HYDRO ENGINEERING & CONSULTING PTY LTD

REPORT

Metropolitan Coal
Surface Water Review
1 January to 30 June 2020

Prepared for: Metropolitan Coal Pty Ltd

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c	Final	CAW	TSM	TSM	23/10/2020

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1.0 INTRODUCTION AND BACKGROUND

Metropolitan Coal is wholly owned by Peabody Energy Australia Pty Ltd and is located adjacent to the township of Helensburgh and approximately 30 kilometres north of Wollongong in New South Wales (NSW). The Metropolitan Coal Project (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 Hydro Engineering & Consulting Pty Ltd (HEC) of the environmental performance of the Project in relation to surface water (water resources and watercourses) in the Metropolitan Coal underground mining area and surrounds for the reporting period (1 January to 30 June 2020), consistent with the Metropolitan Coal Longwall 304 Water Management Plan (2019b), Metropolitan Coal Longwalls 305-307 Water Management Plan[1] (2020b) and Metropolitan Coal Catchment Monitoring Program (2014a). During the review period, the Longwall 304 Water Management Plan was in force from 1 January 2020 to 11 April 2020 (inclusive) and the Longwalls 305-307 Water Management Plan was in force from 12 April 2020 to 30 June 2020 (inclusive).

2.0 CATCHMENT MONITORING AND SURFACE WATER MODELLING

2.1 BACKGROUND

The Metropolitan Coal Catchment Monitoring Program and Longwall 304 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 underground mining area are shown on Figure 1 to Figure 3 respectively.

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 existing WaterNSW gauging station on the Waratah Rivulet (GS 2132102), close to the inundation limits of the Woronora Reservoir;
- the existing WaterNSW gauging station on the Woronora River (GS 2132101), close to the inundation limits of the Woronora Reservoir (control site);
- the existing WaterNSW gauging station on O'Hares Creek at Wedderburn (GS 213200) (control site);
- the existing Metropolitan Coal gauging station on the Eastern Tributary (GS 300078) close to the inundation limits of the Woronora Reservoir;

[1] The Metropolitan Coal Longwalls 305-307 Water Management Plan includes post-mining monitoring and management of water resources and watercourses for Longwalls 20-27, 301-303 and 304.

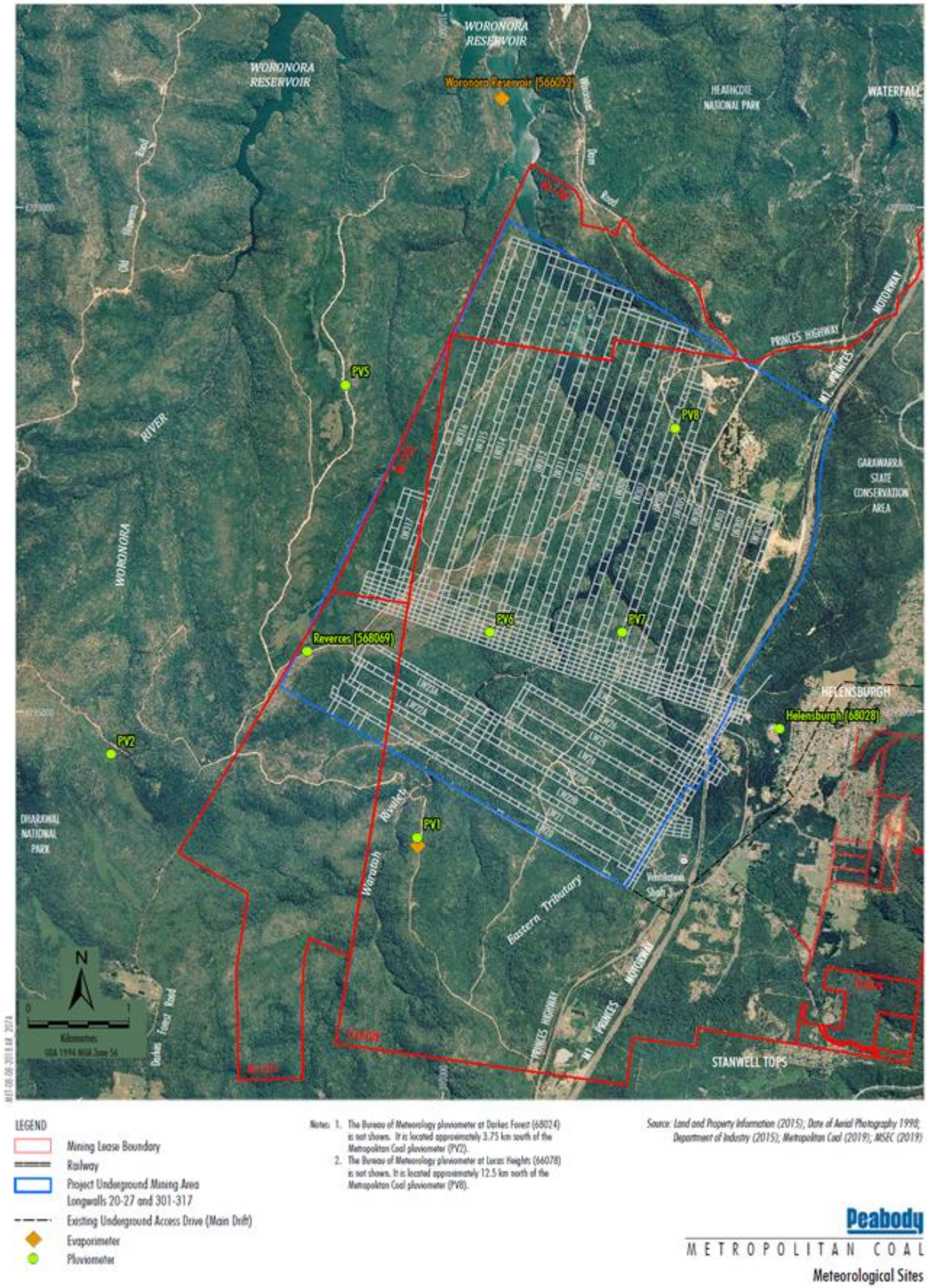


Figure 1 Meteorological Sites

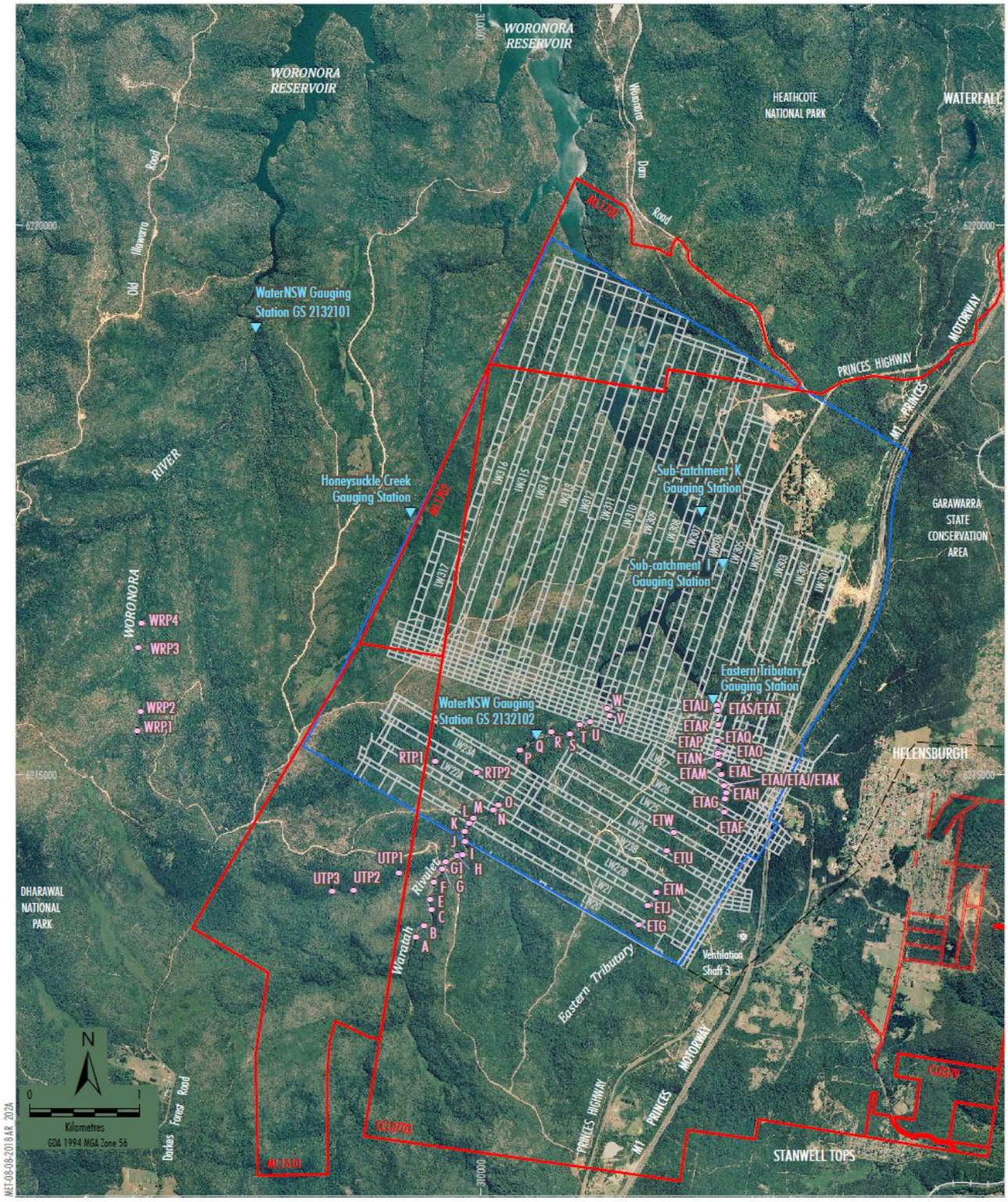
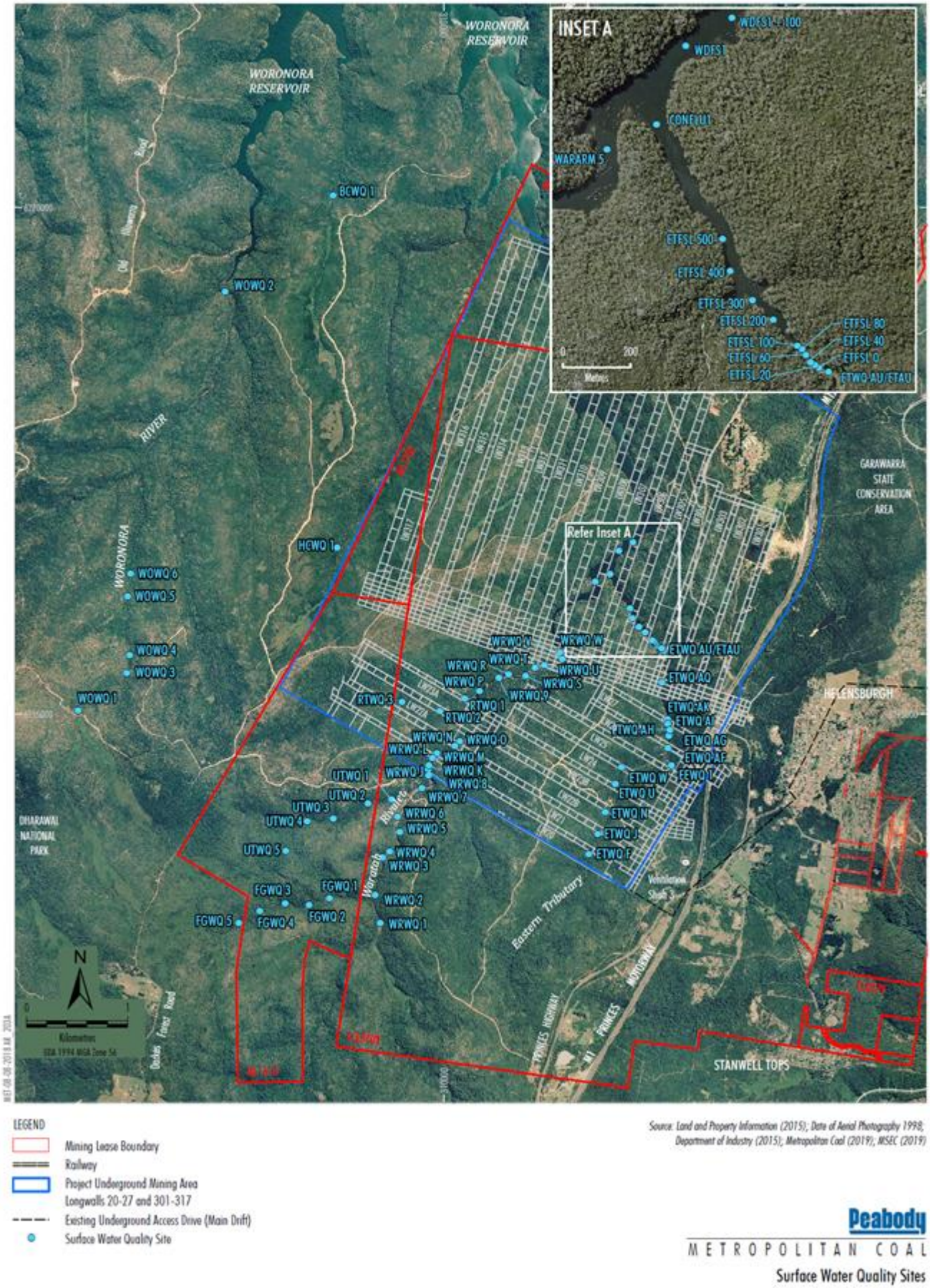


Figure 2 Surface Water Quantity Sites



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Surface Water Quality Site

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody
METROPOLITAN COAL
Surface Water Quality Sites

Figure 3 Surface Water Quality Sites

- the existing 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); and
- the Sub-Catchment K gauging station on a tributary to the east of the Woronora Reservoir (GS 300093).

Flow records from the Waratah Rivulet (GS 2132102), Woronora River (GS 2132101) 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; HEC, 2020) 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, ETU, ETW, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK[2], ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT[3] 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 water level behaviour for each pool during the 1 January to 30 June 2020 reporting period is provided in Table 1. In summary, all pools on Waratah Rivulet remained above the cease to flow level or historical minimum except for Pool A, Pool B and Pool N. Pool A was below the cease to flow level from 1 January to 18 January and again from 28 January to 7 February. Pool B was below the cease to flow level from 1 January to 16 January and Pool N was below the cease to flow level from 1 January to 16 January and on 5 February. The reduced water level at these pools is consistent with a reduction in water level observed at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River in January 2020 (refer Chart A47 to Chart A50,

[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 is 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.

Appendix A). Water level records for control pools WRP1, WRP2, WRP3 and WRP4 indicate that the pool water levels at each of these pools declined below the historically recorded minimum in the first half of January 2020.

Water levels in Pools ETJ, ETM, ETU, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ and ETAR on the Eastern Tributary fell below the cease to flow level or sensor level for parts of January and February 2020. Following a significant rainfall event in February 2020, the water level in all pools rose substantially and remained above the cease to flow level or sensor level for the remainder of the review period. The water level of Pool ETAS/ETAT and Pool ETAU did not fall below the cease to flow level or sensor level during the review period.

Consistent with historical behaviour, the water level at Pool RTP1 on Tributary B was below the sensor level for the majority of the review period except following rainfall events in February and March. Pool RTP2 water level was low for the first half of January before rising in response to the February rainfall event.

Table 1 Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
Monitored Pools on Waratah Rivulet			
A	Effectively impermeable rock bar. (Pool A impacted by previous mine subsidence and subject to previous stream remediation activities)	The water level of Pool A was below the cease to flow level from 1 January to 18 January and again from 28 January to 7 February. The water level rose substantially above the cease to flow level following a significant rainfall event in early February. Thereafter, the water level remained consistently above the cease to flow level with small rises occurring in response to subsequent rainfall events (Chart A1 [manual observations] and Chart A2 [logger data] in Appendix A). The reduced water level at Pool A prior to 7 February 2020 is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool A was not flowing from 1 January to 18 January and from 28 January to 7 February. On 7 February, the pool was observed to be flowing and on all subsequent inspection occasions.
B	Effectively impermeable rock bar. (Pool B impacted by previous mine subsidence)	Water level records for Pool B indicate that the pool ceased to flow from 1 January to 16 January (Chart A3 in Appendix A [manual observations]). From 17 January to 30 June, the water level records indicate that the pool was flowing continuously. The reduced water level at Pool B prior to 17 January is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool B ceased to flow from 1 January to 16 January 2020. Thereafter, the pool was observed to be flowing on all subsequent inspection occasions.
C	Effectively impermeable rock bar. (Pool C impacted by previous mine subsidence)	Pool C water level was consistent with natural behaviour, with water level records indicating that the pool continued to flow for the duration of the review period (Chart A4 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool C was overflowing the rock bar on all inspection occasions.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
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 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
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 in Appendix A [manual observations]).	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 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool G1 was overflowing the rock bar on all inspection occasions.
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 in Appendix A [manual observations]).	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 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate Pool I was overflowing the rock bar on all inspection occasions.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
J	Effectively impermeable rock bar.	Pool water level records (stage 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 in Appendix A [stage levels from the Metropolitan Coal gauging station]).	Metropolitan Coal's visual inspections indicate Pool J was overflowing the rock bar on all inspection occasions.
K	Effectively impermeable rock bar.	Pool K water levels were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A13 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool K was overflowing the rock bar on all inspection occasions.
L	Effectively impermeable rock bar.	Pool L water levels were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A14 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool L was overflowing the rock bar on all inspection occasions.
M	Effectively impermeable rock bar.	Pool M water levels were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A15 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool M was overflowing the rock bar on all inspection occasions.
N	Effectively impermeable rock bar. (Pool N impacted by mine subsidence; first ceased to overflow the rock bar in September 2012)	The water level of Pool N was below the cease to flow level from 1 January to 16 January and again on 5 February. The water level rose substantially above the cease to flow level following a significant rainfall event in February. Thereafter, the water level remained consistently above the cease to flow level with small rises occurring in response to subsequent rainfall events (Chart A16 in Appendix A [logger data]). The reduced water level at Pool N prior to 6 February is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool N ceased to flow from 1 January to 16 January and again on 5 February. The pool was observed to be flowing on all other inspection occasions.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
O	Boulder field.	Pool O water levels were consistent with natural behaviour for the duration of the review period (Chart A17 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
P	Permeable rock bar.	The water level of Pool P was near the historically low recorded water level from 1 January to 7 February. The water level rose substantially following a significant rainfall event in early February and remained above the historically low recorded water level for the remainder of the review period (Chart A18 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool P water levels appeared consistent with natural behaviour on all inspection occasions.
Q	Effectively impermeable rock bar.	Pool Q water levels were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A19 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool Q water levels appeared consistent with natural behaviour on all inspection occasions.
R	Effectively impermeable rock bar.	Recorded pool water levels were above the cease to flow level and consistent with natural behaviour for the duration of the review period (Chart A20 in Appendix A [logger data])[1].	Metropolitan Coal's visual inspections support the analysis of pool water level data.
S	Effectively impermeable rock bar.	Recorded pool water levels were at or above the cease to flow level and consistent with natural behaviour for the duration of the review period (Chart A21 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
T	Permeable rock bar.	The water level of Pool T was near the historically low recorded water level in early January though rose on 7 January following a rainfall event. Following a significant rainfall event in early February the water level rose substantially and remained above the historically low recorded water level for the remainder of the review period (Chart A22 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

[1] The water level sensor malfunctioned between 1 June 2020 and 4 June 2020. As such, no data was recorded during this period.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
U	Boulder field.	The Pool U water level was slightly above the previously recorded minimum water level at the start of January. Between 7 January and 18 February 2020, no water level data were recorded[2]. Following the significant rainfall event in February, the water level rose substantially above the previously recorded minimum and remained elevated for the duration of the review period (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
V	Permeable rock bar.	The Pool V water level was near the historically low recorded water level from 1 January to 7 February. The water level rose following a significant rainfall event in early February 2020 and remained above the historically low recorded water level for the remainder of the review period (Chart A24 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
W	Boulder field (underlain by a rock bar).	The Pool W water level was near the historically low recorded water level from 1 January to 7 February though it rose following a significant rainfall event in early February. Thereafter, the water level rose intermittently in response to subsequent smaller rainfall events (Chart A25 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

[2] The water level sensor was not recording data from 7 January 2020 until 18 February 2020.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
Monitored Pools on Eastern Tributary			
ETG	Effectively impermeable rock bar. (Pool ETG impacted by previous mine subsidence)	The recorded pool water level was at the cease to flow level from 1 January to 7 February though rose substantially following a significant rainfall event in early February. Thereafter, the water level rose intermittently in response to subsequent smaller rainfall events (Chart A26 in Appendix A [logger data]).	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)	The water level was below the pool sensor level from 1 January to 20 January and from 31 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A27 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETJ was dry on 6 January, above the sensor level on 21 January and flowing on all other inspection occasions.
ETM	Permeable rock bar. (Pool ETM impacted by previous mine subsidence)	The water level was below the pool sensor level from 1 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A28 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETM was dry on 6 January and 21 January and flowing on all other inspection occasions.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
ETU	Boulder field. (Pool ETU impacted by previous mine subsidence)	The water level at Pool ETU was below the sensor level from 1 January to 21 January. The water level rose above the sensor level in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the sensor level and continued to rise intermittently in response to subsequent smaller rainfall events[3] (Chart A29 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETU was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETW	Effectively impermeable rock bar. (Pool ETW impacted by previous mine subsidence)	The water level at Pool ETW declined in early to mid-January though rose in mid to late-January in response to a rainfall event. The water level rose substantially in response to a significant rainfall event in early February. Thereafter, the water level continued to rise intermittently in response to subsequent smaller rainfall events (Chart A30 in Appendix A [logger data]).	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)	The water level was below the sensor level from 1 January to 17 January. The water level rose above the sensor level in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the sensor level and continued to rise intermittently in response to subsequent smaller rainfall events (Chart A31 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETU was dry on 6 January though the water level was above the sensor level on all other inspection occasions.

[3] Due to a failure during data download, data was lost from 5/6/2020 until the end of the review period.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
ETAG	Boulder field. (Pool ETAG impacted by previous mine subsidence)	The water level was below the pool sensor level from 1 January to 17 January and from 24 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A32 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAG was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAH	Permeable rock bar. (Pool ETAH impacted by previous mine subsidence).	The water level was below the pool sensor level for the majority of January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A33 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAH was dry on 6 January, above the sensor level on 21 January and flowing on all other inspection occasions.
ETAI/ ETAJ/ETAK	Effectively impermeable rock bar. (Pool ETAI/ETAJ/ETAK impacted by previous mine subsidence).	The water level was below the pool sensor level for the majority of January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained above the sensor level until March. For the remainder of the review period, the water level rose intermittently in response to rainfall events and declined intermittently to the level of the sensor (Chart A34 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAI was dry in January and flowing in February with the water level above the sensor level all other inspection occasions.
ETAL	Boulder field/alluvial deposit. (Pool ETAL impacted by previous mine subsidence).	The water level was below the pool sensor level for the majority of January to 7 February. The water level rose in response to a significant rainfall event in early February and remained above the sensor level until March. For the remainder of the review period, the water level rose intermittently in response to rainfall events and declined intermittently to the level of the sensor (Chart A35 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAL was dry in January, the water level was above the sensor level all inspection occasions from February to May and dry in June 2020.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
ETAM	Boulder field/ alluvial deposit. (Pool ETAM impacted by previous mine subsidence).	The water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A36 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAM was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAN	Permeable rock bar. (Pool ETAN impacted by previous mine subsidence).	The water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A37 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAN was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAO	Permeable rock bar. (Pool ETAO impacted by previous mine subsidence).	The water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A38 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAO was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAP	Boulder field. (Pool ETAP impacted by previous mine subsidence).	The water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A39 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAP was dry on 6 January, the water level was above the sensor level on 21 January and the pool was flowing on all other inspection occasions.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
ETAQ	Effectively impermeable rock bar. (Pool ETAQ impacted by previous mine subsidence).	The Pool ETAQ water level was below the cease to flow level from 1 to 17 January and from 31 January to 7 February 2020. The water level rose in response to a significant rainfall event in early February and remained above the cease to flow level for the remainder of the review period (Chart A40 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAQ was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAR	Permeable rock bar. (Pool ETAR impacted by previous mine subsidence).	The water level was below the sensor level from 1 January to 17 January. The water level rose in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained elevated for the remainder of the review period (Chart A41 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAQ was dry on 6 January though the water level was above the sensor level on all other inspection occasions.
ETAS/ETAT	Effectively impermeable rock bar.	The pool water level was near the historically low recorded water level from 1 to 17 January. The water level rose in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the historically low recorded water level, rising in response to subsequent smaller rainfall events (Chart A42 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

Table 1 (Continued) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 30 Jun 2020	Comments
ETAU	Pool ETAU flows through Eastern Tributary gauging station, then over a rock bar and waterfall.	Pool ETAU water levels were consistent with natural behaviour during the review period (Chart A43 in Appendix A and Chart A44 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
Monitored Pools on Reference Tributary/Tributary B			
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. The water level of Pool RTP1 was below the sensor level for the majority of the review period except following rainfall events in February and March (Chart A45 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
RTP2	Effectively impermeable rock bar.	Records indicate that the water level of Pool RTP2 on Tributary B regularly falls to low levels except during and following rainfall events. The pool water level was low from 1 to 17 January. From 18 January the water level rose in response to a rainfall event before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained elevated for the remainder of the review period (Chart A46 in Appendix A [logger data]).	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 Figure 3:

- sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N, WRWQ P, WRWQ R, WRWQ T 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; 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 (SO_4), bicarbonate (HCO_3), total nitrogen (N_{tot}), total phosphorus (P_{tot}), nitrate (NO_3), 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.

Monitoring results for the sites listed above are shown on a series of plots in Appendix B.

2.4.1 Waratah Rivulet

Upstream sites on Waratah Rivulet (sites WRWQ 2 and WRWQ 6) recorded slightly acidic to near neutral pH values, with higher (slightly alkaline to alkaline) values being recorded at middle and lower reach sites (e.g. at sites WRWQ 8, WRWQ T and WRWQ W). The pH values at sites WRWQ 8 and WRWQ T have shown a generally increasing trend since mid-2016. Historically high pH values (field) were recorded at WRWQ 8 (8.96) and WRWQ T (9.47) in January 2020 prior to a significant rainfall event in February. Following the significant rainfall event, the pH values recorded at these sites returned to within the range of historical values.

Electrical conductivity values were generally lower in comparison with pre-2020 values, particularly following the significant rainfall event in February. There were no historically high electrical conductivity values (laboratory) recorded during the review period.

Dissolved iron concentrations were below 0.6 mg/L during the reporting period at all sites and, at a number of sites, below the limit of detection (0.05 mg/L). A historically high concentration of 0.09 mg/L dissolved aluminium was recorded at WRWQ P, WRWQ R and WRWQ T in February and a historically high concentration of 0.07 mg/L dissolved aluminium was recorded at WRWQ M and WRWQ N in March. From April to June, the dissolved aluminium concentrations recorded at all sites were within the range of historical concentrations or below the limit of detection (0.01 mg/L).

A slightly increasing trend in dissolved manganese concentrations has been recorded for WRWQ 2, WRWQ 6, WRWQ 8, WRWQ M and WRWQ N since 2016 and this continued at most sites in January and early February 2020. Following the significant rainfall event in February, the dissolved

manganese concentrations at all sites reduced to within the range of historical values (less than 0.2 mg/L at all sites). A historically high concentration of 0.41 mg/L dissolved manganese was recorded at WRWQ 2 in January prior to the significant rainfall event in February.

2.4.2 Woronora River

The pH levels recorded at sampling sites WOWQ 1 and WOWQ 2 during the review period indicated acidic to slightly acidic conditions. The pH records were generally more acidic than historical values, with a historically low value of pH 4.1 (field) recorded at WOWQ 2 in February 2020. The electrical conductivity values recorded at WOWQ 1 and WOWQ 2 during the review period were within the range of historically recorded values.

Dissolved iron concentrations were generally low (below 0.67 mg/L) and within the range of historical concentrations. The dissolved aluminium concentrations rose at both WOWQ 1 and WOWQ 2 following the significant rainfall event in February 2020, with a historically high concentration of 0.56 mg/L dissolved aluminium recorded at WOWQ 2 in February.

The dissolved manganese concentrations recorded at WOWQ 2 also rose following the significant rainfall event in February 2020, with a historically high concentration of 0.23 mg/L dissolved aluminium recorded at WOWQ 2 in March.

2.4.3 Eastern Tributary

The pH values recorded during the review period for the Eastern Tributary indicate slightly acidic to slightly alkaline conditions, consistent with historical values. The electrical conductivity values recorded for the majority of Eastern Tributary sites have tended to be more elevated relative to pre-2016 values, though values have slightly declined during the review period.

Variable dissolved aluminium concentrations were recorded at all sites during the review period. A historically high concentration of dissolved aluminium was recorded at ETWQ U (0.18 mg/L) in February 2020, though at other sites the dissolved aluminium concentrations recorded during the review period did not exceed the previously recorded maximum.

Elevated concentrations of dissolved iron have been recorded in the Eastern Tributary since mid-2016. A historically high concentration of 1.19 mg/L dissolved iron was recorded at ETWQ F in February 2020. For all other sites in the Eastern Tributary, the historically high dissolved iron concentration was not exceeded during the review period.

Elevated concentrations of dissolved manganese have been recorded in the Eastern Tributary since mid-2016, though the dissolved manganese concentrations recorded at all sites declined during the review period. The dissolved manganese concentrations were less than 1 mg/L at all sites and there were no exceedances of the historical maximum recorded during the review period.

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

During the monitoring period, the pH levels recorded at Bee Creek (BCWQ 1) and Honeysuckle Creek (HCWQ 1) indicated acidic conditions, while pH levels in Far Eastern Tributary (FEWQ 1), Tributary B/Reference Tributary (RTWQ 1) and Tributary D/Un-named Tributary (UTWQ 1) were slightly acidic to slightly alkaline. The pH levels recorded during the monitoring period were consistent with historical values.

The electrical conductivity values at RTWQ1 have tended to be more elevated and variable relative to pre-2013 values, though this trend has slightly declined during the review period. The electrical conductivity values recorded at all sites were within or less than the range of historical values.

Dissolved iron concentrations recorded during the review period were consistent with historical concentrations and there were no exceedances of the historical maximum at any site. The dissolved aluminium concentrations rose at FEWQ 1, HCWQ 1 and BCWQ 1 following the significant rainfall event in February 2020. A historically high concentration of dissolved aluminium was recorded at BCWQ 1 (1.35 mg/L) and HCWQ 1 (0.87 mg/L) in May 2020.

Dissolved manganese concentrations recorded during the review period were generally consistent with historical values. A spike in dissolved manganese of 0.75 mg/L was recorded at UTWQ 1 in January 2020 although this concentration did not exceed the historical maximum recorded at this site.

2.5 WORONORA RESERVOIR WATER QUALITY

Metropolitan Coal has sourced water quality data for the Woronora Reservoir (at sampling location DWO1), Nepean Reservoir (at sampling location DNE2 or DNE1) and Cataract Reservoir (at sampling location DCA1) 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.

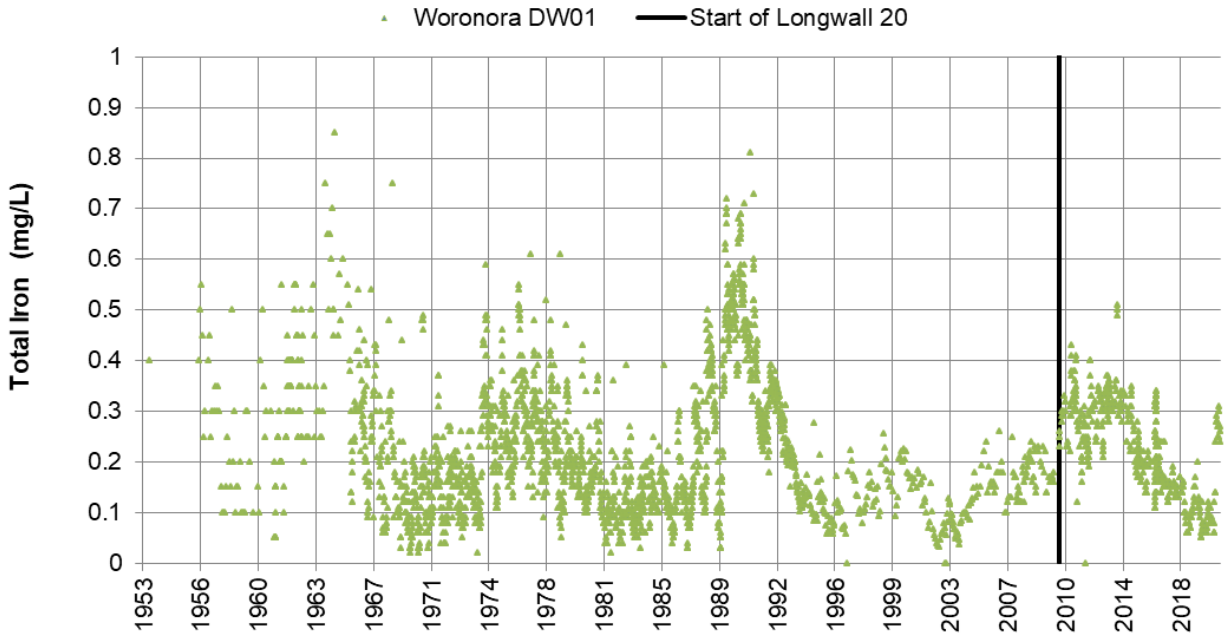


Chart 1 Total Iron Concentration Woronora Reservoir

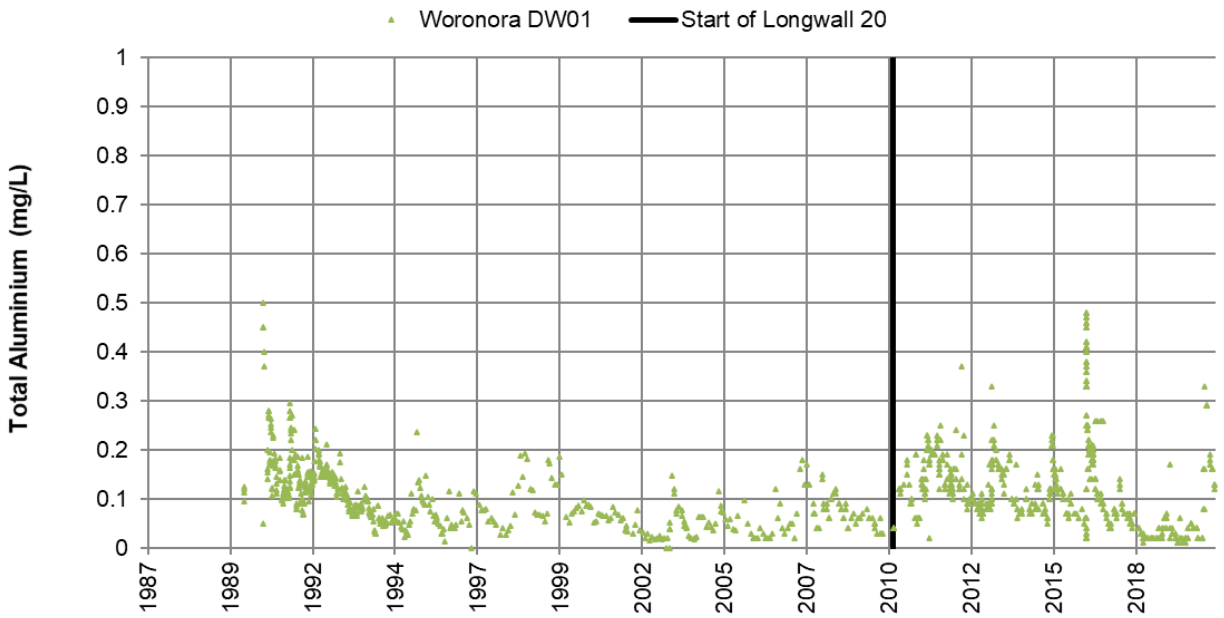


Chart 2 Total Aluminium Concentration Woronora Reservoir

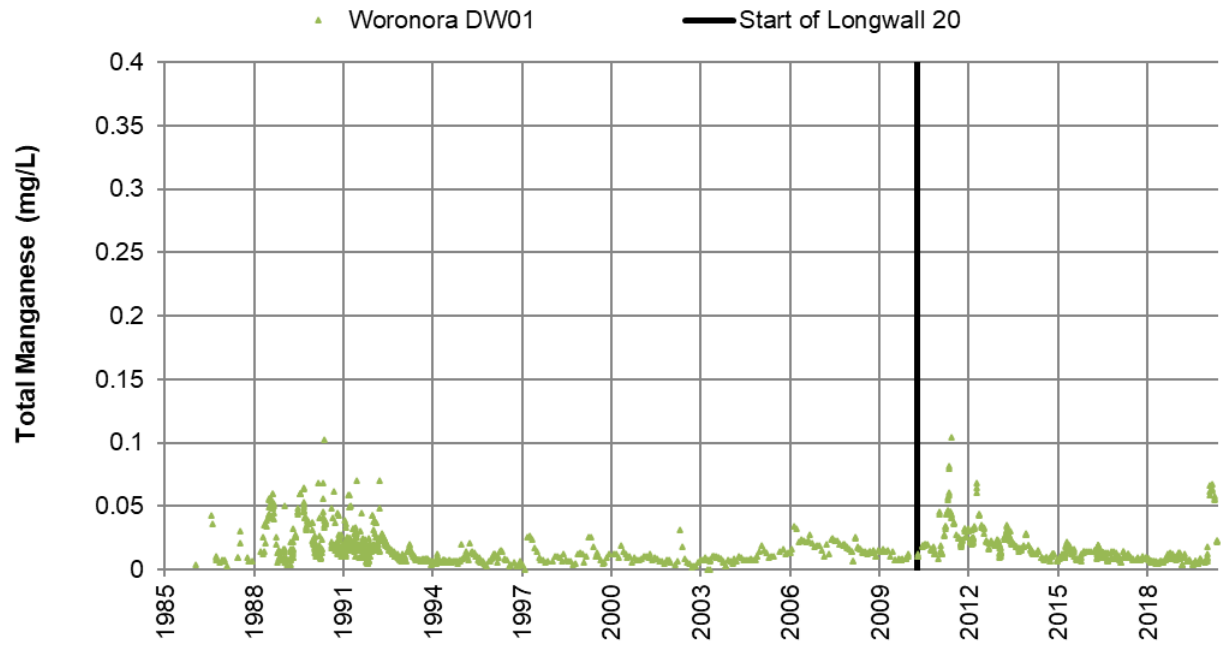


Chart 3 Total Manganese Concentration Woronora Reservoir

The data presented in Chart 1 to Chart 3 indicate an increase in the total concentration of iron, aluminium and manganese recorded in the Woronora Reservoir (0 m to 9 m below the reservoir surface) during the review period. Intermittent increases in the total concentration of iron, aluminium and manganese are evident over the period of record, including during the baseline period prior to the start of Longwall 20. The maximum concentration of total iron, total aluminium and total manganese recorded during the review period did not exceed the maximum concentration of these constituents recorded during the baseline period prior to the start of Longwall 20.

3.0 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 (2010, 2014b, 2016a, 2019a and 2020a).

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 per day [mm/day] or less[4]) 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 over a moving window of 1 year.

The streamflow records for GS 2132102 provided by WaterNSW were incomplete for the previous review period (1 July to 31 December 2019) and, as such, assessment of the results for the review period, 1 July to 31 December 2019, against the Longwall 304 Water Management Plan significance levels/triggers were unable to be conducted at the time of reporting.

The streamflow records for GS 2132102 provided by WaterNSW for the current review period include the period of data from 1 July to 31 December 2019, and, as such, the assessment has been undertaken for the period 1 July 2019 to 30 June 2020. The results for the review period, 1 July 2019 to 30 June 2020, have been assessed against the significance levels/triggers from the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan[5] (below):

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

[5] The Longwall 304 Water Management Plan applies to the period from 1 July 2019 to 11 April 2020 and the Longwalls 305-307 Water Management Plan applies to the period from 12 April 2020 to 30 June 2020. The significance levels/triggers for the performance measure "Negligible reduction to the quantity of water resources reaching the Woronora Reservoir" are the same for the two management plans.

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 35th percentile of the baseline data
Level 2	The median of the ratios falls below the 35th percentile but does not fall below the 20th percentile of the baseline data
Level 3	The median of the ratios falls below the 20th 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 2020.

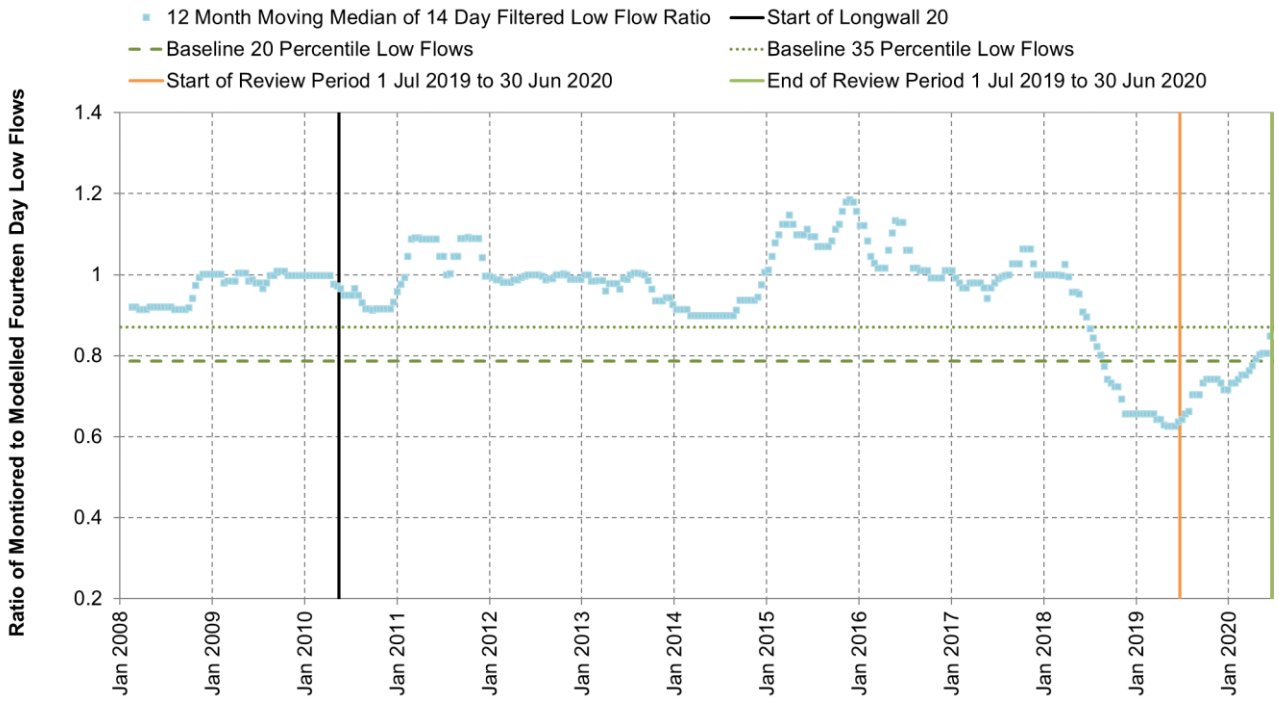


Chart 4 One Year Moving Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Waratah Rivulet (GS 2132102)

The results show that the moving 12 month median of the 14 day filtered low flow ratio fell below the 20th percentile of the baseline data during 2018 and remained below the 20th percentile until late April 2020. From late April 2020, the moving 12 month median of the 14 day filtered low flow ratio increased from the 20th percentile to just below the 35th percentile. In accordance with the Metropolitan Coal Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan Trigger Action Response Plan (TARP), this equates to a Level 3 significance from 1 July 2019 to April 2020 and a Level 2 significance from May to June 2020.

To assess if similar conditions have occurred at the control site in the region, a comparison of the 12 month median of the ratio of 14 day sums of monitored flow at a control site on O'Hares Creek at Wedderburn (GS 213200) and flows simulated with the AWBM have been assessed.

A catchment model was previously developed and calibrated for O'Hares Creek using a modified version of the AWBM. The modified catchment model was calibrated to streamflow records for O'Hares Creek for the period February 2007 to December 2009 (Gilbert & Associates, 2015b). During the re-calibration process, it was identified that the main limitation of the O'Hares Creek model calibration was likely to be the representativeness of the rainfall data adopted in the modelling because there were limited rainfall gauges in the vicinity of the O'Hares Creek catchment during the period of model calibration (Gilbert & Associates, 2015b).

Additional rainfall data recorded in the vicinity of the O'Hares Creek catchment has since become available to enable model re-calibration, in addition to an extended record of streamflow data for GS 213200 (January 2007 to December 2019). The O'Hares Creek catchment model has subsequently been re-calibrated thereby reducing the variability between the recorded and modelled flows and improving the performance of the model as a control against which to assess streamflow reaching the Woronora Reservoir (HEC, 2020). The re-calibrated AWBM has been used to conduct the assessment presented in Chart 5 below.

Chart 5 shows a plot of the moving 12 month median of the ratio of 14 day sums of monitored flow at O'Hares Creek at Wedderburn (GS 213200) and flows simulated with the re-calibrated AWBM to 30 June 2020.

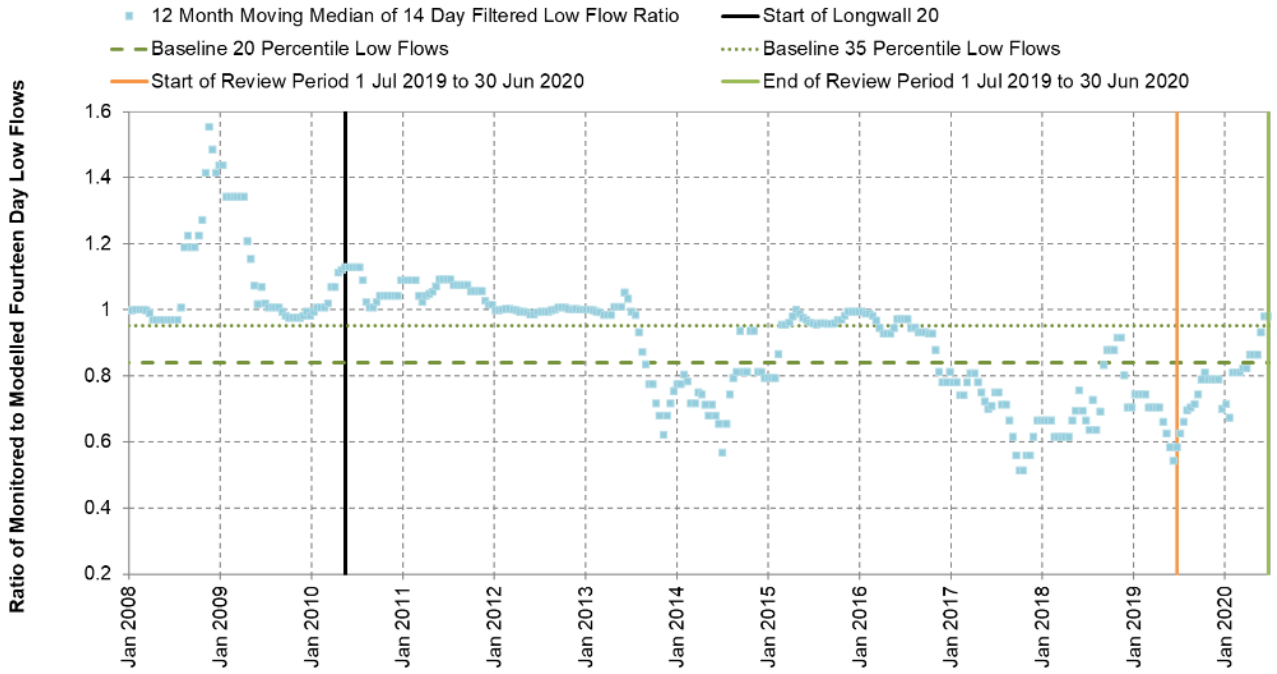


Chart 5 One Year Moving Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at O'Hares Creek at Wedderburn (GS 213200)

The results in Chart 5 show that the moving 12 month median of the 14 day filtered low flow ratio at O'Hares Creek at Wedderburn (GS 213200) also remained below the 20th percentile of the baseline data until late April 2020. From late April 2020, the moving 12 month median of the 14 day filtered low flow ratio increased from the 20th percentile to just above the 35th percentile. This illustrates that similar flow conditions have occurred at both Waratah Rivulet and the control site (O'Hares Creek at Wedderburn). As such, while the Metropolitan Coal Longwalls 304 Water Management Plan Trigger Action Response Plan (TARP) reached Level 3 from January to April 2020, 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 2020 has been provided from gauging station 300078 – Eastern Tributary upstream of Woronora Reservoir. Flow data is available from the time of station establishment on 23 September 2012. The available data is shown on Chart 6 below together with model predicted results.

