Monthly Environmental Monitoring Report

Yancoal Mt Thorley Warkworth

December 2019

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Revision History

Version No.	Person Responsible	Document Status	Date
1.0	**Environmental Advisor**	**Final**	**18/03/2020**

1.0 INTRODUCTION

This report has been compiled to provide a monthly summary of environmental monitoring results for Mt Thorley Warkworth (MTW). This report includes all monitoring data collected for the period 1 December to 31 December 2019.

2.0 AIR QUALITY

2.1 Meteorological Monitoring

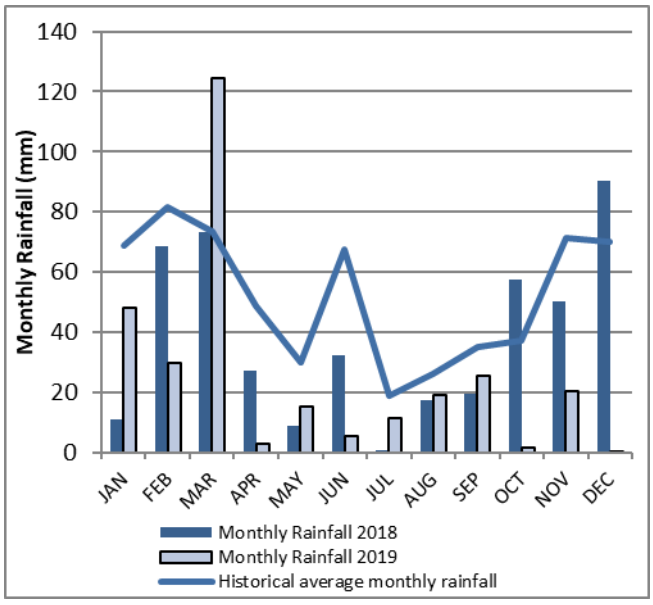
Meteorological data is collected at MTW's 'Charlton Ridge' meteorological station (refer to **Figure 3**: Air Quality Monitoring Locations).

2.1.1 Rainfall

Rainfall for the period is summarised in **Table 1**, the year-to-date trend and historical trend are shown in **Figure 1**.

Table 1: Monthly Rainfall MTW

2019	Monthly Rainfall (mm)	Cumulative Rainfall (mm)
December	0.4	303.8



Note: The historical average monthly rainfall is calculated from 2007 to 2018 monthly totals

2.1.2 Wind Speed and Direction

Winds from the southeast were dominant throughout the reporting period as shown in **Figure 2**.

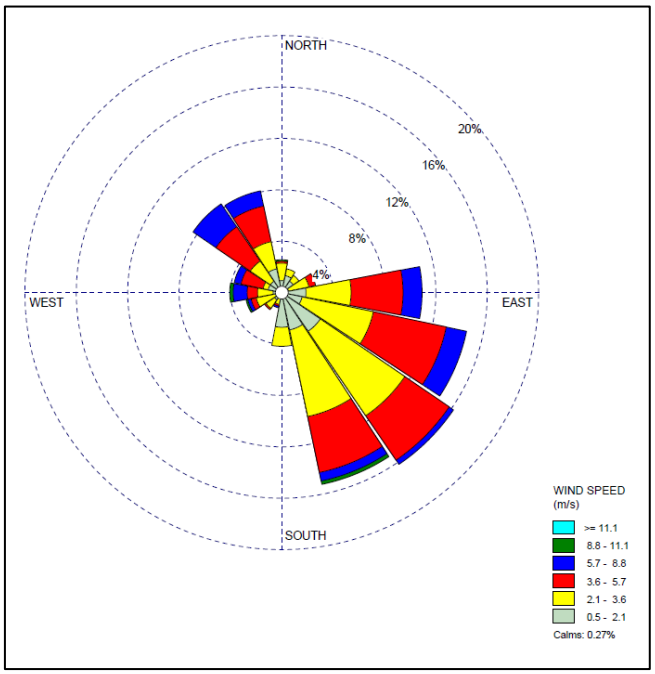


Figure 2: Charlton Ridge Wind Rose – December 2019

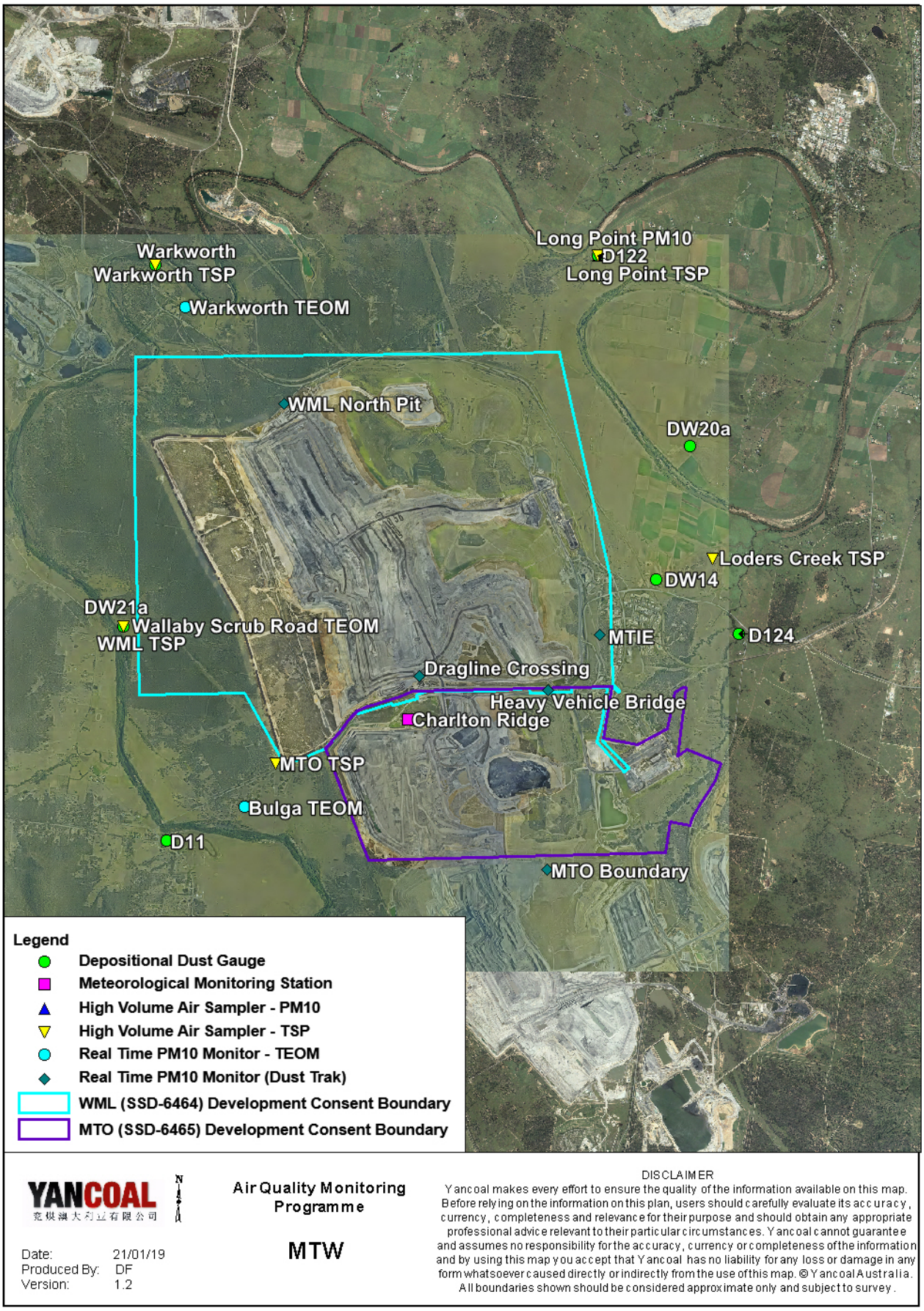


Figure 3: Air Quality Monitoring Locations

2.2 Depositional Dust

To monitor regional air quality, MTW operates and maintains a network of seven depositional dust gauges, situated on private and mine owned land surrounding MTW.

Figure 4 displays insoluble solids results from depositional dust gauges during the reporting period compared against the year-to-date average and the annual impact assessment criteria.

During the reporting period the D11, DW14, DW20a, D122, D124 and Warkworth monitors recorded monthly results above the long-term impact assessment criteria of 4.0 g/m^2 per month. Field notes associated with D124 confirm the presence of insects and bird droppings. As such the result is considered contaminated and will be excluded from calculation of the annual average There is no evidence to suggest that the D11, DW14, DW20a, D122 and Warkworth results are contaminated. Accordingly, the results will be included in the annual average calculation.

An external consultant has been engaged to undertake an assessment of MTW's contribution to the long-term Impact assessment criteria (at the Warkworth monitor). The results of this investigation will be provided in the 2019 Annual Review Report.

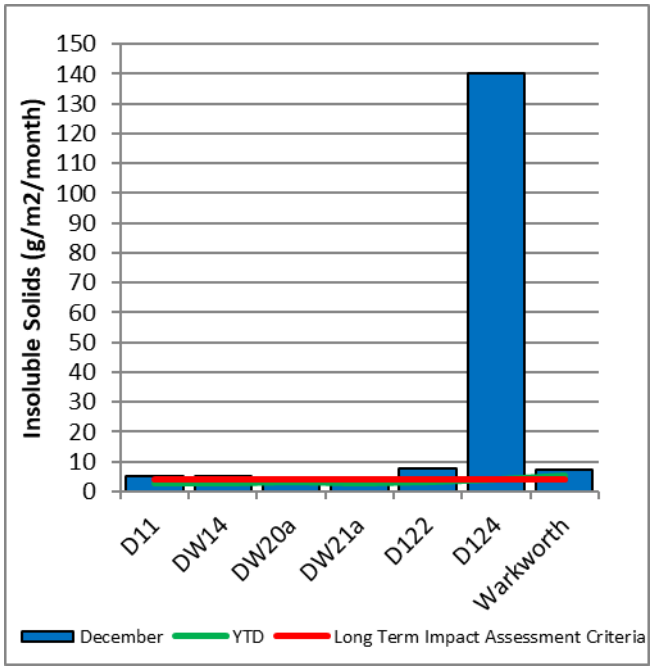


Figure 4: Depositional Dust - December 2019

2.3 Suspended Particulates

Suspended particulates are measured by a network of High Volume Air Samplers (HVAS) measuring Total Suspended Particulates (TSP) and Particulate Matter <10µm (PM_{10}). The location of these monitors can be found in **Figure 3**. Each HVAS was run for 24 hours on a six-day cycle in accordance with EPA requirements.

2.3.1 HVAS PM_{10} Results

Figure 5 shows the individual PM_{10} results at the monitoring station against the short-term impact assessment criteria of 50µg/m^3.

On 4, 10, 16 and 28 December 2019 the Long Point HVAS PM_{10} unit recorded results of 60 µg/m^3, 134 µg/m^3, 80 µg/m^3 and 61 µg/m^3 respectively, which are greater than the short term (24hr) PM_{10} impact assessment criteria.

Investigation determined that the wind direction was generally not from MTW's angle of influence and that the likely MTW contribution to the results is less than 75%. Background PM10 levels were elevated on these days, with bushfires in the region. Accordingly, no further action is required (as per approved Air Quality Monitoring Programme).

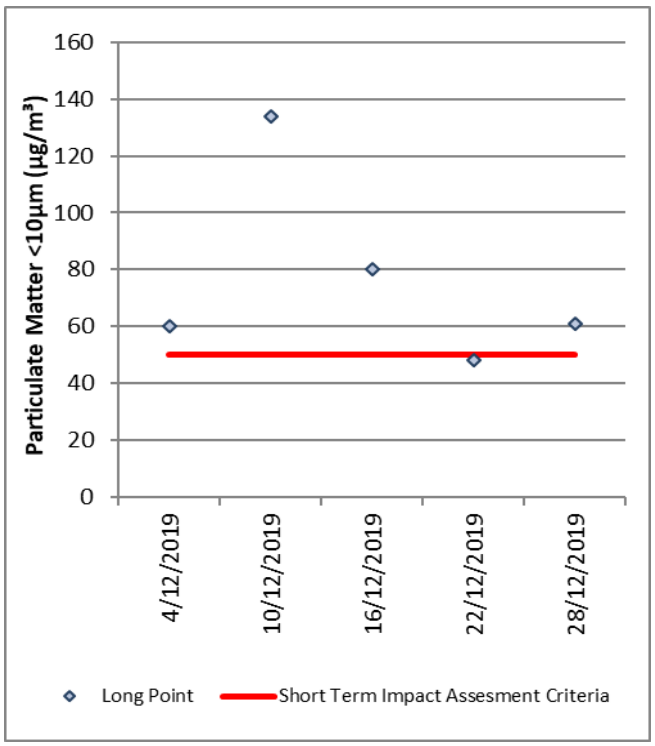


Figure 5: Individual PM_{10} Results – December 2019

Figure 6 shows the annual average PM_{10} results against the long-term impact assessment criteria.

An external consultant has been engaged to undertake an assessment of MTW's contribution to the long-term Impact assessment criteria. The results of this investigation will be provided in the 2019 Annual Review Report.

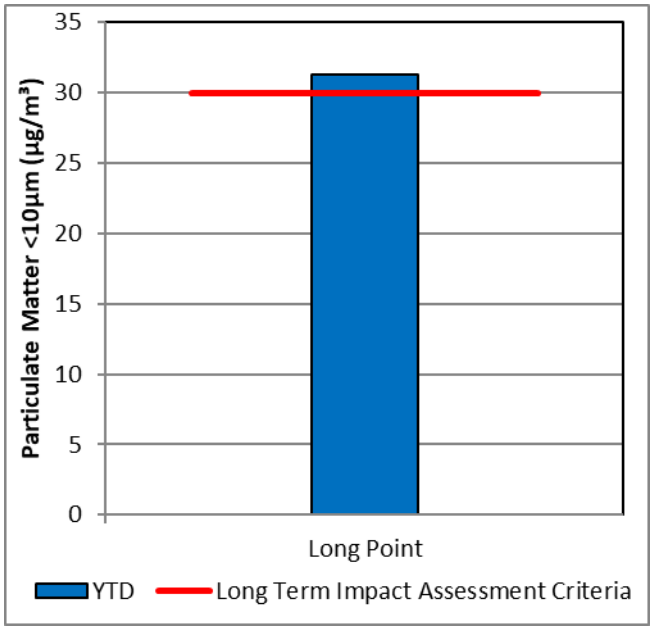


Figure 6: Annual Average PM_{10} – December 2019

2.3.2 TSP Results

Figure 7 shows the annual average TSP results compared against the long-term impact assessment criteria of 90µg/m³.

An external consultant has been engaged to undertake an assessment of MTW's contribution to the long-term Impact assessment criteria (at the Warkworth monitor). The results of this investigation will be provided in the 2019 Annual Review Report.

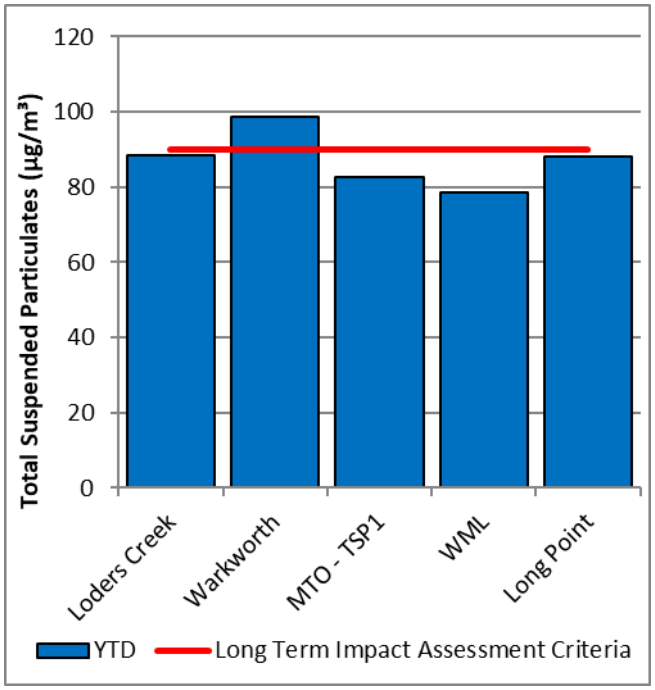


Figure 7: Annual Average Total Suspended Particulates – December 2019

2.3.3 Real Time PM_{10} Results

Mt Thorley Warkworth maintains a network of real time PM_{10} monitors. The real-time air quality monitoring stations continuously log information and transmit data to a central database, generating alarms when particulate matter levels exceed internal trigger limits. It should be noted that the PM10 monitor named the "Wallaby Scrub Road TEOM" is planned to be moved to a representative location west of Wollombi Brook and be renamed "Wambo Road TEOM". This change was submitted to DPIE on 31 July 2019 during an update to the MTW Air Quality Management Plan and was subsequently approved by DPIE on 28 August 2019. Figures in the MEMR will be updated once the monitor has moved to the new location.

Results for real time dust sampling are shown in **Figure 8**, including the daily 24-hour average PM_{10} result and the annual PM_{10} average.

On 1-6, 10-22 and 27-31 December 2019, the Bulga OEH, Wallaby Scrub Road and/or Warkworth OEH TEOM's exceeded the short term (24hr) criteria.

Investigation into these exceedances determined that the wind direction was generally not from MTW's angle of influence and/or background PM_{10} levels were elevated. The maximum potential contributions to the results were less than 75% and less than 50 µg/m³. Accordingly, MTW operations are not

considered to be a significant contributor to the results as described in the MTW Air Quality Management Plan and no further action is required. Elevated PM_{10} levels during December 2019 are considered partially attributable to bushfires in the region.

Data was not available from 7-9 December 2019 from the Bulga OEH, Warkworth OEH and Wallaby Scrub Road monitors due to equipment issues. Data was also not available on 12 and 13 December 2019 from the Wallaby Scrub Road monitor due to equipment issues.

2.3.4 Real Time Alarms for Air Quality

During December, the real-time monitoring system generated 1726 automated air quality related alerts, including 43 alerts for adverse meteorological conditions and 1683 alerts for elevated PM10 levels.

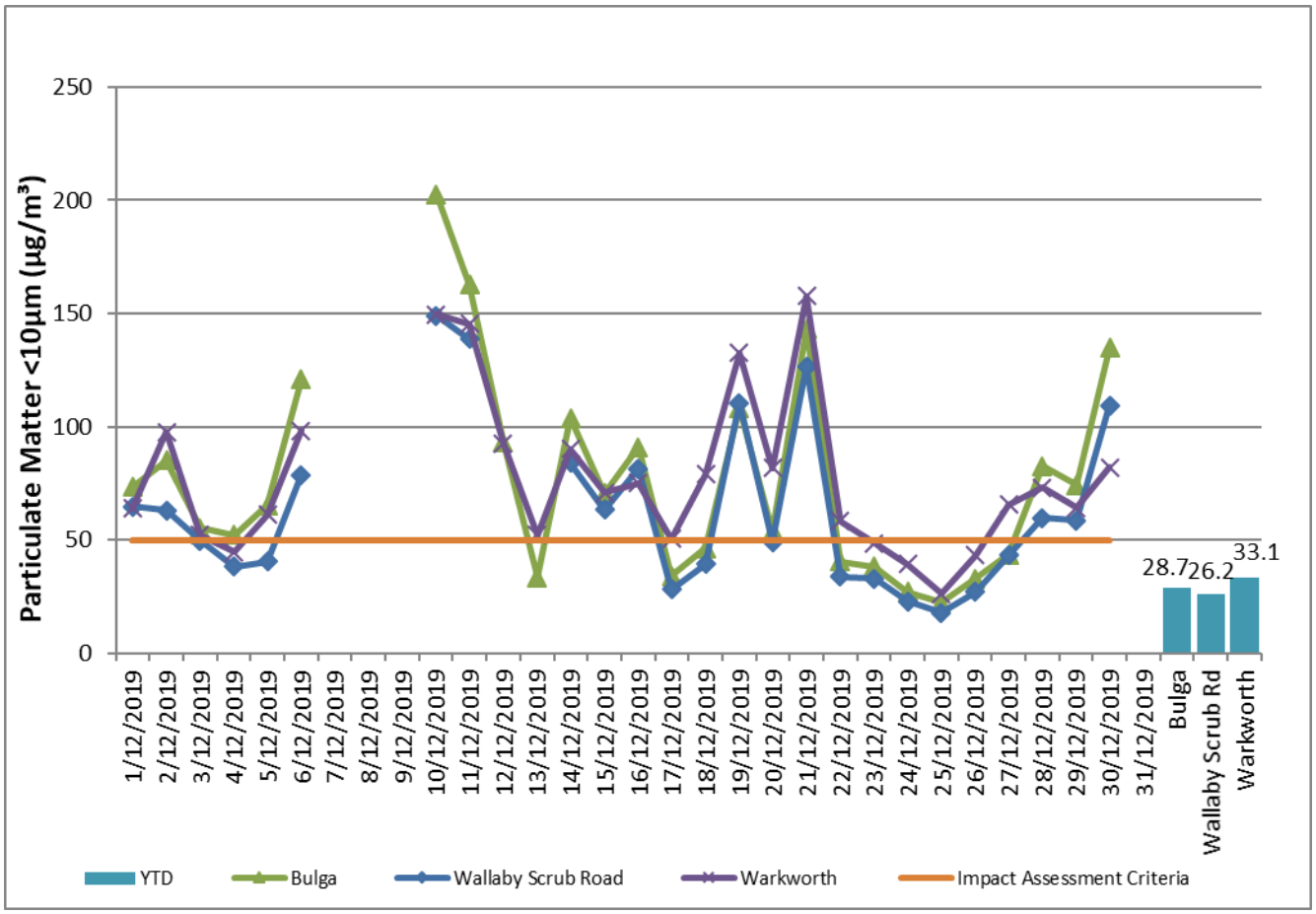


Figure 8: Real Time PM10 24hr average and Year-to-date average – December 2019

3.0 WATER QUALITY

MTW maintains a network of surface water and groundwater monitoring sites.

3.1 Surface Water

Monitoring is conducted at mine site dams and surrounding natural watercourses. The surface water monitoring locations are outlined in **Figure 15**.

Surface water courses are sampled on a monthly or quarterly sampling regime. Water quality is evaluated through the parameters of pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). The Hunter River and the Wollombi Brook are sampled both upstream and downstream of mining operations, to monitor the potential impact of mining. Other Hunter River tributaries are also monitored.

3.1.1 Surface Water Monitoring Results

Figure 9 to **Figure 11** show the long-term surface water trend (2016 – current) within MTW mine dams. **Figure 12** to **Figure 14** show the long-term surface water trend (2016 - current) in surrounding watercourses.

