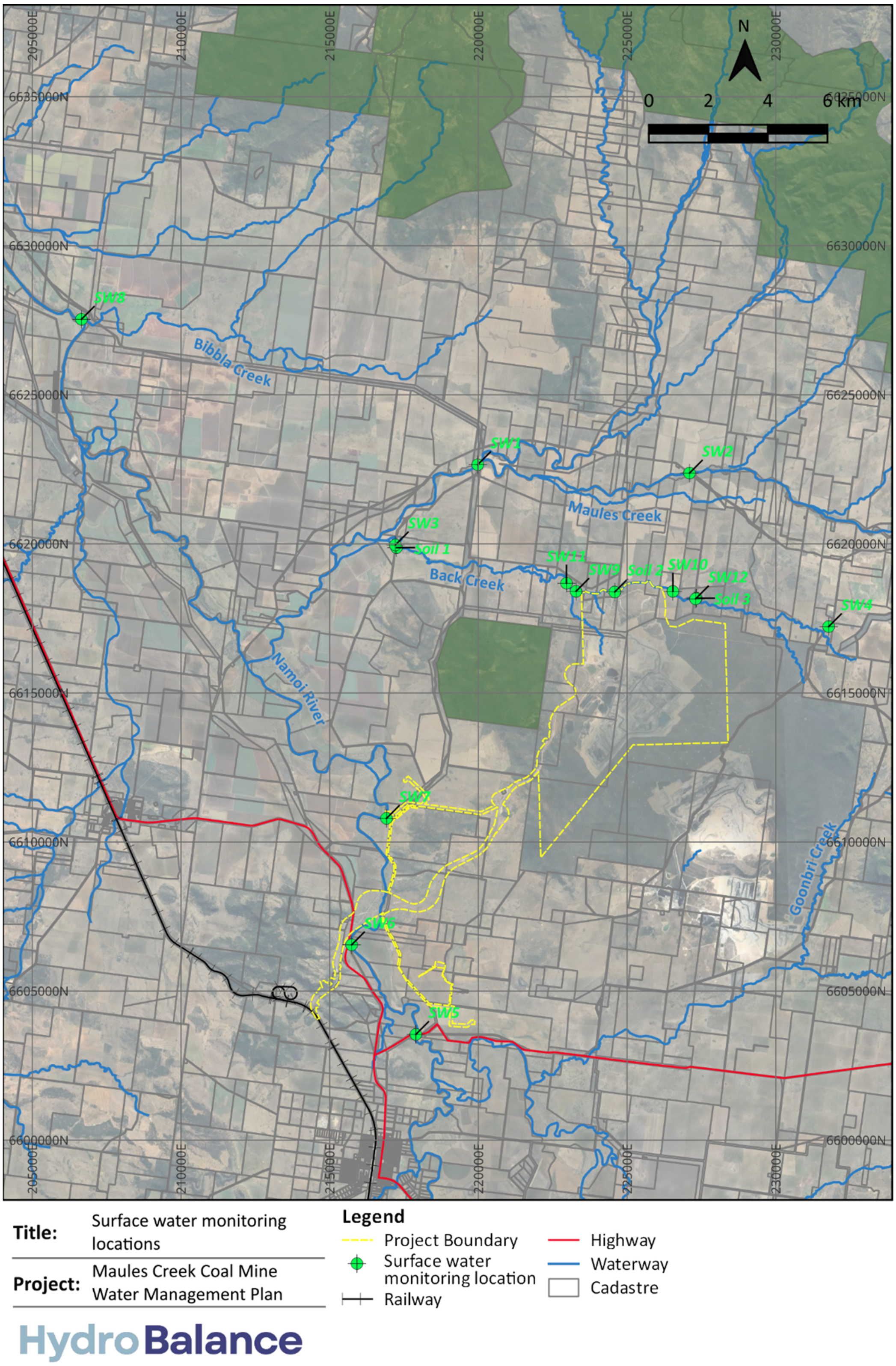


Figure 9 Water Quality Monitoring Locations

Table 3 Surface Water Quality Data, 2019-2023

Monitoring location	pH				EC (µS/cm)				TDS (mg/L)				TSS (mg/L)			
	No. of samples	20th %ile	Median	80th %ile	No. of samples	20th %ile	Median	80th %ile	No. of samples	20th %ile	Median	80th %ile	No. of samples	20th %ile	Median	80th %ile
Namoi River																
SW5	22	7.7	7.97	8.22	22	315	441	571	22	244	295	341	22	29	53	115
SW6	47	7.85	8.1	8.36	47	317	420	591	47	247	306	364	47	32	58	104
SW7	57	7.87	8.12	8.41	57	309	422	598	57	244	282	366	57	35	58	108
SW8	16	7.94	8.09	8.29	16	301	415	657	16	249	271	389	16	37	74	134
Maules Creek																
SW1	55	7.22	7.47	7.7	55	343	364	474	55	235	274	305	54	5[a]	12	34
SW2	26	7.14	7.32	7.47	26	378	372	525	26	280	302	337	26	5[a]	5[a]	6
Back Creek																
SW3	1	N/A	8	N/A	1	N/A	161	N/A	1	N/A	304	N/A	1	N/A	278	N/A
SW4	5	7.17	7.65	8.04	5	173	209	271	5	164	210	273	5	8	16	25
SW9	5	7.6	7.91	8.23	5	89	216	498	5	188	222	453	7	6	56	85
SW10	No samples collected															
SW11	No samples collected															
SW12	No samples collected															

[a] limit of detection

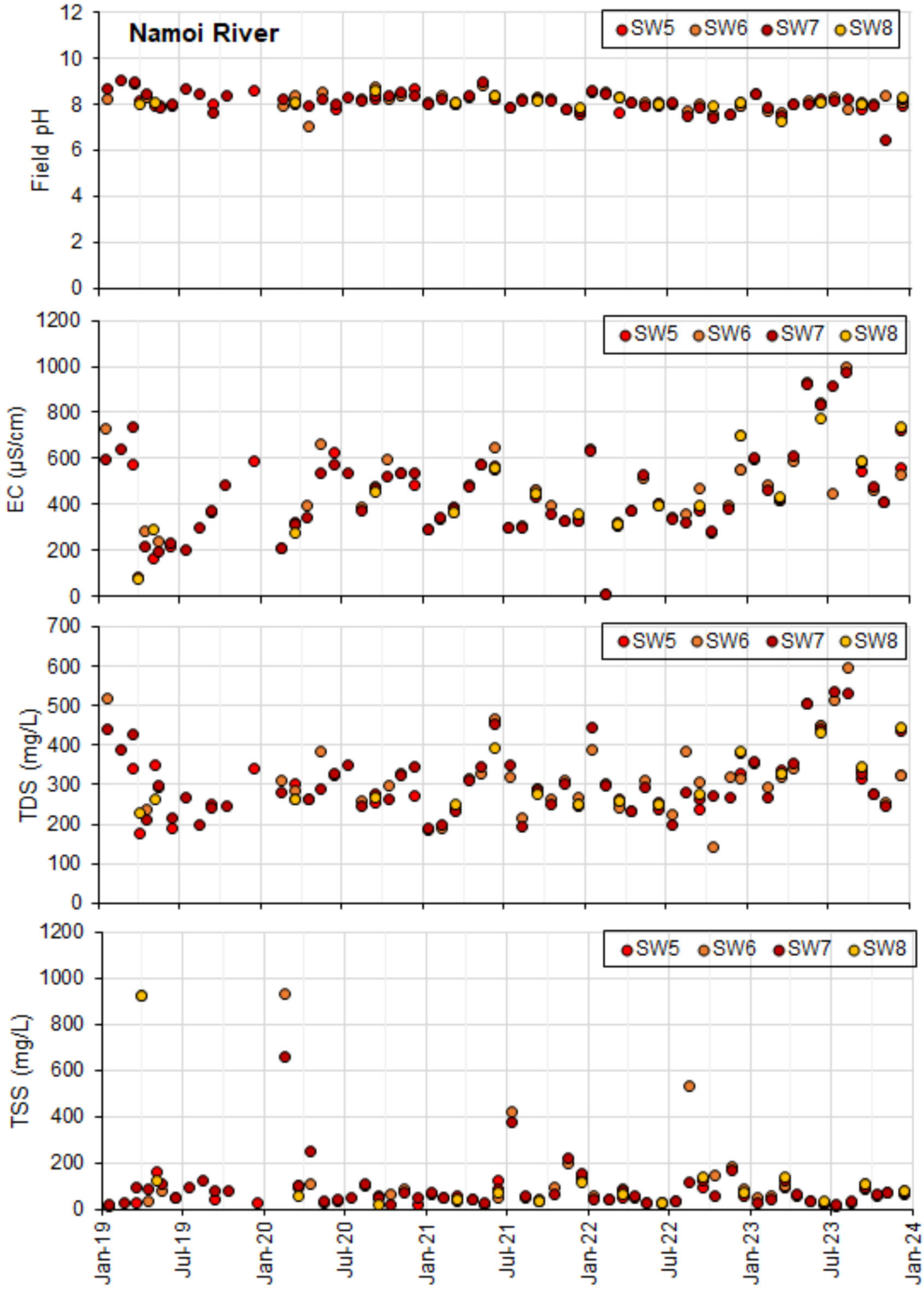


Figure 10 Namoi River Surface Water Quality, 2019 to 2023

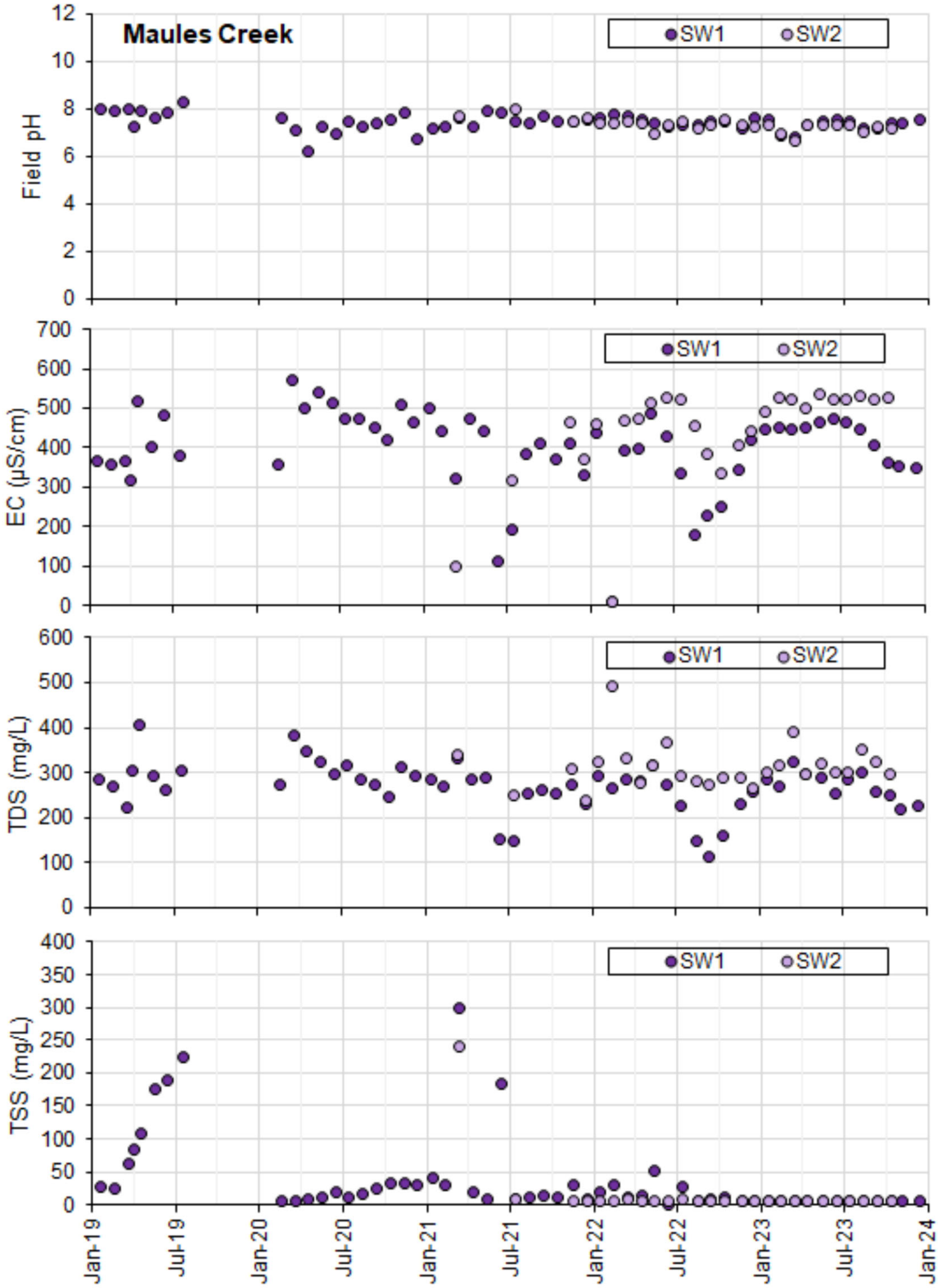


Figure 11 Maules Creek Surface Water Quality, 2019 to 2023

3.4.3 Back Creek

Water quality is sampled at six locations in Back Creek, identified as SW3, SW4, SW9, SW10, SW11 and SW12. SW4 and SW10 are located upstream of MCCM operations, and therefore are not affected by MCCM releases. SW11 is located immediately downstream from the site's WCWDP licence discharge point. Figure 12 shows the pH, EC, TDS and TSS readings respectively for Back Creek monitoring locations between 2019 and 2023.

pH

pH readings range between 7.65 and 8.00 (50^{th} percentile) for SW3, SW4 and SW9. There were no pH readings for SW10, SW11 and SW12. There is no discernible trend in pH at these locations over the last five years.

EC

EC readings range between 161 and 216 µS/cm (50^{th} percentile) for SW3, SW4 and SW9. There were no EC readings for SW10, SW11 and SW12. There is no discernible trend in EC at these locations over the last five years.

TDS

TDS readings range between 210 and 304 mg/L (50^{th} percentile) for SW3, SW4 and SW9. There were no TDS readings for SW10, SW11 and SW12. There is no discernible trend in TDS at these locations over the last five years.

TSS

TSS readings range between 16 and 278 mg/L (50^{th} percentile) for SW3, SW4 and SW9. There were no TSS readings for SW10, SW11 and SW12. There is no discernible trend in TSS at these locations over the last five years.

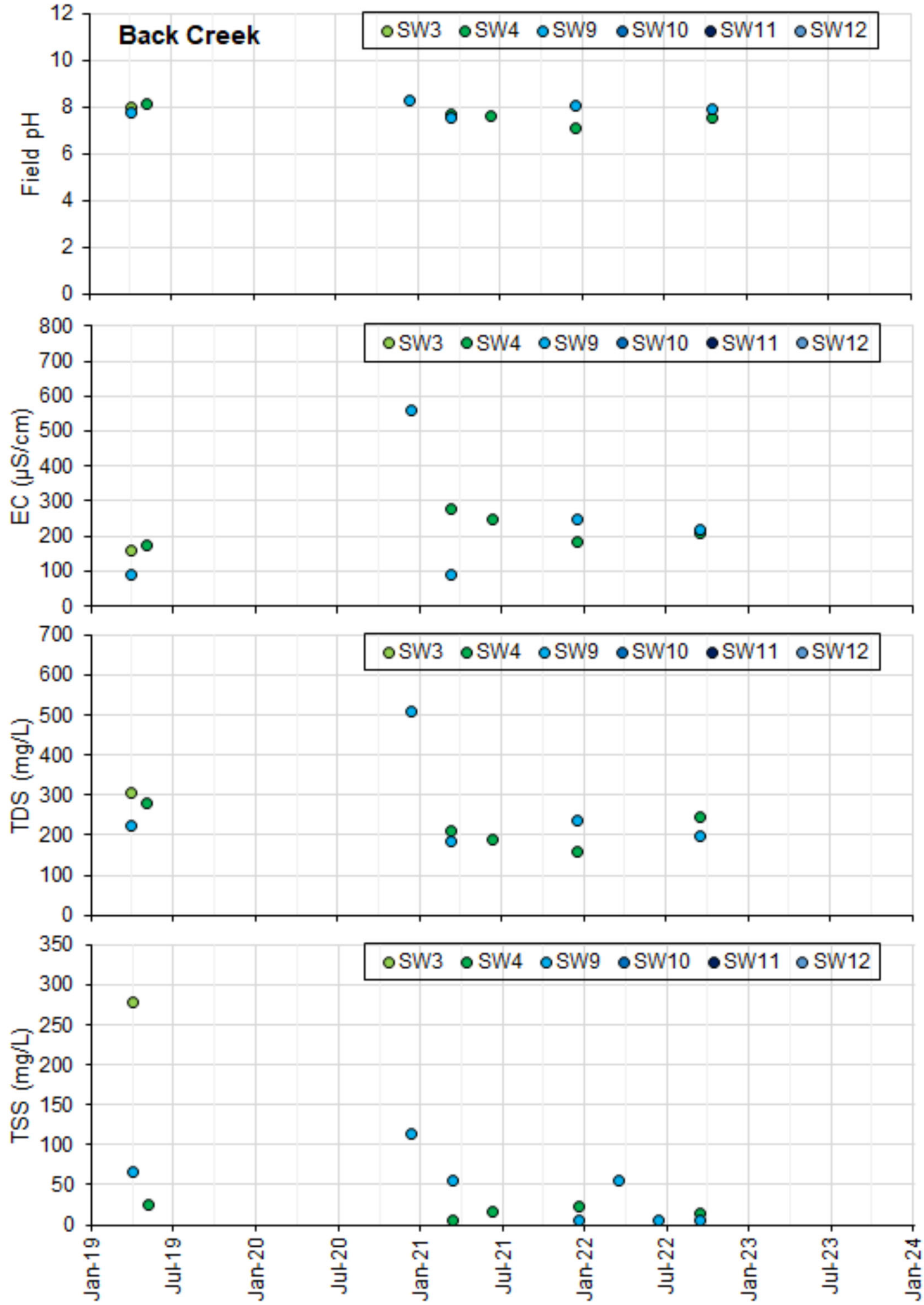


Figure 12 Back Creek surface water quality, 2019 to 2023

3.5 STREAM HEALTH

Bi-annual stream and riparian vegetation health assessments, including macroinvertebrate monitoring as well as physical and chemical monitoring in accordance with Australian River Assessment System (AusRivAS) guidelines, have been undertaken at nine sites along Back Creek and Maules Creek and two sites along the Namoi River since 2015. The selected survey locations are shown Figure 13.

Monitoring locations BCP1 and BCP 2 are located on Back Creek, upstream of the MCCM. Monitoring locations BCP3, BCP4, BCP5, BCP 6 and BCP 8 are located on Back Creek, downstream of the MCCM. BCP7 and BCP9 are located on Maules Creek, upstream and downstream of the Back Creek confluence, respectively.

Monitoring is undertaken on a biannual basis (spring and autumn) at the locations shown in Figure 13. The new monitoring sites are as per the recommendations of Peter Hancock (Eco Logical 2021), they include:

- BCUS2 on Back Creek upstream of MCCM.
- MCUS5 and MCUS1 on Maules Creek, upstream of the Back Creek confluence.
- NRDS1 and Henriendi TSR on the Namoi River upstream of the confluence with Maules Creek.

Details of the methodology and results of the annual stream and riparian vegetation health assessments are provided in the annual assessment reports prepared by Eco Logical Australia (2021).

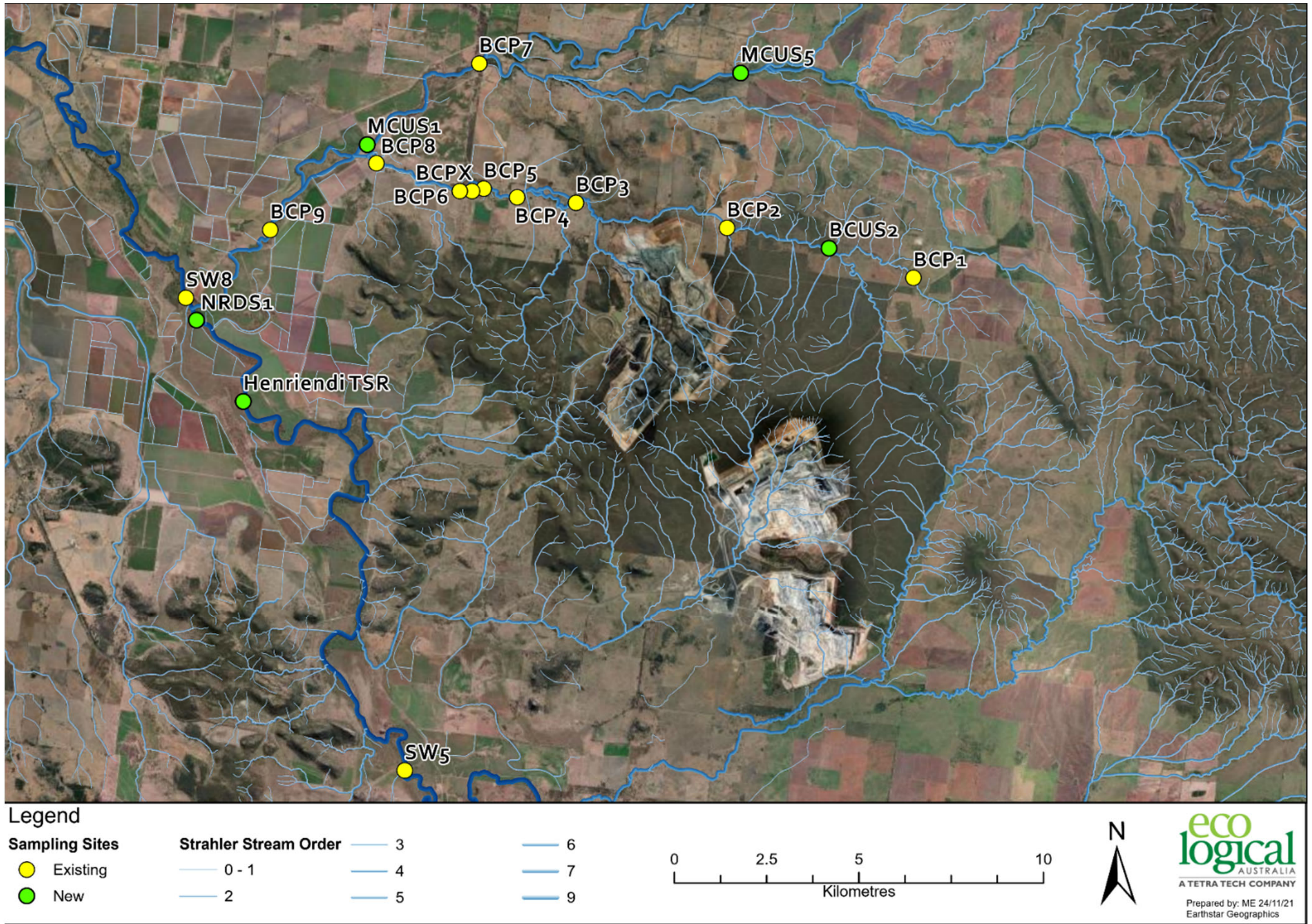


Figure 13 Existing and Proposed New Stream Health Monitoring Locations

4 SURFACE WATER MANAGEMENT SYSTEM

4.1 SURFACE WATER MANAGEMENT OBJECTIVES

The planned water management strategy for MCCM is based on targeted management of water from different sources based on anticipated water quality. Water on the site is categorised as either:

- clean water – water from areas not disturbed by mining;
- mine water – groundwater inflows and surface runoff in mining areas that is likely to come into contact with coal; or
- sediment laden water – runoff from areas disturbed by stripping or placement of overburden material.

The objectives of the water management system are to ensure:

- clean water runoff from undisturbed catchment areas is diverted away from the mining area, where possible and practical to do so;
- sediment laden runoff from disturbed areas is re-used in the water management system or released into the receiving environment if water quality meets EPL requirements (treatment may be required);
- mine water (including water that accumulates within, or drains from, active mining areas, coal reject emplacement areas and Coal Handling and Preparation Plant (CHPP) infrastructure areas) and groundwater collected within open cut pits is contained and reused on-site;
- no uncontrolled discharge of mine water off-site; and
- on-site water demands are satisfied whilst minimising external water requirements.

4.2 WATER MANAGEMENT SYSTEM CONFIGURATION AND INFRASTRUCTURE

Details of the site water management system are provided in Section 3 of the Site Water Balance (Appendix A of the WMP). The main components of the system include storages for containment of:

- clean water, such as Highwall Dams (HWD) and the Western Clean Water Diversion Dam (WCWD);
- the Raw Water Dam (RWD) which receives external water from the Namoi River and Bores;
- mine water, such as the Mine Water Dam (MWD) and Pit Water Storage (PWS). The system is managed so that there is no release of mine water from these storages; and
- sediment laden water, such as sediment dams.

4.3 CLEAN WATER MANAGEMENT SYSTEM

4.3.1 Overview

There are two major clean water management areas within the mine:

- the three HWDs and associated works, located along the highwall on the eastern margin of the mining area.
- the WCWD dam and associated works, located along the western margin of the mining area.

Details of the two clean water management areas are provided in the following sub-sections.

4.3.2 Highwall Dams

The existing clean water management system along the eastern margin of the mining area includes three dams built in early 2022. HWD8, HWD9 and HWD10. will intercept clean runoff from the ephemeral drainage lines which drain towards the open cut. A fourth HWD, HWD11, was also constructed in 2022 to manage clean water runoff, however HWD11 is currently in the process of decommissioning due to the expansion of the Mine Pit.

The eastern margin of the open cut is progressing upslope into undulating ridge lines with multiple small catchments. This ridge country prevents the design of a free-draining clean water management system, with elevation changes of +8 metres (m) to +20 m between the highwall dams. For this reason, runoff collected in the highwall dams will be pumped from each dam into a single backbone pipeline, to divert the captured clean water runoff around the eastern side of the active mining area and into a tributary of Back Creek to the north (Figure 14). The water shall be released from the LDP in accordance with the release criteria in the mines EPL.

The highwall dam capacities and pump rates have been designed to achieve a target containment standard of 10% Annual Exceedance Probability (AEP). Design capacities and pump rates are presented in Table 4, as well as indicative operational periods.

Table 4 HWD and Pump Sizing Details

Dam	Catchment Area (ha)	Capacity (ML)	Pump Rate (L/s)	Operational Period
HWD8	27.1	8	15	2022 to 2024
HWD9	49.0	16	30	2022 to 2024
HWD10	47.3	20	30	2022 to 2024
*HWD11**	*57.1*	*20*	*40*	*2022 to 2023*

ha = hectares, ML = megalitres, L/s = litres per second

* Removed in early 2024

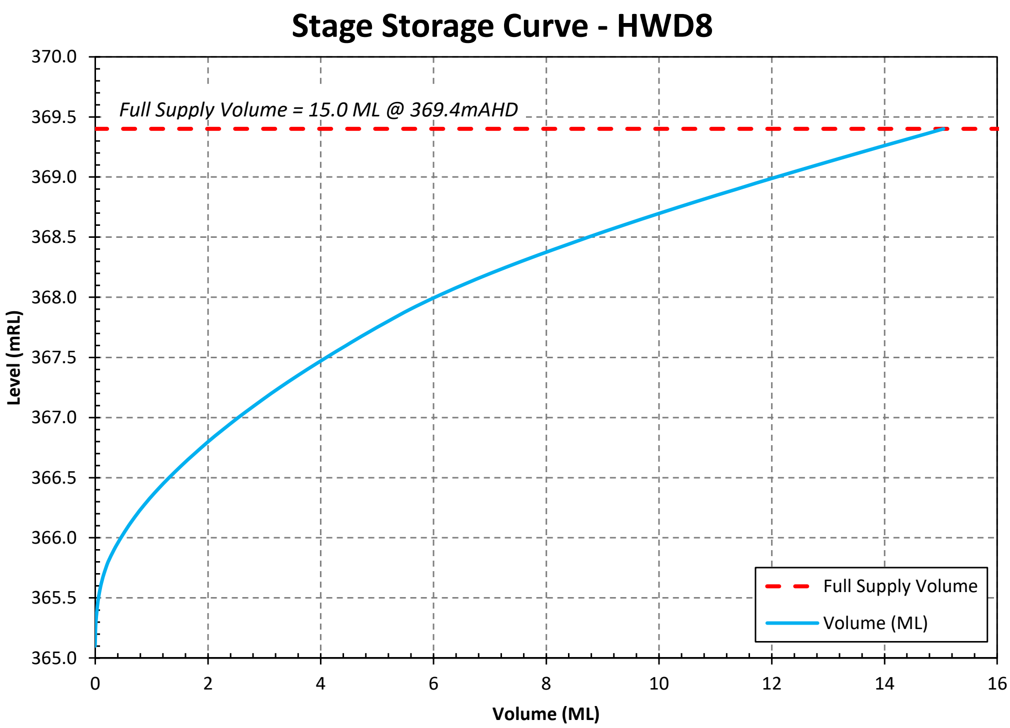


Figure 14 HWD8 stage storage curve

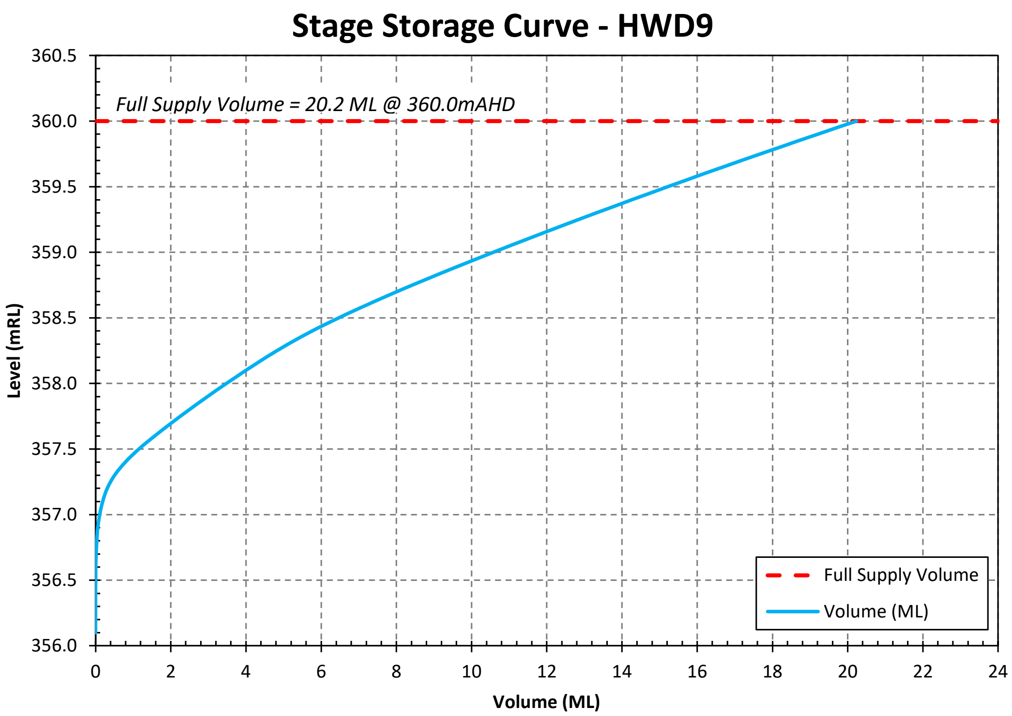


Figure 15 HWD9 stage storage curve

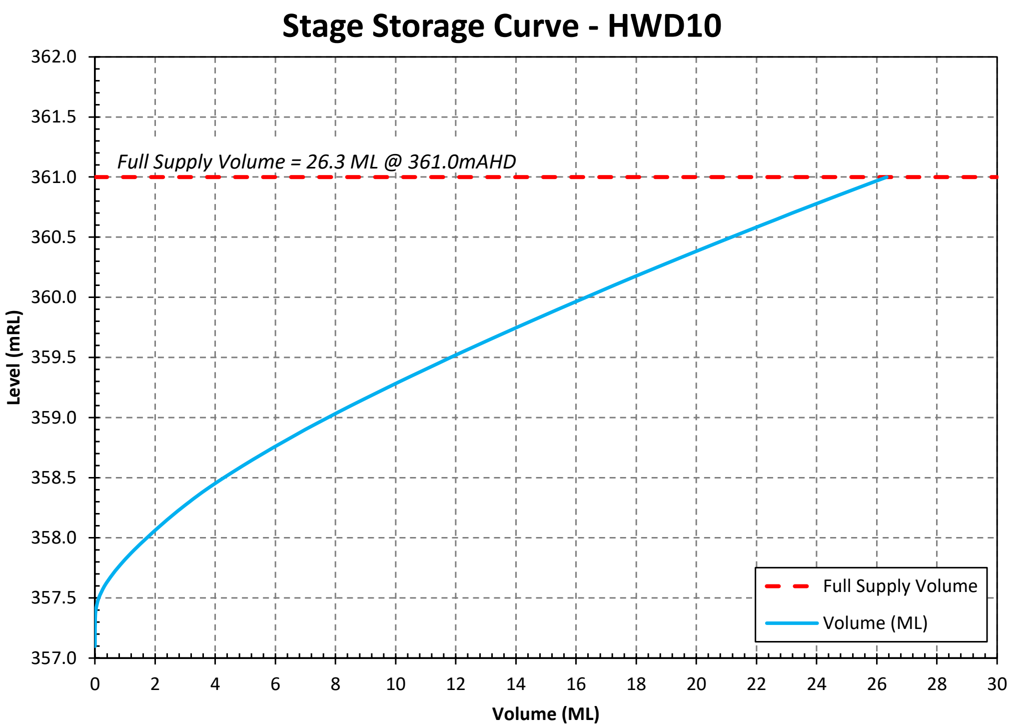


Figure 16 HWD10 stage storage curve

As the open cut progresses towards the east, the highwall dams and the catchments draining to them will be progressively consumed by the open cut. As this occurs, the pump and pipeline arrangements will be augmented to allow runoff from controlled catchments to continue to be diverted around the open cut. When required, the highwall dams will be progressively decommissioned when they are mined through. Replacement highwall dams may be constructed as required, to comply with the WM Act and the project approval.

Refer to Section 6.5 for details regarding monitoring of the HWDs. Stage storage curves for HWD8, HWD9 and HWD10 are provided in Figure 14 to Figure 16. Clean water that is not diverted by HWD8 and HWD9 shall be accounted for against the site's harvestable rights allowance. Clean water that is not diverted by HWD10 shall be accounted for against WAL 41585, which has an annual allocation of 30 ML.

4.3.3 Western Clean Water Diversion

Due to progressive development of the out-of-pit waste rock emplacement, the existing clean water diversion along the western margin of the MCCM required reconfiguration. Previously, the diversion was a free-draining system which allowed upslope runoff to drain around the mining operations and report to a tributary of Back Creek. Progressive development of the waste rock emplacement resulted in topographical constraints that prevented the free-draining system from functioning.

To allow for ongoing management of the upslope clean water catchment, a clean water diversion dam was constructed in 2021 on the existing western clean water diversion, and a new clean water drain was constructed to collect runoff from the undisturbed catchment in the north-western corner of Coal Lease (CL) 375 and direct it to the new clean water diversion dam (Figure 15).

Runoff collected in the clean water diversion dam is pumped via a pipeline around the toe of the waste rock emplacement to the discharge location on a tributary of Back Creek (Figure 15). The clean water diversion dam capacity and pump rate have been designed to achieve a target containment standard of 10% AEP. The design capacity and pump rate are presented in Table 5. Clean water that is not diverted by this dam shall be accounted for against the sites harvestable rights allowance.

Table 5 Western Clean Water Diversion Dam and Pump Sizing Details

Dam	Catchment Area (ha)	Capacity (ML)	Pump Rate (L/s)	Operational Period
Western Clean Water Dam	200	15	400	2021 to closure

Refer to Section 6.5 for details regarding the monitoring strategy for the WCWD Dam. The stage storage curve for the WCWD Dam is provided in the attached Addendum 1.

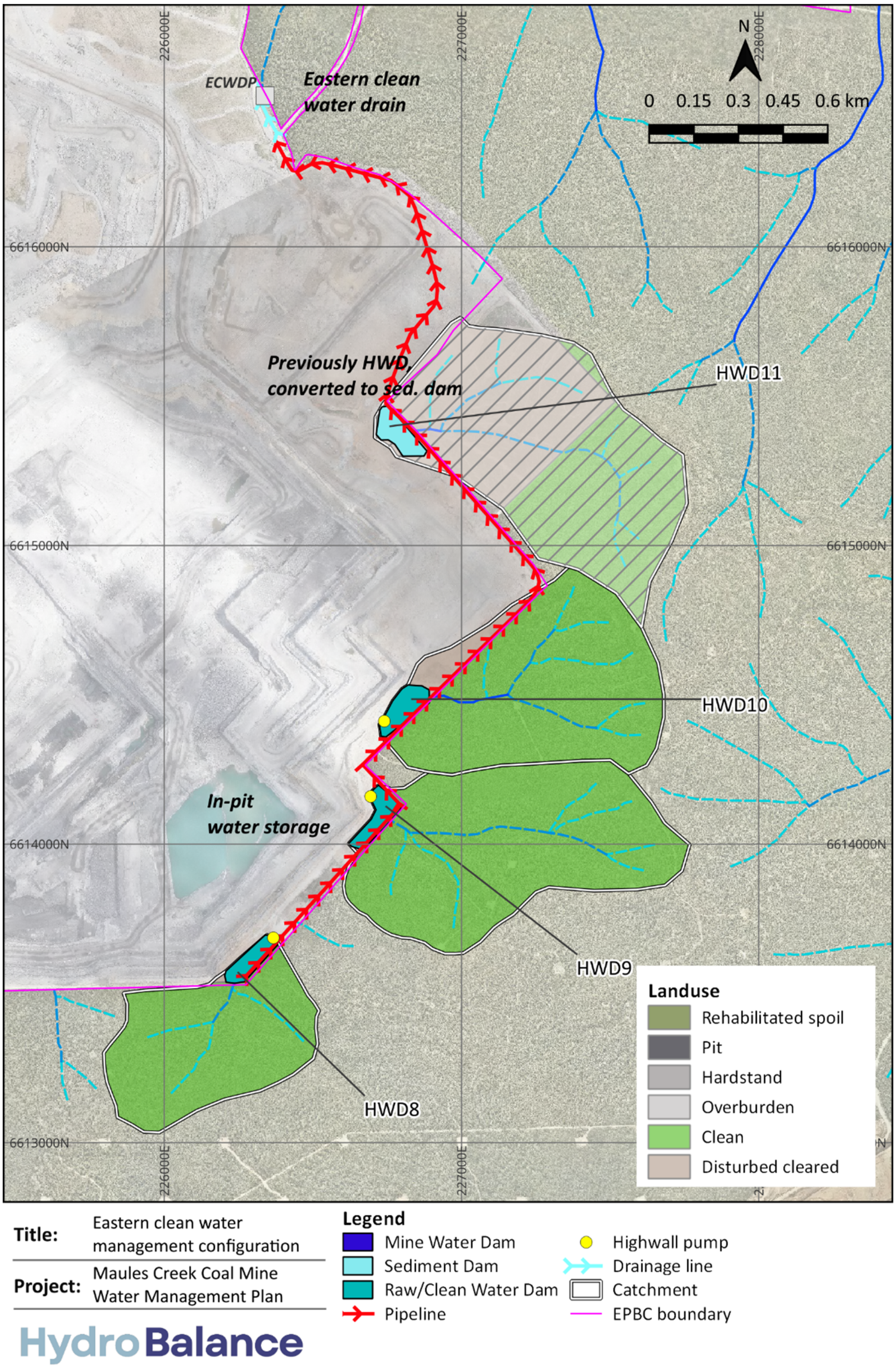


Figure 17 Eastern Clean Water Management Configuration

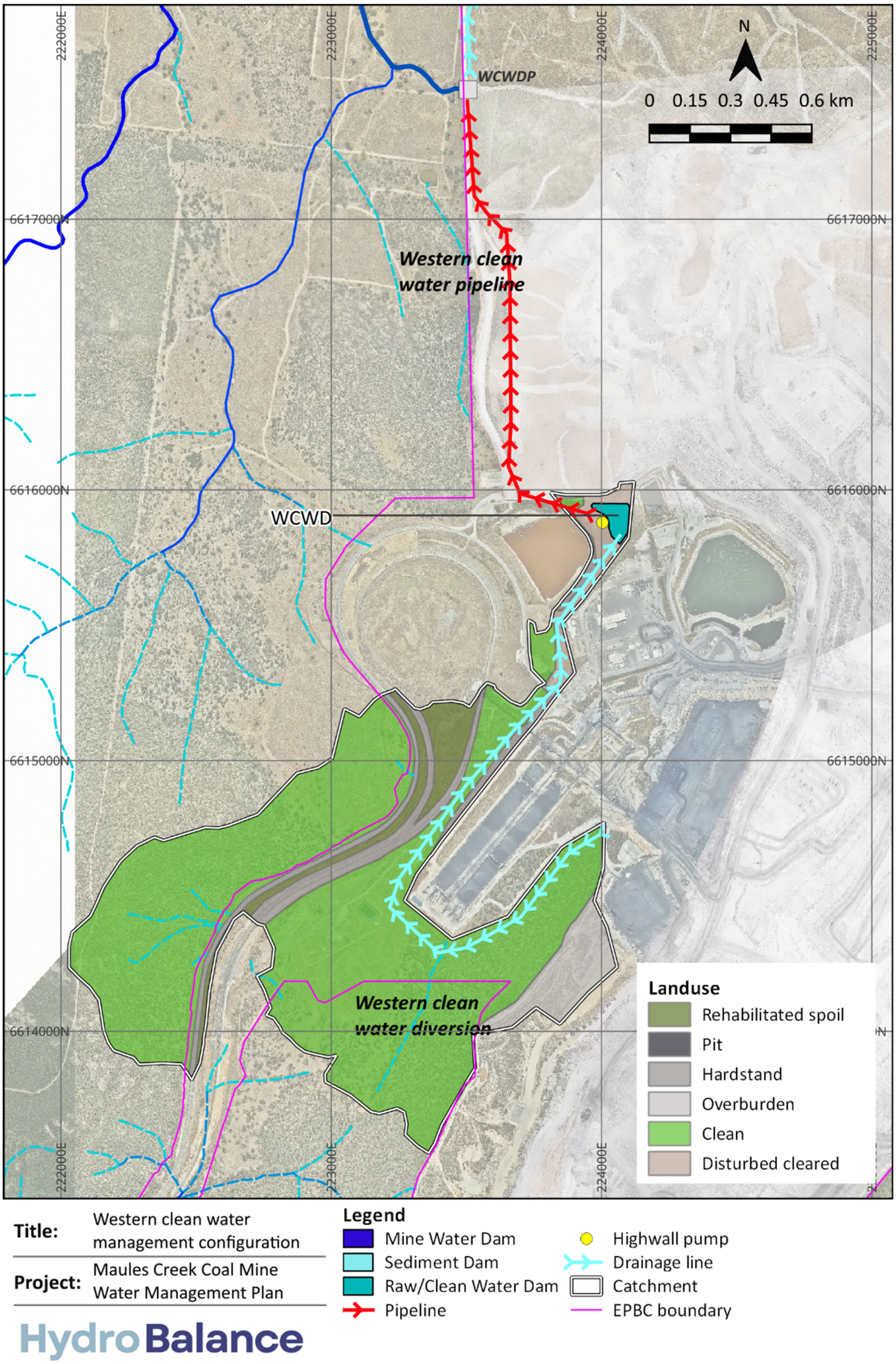


Figure 18 Western Clean Water Management Configuration

4.4 WATER MANAGEMENT FOR THE RAIL SPUR AND MINE ACCESS ROAD

Water management infrastructure along the mine access road and rail spur line consists of a number of minor sediment dams which were used to manage sediment laden runoff during the construction period. The rail spur and mine access road have subsequently been stabilised by vegetation and therefore no longer require active management. These dams were decommissioned in 2022/23. Addendum B has been submitted which documents the proposed decommissioning works.

4.5 REINSTATEMENT OF DRAINAGE LINES AND WATER POLLUTION CONTROL FOR REHABILITATED AREAS

Details of rehabilitation objectives and techniques are described in the Mine Site Rehabilitation Plan. The key goal of rehabilitation activities is to create landforms that are safe, stable, provide adequate post-mining drainage, and have a shape that is consistent with the types of naturally occurring landform features that occur in the region. Runoff from rehabilitation areas is managed through the dirty water management system which includes drains and sediment dams. Runoff from rehabilitation will not drain freely to the receiving environment until water quality data shows that it is equal to or better quality than the receiving environment.

The following drainage design features and techniques may be used to control erosion and provide stable drainage systems for rehabilitated areas:

- Amelioration of dispersive spoil to minimise the risk of rill, gully and tunnel erosion and to allow the infiltration of surface water (reduce the amount and velocity of surface water).
- Contour scarification of compacted surfaces to encourage infiltration and surface roughness.
- Use of cover crops including salt tolerant self-sterile annual grasses (if seasonally and commercially available), native grasses and native legumes to minimise raindrop and sheet erosion of reshaped areas.
- Use of inert rock mulches of appropriate stone sizes and cover where effective and appropriate.
- Vehicle access will be predominantly restricted to designated tracks on mine landforms that have been revegetated to minimise ground disturbance (e.g. erosion and/or compaction).
- Engineered temporary channel banks, slope drains and energy dissipaters in areas where concentrated surface flow may occur to reduce erosion if necessary. However, it should be noted that one of the aims of the landform design process will be to minimises the reliance on structural erosion control measures. Drainage and sediment control structures will be designed in accordance with Table 6.1 of *Managing Urban Stormwater: Soils and Construction Volume 2E – Mines and Quarries* (DECC, 2008). Sediment basins and other water storages will not be located on overburden emplacement areas in order to reduce the potential for tunnel erosion.
- Structural erosion controls may be used on overburden emplacement areas if necessary, until vegetation cover is sufficient to provide adequate erosion protection.
- In the larger drainage systems such as clean water drains and modified natural drainage systems, erosion control methods such as cross vanes, rock vanes and J-hook vanes will be used to provide channel bed and bank protection.

4.6 MANAGEMENT OF POTENTIALLY ACID FORMING MATERIALS

Management of overburden and coal reject materials is described in the MCCM Mining Operations Plan.

Geochemical assessment of site materials indicates that overburden and most potential coal reject materials at MCCM are likely to have negligible (<0.1%) total sulphur content and are therefore classified as Non Acid Forming (NAF). These materials are predicted to generate slightly alkaline and relatively low salinity runoff and seepage following surface exposure, which is evident in water quality data which shows all the dams at the mine are neutral to slightly alkaline. A small proportion of potential coal reject materials are classified as Potentially Acid Forming (PAF) and these materials may generate acidic and more saline runoff and seepage if exposed to oxidising conditions.

Management of overburden and coal reject materials at MCCM includes:

- use of drainage and containment structures;
- pre-stripping topsoil from areas to be mined for use in final rehabilitation activities;
- placement of overburden within the overburden emplacement areas in a manner that limits the risk of surface erosion;
- placement of NAF coal reject materials in the open cut pit and/or co-disposed with overburden;
- burial of PAF coal reject materials from the selected coal seams ensuring at least 15 m final coverage of inert material. Out-of-pit co-disposal of PAF rejects in encapsulation cells may need to be considered until sufficient capacity in the open pit becomes available;
- burial of PAF roof and floor materials from selected coal seams ensuring at least 15m final coverage of inert material; and
- covering carbonaceous waste materials (i.e. not PAF) as soon as practical with at least 5 m of non-carbonaceous NAF overburden material to minimise the length of exposure to oxidising conditions.

