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1 January to 30 June 2023

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APPENDIX B: SURFACE WATER QUALITY MONITORING RESULTS FOR SELECT SITES –
PH, ELECTRICAL CONDUCTIVITY, DISSOLVED IRON, DISSOLVED MANGANESE AND
DISSOLVED ALUMINIUM



1 INTRODUCTION AND BACKGROUND

The Metropolitan Colliery (Metropolitan Coal Mine) is owned and operated by Metropolitan Colliers Pty Ltd (Metropolitan Coal) which is a wholly owned by Peabody Energy Australia Pty Ltd (Peabody). The Metropolitan Coal Mine is located adjacent to the township of Helensburgh and approximately 30 kilometres (km) north of Wollongong in New South Wales (NSW).

Metropolitan Coal was granted approval for the Metropolitan Coal Project (the Project) under section 75J of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 22 June 2009. The Project comprises the continuation, upgrade and extension of underground coal mining operations and surface facilities at Metropolitan Coal. The current underground mining longwall layout is shown on **FIGURE 1**.

This report documents a review undertaken by ATC Williams Pty Ltd (ATCW), of the environmental performance of the Metropolitan Coal Mine in relation to surface water (water resources and watercourses) in the Metropolitan Coal underground mining area and surrounds for the review period (1 January to 30 June 2023), consistent with the Metropolitan Coal Longwalls 308-310 Water Management Plan¹ (Metropolitan Coal, 2022a) and Metropolitan Coal Catchment Monitoring Program (Metropolitan Coal, 2014a).

2 CATCHMENT MONITORING AND SURFACE WATER MODELLING

2.1 Background

The Metropolitan Coal Catchment Monitoring Program and Metropolitan Coal Longwalls 308-310 Water Management Plan include a program to monitor and assess impacts on surface water resources and watercourses. The meteorological sites, surface water quantity sites (i.e. streamflow gauging stations and pool water level monitoring) and surface water quality sites at which baseline data is available for the Metropolitan Coal Mine underground mining area are shown on **FIGURE 2** to **FIGURE 3** respectively. Baseline data is classified as data collected up to the commencement of Longwall 20 on 17 May 2010.

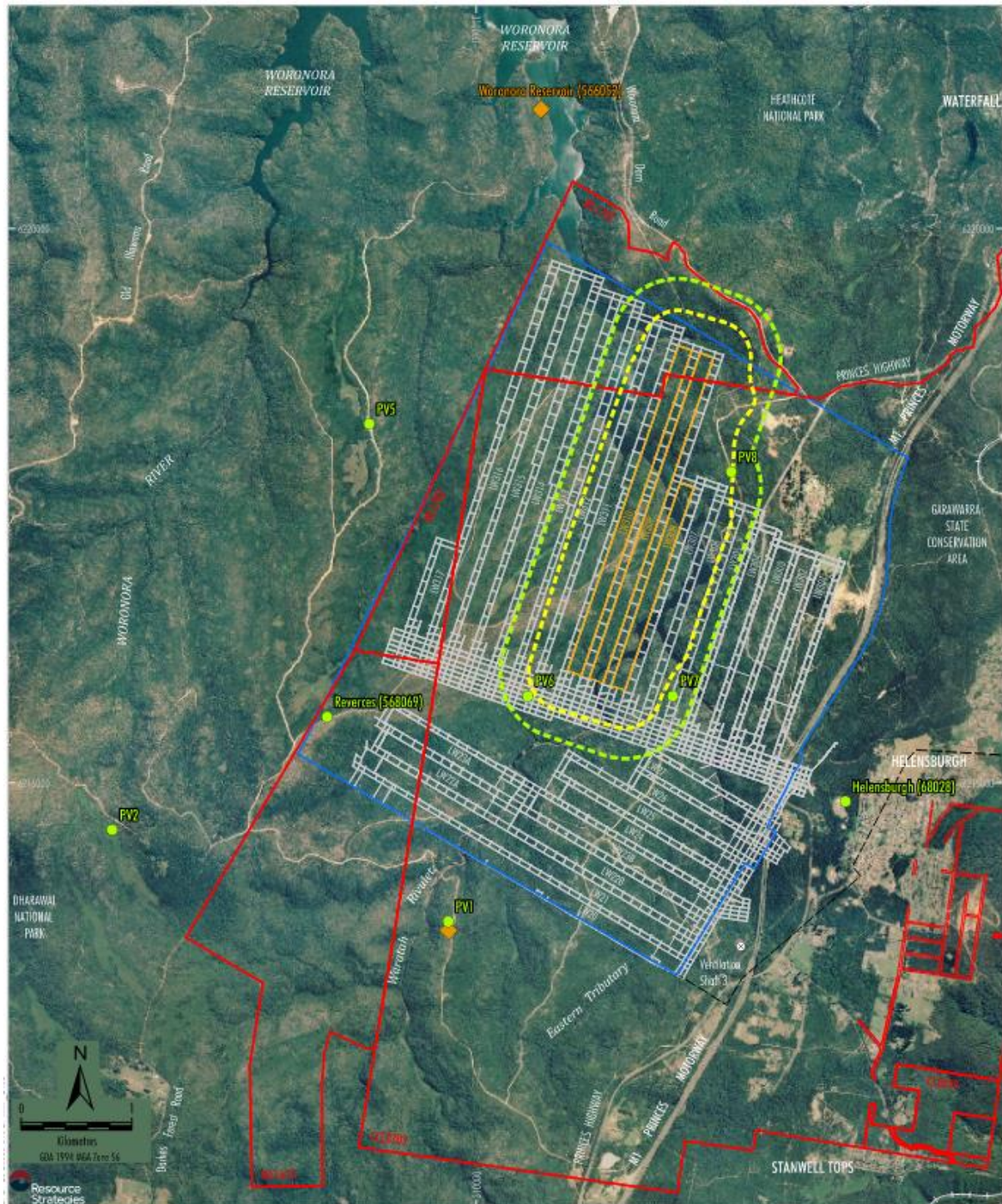
The Metropolitan Coal Catchment Monitoring Program also includes a program for the development, calibration and verification of catchment flow models.

2.2 Streamflow

Surface water flow monitoring is conducted at the following sites:

- the WaterNSW gauging station on the Waratah Rivulet (GS 2132102), close to the inundation limits of the Woronora Reservoir;
- the WaterNSW gauging station on the Woronora River (GS 2132101), close to the inundation limits of the Woronora Reservoir (control site);
- the WaterNSW gauging station on O'Hares Creek at Wedderburn (GS 213200) (control site);
- the Metropolitan Coal gauging station on the Eastern Tributary (GS 300078) close to the inundation limits of the Woronora Reservoir;
- the Metropolitan Coal gauging station on Honeysuckle Creek (GS 300077) - control site;
- the Sub-Catchment I gauging station on a tributary to the east of the Woronora Reservoir (GS 300092);
- the Sub-Catchment K gauging station on a tributary to the east of the Woronora Reservoir (GS 300093);
- the Swamp 92 Weir on a tributary to the west of the Woronora Reservoir (GS 300142); and
- the Swamp 76 Weir on a tributary to the west of the Woronora Reservoir (GS 300143).

1 The Metropolitan Coal Longwalls 308-310 Water Management Plan (Metropolitan Coal, 2022a) includes post-mining monitoring and management of water resources and watercourses for Longwalls 20-27, 301-303, 304 and 305-307.



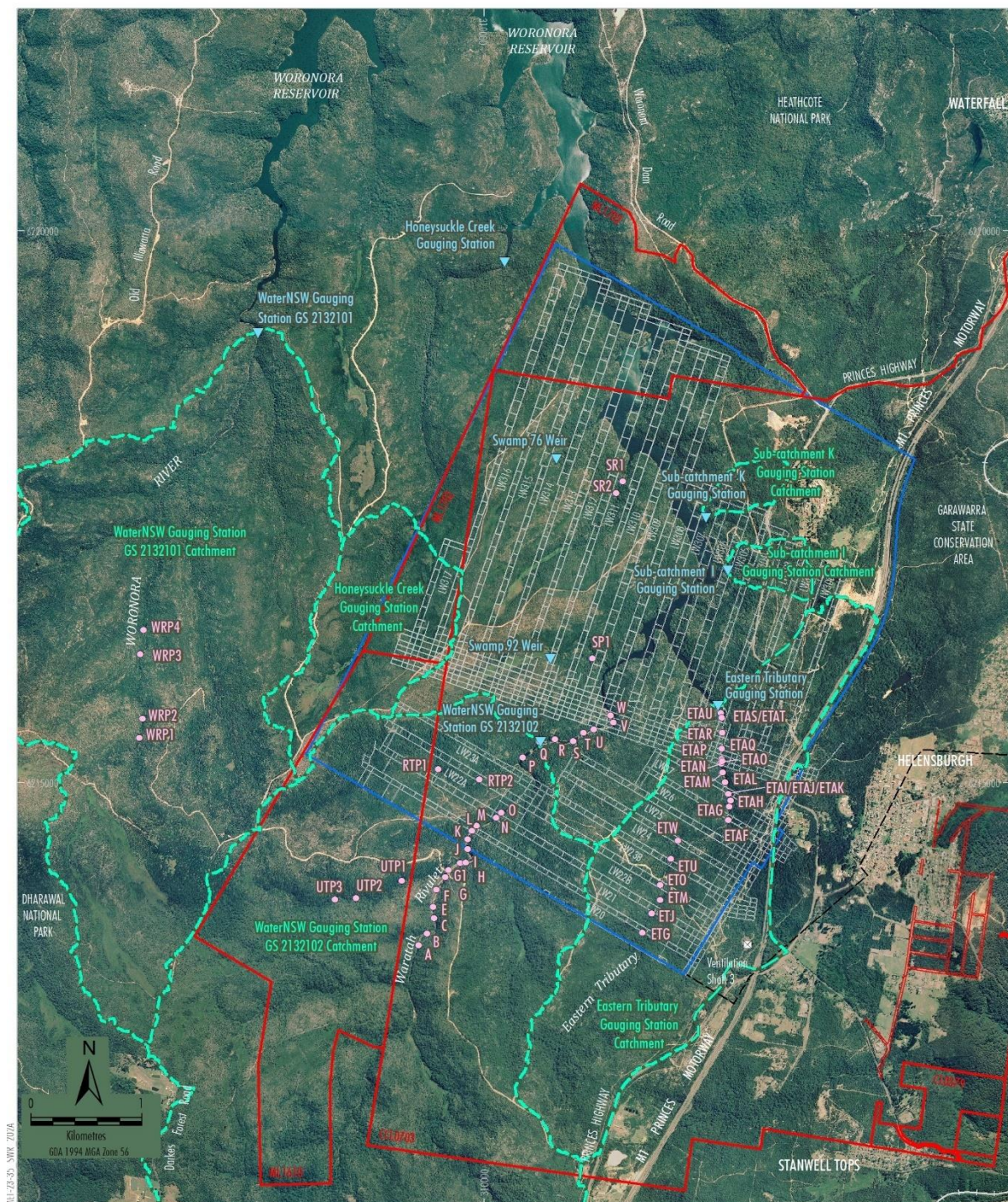
- LEGEND**
- Mining Lease Boundary
 - Railway
 - Project Underground Mining Area
 - Longwalls 20-27 and 301-317
 - Longwalls 308-310 Secondary Extraction
 - Longwalls 308-310 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
 - 600 m from Longwalls 308-310 Secondary Extraction
 - Existing Underground Access Drive (Main Drift)
 - ◆ Evaporimeter
 - Pluviometer

- Notes: 1. The Bureau of Meteorology pluviometer at Darkes Forest (60024) is not shown. It is located approximately 3.75 km south of the Metropolitan Coal pluviometer (PV2).
2. The Bureau of Meteorology pluviometer at Lucas Heights (66078) is not shown. It is located approximately 12.5 km north of the Metropolitan Coal pluviometer (PV8).

Source: Land and Property Information (2015); Data of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2021); NSERC (2021)

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Meteorological Sites

FIGURE 1: METEOROLOGICAL SITES

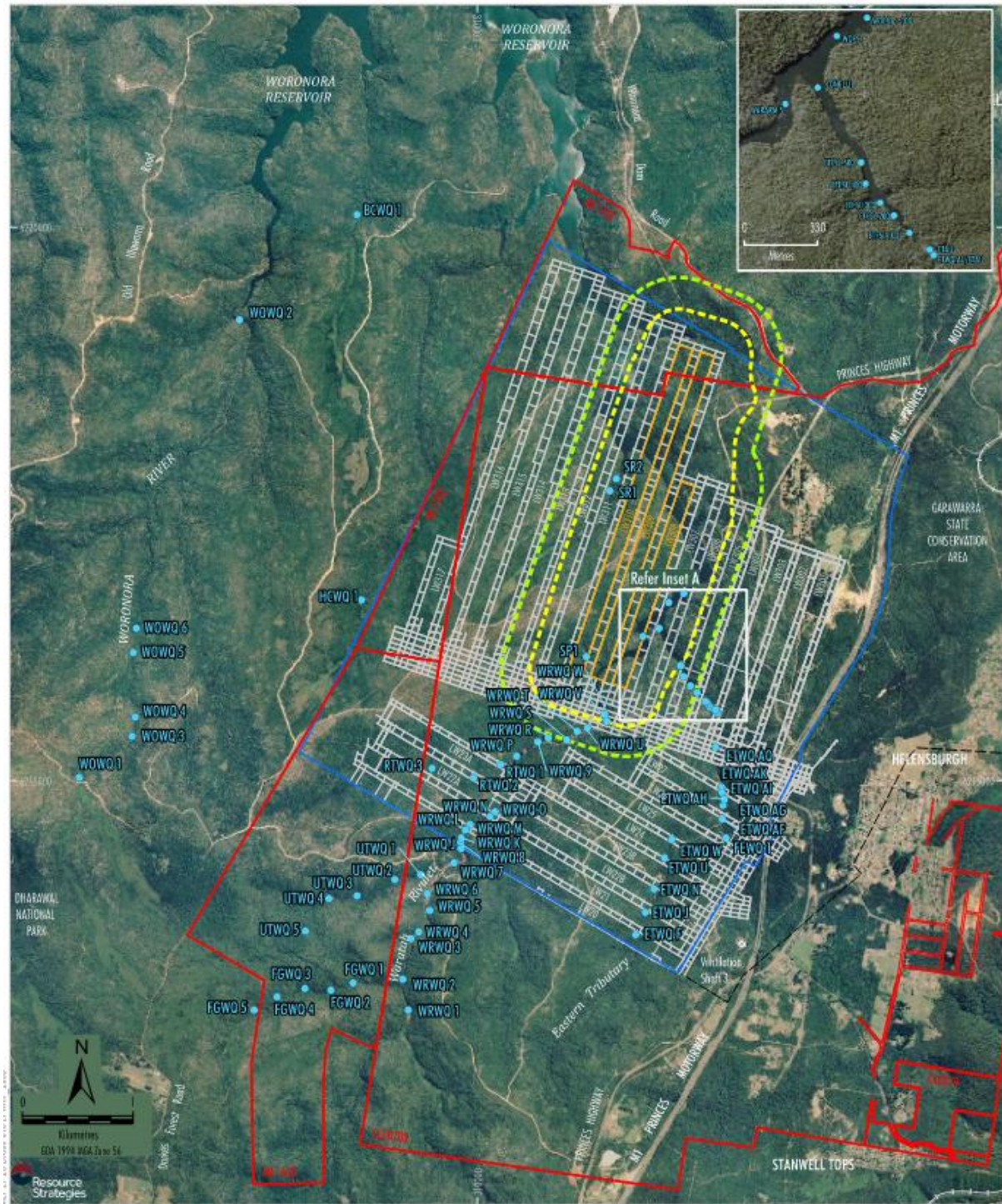


Source: Land and Property Information (2015); Date of Aerial Photography 1998;
Department of Industry (2015); Metropolitan Coal (2023)

- LEGEND**
- Mining Lease Boundary
 - Railway
 - Project Underground Mining Area
Longwalls 20-27 and 301-317
 - Existing Underground Access Drive (Main Drift)
 - Gauging Station
 - Pool Water Level Site

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Surface Water Quantity Sites

FIGURE 2: SURFACE WATER QUANTITY SITES



- LEGEND**
- Mining Lease Boundary
 - Railway
 - Project Underground Mining Area
Longwalls 20-27 and 301-317
 - Longwalls 308-310 Secondary Extraction
 - Longwalls 308-310 35° Angle of Draw and/or
Predicted 20 mm Subsidence Contour
 - 600 m from Longwalls 308-310
Secondary Extraction
 - Existing Underground Access Drive (Main Drift)
 - Surface Water Quality Site

Source: Land and Property Information (2015); Data of Aerial Photography 1998;
Department of Industry (2015); Metropolitan Coal (2021); MSEC (2021)

Peabody
METROPOLITAN COAL
Surface Water Quality Sites

FIGURE 3: SURFACE WATER QUALITY SITES

Flow records from the Waratah Rivulet (GS 2132102) and O'Hares Creek at Wedderburn (GS 213200) gauging stations were regenerated using amended rating relationships developed by Gilbert & Associates (2015a) on behalf of Metropolitan Coal (as described in HEC, 2016).

Numerical catchment models for the Waratah Rivulet and O'Hares Creek catchments have been developed based on the nationally recognised Australian Water Balance Model (AWBM) (Boughton, 2004). The AWBM is a catchment-scale water balance model that estimates streamflow from rainfall and evaporation. Revised and re-calibrated catchment models (Gilbert & Associates, 2015b) have been used to assess potential subsidence impacts on the quantity of water resources reaching the Woronora Reservoir (as described in HEC, 2016).

2.3 Pool Water Levels

Water levels in a number of pools on the Waratah Rivulet (Pools A, B, C, E, F, G, G1, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V and W), Eastern Tributary (Pools ETG, ETJ, ETM, ETO, ETU, ETW, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK², ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT³ and ETAU), Tributary B/Reference Tributary (Pools RTP1 and RTP2) and Woronora River (Pools WRP1, WRP2, WRP3 and WRP4) have been either manually monitored on a daily basis or monitored using a continuous water level sensor and logger. Recorded pool water level hydrographs are provided as a series of charts in **APPENDIX A**.

Pool water levels are controlled by different forms of natural controls with different hydraulic characteristics. Conceptually these can be grouped into the following three types:

1. An 'effectively impermeable' rock bar control with limited continuous jointing and fracturing resulting in negligible flow either through or under the rock bar;
2. A 'permeable' rock bar control where the presence of fractures and open joints in the rock bar permits significant flow through or under the rock bar; and
3. A boulder-field which constricts downstream flow but where a significant flow occurs through the interstices between the boulder rock elements (i.e., braided flow).

A description of the recorded water level behaviour for each pool during the 1 January to 30 June 2023 review period is provided in **TABLE 1**.

In summary, all recorded water levels in pools on Waratah Rivulet remained above the cease to flow level or historical minimum for the duration of the review period. The water levels recorded at Pool ETAI/ETAJ/ETAK and ETAL declined below the sensor levels in early January 2023. The pool ETAM water levels declined below the sensor for periods in June 2023 and Pool ETAO recorded water level declined below the sensor for periods in January, February, March and June 2023. The water level recorded at Pool ETAP declined below the sensor level for periods in January and February 2023. All other pools on the Eastern Tributary were consistent with historical behaviour, with recorded levels remaining above the cease to flow level or historical minimum for the duration of the review period. Consistent with historical behaviour, the recorded water level at Pool RTP1 on Tributary B rose in response to above average rainfall periods and declined below the sensor during periods of lower rainfall. Pool RTP1 was recorded as dry during all visual inspections for the current review period. Pool RTP2 recorded water level was consistent with historical behaviour for the duration of the review period.

² Only small rock bars separate Pools ETAI, ETAJ and ETAK, with the pools joining to become the one large pool as water levels rise. Pool ETAK is controlled by a more substantial rock bar. Readings from the water level sensor situated in Pool ETAI are considered to also be representative of the water level in Pools ETAJ and ETAK.

³ Due to the nature of rock bar ETAS, Pool ETAS and Pool ETAT typically record the same water level.

**TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS**

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
<i>Monitored Pools on Waratah Rivulet</i>			
A	Effectively impermeable rock bar. (Pool A impacted by previous mine subsidence and subject to previous stream remediation activities)	Water level records for Pool A were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A1 [manual observations] and CHART A2 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool A was overflowing the rock bar on all inspection occasions.
B	Effectively impermeable rock bar. (Pool B impacted by previous mine subsidence)	Water level records for Pool B were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A3 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool B was overflowing the rock bar on all inspection occasions.
C	Effectively impermeable rock bar. (Pool C impacted by previous mine subsidence)	Water level records for Pool C were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A4 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool C was overflowing the rock bar on all inspection occasions.
E	Effectively impermeable rock bar. (Pool E impacted by previous mine subsidence)	Water level records for Pool E were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A5 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool E was overflowing the rock bar on all inspection occasions.
F	Effectively impermeable rock bar. (Pool F impacted by previous mine subsidence and subject to previous stream remediation activities)	Water level records for Pool F were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A6 [manual observations] and CHART A7 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool F was overflowing the rock bar on all inspection occasions.
G	Effectively impermeable rock bar. (Pool G impacted by previous mine subsidence and subject to previous stream remediation activities)	Water level records for Pool G were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A8 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool G was overflowing the rock bar on all inspection occasions.
G1	Effectively impermeable rock bar. (Pool G1 impacted by previous mine subsidence)	Water level records for Pool G1 were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A9 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool G1 was overflowing the rock bar on all inspection occasions.

**TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)**

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
H	Effectively impermeable rock bar.	Water level records for Pool H were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A10 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool H was overflowing the rock bar on all inspection occasions.
I	Effectively impermeable rock bar.	Water level records for Pool I were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A11 [manual observations] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool I was overflowing the rock bar on all inspection occasions.
J	Effectively impermeable rock bar.	Pool water level records (stage [depth] levels from GS 300017) indicate that the pool continued to flow for the duration of the review period and were consistent with natural behaviour (CHART A12 [stage levels from the Metropolitan Coal gauging station] in APPENDIX A).	Metropolitan Coal's visual inspections indicate Pool J was overflowing the rock bar on all inspection occasions.
K	Effectively impermeable rock bar.	Water level records for Pool K were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A13 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate Pool K was overflowing the rock bar on all inspection occasions.
L	Effectively impermeable rock bar.	No data is available from 16 February to 15 March 2023 due to loss of the water level sensor in a high flow event. For the remainder of the review period, water level records for Pool L were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A14 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate Pool L was overflowing the rock bar on all inspection occasions.
M	Effectively impermeable rock bar.	Water level records for Pool M were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A15 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate Pool M was overflowing the rock bar on all inspection occasions.

**TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)**

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
N	Effectively impermeable rock bar. (Pool N impacted by mine subsidence; first ceased to overflow the rock bar in September 2012)	Water level records for Pool N were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A16 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate Pool N was overflowing the rock bar on all inspection occasions.
O	Boulder field.	Water level records for Pool O were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (CHART A17 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
P	Permeable rock bar.	Water level records for Pool P were consistent with natural behaviour and indicate that water levels have been above that required to maintain flow over the downstream rock bar (CHART A18 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
Q	Effectively impermeable rock bar.	No data is available from 9 February to 28 March 2023 due to a displaced water level sensor in a high flow event. For the remainder of the review period, water level records for Pool Q were consistent with natural behaviour and indicate that water levels have been above that required to maintain flow over the downstream rock bar (CHART A19 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
R	Effectively impermeable rock bar.	The water level sensor housing was damaged during a high flow event and reliable data was not recorded from 9 to 20 February 2023. For the remainder of the review period, water level records for Pool R were consistent with natural behaviour and indicate that water levels were above that required to maintain flow over the downstream rock bar (CHART A20 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
S	Effectively impermeable rock bar.	No data is available from 20 February to 28 March 2023 due to a displaced water level sensor in a high flow event. For the remainder of the review period, water level records for Pool S were consistent with natural behaviour, indicate that the pool continued to flow and that the water level did not decline below the historical minimum (CHART A21 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

**TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)**

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
T	Permeable rock bar.	The water level sensor housing was damaged during a high flow event and reliable data was not recorded from 9 to 20 February 2023. For the remainder of the review period, water level records for Pool T were consistent with natural behaviour, indicate that water continued to flow and that the water level did not decline below the historical minimum. A period of anomalous data is evident during the review period, with apparent rapid and transient decline in water level occurring during periods of substantial rainfall. The anomalous data are due to errors in recorded water level which occurred during periods of high rainfall ¹ (CHART A22 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
U	Boulder field.	Water level records for Pool U were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period and that the water level did not decline below the historical minimum (CHART A23 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
V	Permeable rock bar.	Water level records for Pool V were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period and that the water level did not decline below the historical minimum (CHART A24 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
W	Boulder field (underlain by a rock bar).	Water level records for Pool W were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period and that the water level did not decline below the historical minimum (CHART A25 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

¹ During periods of high rainfall the logger stand creates an eddy which reduces pressure and causes low level pressure readings to be recorded.

**TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)**

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
<i>Monitored Pools on Eastern Tributary</i>			
ETG	Effectively impermeable rock bar. (Pool ETG impacted by previous mine subsidence)	Pool ETG recorded water levels were consistent with natural behaviour and indicate that water continued to flow for the duration of the review period (CHART A26 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETJ	Effectively impermeable rock bar. (Pool ETJ impacted by previous mine subsidence)	Pool ETJ recorded water levels were consistent with natural behaviour during the review period (CHART A27 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETM	Permeable rock bar. (Pool ETM impacted by previous mine subsidence)	Pool ETM recorded water levels were consistent with natural behaviour and indicate that water continued to flow for the duration of the review period CHART A28 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETO	Effectively impermeable rock bar. (Pool ETO impacted by previous mine subsidence, however rockbar has been remediated with polyurethane grout injection)	Pool ETO recorded water levels were consistent with natural behaviour and indicate water pool continued to flow for the duration of the review period (CHART A29 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETU	Boulder field. (Pool ETU impacted by previous mine subsidence)	Pool ETU recorded water levels were consistent with natural behaviour during the review period (CHART A30 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETW	Effectively impermeable rock bar. (Pool ETW impacted by previous mine subsidence)	Pool ETW recorded water levels were consistent with natural behaviour during the review period (CHART A31 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAF	Permeable rock bar before boulder field. (Pool ETAF impacted by previous mine subsidence)	Pool ETAF recorded water levels were consistent with natural behaviour during the review period (CHART A32 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAG	Boulder field. (Pool ETAG impacted by previous mine subsidence)	Pool ETAG recorded water levels were consistent with natural behaviour during the review period (CHART A33 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.



TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
ETAH	Permeable rock bar. (Pool ETAH impacted by previous mine subsidence).	Pool ETAH recorded water levels were consistent with natural behaviour during the review period (CHART A34 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAI/ ETAJ/ ETAK	Effectively impermeable rock bar. (Pool ETAI/ETAJ/ETAK impacted by previous mine subsidence).	Recorded water levels were consistent with natural behaviour during the review period. The water level was below the level of the sensor for a brief period of time on 1 January 2023. For the remainder of the review period the water level was above the level of the sensor (CHART A35 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAL	Boulder field/alluvial deposit. (Pool ETAL impacted by previous mine subsidence).	The recorded water level rose and fell intermittently in response to rainfall events. The water level was below the level of the sensor for a brief period of time on 1 January 2023. For the remainder of the review period the water level was above the sensor level (CHART A36 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAM	Boulder field/ alluvial deposit. (Pool ETAM impacted by previous mine subsidence).	No data is available from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event. For the remainder of the review period, the recorded water level rose and fell in response to rainfall events. From late May 2023, the water level began to decline and was below the level of the sensor by late June. This behaviour is consistent with previous years (CHART A37 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool ETAM was dry on 29 June 2023. On all other inspection occasions, the water level was above the sensor level.
ETAN	Permeable rock bar. (Pool ETAN impacted by previous mine subsidence).	No data is available from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event. For the remainder of the review period ,the recorded water level rose and fell in response to rainfall events and was above the level of the sensor for the duration of the review period (CHART A38 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.



TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
ETAO	Permeable rock bar. (Pool ETAO impacted by previous mine subsidence).	The recorded water level rose and fell in response to rainfall events. The water level declined below the level of the sensor for brief periods during January, February, March and June 2023. This behaviour is consistent with previous years (CHART A39 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool ETAO was dry on 29 June 2023. On all other visual inspections support the analysis of pool water level data.
ETAP	Boulder field. (Pool ETAP impacted by previous mine subsidence).	The recorded water level rose and fell in response to rainfall events. The water level declined below the level of the sensor for brief periods during January and February 2023. This behaviour is consistent with previous years (CHART A40 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAQ	Effectively impermeable rock bar. (Pool ETAQ impacted by previous mine subsidence).	No data is available from 3 January to 21 February 2023 due to loss of the water level sensor in a high flow event. For the remainder of the review period Pool ETAQ water levels remained above the level of the sensor and rose and fell in response to rainfall events (CHART A41 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAR	Permeable rock bar. (Pool ETAR impacted by previous mine subsidence).	No data is available from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event. Consistent with historical behaviour, the water level rose and fell intermittently in response to rainfall events. (CHART A42 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAS/ ETAT	Effectively impermeable rock bar.	Pool ETAS/ETAT recorded water levels were consistent with natural behaviour during the review period (CHART A43 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAU	Pool ETAU flows through the Eastern Tributary gauging station, then over a rock bar and waterfall.	Pool ETAU recorded water levels were consistent with natural behaviour during the review period (CHART A44 [stage data] in APPENDIX A and CHART A45 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.



TABLE 1: SUMMARY OF POOL WATER LEVEL MONITORING RESULTS (CONT'D)

Pool	Natural Control Characteristics	Recorded Water Level During 1 January to 30 June 2023	Comments
<i>Monitored Pools on Reference Tributary/Tributary B</i>			
RTP1	Effectively impermeable rock bar. (Pool RTP1 previously impacted by mine subsidence).	Records indicate that Pool RTP1 is typically dry with overflow events limited to significant rainfall periods. Consistent with historical behaviour, during the review period, the water level recorded at Pool RTP1 rose in response to significant rainfall periods and declined below the sensor level during periods of lower average rainfall (CHART A46 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections indicate that Pool RTP1 was dry at the times of visual inspection for the duration of the review period.
RTP2	Effectively impermeable rock bar.	No data is available from 16 January to 16 February 2023 due to loss of the water level sensor in a high flow event. For the remainder of the review period the water level records for Pool RTP2 were consistent with historical behaviour (CHART A47 [logger data] in APPENDIX A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

2.4 Stream Water Quality

Surface water quality monitoring and sampling has been conducted at the following sites – refer to **FIGURE 3**:

- sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N, WRWQ P, WRWQ R, WRWQ T, WRWQ U, WRWQ V and WRWQ W on the Waratah Rivulet;
- site RTWQ 1 on Tributary B;
- site UTWQ 1 on Tributary D;
- sites ETWQ F, ETWQ J, ETWQ N, ETWQ U, ETWQ W, ETWQ AF, ETWQ AH, ETWQ AQ and ETWQ AU on the Eastern Tributary;
- site FEWQ 1 on the Far Eastern Tributary;
- site HCWQ 1 on Honeysuckle Creek;
- site BCWQ 1 on Bee Creek;
- sites SR1, SR2 and SP1 on Woronora Reservoir tributaries; and
- control sites WOWQ 1 and WOWQ 2 on the Woronora River.

Water quality parameters recorded include electrical conductivity (EC), pH, redox potential (Eh), dissolved oxygen (DO), turbidity, calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), sulphate (SO₄), bicarbonate (HCO₃), total nitrogen (N_{tot}), total phosphorus (P_{tot}), nitrate (NO₃), barium (Ba), strontium (Sr), manganese (Mn), iron (Fe), zinc (Zn), cobalt (Co) and aluminium (Al). Samples collected for metals analysis have been field filtered. Unfiltered water quality samples were also collected at a select number of sites on the Waratah Rivulet, Eastern Tributary and Woronora River and analysed for total iron.

Key monitoring results for the sites listed above are shown on a series of charts in **APPENDIX B**.

2.4.1 Waratah Rivulet

Water quality trends at monitoring sites over the 1 January to 30 June 2023 review period have been variable, likely due to significant rainfall events in the first quarter of 2023 with intermittent rainfall up to the end of the review period. Upstream sites on Waratah Rivulet (sites WRWQ 2, WRWQ 6 and WRWQ 8) recorded circumneutral pH values, with near neutral to slightly alkaline values recorded at lower reach sites (WRWQ T, WRWQ U, WRWQ V and WRWQ W). Near neutral to slightly acidic conditions were recorded at middle reach sites WRWQ M and WRWQ N. Electrical conductivity values recorded at all sites during the review period were generally low with values generally at or below 260 µS/cm. Dissolved iron concentrations at all lower reach sites increased towards the latter half of the review period then decreased to levels recorded at the beginning of the review period, however, remained below historical maxima. Dissolved iron concentrations at upper and middle reach sites were generally consistent for the duration of the review period and remained below 0.4 mg/L. Dissolved iron concentrations were within the range of historical values for all sites.

Dissolved aluminium concentrations were generally consistent, with most records at or below the level of reporting (0.01 mg/L), with the exception of a slight increase in concentration recorded in April and May 2023 for lower reach sites and upper reach site WRWQ 2.

Dissolved manganese concentrations at the upper and middle reach sites on the Waratah Rivulet were generally higher than those sites at the lower reach for the review period. Dissolved manganese concentrations for the upper and middle reaches were consistent with historical records. Dissolved manganese concentrations at the lower reach sites on Waratah Rivulet increased steadily from March to May 2023 (although remaining below the historical maxima), then declined to levels similar to those at the beginning of the review period.

2.4.2 Woronora River

The field pH levels recorded at sampling sites WOWQ 1 and WOWQ 2 during the review period indicated slightly acidic to acidic conditions. The pH levels recorded at both sites were within the range of historical values. The electrical conductivity values at WOWQ 2 were generally higher than values recorded at WOWQ 1, with WOWQ 2 records demonstrating more variability with results between 91 and 274 $\mu\text{S}/\text{cm}$. Dissolved iron concentrations recorded during the review period were at or below 0.07 mg/L for WOWQ 1. Concentrations for WOWQ 2 were generally low at 0.05 mg/L with two instances of 0.18 mg/L recorded in March 2023. Dissolved iron concentrations for both WOWQ 1 and WOWQ 2 were within the historical range. Dissolved aluminium concentrations were generally lower at WOWQ 2 in comparison to WOWQ 1, with the exception of a concentration of 0.19 mg/L (although below the historical maximum) recorded for WOWQ 2 in March 2023. Dissolved manganese concentrations recorded at WOWQ 1 were consistent with historical values and were under 0.02 mg/L for the review period. Dissolved manganese concentrations recorded at WOWQ 2, although below the historical maximum, were elevated for the duration of the review period, with a peak concentration (for the review period) of 0.127mg/L in March 2023.

2.4.3 Eastern Tributary

The pH values recorded during the review period at sites in the Eastern Tributary were within historical range. Records indicate slightly acidic to circumneutral conditions for the review period. Electrical conductivity values recorded during the review period were below 300 $\mu\text{S}/\text{cm}$ at all sites with the exception of ETWQ F recording 447 $\mu\text{S}/\text{cm}$ in April 2023 (still below historical maximum). Dissolved iron concentrations were generally below 1 mg/L during the review period for all sites except ETWQ AQ. At this site, recorded dissolved iron concentrations generally decreased from the start of the review period until March 2023 before from May to the end of the review period, remaining below the historical maximum. Dissolved aluminium concentrations for ETWQ J, ETWQ AH and ETWQ AU were variable over the review period, with concentrations up to 0.13 mg/L sporadically recorded from January to April 2023, subsequently reducing to less than 0.05 mg/L. Dissolved aluminium concentrations for ETWQ AQ were variable between February and April 2023, with concentrations ranging from 0.01 to 0.07 mg/L. In late June 2023, the dissolved aluminium concentration for ETWQ AQ was 0.16 mg/L (less than the historical maxima. All other sites recorded less than 0.05 mg/L dissolved aluminium for the duration of the review period. Dissolved manganese concentrations for ETWQ AU and ETWQ AQ declined slightly from January to April 2023, from approximately 0.25 to 0.05 mg/L. Between April and June 2023, dissolved manganese concentrations had steadily increased from 0.05 mg/L to approximately 0.27 and 0.38 mg/L for ETWQ AU and ETWQ AQ, respectively, but remained below historical maxima. Dissolved manganese concentrations for all other sites were less than 0.2 mg/L for the duration of the review period.

2.4.4 Bee Creek, Honeysuckle Creek, Far Eastern Creek, Tributaries B and D

Slightly acidic to acidic pH levels were recorded at Bee Creek (BCWQ 1) and Honeysuckle Creek (HCWQ 1) during the review period. Far Eastern Tributary (FEWQ 1) and Tributary D/Un-named Tributary (UTWQ 1) recorded pH levels that were generally circumneutral while Tributary B/Reference Tributary (RTWQ 1) recorded pH levels that were near neutral to slightly alkaline. Review period pH records for BCWQ1, HCWQ 1, FEWQ 1, UTWQ 1 and RTWQ 1 were consistent with the historical range for the current review period.

Electrical conductivity values recorded at BCWQ 1 and HCWQ 1 for the current review period were less than 200 $\mu\text{S}/\text{cm}$. Electrical conductivity values for monitoring sites FEWQ 1, RTWQ 1 and UTWQ 1 ranged between approximately 100 to 300 $\mu\text{S}/\text{cm}$. The values recorded during the review period were consistent with historical values.

Dissolved iron concentrations recorded during the review period were consistent with historical concentrations for all sites, however, concentrations at HCWQ 1, UTWQ 1 and RTWQ 1 increased towards the end of the review period (whilst remaining below the historical maxima). Dissolved aluminium concentrations remained higher at BCWQ 1 and HCWQ 1 in comparison to the other sites but remained quite consistent during the review period and below historical maxima. Dissolved aluminium concentrations for RTWQ 1, UTWQ 1 and FEWQ 1 were below 0.1 mg/L for the duration of the review period.

2.4.5 Western Tributaries of Waratah Rivulet

Monitoring sites SP1, SR1 and SR2 are located downstream of swamps, within western tributaries of the Waratah Rivulet. SP1 is located downstream of Swamp 92 and Swamp 92 Weir. SR1 and SR2 are located downstream of Swamp 77, refer **FIGURE 3**.

Acidic pH levels were recorded at sites SP1, SR1 and SR2, ranging between 4.6 and 5.8. Electrical conductivity values recorded at SP1, SR1 and SR2 ranged between 68 and 200 $\mu\text{S}/\text{cm}$ with values generally higher at the end of the review period, compared to the start of the review period. A historical maximum was recorded for dissolved iron concentrations at SR1 and SR2 in March 2023, with concentrations of 0.12 and 0.1 mg/L, respectively. SP1 also recorded a dissolved iron concentration of 0.1 mg/L in March 2023, however, a historical maximum of 0.19 mg/L was recorded in June 2023. Dissolved aluminium concentrations at SP1, SR1 and SR2 ranged between 0.05 and 0.15 mg/L. A dissolved aluminium historical maximum of 0.15 mg/L was recorded for SR2 in April 2023. Historical maxima were recorded for dissolved manganese at all sites in February 2023, with concentrations of 0.061 mg/L at SR2, 0.064 mg/L at SP1 and 0.065 mg/L at SR1.

2.5 Woronora Reservoir Water Quality

Metropolitan Coal has sourced water quality data for the Woronora Reservoir (at sampling location DW01) from WaterNSW in accordance with a data exchange agreement. Results in relation to total iron, aluminium and manganese at levels from 0 m to 9 m below the reservoir surface for Woronora Reservoir are presented in **CHART 1** to **CHART 3** below.

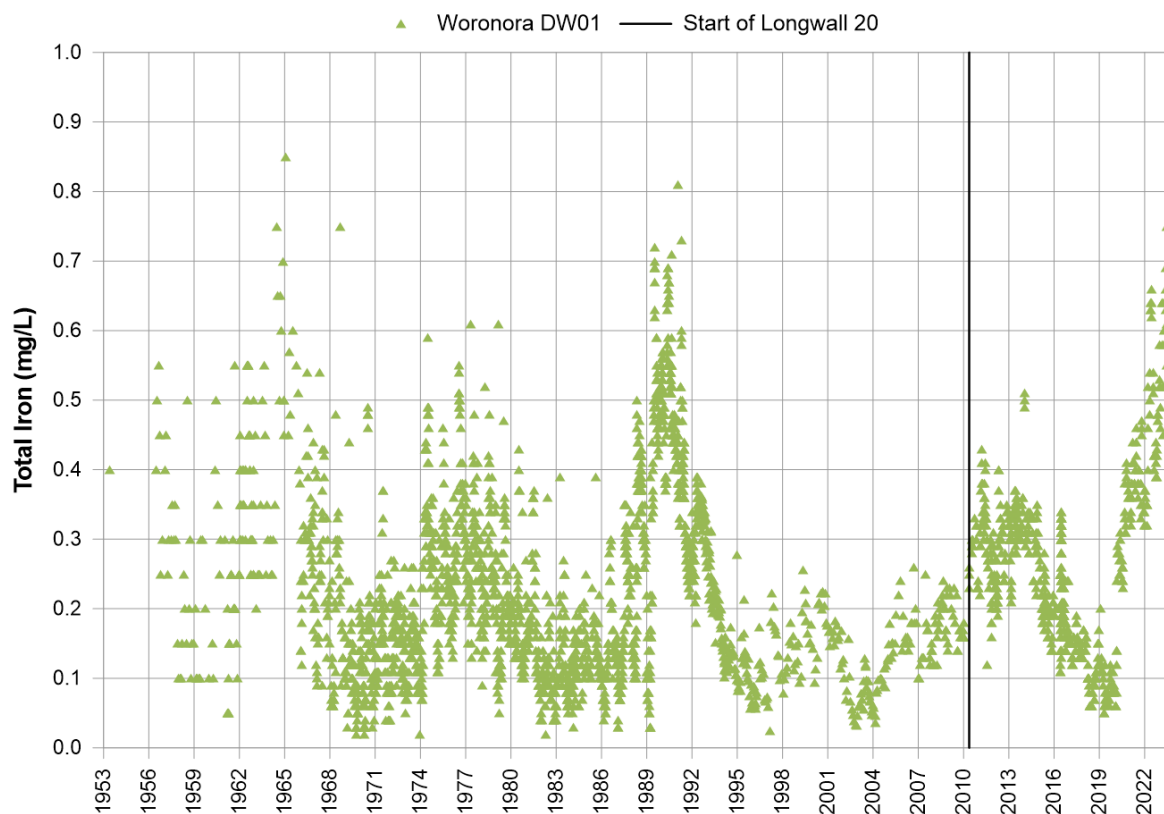


CHART 1: TOTAL IRON CONCENTRATION WORONORA RESERVOIR

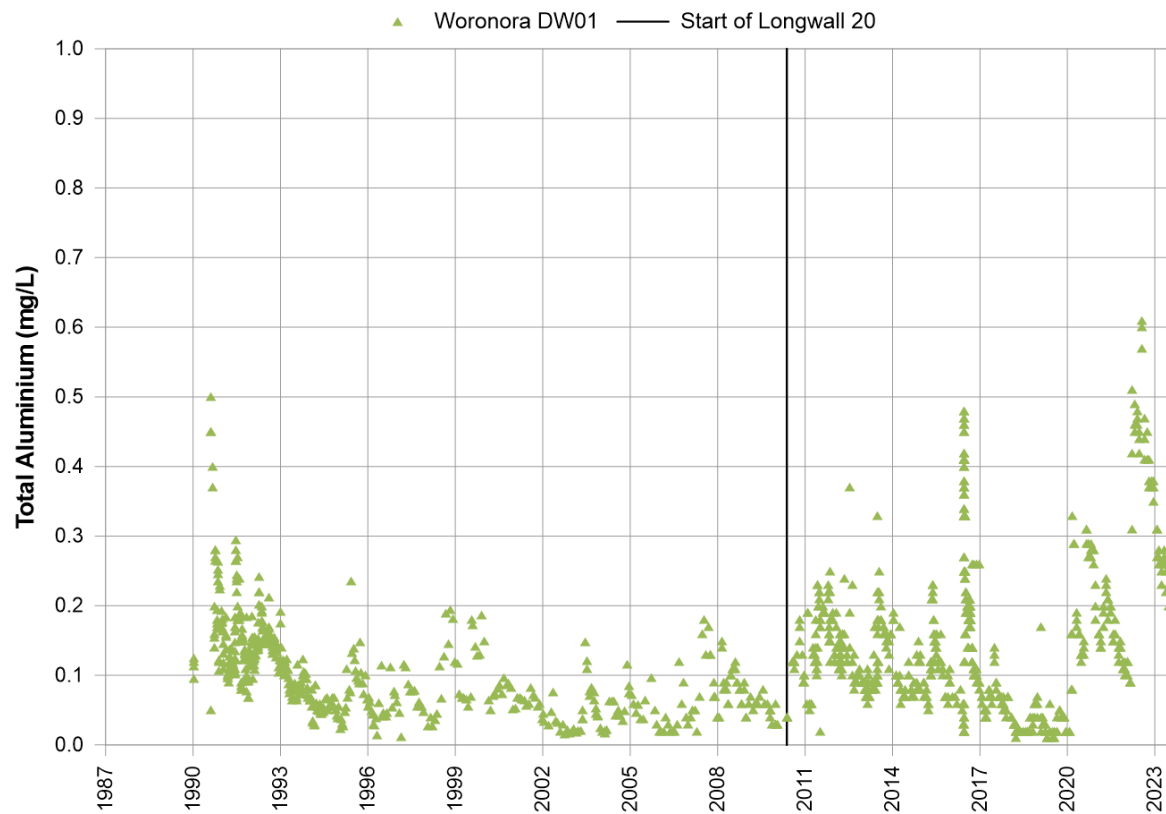


CHART 2: TOTAL ALUMINIUM CONCENTRATION WORONORA RESERVOIR

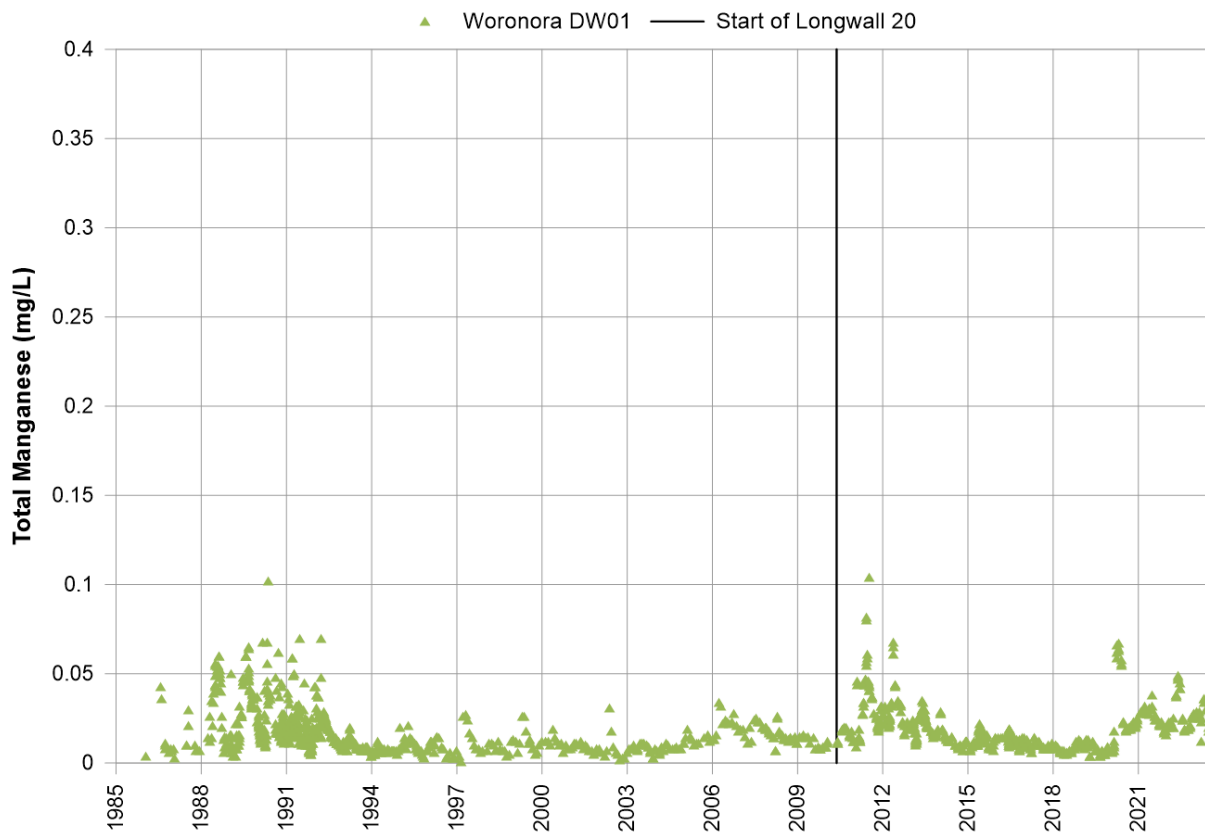


CHART 3: TOTAL MANGANESE CONCENTRATION WORONORA RESERVOIR



The data presented in **CHART 1** indicate a gradual increasing trend in total iron has occurred since early to mid-2020, the trend shown for the current review period resembles that recorded in 1990-1991. The peak concentration recorded for the current review period is less than the historical maximum.