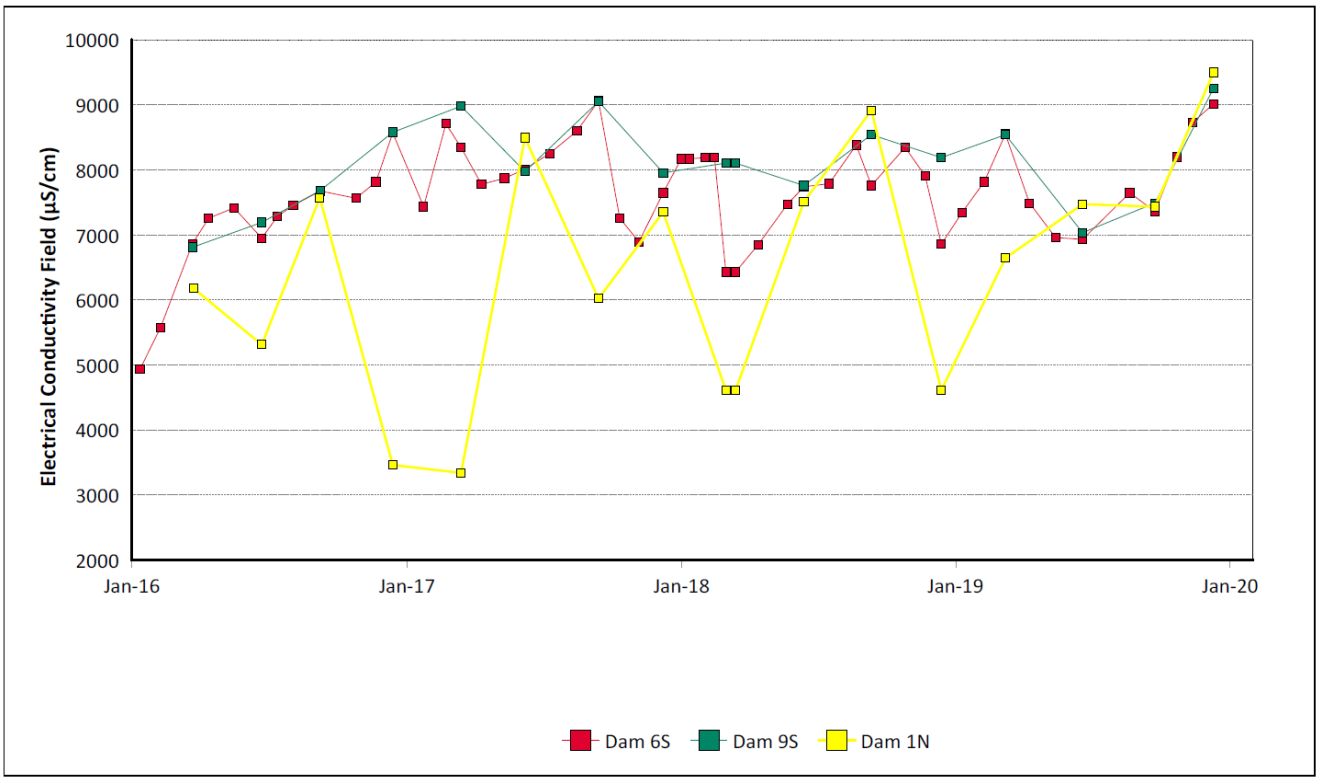


Figure 9: Site Dams Electrical Conductivity Trend – December 2019

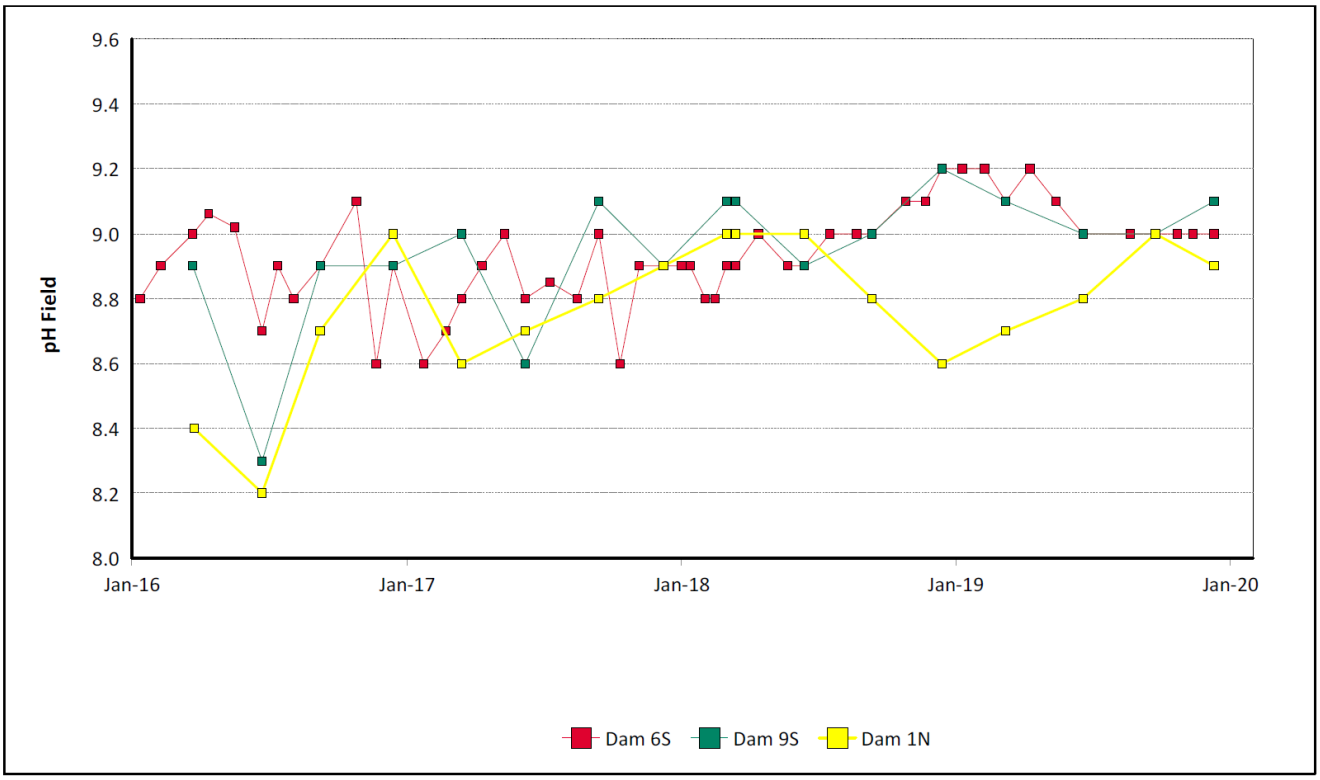


Figure 10: Site Dams pH Trend – December 2019

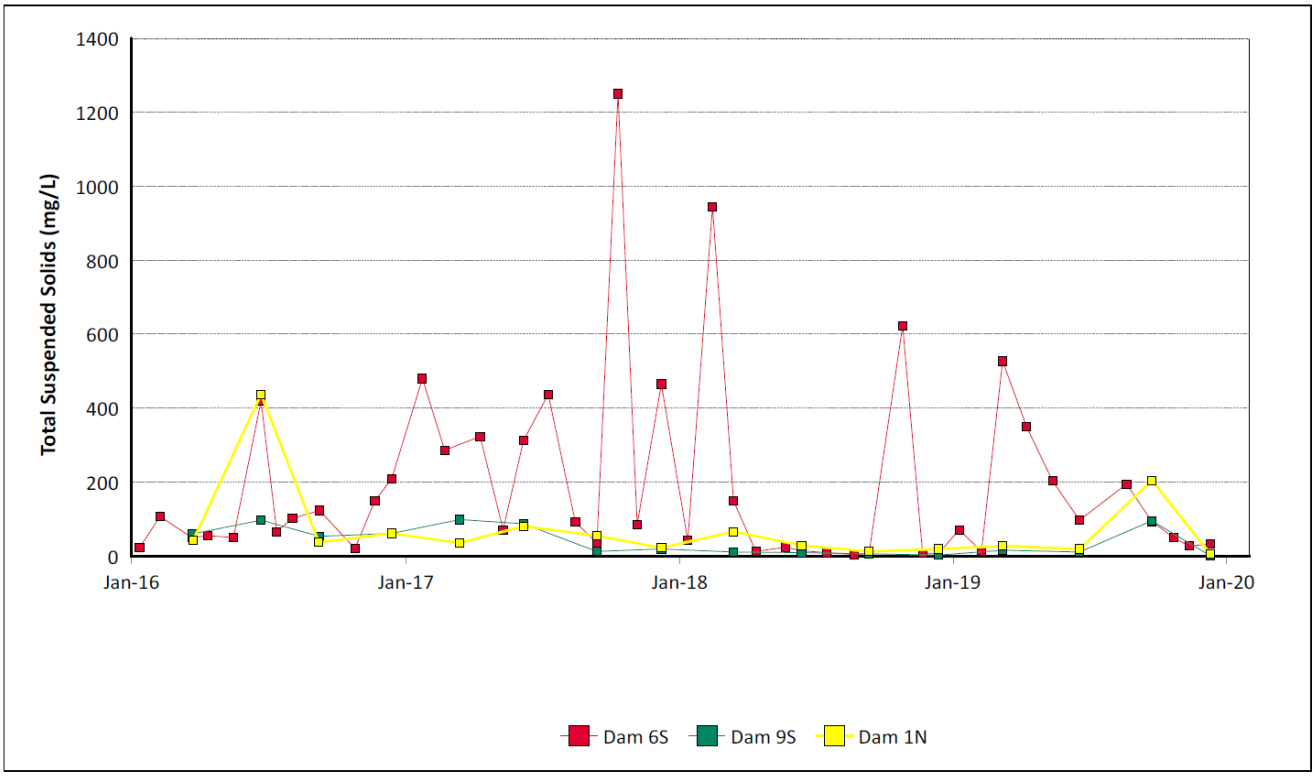
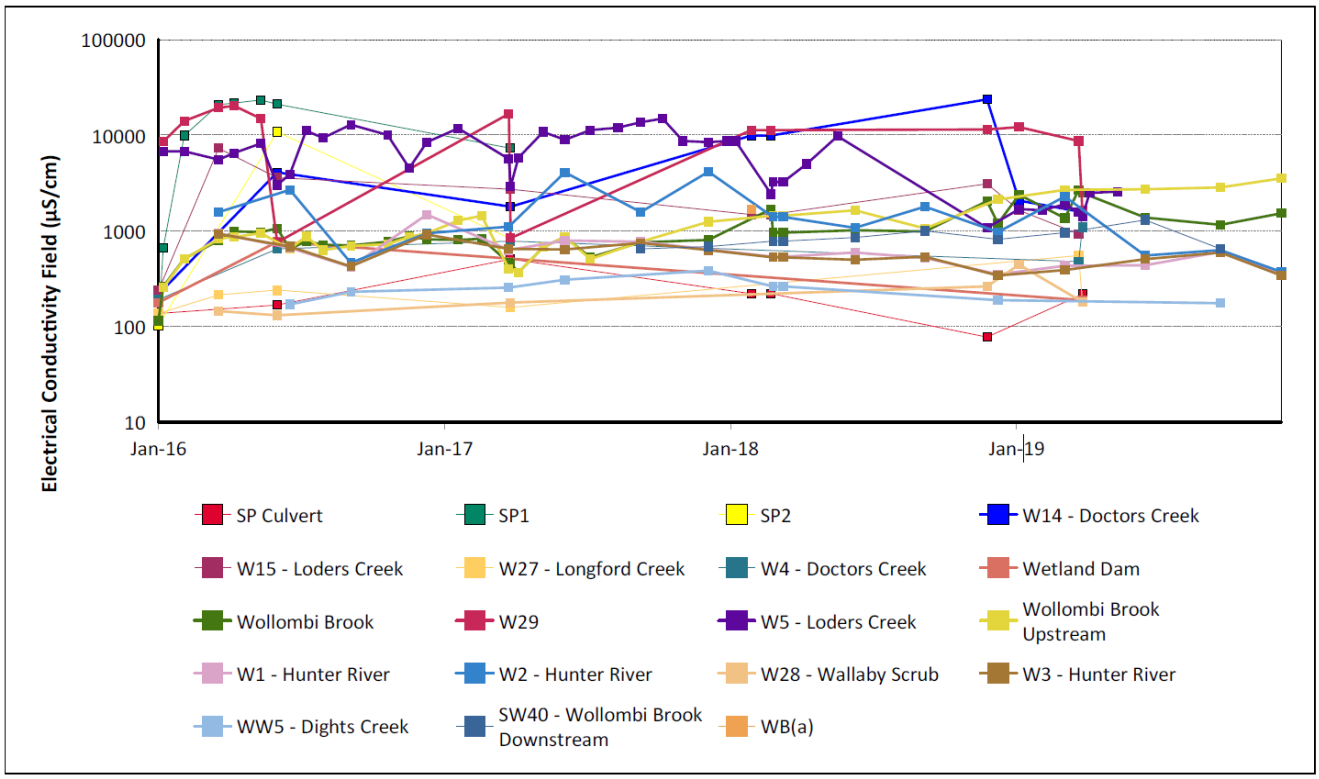
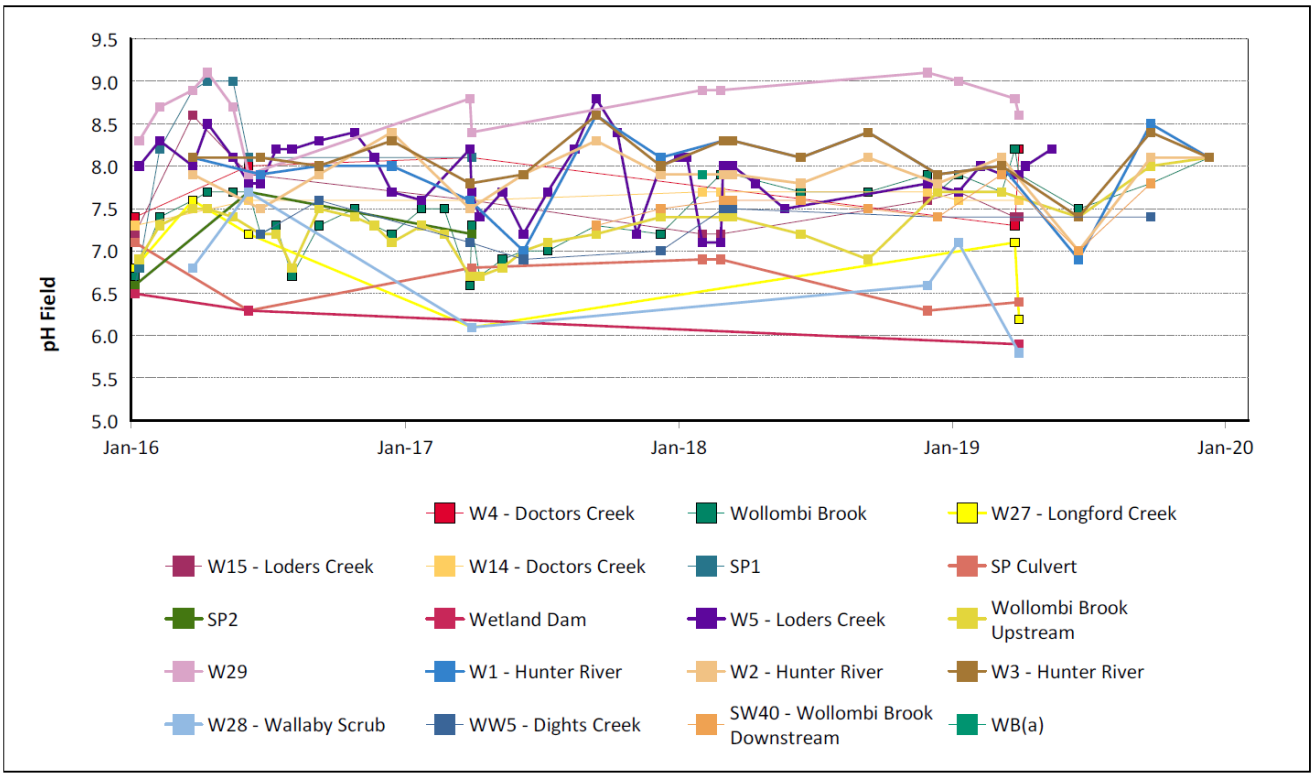


Figure 11: Site Dams Total Suspended Solids Trend – December 2019



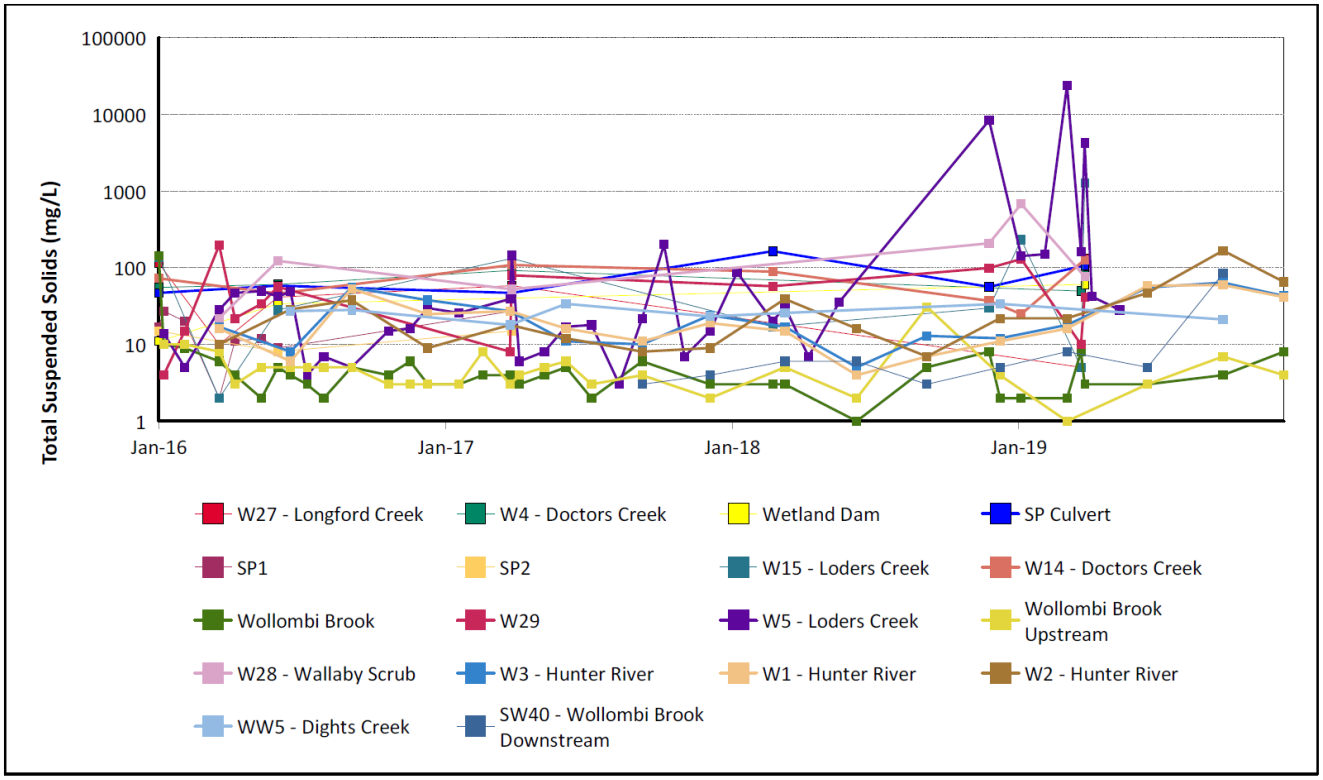
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 12: Watercourse Electrical Conductivity Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 13: Watercourse pH Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 14: Watercourse Total Suspended Solids Trend – December 2019

3.1.2 Surface Water Trigger Tracking

Internal trigger limits have been developed to assess monitoring data on an on-going basis, and to highlight potentially adverse surface water impacts. The process for evaluating monitoring results against the internal triggers and subsequent responses are outlined in the MTW Water Management Plan.

Current internal surface water trigger limit breaches are summarised in **Table 2.**

Table 2: Surface Water Trigger Tracking – December YTD 2019

Site	Date	Trigger Limit Breached	Action Taken in Response
W27	26/03/2019	EC –95th Percentile	Watching Brief* Note: Subsequent monitoring events have confirmed results are back within trigger limits. No further action required.
Wollombi Brook	08/03/2019	EC –95th Percentile	Watching Brief* Note: Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook Upstream showing similar EC results and trends. Continue to watch and monitor.
Wollombi Brook	19/06/2019	EC –95th Percentile	Watching Brief* Note: Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi

Site	Date	Trigger Limit Breached	Action Taken in Response
			Brook Upstream showing similar EC results and trends. Continue to watch and monitor.
Wollombi Brook	23/09/2019	EC –95th Percentile	Watching Brief* Note: Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook Upstream showing similar EC results and trends. Continue to watch and monitor. Investigation commenced.
Wollombi Brook	10/12/2019	EC –95th Percentile	Investigation Undertaken. Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook Upstream showing similar EC results and trends. Continue to watch and monitor.
Wollombi Brook Upstream	08/03/2019	EC –95th Percentile	Watching Brief*
Wollombi Brook Upstream	19/06/2019	EC –95th Percentile	Watching Brief* Note: Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Continue to watch and monitor.
Wollombi Brook Upstream	23/09/2019	EC –95th Percentile	Watching Brief* Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook showing similar EC results and trends. Investigation commenced.
Wollombi Brook Upstream	10/12/2019	EC –95th Percentile	Investigation Undertaken. Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook showing similar EC results and trends. Continue to watch and monitor.
SW40	08/03/2019	EC –95th Percentile	Watching Brief*
SW40	19/06/2019	EC –95th Percentile	Watching Brief* Note: Elevated EC is considered attributable to prolonged dry climatic conditions, and not related to mining related impacts. Wollombi Brook U/S showing similar EC results and trends. Results from subsequent monitoring events have confirmed results are back within trigger limits.
W1	19/06/2019	pH –5th Percentile	Watching Brief*

Site	Date	Trigger Limit Breached	Action Taken in Response
W2	19/06/2019	pH –5th Percentile	Watching Brief*
W3	19/06/2019	pH –5th Percentile	Watching Brief*
W4	26/03/2019	pH –5th Percentile	Watching Brief*
W27	31/03/2019	pH –5th Percentile	Watching Brief*
W28	31/03/2019	pH –5th Percentile	Watching Brief*
W1	19/06/2019	TSS – 50mg/L (ANZECC criteria)	Watching Brief*. Note: Unlikely to be associated with MTW mining related impacts.
W1	23/09/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS considered associated with recent rainfall and increased flow rate in the river at the time. Consistent with nearby W2 and W3 measurements. No signs of mining related impact.
W2	23/09/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS considered associated with recent rainfall and increased flow rate in the river at the time. Consistent with nearby W1 and W3 measurements. No signs of mining related impact.
W2	10/12/2019	TSS – 50mg/L (ANZECC criteria)	Watching Brief*. Note: Unlikely to be associated with MTW mining related impacts. Elevated TSS results most likely attributable to sampling from slow flowing water following extended period of below average rainfall.
W3	19/06/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS considered associated with recent rainfall and increased flow rate in the river at the time. Consistent with nearby W1 and W2 measurements. No signs of mining related impact.
W3	23/09/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS considered associated with recent rainfall and increased flow rate in the river at the time. Consistent with nearby W1 and W2 measurements. No signs of mining related impact.
W4	31/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Field investigation did not identify any mining related sources of sediment. Elevated TSS results most likely attributable to high intensity rainfall event after prolonged dry period (52mm in 24 hours).
W5	09/01/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Field investigation did not identify any mining related sources of sediment. Elevated TSS results considered attributable to sampling from a pool of water with no flow.
W5	08/02/2019	TSS – 50mg/L (ANZECC criteria)	Field investigation did not identify any mining related sources of sediment. Elevated TSS results considered attributable to sampling from a pool of water with no flow.
W5	08/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Investigation did not identify any mining related sources of sediment. Elevated TSS results most likely attributable to sampling from a pool of water with no flow.

Site	Date	Trigger Limit Breached	Action Taken in Response
W14	31/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Field investigation did not identify any mining related sources of sediment. Elevated TSS results most likely attributable to high intensity rainfall event after prolonged dry period (52mm in 24 hours).
W15	31/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Field investigation did not identify any mining related sources of sediment. Elevated TSS results most likely attributable to high intensity rainfall event after prolonged dry period (52mm in 24 hours).
W27	31/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS results most likely attributable to high intensity rainfall event after prolonged dry period (52mm in 24 hours). In addition, TSS results were potentially affected by turbid water associated with the overtopping of an MTW sediment dam as a result of greater than design rainfall on 30 March 2019. This is discussed further in Section 8.0.
W28	31/03/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS results most likely attributable to high intensity rainfall event after prolonged dry period (52mm in 24 hours). In addition, TSS results were potentially affected by turbid water associated with the overtopping of an MTW sediment dam as a result of greater than design rainfall on 30 March 2019. This is discussed further in Section 8.0.
SW40	23/09/2019	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS considered associated with recent rainfall (17-19 and 22 September) resulting in mobilisation of sediment after prolonged dry conditions. Unlikely to be associated with MTW mining related impacts. Continue to monitor.

* = Watching brief established pending outcomes of subsequent monitoring events.

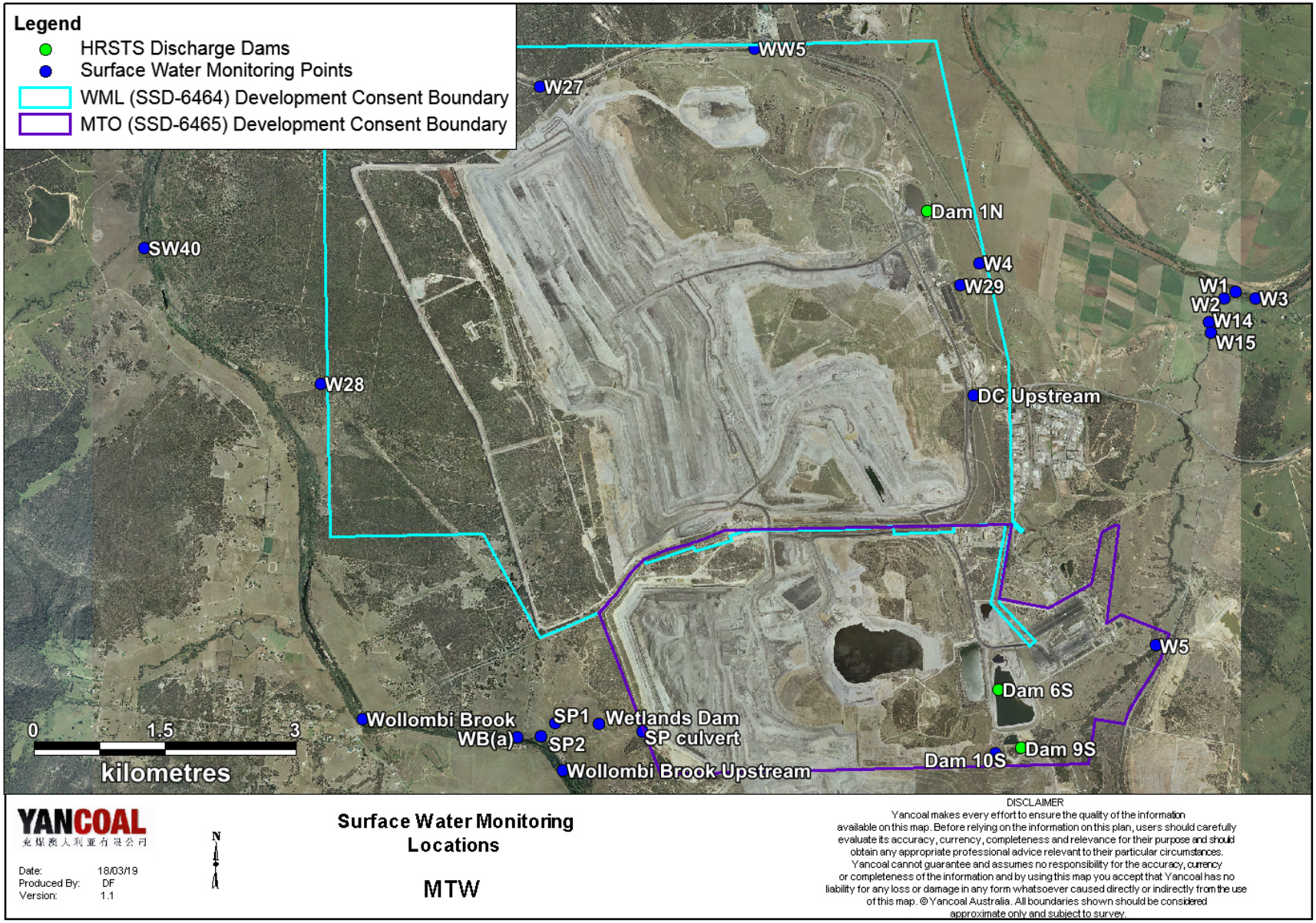
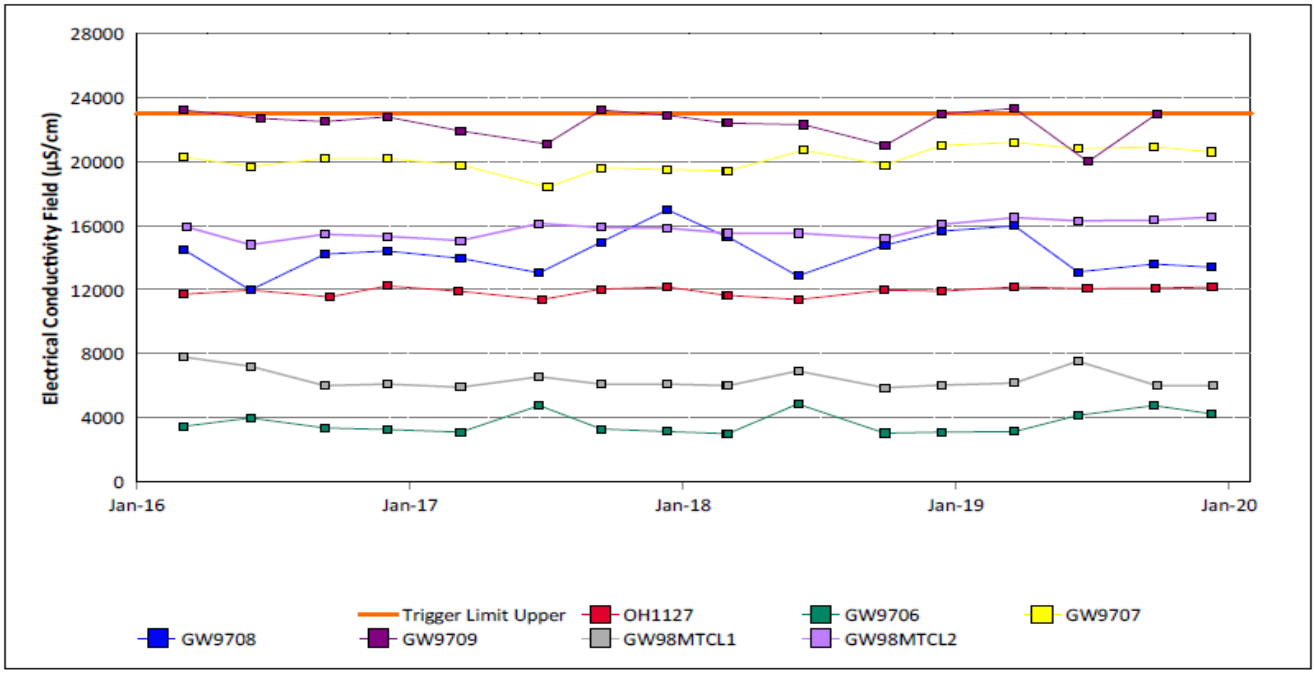


Figure 15: Surface Water Monitoring Location Plan

3.2 Groundwater Monitoring

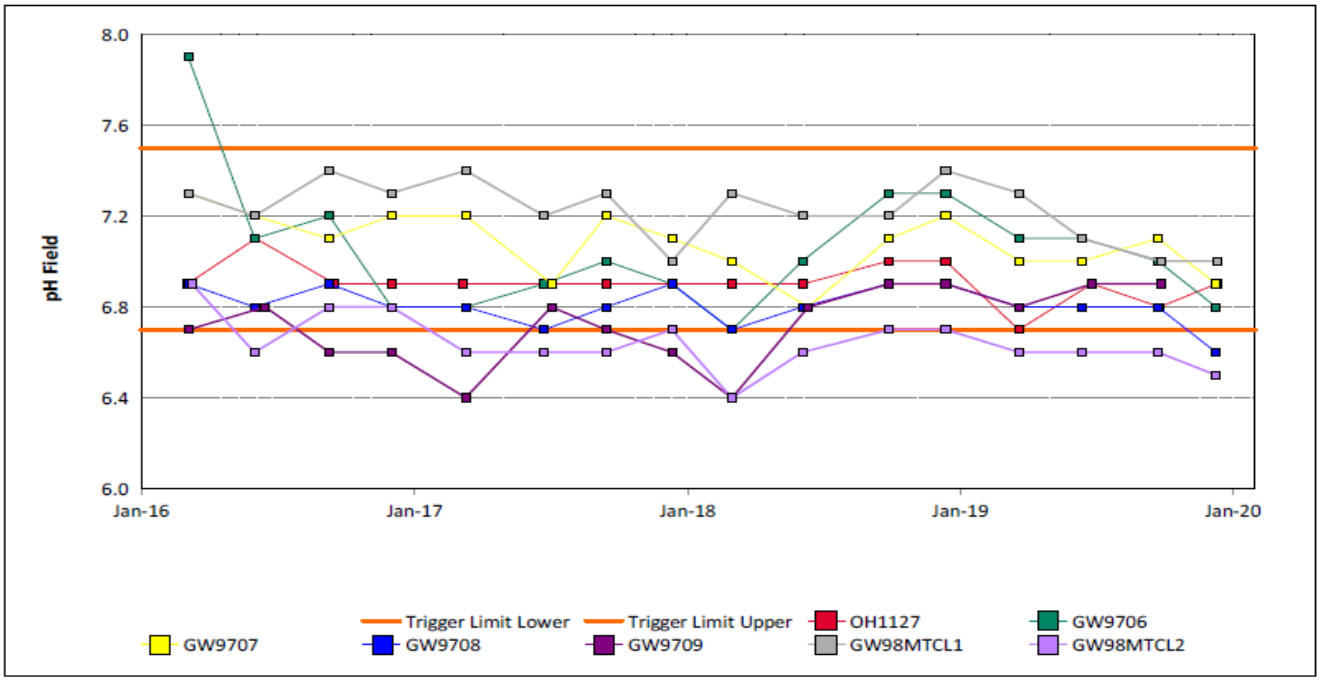
Groundwater monitoring is undertaken on a quarterly basis in accordance with the MTW Groundwater Monitoring Programme.

Figure 16 to **Figure 61** show the long-term water quality trends (2016 – current) for groundwater bores monitored at MTW.