Results show that streamflow recorded at the gauging station has been continuous and has generally been consistent with or above model predictions. This indicates that flows reaching the Woronora Reservoir have not been reduced by mining.

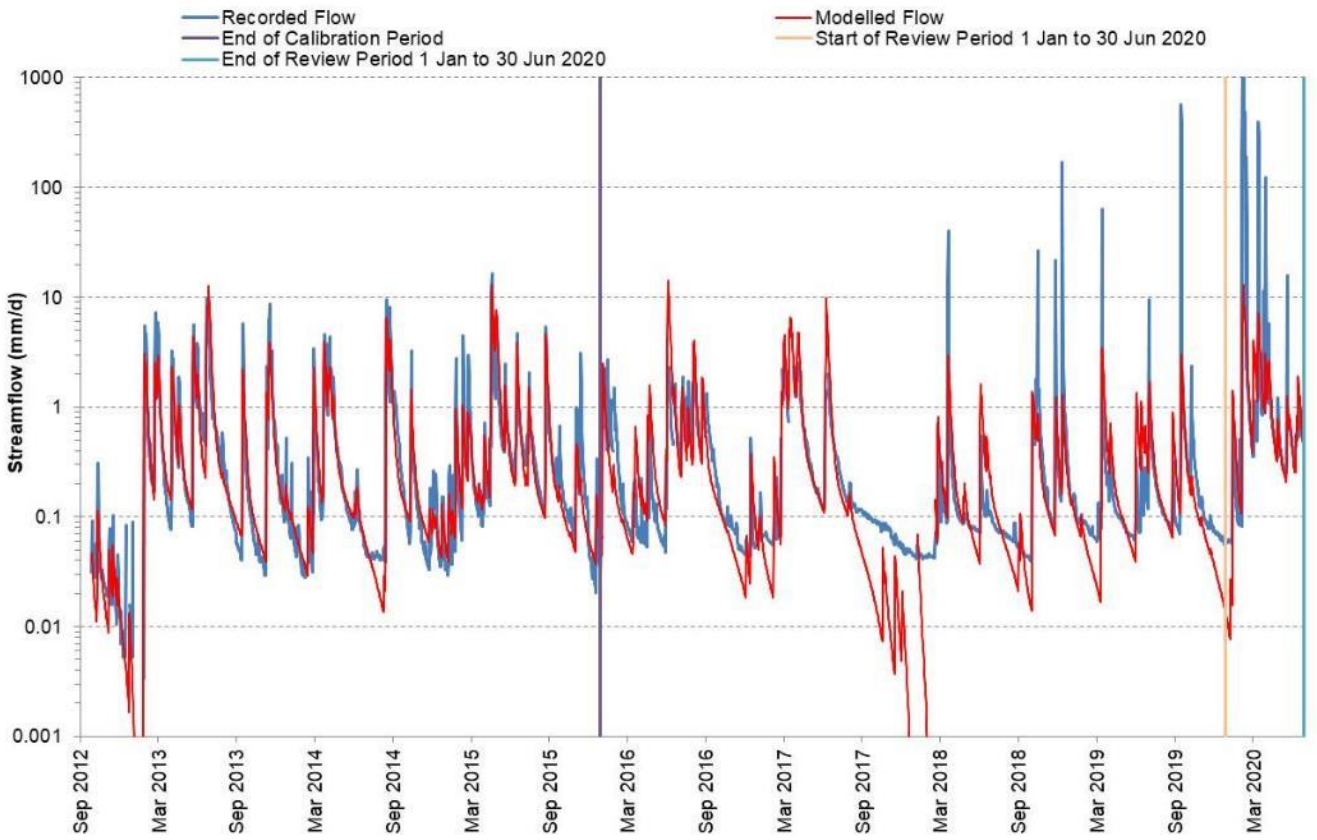


Chart 6 Monitored and Model Predicted Flows – Eastern Tributary Upstream of Woronora Reservoir

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 were installed on small tributary catchments, Sub-Catchment I and Sub-Catchment K, on the eastern side of the Woronora Reservoir (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 forms a control for the assessment of potential impacts to streamflow in Sub-Catchment I associated with development of Longwall 301 to Longwall 304. Sub-Catchment K predominately overlies Longwall 306 and Longwall 307, with a small proportion overlying the northern end of Longwall 305. As such, Sub-Catchment K may also be progressively influenced by subsidence movements associated with Longwall 305 to Longwall 307. Metropolitan Coal will continue to monitor the Sub-Catchment I and Sub-Catchment K streamflow gauging stations until such time as mine subsidence influences are recorded (Metropolitan Coal, 2020b).

Secondary extraction from Longwall 302 was occurring at the commencement of monitoring at these gauging stations and continued to 6 October 2018. Secondary extraction of Longwall 303 commenced in November 2018 and was completed in June 2019, while mining of Longwall 304 commenced in July 2019 and was completed in April 2020. Mining of Longwall 305 commenced in 12 April 2020 and was on-going at end of the review period.

The recorded stage data and the cease to flow (CTF) level for Sub-Catchment I and Sub-Catchment K are presented in Chart 7 and the streamflow records presented in Chart 8.

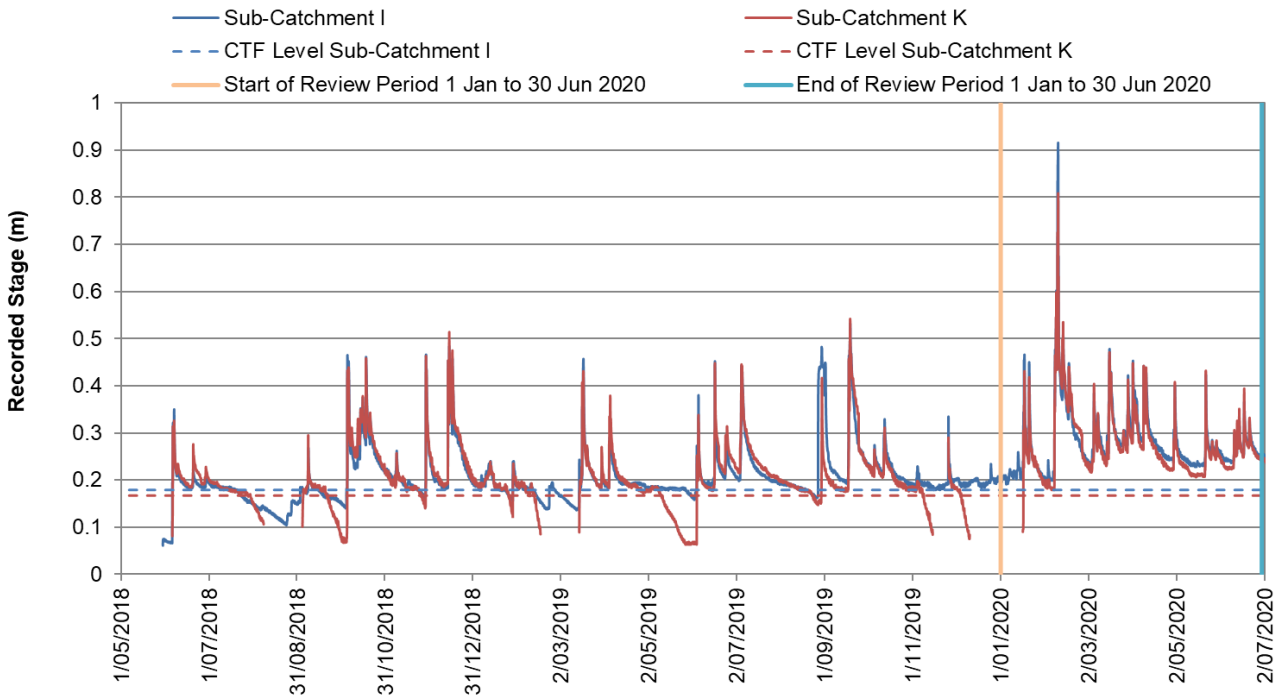


Chart 7 Sub-Catchment I and Sub-Catchment K Recorded Stage and Cease to Flow Level

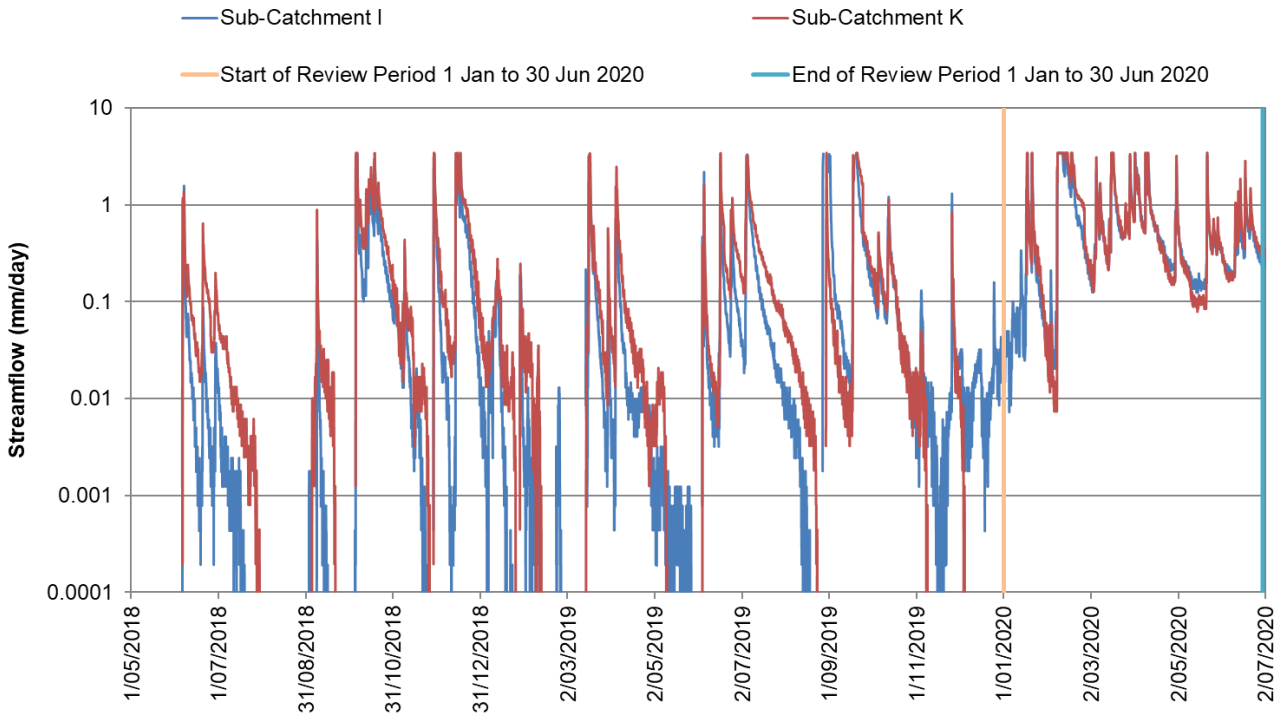


Chart 8 Sub-Catchment I and Sub-Catchment K Streamflow Rates

A detailed assessment of the water level and streamflow records for Sub-Catchment I and Sub-Catchment K for the period June 2018 to July 2019 (HEC, 2019b) identified that the water level and streamflow characteristics were consistent at both sites over the assessment period. The runoff recession during low flow periods was observed to be more rapid at the gauging station for Sub-

Catchment I than for Sub-Catchment K however there was no indication of any change in the recessionary behaviour over the review period.

The water level and streamflow records (refer Chart 7 and Chart 8) illustrate that the water level at Sub-Catchment K was below the cease to flow level for the period January to February 2020. Following the significant rainfall event in February 2020, the water level and streamflow rates increased at both sites with similar characteristics observed at both sites for the remainder of the review period. There is no visual indication of a change in recessionary behaviour (i.e. rate of recession) for Sub-Catchment I (refer Chart 8) and no indication from the recorded stage and streamflow data that mining of Longwall 301 to Longwall 304 has impacted streamflow at the Sub-Catchment I gauging station. Additionally, there is no visual indication of a change in recessionary behaviour (i.e. rate of recession) for Sub-Catchment I or Sub-Catchment K (refer Chart 8) and no indication from the recorded stage and streamflow data that mining of Longwall 305 has impacted streamflow at the Sub-Catchment I or Sub-Catchment K gauging station to date.

3.1.4 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 WOWQ2.*

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 for this review period (1 January to 30 June 2020) have been assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan[6] significance levels/triggers (below):

[6] The Longwall 304 Water Management Plan applies to the period from 1 January 2020 to 11 April 2020 and the Longwalls 305-307 Water Management Plan applies to the period from 12 April 2020 to 30 June 2020. The significance levels/triggers for the performance measure "Negligible reduction to the quality of water resources reaching the Woronora Reservoir" are the same for the two management plans.

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.

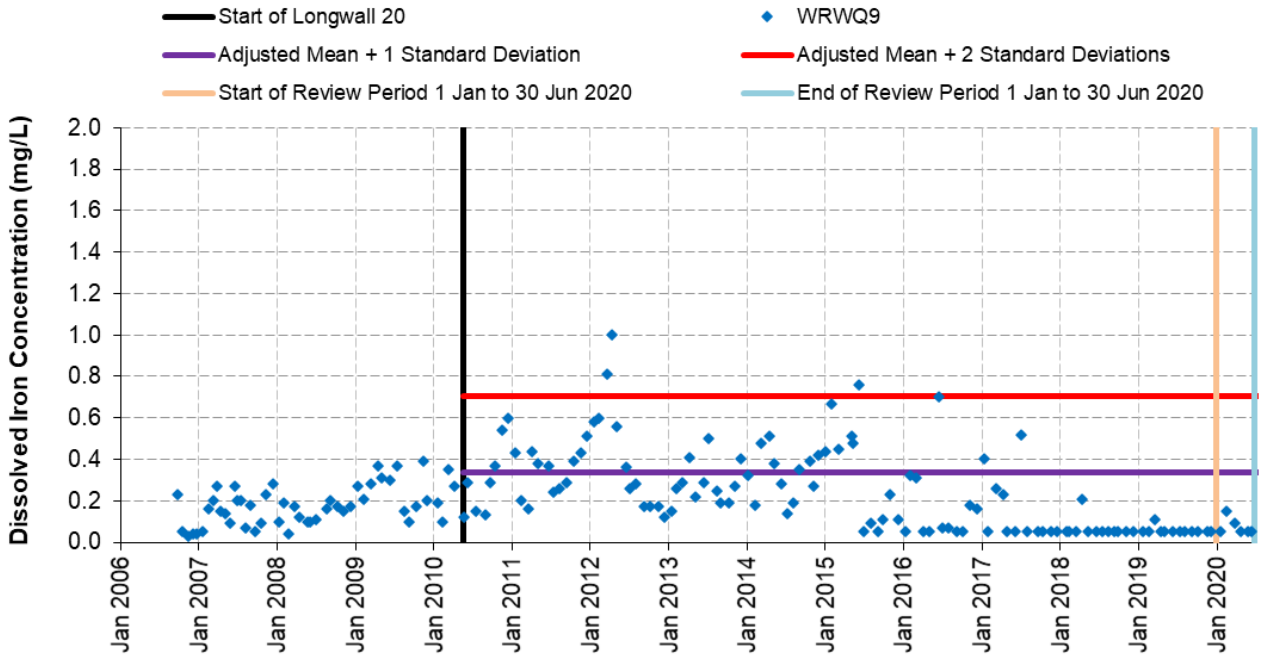


Chart 9 Dissolved Iron Concentrations in Waratah Rivulet at WRWQ9

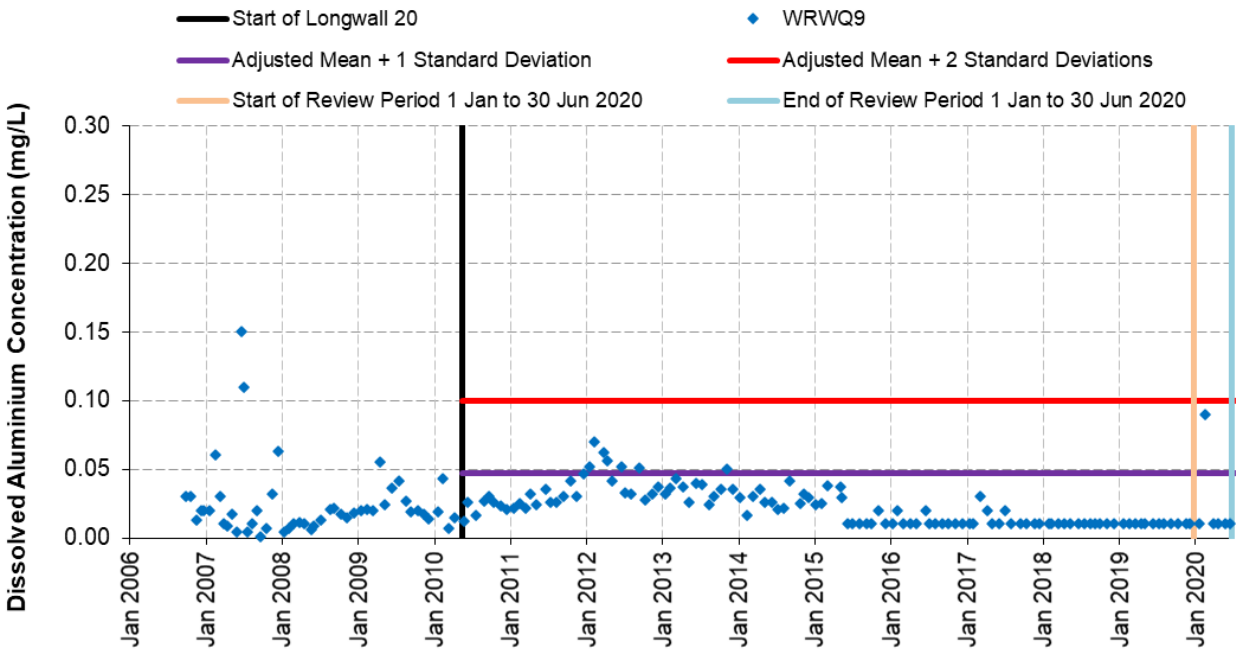


Chart 10 Dissolved Aluminium Concentrations in Waratah Rivulet at WRWQ9

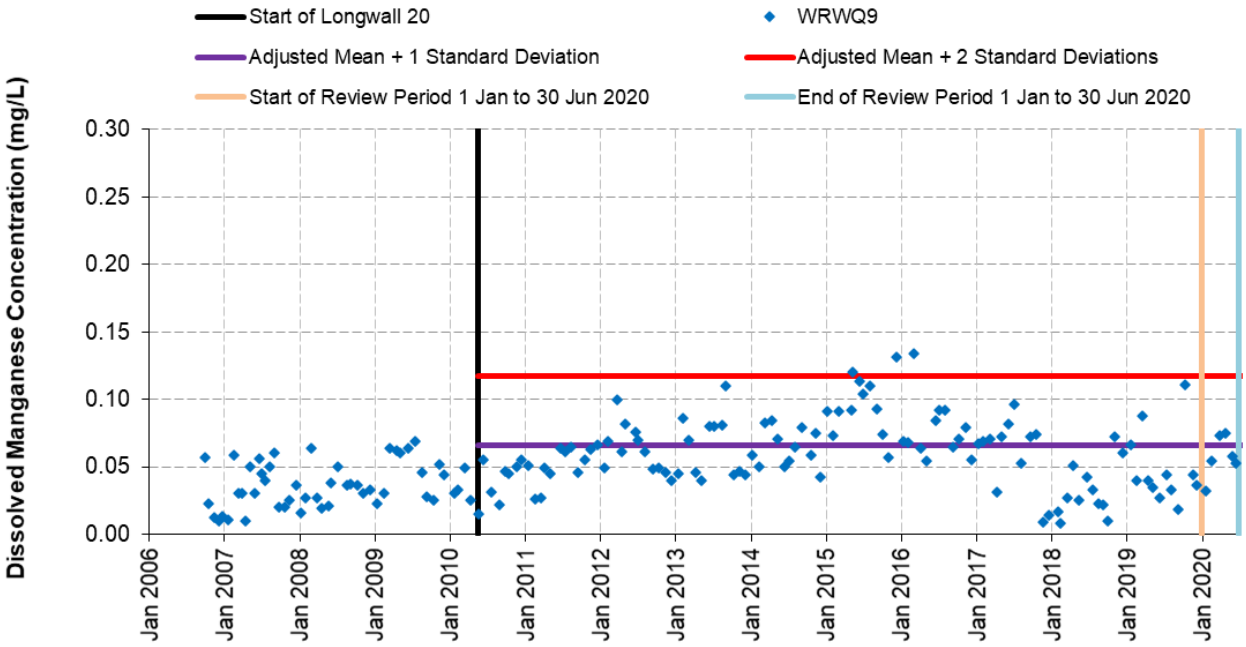


Chart 11 Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ9

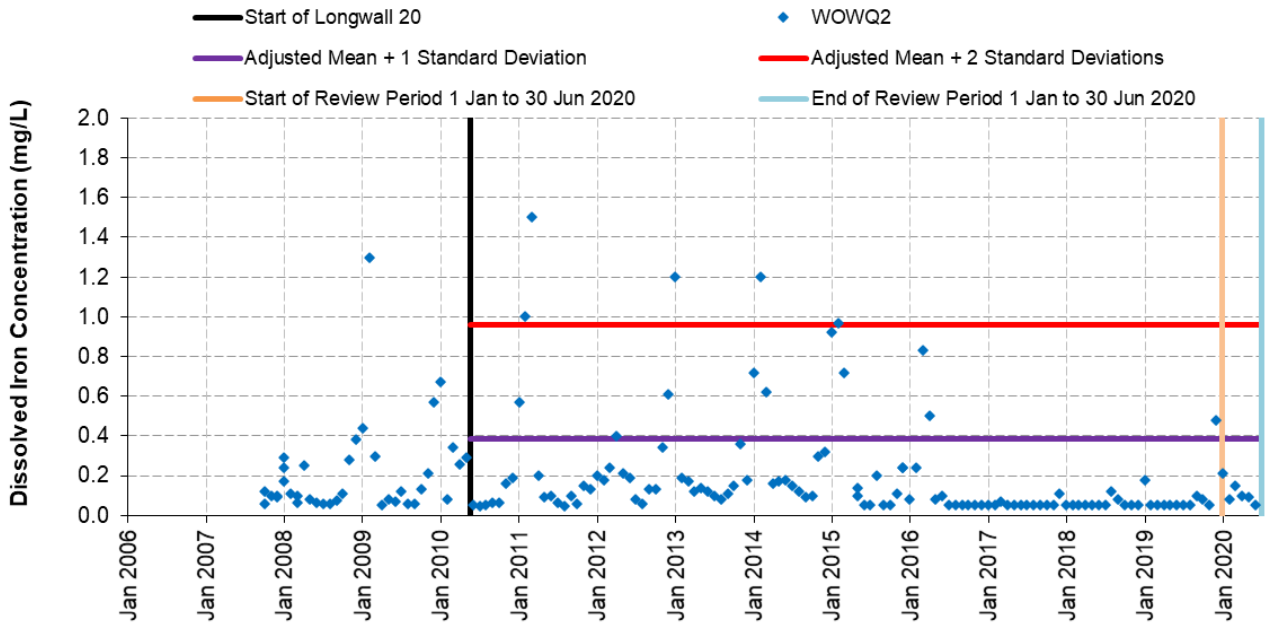


Chart 12 Dissolved Iron Concentrations in Woronora River at WOWQ2

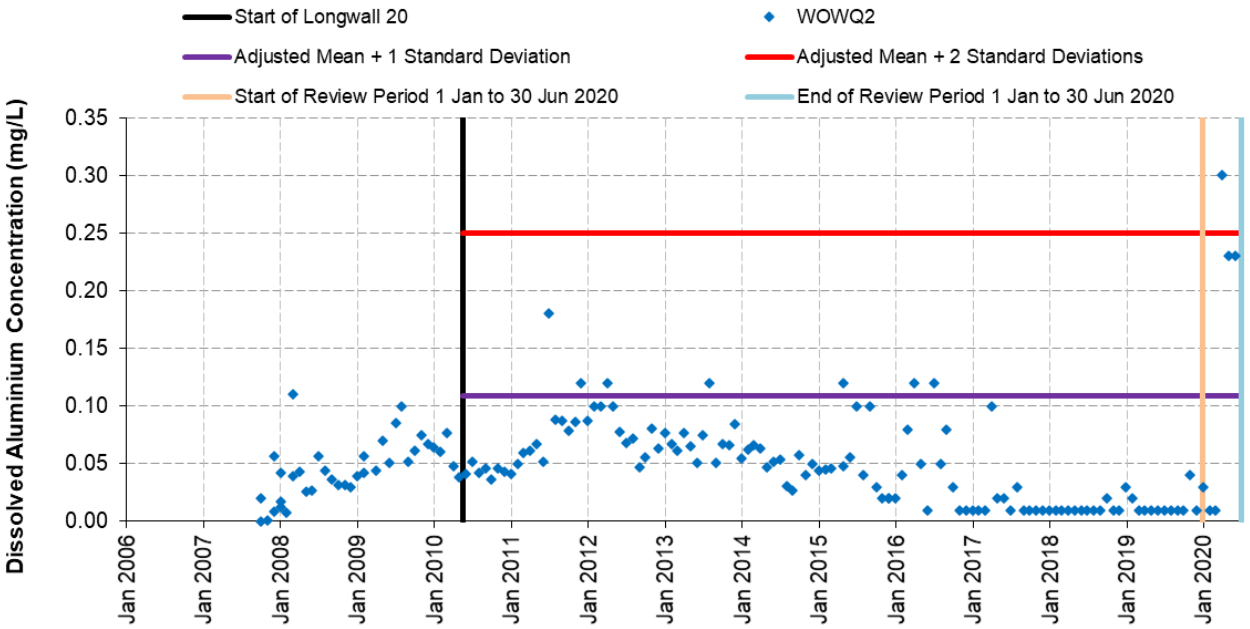


Chart 13 Dissolved Aluminium Concentrations in Woronora River at WOWQ2

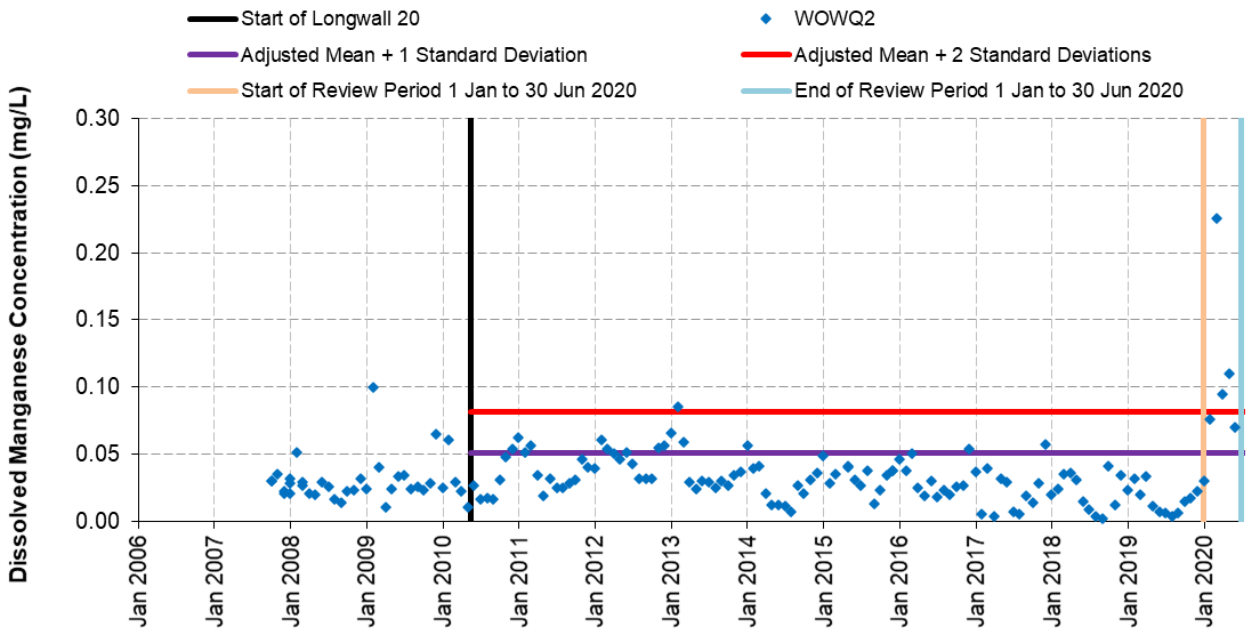


Chart 14 Dissolved Manganese Concentrations in Woronora River at WOWQ2

Chart 9 to Chart 11 indicate that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron, dissolved aluminium or dissolved manganese in Waratah Rivulet at site WRWQ 9 during this reporting period. The results equate to a Level 1 significance level. There were also no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved iron, though the dissolved aluminium concentrations exceeded the adjusted baseline mean plus two standard deviations in April 2020 and the dissolved manganese concentrations exceeded the adjusted baseline mean plus two standard deviations in March to May 2020 (Chart 12 to Chart 14).

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

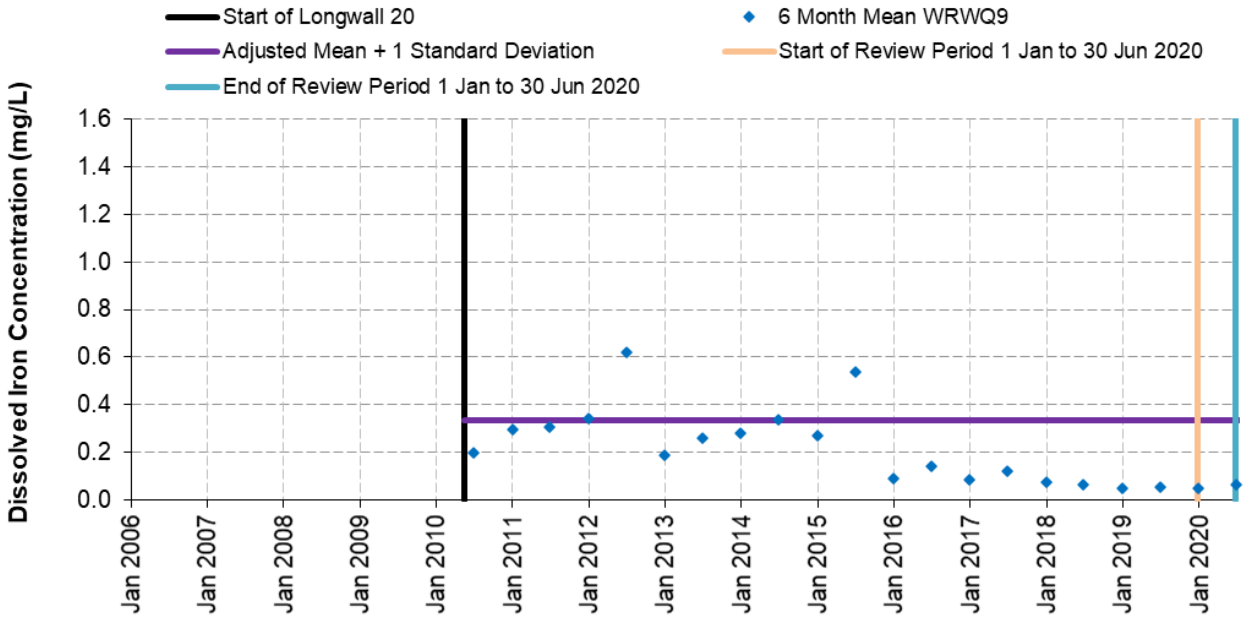


Chart 15 Six Monthly Means of Dissolved Iron Concentrations in Waratah Rivulet at WRWQ9

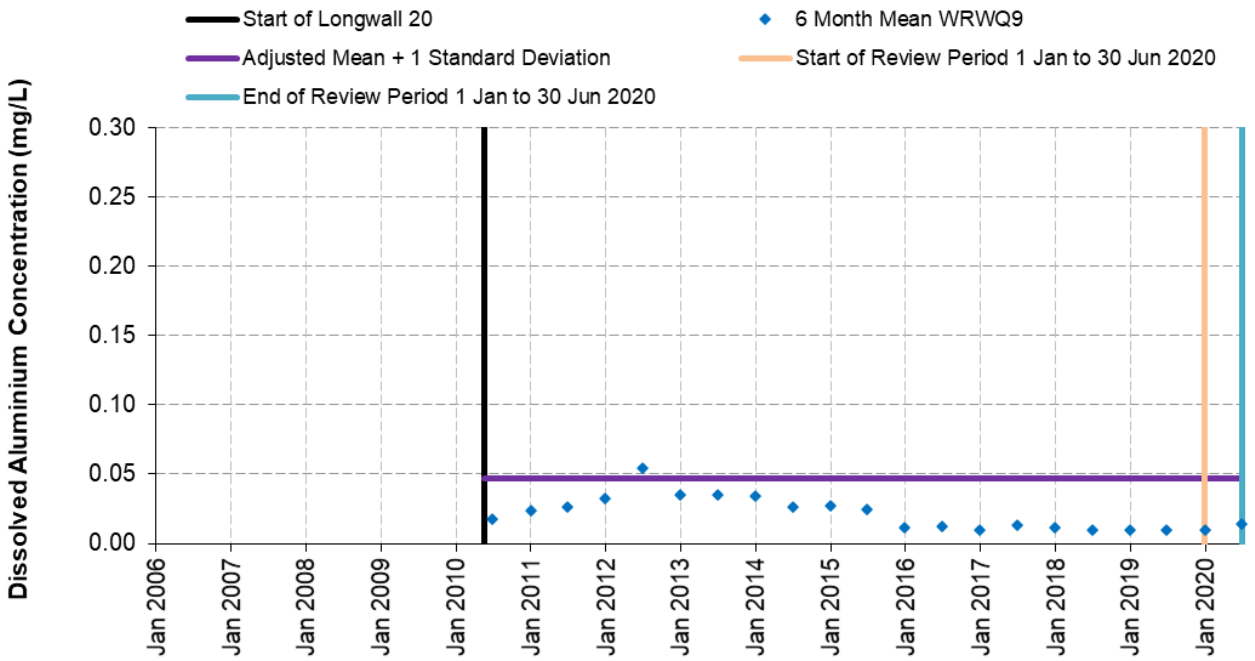


Chart 16 Six Monthly Means of Dissolved Aluminium Concentrations in Waratah Rivulet at WRWQ9

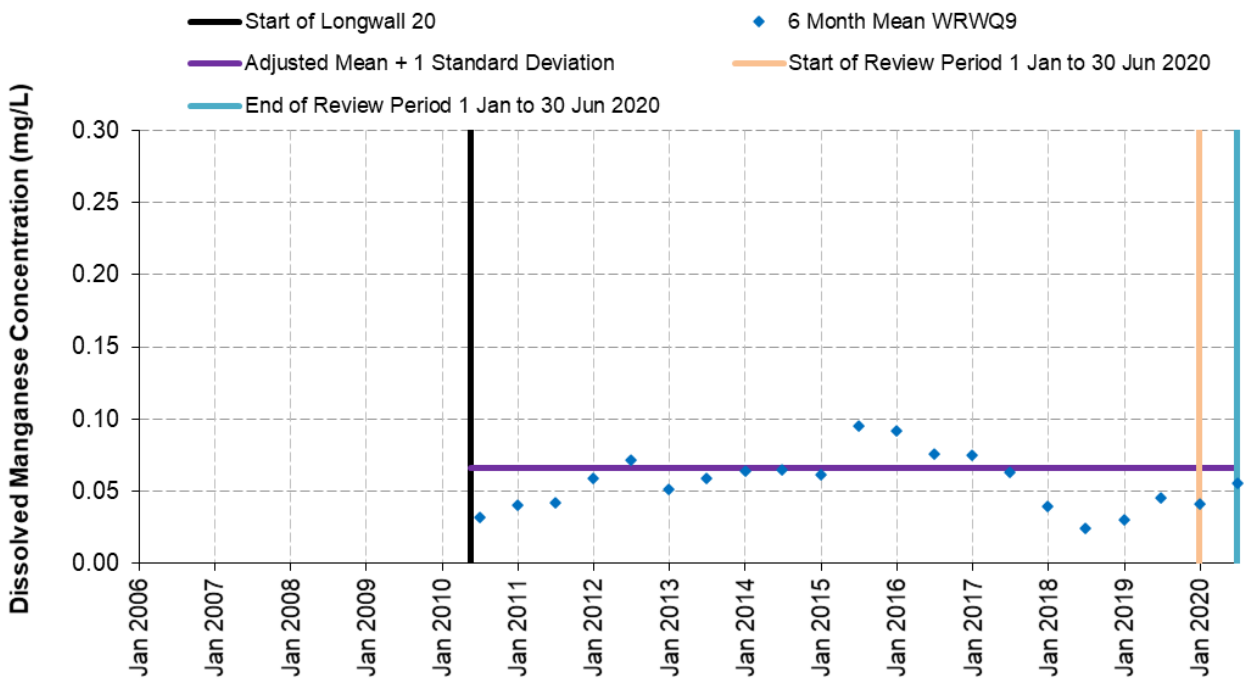


Chart 17 Six Monthly Means of Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ9

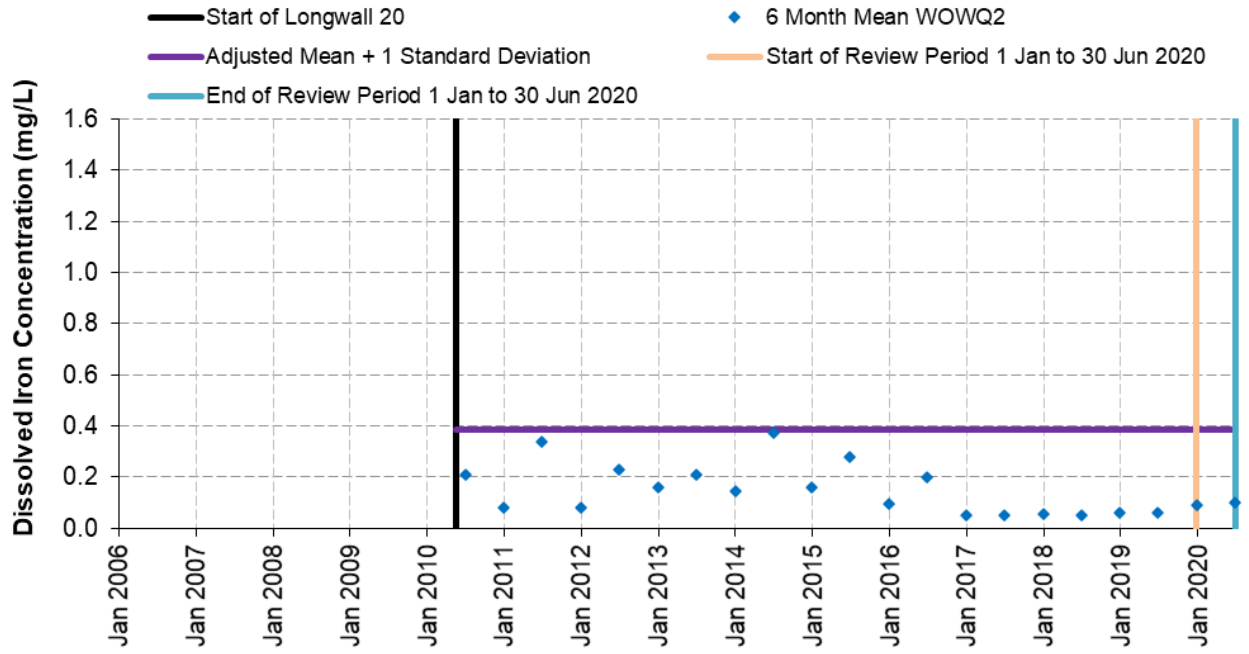


Chart 18 Six Monthly Means of Dissolved Iron Concentrations in Woronora River at WOWQ2

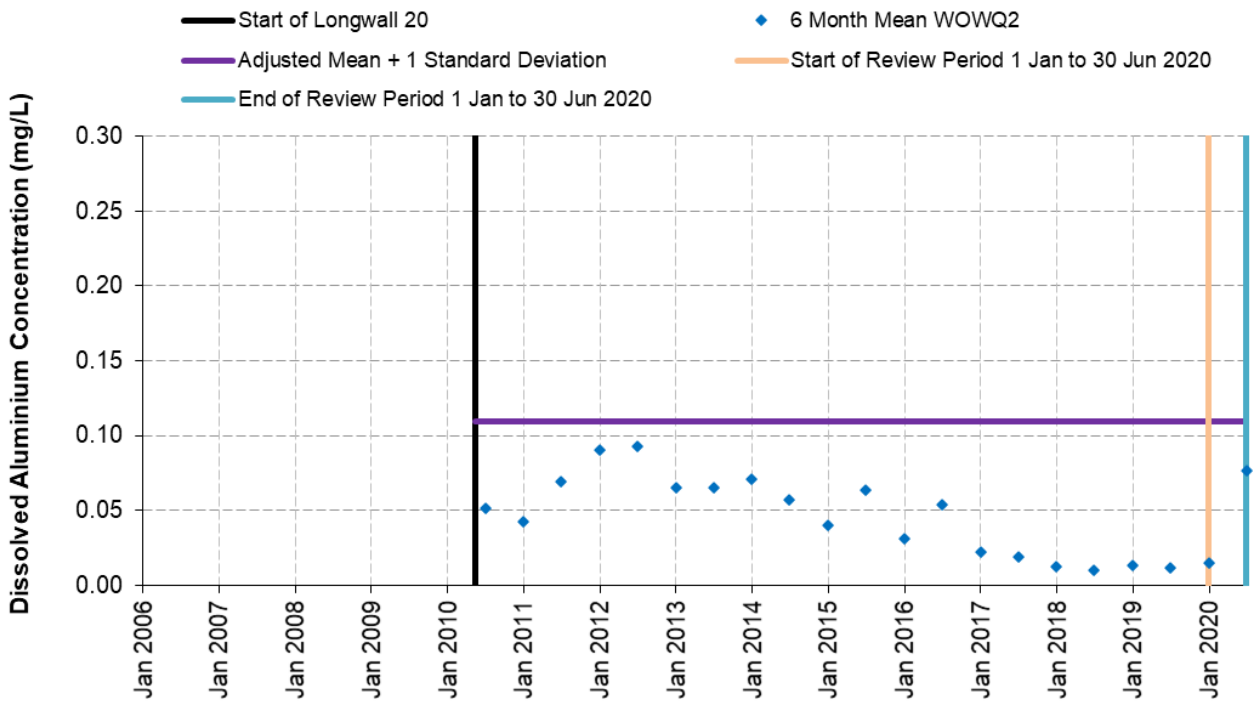


Chart 19 Six Monthly Means of Dissolved Aluminium Concentrations in Woronora River at WOWQ2

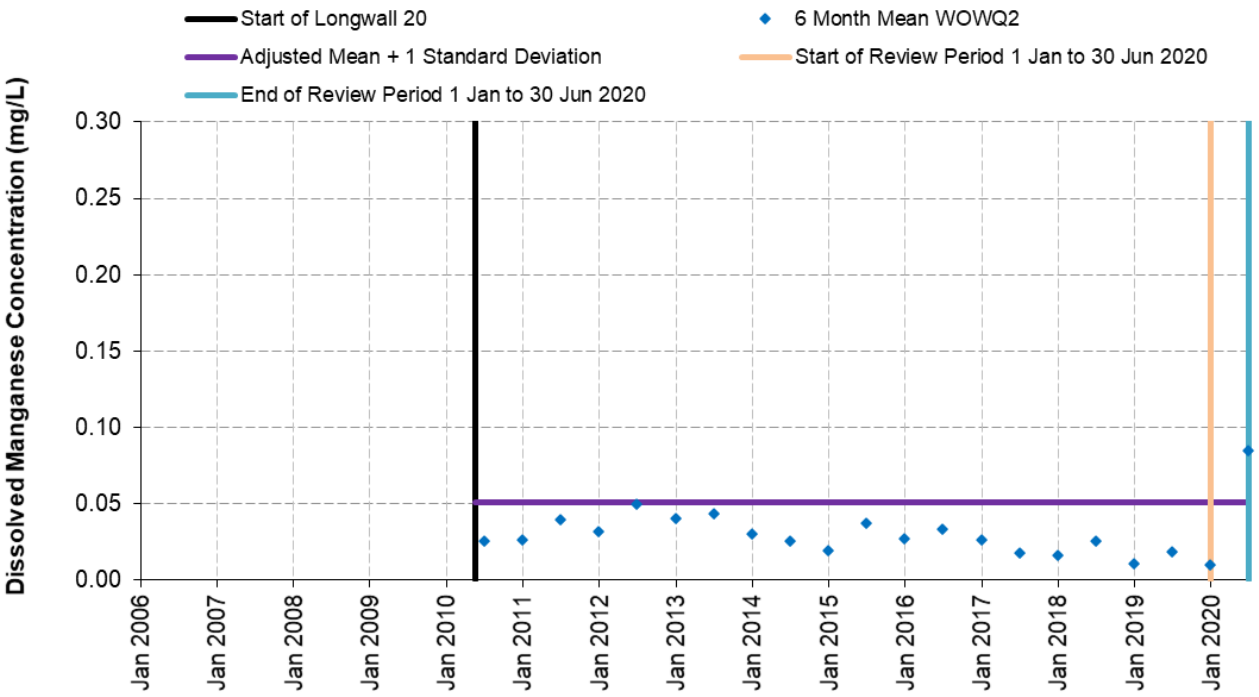


Chart 20 Six Monthly Means of Dissolved Manganese Concentrations in Woronora River at WOWQ2

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).

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 Woronora River at site WOWQ2 (Chart 18 to Chart 20) during the reporting period although dissolved manganese exceeded the adjusted baseline mean plus one standard deviation for the review period (one six month period).

3.2.2 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 23 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.