4.7 FINAL VOID MANAGEMENT AND DESIGN PARAMETERS

The key objectives to be achieved for the final void (Condition 71 of PA 10_0138) are:

- minimise the size and depth of the final void as far as is reasonable and feasible; and
- minimise the drainage catchment of the final void as far as is reasonable and feasible.

Details of the ultimate final landform (including final void) are presented within the Rehabilitation Management Plan. The final void will be designed using a combination of groundwater and surface water models to ensure that it is safe, stable and non-polluting, by creating a groundwater sink. Further mine planning work will be undertaken as mining operations progress and as part of the work required under the Rehabilitation Management Plan to ensure that the objectives from the PA have been met. This will include the preparation and implementation of a Final Void and Mine Closure Plan (FVMCP). The WMP will be updated to reflect the outcomes of the FVMCP.

4.8 CHEMICAL AND HYDROCARBON STORAGE

All chemical and hydrocarbon storages will be constructed and maintained in accordance with Australian Standard 1940 *The Storage and Handling of Flammable and Combustible Liquids*.

4.9 EROSION AND SEDIMENT CONTROL

4.9.1 General Principles

Effective erosion and sediment control (ESC) is based on three key activities:

- Erosion control – prevention or minimisation of erosion caused by runoff on disturbed surfaces.
- Drainage control – a secondary erosion control, prevention or minimisation of soil erosion caused by concentrated flows. Appropriate management and separation of different water types through/around the area of concern.
- Sediment control – trapping or retention of sediment generated from either overland flow or concentrated flow.

Best practice sediment control measures cannot, on their own, be relied upon to provide adequate environmental protection without implementing effective erosion and drainage controls. For ESC measures to be effective the following fundamentals are required:

- Integrate ESC measures into the planning phases of mine operations.
- Separate catchments by water types and control water movement through the site.
- Minimise the duration and extent of topsoil and spoil exposure where possible.
- Promptly stabilise disturbed areas where possible (to reduce the duration of disturbance).
- Maximise sediment retention on the site and maximise discharge of water that will achieve water quality compliance conditions.
- Maintain all ESC measures in proper working order at all times.
- Monitor the site and adjust ESC practices to maintain the required performance standard.

Surface runoff water from areas that are disturbed by mining operations (including out-of-pit overburden and haul roads) is considered sediment laden runoff and may contain high sediment loads. Mining and dumping operations will be managed to ensure that runoff from these areas is not significantly affected by coal contact and hence will not contain contaminated material or high salt concentrations.

Activities that have the potential to cause erosion and sediment laden runoff at MCCM include:

- vegetation clearing and topsoil stripping;
- stockpiling of topsoil;
- construction of roads and infrastructure;
- construction of overburden emplacement areas;
- re-routing drainage lines via clean water diversions; and

- construction activities as detailed below.

Potential impacts from these activities include:

- increased surface erosion from disturbed and rehabilitated areas through the removal of vegetation and stripping of topsoil;
- increased sediment and pollutant load entering the natural water system; and
- siltation or erosion of watercourses and water bodies.

The sediment laden runoff produced from these activities must be managed to ensure that downstream water quality is within the adopted water quality compliance criteria. Topsoil stockpiles will be located within the approved Project Disturbance Boundary and will not be located within any drainage line and be developed considering the potential for erosion and sediment issues. Further detail on the management of topsoil stockpiles is provided within the Rehabilitation Management Plan.

Sediment and erosion control measures for the MCCM are designed to ensure effective management of clean surface water and sediment laden runoff from mining and prestrip areas. Sediment mobilisation and erosion will be minimised by:

- installing appropriate erosion and sediment controls prior to disturbance of any land;
- limiting the extent of the disturbance to the practical minimum;
- reducing the flow rate of water across the ground particularly on exposed surfaces and in areas where water concentrates;
- progressively rehabilitating disturbed land and constructing drainage controls to improve stability of rehabilitated land;
- treating rehabilitation areas to promote infiltration;
- protecting natural drainage lines and watercourses by the construction of erosion control devices such as diversion banks, channels and sediment retention dams;
- installing appropriate erosion and sediment controls around all soil stockpiling areas;
- steep gradients will have suitable control measures in place, as required e.g. rock riprap, geotextile fabric; and
- restricting access to rehabilitated areas.

The design of erosion and sediment control measures at MCCM will be based on the principle of ensuring that runoff from disturbed areas is separated from clean area runoff and collected in sediment dams for treatment. Sediment control structures will be designed in accordance with current recommended design standards including:

- *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004); and
- *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries* (DECC, 2008).

The design of linear construction (including pipelines, roads and rail spur line) will be in accordance with current recommended design standards including:

- *Managing Urban Stormwater, Soils and Construction, Volume 2A Installation of Services*;

- *Volume 2C unsealed roads*; and
- *Volume 2D Main Road Construction*.

4.9.2 Erosion Control Measures

Erosion control measures will be used to manage dispersive soils and spoils, provide soil surface cover, and to minimise the creation of concentrated surface water flow conditions. Erosion control works will include the measures listed below:

- Amelioration of dispersive spoil to minimise the risk of rill, gully and tunnel erosion and to allow the infiltration of surface water (reduce the amount and velocity of surface water). This will be determined during the soil testing program outlined in the Soil Management Protocol.
- Contour scarification of compacted surfaces to encourage infiltration and surface roughness.
- Use of cover crops including salt tolerant self-sterile annual grasses (if seasonally and commercially available), native grasses and native legumes to minimise raindrop and sheet erosion of reshaped areas.
- Use of inert rock mulches of appropriate stone sizes and cover where effective and appropriate.
- Vehicle access will be predominantly restricted to designated tracks on mine landforms that have been revegetated to minimise ground disturbance (e.g. erosion and/or compaction).
- Engineered temporary channel banks, slope drains and energy dissipaters in areas where concentrated surface flow may occur to reduce erosion if necessary. However, one of the aims of the landform design process will be to minimises the reliance on structural erosion control measures. Drainage and sediment control structures will be designed in accordance with Table 6.1 of *Managing Urban Stormwater: Soils and Construction Volume 2E – Mines and Quarries* (DECC, 2008). Sediment basins and other water storages will not be located on overburden emplacement areas to reduce the potential for tunnel erosion.
- Structural erosion controls may be used on overburden emplacement areas if necessary until vegetation cover is sufficient to provide adequate erosion protection.
- In the larger drainage systems such as clean water drains and modified natural drainage systems, erosion control methods such as cross vanes, rock vanes and J-hook vanes will be used to provide channel bed and bank protection.

4.9.3 Drainage and Sediment Control Measures

Dirty water drains and contour banks will direct runoff from disturbed areas to sediment dams for treatment through sedimentation.

The general arrangement of the proposed drainage and sediment control structures is shown in the staged mine plans (see Section 3 of the Site Water Balance - Appendix A of the WMP). The proposed sediment dams are positioned between the active mining area and Back Creek to capture runoff from the overburden emplacement areas and other disturbed land.

All rehabilitated land where required will be shaped to geofluv design criteria. The geofluv design mimics natural slopes which are drained via rock lined channels into toe drains, which direct water to sediment dams. The water collected in sediment dams is either pumped back into the mine water management system, or discharged offsite (as described below). Water captured in the sediment control system may be released offsite at any time, provided water quality meets EPL conditions and is not required to supply the mine water management system.

Sediment dam sizes will be based on the following design standards and methodology:

- "Type F" sediment basins consistent with SD 6-4 (page 6-19, Landcom 2004).
- Sediment basin spillway capacity of 50 year average recurrence interval (ARI) peak discharge (to provide a high level of immunity to protect against structural damage).
- Total sediment basin volume = settling zone volume + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone volume is the minimum required free storage capacity that must restored within 5 days after a runoff event.
- Sediment basin settling zone volume based on 90th percentile (wet conditions) 5-day duration rainfall (38.4 millimetre (mm)) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.5 (note that the percentile referred to in the guidelines is for a 10% chance of exceedance).
- Sediment storage volume = 50% of settling zone volume.

Based on current design guidelines (Landcom 2004, DECC 2008), the sediment dams will be dewatered within 5 days after a runoff event to provide free storage capacity of at least the Settling Zone Volume. Pollutant concentration limits for oil and grease, pH and TSS have been specified in the EPL for discharge from sediment dams. Where pollutant concentrations in sediment dams after a runoff event are less than the limits specified in the EPL, basins may be dewatered to receiving waters. Where a pollutant exceeds the EPL limit, water in basins must be either:

- pumped into the mine water management system;
- pumped to another water storage with available capacity; or
- flocculated to reduce TSS to less than the EPL limit and discharged.

For rainfall events that exceed the design standard (38.4 mm in 5 days), it is possible that the sediment dams may overflow with TSS concentrations that exceed the water quality discharge limits of the EPL. Note however that such overflows are likely to occur during large rainfall events when background suspended solids concentrations in receiving waters are likely to be well above the water quality objective.

4.10 SURFACE WATER DESIGN OBJECTIVES AND PERFORMANCE CRITERIA SUMMARY

Table 6 provides a summary of design objectives and performance criteria for key aspects of surface water management at MCCM, as well as a description of how the various objectives will be achieved. Trigger levels for managing potential adverse surface water impacts are specified in Trigger Action Response Plans (TARPs) in the surface water response plan (see Section 5).

Table 6 Summary of Surface Water Design Objectives and Performance Criteria

Feature	Design objective	Performance criteria	Achieved by
Mine Water Management System	No uncontrolled discharge of mine water	No uncontrolled discharges at Mine Water Dam spillway Mine Water Dam level maintained below MOV[a] during dry weather	Monitor Mine Water Dam level in accordance with monitoring plan Operate Mine Water Dam in accordance with Mine Water Containment TARP (Table 8)
Downstream Surface Water Quality	No adverse impact on downstream water quality	Receiving water quality below trigger levels	Monitor receiving water quality in accordance with monitoring plan Assess monitoring results and undertake impact assessment in accordance with Receiving Water Quality TARP (Table 9)
Erosion and Sediment Control	Effective control of erosion and sediment runoff in accordance with Landcom (2004) and DECC (2008) guidelines.	Compliance with EPL requirements for discharge from sediment dams	Manage land disturbance in accordance with principles of erosion and sediment control Operate and monitor sediment dams in accordance with Sediment Dams TARP (Table 10)
Stream Health	Maintain or improve stream health along receiving watercourses	No reduction in measures of stream health caused by mining	Comparative assessment of stream health following annual inspection
Flooding	No increase in inundation or erosion due to flooding	No community complaints regarding flooding. No visible change in inundation or erosion during flood events.	Mine infrastructure located outside Back Creek floodplain Undertake inspections and maintenance of mine infrastructure in accordance with Flooding TARP (Table 11)
Clean Water Management	Clean water capture and diversion in compliance with the WM act and project approvals	Clean water dams continually dewatered to receiving watercourse	Operate and maintain clean water management system in accordance with Clean Water Dams TARP (Table 12)

[a] MOV = maximum operating volume

5 SURFACE WATER TRIGGERS AND RESPONSE PLAN

Discharge water quality concentration limits from the site sediment dams are specified for MCCM in EPL 20221 and shown in Table 7, The discharge criteria comply with Condition 38 of the PA. The 100th percentile concentration limits have been adopted as the trigger values for discharge water quality.

Table 7 Sediment dam discharge triggers

Parameter	100th percentile
Oil and grease (mg/L)	10
pH	6.5-8.5
Total Suspended Solids (mg/L)	50

Trigger levels and contingency actions to respond to key aspects of the water management system performance are provided below for:

- MWD containment (Table 8);
- receiving water quality (Table 9);
- sediment dams (Table 10);
- flooding (Table 11); and
- clean water dams (Table 12).

Table 13 shows surface water quality impact assessment criteria that will be used as trigger values for assessing the surface water impacts from the Project on receiving watercourses. Exceedance of the trigger values will initiate an investigation to assess whether the identified exceedance has potentially been caused by the Project. Where insufficient local reference data is available to determine trigger levels, Australian New Zealand Environment Conservation Council (ANZECC) eco-system trigger values have been adopted. The adopted trigger values will be refined based on ongoing sampling.

Specific release water monitoring requirements for clean water discharges is discussed further in Section 6.5.

Table 8 TARP - Mine Water Dam Containment

Level	Trigger	Action	Response
Level 1 (Normal)	Mine Water Dam stored volume < 340 ML (MOV)	• Continue to monitor levels in accordance with monitoring plan	• No response required
Level 2 (Early warning)	Current or forecast heavy rainfall (>25mm in 24 hour period).	• Ensure inter-dam transfer pumping network is operational • Review options for water transfer if required	• Post-event review to confirm event was well managed with appropriate resources in place
Level 3A (Exceedance of trigger level)	Mine Water Dam stored volume exceeds 340 ML with inflows still occurring	• Reduce process inflows if practical • Commence transfer from Mine Water Dam to Pit Water Storage to maintain MOV	• Post-event review to confirm suitability of water transfer infrastructure & operational rules • Update operational rules if required • Prepare recommendations and implement modifications or upgrades to water transfer infrastructure
Level 3B (Possible discharge of mine water)	Mine Water Dam stored volume exceeds 473 ML (approximately 90% capacity) with inflows still occurring	• Cease process inflows to storages with highest risk of spill • Maximise pumping capacity for transfer from Mine Water Dam to Pit Water Storage (e.g. relocate mobile pumps)	• Post-event review to confirm suitability of water transfer infrastructure & operational rules • Update operational rules if required • Implement required modifications or upgrades to water transfer infrastructure
Level 4 (Discharge of mine water)	Discharge of mine water from one or more mine water storages	• Complete required actions under Pollution Incident Response Management Plan • Advise DPE of spill • Collect water quality samples of spills at dam overflow point and upstream and downstream in receiving watercourse • Remediate any environmental harm	• Initiate investigation into reasons for system failure, including assessment of environmental harm • Take actions recommended by investigation to prevent recurrence

Table 9 TARP – Receiving Water Quality

Level	Trigger	Action	Response
Level 1 (Normal)	All surface water quality samples below trigger levels in Table 13.	• No action	• Continue to monitor water quality in accordance with monitoring plan
Level 2 (Early warning)	Single value at downstream sampling site exceeds trigger level in Table 13.	• Verify sample analysis to confirm result • Check upstream water quality to assess potential for impact from operations • Advise DPE of trigger exceedance	• If upstream pollutant concentration is higher or within 5% of downstream value, then no further action required • Otherwise, assess whether operation could potentially have affected water quality and take remedial action, if appropriate
Level 3A (Potential water quality impact – no discharge)	Two or more sequential samples at a downstream sampling site exceed trigger level in Table 13.	• Check upstream water quality to assess potential for impact from operations • Report on likely causes of exceedance and all reasonable and feasible mitigation measures • Advise DPE of trigger exceedance	• If upstream pollutant concentration is higher or within 5% of downstream values then consider need for review of trigger levels • Implement appropriate mitigation measures after considering all reasonable and feasible options
Level 3B (Potential water quality impact – sediment dam discharge)	Water quality at multiple downstream sampling sites exceeds trigger levels in Table 13. and discharge from site sediment dams has occurred.	• Check upstream water quality to assess potential for impact from operations • Report on likely causes of exceedance and all reasonable and feasible mitigation measures • Advise DPE of trigger exceedance	• If upstream pollutant concentration is higher or within 5% of downstream values then no further action required • Implement appropriate mitigation measures after considering all reasonable and feasible options
Level 4 (Likely water quality impact –mine water dam discharge).	Single value at downstream sampling site exceeds trigger level in Table 13 and discharge from mine water dam has occurred	• Complete required actions under Pollution Incident Response Management Plan • Check upstream and downstream water qualities to confirm any impact to water quality from operations • Remediate any environmental harm • Advise DPE of trigger exceedance	• Complete detailed incident review to identify cause of water quality exceedance • Review systems and update procedures as required to prevent recurrence • Implement any other appropriate mitigation measures after considering all reasonable and feasible options

Table 10 TARP – Sediment Dams

Level	Trigger	Action	Response
Level 1 (Normal)	No site runoff	• Continue ongoing inspection and maintenance of sediment dams in accordance with monitoring plan	• No response required • De-silt sediment dam(s) if required
Level 2 (Early warning)	Current or forecast heavy rainfall (>25mm in 24 hour period).	• Ensure transfer pumping network is operational • Undertake inspection to check sediment accumulation	• Post-event review to confirm event was well managed • Check post-event sediment dam levels in sediment dams and de-silt if required
Level 3 (Sediment dam discharge)	Discharge from sediment dam within EPL limits	• Collect sample of sediment dam outflow • Confirm discharge complies with EPL water quality limits	• Post-event review to confirm rainfall exceeded design standard • Review system configuration to ensure operating as designed • Check post-event sediment levels in sediment dams and de-silt if required
Level 4 (Exceedance of water quality target)	Discharge from sediment dam exceeds EPL limits	• Complete required actions under Pollution Incident Response Management Plan • Check if event rainfall exceeds design standard • Notify DPE if rainfall below design standard • Collect water quality samples of spills at dam overflow point and in receiving watercourse	• Check post-event sediment levels in sediment dams and de-silt if required • Initiate investigation into reasons for system failure, including assessment of environmental harm • Remediate any environmental harm • Take actions recommended by investigation to prevent recurrence

Table 11 TARP – Downstream Flooding

Level	Trigger	Action	Response
Level 1 (Normal)	No site runoff	• Annual (September) inspection of gauge sites on Back Creek and culverts on access road and rail spur	• Arrange maintenance if required to ensure culverts are clear of sediment and debris and gauges are functional.
Level 2 (Early warning)	Current or forecast heavy rainfall (>25mm in 24 hour period).	• Check gauge recorders on Back Creek are reporting correctly.	• Post-event review to confirm gauges functioned correctly.
Level 3 (Flood event)	Namoi River at Boggabri exceeds Bureau of Meteorology Minor Flood level; or Recorded site rainfall of > 50 mm per day; or Recorded flow rate exceeds 5 m^3/s in Back Creek	• Undertake site inspection including access road and rail spur to identify any flood damage • Make safe any areas of flood damage or major erosion on the mine site. • Prepare post-flood assessment report including: – details of recorded rainfall; – photographs of identifiable flood marks; and – photographs of identifiable changes in stream condition, such as areas of erosion or deposition.	• Post-event review to confirm gauges functioned correctly. • Review flood event trigger and revise up or down to reflect site experience.
Level 4 (Potential flood impact)	Flood event that causes identifiable damage or community complaint regarding flooding	• Complete actions under Level 3. • Review mining disturbance to assess whether mining operations could have contributed to flooding. • Review rainfall and flow data to assess whether mining activity is likely to have contributed to additional flooding. • Prepare a report documenting the investigation, outcomes and recommendations to prevent recurrence. • Advise complainant of outcome of assessment.	• Take actions recommended by investigation to prevent recurrence

Table 12 TARP – Clean Water Dams

Level	Trigger	Action	Response
Level 1 (Normal)	Clean water dams empty & no site runoff	• Continue ongoing inspection and maintenance of clean water dams in accordance with monitoring plan	• No response required
Level 2 (Early warning)	Current or forecast heavy rainfall (>25mm in 24 hour period).	• Ensure transfer pumping network is operational • Undertake daily inspection to identify whether runoff inflow has occurred.	• Post-event check to confirm no clean water capture
Level 3 (Clean water discharge within water quality target)	Rainfall sufficient to generate runoff inflow to clean water dam resulting in discharge to Back Creek	• Commence clean water pumping as soon as practical • Collect sample of clean water discharge and Back Creek in accordance with clean water monitoring plan • Continue pumping until clean water dams are dewatered	• Post-event check to ensure clean water dams are fully dewatered • Review system configuration to ensure operating as designed • Confirm clean water discharge quality consistent with clean water discharge target • Record the volume of water captured and pumped from the dam • Record the volume of water that spilled from the dam to account against site Harvestable Rights or Water Access License
Level 4 (Clean water discharge exceeding water quality target)	Clean water discharge quality exceeds Back Creek receiving water trigger levels (Table 13) for parameters listed in Table 7: • pH 6.5 to 8.3 • TSS < 80 mg/L • Oil and Grease < 10 mg/L	• Stop pumping clean water dams ○ If the water quality in Back Creek during the event exceeds the water quality from the clean water discharge, releases can recommence • Treat the dam prior to re-commencing discharge • If the water cannot be treated, pump to the mine water management system	• Inspect the dams to determine potential source of pollutant • Review system configuration to ensure operating as designed • Review receiving water quality to determine any impact between upstream and downstream water quality • Initiate investigation into reasons for exceedance, including assessment of potential environmental harm • Take actions recommended by investigation to prevent recurrence • Record the volume of water pumped to the mine water management system to account against site Harvestable Rights or Water Access License

Table 13 Receiving Water Quality Trigger Values

Parameter	Unit	ANZG Trigger Value				Recorded Baseline Data (80%ile)			Preliminary Trigger Value			Comment
		Irrigation	Livestock drinking	Eco-system[d]	Recreational	Maules Creek[g]	Back Creek[h]	Namoi River[i]	Maules Creek	Back Creek[k]	Namoi River	
pH	pH	-	-	6.5-8.5	5.0-9.0	7.4-8	7.2-8.3	8-8.6	6.5-8.0	6.5-8.3	6.5-8.6	Lower bound based on ANZG guideline for ecosystem protection, upper bound based on baseline data.
EC	µS/cm	1,000[a]	-	125-2,200	-	432	243	668	430	250	670	Baseline data adopted. Rounded up to nearest ten.
DO (% sat)		-	-	85-110	-	no samples	no samples	no samples	85-110	85-110	85-110	Lack of baseline data, adopted lowest ANZG guideline.
TDS	mg/L	-	2,000[a]	-	1000	272	267	377	300	300	400	Baseline data adopted. Rounded up to nearest hundred.
Turbidity	NTU	-	-	6-50	6	18	235	66	6-50	6-50	6-50	Lowest ANZG guideline adopted.
TSS	mg/L	-	-		-	25	80	62	30	80	70	Baseline data adopted. Rounded up to nearest ten.
Calcium (Ca)	mg/L	-	1,000	-	-	36	17	43	40	20	50	Baseline data adopted. Rounded up to nearest ten.
Sodium (Na)	mg/L	115[c]	-	-	300	34	22	53	40	30	60	Baseline data adopted. Rounded up to nearest ten.
Magnesium (Mg)	mg/L	-	2,000[b]	-	-	14	5	26	20	10	30	Baseline data adopted. Rounded up to nearest ten.
Sulphate (SO_4)	mg/L	-	1,000	-	400	24	10	49	30	10	50	Baseline data adopted. Rounded up to nearest ten.
Chloride (Cl)	mg/L	175[c]	-	-	400	37	19	61	40	20	70	Baseline data adopted. Rounded up to nearest ten.
Arsenic (As)	mg/L	0.1[f]	0.5	0.013[a,e]	0.05	0.001[j]	0.0046	0.002	0.013	0.013	0.013	Lowest ANZG guideline adopted.
Barium (Ba)	mg/L	-	-	-	1	0.07	0.30	0.06	1	1	1	Lowest ANZG guideline adopted.
Cadmium (Cd)	mg/L	0.01[f]	0.01	0.0002[e]	0.005	0.0001[j]	0.0001[j]	0.0001[j]	0.0002	0.0002	0.0002	Lowest ANZG guideline adopted.
Chromium (Cr)	mg/L	0.1[f]	1	0.001[e]	0.05	0.001[j]	0.006	0.002	0.001	0.006	0.002	Baseline data adopted.
Copper (Cu)	mg/L	0.2[f]	0.4[a]	0.0014[e]	1	0.002	0.007	0.005	0.002	0.007	0.005	Baseline data adopted.
Iron (Fe)	mg/L	0.2[f]	-	-	0.3	0.8	9.9	1.9	0.8	10.0	1.9	Baseline data adopted. Rounded up to nearest tenth.
Lead (Pb)	mg/L	2[f]	0.1	0.0034[e]	0.05	0.001[j]	0.005	0.001[j]	0.0034	0.0034	0.0034	Lowest ANZG guideline adopted.
Manganese (Mn)	mg/L	0.2	-	1.9[e]	0.1	0.09	0.5	0.1	0.1	0.1	0.1	Lowest ANZG guideline adopted.
Nickel (Ni)	mg/L	0.2[f]	1	0.011[e]	0.1	0.001[j]	0.01	0.004	0.011	0.011	0.011	Lowest ANZG guideline adopted.
Zinc (Zn)	mg/L	2[f]	20	0.008[e]	5	0.018	0.03	0.015	0.02	0.03	0.02	Baseline data adopted. Rounded up to nearest hundredth.
Mercury (Hg)	mg/L	0.002[f]	0.002	0.0006[e]	0.001	0.0001[j]	no samples	0.0001[j]	0.0006	0.0006	0.0006	Lack of baseline data, adopted lowest ANZG guideline.
Ammonia	mg/L	-	-	0.9	0.1	0.03	0.046	0.03	0.03	0.05	0.03	Baseline data adopted.
Total phosphorus (Total P)	mg/L	0.05[f]	-	0.025	-	0.18	0.28	0.15	0.2	0.3	0.2	Baseline data adopted. Rounded up to nearest tenth.
Total nitrogen (Total N)	mg/L	5	-	0.35	-	1.16	1.5	0.9	1.2	1.5	1	Baseline data adopted.
Nitrate as N	mg/L	-	400	0.7	10	0.3	0.1	0.2	0.7	0.7	0.7	Lowest ANZG guideline adopted.
Nitrite as N	mg/L	-	30	-	1	0.01	0.01	0.01	1	1	1	Lowest ANZG guideline adopted.

- No trigger value recommended
[a] Lowest recommended value
[b] Cattle (insufficient information on other livestock)
[c] Sensitive crops
[d] Upland River (>150 m altitude)
[e] 95% of species protected
[f] Long term trigger value
[g] at SW1 and SW2
[h] at SW3, SW4, SW9, SW10 and SW11
[i] at SW5, SW6, SW7 and SW8
[j] Many samples under detection limit
[k] Only 3 samples = lack of baseline data

6 SURFACE WATER MONITORING PROGRAM

6.1 OVERVIEW

Monitoring of upstream, onsite and downstream water quality and quantity will assist in demonstrating that the site water management system is effective in meeting its objective of no adverse impact on receiving water quality and will allow for early detection of any impacts and appropriate corrective action.

The surface water monitoring program will:

- ensure compliance with the MCCM environment protection licences and the BTM Complex WMS;
- provide valuable information on the performance of the water management system and for the validation of the site water balance model; and
- facilitate adaptive management of water resources on the site.

6.2 STANDARDS

Surface water monitoring will be undertaken in accordance with relevant Australian Standards, legislation and NSW Guidelines, including:

- Approved Methods for the Sampling and Analysis of Water pollutants in NSW (DEC, 2004); and
- Australian Standards/New Zealand Standards (AS/NZS) 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples.

6.3 MONITORING LOCATIONS, PARAMETERS AND FREQUENCY

A summary of the surface water quality and quantity monitoring program is provided in Table 14. Surface water sampling locations are shown in Figure 9.

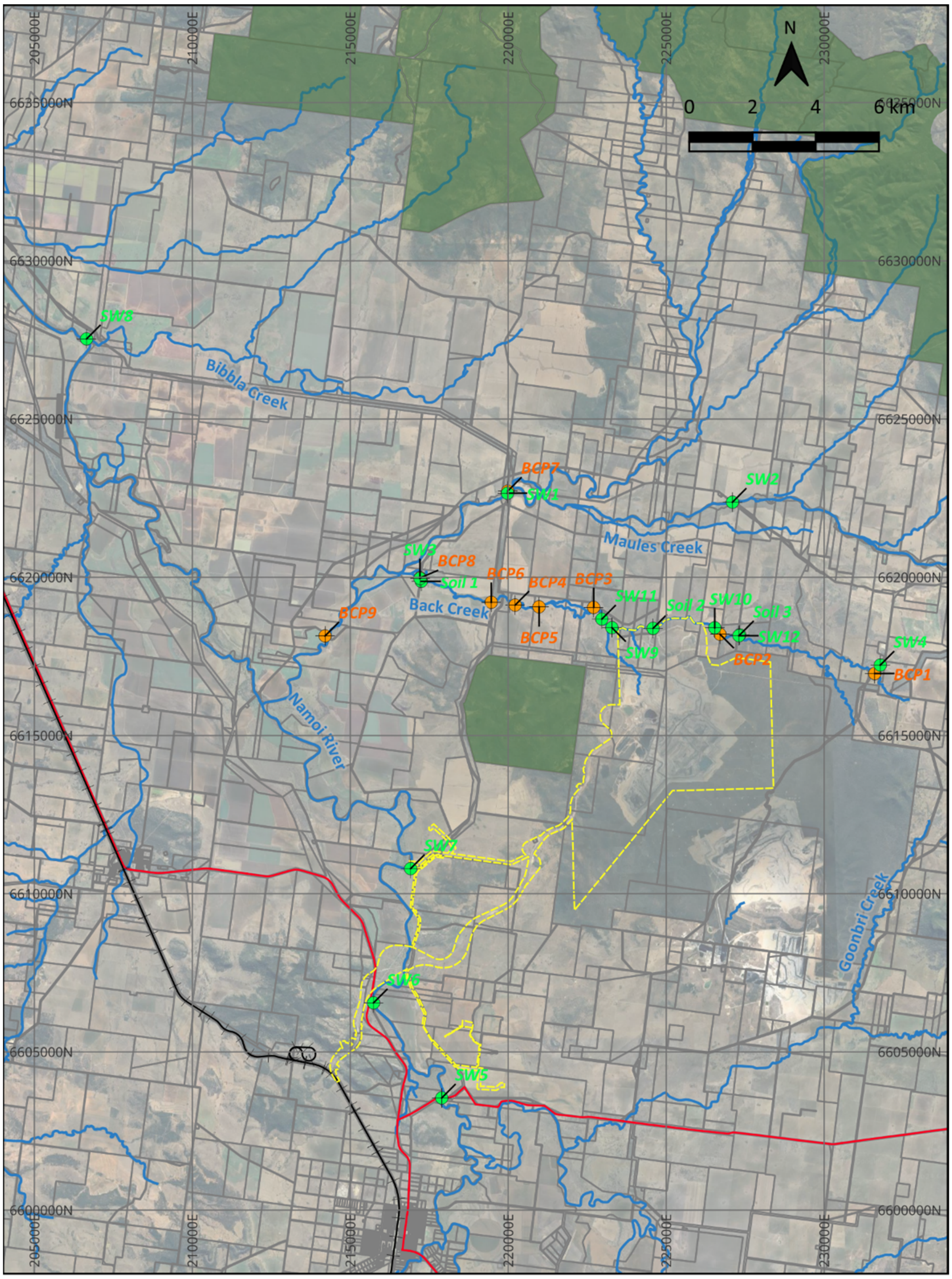
Surface water monitoring at SW4, SW5, SW8 and SW9 (which are part of the BTM Complex WMS cumulative monitoring network) will be undertaken in accordance with the BTM Complex WMS. The water quality parameters included in the BTM Complex Monitoring Suite are provided in Table 15.

Table 14 Surface Water Monitoring Summary

Monitoring location		Parameters	Frequency
On site		Rainfall	Continuous
Maules Creek	SW1, SW2	pH, EC, TSS, TDS, Turbidity	Once during flow events
		Table 15	Monthly if flowing
Namoi River	SW5, SW8	Flow	Continuous
		BTM Complex monitoring suite	Quarterly (+ once during flow events)
	SW6, SW7	pH, EC, TSS, TDS, Turbidity	Monthly
Back Creek	SW4, SW9,	BTM Complex monitoring suite	Quarterly (+ once during flow events)
	SW9, SW10,	Flow	Continuous
	SW11, SW12	Flow Table 15	Continuous Once per discharge event from the clean water dams
	SW3, SW10	Table 15	Once during flow events
Site Clean Water Discharge Points	See Section 6.5		
Mine Water Dam		Table 15	Quarterly
Raw Water Dam & sediment dams		Table 15	Quarterly
Sediment dam overflows		pH, EC, TSS, TDS, Turbidity + Oil & grease	Daily during overflows
In-pit or emplacement seepage flows		Table 15	Quarterly
Emplacement seepage		Table 15	Quarterly
MWD, RWD		Water level	Weekly
HWD and WCWD		Water level, flow rate pH, EC, TSS, TDS, Turbidity + Oil & grease	Continuous Daily during discharge events
Site water use		Water volume pumped from river & bores Make up water delivered to CHPP Water used for dust suppression	Continuous

Table 15 Receiving Water Quality Parameters to be Sampled

Parameter	Units
pH (field & lab)	-
Turbidity	NTU
EC (field & lab)	μs/cm
Total Dissolved Solids	mg/L
Iron (Fe) - dissolved and absorbed	mg/L
Sulphate as SO_4^- - Turbidimetric	mg/L
Bicarbonate Alkalinity as $CaCO_3$	mg/L
Carbonate Alkalinity as $CaCO_3$	mg/L
Hydroxide Alkalinity as $CaCO_3$	mg/L
Total Alkalinity as $CaCO_3$	mg/L
Chloride	mg/L
Calcium	mg/L
Magnesium	mg/L
Sodium	mg/L
Potassium	mg/L
Aluminium	mg/L
Arsenic (filtered)	mg/L
Barium (filtered)	mg/L
Boron (filtered)	mg/L
Bromine (filtered)	mg/L
Cadmium (filtered)	mg/L
Copper (filtered)	mg/L
Iron (filtered)	mg/L
Lead (filtered)	mg/L
Lithium (filtered)	mg/L
Manganese (filtered)	mg/L
Nickel (filtered)	mg/L
Rubidium (filtered)	mg/L
Selenium (filtered)	mg/L
Silver (filtered)	mg/L
Strontium (filtered)	mg/L
Zinc (filtered)	mg/L
Ammonia as N	mg/L
Nitrite as N	mg/L
Nitrate as N	mg/L
Nitrite + Nitrate as N	mg/L
Total Phosphorus as P	mg/L



Title:	Geomorphological & surface water monitoring locations
Project:	Maules Creek Coal Mine Water Management Plan

HydroBalance

Legend

- Project Boundary
- Surface water monitoring location
- Geomorphological monitoring location
- Railway
- Highway
- Waterway
- Cadastre

Figure 19 Surface Water Monitoring Locations

6.4 STREAM HEALTH

Stream and riparian vegetation health will be monitored against the guidelines and standards set out by the Australian River Assessment System: AusRivAS Protocols Development and Testing Report (Final Report) (Water ECOscience Pty Ltd 2002).

The Australian River Assessment System (AusRivAS, Turak et al. 2004) is a nationally standardised approach to biological assessment of stream and riparian environments. It involves a bioassessment using aquatic macroinvertebrates and a complementary physical/chemical assessment to assess the overall ecological health of streams and riparian habitats.

The AusRivAS bioassessment is underpinned by predictive modelling that predicts the aquatic macroinvertebrate fauna assemblage and abundance expected to occur at non-stressed sites. The deviation between the number of taxa expected to occur and the number of taxa that were actually observed (observed:expected ratio, or O/E) is a measure of the ecological health of a stream and riparian environment. The degree to which the number, or type, of taxa collected at a test site deviates from predicted values provides insight on how the water quality or habitat conditions are limiting the biological potential of the site. The O/E ratio ranges from 0 to > 1 and represents a continuum of ecological condition. For ease of interpretation, the continuum can be broken into condition bands that delineate an ecological condition that is impoverished, well below reference, below reference, reference, and richer than reference.

The fundamental assumption behind AusRivAS is that the physical and chemical factors measured at any site are directly related to the number and/or type of macroinvertebrates observed. For this reason, the AusRivAS assessment includes a physical, geomorphological and chemical assessment of the physical condition of the stream environment. Site parameters typically measured include a mixture of the following: geographical position, riparian vegetation, channel morphology, water chemistry, habitat composition, habitat characteristics, organic substratum, inorganic substratum and hydrology (Table 4.11). The AusRivAS physical and chemical assessment uses software that compares site values against predicted values for reference sites. When examined alongside the results of the bioassessment, these results provide an indication of the causes of biological degradation of a stream and riparian environment.

6.4.1 Revised Trigger Action Response Plans (TARPs)

The following triggers for stream and riparian health are included in the 2019 WRP:

- A reduction in O/E scores, such that a site registers in a lower condition band than previously recorded
- Any community complaints relating to adverse impacts on stream and riparian vegetation health
- Visible/observable reduction in stream and riparian vegetation health.

These three triggers are difficult to quantify given the data collected during monitoring (Cumberland Ecology 2015-2020), and they should be replaced with more specific criteria. The O/E scores developed from AUSRIVAS modelling are an unreliable indication of biological condition (Chessman 2021).

The revised triggers for stream health and riparian vegetation are given in Table 16. In applying the triggers, it is important to consider the following when interpreting monitoring results:

- Natural flow variability of Back Creek and Maules Creek. The indices used as triggers will be affected by the natural wetting and drying regime that occurs in ephemeral creeks, so the interpretation of monitoring results should occur in the context of creek hydrological phase.
- Weather or climatic events that may contribute to apparent declines in ecological function, such as increased turbidity following rainfall events.

Additional surveys and sampling are planned for groundwater dependent vegetation communities, and for stygofauna. Once these have been completed and the extent of these groundwater dependent ecosystems determined, additional TARPS will be determined for these if necessary.

Bi-annual monitoring of sites will yield bi-annual data from which change in stream and riparian vegetation health can be measured over time. The following trigger values have been adopted:

- Univate analysis of macroinvertebrate indices (EPT, Taxonomic Richness and Signal scores)
- Multivariate analyses of invertebrate communities
- Any community complaints relating to adverse impacts on stream and riparian vegetation health;
- Stream and riparian vegetation health will be assessed by:
  - Normalised Vegetation Index (NDVI); and
  - Assessment of the Melaleuca Bracteanrthan riparian shrubland by site observation of recruitment (saplings <10 cm tall), flowering individuals, sings of stress and signs of scouring around the roots

Table 16 TARP – Stream Health

Level	Trigger	Action	Response
Level 1 (Normal)	Taxonomic richness, SIGNAL Score, EPT Score, AND invertebrate communities at sites downstream of the mine are all **similar to** sites upstream of the mine	Continue monitoring in accordance with monitoring plan	No response needed
Level 2 (Early warning)	Some of the above ecological indices are within ranges that are similar to sites upstream of the mine	Review existing water quality (Dissolved Oxygen, Electrical Conductivity, pH, turbidity) and flow data to see if there is a reason for loss of diversity or sensitive taxa. Inspect sediment control devices for proper function, inspect drainage lines for signs of erosion. Repair as needed. Continue monitoring in accordance with plan.	Visual inspection of sediment devices to ensure proper function. Assess follow-up monitoring data for improved condition.
Level 3 (Exceedance of trigger level)	Taxonomic richness, SIGNAL Score, EPT Score, or invertebrate communities at sites downstream of the mine are significantly less than (or outside the rang e of one standard deviation of) those sites upstream of the mine.	Review water quality data, flow data, and other site-specific information to see if there is a non-mining related explanation for the decline (e.g. drought, seasonal patterns). If not, examine sediment control structures and other infrastructure that may contribute to poorer macroinvertebrate communities.	Visual inspection of sediment devices to ensure proper function. Assess follow-up monitoring data for improved condition.

Table 17 TARP – Riparian Vegetation

Level	Trigger	Action	Response
Level 1 (Normal)	There is no decline in NDVI for riparian vegetation along Back Creek between survey periods. Diversity in tree and shrub layers, as measured in BAM plots at Back Creek sites, remain consistent through time	Continue monitoring in accordance with monitoring plan Continue monitoring in accordance with monitoring plan	No response needed No response needed
Level 2 (Early warning)	There is a moderate decline in NDVI at some sites along Back Creek, but not all There is a decline in vegetation diversity in shrub and tree layers at some sites along Back Creek.	Compare to field-based assessments such as BAM and RARC and site photos. Review localised groundwater level and water quality data and creek gauging data. Consider supplementary watering of vegetation if necessary. Continue monitoring in accordance with monitoring plan Review groundwater level and water quality data and creek gauging data. Consider supplemental watering if necessary. Continue monitoring in accordance with monitoring plan	Assess follow-up NDVI data for improvement. Review follow-up monitoring data for signs of improvement and increased health in vegetation, including recruitment of shrub and tree species.
Level 3 (Exceedance of trigger level)	There is a severe decline in NDVI at some or all sites along Back Creek There are indications of stress and a lack of recruitment in riparian vegetation communities. Death of several individual trees or shrubs.	Examine BAM data. Review water quality data from groundwater and surface water monitoring programs. Consider supplemental watering. Remediate riparian zone once cause of deaths have been determined and addressed. Review water quality data from groundwater and surface water monitoring programs. Consider supplemental watering. Remediate riparian zone once cause of deaths have been determined and addressed.	Continue monitoring. Follow up assessments on rehabilitation and remediation Continue monitoring. Follow up assessments on rehabilitation and remediation

6.5 CLEAN WATER DISCHARGE MONITORING

6.5.1 Clean Water Release Infrastructure Details

The release of clean water from the HWDs and the WCWD will be operated in accordance with the released criteria in the EPL, with the aim of maximising the volume of clean water diverted through these diversion systems.

The location of the flow meters, water level sensors and pump for each release location is provided in Table 18, Figure 17 and Figure 18. The flow meters will be located on the pump outlet for each dam to measure flows individually.

Table 18 Clean Water Discharge Flow Meter Water Level Sensor and Pump Locations

Release source	Easting (m) GDA95 Z55	Northing (m) GDA95 Z55
HWD8	226,366	6,613,684
HWD9	226,693	6,614,157
HWD10	226,769	6,614,410
HWD11*	226,739	6,615,467
WCWD	224,003	6,615,878

* Removed in early 2024

6.5.2 Clean Water Release Monitoring

Clean water discharged from the clean water management systems (HWDs and WCWD) will be monitoring during each release event, as follows:

- At least one sample during the release will be taken from each dam, for the water quality parameters sampled identified in Table 7.
- At least one sample during the release will be taken in Back Creek at locations upstream and downstream of the clean water discharge point, for the water quality parameters sampled identified in Table 14.

Automated samplers have been installed in the new monitoring stations at “SW11” and “SW12” (see Figure 19). The ability to obtain these samples within water quality testing holding times may be subject to access limitations during the event.

Following each event, the discharge and Back Creek receiving water quality results will be assessed against the trigger values identified in Table 7 and Table 13. This may trigger further investigations to assess any potential impacts from the clean water release during the event.

The results of the water quality monitoring data will be reported quarterly on the publicly available MCCM website.

6.6 STREAMFLOW MONITORING

MCCM currently operate two stream flow gauges in Back Creek, at locations both upstream and downstream of the sediment water and clean water release points (SW9 and SW10 – see Figure 22). An additional two stations are installed at Upstream Flow and Downstream Flow. Refer to Figure 19 for the map showing the locations of the stream flow gauges.

Water level loggers have been installed at each stream gauge location and a rating curve for each site has been derived using the HEC-RAS hydraulic model and surveyed channel cross-sections. The surveyed cross-section locations at SW9 and SW10 are shown in Figure 22. Details of the development of the rating curves are provided in a separate report (WRM 2020).

The rating curves developed for SW9 and SW10 are shown in Figure 20 and Figure 21, respectively. Rating curves will be developed for stations Upstream Flow and Downstream Flow as part of their installation. Annual surveys of the stream bed will be undertaken at each stream gauge and used to review the rating curves and gauge calibration. The survey data will provide a time series of how the stream bed changes over time in response to varying climatic conditions.

Details of the instrumentation and post-processing methodology used to record stream water levels is provided in Table 19.

Two new stream flow gauges have been recently installed on Back Creek (SW11 [downstream] and SW12 [upstream]). See Figure 16 for their locations.

They are currently in the process of being commissioned and rated. Once this is complete, this WMP will be updated to include the rating curves and details of the instrumentation.