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 16: Bayswater Seam Electrical Conductivity Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 17: Bayswater Seam pH Trend – December 2019

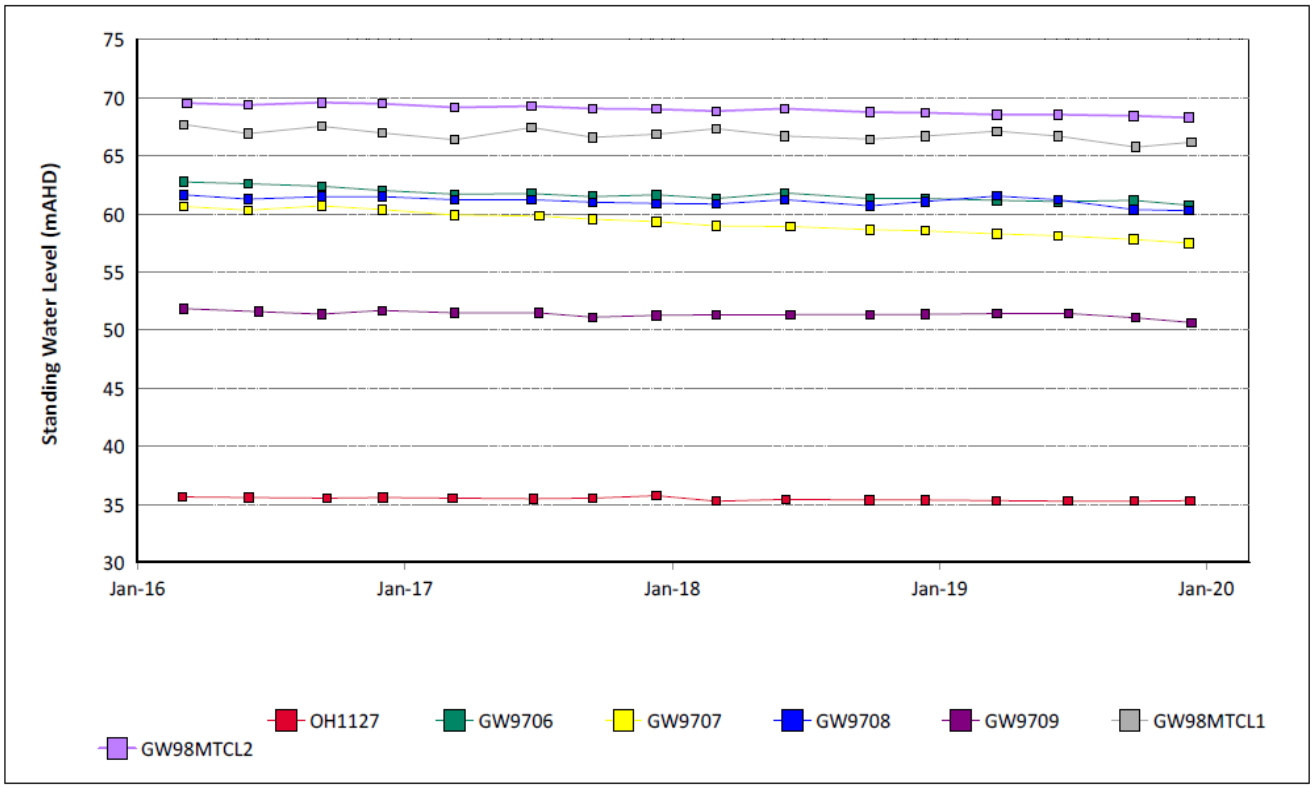


Figure 18: Bayswater Seam Standing Water Level Trend – December 2019

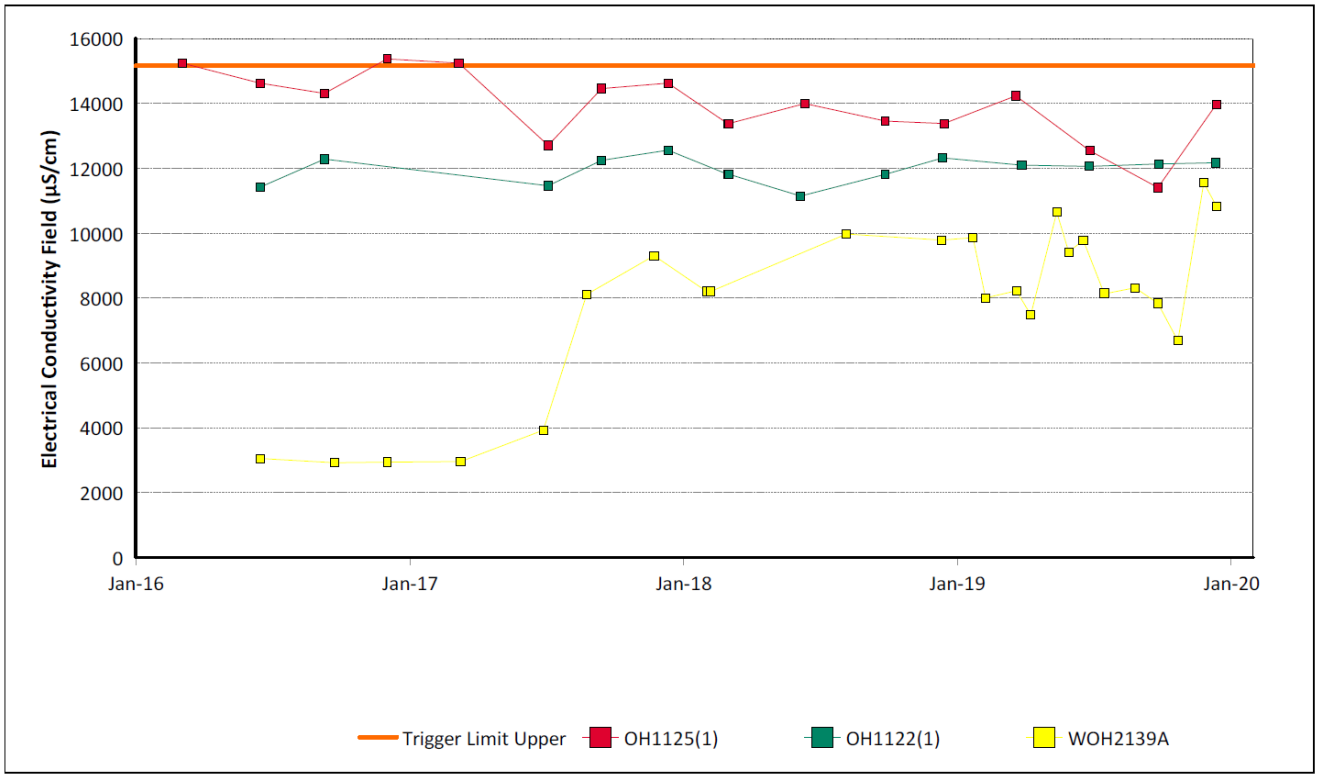


Figure 19: Blakefield Seam Electrical Conductivity Trend – December 2019

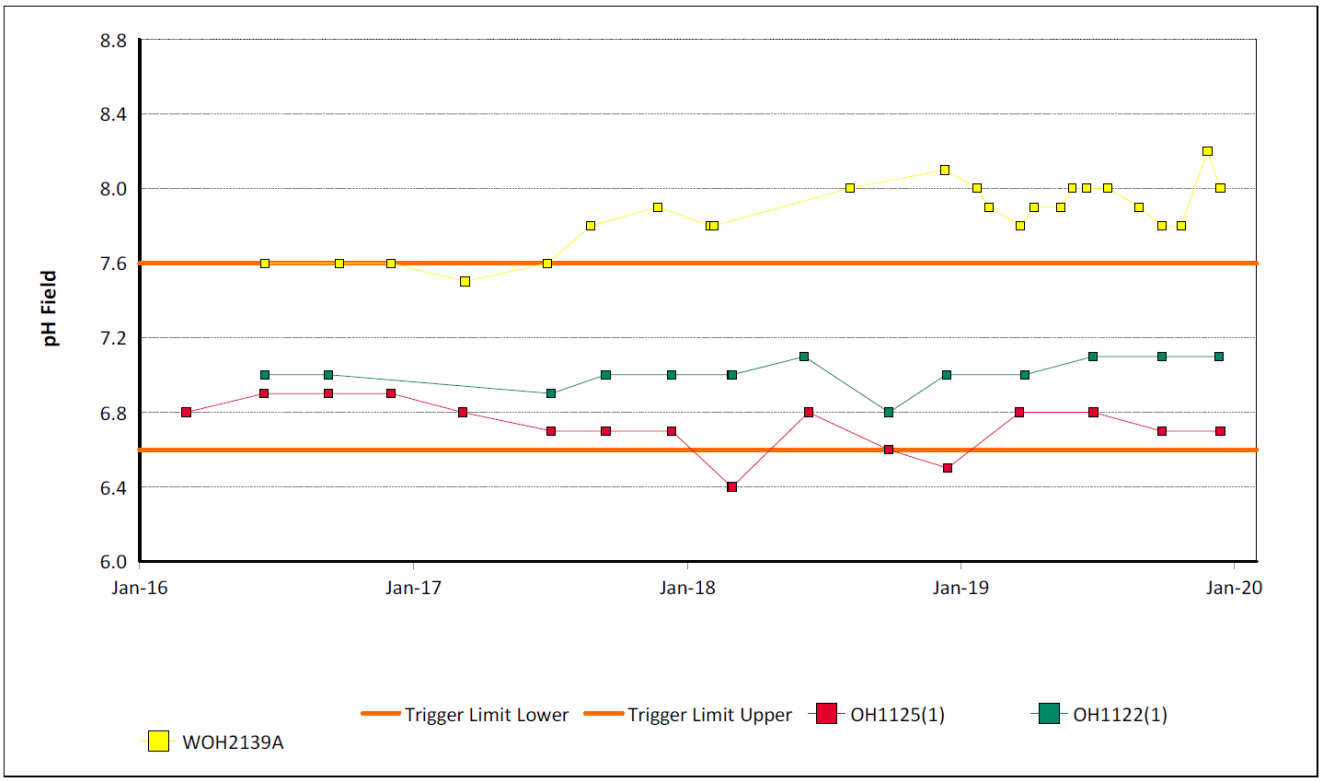


Figure 20: Blakefield Seam pH Trend – December 2019

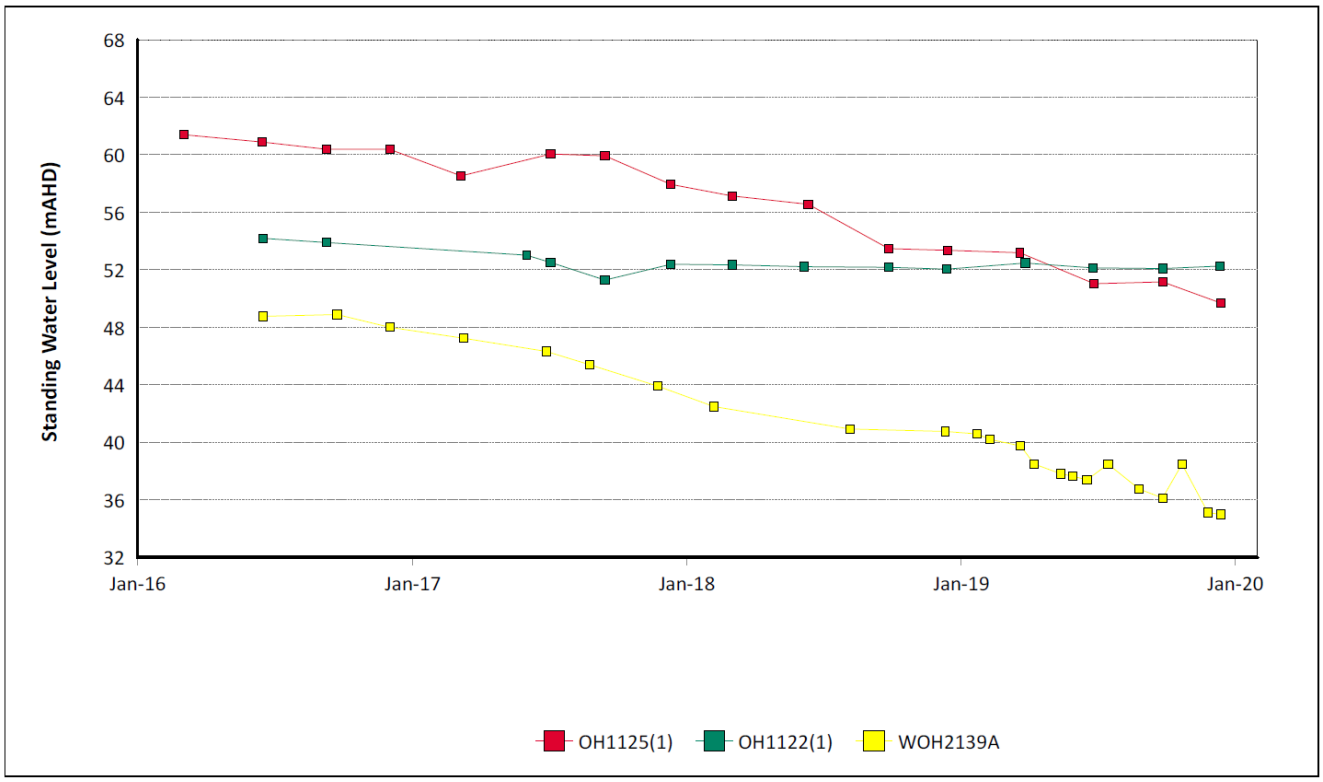


Figure 21: Blakefield Seam Standing Water Level Trend – December 2019

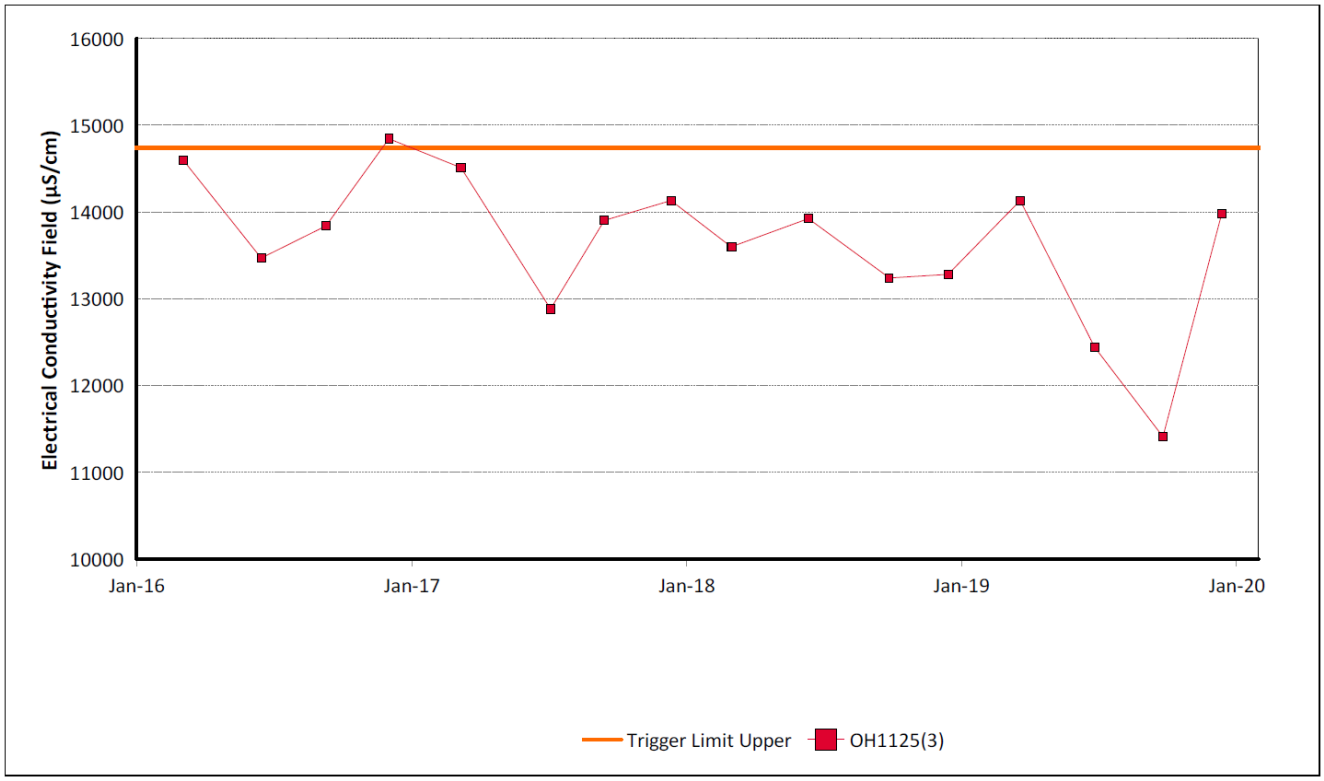


Figure 22: Bowfield Seam Electrical Conductivity Trend – December 2019

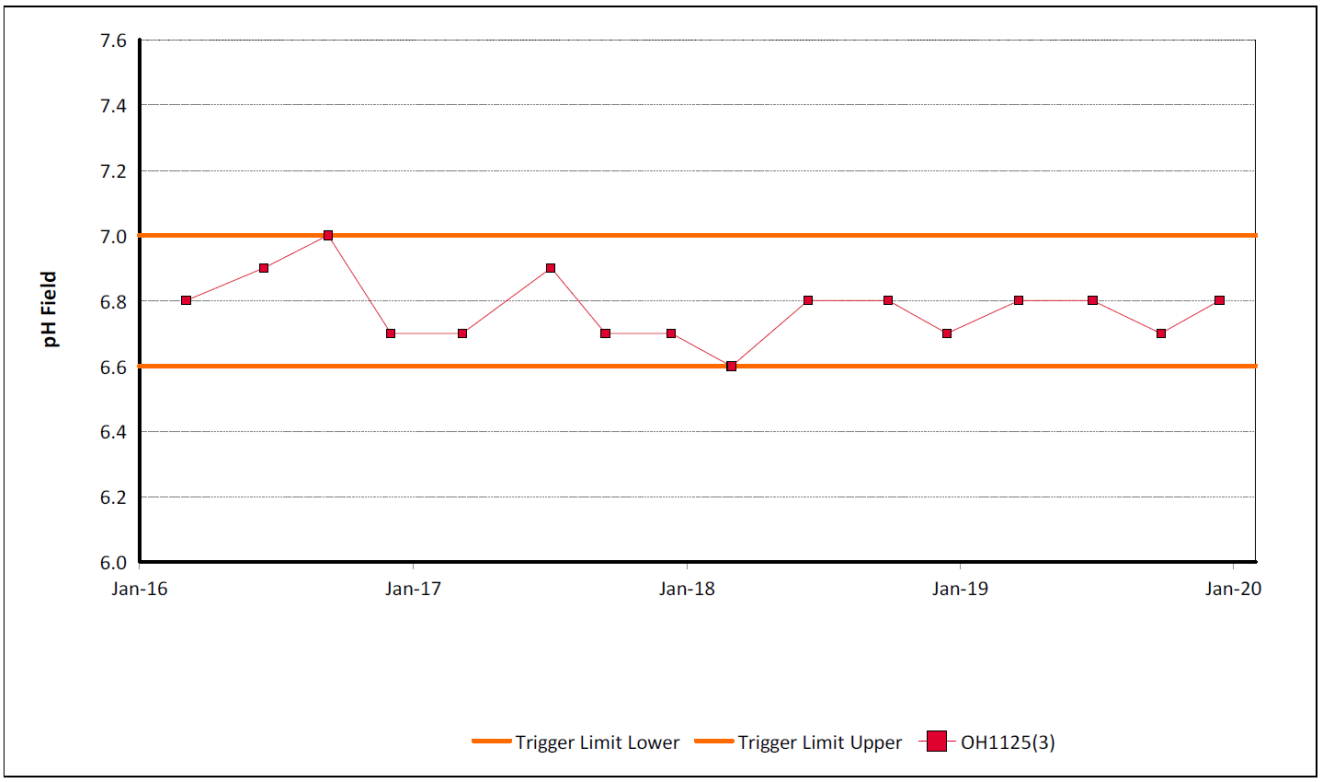


Figure 23: Bowfield Seam pH Trend – December 2019

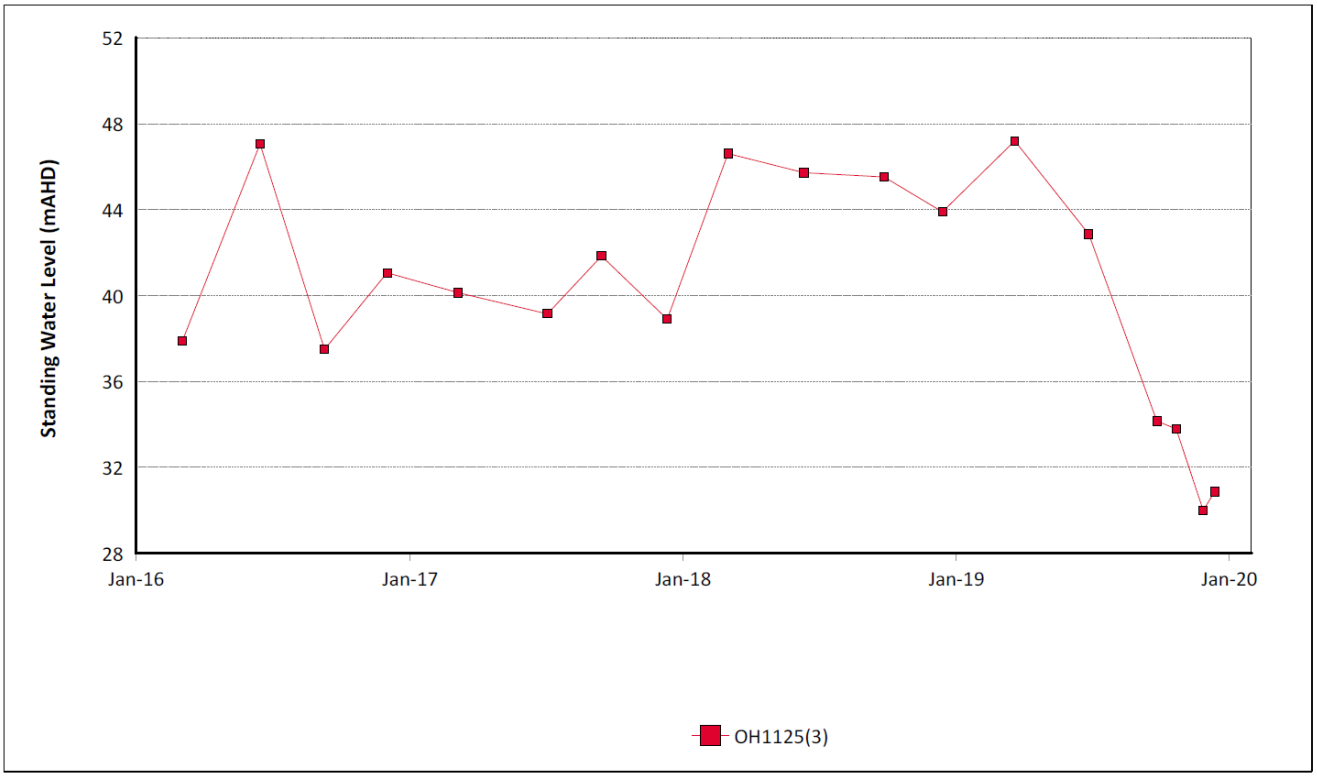


Figure 24: Bowfield Seam Standing Water Level Trend – December 2019

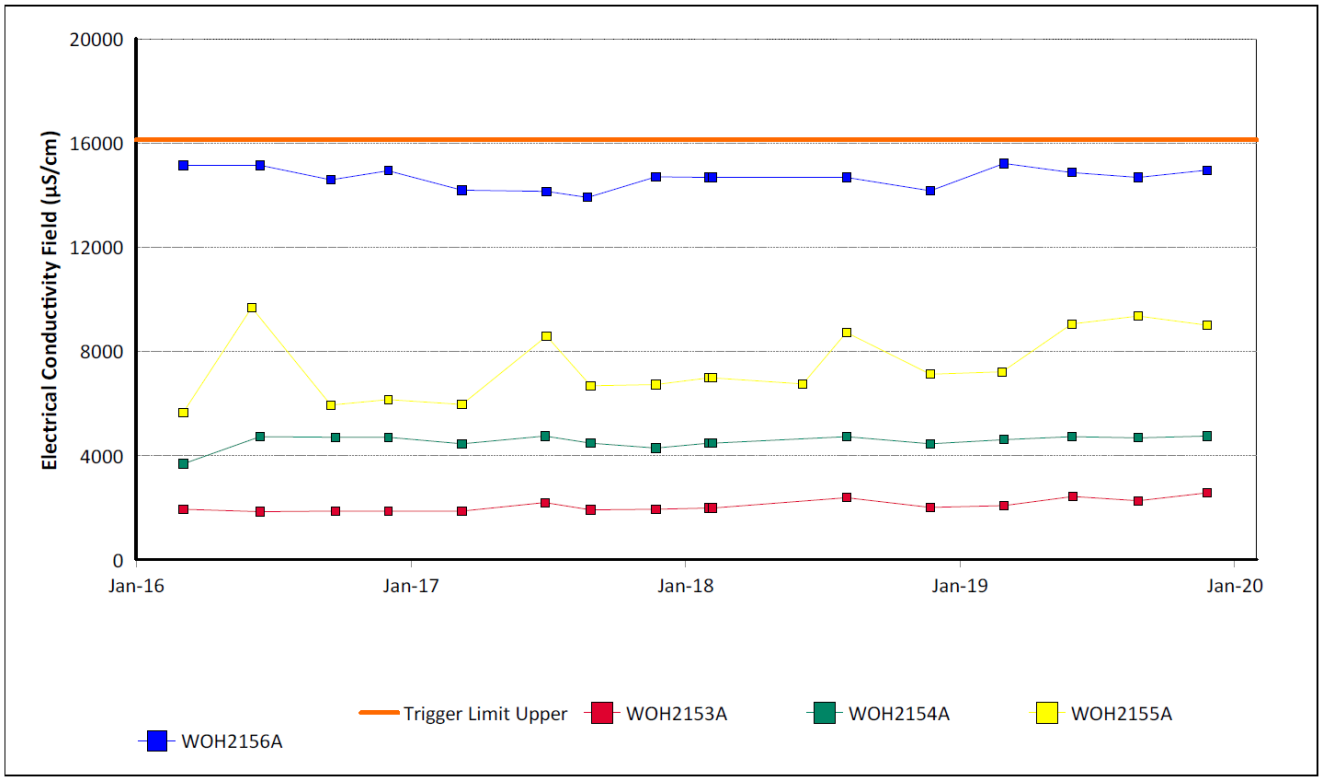


Figure 25: Redbank Seam Electrical Conductivity Trend – December 2019

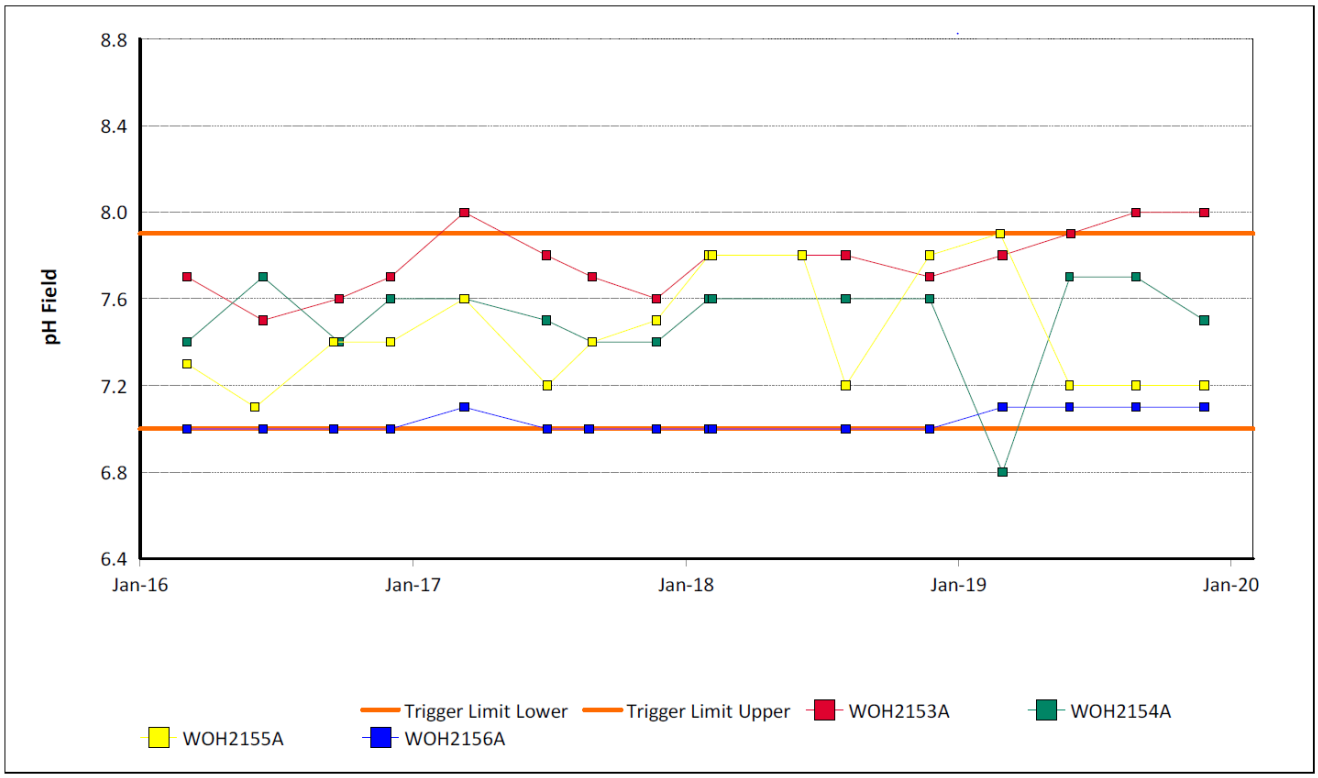


Figure 26: Redbank Seam pH Trend – December 2019