Total aluminium concentrations plotted in **CHART 2**, indicate that following from elevated concentrations at the end of 2022, there was a decrease in total aluminium during the review period with concentrations ranging between approximately 0.2 and 0.3 mg/L during the review period.

CHART 3 indicates that total manganese concentrations have been slightly elevated since early to mid-2020 compared with previous years. Intermittent increases in these constituents are evident over the period of record, including in the period prior to the commencement of mining of Longwall 20.

The maximum concentration of total iron, total manganese and total aluminium recorded during the review period did not exceed the maximum concentration of these constituents recorded during the baseline period (prior to the commencement of mining of Longwall 20). The maximum concentration of total aluminium for the current review period did not exceed the maximum concentration recorded in July 2022.



3 ASSESSMENT AGAINST SURFACE WATER SUBSIDENCE IMPACT PERFORMANCE INDICATORS AND MEASURES

The performance indicators and subsidence impact performance measures described below have been developed to address the predictions of subsidence impacts and environmental consequences on water resources and watercourses included in the Project Environmental Assessment (Helensburgh Coal, 2008), Preferred Project Report (PPR) (Helensburgh Coal, 2009) and Metropolitan Coal Extraction Plans (Metropolitan Coal, 2010; 2014b; 2016; 2019; 2020b, 2022b).

3.1 Quantity of Water Resources Reaching the Woronora Reservoir

Performance Indicator:

Changes in the quantity of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining, that are not also occurring in the control catchment(s).

3.1.1 Assessment of Flow Reaching Woronora Reservoir from Waratah Rivulet at GS 2132102

Streamflow data has been analysed to assess whether a statistically significant reduction in the quantity of water entering Woronora Reservoir in the post-mine period relative to the pre-mine period has occurred, that has not also occurred in the control catchment(s).

Measured flows versus modelled flows in Waratah Rivulet have been analysed using a catchment model (a modified version of the AWBM), specifically:

- monitored flows have been filtered in order to assess low flows (i.e., flows of 1 millimetre/day [mm/day] or less⁴) by setting monitored flows that are greater than 1 mm/day to equal modelled flows;
- the filtered monitored flows on Waratah Rivulet have been integrated over successive 14-day periods to produce a smoothed set of data for comparison with the corresponding integrated flows (14 day totals) predicted by the modified AWBM for Waratah Rivulet; and
- the ratio of filtered monitored flows to the modified AWBM predicted flows has been calculated at 14-day intervals commencing at the beginning of the baseline period and advancing beyond the commencement of Longwall 20 secondary extraction - the median of the ratios has then been calculated and analysed over a moving window of 1 year.

The results have been assessed against the significance levels/triggers from the Longwalls 308-310 Water Management Plan (below):

Significance Levels/Triggers	
Negligible Reduction to the Quantity of Water Resources Reaching the Woronora Reservoir	
Level 1	The median of the ratios does not fall below the 35 th percentile of the baseline data
Level 2	The median of the ratios falls below the 35 th percentile but does not fall below the 20 th percentile of the baseline data
Level 3	The median of the ratios falls below the 20 th percentile of the baseline data

CHART 4 shows a plot of the sliding 12-month median of the ratio of 14-day sums of monitored flow at Waratah Rivulet (GS 2132102) and flows simulated via the modified AWBM to 30 June 2023.

4 Equivalent to a daily flow of 20.5 ML/day at the Waratah Rivulet gauging station.

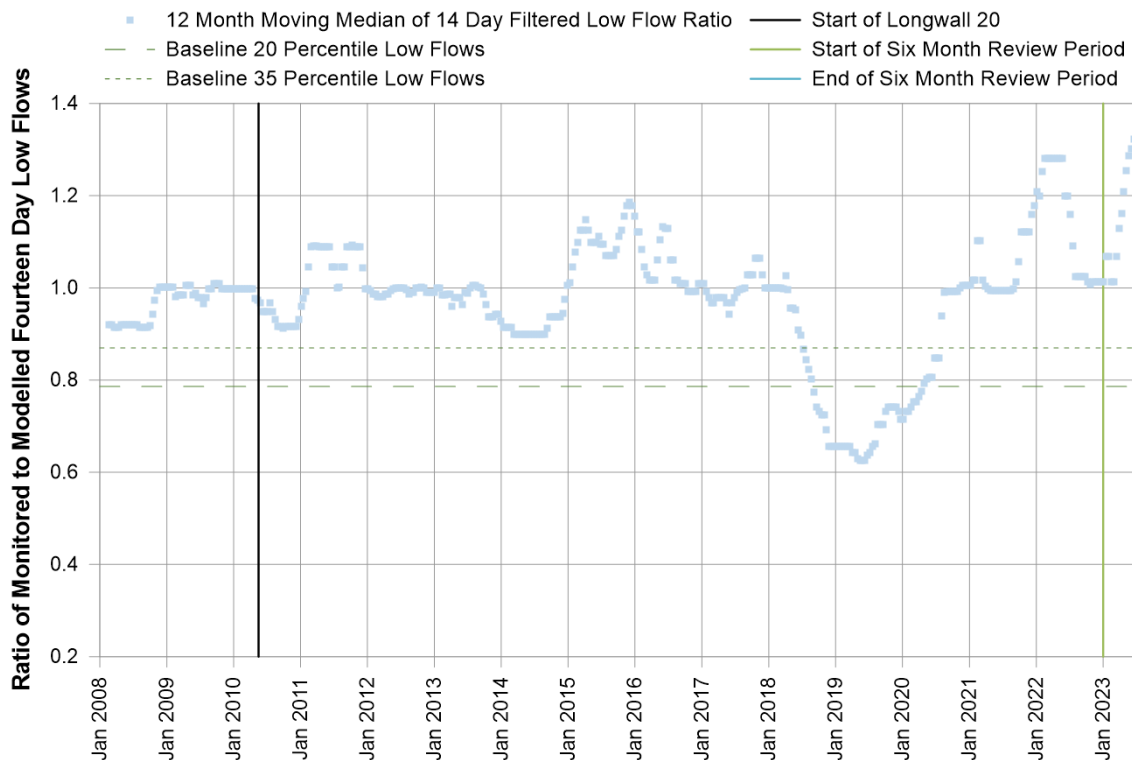


CHART 4: ONE YEAR SLIDING MEDIAN FOR THE RATIOS OF THE 14 DAY SUMS OF MONITORED AND MODELLED FLOW RATES AT WARATAH RIVULET (GS 2132102) ⁵

The results show that the moving 12-month median of the 14-day filtered low flow ratio remained above the 35th percentile for the duration of the review period. In accordance with the Metropolitan Coal Longwalls 308-310 Water Management Plan Trigger Action Response Plan (TARP), this equates to a Level 1 significance from 1 January to 30 June 2023.

As such, it is considered that the performance indicator relating to the quantity of water entering Woronora Reservoir from Waratah Rivulet has not been exceeded and an assessment against the performance measure is not required.

3.1.2 Assessment of Flow Reaching Woronora Reservoir from Eastern Tributary at GS 300078

Flow data up to 30 June 2023 has been provided from gauging station 300078 – Eastern Tributary upstream of Woronora Reservoir. Flow data is available from the date of station establishment on 23 September 2012. Recorded flow data is shown on **CHART 5** below together with model predicted results. Note that in this and subsequent hydrographs, streamflow is plotted on a per unit catchment area basis in mm/d.

During periods of flow recession dating back to spring 2017, the modified streamflow record somewhat exceeds modelled flow. It is considered that this may be related to increased baseflow occurring due to subsidence-induced stream bed fracturing upstream of GS 300078 leading to flow diversion through the fracture network which increases flow routing.

Streamflow records at GS 300078 have been continuous and generally consistent with model predictions. This indicates that flows reaching the Woronora Reservoir have not been reduced by mining.

⁵ It is noted that an error was found in Chart 4 in HEC (2018). However, the error did not affect the conclusion made in relation to the quantity of flows to the Woronora Reservoir.

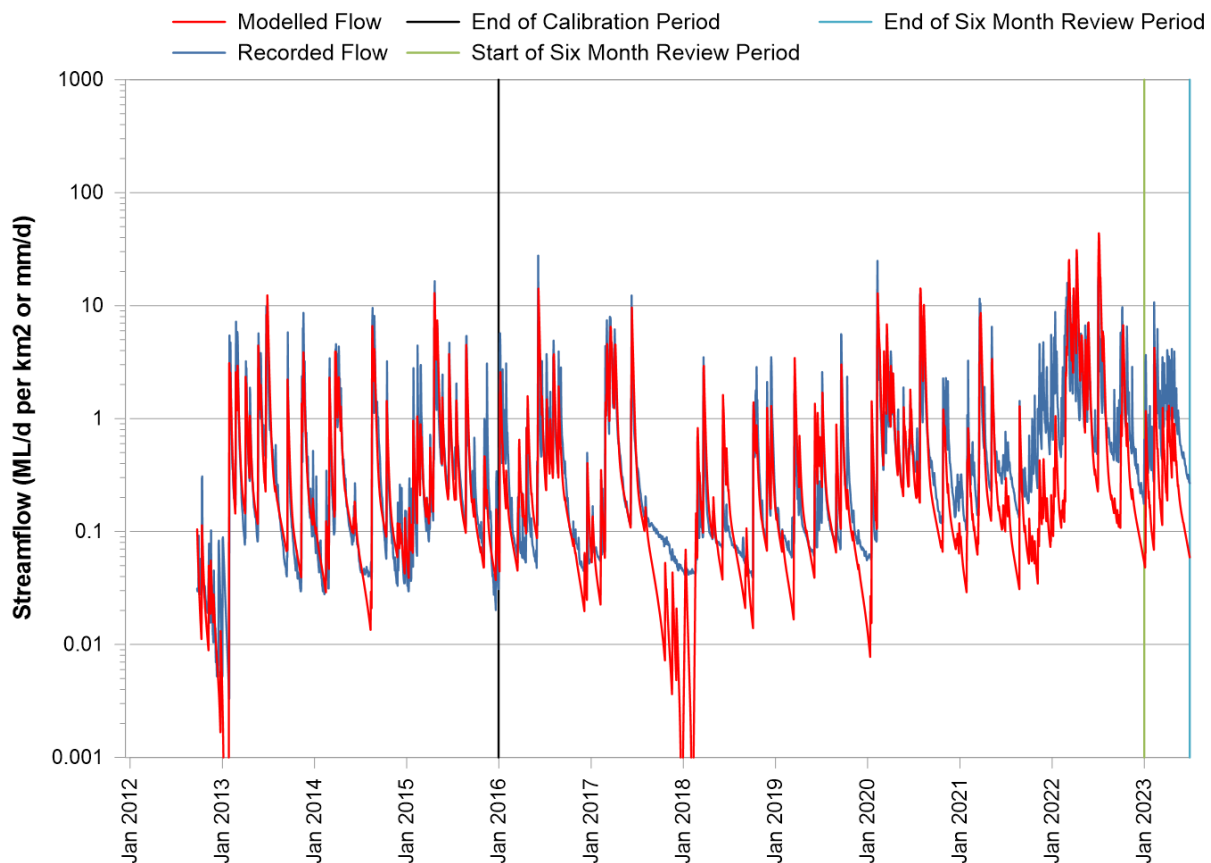


**CHART 5: MONITORED AND MODEL PREDICTED FLOWS – EASTERN TRIBUTARY
UPSTREAM OF WORONORA RESERVOIR**

3.1.3 Assessment of Flow for Sub-Catchment I (GS 300092) and Sub-Catchment K (GS 300093)

Following recommendations made in the *Woronora Reservoir Impact Strategy – Stage 1 Report* (Hebblewhite et al, 2017), streamflow gauging stations (each equipped with a “H flume”) were installed on small tributary catchments, Sub-Catchment I and Sub-Catchment K, on the eastern side of the Woronora Reservoir in 2018 (refer **FIGURE 2**). Sub-catchment I overlies Longwall 301 to Longwall 305 and therefore may be impacted by associated subsidence movements, specifically upsidence. Sub-Catchment K is located north of the predicted subsidence zone of Longwall 301 to Longwall 304 and formed a control for the assessment of potential impacts to streamflow in Sub-Catchment I associated with secondary extraction from Longwall 301 to Longwall 304. Sub-Catchment K predominately overlies Longwall 306 and Longwall 307. Longwall 308 is located west of Sub-Catchment K with the predicted subsidence zone underlying the catchment. Extraction from Longwall 308 commenced on 12 December 2022 and occurred through the review period. As such, Sub-Catchment K may also have been progressively influenced by subsidence movements associated with Longwall 305 to Longwall 308. Metropolitan Coal will continue to monitor streamflow at the Sub-Catchment I and Sub-Catchment K streamflow gauging stations until such time as mine subsidence influences are recorded (Metropolitan Coal, 2020a).

The recorded stage data and the cease to flow (CTF) levels for Sub-Catchment I and Sub-Catchment K are presented in **CHART 6** with the streamflow records, on a per unit catchment area basis, presented in **CHART 7**. Note that the streamflow data presented in **CHART 7** only extends to the capacity of each flume at approximately 3.5 mm/d.

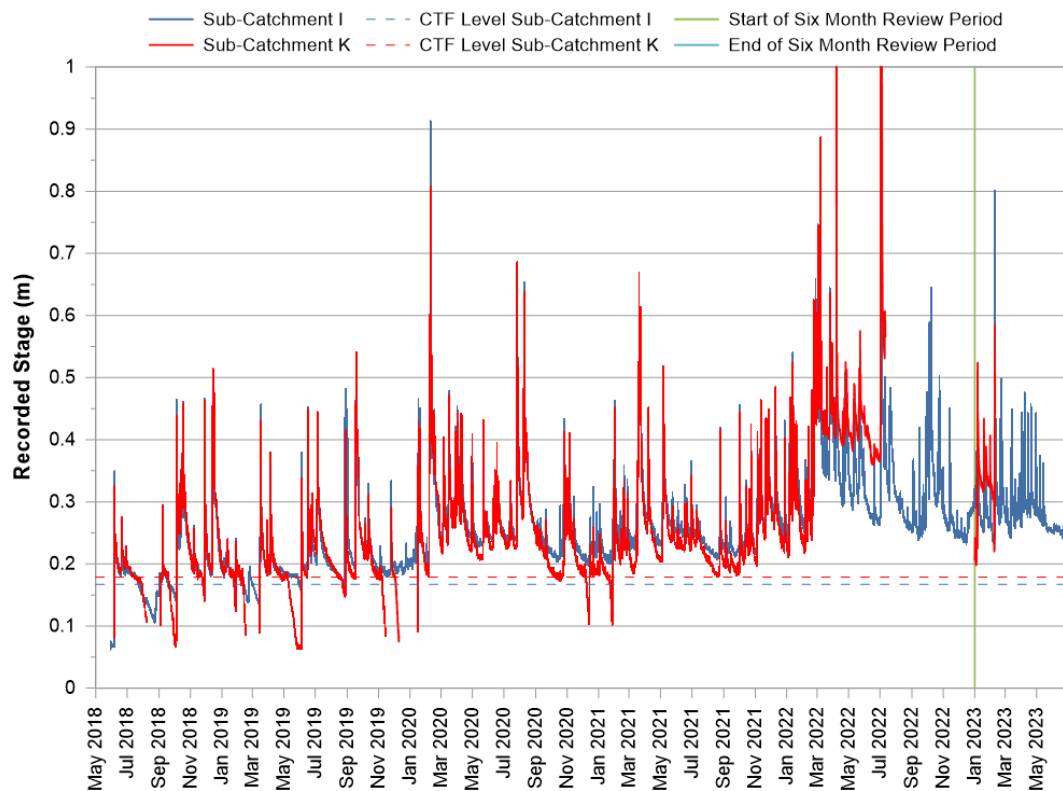


CHART 6: SUB-CATCHMENT I AND SUB-CATCHMENT K RECORDED STAGE AND CEASE TO FLOW LEVELS

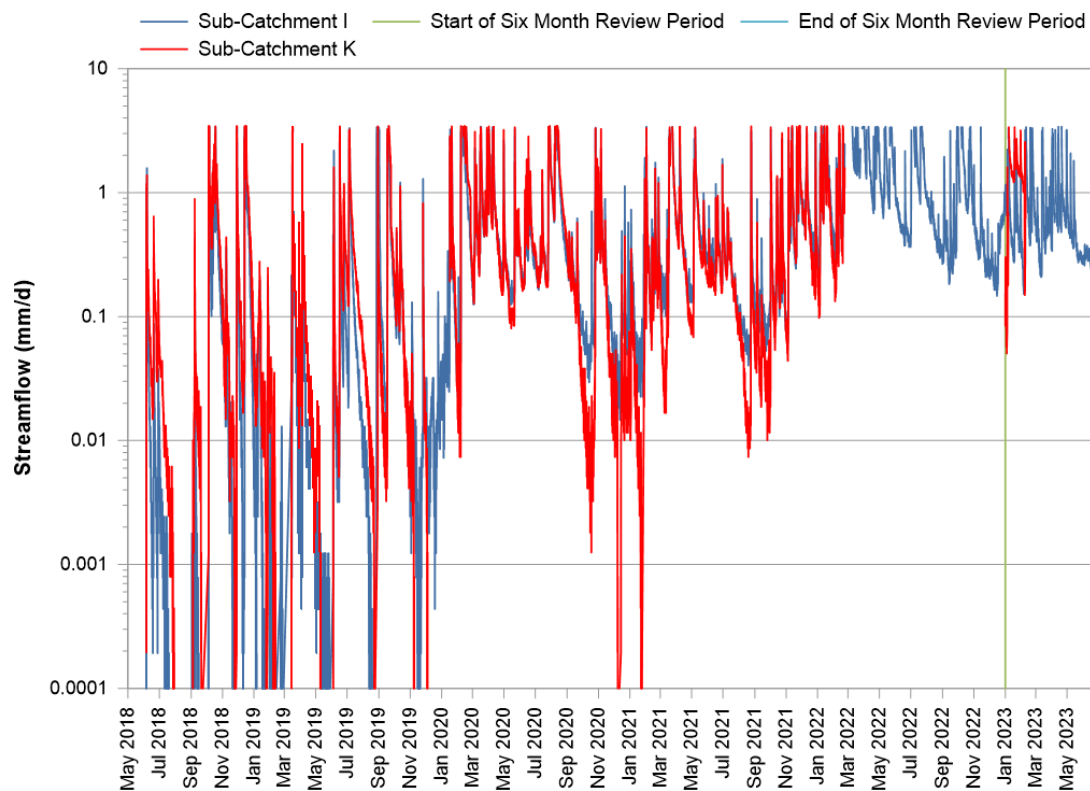


CHART 7: SUB-CATCHMENT I AND SUB-CATCHMENT K RECORDED STREAMFLOW RATES

Following the large rainfall event in late February to early March 2022, the recorded water levels at Sub-Catchment I and Sub-Catchment K have diverged. Recorded stage levels and flow recessionary behaviour for the flume on Sub-Catchment I appear to be similar prior to the unprecedented rainfall event recorded in late February to early March 2022. However, recorded stage levels for the flume on Sub-Catchment K appear higher and flow recession flatter than earlier recorded data.

From February to March 2023 there was above average rainfall in Sub-Catchment I and Sub-Catchment K. Hydrometric Services Pty Ltd (HS) indicated that the Sub-catchment K weir was inundated by backwater from the Woronora Reservoir, as such the water level and streamflow data for sub-catchment K was considered erroneous and removed from the dataset by HS for the period 9 February to 28 June 2023.

From the recorded data at the two flumes in Sub-Catchment I and Sub-Catchment K, there is no evidence to suggest a reduction in catchment yield.

3.1.4 Assessment of Flow for Swamp 92 Weir (GS 300142) and Swamp 76 Weir (GS 3000143)

Following recommendations given in Hydro Engineering & Consulting (2019), flow measuring flumes (each comprising a “H flume”) were installed immediately downstream of Swamps 76 (Swamp 76 Weir) and 92 (Swamp 92 Weir) in November 2020. Swamp 92 Weir and Swamp 76 Weir are located on the eastern side of the Woronora Reservoir (refer **FIGURE 2**). Swamp 92 Weir overlies a small portion the southern end of Longwalls 312, 313 and 314. Swamp 76 Weir overlies longwalls 314, 315 and 316 and is located west of the predicted subsidence zone of Longwall 309 to Longwall 310. In accordance with Metropolitan Coal (2020a), monitoring of streamflow at the Swamp 92 Weir and Swamp 76 Weir streamflow gauging stations is undertaken, with results presented in **CHART 8**. Note that the streamflow data gaps relate to periods of data where the recorded level exceeds the height of the H-flume.

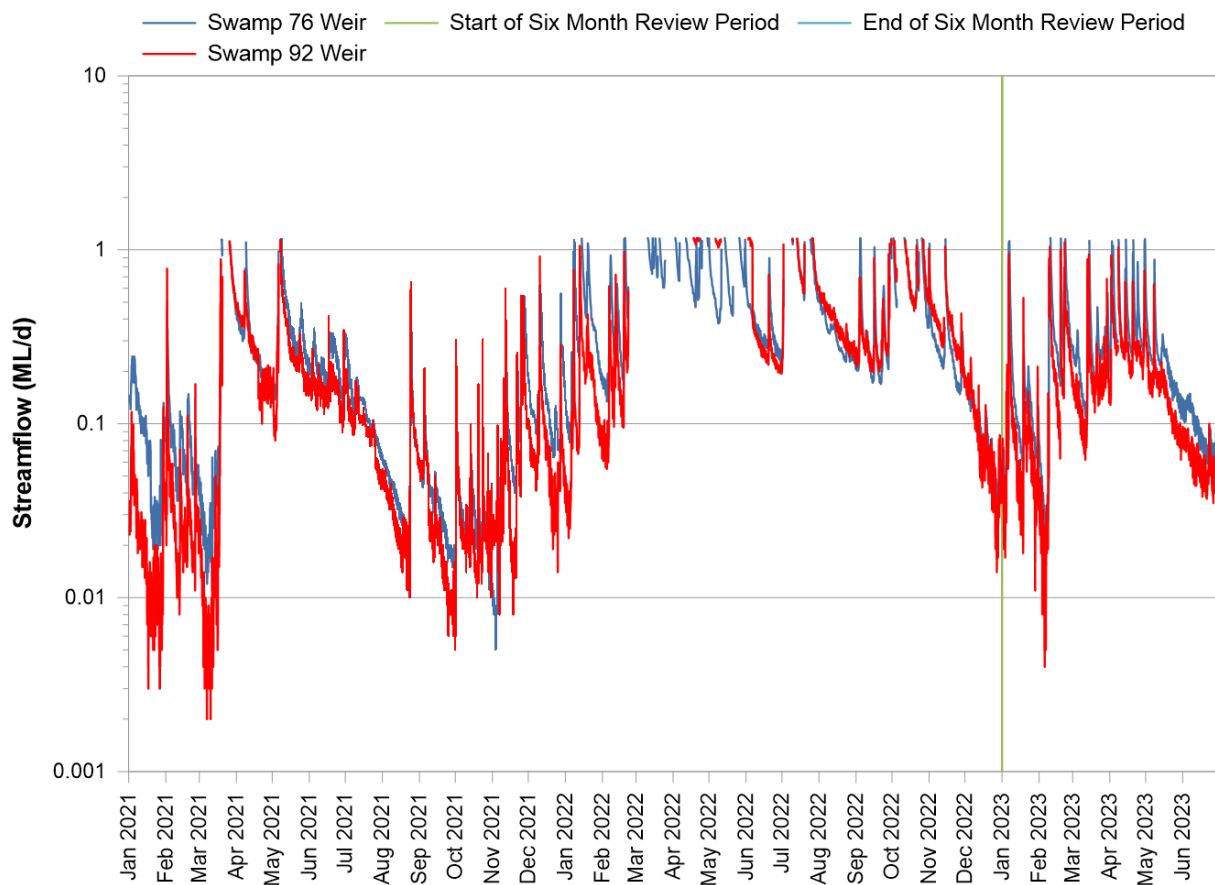


CHART 8: SWAMP 76 WEIR AND SWAMP 92 WEIR RECORDED STREAMFLOW RATES

The data presented in **CHART 8** indicates that there was continuous streamflow recorded at the location of the H-Flumes in Swamp 92 Weir and Swamp 76 Weir for the duration of the review period. The streamflow rates and trends recorded at the Swamp 92 Weir gauging station were similar to or slightly less than that recorded in Swamp 76 Weir, with greater than 0.01 ML/day recorded for the duration of the review period.

3.1.5 Analysis against Subsidence Impact Performance Measure

Subsidence Impact Performance Measure:

Negligible reduction to the quantity of water resources reaching the Woronora Reservoir.

The subsidence impact performance measure is considered to have been exceeded if analysis of the monitoring and modelling results confirms that the Project has resulted in a greater than negligible reduction in the quantity of water resources reaching the Woronora Reservoir.

The performance measure of negligible reduction to the quantity of water resources reaching the Woronora Reservoir has been met.

3.2 Quality of Water Resources Reaching the Woronora Reservoir

Performance Indicator:

Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ 2.

Water quality data has been analysed for key water quality parameters of relevance to water supply and the effects of subsidence, namely dissolved (field filtered) iron, manganese and aluminium at site WRWQ 9 on Waratah Rivulet, site ETWQ AU on Eastern Tributary and at control site WOWQ 2 on the Woronora River.

The results have been assessed against the Longwalls 308-310 Water Management Plan significance levels/triggers (below):

Significance Levels/Triggers	
Negligible Reduction to the Quality of Water Resources Reaching the Woronora Reservoir	
Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.
Level 2	Data analysis indicates any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for one month.
Level 3	Data analysis indicates: - any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or - over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or - the six month mean exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e., over two six monthly reports); and - there was not a similar exceedance of the trigger at the control site.

The performance indicator is exceeded if the results indicate a Level 3 significance level/trigger.

3.2.1 Assessment of Water Quality at Site WRWQ 9

Plots showing the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at sampling site WRWQ 9 in relation to the adjusted baseline mean plus one and two standard deviations are shown on **CHART 9** to

CHART 11 below.

CHART 12 to **CHART 14** show the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at control site WOWQ 2 in comparison to the adjusted baseline mean plus one and two standard deviations.

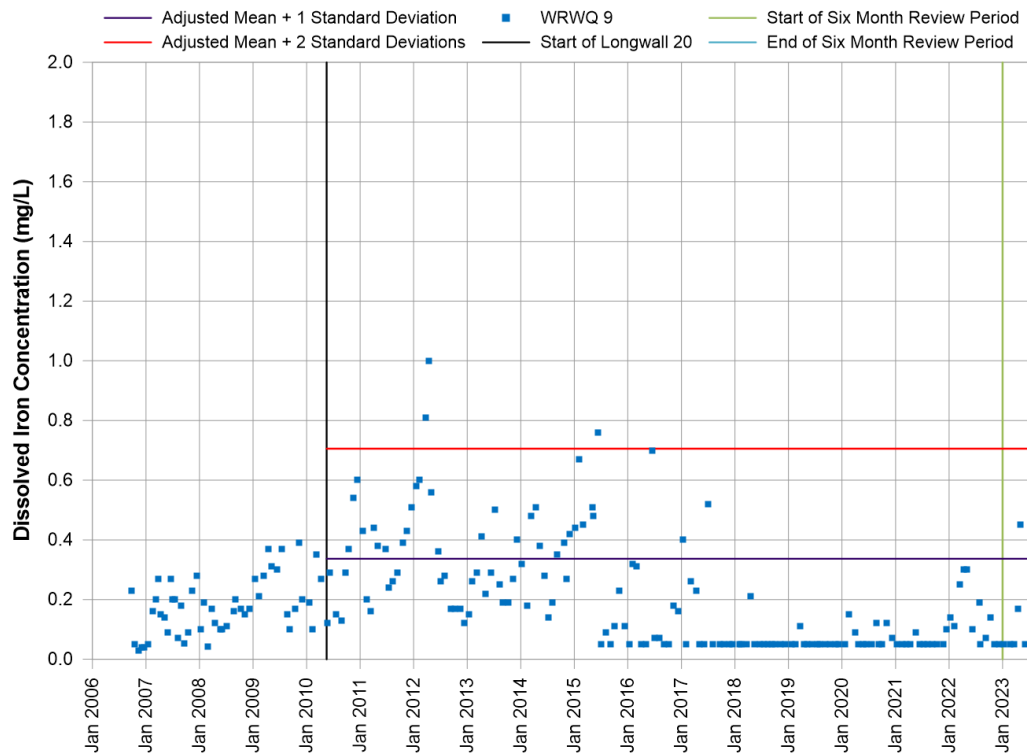


CHART 9: DISSOLVED IRON CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

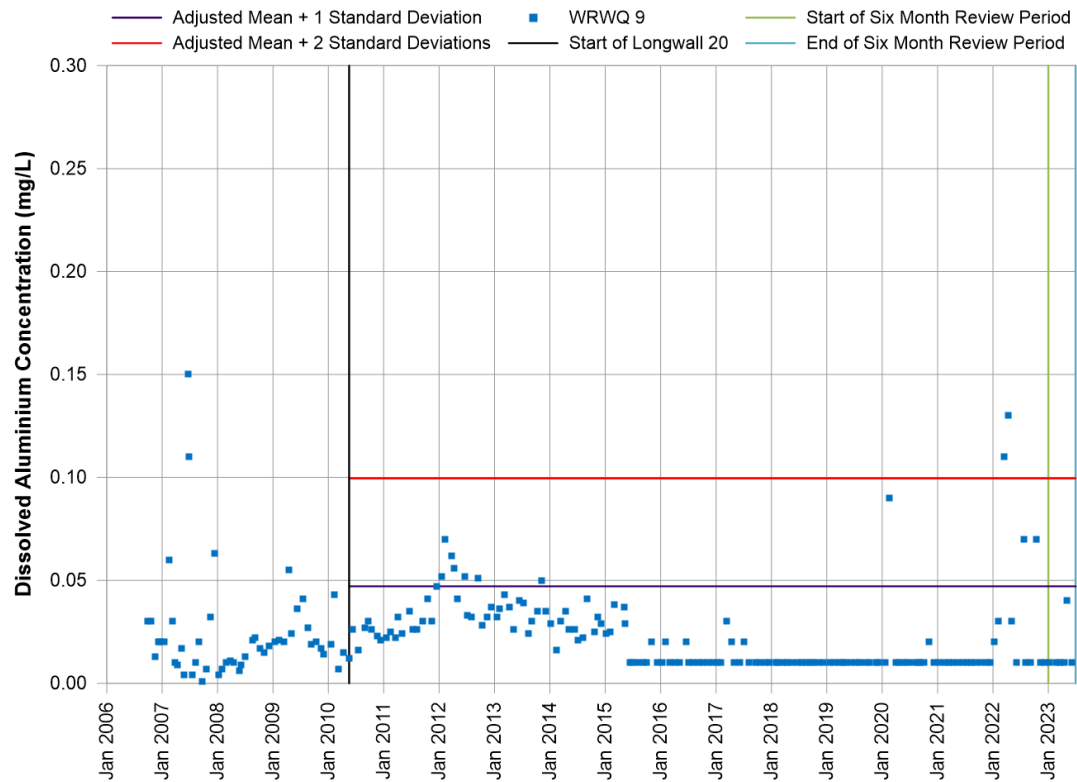


CHART 10: DISSOLVED ALUMINIUM CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

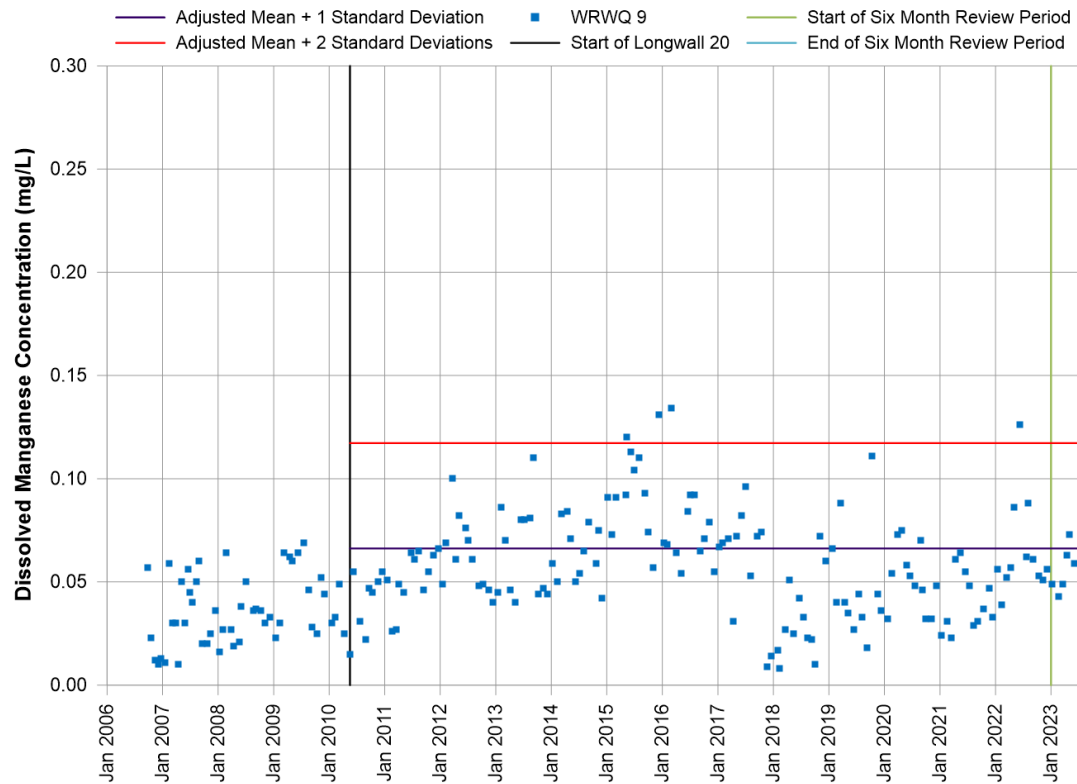


CHART 11: DISSOLVED MANGANESE CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

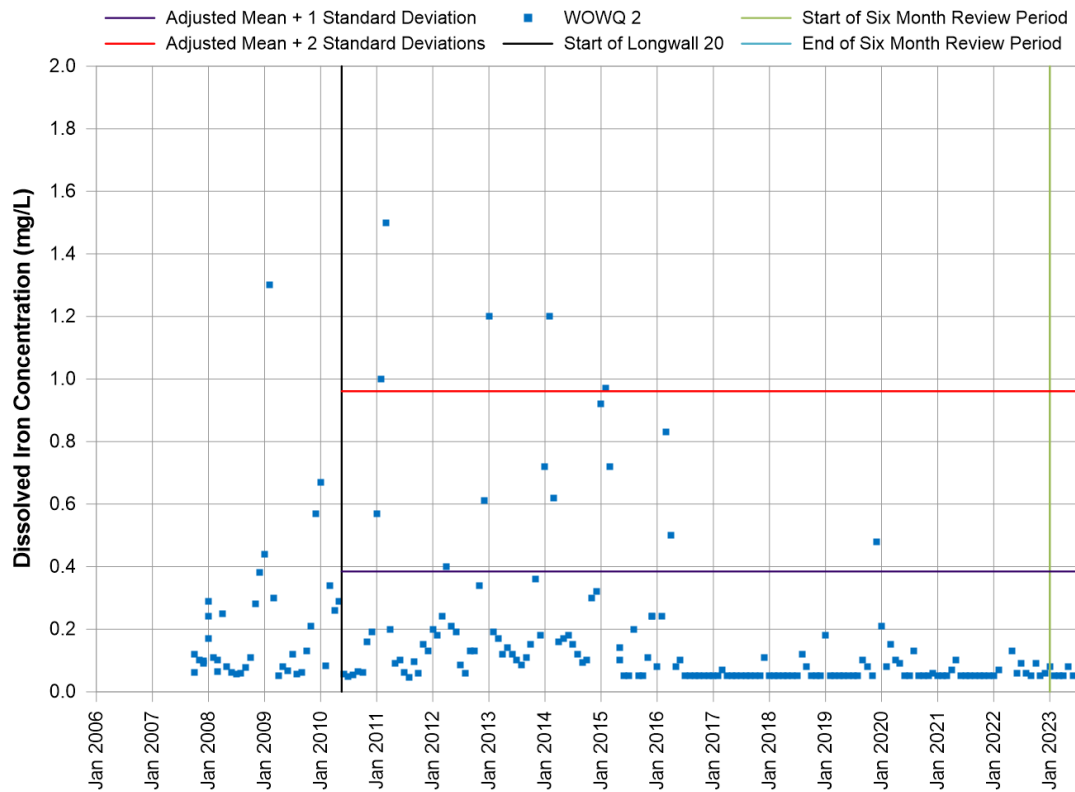


CHART 12: DISSOLVED IRON CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

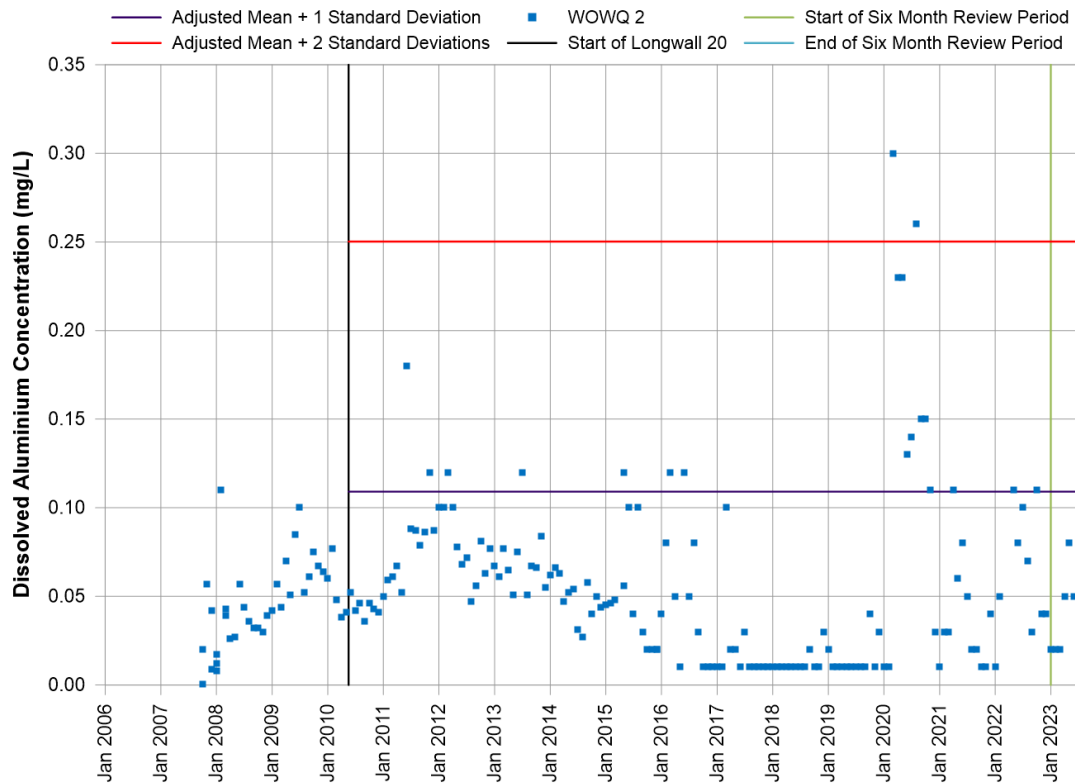


CHART 13: DISSOLVED ALUMINIUM CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

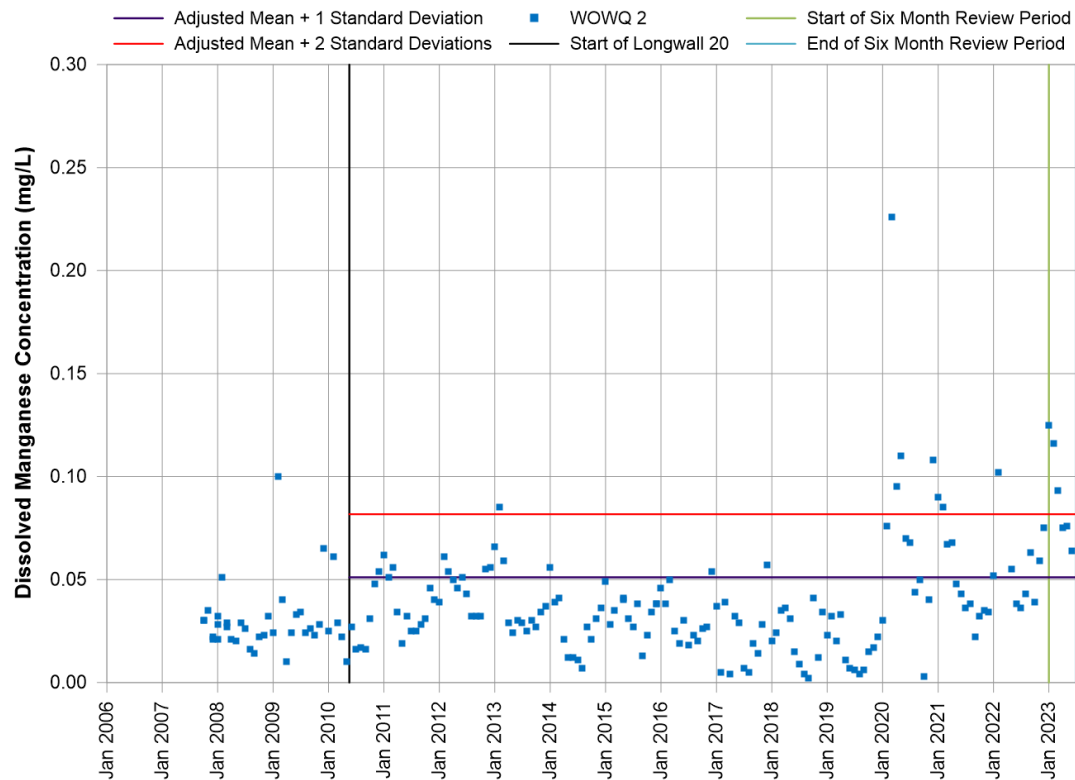


CHART 14: DISSOLVED MANGANESE CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

CHART 9 indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron in Waratah Rivulet at site WRWQ 9 during the review period. There were no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved iron (**CHART 12**). The results equate to a Level 1 significance level for dissolved iron from January to June 2023.