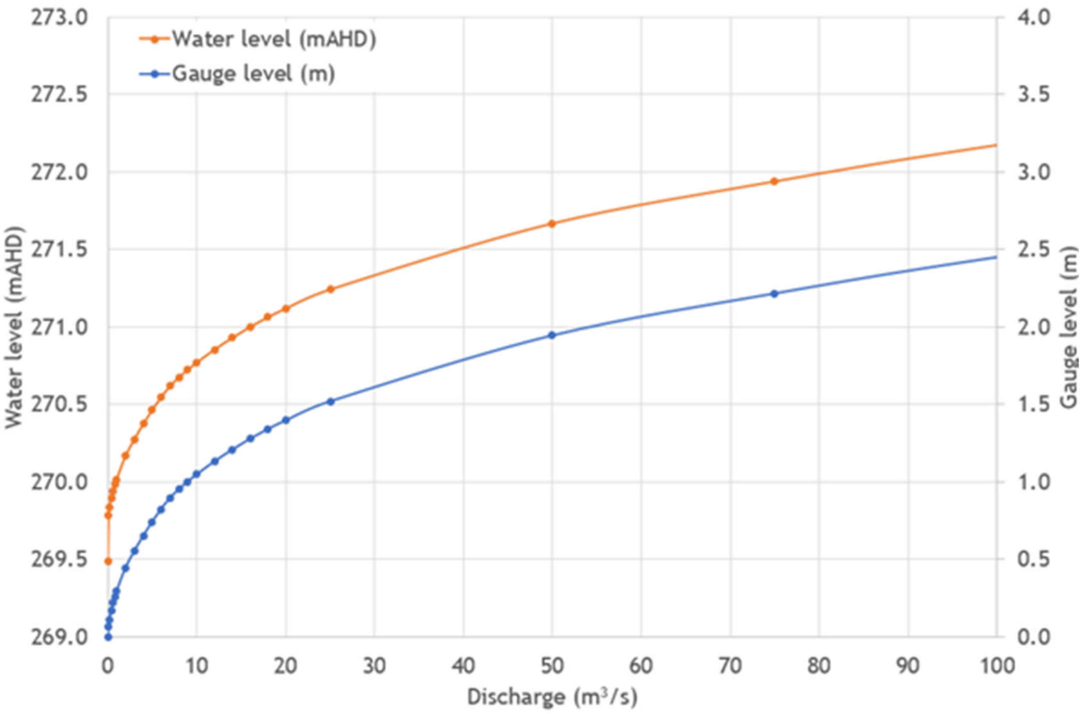


Figure 20 Rating Curve for SW9 Stream Gauge

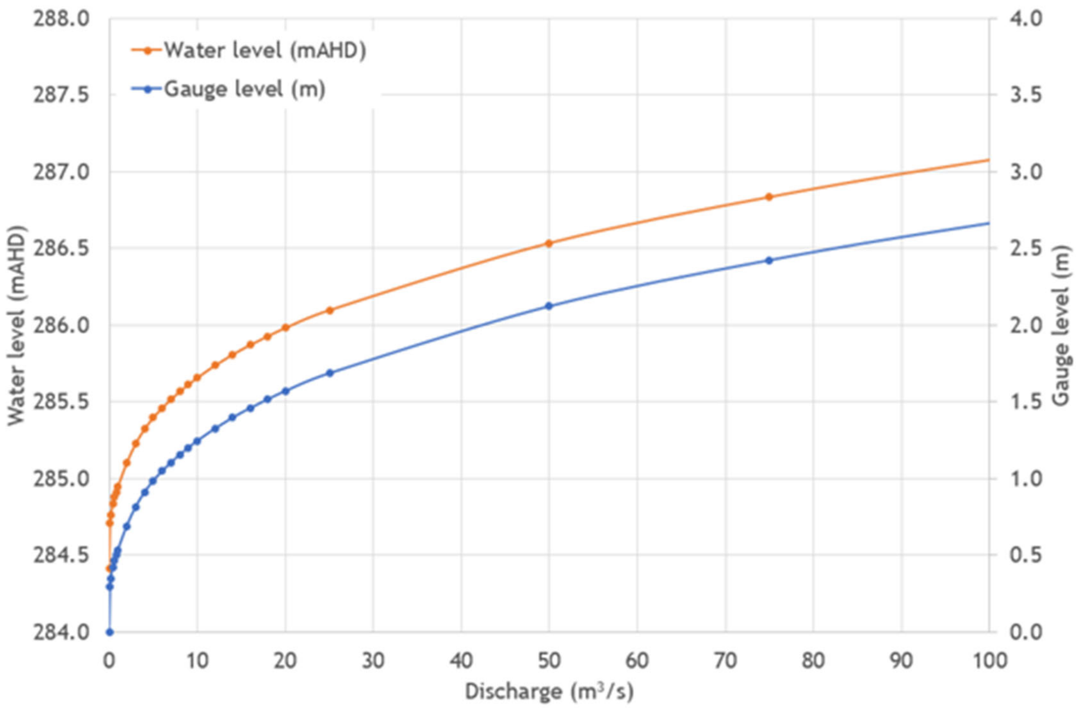


Figure 21 Rating Curve for SW10 Stream Gauge

Table 19 Details of stream water level recording instrumentation

Site	Datalogger/telemetry	Principal sensor array
Upstream Flow *226771.00 m E,* *6618197.00 m S*	Mace Flopro system	• Doppler ultrasonic area velocity sensor with ceramic diaphragm depth sensor • YSI Prosample P automatic water sampler
Downstream Flow *222961.00 m E,* *6618674.00 m S*	Mace Flopro system	• Doppler ultrasonic area velocity sensor with ceramic diaphragm depth sensor • YSI Prosample P automatic water sampler
MC WS09 MC WS09: *223280.00 m E,* *6618403.00 m S*	E-State Automation Cellvisor	• Solinst Aquavent: atmospheric pressure vented cable, Piezoresistive Silicon with Hastelloy pressure sensor
MC WS10 MC WS10: *226536.00 m E,* *6618400.00 m S*	E-State Automation Cellvisor	• Solinst Aquavent: atmospheric pressure vented cable, Piezoresistive Silicon with Hastelloy pressure Sensor

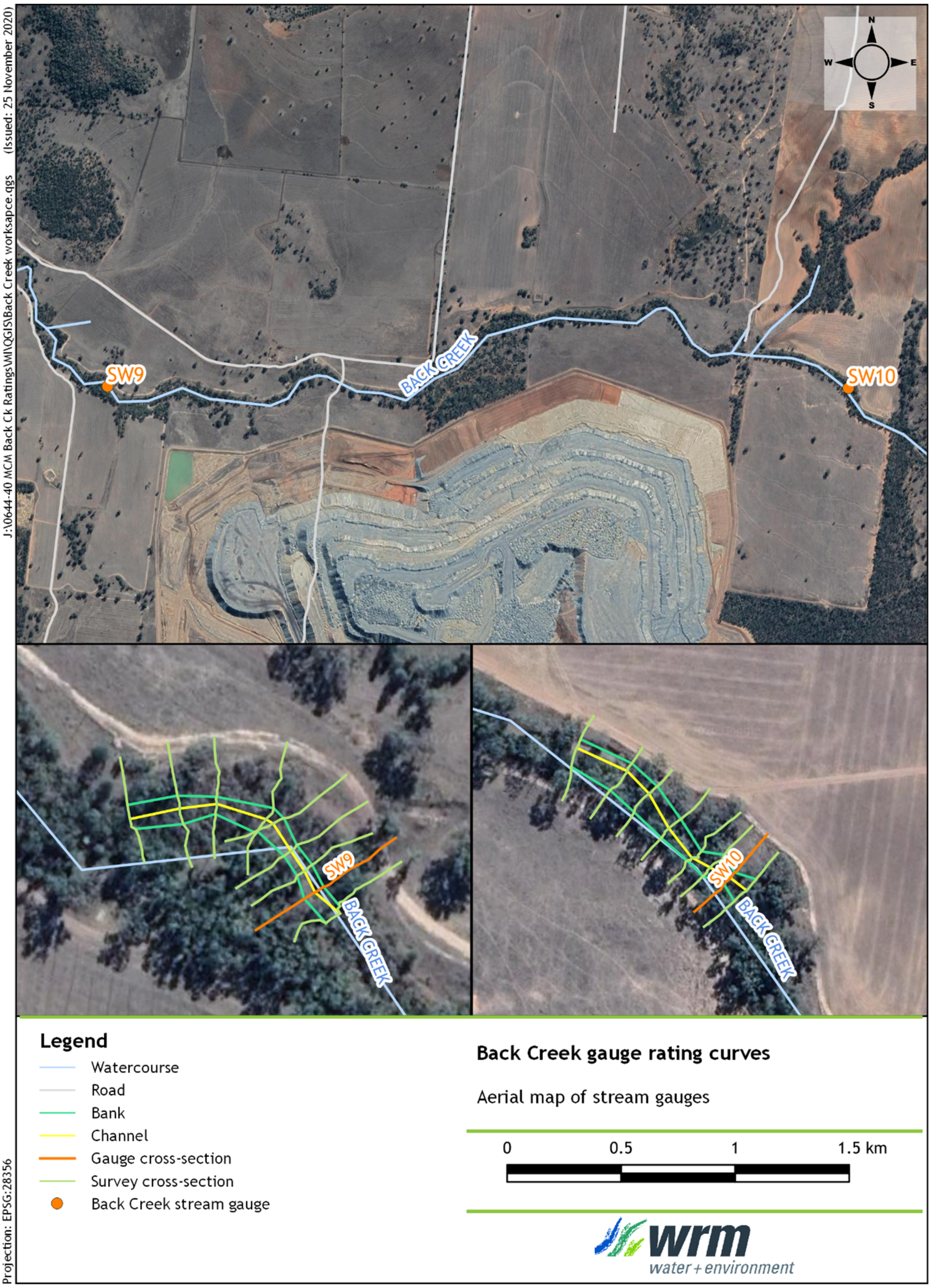


Figure 22 Stream Flow Gauge Locations

6.7 SHALLOW SOIL AND ROCK MOISTURE CONTENT MONITORING

Multi-level monitoring and reporting of shallow soil and rock moisture content will be undertaken at three locations within the main stream bank of Back Creek. The locations selected allow for monitoring of soil moisture upstream and downstream of the mine. Each location is located within a different geological unit traversed by the creek (sedimentary, volcanic and alluvial). Each location will record daily-average soil moisture at 0.5m, 1.5m, 3m and 6m depths.

The soil moisture records will be reviewed as part of surface water and groundwater model calibration where appropriate.

Table 20 documents the location and equipment type installed at each location. The location of the monitoring locations is shown in Figure 19.

Table 20 Soil Moisture Sensor Details

Site	Location	Sensor	Description
Soil 1	217244.00 m E, 6619868.00 m S	E-State Cellvisor	• Soil moisture sensors @ 0.5, 1.5 m, 3 m, 4.5 m, 6 m depth using Acclima TDR 310H integrated time domain reflectometer sensors • HyQuest TB4 tipping bucket raingauge 0.2mm tip
Soil 2	224583.00 m E, 6618381.00 m S	E-State Cellvisor	• Soil moisture sensors @ 0.5, 1.5 m, 3 m, 4.5 m, 6 m depth using Acclima TDR 310H integrated time domain reflectometer sensors • HyQuest TB4 tipping bucket raingauge 0.2mm tip
Soil 3	227327.00 m E, 6618174.00 m S	E-State Cellvisor	• Soil moisture sensors @ 0.5, 1.5 m, 3 m, 4.5 m, 6 m depth using Acclima TDR 310H integrated time domain reflectometer sensors, • HyQuest TB4 tipping bucket raingauge, 0.2mm tip

7 REPORTING AND REVIEW

Details of the processes for reporting the results of the monitoring program and review of the WMP are provided in Sections 4 and 5 of the WMP.

8 REFERENCES

Eco Logical Australia, 2021	Review of Maules Creek Coal Mine Stream Health Monitoring, 30 November 2021.
DECC, 2008	Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries, Department of Environment and Climate Change, June 2008.
Landcom, 2004	Managing Urban Stormwater, Soils and Construction
Turak, E., Waddell, N., and Johnston, G., 2004	New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual 2004. Department of Environment and Conservation, Sydney, NSW, Australia.
WRM, 2020	Back Creek Rating Curves – 2020

WHC_PLN_MCC_WATER MANAGEMENT PLAN_APPENDIX C_GROUNDWATER_MANAGEMENT_PLAN

CONTENTS

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the Groundwater Management Plan (GWMP) for Maules Creek Coal Mine (MCCM), also referred to as the Project. The GWMP outlines the groundwater data collection/analysis methods, performance measures, trigger thresholds and Trigger Action Response Plans (TARPs).

1.2 STRUCTURE OF THE GROUNDWATER MANAGEMENT PLAN

This GWMP forms part of the Water Management Plan (WMP) for MCCM. The MCCM WMP comprises the following documents:

- An overarching WMP;
- Site Water Balance (Appendix A);
- Surface Water Management Plan (Appendix B);
- GWMP (this document) (Appendix C);
- Boggabri-Tarrawonga-Maules Creek Complex (BTM Complex) Water Management Strategy (Appendix D).

The following sections of the GWMP describe:

- Section 2 - Statutory obligations under the project approval;
- Section 3 – Summary of groundwater regime;
- Section 4 – Groundwater monitoring network;
- Section 5 – Data collection methodology;
- Section 6 – Data analysis methods;
- Section 7 – Summary of baseline data;
- Section 8 – TARPs;
- Section 9 – Cumulative impacts and monitoring locations;
- Section 10 – Groundwater model validation;
- Section 11 – Reporting procedures;
- Section 12 – Final void water management; and
- Section 13 – References.

2 STATUTORY OBLIGATIONS

The Maules Creek Coal Project (Application no. 10_0138) was approved by the Minister for Planning and Infrastructure under Section 75J of the Environmental Planning & Assessment Act 1979 on 23 October 2012.

Condition 40 of Schedule 3 of the approval (Environmental Performance Conditions) requires the Proponent to prepare and implement a WMP for the Project, which includes a GWMP. The requirements for the GWMP, and where each requirement is addressed in this document, are provided in Table 2-1.

Table 2-1 GWMP requirements from Project Approval (PA) 10_0138

Requirement for Groundwater Management Plan	Section of GWMP Where Addressed
Detailed baseline data of groundwater levels, yield and quality in the region, and privately-owned groundwater bores including a detailed survey/schedule of groundwater dependent ecosystems (including stygo-fauna and Melaleuca riparian forest communities), that could be affected by the project;	Section 3, Section 5 and Section 7
The monitoring and testing requirements specified in the Planning Assessment Commission (PAC) recommendations for groundwater management as set out in Appendix 6;	Section 12
Detailed plans, including design objectives and performance criteria, for the design and management of:	
• the proposed final void; and	Section 12
• coal reject and potential acid forming material emplacement;	Section 12
Groundwater assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts;	Section 8.1, Section 8.2 and Section 8.3
A program to monitor and assess:	
• groundwater inflows to the open cut mining operations;	Section 5.4 and Section 6.3
• the seepage/leachate from water storages, emplacements, backfilled voids and the final void;	Section 4
• interconnectivity between the alluvial and bedrock aquifers;	Section 4
• background changes in groundwater yield/quality against mine-induced changes;	Section 4
• the impacts of the project on:	
– regional and local (including alluvial) aquifers;	Section 4
– groundwater supply of potentially affected landowners;	Section 4
– groundwater dependent ecosystems (including potential impacts on stygofauna and Melaleuca riparian forest communities) and riparian vegetation;	Section 4

Requirement for Groundwater Management Plan	Section of GWMP Where Addressed
A program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and	Section 10
A plan to respond to any exceedances of the performance criteria.	Section 8.3

3 SUMMARY OF GROUNDWATER REGIME

3.1 HYDROSTRATIGRAPHIC UNITS

The hydrogeological regime in the MCCM region consists of the following hydrostratigraphic units[1]:

- Quaternary alluvium associated with river and creek flood plains that form productive aquifer systems, typically in deeper and coarser grained sediments;
- Weathered bedrock (regolith) that is generally unsaturated in the mining areas, but acts as a temporary water store and pathway during sustained wet periods;
- Permian conglomerate/sandstone/siltstone/shale interburden that act as an aquitard;
- Permian coal seams of the Maules Creek Formation that form a low yielding aquifer; and
- Permian Boggabri Volcanics that typically acts as an aquiclude/aquitard.

3.2 QUATERNARY ALLUVIUM

Quaternary alluvial deposits are associated with floodplains that surround the Permian outcrop, which contains the MCCM footprint. These contains:

- Maules Creek, Middle Creek and Horsearm Creek alluvium to the north;
- Bollol Creek, Driggle Draggle Creek, and Barneys Spring Creek alluvium to the south; and
- Namoi River alluvium to the west.

The alluvial deposits have two stratigraphic units, the basal Gunnedah Formation and the overlying Narrabri Formation. The Narrabri Formation is up to 70 metres (m) thick and is comprised of clayey flood deposits with interbedded sand and gravel, which typically form low to moderate yielding aquifers. The underlying Gunnedah Formation is a productive aquifer used for irrigation, being up to 115 m thick and is dominated by more porous sand and gravel deposits that fill paleo-channels. Finer grained sediments in the Narrabri Formation can act as a concentration and storage zone for salts with water quality varying from fresh to saline. The coarser sediments in the underlying Gunnedah Formation generally contain high quality and low salinity groundwater. A deeply incised paleo-channel, up to 125 m deep which forms a high yielding aquifer is present to the west of the MCCM aligned with the course of the Namoi River. The alluvial material thins in the Maules Creek and Bollol Creek flood plains to the north and south of the MCCM. The alluvial aquifers exhibit variable groundwater yields of between 0.1 litres per second (L/s) and 33 L/s.

3.3 PERMIAN BEDROCK

The bedrock underlying the alluvial aquifers outcrops as distinctive, sometimes rugged hills surrounded by the generally flat to gently sloping plains of the Namoi Valley alluvium. The weathered zone is about

[1] A hydrostratigraphic unit is defined as a part of a body of rock that forms a distinct hydrologic unit with respect to the flow of groundwater.

25 m in thickness and is sometimes up to 60 m thick within the MCCM where the water table is deeper. The shallow bedrock is generally dry in the elevated areas of the Leard State Forest, however acts as a temporary groundwater store during continued wet periods and provides a pathway for recharge into the underlying fresh rock. The Permian strata can be categorised into the following hydrogeological units:

- hydrogeologically "tight" and hence very low yielding non-coal interburden units that comprise the majority of the Maules Creek Formation strata;
- low to moderately permeable coal seams, which are the prime water bearing strata within the Maules Creek Formation; and
- the underlying Boggabri Volcanics that act as a low permeability basement to the overlying sedimentary units.

The Permian sedimentary deposits are part of the Maules Creek sub-basin that occurs east of the Namoi River and has a regular layered easterly to north-easterly dipping sedimentary sequence which is underlain by the Boggabri Volcanics. The basal Boggabri Volcanics outcrop to the west of the MCCM and the other mines within the BTM complex. The BTM complex is located at the western edge of the Maules Creek sub-basin and therefore coal measures do not occur west of the mining areas where the Boggabri Volcanics bedrock outcrops.

3.4 RECHARGE, DISCHARGE AND RECEPTORS

Recharge to the hydrostratigraphic units occurs through diffuse rainfall recharge, as well as seepage through creek and river beds when flowing. Discharge from the groundwater systems occurs through multiple mechanisms including baseflow to river/creeks (mainly the Namoi River), through water supply bores and via evapotranspiration in areas where shallow water tables promote this process.

Groundwater dependent assets in the area are water supply bores used by surrounding agricultural enterprises and high priority groundwater dependent ecosystems, mainly located in riparian areas along creek lines where the water table is relatively shallow.

4 GROUNDWATER INFRASTUCTURE

4.1 EXISTING MONITORING NETWORK

The monitoring infrastructure at MCCM and surrounds include standpipe bores and vibrating wire piezometers (VWP) installed in a series of campaigns since 2010.
Monitoring infrastructure for each campaign are numbered with the following prefixes:

- *'MAC'* series;
- *'RB'* series;
- *'REG'* and '*BCM'* series; and
- *'GW'* bores.

The locations and status of the monitoring network infrastructure are shown in Figure 4-1, with the target geology for each site shown on Figure 4-2. Table 4-1 summarises the details and purpose for each monitoring site in the network.

The 'MAC' series was established around the MCCM footprint in 2010 to gather information on the groundwater regime for the environmental assessment of the mine. This baseline data was used to develop and calibrate a numerical model to predict mining impacts on the groundwater regime. The bores were installed within former exploration holes, with a total of eight groundwater monitoring bores and four VWPs constructed. All of the 'MAC' series monitoring bores and VWPs were damaged or destroyed by the progress of mining, or by protestors, with the exception of standpipe bore MAC1280 which remains active. The MAC1280 monitoring bore is now located immediately to the east of the out of pit waste rock dump.

The 'RB' series of bores was designed to replace the 'MAC' series. The locations of 'RB' and 'REG' bores were discussed with and approved by NSW Office of Water (Tamworth office) prior to installation between October 2013 and February 2014. The 'RB' series comprises three groundwater monitoring bores and five multi-level VWPs. Two of the locations (RB01 and RB02) were constructed in the Maules Creek mining footprint and were removed during mining activities in early 2017.

The 'REG' series comprises twelve regional groundwater monitoring bores and six multi-level VWPs designed to detect cumulative impacts in the alluvial aquifers surrounding the BTM Complex. Of these monitoring locations, BCM1, BCM3 and REG10A were installed along Back Creek to assess the potential for shallow groundwater and the presence of groundwater dependent ecosystems.

The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) maintain a network of monitoring bores within the Namoi alluvium that surrounds MCCM. The purpose of these bores is to monitor groundwater levels and quality within the Narrabri and Gunnedah Formations. These bores all have the prefix 'GW'. A subset of the 'GW' bores have been monitored routinely since the mid-1970s providing a long record of groundwater fluctuations. Some of the bores have electronic water level loggers and are equipped with telemetry with real time datasets available online[2]. 'REG' bores have been strategically located adjacent to selected 'GW' series monitoring bores to create a pair of nested monitoring points that allow the water level trends within the alluvium and underlying bedrock to be recorded and compared, and the potential influence of mining areas assessed.

It should be noted that the 'REG' series monitoring bores were originally intended to form part of the BTM complex regional monitoring network. As these bores were located well beyond the mining areas, the intention was they would allow any cumulative impacts that propagated via the Permian and into the overlying alluvium to be detected and assessed. Since inception MCCM has taken responsibility for monitoring the REG series of bores. While this was not the original intention, for consistency the steps to investigate exceedance events, i.e. the TARPs, have been retained within the MCCM GWMP and are provided in Section 8.3. In the case where exceedances are due to other mines the TARPs provide a process for evaluating cumulative impacts from the BTM complex.

4.2 ADDITIONAL MONITORING NETWORK

To expand the MCCM monitoring network, additional standpipe monitoring bores were installed at the locations identified in Table 4-1 and Figure 4-2. The bores were installed in 2023 and will be monitored for groundwater level and quality as indicated in Table 4-1. The purposes of the additional bores are to:

- improve the monitoring network coverage within the alluvial deposit along Maules Creek (REG15 / REG15A and REG16 / REG16A);
- improve the pore pressure monitoring network within the bedrock underlying the Maules Creek alluvium and to allow the interconnectivity between the alluvium and bedrock to be evaluated (REG15 / REG15A and REG16 / REG16A);
- create additional multi-level nested bores by installing bores adjacent to existing sites at different depths (REG4A);
- provide shallow water table monitoring sites adjacent to the out of pit emplacement to measure water quality trends (WRD1 and WRD2);
- determine the presence of water table along Back Creek which will provide input to Groundwater Dependent Ecosystem (GDE) monitoring (BCM04 and BCM05);
- assess groundwater and surface water interactions along Back Creek and Maules Creek (REG15A, REG16A, BCM04, and BCM05); and
- provide water level measurements from open standpipe monitoring bores to verify the pore pressures recorded by selected VWP's (RB05B and REG10B).

[2] Accessed: https://realtimedata.waternsw.com.au/

4.3 WATER SUPPLY BORES

In 2019 Whitehaven Coal purchased additional groundwater bores and WALs in proximity to mine operations to improve the security of water supply. Under these entitlements and when required, groundwater is extracted via a series of bores from its Roma, Brighton and Olivedene properties. Each extraction bore is equipped with both Whitehaven (WHC) and WaterNSW flowmeters for monitoring purposes.

In addition, routine monitoring of groundwater has been expanded to a series of 14 water supply bores operated by third parties around MCCM since 2014. Of the 14 bores, 11 are located within Whitehaven land and three are located on public land, with land ownership boundaries presented in Figure 4-1 for reference. The purpose of monitoring is to detect changes to groundwater levels and quality at water supply bores in the area. Monitoring activities, such as manual gauging and sample collection, might not be viable when the bore is capped or the pump switched off.

The details of MCCM and third party operated water supply bores are presented in

Table 4-2 and in a map alongside the monitoring network in Figure 4-1.

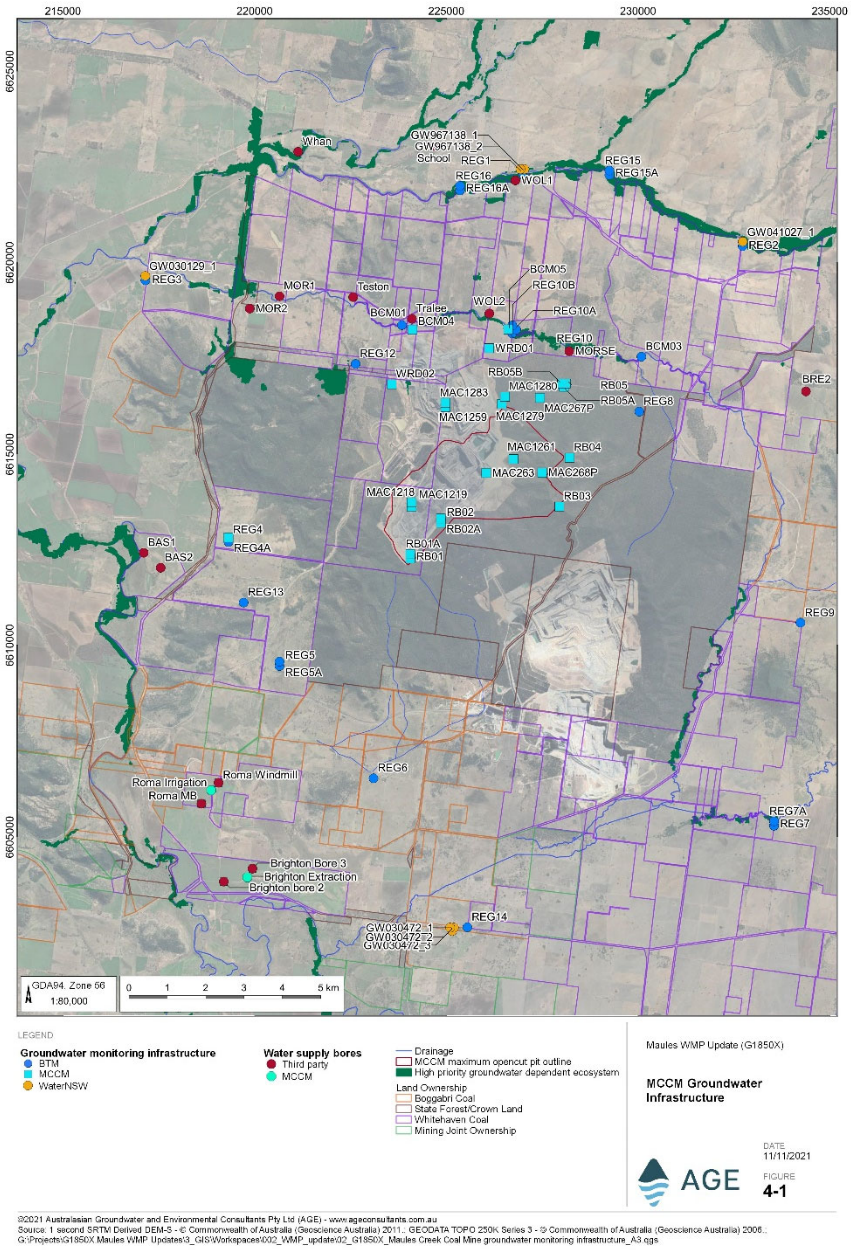


Figure 4-1 MCCM Groundwater Infrastructure

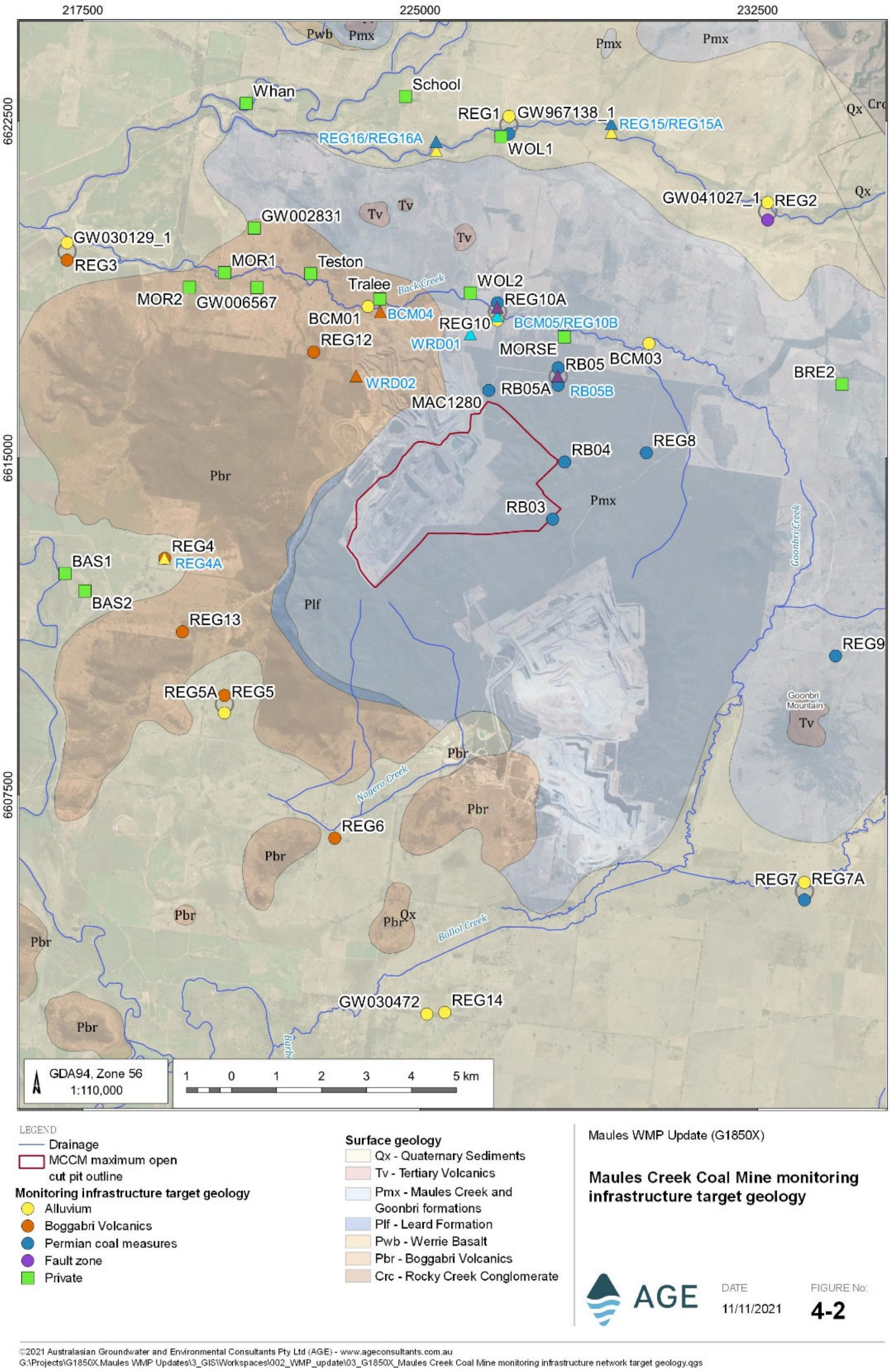


Figure 4-2 MCCM monitoring network target geology

Table 4-1 Summary of groundwater monitoring network

Bore ID	Managed by [a]	Geology [b]	Status [c]	Type [d]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl)[h]	Screen or VWP sensor depth (m bgl)	Purpose [f]	Water quality analysis [g]
MAC252	MCCM	Permian	D	SP	266,231	6,614,775	340.6	260	92.5-98.5	6	-
MAC1218	MCCM	Permian	D	SP	224,016	6,613,693	361.4	110	107-110	6	-
MAC1219	MCCM	Permian	D	SP	224,172	6,613,678	370.4	163	107-220	6	-
MAC1259	MCCM	Permian	D	SP	224,959	6,616,286	317	98	94-97	6	-
MAC1261	MCCM	Permian	D	SP	226,750	6,614,872	382.3	180	161-164	6	-
MAC1279	MCCM	Permian	D	SP	226,446	6,616,312	326.9	144	70-73	6	-
MAC1280	MCCM	Permian	A	SP (LL)	226,525	6,616,503	323.5	60	56-59	5, 6, 8, 9	Q
MAC1283	MCCM	Permian	D	SP	224,989	6,616,291	318.2	91	61-64	6	-
MAC263	MCCM	Permian	D	VWP	226,037	6,614,513	348.3	234	105 / 183	6	-
MAC267P	MCCM	Permian	D	VWP	227,440	6,616,472	405.6	299	164 / 257	6	-
MAC268P	MCCM	Permian	D	VWP	227,498	6,614,521	416.8	318	107-220	6	-
BCM01	BTM	Alluvium	A	SP (dry)	223,841	6,618,371	273.4	10	6.75 - 9.75	4	Q
BCM03	BTM	Alluvium	A	SP (dry)	230,085	6,617,546	305	10	6.75 - 9.75	4	Q
RB01A	MCCM	Permian	D	SP	224,058	6,612,341	432.4	205	213.5 - 219.5	2, 5, 6	-
RB01	MCCM	Permian	D	VWP	224,058	6,612,333	433.1	205	97 / 140.5 / 194.5	2, 6	-
RB02A	MCCM	Permian	D	SP	224,853	6,613,266	398.1	270	227 - 233	2, 5, 6	-
RB02	MCCM	Permian	D	VWP	224,860	6,613,267	381.7	220.5	110 / 162 / 225	2, 6	-

Bore ID	Managed by [a]	Geology [b]	Status [c]	Type [d]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl)[h]	Screen or VWP sensor depth (m bgl)	Purpose [f]	Water quality analysis [g]
RB03	MCCM	Permian	A	VWP	227,947	6,613,635	407.9	324.4	164 / 242 / 289 / 317	2, 6, 10	-
RB04	MCCM	Permian	A	VWP	228,213	6,614,910	437.5	354	209 / 272.5 / 309 / 339	2, 6, 10	-
RB05A	MCCM	Permian	A	SP (LL)	228,065	6,616,810	328.4	245.3	239 - 245	2, 5, 6, 10	Q
RB05	MCCM	Permian	A	VWP	228,071	6,616,813	328	382	107 / 231 / 280 / 382	2, 6, 10	-
REG1	BTM	Permian	A	VWP	226,946	6,622,396	286.2	255.2	118.7 / 134.5 / 193.5 / 281.5	1, 2, 4, 10	-
GW967138_1	WaterNSW	Alluvium	A	SP	227,001	6,622,422	313.6	82.5	7-Oct	1, 7	Q
GW967138_2	WaterNSW	Alluvium	A	SP	227,001	6,622,422	313.6	82.5	71 - 77	1, 7	Q
REG2	BTM	Permian	A	VWP	232,722	6,620,459	317	255.2	60 / 120 / 200 / 260	1, 2, 4, 10	-
GW041027_1	WaterNSW	Alluvium	A	SP	232,730	6,620,523	318.5	18	8.25 - 14.25	1, 7	Q
REG3	BTM	Volcanics	A	SP (LL)	217,164	6,619,558	241.6	57	50.50 - 56.50	1, 2, 5, 8, 10	-
GW030129_1	WaterNSW	Alluvium	A	SP	217,135	6,619,637	248	24.4	23.2 - 24.4	1, 7	Q
REG4	BTM	Volcanics	A	SP (LL)	219,323	6,612,763	260	72.5	65.5 - 71.5	1, 5, 10	Q
REG5A	BTM	Alluvium	A	SP (dry)	220,646	6,609,514	252	22	18 - 21	1, 2, 5, 10	Q
REG5	BTM	Volcanics	A	SP (LL)	220,649	6,609,521	252.2	78.7	72.2 - 78.2	1, 2, 5, 10	Q
REG6	BTM	Volcanics	A	SP (LL)	223,100	6,606,534	250.7	96	88.0 - 94.0	1, 5, 10	Q
REG7A	BTM	Alluvium	A	SP (LL)	233,545	6,605,359	291.7	36	24 - 30	1, 2, 4, 5, 10	Q
REG7	BTM	Permian	A	VWP	233,543	6,605,348	291.6	255.2	67.5 / 148.2 / 242.5	1, 2, 4, 10	-

Bore ID	Managed by [a]	Geology [b]	Status [c]	Type [d]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl)[h]	Screen or VWP sensor depth (m bgl)	Purpose [f]	Water quality analysis [g]
REG8	BTM	Permian	A	VWP	230,030	6,616,113	341.6	TBC	91.5 / 221 / 274	1, 6, 10	-
REG9	BTM	Permian	A	VWP	234,233	6,610,591	346.8	279.2	116.8 / 175.2 / 268	1, 6, 10	-
REG10A	BTM	Alluvium	A	SP (dry)	226,717	6,618,260	287.1	10	6.75 - 9.75	1, 2, 4, 5, 6, 10	Q
REG10	BTM	Permian	A	VWP	226,723	6,618,261	287.1	189.4	55 / 144.2 / 178 / 185.5	1, 2, 4, 6, 10	-
REG12	BTM	Volcanics	A	SP (LL)	222,632	6,617,358	285.6	48.3	38.4 - 44.4	1, 4, 5, 10	Q
REG13	BTM	Volcanics	A	SP (LL)	219,713	6,611,129	277.1	133	128 - 132	1, 5, 10	Q
REG14	BTM	Alluvium	A	SP (LL)	225,547	6,602,649	250.2	102	90 - 96	1, 5, 10	Q
GW030472_1	WaterNSW	Alluvium	A	SP	225,148	6,602,611	248	101.5	23.8 - 25	1, 7	Q
GW030472_2	WaterNSW	Alluvium	A	SP	225,148	6,602,611	248	101.5	57.3 - 59.7	1, 7	Q
GW030472_3	WaterNSW	Alluvium	A	SP	225,148	6,602,611	248	101.5	94.5 - 101.5	1, 7	Q
Roma Windmill	MCCM	Alluvium	A	SP (LL)	219,058	6,606,417	TBC	~12	TBC	3, 5, 7, 10	Q
Roma MB	MCCM	Alluvium	A	SP (LL)	218,612	6,605,871	TBC	89	TBC	3, 5, 7, 10	Q
Brighton Bore 3	MCCM	Alluvium	A	SP (LL)	219,942	6,604,179	TBC	16.4	12.8 – 15.8	3, 5, 7, 10	Q
Brighton Bore 2	MCCM	Alluvium	A	SP	219,194	6,603,840	TBC	TBC	TBC	3, 5, 7, 10	Q
RB05B	MCCM	Braymont seam	A	SP (PLL)	228,057	6,616,825	328	110	106.17	2, 5, 8, 10	Q
REG10B	BTM	Braymont seam	A	SP (PLL)	226,719	6,618,263	289.1	55	42.20	2, 5, 8, 10	Q
WRD01	MCCM	Weathered overburden	A	SP (PLL)	226,113	6,617,766	299.5	20	19.90	5, 9, 10	Q

Bore ID	Managed by [a]	Geology [b]	Status [c]	Type [d]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl)[h]	Screen or VWP sensor depth (m bgl)	Purpose [f]	Water quality analysis [g]
BCM04	MCCM	Volcanics	A	SP (PLL)	224,114	6,618,253	276.6	20	17.99	3, 4, 5, 7, 10, 11	Q
WRD02	MCCM	Volcanics	A	SP (PLL)	223,575	6,616,826	304.5	50	49.19	5, 7, 9, 10	Q
BCM05	MCCM	Alluvium or weathered overburden (first water strike)	A	SP (PLL)	226,705	6,618,254	288.9	20	TBC	3, 4, 5, 7, 10 11	Q
REG15	BTM	Alluvium	A	SP (PLL)	229,249	6,622,349	298.3	<40	28.82	5, 7, 10, 11	Q
REG15A	BTM	Permian coal measures	A	SP (PLL)	229,249	6,622,349	298.3	100	58.96	5, 10	Q
REG16	BTM	Alluvium	A	SP (PLL)	225,355	6,621,947	280.2	<30	28.37	5, 7, 10, 11	Q
REG16A	BTM	Permian coal measures	A	SP (PLL)	225,355	6,621,947	280.2	60	57.44	5, 10	Q
REG4A	MCCM	Alluvium	A	SP (PLL)	219,313	6,612,772	260.2	40	37.94	5, 7, 10	Q

Table 4-2 Summary of groundwater supply bores

Bore ID	Managed by [a]	Geology [b]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl) [h]	Screen depth (m bgl)	Water quality analysis [g]
BAS1	Third party on WHC land	TBC	217,107	6,612,427	239*	TBC	TBC	Bi
BAS2	Third party on WHC land	TBC	217,548	6,612,037	238*	TBC	TBC	Bi

Bore ID	Managed by [a]	Geology [b]	Easting (m)	Northing (m)	Ground elevation [e] (m AHD)	Depth (m bgl) [h]	Screen depth (m bgl)	Water quality analysis [g]
BRE2	Third party	Hard rock	234,377	6,616,639	354*	96.3	TBC	Bi
GW006567	Third party on WHC land	TBC	221,374	6,618,792	TBC	59.1	28.7 - 29.3 / 57.9 - 58.5	Bi
MOR1	Third party	TBC	220,649	6,619,125	260*	TBC	TBC	Bi
MOR2	Third party	TBC	219,871	6,618,803	256*	TBC	TBC	Bi
MORSE	Third party on WHC land	Sandstone	228,203	6,617,691	302*	63.1	TBC	Bi
School	Third party	Gravel	224,673	6,623,048	282*	8.4	TBC	Bi
TESTON	Third party on WHC land	Hard rock	222,568	6,619,102	270*	45.4	TBC	Bi
TRALEE	Third party on WHC land	Basalt	224,102	6,618,538	278*	33.8	TBC	Bi
WHAN	Third party	TBC	221,134	6,622,897	264*	10.0	TBC	Bi
WOL1	Third party on WHC land	TBC	226,799	6,622,149	290*	7.2	TBC	Bi
WOL2	Third party on WHC land	TBC	226,119	6,618,673	285*	TBC	TBC	Bi
GW002831	Third party on WHC land	TBC	221,313	6,620,116	TBC	TBC	TBC	Bi
Roma Irrigation	MCCM	Alluvium	218,867	6,606,221	TBC	TBC	TBC	Bi
Brighton Extraction	MCCM	Alluvium	219,808	6,603,952	TBC	TBC	TBC	Bi

Notes

Complete records are unavailable for some groundwater bores.

a. Owner: MCCM = Maules Creek Coal Mine network; BTM = BTM complex network; and WaterNSW = WaterNSW network;
b. Geology: Permian = Permian coal measures and Volcanics = Boggabri Volcanics;
c. Status: D = decommissioned, A = active and P = proposed
d. SP: standpipe; SP (LL): standpipe with existing pressure transducer; and SP (PLL): standpipe with proposed pressure transducer;
e. Ground elevation: Elevation of water supply bores interpolated from groundwater model digital elevation model. TBC = to be confirmed.
f. Purpose: Each monitoring site within the network has an identified purpose, or multiple purposes depending on the site location and geological unit it is monitoring. The purposes of the monitoring locations include to:
    1. record regional groundwater levels/pressures and trends;
    2. determine water levels within overlying hydrostratigraphic units and connectivity between units;
    3. detect any significant changes to groundwater levels and quality at water supply works;
    4. detect any significant changes to groundwater levels and quality in vicinity of high-priority groundwater dependent ecosystems;
    5. monitor trends in groundwater quality in main hydrostratigraphic units;
    6. detect localised depressurisation due to mine activities;
    7. monitor groundwater in alluvium;
    8. provide a verification of pressure recorded by VWP sensors grouted into drillholes;
    9. determine changes in groundwater level and quality around the out of pit emplacement;
    10. verify groundwater model predictions; and
    11. assess interaction between groundwater and surface water.
g. Water quality analysis: Frequency of analysis of Q = quarterly, Bi = biannually.
h. m bgl - metres below ground level

5 DATA COLLECTION METHODOLOGY

Groundwater data will be collected through a monitoring program for the life of the mine. Groundwater data collection is undertaken at regular intervals by suitably qualified and experienced personnel. Water level measurements and water sample collection, as well as storage and transportation will be conducted in accordance with the Standard Operating Procedures (SOPs) included in Attachment B. The SOPs are drawn from relevant aspects of the following industry standards:

- The Australian/New Zealand Standard Water quality – Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (AS/NZS 5667.1:1998); and
- The Australian/New Zealand Standard Water quality – Sampling, Part 11: Guidance on sampling of groundwaters (AS/NZS 5667.11:1998).

Groundwater data collected from each monitoring round will be collated into a database. The database will include, as a minimum requirement, the following:

- records of manual standing level water measurements and electronic pressure logger or VWP download;
- records of field water quality parameters and sampling methodologies to achieve representative samples;
- records of flow rates of water supply bores equipped with flowmeters;
- tabulated water quality laboratory results and comparison to trigger values;
- a chain of custody supplied to the laboratory of the water samples collected;
- records of original laboratory analysis certificates; and
- records of any issues encountered.

5.1 GROUNDWATER LEVELS

Natural fluctuations in groundwater levels occur in response to a range of stresses. These stresses can range from short term events, such as rainfall recharge events, or long term events, such as multi-year drought. To capture the range of stresses, groundwater levels/pressures will be measured manually and automatically with pressure transducers/loggers, including via VWPs.

Standing groundwater levels will be measured in all standpipe bores with a decontaminated electronic water level dipper and recorded to the top of the bore casing. Electronic pressure transducers/loggers have been progressively installed since 2014 and are recording water pressures at daily intervals. To allow for barometric correction of water pressure recorded by the standpipe transducer/logger, a barometric logger will be installed in one of the standpipe bores. Pore water pressures is recorded at boreholes installed with multi-level VWPs. Manual level gauging and pressure logger/VWP sensor downloads will occur as part of each monthly monitoring round. To assess interaction between groundwater and surface water, pressure transducer logging at daily intervals will be undertaken at existing and proposed shallow bores along Back and Maules Creek.

Registered water supply bores (managed by third parties) identified as being within the simulated zone of depressurisation will be inspected to determine if the bores are still operational and in-use within the

2021/2022 water year. Standing groundwater level measurements will be conducted on a biannual frequency on these water supply bores.

5.2 GROUNDWATER QUALITY

To ensure water samples collected are representative and repeatable for the screened hydrostratigrahic unit, bore purging will be conducted prior to collection of water sample. Field measurement/observations of parameters, including pH, electrical conductivity, temperature, redox potential, colour, odour and sediment load will be recorded. Collected samples will be analysed by a National Association of Testing Authorities (NATA) accredited laboratory for:

- physico-chemical parameters - pH, electrical conductivity and total dissolved solids (TDS);
- major cations - calcium, magnesium, sodium and potassium;
- major anions - chloride and sulfate;
- alkalinity - total, carbonate, bicarbonate and hydroxide;
- nutrients – nitrite, nitrate, ammonia and phosphorous;
- metals (dissolved) - aluminium, arsenic, barium, boron, cadmium, chromium, copper, cobalt, iron, lead, manganese, molybdenum, nickel, selenium, strontium, zinc; and
- ionic checks – total anions, total cations and ionic balance.

Groundwater samples will be collected from the standpipe bores each quarter. The SOP in Attachment B describes the process for collecting groundwater samples.

Samples for water quality analysis are collected from the water supply bores on a biannual basis. The process of collection of groundwater samples from watery supply bores will follow that of monitoring bores.

5.3 GROUNDWATER DEPENDENT ECOSYSTEMS

The Water Sharing Plan (WSP) for the Namoi Alluvial Groundwater Sources 2020 and the WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020 identify the boundaries of high priority groundwater-dependent ecosystems in the MCCM region. The WSPs defines high priority groundwater dependent ecosystems as:

- *any instream ecosystem associated with rivers that have a base flow component to their flow regime;*
- *vegetation that has a high probability of being groundwater-dependent, and is of very high or high ecological value; and*
- *Ramsar wetlands, or wetlands listed in the Directory of Important Wetlands in Australia.*

The location of the high priority groundwater dependent ecosystems identified within the WSP area are shown on Figure 4-1, along with the groundwater monitoring infrastructure. The figure shows that the high priority groundwater dependent ecosystems are predominantly located in riparian zones along Maules Creek, Back Creek and the Namoi River. Table 4-1 identifies the purpose of each monitoring bore within the MCCM network and those which will be utilised to assess groundwater level/quality changes in areas where the high priority groundwater dependent ecosystems occur. The historical monitoring of potential impact to GDEs at bores listed in Table 4-1 in the vicinity of potential GDEs shown in Figure 4-1 has indicated no impact to groundwater levels or quality that would trigger further investigation or monitoring for GDEs.

During 2022/2023, MCCM shall engage a suitably qualified and experienced Aquatic and Groundwater Ecologist to conduct additional detailed surveys of Maules Creek and Back Creek to confirm if GDEs (Melaleucia riparian forest communities and stygo-fauna) are present in the areas shown in Figure 4-1. The pre-dawn leaf water potential will be measured at four sites selected along Back Creek to determine if the vegetation is groundwater dependent.

Samples will be collected from 15 selected bores in spring and autumn using a specifically designed net that will be lowered to the bottom and slowly retrieved six times to trap any stygofauna within the bore. The samples will be preserved and analysed under microscope for the presence of stygofauna. Monitoring bore sites situated within the riparian zones along Back Creek, Maules Creek, and the Namoi River around the Maules Creek confluence will be targeted for sample collection.

5.4 GROUNDWATER QUANTITY

The MCCM operates in relatively low permeability geological strata where there is no need for advance depressurisation or dewatering prior to mining for operational and safety reasons. During mining at MCCM, groundwater is allowed to seep into the mining area through the pit walls and floor, with the low permeability of the rock mass meaning the volume of groundwater entering the mining areas is not problematic.