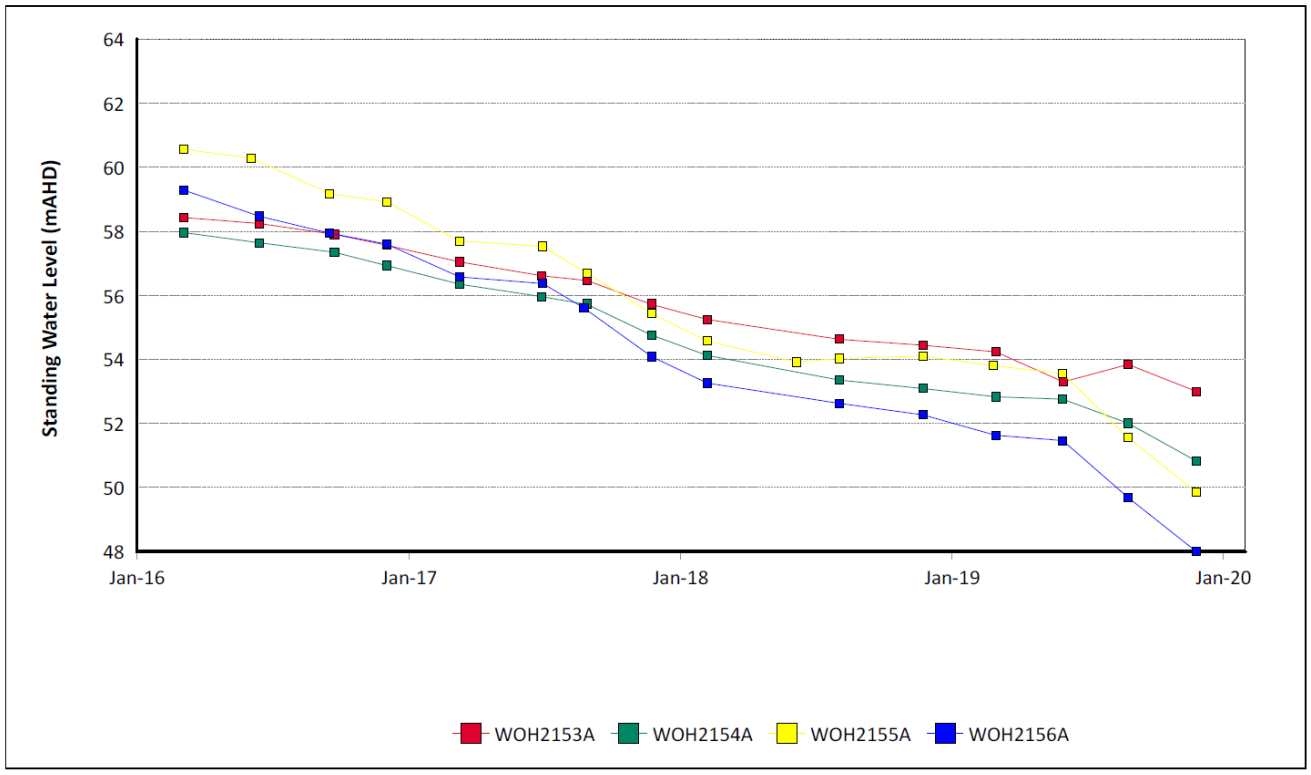


Figure 27: Redbank Seam Standing Water Level Trend – December 2019

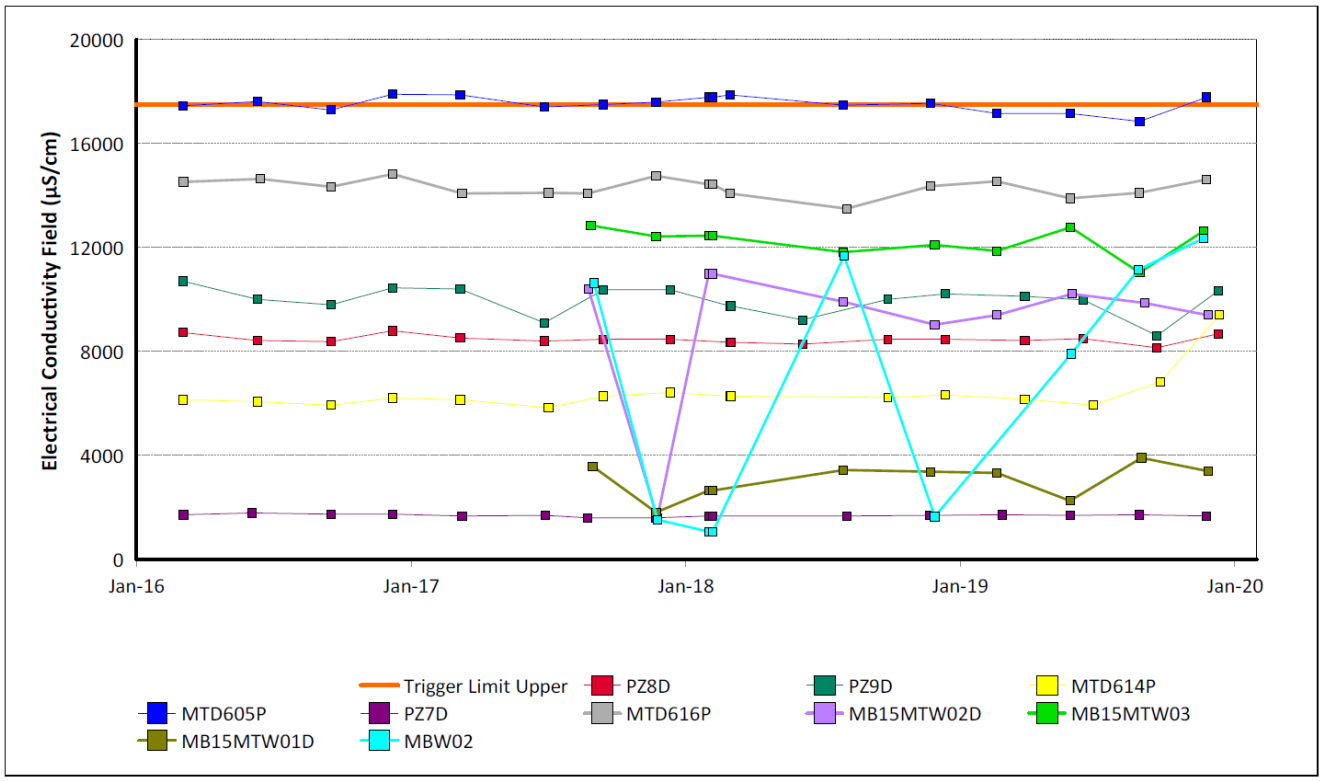


Figure 28: Shallow Overburden Electrical Conductivity Trend – December 2019

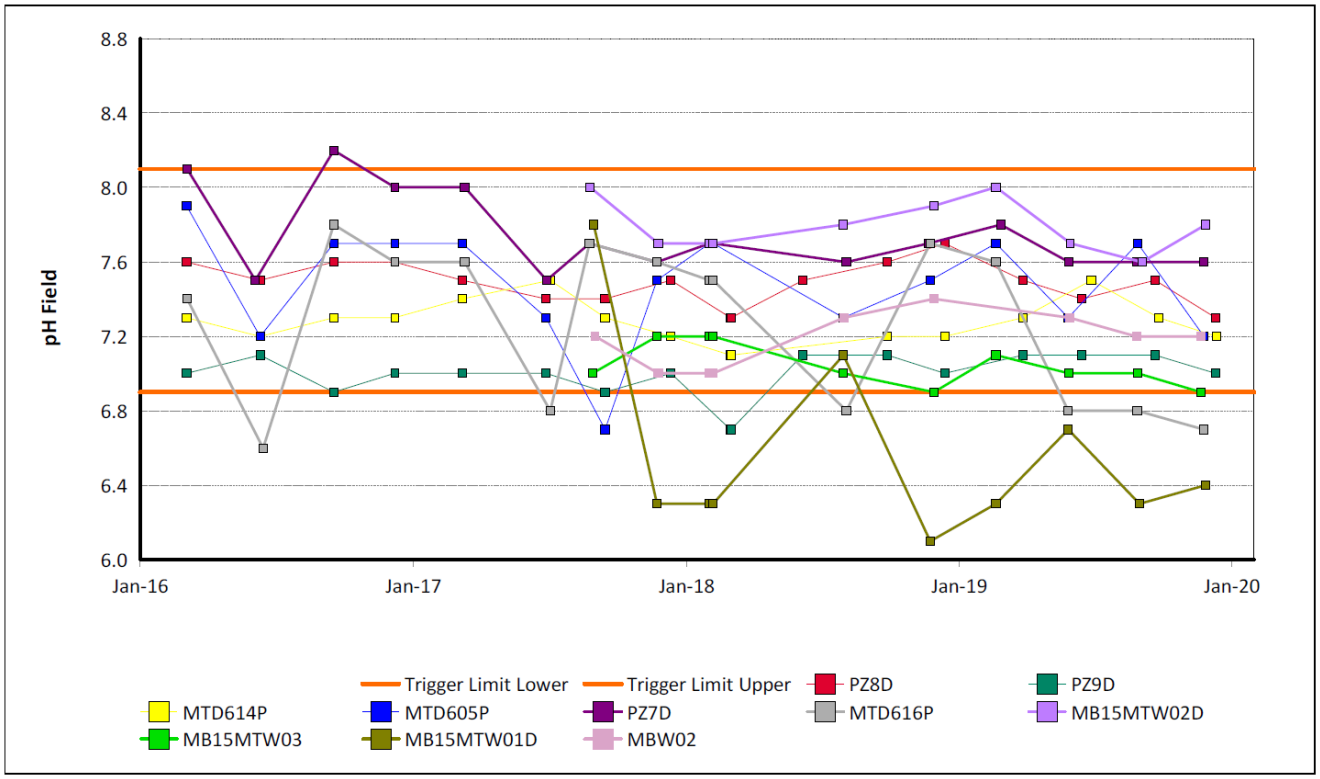


Figure 29: Shallow Overburden pH Trend – December 2019

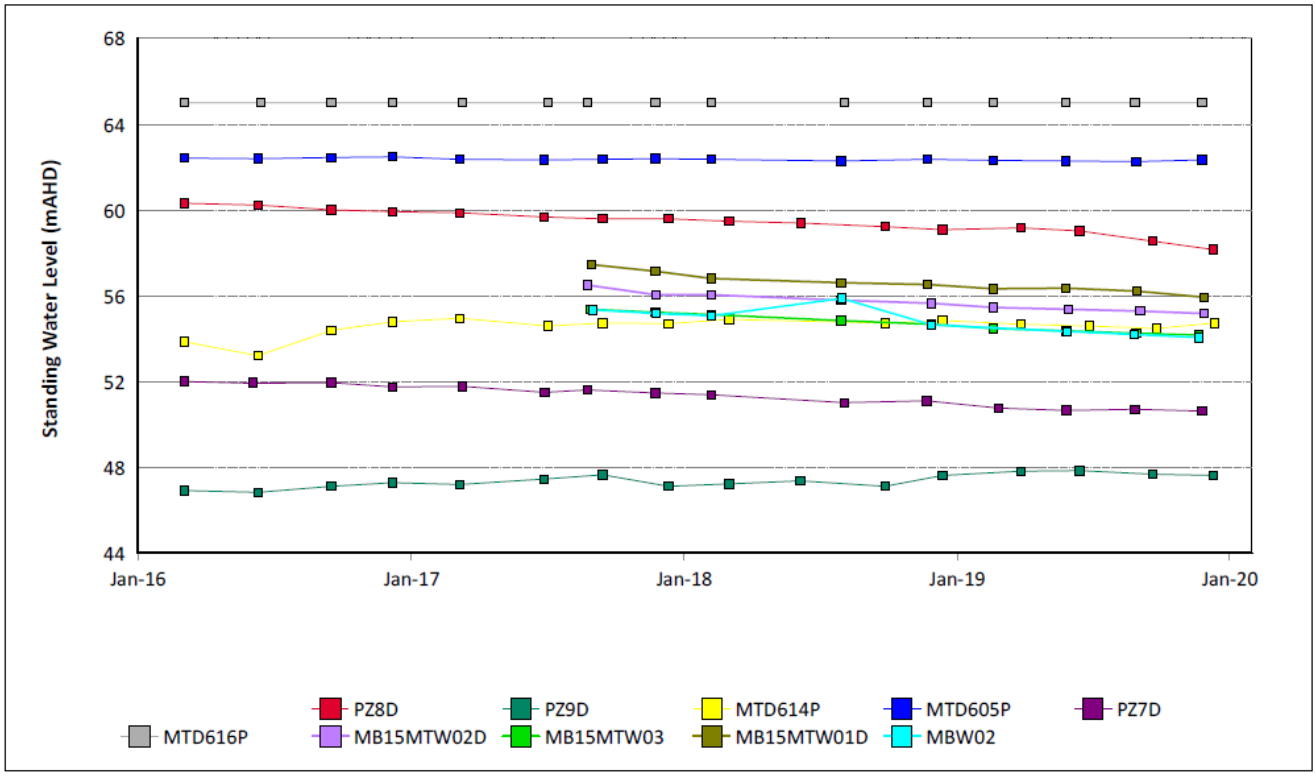
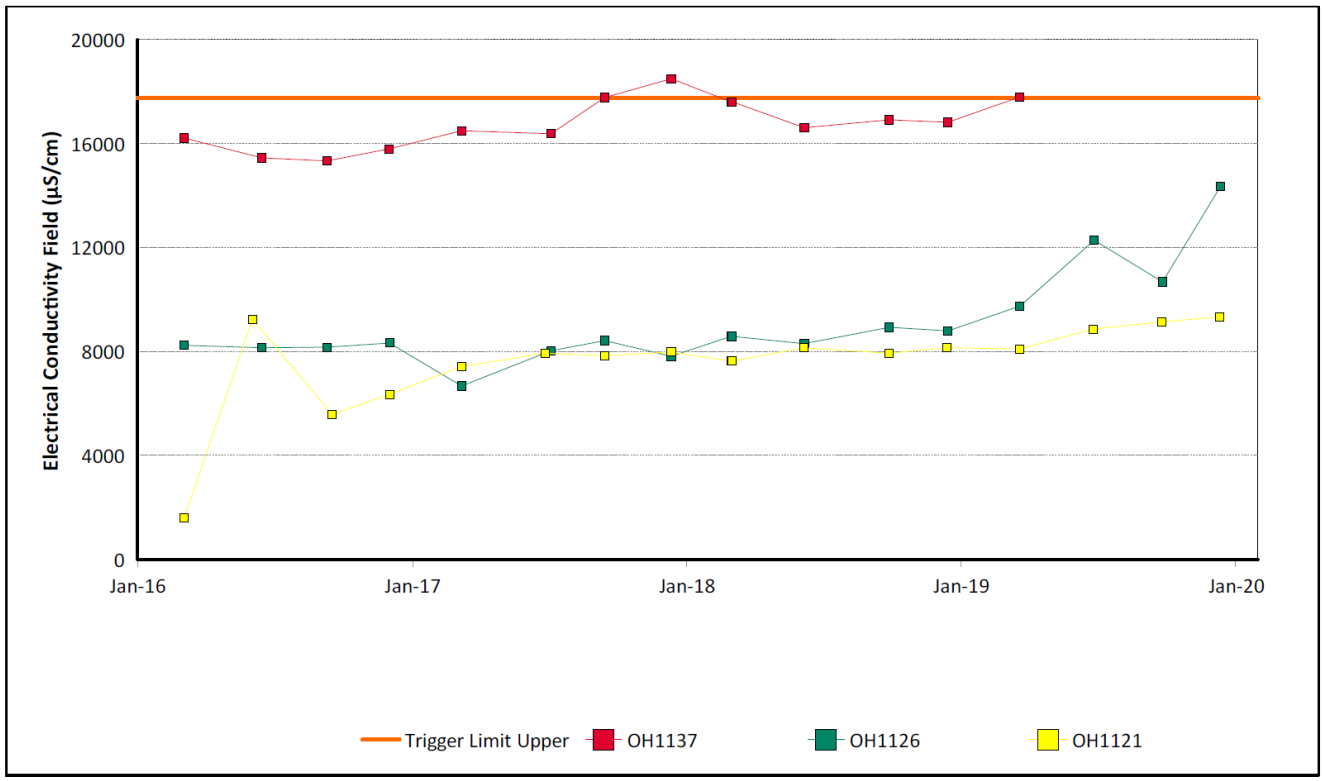
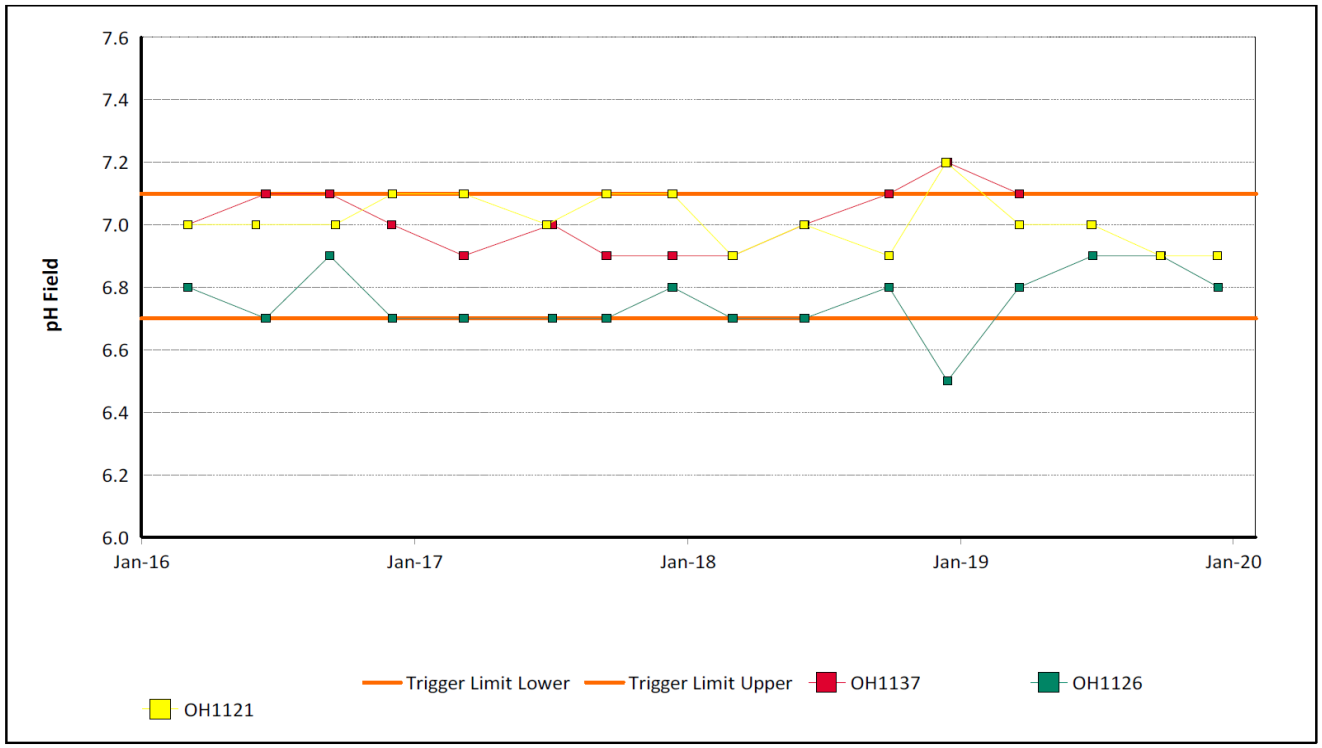


Figure 30: Shallow Overburden Standing Water Level Trend – December 2019



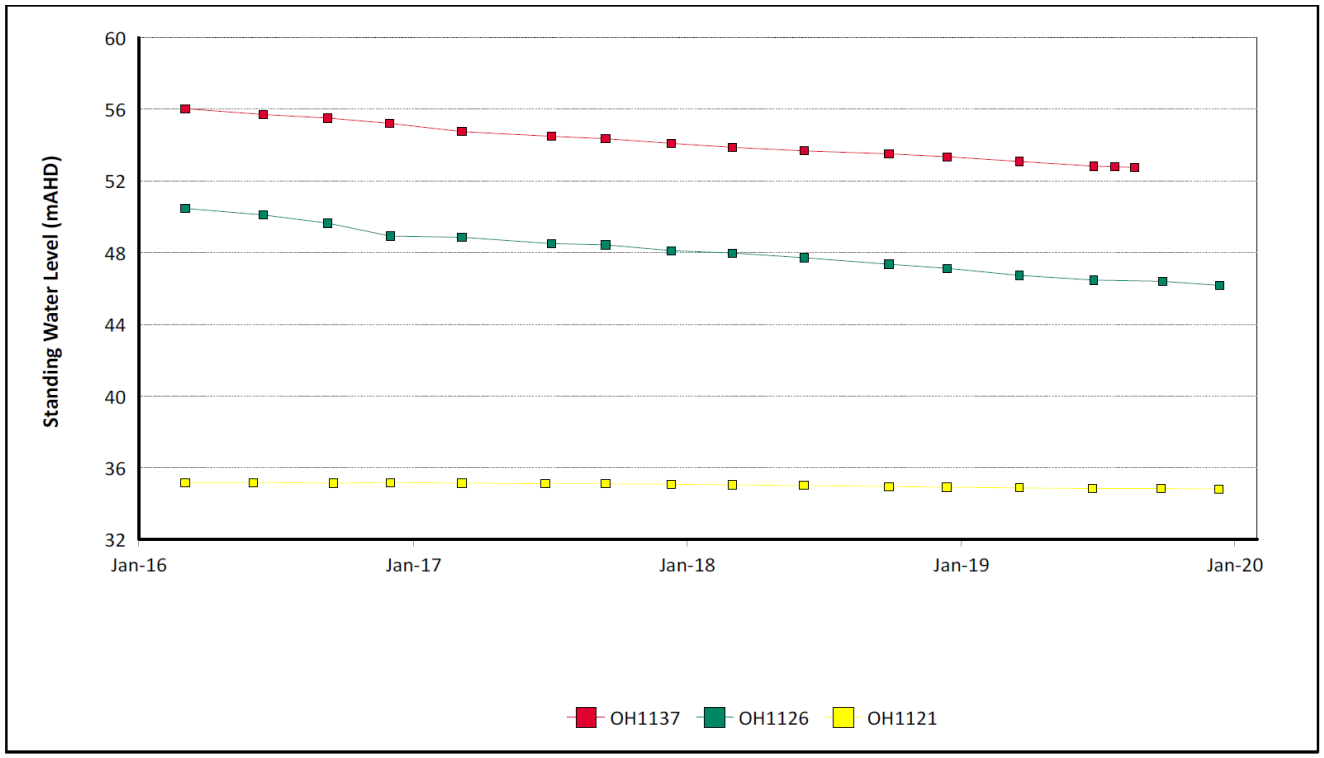
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 31: Vaux Seam Electrical Conductivity Trend – December 2019



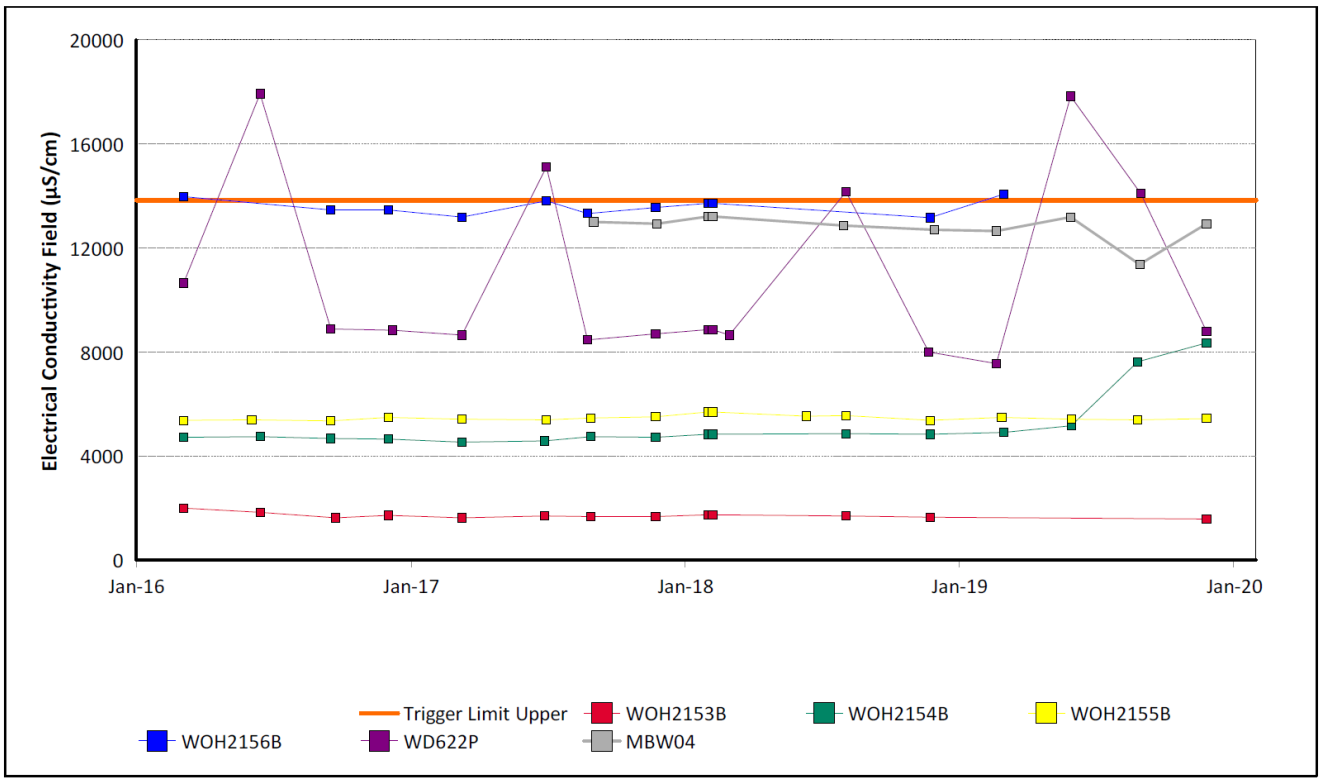
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 32: Vaux Seam pH Trend – December 2019



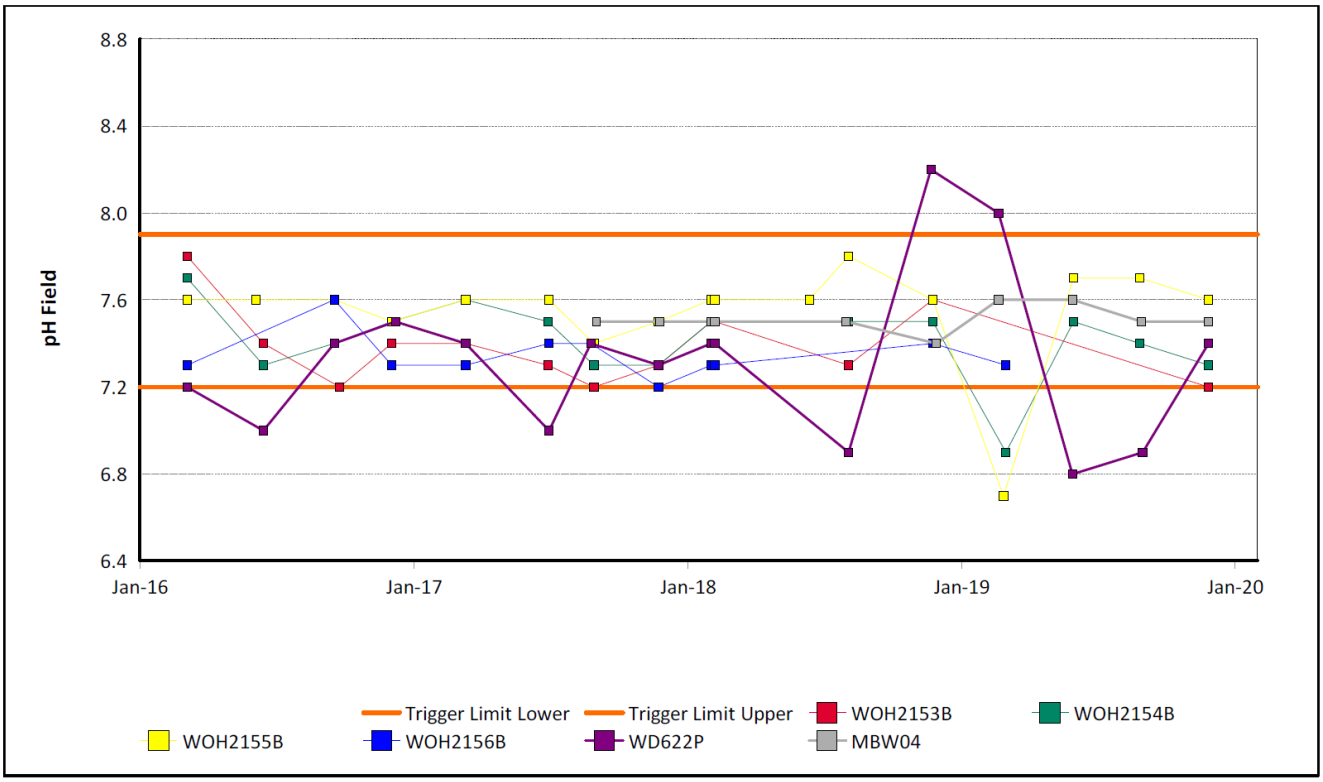
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 33: Vaux Seam Standing Water Level Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 34: Wambo Seam Electrical Conductivity Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 35: Wambo Seam pH Trend – December 2019