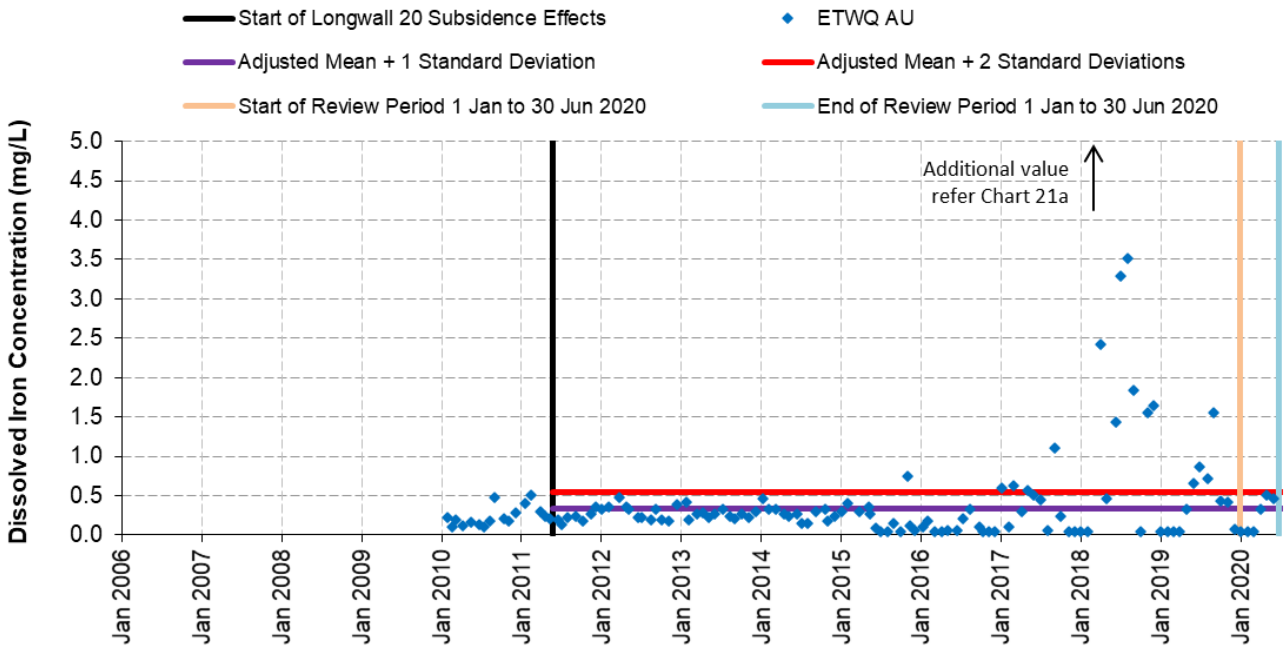


Chart 21 Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

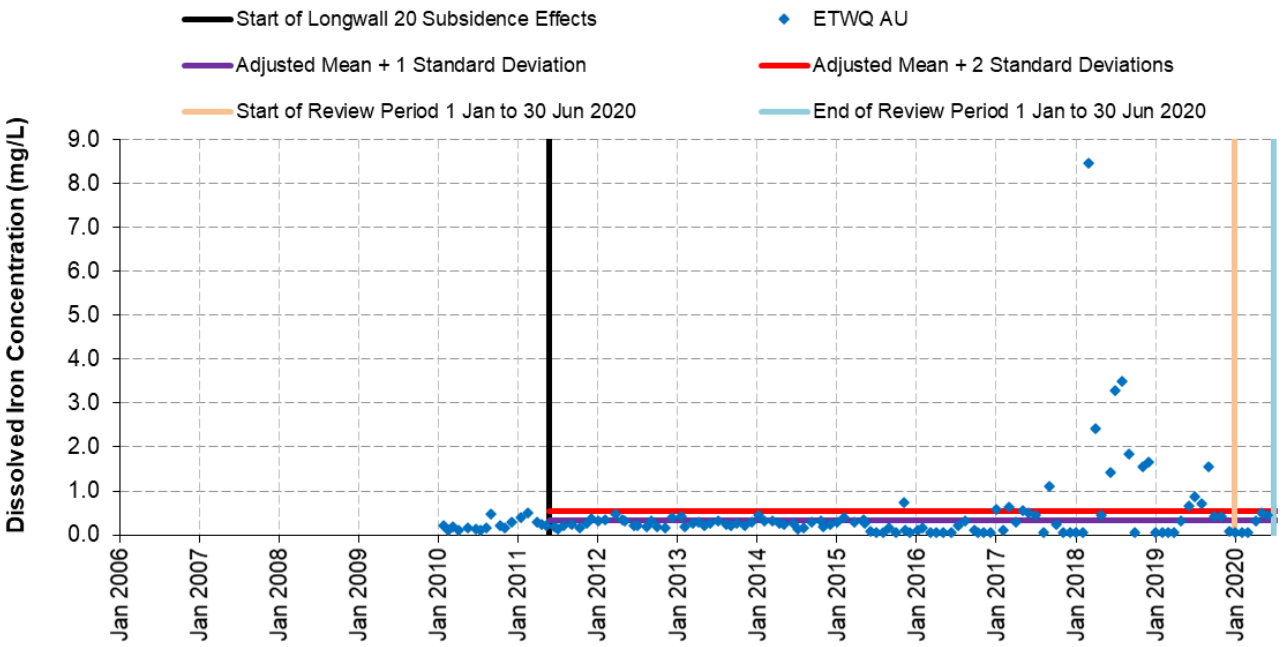


Chart 21a Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

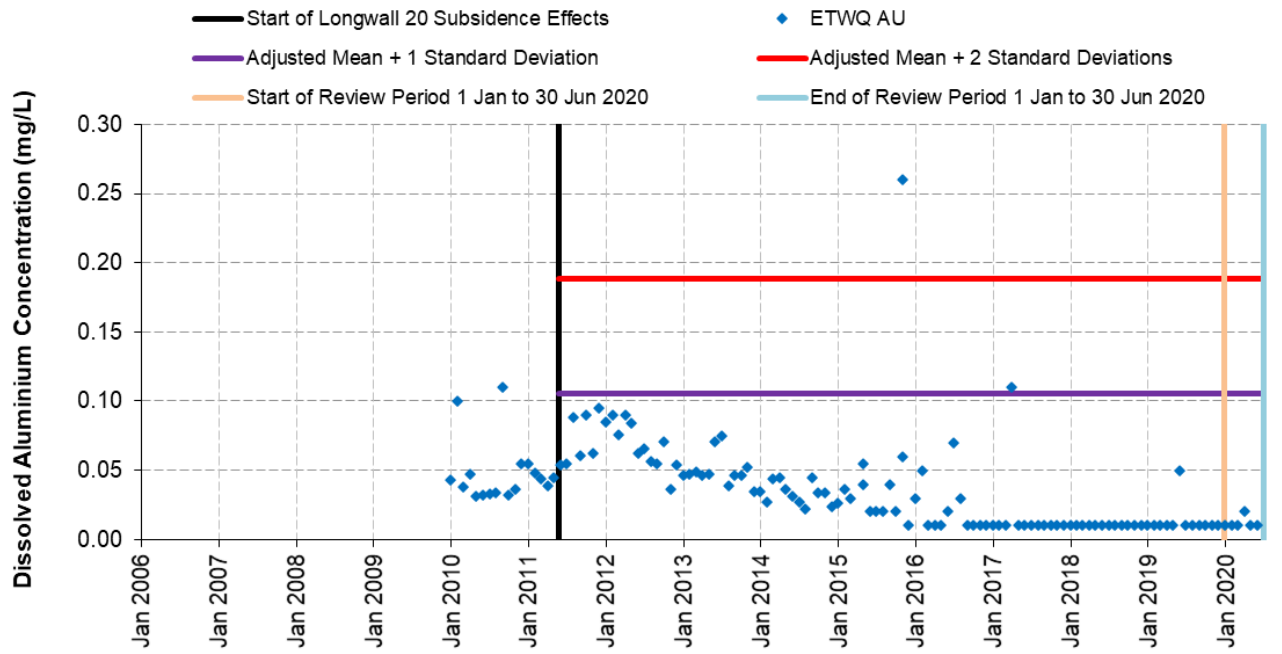


Chart 22 Dissolved Aluminium Concentrations in Eastern Tributary at ETWQ AU

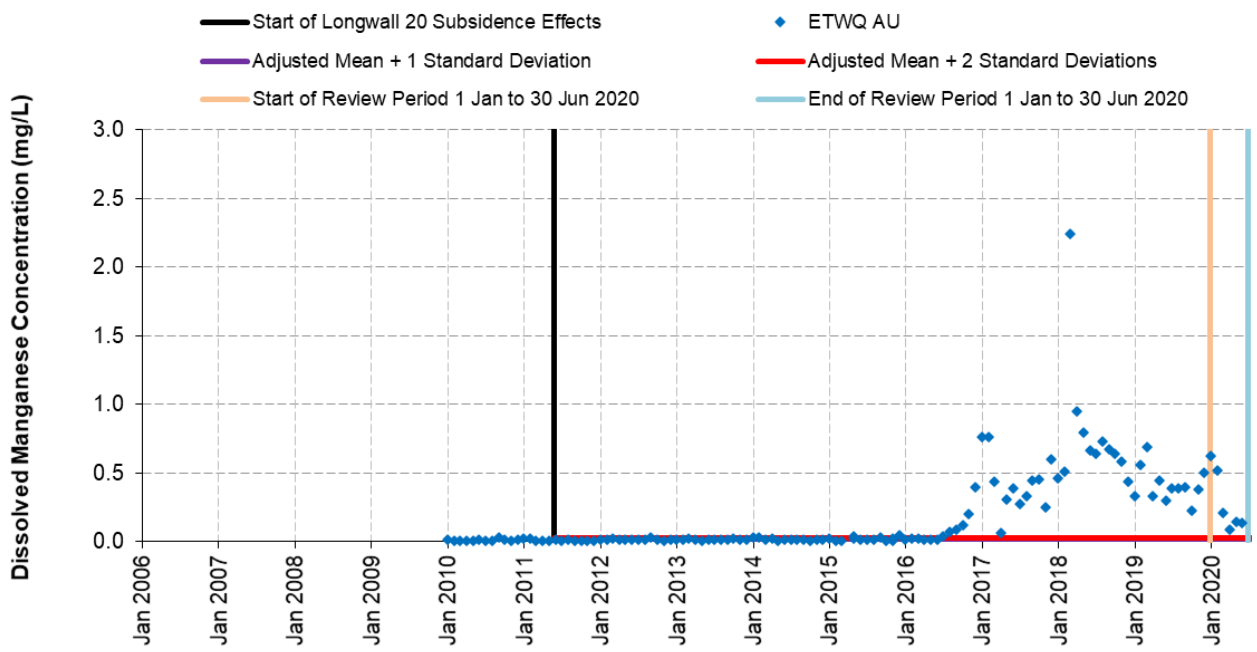


Chart 23 Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

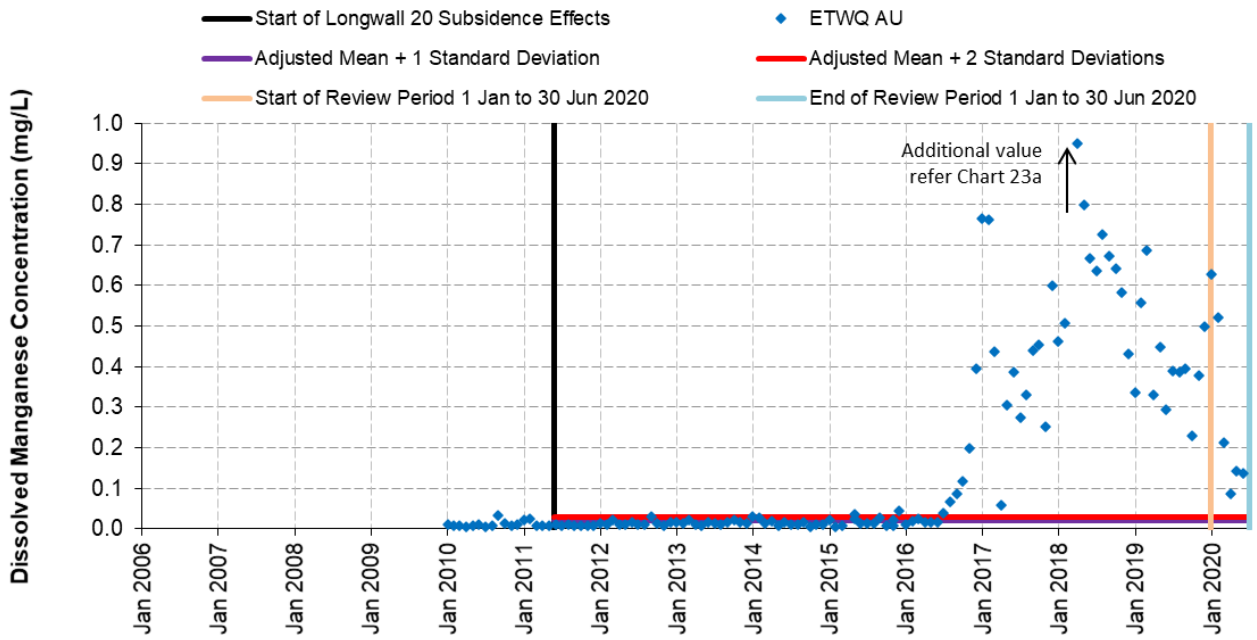


Chart 23a Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

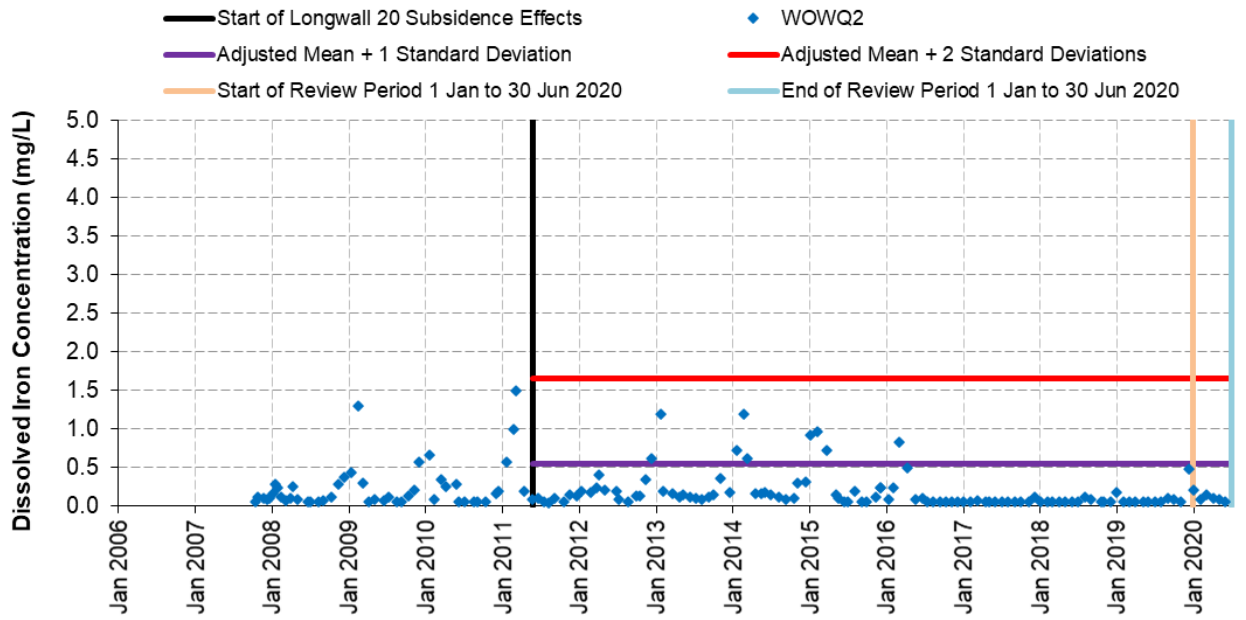


Chart 24 Dissolved Iron Concentrations in Woronora River at WOWQ2

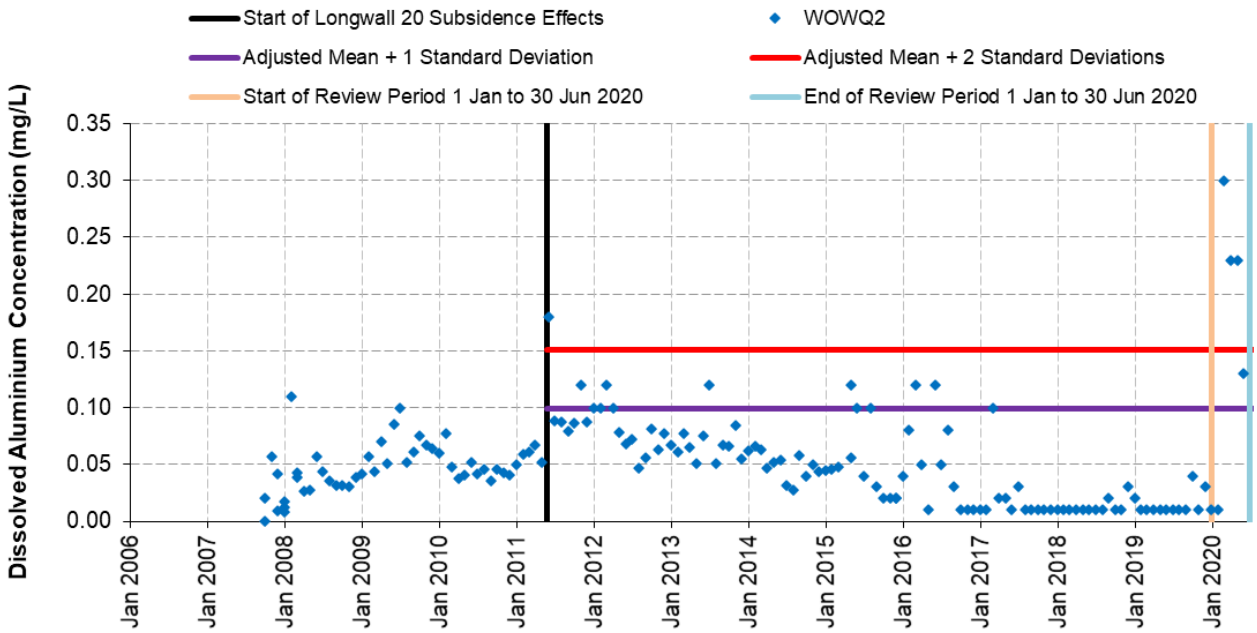


Chart 25 Dissolved Aluminium Concentrations in Woronora River at WOWQ2

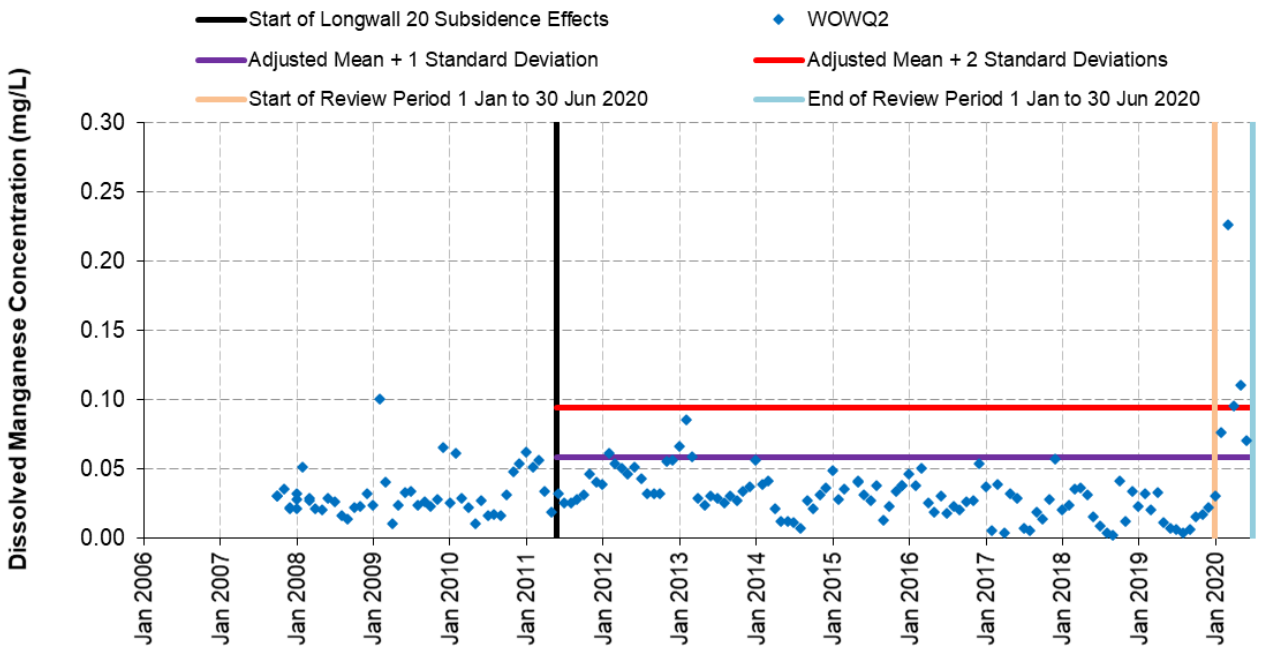


Chart 26 Dissolved Manganese Concentrations in Woronora River at WOWQ2

Chart 21/21a indicate that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron at sampling site ETWQ AU during the review period. There were also no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron at the control site WOWQ 2 on the Woronora River (Chart 24). These results equate to a Level 1 significance for the review period.

Chart 22 indicates that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved aluminium at sampling site ETWQ AU during the reporting period. The results for dissolved aluminium equate to a Level 1 significance. In comparison, there was an exceedance of the adjusted baseline mean plus two standard deviations for dissolved aluminium at control site WOWQ 2 on the Woronora River from March to May 2020 (Chart 25).

The dissolved manganese concentrations continued to exceed the adjusted baseline mean plus two standard deviations at site ETWQ AU during the reporting period in all months (Chart 23/23a). Dissolved manganese concentrations also 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 reporting period.

In comparison, the dissolved manganese concentrations recorded at the control site WOWQ 2 on the Woronora River exceeded the baseline mean plus two standard deviations for this site in March, April and May 2020 (Chart 26). Therefore the dissolved manganese concentrations at the control site WOWQ 2 on the Woronora River exceeded the baseline mean plus two standard deviations for two consecutive months in April and May. Dissolved manganese concentrations also 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 in May. As the trigger was also exceeded at the control site in April and May 2020, the trigger level exceedance at site ETWQ AU equates to a Level 3 significance in January to March and in June and a Level 2 significance in April and May 2020.

Plots showing the six monthly 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 monthly mean concentrations for the same water quality

parameters at control site WOWQ 2 are shown on Chart 30 to Chart 32. Each plot shows the adjusted baseline mean plus one standard deviation value.

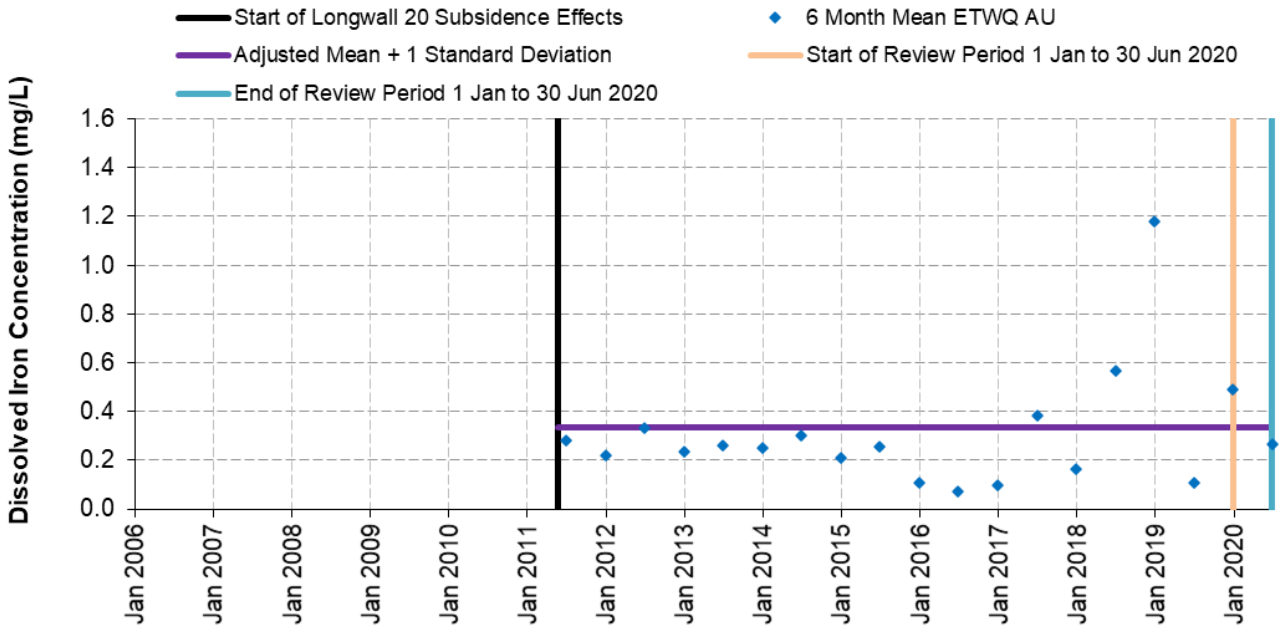


Chart 27 Six Month Means of Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

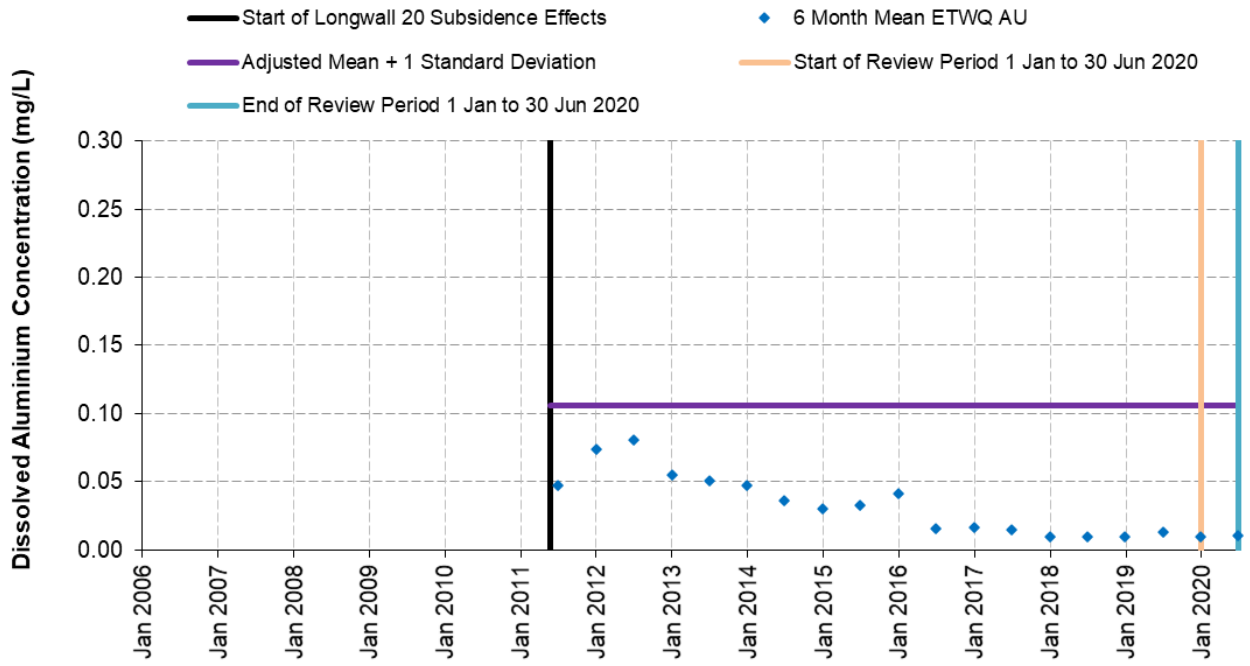


Chart 28 Six Month Means of Dissolved Aluminium Concentrations in Eastern Tributary at ETWQ AU

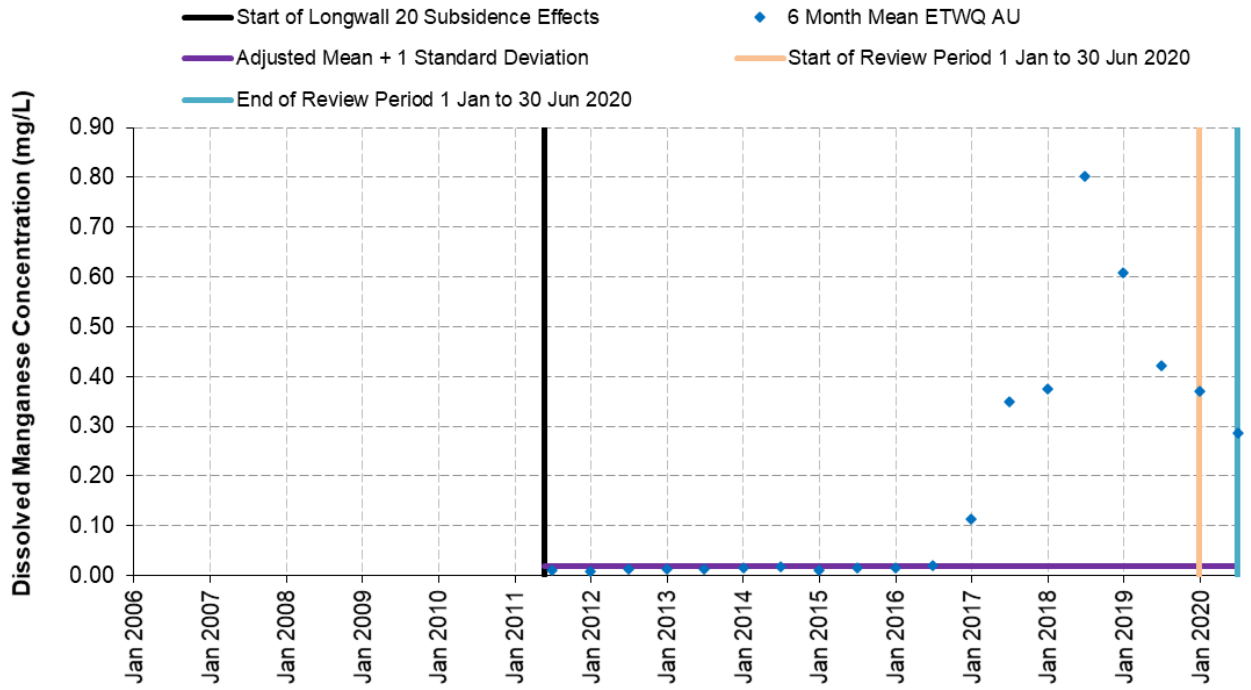


Chart 29 Six Month Means of Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

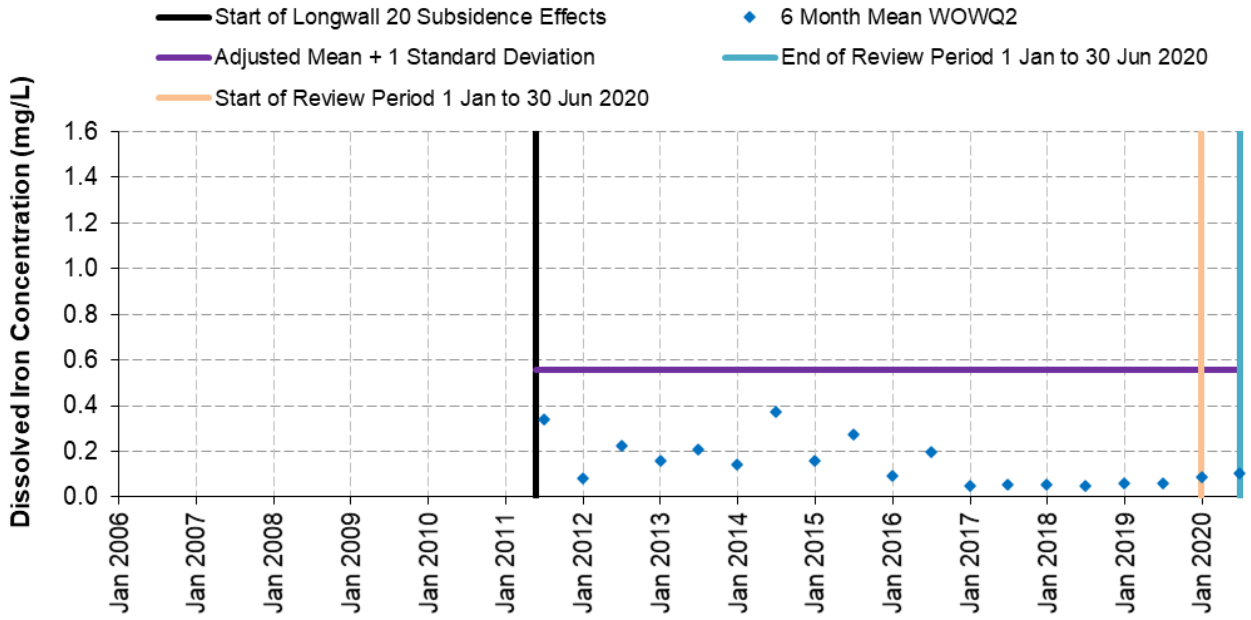


Chart 30 Six Month Means of Dissolved Iron Concentrations in Woronora River at WOWQ2

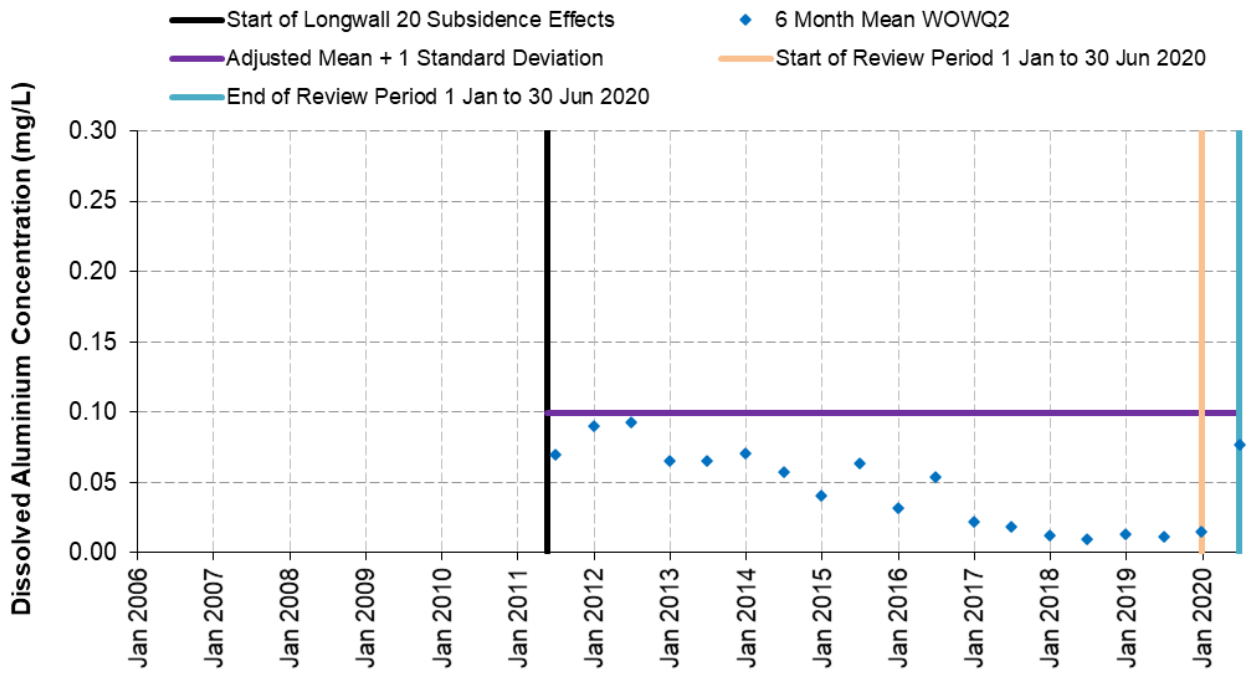


Chart 31 **Six Month Means of Dissolved Aluminium Concentrations in Woronora River at WOWQ2**

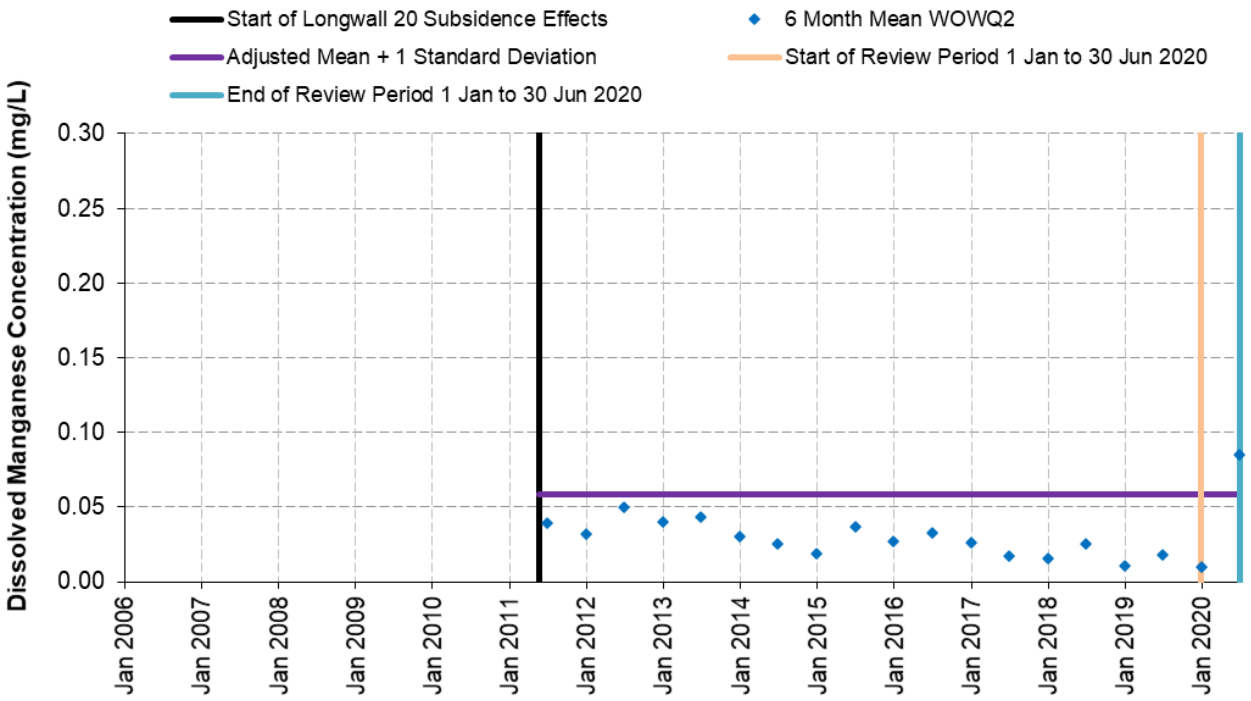


Chart 32 **Six Month Means of Dissolved Manganese Concentrations in Woronora River at WOWQ2**

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 the Eastern Tributary at site ETWQ AU (Chart 27 and Chart 28). 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 reporting period (Chart 29). At control

site WOWQ 2 on the Woronora River the adjusted baseline mean plus one standard deviation for dissolved manganese was exceeded in only one six month period (January to June 2020 - Chart 32). Accordingly, the results for dissolved manganese in the Eastern Tributary at site ETWQ AU equate to a Level 3 significance level as at June 2020. It is worth noting that there has been a steady decline in the six month mean for dissolved manganese at ETWQ AU from the peak value of 0.8 mg/L in mid-2018 to 0.29 mg/L at the end of the review period.

3.2.3 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 (from January to March and in June 2020) 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 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 for this review period (1 January to 30 June 2020) are assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan[7] significance levels/triggers (below):

[7] The Longwall 304 Water Management Plan applies to the period from 1 January 2020 to 11 April 2020 and the Longwalls 305-307 Water Management Plan applies to the period from 12 April 2020 to 30 June 2020. The significance levels/triggers for the performance measure "No diversion of flows, no change in the natural drainage behaviour" are the same for the two management plans.

Negligible Environmental Consequences on Waratah Rivulet: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	**Significance Levels/Triggers**	
No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.	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.
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.	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).
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.	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 minimums. 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 (refer Figure 2).

As reported in the Metropolitan Coal 2017 Annual Review, the natural drainage behaviour of Pools ETAG, ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, 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 301-303 Water Management Plan (2016b) and Longwall 304 Water Management Plan for Pools ETAS, ETAT and ETAU and the results for the reporting 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 for this review period (1 January to 30 June 2020) are assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan[8] significance levels/triggers (below):

[8] The Longwall 304 Water Management Plan applies to the period from 1 January 2020 to 11 April 2020 and the Longwalls 305-307 Water Management Plan applies to the period from 12 April 2020 to 30 June 2020. The significance levels/triggers for the performance measure "No diversion of flows, no change in the natural drainage behaviour" are the same for the two management plans.

Negligible Environmental Consequences on Eastern Tributary: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	**Significance Levels/Triggers**	
No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.	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.
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.	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 reporting 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 reporting 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 reporting periods and has been reported to the Department of Planning and Environment (now the Department of Planning, Industry and Environment) 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 Water Management Plans. Assessments against the subsidence impact performance indicators and performance measures have been conducted for the reporting period (1 January to 30 June 2020) 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	*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).*	WaterNSW gauging station on Waratah Rivulet (GS 2132102)	Surface water flow.	Level 3	The median of the ratios falls below the 20th percentile of the baseline data.	Surface water flow was at Level 3 from 1 January to 27 April 2020, though the same was also occurring in the control catchment. Surface water flow was also at Level 3 from 1 July to 31 December 2019, though the same was also occurring in the control catchment during this period[1].	No	No
				Level 2	The median of the ratios falls below the 35th percentile but does not fall below the 20th percentile of the baseline data.	Surface water flow was at Level 2 from 28 April to 30 June 2020.	No	No
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	*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 WOWQ2.*	Site WRWQ9 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, aluminium and manganese were at Level 1 throughout the reporting period.	No	No

[1] The streamflow records for GS 2132102 provided by WaterNSW were incomplete for the previous review period (1 July to 31 December 2019) and, as such, assessment of the results for the previous review period, 1 July to 31 December 2019, were unable to be conducted at the time of reporting. The streamflow records for GS 2132102 provided by WaterNSW for the current review period include the period of data from 1 July to 31 December 2019, and, as such, the assessment has been undertaken for the period 1 July 2019 to 30 June 2020.

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	*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 WOWQ2.*	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 aluminium and dissolved iron were at Level 1 throughout the reporting period.	No	No
				Level 2	Data analysis indicates any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for one month.	Dissolved manganese was at Level 2 in April and May 2020.	No	No
				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 in January to March and in June 2020.	Yes (January to March and in June 2020)	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 (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).	*No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.*	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 reporting period.	No	No
	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.	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 reporting period.	No	No
	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.	Pools Q, R and S on the Waratah Rivulet.	Pool water level.	Level 1	The water level in Pools Q, R or 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 reporting period.	No	No
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	*No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.*	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 reporting period.	No	Refer Note 2
	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.	Pool ETAS/ETAT and Pool ETAU on the Eastern Tributary.	Pool water level.	Level 1	The water levels in Pool ETAS/ETAT and Pool ETAU has been above that required to maintain water over the downstream rock bar.	Pool ETAS/ETAT and Pool ETAU were at Level 1 throughout the reporting period.	No	Refer Note 2

[2] 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 monitors 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 305-307.

4.0 REFERENCES

Boughton, W.C. (2004) The Australian Water Balance Model. Environmental Modelling and Software, Vol 19, pp. 943–956.

Helensburgh Coal (2008). "Metropolitan Coal Project Environmental Assessment". Helensburgh Coal Pty Ltd.

Helensburgh Coal (2009). "Metropolitan Coal Project Preferred Project Report". Helensburgh Coal Pty Ltd.

Gilbert & Associates (2015a) "Metropolitan Coal – Revised Rating Curves for Waratah Rivulet (GS2132102), Woronora River (GS2132101) and O'Hares Creek at Wedderburn (GS213200)". Report prepared for Metropolitan Coal.

Gilbert & Associates (2015b) "AWBM Model Calibration - Waratah Rivulet, Woronora River and O'Hares Creek". Report prepared for Metropolitan Coal.

Hebblewhite, B., Kalf, F and McMahon, T. (2017) "Woronora Reservoir Impact Strategy – Stage 1 Report".

Hydro Engineering & Consulting (2016) "Metropolitan Coal Annual Surface Water Review 2015". Report prepared for Metropolitan Coal.

Hydro Engineering & Consulting (2019a). "Metropolitan Coal Surface Water Review 1 January to 30 June 2019". Report prepared for Metropolitan Coal.

Hydro Engineering & Consulting (2019b) "Assessment of Recorded Stage and Flow Data – Catchments I and K". Letter report prepared for Metropolitan Coal, August.

Hydro Engineering & Consulting (2020) "Recalibration of O'Hares Creek Catchment Model". Letter report prepared for Metropolitan Coal, April.

Metropolitan Coal (2010). "Metropolitan Mine Longwalls 20-22 Extraction Plan".

Metropolitan Coal (2014a). "Metropolitan Coal Catchment Monitoring Program".

Metropolitan Coal (2014b). "Metropolitan Coal Longwalls 23-27 Extraction Plan".

Metropolitan Coal (2016a). "Metropolitan Coal Longwalls 301-303 Extraction Plan".

Metropolitan Coal (2016b). "Metropolitan Coal Longwalls 301-303 Water Management Plan".

Metropolitan Coal (2018). "Metropolitan Coal 2017 Annual Review".

Metropolitan Coal (2019a). "Metropolitan Coal Longwall 304 Extraction Plan".

Metropolitan Coal (2019b). "Metropolitan Coal Longwall 304 Water Management Plan".

Metropolitan Coal (2020a). "Metropolitan Coal Longwalls 305-307 Extraction Plan".

Metropolitan Coal (2020b). "Metropolitan Coal Longwalls 305-307 Water Management Plan".

