Waste Discharge Licence 174-13

Monitoring Report

1 May 2022 to 30 April 2023

MCARTHUR RIVER MINE

McArthur River Mining Pty Ltd

DOCUMENT PROPERTIES

Date	31/08/2023
Department	Health, Safety and Environment
Prepared by	McArthur River Mining Pty Ltd
Licence Expiry Date	25 May 2023 (WDL 174-13)

Executive Summary

Pursuant to Section 74 of the *Water Act 1992* (Northern Territory [NT]), McArthur River Mining Pty Ltd (MRM) was granted an amended Waste Discharge Licence (WDL) 174-13 on 10 March 2022. The WDL permitted the conditional release of water at authorised discharge points. The WDL allowed for the release of water into the McArthur River catchment at the McArthur River Mine (the Mine) and into the marine waters of the Gulf of Carpentaria from the Dredge Spoil Emplacement Area (DSEA) at the Bing Bong Loading Facility (BBLF).

In addition, pursuant to the *Mining Management Act 2001* (NT), the Variation of Authorisation (VoA) 0059 permitted the conditional release of water at the Water Management Dam Release Point into the McArthur River catchment via Little Barney Creek.

Strict environmental conditions are in place to protect the beneficial uses and community values of the McArthur River and Gulf of Carpentaria marine waters. The WDL identifies the downstream compliance point on the McArthur River as SW11, which is appropriately located downstream of the operations to identify any potential for impact on the receiving environment. The WDL also identifies the compliance point downstream of the DSEA as the Bing Bong Dredge Discharge Point (BBDDP).

Site-specific Trigger Values (SSTVs) are listed in the WDL for SW11 and BBDDP. Over the reporting period, the SSTVs were compared to water quality monitoring results for the compliance points. Where results were triggered pursuant to Condition 40 of WDL 174-13, an investigation report was documented by MRM and submitted to the NT Department of Environment, Parks and Water Security (DEPWS).

This Monitoring Report has been submitted in accordance with Condition 43 of WDL 174-13 and covers the reporting period 1 May 2022 to 30 April 2023. WRM Water & Environment Pty Ltd (WRM) was commissioned by MRM to assess site surface water monitoring data (WRM, 2023a) and mine derived analyte loads (WRM, 2023b) for the reporting period.

Climate Influences at the Mine

The McArthur River catchment experiences a monsoonal climate regime, which is strongly seasonal with distinct wet and dry seasons. Climatic conditions are known to significantly influence the natural environment in the vicinity of the Mine, in particular the McArthur River and its tributaries. The total rainfall over the 12-month reporting period was approximately 872 millimetres (mm), which is higher than the annual average of 717 mm. The highest daily rainfall during the period was 70 mm, which was recorded on 15 November 2022.

Notably, over the reporting period, the compliance monitoring point SW11 (on the McArthur River) experienced cease to flow conditions during the dry season between May 2022 and mid-November 2022.

Climate Influences at the Bing Bong Loading Facility

The BBLF experiences a monsoonal climate regime similar to the Mine, which is strongly seasonal with distinct wet and dry seasons. The total rainfall over the 12-month reporting period was approximately 923 mm, which is higher than the annual average of 893 mm.

Notably, over the reporting period, the compliance monitoring point BBDDP experienced cease to flow or dry conditions for most of the scheduled sampling events.

Water Treatment and Managed Releases

During the reporting period, water generated at the Mine was treated with hydrated lime in the South-Eastern Perimeter Runoff Dam. The dam was periodically filled with various sources of water for lime treatment. Treated water was dewatered to Pond 2 and then stored in the Water Management Dam for potential release under conditions of the WDL and VoA. A total of 574 tonnes (t) of hydrated lime was used to treat approximately 1,783 megalitres (ML) of water from the Mine over the reporting period.

However, there were no managed releases to the receiving environment from the Mine during the reporting period owing to water conservation for processing and construction purposes. Further, dredge spoil was not

actively emplaced at the BBLF over the reporting period and as such there were no managed releases from the DSEA.

Downstream McArthur River Water Quality

In the McArthur River, a circa neutral to slightly alkaline pH was reported across all the monitoring locations over the reporting period, with no pH results recorded outside of the SSTV range at SW11. The pH results were generally consistent between monitoring locations upstream and downstream of the Mine. There were no electrical conductivity or sulphate results beyond the SSTVs at SW11 over the reporting period. The recorded levels of these analytes were also lower over the reporting period compared to historical trends.

Filtered metal results in the McArthur River were consistently low over the reporting period, including for the key metals of potential concern (cadmium, cobalt, copper, lead, nickel, thallium, and zinc). During the reporting period, there were four (4) individual results beyond the SSTVs at SW11. These were related to dissolved oxygen (3) and filtered iron (1). Of these results, no formal investigations were triggered under the conditions of WDL 174-13.

A review of the data determined that influences from catchments upstream of the Mine contributed to the results beyond the SSTVs at SW11. Both the McArthur River and Glyde River were highlighted as contributors in the monitoring data, consistent with previous years' monitoring results.

Bing Bong Dredge Discharge Point Water Quality

An investigation report was triggered at the BBLF due to a sample being collected at the BBDDP on 2 January 2023 that returned a result that was beyond the SSTV for filtered arsenic. The filtered arsenic result was 2.5 micrograms per litre (µg/L), compared to the SSTV of 2.3 µg/L.

The investigation report concluded that the BBDDP site was subject to natural fluctuations in filtered arsenic from tidal influence, groundwater expression and localised run-off from the natural catchment, which were the likely causes of the subject result. The filtered arsenic result at BBDDP was therefore considered non-mine related and a result of natural influences.

Analyte Loads

WRM (2023b) also reviewed the mine derived analyte loads for the reporting period. No managed releases occurred during the reporting period. Hence, the estimated total lead and total zinc loads discharged to the McArthur River in managed releases were both zero. These loads were less than the annual limits specified in the Mine's Adaptive Management Plan. This is consistent with recommendation 3 of the NT Environment Protection Authority (EPA) Assessment Report 86.

Conclusion

Based on the review of surface water quality monitoring data between 1 May 2022 and 30 April 2023, WRM (2023a) concluded that:

> *MRM continue to implement effective controls to minimise the risk of environmental harm of downstream receiving waters due to Mine operations. The review concluded that the beneficial uses and community values of the McArthur River continue to be protected from potential mine derived impacts.*
>
> *…*
>
> *There were no mine derived SSTV exceedances or non-compliances recorded at the SW11 compliance point in the McArthur River during the reporting period. The SSTV exceedances recorded at SW11 during the reporting period were unrelated to mine activities and were a result of natural river processes and contributions from sources upstream of the Mine.*

MRM will continue to implement the existing monitoring program in accordance with conditions of the current WDL.

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1 Introduction

The McArthur River Mine (the Mine) is an Open Pit zinc, lead and silver mining operation in the Northern Territory (NT) located approximately 700 kilometres (km) south-east of Darwin, and approximately 45 km south-west of the township of Borroloola (Figure 1).

In addition to mining activities, the operations include an on-site concentrator and processing plant, and the Bing Bong Loading Facility (BBLF) located on the Gulf of Carpentaria approximately 95 km north-northeast of the Mine (Figure 1). McArthur River Mining Pty Ltd (MRM) is the operator of the Mine and is a wholly owned subsidiary of Glencore. MRM is the world's largest producer of zinc in bulk concentrate form.

MRM operates consistent with its approved *Mining Management Plan* (2020) and associated amendments. On-site mining and processing activities are conducted within Mineral Lease Northern (MLN) 1121, MLN 1122, MLN 1123, MLN 1124 and MLN 1125 (Figure 2).

The BBLF is located within MLN 1126 (Figure 3). Adjacent to the Bing Bong MLN is the Bing Bong Dredge Spoil Emplacement Area (DSEA), located on the former Non-Pastoral Land Use Approval NP033. It is noted no dredging or dredge spoil emplacement has been undertaken by MRM since 2013.

MRM was granted the amended Waste Discharge Licence (WDL) 174-13 on 10 March 2022. WDL 174-13 authorised the conditional release of water at specified locations, which include the Mine Levee Discharge Point (MLDP) into the old McArthur River channel, the South-East Levee 1 Discharge Point (SEL1 DP) into Barney Creek, the McArthur River Diversion Channel Discharge Point (MRDC DP) into the McArthur River Diversion Channel, and the Bing Bong Dredge Discharge Point (BBDDP) into the marine waters of the Gulf of Carpentaria at the BBLF.

In addition, pursuant to the *Mining Management Act 2001* (NT) in the Variation of Authorisation (VOA) 0059, MRM was authorised over the reporting period for the conditional release of water at the Water Management Dam Release Point into the McArthur River catchment via Little Barney Creek.

1.1 Monitoring Report

This Monitoring Report has been submitted in accordance with Condition 43 of WDL 174-13. WDL 174-13 is provided in Attachment 1.

Condition 44 of WDL 174-13 outlines the requirements of this Monitoring Report and has been reproduced in Table 1, along with a reconciliation of the reporting requirements with this Monitoring Report and its Attachments.

A recent review of the environmental performance of the Mine and BBLF over the period 1 May 2022 to 30 April 2023 was undertaken for the *McArthur River Mine 2022-2023 Environmental Monitoring Report* (EMR) (Attachment 2).

To supplement and verify MRM's collection, review and analysis of environmental monitoring data for the EMR, external experts were engaged to review and provide conclusions regarding environmental performance (as reported in the technical appendices to the EMR). The operational activities of the Mine and BBLF during the EMR reporting period are described in Section 2 of the EMR (Attachment 2). The historical and recent observations of the physical environment relevant to water management and monitoring (e.g., climate, hydrology, river heights) are described in Attachment 3.

During the reporting period, MRM operated under WDL 174-13, as well as VoA 0059. WDL 174-13 was operated under from 10 March 2022 to 25 May 2023. A renewed WDL (174-14) commenced on 26 May 2023, after the end of the reporting period, and is not discussed further in this report.

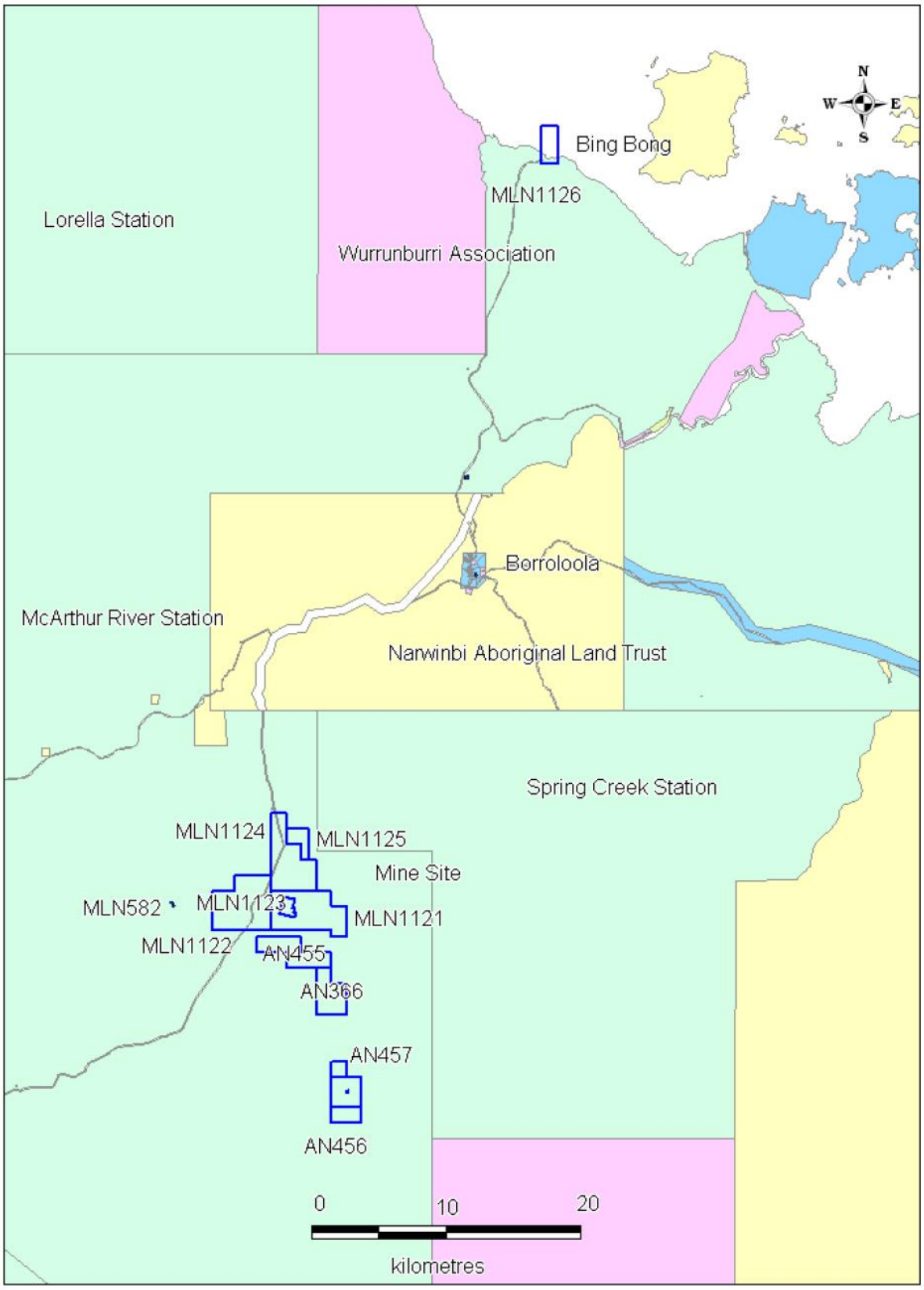


Figure 1: Regional Locality

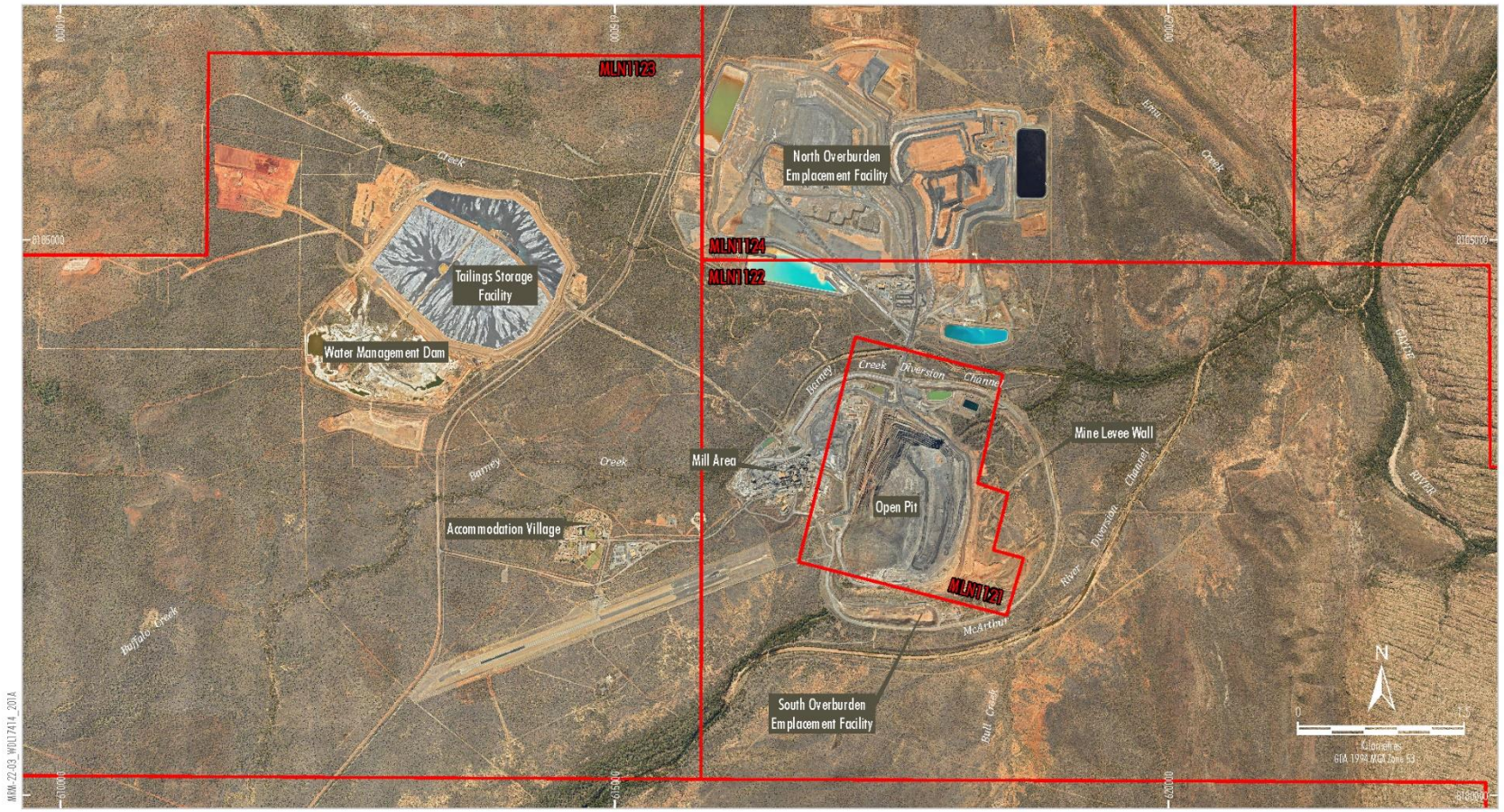


Figure 2: Mine Site

Source: Orthophoto MRM (2022); Department of Environment and Natural Resources (2016); IPE (2019); MRM (2019)

Figure 3: Bing Bong Loading Facility

TABLE 1: WDL 174-13 MONITORING REPORT REQUIREMENTS

Requirement	Section
44 The licensee must ensure that each Monitoring Report is prepared in consultation with a Qualified Person to determine the relevance of the information being provided as it relates to the waste discharge component of the site and in the format described in the National Water Quality Management Strategy, Australian Guidelines for Water Quality Monitoring and Reporting, Chapter 7 and must include:	This Monitoring Report and its appendices have been generally structured consistent with Chapter 7 of the Guideline. This includes the provision of the executive summary and primary technical report. This Monitoring Report is based on reviews completed by the qualified specialists WRM Water & Environment Pty Ltd (WRM).
44.1 a data analysis and interpretation using the National Water Quality Management Strategy, Australian Guidelines for Water Quality Monitoring and Reporting, Chapter 6;	This Monitoring Report has been generally structured consistent with Chapter 6 of the Guideline. This includes: • analysis of changes in time and space (Section 4); • checks for data integrity (Appendix A); • comparison of site and water quality guidelines (Section 6); and • interpretation in relation to study objectives (Section 7).
44.2 a tabulation of all monitoring data required as a condition of this licence and any additional data used as part of the analysis and interpretation undertaken in the report, to be submitted in electronic Microsoft Excel format;	Tabulation of data required under the monitoring schedules listed in Conditions 26 and 27 is provided in electronic Microsoft Excel format (Attachment 6). The data required under the specialist biota monitoring listed in Condition 28 is provided in the EMR (Attachment 2) and its Appendices.
44.3 includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years (where the data is available);	A summary of long-term trends for surface water sites in the McArthur River has been provided from 1 January 2008 (where data was available) in Section 4.3 of this report. Only a single sample was collected at BBDDP during the reporting period as this location experienced cease to flow or dry conditions for most of the scheduled sampling events. Similarly, as MRM has not undertaken dredging or dredge spoil emplacement since 2013, there is limited data available for long term trend analysis at BBDDP. Long term trend analysis for the various freshwater and marine monitoring programs is also provided in the EMR (Attachment 2) and its Appendices.
44.4 includes mine derived loads entering the McArthur River from the mine site for the contaminants listed in Appendix 3 Table 1;	Refer to Section 5 and Attachment 4.
44.5 compares the mine derived load for each contaminant listed in Appendix 3 Table 1 against the background loads in the McArthur River (SW11 and SW12) and Glyde River (SW09);	Refer to Section 5 and Attachment 4.
44.6 a comparison of the mine derived contaminant loads referred to in Condition 44.4 against contaminant loads reporting to the McArthur River from July 2017 to June 2018;	Refer to Section 5 and Attachment 4.
44.7 an assessment of all monitoring data (including flow rate and calculated volume from each river contributing to water quality at SW11) and whether the activity has been conducted in a manner that has ensured the McArthur River is being protected at all times from mine related impacts.	Refer to Section 6 and Attachment 4.