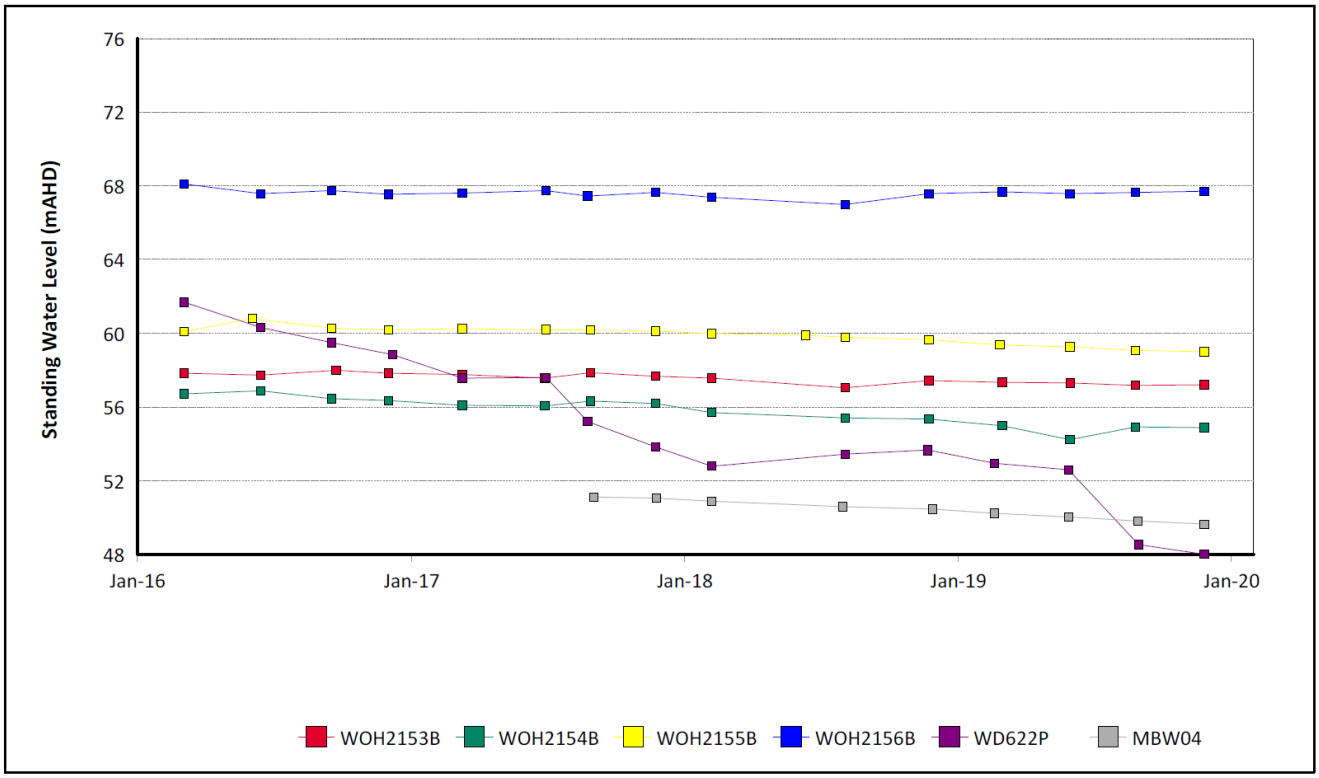


Figure 36: Wambo Seam Standing Water Level Trend – December 2019

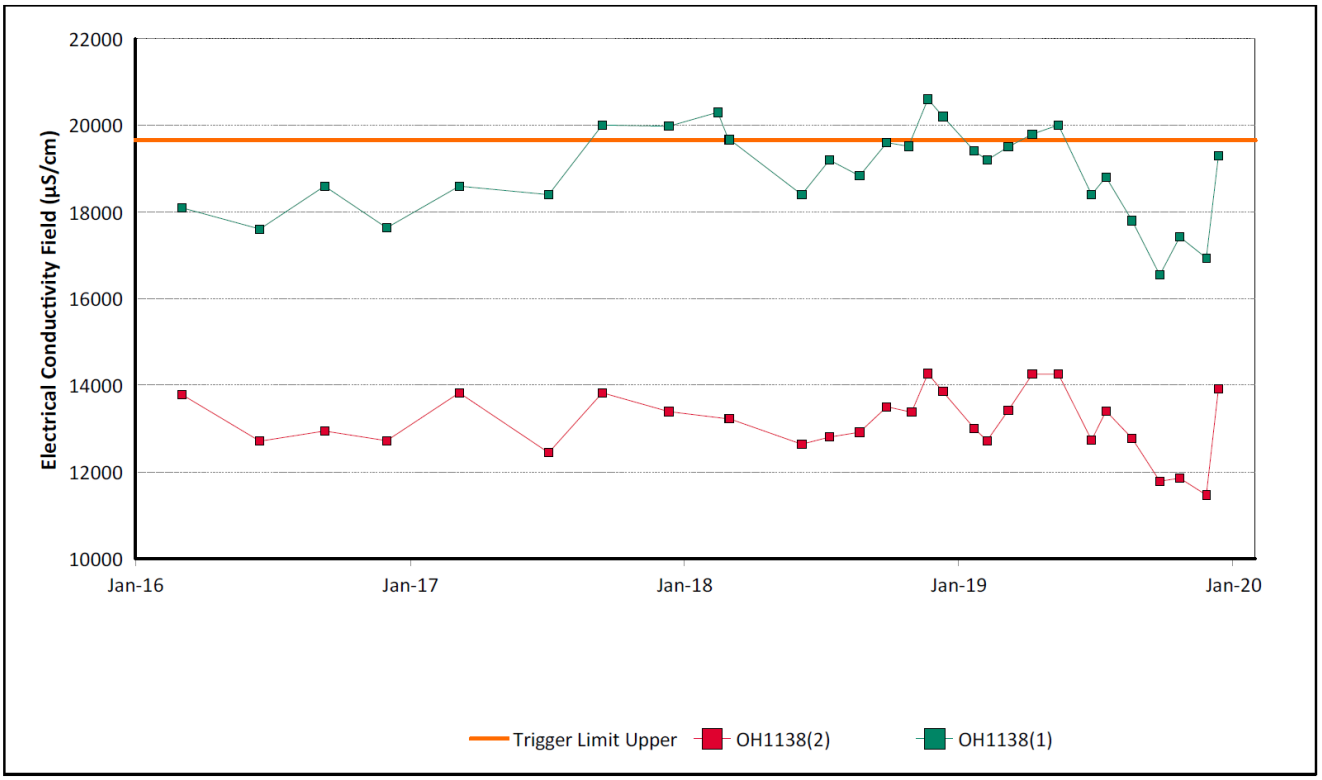


Figure 37: Warkworth Seam Electrical Conductivity Trend – December 2019

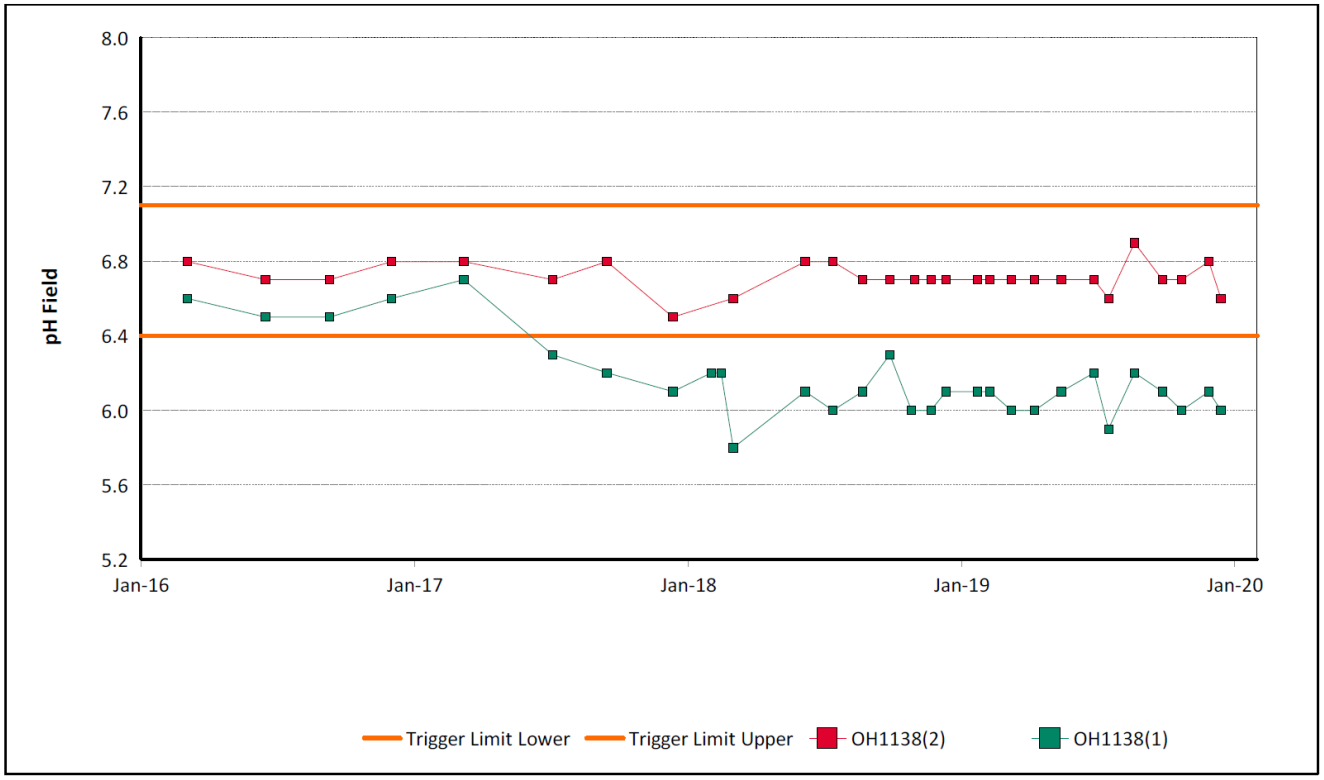


Figure 38: Warkworth Seam pH Trend – December 2019

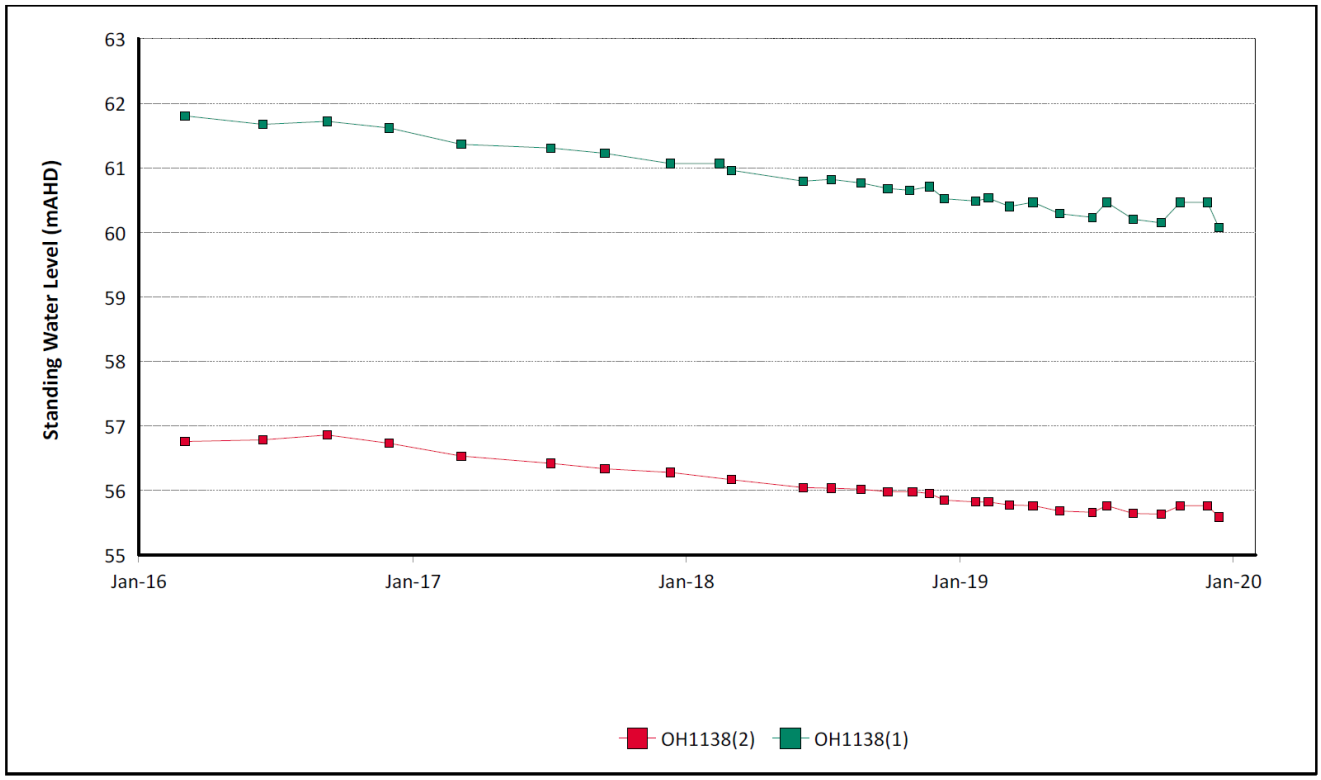


Figure 39: Warkworth Seam Standing Water Level Trend – December 2019

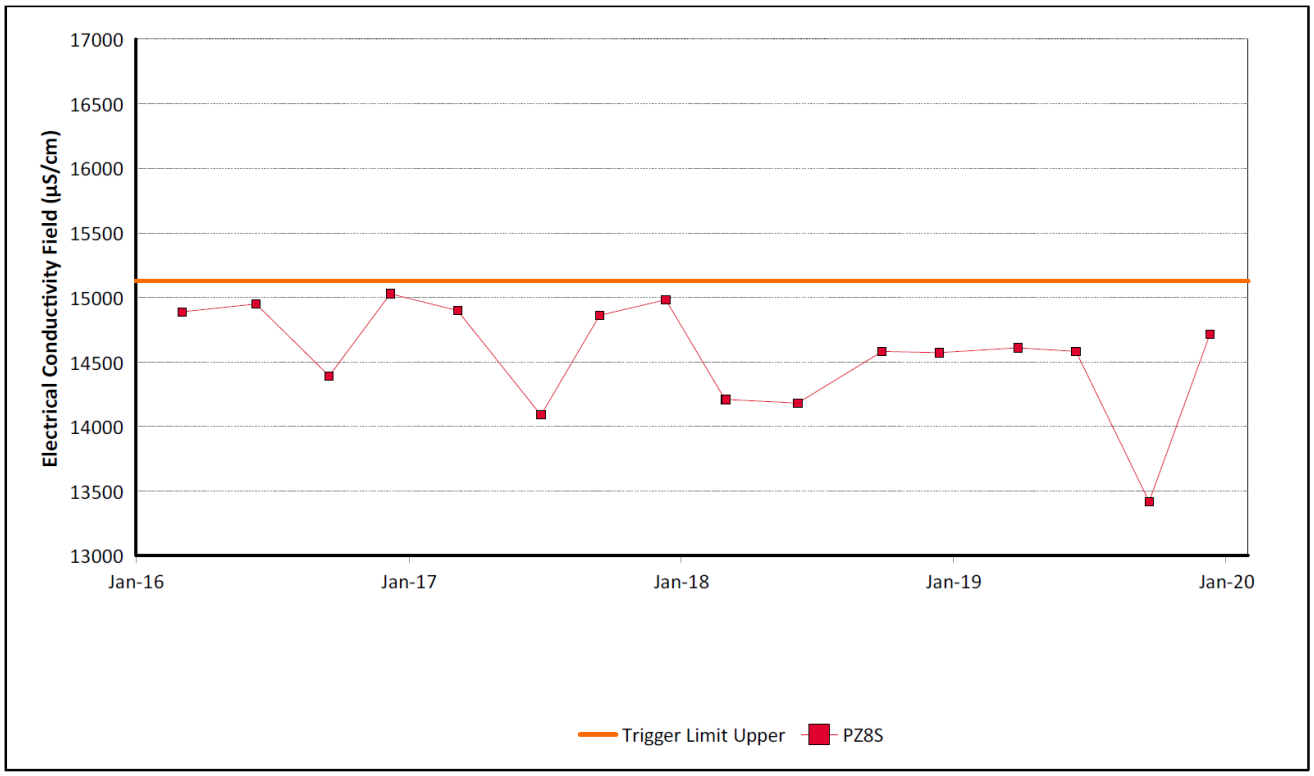


Figure 40: Wollombi Alluvium Electrical Conductivity Trend – December 2019

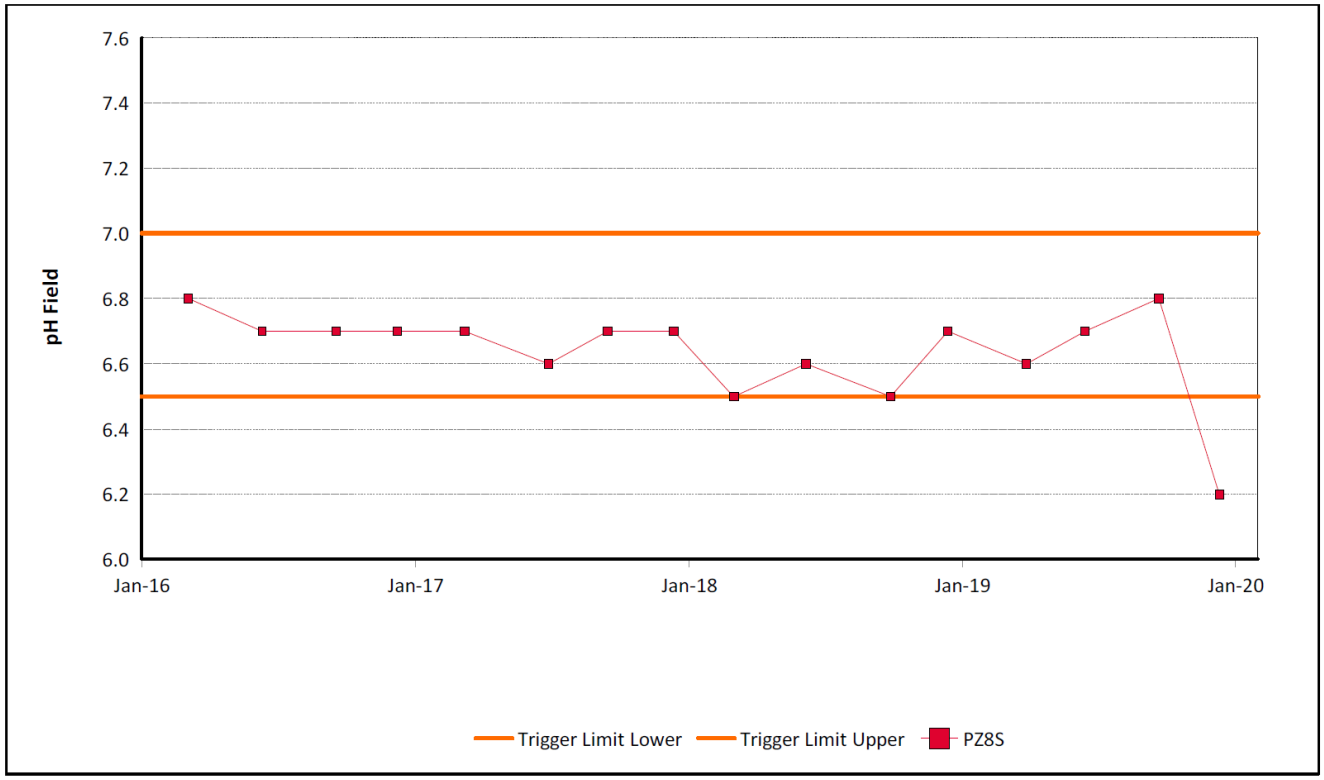
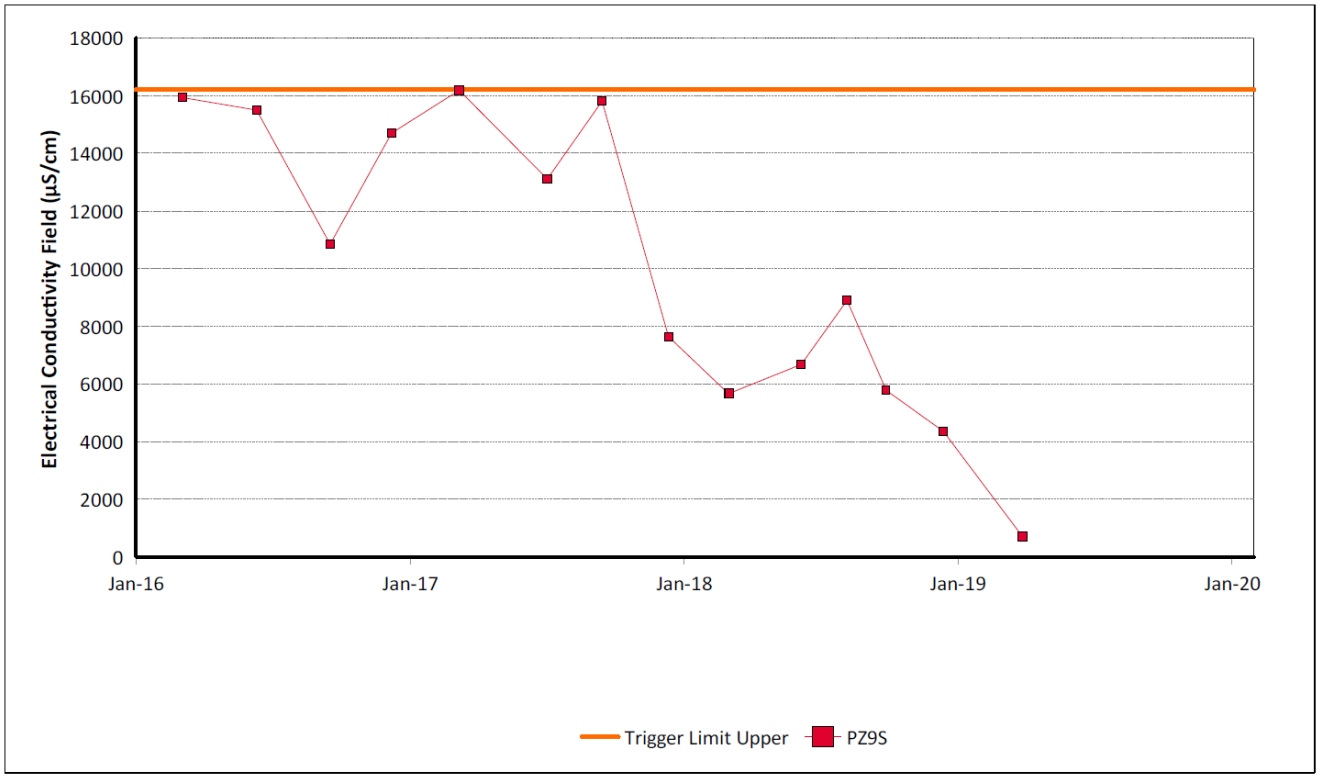
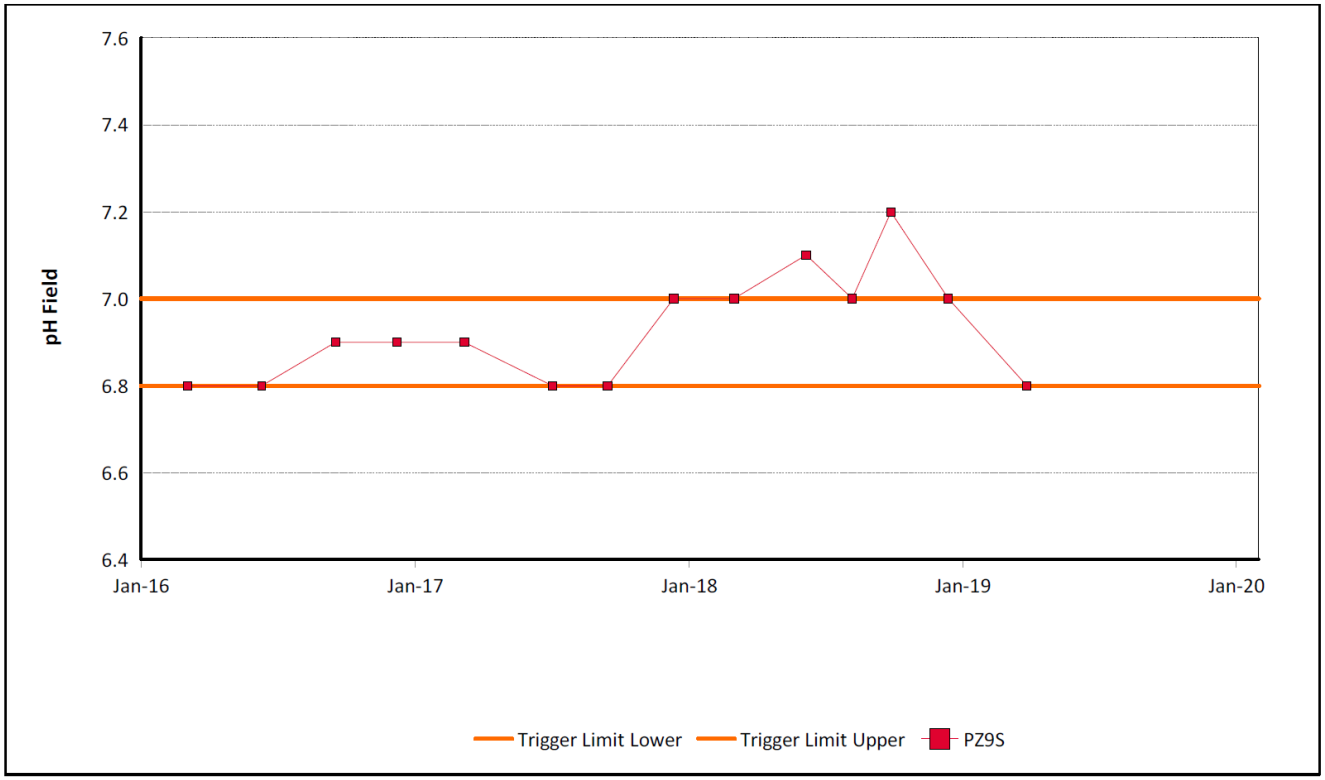


Figure 41: Wollombi Alluvium pH Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 42: Wollombi Alluvium 2 Electrical Conductivity Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 43: Wollombi Alluvium 2 pH Trend – December 2019