APPENDICES

Appendix A
Monitored Pool Water Level Hydrographs

Pools on Waratah Rivulet

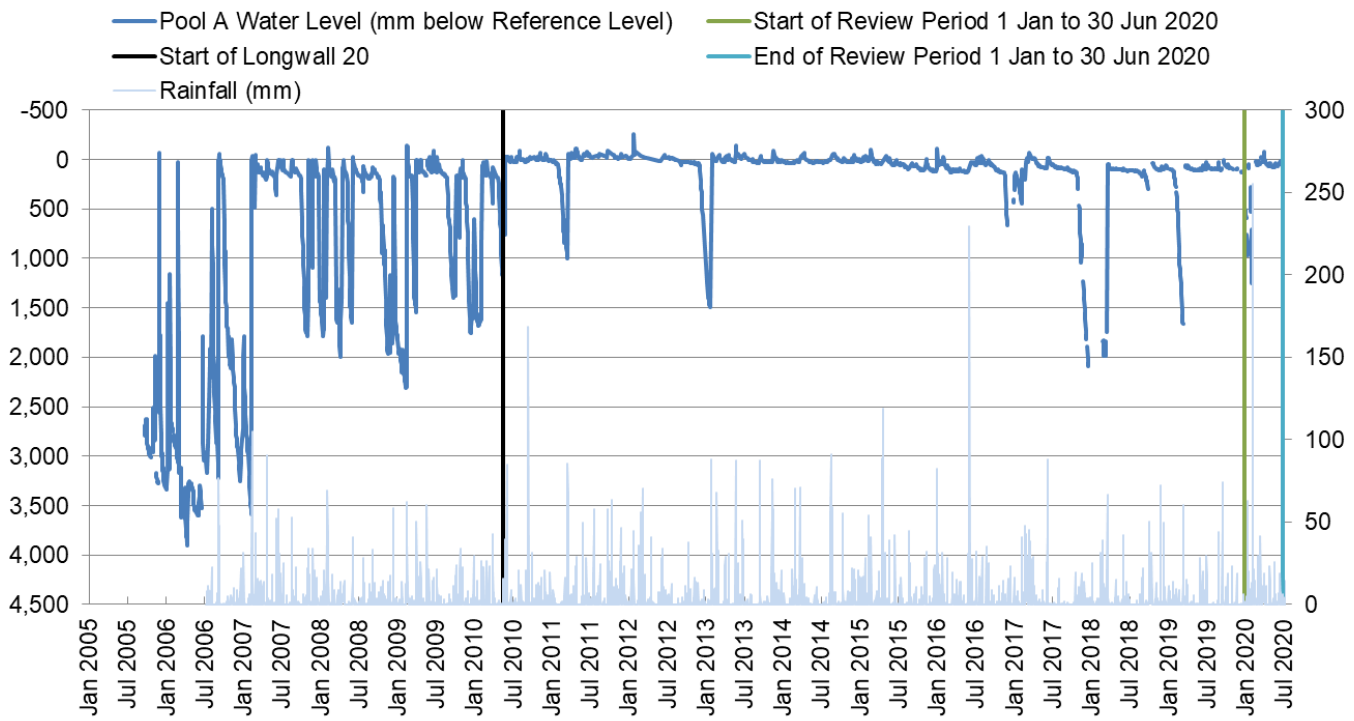


Chart A1 Pool A Waratah Rivulet (Manual Observations)

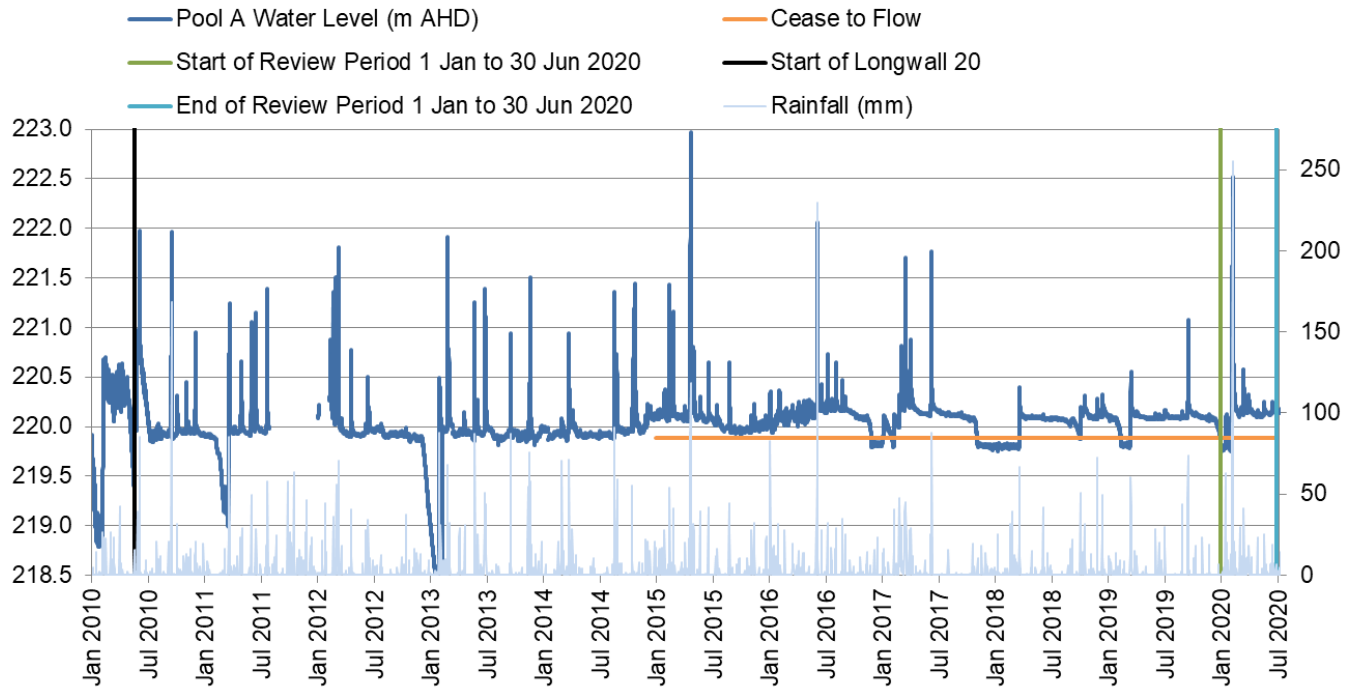


Chart A2 Pool A Waratah Rivulet

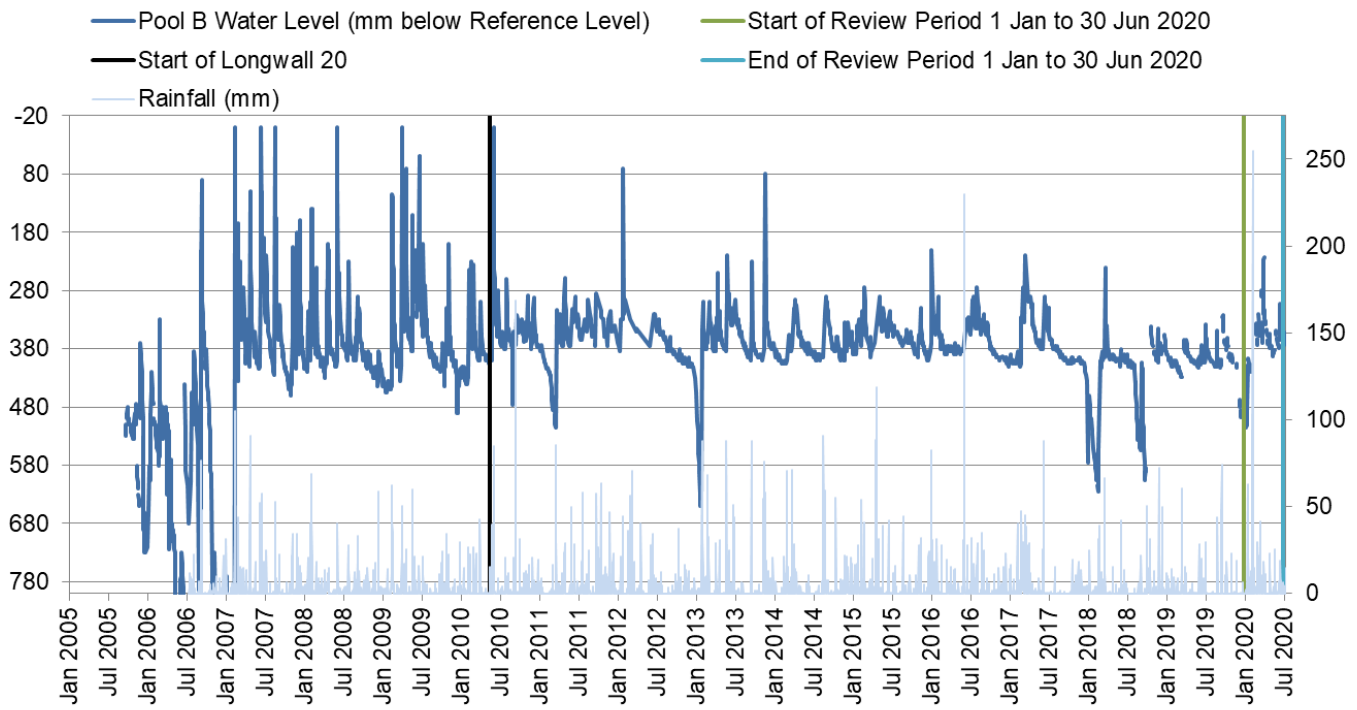


Chart A3 Pool B Waratah Rivulet (Manual Observations)[9]

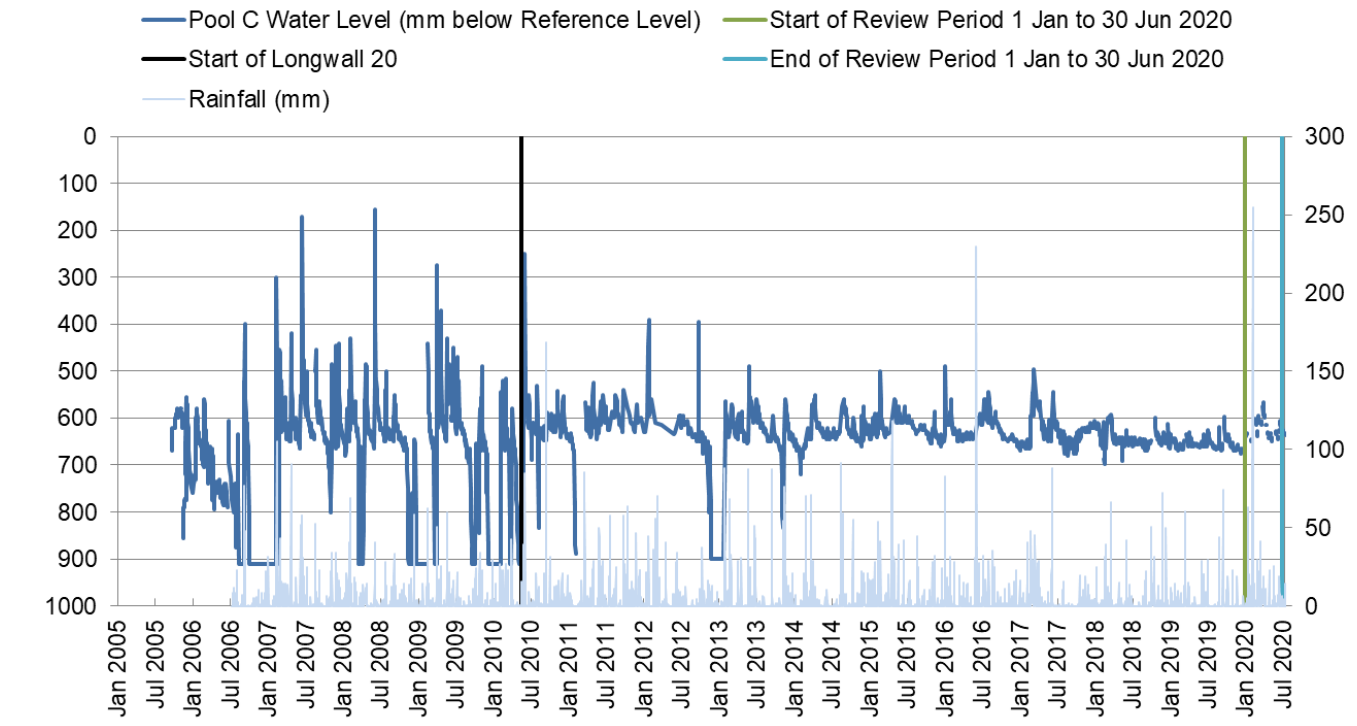


Chart A4 Pool C Waratah Rivulet (Manual Observations)

[9] Data gaps in the manual measurements for Pool B during the review period are due to periods in which high rainfall or fire restrictions prevented access to the monitoring site.

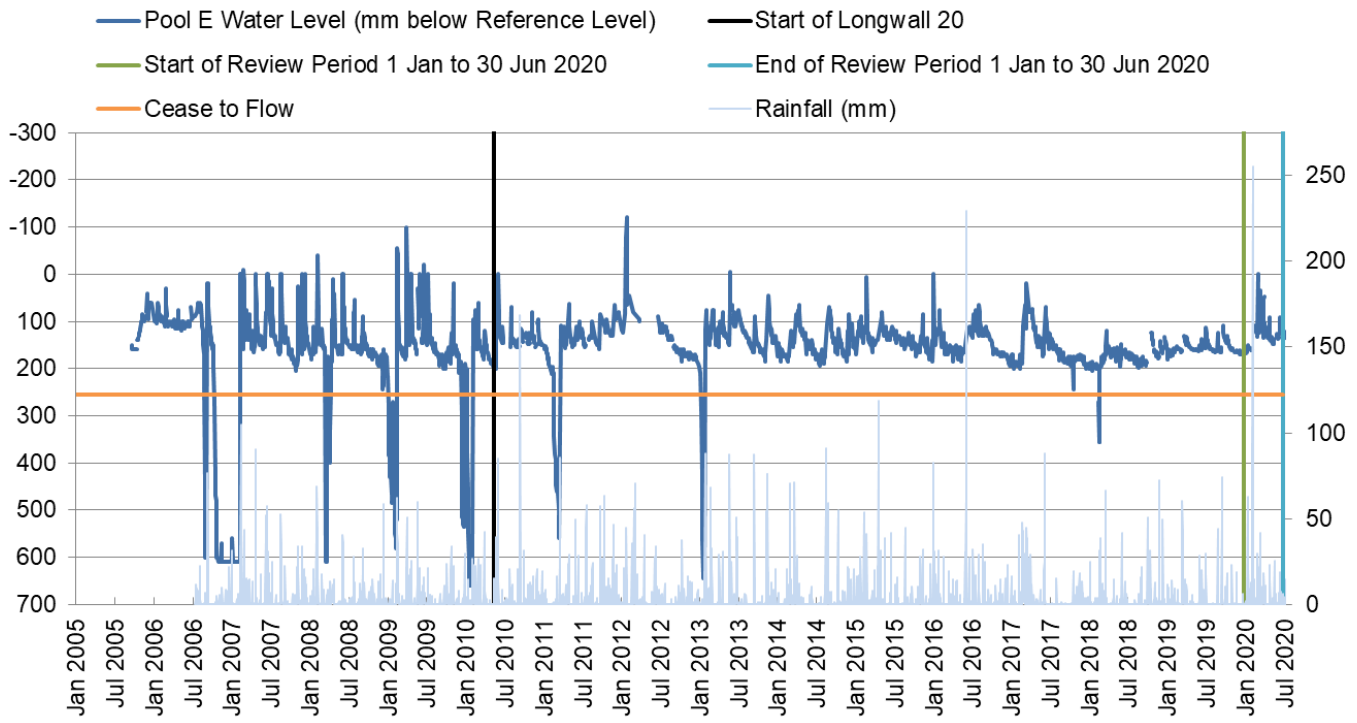


Chart A5 Pool E Waratah Rivulet (Manual Observations)

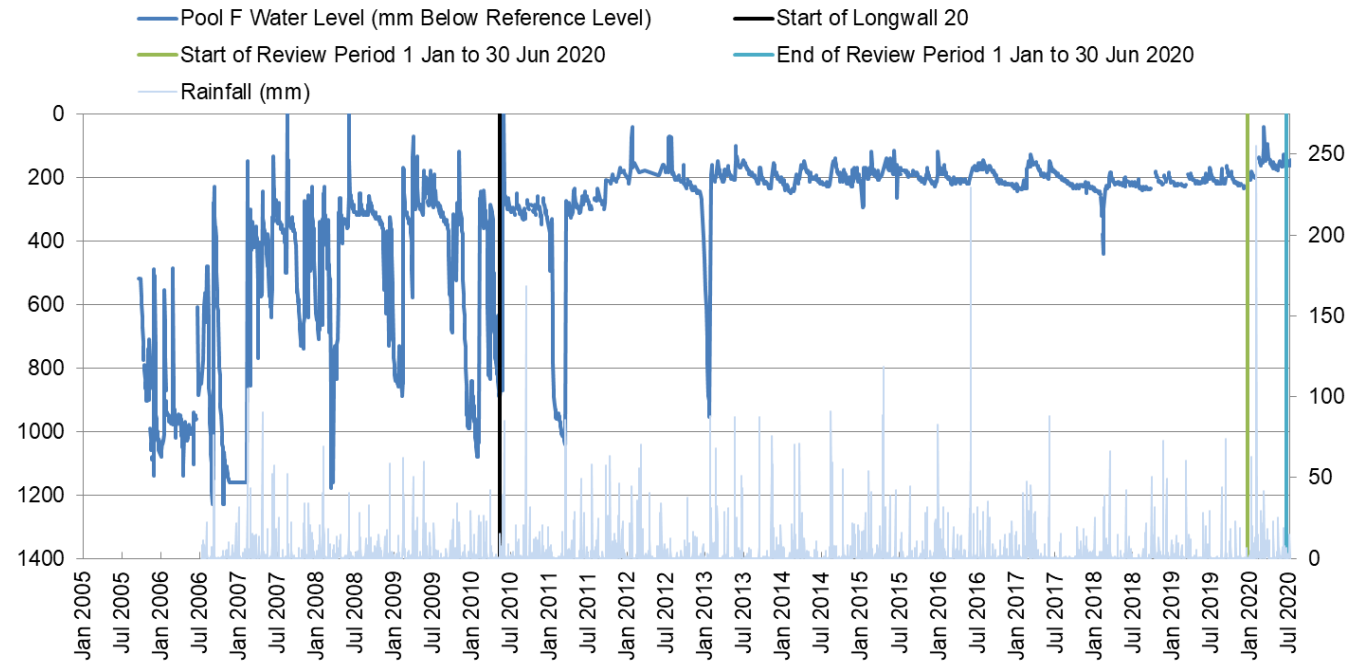


Chart A6 Pool F Waratah Rivulet (Manual Observations)

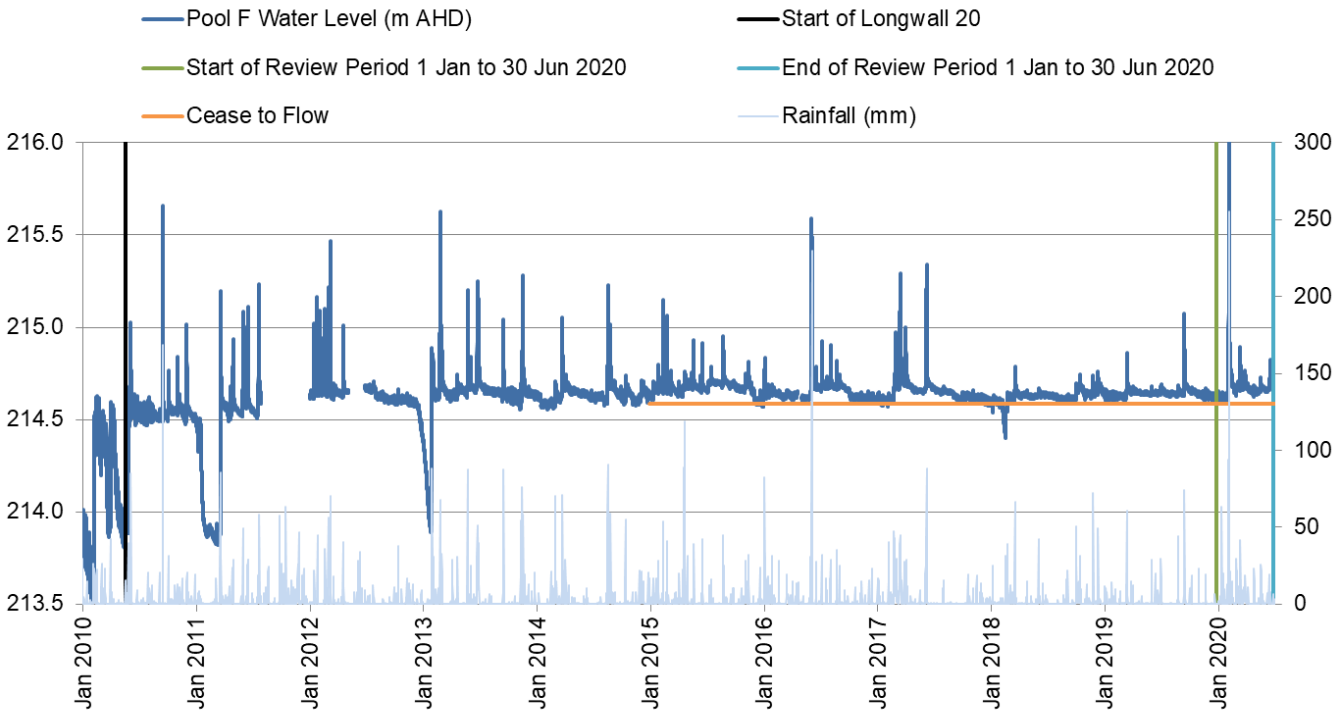


Chart A7 Pool F Waratah Rivulet

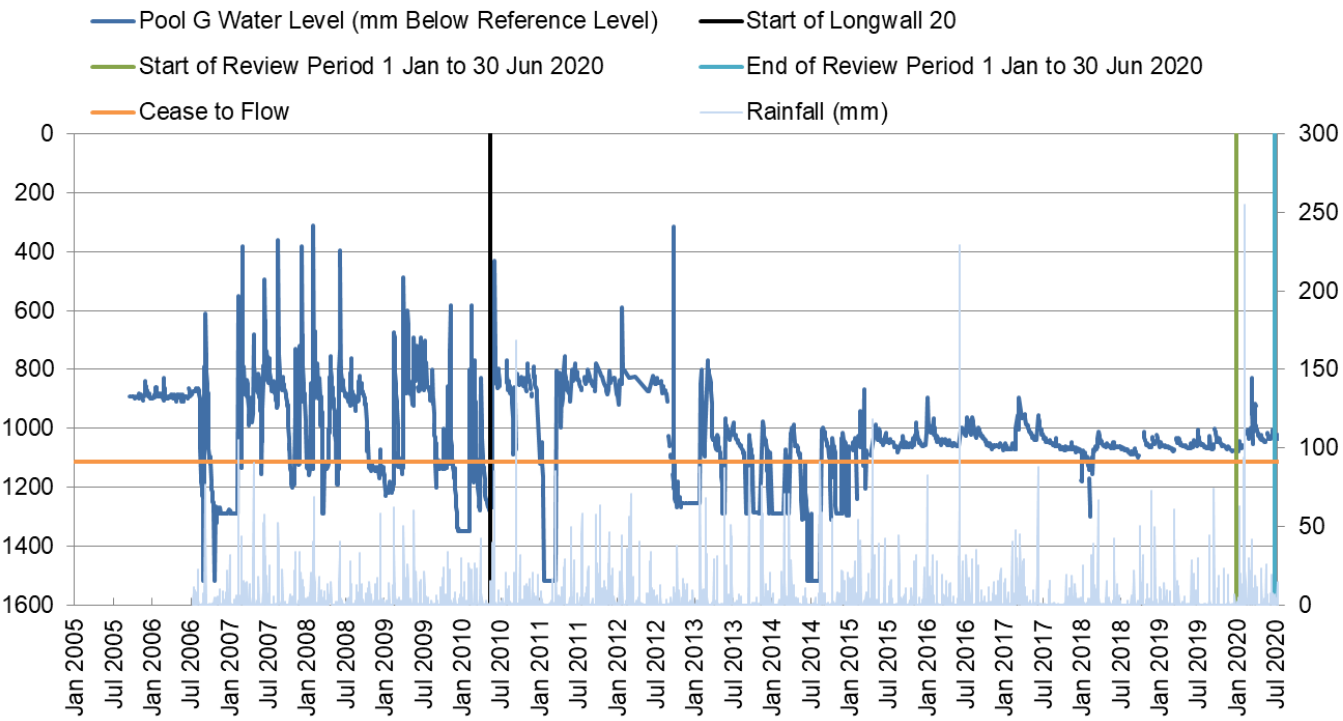


Chart A8 Pool G Waratah Rivulet (Manual Observations)

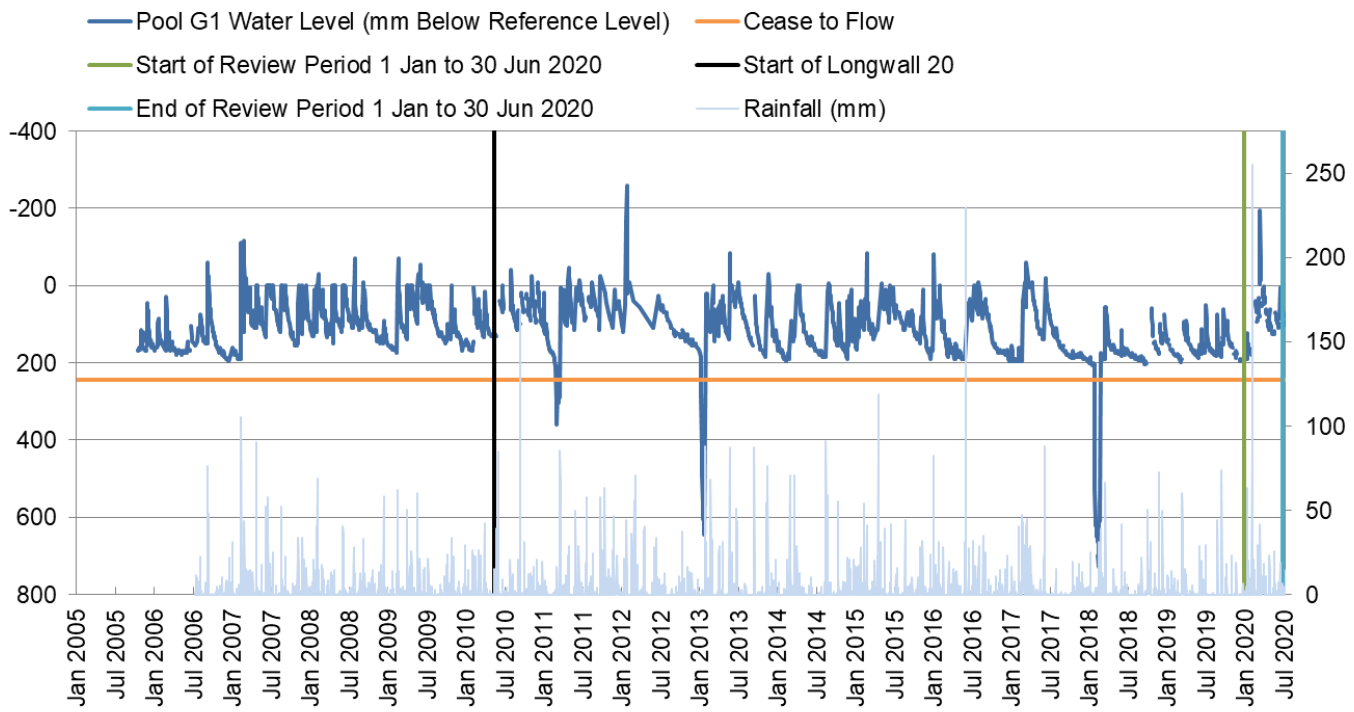


Chart A9 Pool G1 Waratah Rivulet (Manual Observations)

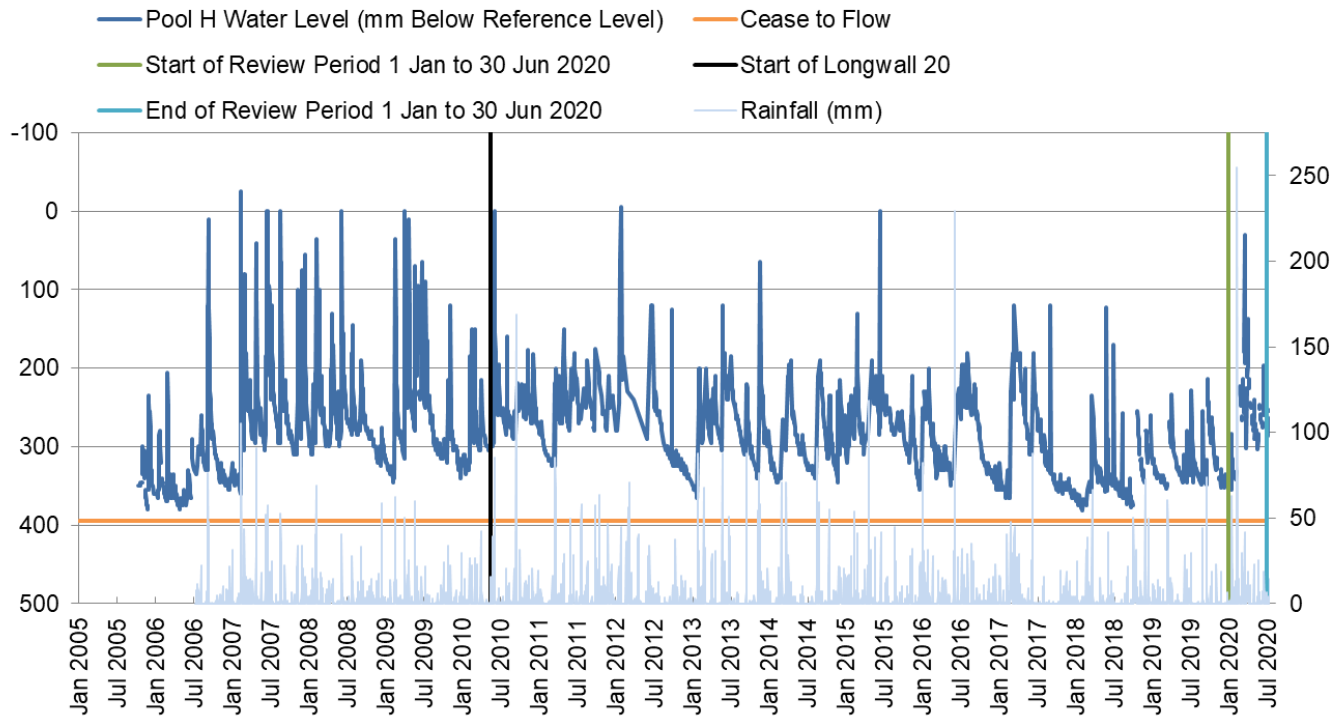


Chart A10 Pool H Waratah Rivulet (Manual Observations)

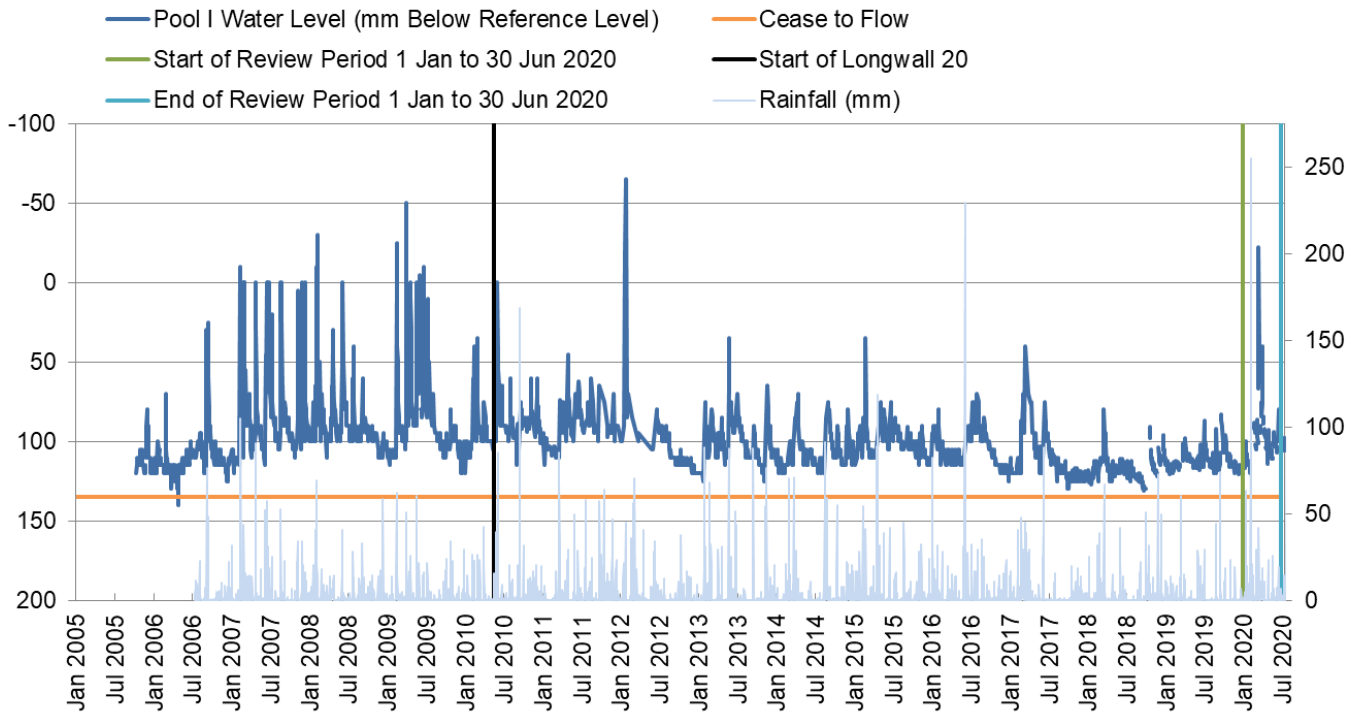


Chart A11 Pool I Waratah Rivulet (Manual Observations)

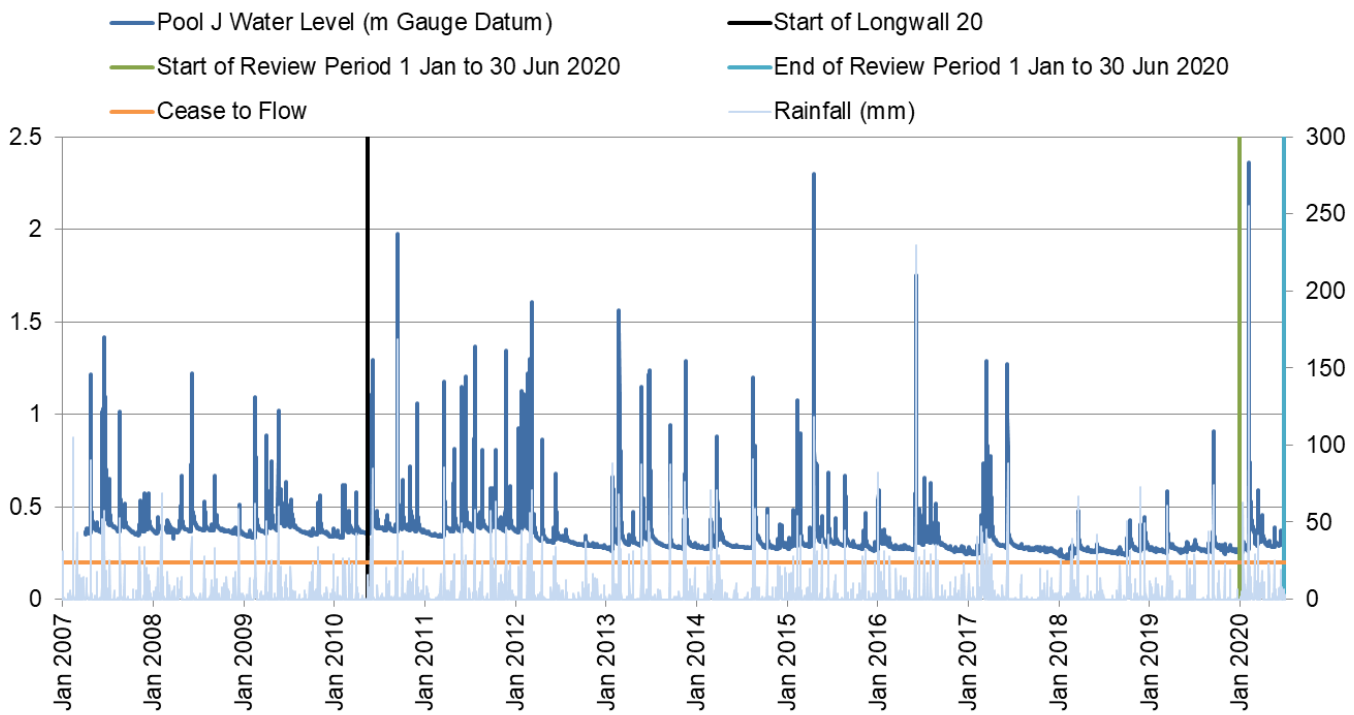


Chart A12 Pool J Waratah Rivulet

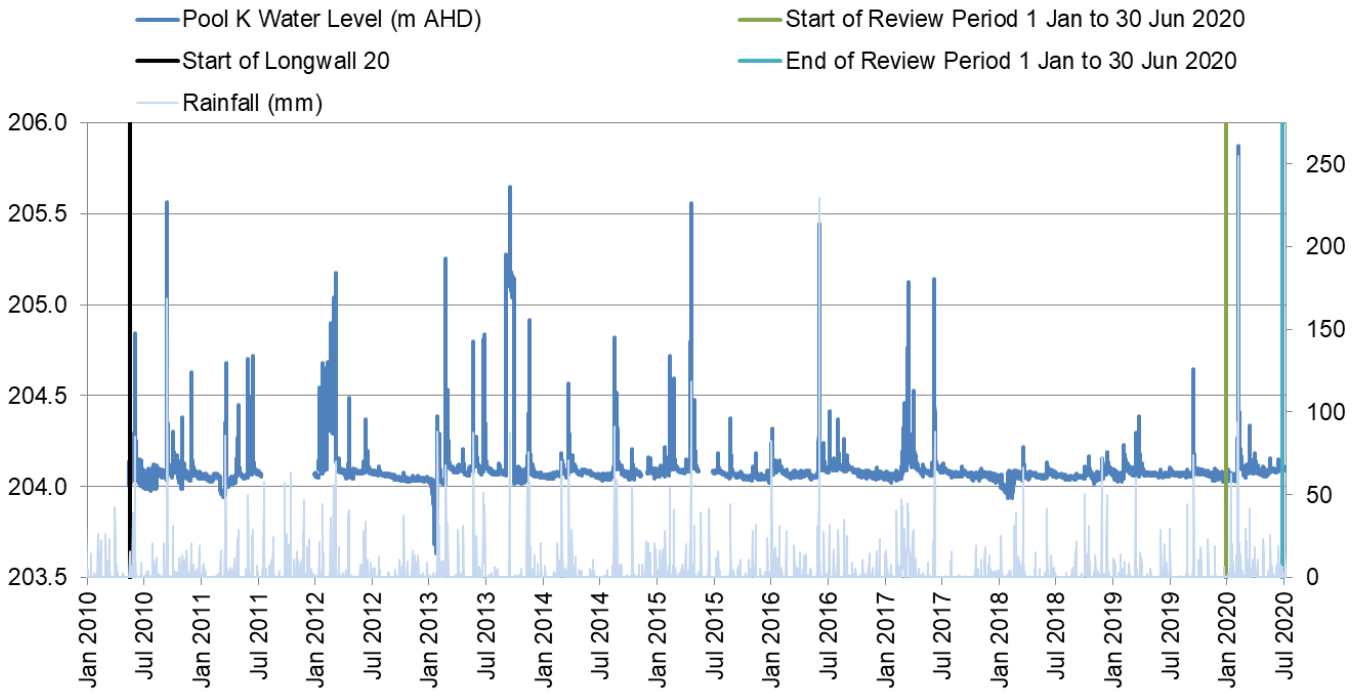


Chart A13 Pool K Waratah Rivulet

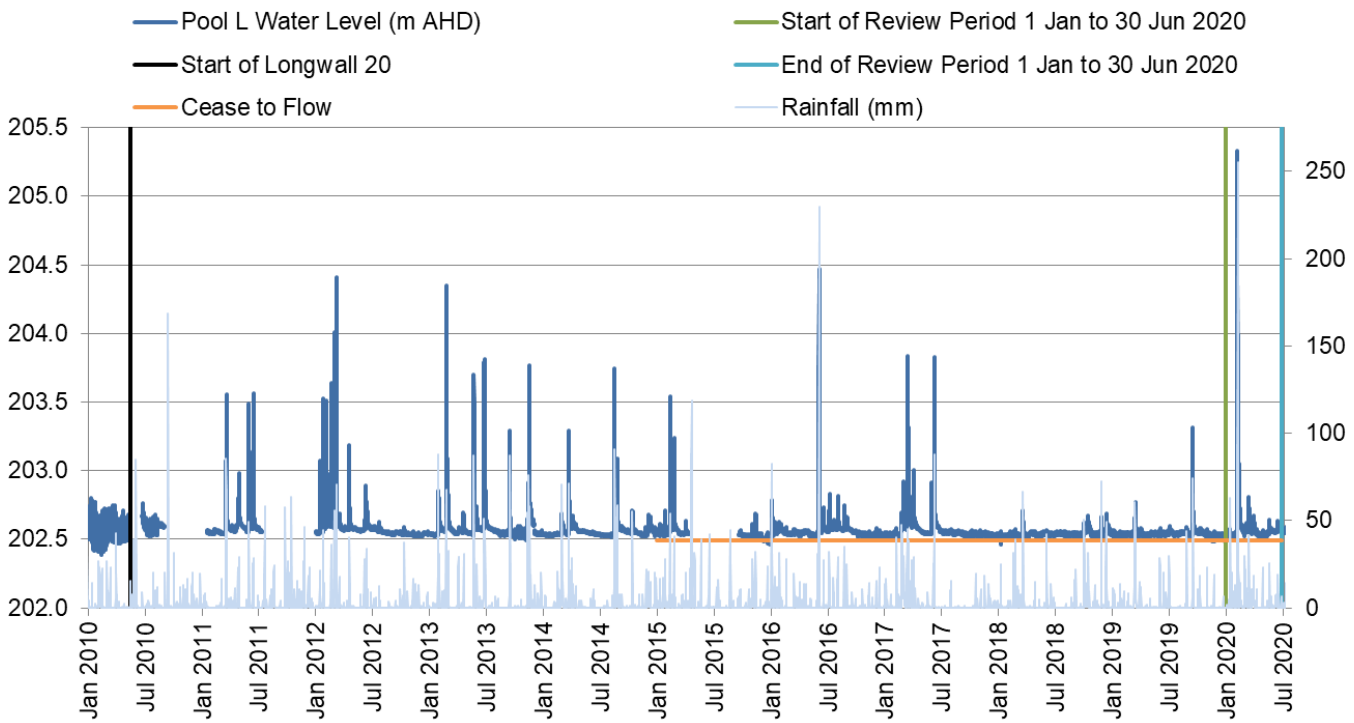


Chart A14 Pool L Waratah Rivulet

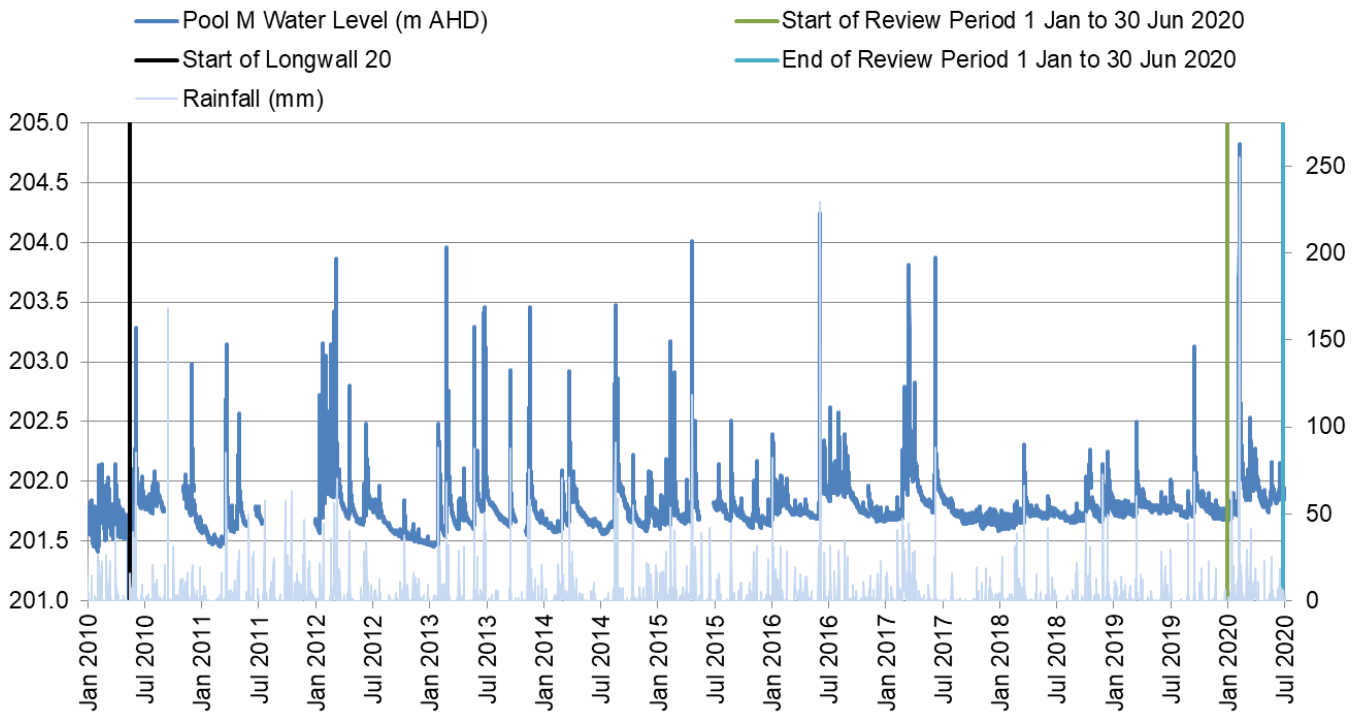


Chart A15 Pool M Waratah Rivulet

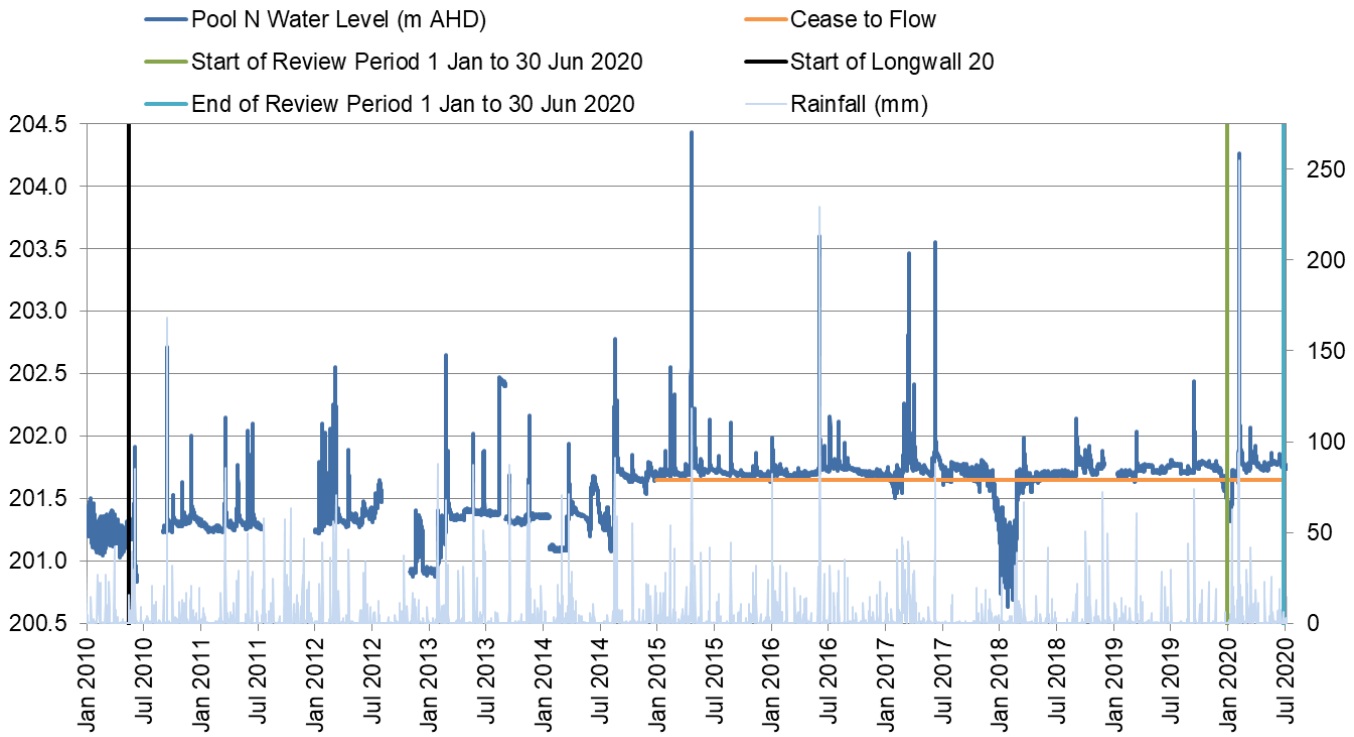


Chart A16 Pool N Waratah Rivulet[10]

[10] Pool N water level sensor did not record any data during December 2018. Subsequently, the sensor was replaced in January 2019.