CHART 10 indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved aluminium in the Waratah Rivulet at site WRWQ 9 during the review period. There were no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved aluminium (**CHART 13**). The results equate to a Level 1 significance level for dissolved aluminium from January to June 2023.

CHART 11 indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved manganese in Waratah Rivulet at site WRWQ 9 during the review period. There was an exceedance of the adjusted baseline mean plus two standard deviations for dissolved manganese at control site WOWQ 2 on the Woronora River from January to March 2023 but not for the remainder of the review period (**CHART 14**). The results equate to a Level 1 significance level for dissolved manganese from January to June 2023.

Plots showing the six month mean concentrations for dissolved iron, dissolved aluminium and dissolved manganese recorded at site WRWQ 9 are shown on **CHART 15** to **CHART 17**. For comparison, plots showing the six month mean concentrations for the same water quality parameters at control site WOWQ 2 are shown on **CHART 18** to **CHART 20**. Each plot includes the adjusted baseline mean plus one standard deviation value.

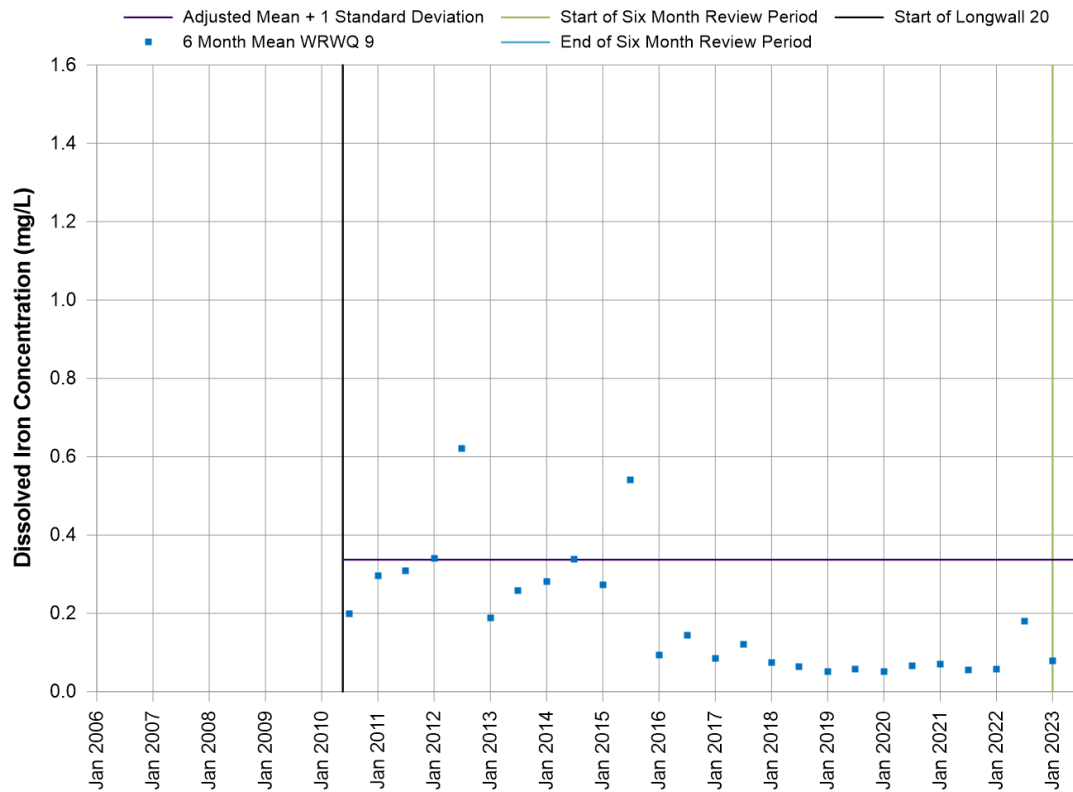


CHART 15: SIX MONTH MEANS OF DISSOLVED IRON CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

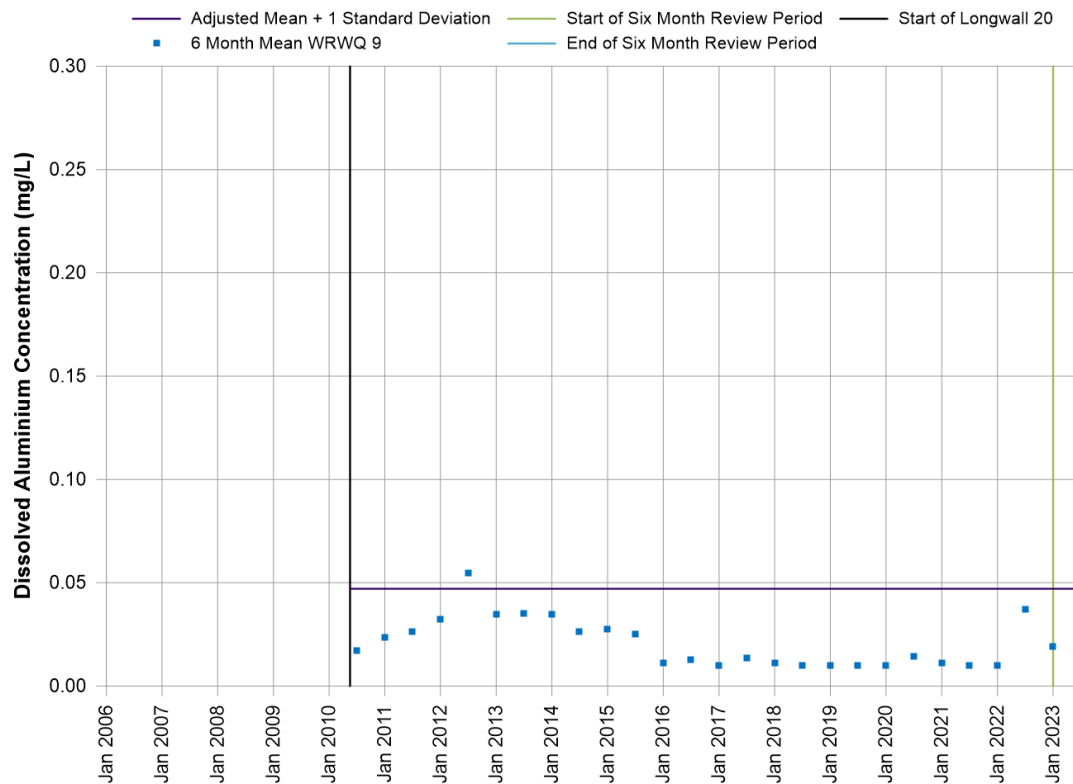


CHART 16: SIX MONTH MEANS OF DISSOLVED ALUMINIUM CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

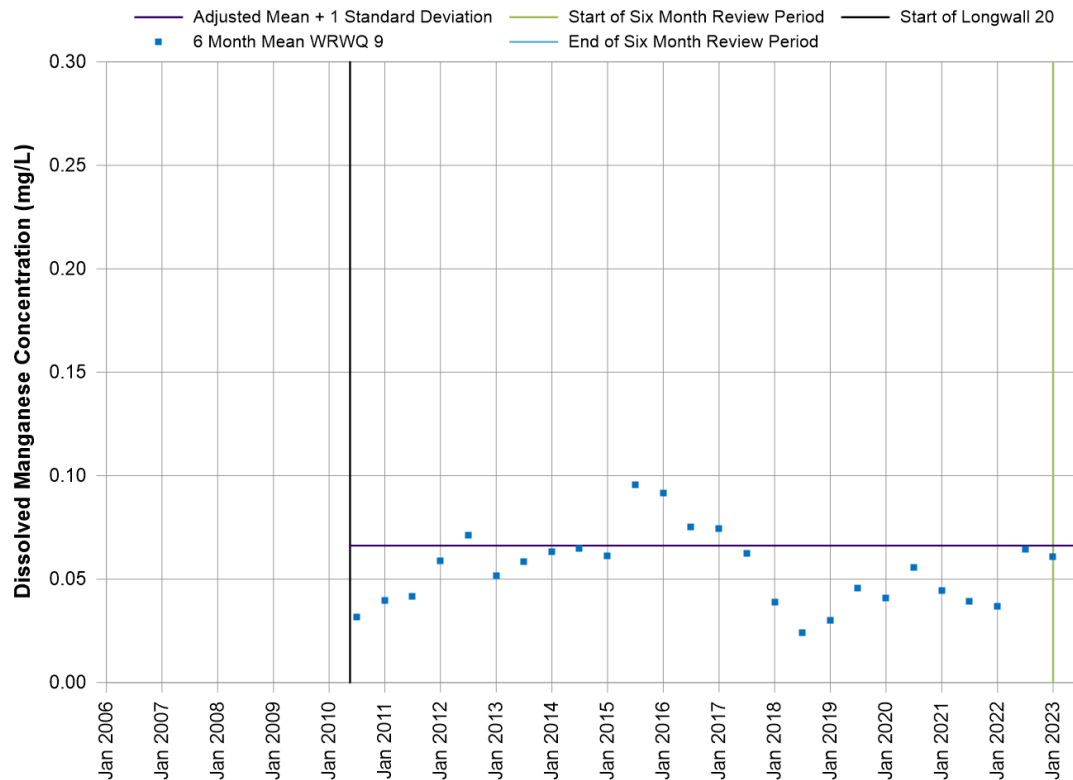


CHART 17: SIX MONTH MEANS OF DISSOLVED MANGANESE CONCENTRATIONS IN WARATAH RIVULET AT WRWQ 9

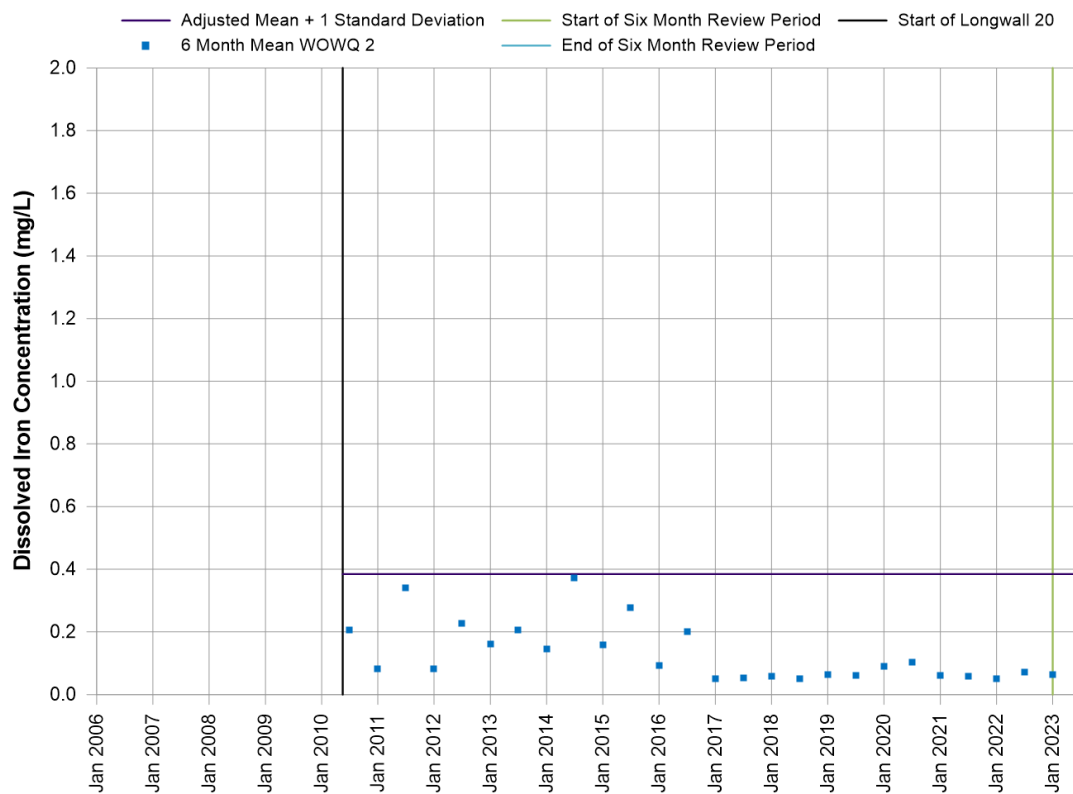


CHART 18: SIX MONTH MEANS OF DISSOLVED IRON CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

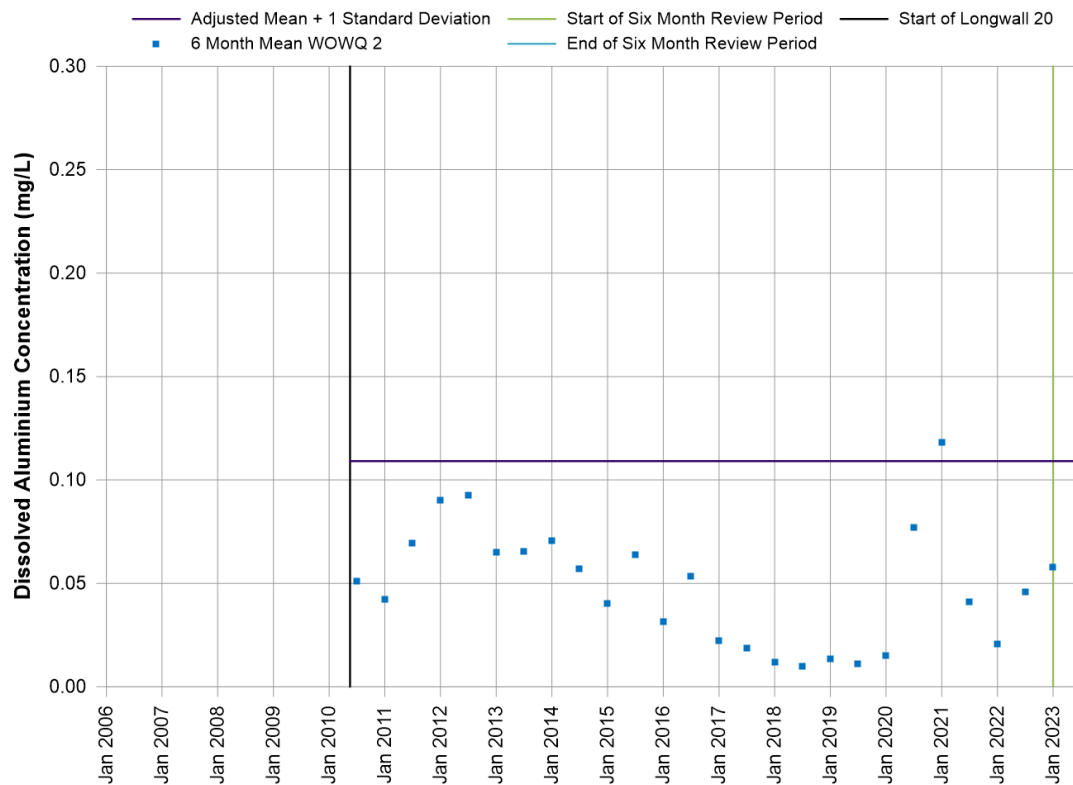


CHART 19: SIX MONTH MEANS OF DISSOLVED ALUMINIUM CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

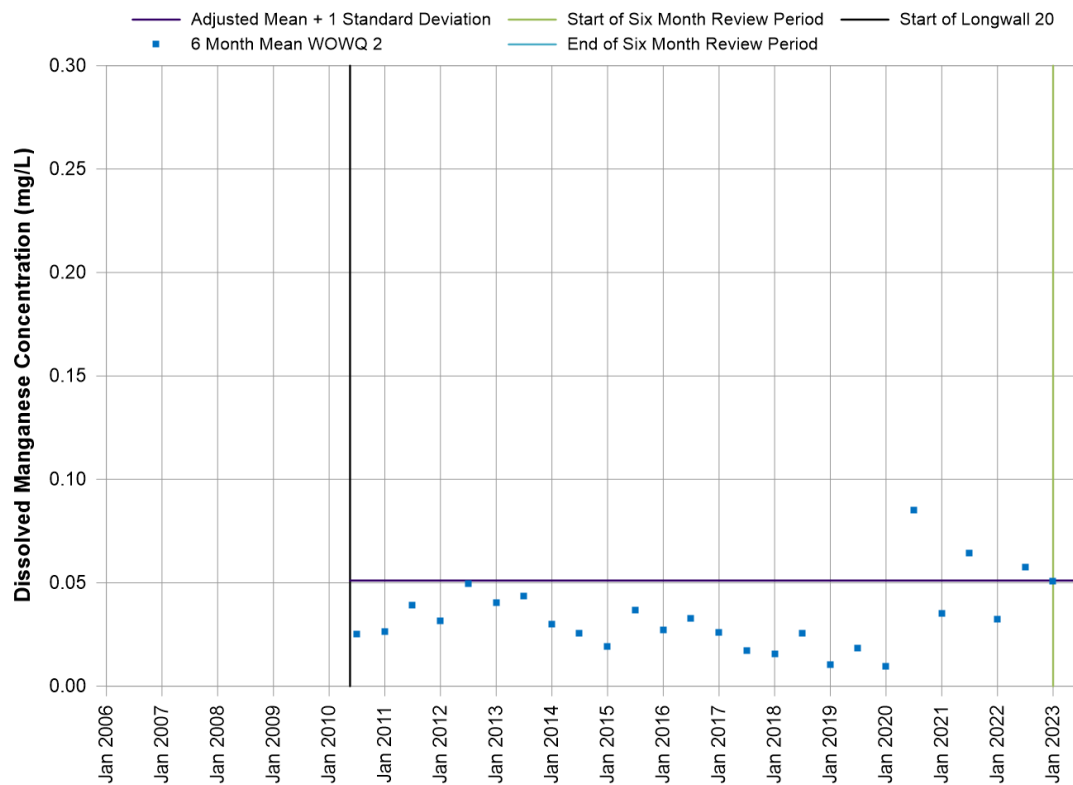


CHART 20: SIX MONTH MEANS OF DISSOLVED MANGANESE CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

There were no exceedances of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved iron, dissolved aluminium or dissolved manganese in Waratah Rivulet at site WRWQ 9 (**CHART 15 to CHART 17**) or dissolved iron, dissolved aluminium and dissolved manganese in Woronora River at site WOWQ 2 (**CHART 18 to CHART 20**) during the review period. There was an exceedance of the adjusted baseline mean plus one standard deviation for dissolved manganese (January to June 2023) in Woronora River at site WOWQ 2 (**CHART 20**) during the review period. The six month mean results do not affect the preceding conclusions with regard to water quality significance levels for Waratah Rivulet at site WRWQ 9.

3.2.2 Analysis against Subsidence Impact Performance Measure – Waratah Rivulet

Subsidence Impact Performance Measure:

Negligible reduction to the quality of water resources reaching the Woronora Reservoir.

The subsidence impact performance measure is considered to have been exceeded if analysis of the monitoring and modelling results confirms that the Project has resulted in a greater than negligible reduction in the quality of water resources reaching the Woronora Reservoir.

The performance measure of negligible reduction to the quality of water resources reaching the Woronora Reservoir from the Waratah Rivulet has been met.

3.2.3 Assessment of Water Quality at Site ETWQ AU

Plots showing the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at site ETWQ AU are shown on

CHART 21 to CHART 23A in relation to the adjusted baseline mean plus one and two standard deviations calculated using data prior to potential subsidence effects from Longwall 20 on the Eastern Tributary.

CHART 24 to CHART 26 show the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at control site WOWQ 2 in comparison to the adjusted baseline mean plus one and two standard deviations calculated using data collected prior to potential subsidence effects from Longwall 20 on the Eastern Tributary.

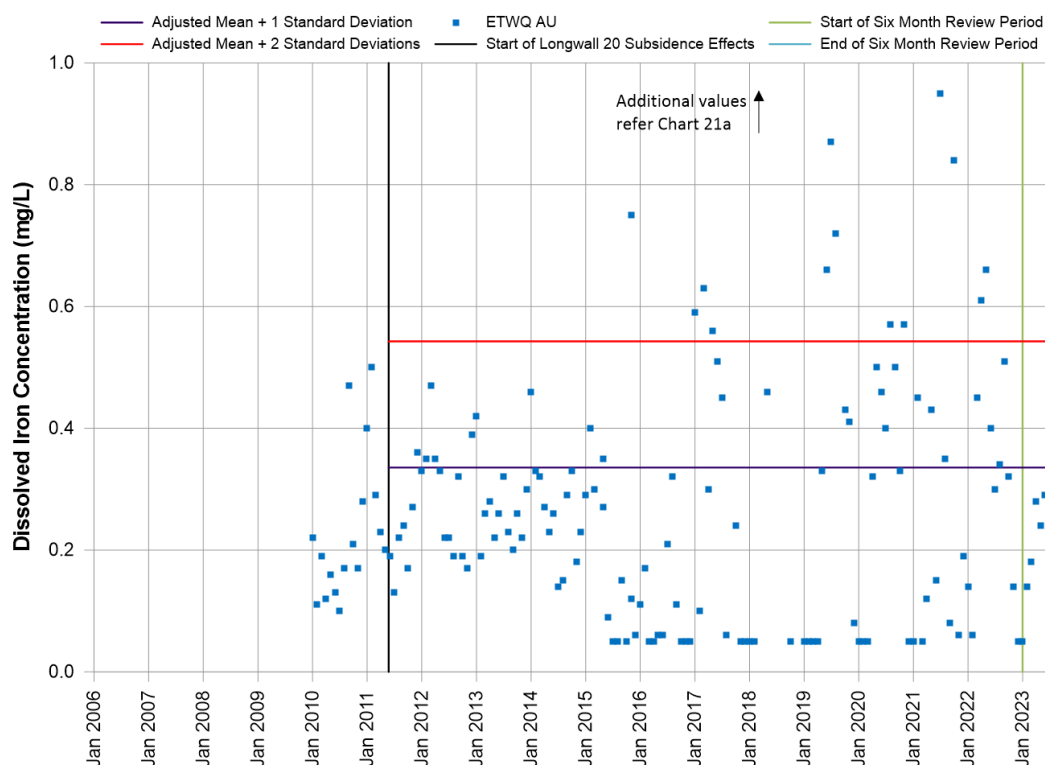


CHART 21: DISSOLVED IRON CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

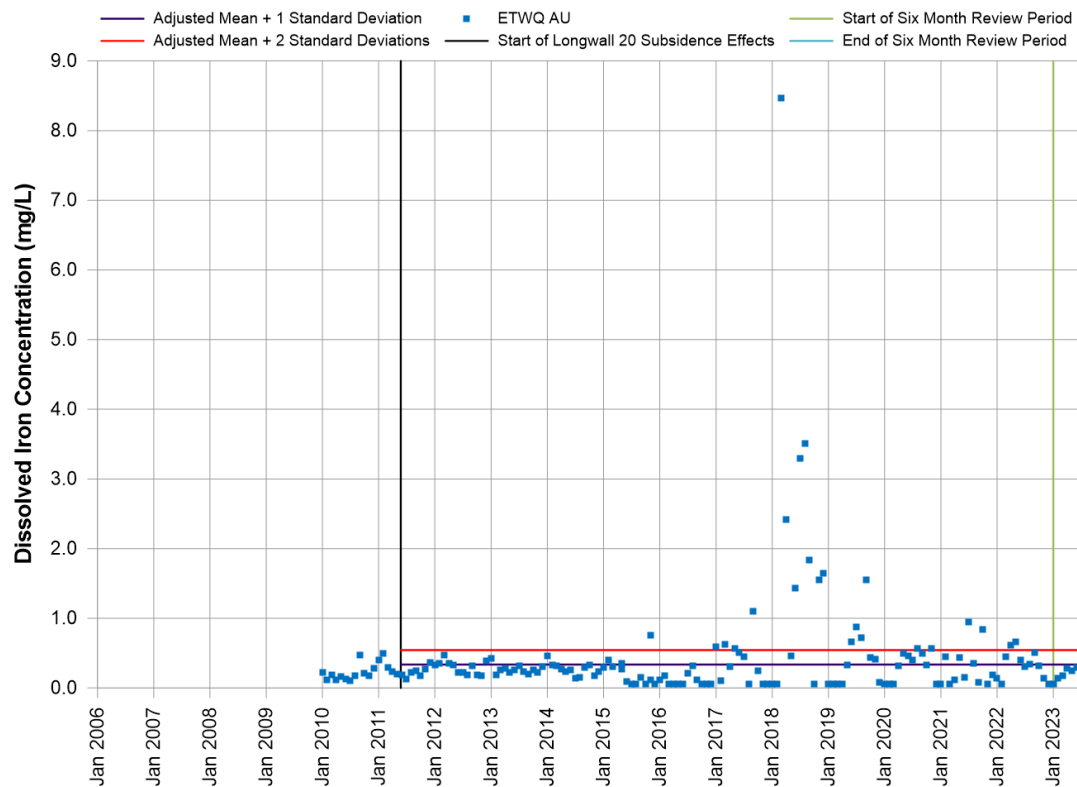


CHART 21A: DISSOLVED IRON CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

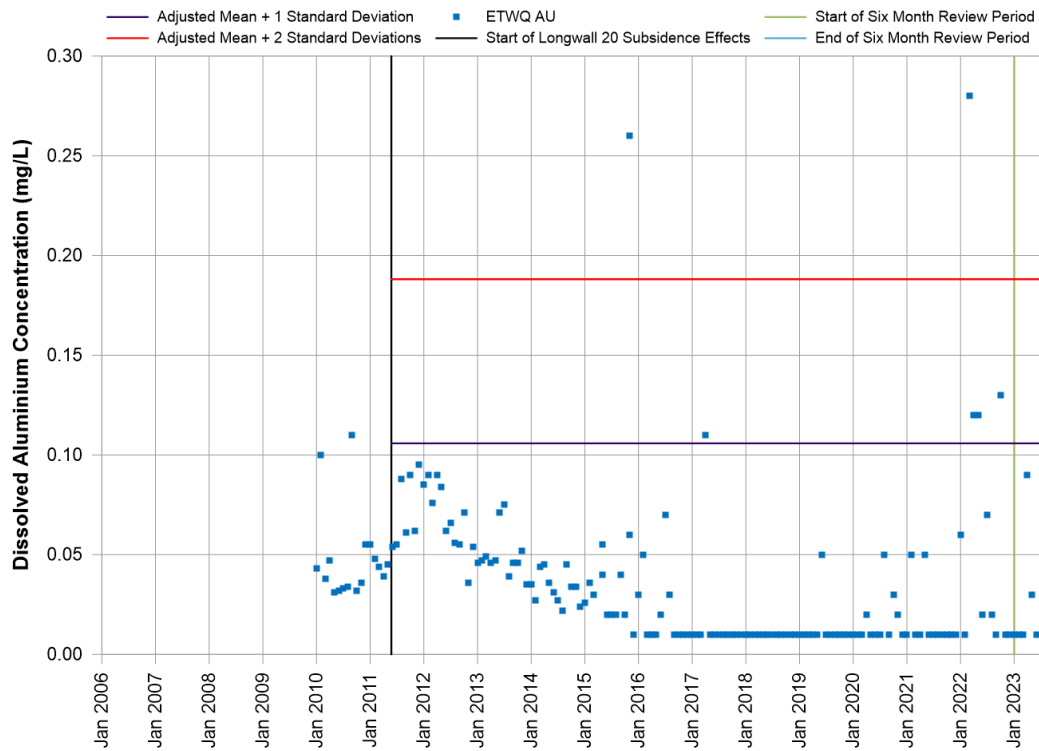


CHART 22: DISSOLVED ALUMINIUM CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

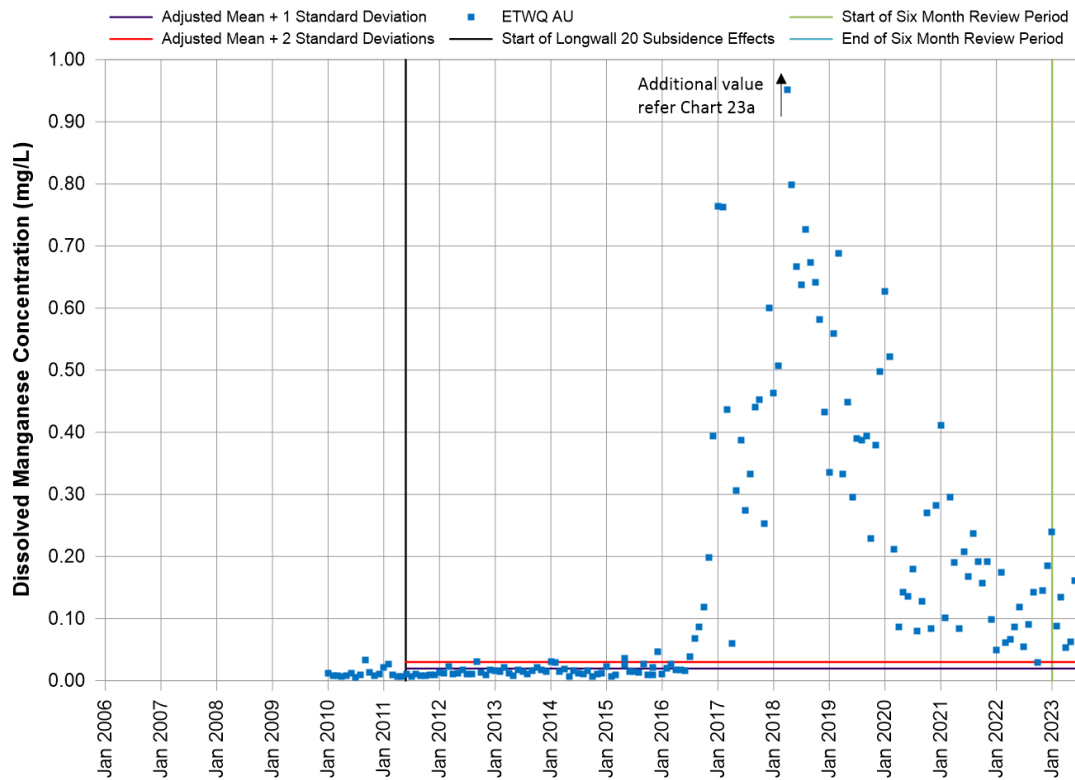


CHART 23: DISSOLVED MANGANESE CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

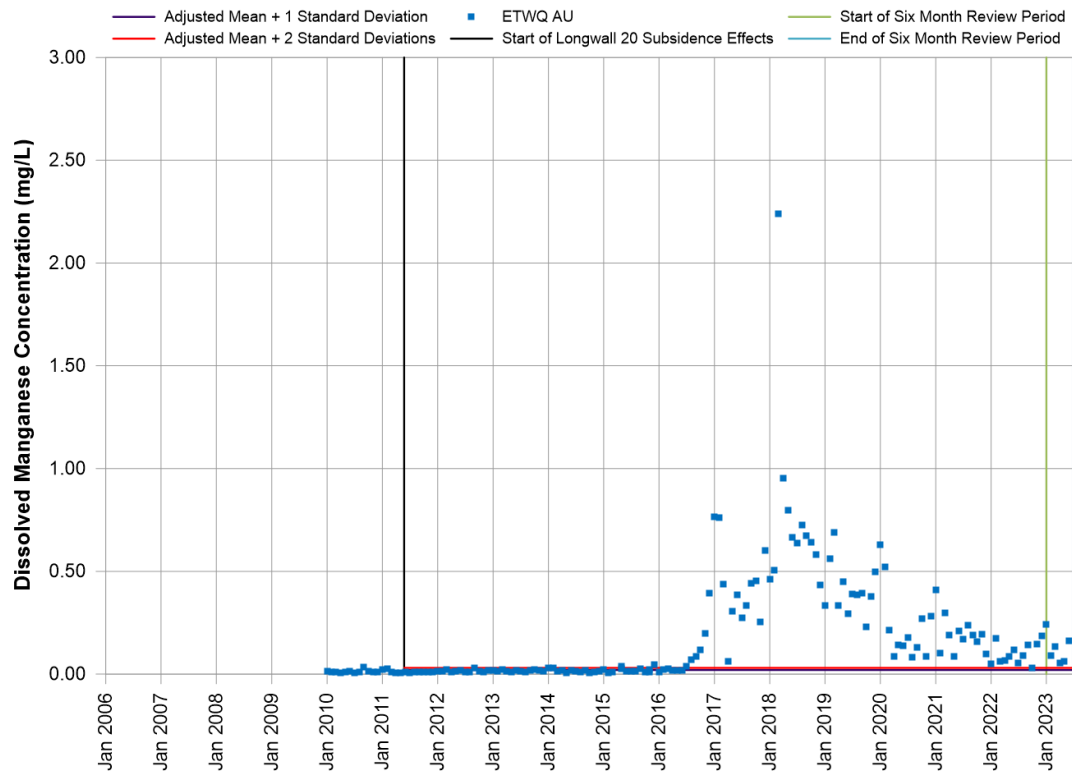


CHART 23A: DISSOLVED MANGANESE CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

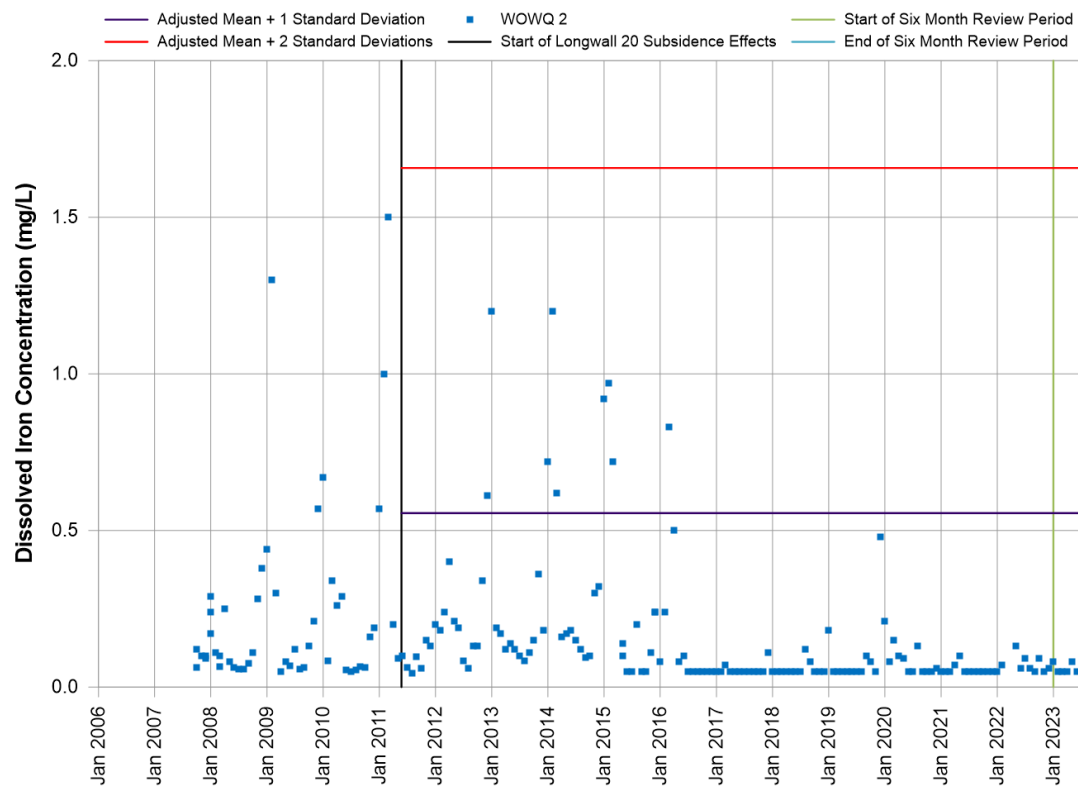


CHART 24: DISSOLVED IRON CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

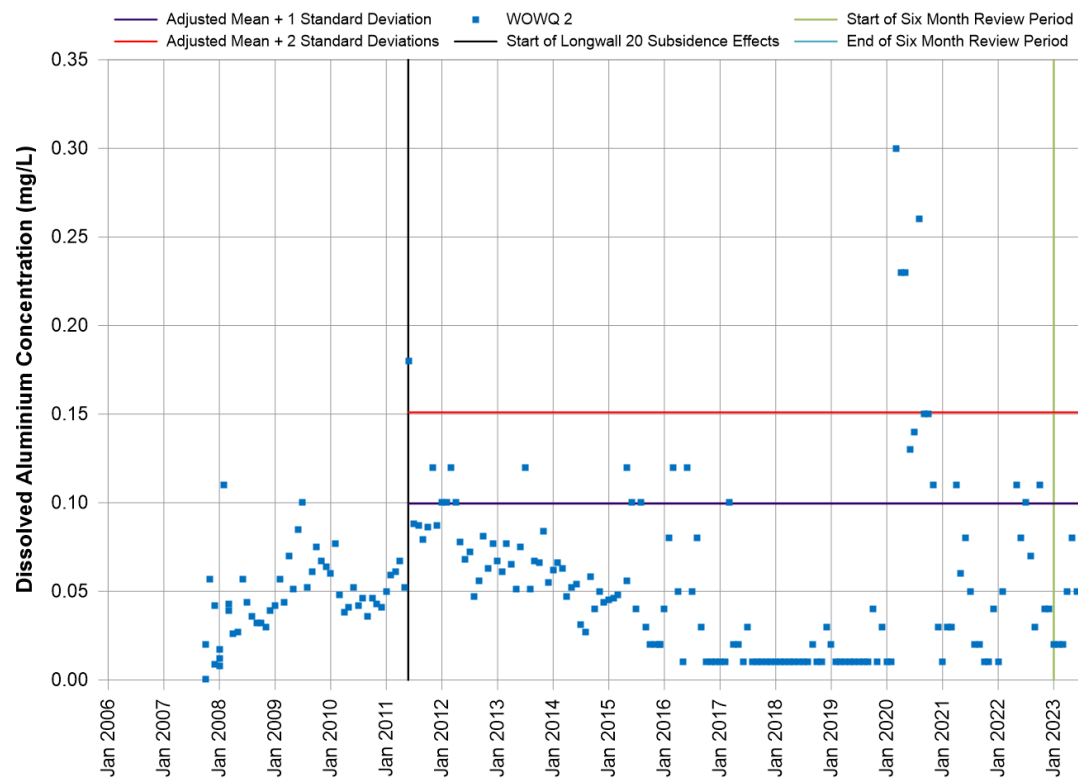


CHART 25: DISSOLVED ALUMINIUM CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

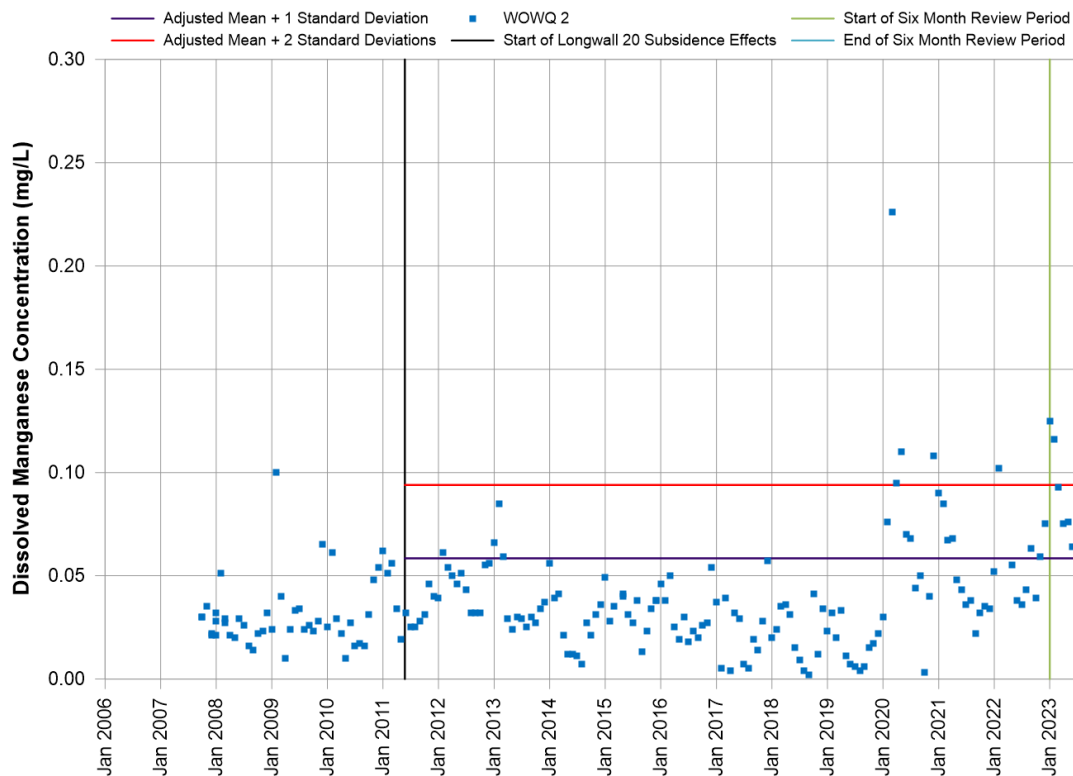


CHART 26: DISSOLVED MANGANESE CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

CHART 21/CHART 21A indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron in the Eastern Tributary at site ETWQ AU from January to June 2023. There were no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved iron (**CHART 24**). The results equate to a Level 1 significance level for dissolved iron from January to June 2023.

CHART 22 indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations from January to June 2023. There were no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved aluminium (**CHART 25**). The results equate to a Level 1 significance level for dissolved aluminium from January to June 2023.

The dissolved manganese concentrations continued to exceed the adjusted baseline mean plus two standard deviations at site ETWQ AU during the review period (**CHART 23/CHART23A**). Dissolved manganese concentrations exceeded the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month throughout the review period. The monthly dissolved manganese concentration at the control site WOWQ 2 on the Woronora River exceeded the adjusted baseline mean plus two standard deviations for two months during the review period (January and February 2023) for dissolved manganese (**CHART 26**). From March to June 2023 concentrations remained below the adjusted baseline mean plus two standard deviations. The results equate to a Level 2 significance level in January and February 2023 for dissolved manganese at site ETWQ AU as there was a similar exceedance at the control site WOWQ 2. From March to June 2023 the results equate to a Level 3 significance level for dissolved manganese.

Plots showing the six month mean concentrations for dissolved iron, dissolved aluminium and dissolved manganese recorded at site ETWQ AU are shown on **CHART 27** to **CHART 29**. For comparison, plots showing the six month mean concentrations for the same water quality parameters at control site WOWQ 2 are shown on **CHART 30** to **CHART 32**. Each plot includes the adjusted baseline mean plus one standard deviation value.