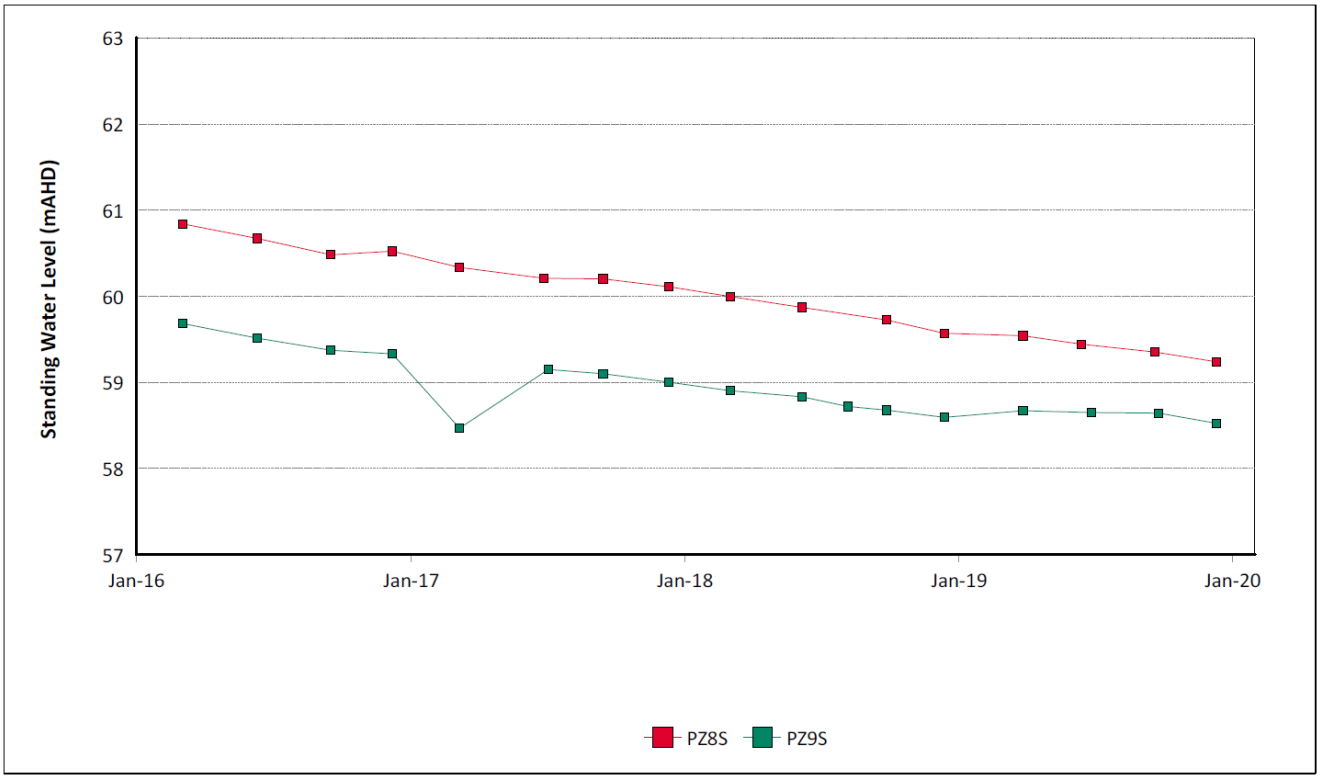


Figure 44: Wollombi Alluvium Standing Water Level Trend – December 2019

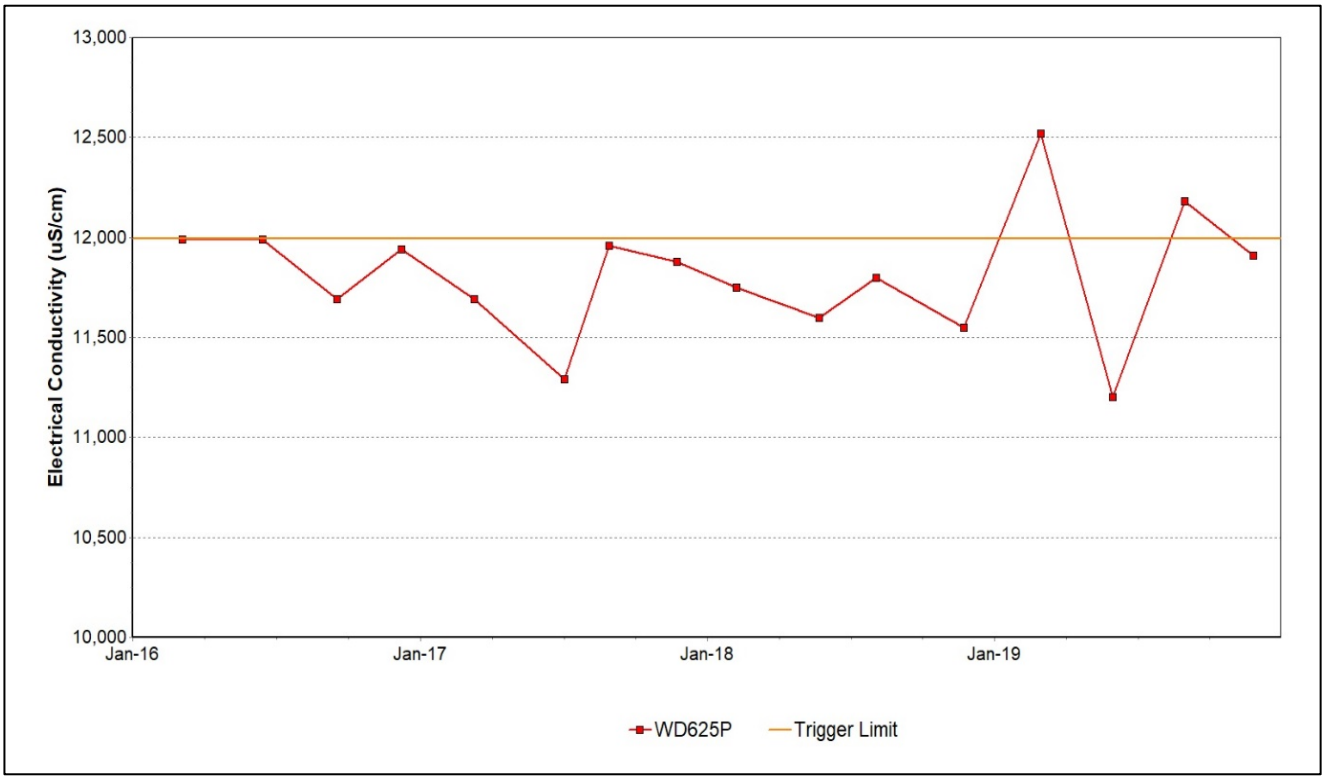


Figure 45: Woodlands Hill Seam Electrical Conductivity Trend - December 2019

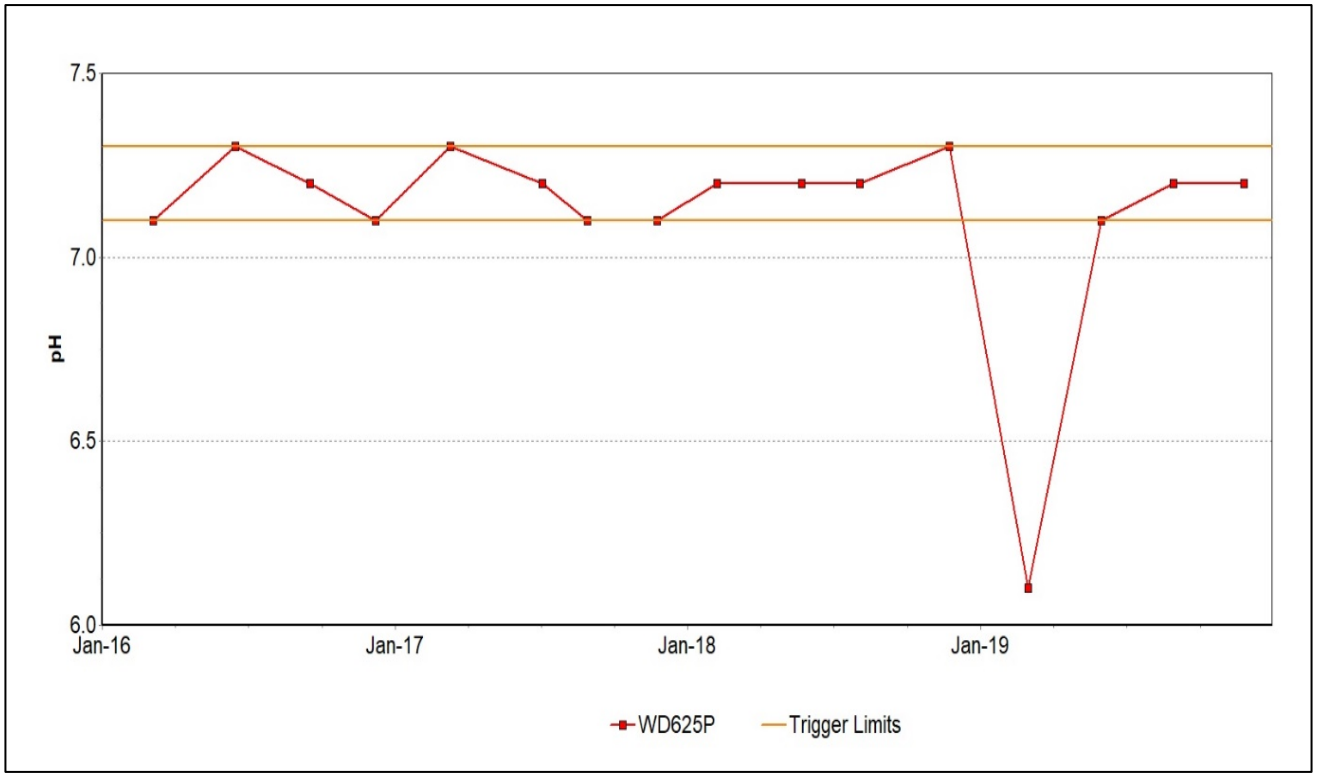


Figure 46: Woodlands Hill Seam pH Trend - December 2019

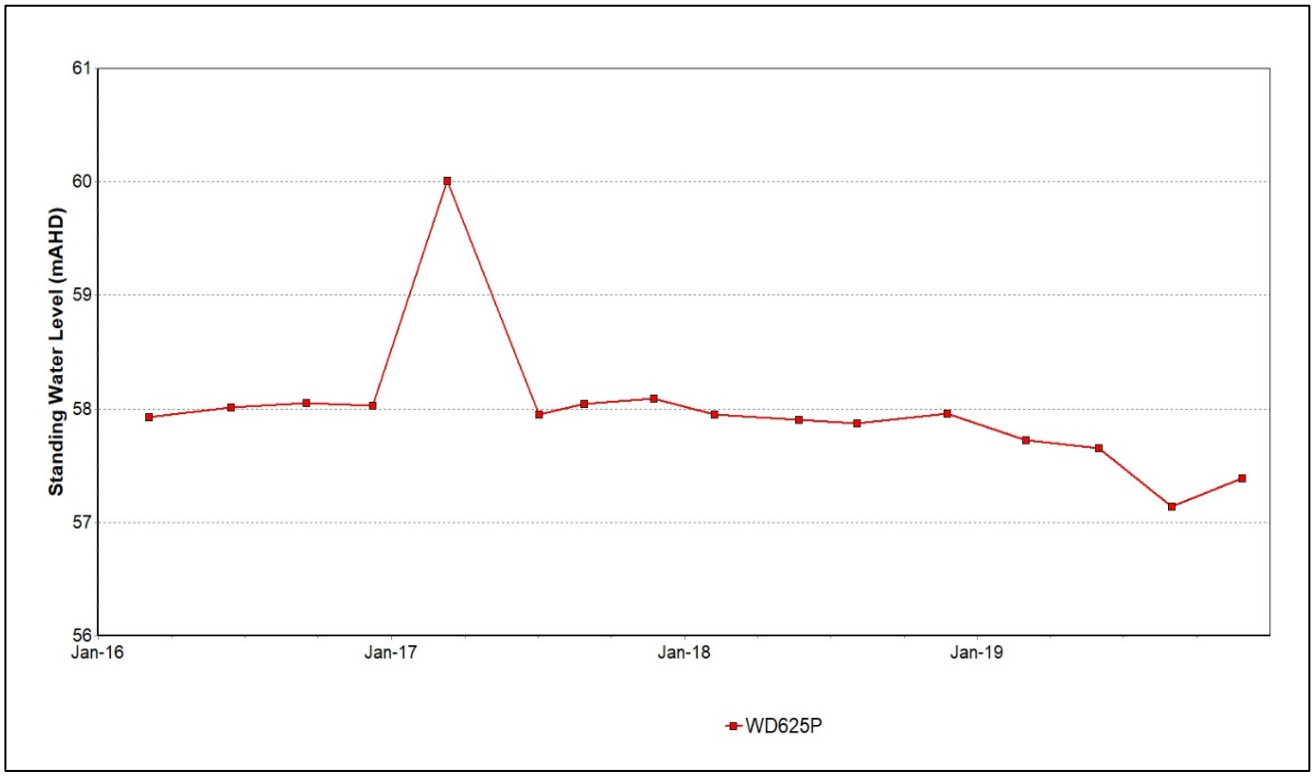


Figure 47: Woodlands Hill Seam Standing Water Level Trend - December 2019

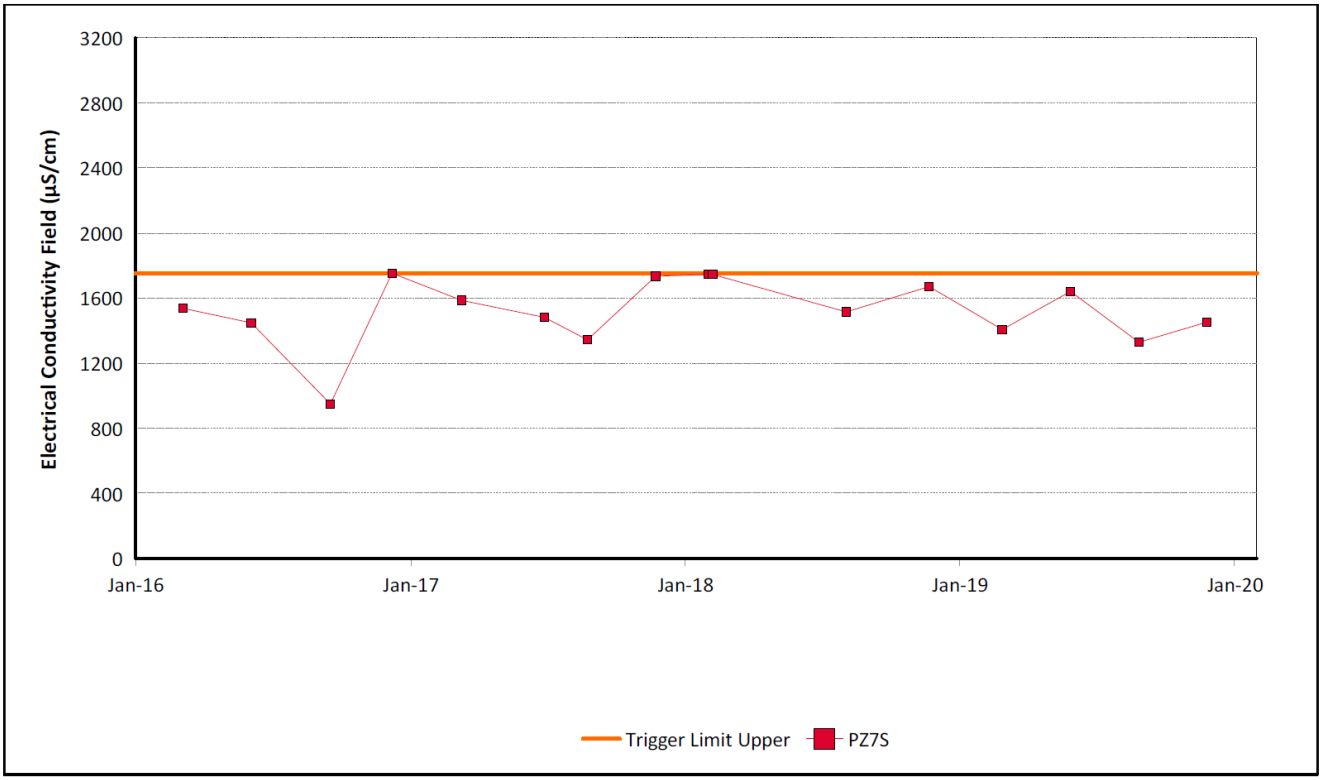


Figure 48: Aeolian Warkworth Sands Electrical Conductivity Trend – December 2019

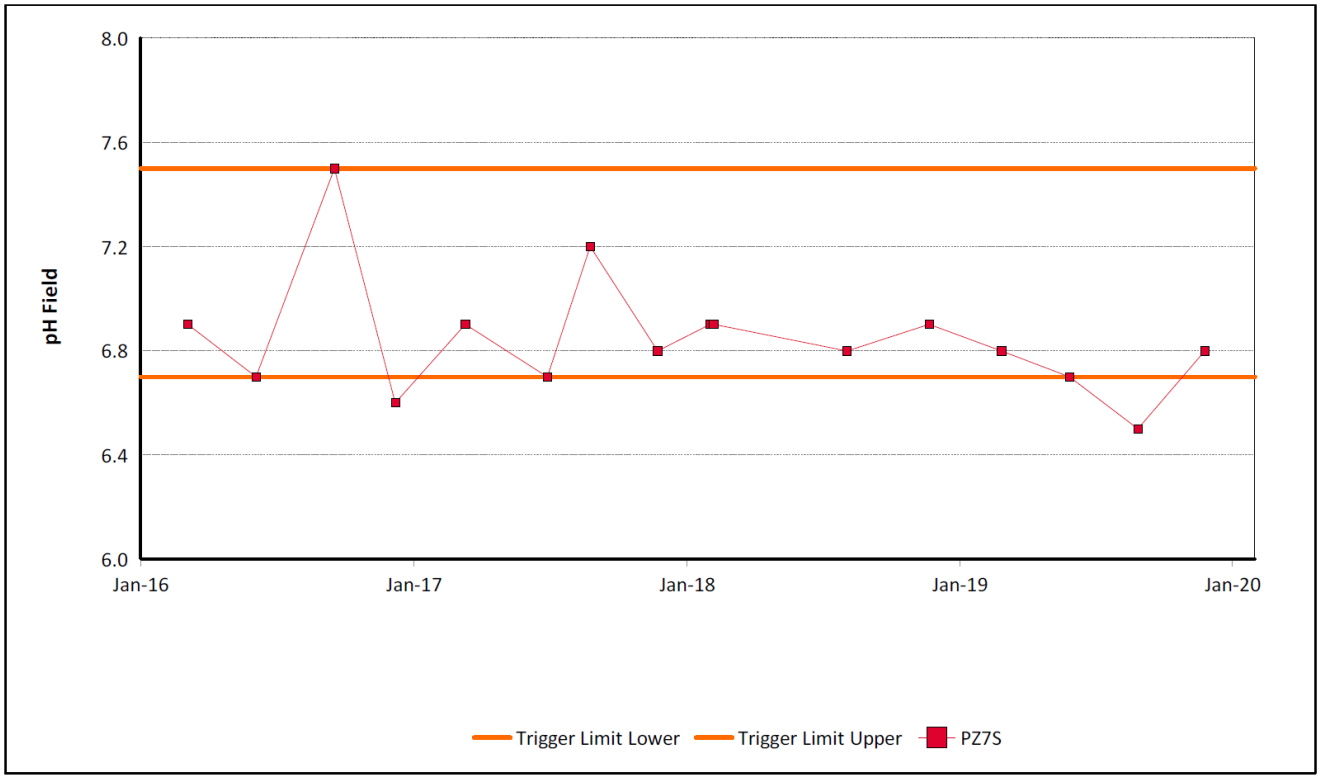


Figure 49: Aeolian Warkworth Sands pH Trend – December 2019

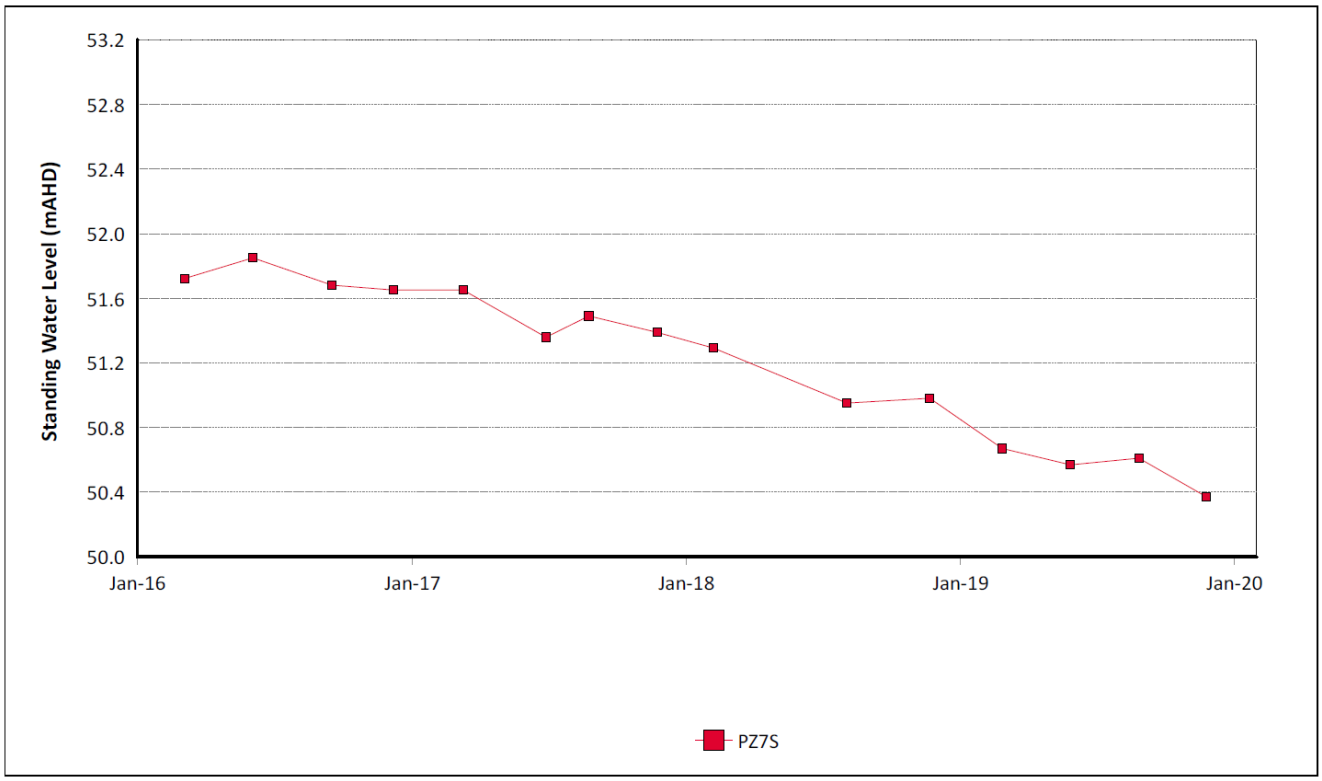


Figure 50: Aeolian Warkworth Sands Standing Water Level Trend – December 2019

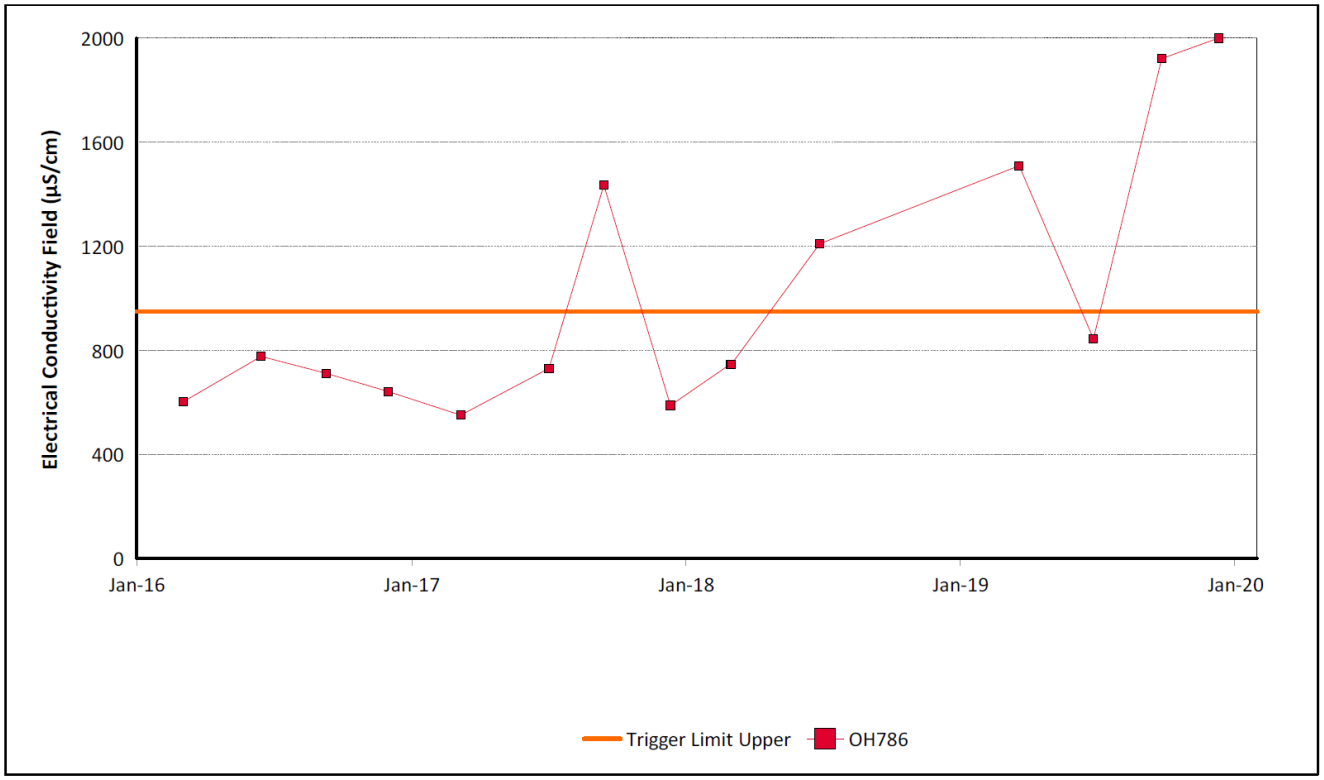


Figure 51: Hunter River Alluvium 1 Electrical Conductivity Trend – December 2019

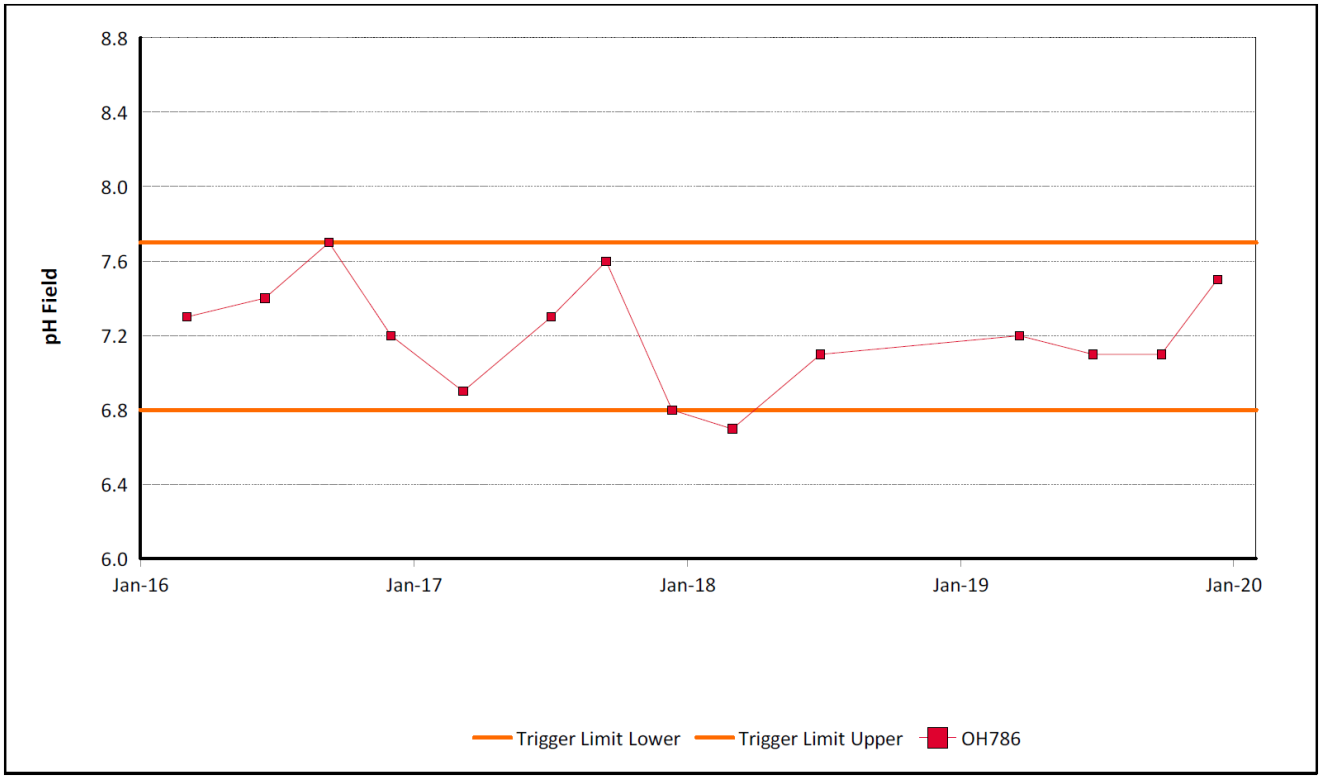


Figure 52: Hunter River Alluvium 1 pH Trend – December 2019

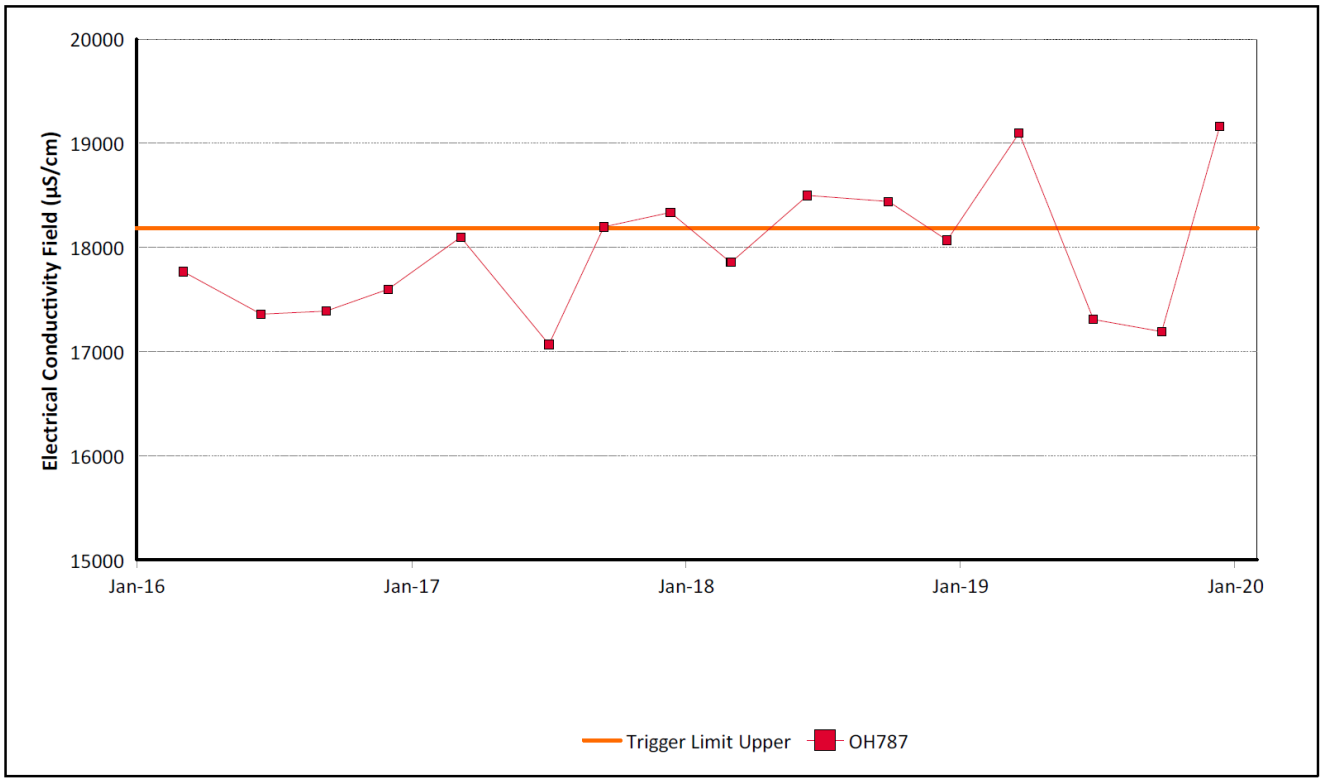


Figure 53: Hunter River Alluvium 2 Electrical Conductivity Trend – December 2019

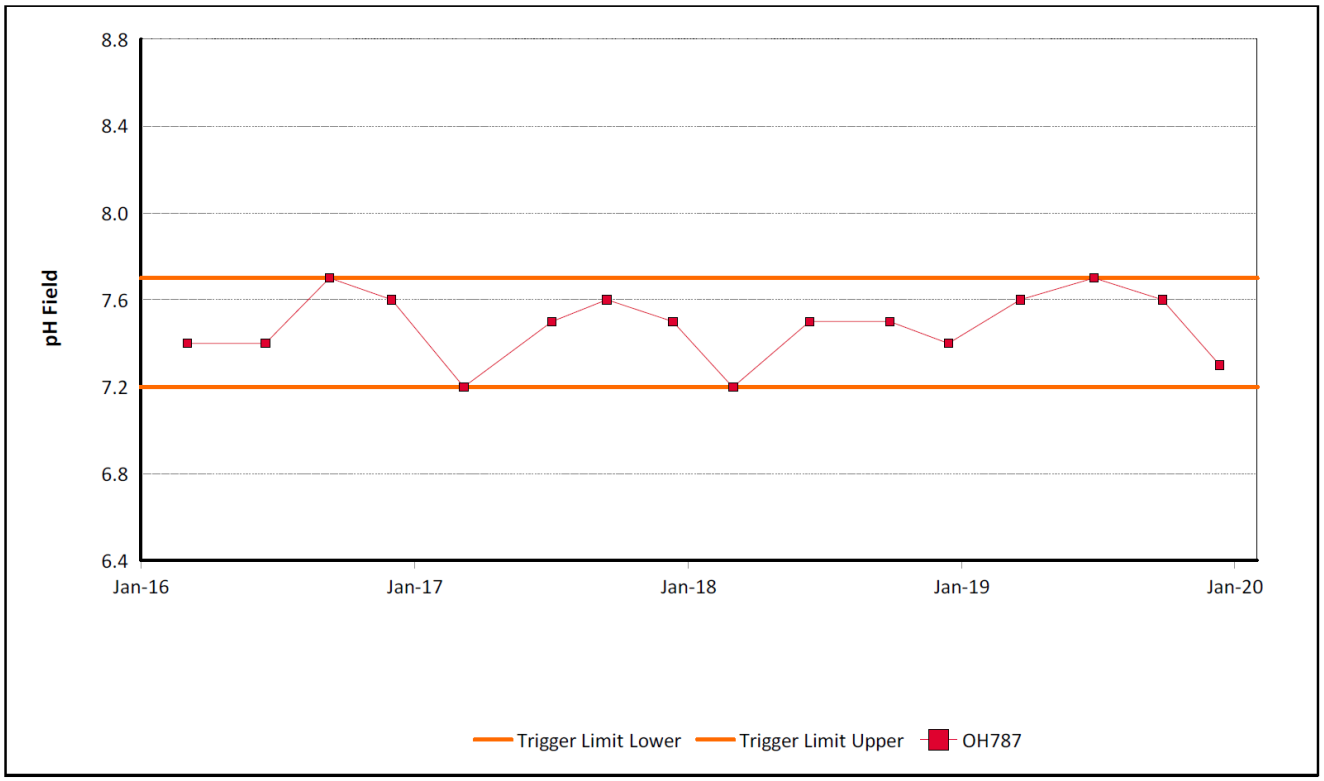


Figure 54: Hunter River Alluvium 2 pH Trend – December 2019

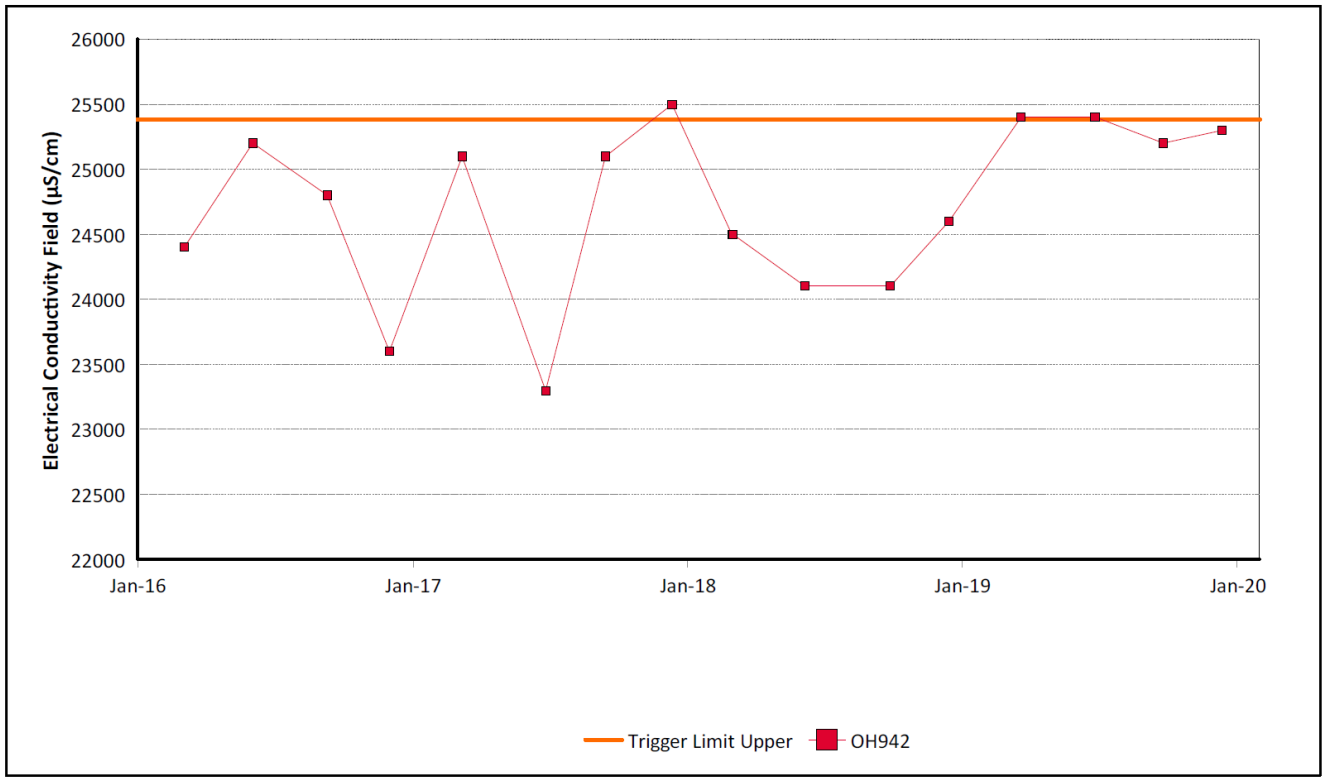


Figure 55: Hunter River Alluvium 3 Electrical Conductivity Trend – December 2019

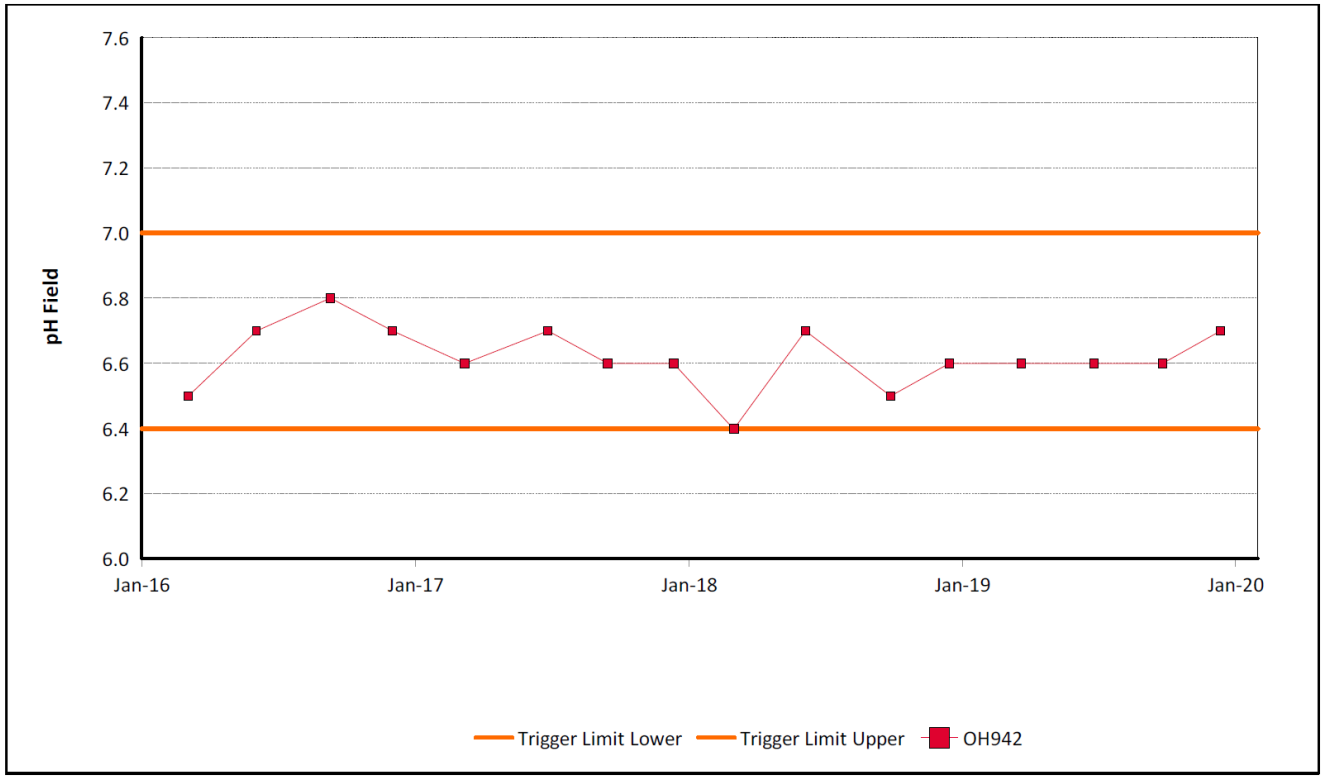
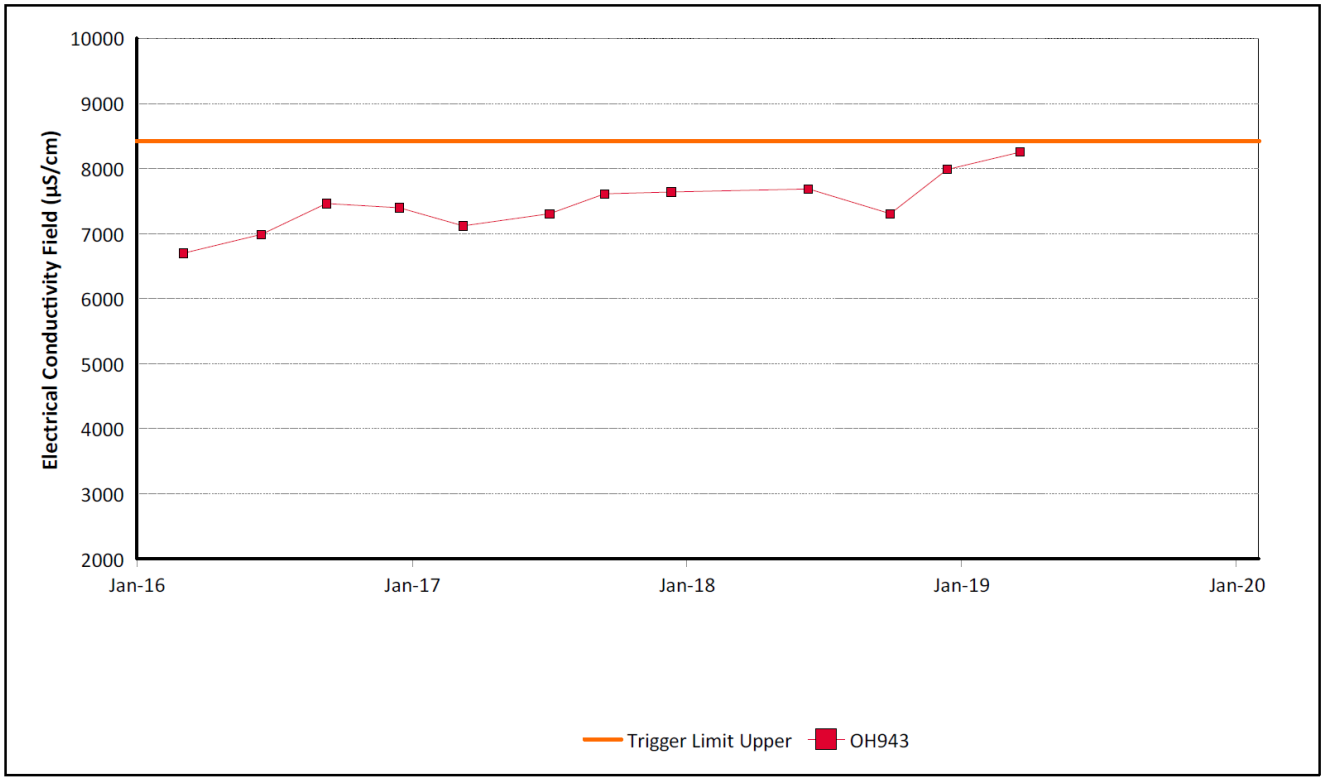
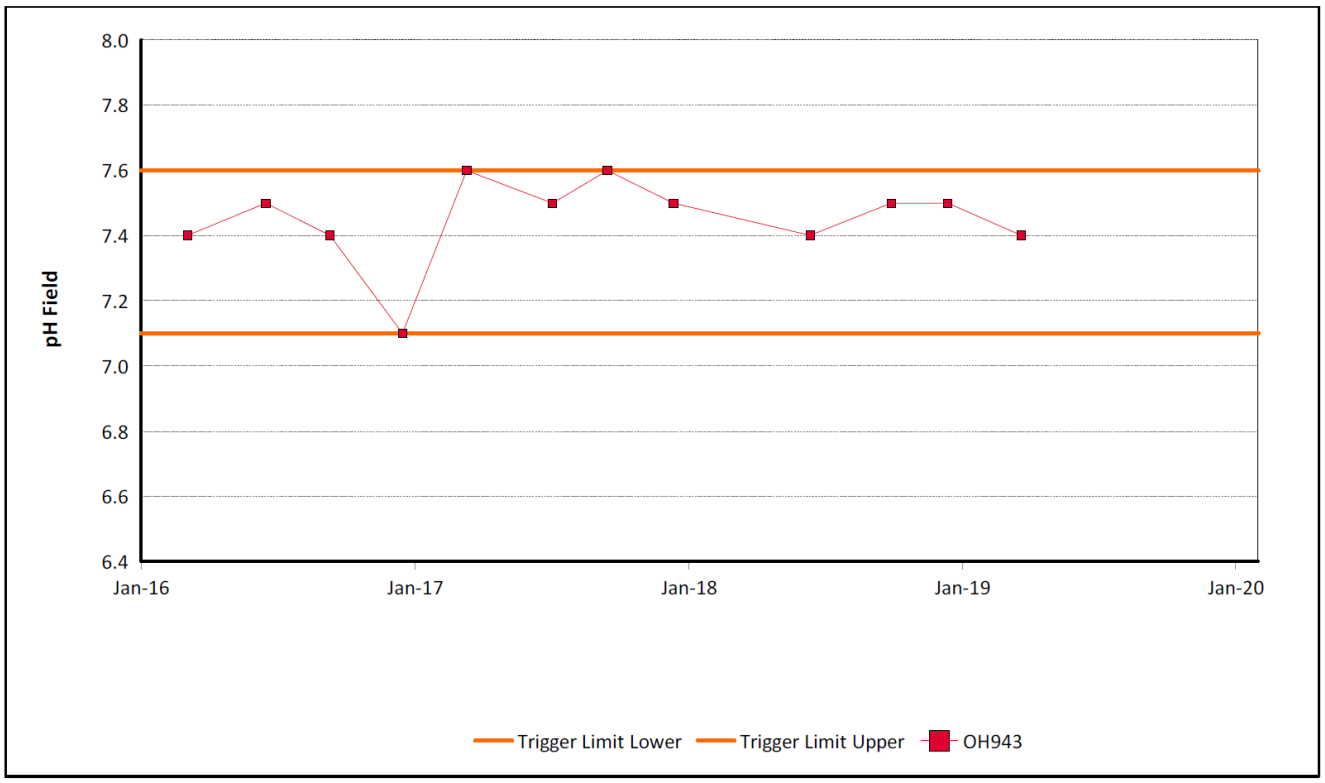


Figure 56: Hunter River Alluvium 3 pH Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 57: Hunter River Alluvium 4 Electrical Conductivity Trend – December 2019



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 58: Hunter River Alluvium 4 pH Trend – December 2019

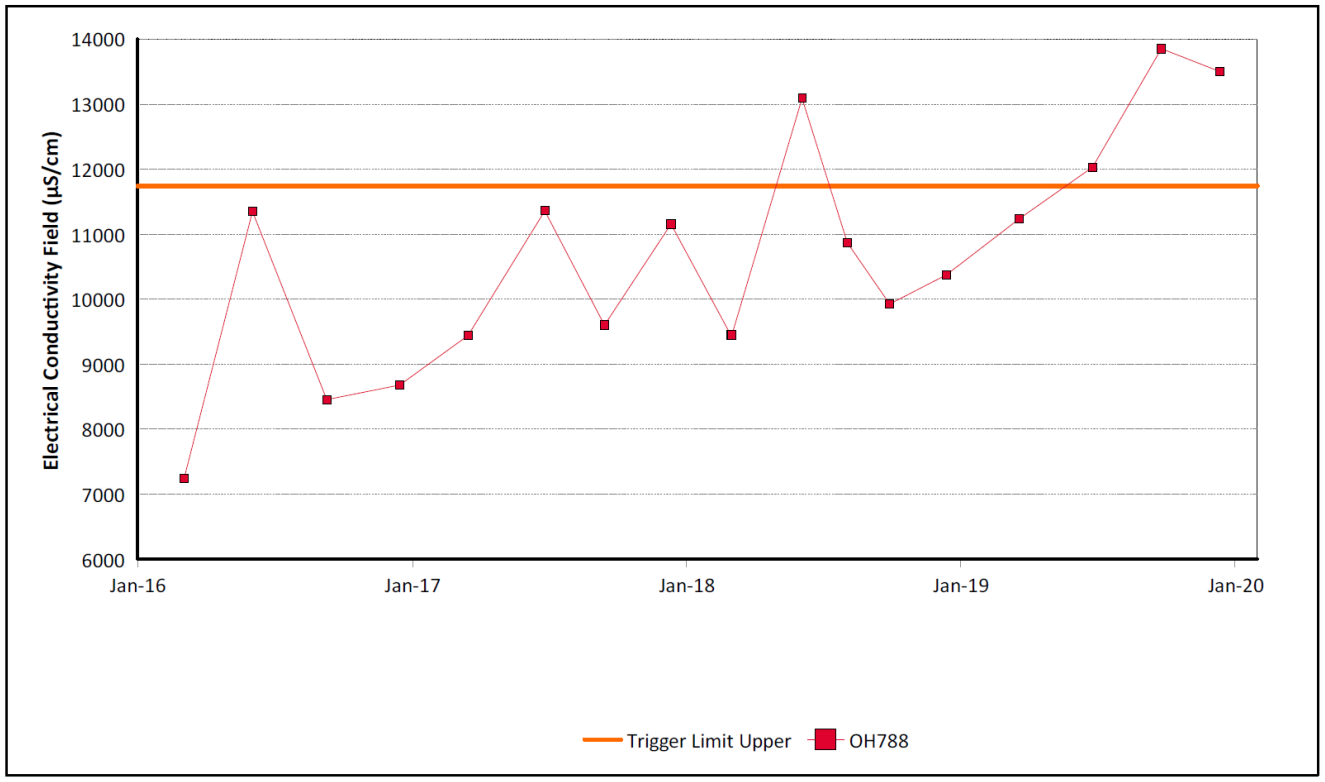


Figure 59: Hunter River Alluvium 5 Electrical Conductivity – December 2019

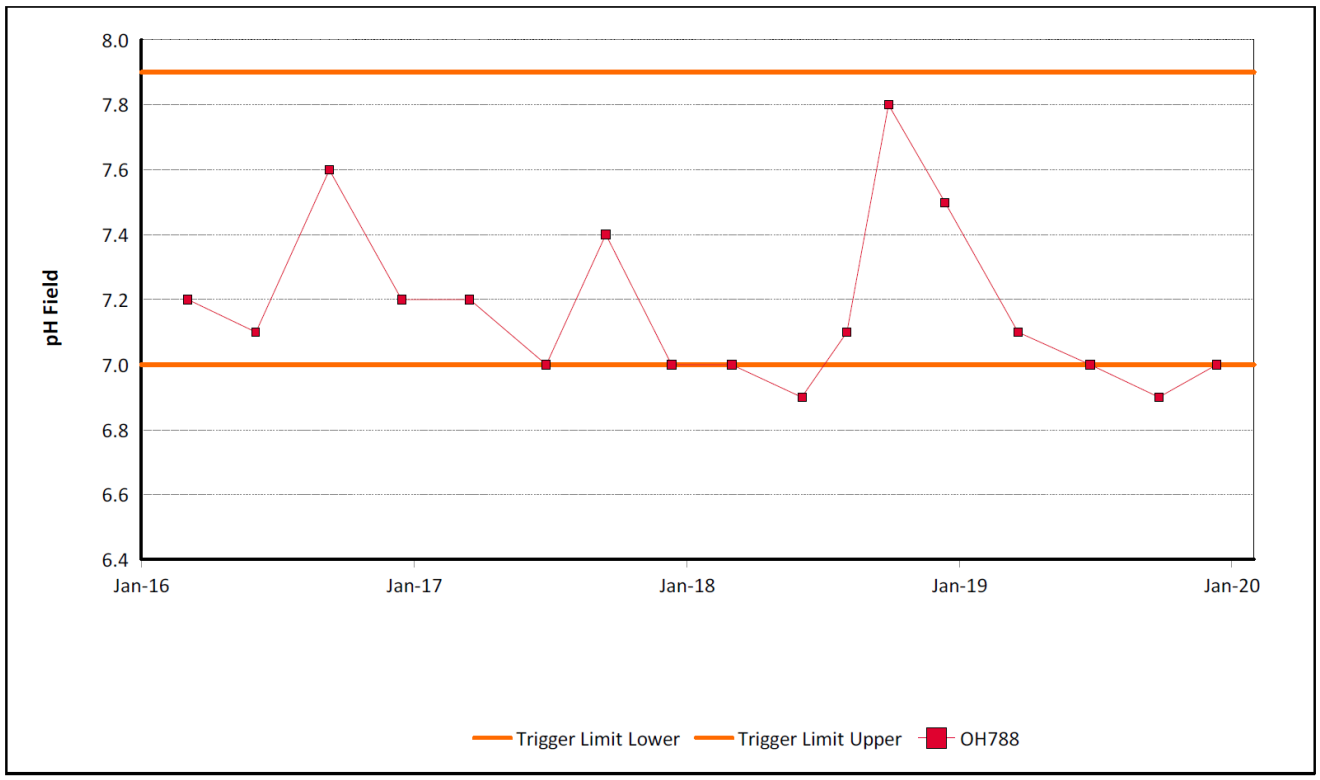


Figure 60: Hunter River Alluvium 5 pH Trend – December 2019

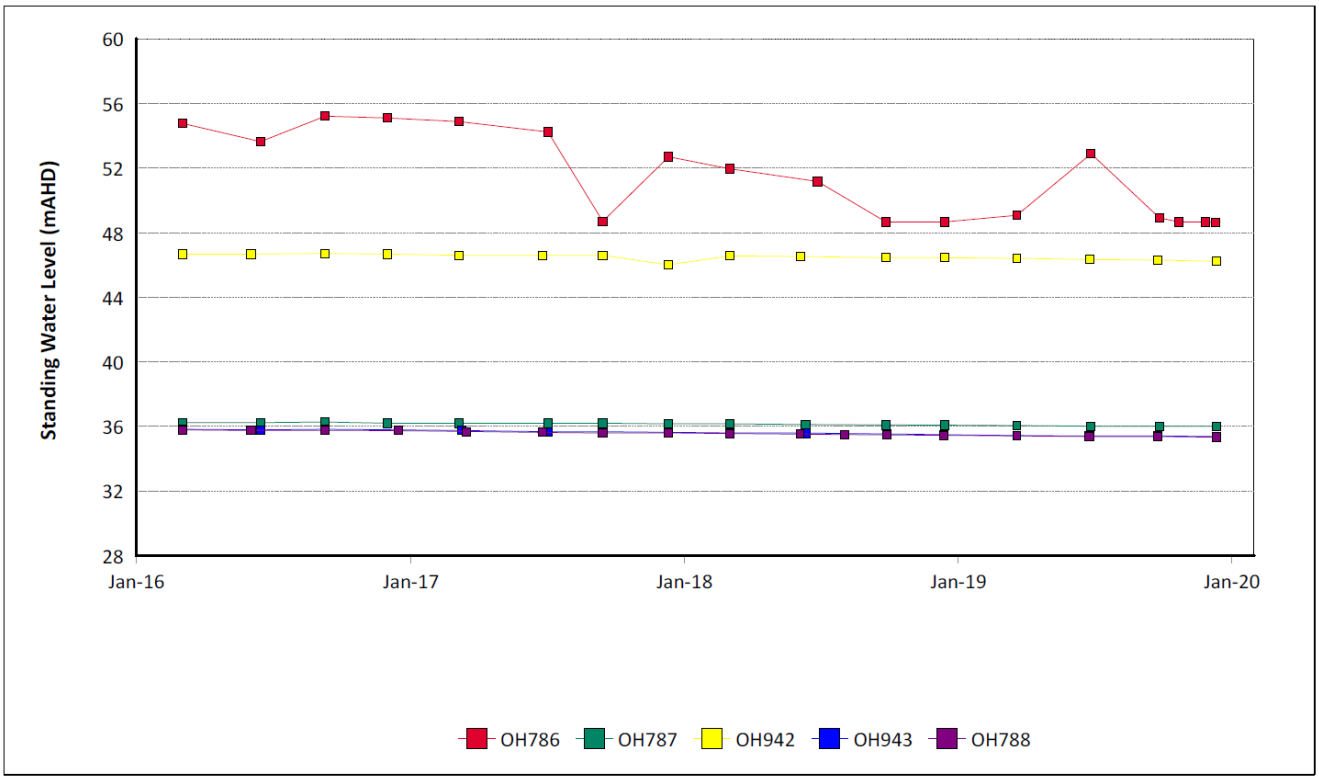


Figure 61: Hunter River Alluvium Standing Water Level Trend – December 2019

3.2.1 Groundwater Trigger Tracking

Internal trigger limits have been developed to assess monitoring data on an on-going basis, and to highlight potentially adverse groundwater impacts. The process for evaluating monitoring results against the internal triggers and subsequent responses are outlined in the MTW Water Management Plan. Locations of groundwater bores are shown in **Figure 62**.

Current internal groundwater trigger limit breaches are summarised in **Table 3**.

Table 3: Groundwater Triggers – 2019

Site	Date	Trigger Limit Breached	Action Taken in Response
WOH2156B	01/03/2019	EC – 95th Percentile	Watching Brief* Note: Insufficient water volume recorded during sampling rounds in June and September 19.
WD625P	01/03/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in May 19 shows values back within trigger limits.
WD625P	30/08/2019	EC – 95th Percentile	Watching Brief*
OH 786	20/03/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in June 19 was within trigger limits.
OH 786	26/09/2019	EC – 95th Percentile	Watching Brief* Note: Elevated EC levels likely to be attributed to prolonged dry climatic conditions. Continue to monitor.
OH 786	10/12/2019	EC – 95th Percentile	Watching Brief*
OH 787	20/03/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in June 19 and September shows values back within trigger limits.
OH 787	12/12/2019	EC – 95th Percentile	Watching Brief*
OH942	20/03/2019	EC – 95th Percentile	Watching Brief*
OH942	26/06/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in September 19 was within trigger limits. No further action required.
OH788	25/06/2019	EC – 95th Percentile	Watching Brief* Note: Elevated EC levels likely to be attributed to prolonged dry climatic conditions. Continue to monitor.
OH788	25/09/2019	EC – 95th Percentile	Watching Brief* Note: Elevated EC levels likely to be attributed to prolonged dry climatic conditions. Continue to monitor.
OH788	12/12/2019	EC – 95th Percentile	Investigation Undertaken. Elevated EC levels likely to be attributed to prolonged dry climatic conditions.
GW9709	21/03/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in June 19 shows values back within trigger limits.
GW9709	27/09/2019	EC – 95th Percentile	Watching Brief* Note: Elevated EC levels likely to be attributed to prolonged dry climatic conditions. Note: Monitoring result unable to be obtained in December 19 due to sample location being dry. Continue to monitor.
MTD605P	25/11/2019	EC – 95th Percentile	Watching Brief*
OH1137	20/03/2019	EC – 95th Percentile	Watching Brief* Note: Insufficient water volume recorded during sampling rounds in June, September and December 19. Continue to monitor.

Site	Date	Trigger Limit Breached	Action Taken in Response
WD622P	29/05/2019	EC – 95th Percentile	Watching Brief*
WD622P	30/08/2019	EC – 95th Percentile	Watching Brief* Note: Bore is located at edge of pre-strip area. Bore likely to influenced by active mining area. Monitoring result obtained in November 19 shows values back within trigger limits.
OH1138(1)	09/04/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in June 19 shows values back within trigger limits.
OH1138(1)	14/05/2019	EC – 95th Percentile	Watching Brief* Note: Monitoring result obtained in June 19 shows values back within trigger limits.
OH788	25/09/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in December 19 shows values back within trigger limits.
PZ8S	10/12/2019	pH – 5th Percentile	Watching Brief*
PZ7S	27/08/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in November 19 shows values back within trigger limits.
GW98MTCL2	09/12/2019	pH – 5th Percentile	Watching Brief*
WOH2139A	22/01/2019	pH – 95th Percentile	Watching Brief*
WOH2139A	08/02/2019	pH – 95th Percentile	Watching Brief*
WOH2139A	21/03/2019	pH – 95th Percentile	Investigation commenced. Note: pH results are dropping and trending back within trigger limits. Continue to watch and monitor trend.
WOH2139A	09/04/2019	pH – 95th Percentile	Under Investigation.
WOH2139A	14/05/2019	pH – 95th Percentile	Under Investigation.