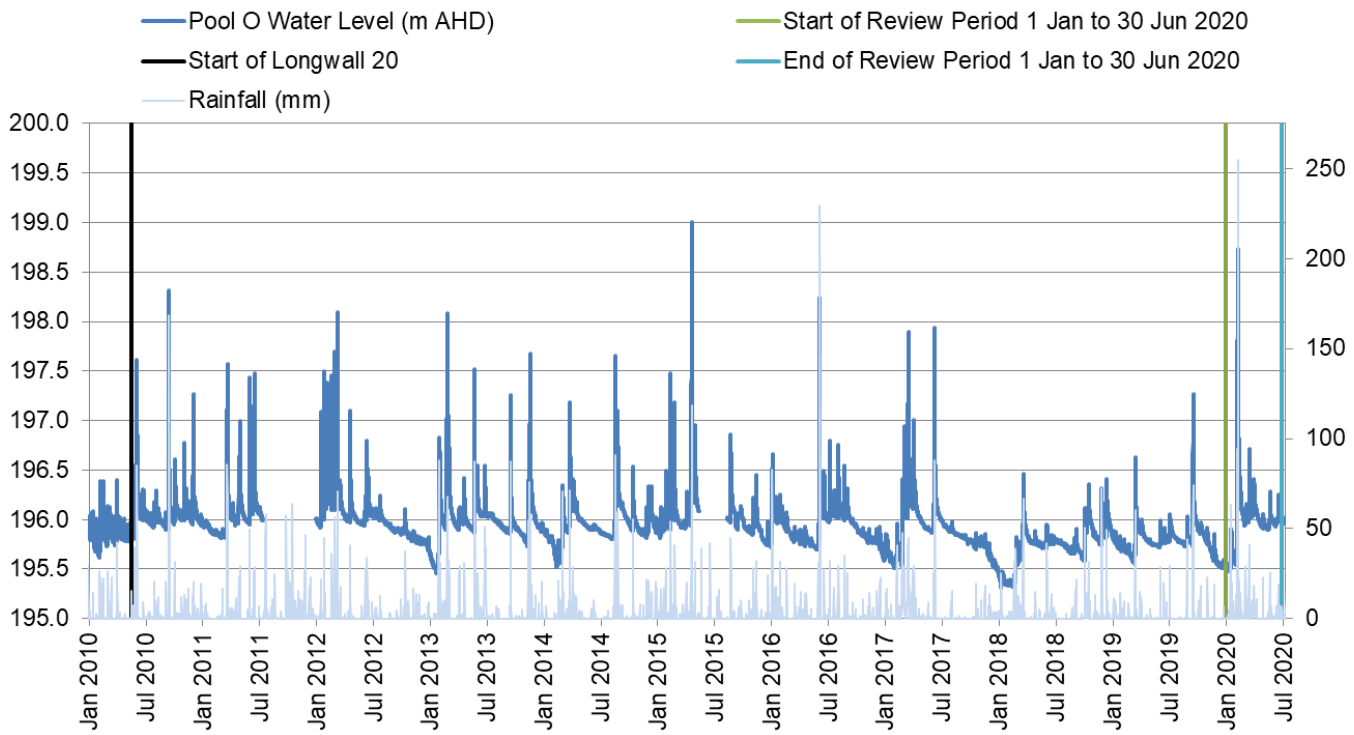


Chart A17 Pool O Waratah Rivulet

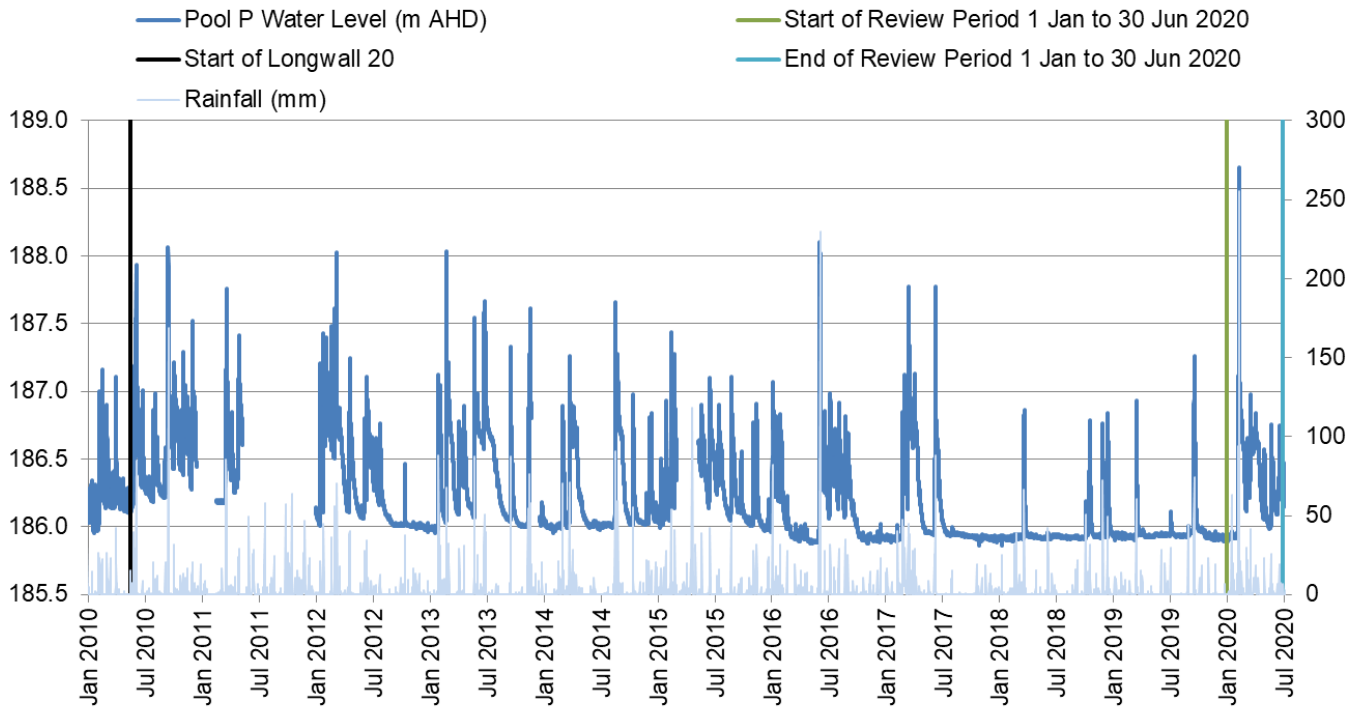


Chart A18 Pool P Waratah Rivulet

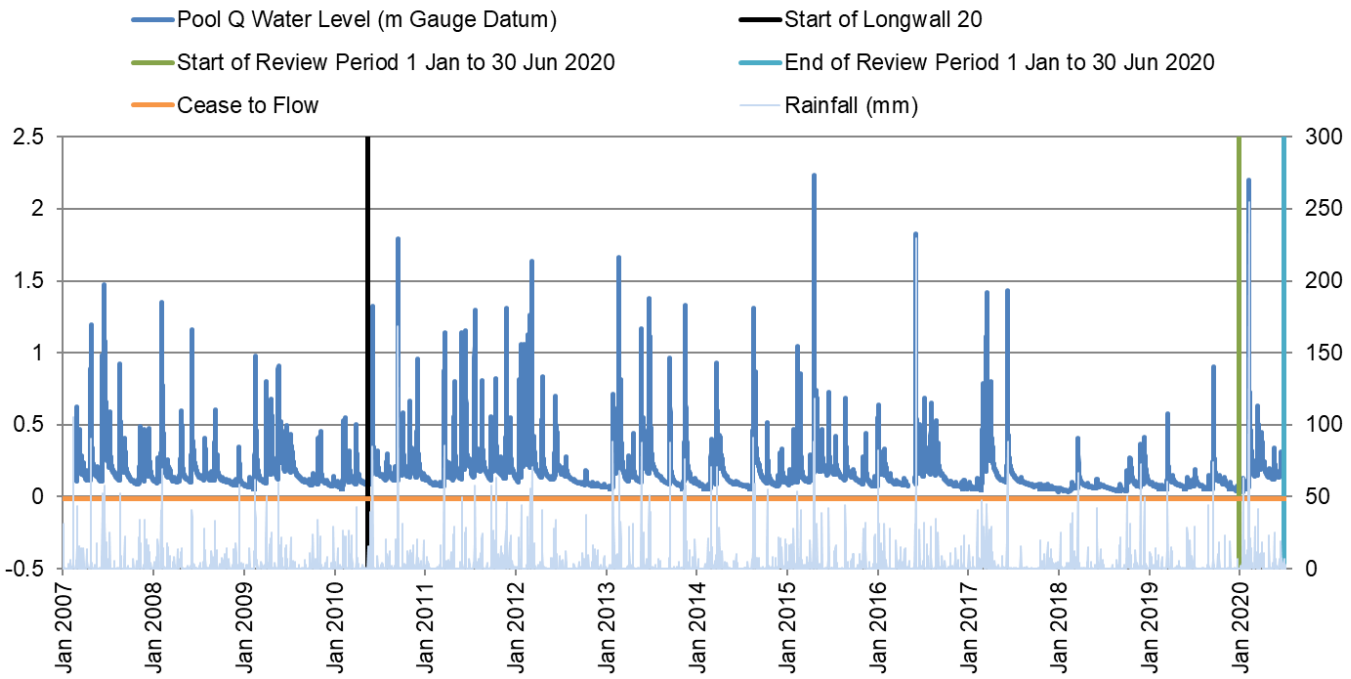


Chart A19 Pool Q Waratah Rivulet

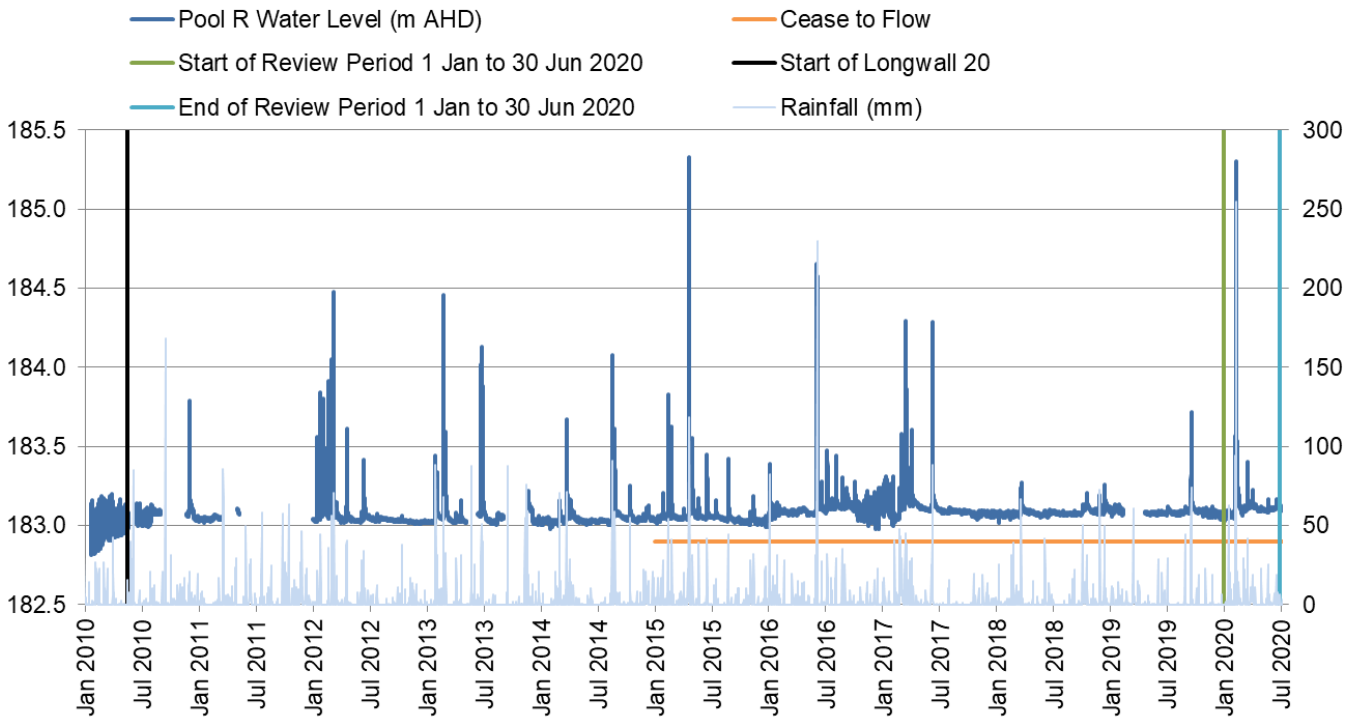


Chart A20 Pool R Waratah Rivulet[11]

[11] The sensor malfunctioned on 14 February 2019 and was replaced on 24 April 2019. As such, no data was recorded during this period. The sensor also failed to record data between 1 and 4 June 2020.

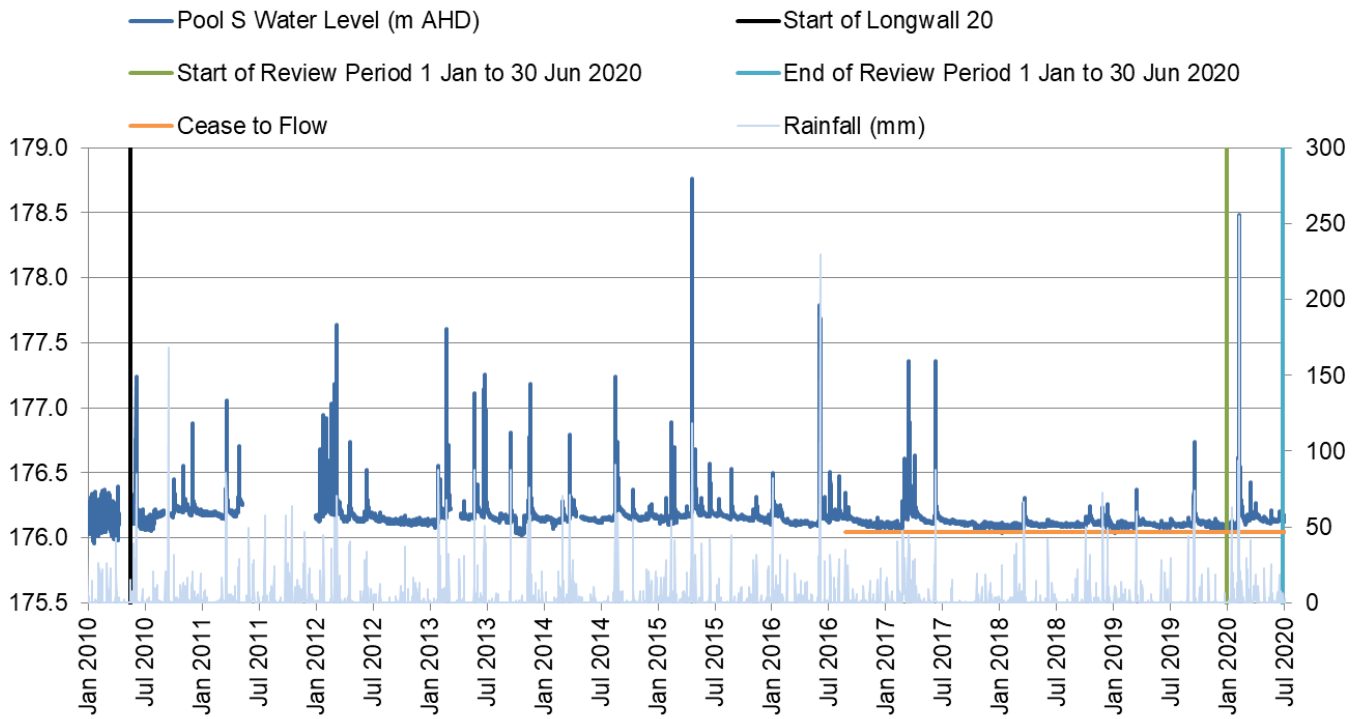


Chart A21 Pool S Waratah Rivulet

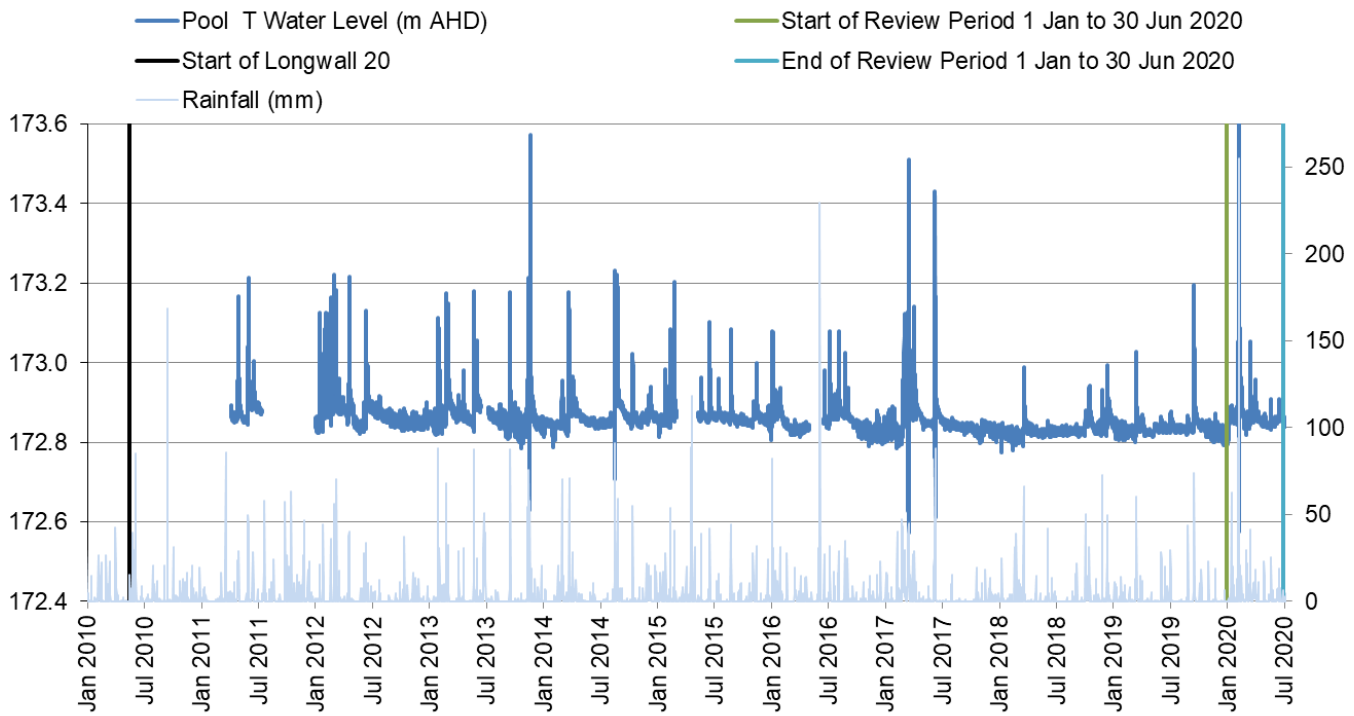


Chart A22 Pool T Waratah Rivulet

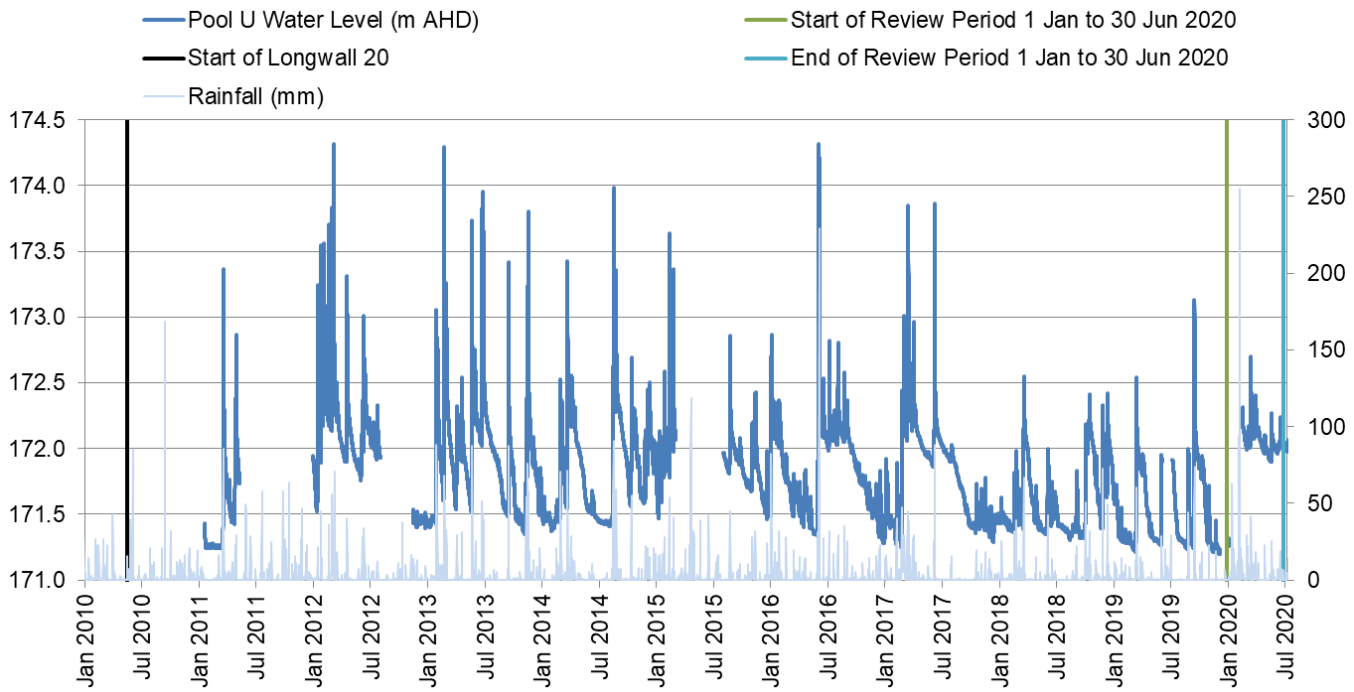


Chart A23 Pool U Waratah Rivulet[12]

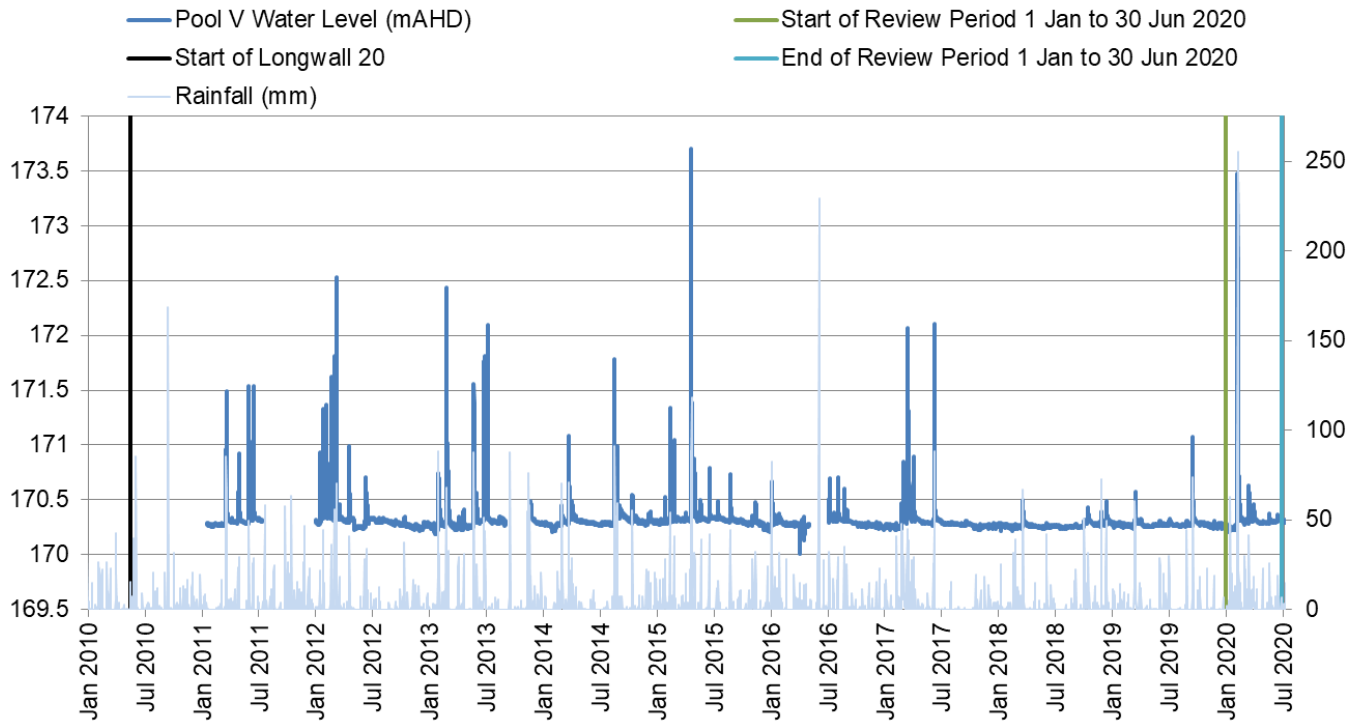


Chart A24 Pool V Waratah Rivulet

[12] The sensor malfunctioned on 6 June 2019 and was replaced in July 2019. The sensor clock was off and was not recording data from 7 January to 18 February 2020.

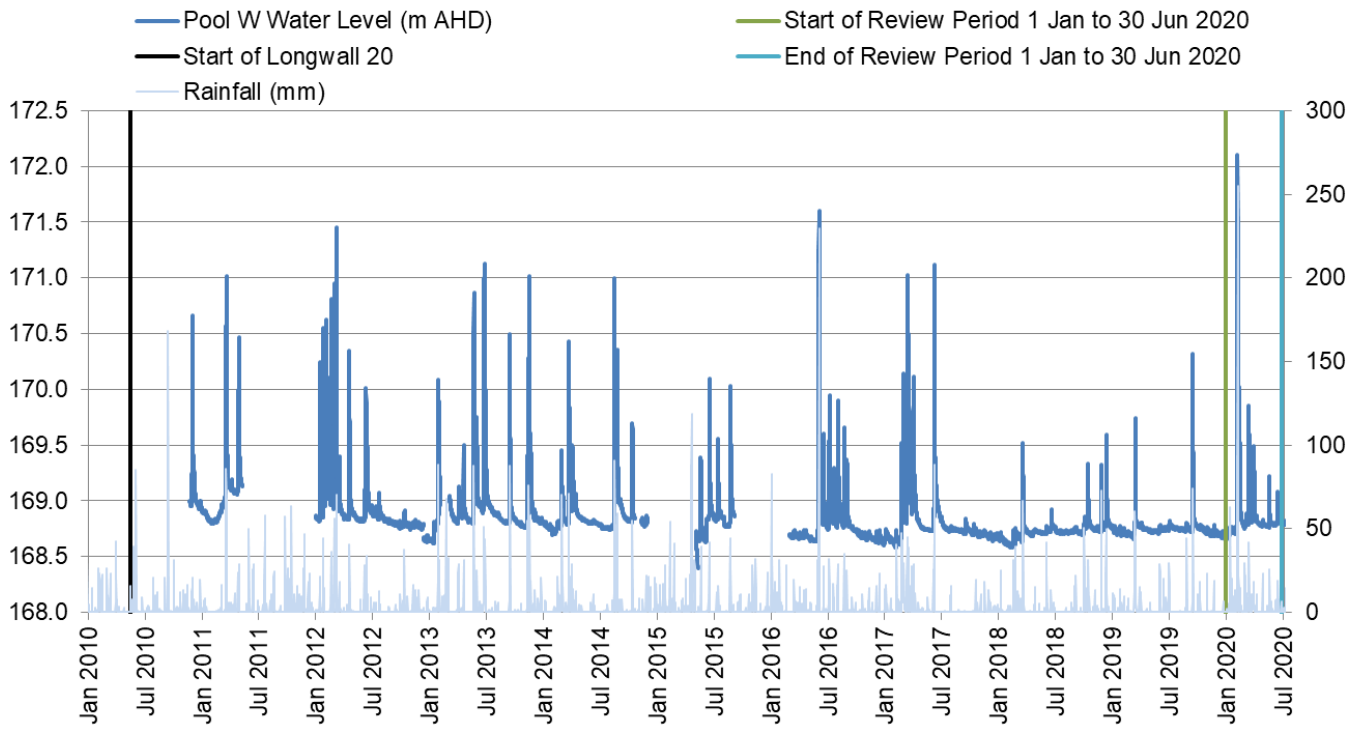


Chart A25 Pool W Waratah Rivulet

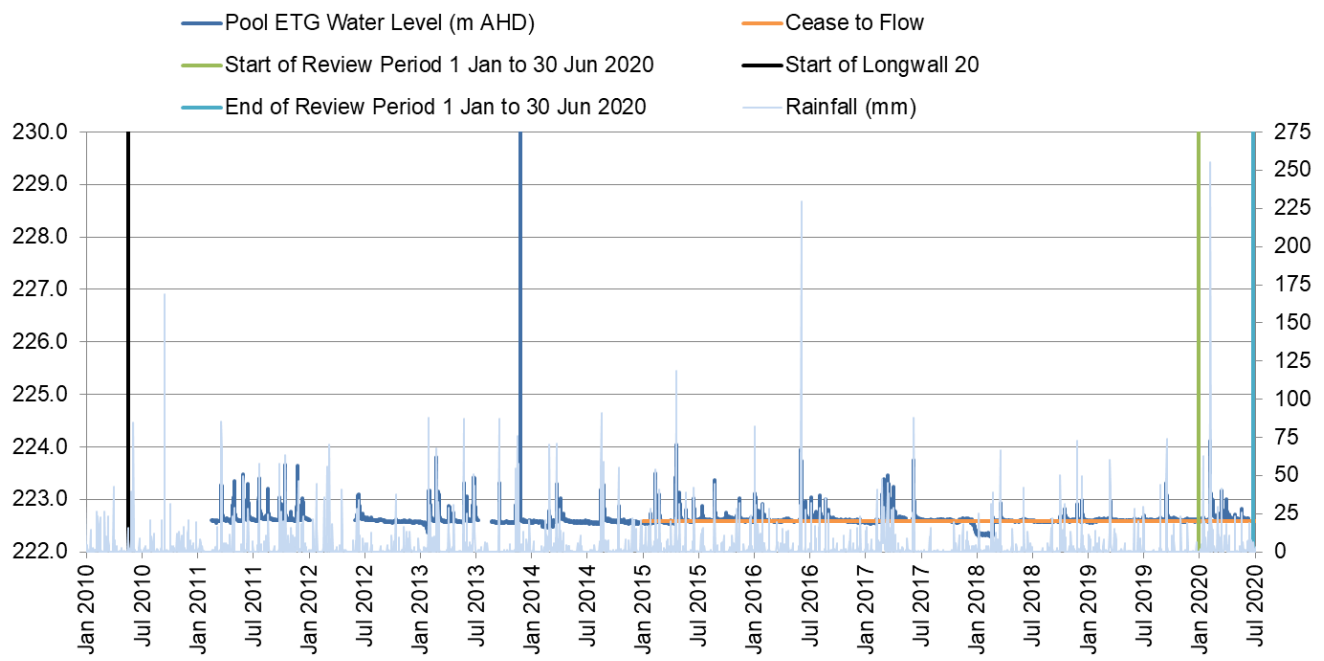


Chart A26 Pool ETG

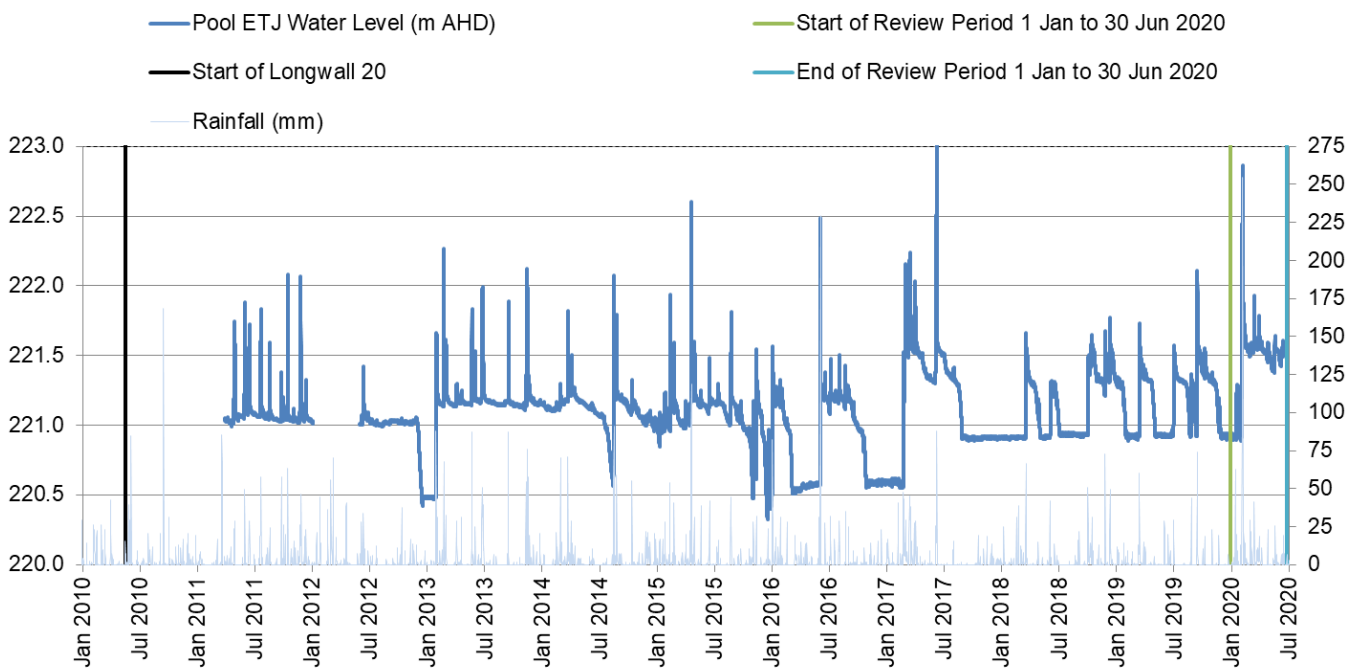


Chart A27 Pool ETJ

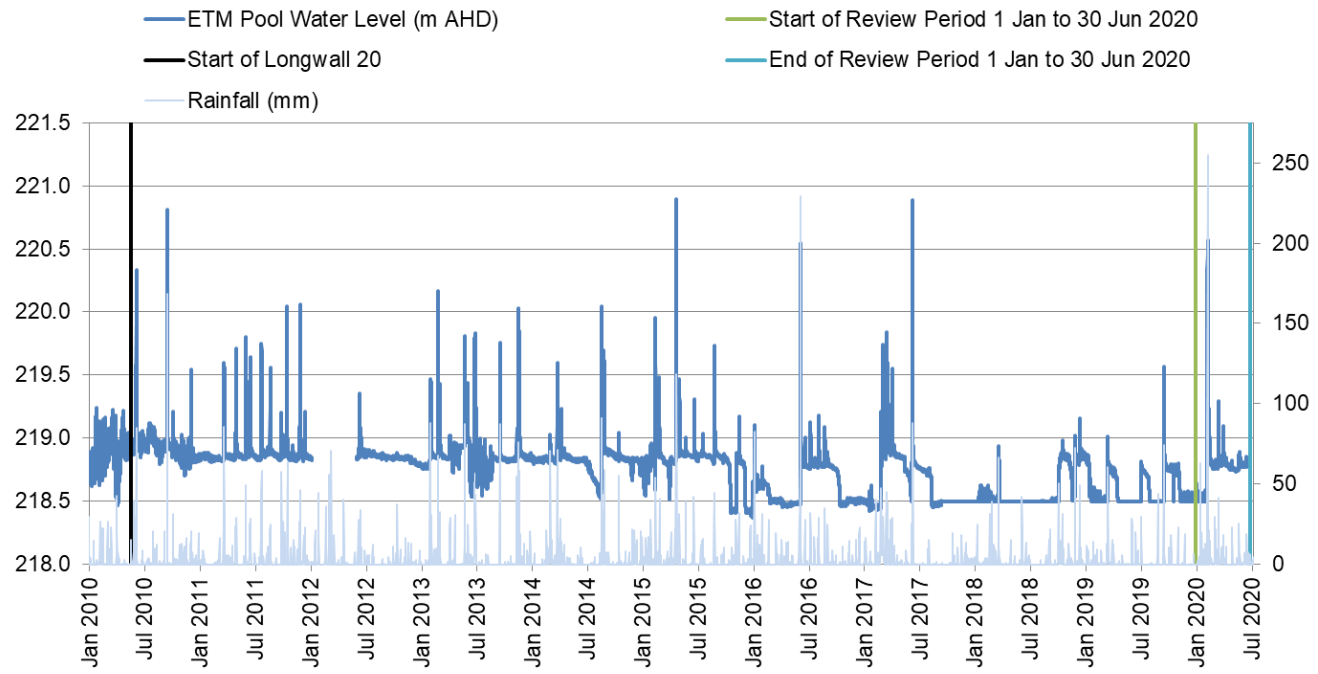


Chart A28 Pool ETM

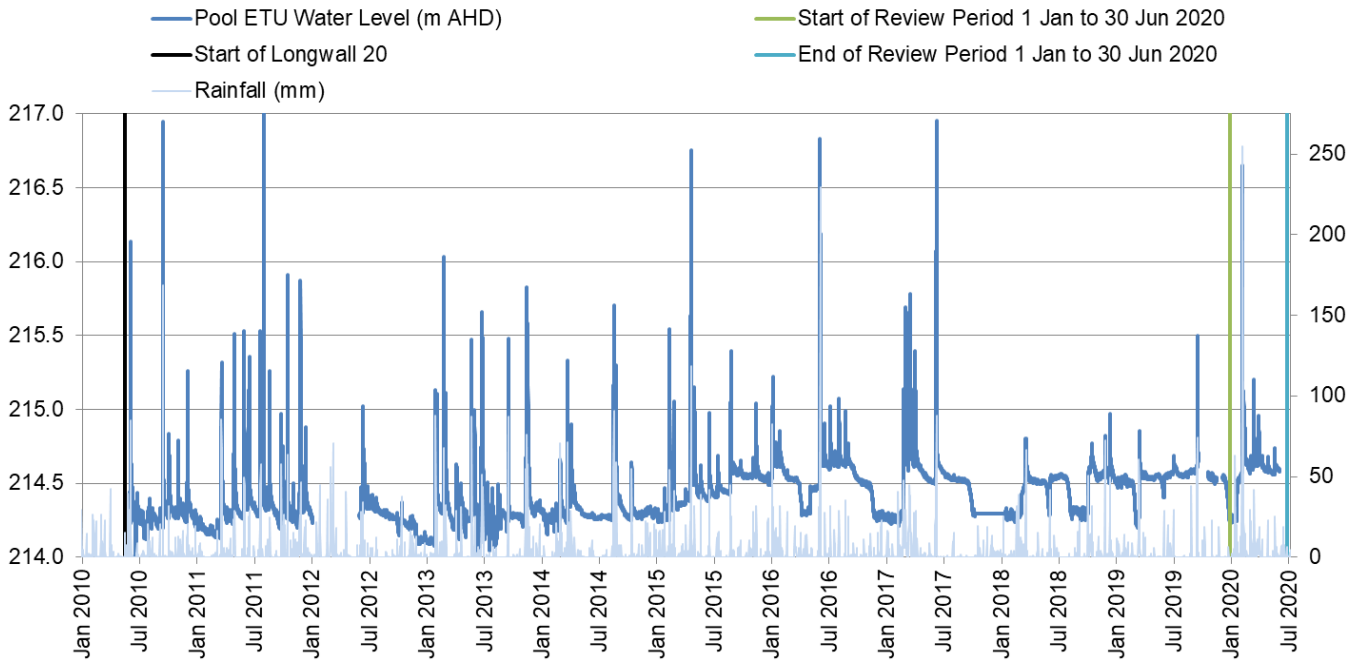


Chart A29 Pool ETU[13]

[13] The water level sensor was not restarted and hence data was not recorded between 23 September 2019 and 21 October 2019. A communication error with the sensor occurred resulting in lost data between 18 November 2019 and 8 December 2019. Failure during data download occurred on 5 June 2020 and data records to the end of June 2020 were lost.

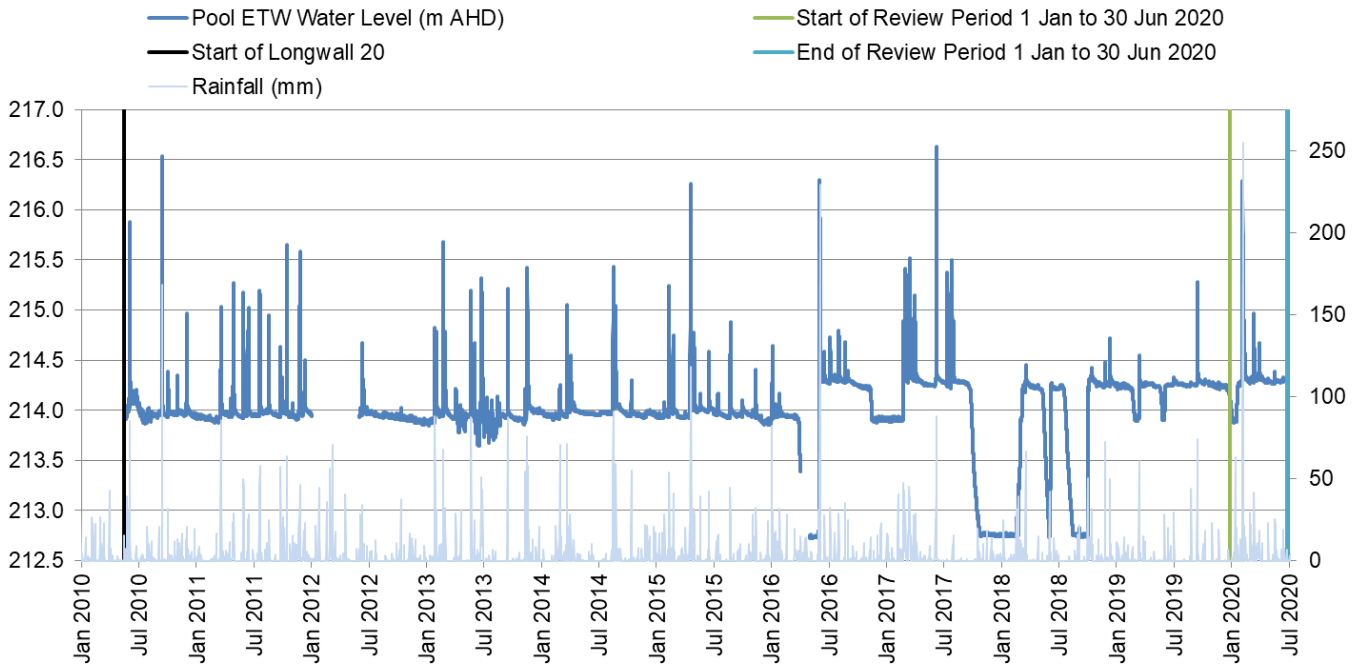


Chart A30 Pool ETW[14,15]

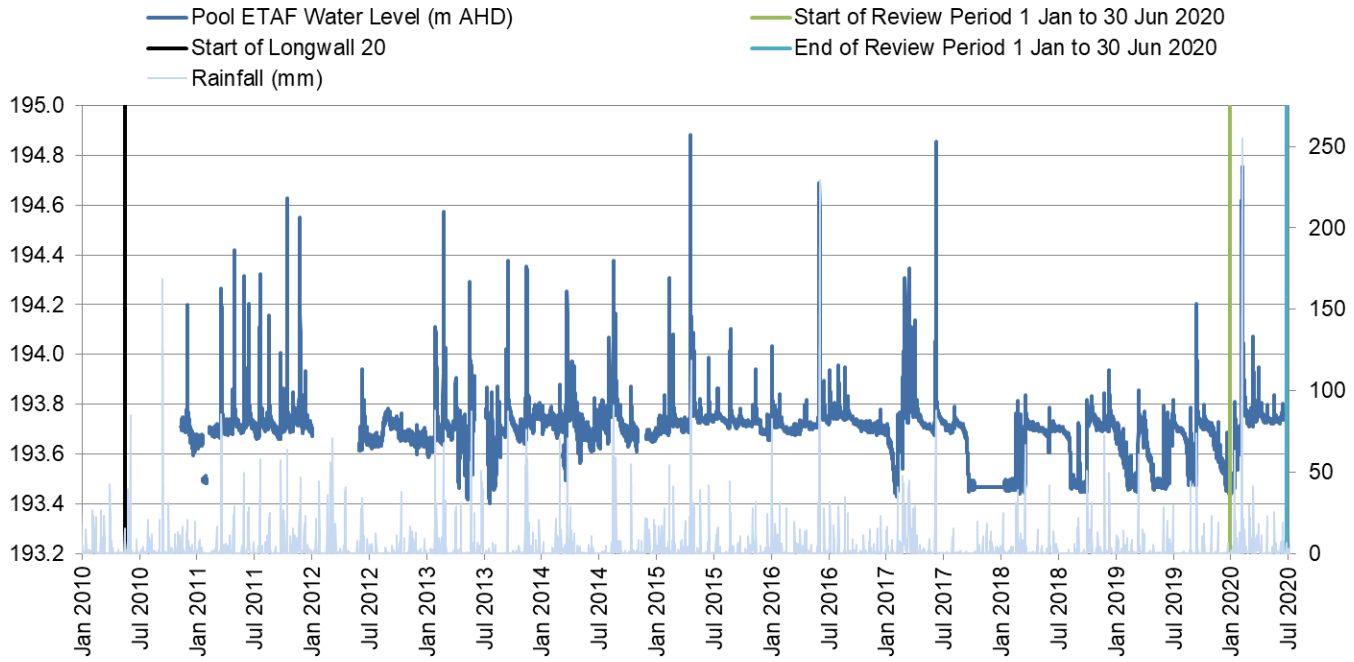


Chart A31 Pool ETAF

[14] Note discrepancies in water levels caused by the pool being dry and the water level sensor being exposed at time of download.

[15] After heavy rainfalls in early June 2016, the sensor stand at Pool ETW became clogged with sediment and the sensor was unable to reach the bottom. On 14 July 2016, a new sensor was installed at Pool ETW to replace the previous sensor. In September 2017, the old sensor was cleared of sediment and was able to be used again. The original sensor extends deeper into the pool, allowing additional information to be obtained during periods when the pool water level is below the cease to flow level. Data shown after September 2017 is from the original sensor.