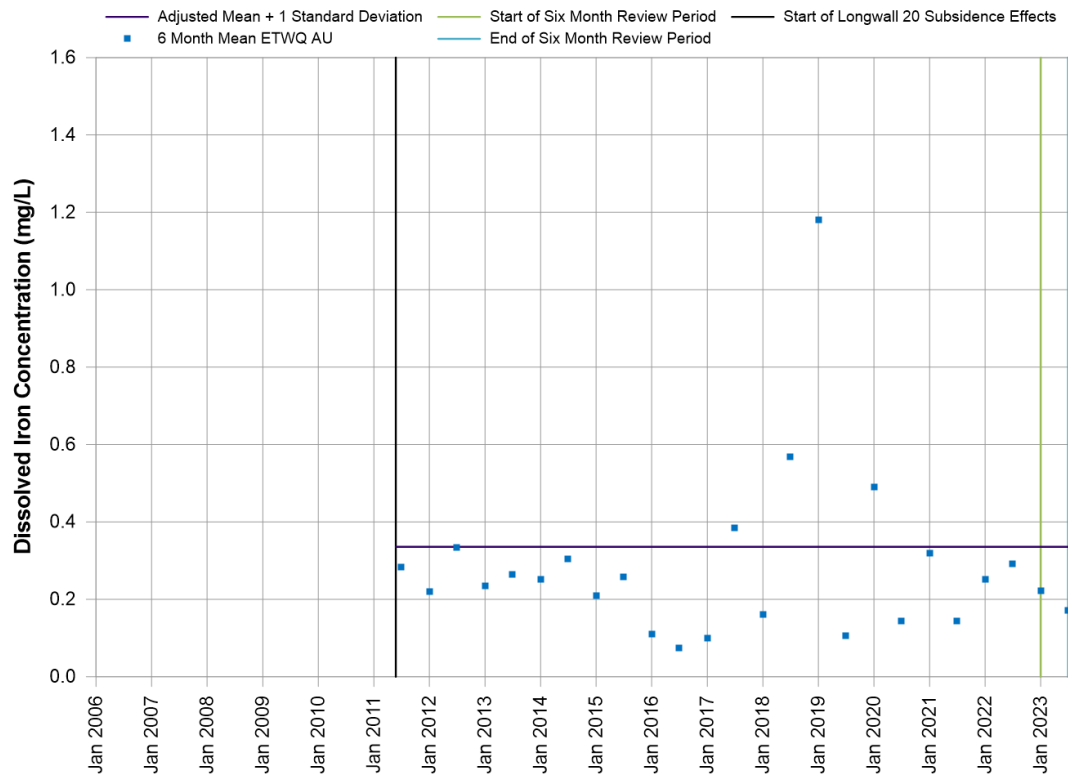


CHART 27: SIX MONTH MEANS OF DISSOLVED IRON CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

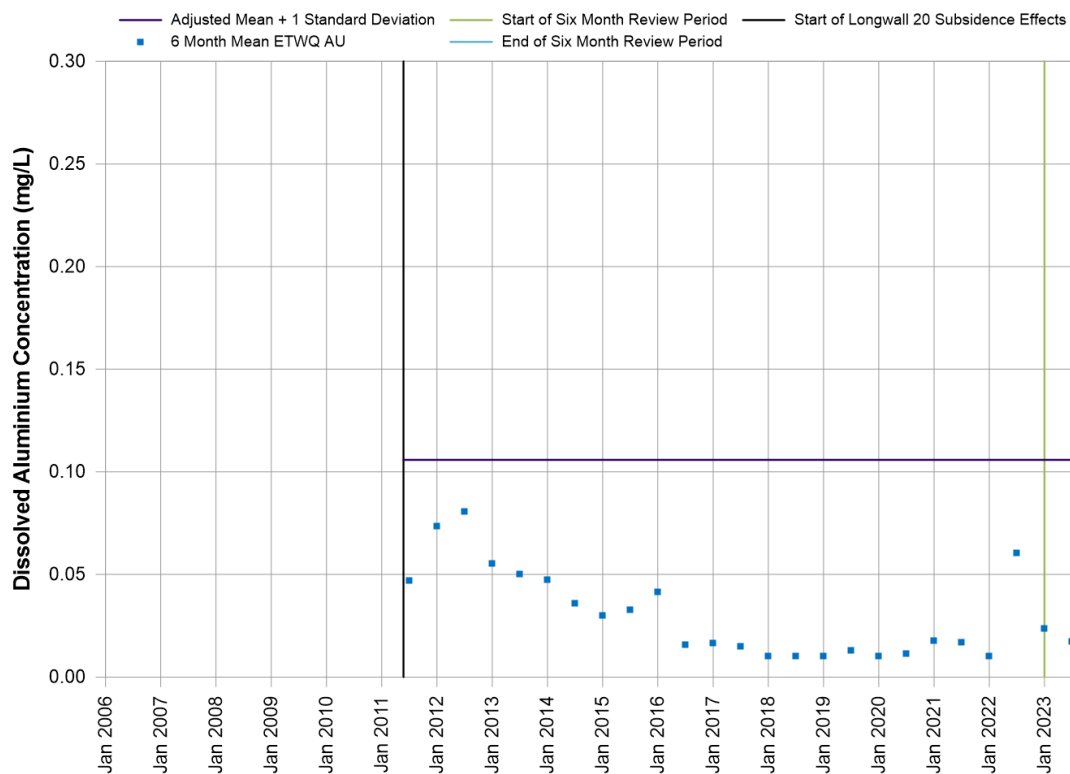


CHART 28: SIX MONTH MEANS OF DISSOLVED ALUMINIUM CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

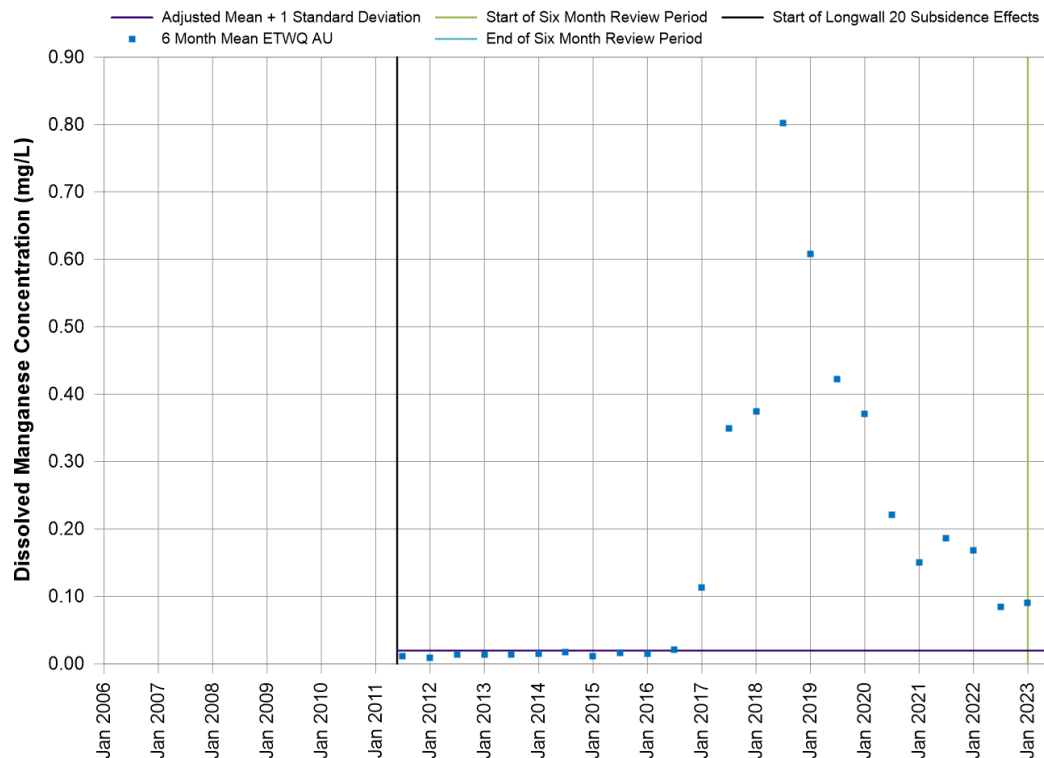


CHART 29: SIX MONTH MEANS OF DISSOLVED MANGANESE CONCENTRATIONS IN EASTERN TRIBUTARY AT ETWQ AU

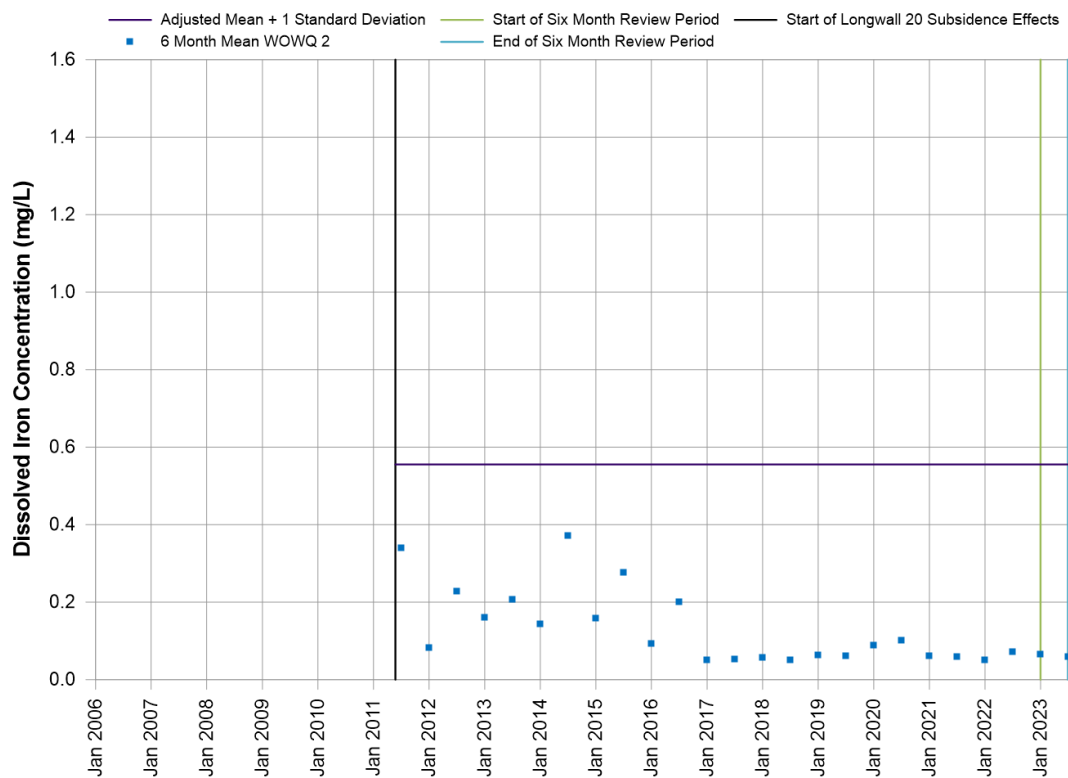


CHART 30: SIX MONTH MEANS OF DISSOLVED IRON CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

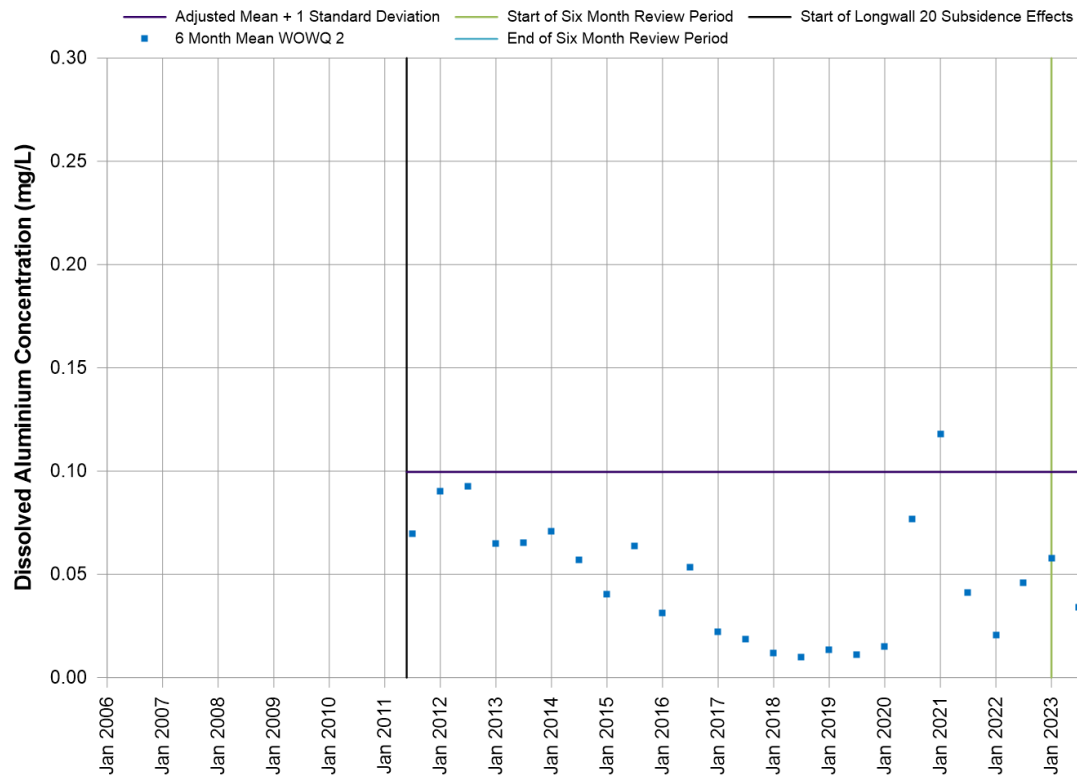


CHART 31: SIX MONTH MEANS OF DISSOLVED ALUMINIUM CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

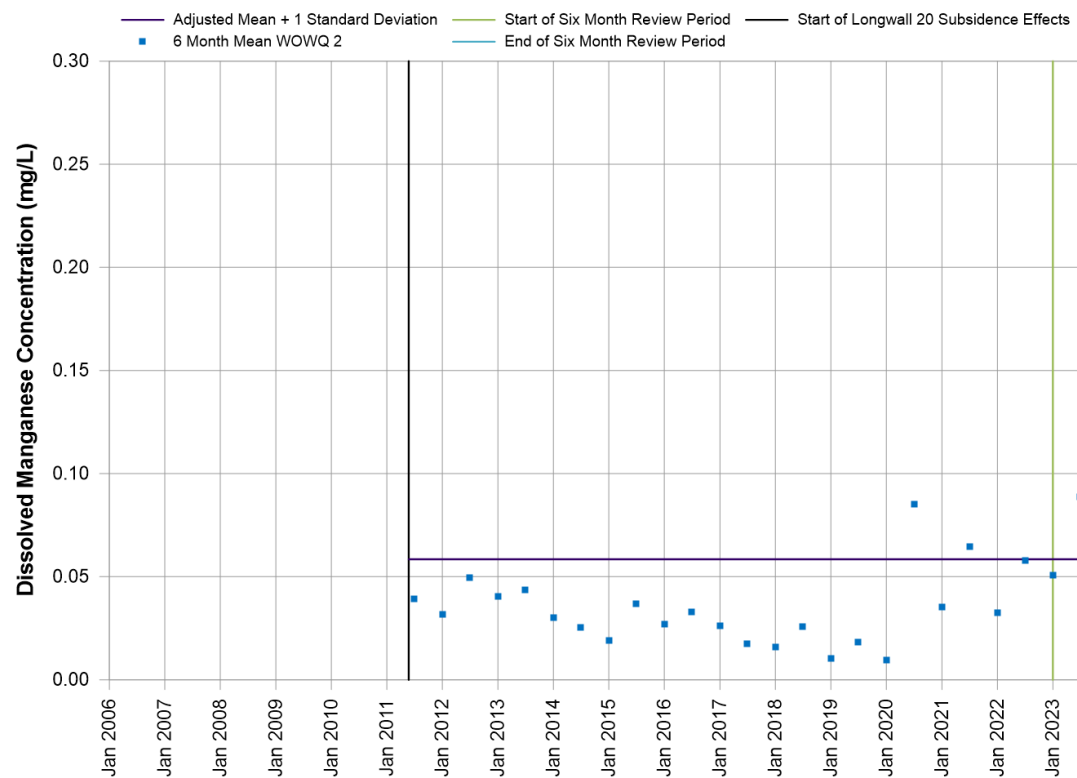


CHART 32: SIX MONTH MEANS OF DISSOLVED MANGANESE CONCENTRATIONS IN WORONORA RIVER AT WOWQ 2

There were no exceedances of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved iron or dissolved aluminium in Eastern Tributary at site ETWQ AU (**CHART 27** and **CHART 28**). There were also no exceedances at control site WOWQ 2 in the Woronora River for dissolved iron or dissolved aluminium for two consecutive six month means (**CHART 30** and **CHART 31**). There continued to be an exceedance of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved manganese in Eastern Tributary at site ETWQ AU for the review period (**CHART 29**). There was an exceedance of the adjusted baseline mean plus one standard deviation at the control site WOWQ 2 on the Woronora River from January to June 2023. However, there were not exceedances for two consecutive six month means (**CHART 32**). Accordingly, the results for dissolved manganese in the Eastern Tributary at site ETWQ AU equate to a Level 3 significance level for the review period.

3.2.4 Analysis against Subsidence Impact Performance Measure – Eastern Tributary

Subsidence Impact Performance Measure:

Negligible reduction to the quality of water resources reaching the Woronora Reservoir.

The exceedance of the performance indicator in relation to dissolved manganese (for January to June 2023) has triggered assessments of whether the subsidence impact performance measure for catchment yield to the Woronora Reservoir has been exceeded in relation to water quality (i.e., whether the Project has resulted in a greater than negligible reduction in the quality of water resources reaching the Woronora Reservoir). These assessments have been / are being undertaken by an environmental water quality expert: Professor Barry Noller from The University of Queensland.

3.3 Flow Diversion and Natural Drainage Behaviour of Downstream Pools

3.3.1 Waratah Rivulet Downstream of Maingate of Longwall 23

Performance Indicators:

No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.

Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum.

Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar.

The results are assessed against the Longwalls 308-310 Water Management Plan significance levels/triggers (below):



Negligible Environmental Consequences on Waratah Rivulet: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	Significance Levels/Triggers	
<i>No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.</i>	Level 1	No mine-induced surface cracking or impacts to natural drainage behaviour observed
	Level 2	Mine-induced surface cracking observed. No impacts to natural drainage behaviour observed.
	Level 3	There appear to be impacts to natural drainage behaviour such that: - a pool does not continue to flow over, through and/or below the rock bars (where relevant); or - surface flow is not evident along the length of Pools P or T prior to flowing through/below the rock bars; - surface flow is not evident along the length of Pools Q, R or S prior to flowing over the rock bars; - surface flow is not evident along the length of Pool V prior to flowing over/through/below the rock bar; and - surface flow is not evident along the length of Pools U or W prior to flowing through the downstream boulder field.
<i>Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum.</i>	Level 1	The water level in Pools P, T, U, V or W has not been below the pool's previous minimum.
	Level 2	The water level in Pools P, T, U, V or W has been below the pool's previous minimum, however, is considered to be due to an error type.
	Level 3	The water level in Pools P, T, U, V or W has been below the pool's previous minimum and does not appear to be due to an error type; and the same is not occurring in control pool(s).
<i>Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar.</i>	Level 1	The water level in Pools Q, R or S has been above that required to maintain water over the downstream rock bar.
	Level 2	The water level in Pools Q, R or S has been below that required to maintain water over the downstream rock bar, however, appears to be due to an error type.
	Level 3	The water level in Pools Q, R or S has been below that required to maintain water over the downstream rock bar and does not appear to be due to an error type and the same is not occurring in control pool(s).

Metropolitan Coal's visual inspections of Pools P, Q, R, S, T, U, V and W downstream of the maingate of Longwall 23 indicate no mine-induced surface cracking and no observed changes to the natural drainage behaviour of the pools (Metropolitan Coal, pers. comm). The visual inspection results equate to a Level 1 significance level.

The recorded water levels in Pools P, T, U, V and W have remained at or above the pools' previously recorded minimum levels. The recorded water levels in Pools Q, R and S have remained above that required to maintain water over the downstream rock bar. The results equate to a Level 1 significance level for these pools.

3.3.2 Analysis against Subsidence Impact Performance Measure – Waratah Rivulet Downstream of Maingate of Longwall 23

Subsidence Impact Performance Measure:

Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).

Assessment against Performance Measure

The performance measure, *negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools)*, has been met.

3.3.3 Eastern Tributary Downstream of Maingate 26

Pools ETAG to ETAU on the Eastern Tributary are situated between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. Pools ETAG and ETAH are situated above Longwall 27, Pools ETAI, ETAJ and ETAK are situated above the maingate of Longwall 27 and Pools ETAL to ETAU are situated downstream of the maingate of Longwall 27.

As reported in the Metropolitan Coal 2017 Annual Review, the natural drainage behaviour of Pools ETAG, ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN, ETAO, ETAQ and ETAR have been impacted by mine subsidence (Metropolitan Coal, 2018). The observed impacts to the Eastern Tributary pools in December 2016/January 2017 resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour.

Performance indicators have been developed for the Longwalls 308-310 Water Management Plan for Pools ETAS, ETAT and ETAU and the results for the review period are assessed below.

Performance Indicators:

No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.

Analysis of water level data for Pool ETAS/ETAT and Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar.

The results are assessed against the Longwalls 308-310 Water Management Plan significance levels/triggers (below):

Negligible Environmental Consequences on Eastern Tributary: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	Significance Levels/Triggers	
<i>No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.</i>	Level 1	No mine-induced surface cracking at Pool ETAS or Pool ETAT; no increase in previous cracking at Pool ETAU. No impacts to natural drainage behaviour observed.
	Level 2	Mine-induced surface cracking observed at Pool ETAS or Pool ETAT, or increase observed in previous cracking at Pool ETAU. No impacts to natural drainage behaviour observed.
	Level 3	There appear to be impacts to natural drainage behaviour such that there is not continual surface flow along the length of Pools ETAS, ETAT or ETAU.
<i>Analysis of water level data for Pool ETAS/ETAT and Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar.</i>	Level 1	The water levels in Pool ETAS/ETAT and Pool ETAU have been above that required to maintain water over the downstream rock bar.
	Level 2	The water levels in Pool ETAS/ETAT and Pool ETAU has been below that required to maintain water over the downstream rock bar, however, appears to be due to an error type.
	Level 3	The water levels in Pool ETAS/ETAT and Pool ETAU has been below that required to maintain water over the downstream rock bar and does not appear to be due to an error type.

Metropolitan Coal's visual inspections of Pools ETAS, ETAT and ETAU (and associated rock bars) indicate no mine-induced surface cracking has been observed at Pools ETAS and ETAT during the review period and no increase in the occurrence of cracking has been observed at Pool ETAU. There have been no observed changes to the natural drainage behaviour of Pools ETAS, ETAT or ETAU during the review period (Metropolitan Coal, pers. comm.). The visual inspection results equate to a Level 1 significance level for Pools ETAS, ETAT and ETAU.

The recorded water level hydrograph for Pool ETAU indicates that the water level in Pool ETAU has been above that required to maintain water over the downstream rock bar. The water level results equate to a Level 1 significance level for Pool ETAU.

The recorded water level hydrograph for Pool ETAS/ETAT indicates that the water level in Pool ETAS/ETAT has been above that required to maintain water over the downstream rock bar. The water level results equate to a Level 1 significance level for Pool ETAS/ETAT.

3.3.4 Analysis against Subsidence Impact Performance Measure – Eastern Tributary Downstream of Maingate 26

Subsidence Impact Performance Measure:

Negligible environmental consequences over at least 70% of the stream length (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26.



Assessment against Performance Measure

The above performance measure for no diversion of flows or change in the natural drainage behaviour of pools has been exceeded during previous review periods and has been reported to the Department of Planning and Environment (DPE) and other relevant agencies. The natural drainage behaviour of Pool ETAS, Pool ETAT and Pool ETAU has not been impacted by mine subsidence.

3.4 Summary of Assessment Against Subsidence Impact Performance Indicators and Performance Measures

The subsidence impact performance indicators and performance measures in **TABLE 2** were developed to address the predictions of subsidence impacts and environmental consequences on surface water included in the Project Environmental Assessment, PPR and Metropolitan Coal Extraction Plans. Assessments against the subsidence impact performance indicators and performance measures have been conducted for the review period (1 January to 30 June 2023) in **TABLE 2**.



TABLE 2: SUMMARY OF SURFACE WATER ENVIRONMENTAL PERFORMANCE ASSESSMENT

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible reduction to the quantity of water resources reaching the Woronora Reservoir	<i>Changes in the quantity of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining, that are not also occurring in the control catchment(s).</i>	WaterNSW gauging station on Waratah Rivulet (GS 2132102)	Surface water flow.	Level 1	The median of the ratios does not fall below the 35 th percentile of the baseline data.	Surface water flow was at Level 1 throughout the review period.	No	No
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	<i>Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ 2.</i>	Site WRWQ 9 on the Waratah Rivulet.	Iron (Fe). Manganese (Mn). Aluminium (Al). [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.	Dissolved iron, dissolved aluminium and dissolved manganese were at Level 1 throughout the review period.	No	No
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	<i>Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ 2.</i>	Site ETWQ AU on the Eastern Tributary.	Iron (Fe). Manganese (Mn). Aluminium (Al). [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.	Dissolved iron and dissolved aluminium were at Level 1 throughout the review period.	No	No



TABLE 2 (CONT.) SUMMARY OF SURFACE WATER ENVIRONMENTAL PERFORMANCE ASSESSMENT

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	<i>Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ 2.</i>	Site ETWQ AU on the Eastern Tributary.	Iron (Fe). Manganese (Mn). Aluminium (Al). [Field filtered]	Level 3	Data analysis indicates: - any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or - over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or - the six month mean exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e., over two six monthly reports); and - there was not a similar exceedance of the trigger at the control site.	Dissolved manganese was at Level 3 throughout the review period.	Yes	Assessment to be conducted by Associate Professor Barry Noller.



TABLE 2 (CONT.) SUMMARY OF SURFACE WATER ENVIRONMENTAL PERFORMANCE ASSESSMENT

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible environmental consequences over at least 70% of the stream length (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	<i>No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.</i>	Pools ETAS, ETAT and ETAU on the Eastern Tributary.	Stream cracking and drainage behaviour.	Level 1	No mine-induced surface cracking at Pool ETAS or Pool ETAT; no increase in previous cracking at Pool ETAU. No impacts to natural drainage behaviour observed.	Pools ETAS, ETAT and ETAU were at Level 1 throughout the review period.	No	Refer Note 1
	<i>Analysis of water level data for Pool ETAS/ETAT and Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar.</i>	Pools ETAS, ETAT and ETAU on the Eastern Tributary.	Pool water level.	Level 1	The water levels in Pool ETAS/ETAT and Pool ETAU have been above that required to maintain water over the downstream rock bar.	Pool ETAS/ETAT and Pool ETAU were at Level 1 throughout the review period.	No	Refer Note 1

¹ The no diversion of flows, no change in natural drainage behaviour component of this performance measure was exceeded during the mining of Longwalls 23-27, triggering contingency measures for the impacted pools. This TARP includes monitoring of pools not impacted during the mining of Longwalls 23-27. The minimal iron staining component of this performance measure was exceeded during the mining of Longwalls 23-27, triggering contingency measures for the impacted pools. The nature and extent of iron staining on the Eastern Tributary will continue to be monitored during the mining of Longwalls 308-310.



TABLE 2 (CONT.) SUMMARY OF SURFACE WATER ENVIRONMENTAL PERFORMANCE ASSESSMENT

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).	<i>No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.</i>	Pools P to W on Waratah Rivulet.	Streambed cracking and drainage behaviour.	Level 1	No mine-induced surface cracking or impacts to natural drainage behaviour observed.	Pools P to W were at Level 1 throughout the review period.	No	No
	<i>Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum.</i>	Pools P, T, U, V and W on Waratah Rivulet.	Pool water level.	Level 1	The water level in Pools P, T, U, V or W has not been below the pool's previous minimum.	Pools P to W were at Level 1 throughout the review period.	No	No
	<i>Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar.</i>	Pools Q, R and S on the Waratah Rivulet.	Pool water level.	Level 1	The water level in Pools Q, R and S has been above that required to maintain water over the downstream rock bar.	Pools Q, R and S were at Level 1 throughout the review period.	No	No

REFERENCES

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- [12] Metropolitan Coal (2010). “Metropolitan Mine Longwalls 20-22 Extraction Plan”.
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- [21] Metropolitan Coal (2022b). “Metropolitan Coal Longwalls 308-310 Extraction Plan”.

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APPENDICES



APPENDIX A – MONITORED POOL WATER LEVEL HYDROGRAPHS



POOLS ON WARATAH RIVULET

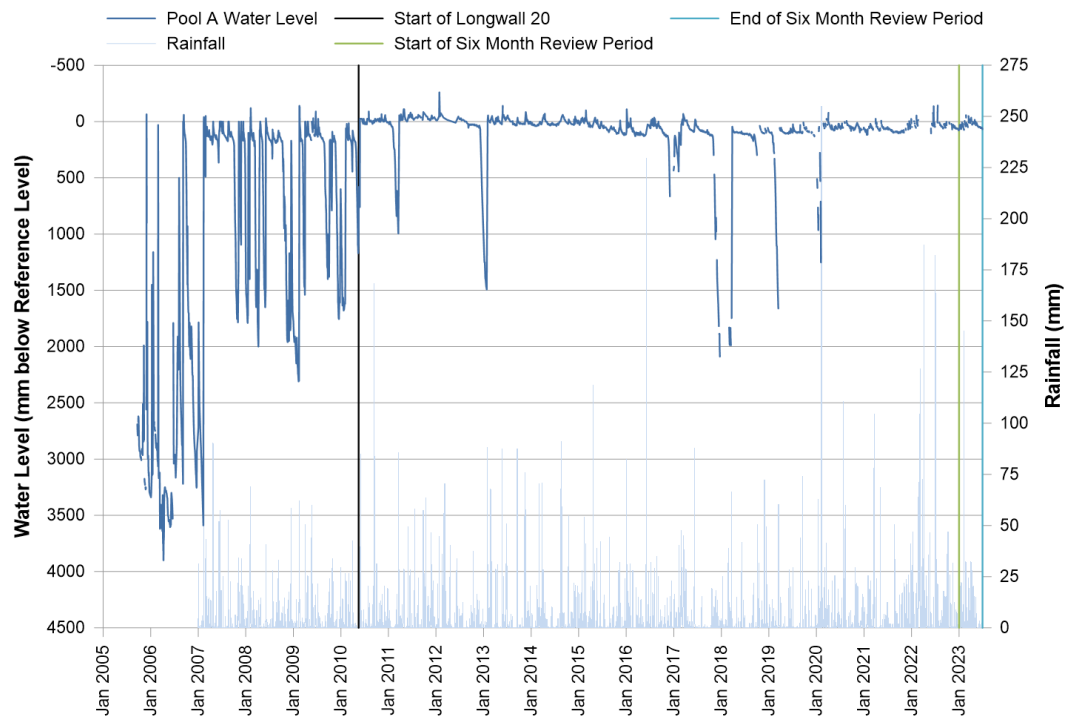


CHART A33: POOL A WARATAH RIVULET (MANUAL OBSERVATIONS)

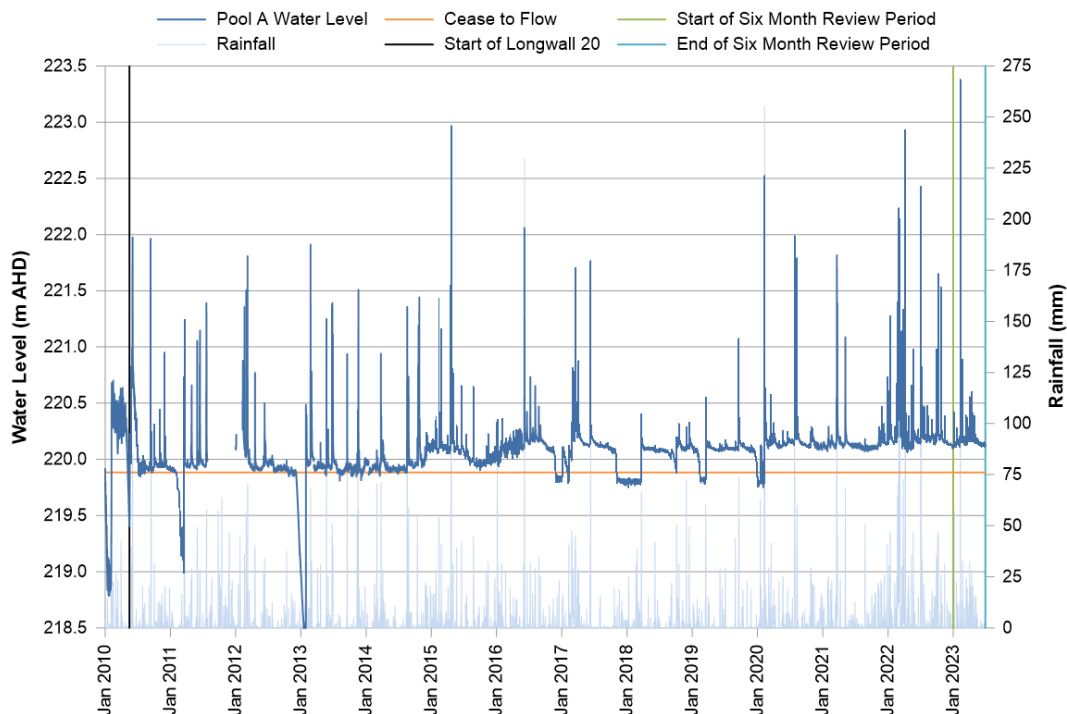


CHART A34: POOL A WARATAH RIVULET

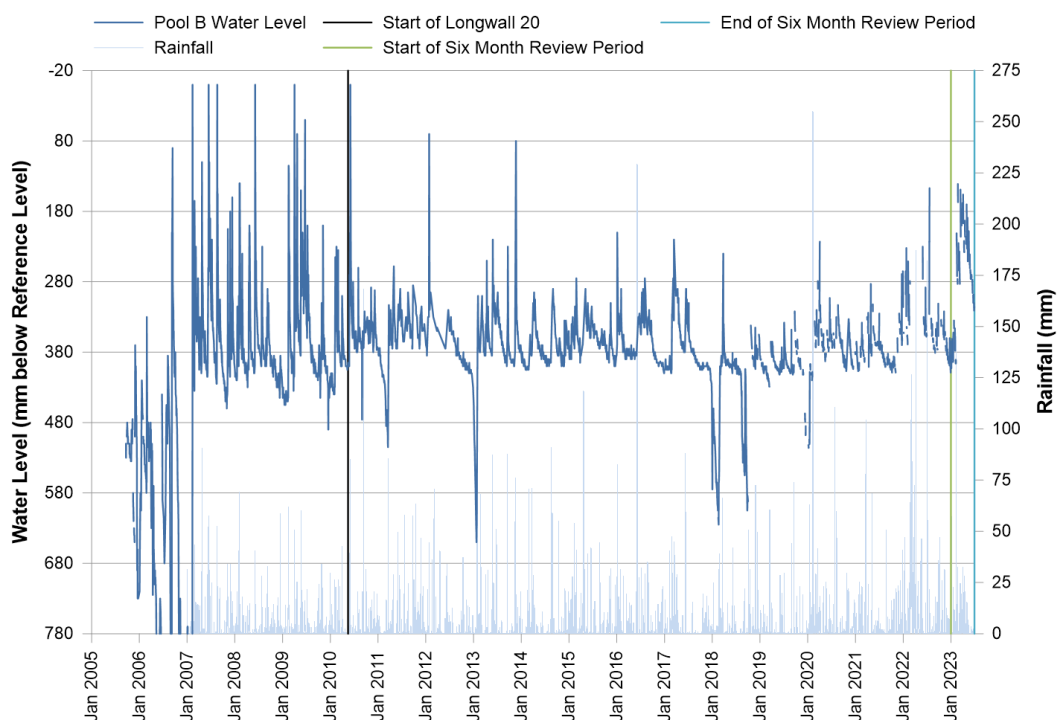


CHART A35: POOL B WARATAH RIVULET (MANUAL OBSERVATIONS)

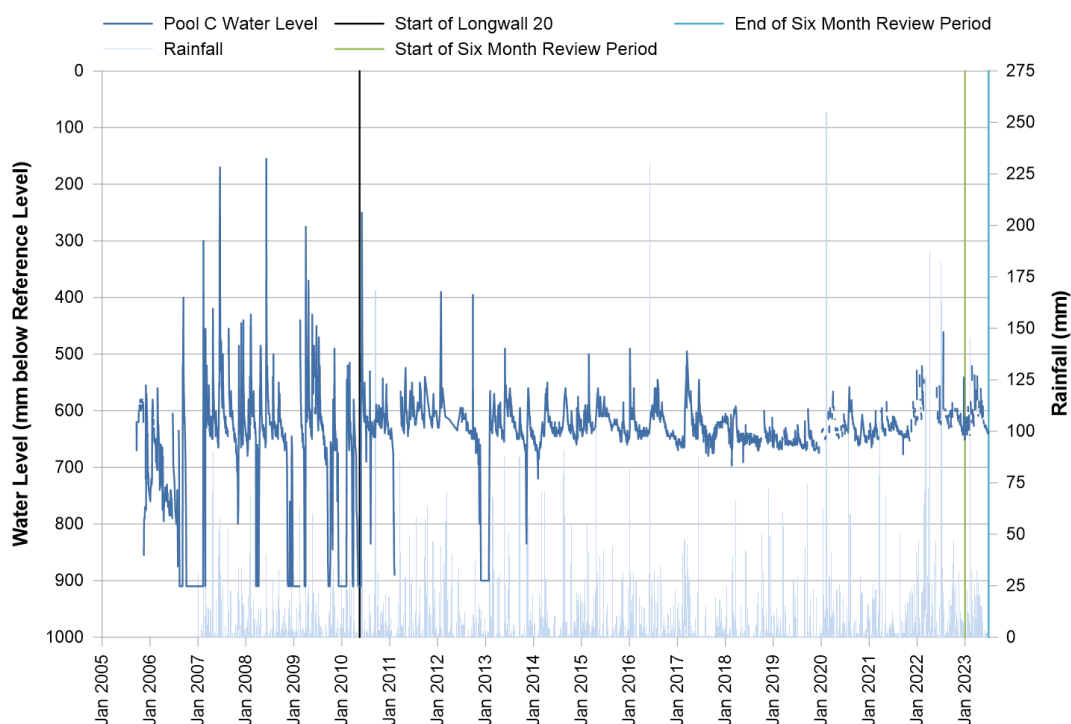


CHART A36: POOL C WARATAH RIVULET (MANUAL OBSERVATIONS)

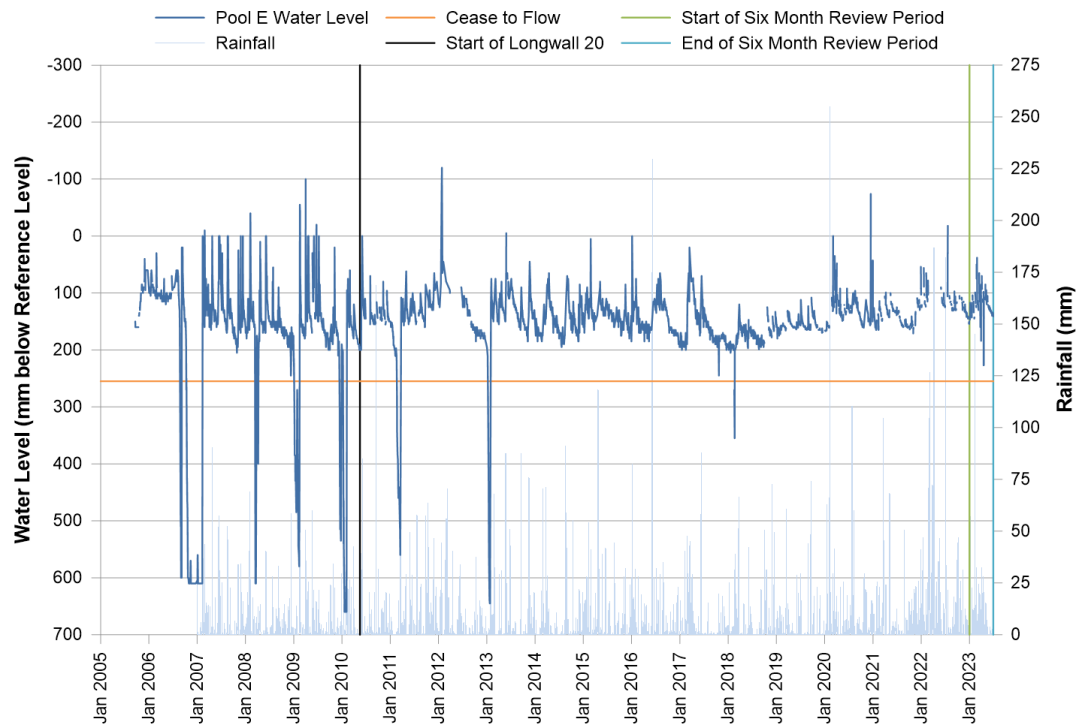


CHART A37: POOL E WARATAH RIVULET (MANUAL OBSERVATIONS)

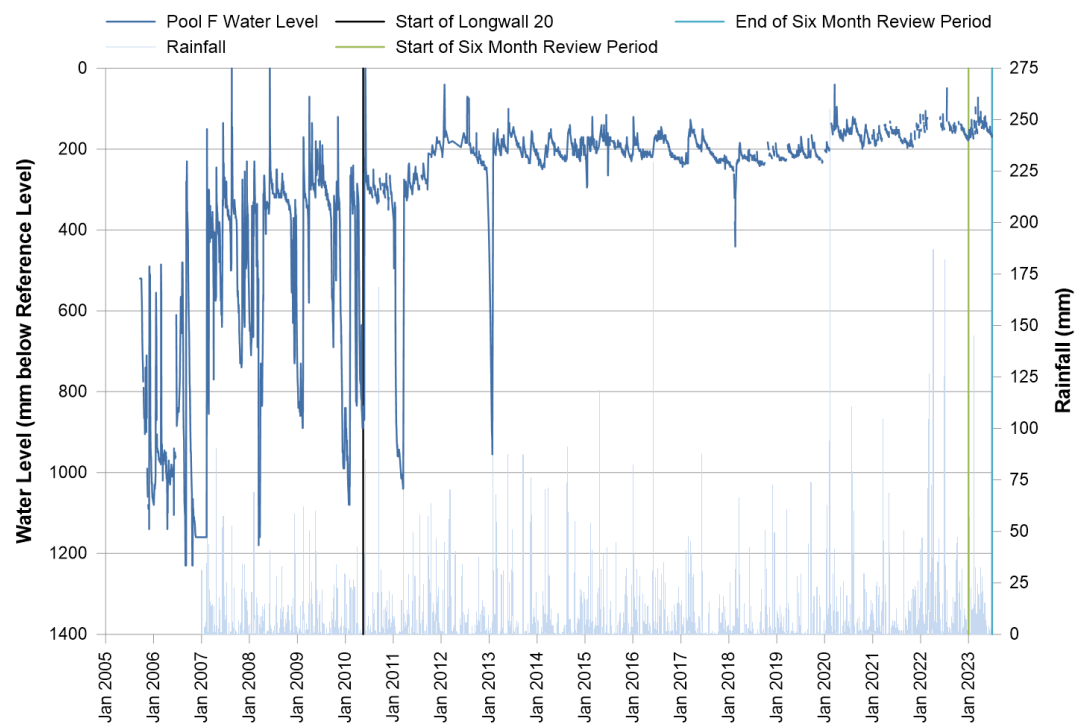


CHART A38: POOL F WARATAH RIVULET (MANUAL OBSERVATIONS)

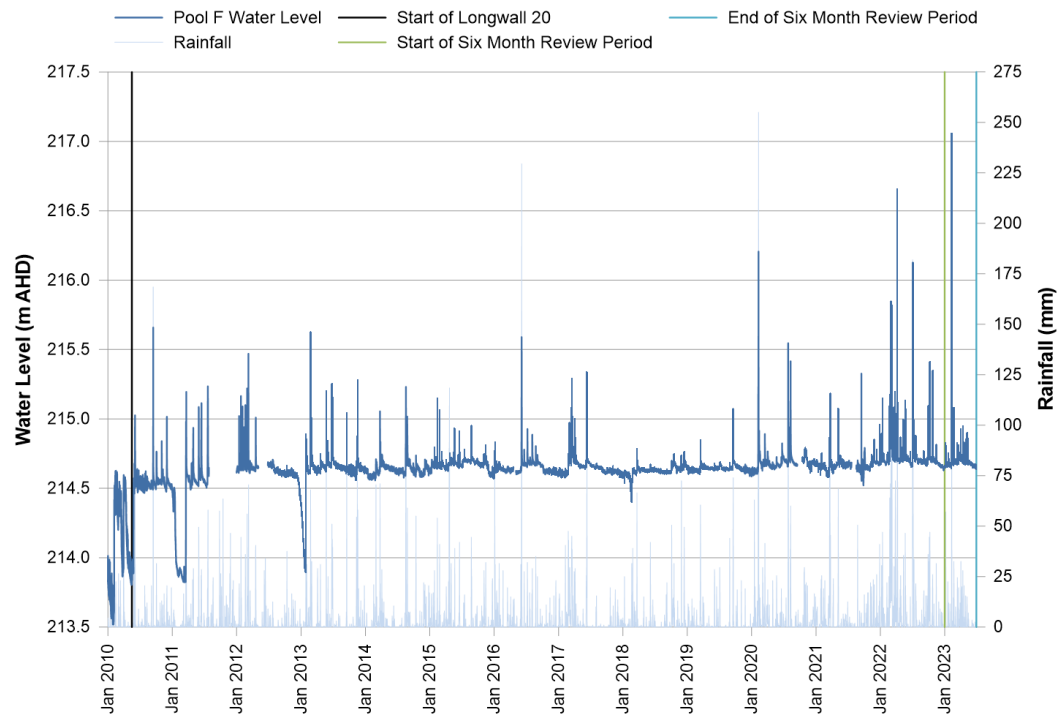


CHART A39: POOL F WARATAH RIVULET⁶

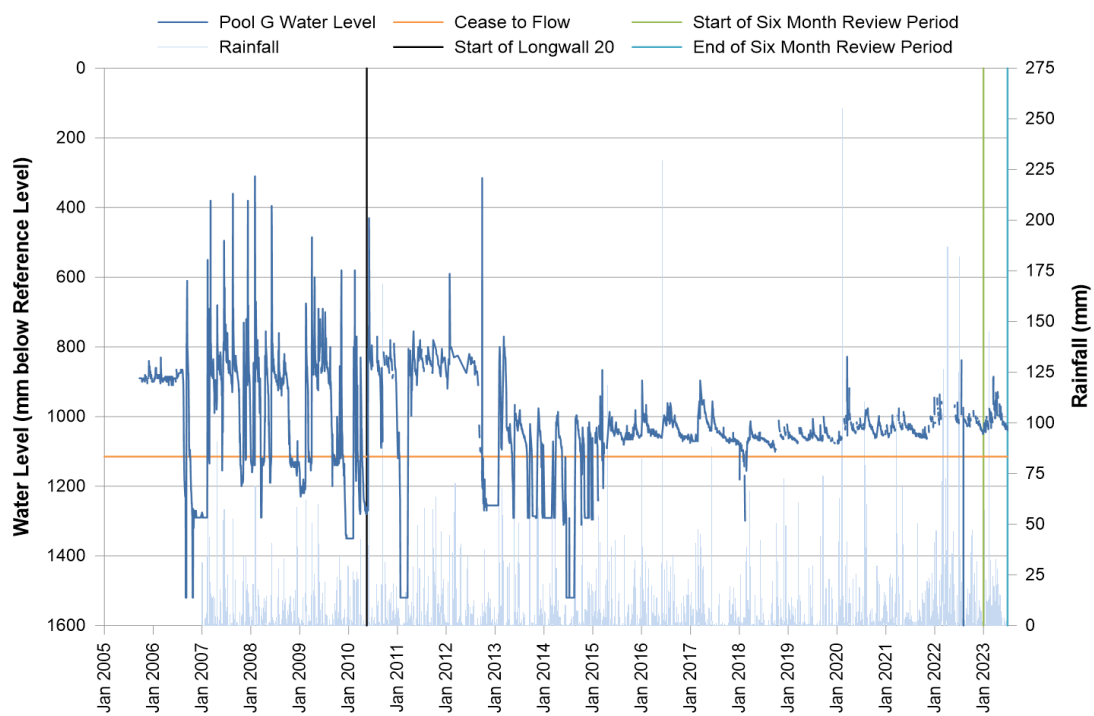


CHART A40: POOL G WARATAH RIVULET (MANUAL OBSERVATIONS)

⁶ The CTF level has been removed from this plot as the visual observation records indicate that the previously presented CTF level was incorrect.

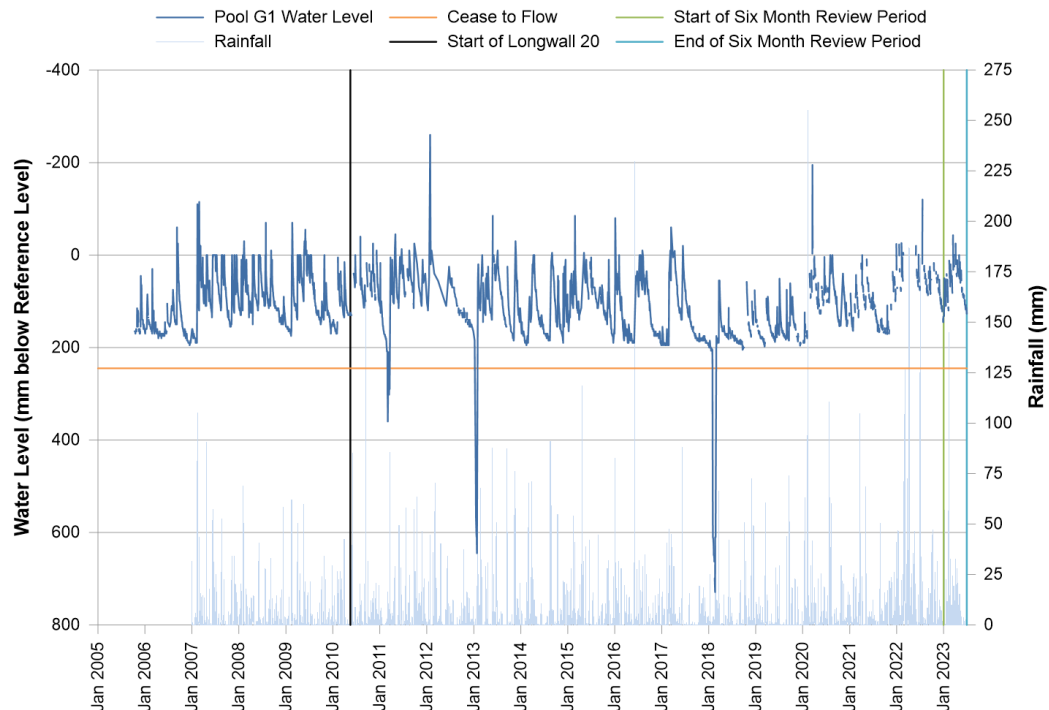


CHART A41: POOL G1 WARATAH RIVULET (MANUAL OBSERVATIONS)

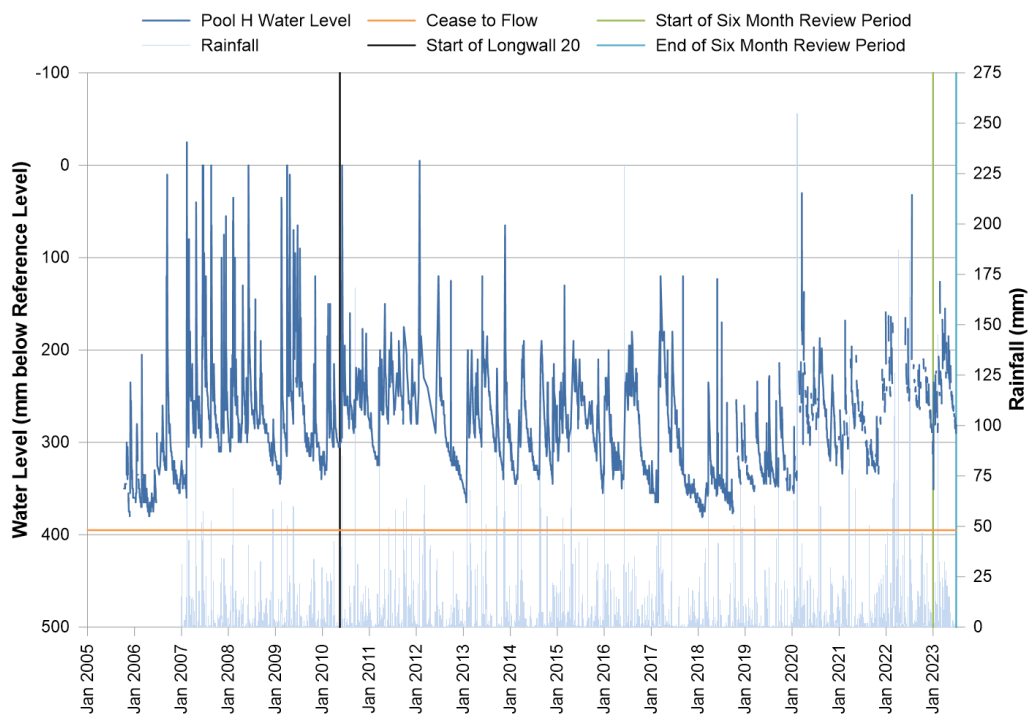


CHART A42: POOL H WARATAH RIVULET (MANUAL OBSERVATIONS)

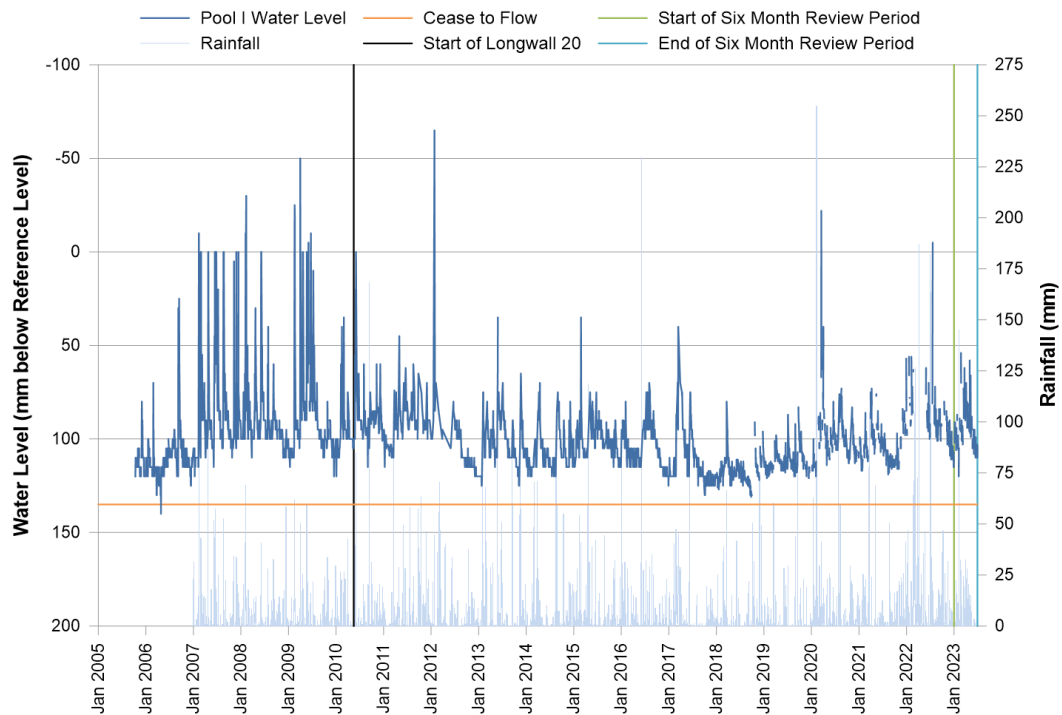


CHART A43: POOL I WARATAH RIVULET (MANUAL OBSERVATIONS)

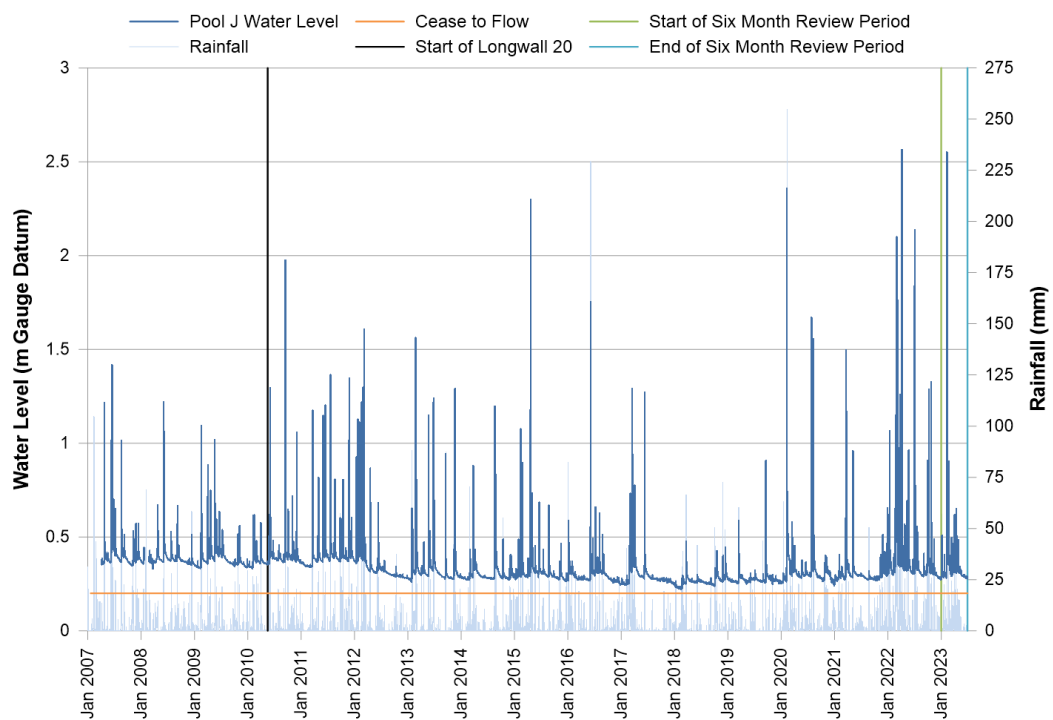


CHART A44: POOL J WARATAH RIVULET

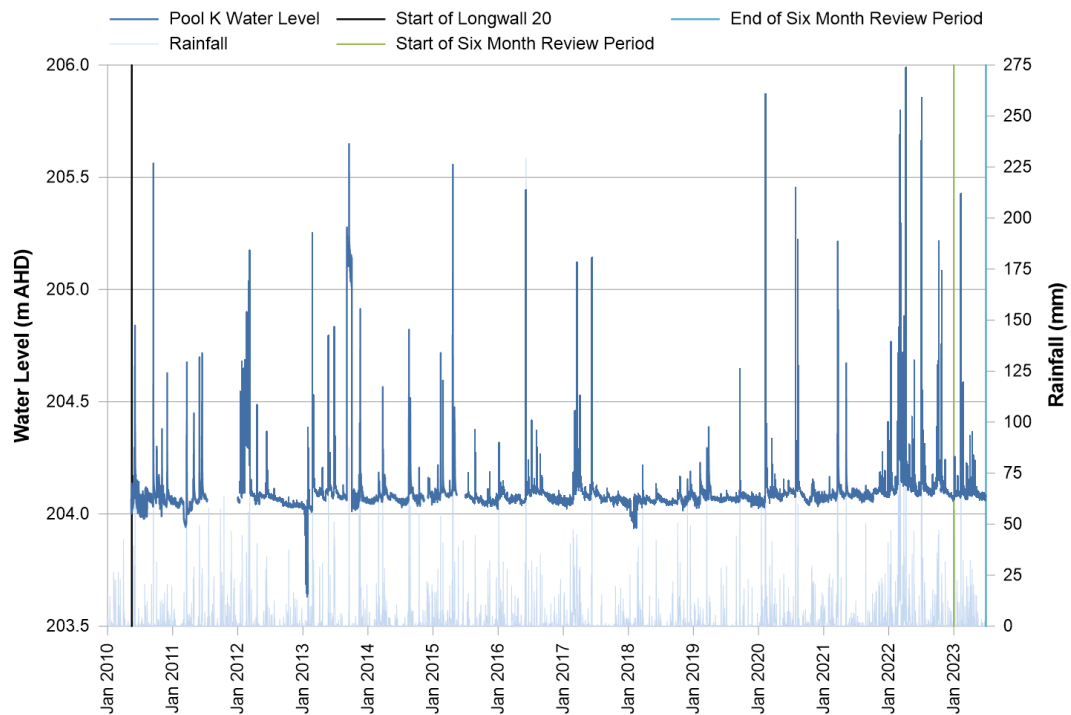


CHART A45: POOL K WARATAH RIVULET

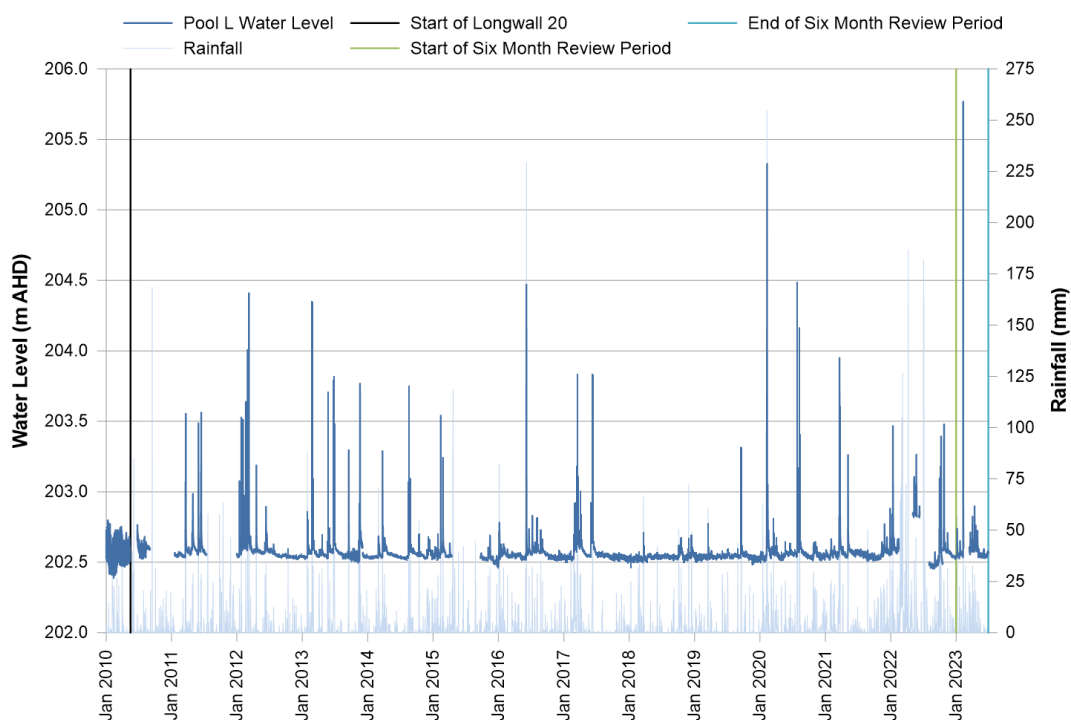


CHART A46: POOL L WARATAH RIVULET⁷

⁷ The cease to flow level has been removed from this plot as the visual observation records indicate that the previously present cease to flow level was incorrect.

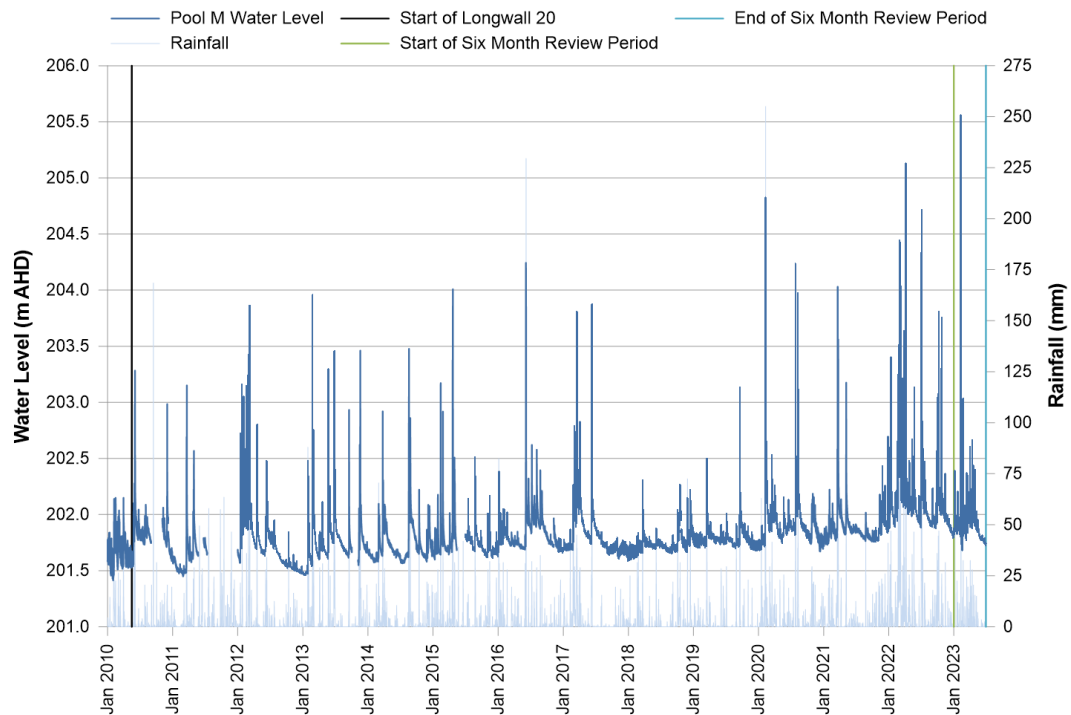


CHART A47: POOL M WARATAH RIVULET

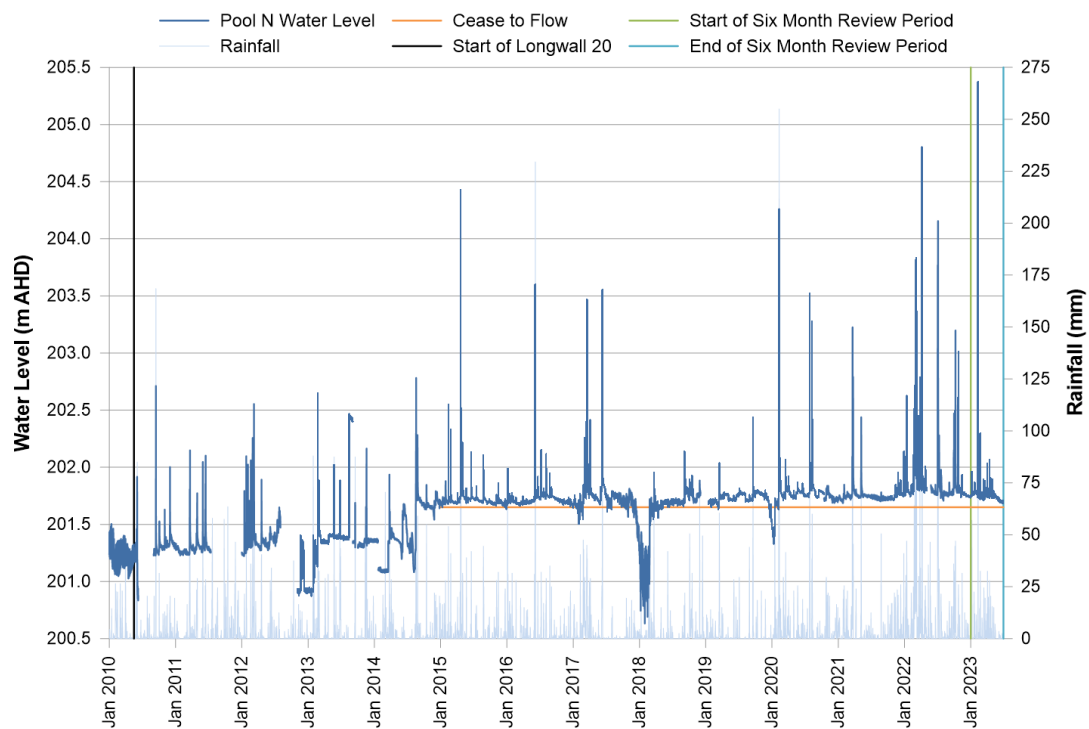


CHART A48: POOL N WARATAH RIVULET

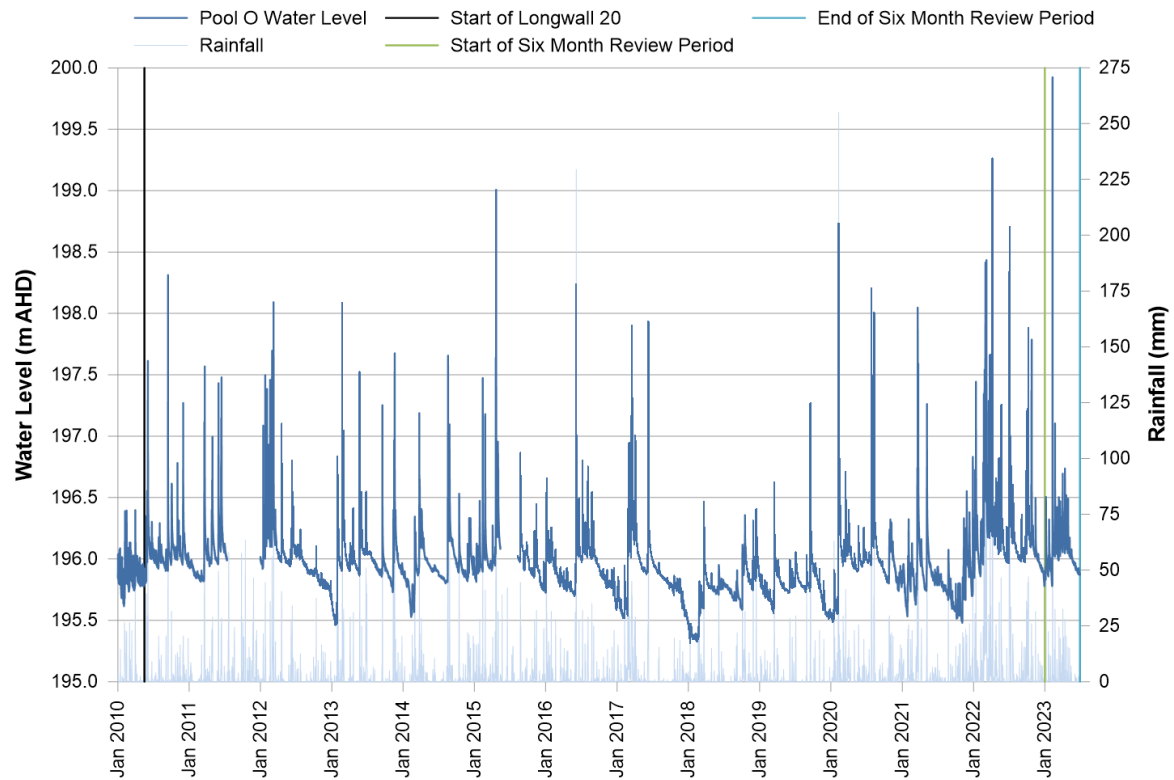


CHART A49: POOL O WARATAH RIVULET

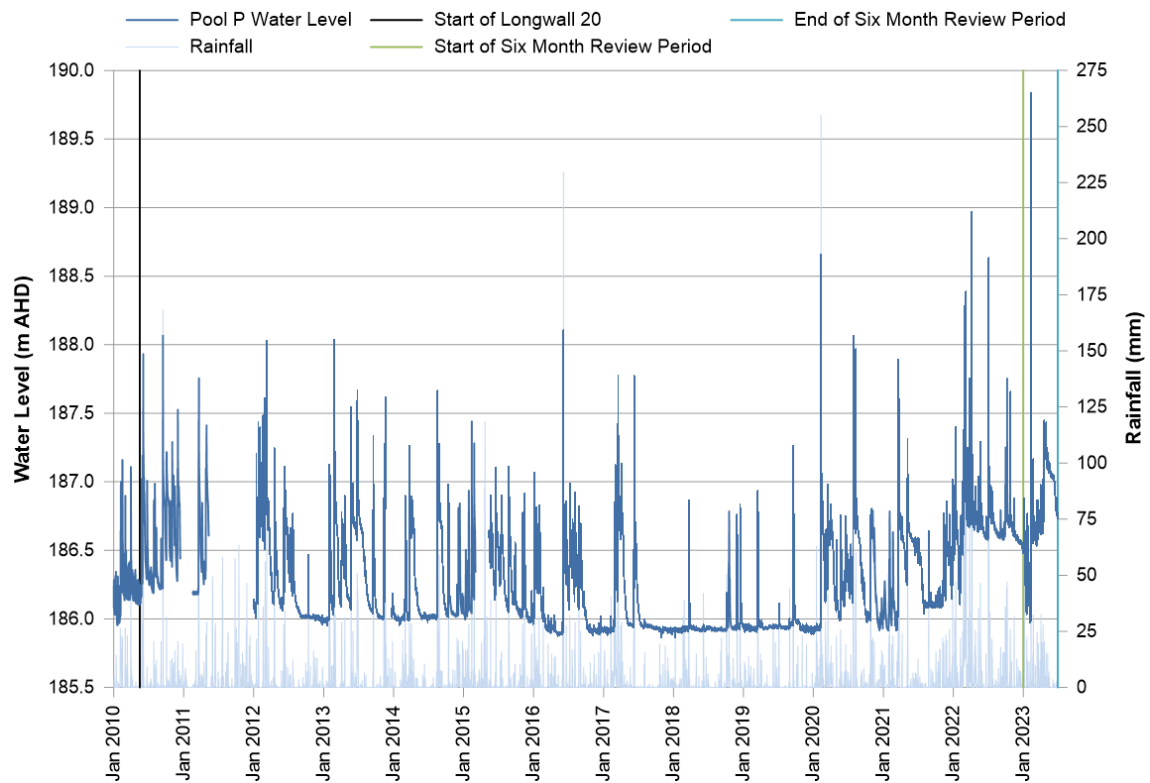


CHART A50: POOL P WARATAH RIVULET

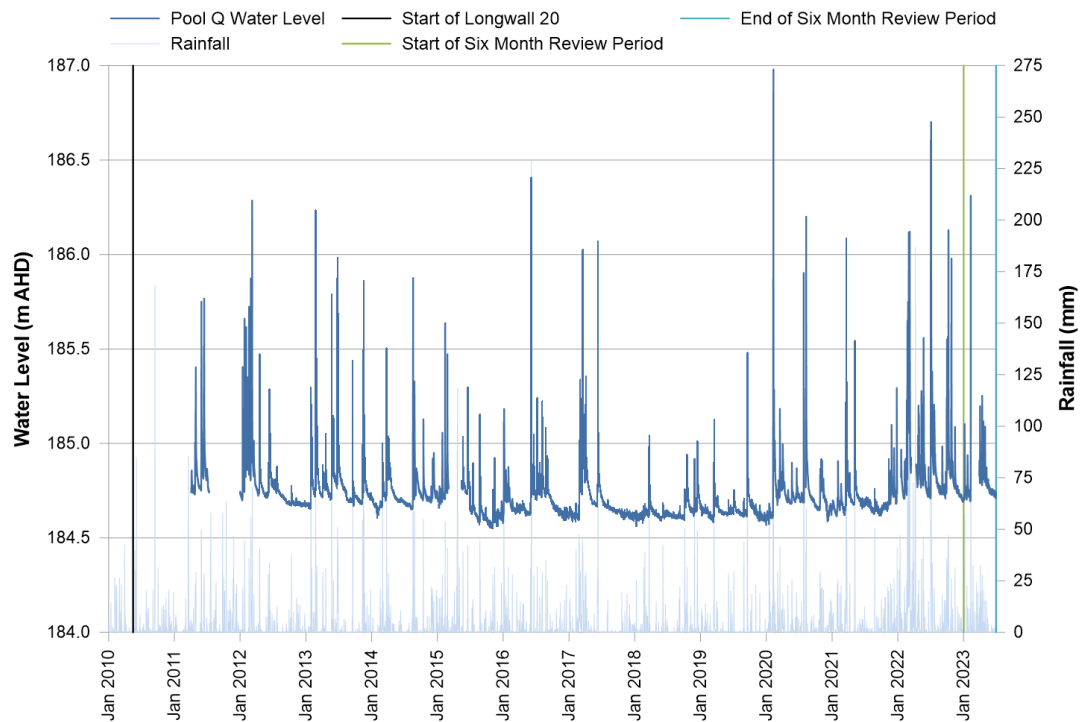


CHART A51: POOL Q WARATAH RIVULET⁸

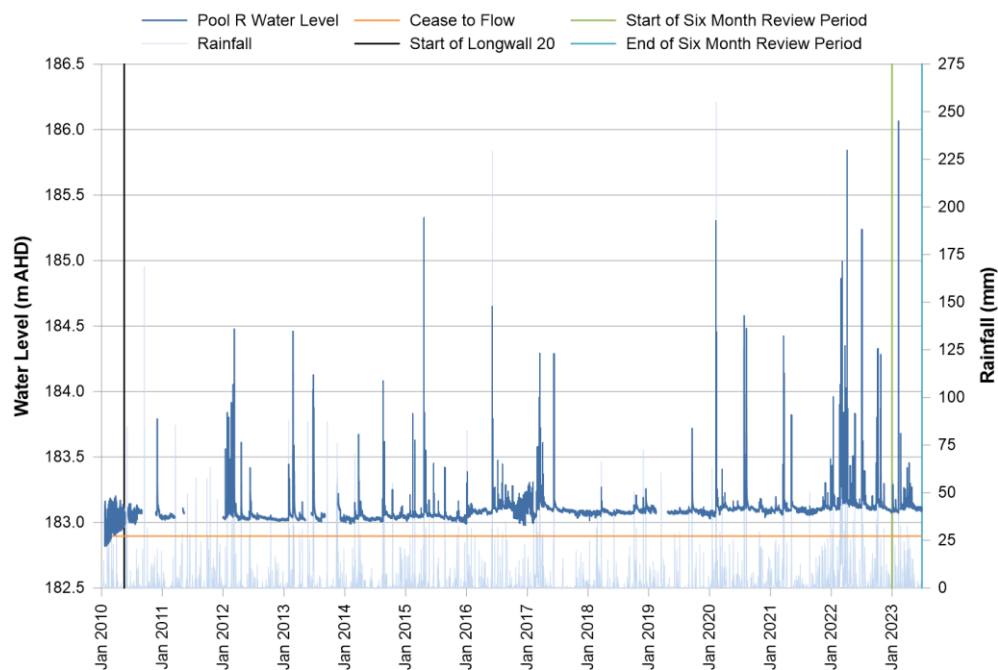


CHART A52: POOL R WARATAH RIVULET⁹

⁸ No data is available from 28 December 2021 to 18 January 2022 due to a damaged water level sensor. No data is available from 15 March to 12 April 2022 due to loss of the water level sensor in a high flow event. No data is available from 9 February to 28 March 2023 due to a displaced water level sensor in a high flow event.

⁹ The water level sensor malfunctioned between 1 and 4 June 2020 with no data recorded during this period. Water level data from 9 to 20 February 2023 were removed from the record due to damage to the water level sensor stand in a high flow event.

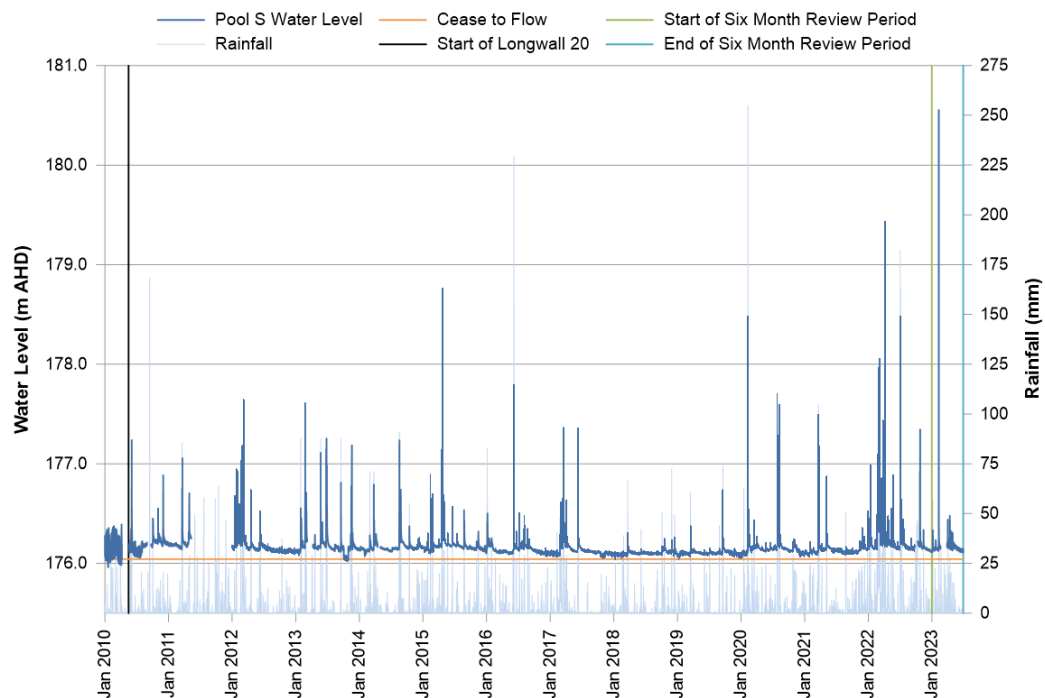


CHART A53: POOL S WARATAH RIVULET¹⁰

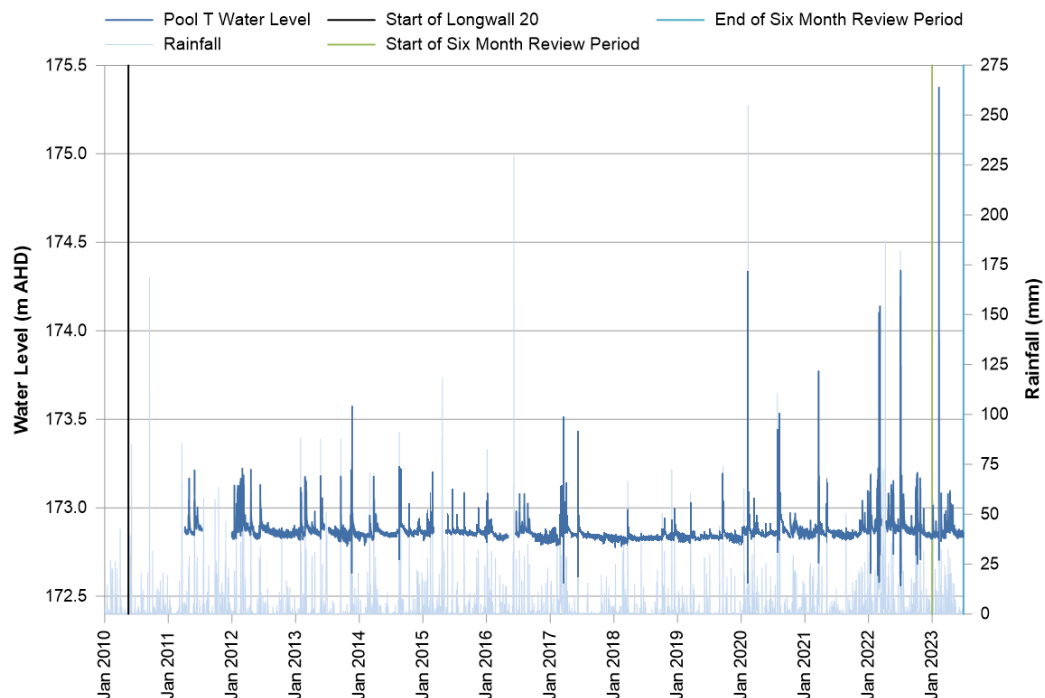


CHART A54: POOL T WARATAH RIVULET¹¹

¹⁰ No data is available from 20 February to 28 March 2023 due to a displaced water level sensor in a high flow event.

¹¹ During periods of high rainfall, the logger stand creates an eddy which reduces pressure and causes low level pressure readings to be recorded during periods of high rainfall. No data is available from 15 March to 12 April 2022 due to loss of the water level sensor in a high flow event. The water level sensor stand was damaged during a high flow event and reliable data was not recorded from 9 to 20 February 2023.

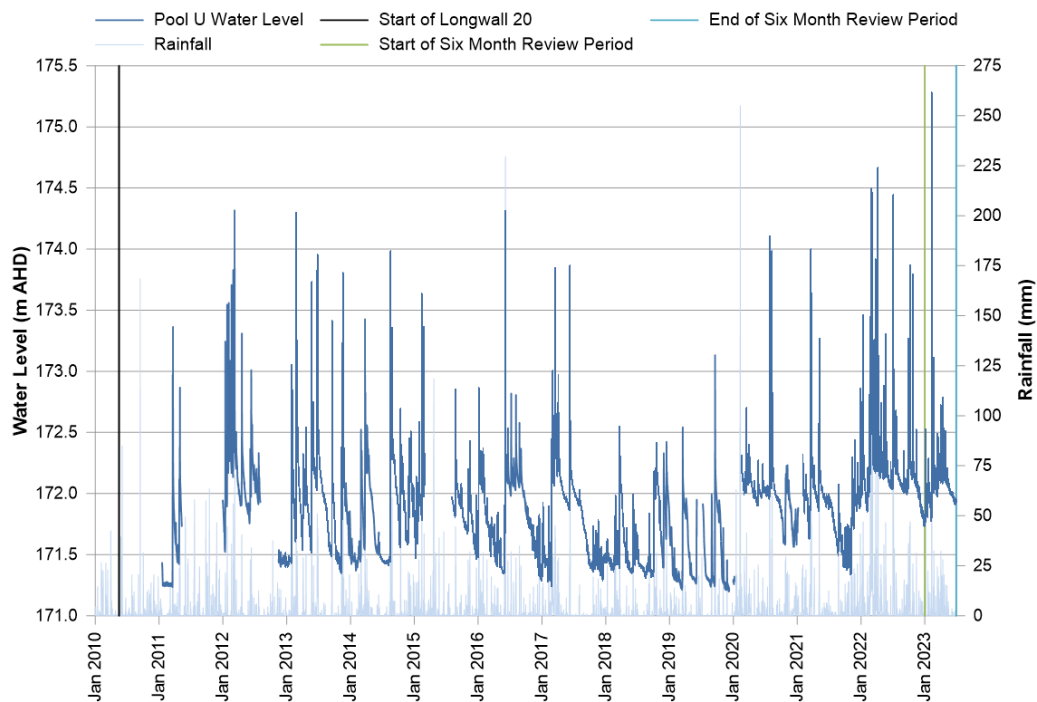


CHART A55: POOL U WARATAH RIVULET¹²

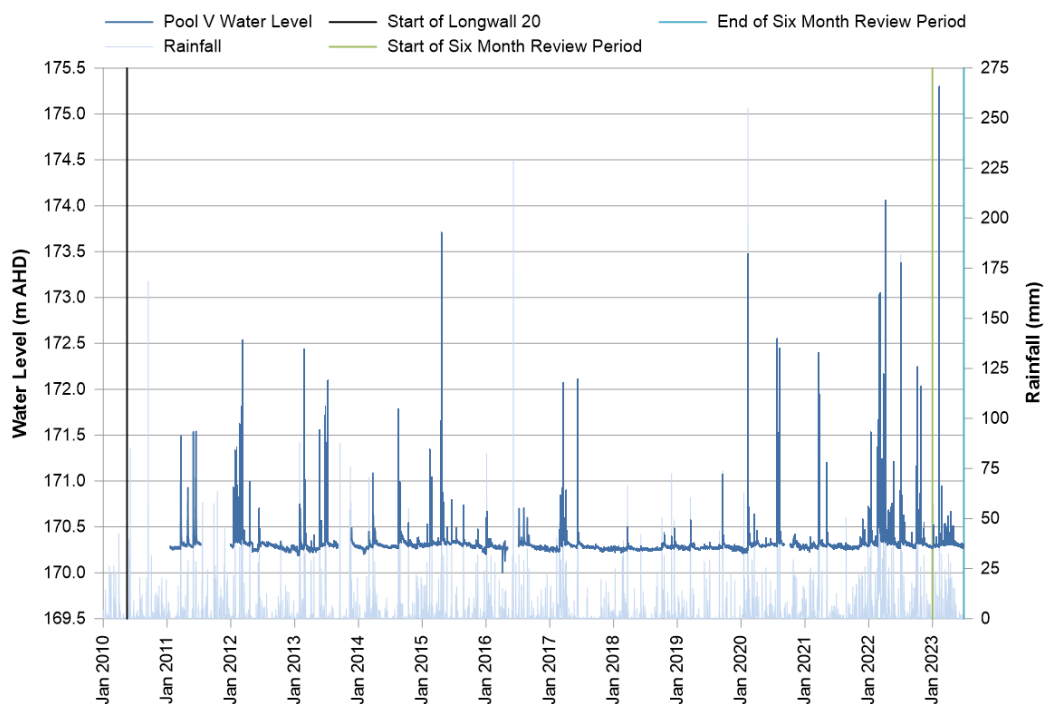


CHART A56: POOL V WARATAH RIVULET¹³

¹² The water level sensor was not recording data from 7 January 2020 until 18 February 2020. The water level sensor malfunctioned between 6 January 2021 and 2 February 2021 resulting in erroneous data and the erroneous data was removed for this period.

¹³ The water level sensor malfunctioned and was recording erroneous data from 3 September 2020 until 8 October 2020, this water level data has been omitted from Chart A24.

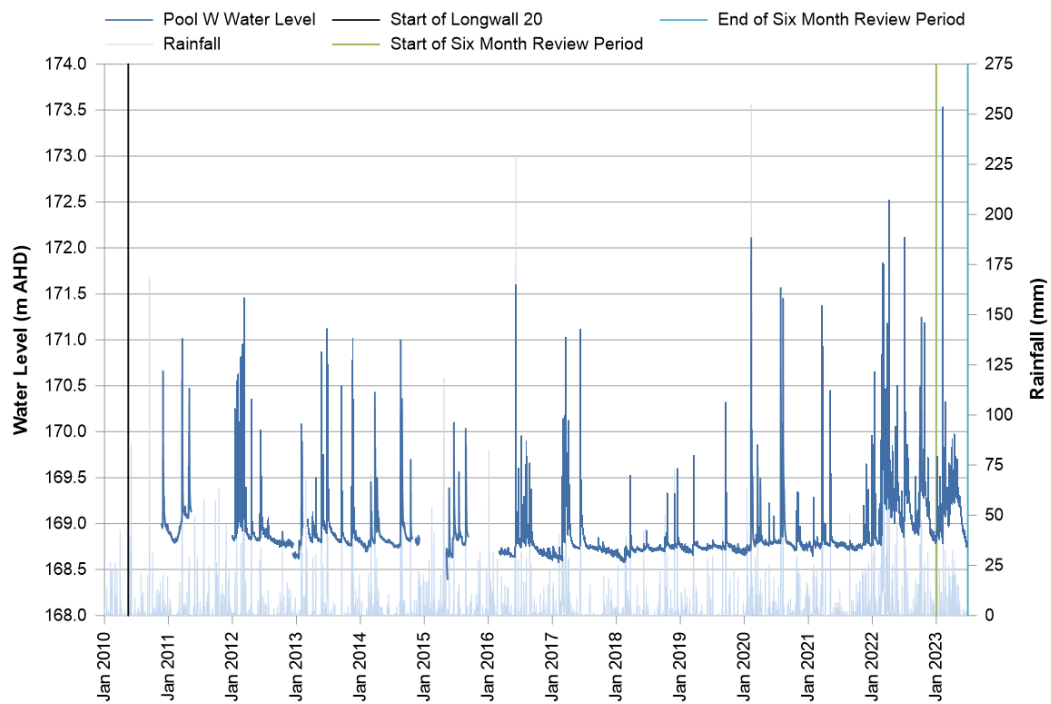


CHART A57: POOL W WARATAH RIVULET



POOLS ON EASTERN TRIBUTARY

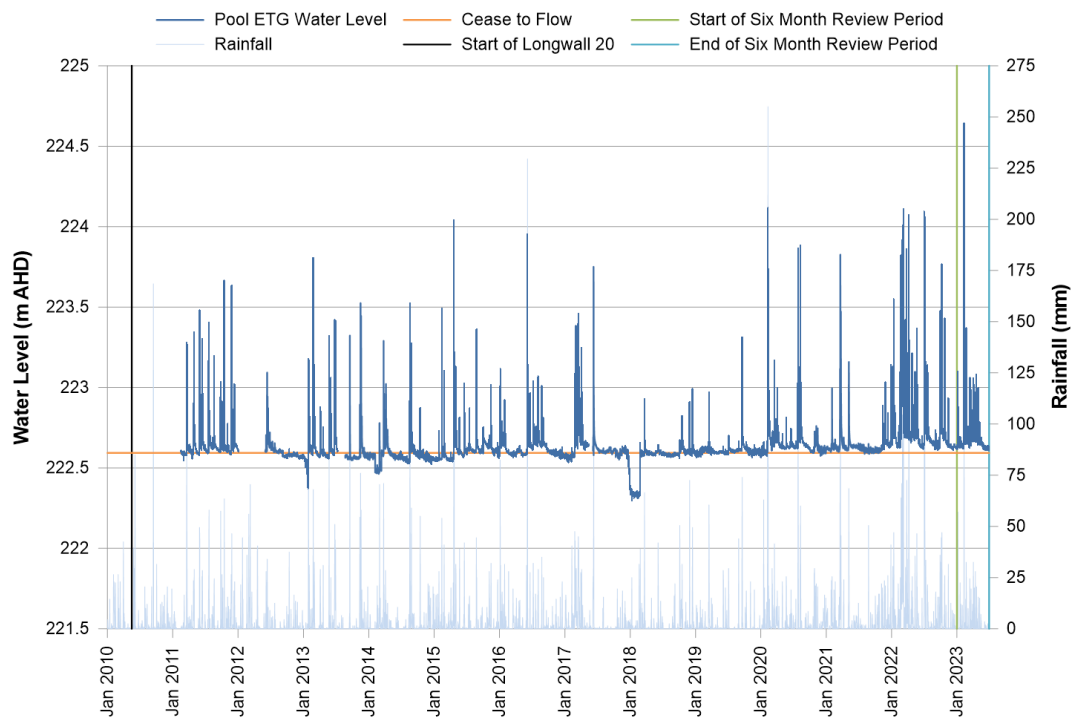


CHART A58: POOL ETG

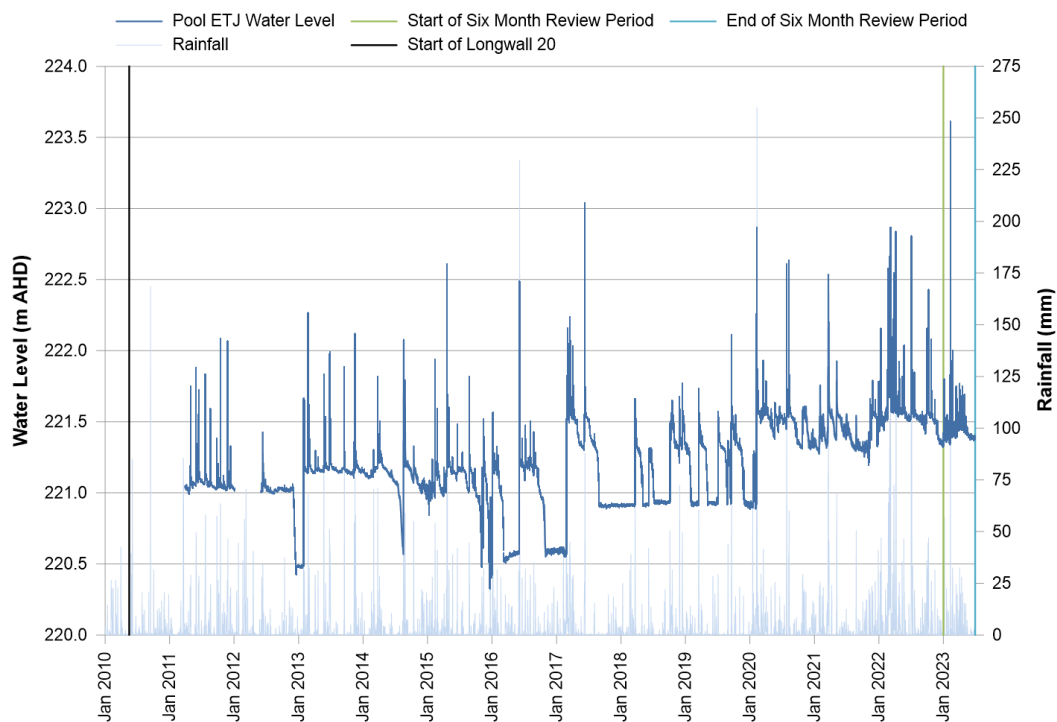


CHART A59: POOL ETJ

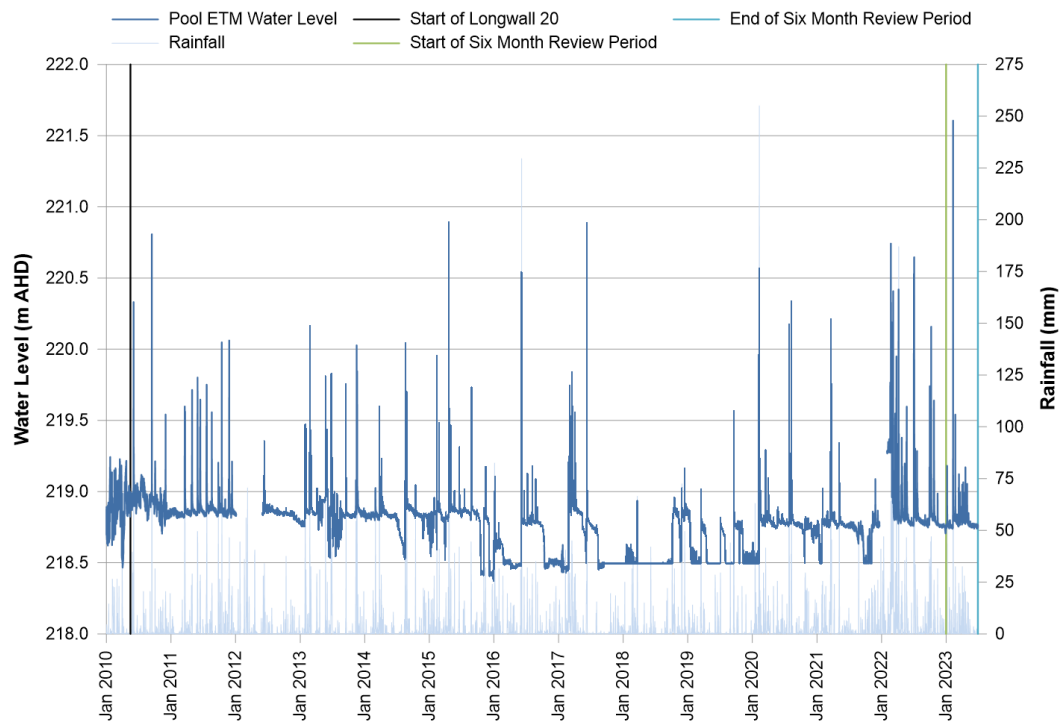


CHART A60: POOL ETM¹⁴

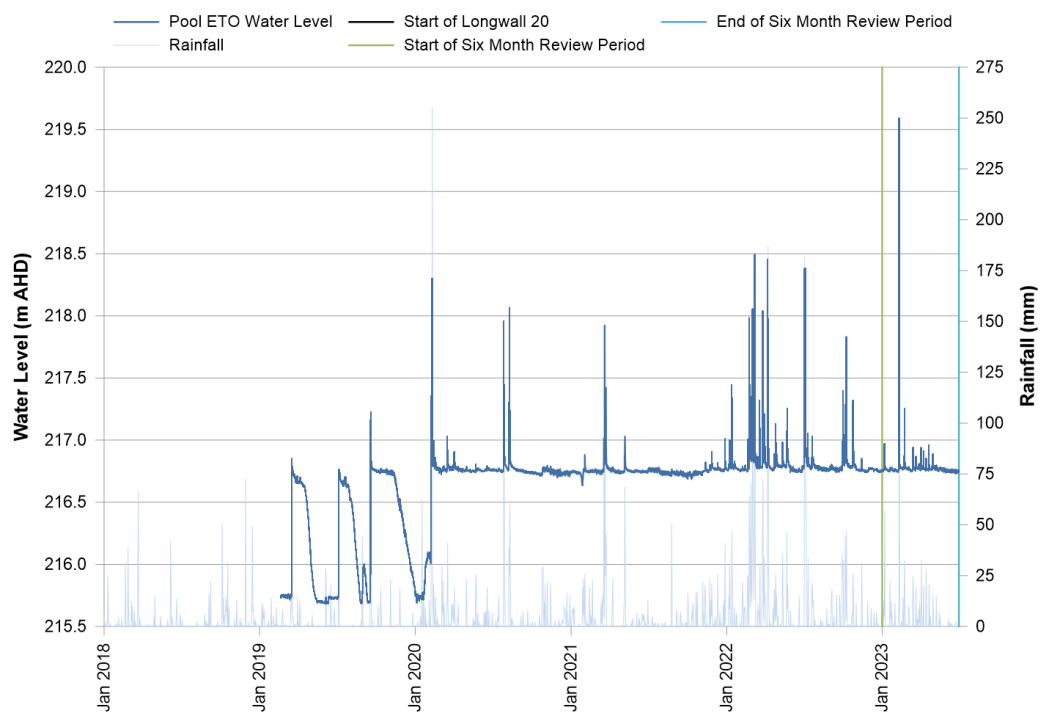


CHART A61: POOL ETO

¹⁴ No data available from 20 December 2021 to 31 January 2022.

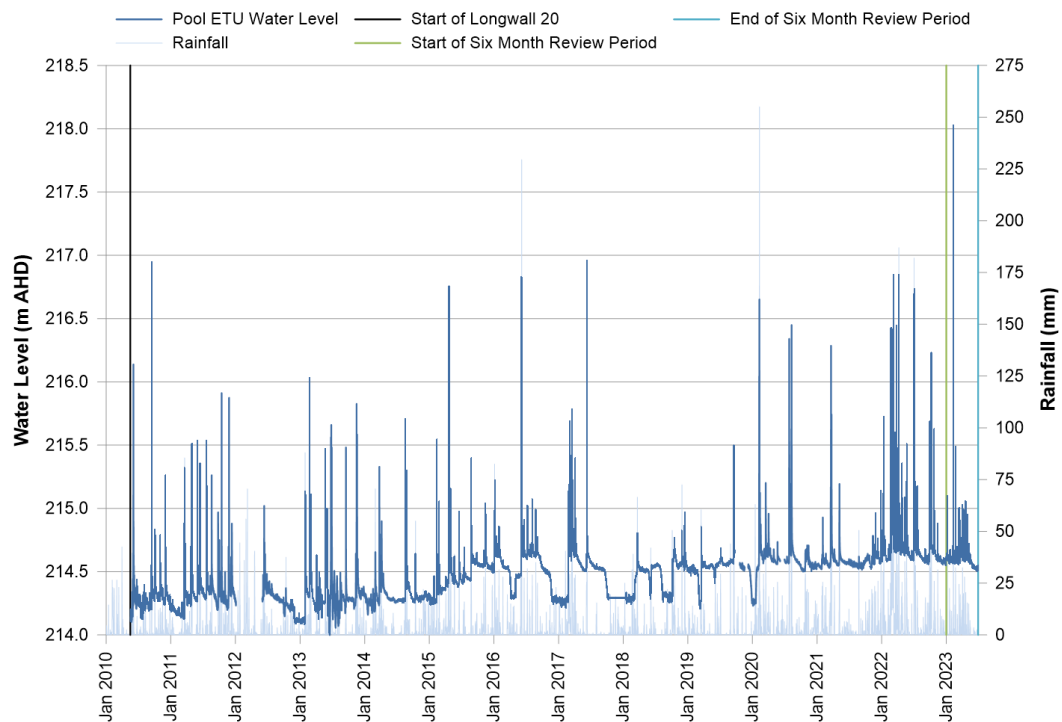


CHART A62: POOL ETU¹⁵

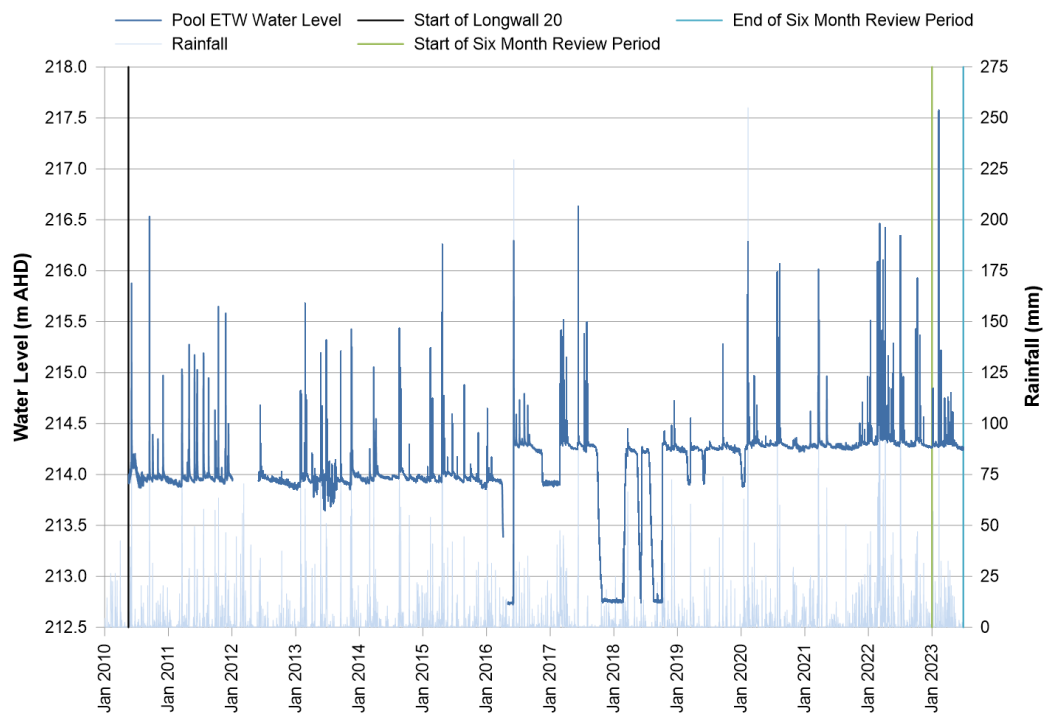


CHART A63: POOL ETW

¹⁵ Due to a failure during data download, data was lost from 5 June 2020 to 30 June 2020.

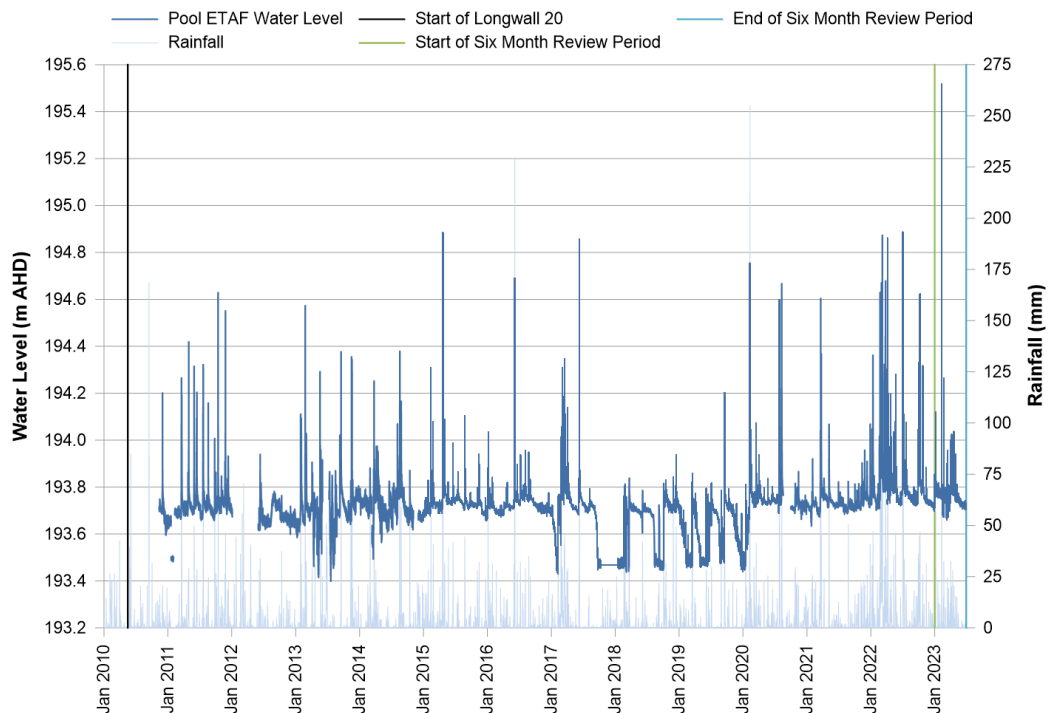


CHART A64: POOL ETAF¹⁶

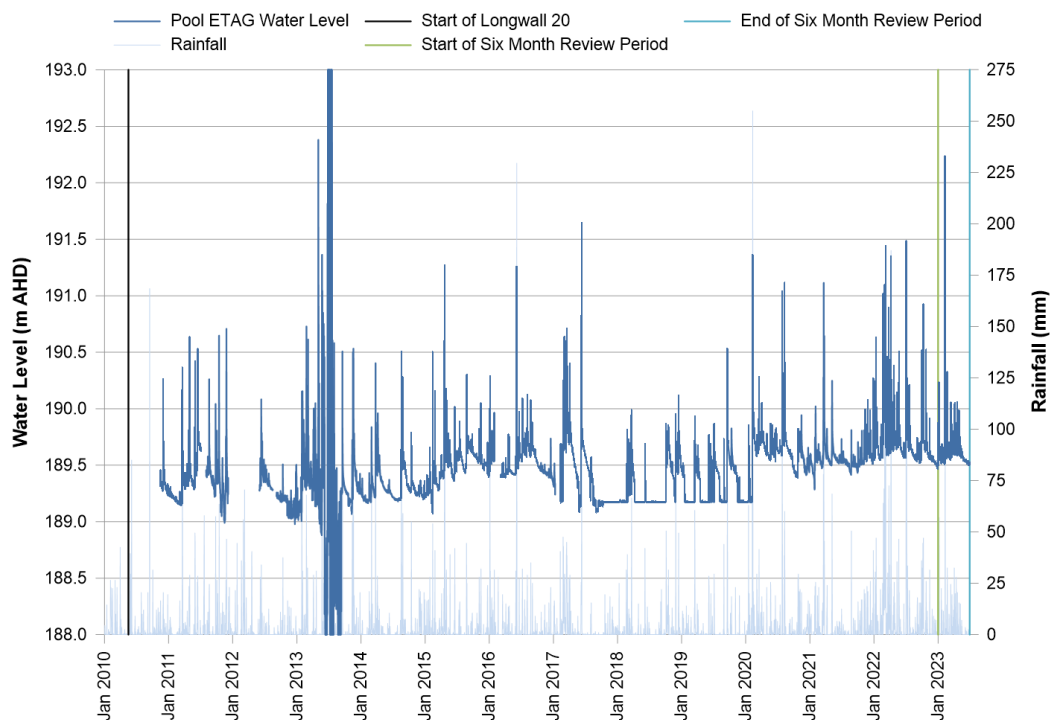


CHART A65: POOL ETAG

¹⁶ The water level sensor failed late August 2020 and was replaced in late September 2020.

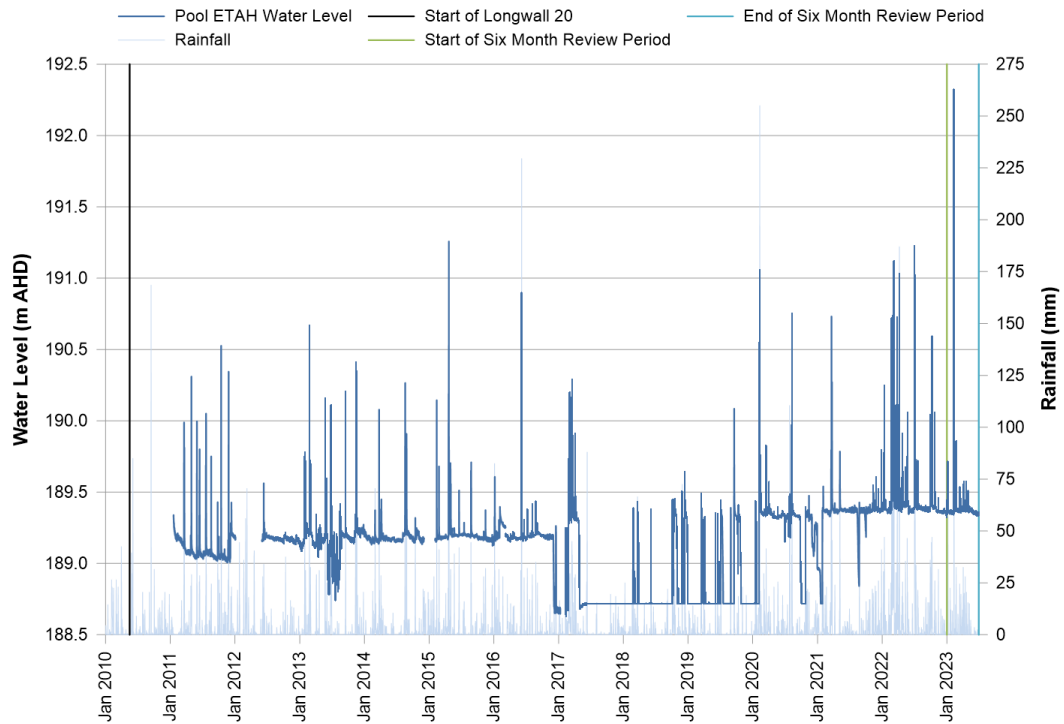


CHART A66: POOL ETAH

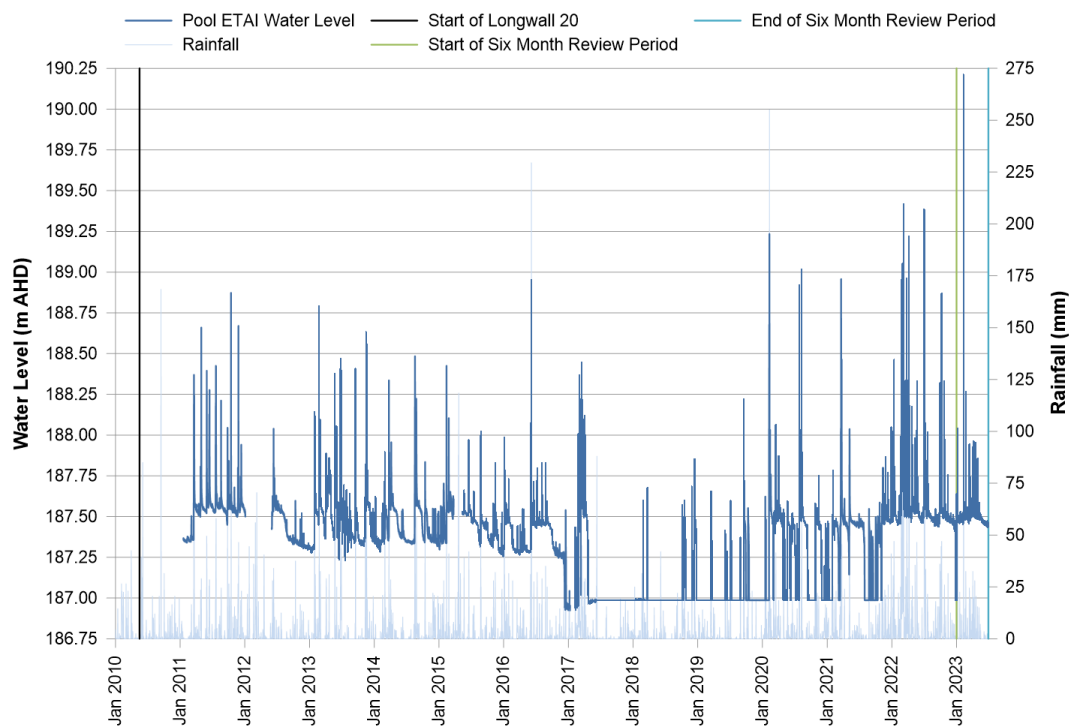


CHART A67: POOL ETAI

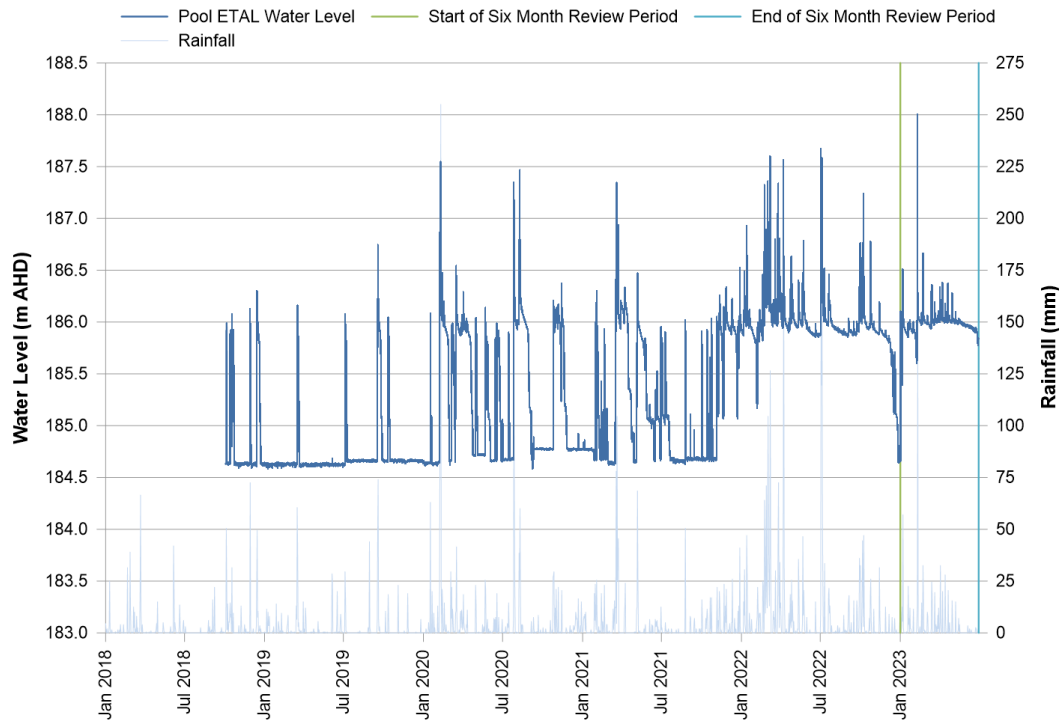


CHART A68: POOL ETAL

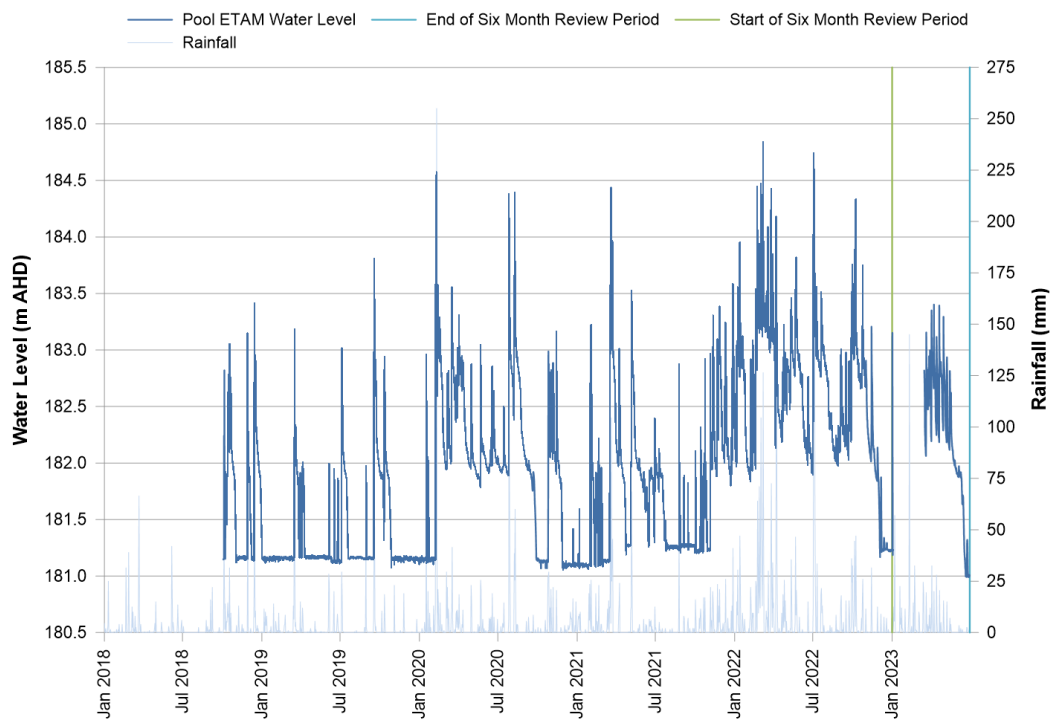


CHART A69: POOL ETAM¹⁷

¹⁷ No data is available for Pool ETAM from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event.

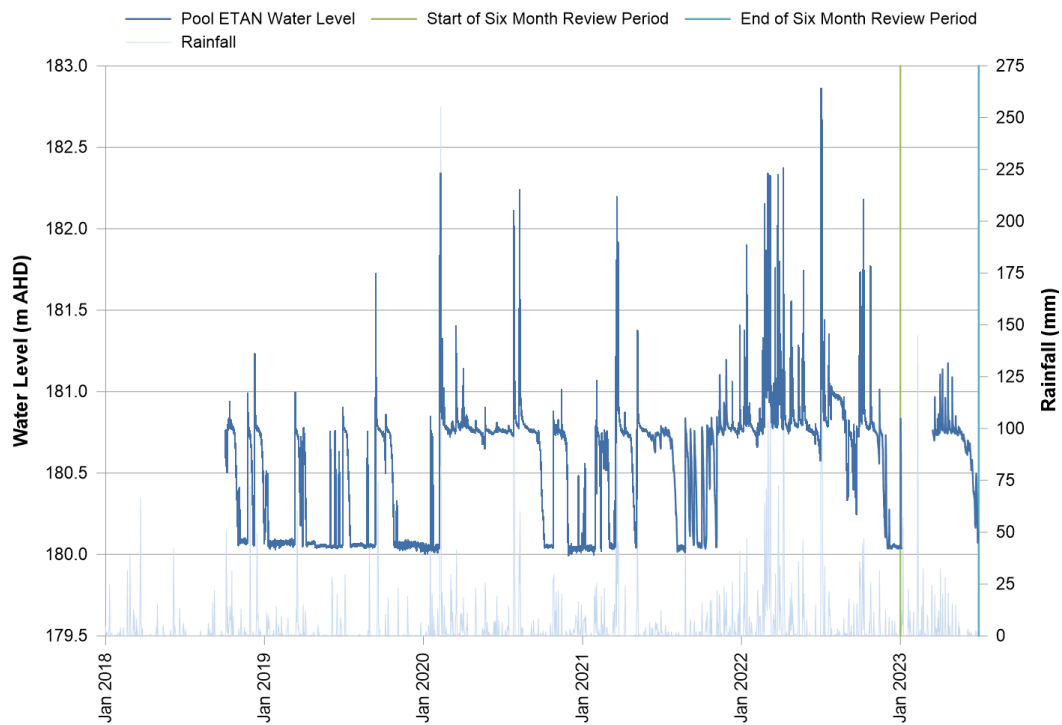


CHART A70: POOL ETAN¹⁸

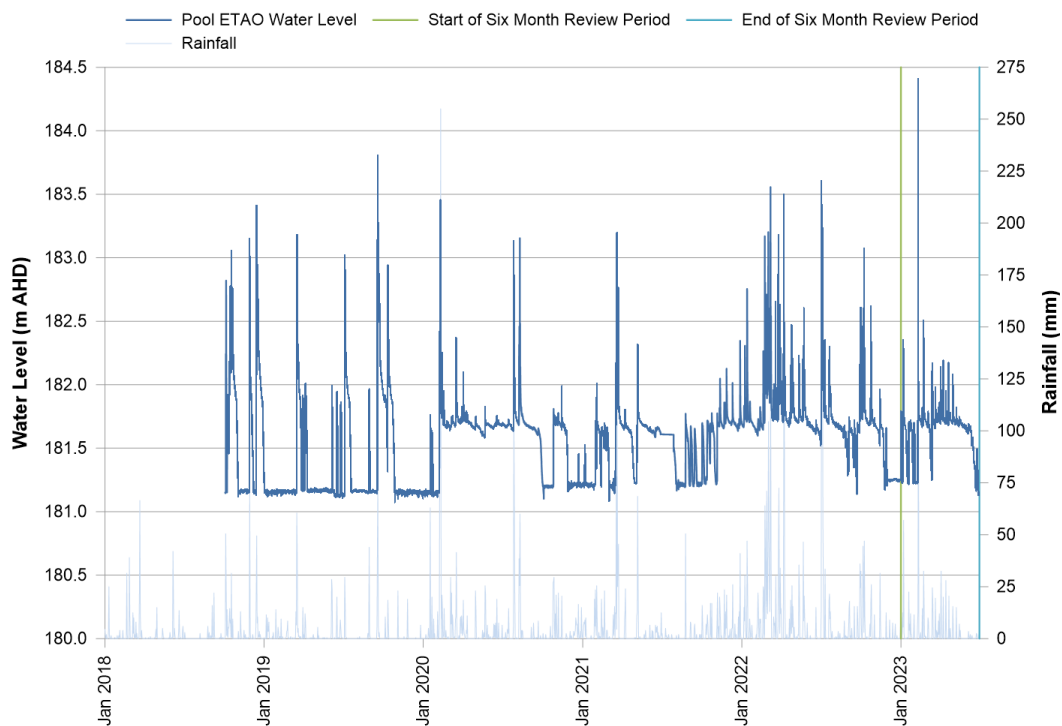


CHART A71: POOL ETAO

¹⁸ No data is available for Pool ETAN from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event.

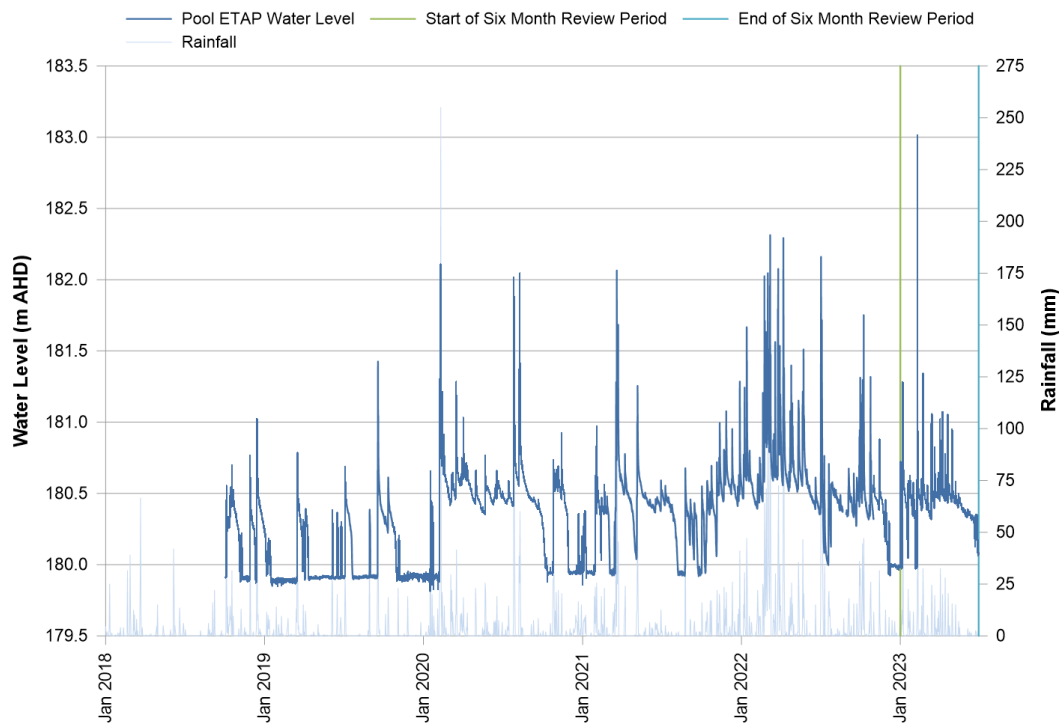


CHART A72: POOL ETAP

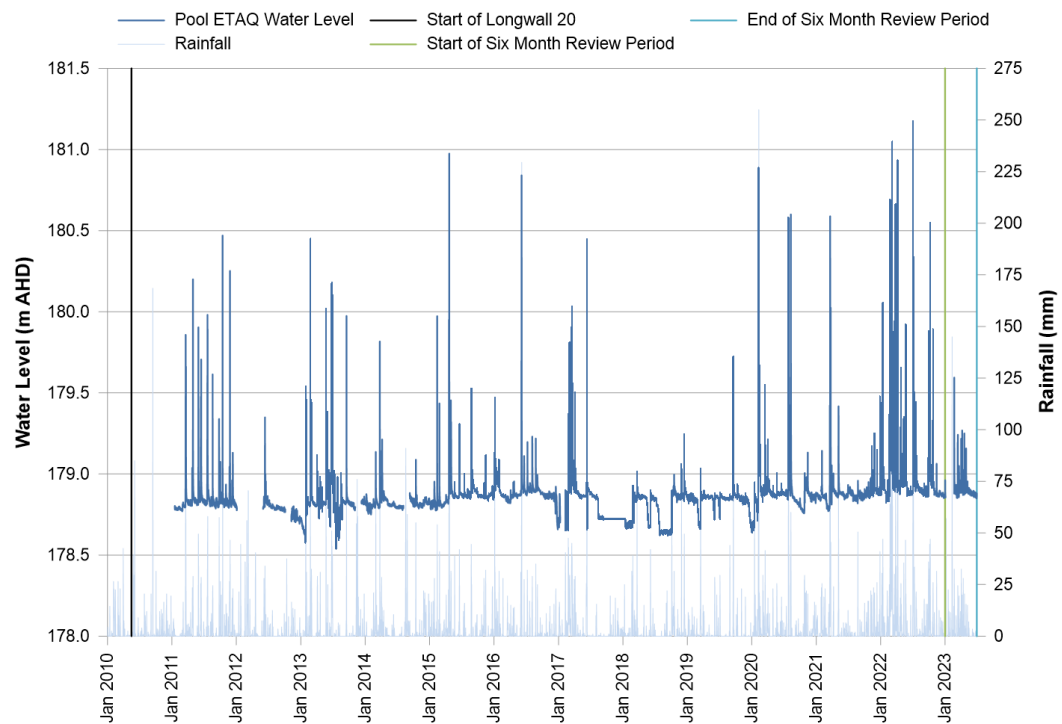


CHART A73: POOL ETAQ¹⁹

¹⁹ No data is available from 3 January to 21 February 2023 due to loss of the water level sensor in a high flow event.

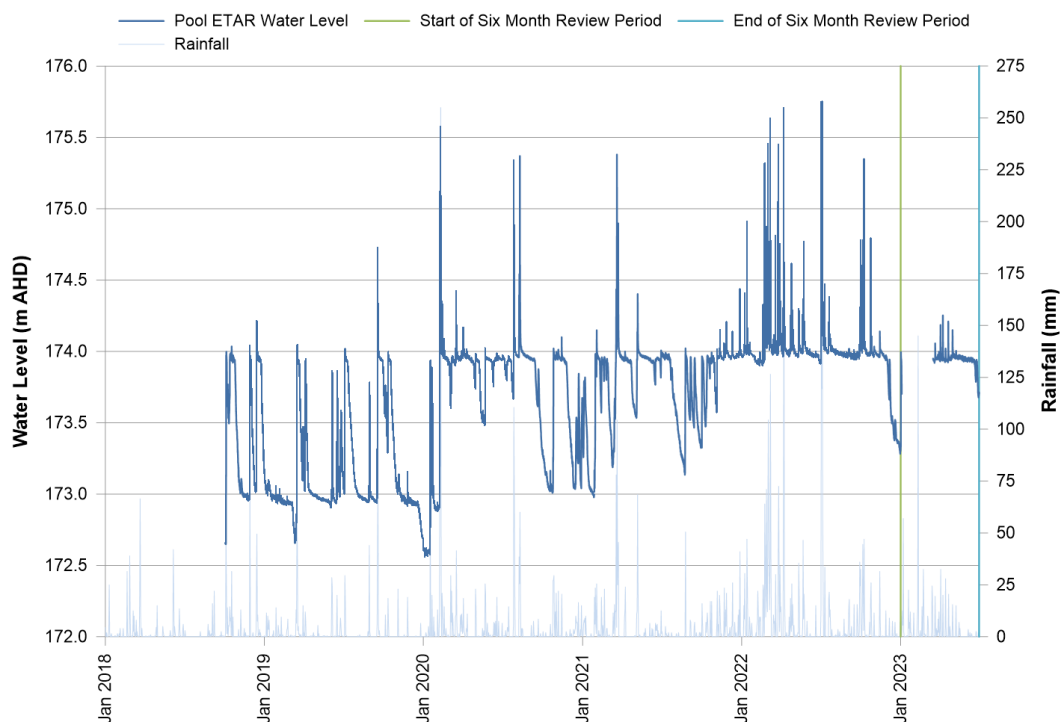


CHART A74: POOL ETAR²⁰

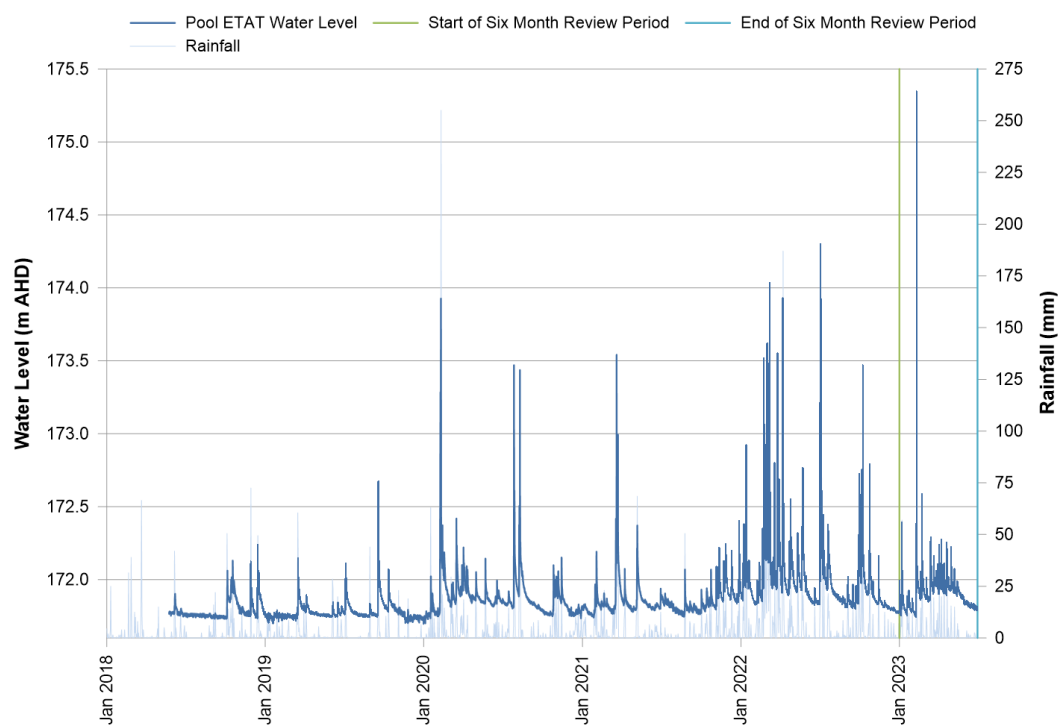


CHART A75: POOL ETAT

²⁰ No data is available from 3 January to 16 March 2023 due to loss of the water level sensor in a high flow event.

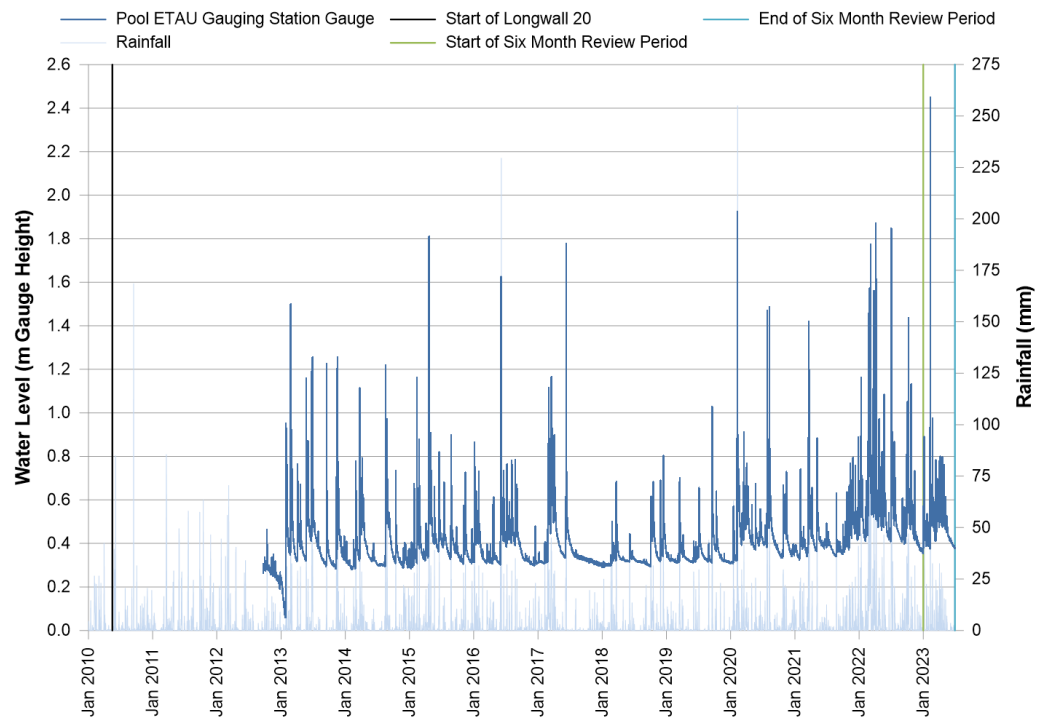


CHART A76: POOL ETAU (STAGE DATA)

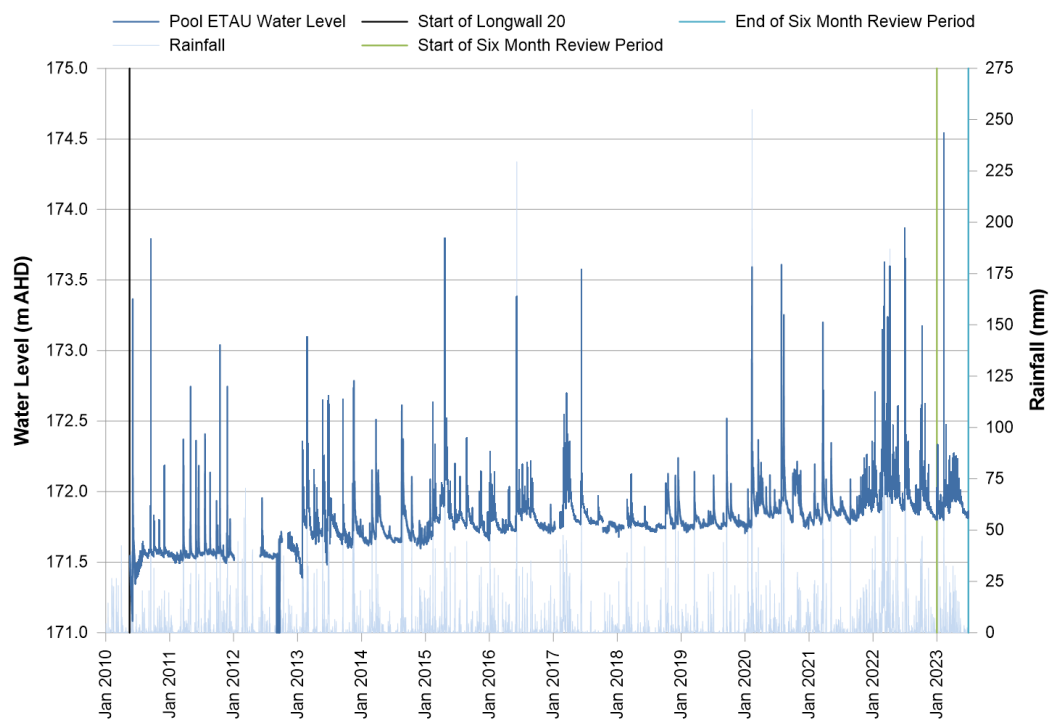


CHART A77: POOL ETAU



POOLS ON TRIBUTARY B/REFERENCE TRIBUTARY

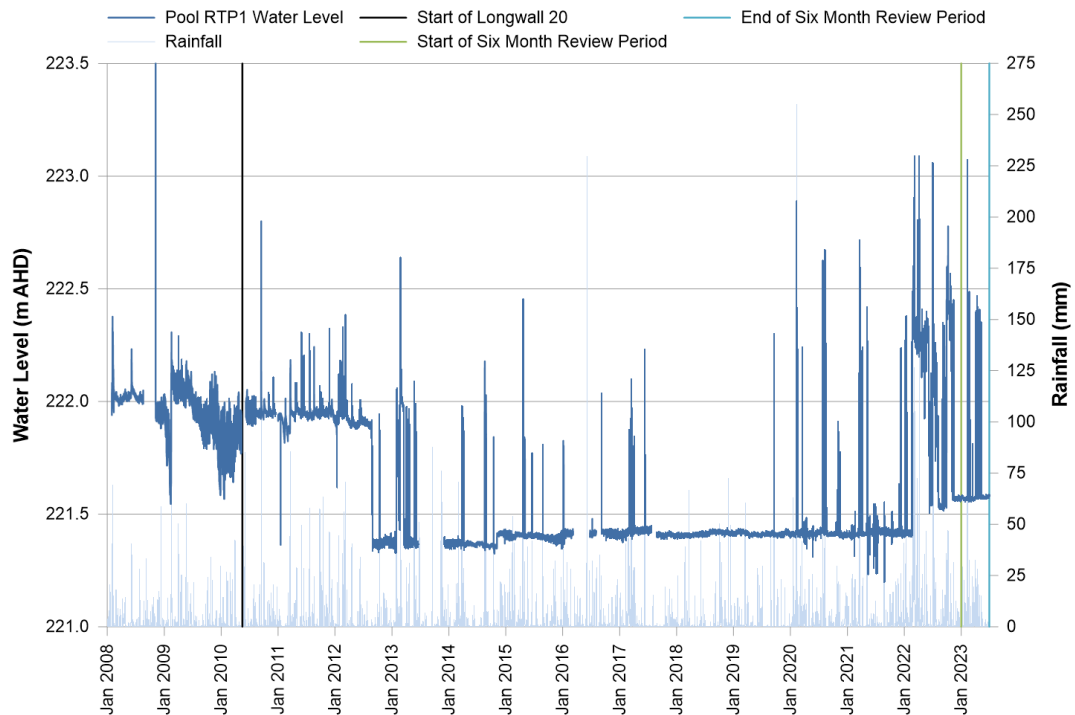


CHART A78: POOL RTP1

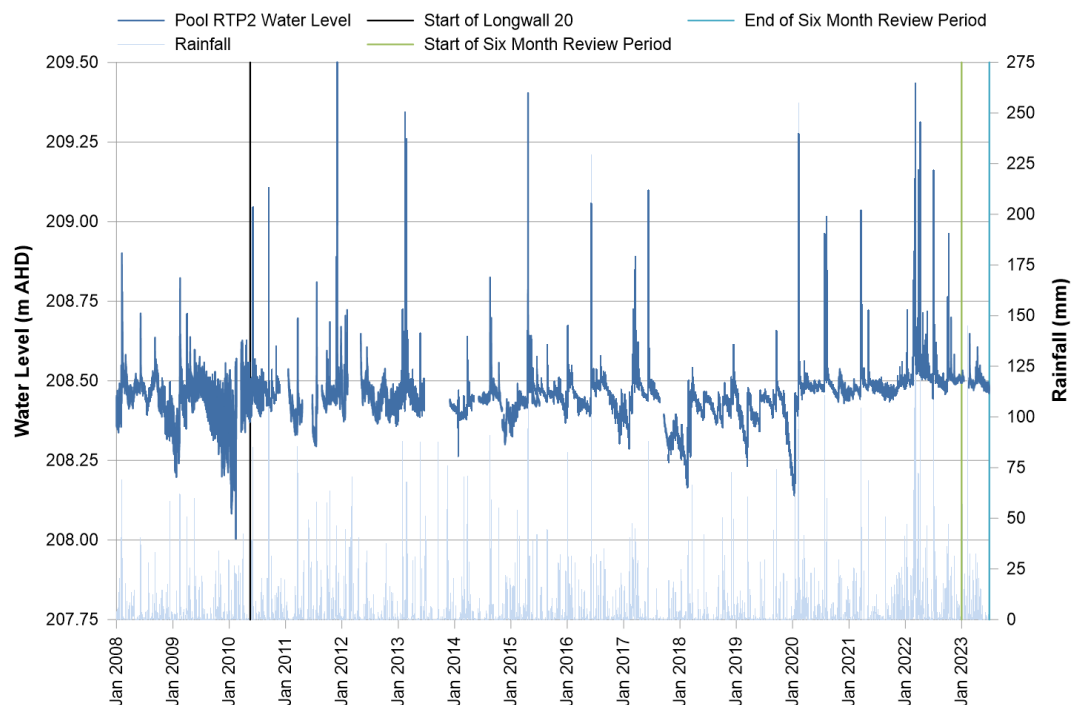


CHART A79: POOL RTP2²¹

²¹ No data is available from 16 January to 16 February 2023 due to loss of the water level sensor in a high flow event.



POOLS ON WORONORA RIVER²²

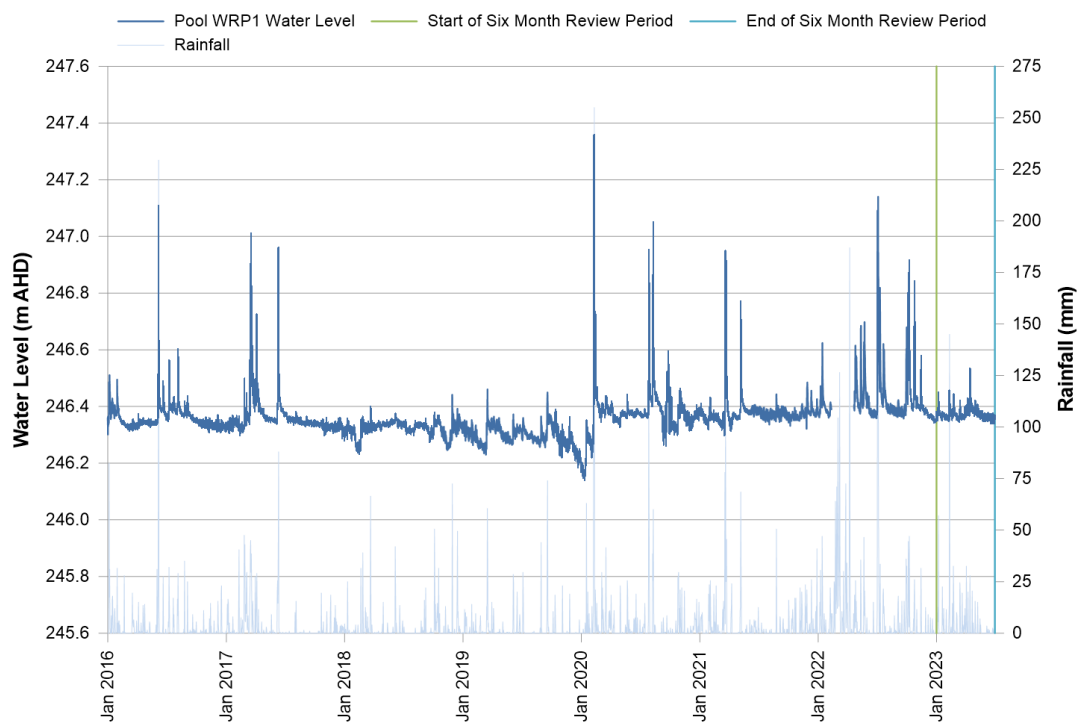


CHART A80: POOL WRP1

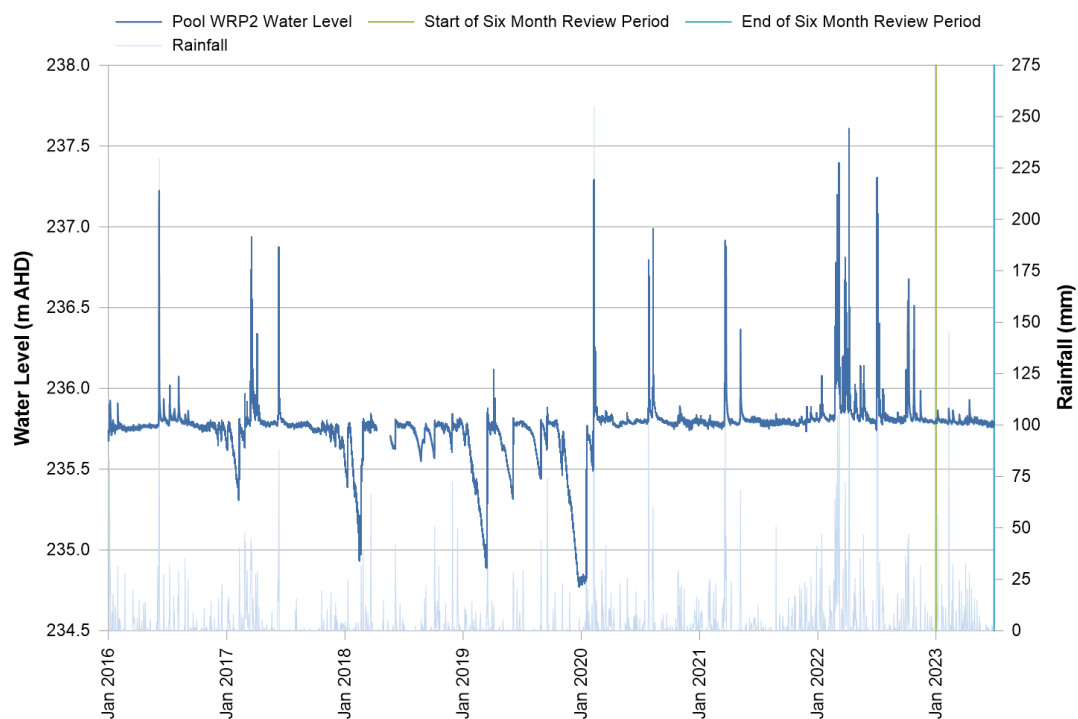


CHART A81: POOL WRP2

²² Pool water level data for the Woronora River pools prior to January 2016 is considered to be largely erroneous as a result of water level sensor issues and is not shown.

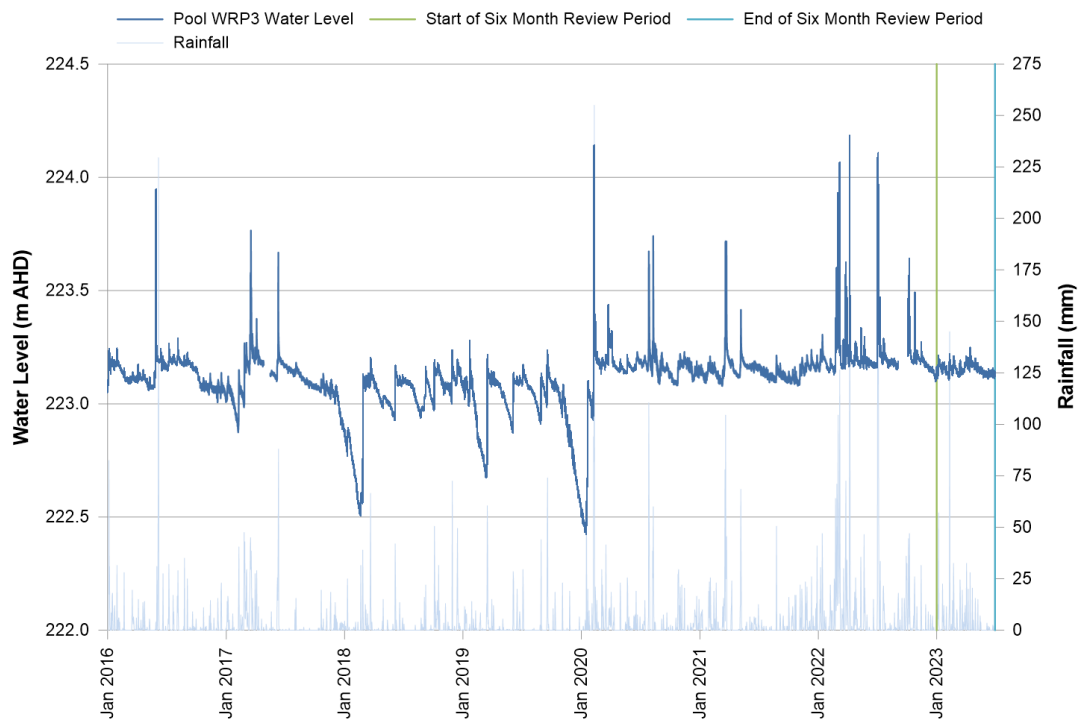


CHART A82: POOL WRP3

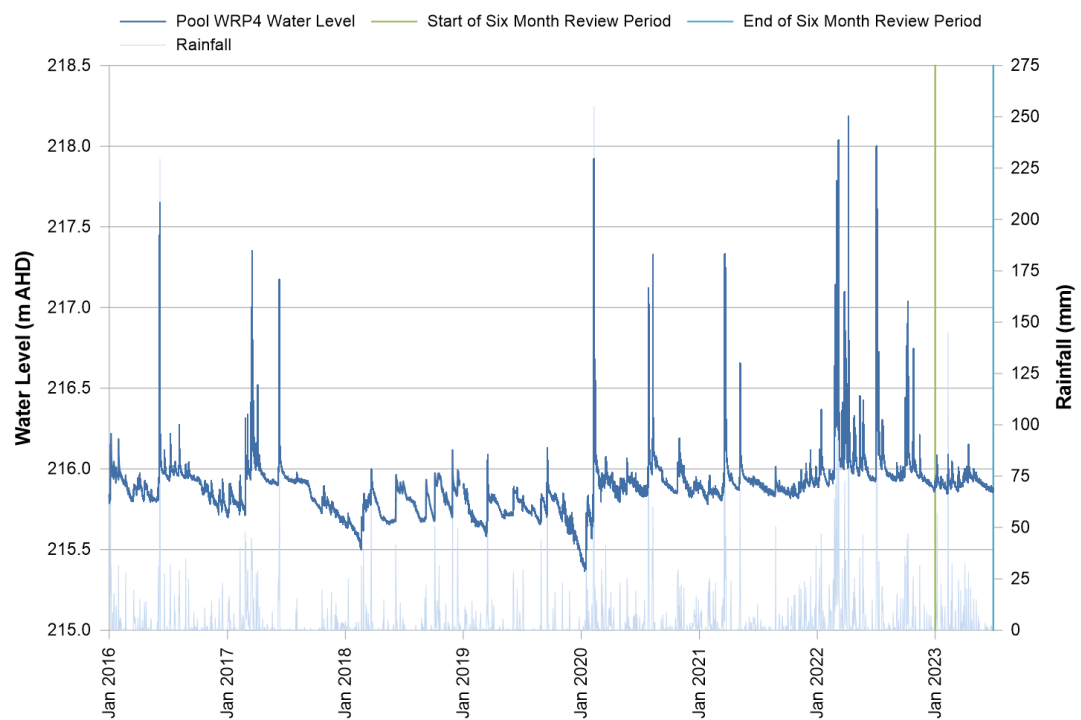


CHART A83: POOL WRP4²³

²³ Pool water level data for WRP4 was erroneous from 20 December 2018 to 1 January 2019 and removed from the dataset. The erroneous data was a result of a logger positioning error.



**APPENDIX B – SURFACE WATER QUALITY MONITORING RESULTS FOR
SELECT SITES – pH, ELECTRICAL CONDUCTIVITY, DISSOLVED IRON,
DISSOLVED MANGANESE AND DISSOLVED ALUMINIUM**



WARATAH RIVULET

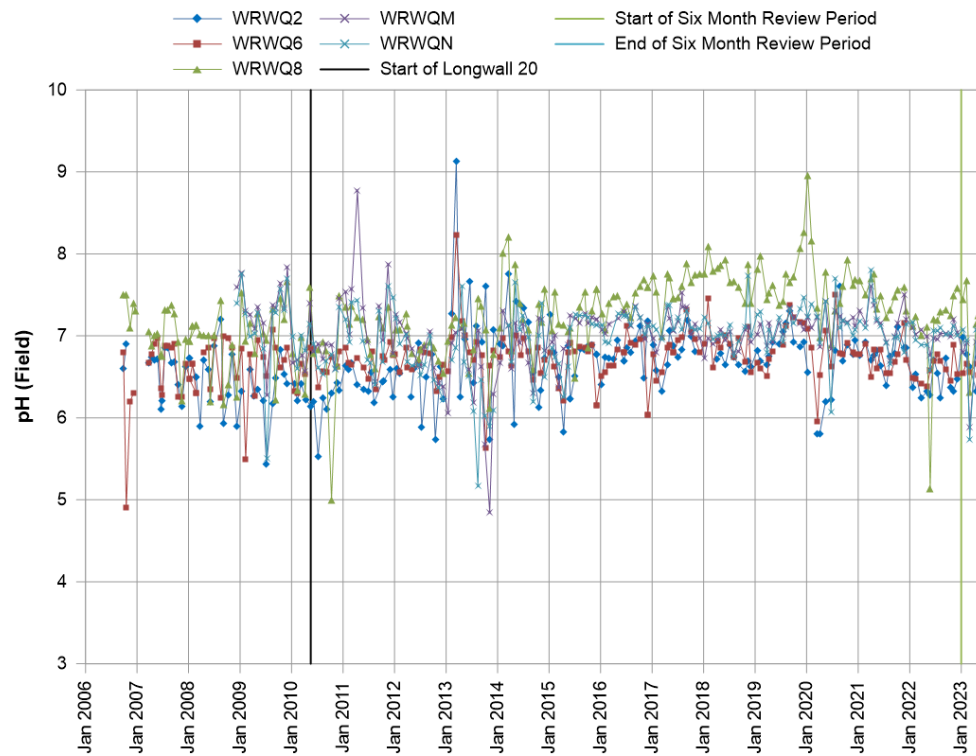


CHART B1: pH LEVELS WARATAH RIVULET – UPPER TO MIDDLE REACH SITES

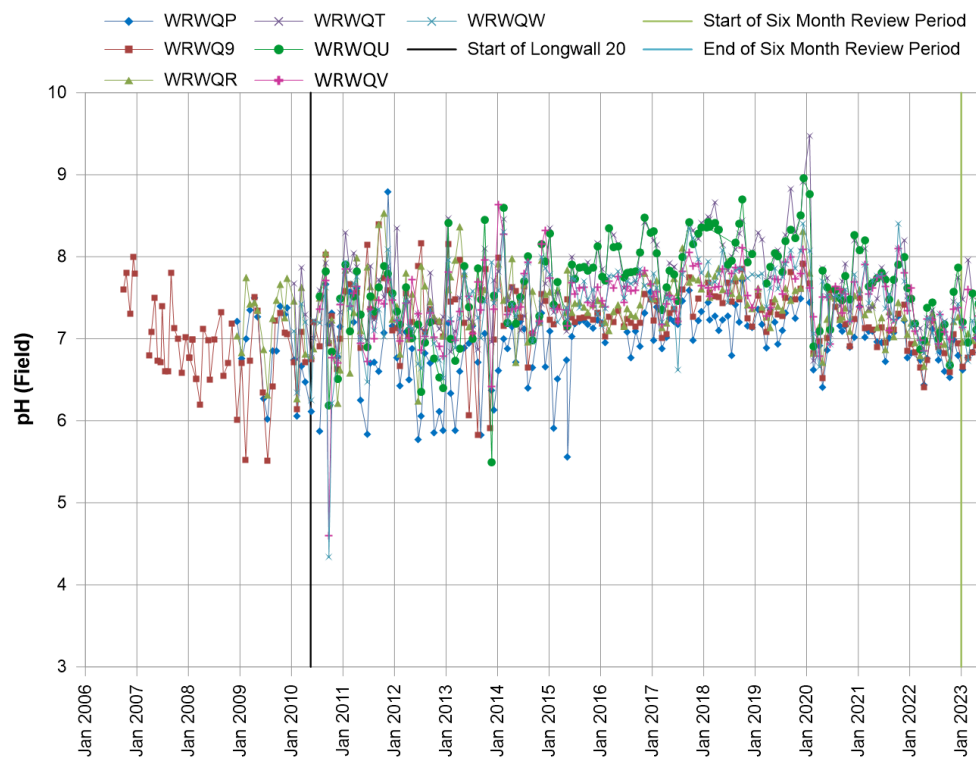


CHART B: pH LEVELS WARATAH RIVULET – LOWER REACH SITES

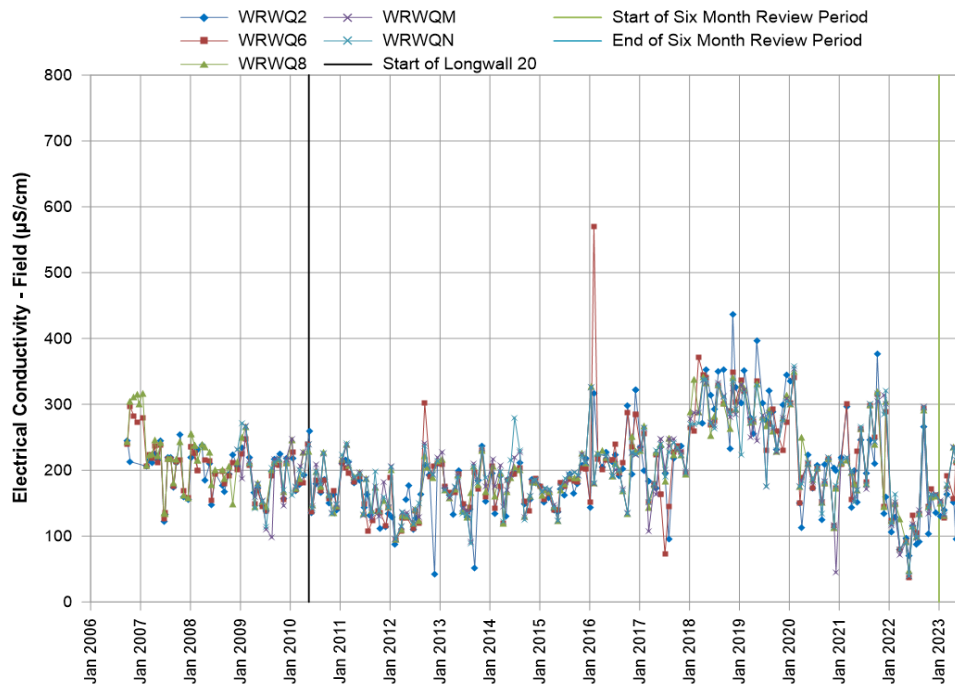


CHART B3: ELECTRICAL CONDUCTIVITY WARATAH RIVULET – UPPER TO MIDDLE REACH SITES²⁴

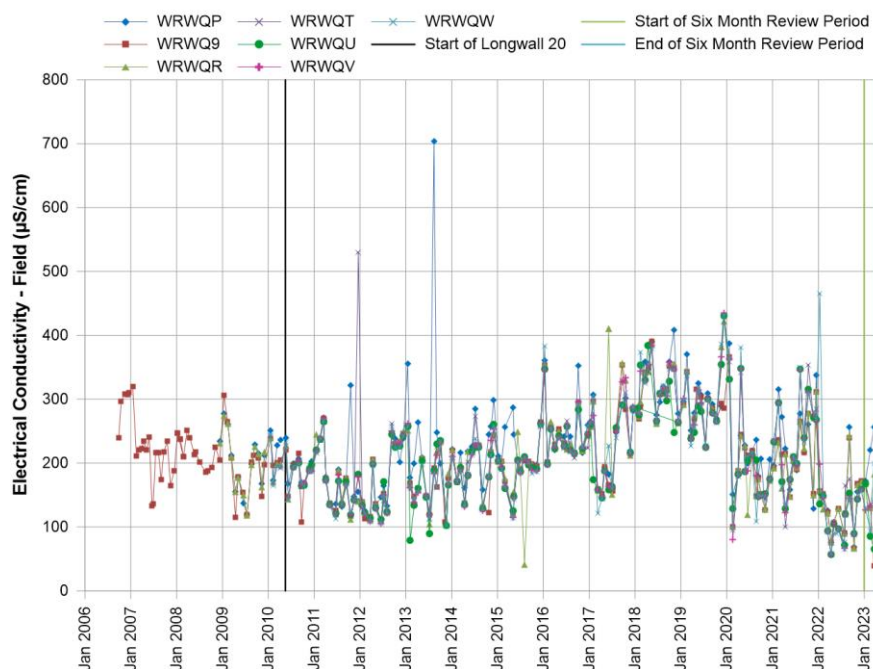


CHART B4: ELECTRICAL CONDUCTIVITY (EC) WARATAH RIVULET – LOWER REACH SITES

²⁴ The water quality meter was calibrated to a much lower temperature of water than that recorded in the Waratah Rivulet during the June to December 2019 review period and, as such, the field recorded electrical conductivity values were found to be inaccurate. Consequently, the laboratory values for electrical conductivity have been presented for this period rather than field recorded electrical conductivity values.