2 Community Values and Beneficial Uses

2.1 Community Values

Community values are particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, health, safety or welfare, and requires protection from the effects of stressors.

In accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Governments [ANZG], 2018), MRM has identified the following community values for the receiving waters downstream of the Mine, including:

- aquatic ecosystems (slightly to moderately disturbed);
- primary industries including stock drinking water, irrigation and general water uses;
- recreation and aesthetics; and
- cultural and spiritual values.

Typically, the most stringent water quality objectives are associated with the protection of aquatic ecosystems. Where more stringent water quality guidelines have been identified for other McArthur River community values (e.g. primary industries, recreation and aesthetics or cultural and spiritual), these have been incorporated into MRM's environmental management and monitoring program targets in addition to the aquatic ecosystem values.

The condition of the McArthur River in the vicinity of the Mine is considered as a 'slightly to moderately disturbed system' due to the influence of pastoralism and grazing throughout the catchment. The ANZG (2018) guidelines recommend that generally a 95 percent (%) species protection level should be applied to slightly to moderately disturbed systems, as is the case for the McArthur River in the vicinity of the Mine.

2.2 Beneficial Uses

The WDL lists the following beneficial uses as declared under the *Water Act 1992* (NT) and the sensitivity of the surrounding land use and environment in the vicinity of the Mine. These include:

- Declared beneficial uses and/or water quality objectives are:
  - McArthur River Area: aquatic ecosystem protection, recreational water quality and aesthetics (Gazette references G9 11 March 1998 and G20 27 May 1988); and
  - McArthur River Catchment Area: environment, cultural and riparian (Gazette reference G10 14 March 2001).
- Sites of conservation significance (SOCS):
  - Sir Edward Pellow Island group (SOCS No. 33);
  - McArthur River coastal floodplain (SOCS No. 34); and
  - Borroloola area (SOCS No. 35).

2.3 Mixing Zones

In accordance with NT EPA *Guidelines on Mixing Zones* (2013), mixing zones are specifically defined areas where the water quality may be below that required to protect environmental values and beneficial uses.

Mixing zones allow for a designated zone of potential impact between the authorised discharge points and the compliance points, in lieu of prescribing concentration requirements at authorised discharge points (NT EPA, 2013). At the Mine, the mixing zone is located between the authorised discharge points within the mineral leases and the SW11 compliance monitoring point in the McArthur River receiving environment.

The zone extends along the McArthur River from the McArthur River Diversion Channel Discharge Points, past the end of the McArthur River Diversion Channel (Barney Creek and McArthur River confluence), finishing at the northern (downstream) boundary of MLN 1122.

Managed release is also conveyed along Little Barney Creek and Barney Creek (including the Barney Creek Diversion Channel). However, these waterway reaches are in operational areas of the Mine site, are highly ephemeral, are not considered important refugia for the persistence of any aquatic species, nor do they provide a major ecological role within the wider catchment (Indo-Pacific Environmental [IPE], 2019). For these reasons, the Little Barney Creek and the Barney Creek reaches are not afforded mixing zone status.

3 Monitoring Objectives and Method

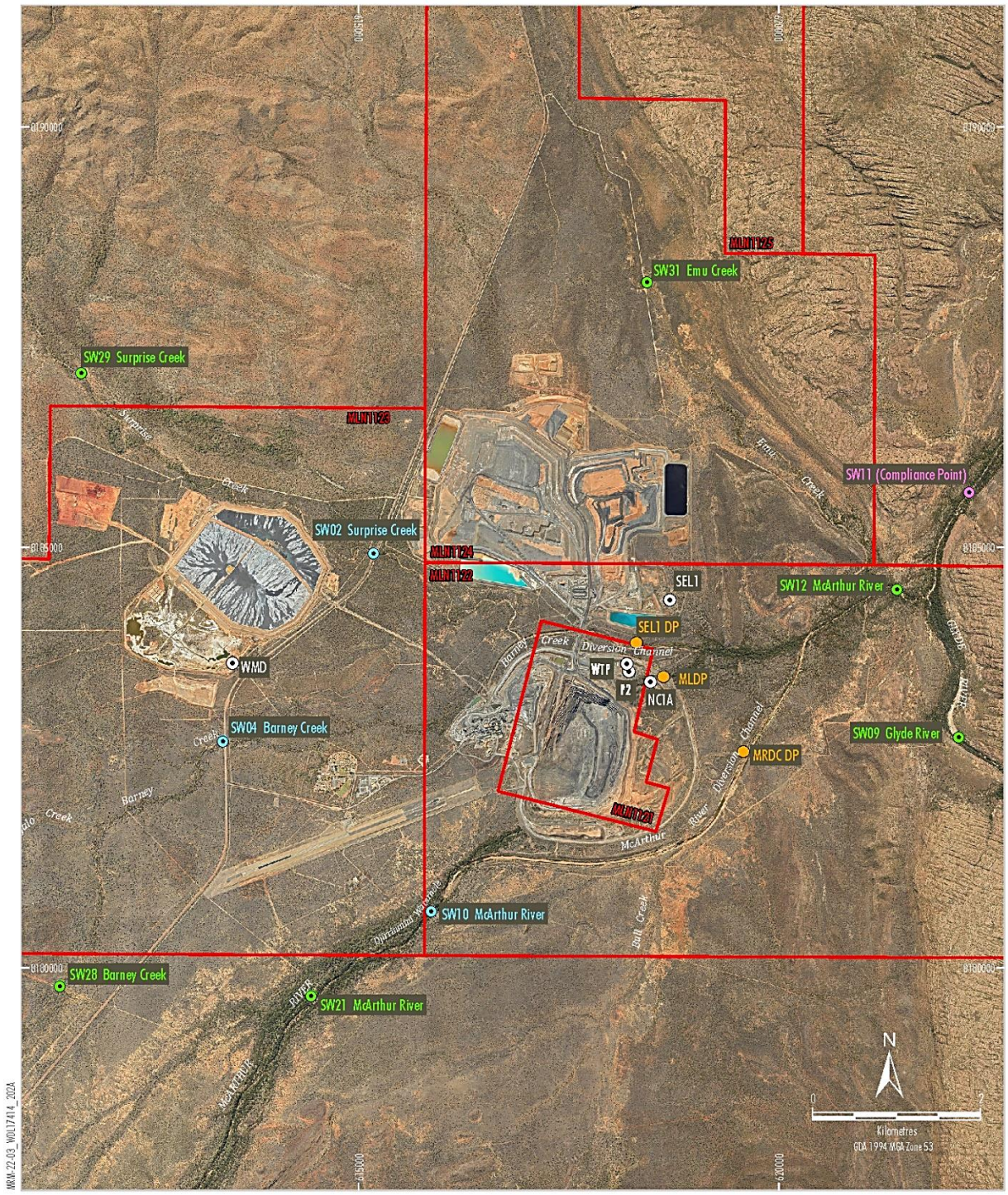
3.1 Authorised Discharge Points

The authorised discharge points, key monitoring points and compliance points over the reporting period (as detailed in WDL 174-13) are reproduced in Table 2 below, and shown on Figure 4 and Figure 5 for the Mine and Figure 6 for the BBLF.

In addition, pursuant to the *Mining Management Act, 2001* (NT) in the VoA 0059, MRM is authorised for managed releases of water at the Water Management Dam into Little Barney Creek via the Water Management Dam (WMD) Release Point (RP).

TABLE 2: WDL 174-13 AUTHORISED DISCHARGE AND COMPLIANCE MONITORING POINTS

Point	Description	Location
Authorised Discharge Points		
Mine Levee Discharge Point(s) (MLDP) (Mine levee pumping outlets)	Discharges through Mine Levee Discharge Point(s) (MLDP) include: 1. Rain water collecting in the old McArthur River Channel (NC1A) inside the Mine levee. 2. Groundwater from dewatering bores around main pit collected in and then discharged from Pond 2 (P2). 3. Water from the water management dam. 4. Treated water from the Water Treatment Plant that will be stored in P2 prior to discharge from the MLDP. Waters discharged at MLDP are pumped over the mine levee wall and flow into the Old McArthur River channel upstream of the McArthur River and Glyde River confluence.	Easting: 618661 Nothing: 8183459
South-East Levee 1 Discharge Point (SEL1 DP)	Rain water collecting inside the South Eastern Levee and separated from all contaminated seepages. Discharges are pumped via pipe line to Barney Creek and then flow into the McArthur River. Discharge can only occur when flow as measured in the McArthur River at the downstream gauging station is in excess of 20 cubic metres per second (m^3/s).	Easting: 618332 Nothing: 8183859
McArthur River Diversion Channel Discharge Point(s) (MRDC DP)	Discharges through McArthur River Diversion Channel Discharge Point(s) (MRDC DP) include: 1. Groundwater from dewatering bores around main pit collected in and then discharged from Pond 2 (P2). 2. Water from the water management dam. 3. Treated water that will be stored in (P2) prior to discharge from the MRDC DP. Waters discharged at the McArthur River Diversion Channel Discharge Point(s) are pumped into McArthur River Diversion Channel upstream of the McArthur River and Glyde River confluence.	Easting: 619595 Nothing: 8182573
Bing Bong Dredge Discharge Point (BBDDP)	The dredge spoil perimeter drain exit point (BBDDP) is located on the tidal mudflats to the east of the loading facility and within a tidal area. The drain is constructed around the external boundary of the dredge spoil cells to intercept saline water and extends approximately 400 metres from the final cell. The drain receives overflow from: 1. the final dredge spoil emplacement area cell when in operation; and 2. saline water from the perimeter drain which surrounds the dredge spoil emplacement area. At BBDDP passive releases flow across the intertidal flats to the Gulf of Carpentaria via the Bing Bong navigation channel. For purposes of clarity this licence does not authorise dredging and/or pumping or disposal of dredge slurry to the Dredge Spoil Emplacement Area.	Easting: 649514 Nothing: 8271536
Compliance Monitoring Points		
SW11	The monitoring point is situated along the McArthur River approximately at the edge of MLN 1122. SW11 is downstream of the confluence of the Glyde River. SW11 is approximately: • 5 km downstream of MLDP; and • 6 km downstream of SEL1 DP.	Easting: 622238 Nothing: 8185656
BBDDP	The BBDDP is located on tidal mudflats approximately 750 metres east of the loading facility. The BBDDP is the compliance point (as per WDL 174-13) at the BBLF.	Easting: 649514 Nothing: 8271536

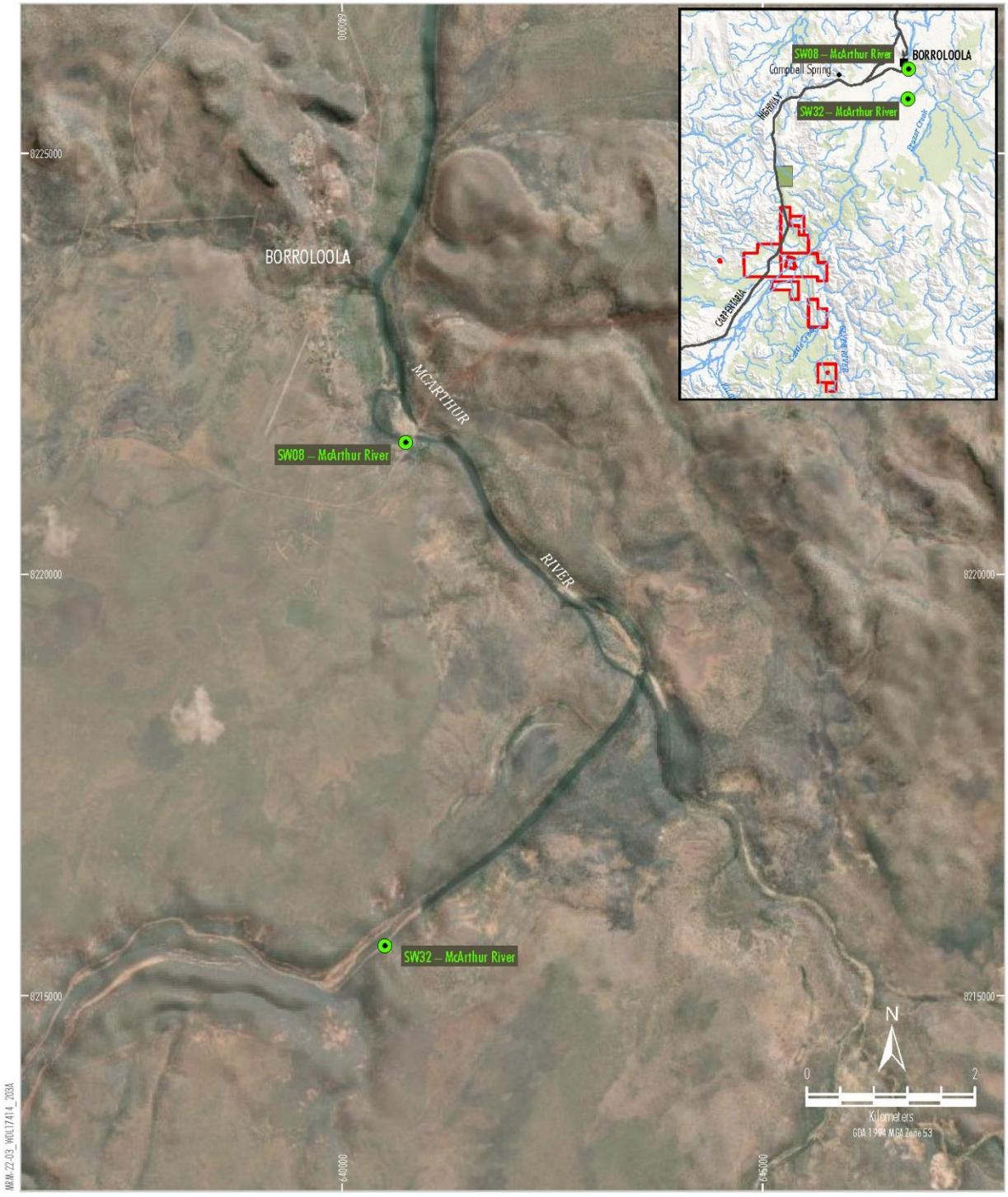


LEGEND

- Mining Lease
- Authorised Discharge Point
- Compliance Point
- Monitoring Site (water & sediment)
- Monitoring Site (flow)
- Monitoring Site (water)

Source: Orthophoto MRM (2022); Department of Environment and Natural Resources (2016); MRM (2020)

Figure 4: Mine Surface Water Monitoring Sites and Discharge Locations



LEGEND

Monitoring Site (water & sediment)

Source: Orthophoto Esri, Maxar, Earthstar Geographics, and the GIS User Community; Department of Environment and Natural Resources (2016); MRM (2020)

Figure 5: McArthur River Downstream Surface Water Monitoring Sites

Figure 6: Bing Bong Loading Facility Surface Water Monitoring Sites

3.2 Compliance Points and Trigger Levels

WDL 174-13 details SSTVs for compliance monitoring points SW11 and BBDDP. The SSTVs for the compliance points are reproduced in Table 3 below. SSTV compliance is assessed against Condition 40 of WDL 174-13 which is reproduced below:

> *40. The Licensee must ensure there is no:*
>
> *40.1. exceedance of a trigger value at SW11, as specified in Appendix 3, on three consecutive sampling occasions as a result of the activity; or*
>
> *40.2. exceedance greater than or equal to three times a trigger value at SW11 as a result of the activity.*

TABLE 3: WDL 174-13 COMPLIANCE POINTS AND SSTVS

	Site Code			SW11	BBDDP
Parameter	**Abbreviation**	**Units**	**Analysis**	**SSTVs***	**ANZECC (2000)***
Field Measurements					
pH	pH	pH Units	In situ	6.0-8.5	8.0-8.4
Electrical Conductivity	EC	µS/cm		1,000	-
Dissolved Oxygen	DO	% saturation		85-120	-
Metals and Metalloids					
Aluminium	Al	µg/L	Filtered (0.45 µm)	269	0.5
Arsenic	As			24	2.3
Cadmium	Cd			1.73	5.5
Cobalt	Co			1.4	-
Copper	Cu			9	1.3
Iron	Fe			347	-
Lead	Pb			17	4.4
Manganese	Mn			1,900	80
Nickel	Ni			11	70
Thallium	Tl			58	-
Zinc	Zn			32	15
Total Petroleum Hydrocarbons (TPH)					
TPH Fraction C6 – C9	NA	µg/L		-	-
Benzene	NA			10	500
TPH Fraction C10 – C14	NA			600	600
C15 – C28	NA				
C29 – C36	NA				
Other					
Sulphate	SO_4	mg/L		1,000	-
Nitrate	NO_3	mg/L		10.6	-

µS/cm = microSiemens per centimetre, µg/L = micrograms per litre, mg/L = milligrams per litre

* SSTV are applicable to filtered samples for metals and metalloids. The derivation of the SSTVs is documented within the WDL.

3.3 WDL 174-13 Monitoring Program

Conditions 26 to 28 of WDL 174-13 outline MRM's monitoring requirements, and these conditions are reproduced below.

> *26. The licensee must conduct surface water monitoring in accordance with Appendix 4, Table 1 and Table 2.*
>
> *27. The licensee must conduct fluvial sediment monitoring in accordance with Appendix 5, Table 1 and Table 2.*
>
> *28. The licensee must conduct biota monitoring in accordance with Appendix 6.*

A summary of reporting period and long-term water quality trends for the McArthur River, including SW11, is provided in Section 4.3. Further information is provided in Attachment 3 and summarised in Section 4 of the EMR (Attachment 2).

Only a single sample was collected at BBDDP during the reporting period as this location experienced cease to flow or dry conditions for most of the scheduled sampling events. Similarly, as MRM has not undertaken dredging or dredge spoil emplacement since 2013, there is limited data available for long term trend analysis at BBDDP.

The results for all other monitoring required under WDL 174-13, including long-term trend analysis where data is available, can be sourced directly from the specialist consultant reports appended to the EMR (Attachment 2):

- *Assessment of Bioavailable Metal Concentrations and Lead Isotope Ratios of Seafloor Sediments in the Bing Bong Loading Facility Transshipment Area, 2022.*
- *Annual Marine Monitoring Program of the Bing Bong Loading Facility, 2022.*
- *Monitoring of Select Analytes and Lead Isotope Ratios in Fluvial Sediments, Fish and Molluscs of the McArthur River 2022.*
- *Annual Seagrass Survey of the Bing Bong Loading Facility, 2022*.
- *Aquatic Fauna of the McArthur River, Northern Territory, Early Dry Season, 2022*.
- *Aquatic Fauna of the McArthur River, Northern Territory, Late Dry Season, 2022.*
- *McArthur River Freshwater Aquatic Macroinvertebrate Assessment, 2022*.
- *Surface Water Monitoring Report 2022/23* (WRM, 2023a) (Attachment 3).

The monitoring programs, including the sampling and analysis methodology used, are described in the specialist consultant reports appended to the EMR (Attachment 2). The specialist reports also describe the environmental settings during the sampling and EMR reporting period (where relevant).

Additionally, the *2022/23 Mine Derived Analyte Loads Assessment* is included as Attachment 4.

In addition to addressing the requirements of WDL 174-13, the objectives of the monitoring programs are to allow for the assessment of MRM's performance against its key environmental objectives, which are as follows:

- protect the McArthur River beneficial uses and community values from mining impacts;
- facilitate development of the ecosystems and their functions along the McArthur River Diversion Channel for terrestrial and aquatic flora and fauna;
- achieve a recovering trend in the water quality and ecosystem function in creeks on the Mine site within 20 years of cessation of mining;
- minimise air quality related impacts from the Mine's operations with respect to community health and environment; and
- protect the community values and beneficial uses adjacent to the BBLF and transhipment corridor.

4 Monitoring Results

4.1 Summary of Authorised Discharges

There were no managed releases from the Mine during the reporting period owing to water conservation for processing and construction purposes.

4.1.1 Water Treatment

During the reporting period, water generated at the Mine was treated with hydrated lime in the South-Eastern Perimeter Runoff Dam. The dam was periodically filled with various sources of water for lime treatment. Treated water was dewatered to Pond 2 and then stored in the Water Management Dam for potential release under conditions of the WDL and VoA. A total of 574 tonnes (t) of hydrated lime was used to treat approximately 1,783 megalitres (ML) of water from the Mine over the reporting period.