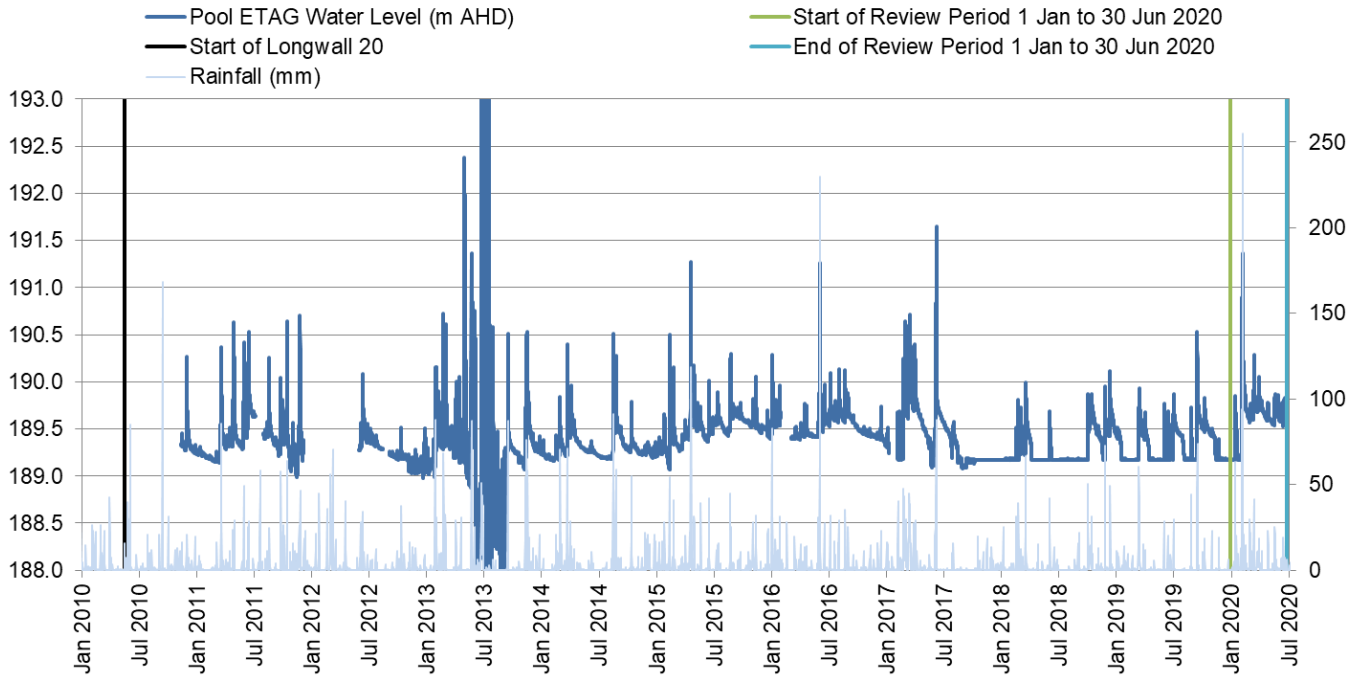


Chart A32 Pool ETAG

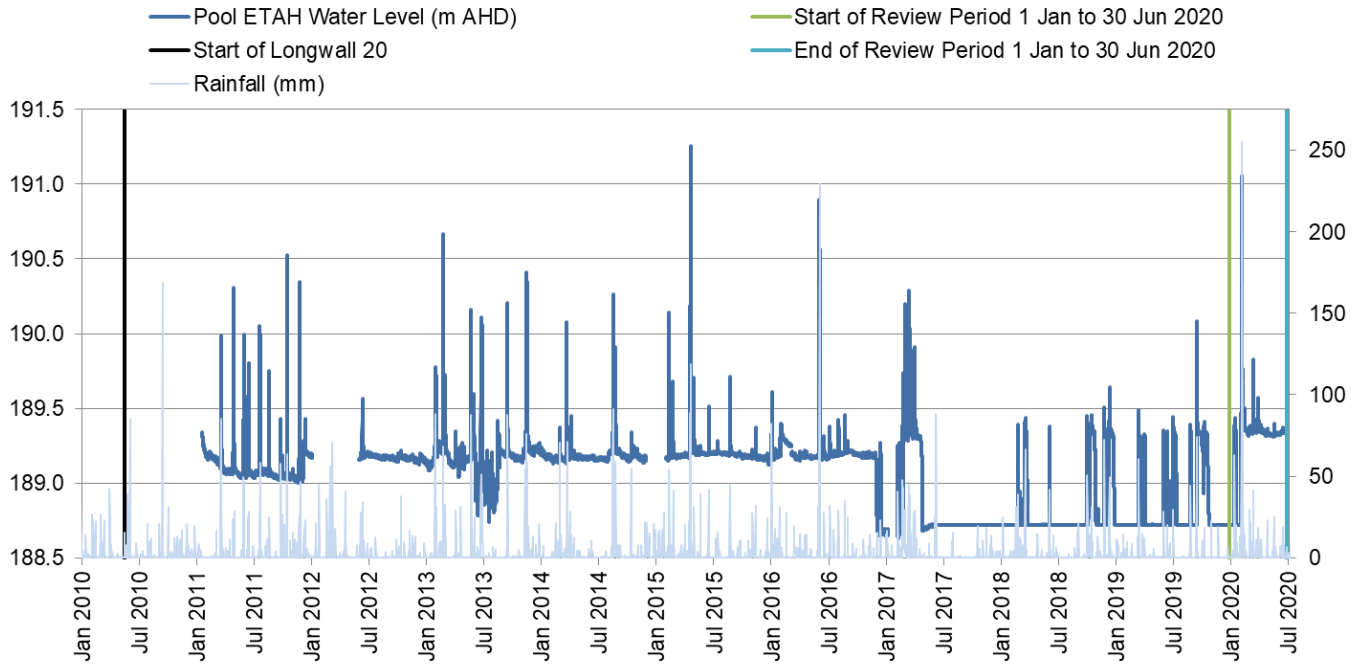


Chart A33 Pool ETAH

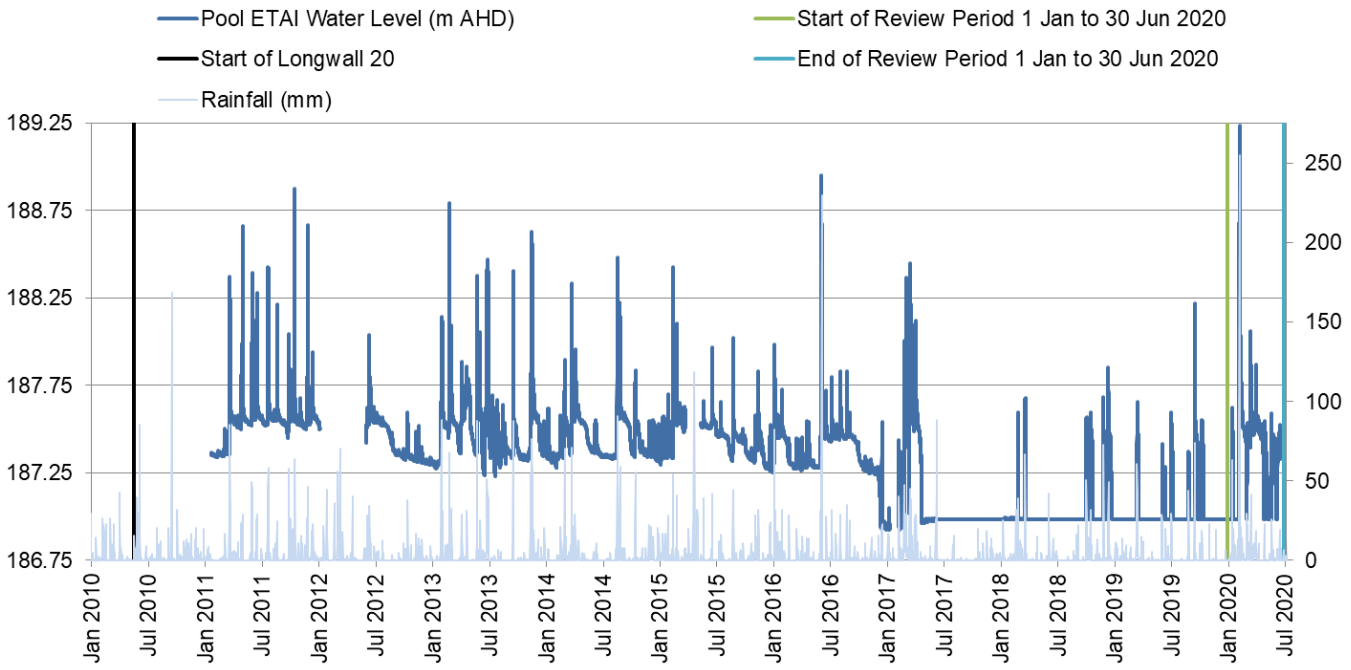


Chart A34 Pool ETAI

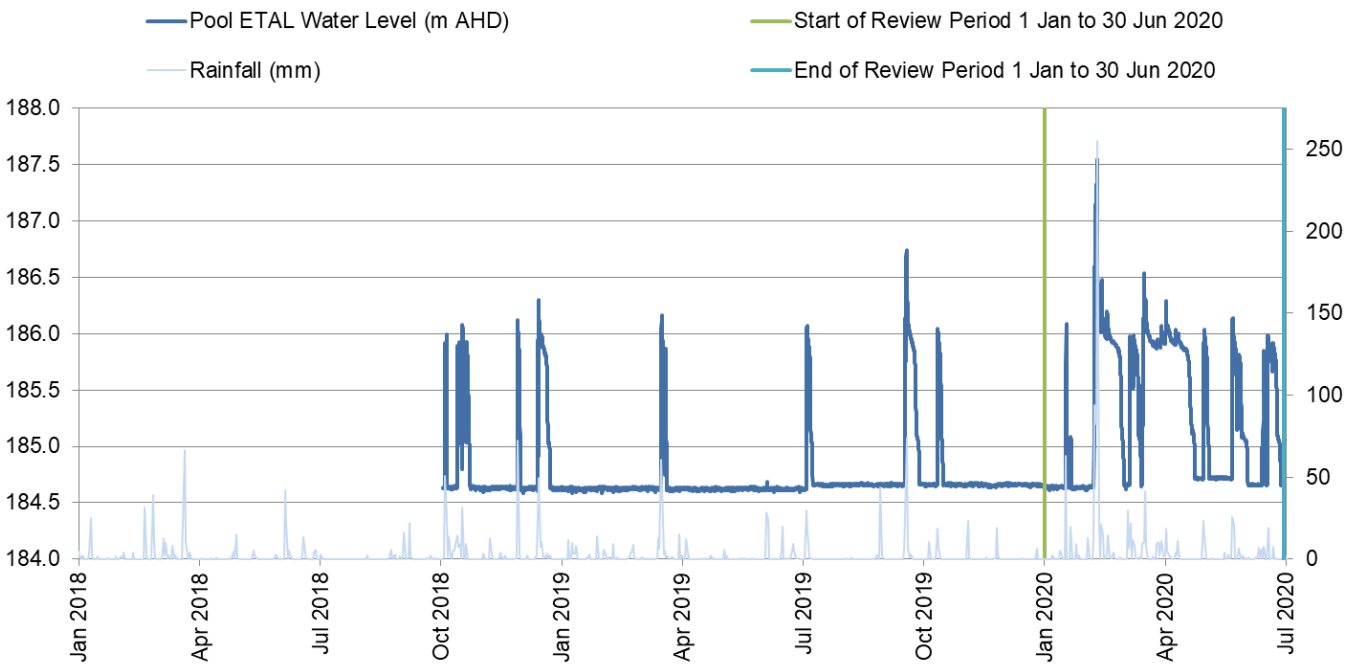


Chart A35 Pool ETAL

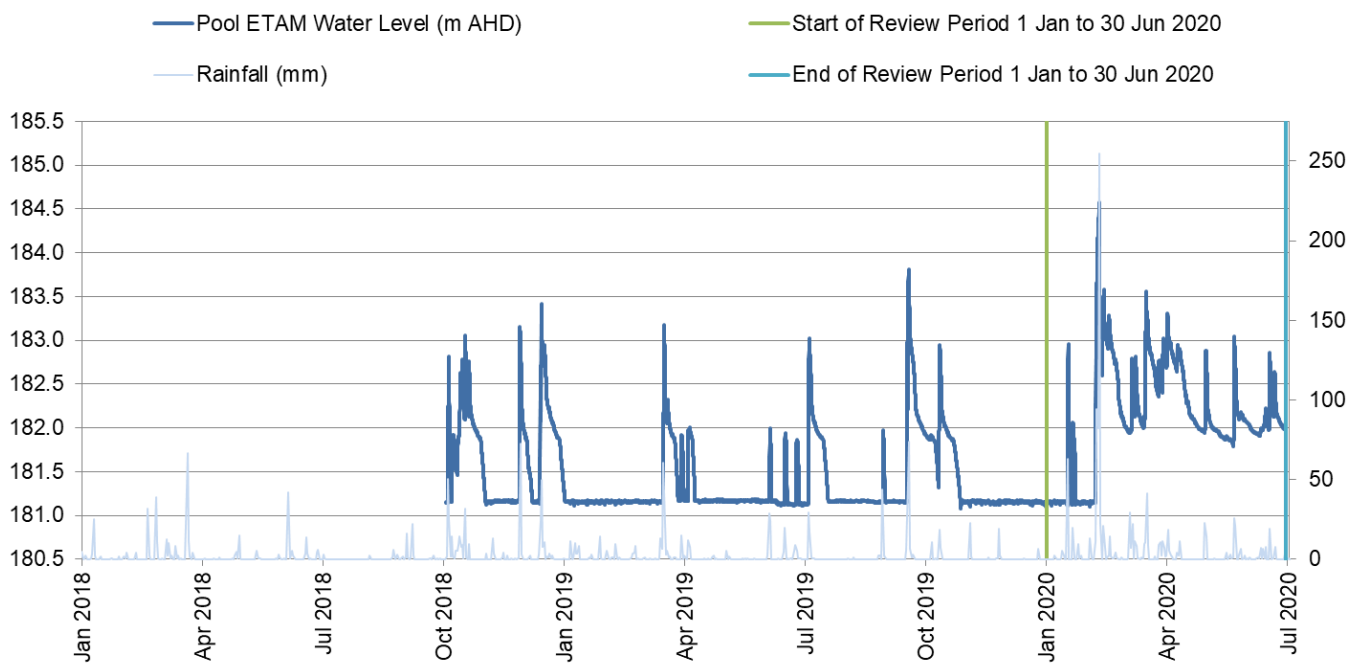


Chart A36 Pool ETAM

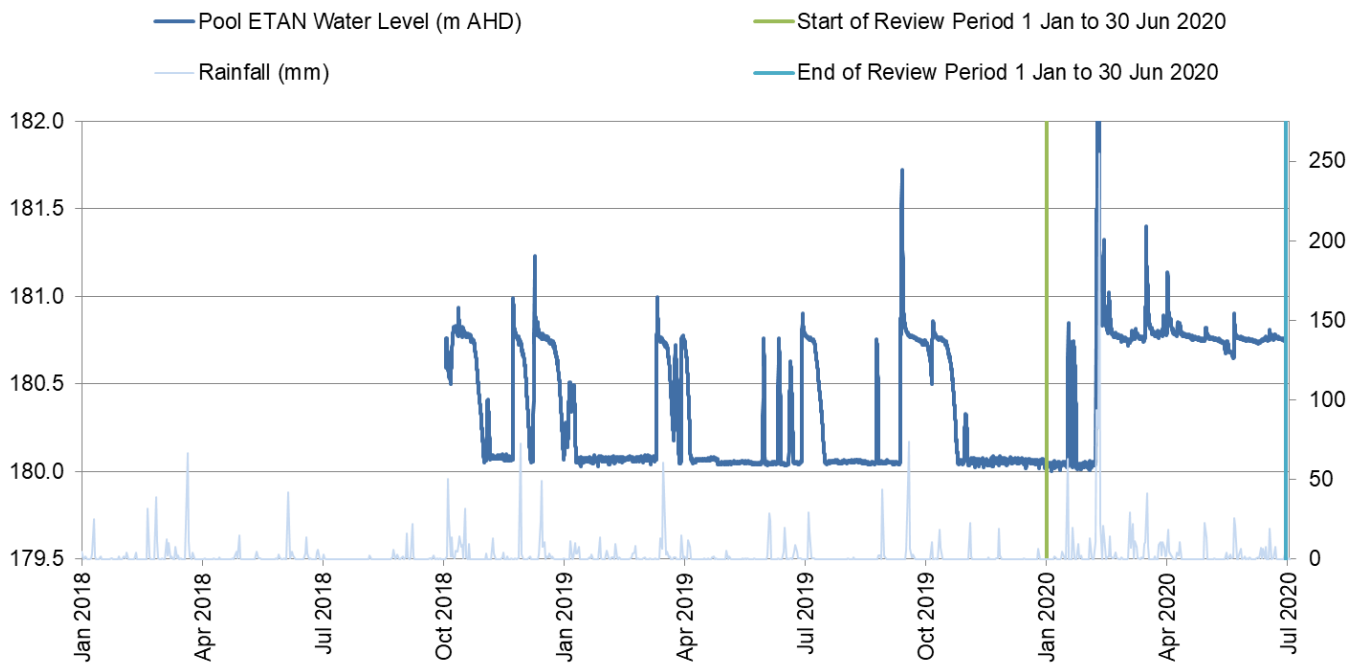


Chart A37 Pool ETAN

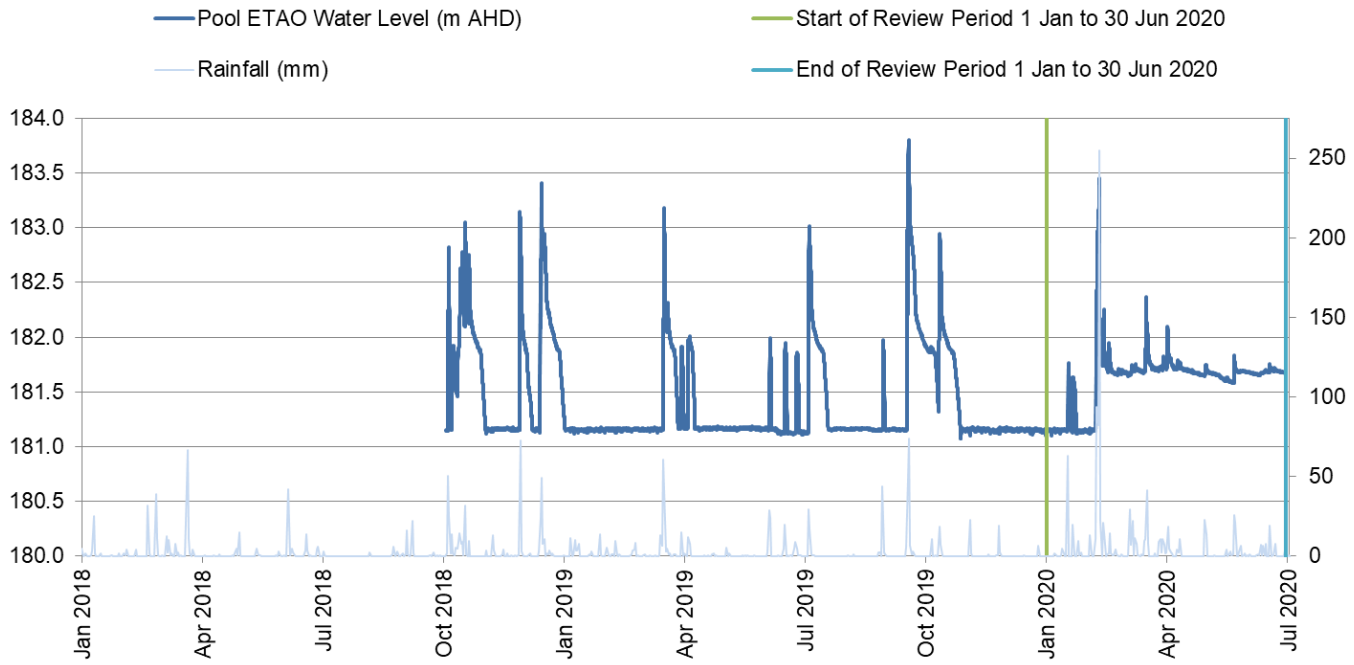


Chart A38 Pool ETAO

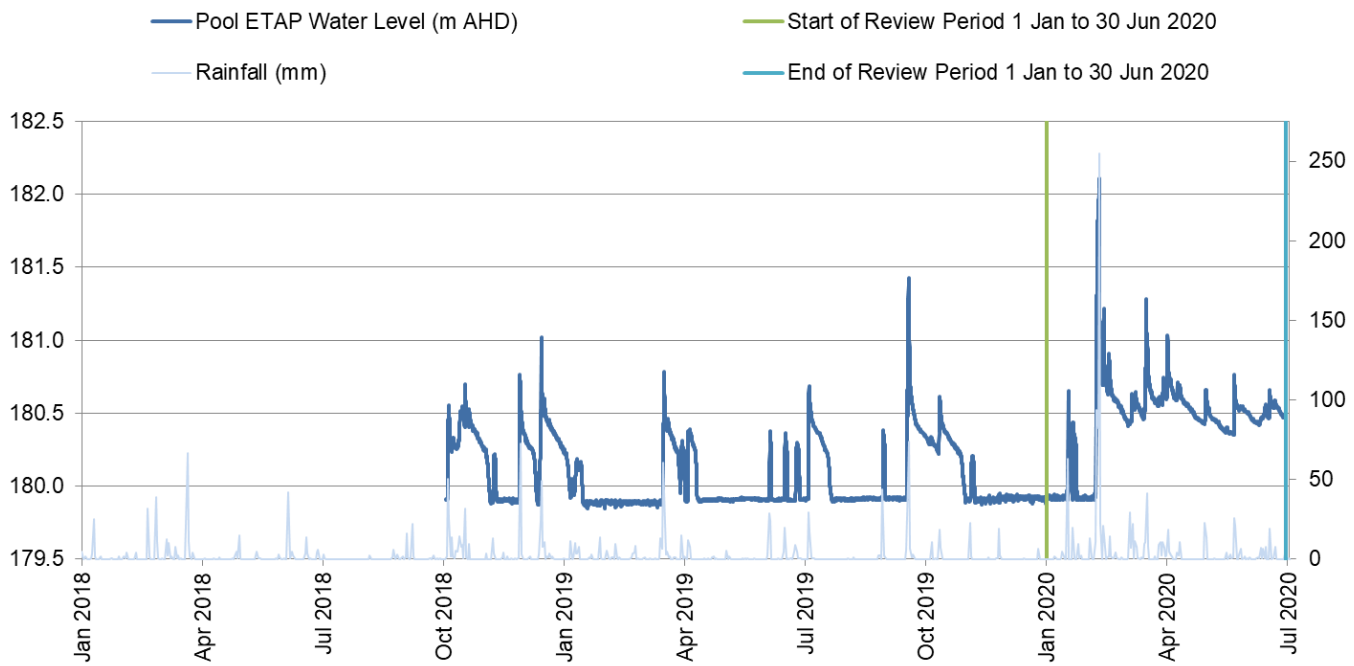


Chart A39 Pool ETAP

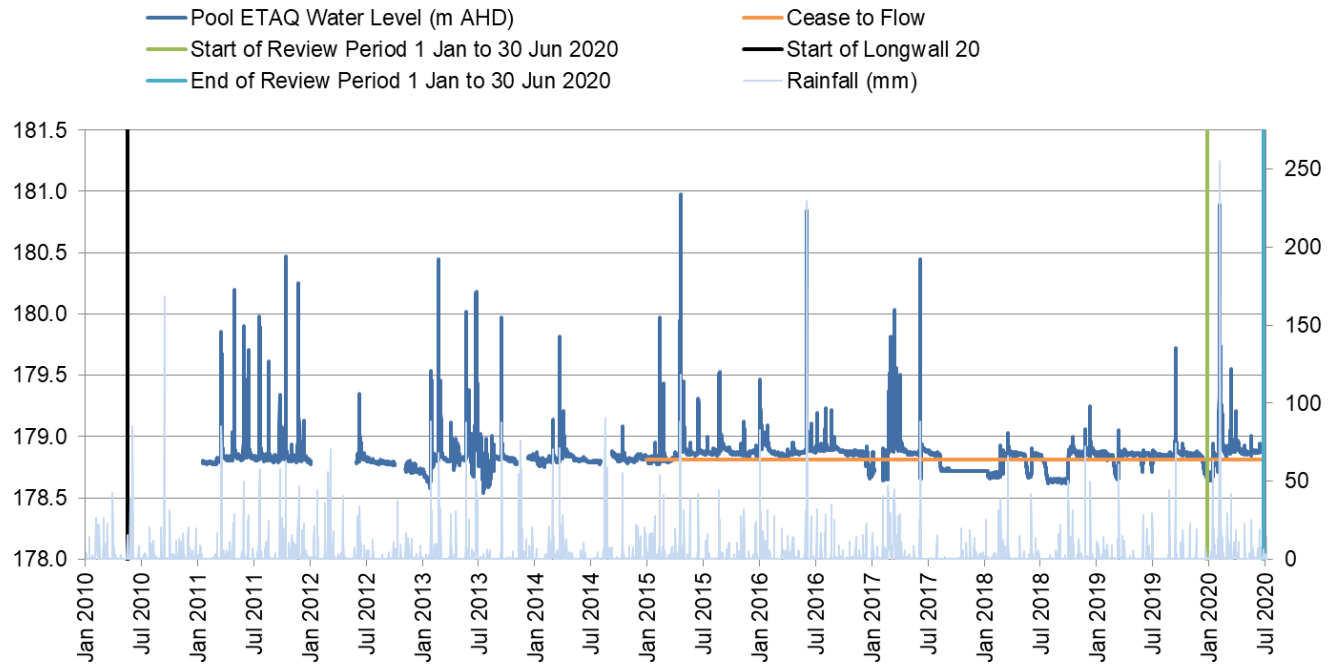


Chart A40 Pool ETAQ

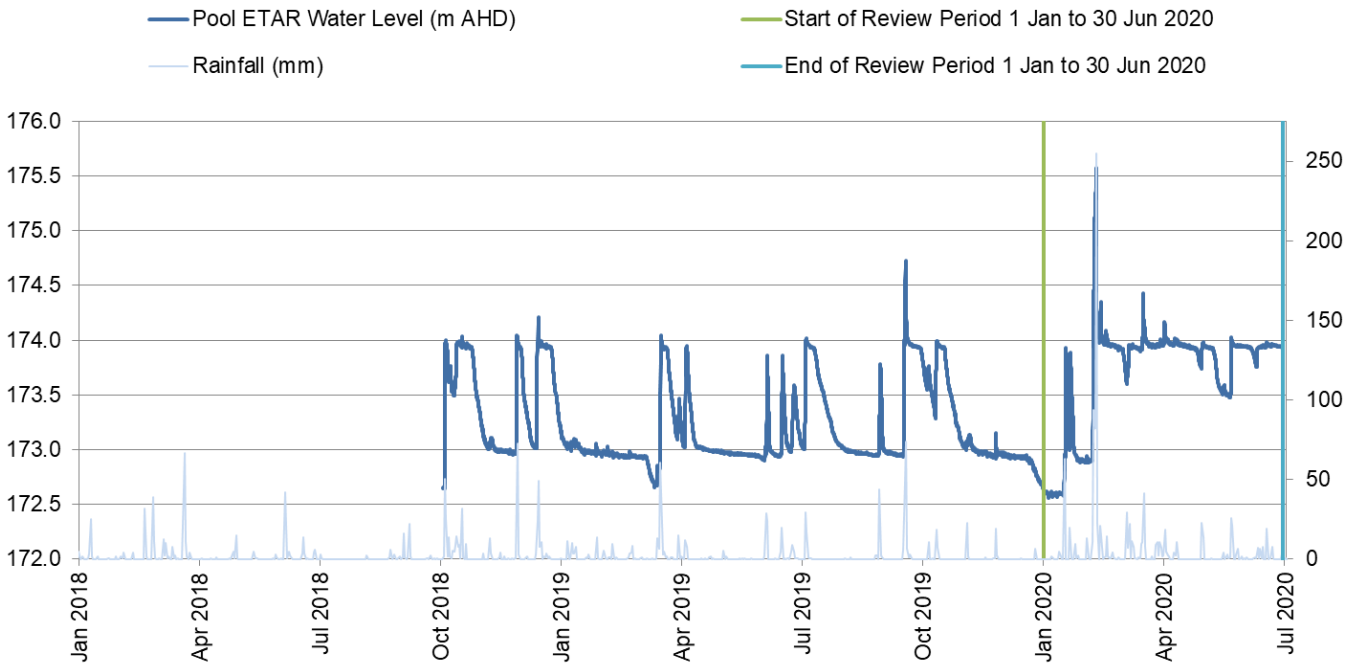


Chart A41 Pool ETAR

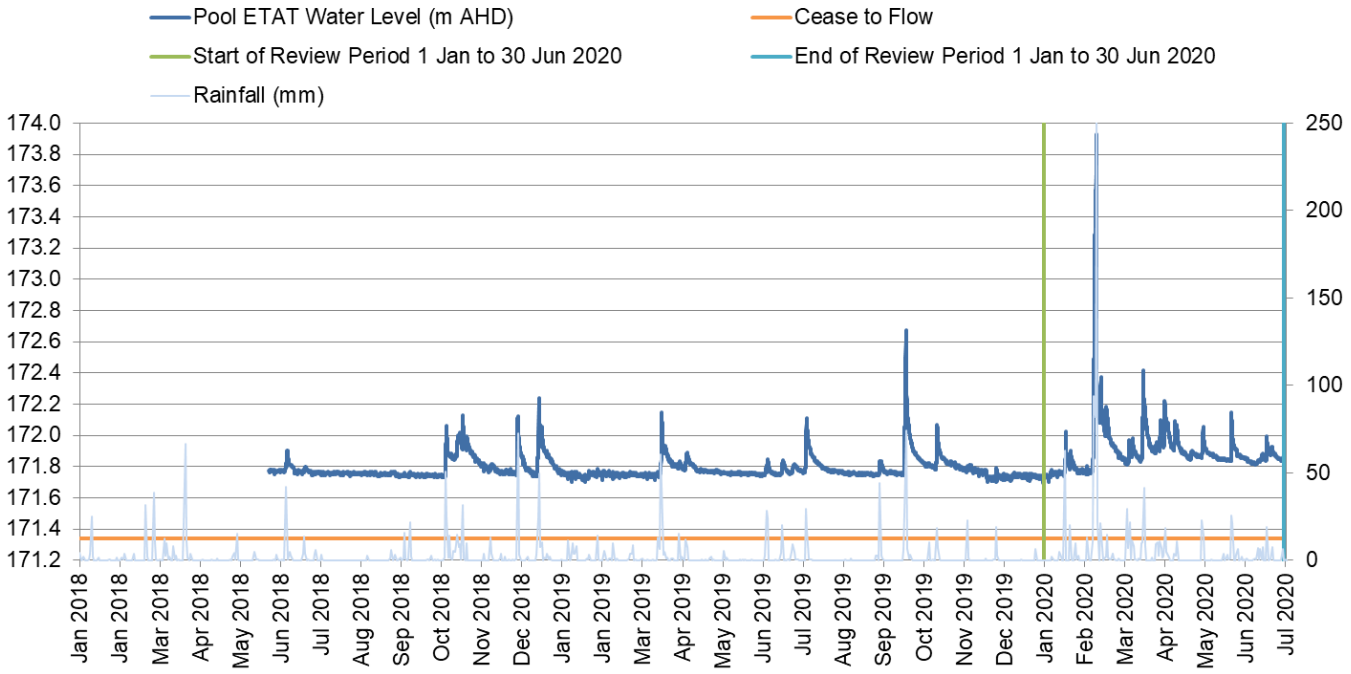


Chart A42 Pool ETAT

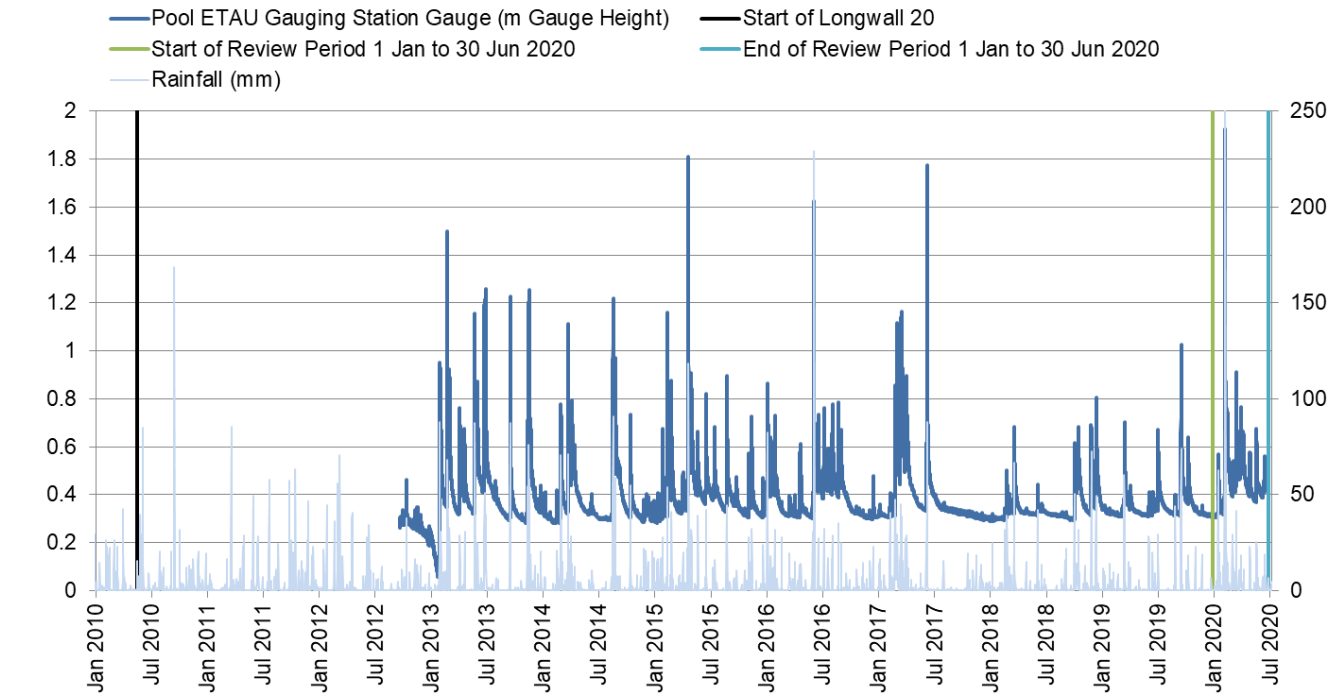


Chart A43 Pool ETAU (Stage data)

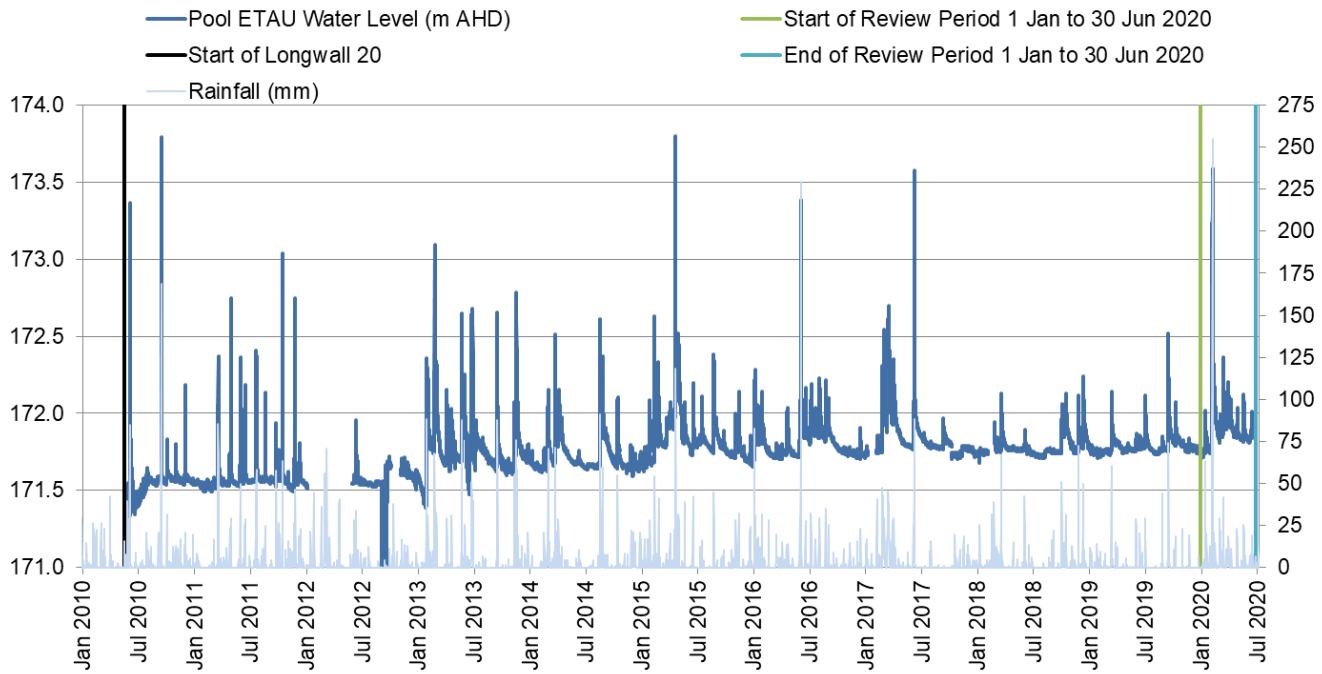


Chart A44 Pool ETAU

Pools on Tributary B/Reference Tributary

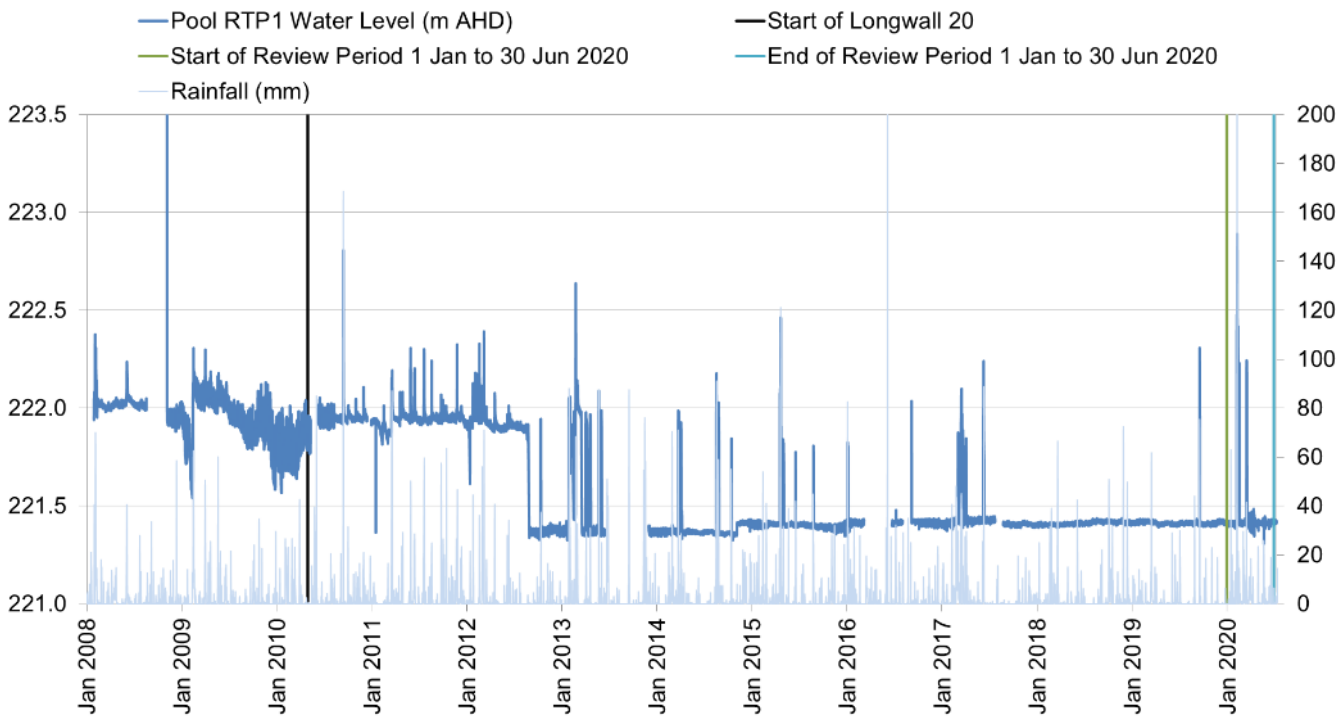


Chart A45 Pool RTP1

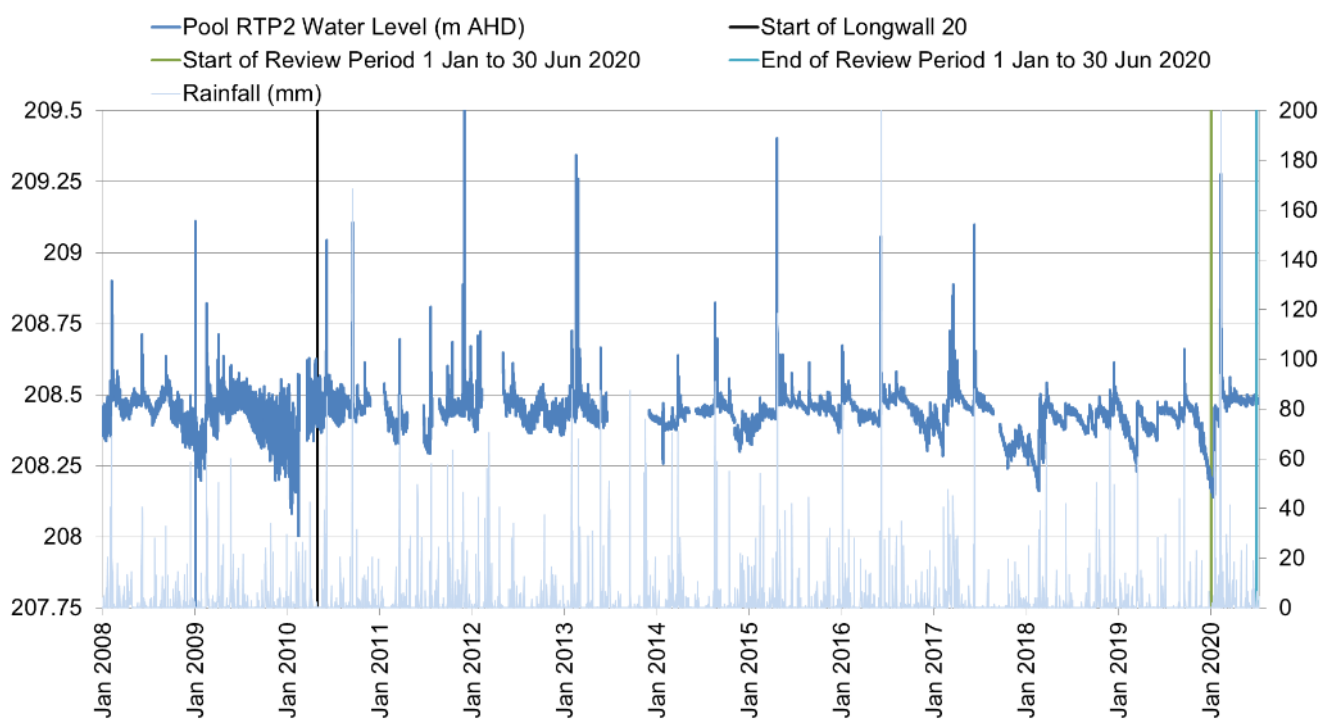


Chart A46 Pool RTP2

Pools on Woronora River[16]

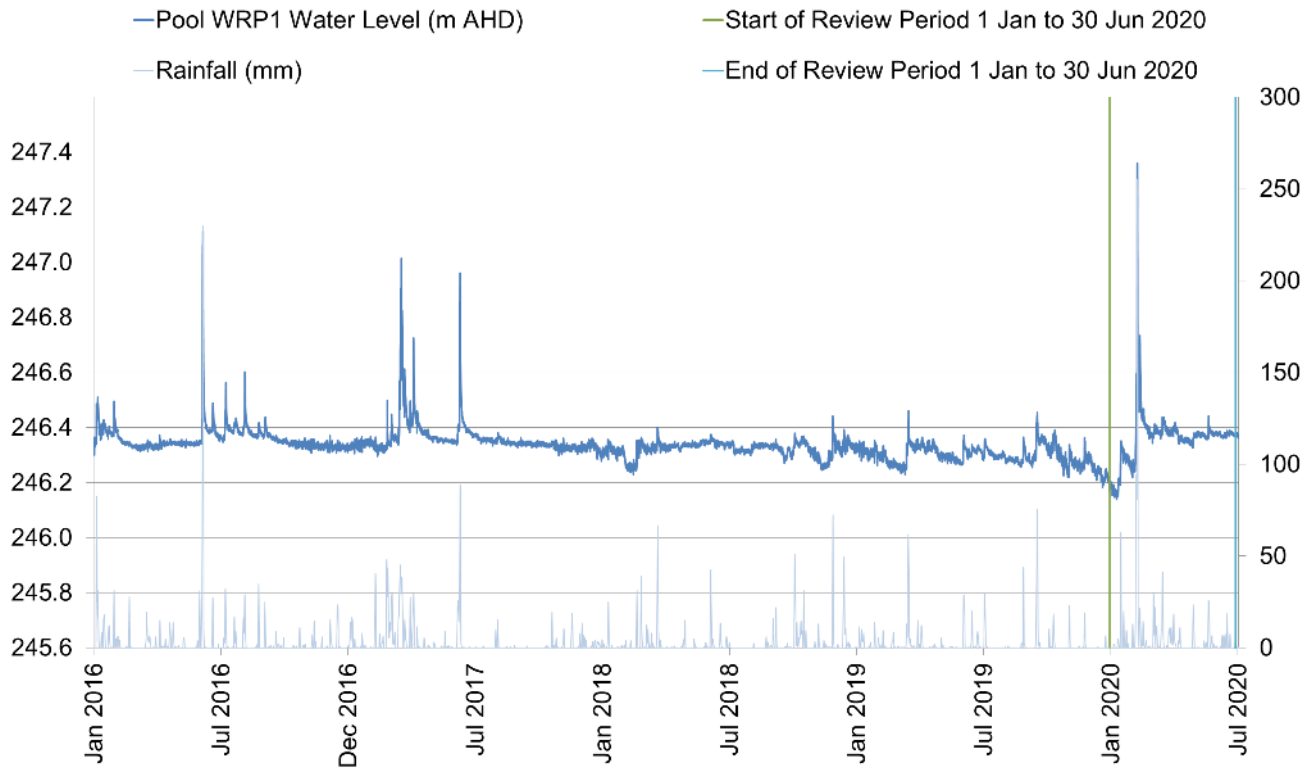


Chart A47 Pool WRP1

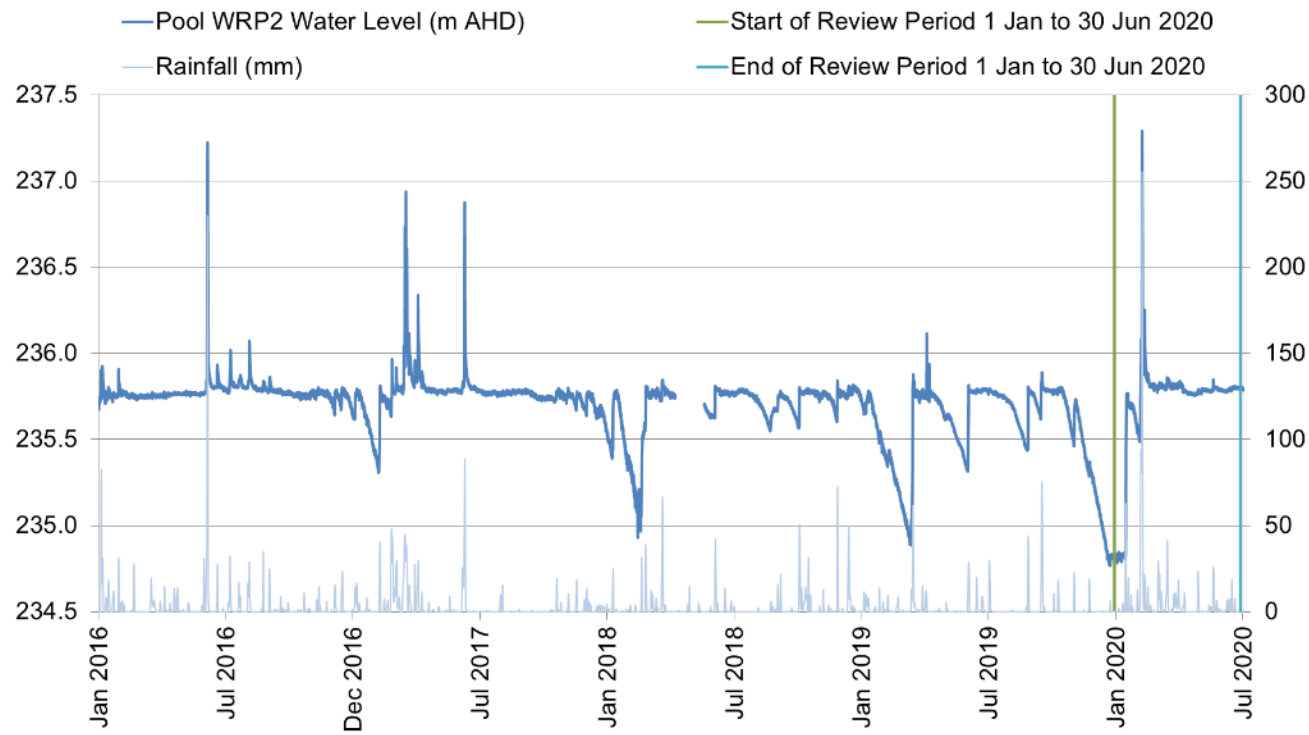


Chart A48 Pool WRP2

[16] 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.