The groundwater seepage rates are commonly difficult to measure as continuous pumping out of the pits is not required. This is because the area of the pit walls and floors is relatively large and promotes evaporation of seepage before groundwater reaches the pit floor or sumps and therefore can’t be measured or monitored. Seepage that does flow to the pit floor also commonly becomes bound to material excavated from the pit without needing to be removed via pumping. Any remaining groundwater flows into sumps and is pumped out of mining areas along with any rainfall and runoff that has been collected. It is not possible to accurately monitor groundwater inflows into the pit, which is why MCCM relies on a groundwater model. A groundwater model is a more conservative method of quantifying inflows to the mine workings as its able to determine inflows prior to any evaporation or being bound to excavated material.

Proponents of aquifer interference activities are required to provide predictions of the volume of water to be taken from a water source as a result of the activity. These predictions need to occur prior to approval and during operations. Water take is categorised based on the manner in which it occurs as follows:

- **Incidental take:** This is water take that is incidental to the mining activity. It includes water that is encountered within and extracted from mine pit workings. Groundwater seepage into the MCCM pits is classified as incidental take.
- **Passive take:** Passive take is water losses from an adjacent groundwater system that occurs indirectly due to an adjacent activity. Passive take is predicted to occur from the Namoi alluvials due to the MCCM activities, even through the alluvial aquifer are not directly intercepted by the mining activity.

- **Consumptive use**: This category is for water that is pumped from licensed extraction bores and consumed by the mining activity. Water extracted from the Roma, Brighton and Olivedene water supply bores

The estimated volumes of water take from each category need to be measured and reported in an annual review. MCCM must hold a sufficient share component and water allocation to account for the take of water from the relevant water source when the take occurs.

Groundwater in the MCCM region is managed under two Water Sharing Plans, namely the:

- WSP for the Namoi Alluvial Groundwater Sources 2020; and
- WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020.

The WSP for the Namoi Alluvial Groundwater Sources includes all water contained in unconsolidated alluvial sediment aquifers, which are associated with the Namoi River and its tributaries at Maules Creek and Bollol Creek. The Namoi alluvial aquifers are divided into a number of management zones, with Upper Zone 11, Zone 5 and Zone 4 surrounding the MCCM.

Beyond and underlying the alluvial areas, groundwater is managed under the Gunnedah-Oxley Basin sub-division of the WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources. This plan includes all rocks that are Permian, Triassic, Jurassic, Cretaceous and Tertiary in age, as well as any alluvial sediments within outcropped areas.

Table 5-1 provides a summary of Water Access Licences (WALs) and entitlements held by MCCM to account for water taken during mining, with the methodology used to estimate the water take discussed in Section 6.3.

Table 5-1 Summary of entitlements held by MCCM to account for water take

Water Sharing Plan	WAL Number	Management Zone	Total Entitlement (ML/year)	Purpose
Porous Rock	29467	Gunnedah-Oxley Basin	306	Incidental take
Porous Rock	36576	Gunnedah-Oxley Basin	600	Incidental take
Porous Rock	36641	Gunnedah-Oxley Basin	800	Incidental take
Alluvial	27385	Upper Zone 4	38	Passive take
Alluvial	12613	Upper Zone 4	50	Passive take
Alluvial	36548 (in application)	Upper Zone 4	36	Passive take
Alluvial	12811	Upper Zone 5	135	Passive take
Alluvial	12479	Upper Zone 11	78	Passive take

Water Sharing Plan	WAL Number	Management Zone	Total Entitlement (ML/year)	Purpose
Alluvial	12791	Upper Zone 5	115	Consumptive use - Olivedene
Alluvial	12722	Upper Zone 4	77	Consumptive use - Roma
Alluvial	12718	Upper Zone 4	102	Consumptive use - Brighton

Notes

Total entitlement presented for each WAL captures the volumes for the 2021/2022 water year and is subjected to change from licence acquisition, trading and/or transfers.

6 DATA ANALYSIS METHODS

The methods for analysis of groundwater level, quality and quantity information are described in the sections below.

6.1 GROUNDWATER LEVEL

The methods for analysis of groundwater level data are summarised in a flowchart in Figure 6-1. The flowchart outlines the pre-processing steps, including quality assurance/quality control (QA/QC), that will be undertaken for groundwater level data analysis.

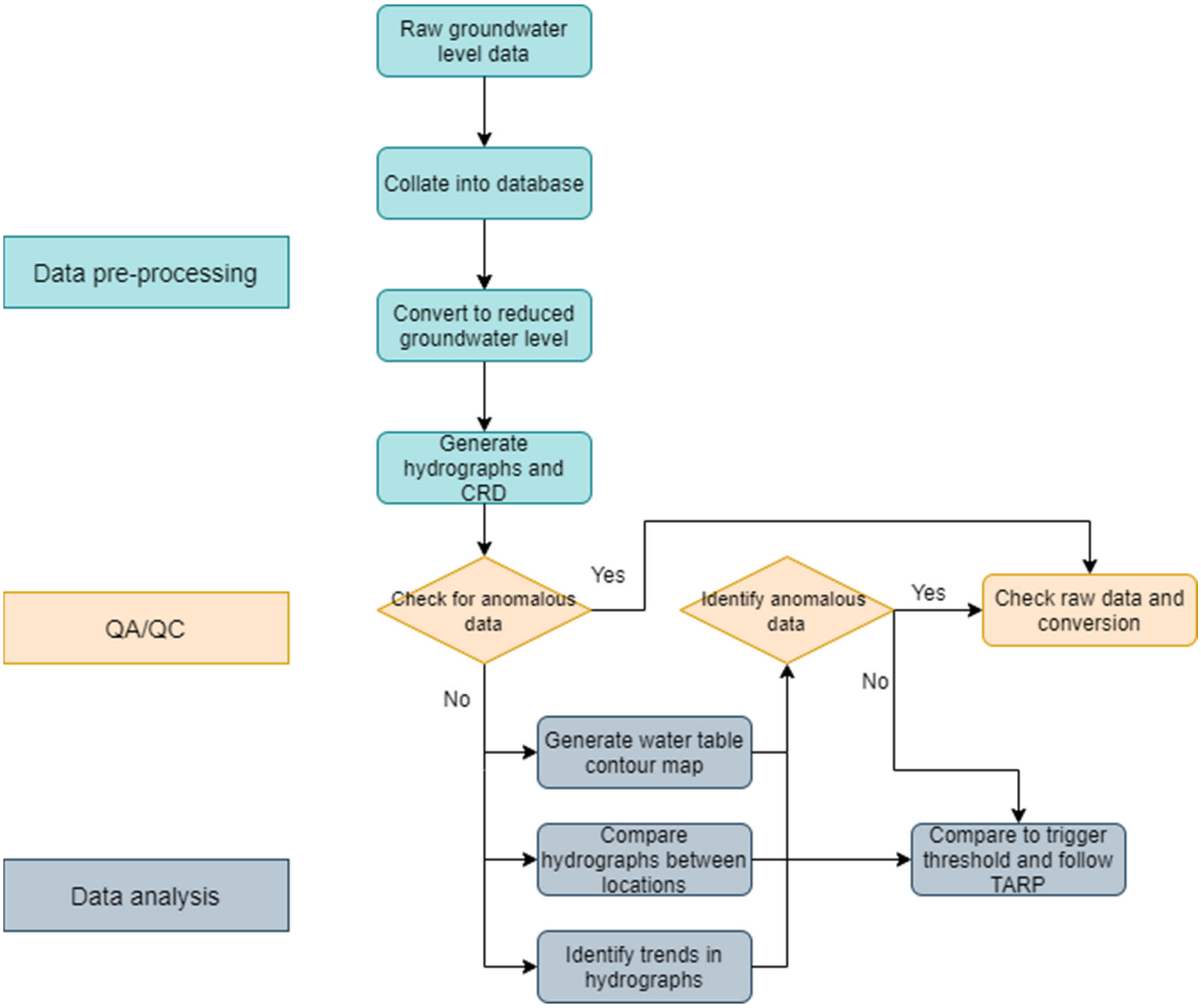


Figure 6-1 Groundwater level data pre-processing and analysis flowchart

As indicated in the flowchart, manual standing water levels and electronic pressure logger/VWP data will be converted to a reduced water level with respect to Australian heigh datum (m AHD). Pressure logger data will be adjusted to remove the effects of barometric pressure changes where required.

The reduced water level data will be visualised as time series charts (hydrographs). An example hydrograph is provided in Figure 6-2. Hydrographs will be utilised as a tool to identify occurrence of anomalous data points, which can form part of the QA/QC process. Once anomalous data points are rectified or removed, the hydrographs will be used to understand the behaviour of water in the groundwater regime including:

- recharge/discharge events as indicated by the relationship to the Cumulative Rainfall Departure from mean (CRD);
- the influence of abstraction from irrigation, stock and domestic bores;
- vertical hydraulic gradients at nested locations monitoring water levels in alluvial and Permian strata; and
- any depressurisation effects from MCCM and the BTM complex.

Hydrographs will be compared between monitoring locations to reveal more significant water level changes that could be a result of MCCM activities. Where water level measurements are outside the trigger threshold the TARP process (as outlined in Section 8.3) will be initiated.

Horizontal flow directions within key hydrostratigraphic units with sufficient spatial data will be illustrated by piezometric contour maps. These contour maps will be generated from monitoring data by connecting areas of equal groundwater elevation to create a two-dimensional representation of the piezometric surface. Comparison of contour maps with previous time periods will provide information towards changes in groundwater flow directions over time.

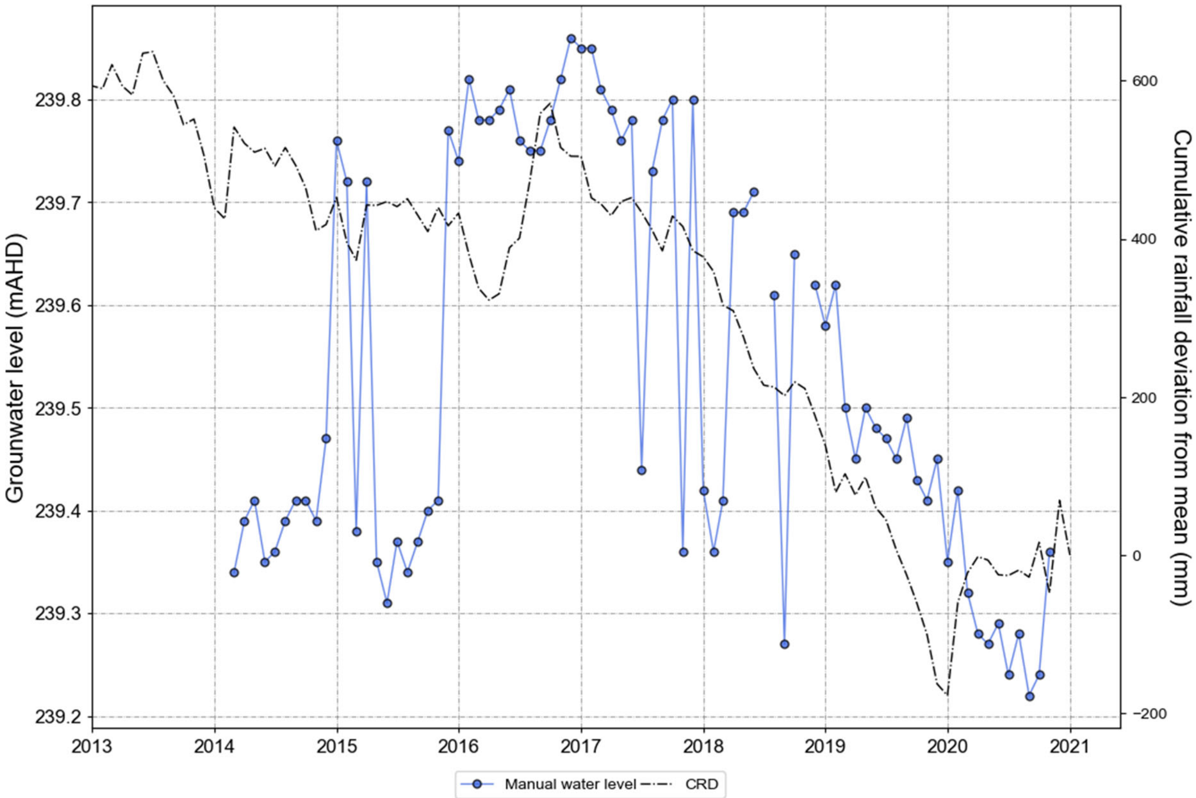


Figure 6-2 Example hydrograph (REG4) for analysis

6.2 GROUNDWATER QUALITY

A total of 29 monitoring bores, 16 water supply bores (14 managed by third parties and two managed by MCCM) will have water samples collected for water quality analysis on a quarterly and biannual basis, respectively. The methodology for analysis of groundwater quality data is summarised in the flowchart in Figure 6-3. Similar to the water level flowchart in Figure 6-1, this flowchart outlines the pre-processing, including QA/QC, as well as the steps that will be undertaken for groundwater quality data analysis.

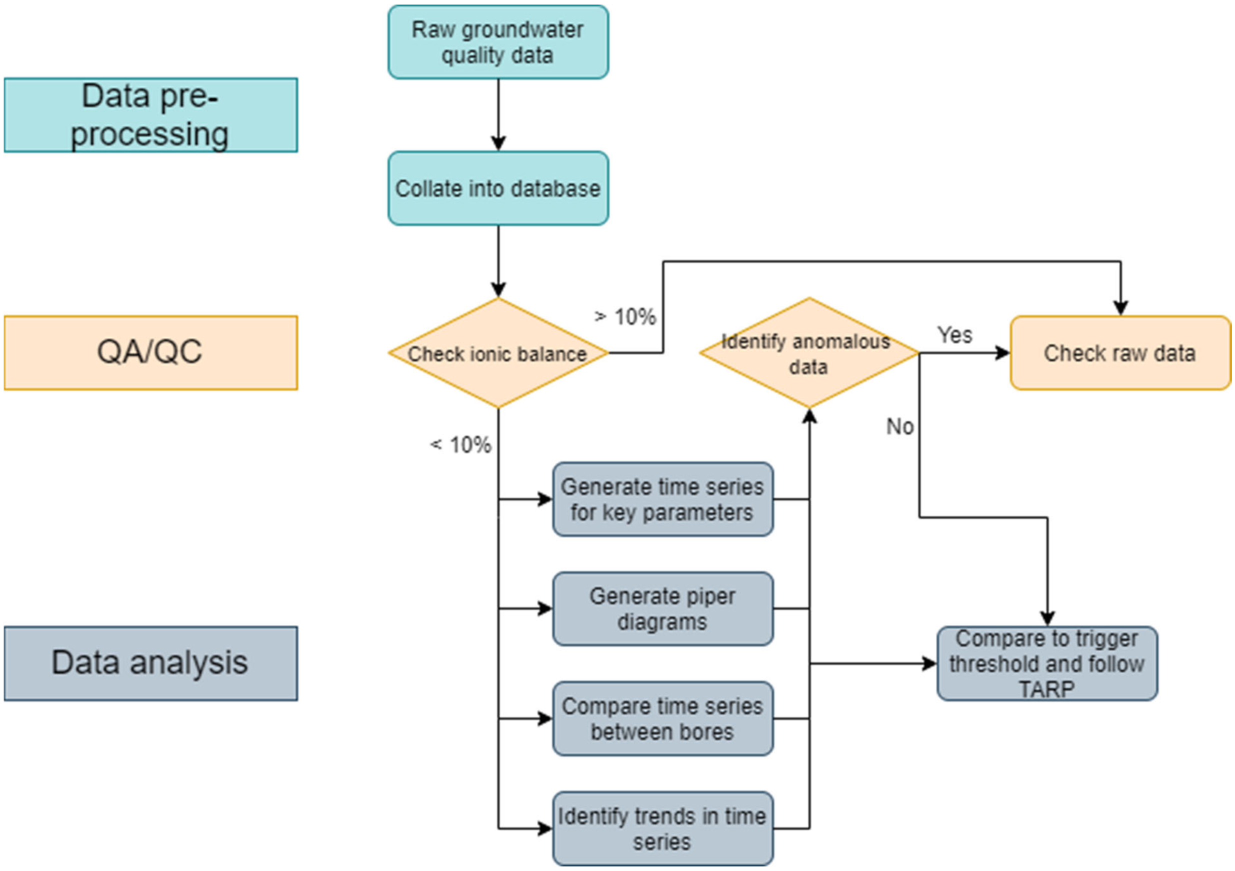


Figure 6-3 Groundwater quality data pre-processing and analysis procedures

Groundwater quality data will be pre-processed for analysis in a similar approach as the method adopted for groundwater levels. Field and laboratory results will be collated and tabulated in a single database that will identify:

- key parameters including pH, TDS and sulfate concentrations that are either greater than the 95th percentile of baseline data or less than the 5th percentile of baseline data;
- ionic balance results which exceed the ± 10% margin. (charge of cations should balance that of anions in natural groundwaters); and
- dissolved metal concentrations that exceed ANZECC guidelines for stock and/or irrigation water. Dissolved metals are used for guideline comparison because of their higher bio-availability when compared to total metals.

Groundwater samples with ionic balance beyond the ± 10% range will be identified and the cause determined. If necessary, an additional sample will be collected for laboratory analysis within seven days of original sample. Samples that are determined not to be representative will be flagged and removed in subsequent data analysis. Records of sampling method, sample transportation and laboratory consistency of reporting limits are also factors that could influence the occurrence of nonrepresentative values.

Time series plots will be generated for water quality indicators that have trigger values based on the 5th and 95th percentile of baseline data for pH, TDS and sulfate and compared with short- and long-term water level trends. Figure 6-4 shows an example of the stacked charts that will be generated for each monitoring bore, and the trigger thresholds based on baseline data.

In addition to location specific trigger thresholds for pH, TDS and sulfate, all field and laboratory analytes will be tabulated and compared against ANZECC guideline values for stock and/or irrigation water. Exceedances against the ANZECC stock and/or irrigation guidelines will form water quality trigger thresholds for dissolved metal concentrations as discussed in Section 8.2.3; and will provide information towards existing and evolving conditions of the monitored hydrostratigraphy for other parameters listed in Section 5.2.

Piper diagrams will be generated as a visualisation tool to understand the relative major ion abundance and water chemistry at each monitoring location. Piper diagrams are useful in identifying differing, or mixing, chemistry signatures between hydrostratigraphic units, and how signatures change over with time. An example Piper diagram for water samples collected from third party water supply bores is provided in Figure 6-5.

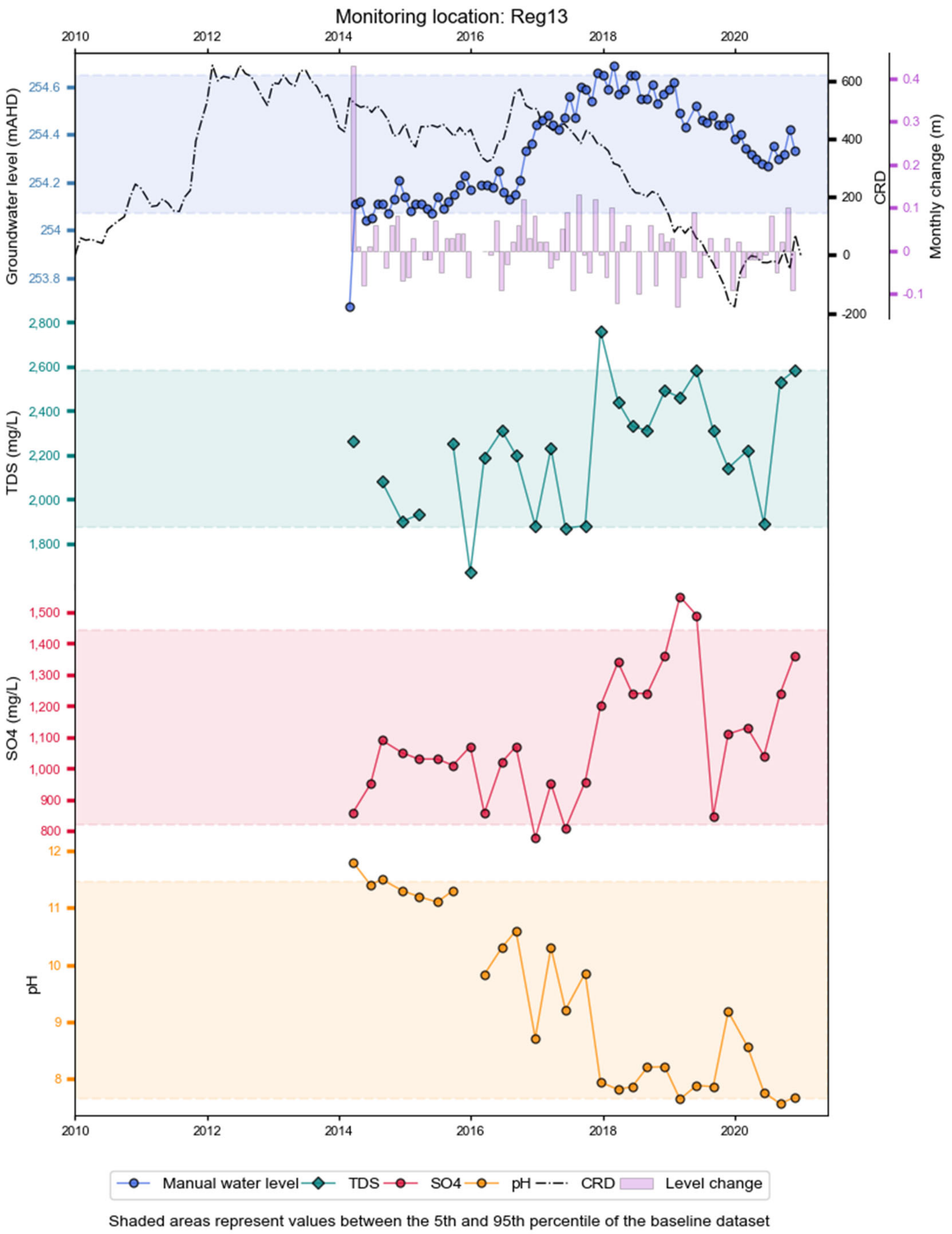
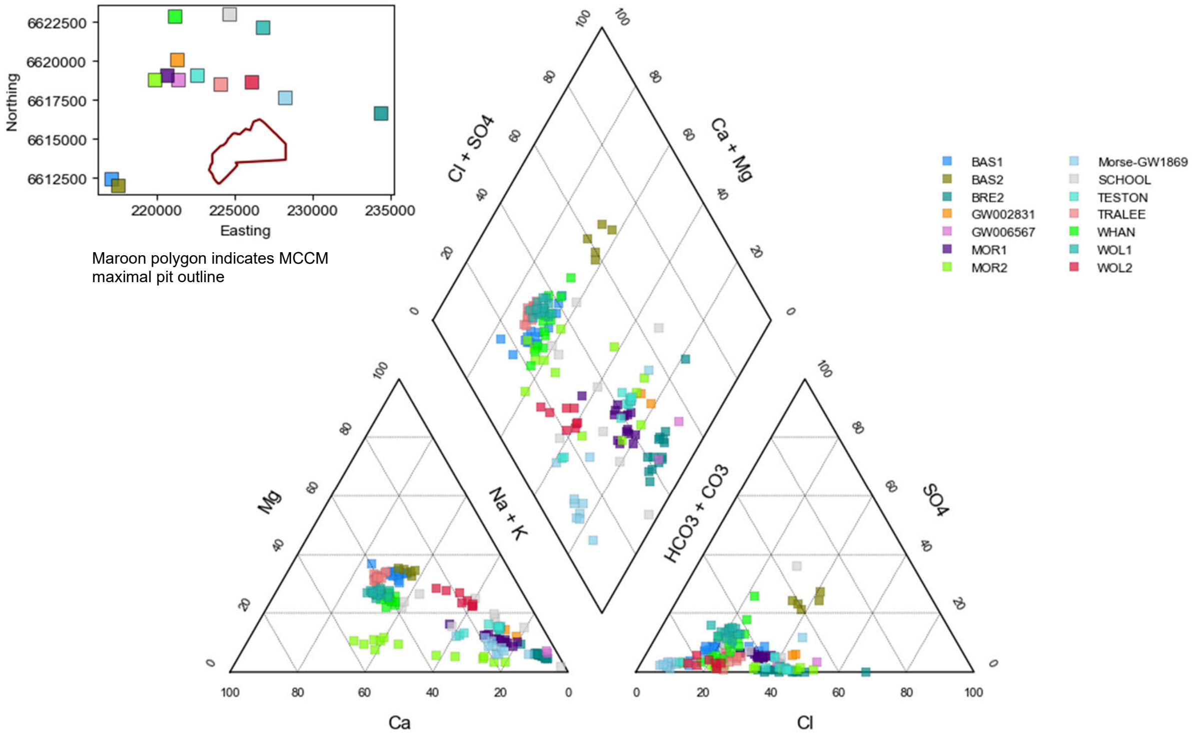


Figure 6-4 Example stacked water quality and water level charts



Colour of symbology corresponds in Piper Diagram and locational map inlet (top left).

Figure 6-5 Example Piper Diagram for third party water supply bores

6.3 GROUNDWATER DEPENENDENT ECOSYSTEMS

The outcomes of 2023/2024 field campaign will be used to identify the occurrence and distribution of stygofauna within the groundwater regime. Groundwater invertebrate (stygofauna) detected will provide an indication of the ecological condition of aquifer ecosystems. Monitoring bores located in areas of high diversity will be selected for use in future monitoring. These bores will be assigned trigger values likely based on water level and electrical conductivity, and will be subject to future stygofauna sampling as part of bi-annual stream health monitoring. TARPS for stygofauna communities and groundwater dependent vegetation will be set during the development of the monitoring program and provided in an updated version of the GWMP.

The location of groundwater dependent vegetation communities will be assessed using the pre-dawn leaf water potential measured at the four selected sites along Back Creek.

Based on the outcome of this survey, MCCM will undertake the following:

- Document the types of GDEs located and the potential for impact from the operation;
- Update mapping in Figure 4-1 to identify where GDEs are present and identify the different GDE communities
- Update the monitoring locations and techniques in Table 4-1 based on the presence of GDEs

- Develop a TARP for assessing impacts to GDEs at the locations where they have been identified and specific for the type of GDE.

The outcome of this survey work and the updated monitoring program shall be included in future updates of the WMP.

6.4 GROUNDWATER QUANTITY

The volume of incidental groundwater take to the mining areas will be estimated each calendar year using the site water balance model. The site water balance method compares rainfall and runoff inputs to the pits with pumping outputs and storage changes to provide an estimate of pumpable incidental groundwater take from the mining areas. The site water balance model is updated at the end of each calendar year with the results provided in the annual review (refer to separate Site Water Balance Management Plan).

The PA requires "a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions". Every three years the numerical groundwater flow model will be reviewed, validated and if necessary updated. The process will be undertaken with the input of a third party reviewer. The numerical model simulates the subsurface flow of groundwater and provides estimates of incidental water take from the MCCM pits and passive take from the surrounding alluvial aquifers. These water takes will be reviewed as part of the annual review and be used as the basis for determining entitlements required to account for groundwater taken by the mine each calendar year. This will only occur after the model has been approved for use by the DPHI.

Any consumptive water take from the Roma/Brighton water supply bores will be monitored with flowmeters at the bore outlet and reported in the annual review.

The total volume of incidental, passive and consumptive groundwater take will be tabulated each year and compared quantitatively with the licenced entitlements in the annual review.

Different incidental take estimated by the site water balance method and groundwater modelling is not uncommon due to different underlying methodologies and assumptions. Where the water balance model and the numerical model provide differing estimates of groundwater inflow commentary on the potential cause will be provided within the annual review. A conservative approach will be undertaken utilising the highest estimates of groundwater inflow to the mining area to ensure adequate water licenses are held to account for the groundwater intercepted.

7 SUMMARY OF BASELINE DATA

MCCM have been collecting groundwater data through the existing and progressively expanding monitoring infrastructure since October 2010. The results of the monitoring have been provided each year in annual reviews. Groundwater levels have fluctuated over this period due to a range of factors including climatic conditions (i.e., drought), agricultural extraction and local mine dewatering of open pits.

Figure 7-1 provides a graphical summary of the quarterly groundwater level changes compared with quarterly rainfall and the CRD. Each row of squares in Figure 7-1 represents one monitoring location. The bottom chart in Figure 7-1 displays quarterly rainfall and CRD. By comparing the bottom chart with the upper chart, the influence of climate on the entire groundwater system can be observed. Events such as the declining groundwater levels experienced during the 2017 to 2019 drought, and the subsequent recovery in the volcanics and alluvium in early 2020 are evident. Less pronounced recoveries in groundwater levels are observed closer to the mining operations in the Permian coal measures due to the influence of mining induced depressurisation on the strata, as predicted by groundwater modelling.

In general, depressurisation due to mining has been limited to the vicinity of MCCM within the Permian coal measures. Monitoring locations targeting these units near the open pits have recorded declines in groundwater levels once mining has progressed into the geological layer which is being monitored. Monitoring locations designed to target the alluvium (to the north and south) and Bogabri Volcanics (to the west and south-west) have not recorded changes in groundwater levels and quality that can be attributed to the dewatering of MCCM pits. The changes in groundwater levels recorded at the more distant monitoring locations are characteristic of climate factors, such as the multi-year drought between 2017 and 2019, and to a certain extent agricultural abstraction in the alluvial systems.

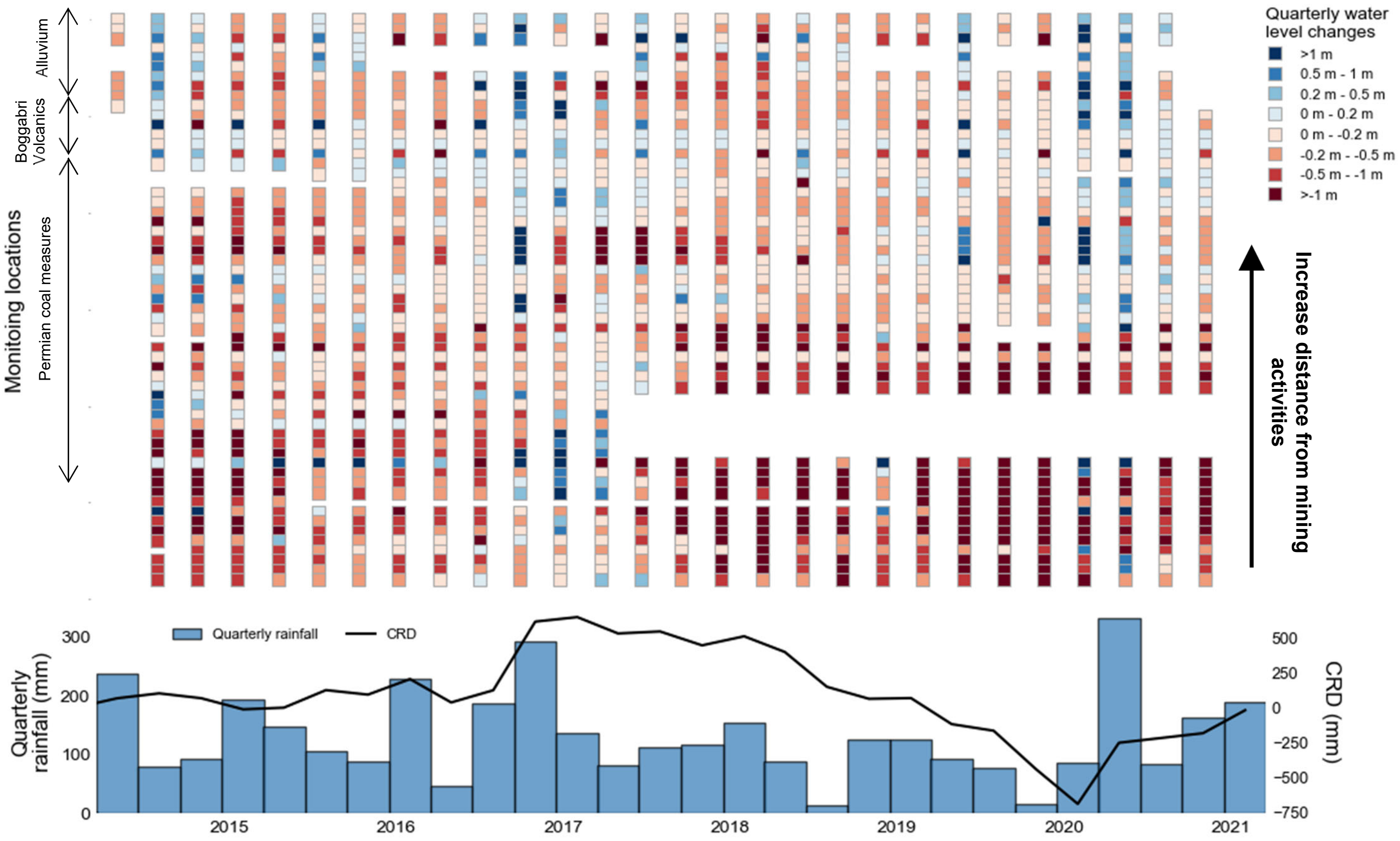


Figure 7-1 Summary of quarterly groundwater level changes at each location over time

The relationship between groundwater levels, physio-chemical parameters (pH and TDS) and sulfate concentrations at each location are further illustrated graphically in timeseries charts within Attachment C. Stable trends for groundwater quality parameters, including physio-chemical parameters, major ions and metal concentrations are generally recorded at monitored standpipe bores. Exceptions to this include:

- a number of monitoring bores that have yielded highly alkaline samples due to cement grout use during installation of the bore (MAC1280, REG4, REG13); and
- slow rises in salinity as measured by TDS (REG12, RB05A) and sulfate (REG5).

Attachment E includes a summary of water quality datasets.

8 TRIGGER ACTION RESPONSE PLANS

8.1 PERFORMANCE MEASURES

Schedule 3 Condition 40(c) of the PA 10_0138 stipulates that the groundwater monitoring program must establish performance measures to evaluate potential changes to existing groundwater sources. Mining activities that intercept the water table or interfere with groundwater systems are considered aquifer interference activities under the New South Wales Aquifer Interference Policy (AIP). The minimal impact considerations described in the AIP have been adopted as the groundwater performance measures for the MCCM. The minimal impact considerations in the AIP are dictated by the productivity (highly or less productive) and nature of the groundwater source (alluvial or porous/fractured rock).

The Quaternary alluvial system, which is classified as a highly productive groundwater source, has some differences in performance measures compared with the Permian bedrock units of the Gunnedah Oxley Basin, which are classified as a less productive porous rock system. The performance measure will vary for each type of monitored receptor, which includes water supply works, monitoring bores in close vicinity to high-priority groundwater dependent ecosystems and regional monitoring bores. The boundaries of high-priority groundwater dependent ecosystems are defined by the WSP for the Namoi Alluvial Groundwater Sources and WSP for the NSW Murray Darling Basin Porous Rock Groundwater.

The performance measures of each monitored groundwater system with respect to groundwater receptors and the applicable monitoring locations are presented in Table 8-1 and graphically on a map in Figure 8-1.

While monitoring locations REG12 and REG10 are located in close proximity to high-priority groundwater dependent ecosystems, the bore screen targets the deep Permian bedrock groundwater system, which is unlikely to support groundwater dependent ecosystems. No performance measures are applied to these bores.

Table 8-1 Groundwater performance measures

Potential mining issue or impact	Receptor	Water source type	Applicable to	Performance measures
Water level changes due to water take, drawdown and aquifer interconnectivity	Water supply bores	• Highly productive alluvial • Less productive porous rock	BRE2, MORSE, WOL1, WOL2, Tralee, Teston, MOR1, MOR2, Whan, BAS1, BAS2, School, GW006567, GW002831, Brighton Extraction and Roma Irrigation	No more than 2 m drawdown attributable to mining activities
	Standpipe monitoring bore within 40 m of high priority groundwater dependent system	• Highly productive alluvial • Less productive porous rock	BCM01, BCM03, BCM05, REG7A, REG10A, GW967138_1, GW967138_2 and GW041027_1	Not more than 10% cumulative variation in water table 40m from GDEs attributable to mining
	Regional standpipe monitoring bore	• Highly productive alluvial	REG3, REG5A, REG7A, REG14, GW967138_1, GW967138_2, GW041027_1, GW030472_1, GW030472_2, GW030472_3 GW030129_1, Roma Windmill, Roma MB and Brighton Bore 3	Cumulative pressure head decline of not more than 40% of pressure head above base of water source
Water quality changes due to mining activities, final void and emplacement waters	Water supply bore	• Highly productive alluvial • Less productive porous rock	BRE2, MORSE, WOL1, WOL2, Tralee, Teston, MOR1, MOR2, Whan, BAS1, BAS2, School, GW006567, GW002831, Brighton Extraction and Roma Irrigation	No change in existing beneficial use category due to mining
	Standpipe monitoring bore within 40 m of high priority groundwater dependent system	• Highly productive alluvial (semi-confined) • Less productive porous rock	BCM01, BCM03, BCM05, REG7A, REG10A, GW967138_1, GW967138_2, GW041027_1	No change in existing beneficial use category due to mining

Potential mining issue or impact	Receptor	Water source type	Applicable to	Performance measures
	Regional standpipe monitoring bore	• Highly productive alluvial • Less productive porous rock	REG3, REG5A, REG7A, REG14, GW967138_1, GW967138_2, GW041027_1, GW030472_1, GW030472_2, GW030472_3, GW030129_1, Roma Windmill, Roma MB and Brighton Bore 3	No change in existing beneficial use category due to mining

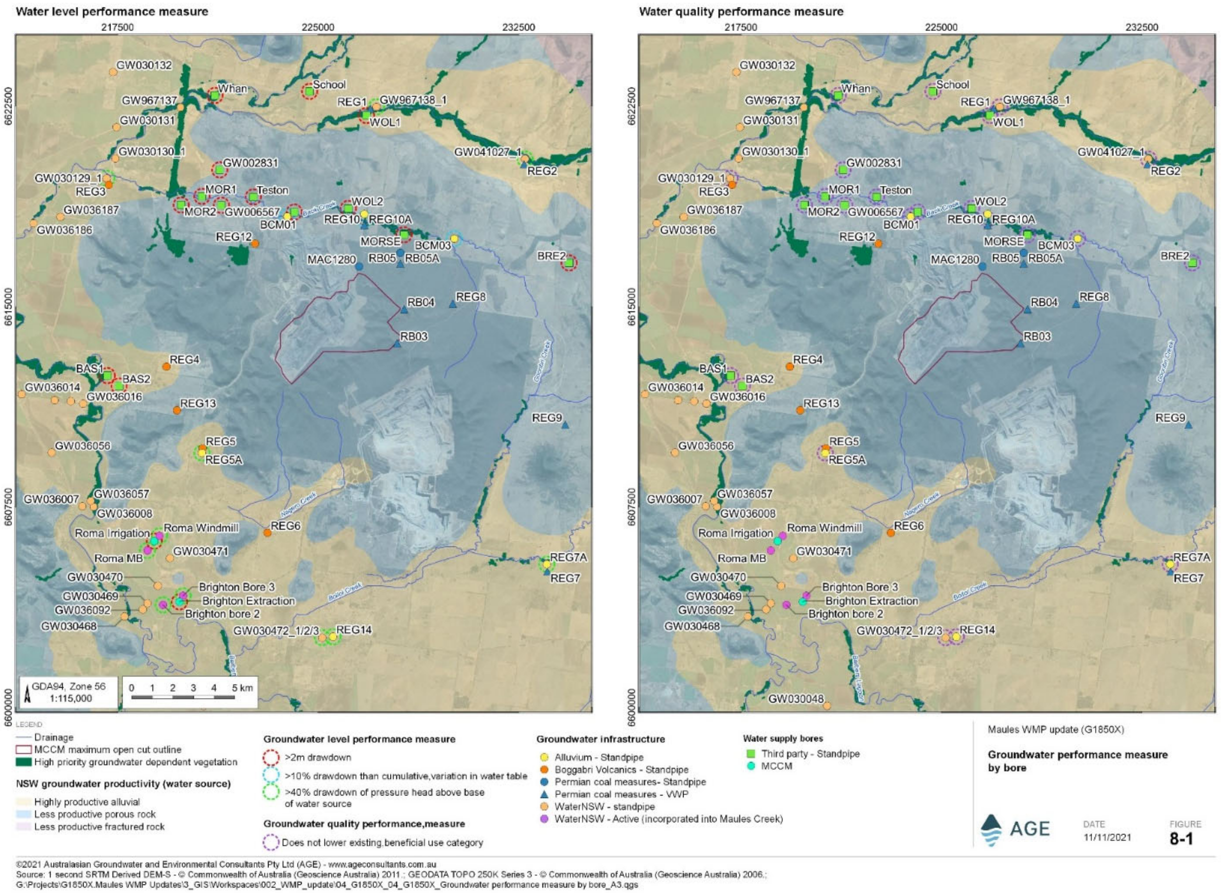


Figure 8-1 Groundwater performance measures by bore

8.2 TRIGGERS AND CONTROL CHARTS

Control charting is a graphical and statistical tool to track changes in recorded data over time. The inclusion of appropriate thresholds on control charts is used to inform trigger management actions. Control charts and threshold triggers developed for the monitoring network are shown on the charts included in Attachment C and Attachment D.

8.2.1 Standpipe Groundwater Levels

Groundwater data, including levels and quality, have been analysed with methods described in Section 6 to determine the baseline period for each monitoring standpipe location. The baseline dataset is used to calculate the 5th and 95th percentile of measured groundwater levels as outlined in Section 6.1 for each monitoring standpipe location which is set as the trigger threshold on the control charts. Groundwater levels are expected to exceed the 5th/95th percentile threshold on ten percent of measurements given future fluctuations are representative of baseline conditions.

Water levels in the majority of monitoring locations not affected by BTM complex mining are categorised to reflect baseline conditions up to 2020. Interim trigger thresholds have been calculated for locations do not have sufficient data (less than eight measurements) assuming the existing data is reflective of baseline conditions. The interim trigger thresholds will be updated once sufficient data is acquired for these locations. The water level trigger thresholds for each monitoring location are summarised in Table 8-2.

Table 8-2 Water level trigger thresholds for monitoring bores and water supply bores

Monitoring location	Measurement unit	Baseline period	Rationale behind baseline period selection ^	Trigger threshold calculated from baseline data	
				5%	95%
BAS1	Metres below reference point	Start – 2020	2, 5	8.9 *	9.3 *
BAS2		Start – 2020	5, 6	7.5 *	11 *
BRE2		Start – 2020	1, 2, 3	17.9	19
GW002831		NA	5, 6	TBC	TBC
GW006567		Start – 2020	5, 6	18.3 *	18.6 *
MOR1		Start – 2020	1, 2	12.1	13.4
MOR2		Start – 2020	1, 2, 3	13.1	13.3
Morse-GW1869		Start – 2020	1, 2, 3	21.6	21.9
SCHOOL		NA	2, 5	TBC	TBC
TESTON		Start – 2020	1, 2	19.7	20.0
TRALEE		Start – 2020	1, 2	19.7	20.3
WHAN		Start – 2020	1, 2, 3	3.5	5.6
WOL1		Start – 2020	1, 2, 3	3.1	6.4
WOL2		Start - 2018	2	9.9	12.0
Roma Windmill #		Start – 2020	1, 3	6.8	12.4
Roma MB #		Start – 2020	1, 3	7.9	16.5
Brighton Bore 3 #		Start – 2020	1, 3	7.8	11.5

Monitoring location	Measurement unit	Baseline period	Rationale behind baseline period selection ^	Trigger threshold calculated from baseline data	
				5%	95%
Brighton Bore 2		TBC	TBC	TBC	TBC
MAC1280	Metres Australia Height Datum	Start – 2020	1, 2	263.4	273.7
RB05a		Start – 2017	1, 2	269.4	272.5
REG12		Start – 2020	1, 3	259.6	259.9
REG13		Start – 2020	1, 3	254.1	254.7
REG14		Start – 2020	1, 3, 4	228.2	230.6
REG3		Start – 2020	1, 2, 3, 4	225.3	228.9
REG4		Start – 2020	1, 2, 3	239.3	239.8
REG5		Start – 2020	1, 3	234.1	234.6
REG6		Start – 2020	1, 2, 3, 4	227.8	230.5
REG7a		Start – 2020	1, 2, 3	282.5	285.5
GW967138_1		Start – 2020	1, 3	279.9	284.4
GW967138_2		Start – 2020	1, 3	278.1	281.4
GW041027_1		Start – 2020	1, 3	306.9	314.4
GW030129_1		Start – 2020	1, 3, 4	239.2	241.6
GW030472_1		Start – 2020	1, 3, 4	229.0	229.4
GW030472_2		Start – 2020	1, 3, 4	230.2	232.4
GW030472_3		Start – 2020	1, 3, 4	230.3	232.1
REG2_VW1 #		Start – 2020	7	307.8	313.2
REG7_VW1 #		Start – 2020	3, 7	295.1	296.5

Notes

* = Interim water level triggers as less than eight data points or two years of baseline monitoring; TBC = less than two years of monitoring; # = VWP sensors only included where no impact was predicted by numerical modelling; and Start = beginning of monitoring; ^ = Classification of rationale behind baseline period selection for each standpipe monitoring location and includes:

1. stable trends exhibited in groundwater levels;
2. stable trends exhibited in majority of groundwater quality parameters;
3. groundwater level fluctuations reflective of climate influences;
4. groundwater level fluctuations reflective of agricultural abstractions;
5. insufficient groundwater level data to represent features of hydrostratigraphy;
6. insufficient groundwater quality data to represent features of hydrostratigraphy; and
7. no predicted impacts from numerical modelling.

8.2.2 VWP Groundwater Levels

The majority of VWPs are designed to detect local depressurisation under the influence of mine dewatering. It is expected and predicted by numerical modelling the pore pressures will decline at these locations that are around the mine pit. A two-tier approach based on numerical modelling results has been adopted to develop triggers for the VWP sensors next to the mining area, which is a different approach compared to computing percentile thresholds from the baseline dataset. The first tier is the model predicted maximum drawdown, with the second tier being the lowest predicted groundwater elevation. Both tiers must be exceeded to be to an exceedance event.

Sensor REG2_VW1 and REG7_VW1 are not predicted to exhibit impacts to groundwater levels from mining activities. Triggers for these sensors are computed from percentile thresholds and presented in Table 8-2. The two-tier trigger threshold that applies for the rest of the VWP sensors are summarised in Table 8-3. Hydrographs showing the two tiers are included in Attachment C.

Table 8-3 Water level trigger thresholds for VWP monitoring locations

VWP sensor	Tier 1 threshold	Tier 2 threshold
RB03_VW1	231.2	242.2
RB03_VW2	168.8	169.5
RB03_VW3	125.9	129.7
RB03_VW4	142.2	142.4
RB04_VW1	280.7	244.5
RB04_VW2	127.6	173.3
RB04_VW3	140.4	141.2
RB04_VW4	135.7	138.7
RB05_VW1	256.8	262.5
RB05_VW2	209.9	211.3
RB05_VW3	188.0	190.8
RB05_VW4	195.8	216.6
REG1_VW1	260.6	259.4
REG1_VW2	259.5	258.3
REG1_VW3	255.9	258.2
REG1_VW4	244.8	258.4
REG2_VW1	310.1	295.1
REG2_VW2	No predicted impact – triggers based on 5th/95th threshold	
REG2_VW3	301.4	272.4
REG2_VW4	262.6	235.9
REG7_VW1	No predicted impact – triggers based on 5th/95th threshold	
REG7_VW2	249.6	228.8
REG7_VW3	242.3	224.9
REG8_VW1	270.0	260.4
REG8_VW2	163.9	186.0
REG8_VW3	183.5	177.9
REG9_VW1	308.0	278.2
REG9_VW2	252.3	205.5
REG9_VW3	239.8	204.0

VWP sensor	Tier 1 threshold	Tier 2 threshold
REG10_VW1	269.4	276.1
REG10_VW2	226.2	230.7
REG10_VW3	225.8	226.7
REG10_VW4	223.2	226.6

8.2.3 Groundwater Quality

As discussed in Section 8.2.1, groundwater level and quality data, including the wide range of parameters, have been analysed to identify location-specific baseline conditions/period by the methods described in Section 6.2. Review of the baseline data have identified representative parameters to adopt for groundwater quality thresholds. 5th and 95th percentile triggers for pH, TDS and sulfate concentrations have been calculated and are presented on the control charts included in Attachment C. The trigger thresholds for each monitoring site and water quality indicator are summarised in Table 8-4.