4.2 Tabulation of Monitoring Data

Condition 44.2 of WDL 174-13 requires that the Monitoring Report provide a tabulation of monitoring data, to be submitted in Microsoft Excel format. The water quality monitoring data for the McArthur River downstream compliance point SW11 is provided in Table 4 for those parameters with corresponding SSTVs. Sampling was undertaken on at least a weekly basis at SW11, except for the period between May 2022 and mid-November 2022 where cease to flow conditions were observed.

The BBDDP is required to be sampled weekly during active dredging. No active dredging occurred during the reporting period and therefore weekly sampling was not recorded. The BBDDP was inspected on a monthly basis for flow in accordance with the WDL. The water quality monitoring data for the BBDDP compliance point is provided in Table 5 for those parameters with corresponding SSTVs. Water quality samples were unable to be taken on all inspection days due to no observed flow and access issues, except for one sample collected on 02/01/2023.

Water quality monitoring data for all surface water monitoring sites outlined in Appendix 4: Table 1 of WDL 174-13 is tabulated in Attachment 5. These water quality monitoring sites are also shown on Figure 4 and Figure 5.

TABLE 4: WATER QUALITY DATA FOR SW11 SSTV PARAMETERS

Monitoring Location	Date	Flow	Access	Comment	pH – Field	EC – Field	DO – Field	Filtered Al	Filtered As	Filtered Cd	Filtered Co	Filtered Cu	Filtered Fe	Filtered Pb	Filtered Mn	Filtered Ni	Filtered Tl	Filtered Zn	Benzene	TPH C10-C36	SO_4	NO_3
					(pH Unit)	(µS/cm)	(%)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(µg/L)
		(Yes/No)	(Yes/No)		6.0-8.5	1,000	85-120	269	24	1.73	1.4	9	347	17	1,900	11	58	32	10	600	1,000	10,600
SW11	1/05/2022 15:00	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	8/05/2022 11:42	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	14/05/2022 13:10	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	29/05/2022 13:10	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	5/06/2022 12:05	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	12/06/2022 12:05	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	19/06/2022 9:55	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	27/06/2022 13:25	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	10/07/2022 10:54	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	17/07/2022 10:54	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	24/07/2022 10:54	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	31/07/2022 10:54	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	7/08/2022 10:01	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	7/08/2022 10:55	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	14/08/2022 10:01	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	21/08/2022 14:24	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	28/08/2022 10:01	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	4/09/2022 10:25	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	11/09/2022 9:21	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	18/09/2022 9:21	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	25/09/2022 9:21	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	2/10/2022 11:30	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	9/10/2022 7:40	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	16/10/2022 11:31	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	30/10/2022 13:27	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	6/11/2022 7:34	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	12/11/2022 7:34	No	Yes		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	20/11/2022 10:48	Yes	Yes		7.69	169.6	90.1	69	0.7	<0.2	<1	1	124	<0.5	4.2	<1	<0.1	<2	<1	<50	9.7	<100
SW11	28/11/2022 11:07	Yes	Yes		7.37	62.9	82.3	188	0.6	<0.2	<1	1	261	<0.5	1.2	<1	<0.1	<2	<1	<50	2.1	324
SW11	4/12/2022 9:53	Yes	Yes		7.39	99.4	86.8	47	0.7	<0.2	<1	<1	191	<0.5	2.3	<1	<0.1	9	<1	<50	2.7	1,344
SW11	12/12/2022 9:56	Yes	Yes		7.4	153.3	92.7	13	1.2	<0.2	<1	<1	475	<0.5	25	<1	<0.1	<2	<1	50	4	321
SW11	18/12/2022 9:51	Yes	Yes		7.55	152.1	93.6	47	<0.5	<0.2	<1	1	220	<0.5	6.9	<1	<0.1	<2	-	-	3.6	260
SW11	26/12/2022 9:02	Yes	Yes		7.62	59.2	90.4	113	<0.5	<0.2	<1	<1	188	<0.5	1.4	<1	<0.1	<2	<1	<50	1.1	391
SW11	31/12/2022 9:50	Yes	Yes		7.47	26.1	86.6	73	<0.5	<0.2	<1	<1	120	<0.5	1	<1	<0.1	<2	<1	<50	0.6	670
SW11	8/01/2023 9:52	Yes	Yes		6.68	37.4	78.7	97	<0.5	<0.2	<1	<1	163	<0.5	1.2	<1	<0.1	<2	<1	<50	0.6	377
SW11	15/01/2023 10:08	Yes	Yes		7.71	79.4	91.6	27	<0.5	<0.2	<1	<1	29	<0.5	<0.5	<1	<0.1	<2	-	-	2.6	282
SW11	22/01/2023 10:41	Yes	Yes		7.07	104.2	87.2	8	<0.5	<0.2	<1	<1	51	<0.5	<0.5	<1	<0.1	4	<1	<50	2.7	484
SW11	29/01/2023 10:40	Yes	Yes		7.35	73.5	85.2	<5	<0.5	<0.2	<1	<1	24	<0.5	31	<1	<0.1	<2	<1	<50	2.9	652
SW11	5/02/2023 10:24	Yes	Yes		7.42	83.6	88.4	8	<0.5	<0.2	<1	<1	41	<0.5	5.5	<1	<0.1	<2	<1	<50	1.1	388
SW11	12/02/2023 8:45	-	No	No helicopter access, ongoing safety investigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Location	Date	Flow	Access	Comment	pH – Field	EC – Field	DO – Field	Filtered Al	Filtered As	Filtered Cd	Filtered Co	Filtered Cu	Filtered Fe	Filtered Pb	Filtered Mn	Filtered Ni	Filtered Tl	Filtered Zn	Benzene	TPH C10-C36	SO_4	NO_3
					(pH Unit)	(µS/cm)	(%)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(µg/L)
		(Yes/No)	(Yes/No)		6.0-8.5	1,000	85-120	269	24	1.73	1.4	9	347	17	1,900	11	58	32	10	600	1,000	10,600
SW11	19/02/2023 11:41	Yes	Yes		7.26	45.1	88	24	<0.5	<0.2	<1	<1	111	<0.5	0.9	<1	<0.1	<2	<1	<50	0.4	<100
SW11	27/02/2023 15:31	Yes	Yes		7.44	30.8	80.6	56	<0.5	<0.2	<1	<1	104	<0.5	2.9	<1	<0.1	<2	<1	<50	0.4	<100
SW11	7/03/2023 11:55	Yes	No	Intermittent rainfall, flood event, no safe access with helicopter	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW11	13/03/2023 14:01	Yes	Yes		7.85	204.4	90	<5	0.5	<0.2	<1	<1	37	<0.5	<0.5	<1	<0.1	<2	<1	<50	2.4	250
SW11	19/03/2023 13:12	Yes	Yes		7.88	342.7	96.7	<5	0.9	<0.2	<1	<1	32	<0.5	2.2	<1	<0.1	<2	<1	<50	4.2	181
SW11	27/03/2023 9:09	Yes	Yes		7.69	538.3	86.4	<5	0.6	<0.2	<1	<1	49	<0.5	28	<1	<0.1	<2	<1	<50	4.7	188
SW11	2/04/2023 10:37	Yes	Yes		8.07	437.9	94	<5	0.9	<0.2	<1	<1	10	<0.5	16	<1	<0.1	<2	<1	<50	7.4	175
SW11	10/04/2023 11:29	Yes	Yes		8.17	486	96.4	<5	0.9	<0.2	<1	<1	<5	<0.5	<0.5	<1	<0.1	<2	<1	<50	8.5	153
SW11	18/04/2023 9:32	Yes	Yes		7.89	-	91.3	<5	0.8	<0.2	<1	<1	18	<0.5	27	<1	<0.1	<2	<1	<50	8.8	130
SW11	23/04/2023 10:41	Yes	Yes		7.84	-	96.2	<5	1	<0.2	<1	<1	5	<0.5	32	<1	<0.1	<2	<1	<50	11	196
SW11	30/04/2023 15:31	Yes	Yes		7.99^	579.6^	95.1^	<5	1	<0.2	<1	<1	<5	<0.5	42	<1	<0.1	<2	<1	<50	12	133

Note: Shaded results show instances whereby monitoring results exceeded SSTV value.

^ Field reading taken 1 May 2023.

TABLE 5: WATER QUALITY DATA FOR BBDDP SSTV PARAMETERS

Monitoring Location	Date	Dry	Access	Comment	pH – Field	EC – Field	DO – Field	Filtered Al	Filtered As	Filtered Cd	Filtered Co	Filtered Cu	Filtered Fe	Filtered Pb	Filtered Mn	Filtered Ni	Filtered Tl	Filtered Zn	Benzene	TPH C10-C36	SO_4	NO_3
					(pH Unit)	(µS/cm)	(%)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(µg/L)
		(Yes/No)	(Yes/No)		8-8.4	-	-	0.5	2.3	5.5	-	1.3	-	4.4	80	70	-	15	500	600	-	-
BBDDP	6/05/2022 14:49	Yes	Yes	Dry																		
BBDDP	24/05/2022 14:00	Yes	Yes																			
BBDDP	1/07/2022 13:52	Yes	Yes	Dry/No flow																		
BBDDP	1/08/2022 14:29	Yes	Yes	Dry/No flow																		
BBDDP	1/09/2022 13:38	Yes	Yes	Dry																		
BBDDP	1/10/2022 11:46	Yes	Yes	Dry																		
BBDDP	2/11/2022 13:15	Yes	Yes	Dry																		
BBDDP	2/12/2022 14:00	Yes	Yes	Dry																		
BBDDP	2/01/2023 10:09	No	Yes	Little flow. Probe bump tested to be high. Confirmation lab sample at the time had pH 8.07	-	38,919.7	104.7	<5	2.5	<0.2	<1	<1	<5	<0.5	0.6	<1	<0.1	3	-	-	1,576	2,257
BBDDP	5/01/2023 7:54	No	Yes	Field testing only																		
BBDDP	1/02/2023 13:40	No	Yes	Cease flow																		
BBDDP	2/03/2023 14:30	No	No	No access, water over road																		
BBDDP	1/04/2023 12:43	No	Yes	No flow																		

4.3 McArthur River Surface Water Quality

Surface water quality for each SSTV parameter at select sites on the McArthur River and Glyde River for the Reporting Period and historically are presented in Chart 1 to Chart 36. The reporting period graphs present the weekly rainfall record from the gauge at McArthur River Airport from the Department of Environment and Science SILO Patched Point Data Service, and the historical graphs present the rainfall as monthly. The results presented in this section focus on the following key monitoring locations:

- SW21 (upstream McArthur River);
- SW12 (downstream McArthur River);
- SW11 (Compliance Monitoring Point); and
- SW09 (upstream Glyde River).

4.3.1 pH

Field measured pH is presented on Chart 1 for the reporting period. Recorded pH measurements at SW11 were within the SSTV limits. The pH values during the reporting period were generally consistent with the range of historical values (Chart 2), ranging between approximately 6.5 and 8.0 (pH units). Decreases in pH were observed during the wet season, coinciding with periods of rainfall runoff events.

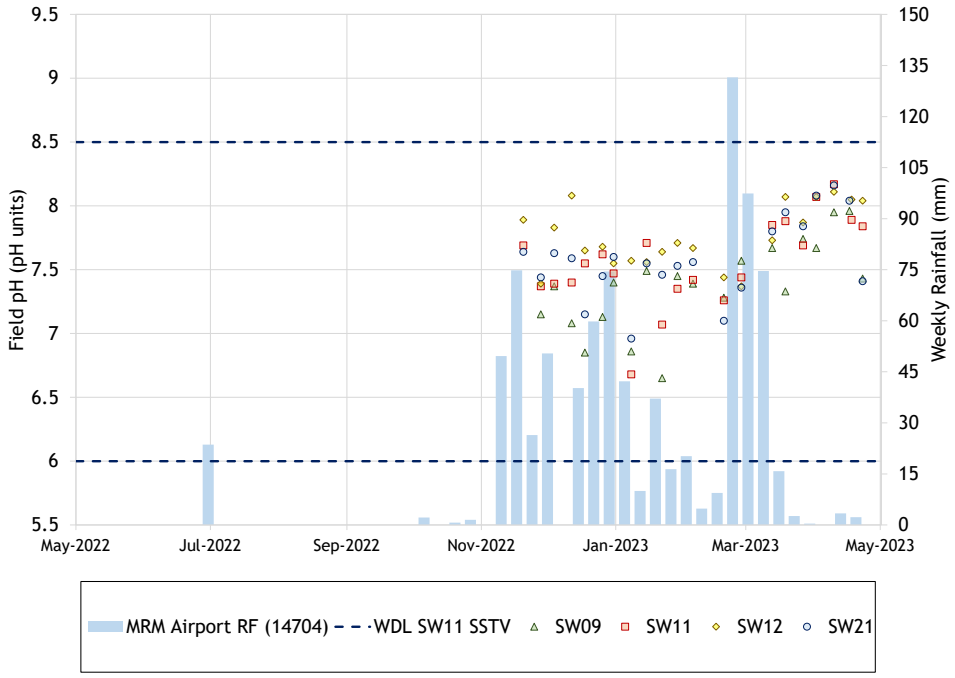


Chart 1: Reporting Period Field pH and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

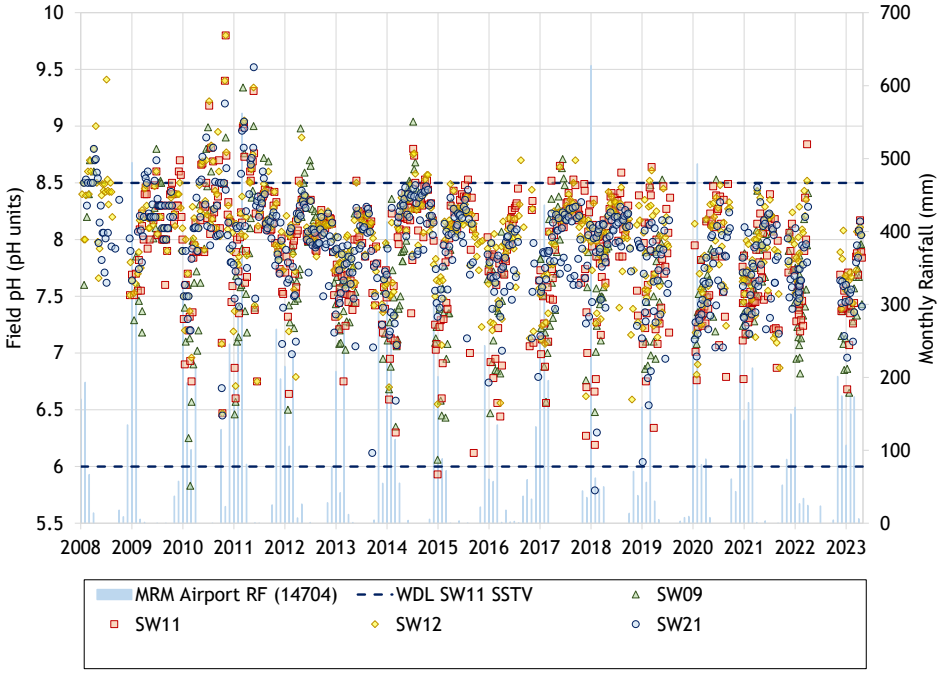


Chart 2: Historical Field pH and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.2 Electrical Conductivity

Electrical conductivity (EC) (laboratory measured) are presented on Chart 3 for the reporting period. Recorded EC concentrations were below the SSTV at SW11 during the reporting period. An increasing trend is observed as the dry season progresses as a result of evaporation and reduced flow volumes, and a higher contribution from groundwater expressing as surface water baseflow. Rapid decreases in EC occur as a result of the dilution provided by rainfall events. During the reporting period, EC levels were generally consistent with the range of historical values (Chart 4).

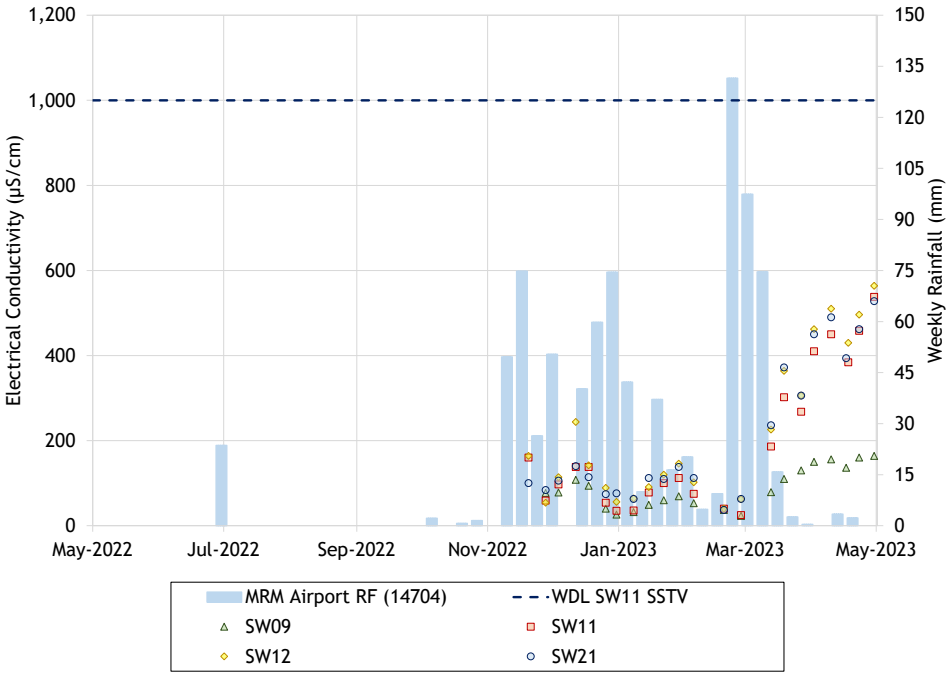


Chart 3: Reporting Period Laboratory Electrical Conductivity and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

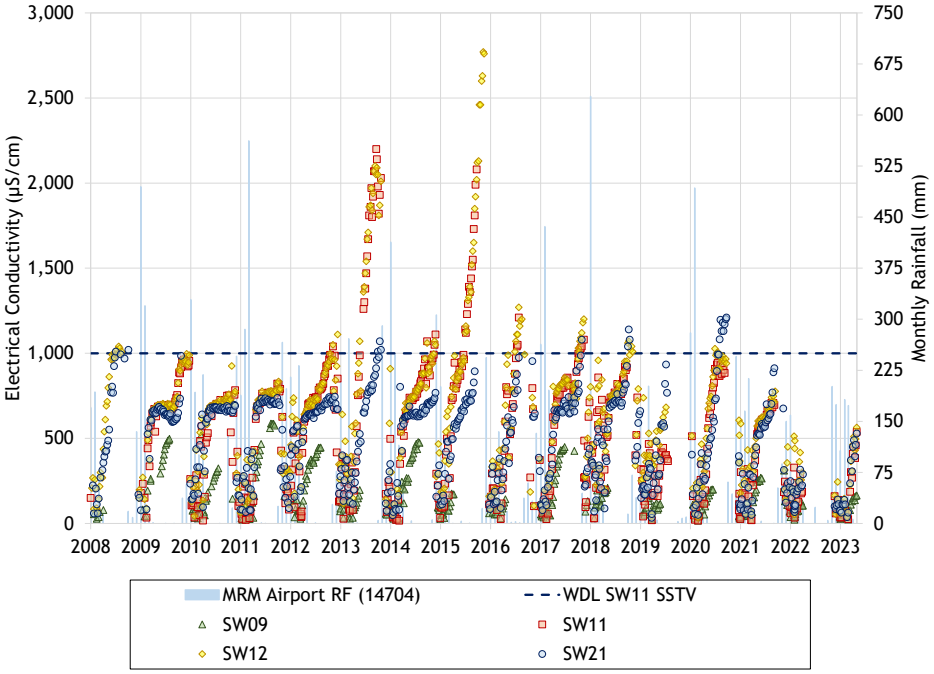


Chart 4: Historical Laboratory Electrical Conductivity and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.3 Dissolved Oxygen

Field dissolved oxygen (DO) measurements are presented on Chart 5 for the reporting period. DO concentrations were typically in the range 60 to 120 % saturation. The levels exhibit a slightly greater variation during the dry season, including sites upstream of the Mine (Chart 6). There were three instances where the DO water quality parameter measured below the minimum SSTV (85 % saturation) at SW11 during the reporting period. However, as shown in the data, low DO levels also occurred at the McArthur upstream control site SW21 on the same dates as the three exceedances at SW11. The data clearly showed that the low DO readings observed at SW11 were derived from natural catchment sources located upstream of the Mine.