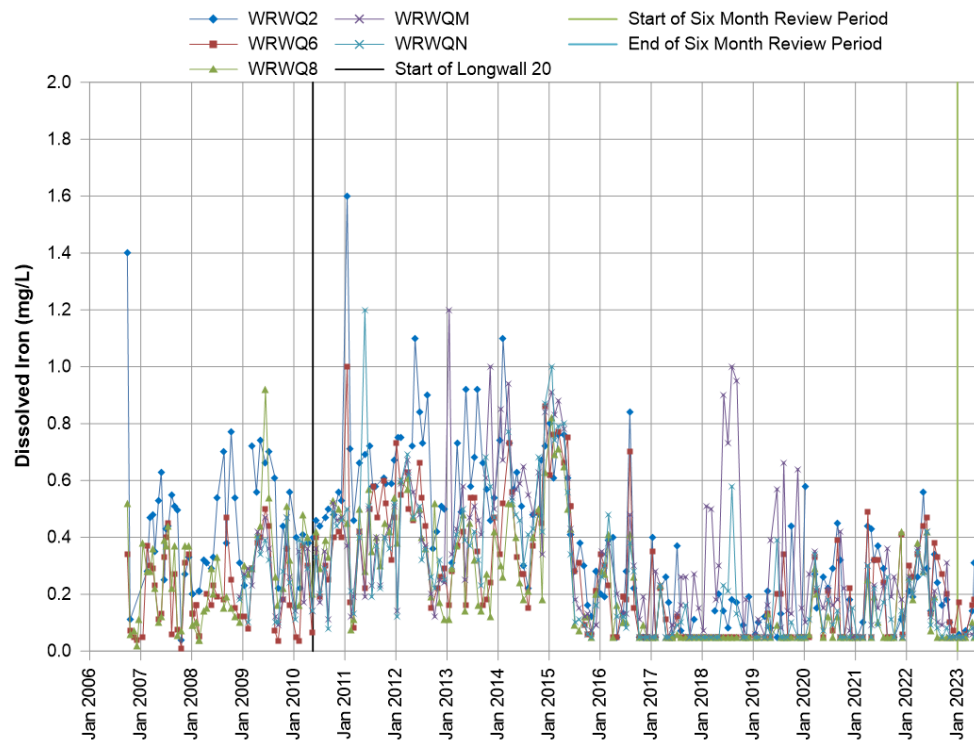


CHART B5: DISSOLVED IRON WARATAH RIVULET – UPPER AND MIDDLE REACH SITES

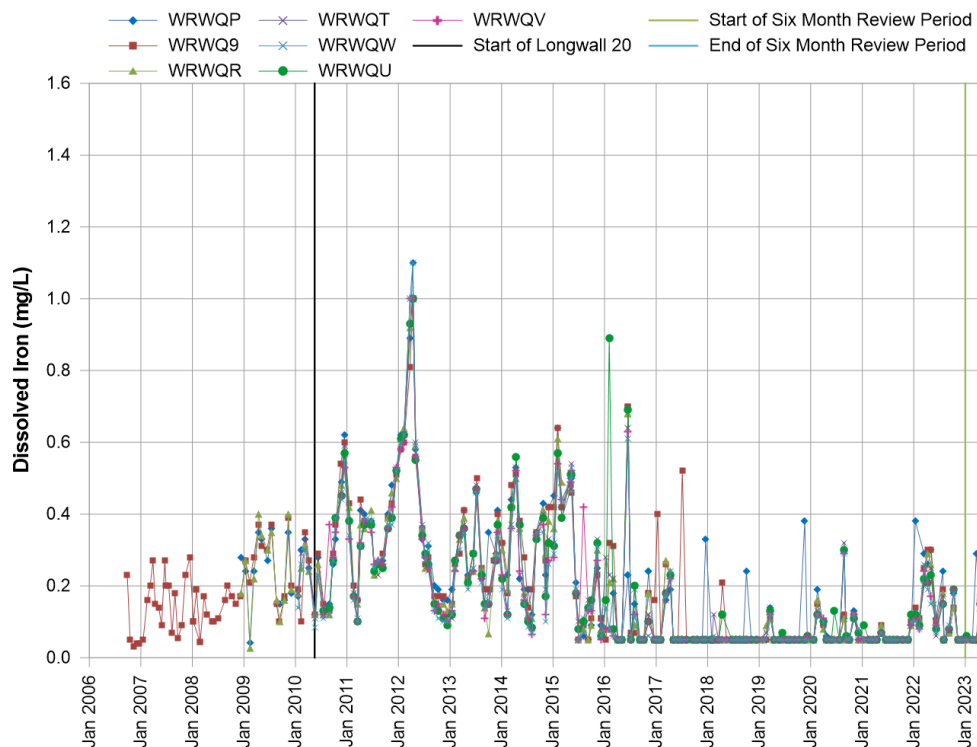


CHART B6: DISSOLVED IRON WARATAH RIVULET – LOWER REACH SITES

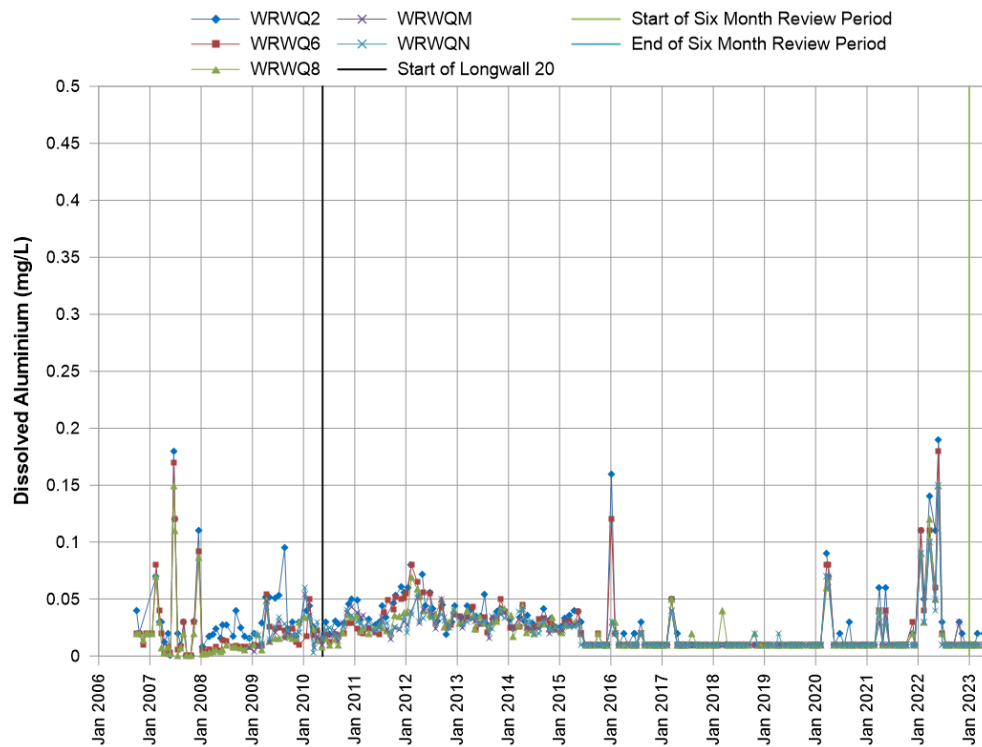


CHART B7: DISSOLVED ALUMINIUM WARATAH RIVULET – UPPER TO MIDDLE REACH SITES

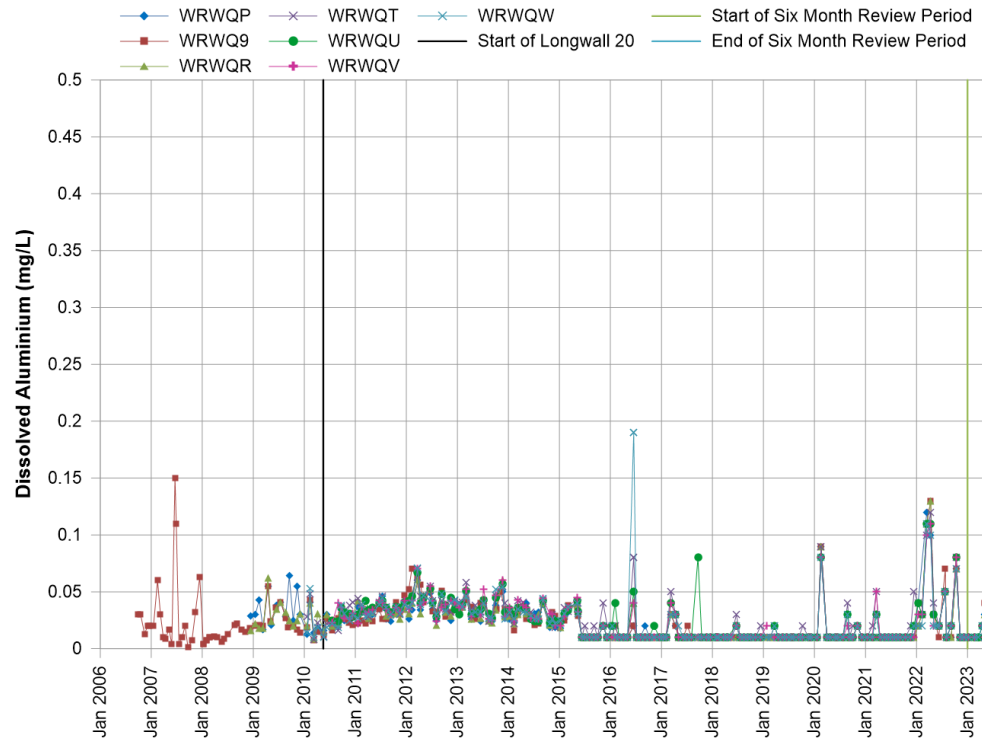


CHART B8: DISSOLVED ALUMINIUM WARATAH RIVULET – LOWER REACH SITES

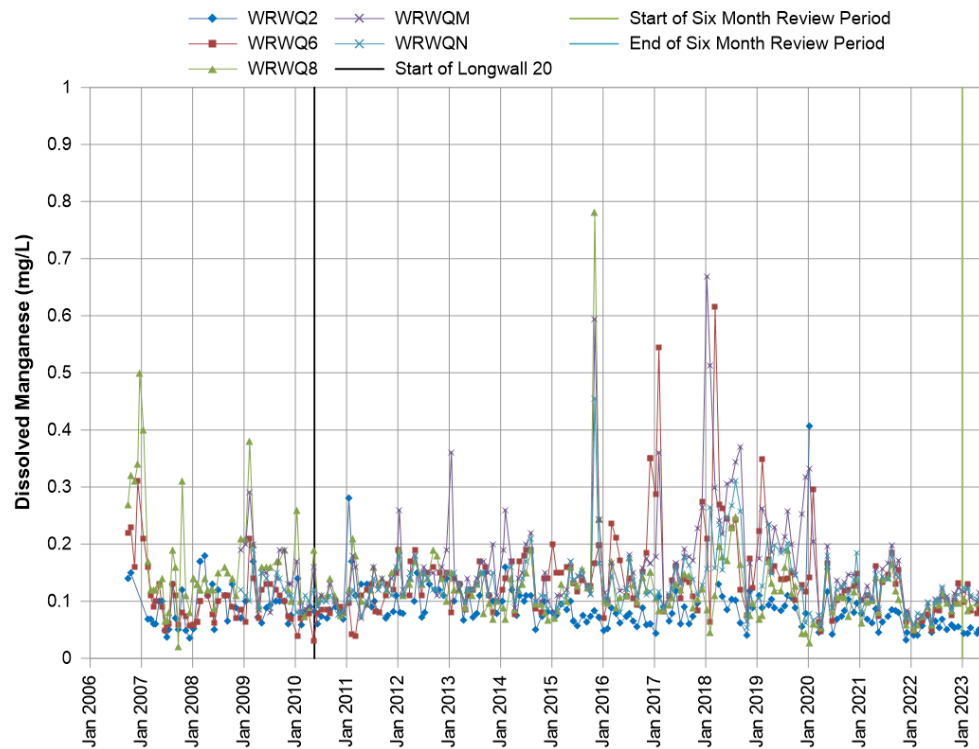


CHART B9: DISSOLVED MANGANESE WARATAH RIVULET – UPPER TO MIDDLE REACH SITES

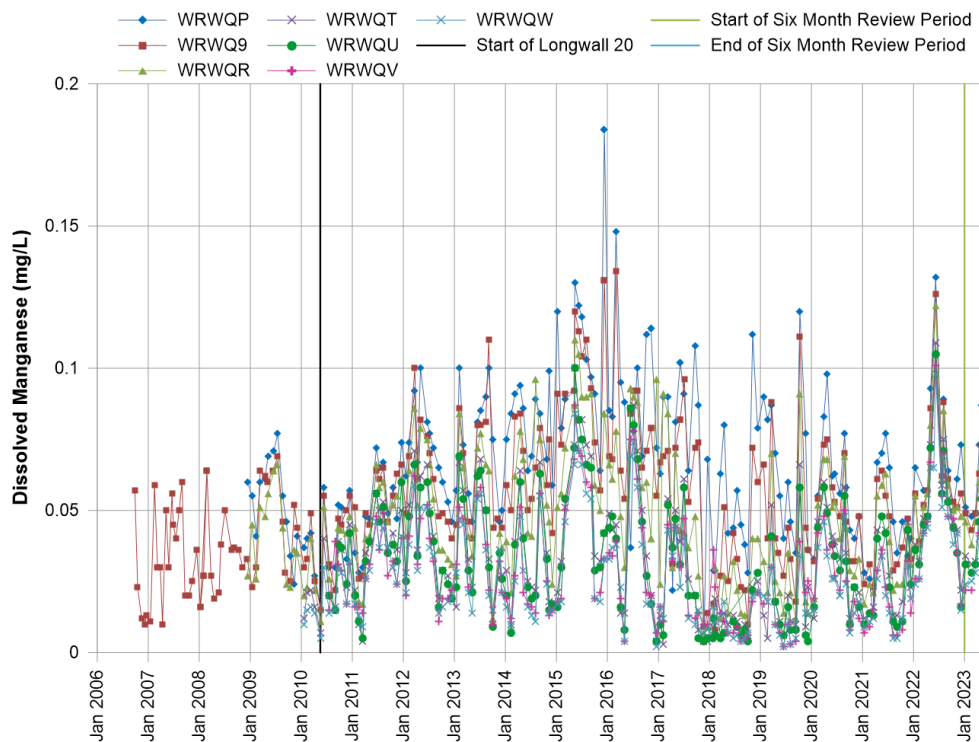


CHART B10: DISSOLVED MANGANESE WARATAH RIVULET – LOWER REACH SITES



WORONORA RIVER

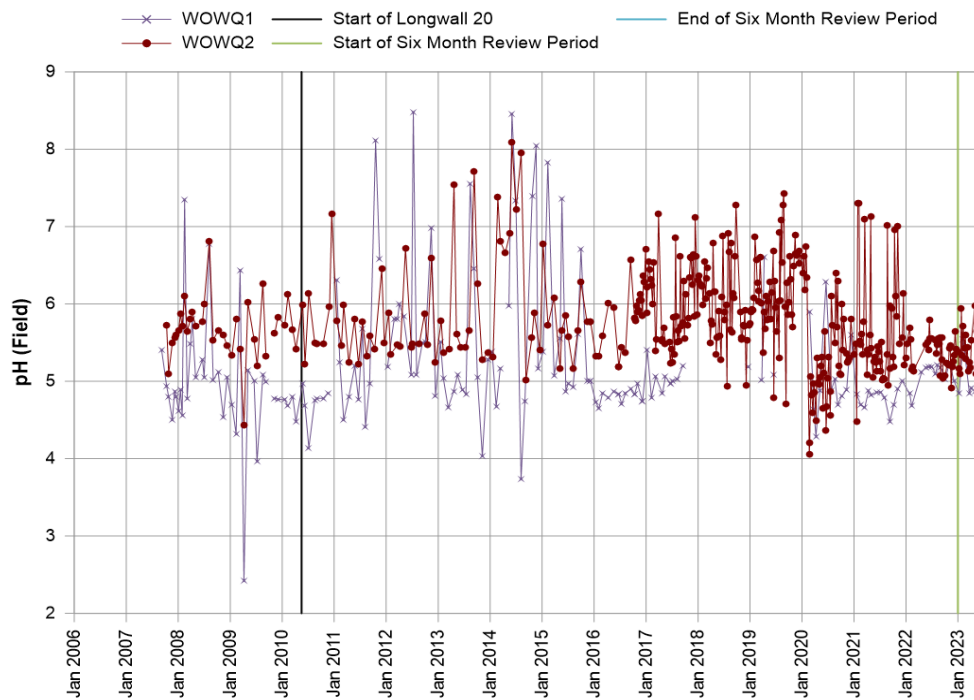


CHART B11: pH LEVELS WORONORA RIVER²⁵

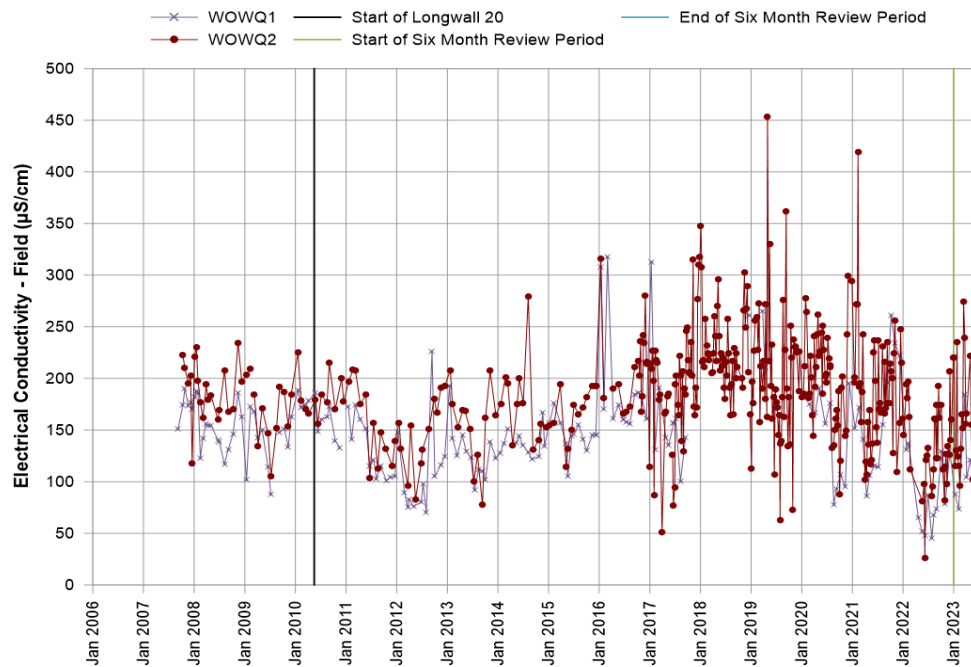


CHART B12: ELECTRICAL CONDUCTIVITY WORONORA RIVER²⁵

²⁵ WOWQ 1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

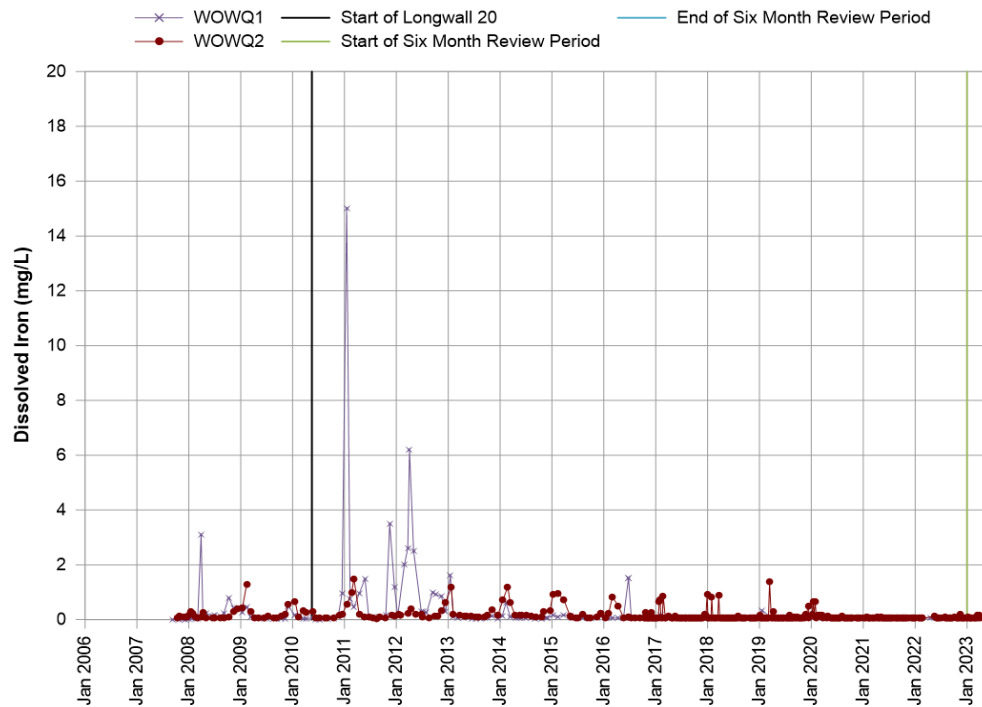


CHART B13: DISSOLVED IRON WORONORA RIVER²⁶

²⁶WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

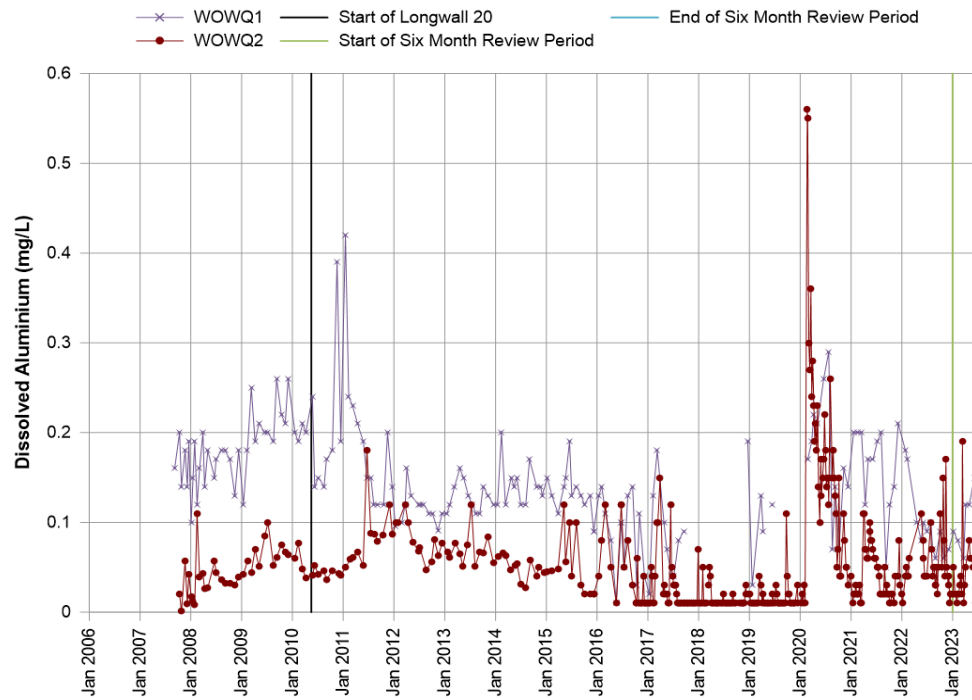


CHART B14: DISSOLVED ALUMINIUM WORONORA RIVER²⁷

²⁷ WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

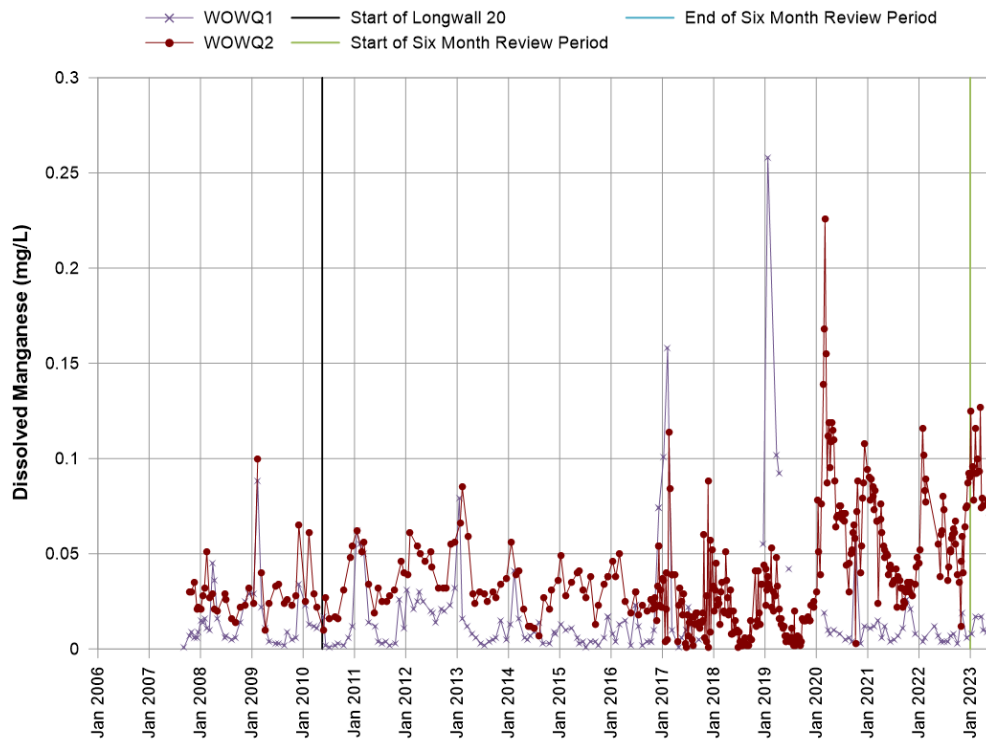


CHART B15: DISSOLVED MANGANESE WORONORA RIVER²⁸

²⁸WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.



EASTERN TRIBUTARY

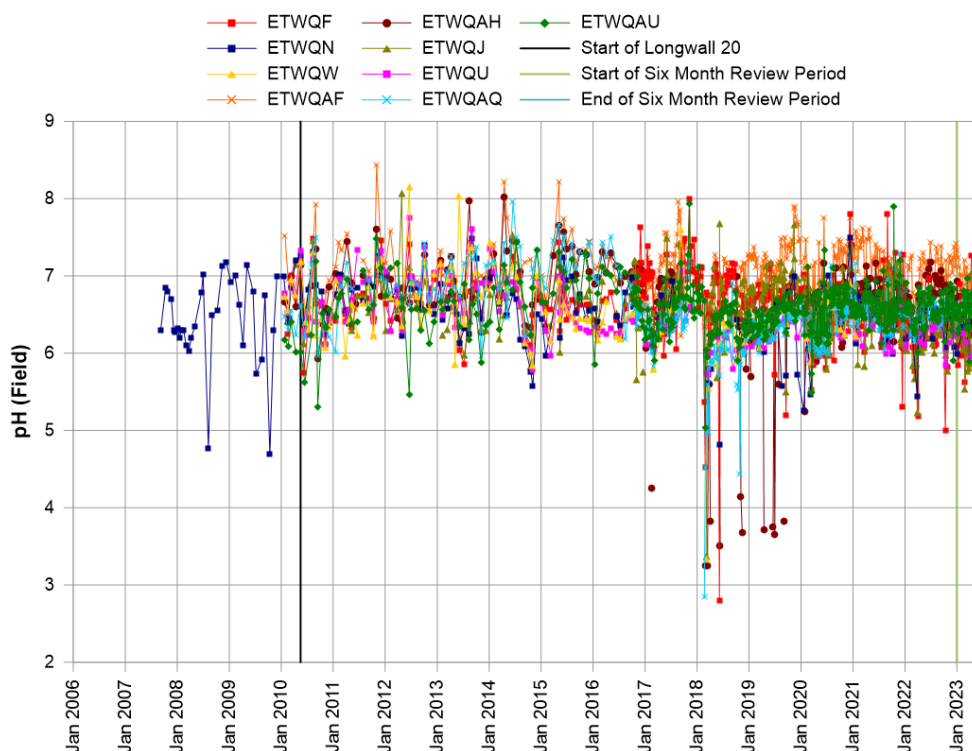


CHART B16: pH LEVELS EASTERN TRIBUTARY

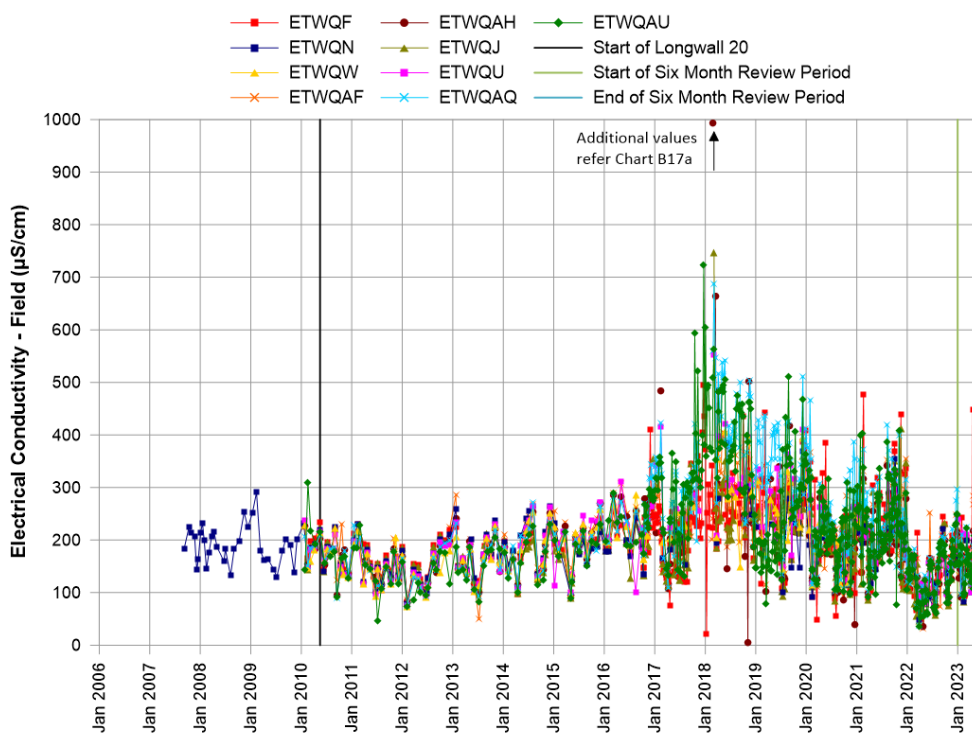


CHART B17: ELECTRICAL CONDUCTIVITY EASTERN TRIBUTARY

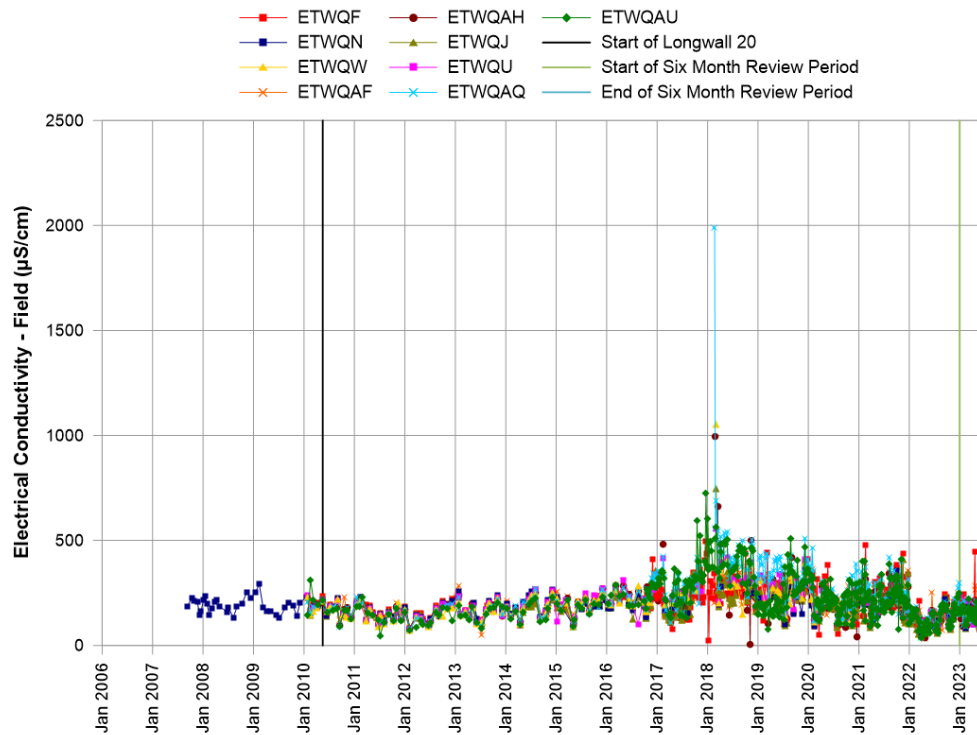


CHART B17A: ELECTRICAL CONDUCTIVITY EASTERN TRIBUTARY

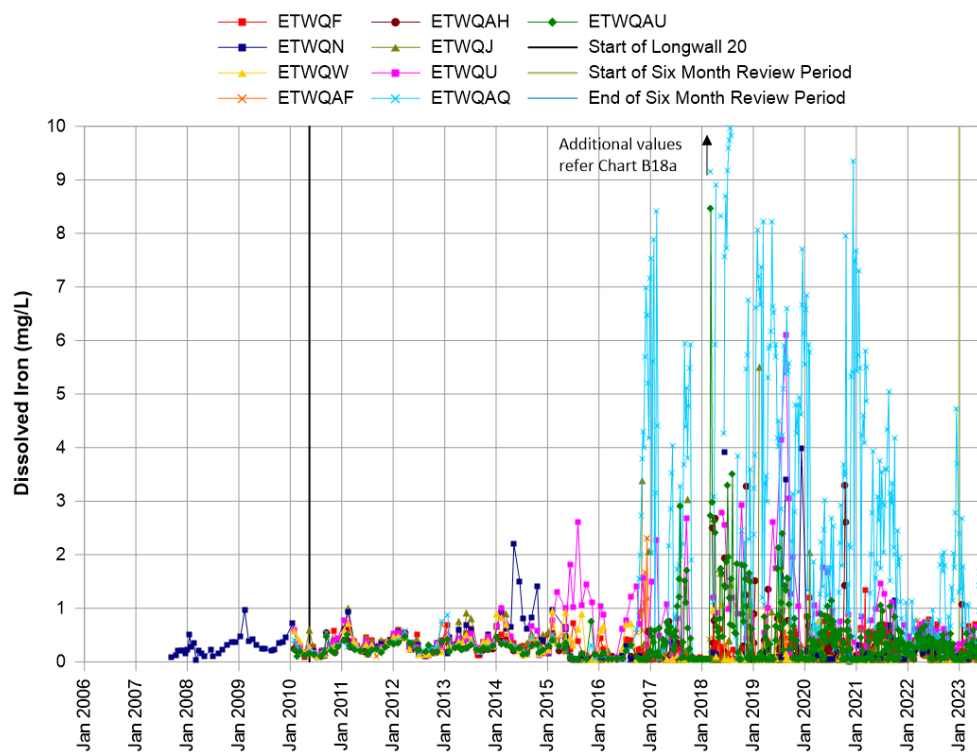


CHART B18: DISSOLVED IRON EASTERN TRIBUTARY

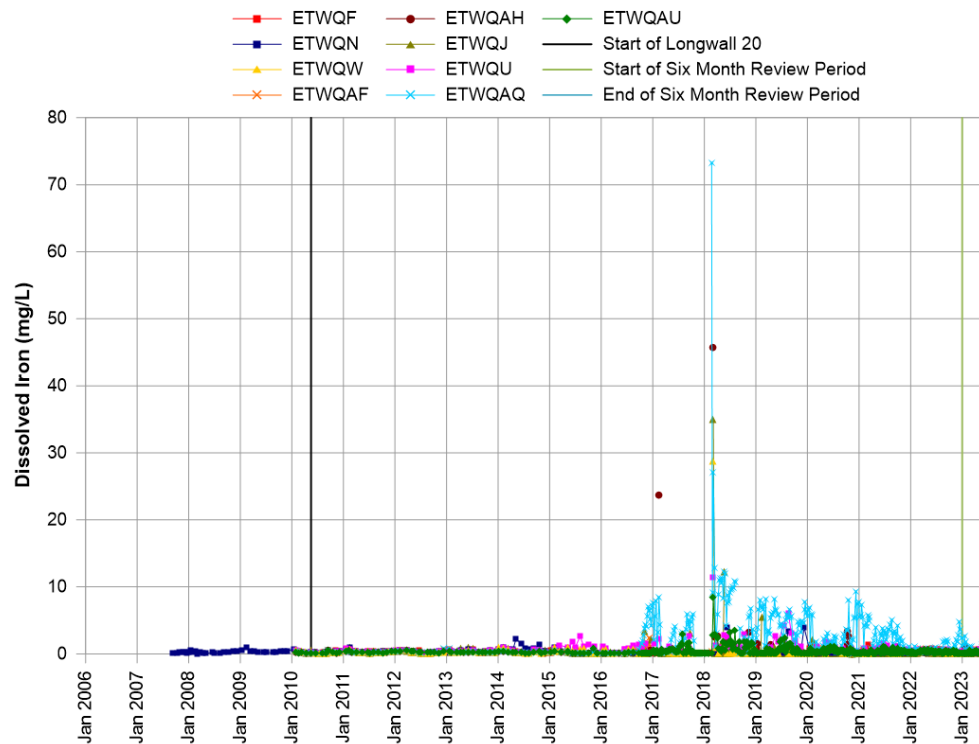


CHART B18A: DISSOLVED IRON EASTERN TRIBUTARY

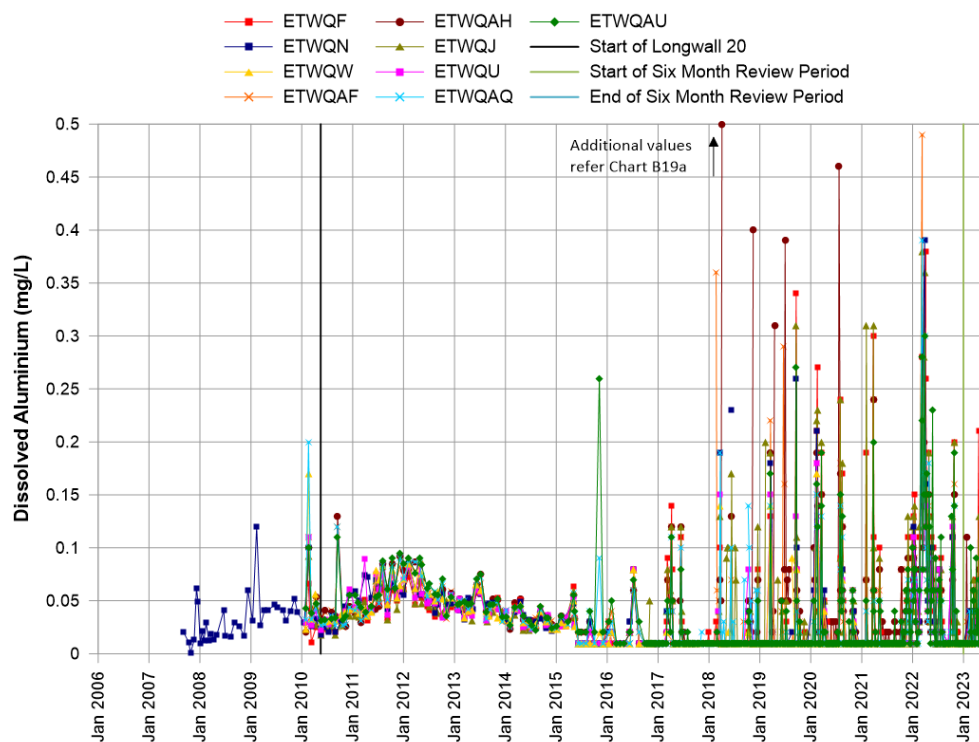


CHART B19: DISSOLVED ALUMINIUM EASTERN TRIBUTARY

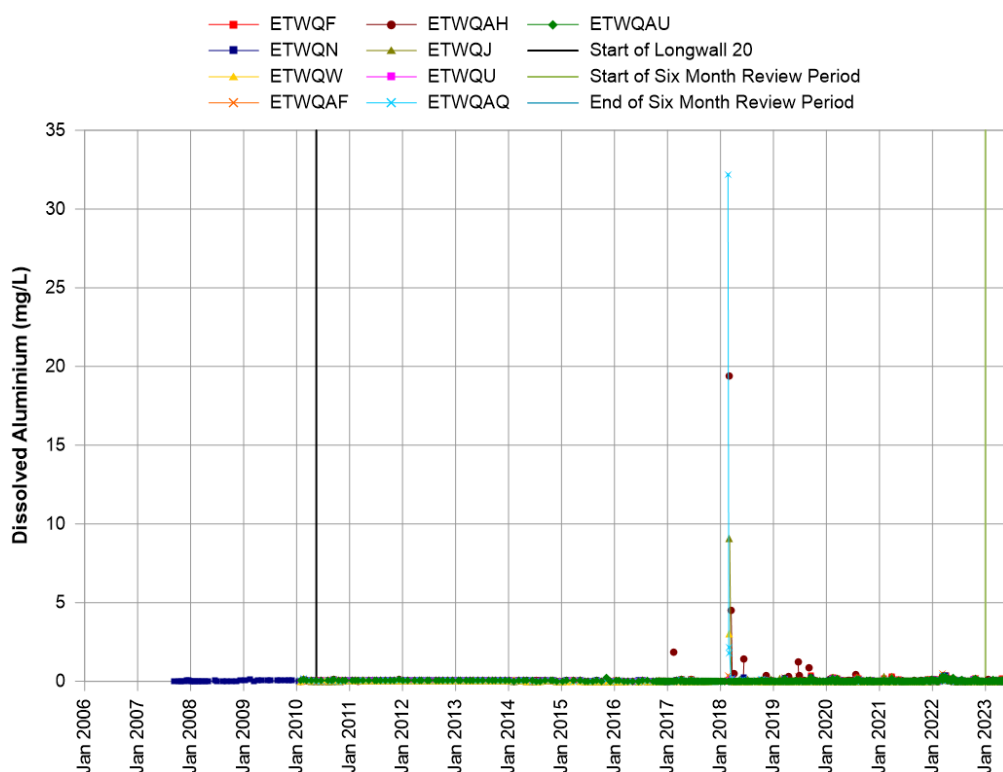


CHART B19A: DISSOLVED ALUMINIUM EASTERN TRIBUTARY

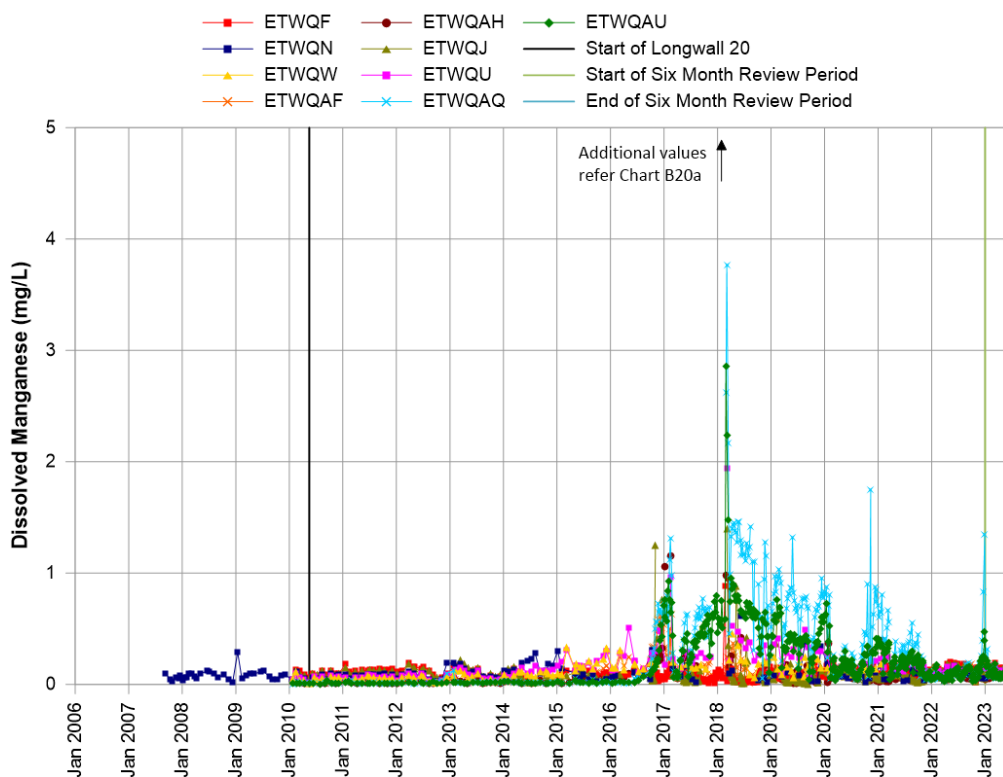


CHART B20: DISSOLVED MANGANESE EASTERN TRIBUTARY

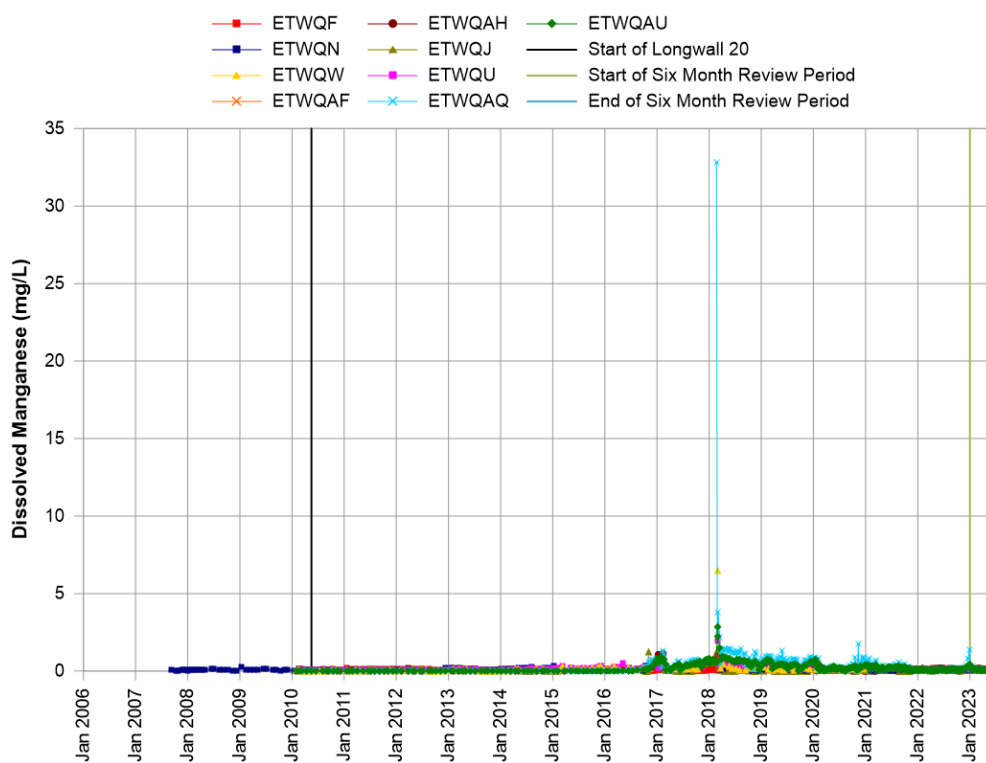


CHART B20A: DISSOLVED MANGANESE EASTERN TRIBUTARY



TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

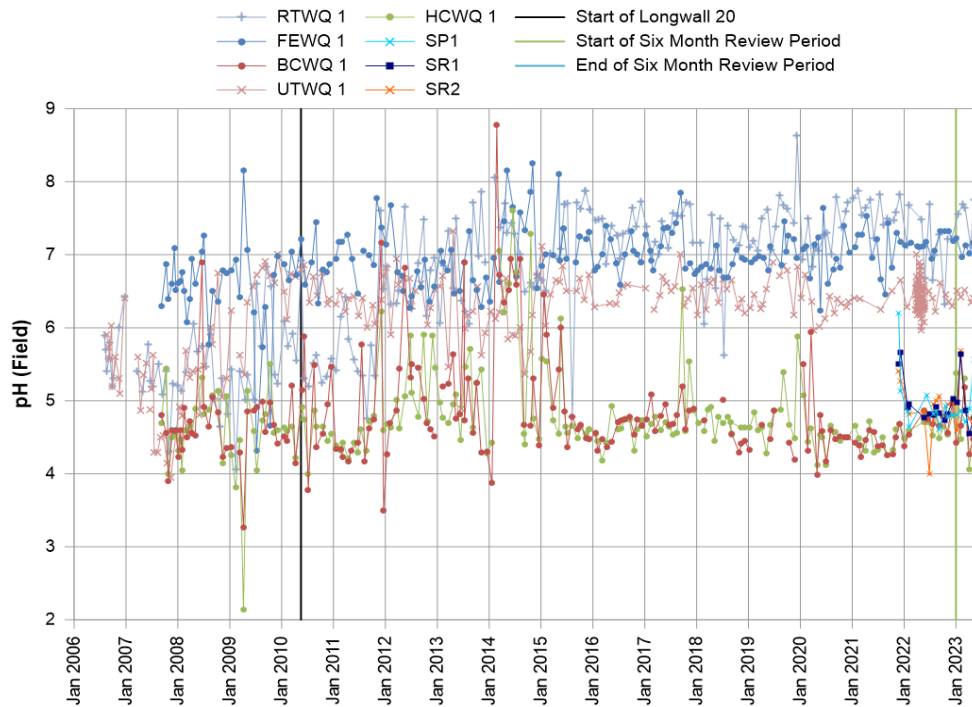


CHART B21: pH LEVELS TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

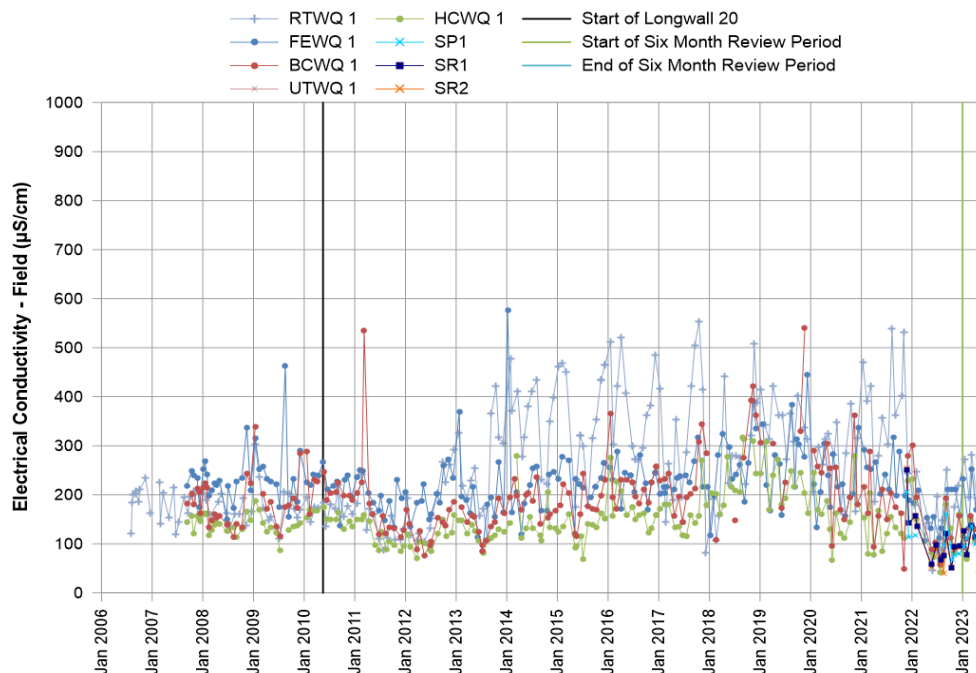


CHART B22: ELECTRICAL CONDUCTIVITY TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

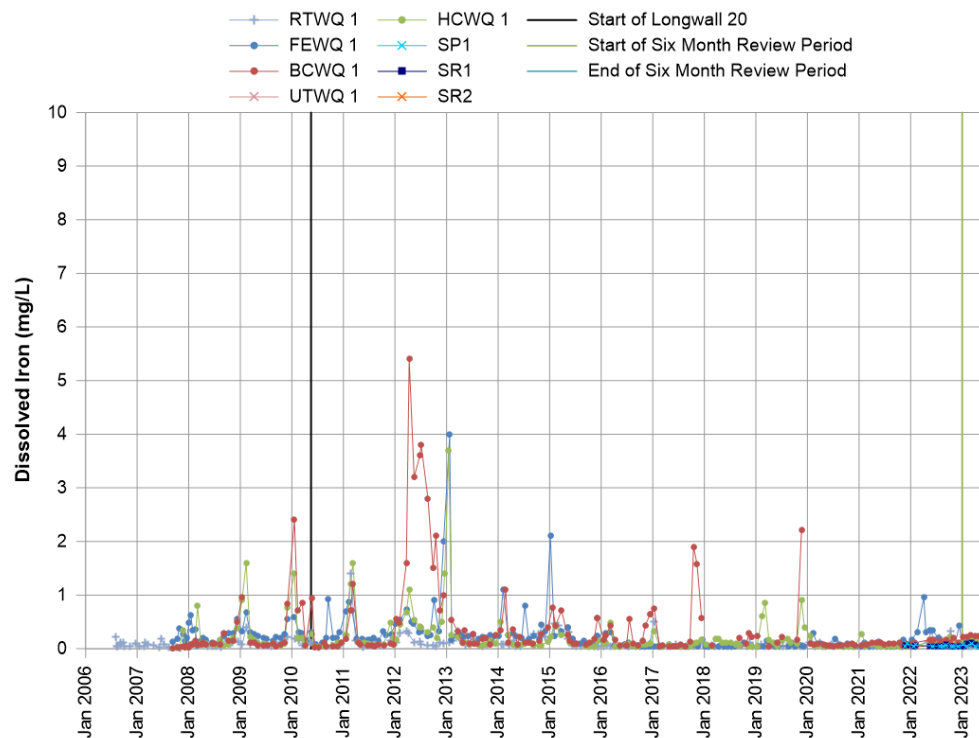


CHART B23: DISSOLVED IRON TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

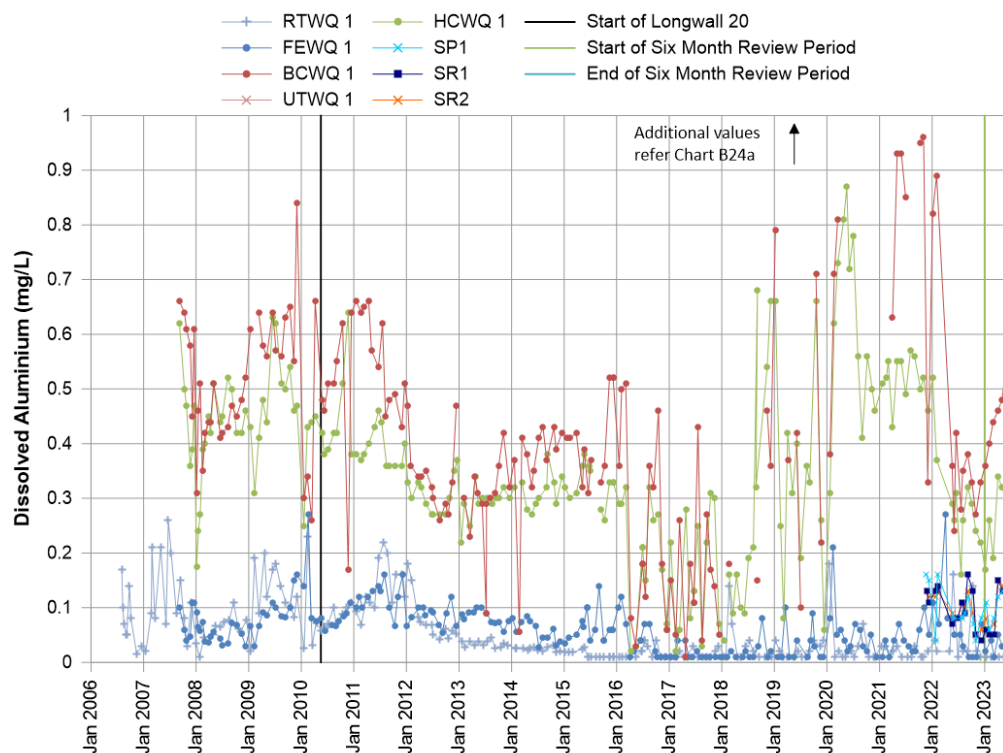


CHART B24: DISSOLVED ALUMINIUM TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

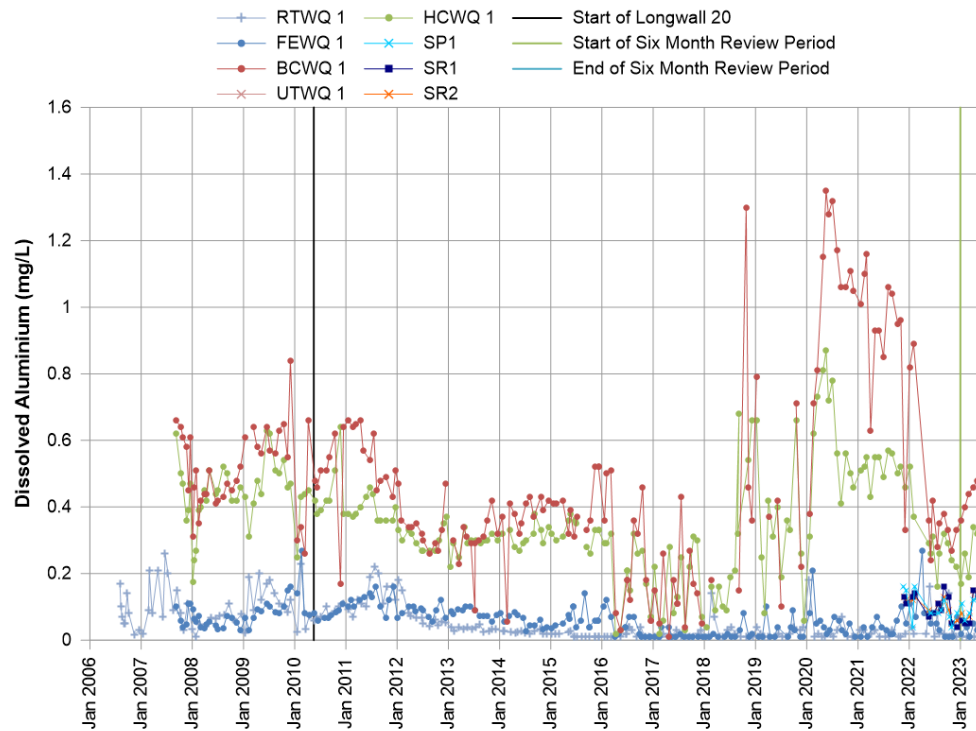


CHART B24A: DISSOLVED ALUMINIUM TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R

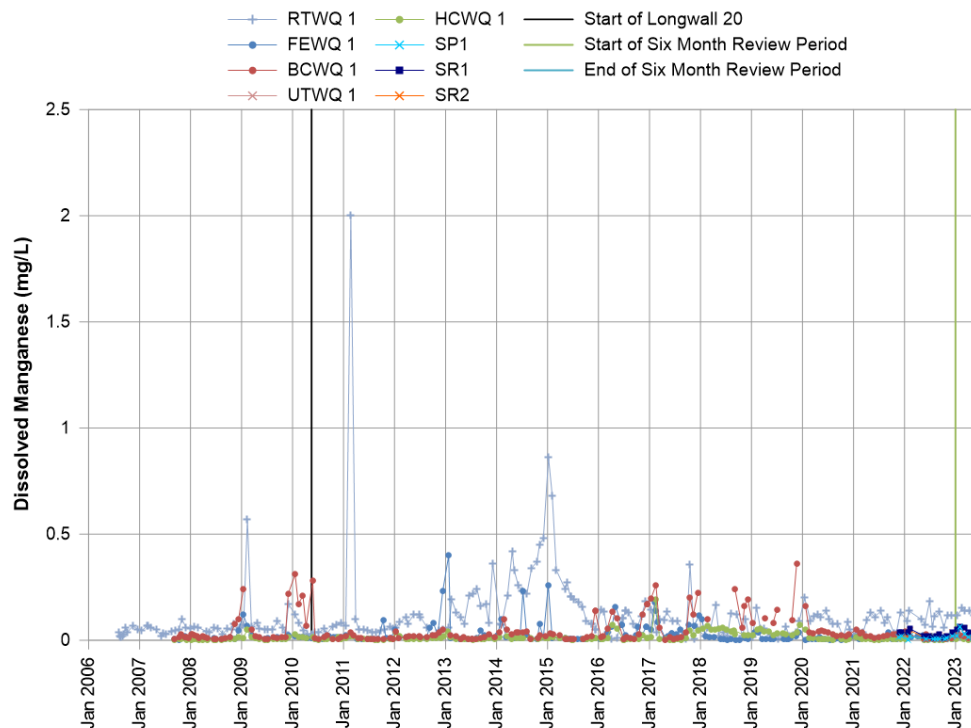


CHART B25: DISSOLVED MANGANESE TRIBUTARY B, TRIBUTARY D, FAR EASTERN TRIBUTARY, BEE CREEK, HONEYSUCKLE CREEK AND STREAMS P AND R