WOH2139A	18/06/2019	pH – 95th Percentile	Investigation undertaken. Note: pH values for WOH2139A considered to be associated with prolonged dry climatic conditions and are consistent with results obtained since 2017 at this location. Continue with increased frequency to confirm observations.
WOH2139A	16/07/2019	pH – 95th Percentile	As above.
WOH2139A	26/08/2019	pH – 95th Percentile	As above.
WOH2139A	26/09/2019	pH – 95th Percentile	As above.
WOH2139A	22/10/2019	pH – 95th Percentile	As above.

Site	Date	Trigger Limit Breached	Action Taken in Response
WOH2139A	26/11/2019	pH – 95th Percentile	As above.
WOH2139A	13/12/2019	pH – 95th Percentile	Increased frequency monitoring has confirmed observations since June 19. The pH values for WOH2139A considered to be associated with prolonged dry climatic conditions and are consistent with results obtained since 2017 at this location. Monitoring to be moved to quarterly.
WOH2153A	26/08/2019	pH – 95th Percentile	Watching Brief*
WOH2153A	26/11/2019	pH – 95th Percentile	Watching Brief*
WOH2154A	01/03/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in May 19 shows values back within trigger limits. No further action required.
MTD616P	27/05/2019	pH – 5th Percentile	Watching Brief*
MTD616P	27/08/2019	pH – 5th Percentile	Watching Brief*
MTD616P	25/11/2019	pH – 5th Percentile	Investigation Undertaken. Historically, fluctuations in pH at this location coincide with changes to the sampling methodology, from quarterly grab sampling to low flow pumping/purging prior to annual comprehensive sampling and analysis. A change to the sampling methodology implemented in 2019 i.e. low flow pumping/purging prior to all sampling and analysis, is considered the cause of the measured drop in pH.
MB15MTW01D	19/02/2019	pH – 5th Percentile	Watching Brief*
MB15MTW01D	27/05/2019	pH – 5th Percentile	Watching Brief*
MB15MTW01D	30/08/2019	pH – 5th Percentile	Investigation undertaken. Note: pH values for MB15MTW01D consistent with prolonged dry weather and are consistent with results obtained over the last 24 months at this location.
MB15MTW01D	27/11/2019	pH – 5th Percentile	Watching Brief* Note: pH values for MB15MTW01D consistent with prolonged dry weather and are consistent with results obtained over the last 24 months at this location.
WD622P	19/02/2019	pH – 95th Percentile	Watching Brief*
WD622P	29/05/2019	pH – 5th Percentile	Watching Brief*
WD622P	30/08/2019	pH – 5th Percentile	Investigation undertaken. Note: Fluctuating pH is considered to be attributable to coal seam depressurisation, as evidenced by historical trending of falling water level. This trend is consistent with the effects of nearby mining. Fluctuations also coincide with changes to the sampling methodology, from quarterly grab sampling to low flow pumping/purging prior to annual comprehensive sampling and analysis.

Site	Date	Trigger Limit Breached	Action Taken in Response
WOH2154B	01/03/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in May 19 shows values back within trigger limits. No further action required.
WOH2155B	26/02/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in May 19 shows values back within trigger limits. No further action required.
WD625P	01/03/2019	pH – 5th Percentile	Watching Brief* Note: This anomalous result is considered likely due to an incorrect recording of the field result.
WD625P	31/05/2019	pH – 5th Percentile	Watching Brief* Note: Monitoring result obtained in May 19 shows values back within trigger limits. No further action required.
OH 1138(1)	22/01/2019	pH – 5th Percentile	Watching Brief* Continue to monitor on increased frequency.
OH 1138(1)	08/02/2019	pH – 5th Percentile	Watching Brief* Continue to monitor on increased frequency.
OH 1138(1)	08/03/2019	pH – 5th Percentile	Investigation commenced. Continue to monitor on increased frequency.
OH 1138(1)	09/04/2019	pH – 5th Percentile	Under Investigation
OH 1138(1)	14/05/2019	pH – 5th Percentile	Under Investigation
OH 1138(1)	27/06/2019	pH – 5th Percentile	Investigation undertaken. Note: pH values consistent with results obtained at this location since 2017, trending up towards trigger limit in recent months. Continue to monitor on increased frequency.
OH 1138(1)	16/07/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017, trending up towards trigger limit in recent months. Continue to monitor on increased frequency.
OH 1138(1)	20/08/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017, trending up towards trigger limit in recent months. Continue to monitor on increased frequency.
OH 1138(1)	26/09/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017, trending up towards trigger limit in recent months. Continue to monitor on increased frequency.
OH 1138(1)	22/10/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017. Continue to monitor on increased frequency.
OH 1138(1)	27/11/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017. Continue to monitor on increased frequency.
OH 1138(1)	13/12/2019	pH – 5th Percentile	Watching Brief* Note: pH values consistent with results obtained at this location since 2017. Continue to monitor on increased frequency.
* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.			

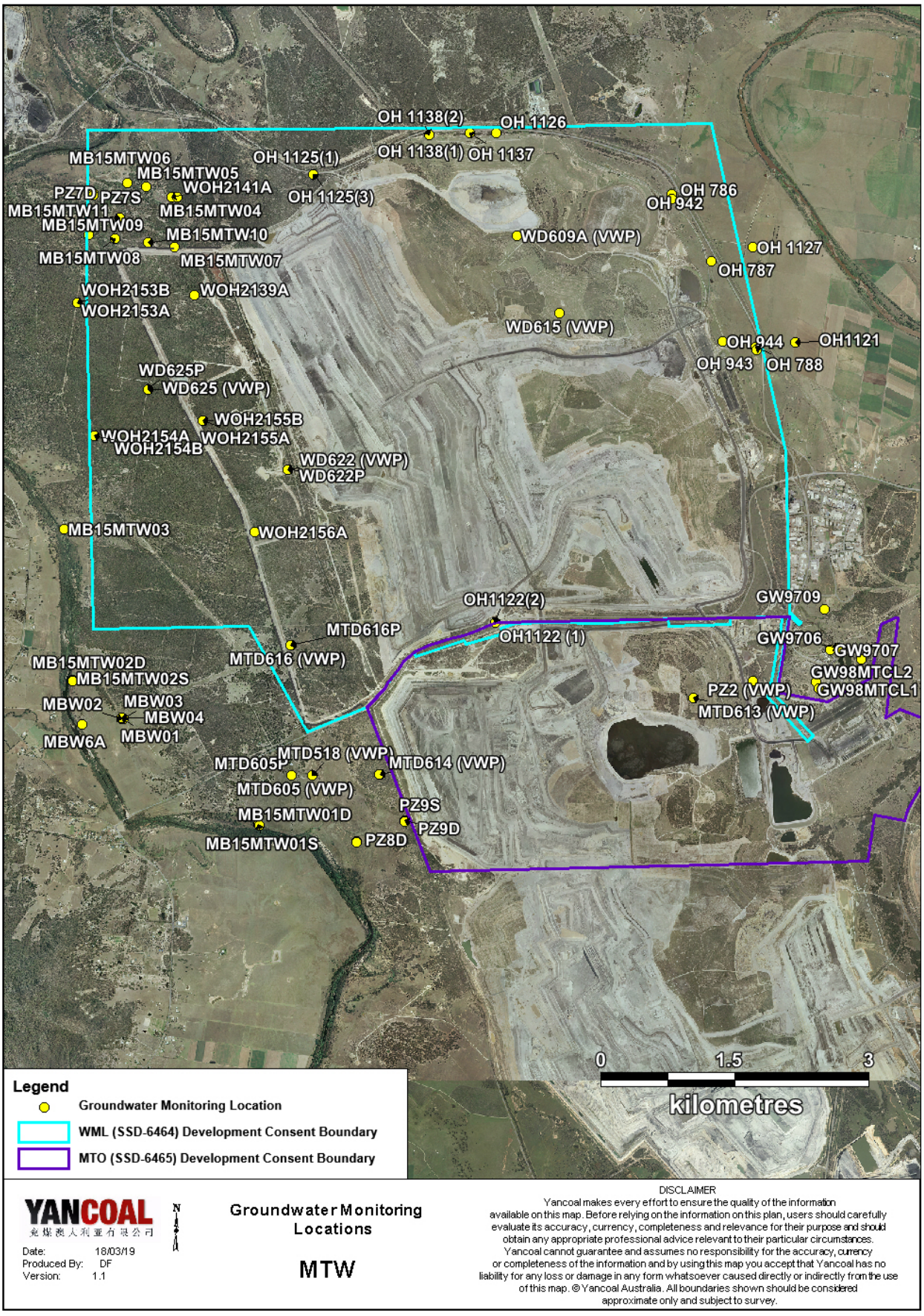


Figure 62: Groundwater Monitoring Location Plan

4.0 BLAST MONITORING

MTW have a network of six blast monitoring units. These are located at nearby privately-owned residences and function as regulatory compliance monitors.

The location of these monitors can be found in **Figure 69**.

4.1 Blast Monitoring Results

During December 2019, 18 blasts were initiated at MTW. **Figure 63** to **Figure 68** show the blast monitoring results for the reporting period against the impact assessment criteria. The criteria are summarised in **Table 4**.

Table 4: Blasting Limits

Airblast Overpressure (dB(L))	Comments
115	5% of the total number of blasts in a 12-month period
120	0%
Ground Vibration (mm/s)	**Comments**
5	5% of the total number of blasts in a 12-month period
10	0%

During the reporting period one blast exceeded the 5 mm/s threshold for ground vibration at the Wollemi Peak Road blast monitor on 10 December at 14:09. No blast exceeded the 115 dB(L) criteria for airblast overpressure.

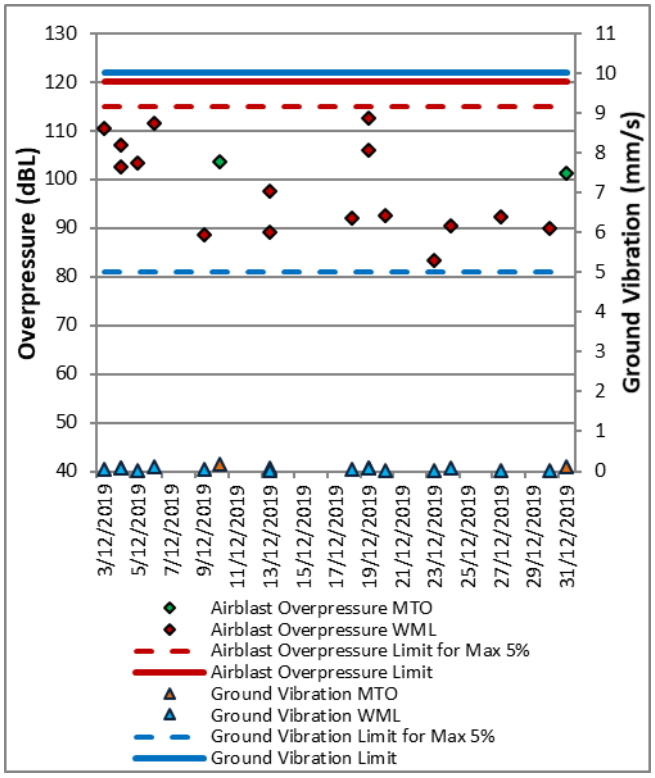


Figure 63: Abbey Green Blast Monitoring Results – December 2019

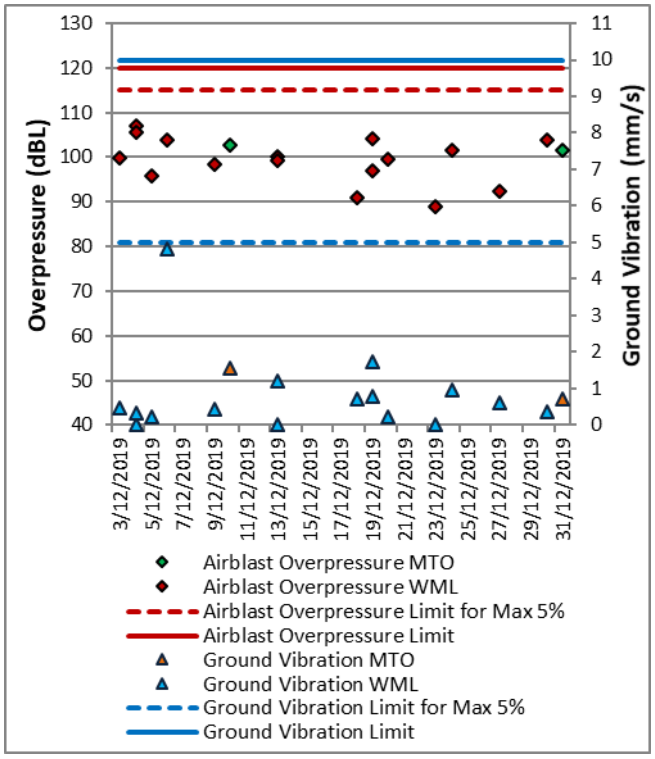


Figure 64: Bulga Village Blast Monitoring Results – December 2019

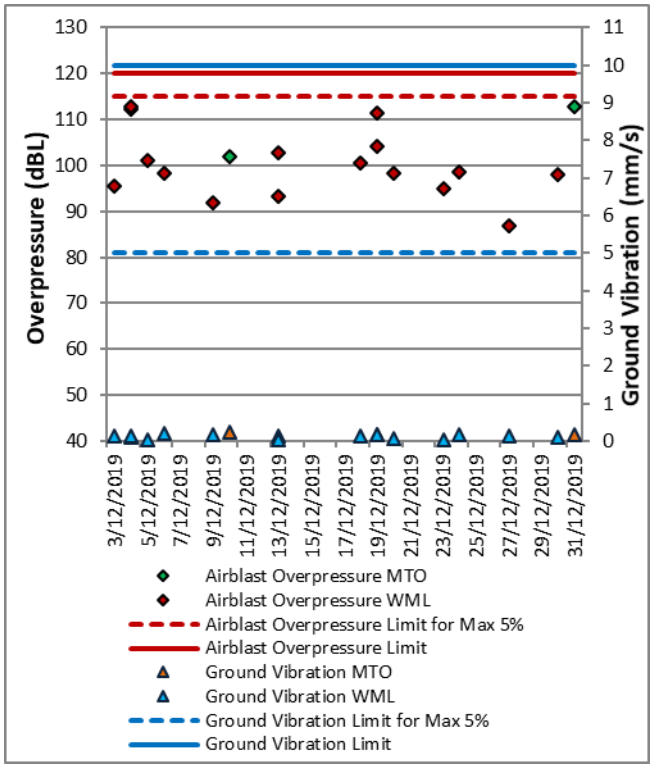


Figure 65: MTIE Blast Monitoring Results – December 2019

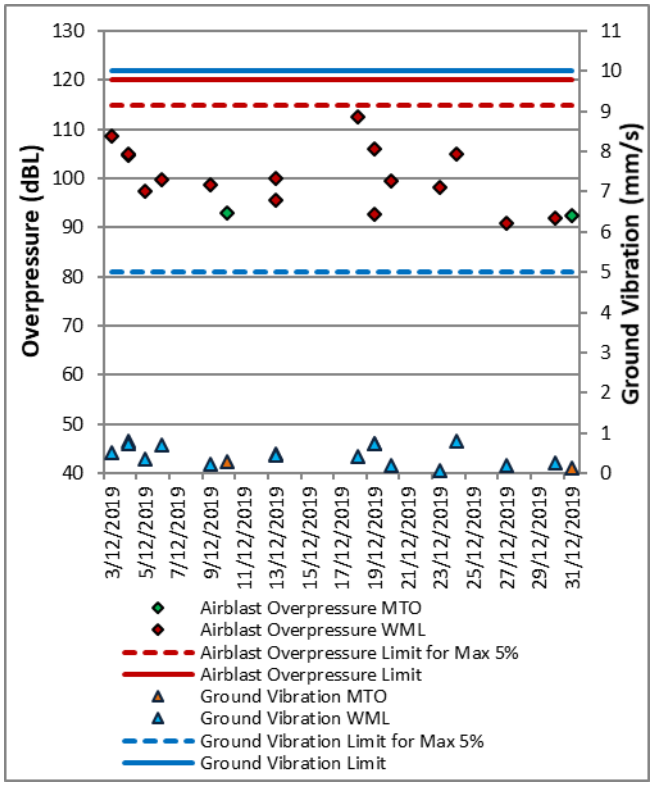


Figure 66: Warkworth Blast Monitoring Results - December 2019

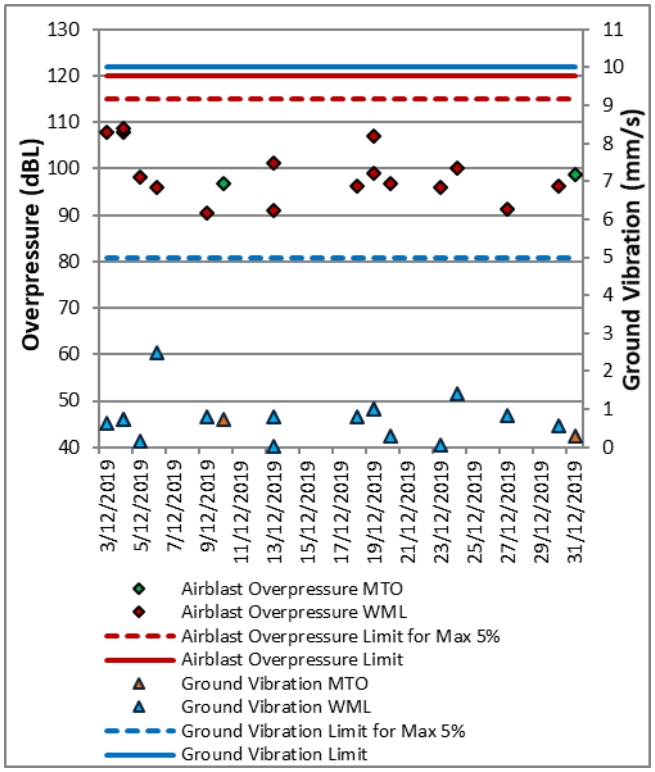


Figure 67: Wambo Road Blast Monitoring Results – December 2019

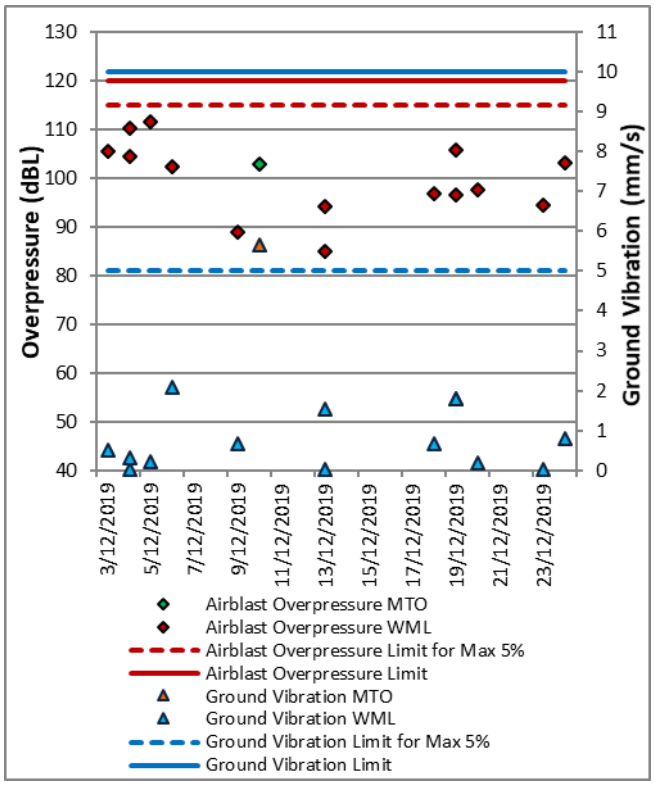


Figure 68: Wollemi Peak Road Blast Monitoring Results - December 2019

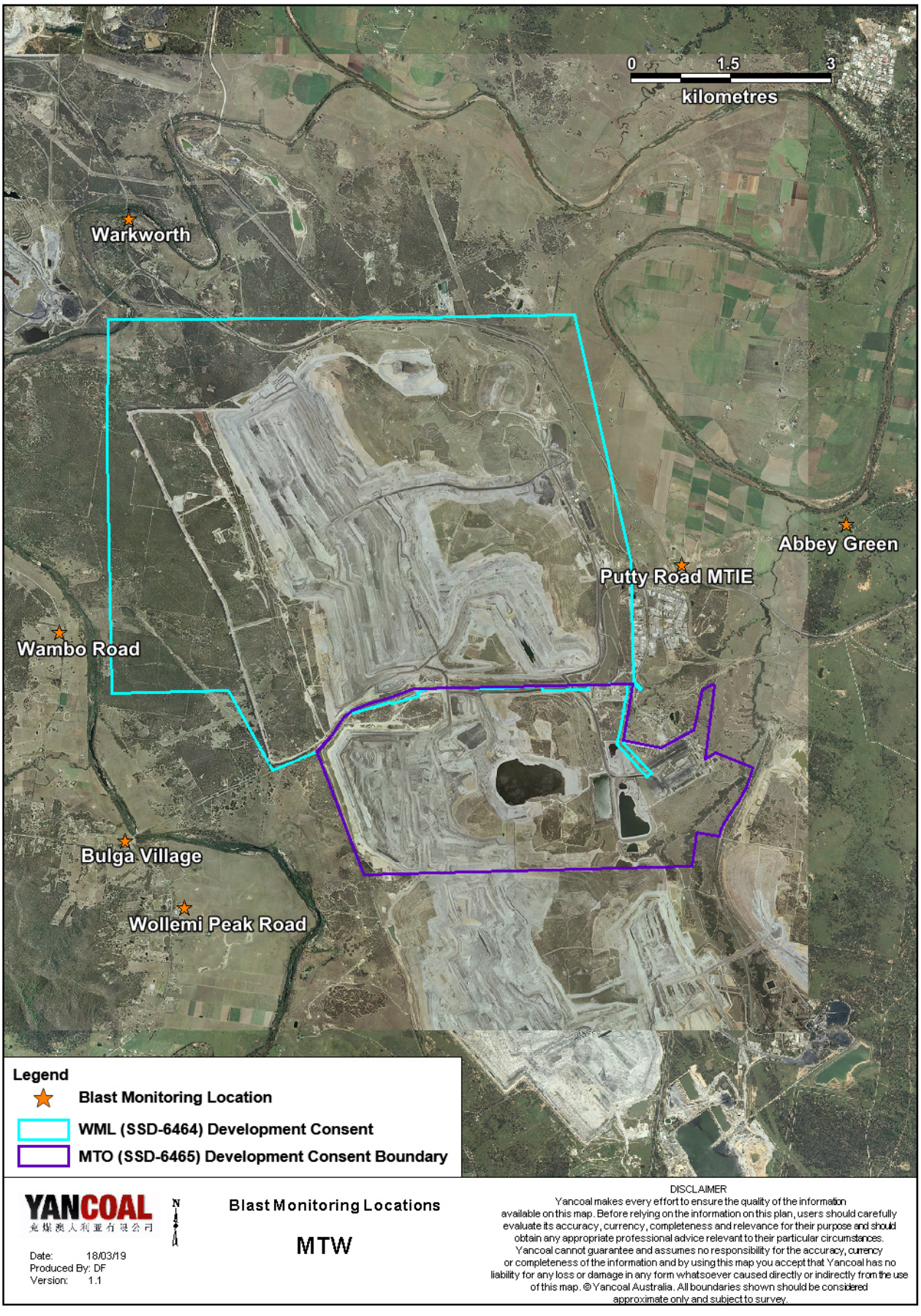


Figure 69: Blast and Vibration Monitoring Location Plan

5.0 NOISE

Routine attended noise monitoring is carried out in accordance with the MTW Noise Management Plan. A review against EIS predictions will be reported in the Annual Review Report. The purpose of the noise surveys is to quantify and describe the acoustic environment around the site and compare results with specified limits. Unattended monitoring (real time noise monitoring) also occurs at five sites surrounding MTW. The attended noise monitoring locations are displayed in **Figure 70.**

5.1 Attended Noise Monitoring Results

Attended monitoring was conducted at receiver locations surrounding MTW on the night of 5 December 2019. All measurements complied with the relevant criteria. Results are detailed in **Table 5** to **Table 8**.

5.1.1 WML Noise Assessment

Compliance assessments undertaken against the WML noise criteria are presented in **Table 5** and **Table 6**.

Table 5: $L_{Aeq,\ 15\ minute}$ Warkworth Impact Assessment Criteria – December 2019

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion (dB(A))	Criterion Applies?[1]	WML L_{Aeq} dB[2,3]	Exceedance[3,4]
Bulga RFS	5/12/2019 23:00	3.0	D	37	Yes	IA	Nil
Bulga Village	5/12/2019 23:18	3.2	D	38	No	IA	NA
Gouldsville	5/12/2019 21:22	2.8	D	38	Yes	30	Nil
Inlet Rd	5/12/2019 21:25	3	D	37	Yes	IA	Nil
Inlet Rd West	5/12/2019 21:00	3.1	D	35	No	IA	NA
Long Point	5/12/2019 21:00	3.1	D	35	No	IA	NA
South Bulga	5/12/2019 23:53	3	D	35	Yes	IA	Nil
Wambo Road	5/12/2019 21:53	2.6	D	38	Yes	IA	Nil

Notes:
1. Noise emission limits apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Estimated or measured LAeq,15minute attributed to WML;
3. Bold results in red are possible exceedances of relevant criteria;
4. NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not Applicable.

Table 6: $L_{A1,\ 1\ minute}$ Warkworth Impact Assessment Criteria – December 2019

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion (dB(A))	Criterion Applies?[1]	WML L_{Aeq} dB[2,3]	Exceedance[3,4]
Bulga RFS	5/12/2019 23:00	3.0	D	47	Yes	IA	Nil
Bulga Village	5/12/2019 23:18	3.2	D	48	No	IA	NA
Gouldsville	5/12/2019 21:22	2.8	D	48	Yes	33	Nil
Inlet Rd	5/12/2019 21:25	3	D	47	Yes	IA	Nil
Inlet Rd West	5/12/2019 21:00	3.1	D	45	No	IA	NA
Long Point	5/12/2019 21:00	3.1	D	45	No	IA	NA
South Bulga	5/12/2019 23:53	3	D	45	Yes	IA	Nil
Wambo Road	5/12/2019 21:53	2.6	D	48	Yes	IA	Nil

Notes:
1. Noise emission limits apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Estimated or measured LA1,1minute attributed to WML;
3. Bold results in red are possible exceedances of relevant criteria;
4. NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not Applicable.

5.1.2 MTO Noise Assessment

Compliance assessments undertaken against the MTO noise criteria are presented in **Table 7** and **Table 8**.

Table 7: $L_{Aeq, 15minute}$ Mount Thorley Operations - Impact Assessment Criteria – December 2019

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion dB	Criterion Applies?[1]	MTO L_{Aeq} dB[2,3]	Exceedance[3,4]
Bulga RFS	5/12/2019 23:00	3.0	D	37	Yes	IA	Nil
Bulga Village	5/12/2019 23:18	3.2	D	38	No	IA	NA
Gouldsville	5/12/2019 21:22	2.8	D	35	Yes	IA	Nil
Inlet Rd	5/12/2019 21:25	3	D	37	Yes	IA	Nil
Inlet Rd West	5/12/2019 21:00	3.1	D	35	No	IA	NA
Long Point	5/12/2019 21:00	3.1	D	35	No	IA	NA
South Bulga	5/12/2019 23:53	3	D	36	Yes	IA	Nil
Wambo Road	5/12/2019 21:53	2.6	D	38	Yes	IA	Nil

Notes:
1. Noise emission limits apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Estimated or measured LAeq,15minute attributed to MTO;
3. Bold results in red are possible exceedances of relevant criteria;
4. NA in exceedance column means atmospheric conditions outside conditions specified in project approval and so criterion is not applicable.

Table 8: $L_{A1, 1Minute}$ Mount Thorley Operations - Impact Assessment Criteria – December 2019

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion dB	Criterion Applies?[1]	MTO $L_{A1, 1min}$ dB[2,3]	Exceedance[3,4]
Bulga RFS	5/12/2019 23:00	3.0	D	47	Yes	IA	Nil
Bulga Village	5/12/2019 23:18	3.2	D	48	No	IA	NA
Gouldsville	5/12/2019 21:22	2.8	D	45	Yes	IA	Nil
Inlet Rd	5/12/2019 21:25	3	D	47	Yes	IA	Nil
Inlet Rd West	5/12/2019 21:00	3.1	D	45	No	IA	NA
Long Point	5/12/2019 21:00	3.1	D	45	No	IA	NA
South Bulga	5/12/2019 23:53	3	D	46	Yes	IA	Nil
Wambo Road	5/12/2019 21:53	2.6	D	48	Yes	IA	Nil

Notes:
1. Noise emission limits apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Estimated or measured LAeq,15minute attributed to MTO;
3. Bold results in red are possible exceedances of relevant criteria;
4. NA in exceedance column means atmospheric conditions outside conditions specified in project approval and so criterion is not applicable.

5.1.3 Low Frequency Assessment

In accordance with the requirements of the EPA's Noise Policy for Industry (NPfI), the applicability of the low frequency modification penalty has been assessed. There were no noise measurements taken during the reporting period which required the penalty to be applied. The assessment for low frequency noise is shown in **Table 9**.

Table 9: Low Frequency Noise Assessment – December 2019

Location	Date and Time	Measured Site Only LA_{eq} dB (WML/MTO)	Site Only LC_{eq} dB[1] (WML/MTO)	Site Only LC_{eq}-LA_{eq} dB [1,3] (WML/MTO)	Result Max exceedance of ref spectrum dB[1,3] (WML/MTO)	Penalty dB[1] (WML/MTO)	Exceedance
Bulga RFS	5/12/2019 23:00	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Bulga Village	5/12/2019 23:18	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Gouldsville	5/12/2019 21:22	30/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Inlet Rd	5/12/2019 21:25	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Inlet Rd West	5/12/2019 21:00	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Long Point	5/12/2019 21:00	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
South Bulga	5/12/2019 23:53	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA
Wambo Road	5/12/2019 21:53	IA/IA	NA/NA	NA/NA	NA/NA	NA/NA	NA

Notes:

1. Where it is not possible to determine the site-only result due to the presence of other low-frequency noise sources occurring during the measurement, or where criteria were not applicable due to meteorological conditions, or where site-only contributions were more than 5 dB less than the relevant LAeq criterion this is noted as NA (not available) and no further assessment has been undertaken;

2. As per NPfI, if LCeq −LAeq ≥ 15 dB further assessment of low-frequency noise required as detailed in Sections 2.4 and 3.3 of this report;

3. As per NPfI, compare measured spectrum against reference spectrum to determine if the low-frequency modifying factor is triggered and application of penalty is required.

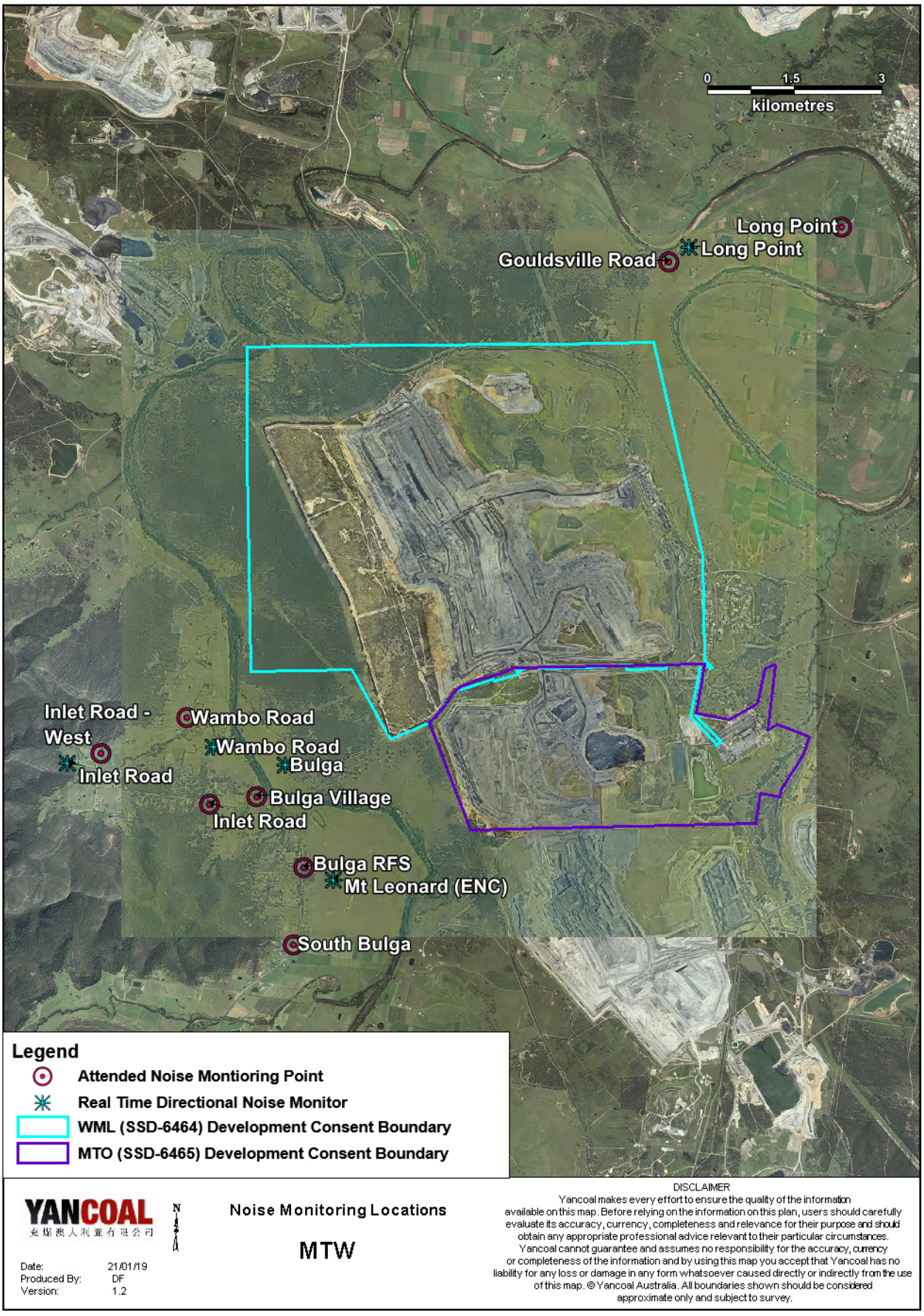


Figure 70: Noise Monitoring Location Plan

5.2 Noise Management Measures

A program of targeted supplementary attended noise monitoring is in place at MTW, supported by the real-time directional monitoring network and ensuring the highest level of noise management is maintained. The supplementary program is undertaken by MTW personnel and involves:

- Routine inspections from both inside and outside the mine boundary;
- Routine and as-required handheld noise assessments (undertaken in response to noise alarm and/or community complaint), comparing measured levels against consent noise limits; and
- Validation monitoring following operational modifications to assess the adequacy of the modifications.

Where a noise assessment identifies noise emissions which are exceeding the relevant noise limit(s) for any particular residence, modifications will be made so as to ensure that the noise event is resolved within 75 minutes of identification. The actions taken are commensurate with the nature and severity of the noise event, but can include:

- Changing the haul route to a less noise sensitive haul;
- Changing dump locations (in-pit or less exposed dump option)
- Reducing equipment numbers;
- Shut down of task; or
- Site shut down.

A summary of these assessments undertaken during December are provided in **Table 10**.

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Table 10: Supplementary Attended Noise Monitoring Data – December 2019

No. of assessments	No. of assessments > trigger	No. of nights where assessments > trigger	% greater than trigger
547	0	0	0

Note: Measurements are taken under all meteorological conditions, including conditions under which the consent noise criteria do not apply.

6.0 OPERATIONAL DOWNTIME

During December a total of 4900 hours of equipment downtime was logged in response to environmental events such as dust, smoke, noise and elevated wind impacts. Operational downtime by equipment type is shown in **Figure 71**.

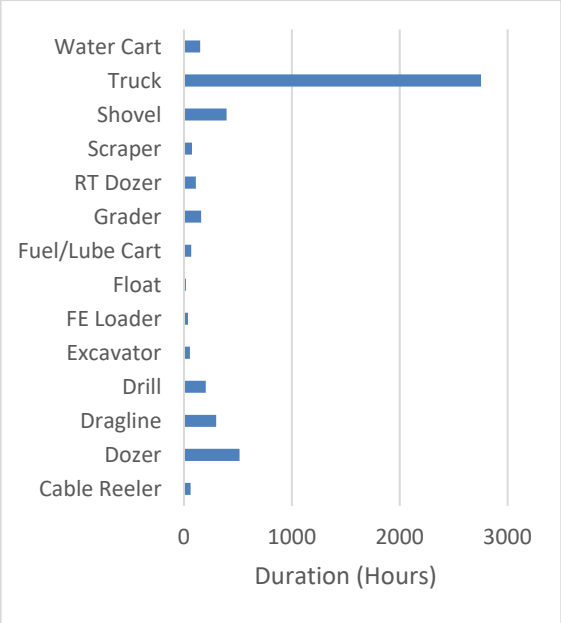

Figure 71: Operational Downtime by Equipment Type – December 2019

7.0 REHABILITATION

During December 2.2Ha of land was released for rehabilitation, 2.3Ha was bulk shaped, 9.6Ha was topsoiled, 16.1Ha was composted and 20.3Ha was rehabilitated. Year-to-date progress can be viewed in **Figure 72.**

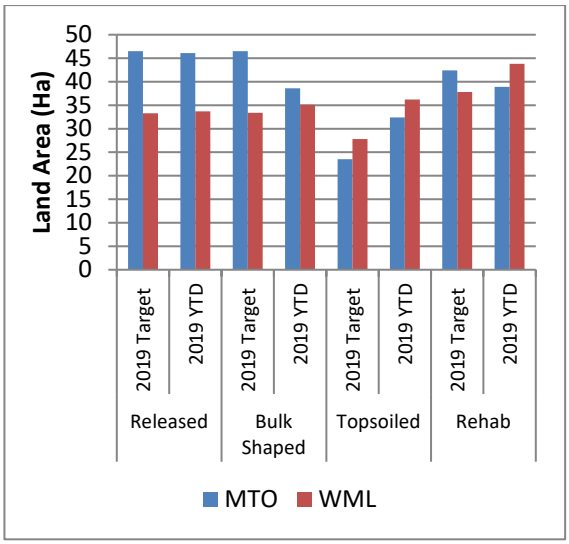

Figure 72: Rehabilitation YTD - December 2019

8.0 ENVIRONMENTAL INCIDENTS

There were no reportable environmental incidents recorded during the reporting period.

9.0 COMPLAINTS

During the reporting period 16 complaints were received, details of these complaints are displayed in **Table 11** below.

Table 11: Complaints Summary - YTD December 2019

	Noise	Dust	Blast	Lighting	Other	Total
January	7	6	9	3	0	25
February	14	16	11	2	0	43
March	20	8	4	2	0	34
April	15	5	3	6	0	29
May	15	8	6	3	0	32
June	13	17	5	0	1	36
July	10	16	3	0	3	32
August	1	32	8	4	0	45
September	7	13	9	2	1	32
October	5	8	13	4	0	30
November	5	12	13	0	1	31
December	0	5	10	1	0	16
Total	112	146	94	27	6	385

Appendix A: Meteorological Data

Table 12: Meteorological Data – Charlton Ridge Meteorological Station – December 2019

Date	Air Temperature Maximum (°C)	Air Temperature Minimum (°C)	Relative Humidity Maximum (%)	Relative Humidity Minimum (%)	Wind Direction Average (°)	Wind Speed Average (m/sec)	Rainfall(mm)
1/12/2019	31	16	83	4	191	3.4	0.0
2/12/2019	23	15	54	18	282	6.2	0.0
3/12/2019	30	12	44	11	303	5.3	0.0
4/12/2019	33	16	36	4	286	3.9	0.0
5/12/2019	35	15	31	5	270	3.6	0.0
6/12/2019	36	19	53	7	237	2.8	0.0
7/12/2019	32	17	77	14	142	2.7	0.0
8/12/2019	32	17	81	25	124	3.8	0.0
9/12/2019	36	17	80	22	134	2.6	0.0
10/12/2019	40	18	81	6	219	3.6	0.0
11/12/2019	30	17	71	32	135	4.0	0.0
12/12/2019	27	16	76	37	123	3.3	0.0
13/12/2019	27	15	84	37	118	2.9	0.0
14/12/2019	33	18	73	15	171	2.8	0.0
15/12/2019	35	18	81	8	201	2.8	0.0
16/12/2019	29	17	63	14	137	3.4	0.0
17/12/2019	29	15	75	26	123	3.2	0.0
18/12/2019	35	14	79	12	134	2.3	0.0
19/12/2019	39	16	68	7	247	3.5	0.0
20/12/2019	32	16	78	20	119	3.3	0.0
21/12/2019	43	17	83	7	243	3.6	0.0
22/12/2019	26	17	66	34	137	4.3	0.0
23/12/2019	23	15	85	59	140	3.2	0.0
24/12/2019	32	19	92	40	128	3.6	0.4
25/12/2019	32	19	89	31	111	3.8	0.0
26/12/2019	35	17	81	16	130	3.2	0.0
27/12/2019	35	17	69	10	125	3.2	0.0
28/12/2019	39	16	80	4	144	2.1	0.0
29/12/2019	41	18	65	0	143	2.2	0.0
30/12/2019	41	19	69	1	170	2.3	0.0
31/12/2019	42	21	59	4	260	4.4	0.0

"-" Indicates that data was not available due to technical issues.