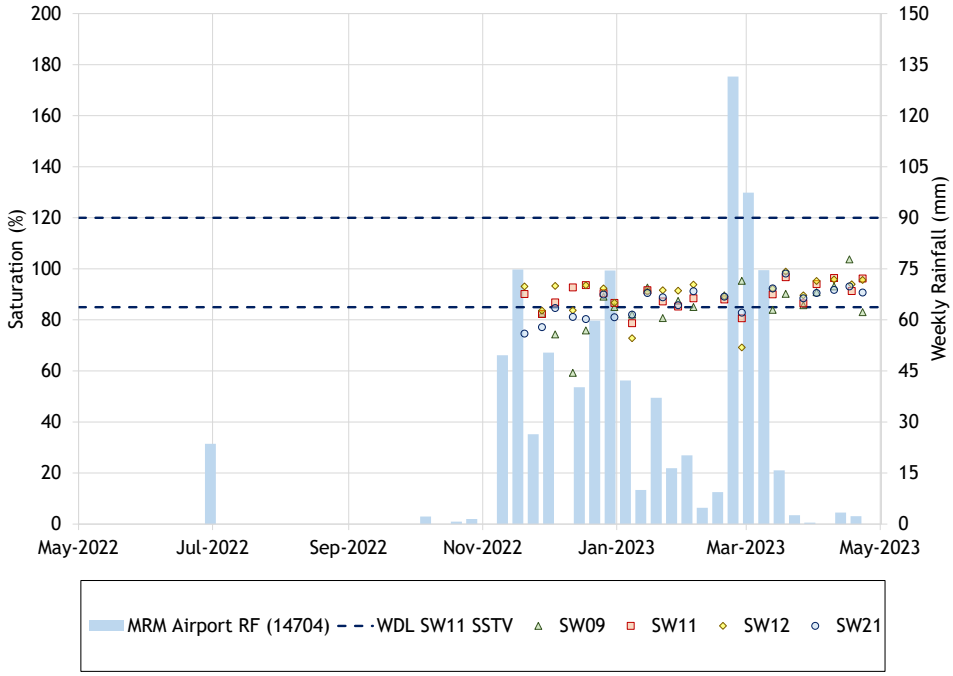


Chart 5: Reporting Period Dissolved Oxygen and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

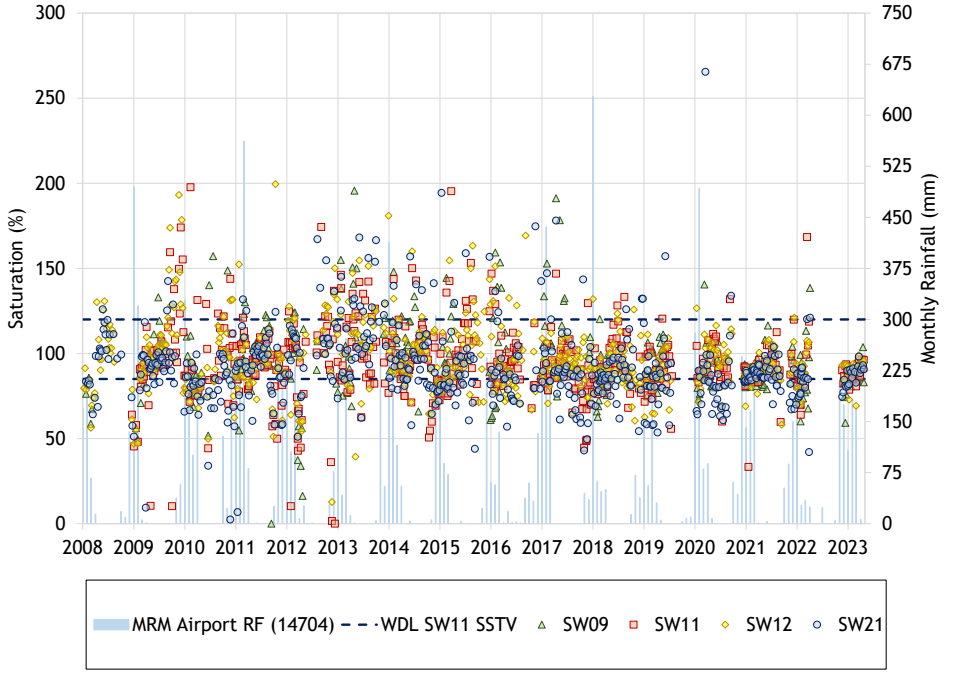


Chart 6: Historical Dissolved Oxygen and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.4 Filtered Aluminium

Filtered aluminium (Al) concentrations are presented on Chart 7 for the reporting period. There were no instances where the filtered Al concentrations were beyond the SSTV at SW11.

The data indicates consistently low concentrations during the dry season, and higher concentrations during the wet season. Spikes in filtered Al, of similar concentration, are observed in the historical time series (Chart 8), also coinciding with periods of high rainfall.

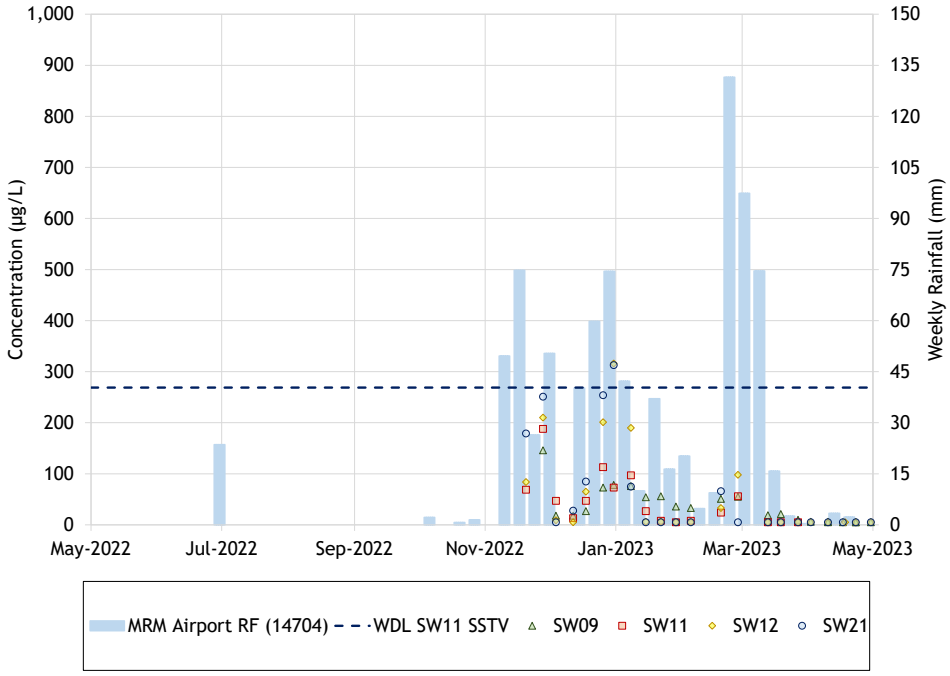


Chart 7: Reporting Period Filtered Al and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

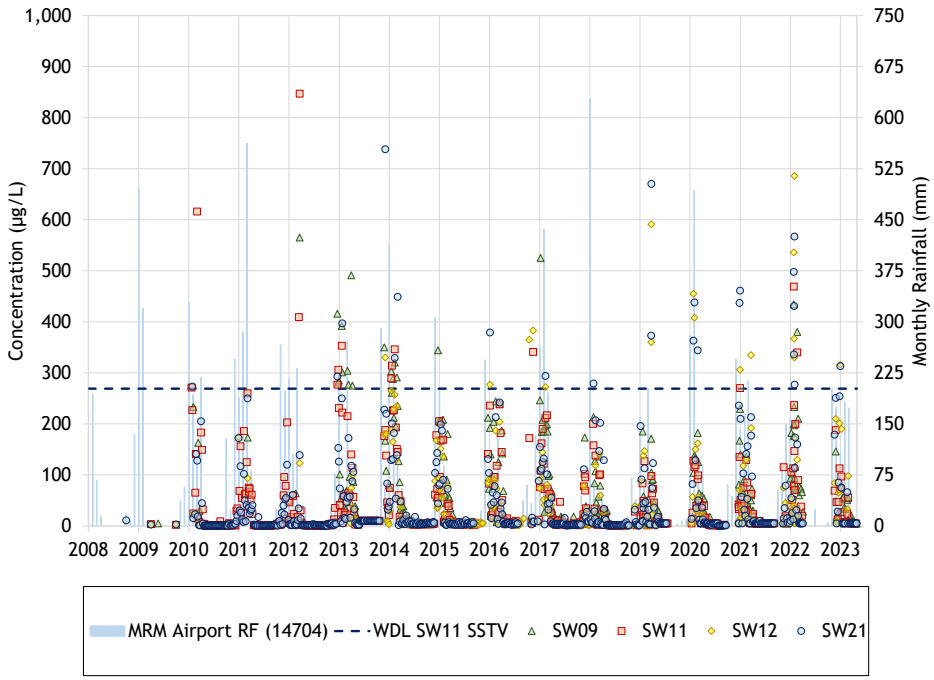


Chart 8: Historical Filtered Al and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.5 Filtered Arsenic

Filtered arsenic (As) concentrations are presented on Chart 9 for the reporting period. Recorded filtered As concentrations were below the SSTV at SW11 during the reporting period. Filtered As concentrations were low, which is consistent with the historical data (Chart 10).

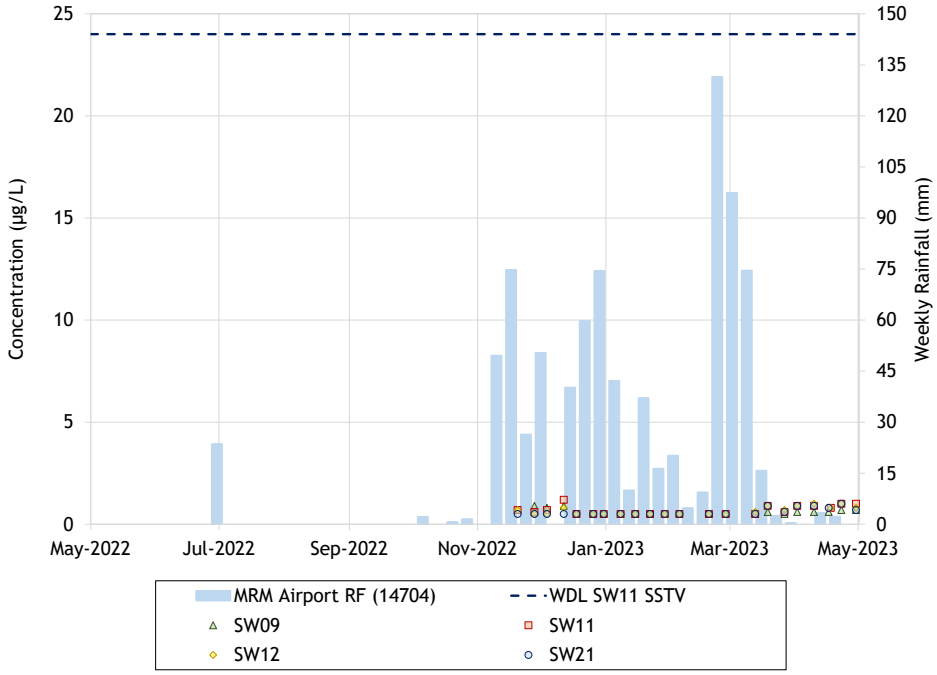


Chart 9: Reporting Period Filtered As and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

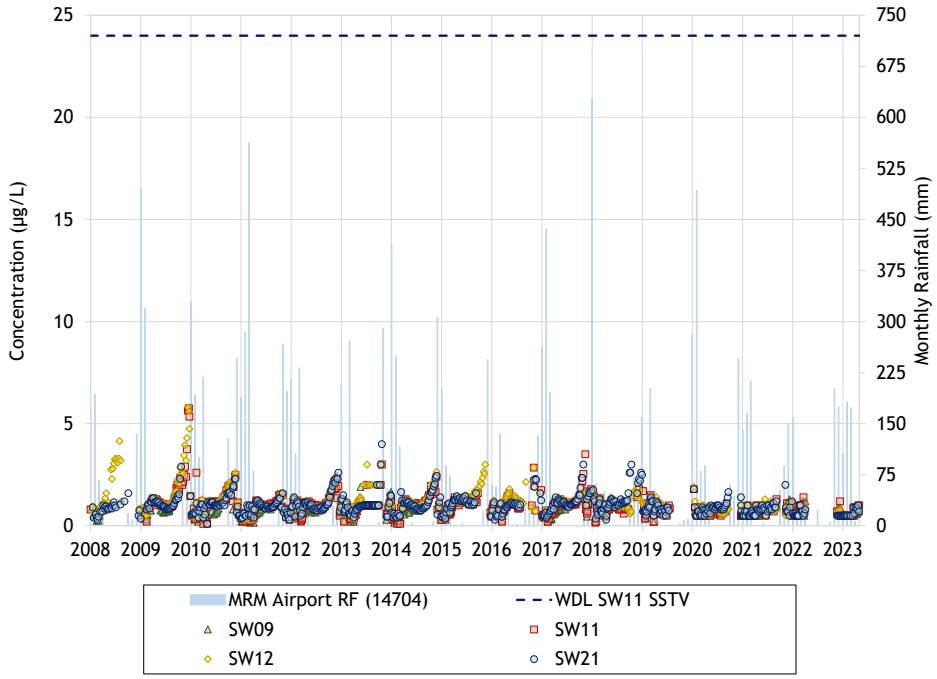


Chart 10: Historical Filtered As and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.6 Filtered Cadmium

Filtered cadmium (Cd) concentrations are presented on Chart 11 for the reporting period. Recorded filtered Cd concentrations were below the SSTV at SW11 during the reporting period. The data show no significant trends during the reporting period. The majority of the samples were below the limit of reporting (LOR) (0.2 µg/L), and consistent with historical concentrations (Chart 12).

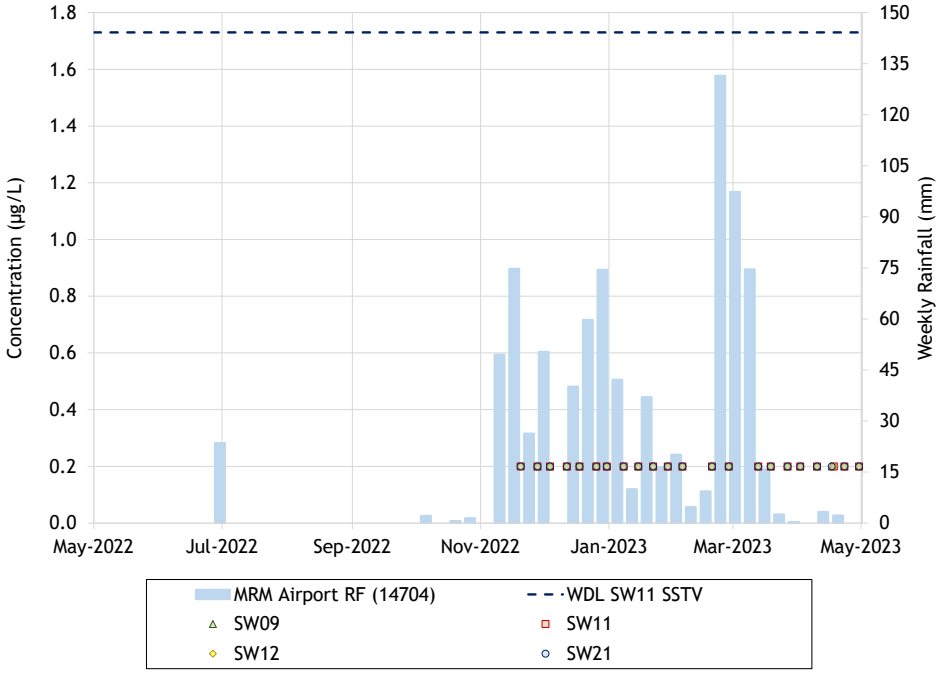


Chart 11: Reporting Period Filtered Cd and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

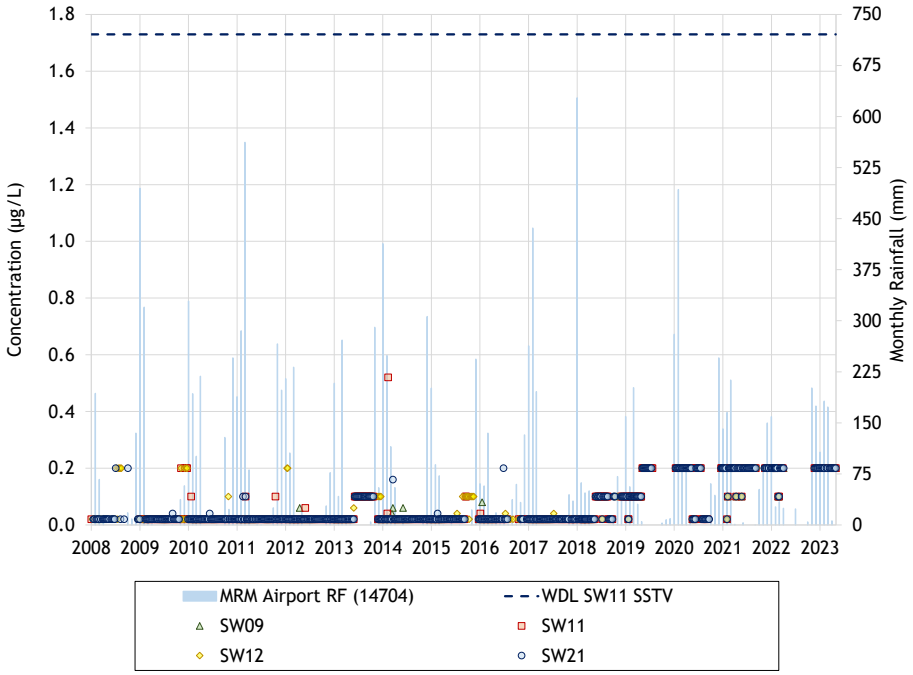


Chart 12: Historical Filtered Cd and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.7 Filtered Cobalt

Filtered cobalt (Co) concentrations are presented on Chart 13 for the reporting period. Recorded filtered Co concentrations were below the SSTV at SW11 throughout the reporting period. During the reporting period, all measured filtered Co concentrations were below 1.0 µg/L, which is consistent with the historical data (Chart 14).

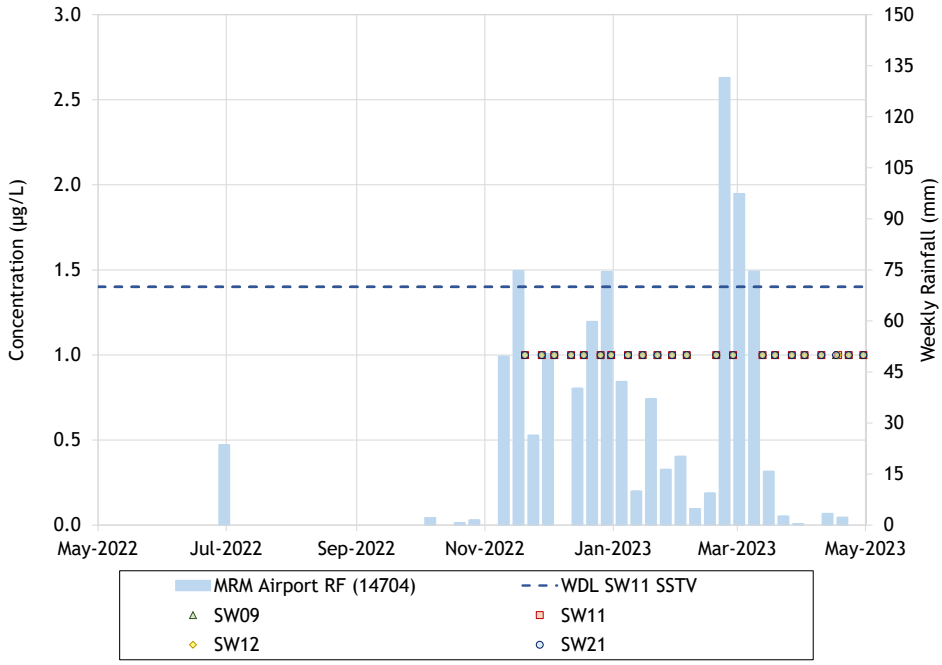


Chart 13: Reporting Period Filtered Co and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

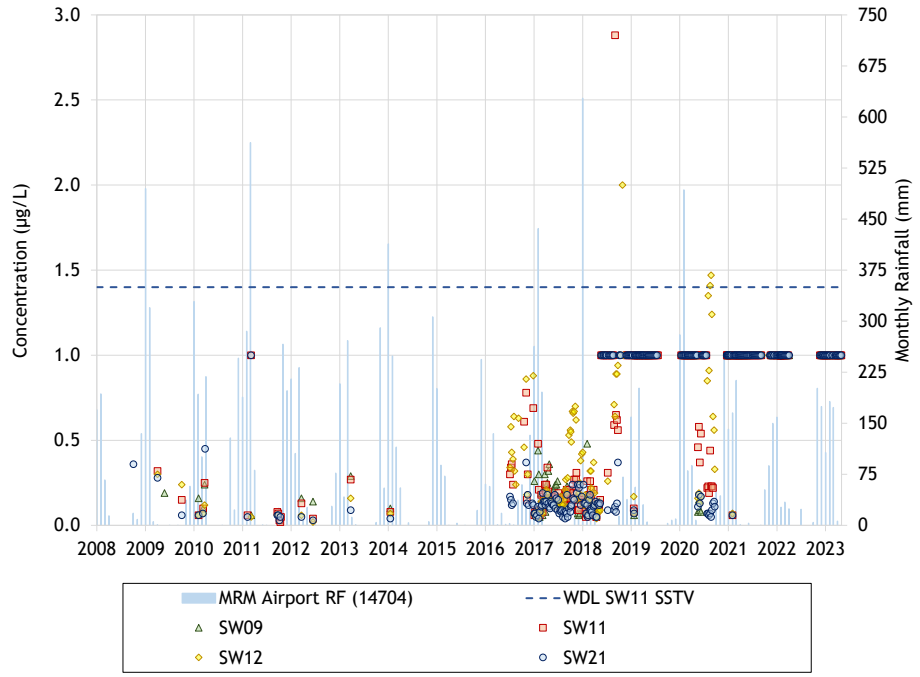


Chart 14: Historical Filtered Co and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.8 Filtered Copper

Filtered copper (Cu) concentrations are presented on Chart 15 for the reporting period. Recorded filtered Cu concentrations were below the SSTV at SW11 throughout the reporting period. During the reporting period, all measured filtered Cu concentrations were below 1.0 µg/L, which is consistent with the historical data (Chart 16).

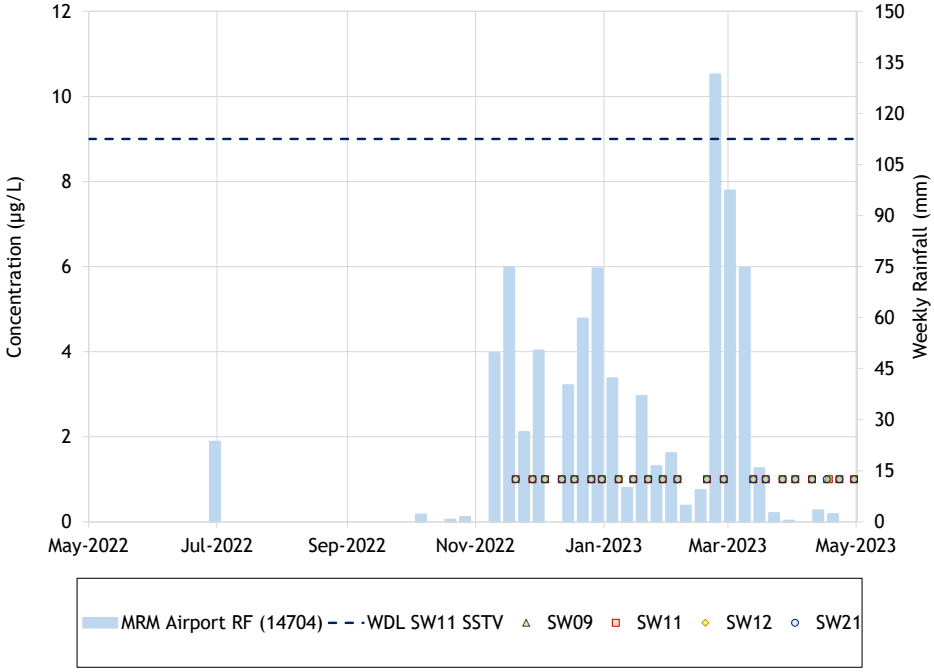


Chart 15: Reporting Period Filtered Cu and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

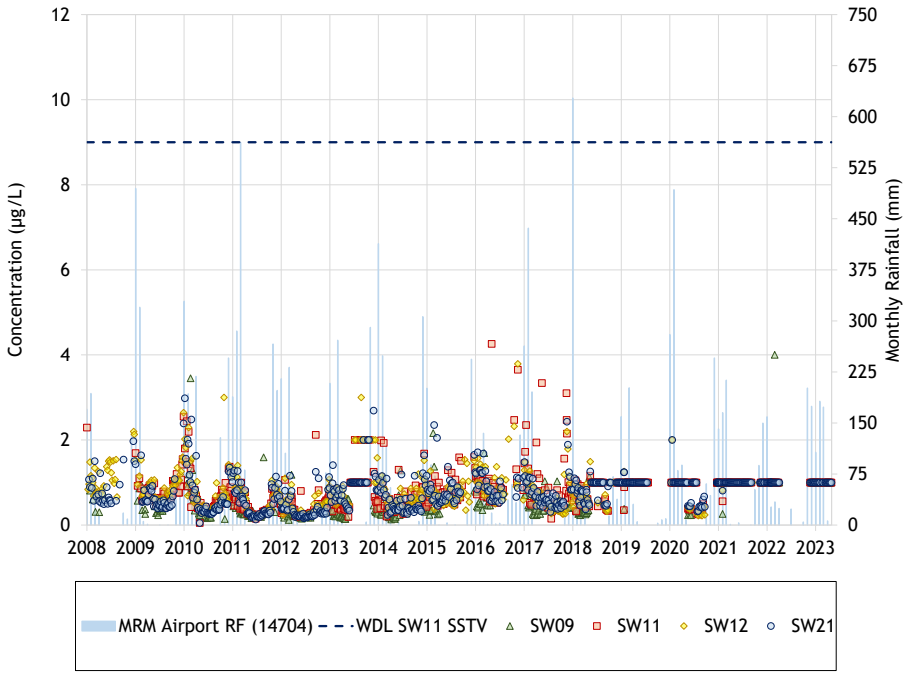


Chart 16: Historical Filtered Cu and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.9 Filtered Iron

Filtered iron (Fe) concentrations are presented on Chart 17 for the reporting period. Concentrations were generally lower through the dry season with fluctuations through the wet season associated with the rainfall events. The data for the reporting period is generally consistent with the historical data (Chart 18). There was however one instance where filtered Fe recorded at SW11 (475 µg/L) was beyond the SSTV during the reporting period. The filtered Fe concentration in the Glyde River at SW09 on the same date was 495 µg/L. No managed releases from the Mine were occurring at this time. Hence, the water quality at SW11 was likely influenced by Glyde River contributions from upstream of the Mine.

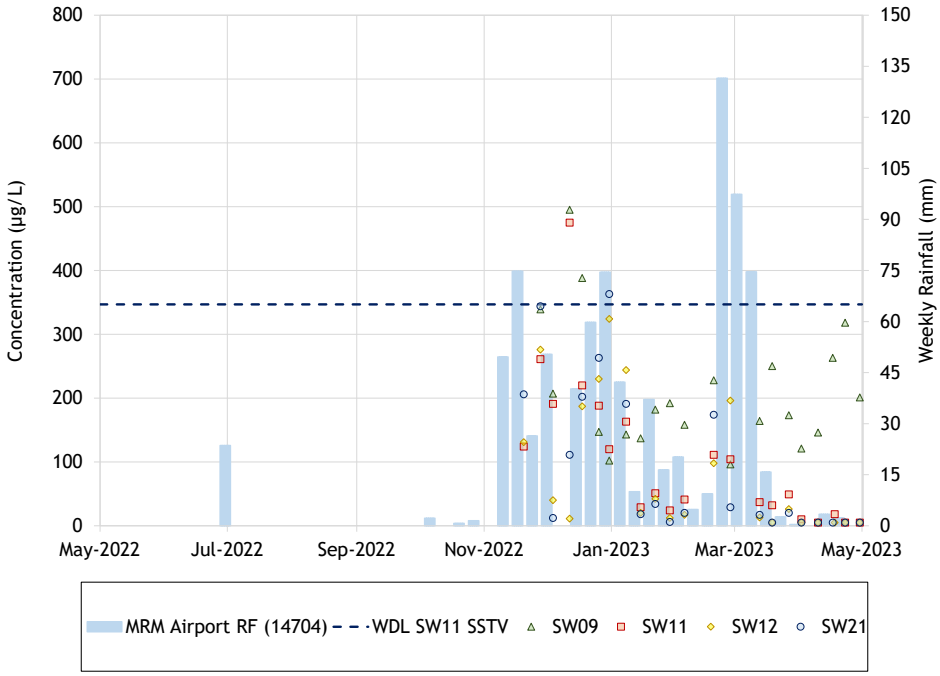


Chart 17: Reporting Period Filtered Fe and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

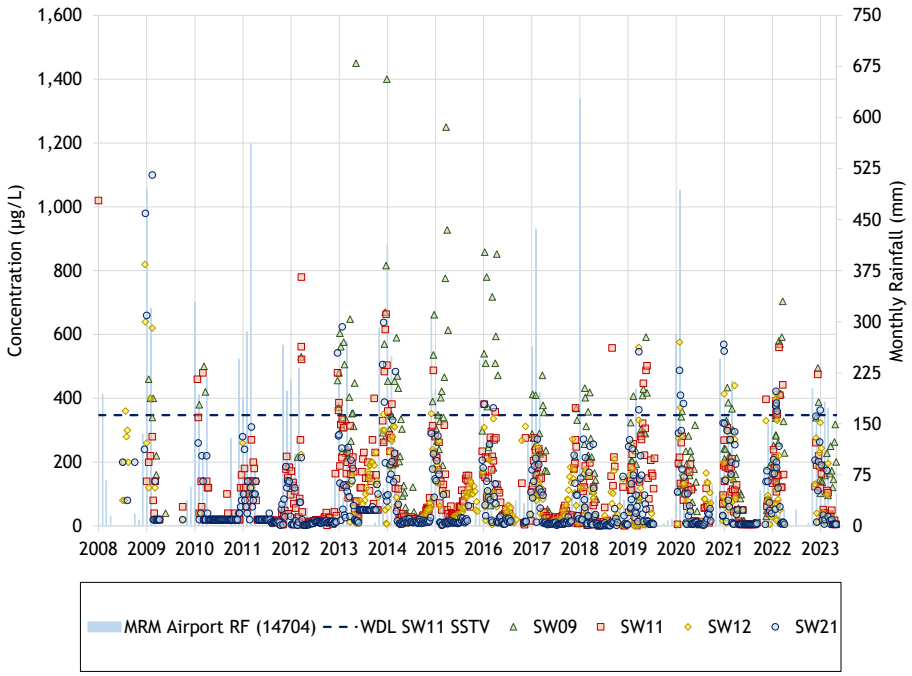


Chart 18: Historical Filtered Fe and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.10 Filtered Lead

Filtered lead (Pb) concentrations are presented on Chart 19 for the reporting period. Recorded filtered Pb concentrations were below the SSTV at SW11 during the reporting period. During the reporting period, low concentrations were recorded throughout, with all concentrations below 0.5 µg/L, consistent with the historical dataset (Chart 20).

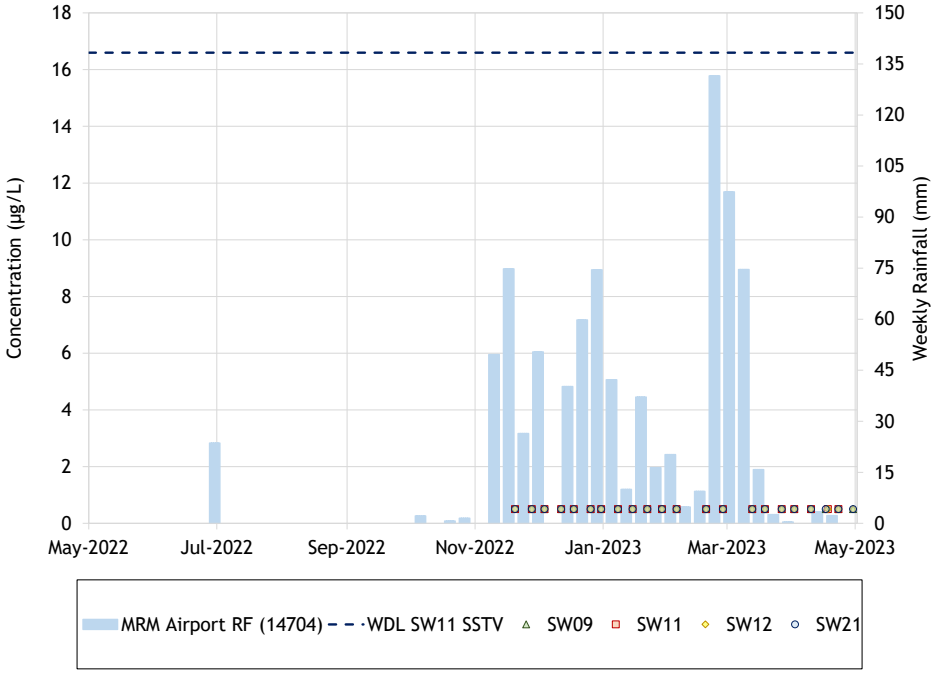


Chart 19: Reporting Period Filtered Pb and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

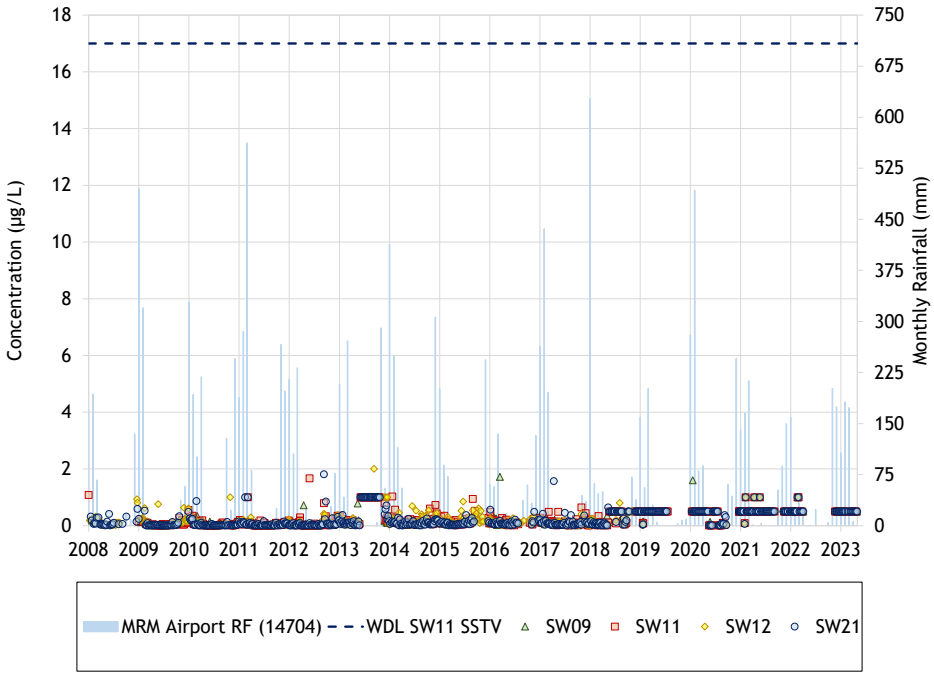


Chart 20: Historical Filtered Pb and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.11 Filtered Manganese

Filtered manganese (Mn) concentrations are presented on Chart 21 for the reporting period. Recorded filtered Mn concentrations were below the SSTV at SW11 during the reporting period.

The historical data (Chart 22) shows that the filtered Mn levels in upstream McArthur River (SW21) and Glyde River (SW09) were consistently low. Filtered Mn levels downstream of the Mine (SW11 and SW12) were generally low during the wet seasons but comparatively elevated during the dry seasons.

During the reporting period, the filtered Mn levels were consistent with the historical trends.

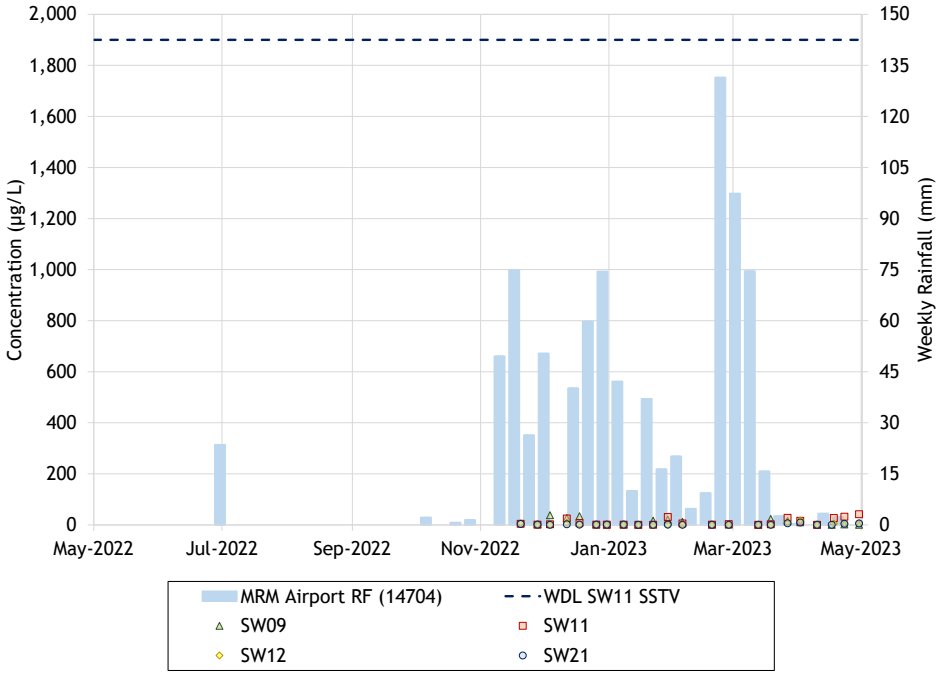


Chart 21: Reporting Period Filtered Mn and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

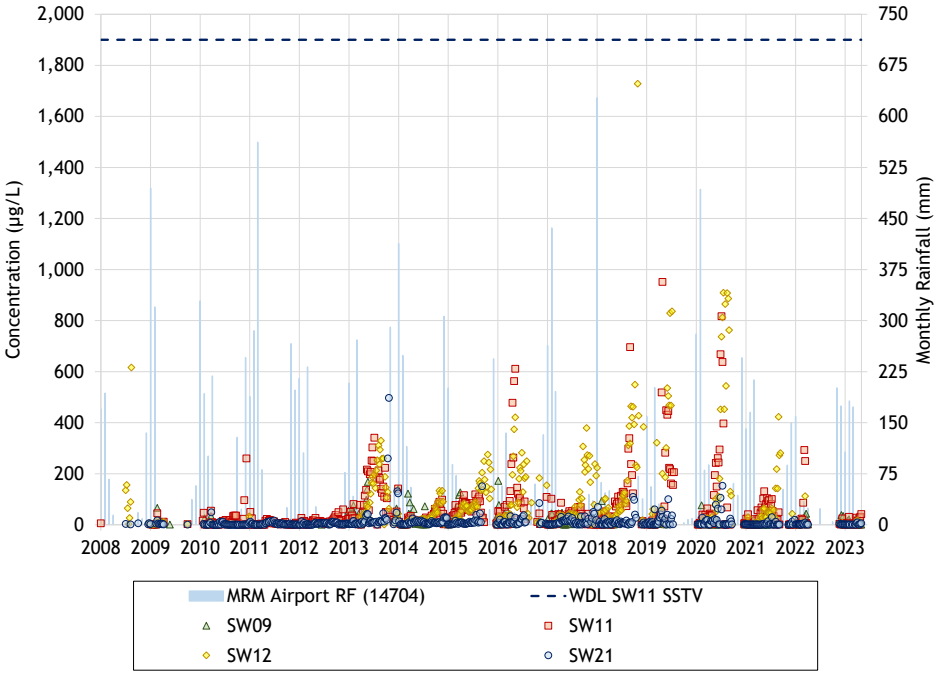


Chart 22: Historical Filtered Mn and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.12 Filtered Nickel

Filtered nickel (Ni) concentrations are presented on Chart 23 for the reporting period. Recorded filtered Ni concentrations at SW11 were below the SSTV during the reporting period. All samples for filtered Ni recorded concentrations below 1.0 µg/L. Concentrations during the reporting period were consistent with the historical record (Chart 24).

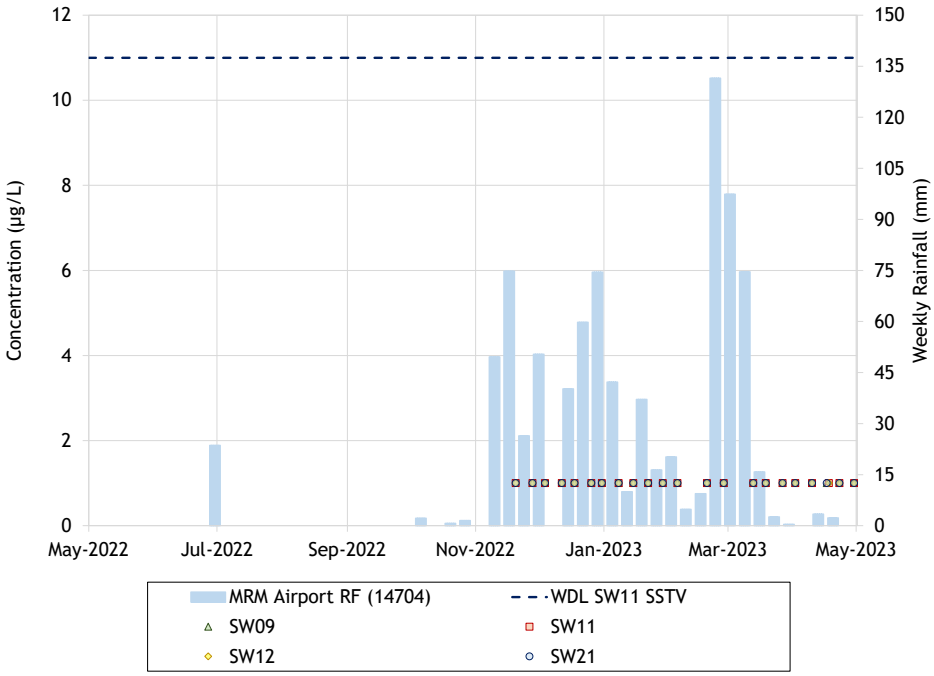


Chart 23: Reporting Period Filtered Ni and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

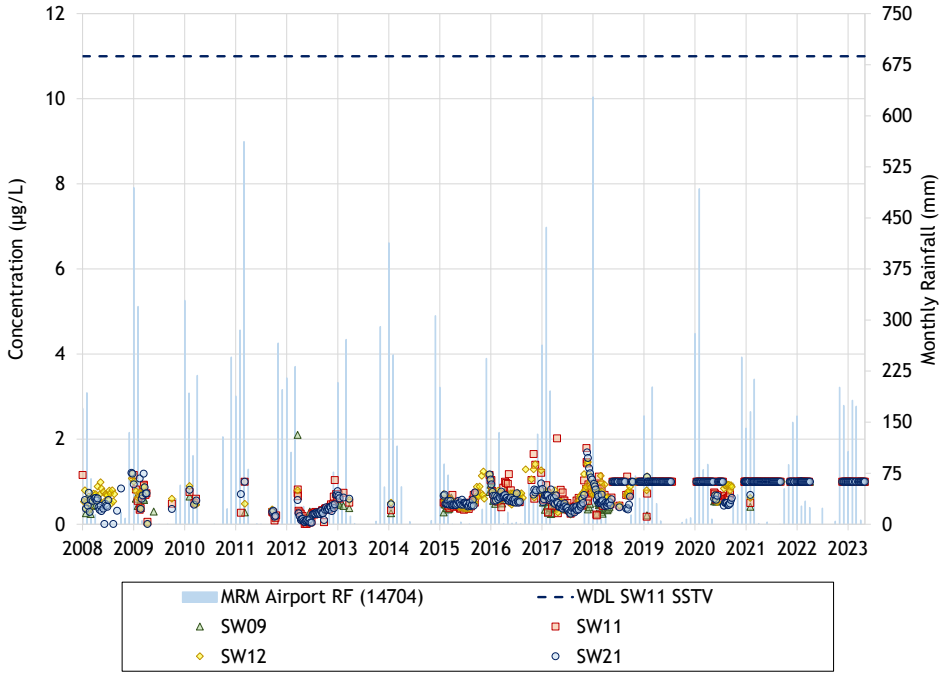


Chart 24: Historical Filtered Ni and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.13 Filtered Thallium

Filtered thallium (Tl) concentrations are presented on Chart 25 for the reporting period. Recorded filtered Tl concentrations at SW11 were below the SSTV during the reporting period. All samples for filtered Tl recorded concentrations below 1.0 µg/L. Concentrations during the reporting period were consistent with the historical record (Chart 26).

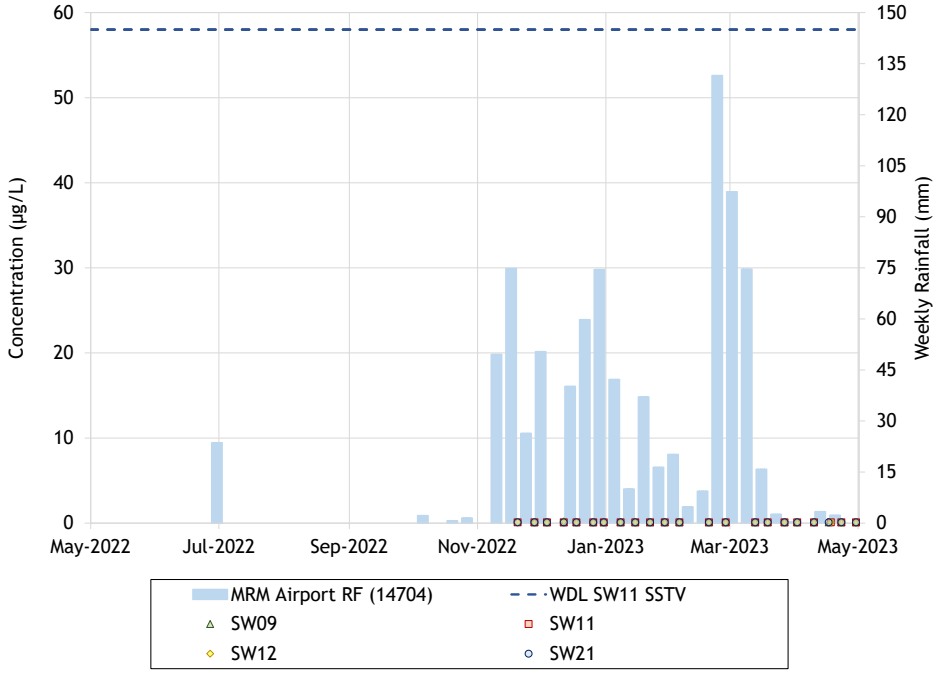


Chart 25: Reporting Period Filtered Tl and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

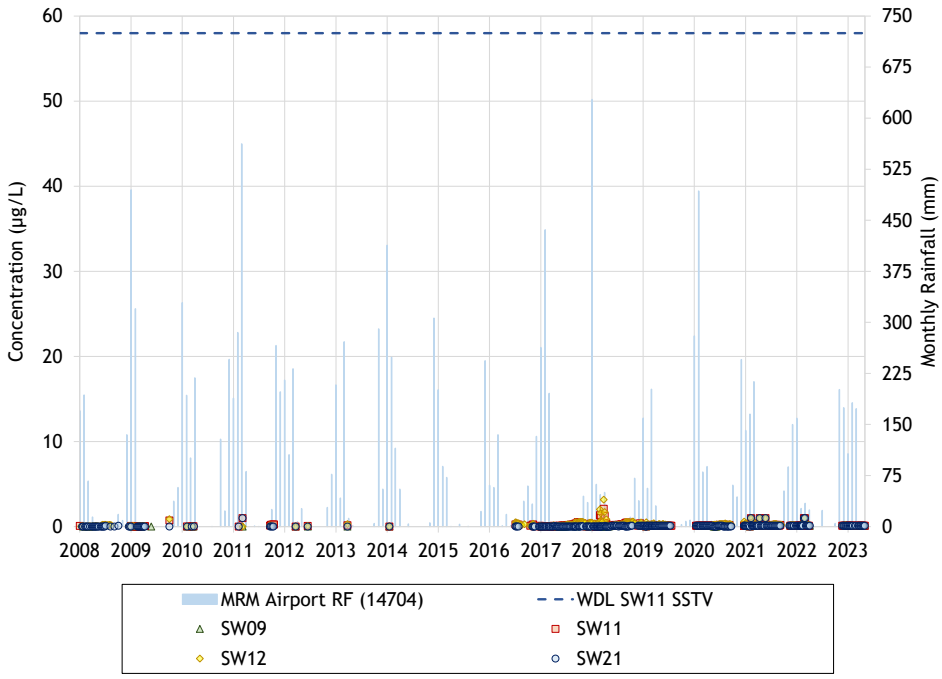


Chart 26: Historical Filtered Tl and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.14 Filtered Zinc

Filtered zinc (Zn) concentrations are presented on Chart 27 for the reporting period. Recorded filtered Zn concentrations at SW11 were below the SSTV during the reporting period. Concentrations measured throughout the reporting period were low and are within the range of historical concentrations (Chart 28).

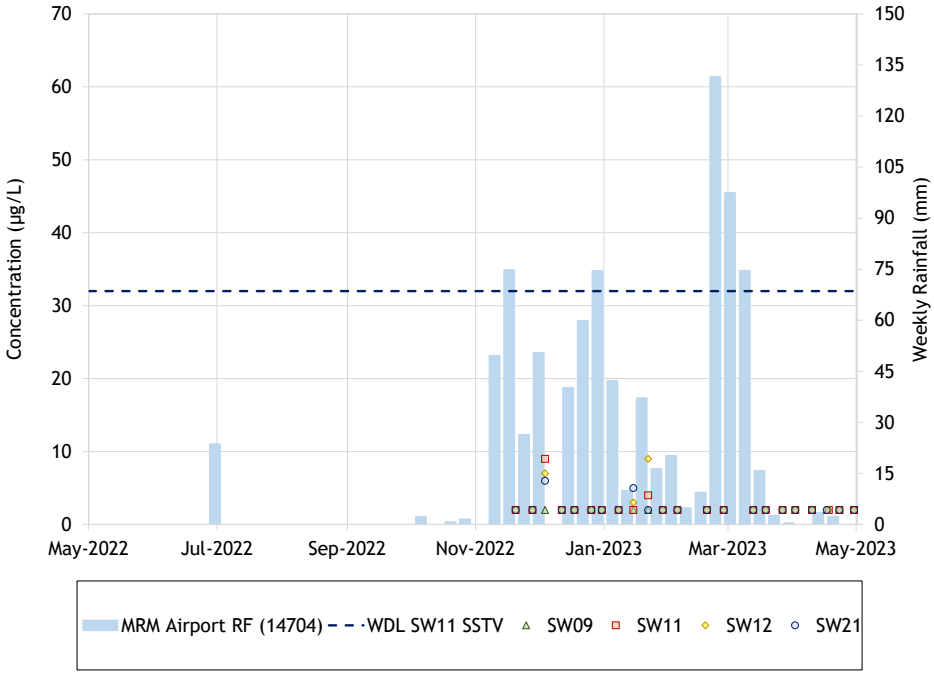


Chart 27: Reporting Period Filtered Zn and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

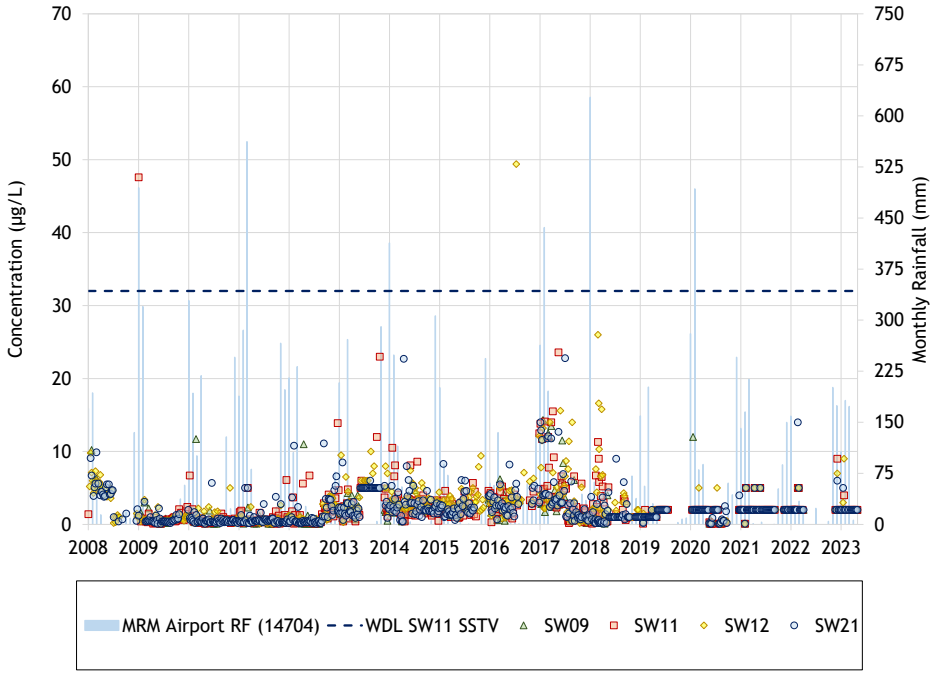


Chart 28: Historical Filtered Zn and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.15 Sulphate

Sulphate (SO_4) concentrations are presented on Chart 29 for the reporting period. Recorded SO_4 concentrations at SW11 were below the SSTV during the reporting period. SO_4 concentrations show a similar trend to EC levels where values are highest during the dry season and lowest during the wet season. During the reporting period, SO_4 levels were generally consistent with historical levels (Chart 30).

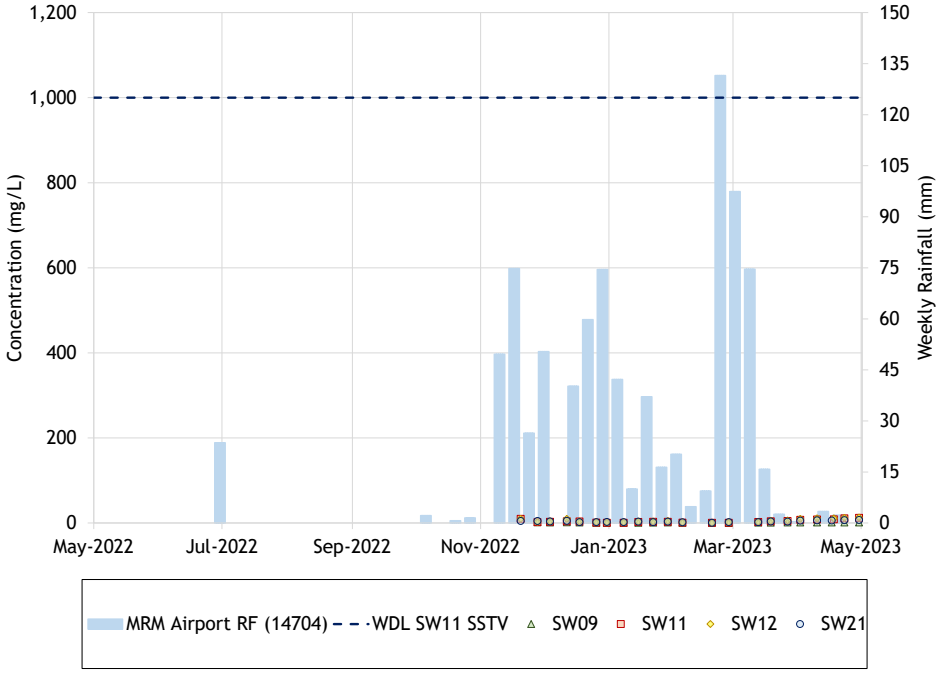


Chart 29: Reporting Period SO_4 and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

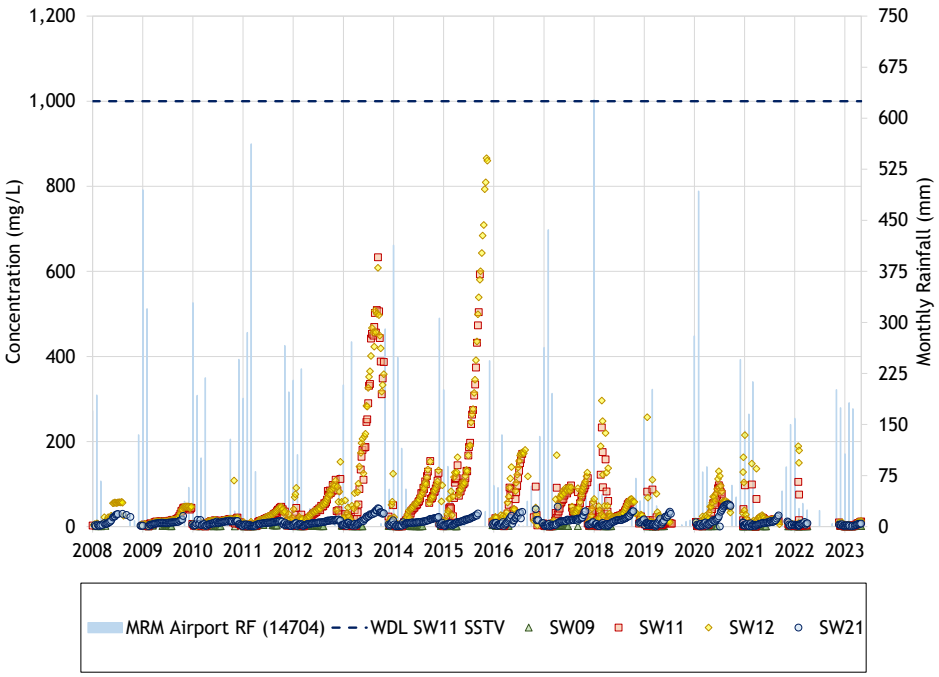


Chart 30: Historical SO_4 and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.16 Nitrate

Nitrate (NO_3) concentrations are presented on Chart 31 for the reporting period. Recorded NO_3 levels were below the SSTV at SW11 during the reporting period. During the reporting period, SW21 and SW12 NO_3 levels remained relatively low while NO_3 levels at SW09 and SW11 were elevated from the onset of the wet season. This is consistent with the historical trends (Chart 32).