Table 8-4 Water quality trigger thresholds

Monitoring location	Trigger threshold calculated from baseline data					
	TDS (mg/L)		pH		SO4 (mg/L)	
	5%	95%	5%	95%	5%	95%
BAS1	259	391	6.9	7.6	10	29
BAS2 *	527	789	7.0	7.6	101	168
BRE2	1,314	2,976	7.8	8.3	1	18
GW002831 *	727	826	7.6	7.9	38	42
GW006567 *	1,065	1,155	8.4	8.5	37	38
MOR1	766	999	7.6	8.1	33	48
MOR2	47	134	7.3	8.0	1	1
Morse-GW1869	496	787	7.2	7.8	7	47
SCHOOL	19	313	6.6	7.7	2	21
TESTON	790	1,412	7.3	8.0	10	61
TRALEE	716	788	7.1	7.8	17	42
WHAN	193	318	7.1	7.7	7	49
WOL1	265	347	7.2	7.9	30	39
WOL2	284	404	8.0	8.3	5	15
MAC1280	1,440	2,460	11.5	12.6	1	36
RB05a	825	1,095	7.4	8.0	50	117
Reg12	1,085	1,431	7.5	8.4	44	71
Reg13	1,873	2,580	7.7	11.5	821	1445
Reg14	451	712	7.6	8.5	29	80
Reg3	598	791	7.9	8.5	74	107
Reg4	411	762	8.3	11.7	9	29

Monitoring location	Trigger threshold calculated from baseline data					
	TDS (mg/L)		pH		SO4 (mg/L)	
	5%	95%	5%	95%	5%	95%
Reg5	943	1,221	7.4	8.3	103	295
Reg6	955	1,415	7.8	10.5	109	180
Reg7a	380	548	7.2	8.0	25	60
GW967138_1	TBC	TBC	TBC	TBC	TBC	TBC
GW967138_2	TBC	TBC	TBC	TBC	TBC	TBC
GW041027_1	TBC	TBC	TBC	TBC	TBC	TBC
GW030129_1	TBC	TBC	TBC	TBC	TBC	TBC
GW030472_1	TBC	TBC	TBC	TBC	TBC	TBC
GW030472_2	TBC	TBC	TBC	TBC	TBC	TBC
GW030472_3	TBC	TBC	TBC	TBC	TBC	TBC
Roma Windmill	TBC	TBC	TBC	TBC	TBC	TBC
Roma MB	TBC	TBC	TBC	TBC	TBC	TBC
Brighton Bore 3	TBC	TBC	TBC	TBC	TBC	TBC
Brighton Bore 2	TBC	TBC	TBC	TBC	TBC	TBC

Notes

* = Interim water level triggers as insufficient data has been recorded; and TBC = to be confirmed.

The control charting method has not been adopted for metal concentrations as these are typically less variable. Dissolved metal concentrations will be compared to the most appropriate ANZECC guidelines depending on the environmental value of the monitored hydrostratigraphy, which generally draws water for stock, domestic and irrigation purposes.

8.2.4 Groundwater Quantity

The total volume of incidental, passive and consumptive groundwater take will be tabulated each year and reported in the annual review. The next three years will also be reported and compared to WALs held by MCCM to demonstrate there is sufficient water held to account for water taken incidentally, passively and consumptively. Should the estimated annual groundwater take be greater than the water access licenses held by MCCM then additional units will be acquired or transferred on the water market.

The flow and volume recorded on the flowmeters of each extraction bore will be reported in the Annual Review.

8.2.5 Groundwater Dependent Ecosystems

The outcome of the GDE survey work, updated monitoring program and TARPs shall be included in future updates of the WMP.

8.2.6 Summary of Triggers

The control chart triggers for groundwater levels, quality and water take are summarised in Table 8-5.

Table 8-5 Control chart triggers for groundwater levels, quality and pit inflows

Component	Applicable to	Control chart triggers
Groundwater level	All standpipe monitoring bores	5% / 95% of baseline data
	All VWPs	Two tier approach
	All monitored water supply bores	5% / 95% of baseline data
Groundwater quality (pH, TDS and SO4)	All Standpipe monitoring bores	5% / 95% of baseline data
	All monitored water supply bores	5% / 95% of baseline data
Groundwater quality (metals)	All standpipe monitoring bores	Three exceedances of appropriate ANZECC guidelines based on beneficial use
	All monitored water supply bores	Three exceedances of appropriate ANZECC guidelines based on beneficial use
Water take	Incidental, passive and consumptive groundwater take	> 100 % of Water Access Licences units for each applicable water source affected by MCCM

8.2.7 Compensatory Water Supply

Based on the predicted drawdowns from the MCCM operation, no 3rd party bores are predicted to be impacted. In the event of impacts to water supply on third party landowners of privately owned land are proven to be as a result of the mining operation (not a result of natural climate variation or over pumping by other water users), Maules Creek will enter into a “Make good” agreement, which will generally include:

- Provide compensatory water supply measures which is a long term equivalent lost supply due to the operation
- Interim water supply will be provided within 24 hours where possible
- If there is a dispute over the agreed compensation, the matter will be refer to the Planning secretary for resolution.
- If long term alternate supply of water can’t be provided, alternate compensation will the provided to the satisfaction of the Planning Secretary.

8.3 TRIGGER ACTION RESPONSE PLAN

The performance measures and control thresholds described in the previous two sections form the basis of a trigger action response plan (TARP) that outlines actions and responses in the event trigger thresholds are exceeded. The exceedance of a trigger threshold on their own occurrence does not indicate when and what mitigation, management or ceasing work may be an appropriate response. The re-confirmed exceedances will prompt an investigation, carried by suitably qualified personnel, to determine the reasons for triggers, which could include but not be limited to climatic conditions, agriculture abstraction and mining activities. In the case exceedances are attributed to mining activities, the changes in groundwater conditions, such as a decrease in water level or increase in salinity, will be compared to performance measures (discussed in Section 8.1) to evaluate the significance of any impacts manifested on the groundwater systems. The procedures to be undertaken in the event of a trigger event is graphically summarised Figure 8-2.

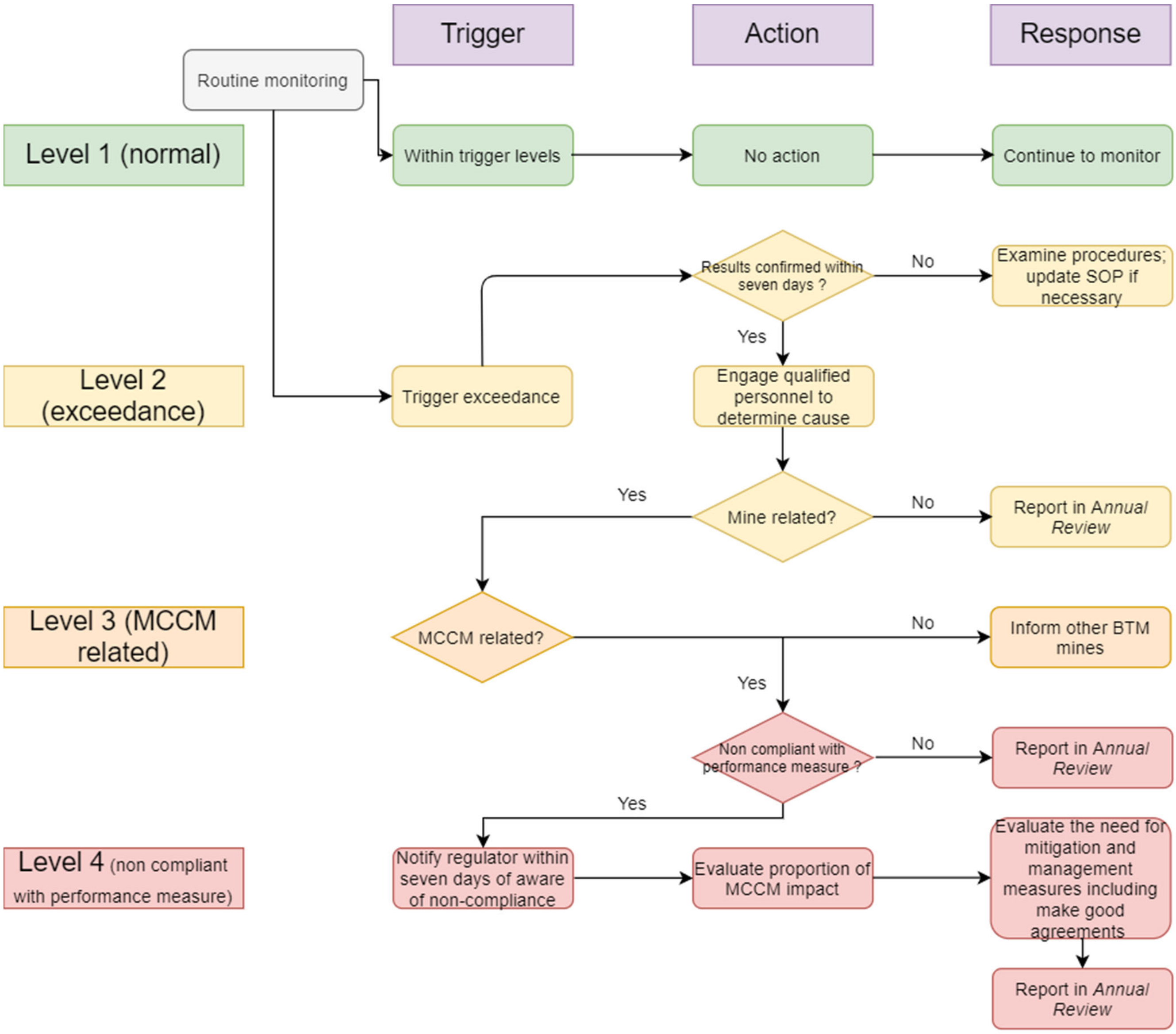


Figure 8-2 Flowchart and decision tree of procedures to be undertaken for trigger events

The results of the trigger investigations will be reported in each annual review. Qualified personnel will be engaged to undertake an independent assessment of all TARP exceedances and these will be discussed in the annual review. Each year if it is clear the baseline dataset is changing in response to factors not related to mining such as climate or agriculture then the trigger thresholds will be recalculated, and the control thresholds adjusted to improve the baseline statistics. When this occurs the GWMP will be updated.

9 CUMULATIVE IMPACTS AND MONITORING LOCATIONS

The close proximity of the BTM mining operations will result in a cumulative impact whereby the zones of depressurisation produced by each operation overlap and become more extensive in the overlapping areas. As per the recommendations of the Groundwater Impact Assessment presented in the Maules Creek Coal Project Environmental Impact Statement (Hansen Bailey 2011), MCCM established a regional monitoring network (the REG series of bores) in 2013 specifically designed to monitor and manage cumulative groundwater impacts resulting from mining activities. This series of bores is currently monitored and with exceedances investigated by MCCM.

Should the resultant investigation, as outlined by the TARP in Section 8.3, conclude the exceedance is attributed to mining within other BTM mines and resulted in performance measures not being met then the BTM Water Management Strategy will be used to determine how the complex implements management and mitigation measures.

10 GROUNDWATER MODEL VALIDATION

The validity of the BTM complex groundwater model predictions will be reviewed every three years by a suitably qualified and experience person on behalf of the Boggabri, Tarrawonga and Maules Creek Coal Mines. The predictions will be reviewed against water level data from monitoring bores and estimates of water take to determine if the model is providing useful predictions. As more data becomes available from ongoing monitoring this will be utilised to calibrate the model. If the numerical model predictions do not compare well with the observations over the previous three-year period, and if necessary recalibrated in consultation with DPHI. Predictions of water level changes and water take will be undertaken using the updated model. The uncertainty in predictions will also be assessed.

Where changes to the nature of the predicted impacts is identified through the modelling then the suitability of the monitoring network and water supply bore monitoring will be reviewed to determine if changes are warranted.

11 REPORTING

11.1 ANNUAL REVIEW

The results of groundwater monitoring data will be compiled in the Annual Review. The results of any trigger exceedance investigations will also be summarised in the Annual Review.

11.2 MODEL VALIDATION

The validation of the groundwater model will be reported every three years commencing August 2024.

12 FINAL VOID

12.1 PAC REQUIREMENTS

During the review of the Maules Creek Coal Project by the PAC, it was suggested that there may be potential adverse impacts to the quality of groundwater resources post mining, should rejects and Potentially Acid Forming (PAF) materials not be managed appropriately.

As per Schedule 6 of PA 10_0138, the expert advisor to the PAC recommended gathering further hydro-geochemical information at MCCM, including:

- The proposed 17 additional monitoring bores be equipped with water level or pore pressure monitoring transducers installed at vertical separations such that the future impacts of strata depressurisation can be adequately measured and mapped;
- Core tests to be completed to assess the distribution and variability of hydraulic conductivities of (unfractured) interburden at sufficient number of bore locations to quantify porous groundwater flow and storage contributions associated with interburden;
- XRD-XRF analyses to be undertaken on core samples obtained at a sufficient number of bore locations to establish mineralogy of interburden likely to be exposed to pit resaturation;
- Hydro chemical modelling to be undertaken in order to determine the long term void water quality. This study should include batch reaction (full saturation) trials on waste interburden (spoils) to confirm hydro chemical modelling outcomes.

These requirements of collecting additional information have now been completed and is described in reports prepared by RGS (2019, 2020) and AGE (2017).

12.2 FINAL VOID MINE CLOSURE PLAN

A draft final void mine closure plan (FVMCP) was prepared in 2020 by MCCM. It was recommended the final version of the FVMCP that is due in 2026 include:

- using the updated BTM complex groundwater flow model to simulate water level recovery in the final void and provide estimates of groundwater inflow for the water balance model;
- collecting spoil samples from site and conducting laboratory testing to determine permeability and porosity (at emplaced pressure) for use in updated groundwater modelling;
- conducting additional column testing to resolve inherent uncertainties including:
  - replacing deionised water with groundwater collected from bores or in-pit at the MCCM;
  - replacing crushed core with actual spoil material collected from the MCCM emplacements;
  - using peristaltic pumps to pump groundwater through columns to represent gradual movement of groundwaters;
- continuing to investigate the timeframe for the first flush of salts using continued column testing and hydrochemical modelling; and

- extending the period of hydrochemical modelling to estimate the period for which the void waters will have a beneficial use, as for example stock water.

This will be further considered prior to commencement of the Final FVMCP.

13 REFERENCES

Australasian Groundwater and Environmental Consultants Pty Ltd, AGE (2017), Letter entitled "*Maules Creek Interburden Permeability Testing*" dated November 2017

Hansen Bailey (2011), Maules Creek Coal Project Environmental Impact Statement.

New South Wales Government (2020), "*Water Sharing Plan for the Namoi Alluvial Groundwater Sources Order 2020*", Website accessed at: https://legislation.nsw.gov.au/view/html/inforce/current/sl-2020-0346

New South Wales Government, (2020), "*Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources Order 2020*", Website accessed at: https://legislation.nsw.gov.au/view/html/inforce/current/sl-2020-0349

RGS (2019). Final Void Hydrogeochemical Assessment – Maules Creek Coal Mine. Report No. 2018041, dated 06/09/2019

RGS (2020). Characterisation of Mining Waste Materials – Maules Creek Coal Mine. Report No. 2017003, dated 12/10/2020

14 ATTACHMENT A – STANDARD OPERATING PROCEDURES

Standard Operating Procedure on
Field Documentation, Groundwater Level Gauging. Groundwater Sampling and Appropriate Storage and Handling Practices

1) Purpose

These procedures describe the approach to be taken for the collection, storage/handling and documentation of representative groundwater samples.

2) Scope

These procedures apply to groundwater monitoring and sampling activities for Maules Creek Coal Mine. Where there is substantial variation from these procedures, a note must be made in the job briefing sheets or field notes describing the procedure that is to be used.

3) Procedures

3.1) Field equipment

All necessary equipment to conduct the groundwater sampling should be checked prior arriving on site. Field equipment required to conduct the perform the groundwater sampling include:

- Water level dipper;
- Tape measure;
- GPS unit;
- Tablet, Laptop or similar for pressure logger data download;
- Water quality meter with sensor probes for pH, electrical conductivity, temperature and redox potential, and appropriate calibration solutions;
- Appropriate personal protective equipment including long sleeve shirt and long pants, hard hat or broad brimmed hat, sun screen, gloves, protective eyewear and protective footwear;
- Water quality sample bottles;
- Filters and syringes;
- Nitrile gloves;
- Freshwater for rinsing;
- 12 fridge or cooler box and ice;
- Bailer or submersible pump; and
- Decontamination liquid to rinse reusable equipment.

3.1) Field notes

Written or digital records must be maintained for groundwater monitoring and sampling activities. These records must cover field observations and give an account of daily works and events. Paper based records must protected from the elements and all entries made in indelible ink. Field data recorded digitally in the field using a tablet, laptop or similar device must be backed up to a secondary storage device on a regular basis (e.g. daily).

Field observations collected shall include the following:

- Weather conditions;
- GPS coordinates and elevation of bore if survey has not been completed yet;
- Health and safety issues on site;
- Description of the conditions of the monitoring bore;
- Total depth of bore (where possible);
- Results of any field testing;
- Calibration results of water quality meter;
- Details of samples collected including time and date, sample, identification number and bore location, procedures used in sample collection, and instrument readings;
- Descriptions of visual and olfactory characteristics during each measurement including details such as elapsed time, volume purged, colour, turbidity, odour, sheen etc. when performing a well purge; and
- Photographs of the monitoring location visited.

Supporting information such as safety plans, site plans, and a copy of this standard operating procedures must be accessible to the field sampler when conducting monitoring and sampling.

3.2) General sampling procedures:

1. Record the condition, coordinates and elevation.
2. Record depth to standing groundwater level in the bore with a water level meter. Depth measurements should be referenced to an established datum or measuring point (e.g., top of bore casing).
3. Retrieve pressure logger (if present) within bore. Download data from pressure logger with correct cables and software with laptop.
4. Record the top of bore casing from ground level.
5. Decontaminate all reusable sampling equipment (i.e., pumps and cables) prior to use at each location.
6. Ensure that the water quality meter has been calibrated within the last 24 hours.
7. Compute water volume in the bore with standing water level, bore depth and bore diameter.
8. Lower the decontaminated pump or bailer into the bore. Ensure discharge outlet is placed at distances from bore when utilising a pump setup. Safe manual handling practices must be

followed when lifting / carrying sampling equipment. Note any trip hazards prior to proceeding. If required; seek assisting when lifting heavy equipment and the position the field vehicle to minimise carry distance.

9. During purging, field water quality parameters such as pH, electrical conductivity, redox potential, temperature and sediment load should be recorded at regular intervals. Once sediment load is minimal, three bore volumes have been removed and field parameters are stable (within 10%, within 0.2°C for temperature), a groundwater sample can be collected.
10. Low yielding wells that do not yield three bore volumes in one visit should be purged dry and left to recover. Following recovery of groundwater levels, sampling can proceed as the recovered standing water should be representative of inflows from the screened hydrostratigraphic unit.
11. Scan the sample bottles with digital application provided by testing laboratory on tablet or mobile phone. If digital application is not available from testing laboratory, label sample bottles using a Xylene free permanent marker with details including bore name, sample round number, sampler name, date and time.
12. Record any other specific bottle filling instructions on the sample bottles before filling them. Note which samples need to be field filtered and/or contain preservatives such as acids.
13. Conduct filling of sample bottle with nitrile gloves.
14. For samples requiring field filtration, rinse and fill a new container with the water from the bore. Fill the syringe with water from the bore, attach the filter to the end of the syringe. Sit the filter over the sample bottle and push the water through from the syringe. Continue to do this until the sample bottle is full before screwing the cap on tightly.
15. Preserve samples in cooler boxes/eskies provided by testing laboratory that are chilled at or around 4ºC. The cooler boxes will be sealed, clearly labelled with the name and address of the testing laboratory.
16. Ensure preservation of samples in cooler boxes do not exceed the recommended sample holding times. The holding times will vary according to the NATA-certified method being used by the laboratory and should be clarified with the nominated laboratory.
17. Include chain of custody (COC) form detailing each sample sent to the laboratory. A COC form must be completed while in the field. When groundwater samples are relinquished, ensure that the receiving party have signed the form indicating the time and date. A copy of the signed form must be retained and filed as a record of samples sent and analyses requested. Where electronic COCs are used, all digital records and emails must be filed appropriately.

Care must be given to avoid loss or decay of sample labels during storage and handling. The sample label must be written on the cap of the sample bottle if the decay of sample label is unavoidable. The sample will then be sealed and recorded in a chain-of-custody form from the laboratory nominated for the analysis.

3.3) Pressure logger/VWP download procedures:

1. Connect to pressure logger/VWP sensor with appropriate cable.
2. Download data once connection is secured.
3. Check the recording interval times for synchrony for all pressure loggers/barometric loggers/VWP sensors.
4. Record the battery storage and memory of pressure logger/VWP sensors.

<u>**Standard Operating Procedure on Quality Assurance Sampling**</u>

1) Purpose

The purpose of this procedure is to describe the approach to be taken for the collection of quality assurance samples during groundwater sampling.

2) Scope

This procedure applies when groundwater samples are collected.

3) Procedures

For the collection of the required field quality control (QC) samples refer to SOP on Field Documentation, Groundwater Level Gauging. Groundwater Sampling and Appropriate Storage and Handling Practices.

3.1) Quality assurance sampling

3.1.1) Field blind duplicates (Intra-laboratory duplicates)

Field blind duplicates are duplicate samples that are sent as independent samples to the same laboratory for analysis to assess the repeatability of the analytical results and the variation in analyte concentration between samples collected from the same sampling point. Field blind duplicates must be collected typically at a frequency of 1 in 20 samples (i.e., 5%).

Field blind duplicates must be taken simultaneously when the original sample is taken. Both the duplicate sample and the sample should be agitated as little as possible, preferably direct from the discharge line. The duplicates should be labelled without any indication of its original sampling point and sent for analysis as usual.

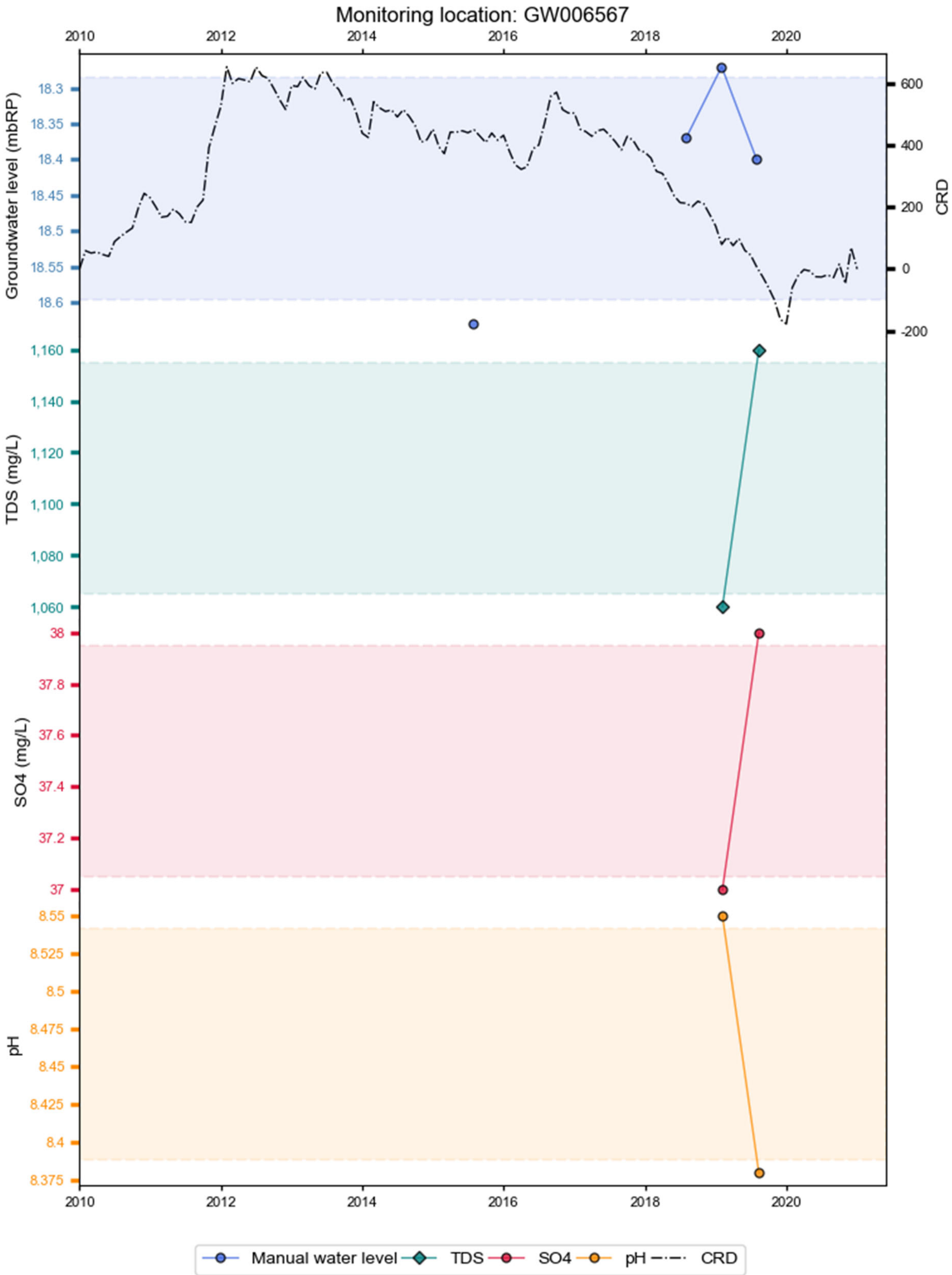
3.1.2) Field split duplicates (Inter-laboratory duplicates)

Field splits are duplicate samples that are sent to different laboratories for analysis to assess the analytical proficiency of the laboratories. Field split duplicates must be collected at a frequency of 1 in 20 samples (i.e. 5%). The combined blind and split frequency should be at least 10% of the total sample number. Field split duplicates are be collected using the same procedures as for field blind duplicates.

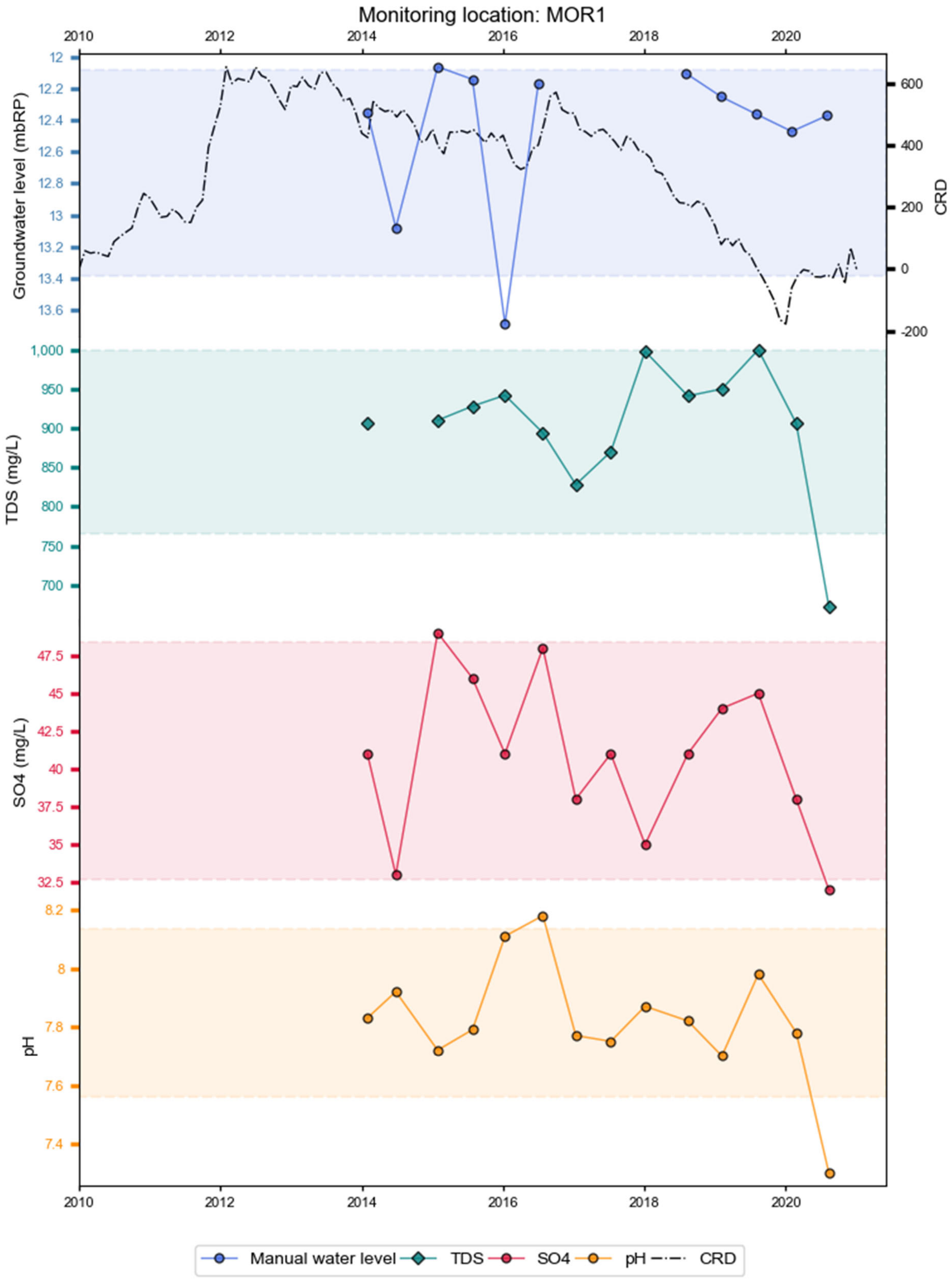
3.1.3) Field blanks

Field blanks monitor possible contamination that may be accidentally introduced when actually collecting the sample in the field. A sample container must be filled with deionised water in the field, sealed, labelled and sent for analysis as usual.

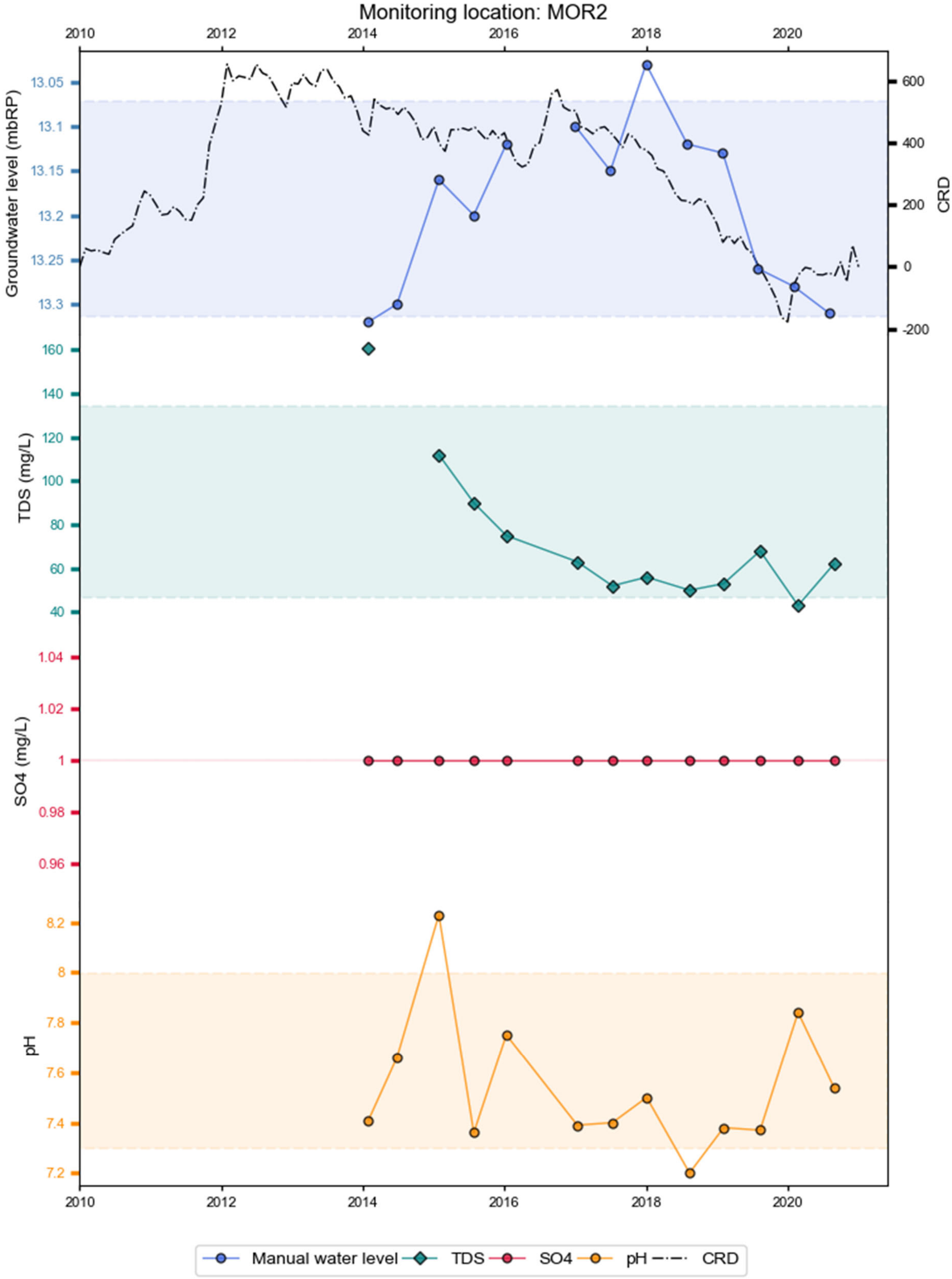
15 ATTACHMENT B – SUMMARY OF WATER LEVEL AND WATER QUALITY TIME SERIES DATA



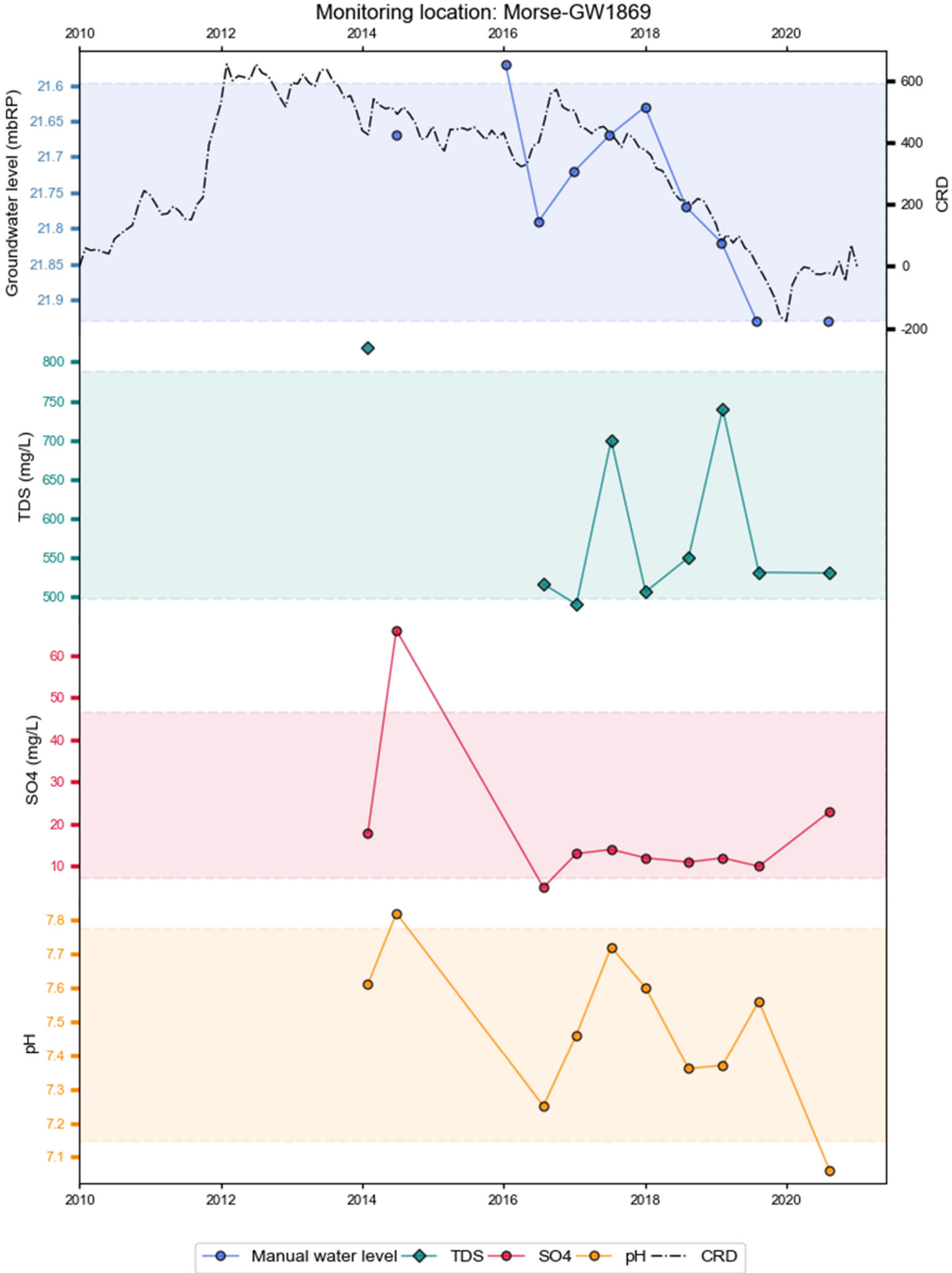
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



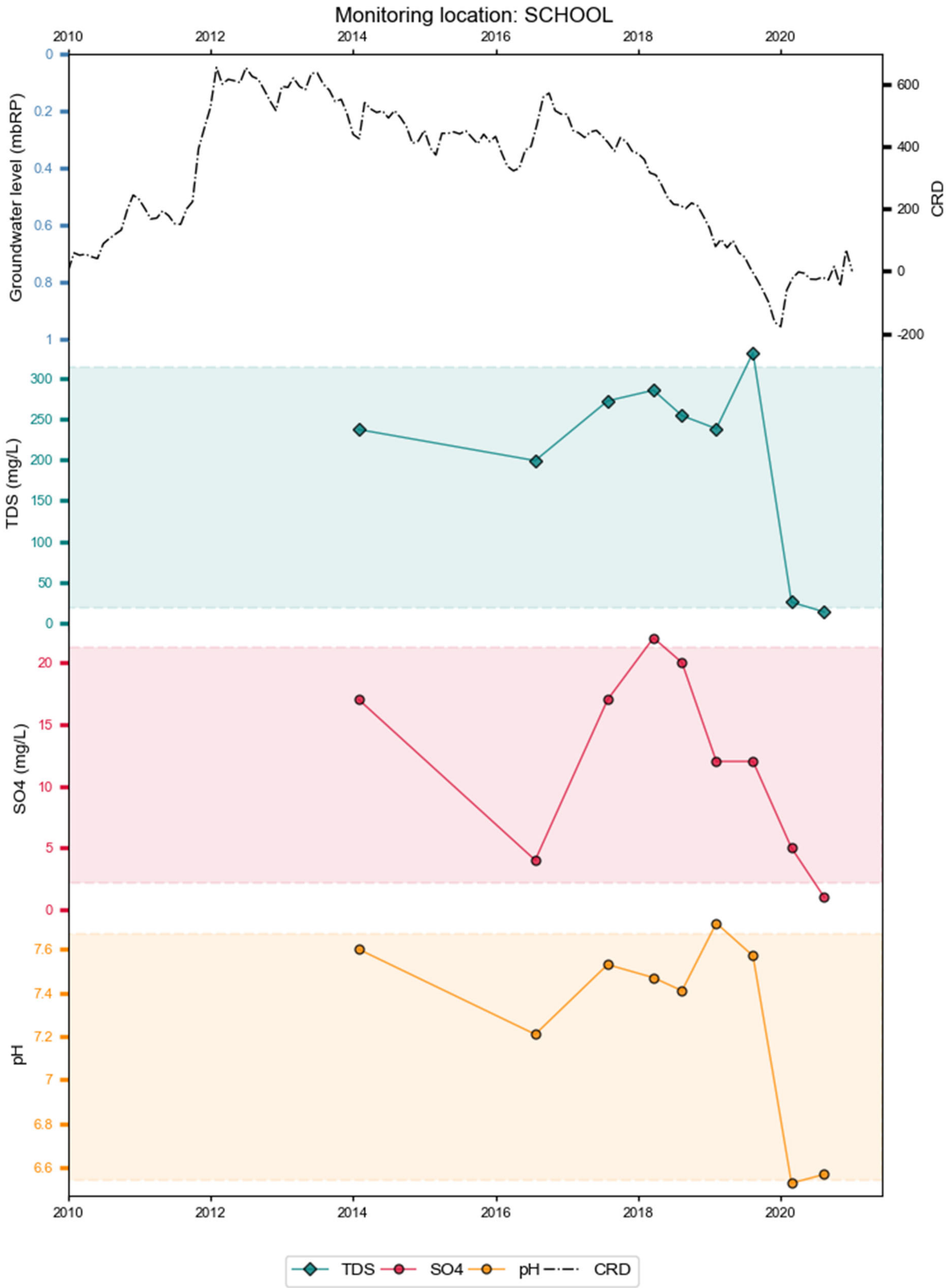
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



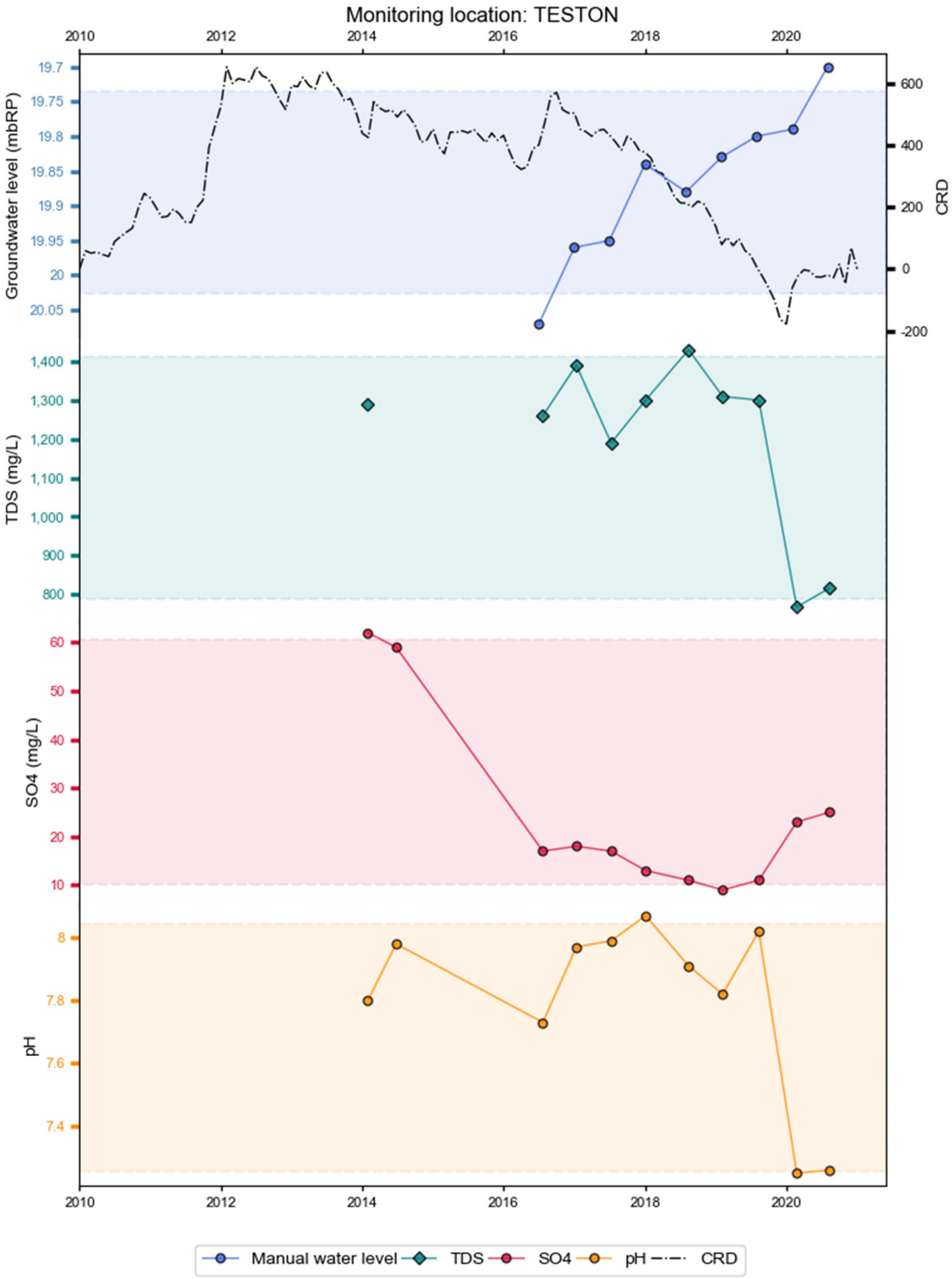
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



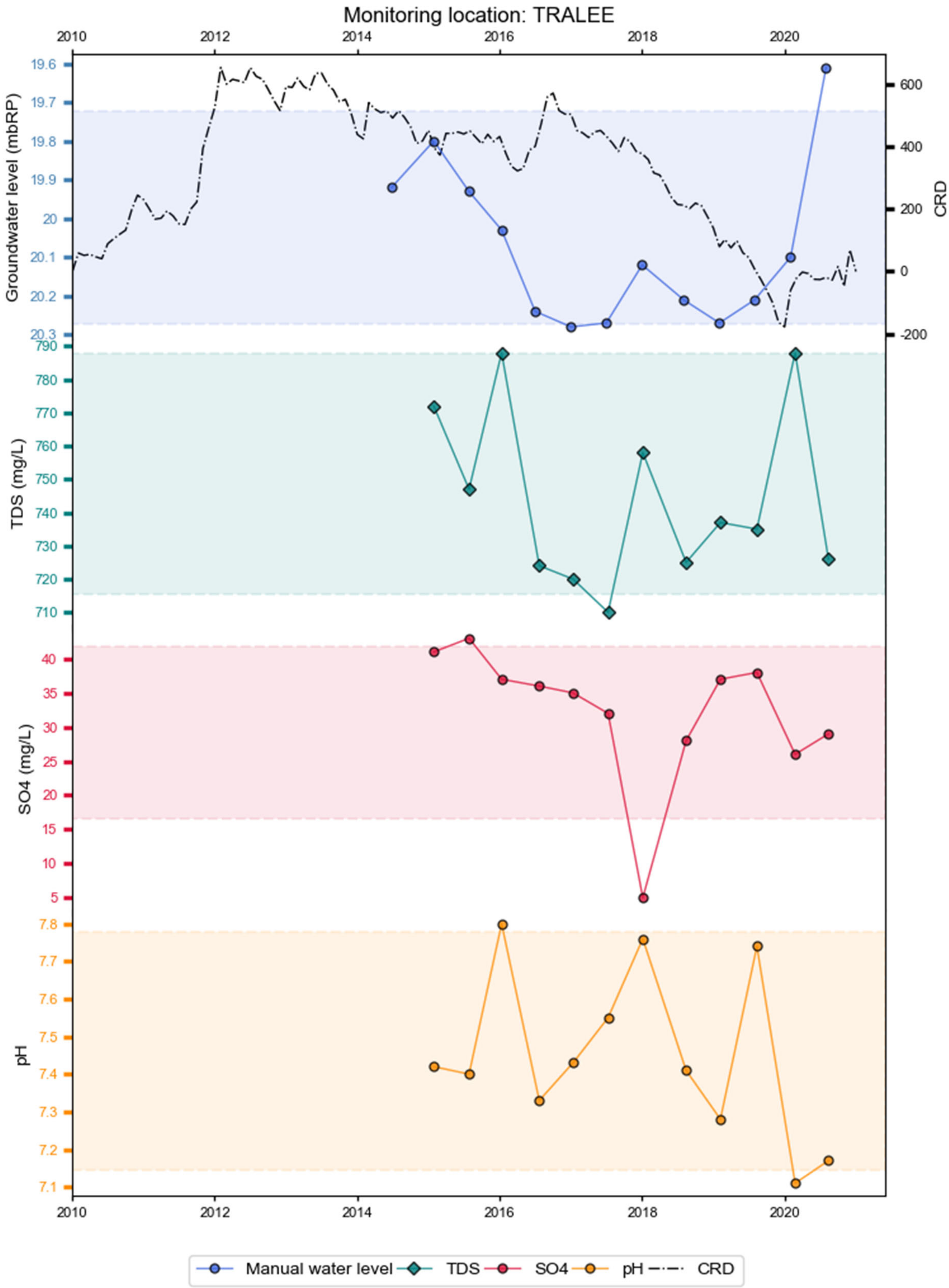
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



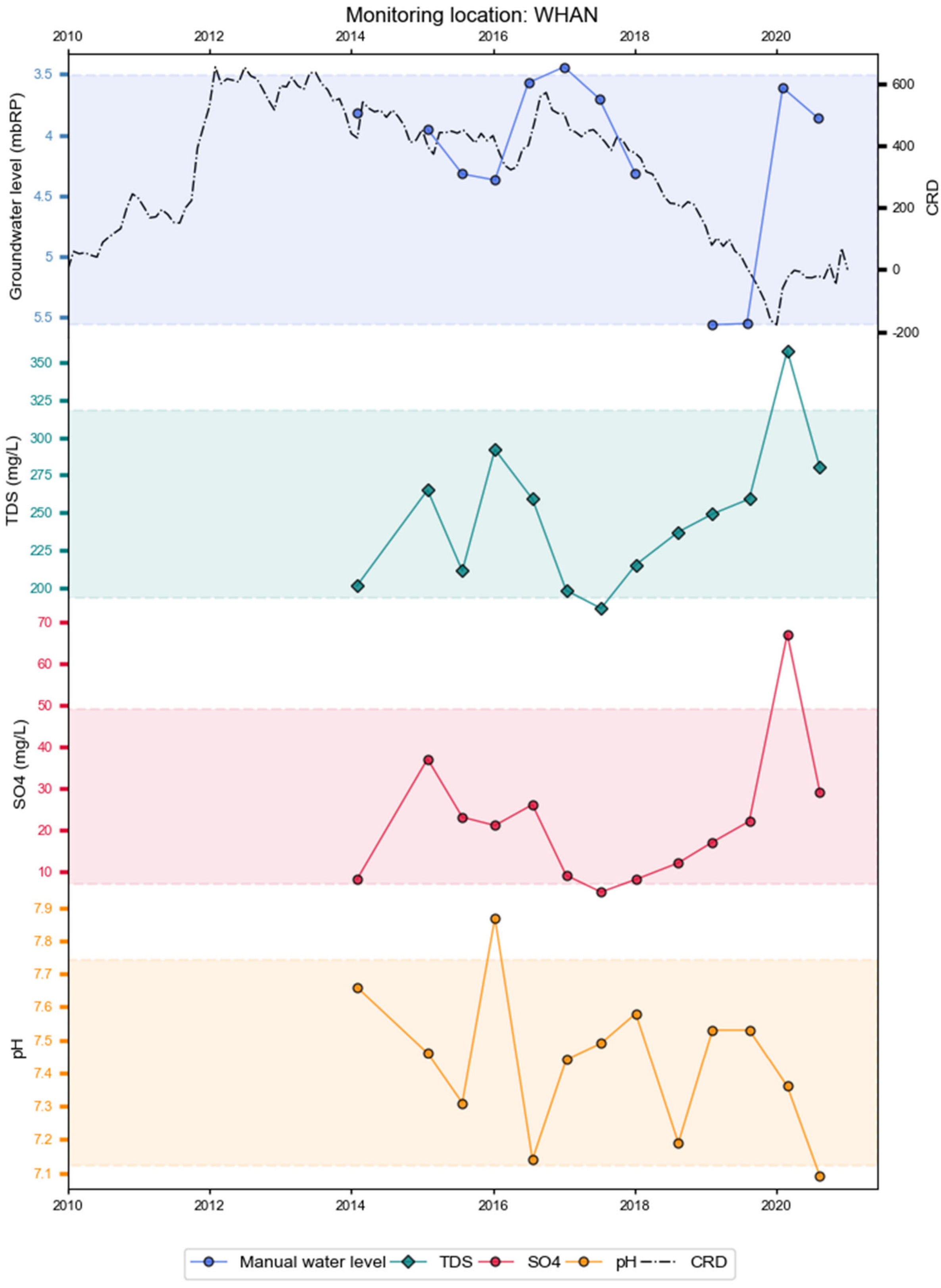
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



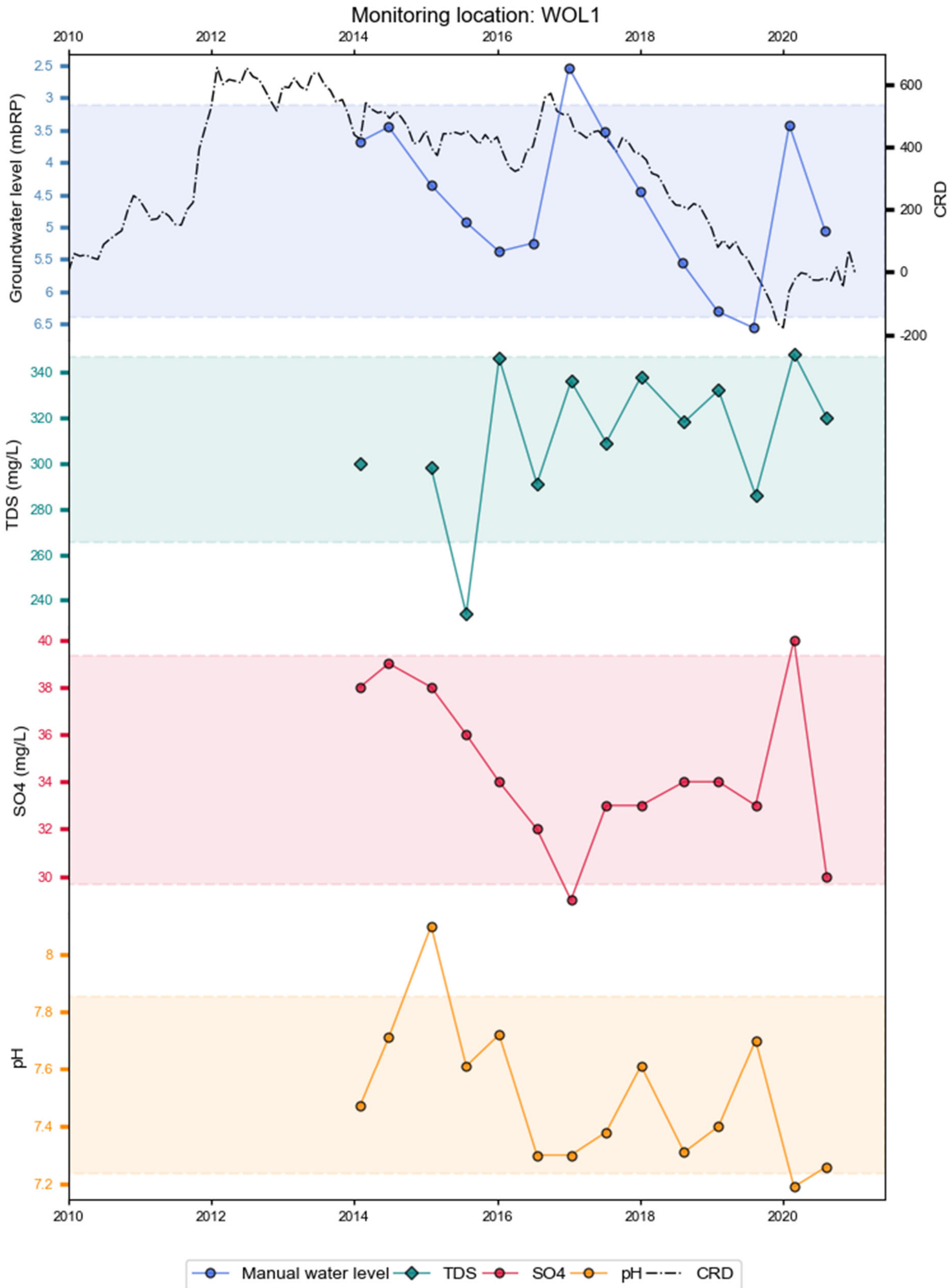
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



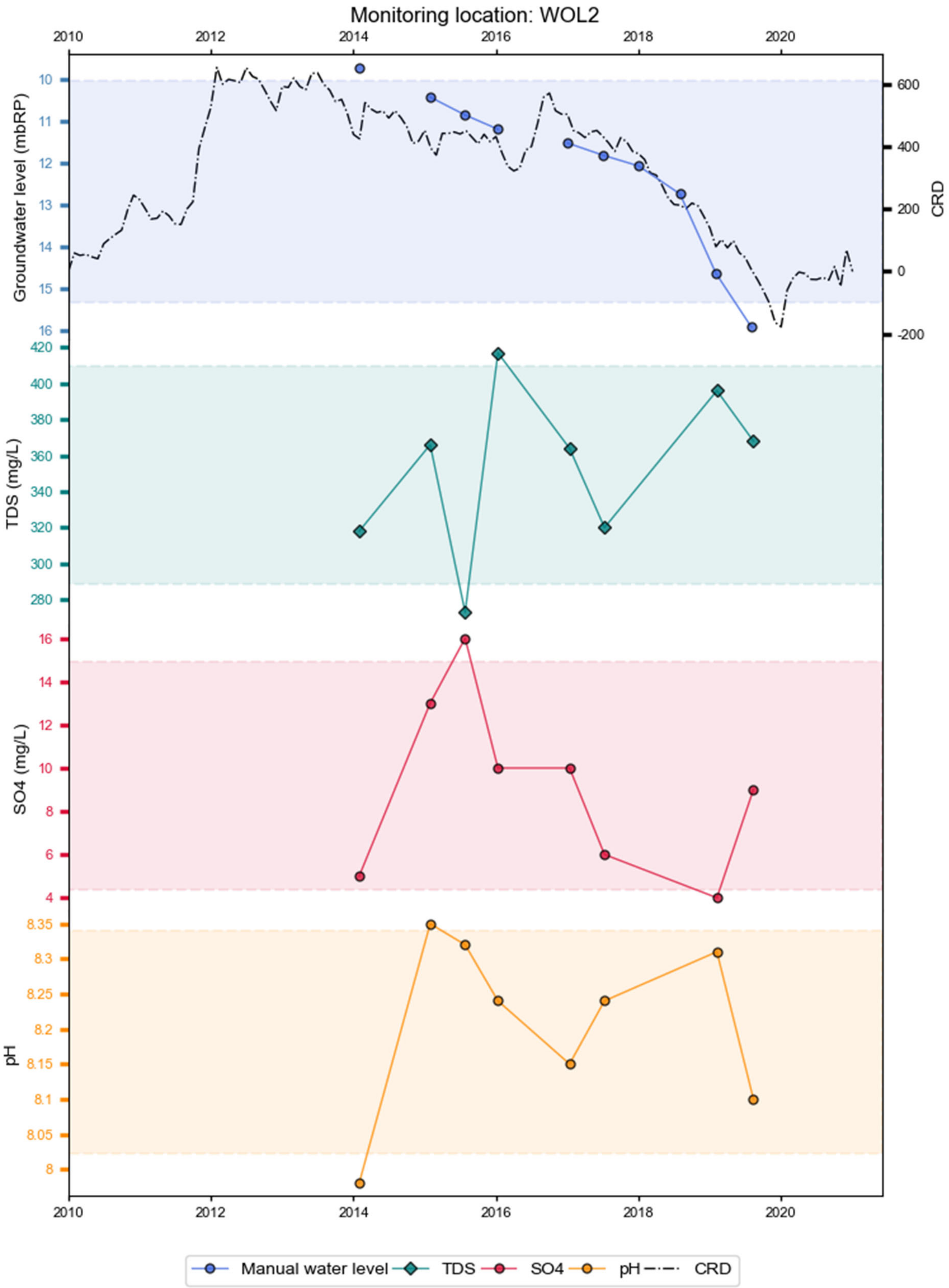
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



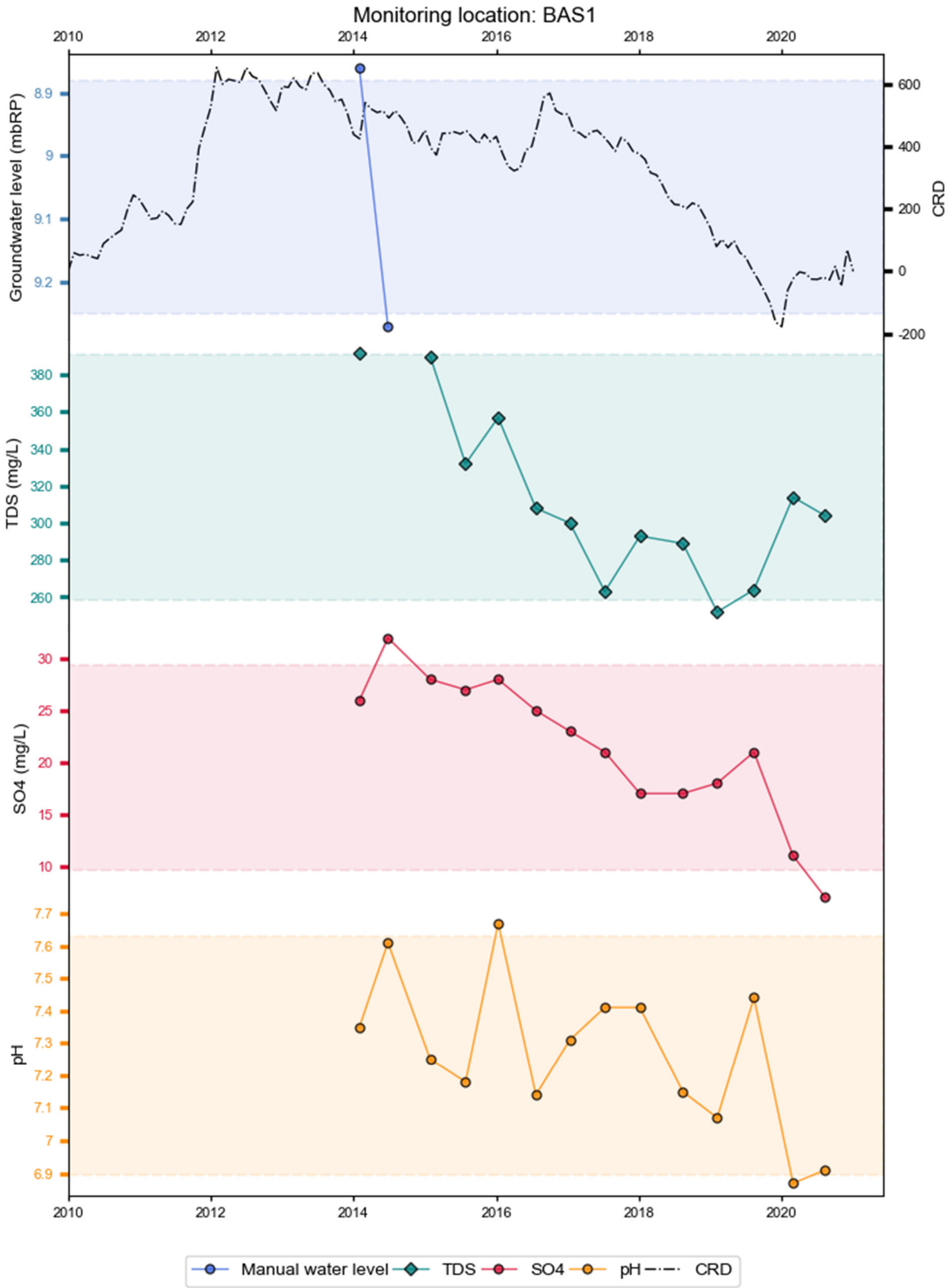
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



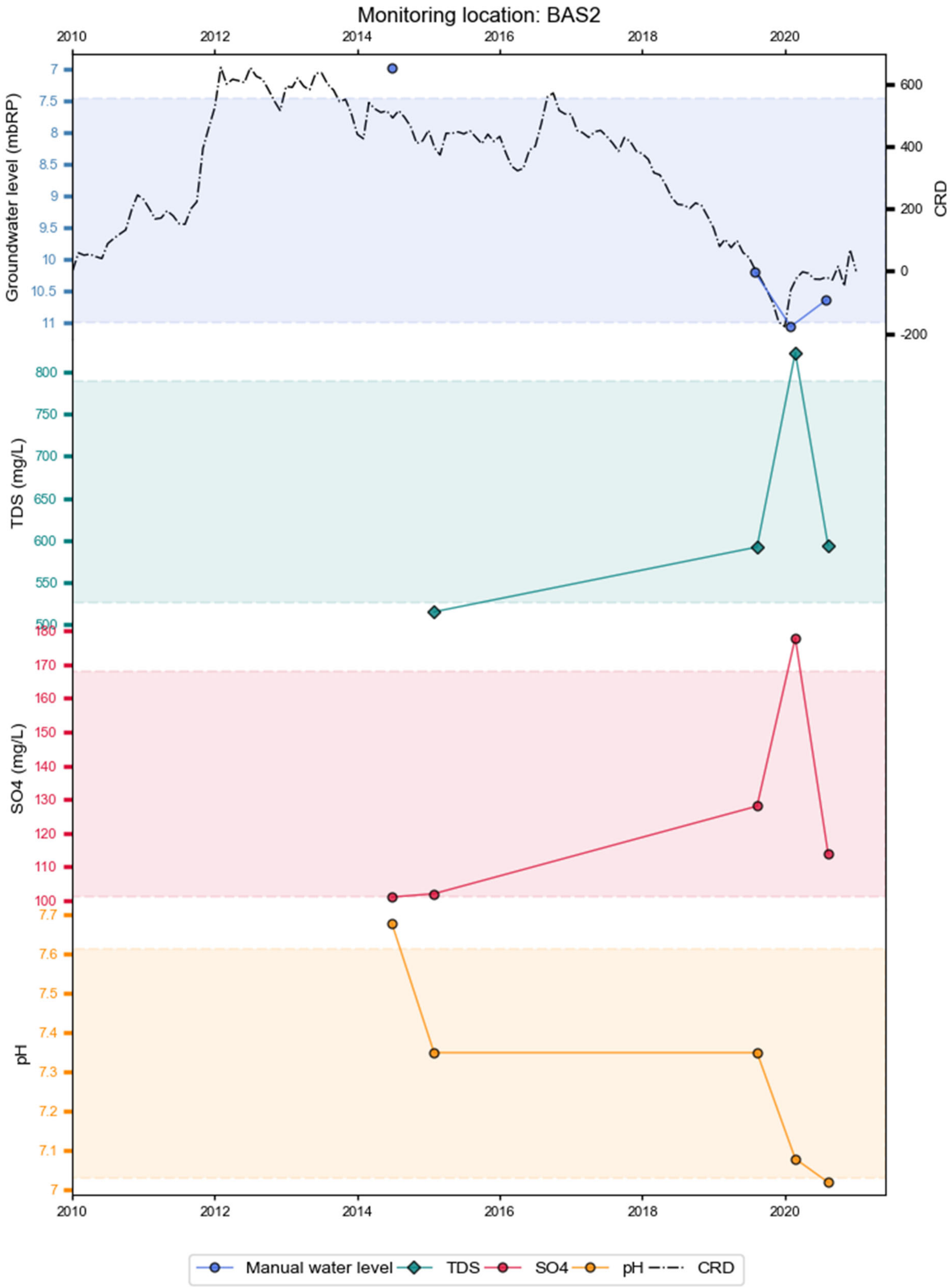
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



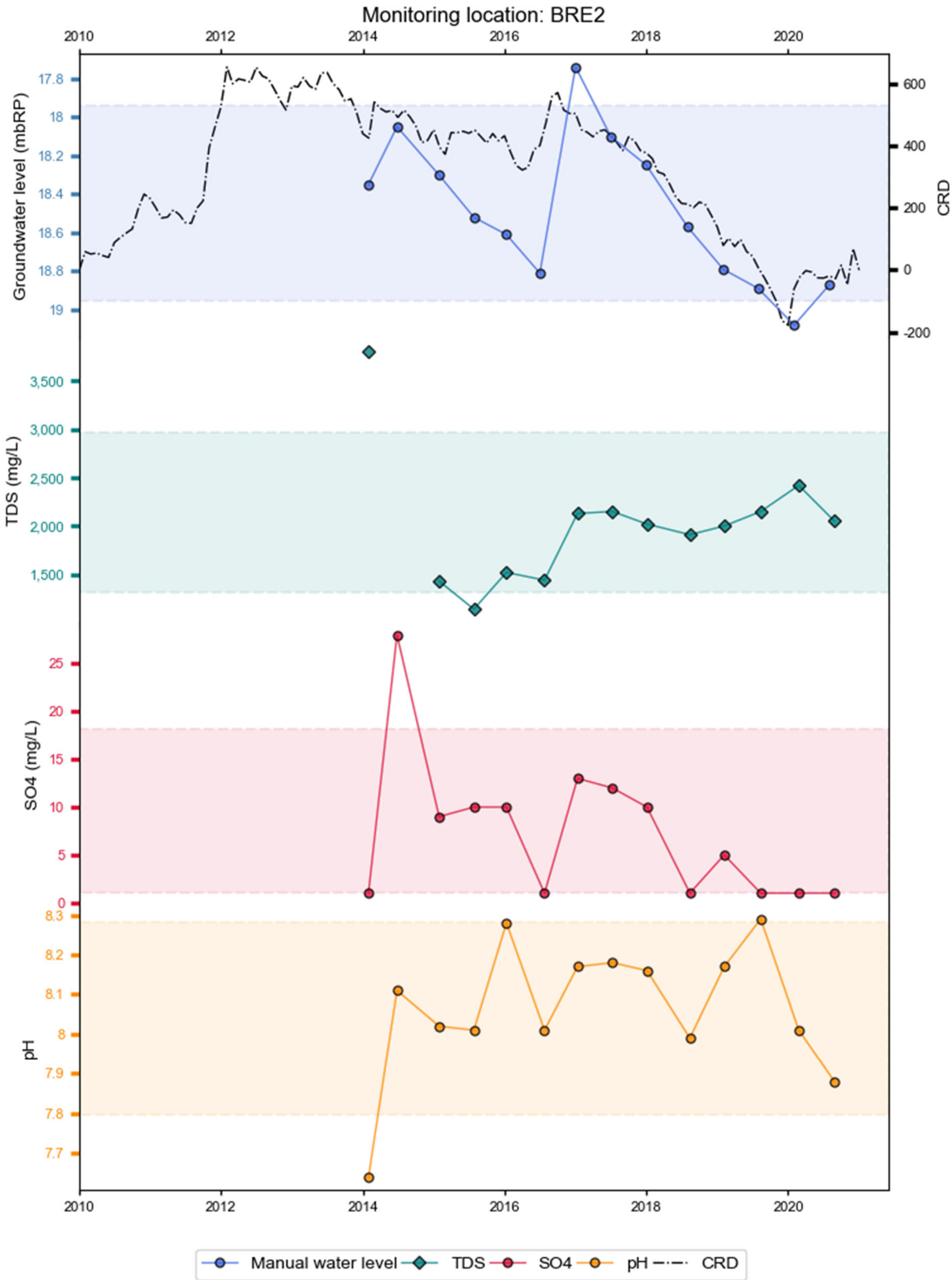
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



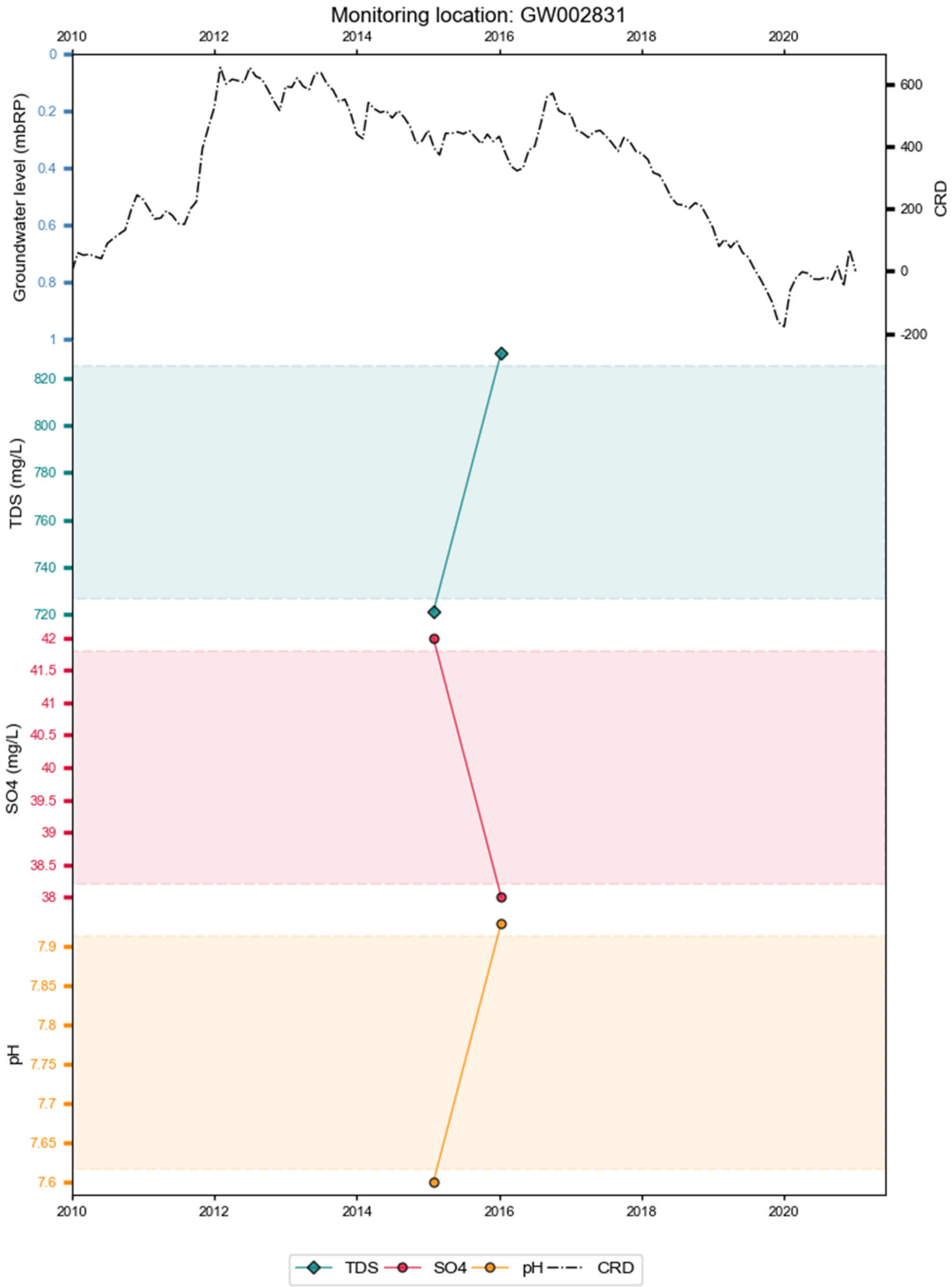
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



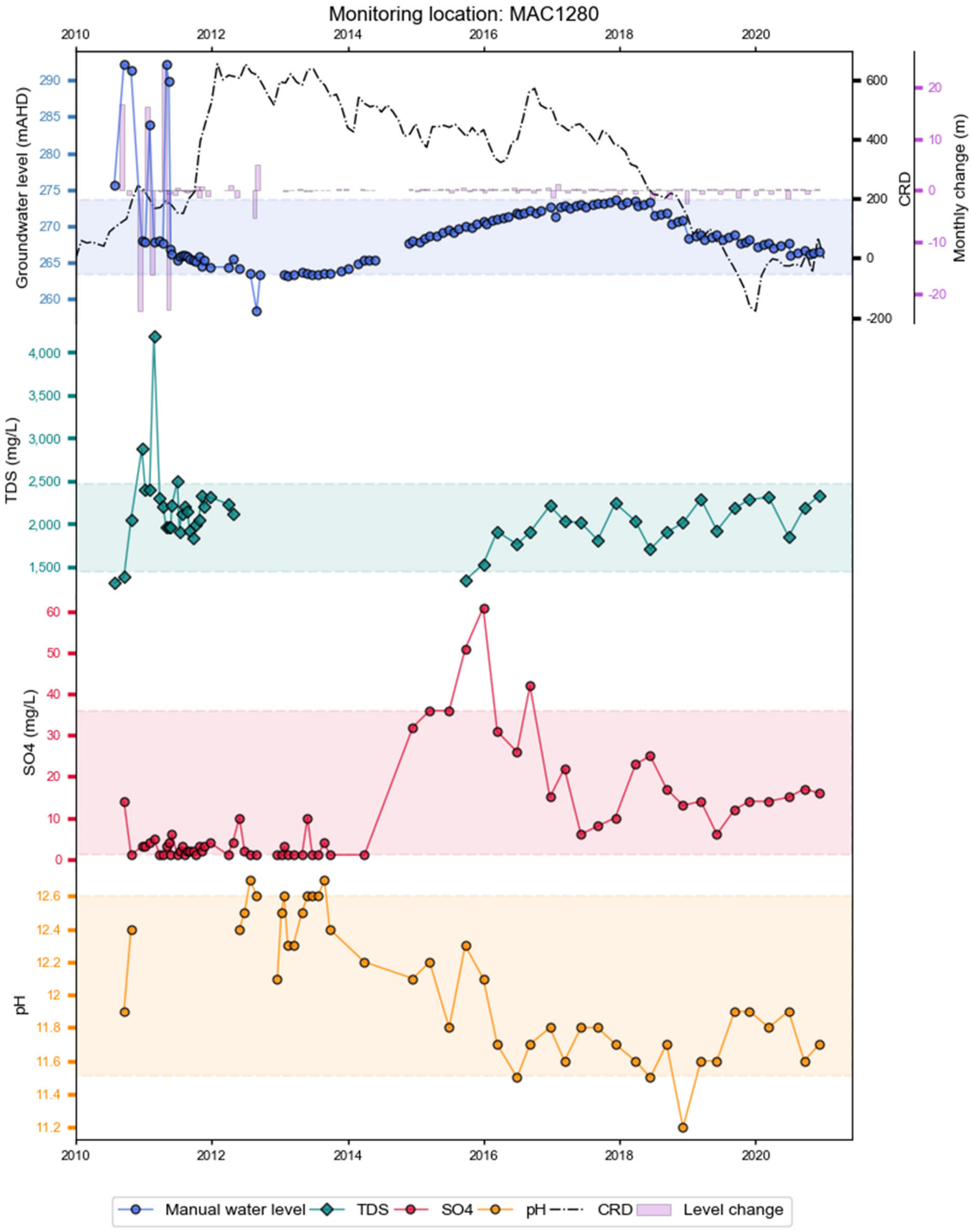
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



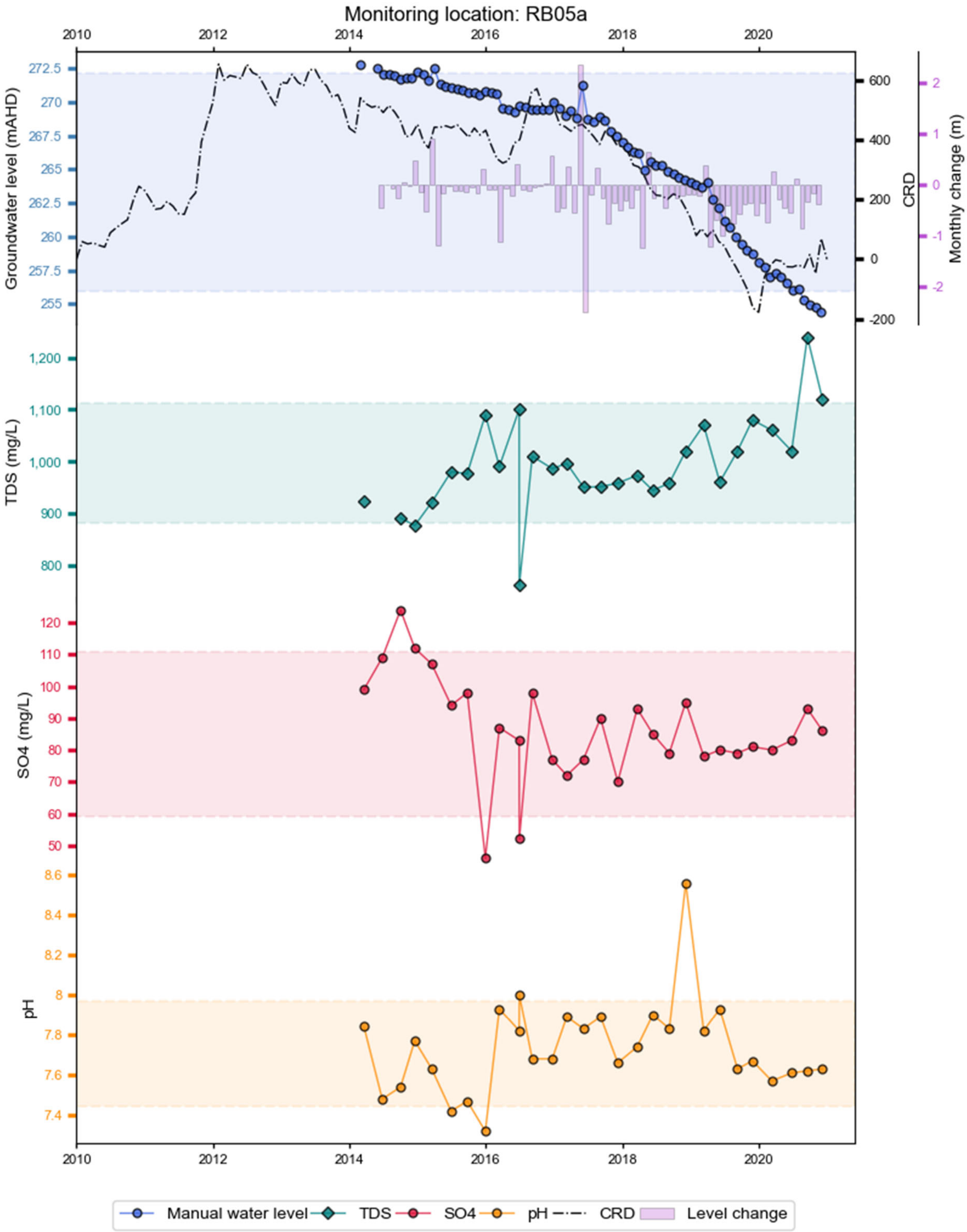
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



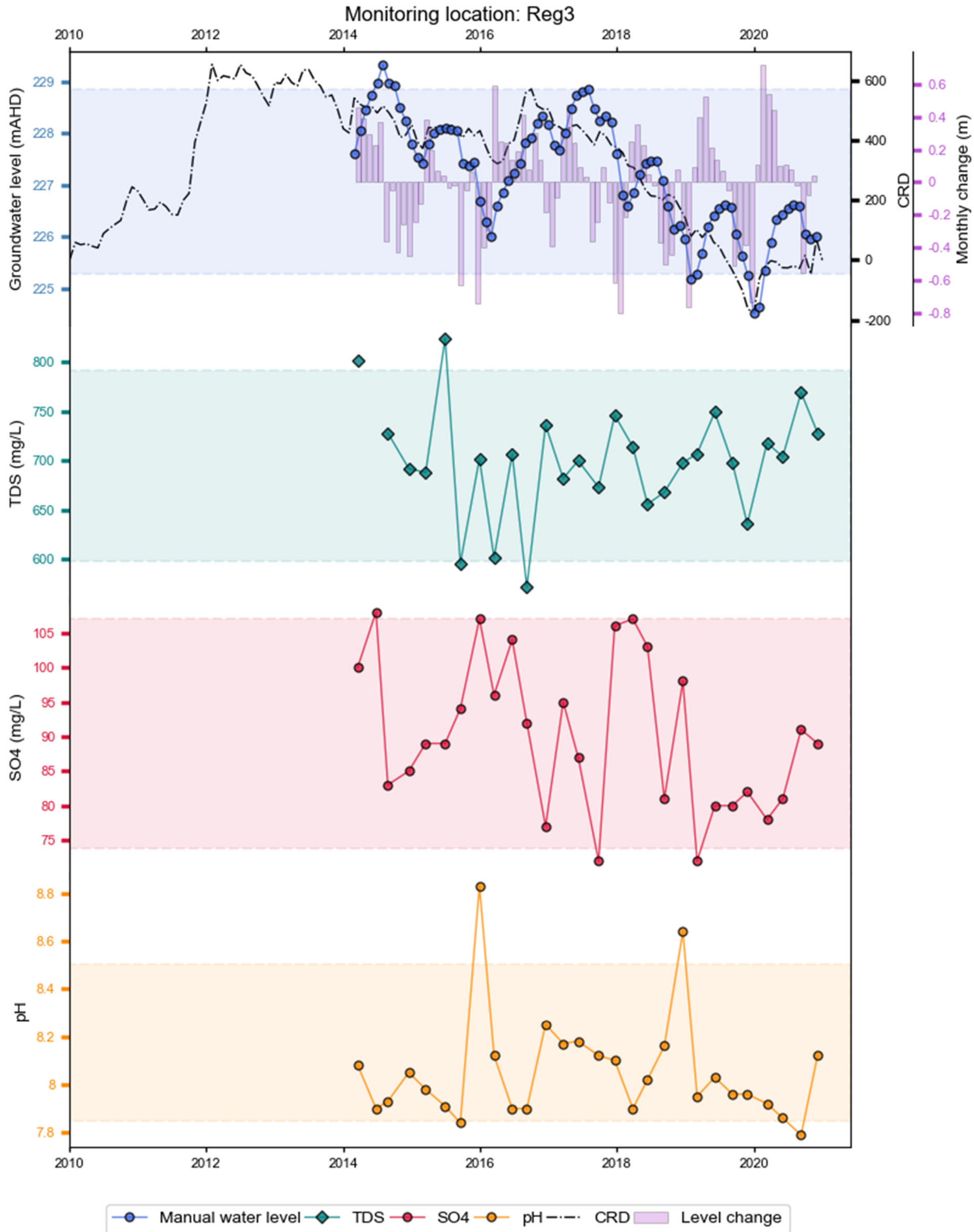
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



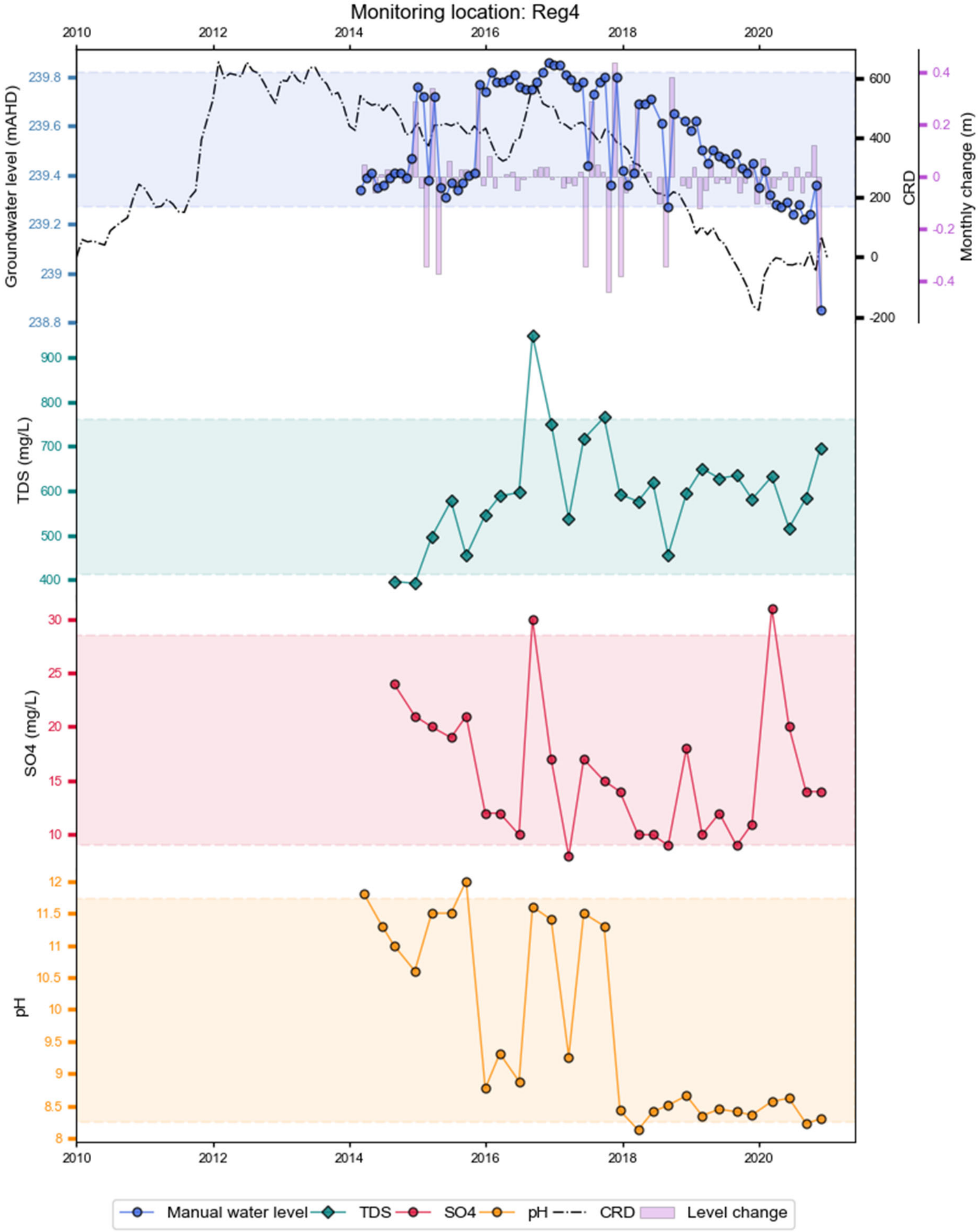
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



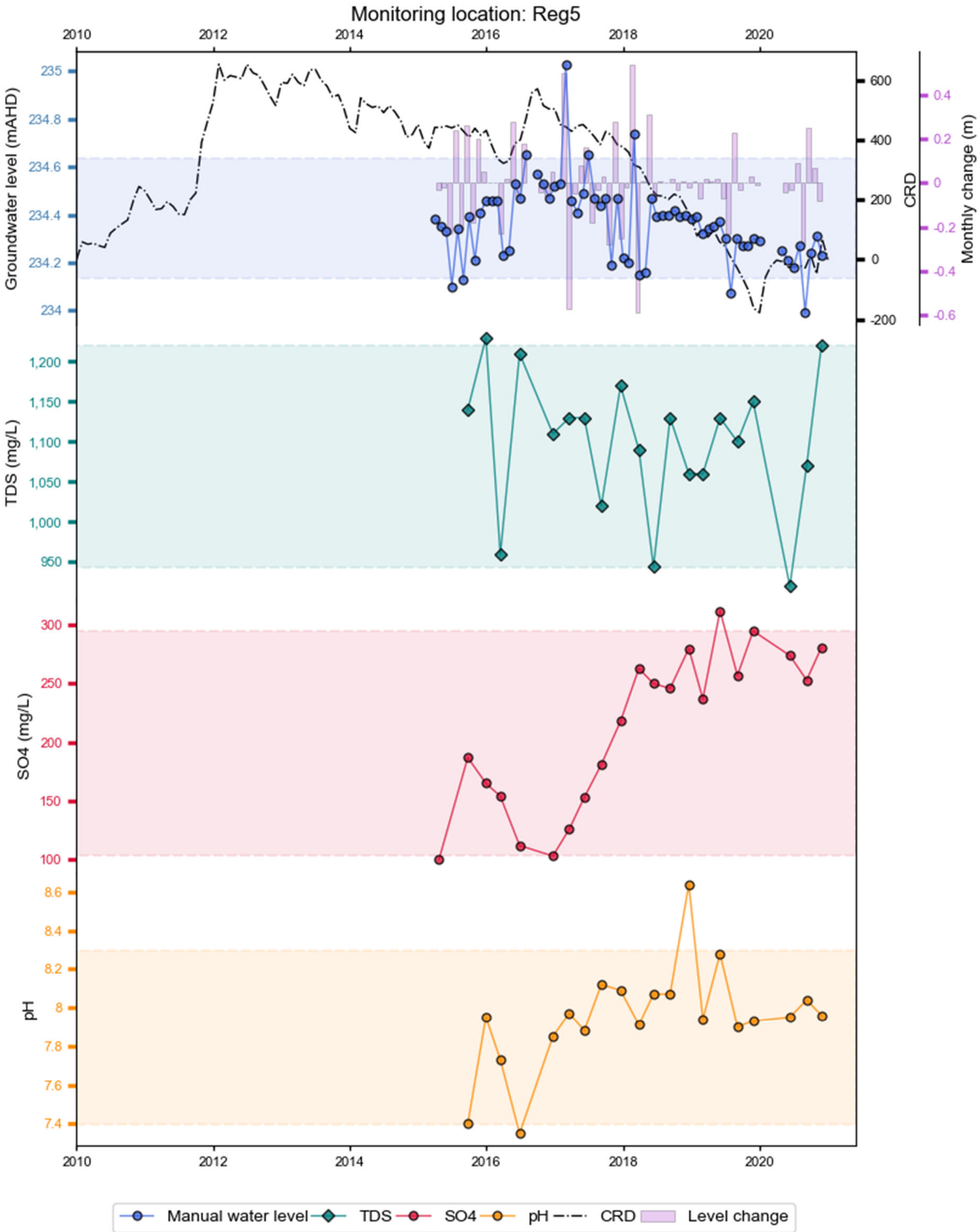
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



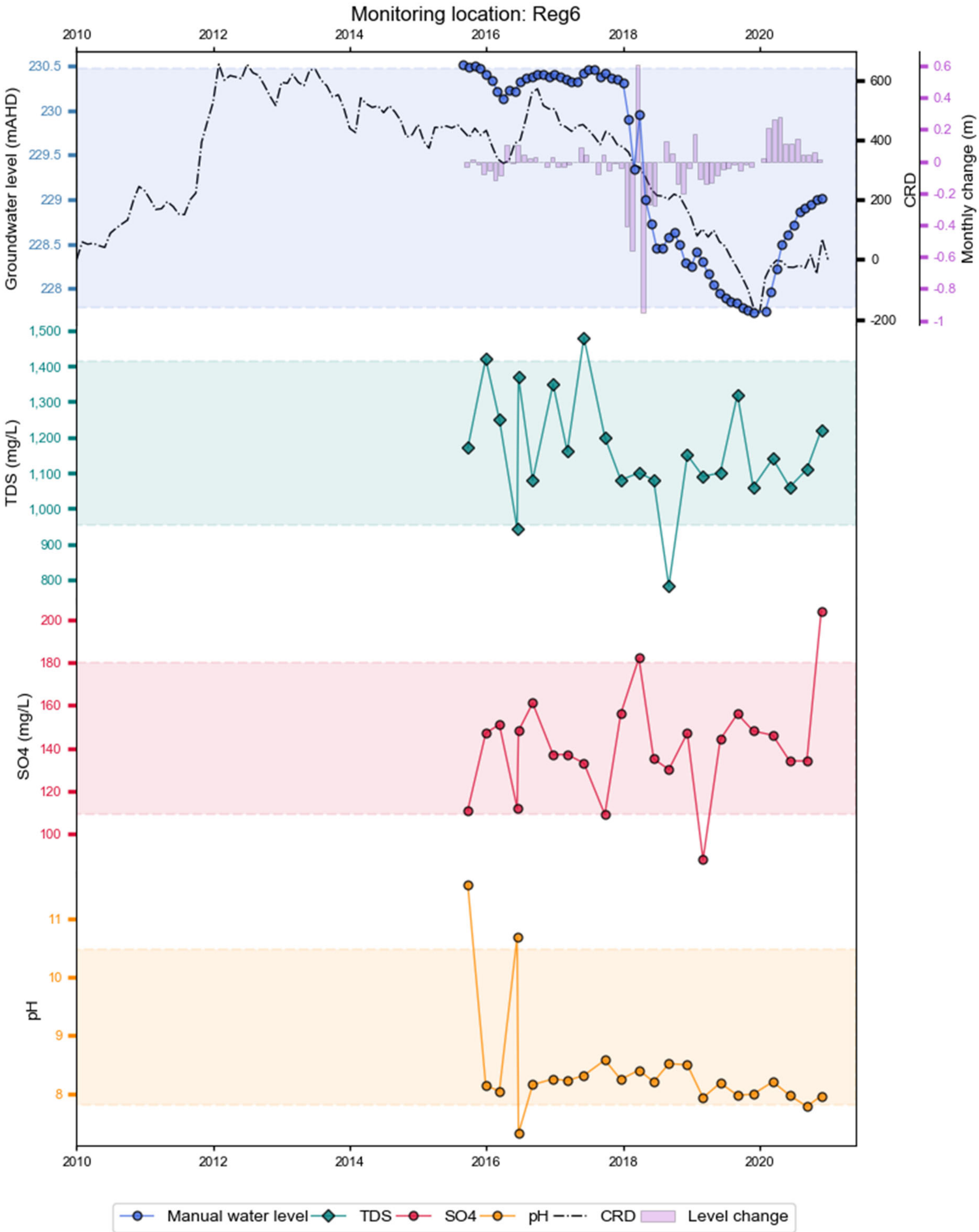
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



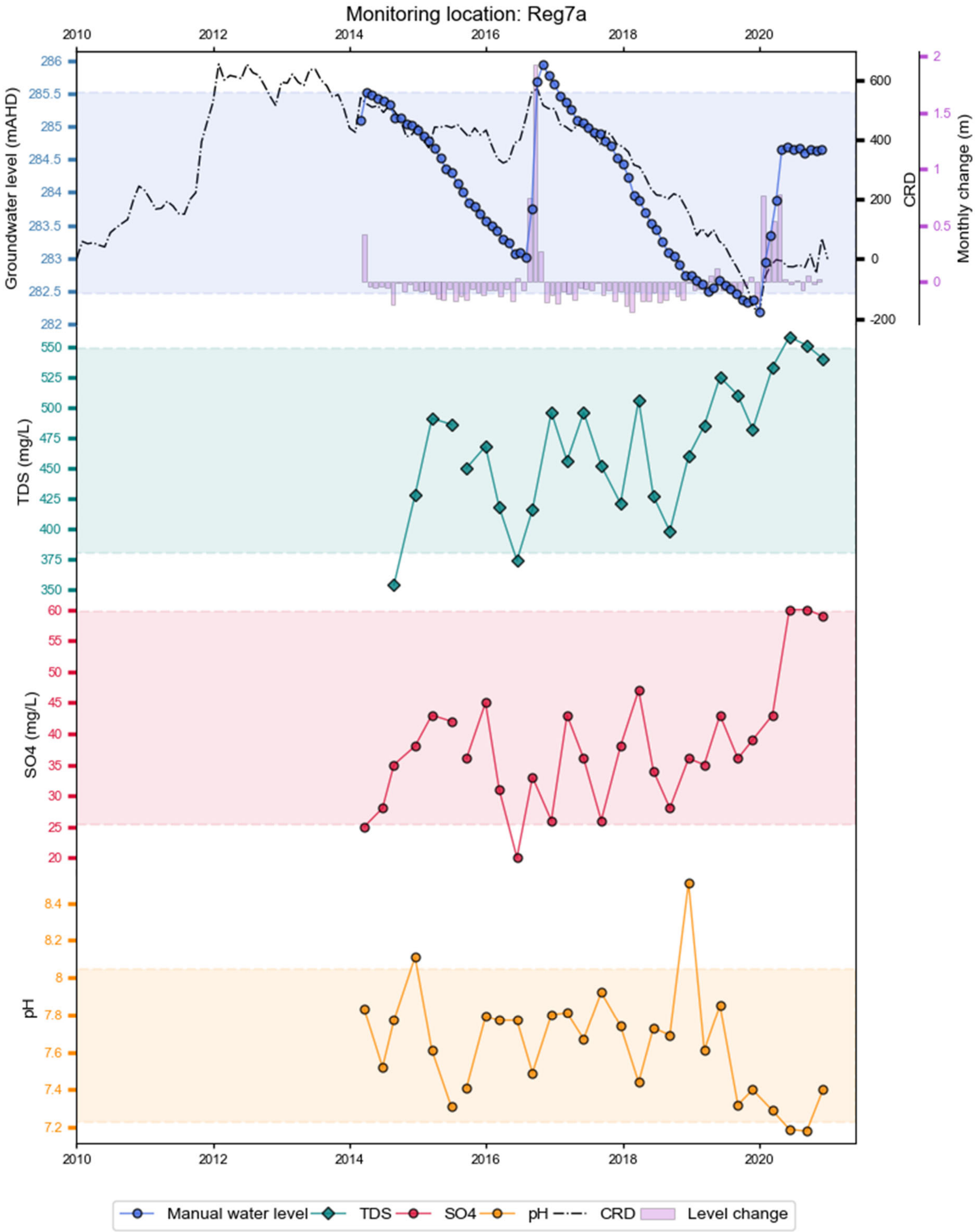
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



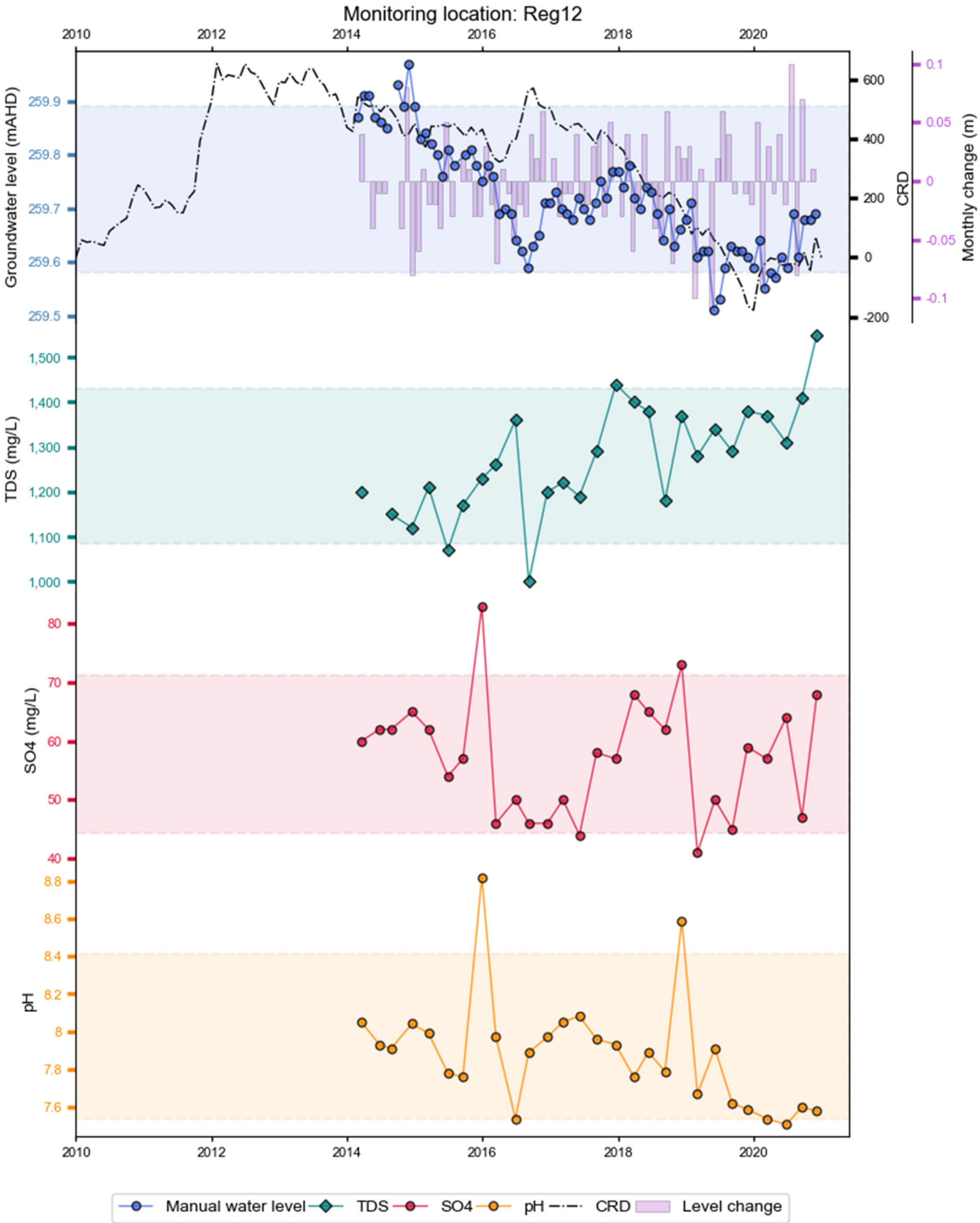
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



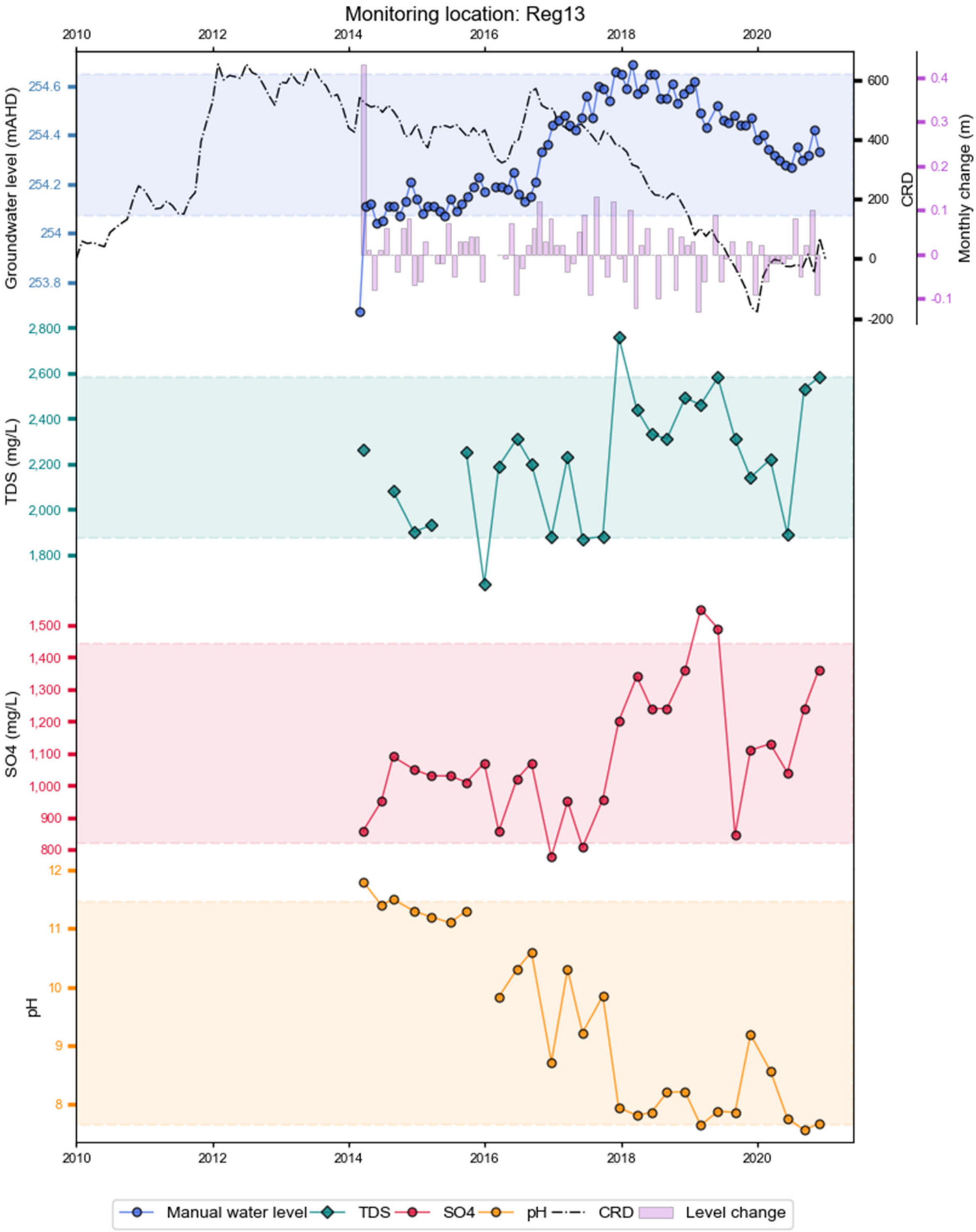
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



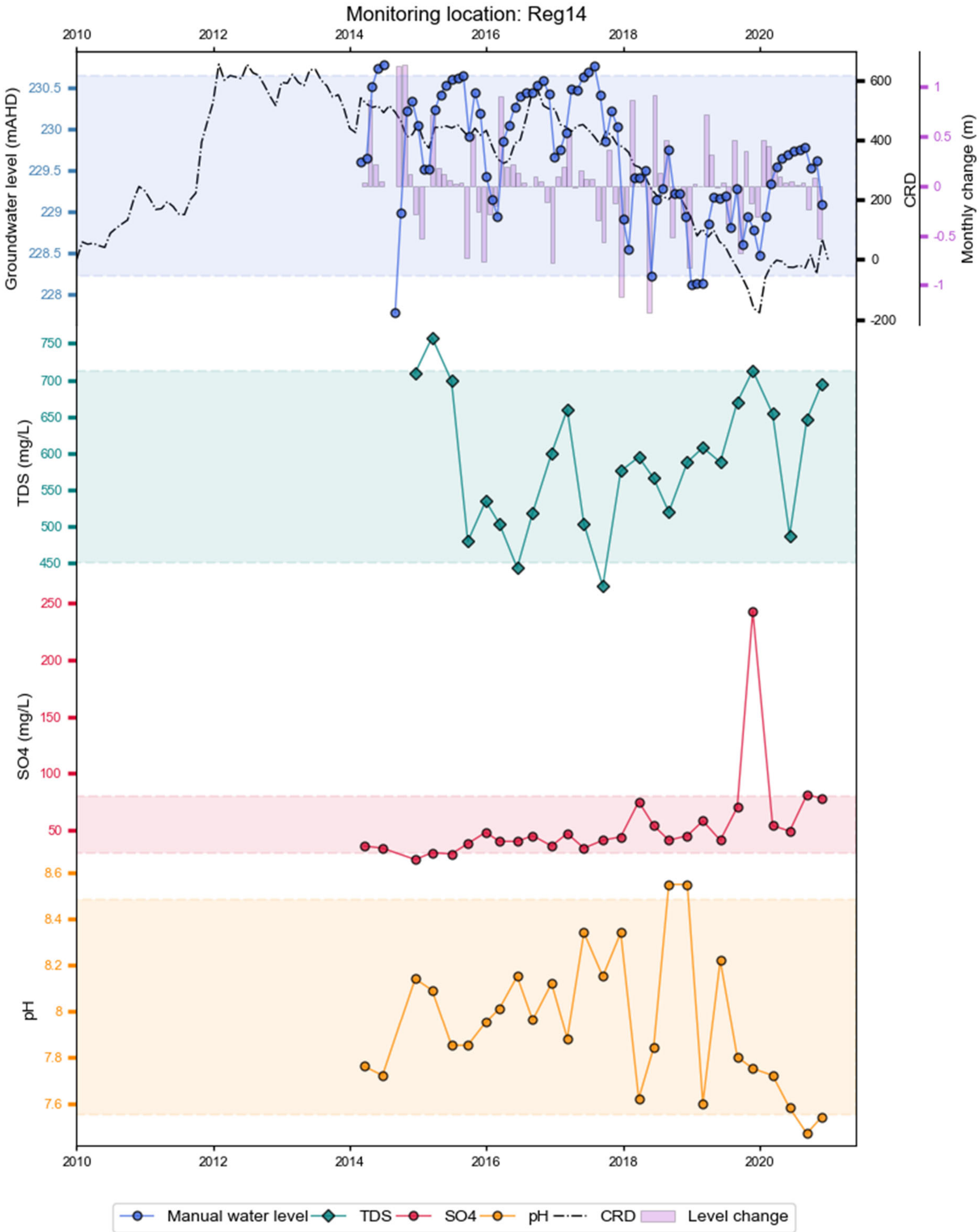
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



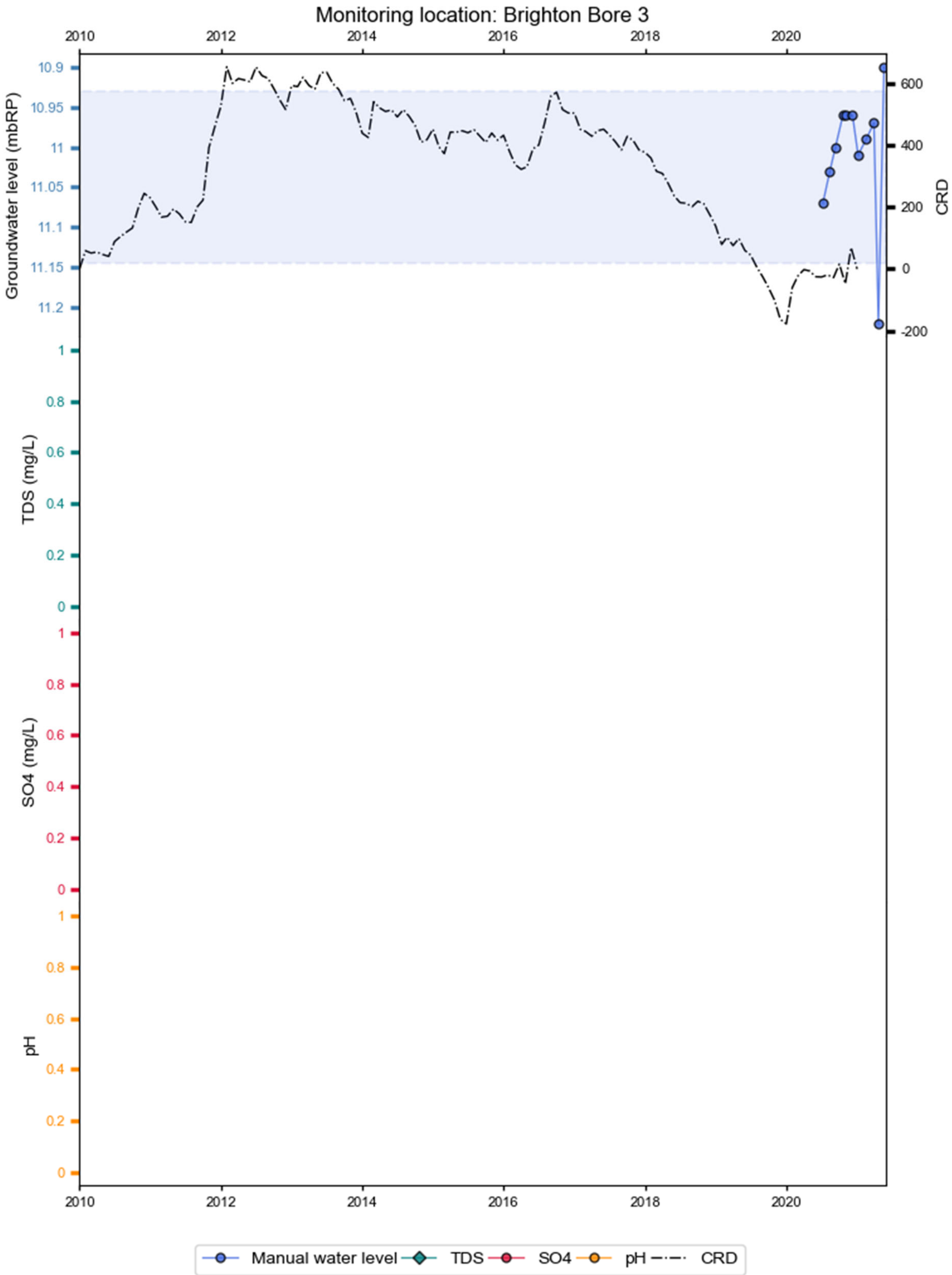
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



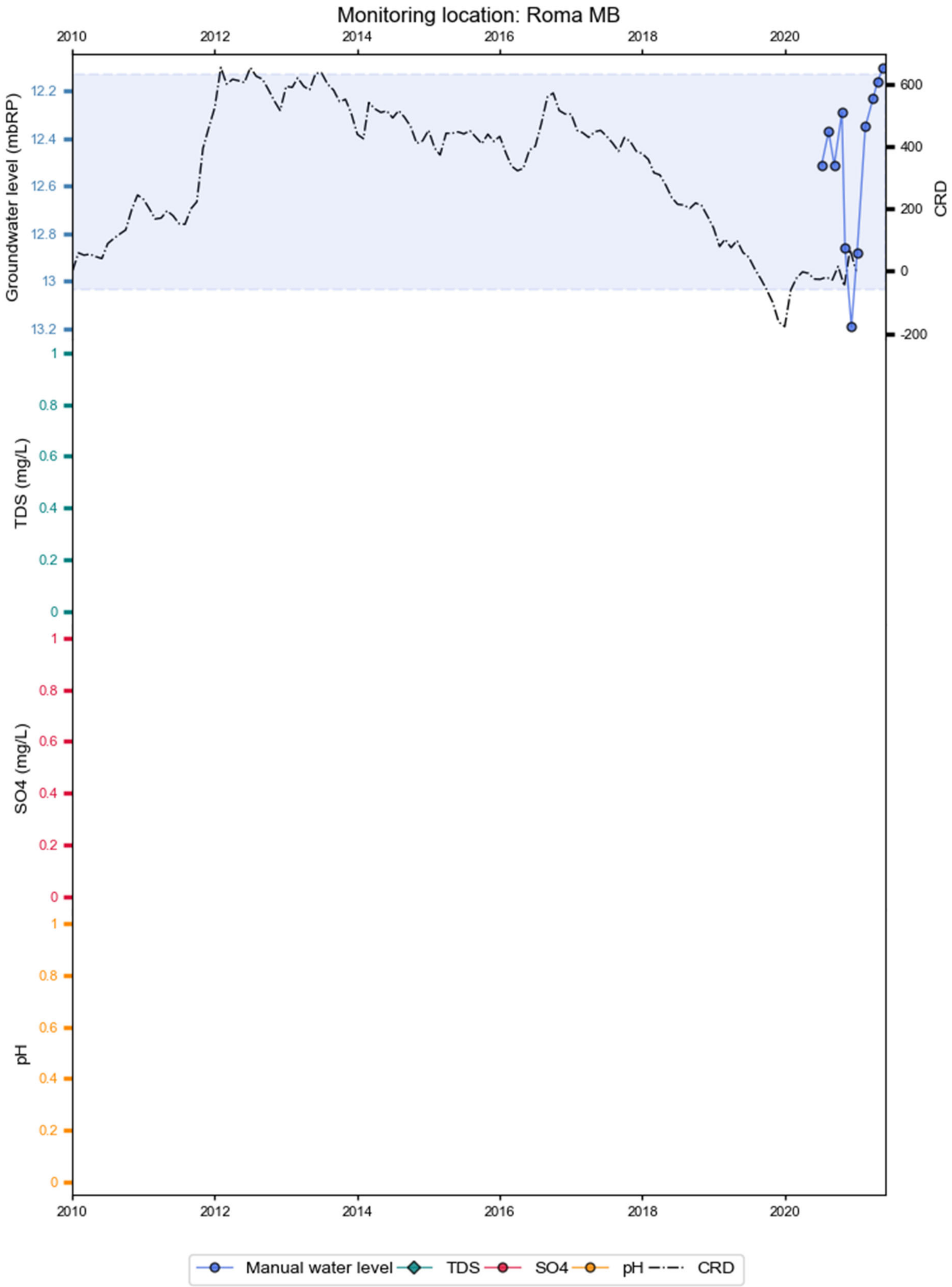
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



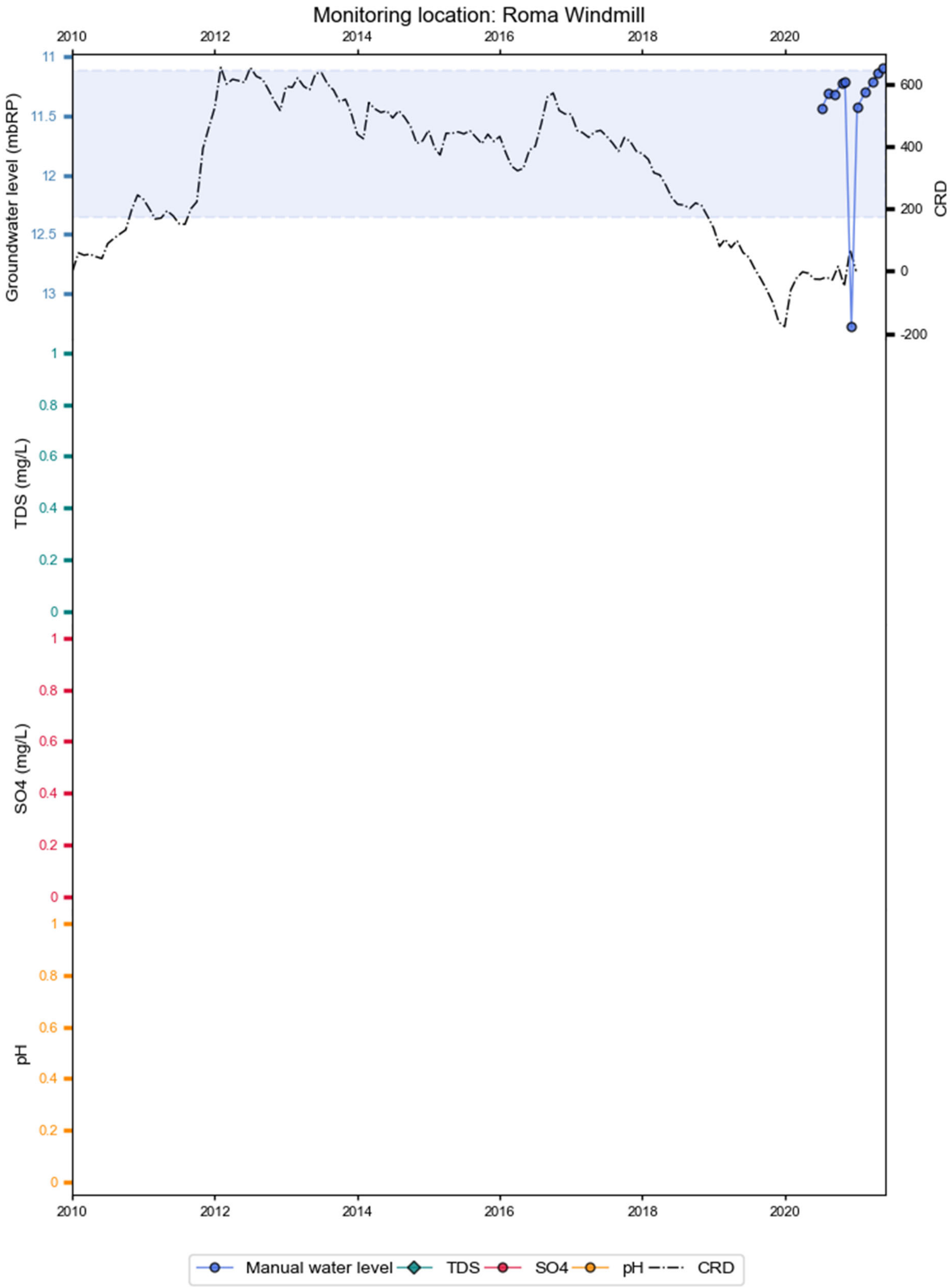
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



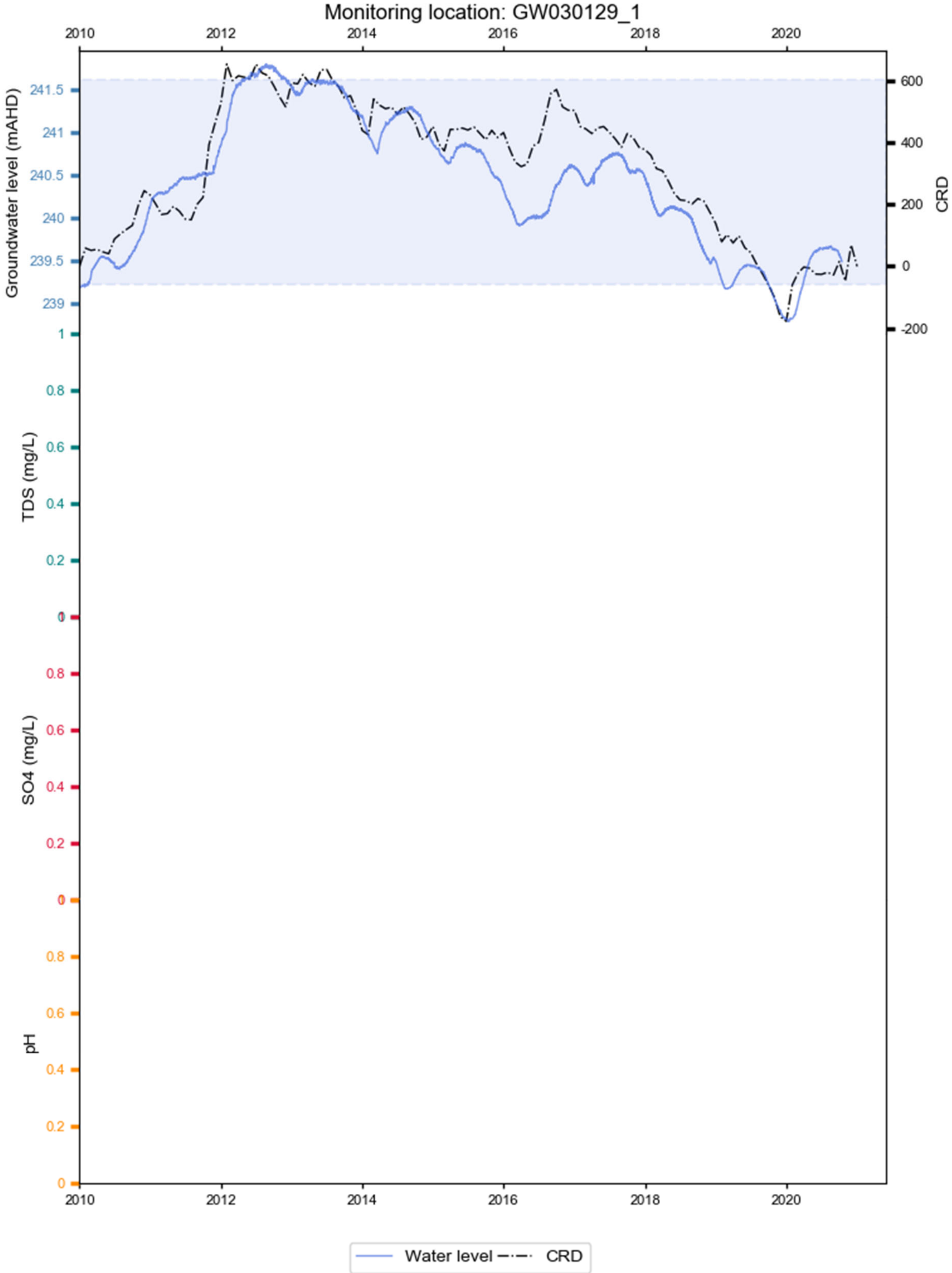
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



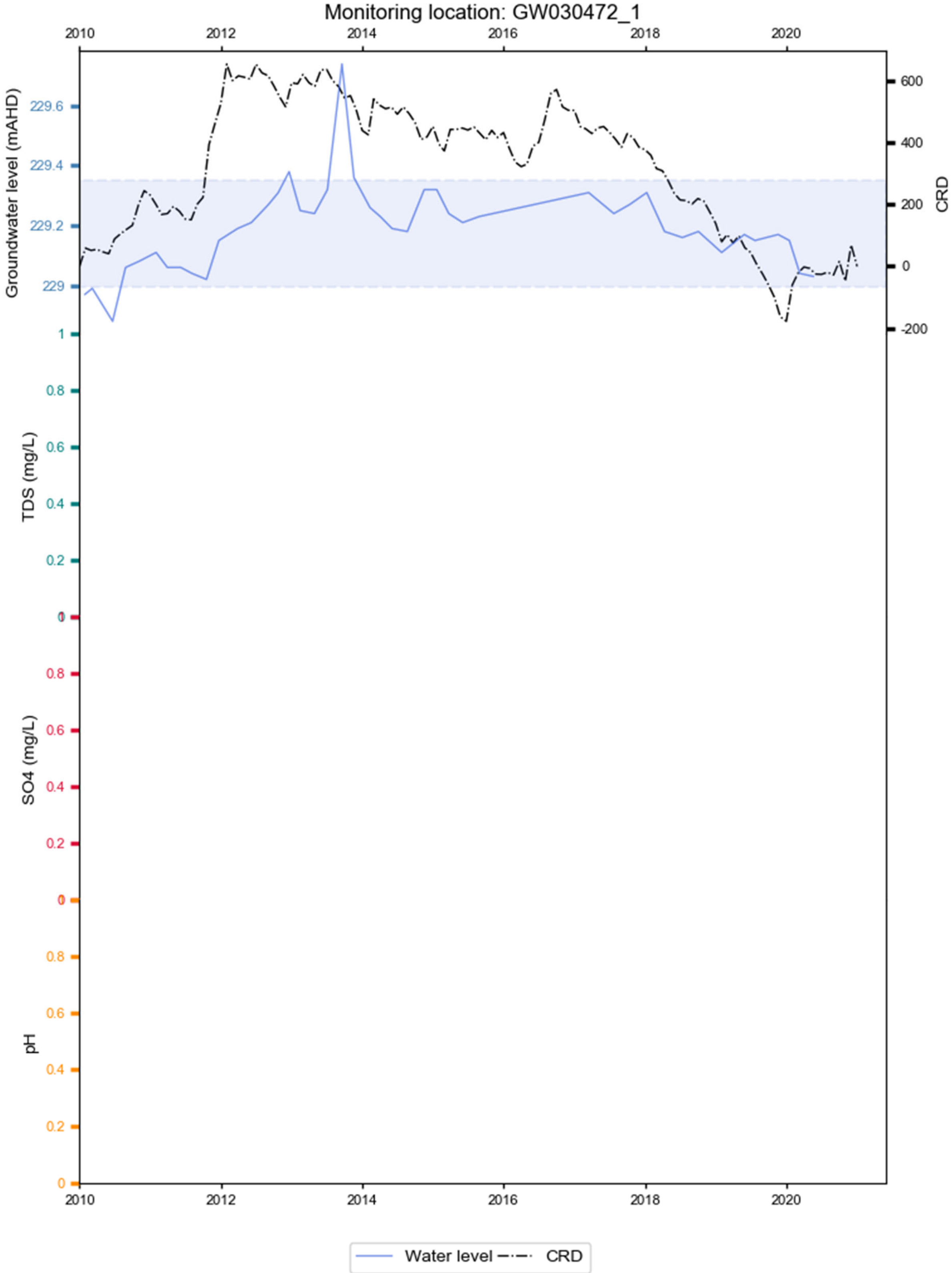
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



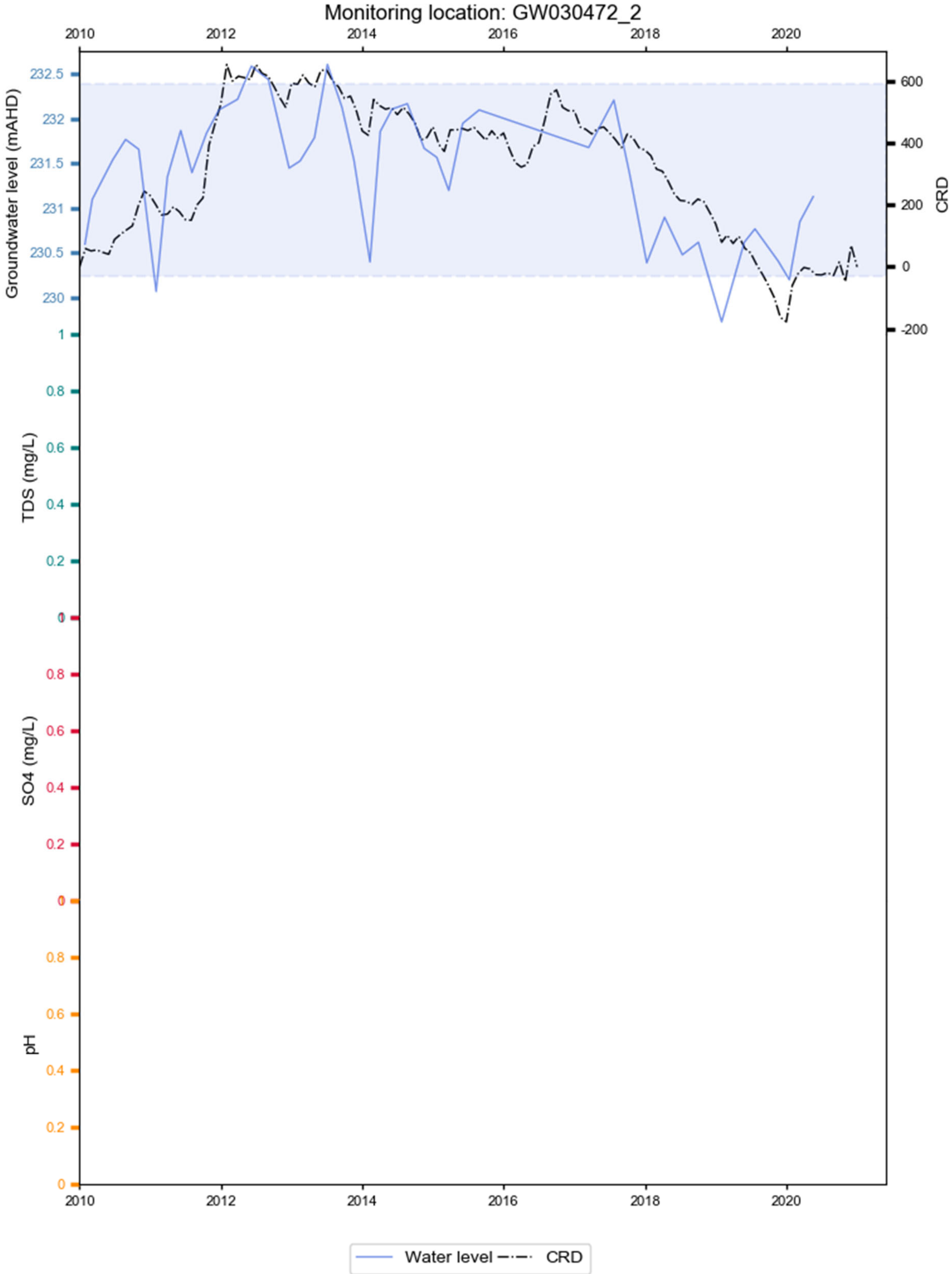
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



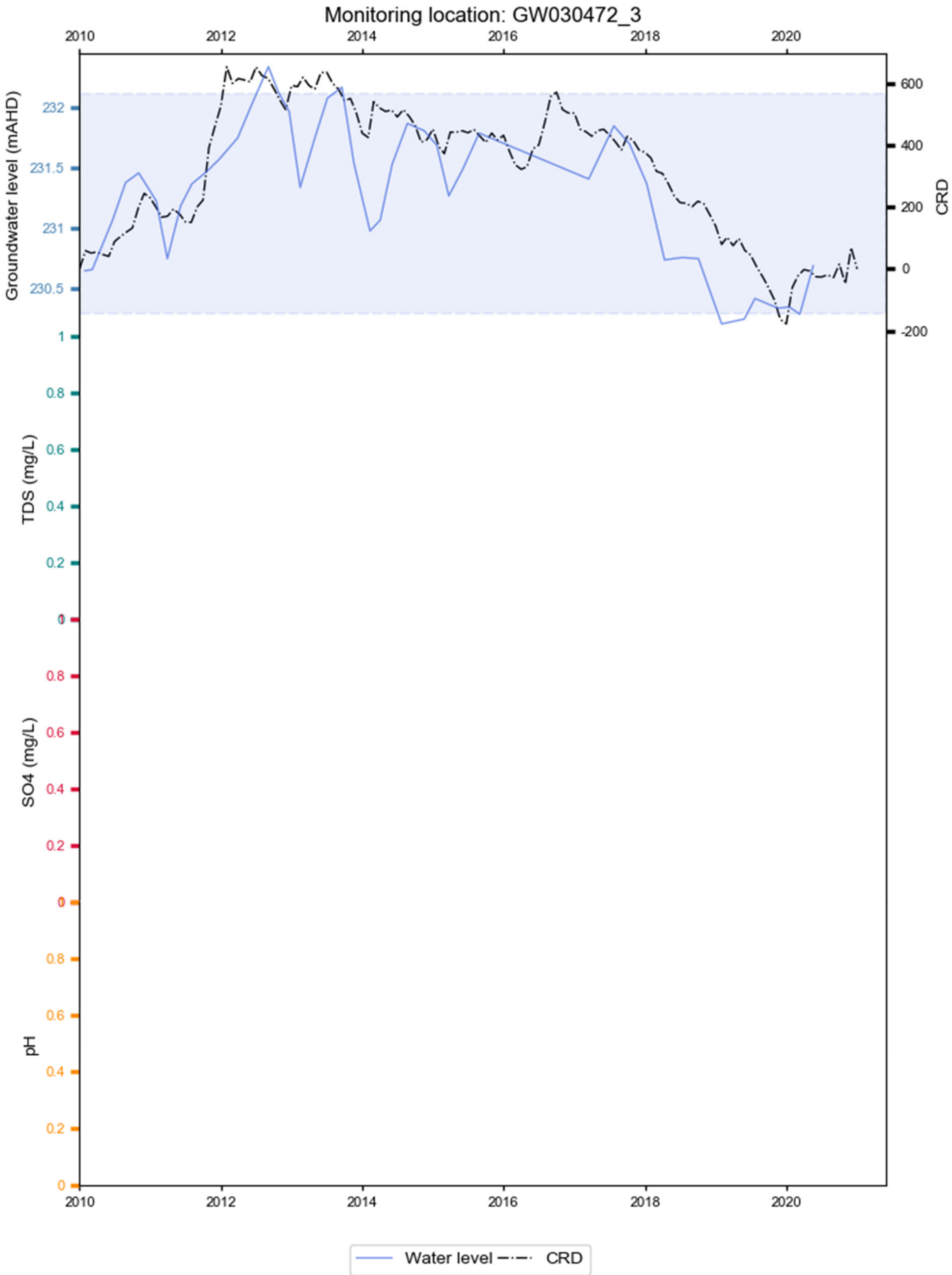
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



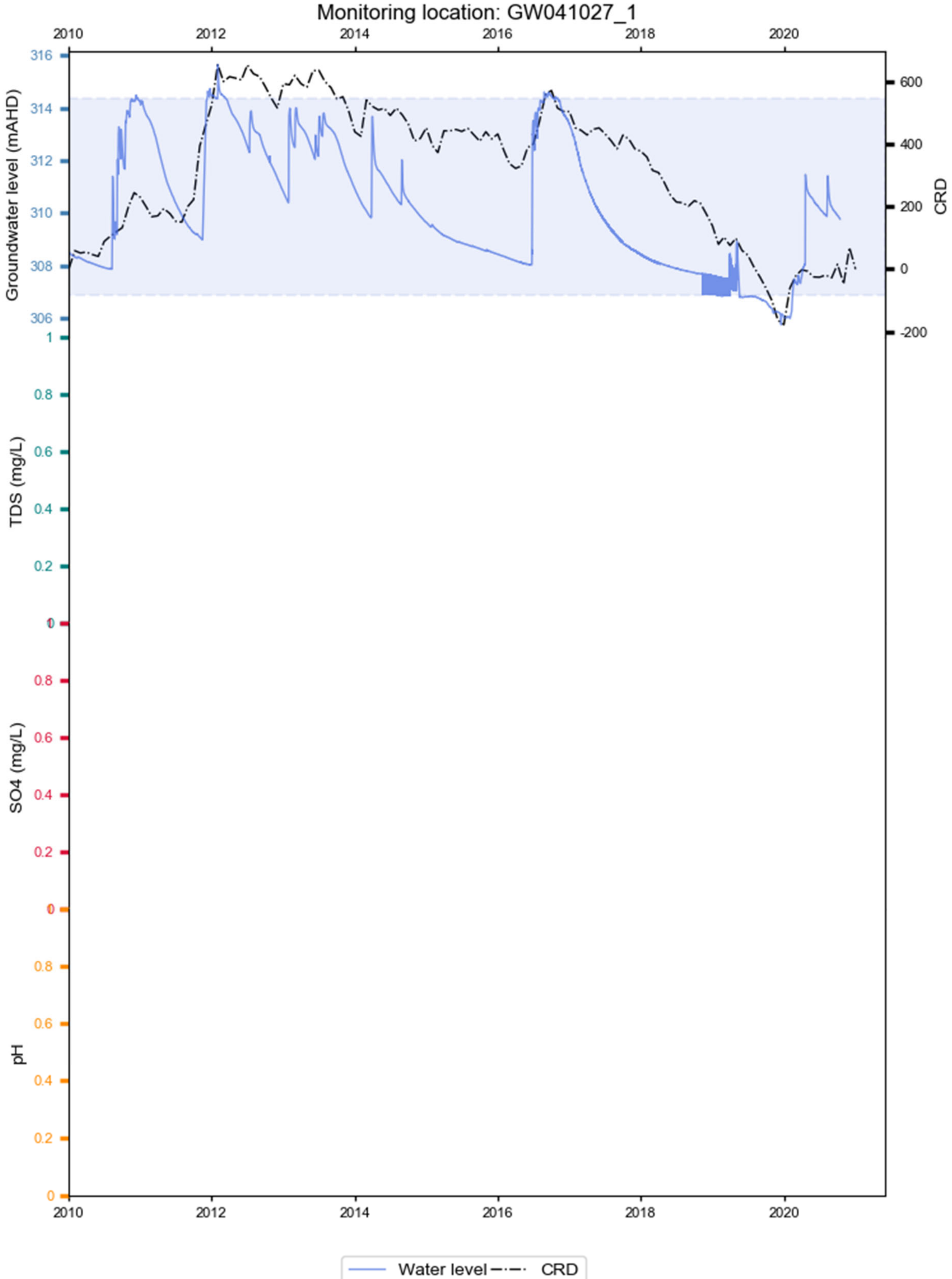
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



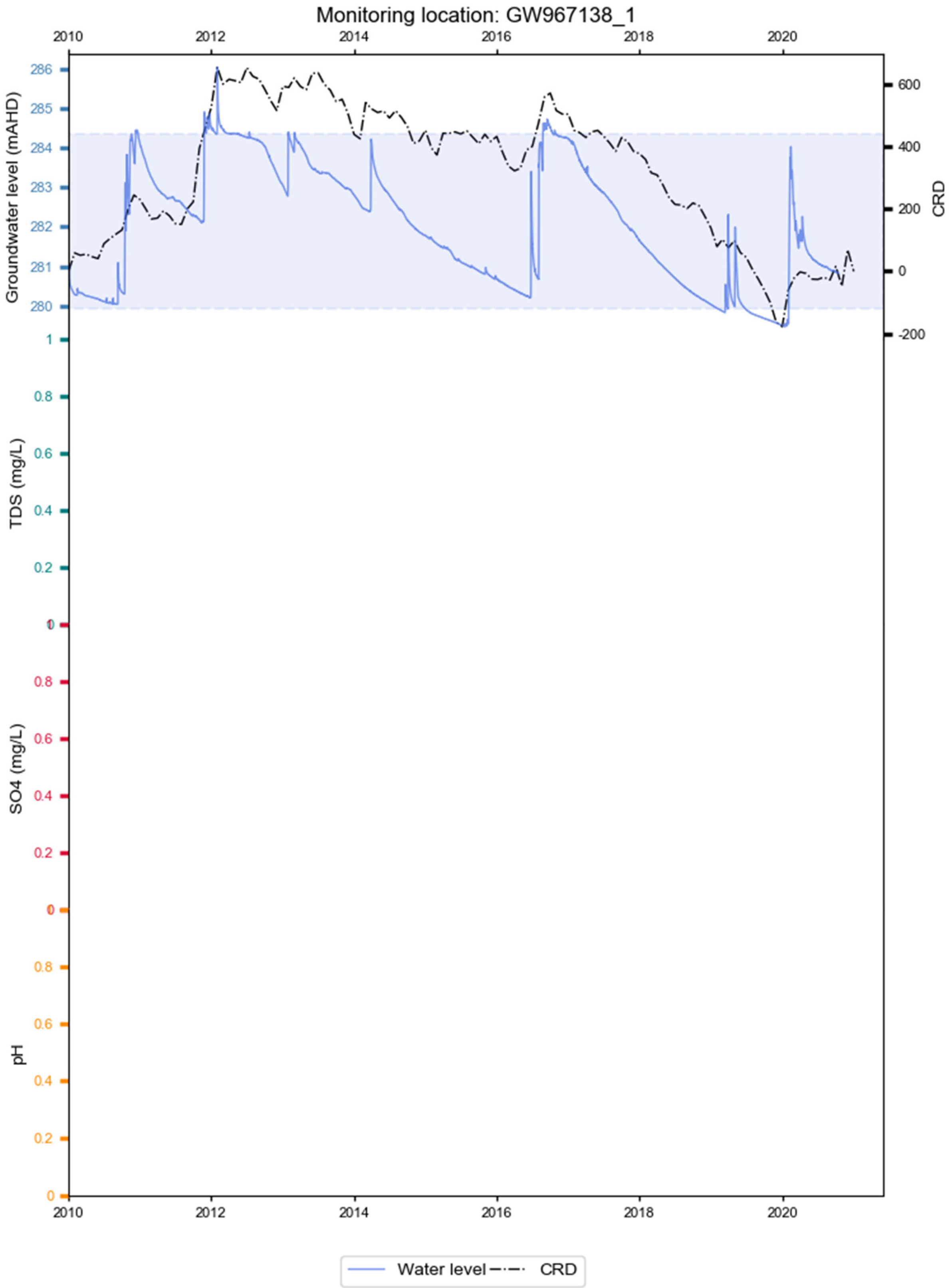
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



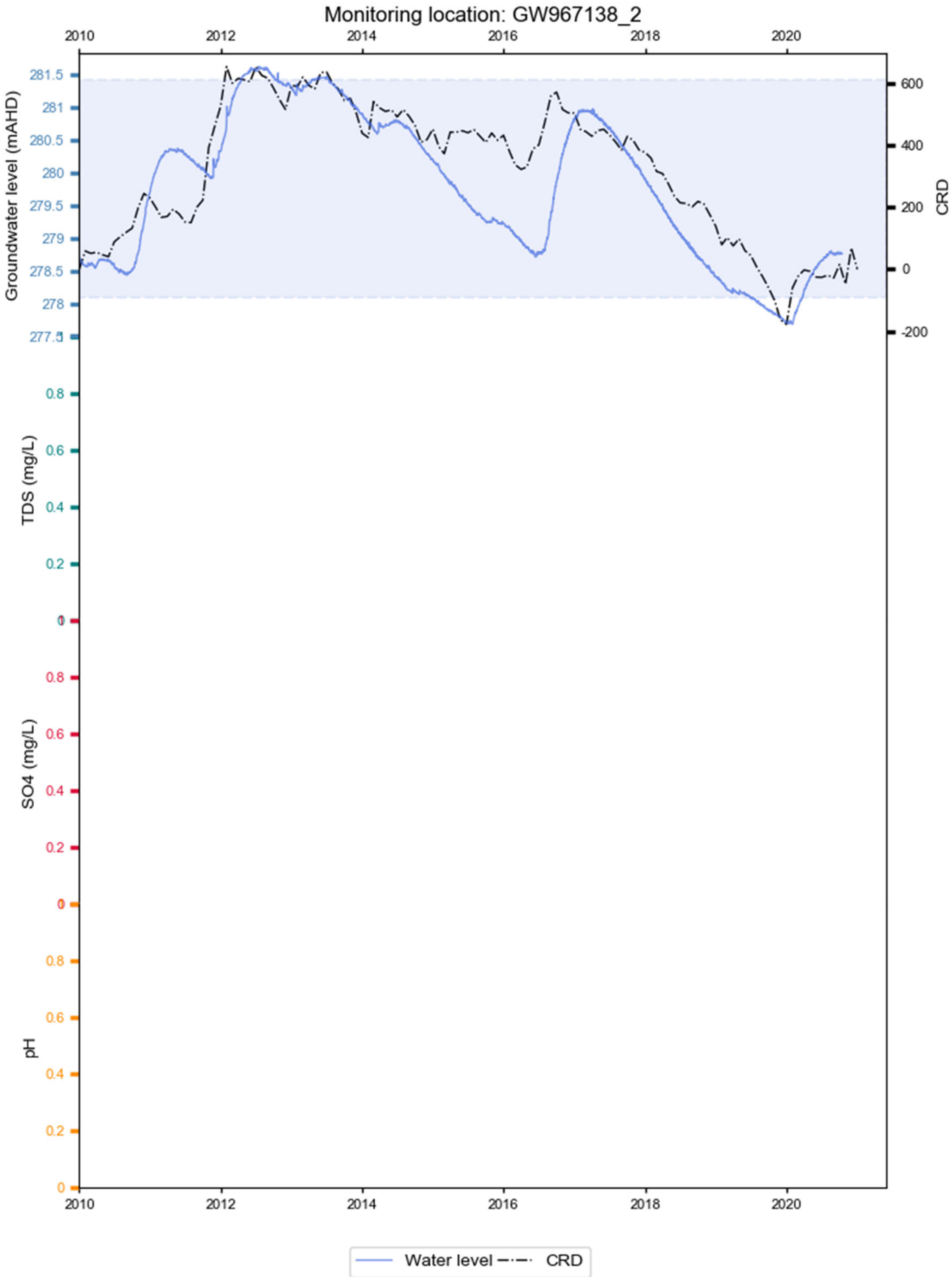
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset



Shaded areas represent values between the 5th and 95th percentile of the baseline dataset

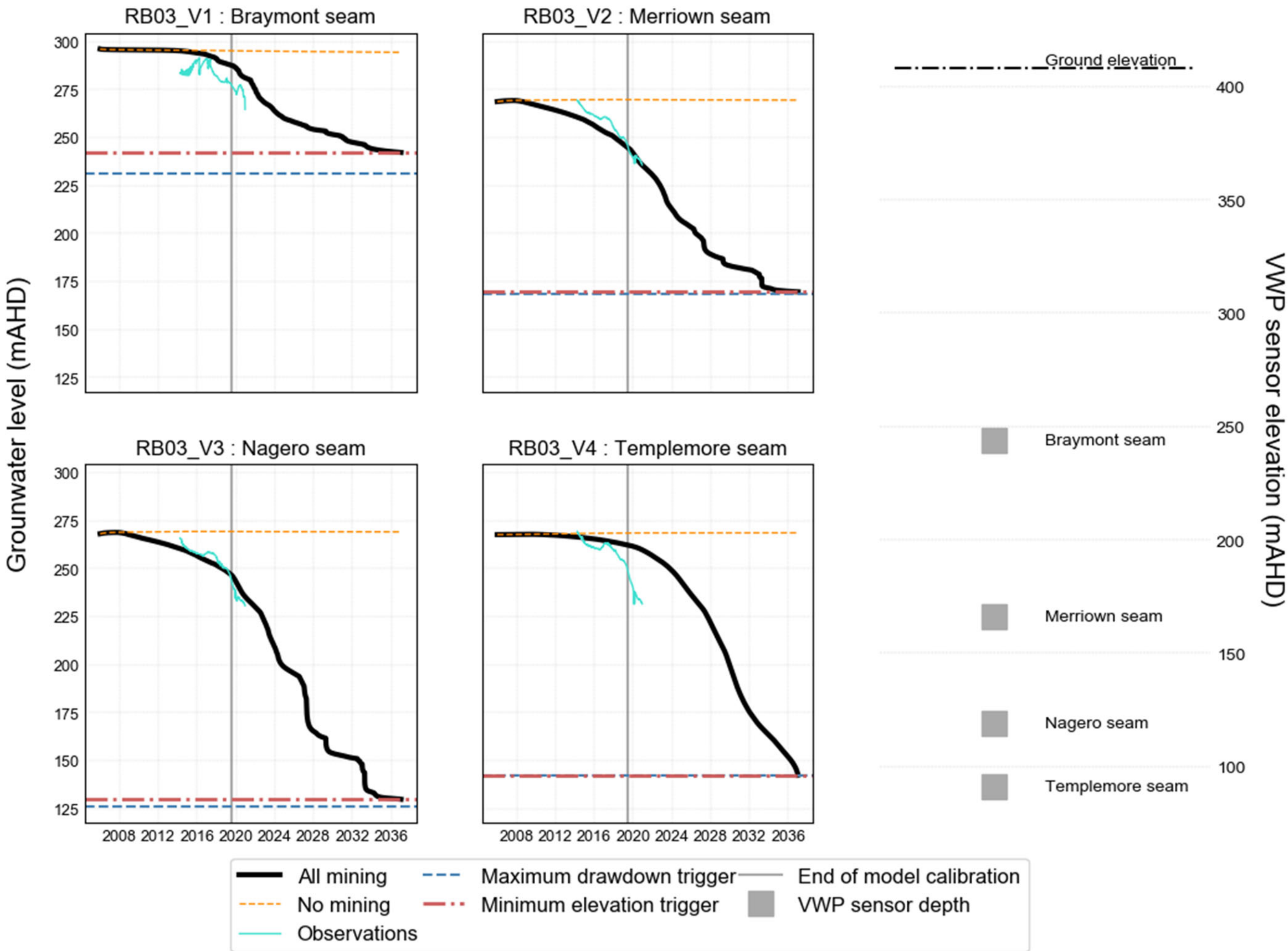


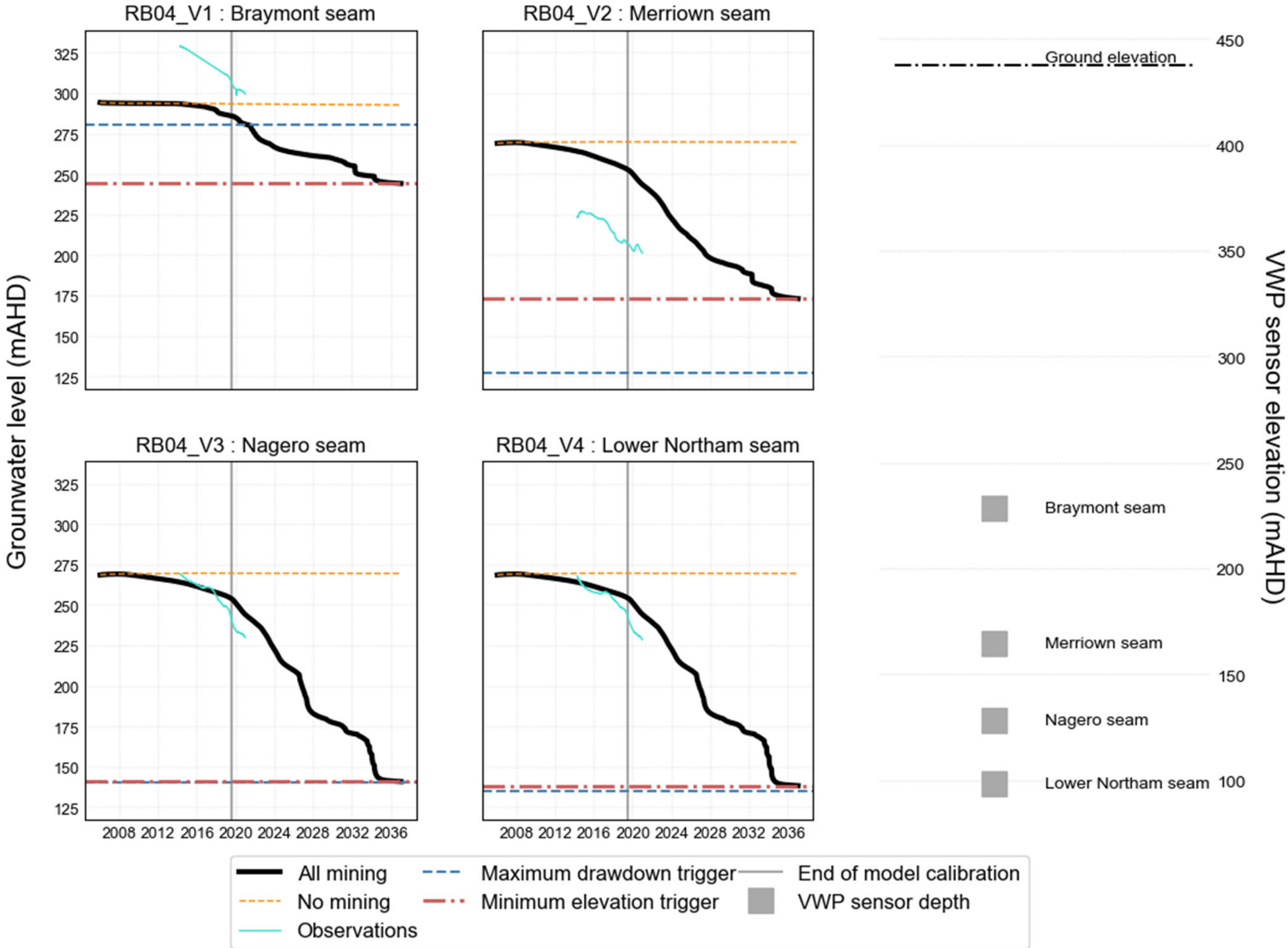
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset

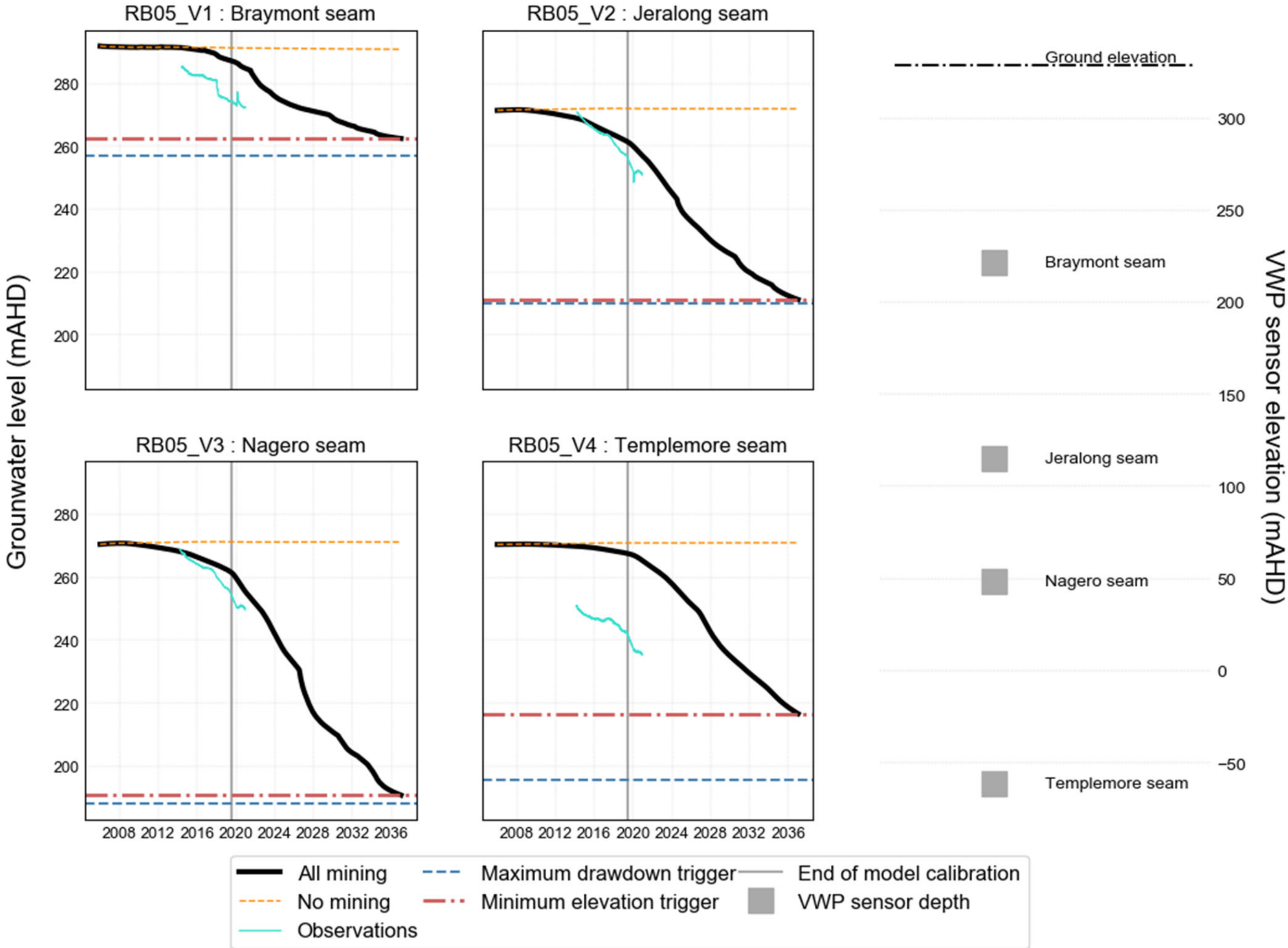


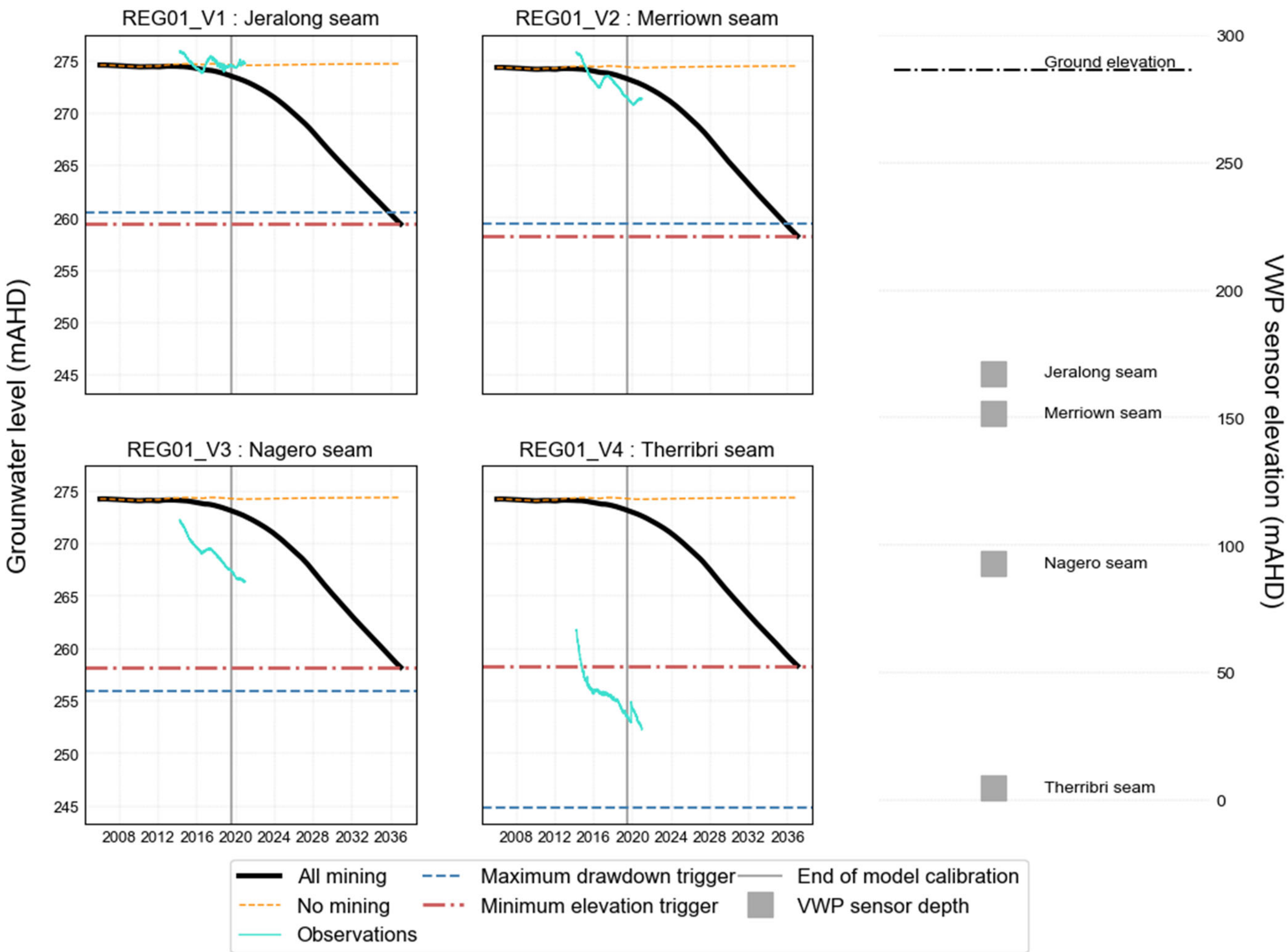
Shaded areas represent values between the 5th and 95th percentile of the baseline dataset

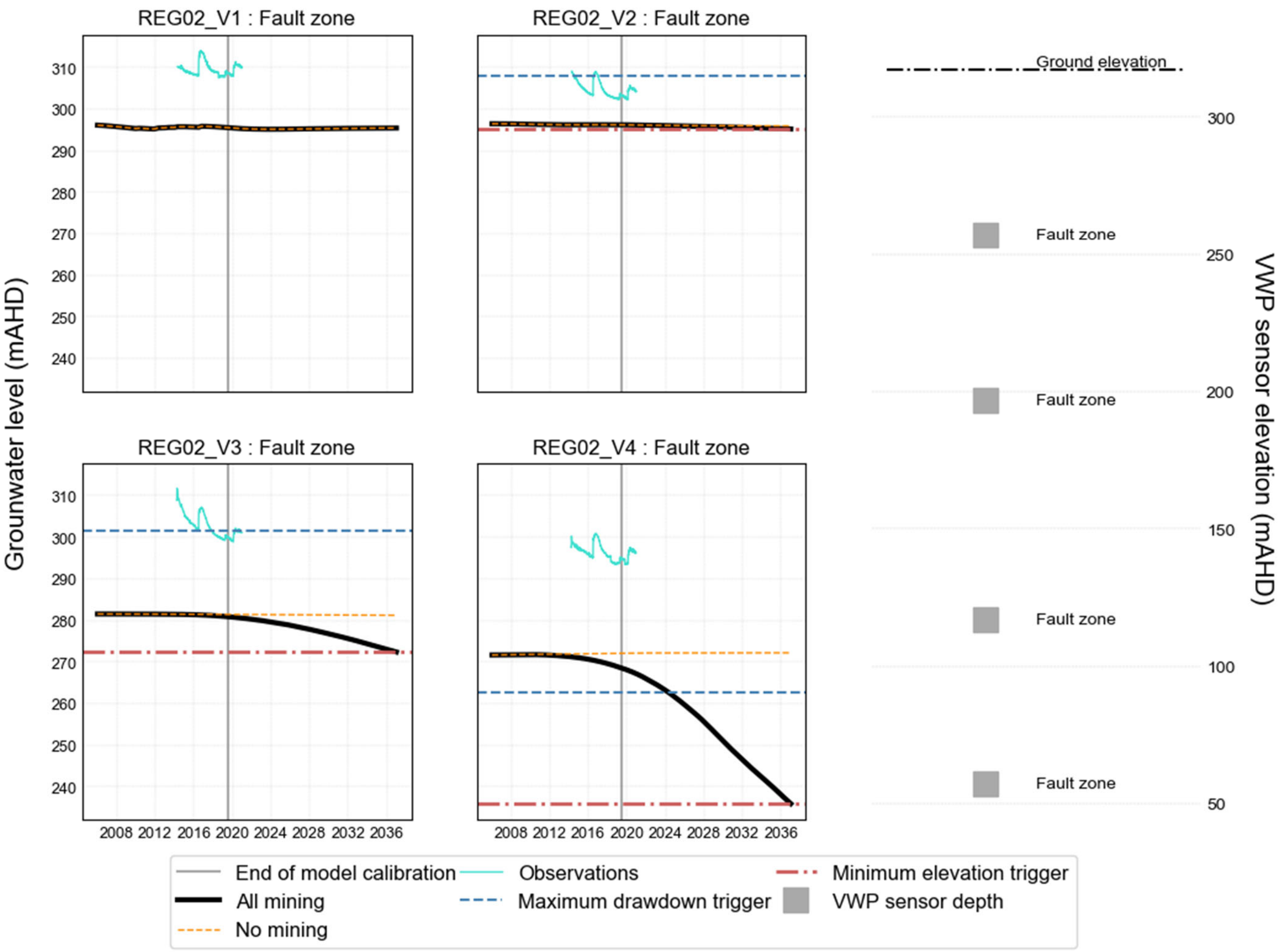
16 ATTACHMENT C – SUMMARY OF VWP MONITORING DATA AND TRIGGERS

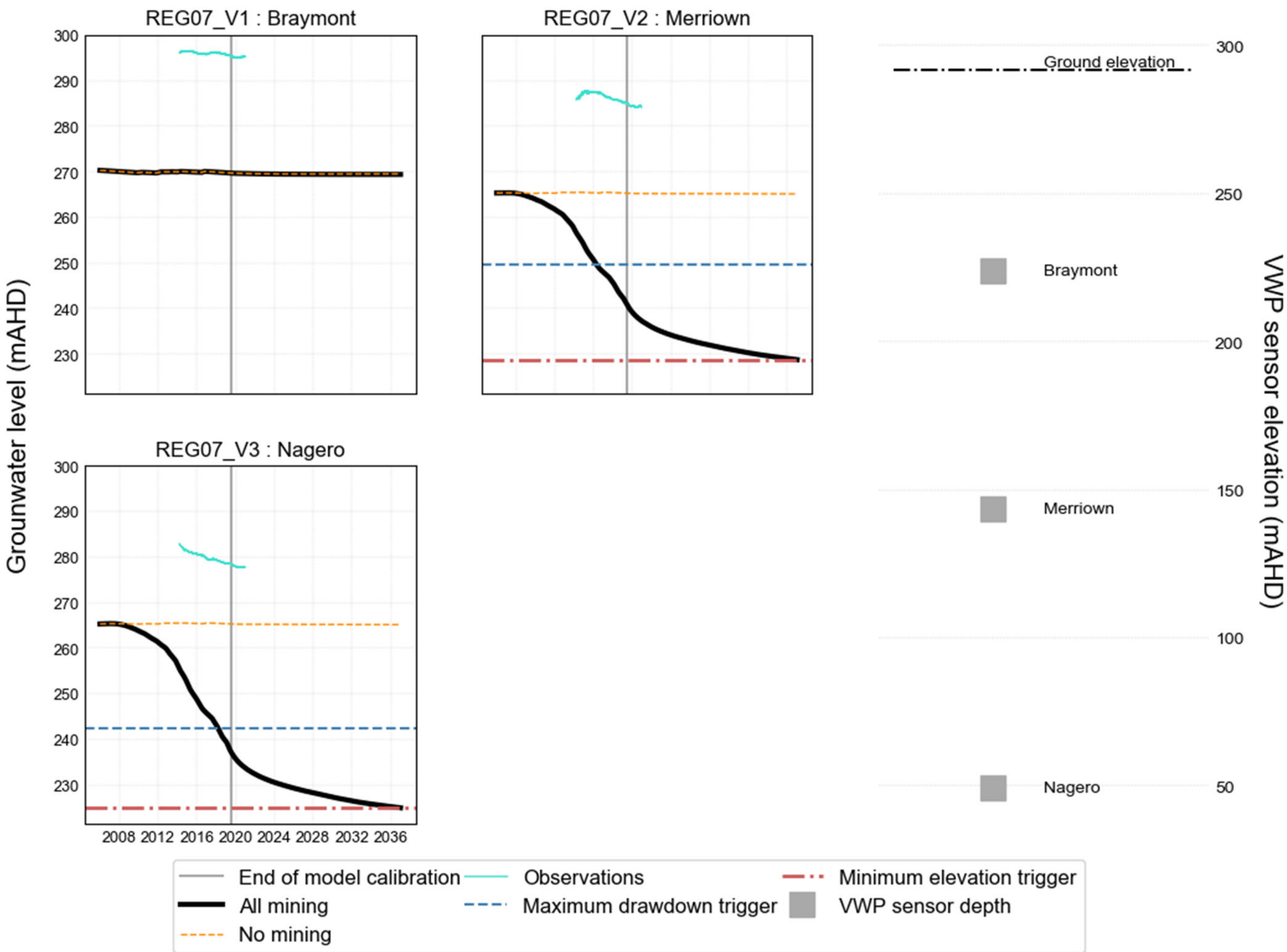

RB03_V1 : Braymont seam
RB03_V2 : Merriown seam
RB03_V3 : Nagero seam
RB03_V4 : Templemore seam
Grounwater level (mAHD)
300
275
250
225
200
175
150
125
2008 2012 2016 2020 2024 2028 2032 2036
Ground elevation
Braymont seam
Merriown seam
Nagero seam
Templemore seam
400
350
300
250
200
150
100
VWP sensor elevation (mAHD)
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth

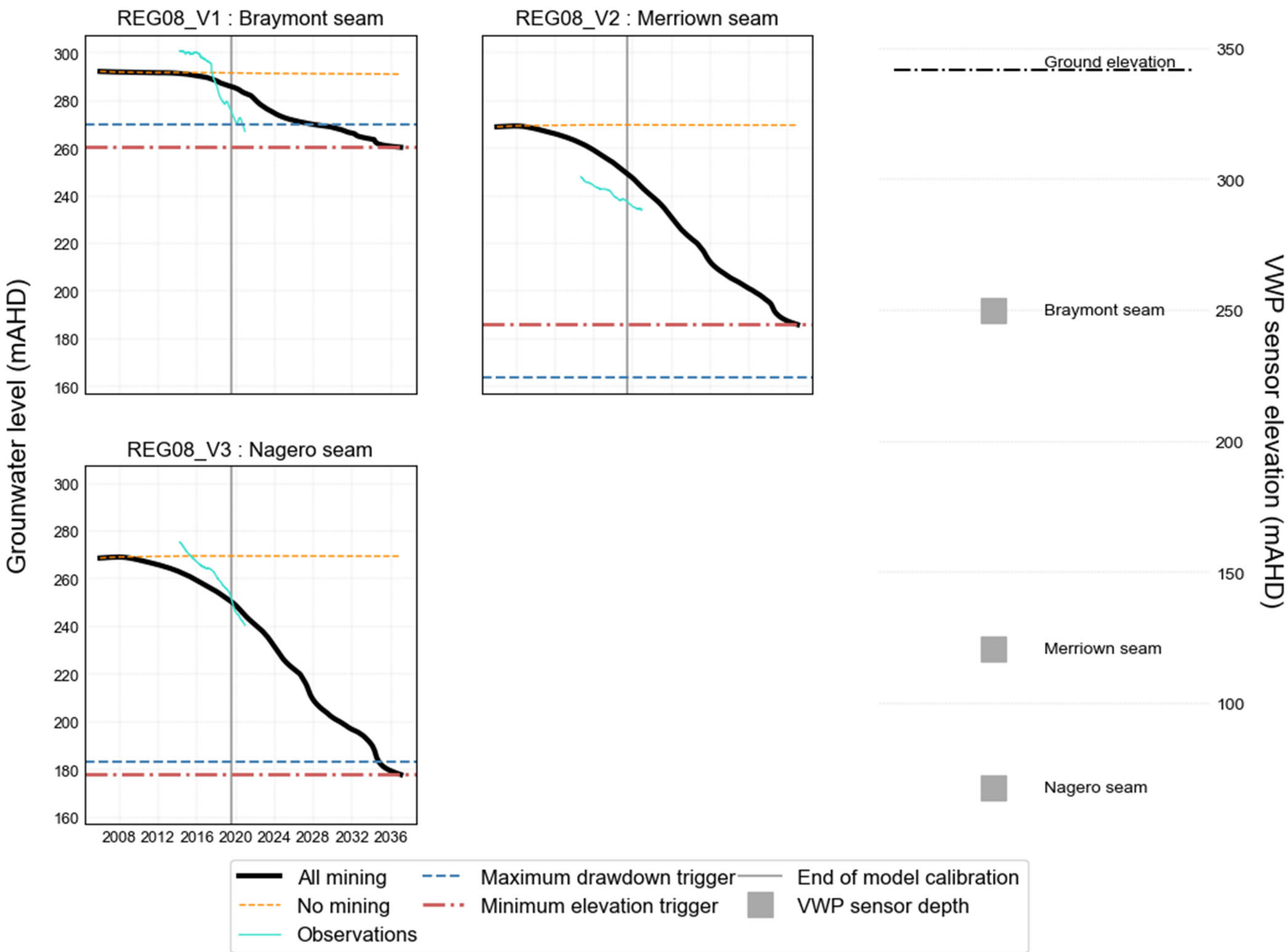

RB04_V1 : Braymont seam
RB04_V2 : Merriown seam
RB04_V3 : Nagero seam
RB04_V4 : Lower Northam seam
Grounwater level (mAHD)
325
300
275
250
225
200
175
150
125
2008 2012 2016 2020 2024 2028 2032 2036
Ground elevation
Braymont seam
Merriown seam
Nagero seam
Lower Northam seam
450
400
350
300
250
200
150
100
VWP sensor elevation (mAHD)
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth

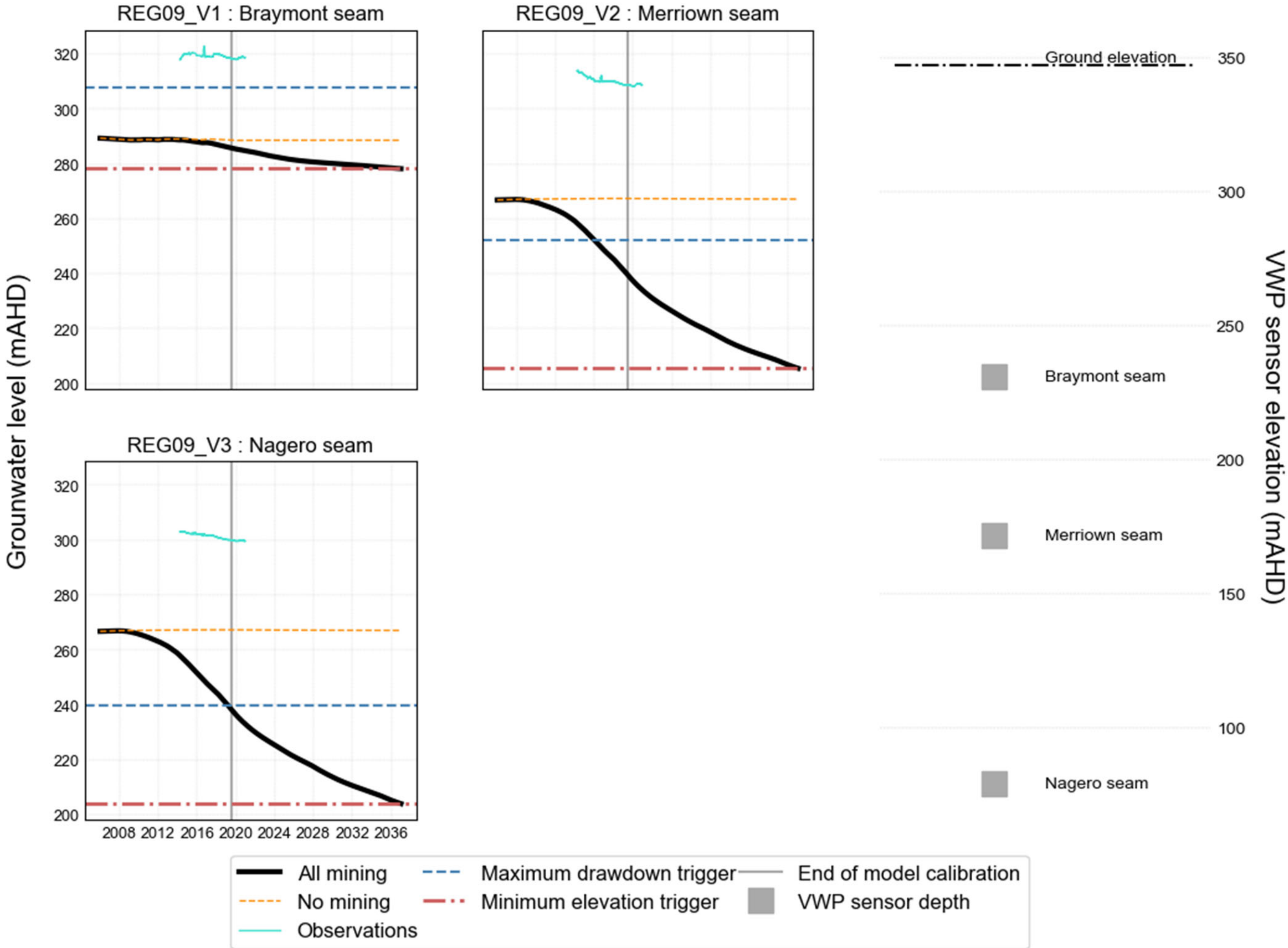

RB05_V1 : Braymont seam
RB05_V2 : Jeralong seam
RB05_V3 : Nagero seam
RB05_V4 : Templemore seam
Grounwater level (mAHD)
280
260
240
220
200
2008 2012 2016 2020 2024 2028 2032 2036
Ground elevation
300
250
200
150
100
50
0
−50
Braymont seam
Jeralong seam
Nagero seam
Templemore seam
VWP sensor elevation (mAHD)
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth


REG01_V1 : Jeralong seam
REG01_V2 : Merriown seam
REG01_V3 : Nagero seam
REG01_V4 : Therribri seam
Grounwater level (mAHD)
275
270
265
260
255
250
245
2008 2012 2016 2020 2024 2028 2032 2036
VWP sensor elevation (mAHD)
300
250
200
150
100
50
0
Ground elevation
Jeralong seam
Merriown seam
Nagero seam
Therribri seam
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth

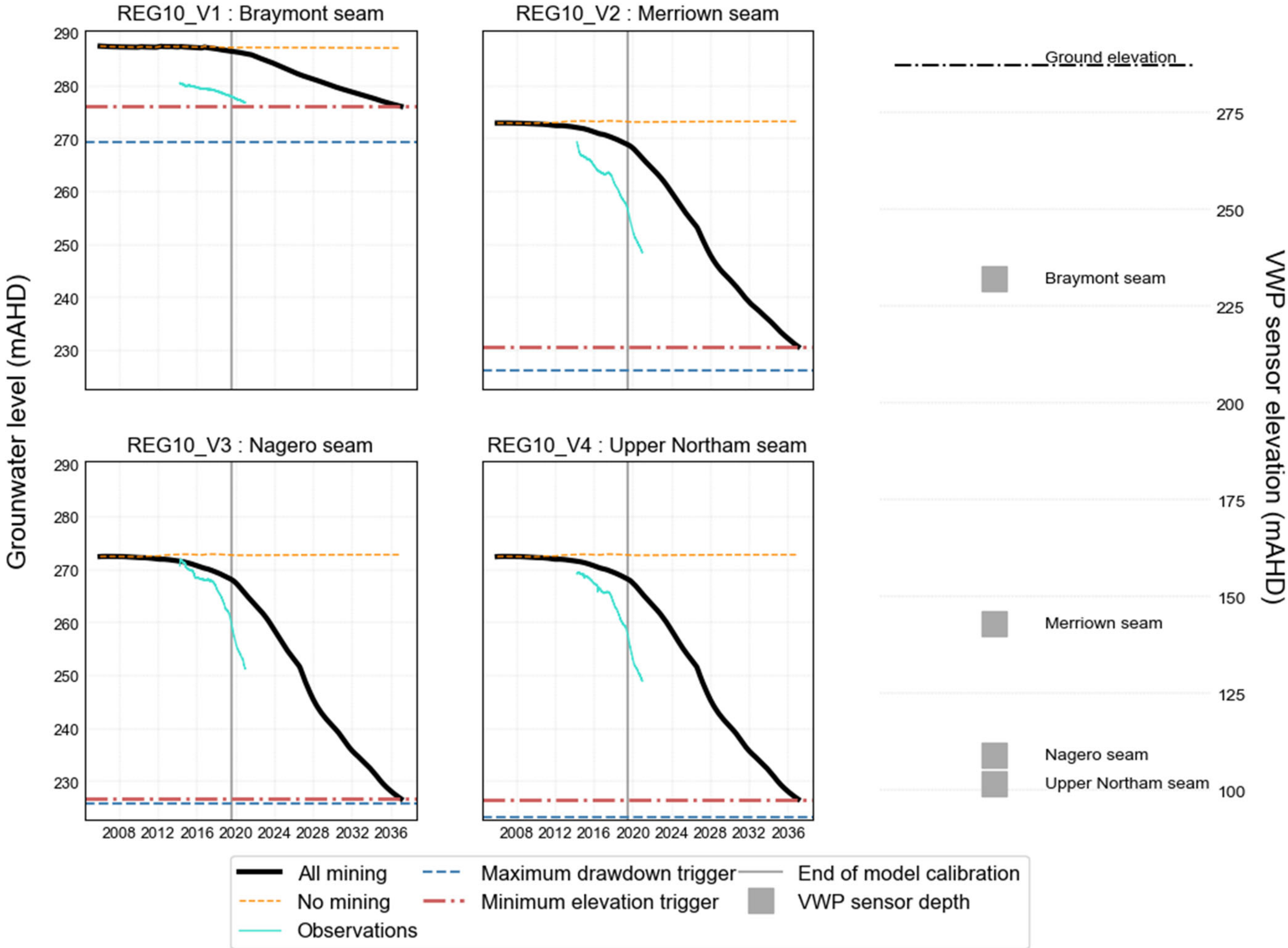

REG02_V1 : Fault zone
REG02_V2 : Fault zone
REG02_V3 : Fault zone
REG02_V4 : Fault zone
Grounwater level (mAHD)
VWP sensor elevation (mAHD)
Ground elevation
Fault zone
Fault zone
Fault zone
Fault zone
End of model calibration
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
VWP sensor depth


REG07_V1 : Braymont
REG07_V2 : Merriown
REG07_V3 : Nagero
Grounwater level (mAHD)
VWP sensor elevation (mAHD)
Ground elevation
Braymont
Merriown
Nagero
2008 2012 2016 2020 2024 2028 2032 2036
End of model calibration
Observations
Minimum elevation trigger
All mining
Maximum drawdown trigger
VWP sensor depth
No mining


REG08_V1 : Braymont seam
REG08_V2 : Merriown seam
REG08_V3 : Nagero seam
Grounwater level (mAHD)
300
280
260
240
220
200
180
160
2008 2012 2016 2020 2024 2028 2032 2036
Ground elevation
Braymont seam
Merriown seam
Nagero seam
350
250
150
100
VWP sensor elevation (mAHD)
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth


REG09_V1 : Braymont seam
REG09_V2 : Merriown seam
REG09_V3 : Nagero seam
Grounwater level (mAHD)
VWP sensor elevation (mAHD)
Ground elevation
Braymont seam
Merriown seam
Nagero seam
320
300
280
260
240
220
200
350
250
150
100
2008 2012 2016 2020 2024 2028 2032 2036
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth

1


REG10_V1 : Braymont seam
REG10_V2 : Merriown seam
REG10_V3 : Nagero seam
REG10_V4 : Upper Northam seam
Grounwater level (mAHD)
VWP sensor elevation (mAHD)
Ground elevation
Braymont seam
Merriown seam
Nagero seam
Upper Northam seam
2008 2012 2016 2020 2024 2028 2032 2036
All mining
No mining
Observations
Maximum drawdown trigger
Minimum elevation trigger
End of model calibration
VWP sensor depth