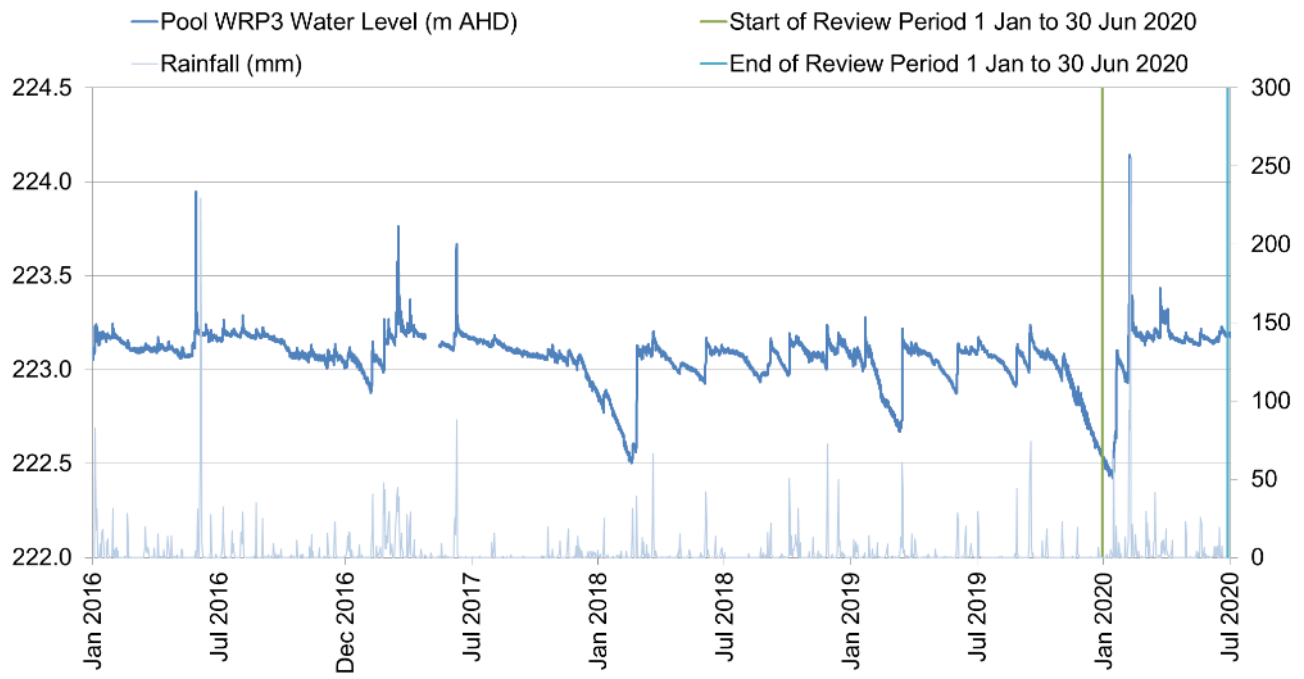


Chart A49 Pool WRP3

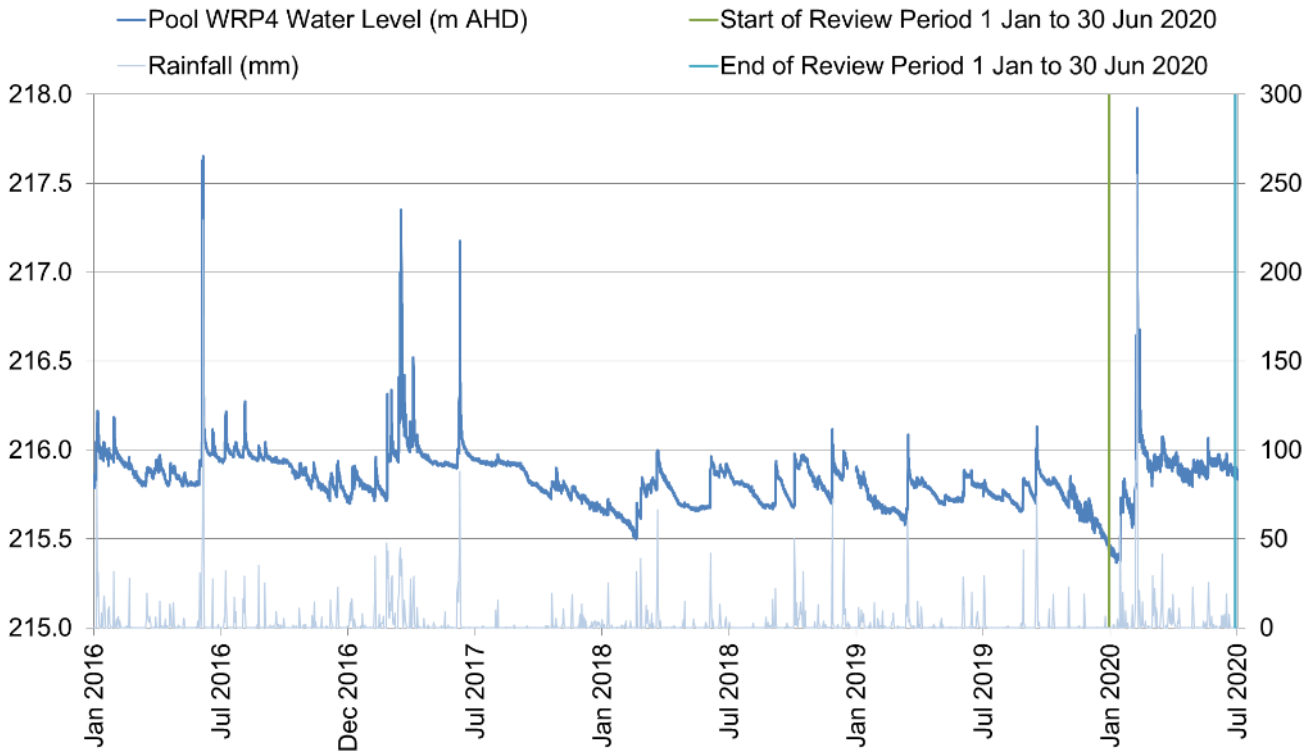


Chart A50 Pool WRP4[17]

[17] 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

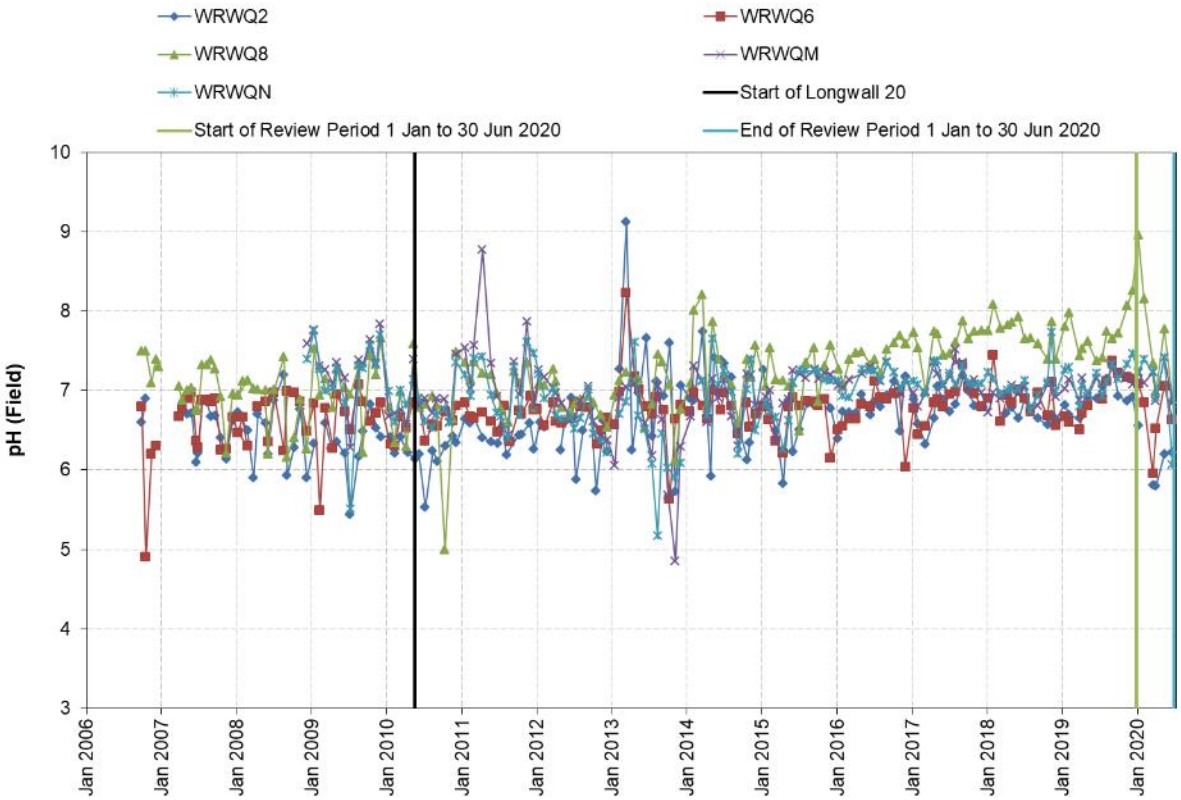


Chart B1 pH Levels Waratah Rivulet – Upper to Middle Reach Sites

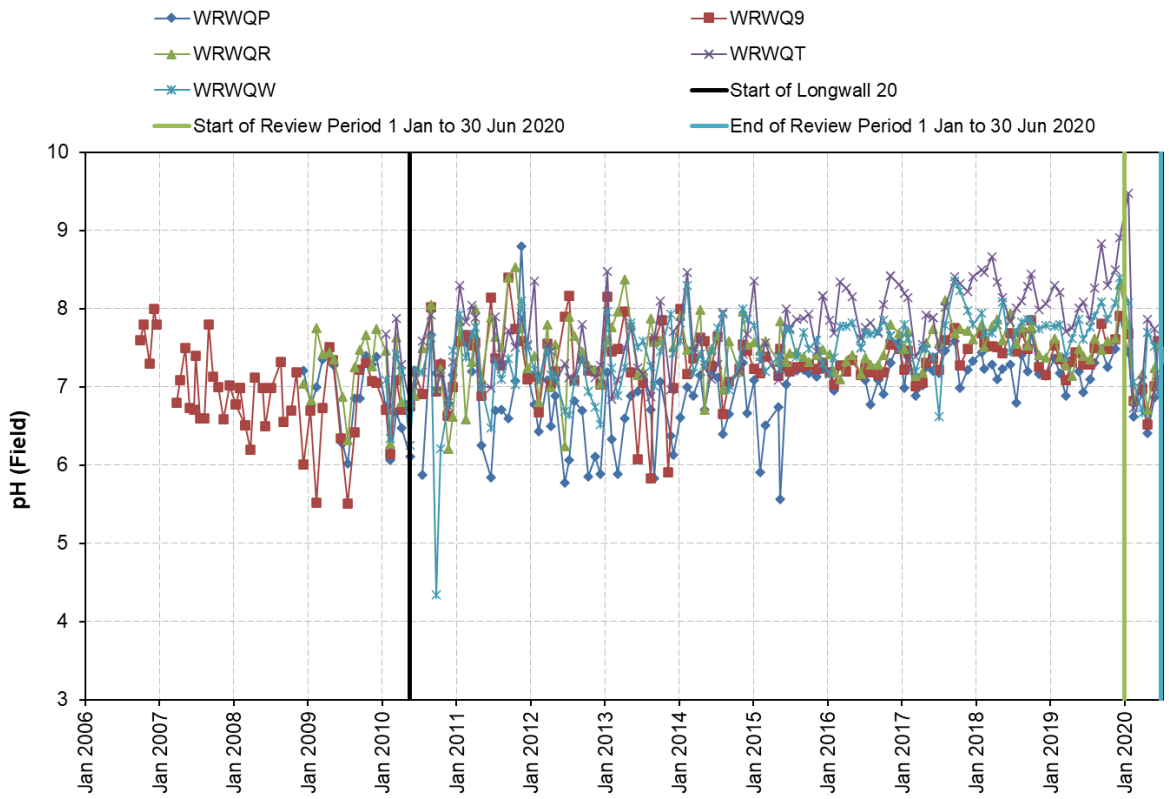


Chart B2 pH Levels Waratah Rivulet – Lower Reach Sites

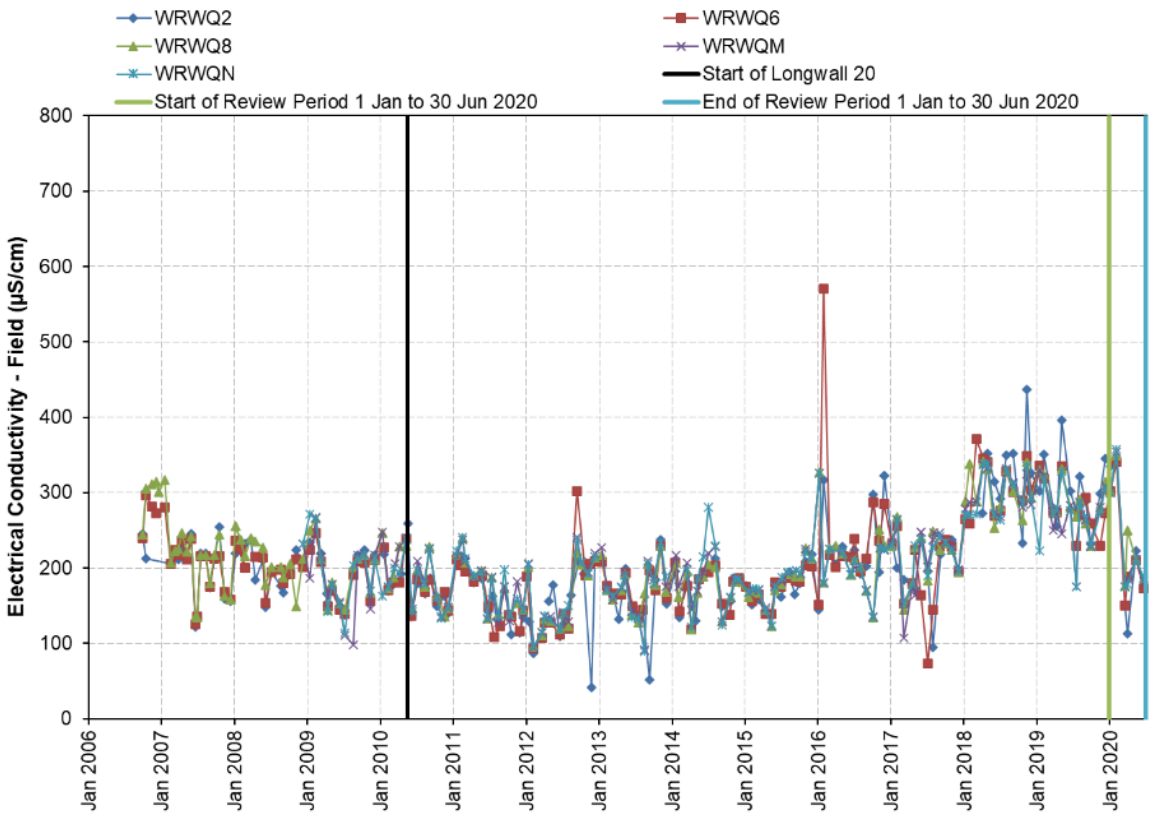


Chart B3 Electrical Conductivity (EC) Waratah Rivulet – Upper to Middle Reach Sites[18]

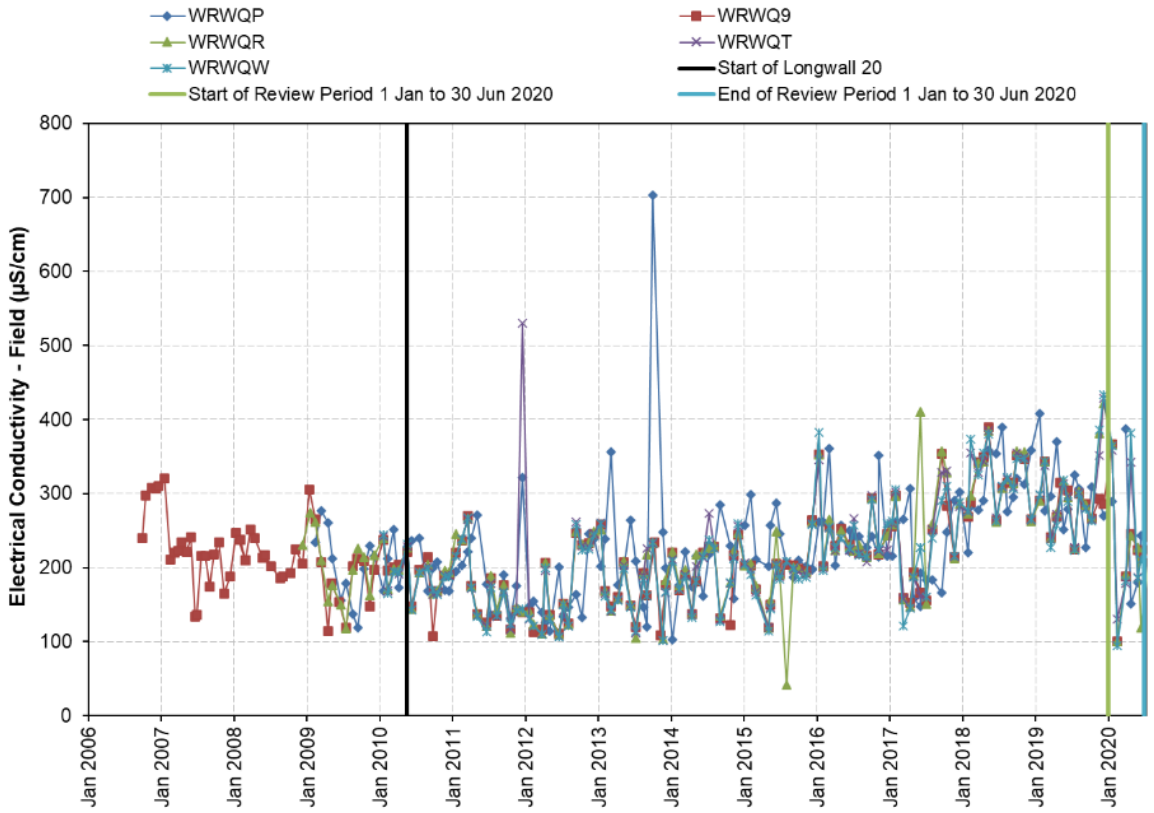


Chart B4 Electrical Conductivity (EC) Waratah Rivulet – Lower Reach Sites[14]

[18] 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.

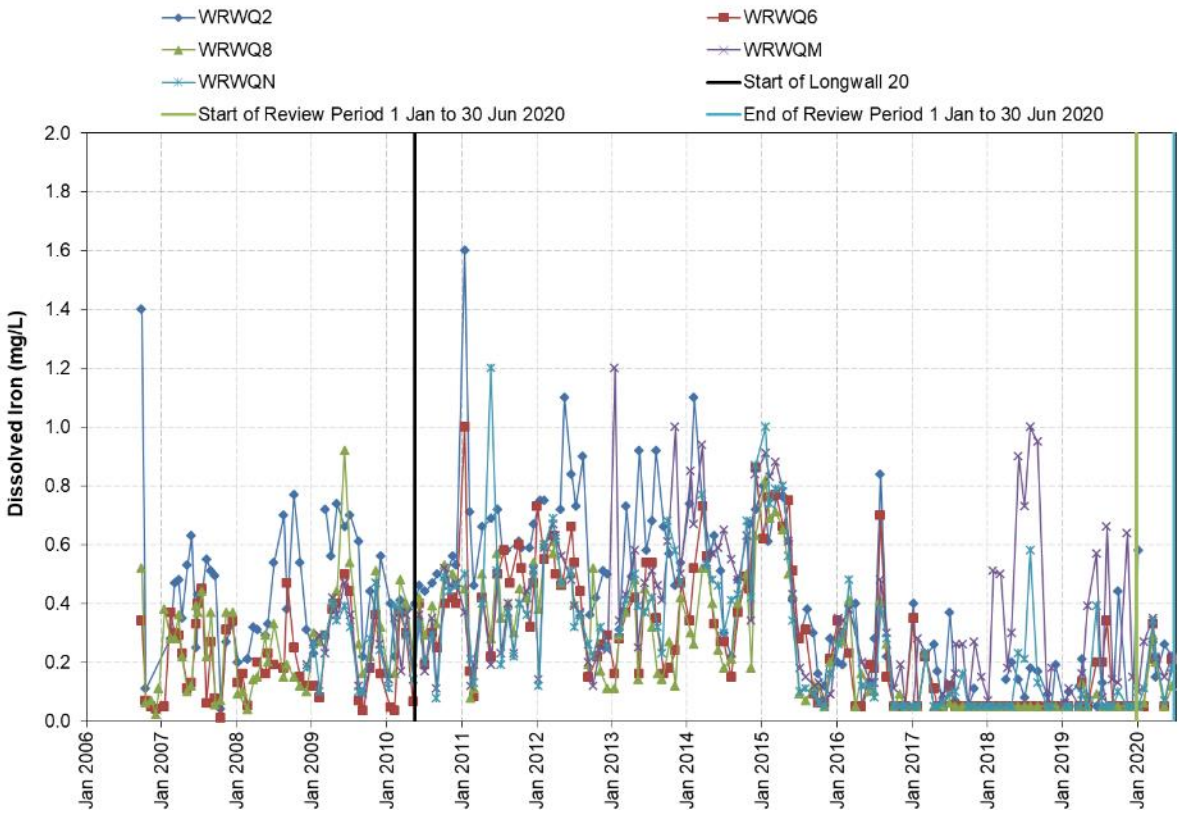


Chart B5 Dissolved Iron Waratah Rivulet – Upper and Middle Reach Sites

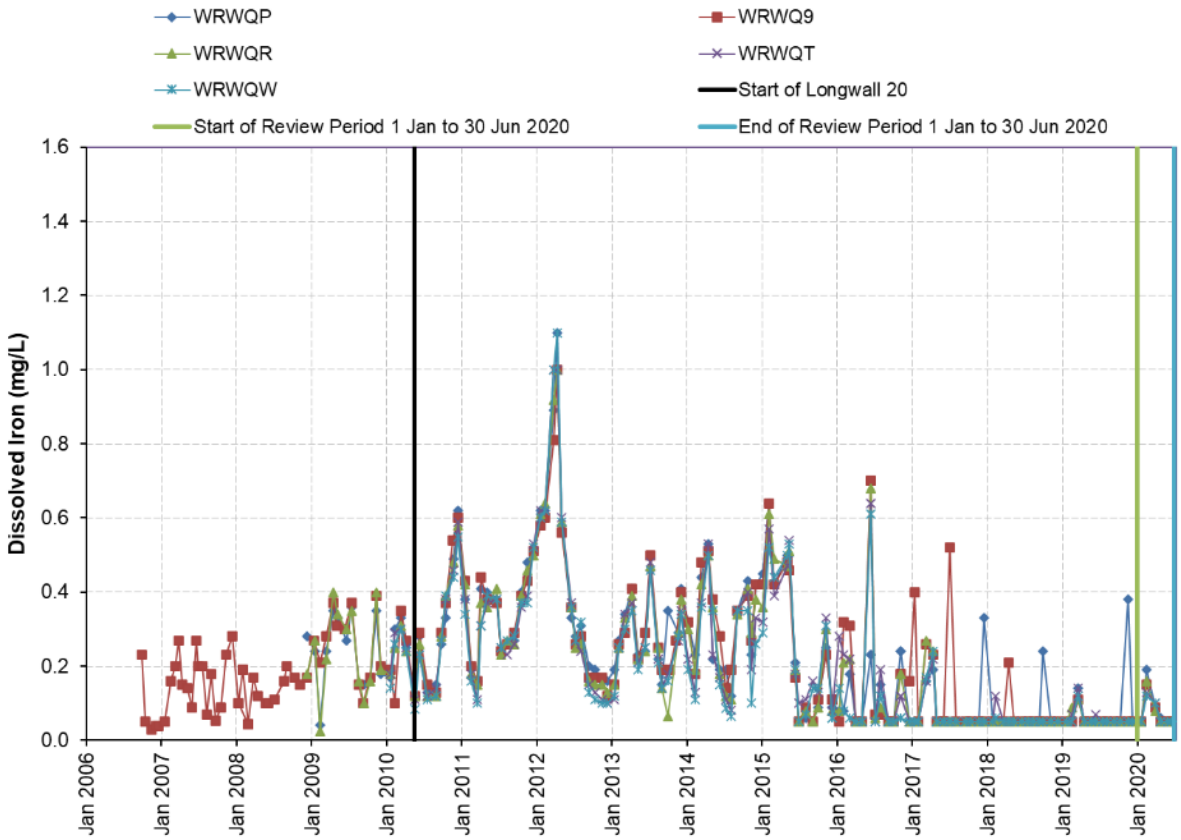


Chart B6 Dissolved Iron Waratah Rivulet – Lower Reach Sites

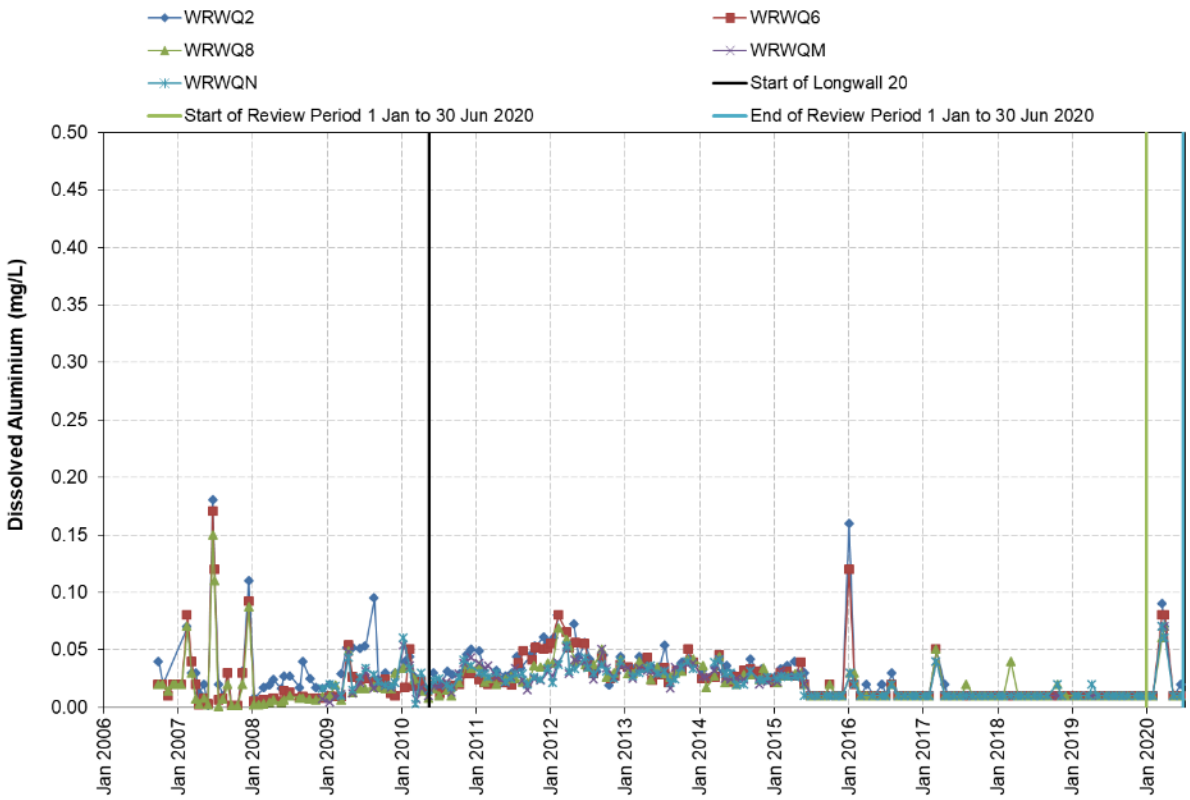


Chart B7 Dissolved Aluminium Waratah Rivulet – Upper to Middle Reach Sites

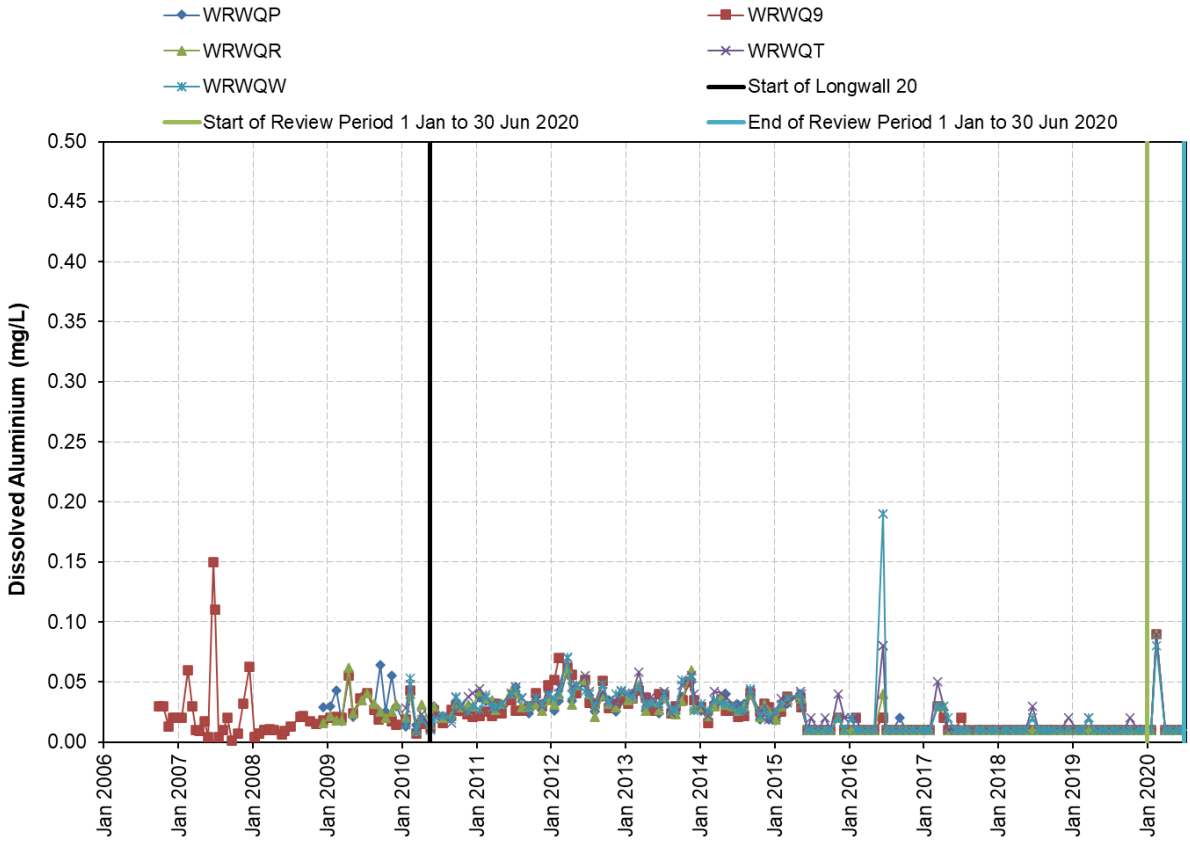


Chart B8 Dissolved Aluminium Waratah Rivulet – Lower Reach Sites

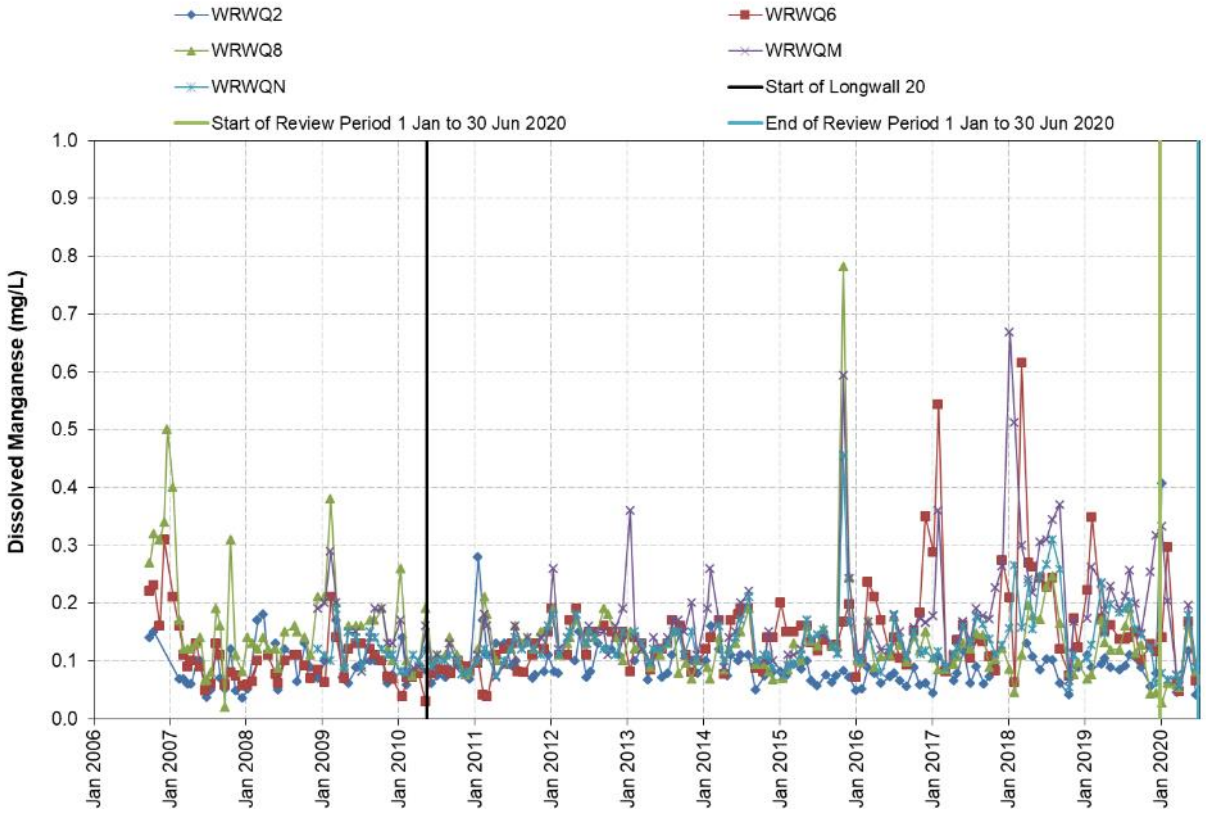


Chart B9 Dissolved Manganese Waratah Rivulet – Upper to Middle Reach Sites

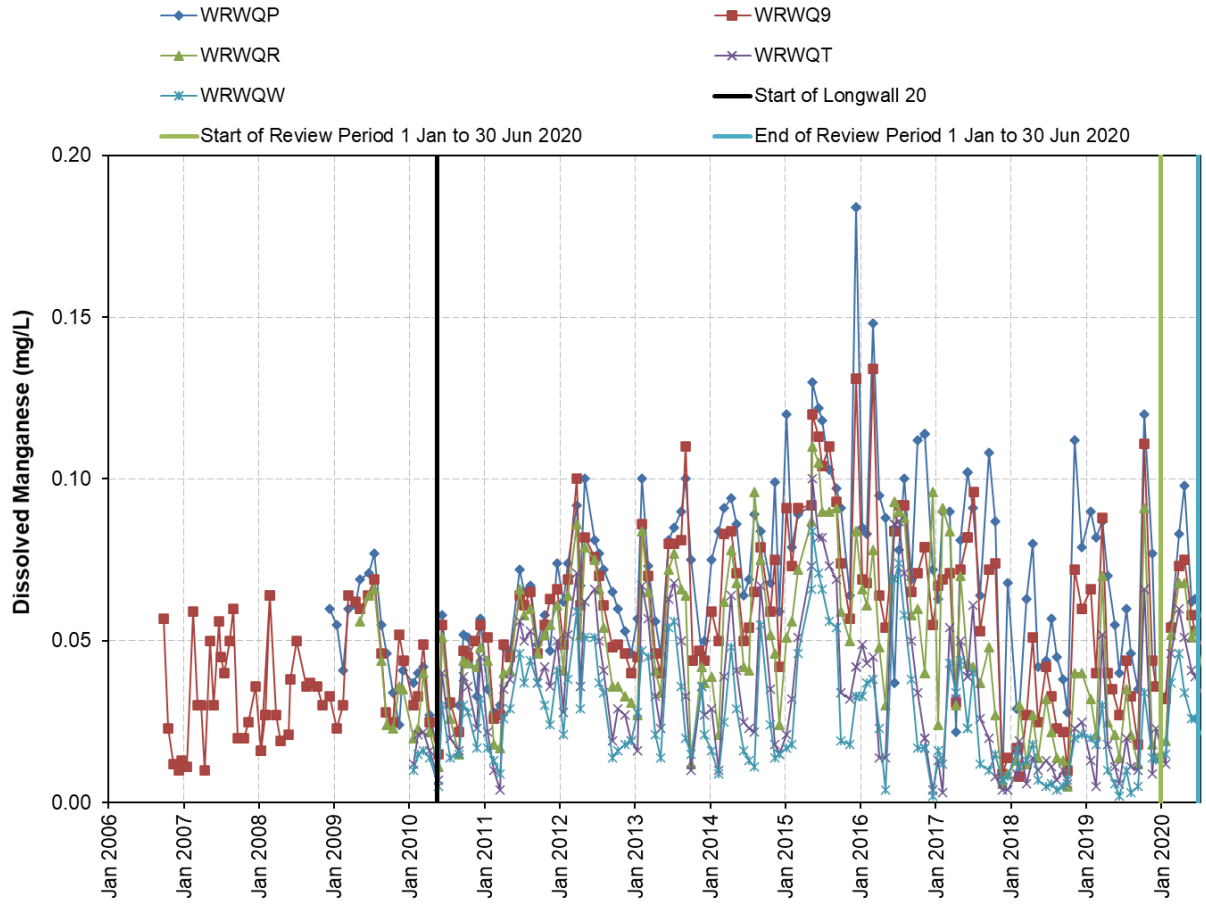


Chart B10 Dissolved Manganese Waratah Rivulet – Lower Reach Sites

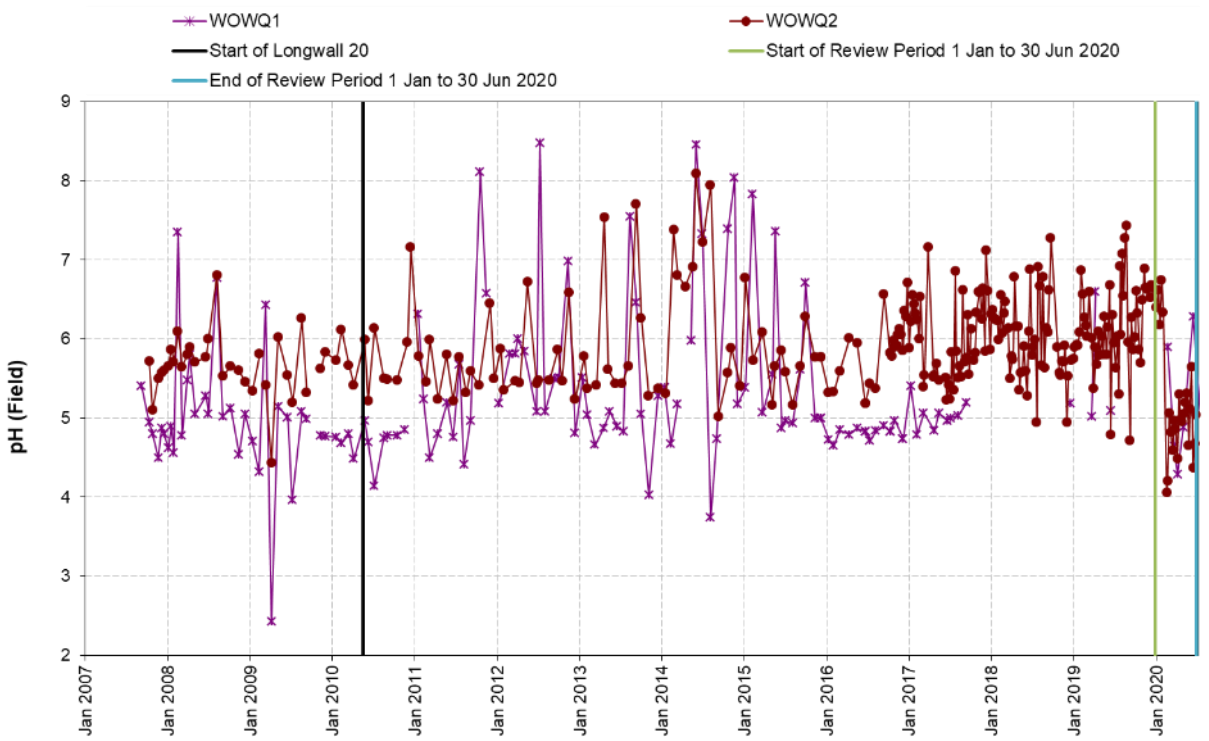


Chart B11 pH Levels Woronora River[19]

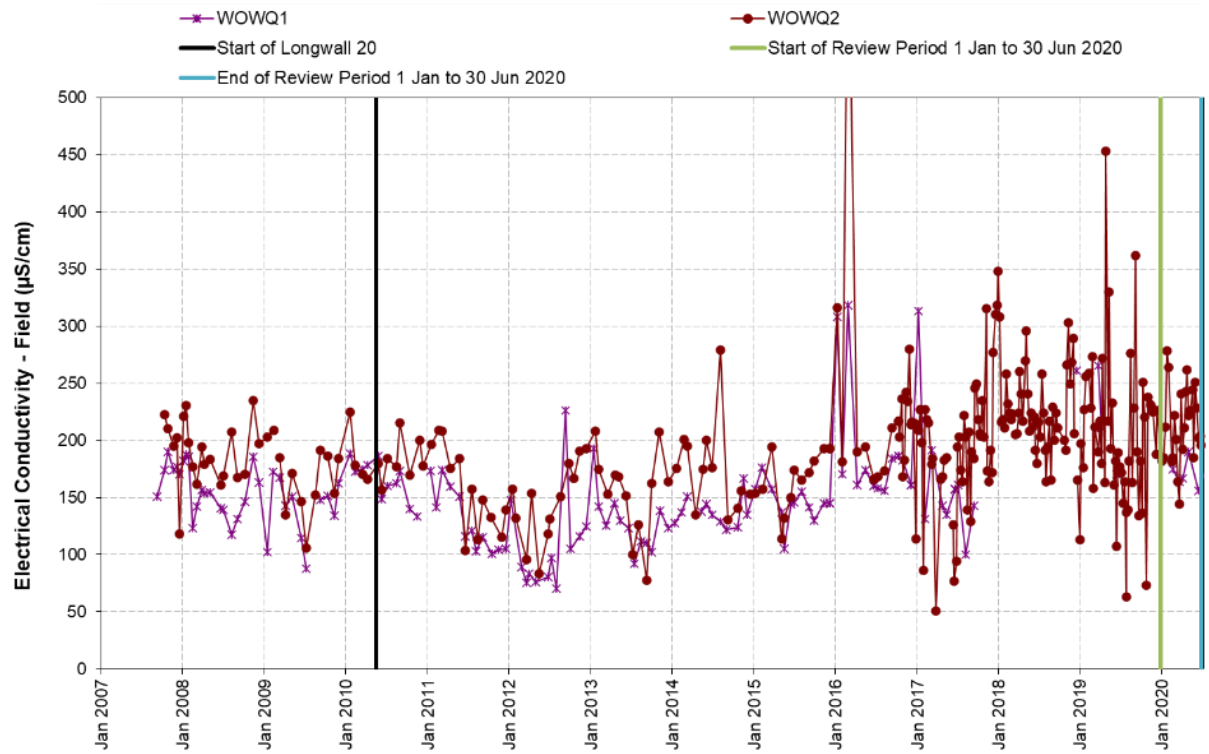


Chart B12 Electrical Conductivity (EC) Woronora River

[19] WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 12 December 2019 and hence no water quality samples were collected.