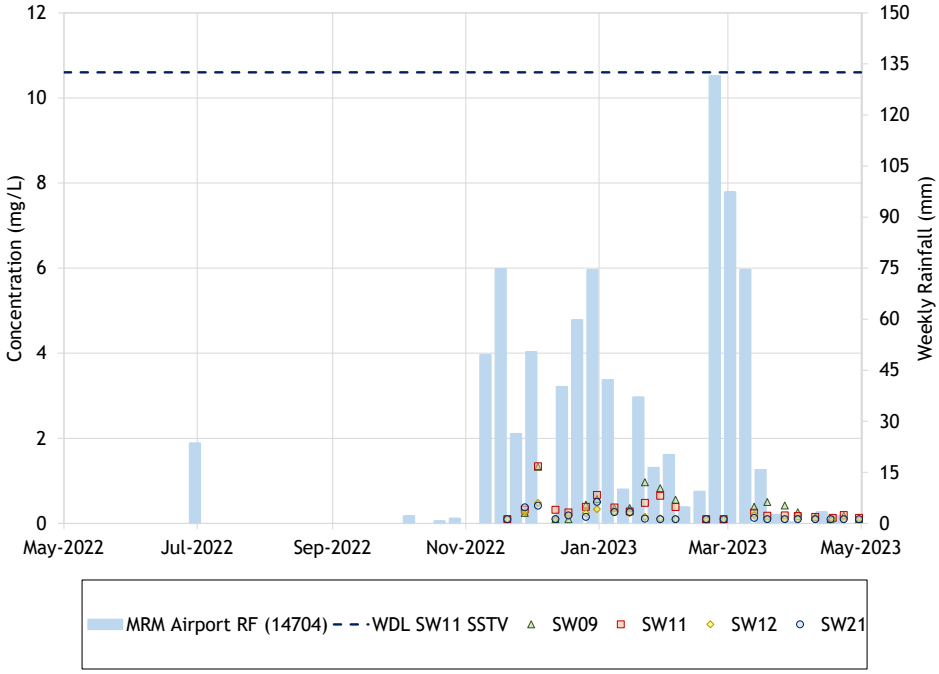


Chart 31: Reporting Period NO_3 and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

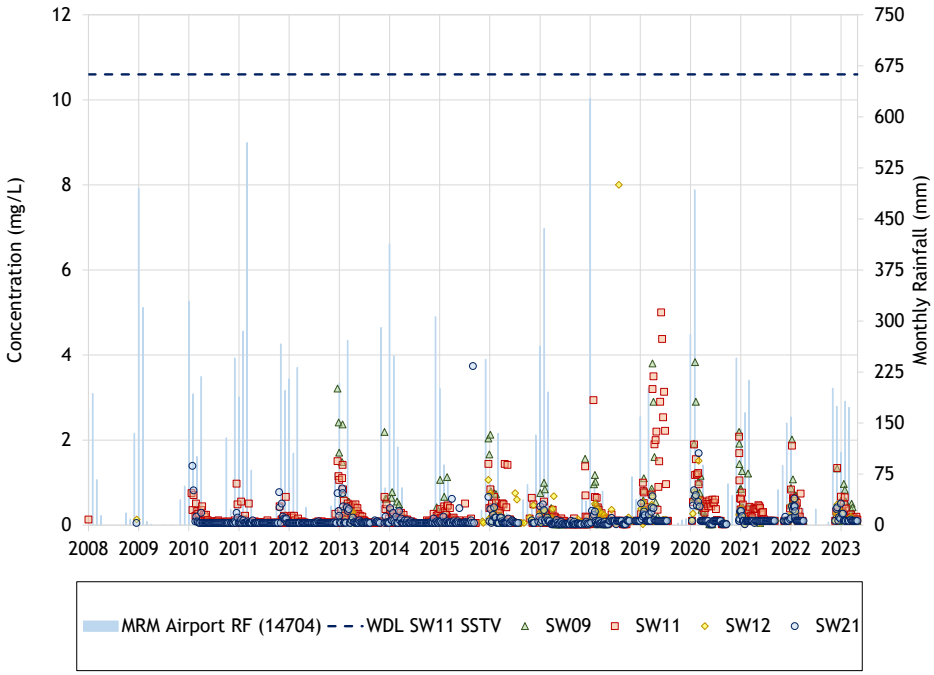


Chart 32: Historical NO_3 and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.17 Total Petroleum Hydrocarbons C10 – C36

Total petroleum hydrocarbon (TPH) (C10-C36 sum) concentrations are presented on Chart 33 and Chart 34 for the reporting and historical periods. Recorded TPH C10-C36 concentrations at SW11 were below the LOR (50 µg/L) during the reporting period, which is consistent with the historical data.

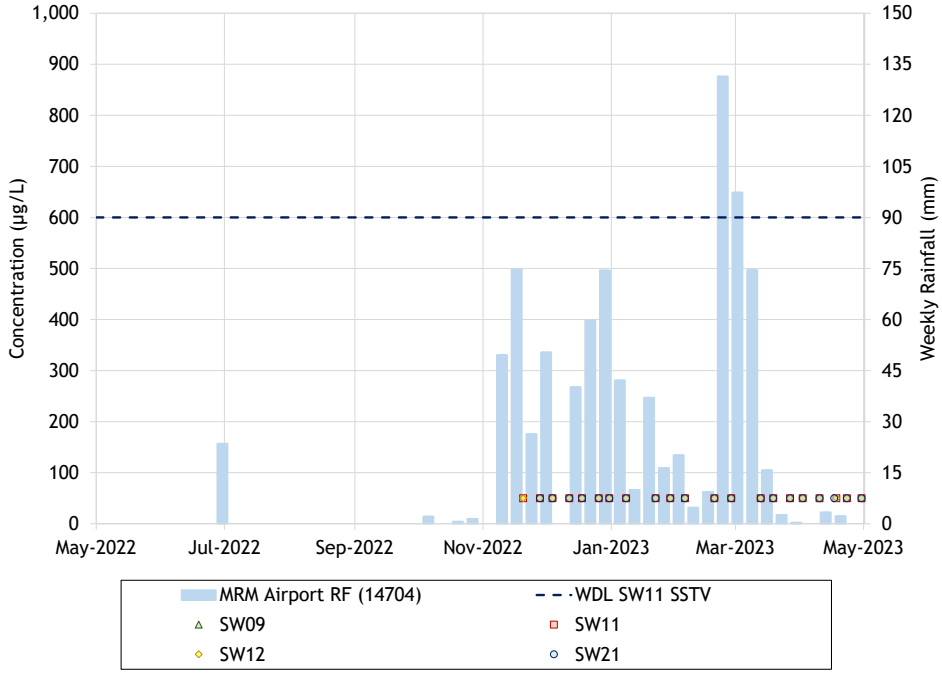


Chart 33: Reporting Period TPH C10-C36 Fraction and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

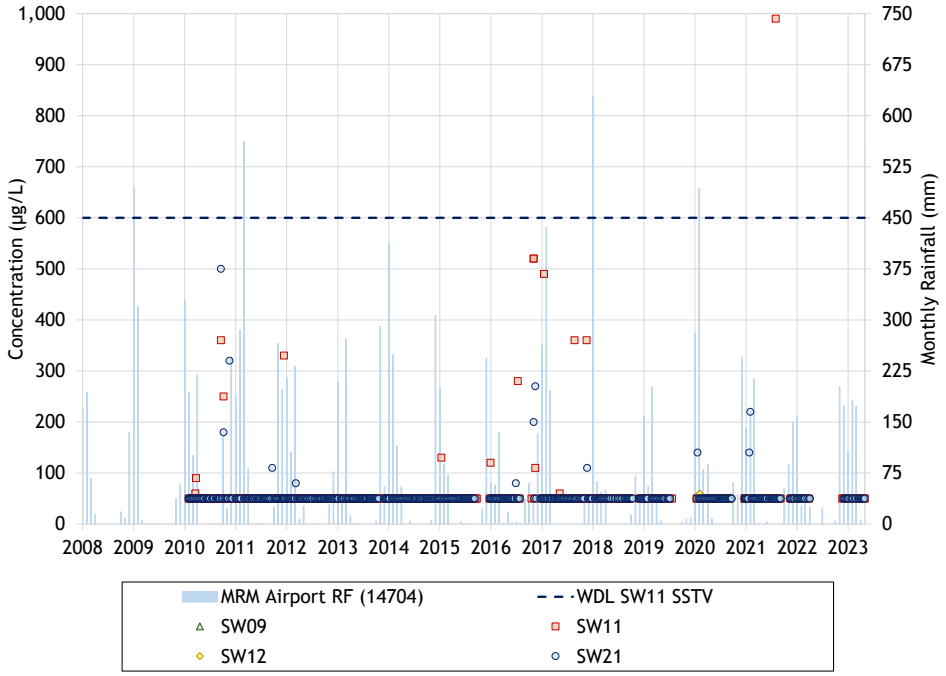


Chart 34: Historical TPH C10-C36 Fraction and Monthly Rainfall – McArthur River and Glyde River Monitoring Sites

4.3.18 Benzene

Benzene concentrations are presented on Chart 35 and Chart 36 for the reporting and historical periods. Benzene concentrations were extremely low during the reporting period. Recorded benzene concentrations at SW11 were below the LOR (1.0 µg/L) and SSTV, which is consistent with the historical data.

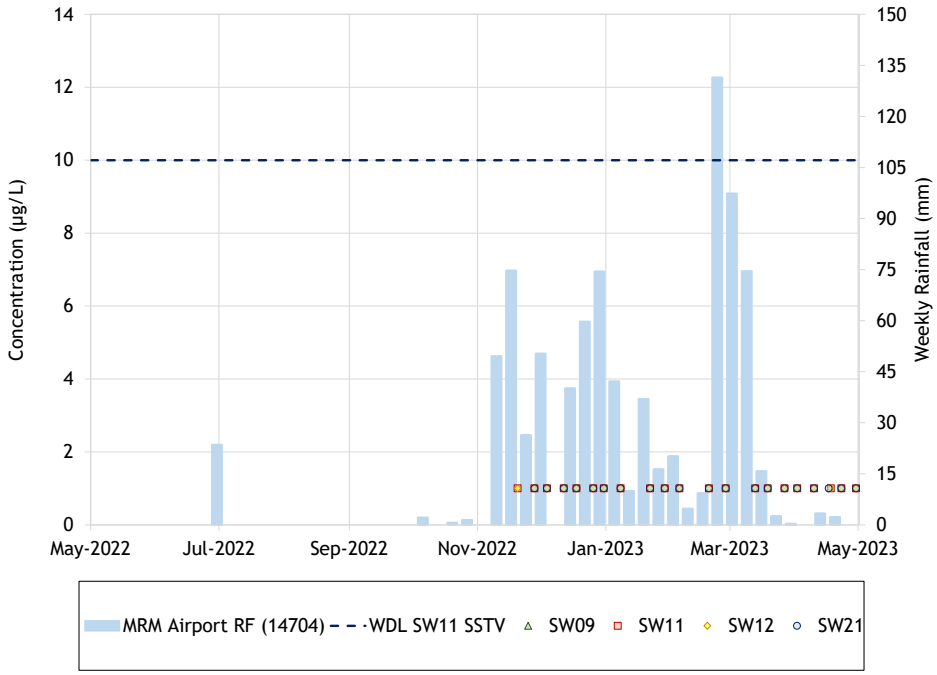


Chart 35: Reporting Period Benzene and Weekly Rainfall – McArthur River and Glyde River Monitoring Sites

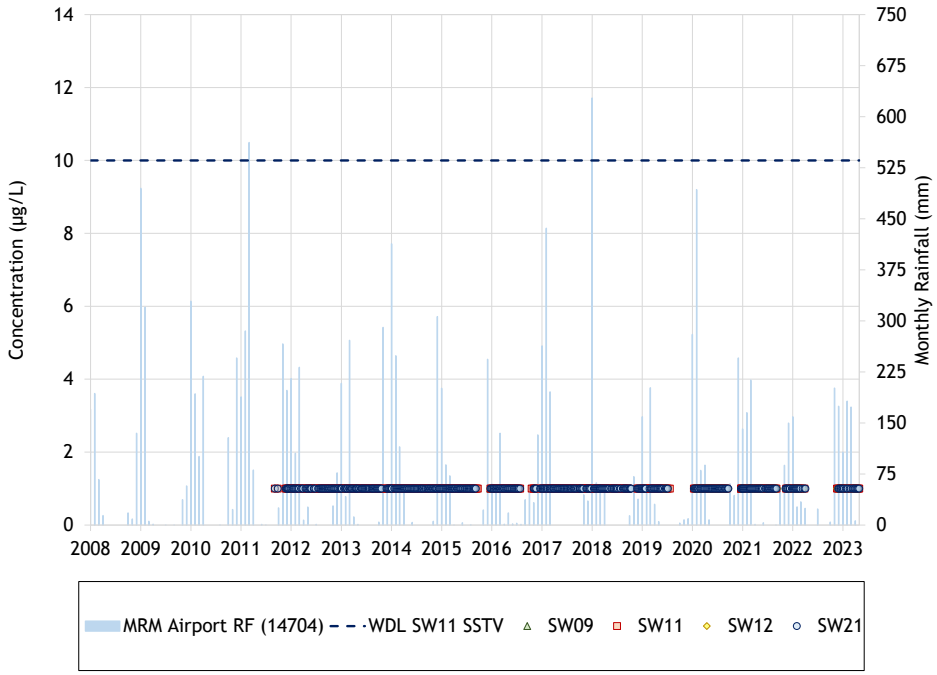


Chart 36: Historical Benzene and Monthly Rainfall – McArthur River and Glyde River Monitoring Site

5 Analyte Loads

Analyte loads have been estimated for the period between 1 May 2022 and 30 April 2023 by WRM (2023b). The full assessment report is provided in Attachment 4, with a summary of key findings provided below.

The loads assessment was undertaken to:

- estimate the actively released mine derived analyte loads produced by the Mine from managed releases during the current reporting period;
- compare the annual managed release loads released since 2017/18 reporting period; and
- compare the managed release loads to the background loads in McArthur River (at SW21 and SW11) and Glyde River (at SW09) during the current reporting period.

Analyte loads for the reporting period were estimated using the following methodology:

1. Daily surface water volumes:
    a. Daily water level data at SW11 was provided by MRM. Water level data was converted to streamflow volumes using the rating curves presented in Appendix A of Attachment 4.
    b. Daily streamflow volumes at M.I.M Pump were obtained from the NT Government website and applied to calculations at SW21.
    c. Daily water level data at SW09 was provided by MRM for the period 20 November 2022 to 3 March 2023. Water level data was converted to streamflow volumes using the rating curves presented in Appendix A of Attachment 4.
2. Daily analyte concentrations:
    a. Analyte concentrations were typically recorded on a weekly timestep. Daily concentrations were obtained by linearly interpolating between the recorded data points.
    b. Water quality values that were listed as below the LOR were assumed to be equal to the LOR value, which will likely overestimate the concentration (and therefore the estimated load).
3. Annual analyte load estimation:
    a. The annual analyte loads for a given period were estimated by:
        i. Multiplying the interpolated daily concentrations by the interpolated daily flows to give an estimated daily load.
        ii. Summing the estimated daily loads over the annual reporting period.

In loads assessments, the total concentrations are considered more environmentally significant, especially for those analytes with the potential for bioaccumulation in sediment-ingesting biota and biomagnification within the aquatic food chain.

5.1 Loads Estimate for SW09, SW21 and Managed Release

Loads estimates, which are presented in Table 6, included the McArthur River and Glyde River upstream of the Mine (at SW09 and SW21 respectively) and mine derived analyte loads produced by the Mine from managed releases.

Given the array of inherent uncertainties in the calculation of annual analyte loads in natural systems such as the upstream McArthur River, there are a number of limitations in the current assessment. These include (WRM, 2023b):

- There is a naturally high uncertainty in estimating loads in natural systems due to their dynamic nature and natural variability. Weekly or even daily water quality measurements may not capture a number of the natural processes that affect water quality during a flow event. Hence, there is a level of uncertainty in the estimated annual analyte loads, particularly for natural surface water reporting locations; and
- It is very difficult to accurately measure every source of water in a dynamic system such as the McArthur River and the Mine to the point that the sum of pre-mine analyte loads and mine derived analyte loads will equal the post-mine loads. As such, it is impossible to achieve an accurate metal balance.

TABLE 6: ESTIMATED SURFACE WATER FLOW VOLUMES AND ANALYTE LOADS FOR THE PERIOD 1 MAY 2022 TO 30 APRIL 2023 (AFTER WRM 2023B)

Parameter	Unit	SW21 + SW09 (pre-mine)	Managed Releases from the Mine	Percentage Increase
Total Flow	ML	2,500,880	0	0%
Al_F	kg	125,119	0	0%
Al_T	kg	27,466,310	0	0%
As_F	kg	1,322	0	0%
As_T	kg	5,627	0	0%
B_F	kg	44,486	0	0%
B_T	kg	64,301	0	0%
Cd_F	kg	500	0	0%
Cd_T	kg	500	0	0%
Co_F	kg	2,501	0	0%
Co_T	kg	7,133	0	0%
Cu_F	kg	2,501	0	0%
Cu_T	kg	12,645	0	0%
Fe_F	kg	276,605	0	0%
Fe_T	kg	24,706,886	0	0%
Pb_F	kg	1,250	0	0%
Pb_T	kg	10,855	0	0%
Mn_F	kg	7,772	0	0%
Mn_T	kg	229,080	0	0%
Hg_F	kg	25	0	0%
Hg_T	kg	125	0	0%
Ni_F	kg	2,501	0	0%
Ni_T	kg	12,891	0	0%
Tl_F	kg	250	0	0%
Tl_T	kg	278	0	0%
Zn_F	kg	5,104	0	0%
Zn_T	kg	42,285	0	0%
SO_4	tonnes	3,379	0	0%
NO_3	kg	822,882	0	0%
TDS	tonnes	155,339	0	0%

Parameter	Unit	SW21 + SW09 (pre-mine)	Managed Releases from the Mine	Percentage Increase
TSS	tonnes	489,590	0	0%

kg = kilograms, TDS = total dissolved solids, TSS = total suspended solids

The following observations, as reported in WRM (2023b), are made:

> *The McArthur River flow volume passing post mine gauging station SW11 was approximately 10% higher than the sum of pre-mine gauging stations (SW21 and SW09) for the reporting period. This is mainly due to the contribution of natural surface water sources including Barney Creek, Surprise Creek, Emu Creek and Bull Creek.*
>
> *No managed releases occurred during the 2022/23 reporting period, hence the relative contribution to the analyte loads downstream of the Mine from managed releases was 0%.*

Comparison of 2017/18 Managed Release Loads

The NT EPA Assessment Report 86 recommends (under Recommendation 3) that the annual loads of Pb and Zn released to the McArthur River in future years (July to June) do not exceed the loads released in 2017/18, taking into account seasonal variations in rainfall, and subject to future annual load calculations. Load limits on total Pb and Zn in managed release waters are also provided as a commitment in the Mine's Adaptive Management Plan.

The annual managed release loads for total Zn and total Pb for the previous four years have been compared to the managed release loads for the 2017/18 period (Chart 37). No managed releases occurred during the 2022/23 reporting period. Hence, the estimated 2022/23 total Pb and total Zn managed release loads are less than the annual baseline limit defined by the 2017/18 period. Furthermore, based on the comparison and in accordance with Recommendation 3 of the NT EPA Assessment Report, the managed release loads for the 2021/22, 2020/21, 2019/20 and 2018/19 reporting periods were less than the 2017/18 values.

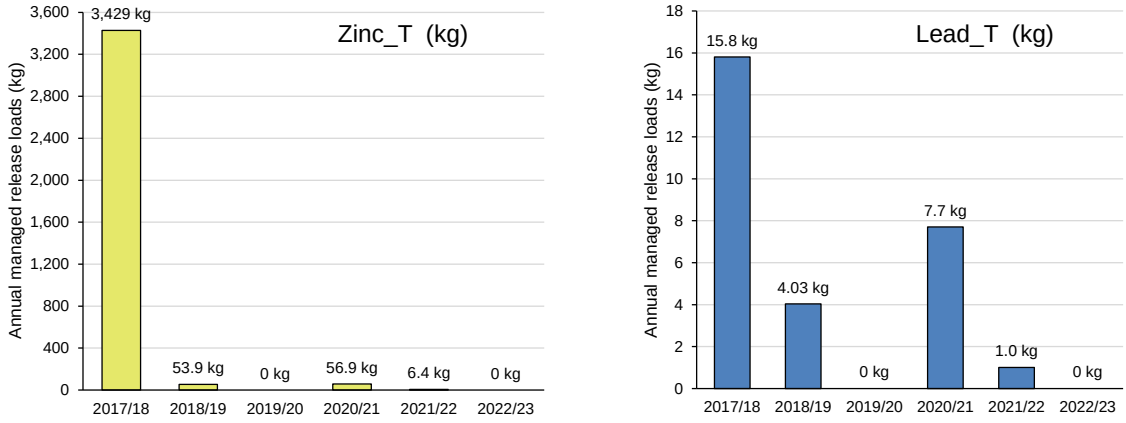


Chart 37: Comparison of Estimated Total Zinc and Total Lead Loads 2022/23 to 2017/18

6 Discussion

All water quality results collected at SW11 and BBDDP were compared to the relevant SSTVs. Where results were triggered by Condition 40 of WDL 174-13, an investigation was conducted to confirm if the cause was attributable to MRM's operations, including in consideration of:

- whether managed release was occurring at the time; and
- comparison to upstream water quality results at control sites (e.g., catchments unaffected by the Mine, such as the Glyde River and upstream McArthur River).

MRM provided an investigation report to the NT DEPWS in accordance with Condition 39 of WDL 174-13. The investigation report included consideration of the potential contributing factors to instances when monitoring results were beyond SSTVs (e.g. operational or naturally occurring) and the likely risk of environmental harm.

One (1) investigation report (as triggered by WDL 174-13 Condition 40) was submitted to NT DEPWS over the reporting period for the BBLF compliance monitoring site BBDDP. Elevated results above the SSTVs are summarised in Table 7.

TABLE 7: REVIEW OF ANALYTE RESULTS AT SW11 AGAINST WDL 174-13 SSTVS

Site	Sample Date	Analyte Result			Elevated Result Related to Managed Release?	Investigation Triggered?	Investigation Report Confirms Elevated Result is from MRM Operations?
	Quality Parameter	DO	Fe*	As*			
		% sat	µg/L	µg/L			
	SSTV	85 – 120	300	2.3			
SW11	28 November 2022	82.3	-	-	No	No	N/A
SW11	12 December 2022	-	475	-	No	No	N/A
SW11	8 January 2023	78.7	-	-	No	No	N/A
SW11	27 February 20223	80.6	-	-	No	No	N/A
BBDDP	2 January 2023	-	-	2.5	No	Yes	No

* Analytes are filtered.

6.1 Review of Monitoring Data Against SSTVs at SW11

The section below provides further details on the analytes for which concentrations were elevated beyond the SSTV at SW11 (DO and filtered Fe). The performance for other sites along the McArthur River and its tributaries is provided in Attachment 3.

During the reporting period, there were no managed release events from the Mine.

McArthur River Dissolved Oxygen

DO results were outside the SSTV limits on three (3) occasions during the reporting period. The three (3) results were below the minimum SSTV (85% saturation) and no result triggered an investigation report. DO concentrations below 85% were frequently recorded for many sites during the middle and late stages of the dry season, including upstream monitoring sites unaffected by mining activities. The data indicated that DO concentrations below the SSTV were likely caused by natural catchment variation.

The DO results outside the SSTV range during the reporting period are considered non-mine related and resultant of natural river processes.

McArthur River Filtered Iron

Filtered Fe results were beyond the SSTV at SW11 on one (1) occasion during the reporting period and did not trigger an investigation report.

The result that was beyond the SSTV for filtered Fe coincided with elevated filtered Fe levels at the Glyde River monitoring station SW09, which is considered to be outside of the influence of the Mine. This indicates that the filtered Fe levels at SW11 were influenced by the natural Glyde River catchment inflows upstream of SW11. This is further supported by the fact that filtered Fe levels at SW12 were substantially lower than the SSTV at the time of the elevated results.

6.2 Review of Monitoring Data Against SSTVs at BBDDP

As described in WDL 174-13, the dredge spoil perimeter drain exit point (i.e., the authorised discharge and compliance monitoring point BBDDP) is located on the tidal mudflats to the east of the BBLF. The dredge spoil perimeter drain is constructed around the external boundary of the dredge spoil cells to intercept saline water (i.e., runoff or seepage from the dredge spoil emplacement area).

Bing Bong Loading Facility Filtered Arsenic

An investigation report was triggered at the BBLF due to a sample being collected at the BBDDP on 2 January 2023 that returned a result that was beyond the SSTV for filtered As. The filtered As result was 2.5 ug/L, compared to the SSTV of 2.3 µg/L.

The investigation report concluded that the BBDDP site was subject to natural fluctuations in filtered arsenic from tidal influence, groundwater expression and localised run-off from the natural catchment, which were the likely causes of the subject result. The filtered arsenic result at BBDDP was therefore considered non-mine related and a result of natural influences.

7 Conclusion

This Monitoring Report has been submitted in accordance with Condition 43 of WDL 174-13 and covers the reporting period 1 May 2022 to 30 April 2023. Site surface water monitoring data and mine derived analyte loads for the reporting period have been assessed by WRM (2023a and 2023b) (Attachment 3 and Attachment 4, respectively).

In addition to addressing the requirements of WDL 174-13, the objectives of the monitoring programs are to allow for the assessment of MRM's performance against its key environmental objectives, which are as follows:

- protect the McArthur River's beneficial uses and community values from mining impacts;
- facilitate development of the ecosystems and their functions along the McArthur River Diversion Channel for terrestrial and aquatic flora and fauna;
- achieve a recovering trend in the water quality and ecosystem function in creeks on the Mine site within 20 years of cessation of mining;
- minimise air quality related impacts from the Mine's operations with respect to community health and environment; and
- protect the community values and beneficial uses adjacent to the BBLF and transhipment corridor.

Over the reporting period, the compliance monitoring point SW11 (on the McArthur River) experienced cease to flow conditions during the dry season between May 2022 and mid-November 2022. There were no managed releases to the receiving environment from the Mine during the reporting period owing to water conservation for processing and construction purposes.

In the McArthur River, a circa neutral to slightly alkaline pH was reported across all the monitoring locations, with no pH results recorded outside of the SSTV range at SW11 over the reporting period. The pH results were generally consistent between monitoring locations upstream and downstream of the Mine. There were no EC or SO_4 results beyond the SSTVs at SW11 over the reporting period. The recorded pH, EC and SO_4 levels were also lower over the reporting period compared to historical trends.

Filtered metal results in the McArthur River were consistently low over the reporting period, including for the key metals of potential concern (Cd, Co, Cu, Pb, Ni, Tl, and Zn). During the reporting period, there were four (4) individual results beyond the SSTVs at SW11. These were related to dissolved oxygen (3) and filtered iron (1). Of these results, no formal investigations were triggered under the conditions of WDL 174-13. However, a review of the data by WRM (2023a) determined that these results were unrelated to mine activities and were a result of natural river processes and contributions from sources upstream of the Mine.

Over the reporting period, the compliance monitoring point BBDDP experienced cease to flow or dry conditions for most of the scheduled sampling events. Further, dredge spoil was not actively emplaced at the BBLF over the reporting period and as such there was no managed release from the DSEA.

An investigation report was triggered at the BBLF due to a sample being collected at the BBDDP on 2 January 2023 that returned a result that was beyond the SSTV for filtered As. The filtered As result was 2.5 ug/L, compared to the SSTV of 2.3 µg/L.

The investigation report concluded that the BBDDP site was subject to natural fluctuations in filtered As from tidal influence, groundwater expression and localised run-off from the natural catchment, which were the likely causes of the subject result. The filtered As result at BBDDP was therefore considered non-mine related and a result of natural influences. The investigation report was review and supported by WRM (2023a).

WRM (2023b) also reviewed the mine derived analyte loads for the reporting period between 1 May 2022 and 30 April 2023. No managed releases occurred during the reporting period. Hence, the estimated total lead and total zinc loads discharged to the McArthur River in managed release were both zero. These loads were less than the annual limits specified in the Mine's Adaptive Management Plan. This is consistent with recommendation 3 of the NT Environment Protection Authority (EPA) Assessment Report 86.

Conclusion

Based on the review of surface water quality monitoring data between 1 May 2022 and 30 April 2023, WRM (2023a) concluded that:

> *MRM continue to implement effective controls to minimise the risk of environmental harm of downstream receiving waters due to Mine operations. The review concluded that the beneficial uses and community values of the McArthur River continue to be protected from potential mine derived impacts.*
>
> *…*
>
> *There were no mine derived SSTV exceedances or non-compliances recorded at the SW11 compliance point in the McArthur River during the reporting period. The SSTV exceedances recorded at SW11 during the reporting period were unrelated to mine activities and were a result of natural river processes and contributions from sources upstream of the Mine.*

MRM will continue to implement the existing monitoring program in accordance with conditions of the current WDL.

8 Certification

I, Lana Treasure, have reviewed this report and I confirm that to the best of my knowledge and ability all the information provided in the report is true and accurate.

Lana Treasure
Manager – Health, Safety and Environment
McArthur River Mining Pty Ltd

9 References

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

Australian and New Zealand Governments (2018) *ANZ Guidelines for Fresh and Marine Water Quality.*

Indo-Pacific Environmental (2019) Memorandum; *Recommendations on potential bund heights within the Barney Creek Channel.*

McArthur River Mining Pty Ltd (2018) *Waste Discharge Licence 174-10 Monitoring Report 1 June 2017 – 31 May 2018.*

Northern Territory Environmental Protection Authority (2013) *Guidelines on Mixing Zones.*

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WRM Water & Environment Pty Ltd (2023a) *Surface Water Monitoring Report 2022/23*.

WRM Water & Environment Pty Ltd (2023b) *2022/23 Mine Derived Analyte Loads Assessment.*

10 Abbreviations

Acronym	Definition
%	percent
Al	Aluminium
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Governments
As	Arsenic
BBDDP	Bing Bong Dredge Spoil Discharge Point
BBLF	Bing Bong Loading Facility
Cd	Cadmium
Cu	Copper
DEPWS	Department of Environment, Parks and Water Security
DO	dissolved oxygen
DP	discharge point
EC	electrical conductivity
EMR	Environmental Monitoring Report
Fe	Iron
Hg	Mercury
IPE	Indo-Pacific Environment
kg	kilograms
km	kilometres
L/s	litres per second
LOR	limit of reporting
m	metres
m^3/s	Cubic metres per second
mg/L	milligrams per litre
ML	megalitres
MLDP	Mine Levee Discharge Point
MLN	Mineral Lease Number
Mn	Manganese
MRM	McArthur River Mining Pty Ltd
Ni	Nickel
NO_3	Nitrate
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
P2	Pond 2
Pb	Lead
RP	Release Point
RPD	Relative percentage difference
SEL 1 DP	South-east Levee 1 Discharge Point
SO_4	Sulphate
SOCS	sites of conservation significance
SSTV	site-specific trigger values
TDS	total dissolved solids

Acronym	Definition
the Mine	McArthur river Mine
TPH	Total Petroleum Hydrocarbons
TSS	total suspended solids
WDL	Waste Discharge Licence
WMD	Water Management Dam
WRM	WRM Water & Environment Pty Ltd
Zn	Zinc
µg/L	micrograms per litre
µS/cm	microSiemens per centimetre

Appendix A

Quality Assurance

All surface water samples have been collected according to MRM management plans and procedures and the requirements of WDL 174-13 (Conditions 29, 34 and 35), which includes:

- Collection of samples in accordance with Australian Standards by or under the supervision of a qualified sampler.
- The date on which the sample was collected.
- The time at which the sample was collected.
- The location at which the sample was collected.
- The name of the person who collected the sample.
- The chain of custody forms relating to the sample.
- The field measurements (if any) and analytical results (if any) relating to the sample.
- Laboratory quality assurance and quality control documentation including certification of the MRM Environmental Laboratory in accordance with requirements of the National Association of Testing Authorities.

Quality assurance and quality control is routinely undertaken as part of the natural surface water monitoring program. This includes collection of duplicate samples and analysis of both field and laboratory 'blank' samples.

To monitor the consistency of the laboratory instruments used to measure water quality and examine the variability introduced during sample collection and preparation, MRM frequently collects duplicate water samples as part of the monitoring program. The relative percentage difference (RPD) between these duplicate analyses and the original analytical result provide a useful measure of instrumental consistency.

The relationship between concentrations of analytes (i.e. filtered primary metals, total primary metals and major ions) in the original samples and concentrations of the analytes in the blind sample are presented on Chart A1 to Chart A3. The following is of note regarding the duplicate sample analysis during the reporting period:

For primary filtered metals, a total of 28 duplicate samples (644 analyte samples) were collected during the reporting period. Of the 644 analyte samples, 9 analyte samples exceeded 20% of the RPD. Only 3 of the 9 sample exceedances had levels greater than ten times the LOR. These exceedances were as follows:

- Filtered Fe in 2 duplicate samples; and
- Filtered Mn in 1 duplicate sample.

For primary total metals, a total of 24 duplicate samples (552 analyte samples) were collected for primary total metals during the reporting period. Of the 552 analyte samples, 34 analyte samples exceeded 20% of the RPD. Only 4 of the 34 sample exceedances had levels greater than ten times the LOR (note that where LOR values were unknown for total metals, the filtered LORs were adopted). These exceedances were as follows:

- Total Al in 5 duplicate samples;
- Total Fe in 9 duplicate samples;
- Total Pb in 1 duplicate sample; and
- Total Mn in 1 duplicate sample.

For major ions, a total of 24 duplicate samples (168 analyte samples) were collected for major ions during the reporting period. Of the 168 analyte samples, 4 analyte samples exceeded 20% of the RPD. None of the 4 sample exceedances had levels greater than ten times the LOR.

None of these results are indicative of instrument malfunction or procedural errors, and the analytical reproducibility indicated is adequate for monitoring of natural surface water. Overall, the duplicate results show low variability which provides a high degree of confidence in the monitoring program data.

Blank water samples are routinely analysed to check that the analytical instruments are not reporting erroneously high values (e.g. due to contamination or instrument malfunction). 94 blank samples were prepared and sent for analysis from the surface water monitoring program over the reporting period. In general, the

quality of the blanks was very high, with most target analytes below the limit of detection. The results provide further confidence in the monitoring program data. Further details of the quality assurance results are provided in Attachment 2.

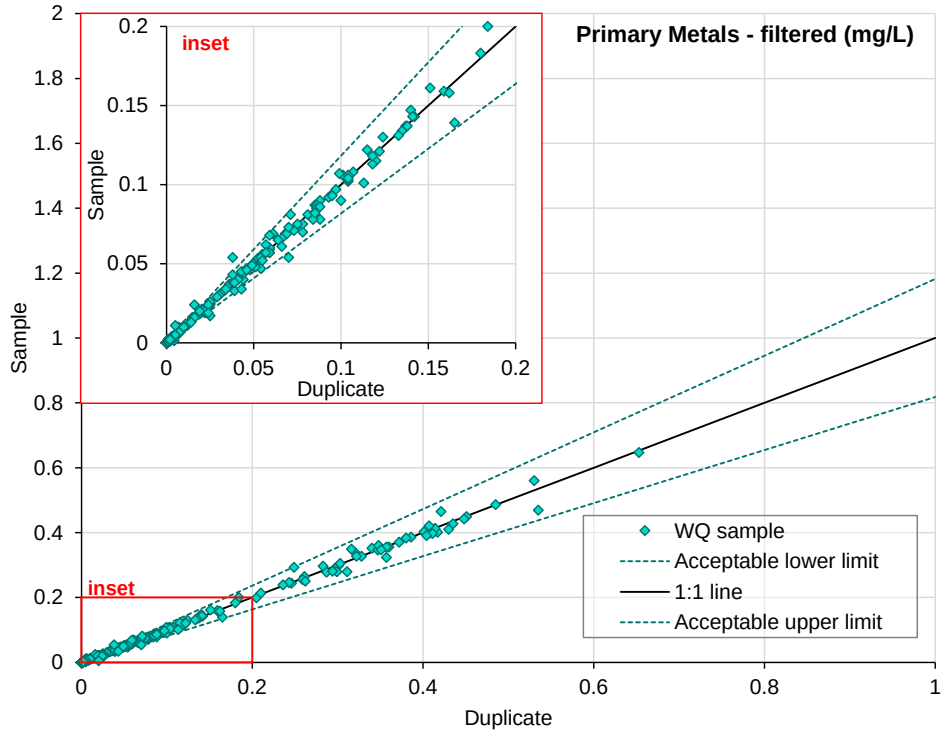

Chart A1: Relationship Between Filtered Primary Metal Concentrations in Samples and Blind Duplicates

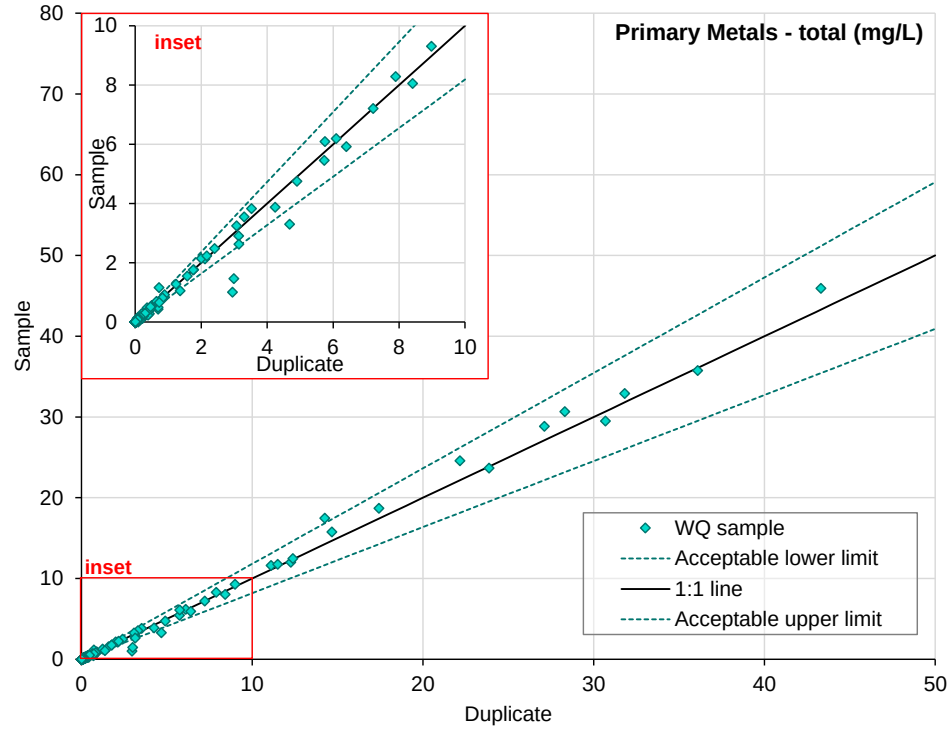

Chart A2: Relationship Between Total Primary Metal Concentrations in Samples and Blind Duplicates

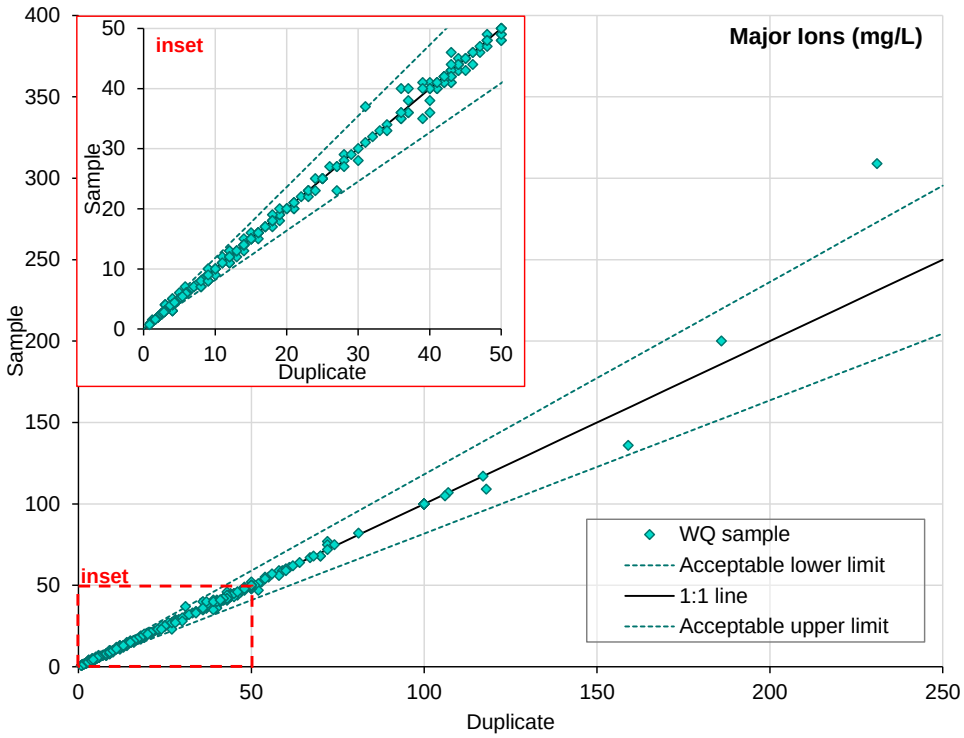

Chart A3: Relationship Between Major Ion Concentrations in Samples and Blind Duplicates

Attachment 1

Waste Discharge Licence 174-13

Attachment 2

Environmental Monitoring Report 2022/23

(download link to documents provided separately)

Attachment 3

Surface Water Monitoring Report 2022/23

Attachment 4

Mine Derived Analyte Loads Assessment 2022/23

Attachment 5

Tabulated Monitoring Data for the Period 2022/23

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