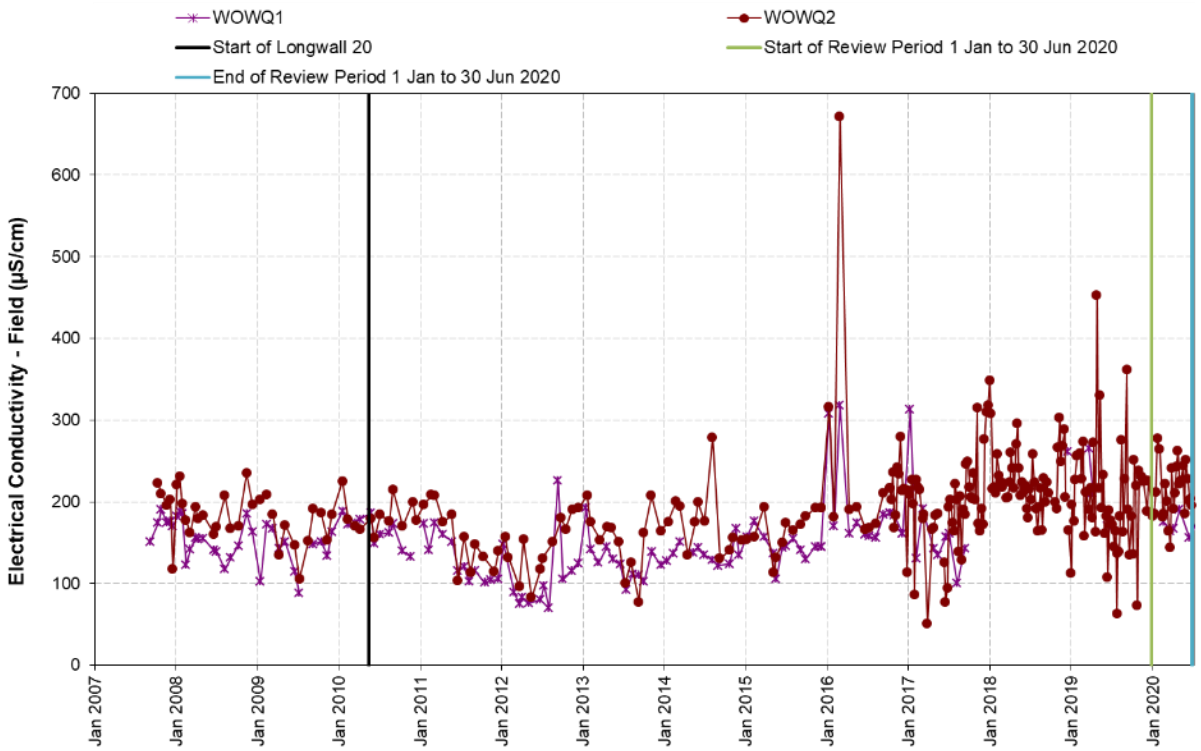


Chart B12a Electrical Conductivity (EC) Woronora River

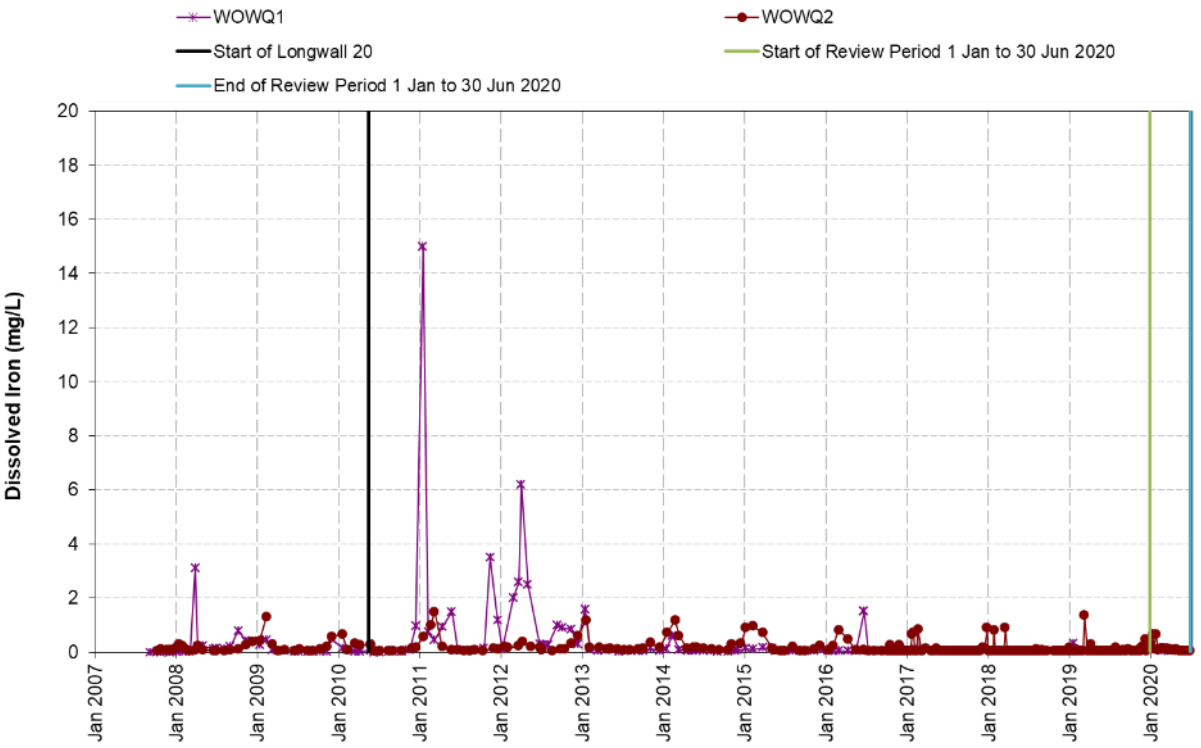


Chart B13 Dissolved Iron Woronora River

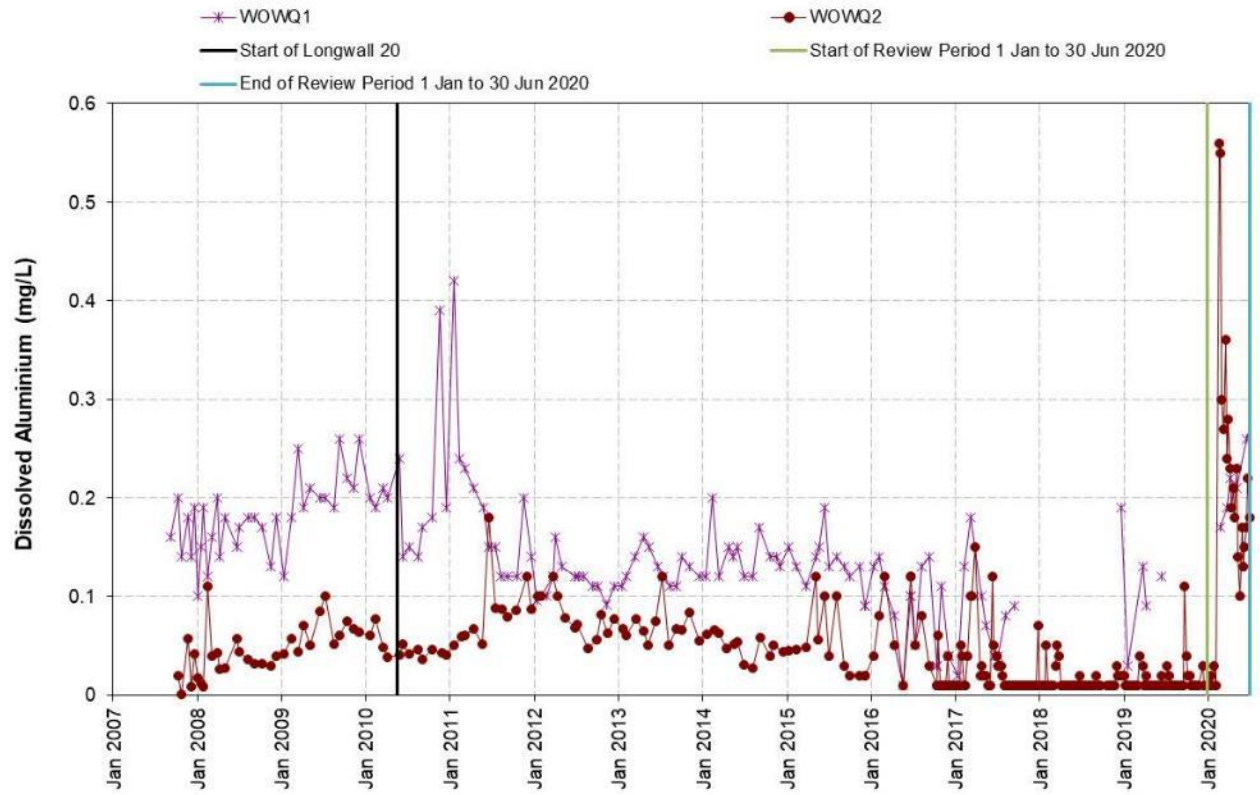


Chart B14 Dissolved Aluminium Woronora River

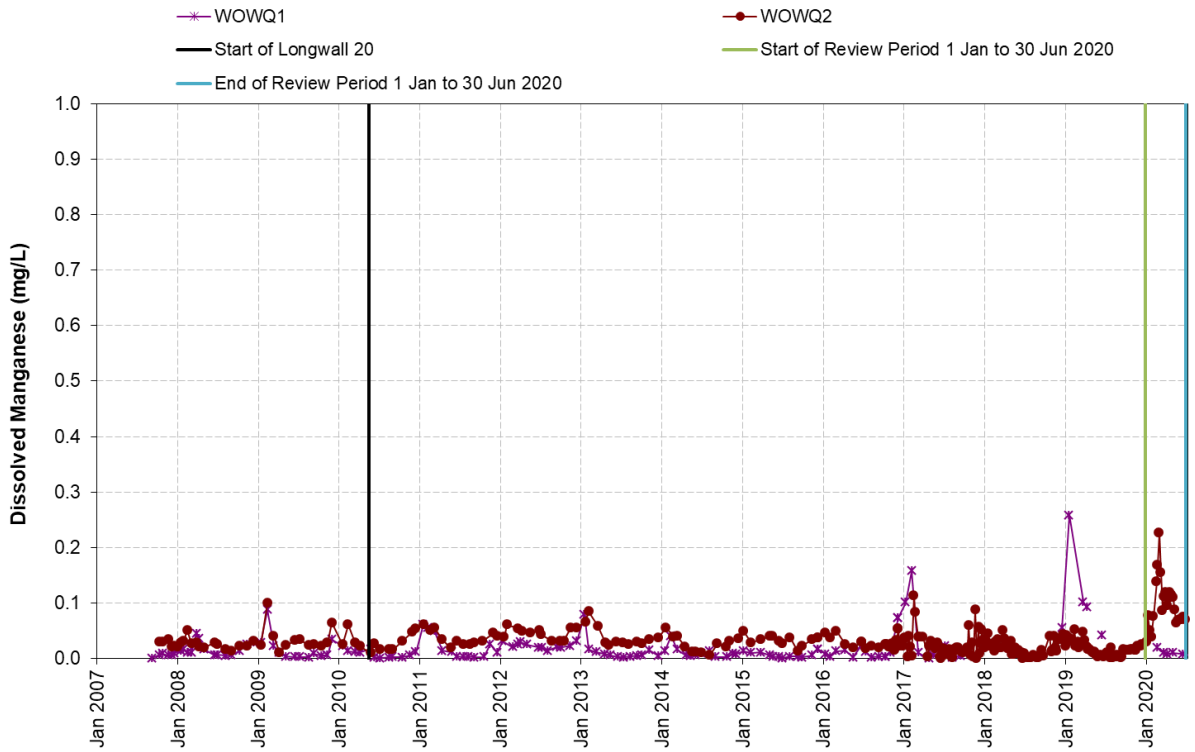


Chart B15 Dissolved Manganese Woronora River

Eastern Tributary

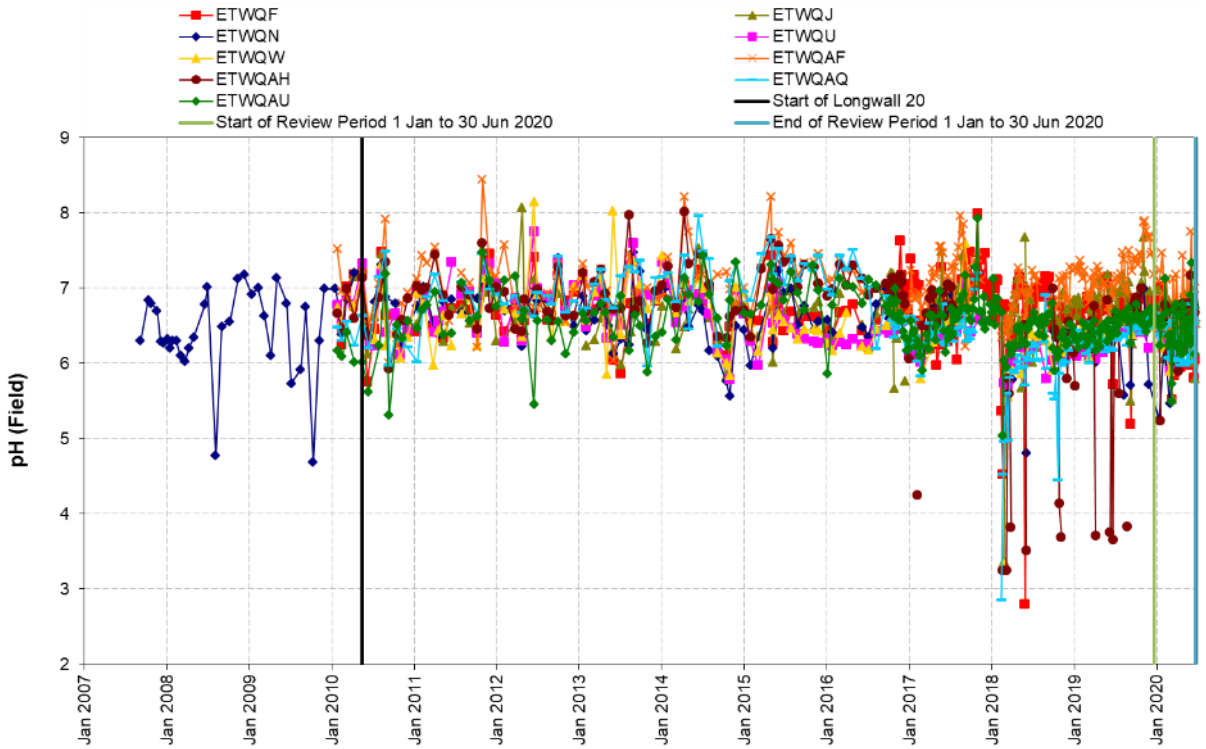


Chart B16 pH Levels Eastern Tributary

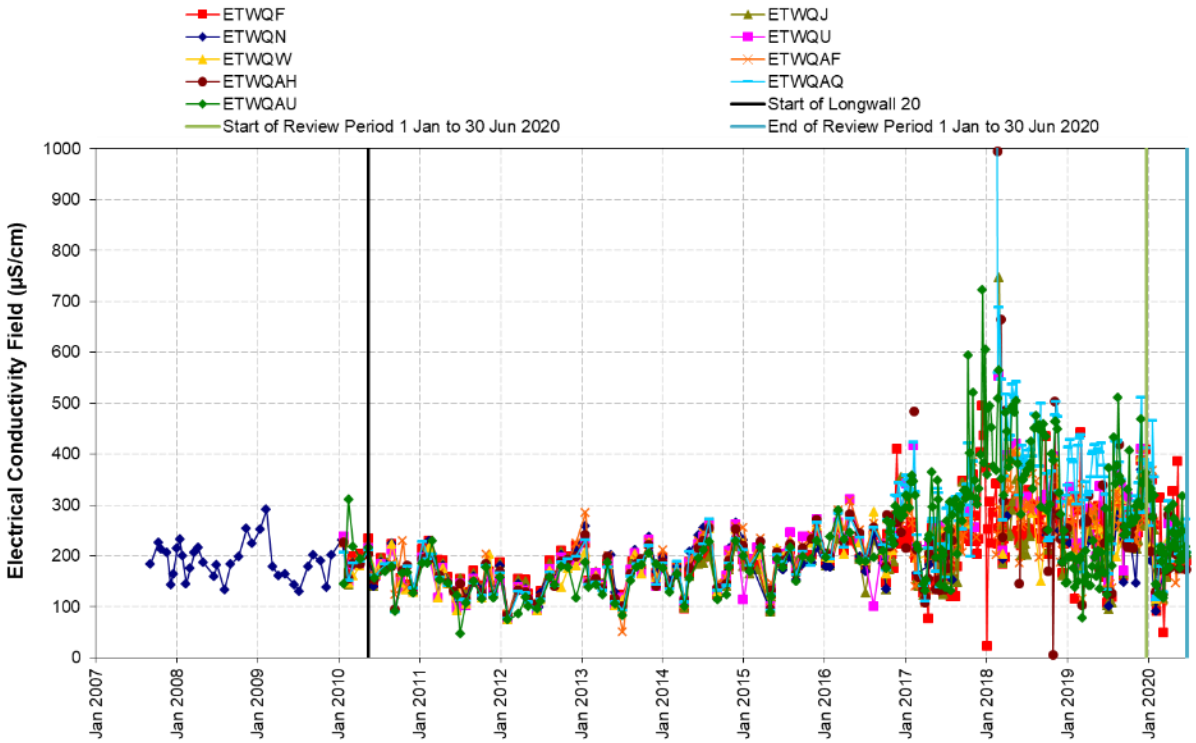


Chart B17 Electrical Conductivity (EC) Eastern Tributary

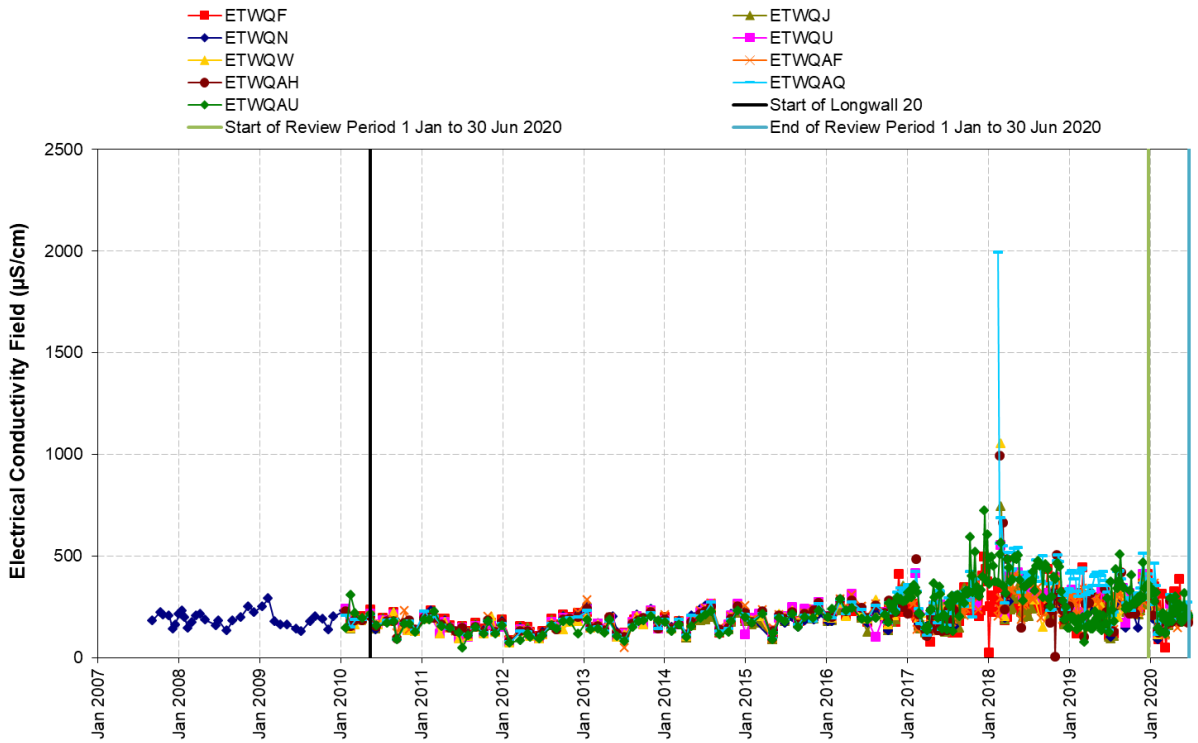


Chart B17a Electrical Conductivity (EC) Eastern Tributary

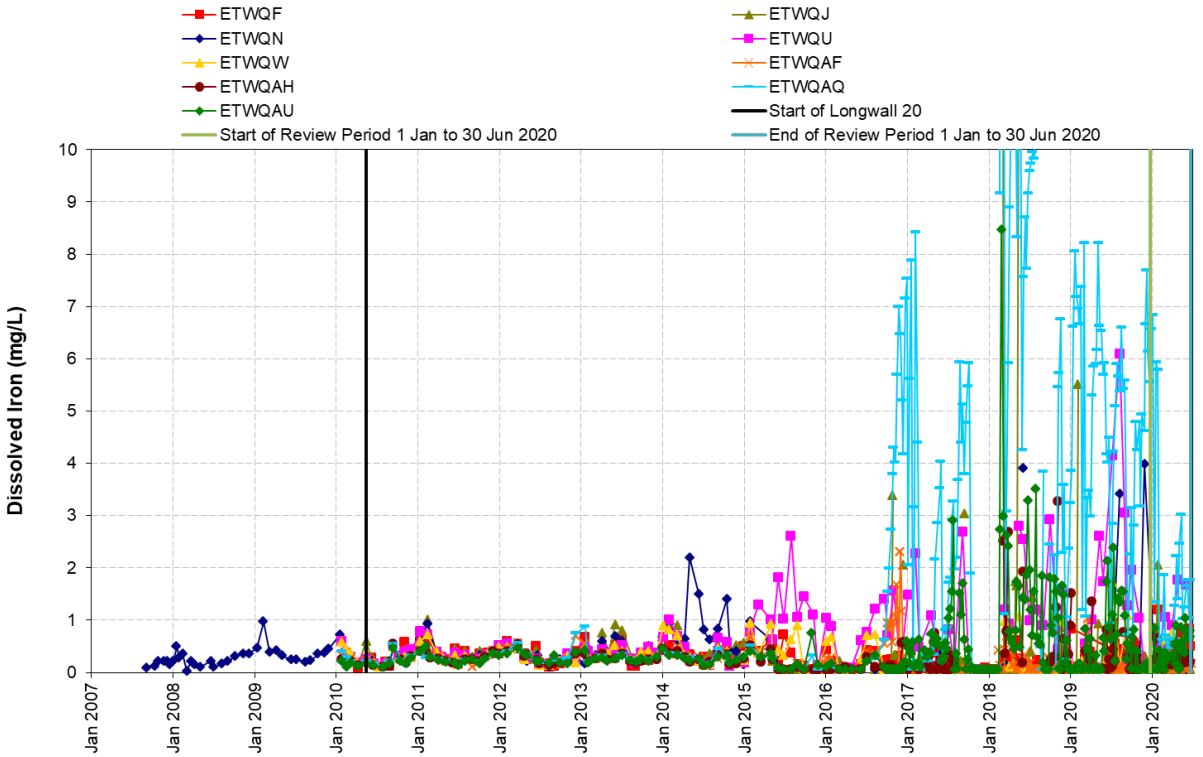


Chart B18 Dissolved Iron Eastern Tributary

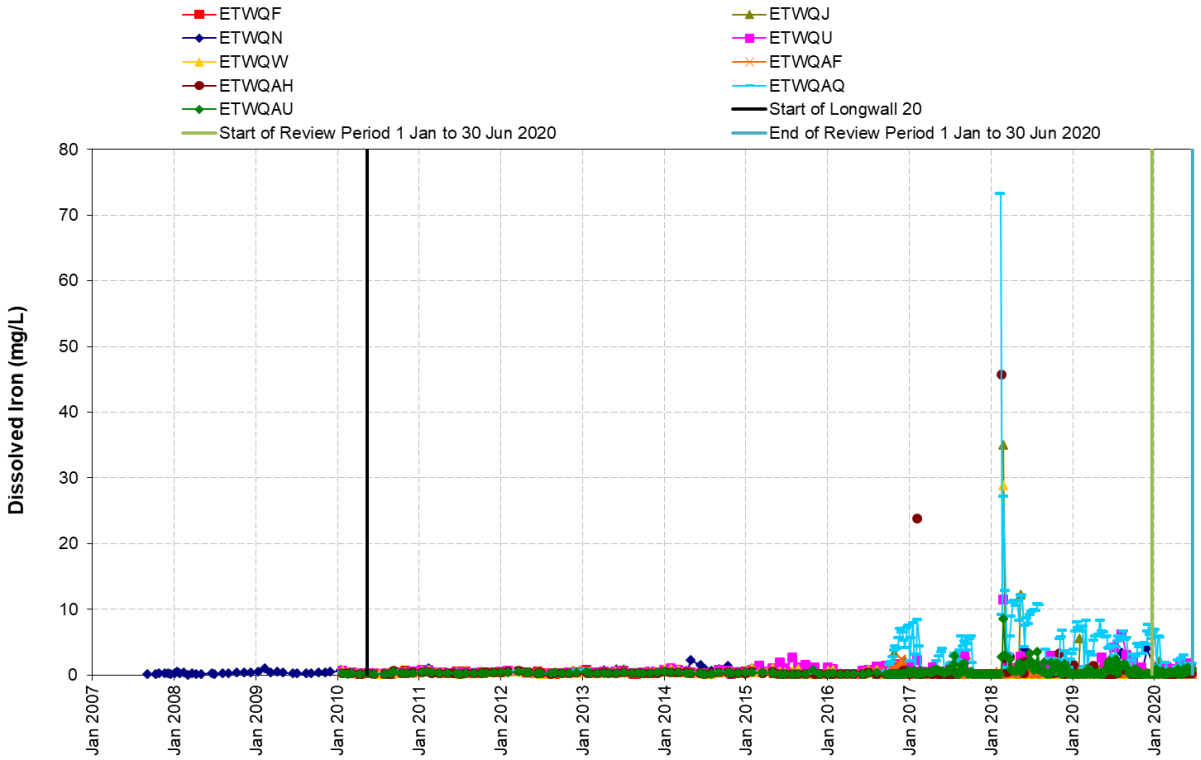


Chart B18a Dissolved Iron Eastern Tributary

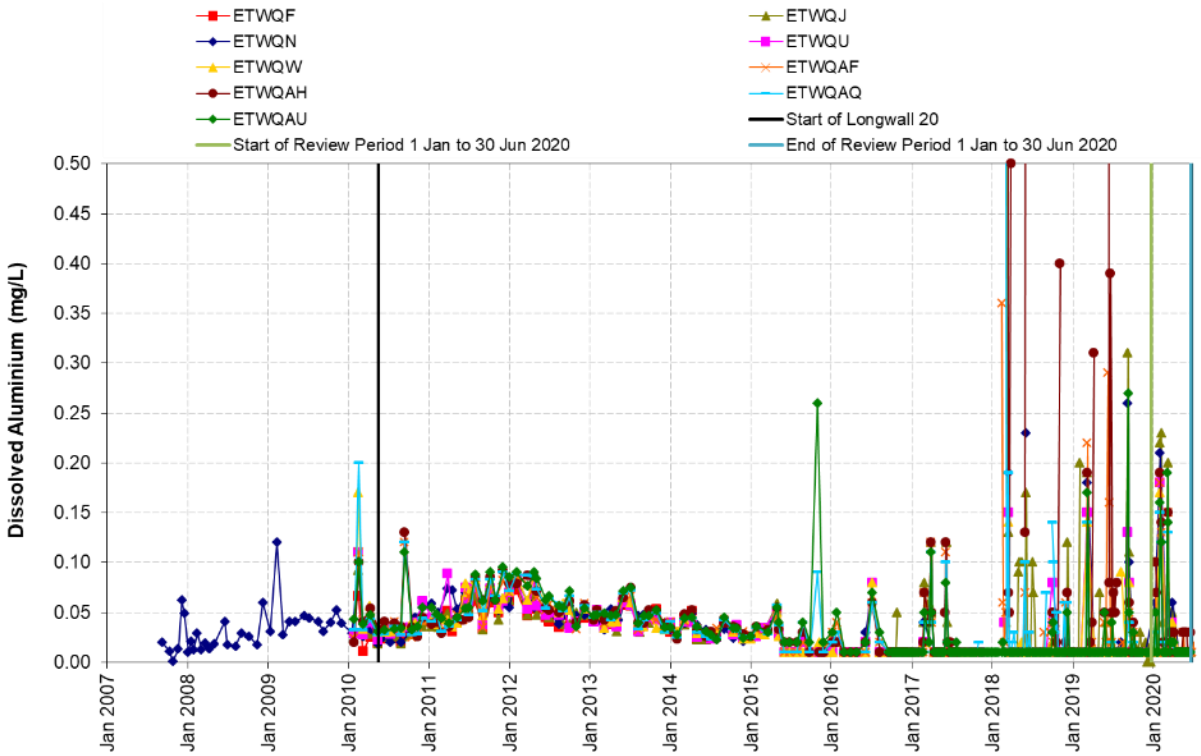


Chart B19 Dissolved Aluminium Eastern Tributary

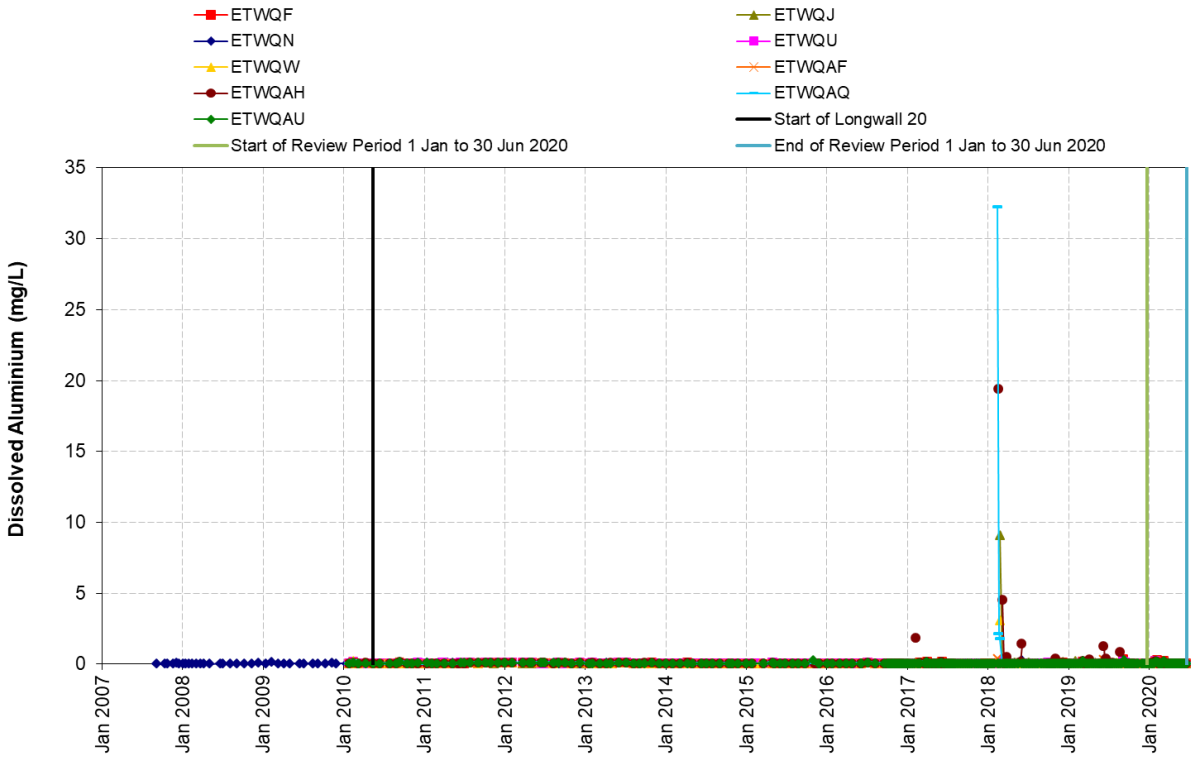


Chart B19a Dissolved Aluminium Eastern Tributary

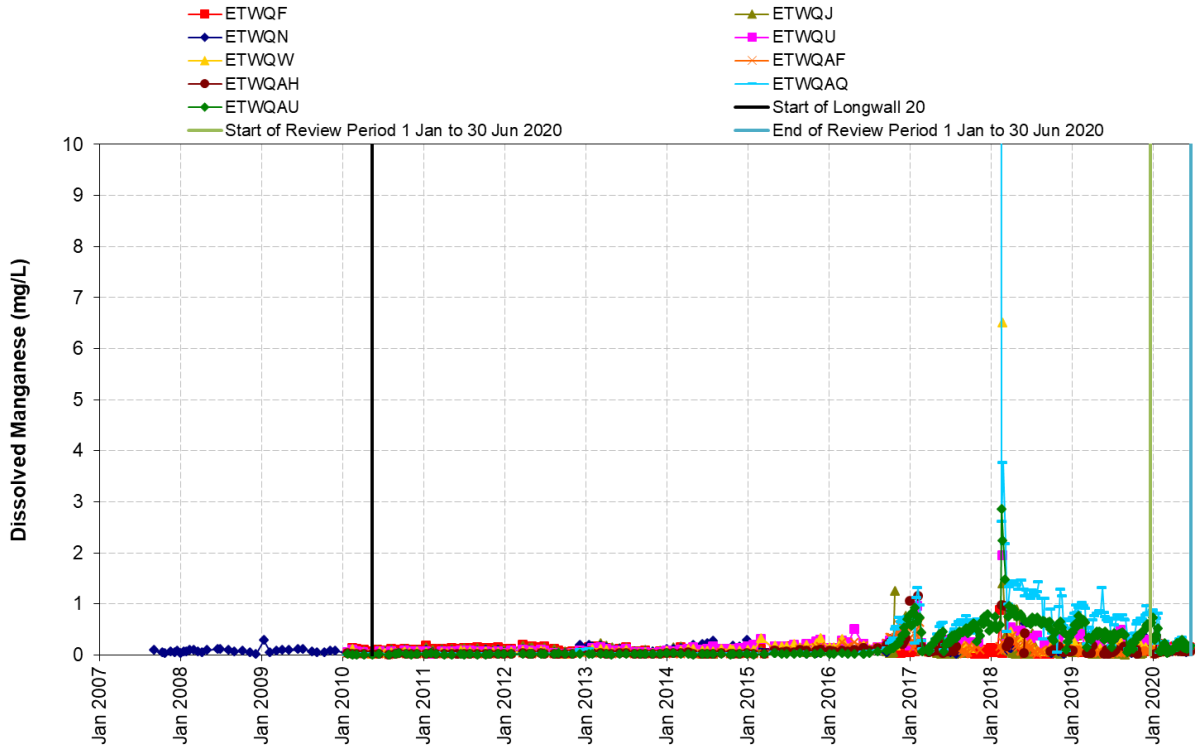


Chart B20 Dissolved Manganese Eastern Tributary

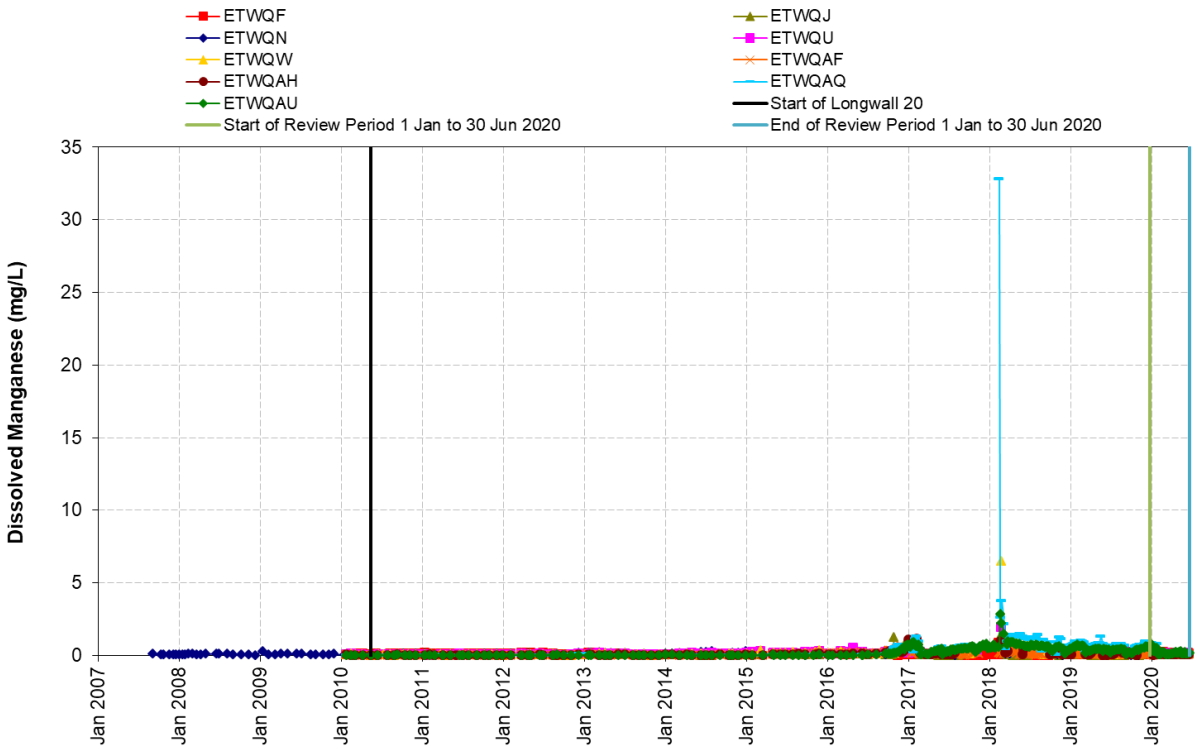


Chart B20a Dissolved Manganese Eastern Tributary

Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

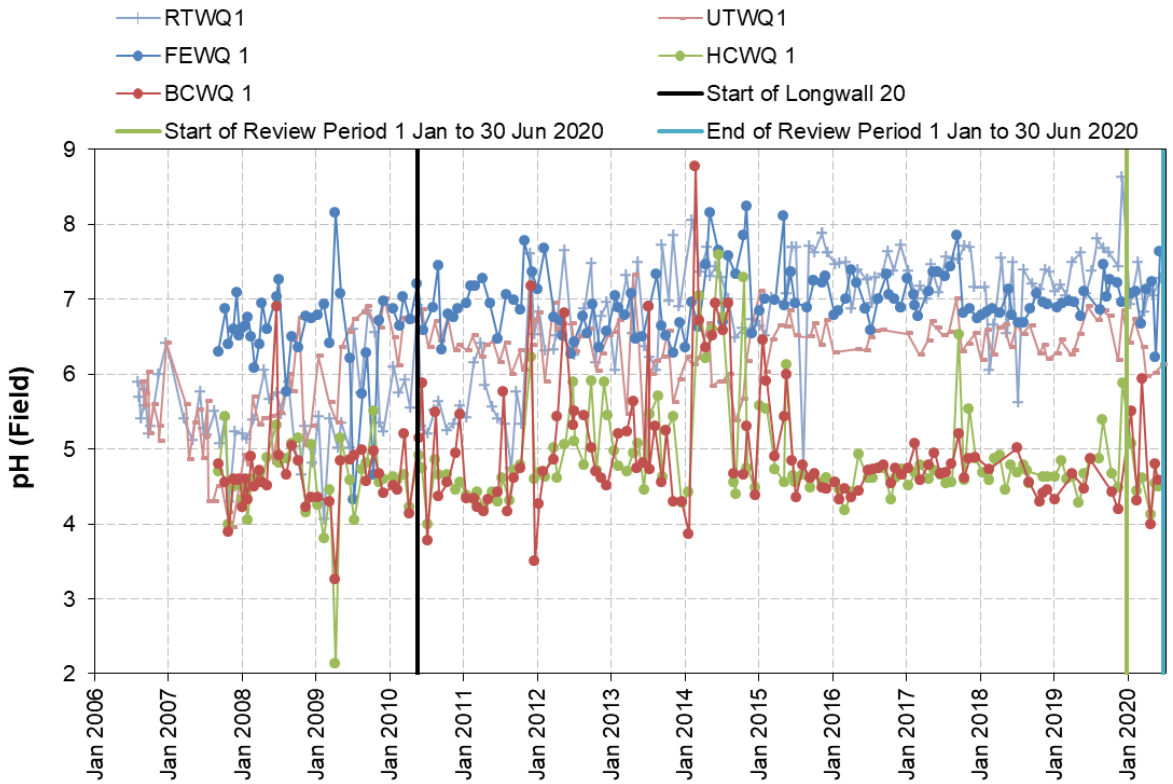


Chart B21 pH Levels Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

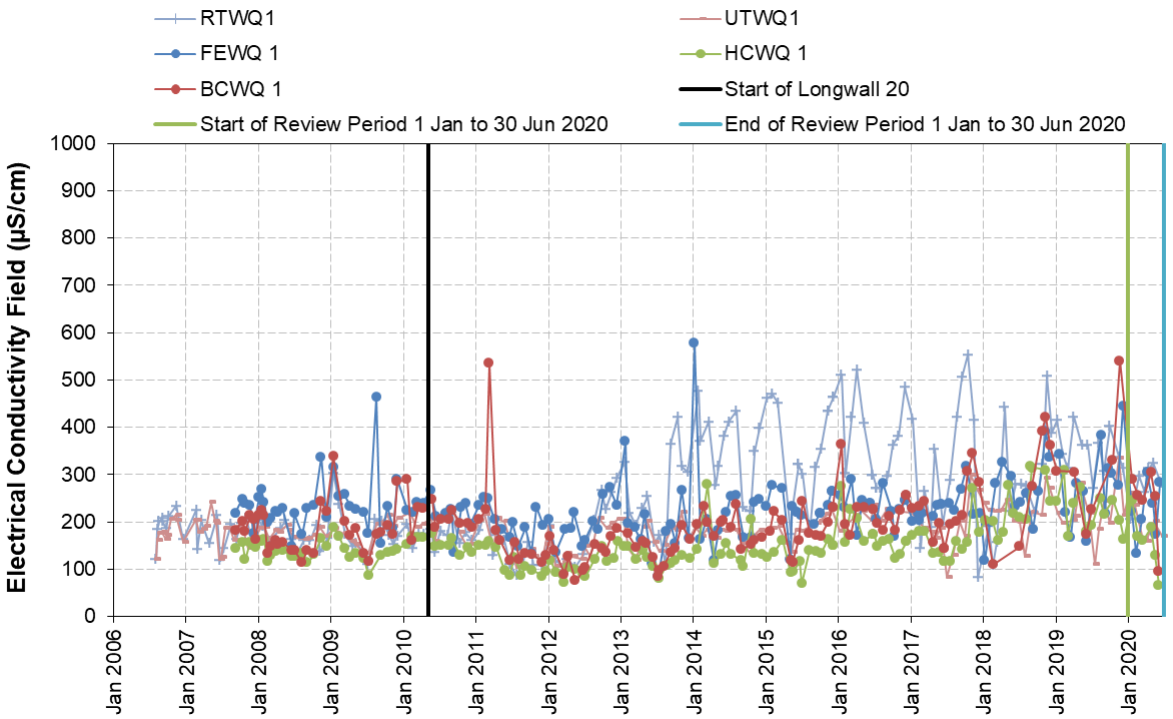


Chart B22 Electrical Conductivity (EC) Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

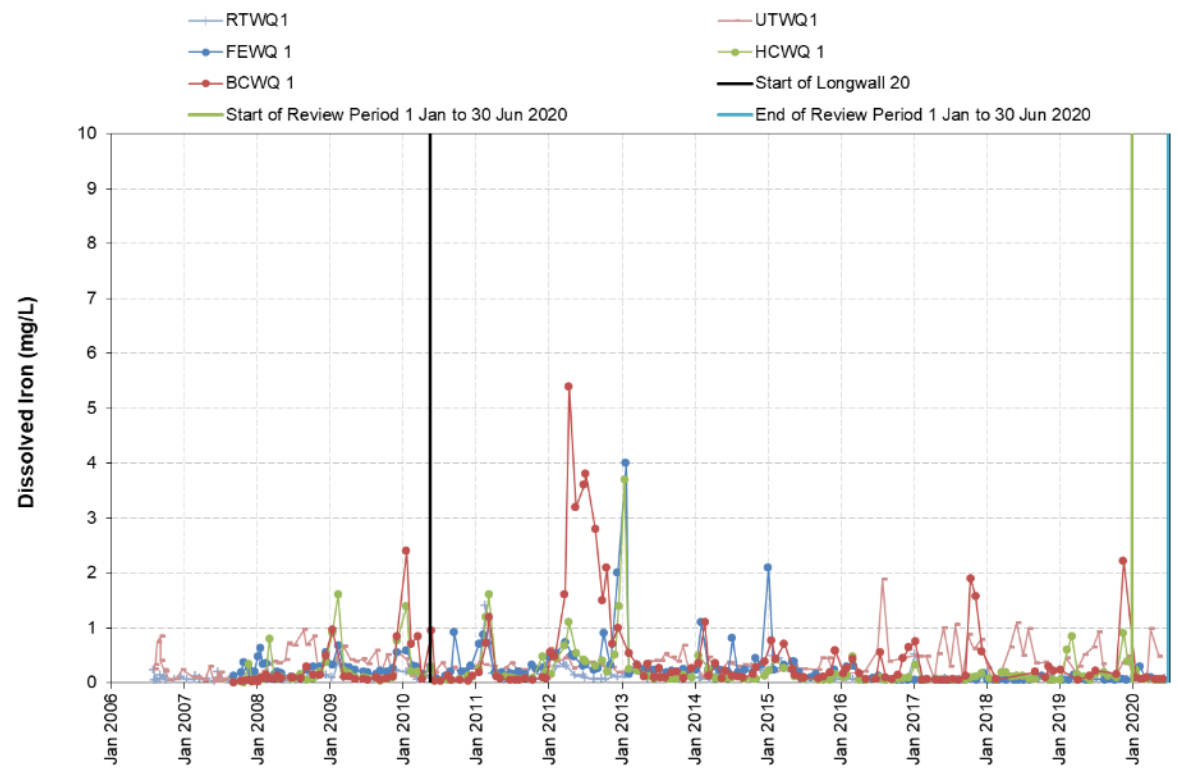


Chart B23 Dissolved Iron Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

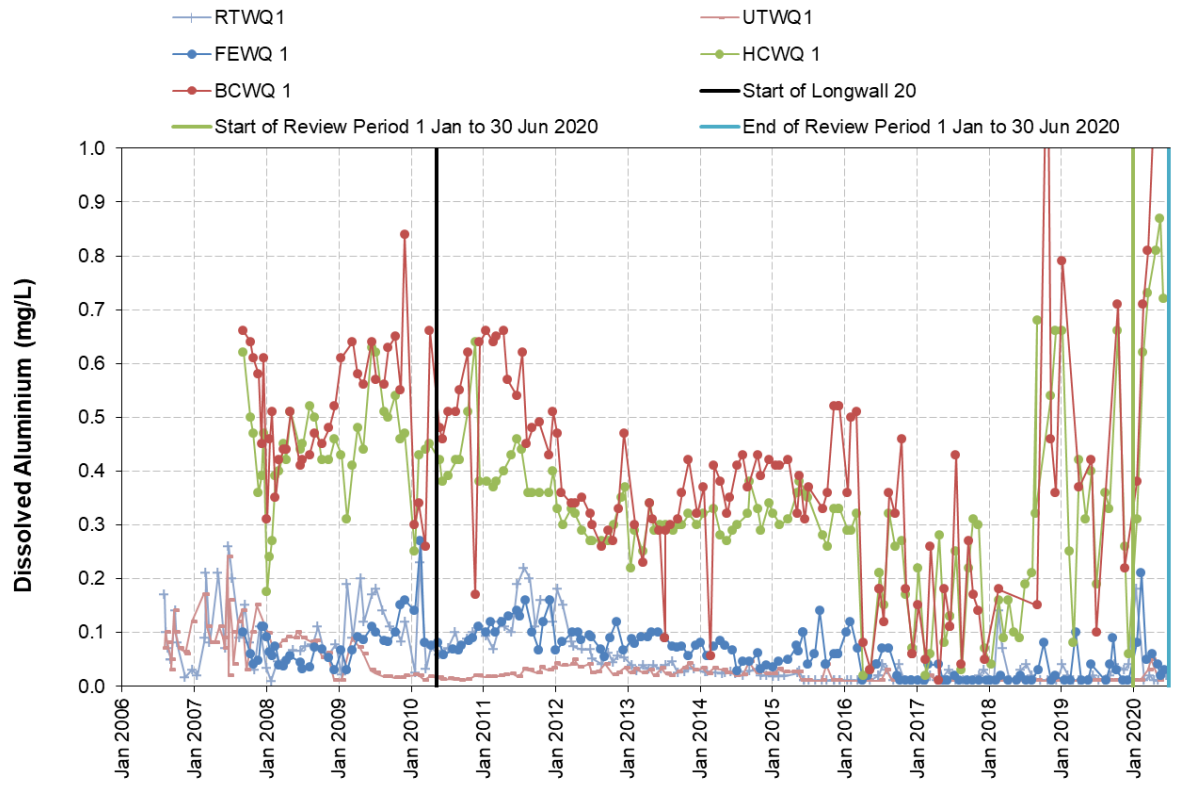


Chart B24 Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

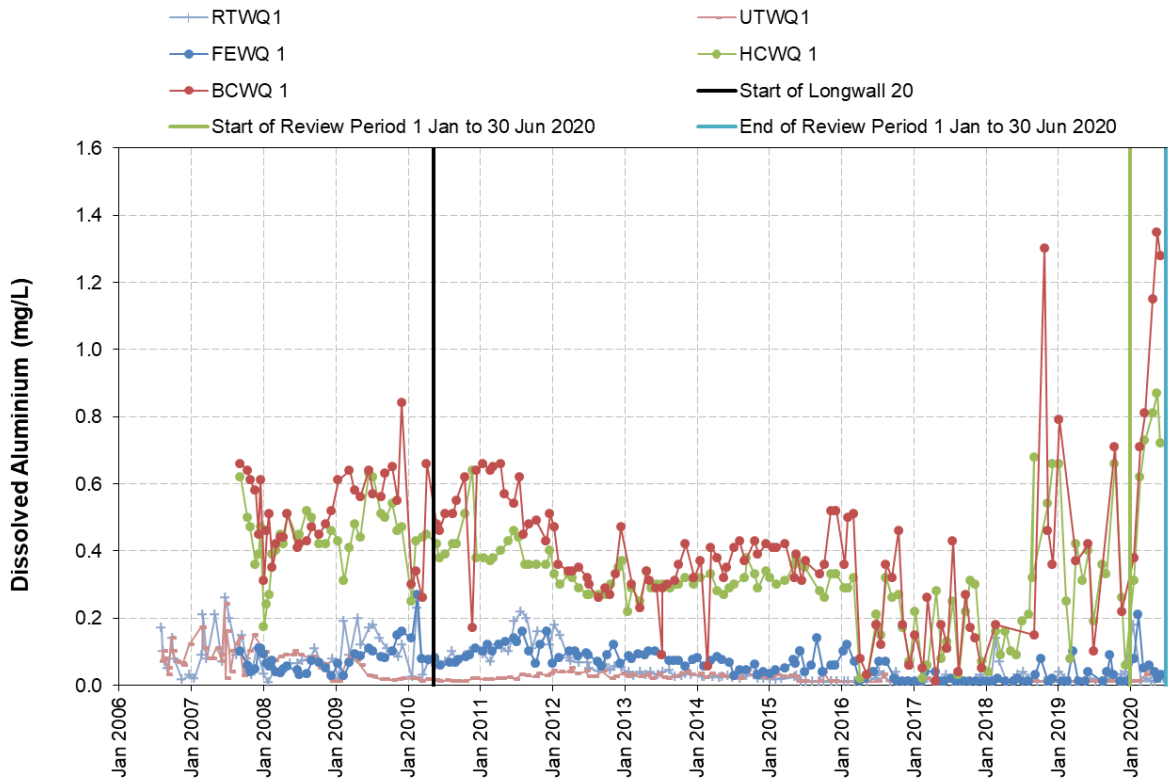


Chart B24a Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

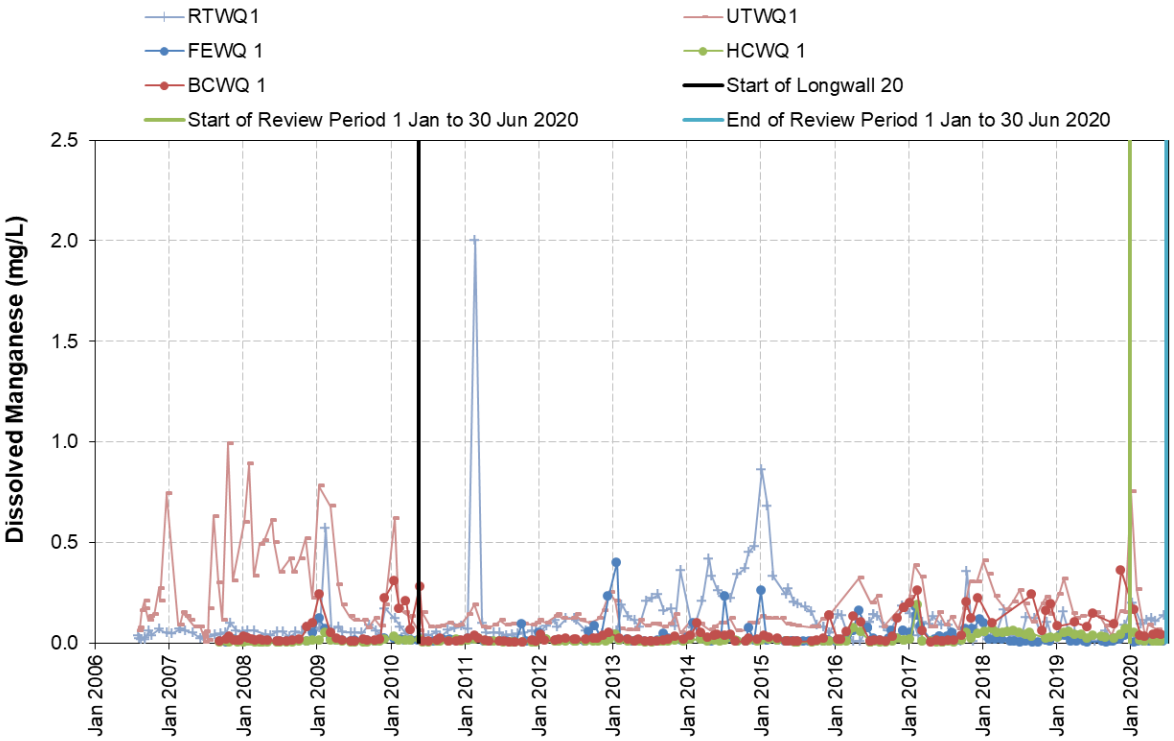


Chart B25 Dissolved Manganese Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek