South32 - Illawarra Metallurgical Coal

DENDROBIUM MINE

End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 16 (Area 3B)

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Cover photo: Cordeaux River tributary location CR29_S1, looking upstream on 27/10/2016

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Executive summary

This report summarises the observed, measured and estimated effects on hydrological features resulting from the extraction of Dendrobium Longwall 16.

Longwall 16 is the eighth panel to be extracted from Dendrobium Area 3B. Extraction of Longwall 16 commenced on 26/2/2020 and was completed on 4/11/2020. Rainfall in 2020 totalled 1436 mm, well above the long-term average and the highest rainfall year since the start of mining at Dendrobium. The high rainfall in 2020 marks the end of a severe drought period between 2017 and 2019 and has resulted in significant recovery of stream flows, shallow groundwater and soil moisture levels and improvements in stream water quality.

The Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) conducts monitoring and inspections on landscape features including watercourses and swamps within Dendrobium Area 3B. This monitoring is conducted in accordance with the Dendrobium Area 3B Subsidence Management Plan (SMP) and monitoring and contingency plans contained therein. Trigger Action Response Plans (TARPs) contained in the SMP form the basis of the impact assessments in this report. A total of 58 new (or updated) surface impacts attributed to the extraction of Longwall 16 were recorded, of which **5** were in stream beds within the zone of mining influence.

Surface water quality

At many stream monitoring sites including reference sites, water electrical conductivity (EC) declined during 2020 following a period of increased EC during the 2017-2019 drought period. Water EC remained elevated at several locations on Donalds Castle Creek (TARP Level 3), LA4 (Level 2) and in Sandy Creek (SC10C and SC10). Elevated EC at LA4 and Sandy Creek reflect subsidence impacts on the watercourses, whereas mining effects at Donalds Castle Creek are not clear.

On 19/10/2020 iron staining was noted in Sandy Creek tributary SC10C (Level 2 TARP), extending downstream to Sandy Creek. Staining was first reported at SC10C on 11/3/2013, following extraction of Longwall 8. The recent recurrence of staining at SC10C seven years after the first occurrence is likely the result of recovering groundwater flooding previously drained fractures in the vicinity of SC10C. This is supported by groundwater monitoring data.

Stream flow

Assessment of stream flow gauging records (Table 1) has identified mining-related effects on the flow regime in tributaries to Donalds Castle Creek (DCS2 and DC13S1 – Level 3), tributaries to Wongawilli Creek (WC21S1 and WC15S1 – Level 2 to 3) as well as in Lake Avon tributary sites - LA4S1 (Level 1 and 3), LA3S1 (Level 3). New effects detected during Longwall 16 were at LA2S1 (one indicator at Level 3). No changes in flow characteristics were detected at WC12S1, which is close to the end of Longwall 16.

No change to catchment flow characteristics was identified at the Wongawilli Creek gauge downstream of Area 3B (WWL). The TARP assessment methods indicate a continuation of modified low-flow characteristics at the downstream gauge of Donalds Castle Creek (DCU), which remains at TARP Level 1. Reductions in median flow (Q50) at sites upstream of DCU are obvious, and total approximately 40-60% of median flow at DCU, and so should be able to be detected at DCU, but no reduction in Q50 is apparent.

While noting 'no change' was detected, it is acknowledged that the scale of impacts in headwater streams overlying longwalls (e.g. WC21, DC13) may be impossible to detect further downstream given natural variability, larger contributing (and un-mined) catchments downstream at WWL, as well as the inherent uncertainties of the assessment methods. However, the assessments of WWL and DCU appear to indicate that there is clear potential for returned or re-emergent flow that has been identified as lost from upstream headwater catchments.

Table 1. Summary of Surface Water flow TARPs – Longwall 16

Site	Watercourse	Catchment Mined under?	Position of sub-catchment relative to mining	A) Low flow Q%ile outside Reference Site Q%ile	B) Change in cease-to-flow frequency (beyond natural)	C) Change in median flow, Q50 (beyond natural)	Comment
DC13S1	DC13	Yes	Above LWs	●●Level 3	●●Level 2	●●Level 3	Similar to LW14,15.
DCS2	Donalds Castle Creek	Yes	Above LWs	●●Level 3	●●Level 3	●●Level 3	Similar to LW14,15.
DCU	Donalds Castle Creek	Yes	Downstream	●●Not triggered	●●Level 1	●●Not triggered	Similar to LW14,15. Findings supported by rainfall-runoff modelling.
WC21S1	WC21	Yes	Above LWs	●●Level 3	●●Level 2	●●Level 3	Similar to LW14,15.
WC15S1	WC15	Yes	Above LWs	●●Level 3	●●Not triggered* (Level 1*)	●●Level 3	Similar to LW15. * However, changes to low flow accuracy means that Method B assessment not completely reliable. Level 1 is likely.
WC12S1	WC12	Yes	Above LWs	●●Not triggered	●●Not triggered	●●Not triggered	First panel under catchment. No discernible effect. Findings supported by rainfall-runoff modelling.
WWL	Wongawilli Creek	Yes	Downstream	●●Not triggered	●●Not triggered	●●Not triggered	Similar to LW14,15. Findings supported by rainfall-runoff modelling.
LA4S1	LA4	Yes	Above LWs	●●Level 1	●●Not triggered* (Level 3*)	●●Level 3	Effects appear to have reduced slightly since LW14. * However, changes to low flow accuracy means that Method B assessment not completely reliable. Level 3 is likely.
LA3S1	LA3	Yes	Above LWs	●●Level 3	●●Level 3	●●Level 3	Similar to LW15, but increase in low flow frequency.
LA2S1	LA2	Yes	Above LWs	●●Not triggered	●●Not triggered	●●Level 3	LW16 under headwaters. Reduction in Q50.
NDS1	ND1	No	Headwater	●●Not yet mined under	●●Not yet mined under	●●Not yet mined under	To be assessed in future EoP report.

●●●●● = result of previous longwalls (LW14, LW15)

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Site Watercourse	Position of sub-catchment relative to mining	D) Surface flow observations		Comment
Wongawilli Creek	Between A3A andA3B	February 2020	Level 2	Refer to Performance Measures

Table 2. Summary of surface water flow Performance Measures– Longwall 16

Wongawilli Creek – minor environmental consequences	**This Performance Measure is met.**
Donalds Castle Creek – minor environmental consequences	**This Performance Measure is met.**
Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon	**This Performance Measure is met.**
Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	**This Performance Measure is met.**

Pool levels

The water level in Pool 43a on Wongawilli Creek declined since 2012, and a TARP Level 3 impact was recorded when water levels were recorded below baseline on 20/11/2017, following the identification of a stream bed fracture in 2013. The decline in pool levels started prior to the formation the fracture and was coincident with a decline of groundwater pressures in lower Hawkesbury Sandstone associated with mining in Area 3A and Area 3B. There is evidence that piezometric levels in the sandstone substrate adjacent to Wongawilli Creek are starting to recover as mining in Area 3B moves south and away from Pool 43A. Water levels in Pool 43A remained steady during the Longwall 16 reporting period.

WC15 is a second order stream that flows in a north-easterly direction across the eastern part of Area 3B. The watercourse was approached within 40 m by Longwalls 13 and 14, and the upper reaches of WC15 were mined under by Longwalls 15 and 16, resulting in fracturing of the stream bed and diversion of flow at some locations. Routine field observations indicate that the level and flow at most pools upstream of Pool 13 have declined relative to baseline observations.

Swamps

At reference swamp sites, shallow groundwater levels recovered in 2020, with saturation levels similar to those prior to the 2017-2019 drought.

Longwall 16 passed beneath (or within 400 m of) Swamps 23, 13 and 14 during 2020. Those swamps were partially mined under by Longwall 15. At Swamp 23, one piezometer (23_01) out of two installed in the swamp records a change in saturation duration following rainfall and represents a Level 2 TARP. At Swamp 14, both piezometers installed in the swamp recorded a decrease in saturation and an increase in recession rate following the passage of Longwall 15 and 16, representing a Level 3 TARP. At swamp 13, peak groundwater level and duration of saturation remain somewhat lower than in pre-drought conditions, and relative to reference sites (TARP Level 3). The observed effects at swamps are in line with impacts anticipated in the SMP.

At Swamp 14 there is evidence for a decline in moisture levels at S14_S01 following passage of Longwall 16 which contrasts with the recovery in soil moisture at reference swamps. Soil moisture recovered at S14_S02 during 2020 with no clear evidence of a mining effect. Observed effects represent a TARP level 2 trigger. At Swamp 23, soil moisture levels recovered during 2020 following the 2017-2019 drought, to a range similar to the baseline period. On this basis, a soil moisture TARP was not triggered (revised from Level 2 in the previous assessment). Similarly, the soil moisture TARP level at Swamp 13 has been revised down to Level 2 due to recovery in 2020 at one piezometer.

1. Introduction

Illawarra Metallurgical Coal (IMC) operates the Dendrobium underground coal mine, located approximately 12 km west of Wollongong (NSW) in the Southern Coalfield. IMC is required under the conditions of mining approval to submit regular reviews of the local hydrological data, including water quantity and quality, for watercourses and water bodies above and adjacent to Dendrobium Mine.

Surface water monitoring has been undertaken by IMC since 2003. Field parameter measurements and sampling for more detailed laboratory chemical analyses were collected by the IMC Environmental Field Team (IMCEFT). Field observation sites include hydrographic gauging stations, shallow groundwater piezometers and surface water sampling sites.

This End of Panel (EoP) assessment reviews hydrographic and water quality data for the Wongawilli Creek catchment, upper Donalds Castle Creek catchment, Lake Avon sub-catchments and the Sandy Creek catchment up to one month after the completion of Longwall 16. Data are assessed against baseline and impact criteria defined in the Trigger Action Response Plan (TARP) which forms part of the Subsidence Management Plan for Area 3B (BHP Billiton, 2015) and the Swamp and Watercourse management plans contained therein.

1.1 Reporting Objectives

This EoP surface water assessment report has been prepared to form part of IMC's EoP Review which satisfies Condition 3-9 of the Approval for Dendrobium Mine (DA 60-03-2001). The EoP Review:

- reports all subsidence effects (both individual and cumulative) for the panel and compares subsidence effects with predictions;
- describes in detail all subsidence impacts (both individual and cumulative) for the panel;
- discusses the environmental consequences for watercourses, swamps, water yield, water quality, aquatic ecology, terrestrial ecology, groundwater, cliffs and steep slopes; and
- compares subsidence impacts and environmental consequences with predictions.

This report

provides the following assessment for the EoP Review:

- Impacts to water flow, water levels and water quality in watercourses, including: Wongawilli Creek, Donalds Castle Creek, Sandy Creek, Native Dog Creek and relevant tributaries to Avon Reservoir.
- Impacts to shallow groundwater levels and soil moisture levels in mapped Coastal Upland Swamps within the mining area of influence, compared with reference swamps.

1.2 Longwall 16

Longwall mining at Dendrobium has been carried out in three designated areas: Area 1 (east of Lake Cordeaux), Area 2 (west of Lake Cordeaux), and Areas 3A and 3B (between Lake Cordeaux and Lake Avon). Coal is extracted from the Wongawilli Seam in Areas 1 through 3B. Previous workings in the Wongawilli Seam are located to the south at Elouera and Nebo, and to the east at Kemira. The overlying Bulli Seam was mined previously at Mt Kembla to the east of and partially overlapping Area 1.

Extraction of Longwall 16 commenced on 26/2/2020 and was completed on 4/11/2020. The assessment period for this longwall is one month after the end of the panel, i.e. 04/12/2020. Longwall 16 is the eighth panel to be extracted in Area 3B, with an extracted length of 1864 m, a void width of 305 m (including first workings) and a cutting height of up to 3.9 m.

1.3 Feedback from agencies on previous assessment

WaterNSW and the Independent Advisory Panel for Underground Mining (IAPUM) provided feedback on the Surface Water components of the Longwall 15 End of Panel (Table 3)

Table 3. Comments on previous EOP assessment

WaterNSW comment	Response
WaterNSW is generally satisfied with the application of the amended surface water flow TARPs and assessment methodology. The trend of increased cease to flow frequencies and flow reductions as a result of mining remains of concern to WaterNSW.	Watercourses that are mined under clearly exhibit loss of flow that is primarily consistent with reduction in baseflow, which effects the frequency of cease-to-flow events and overall magnitude of flow in these sub-catchments. Down-gradient effects are much less significant, even to the point of non-detection. This is consistent with increased permeability and porosity above longwalls but limited 'consumptive' loss from creeks.
The estimated change in median flows between baseline and postmining period is influenced by availability of data in the baseline period with several gauges having less than 2 years of data.	The gauging sites at LA2, LA3, WC12 were installed after a government request to monitor these, hence the short baseline. Of these, the most notable is LA3 which has only 2.8 months or 84 days of pre-mining flow data. There is no doubt that subsequent assessments at LA3, which rely on the pre-mining statistics, are rendered somewhat unreliable by that very short baseline period. The Longwall 15 assessment acknowledges this: "the pre-mining baseline period is only 2 months, and so the statistical assessment of impacts is considered somewhat unreliable. However, based on experience with other catchments that are mined under, flow reductions will very likely occur at this site". The expectation is that changes to hydrology (reductions in median flow, increased cease-to-flow frequency, etc) after Longwalls 15 and 16 would be similar to those assessed at LA4 (and probably then at LA2 (after Longwall 17).
Comparison of results for LW14 and LW15 suggest that using a reference site (e.g. O'Hares Creek) that has higher flows compared to assessment of the catchment may introduce bias for quantification of mining induced changes as the length of the postmining period is increasing	Having reviewed the results of all three methods between Longwall 14 and Longwall 15 EOP reports, we do not see what the basis for the WaterNSW comment is. Despite the comment above about possible bias not being evident (to me), if a bias that affects the use of O'Hares Creek for the purpose of the TARPs can be demonstrated, then other smaller catchments should be investigated for use as a partial remedy to this perceived or possible issue.
IAPUM	
The previous (pre-LW15) surface water flow TARPs should be employed in parallel with the new surface water flow TARPs, and the most conservative outcome taken, until the new trigger metrics have undergone further assessment and peer review for fitness for purpose.	A comparison against the pre-LW15 method (comparison against rainfall-runoff modelling) for selected sites is presented in Section 5.3.13 and Appendix H. If this method were to be continued for use, some modification to the method should be applied and agreed. The revised TARPs underwent a lengthy consultation process in 2018-20 with input from DPIE, WaterNSW and OEH, with almost all recommendations made by agencies having been adopted.
A method of quantifying and reporting trends in key water quality indicators (both concentrations and loads) should be trialled in addition to applying the proposed water quality TARPs.	A trial study will be caried out in 2021. Water quality trend analysis based on the outcomes of the study will be incorporated into the next EOP report.

2. Surface water and groundwater management

This section outlines the network of monitoring infrastructure and sites operated by IMC at and around the Dendrobium Mine. Further details of monitoring sites and procedures are outlined in the Dendrobium Area 3B Watercourse Impact Monitoring Management and Contingency Plan (South32, 2020a).

2.1 Surface Water Monitoring

Monitoring includes a selection of sites downstream and within the mining area, as well as sites located away from the mining area to provide control sites and act as a comparison to impact sites. Pools within streams are monitored monthly before and following mining and weekly (when site access available) during active subsidence and in response to any observed impacts. Surface water monitoring sites fall into four categories:

1. **Flow gauge sites** at which stream flow is monitored at a calibrated gauge or weir.
2. **Water chemistry sites** at which samples are collected for laboratory analysis (DOC, Na, K, Ca, Mg, Filt. SO_4, Cl, T. Alk., Total Fe, Mn, Al, Filt. Cu, Ni, Zn, Si), in addition to water observations, field parameters.
3. **Water field parameter sites**, at which water quality field parameters are measured (pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), Oxygen Reduction Potential (ORP), in addition to water observations.
4. **Water observation sites**, at which pool water levels and flow status are noted and photographs taken upstream and downstream.

At a subset of sites, data loggers are installed in pools to allow monitoring of pool water level and temperature at hourly intervals. The monitoring of water quality parameters provides a means of detecting and assessing the effects of streambed fracturing or induction of ferruginous springs.

Figure 1 shows the location of surface water monitoring and sampling sites in relation to the extracted and planned longwall panels. Figure 2 shows the locations of hydrographic gauging stations which extend beyond the mining lease.

A summary of water flow monitoring sites in Areas 3A and 3B is presented in Table 4 and a full list of all installations is included in Appendix B.

Table 4. Surface Water Flow Monitoring Sites in Area 3A and 3B

Area	Site	Installation	Catchment	Easting (MGA z56)	Northing	Catchment area (km2)
A3B	WWU	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290808	6189716	3.211
A3B	WWL	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290975	6197526	20.079
A3B	WWL_A	Recently installed - Weir and half pipe; PVC housing; Orpheus logger	Wongawilli Creek	290962	6197370	19.602
A3B	WC21S1	Natural control; Stainless Steel housing; Diver logger	Wongawilli Creek	290529	6194255	2.434
A3B	WC15S1	Natural control; PVC housing; Diver logger	Wongawilli Creek	290754	6192239	1.192
A3B	WC12S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Wongawilli Creek	290964	6191459	0.38

A3B	LA2S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288364	6191364	0.824
A3B	LA3S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288385	6191548	0.375
A3B	LA4S1	Modified control; Stainless Steel housing; Diver logger	Lake Avon	288134	6192565	0.817
A3B	NDT1S1	Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Avon	288607	6190491	1.13
A3B	DC13S1	Natural control; PVC housing; Diver logger	Donalds Castle Creek	289401	6194605	1.638
A3B	DCS2	Natural control; PVC housing; Diver logger	Donalds Castle Creek	289502	6194572	1.084
A3B	DCU	Natural control; Stainless Steel housing; Diver logger	Donalds Castle Creek	289407	6195577	6.219
A3A	SC10S1	Natural control; Stainless Steel housing; Diver logger	Sandy Creek	293608	6192516	2.771
A3A	SC10CS1	Natural control; Stainless Steel housing; Diver logger	Sandy Creek	293358	6192433	0.817
A3A	SCL2	Modified control; Stainless Steel housing; Diver logger	Sandy Creek	293819	6192648	7.029
A3A,C	LC5S1	Reference site until Area 3C is mined. Weir and half pipe flume; Polypipe housing; Orpheus logger	Lake Cordeaux	293043	6195327	1.861

2.2 Improvements to monitoring network in reporting period

Type of change / improvement	Description of recent change	Reference / comment
New surface water gauging sites	None during recent EOP period	None installed
Upgrade of existing sites	None during recent EOP period	
Gauge rating curves	More gaugings taken at most sites. Rating curves updated at most sites.	Details from ALS (hydrographic consultants) can be requested via IMC.
Pool monitoring sites	Installation of additional water level data loggers in key pools.	Additional water level loggers installed in pools in Wongawilli Ck (more relevant to Area 3C).
Revision of assessment methods	Surface flow TARPs (Assessments A-D) not change since agreement in early 2020. IAPUM requested that old method (comparison of rainfall-runoff modelling) be re-instated.	Section 5.3, WIMMCP (IMC, 2020a) and Watershed HydroGeo, 2019a. Section 2.3.1.

2.3 Surface water flow data update

IMC's contract hydrographers, ALS, provided the most recent flow data for assessment for sites in and around Area 3B (details in Table C1 of Appendix C). This has been augmented by flow data from sites managed by WaterNSW, specifically one of the primary reference flow gauges (O'Hares Creek at Wedderburn) and for WaterNSW's Sandy Creek gauging station (GS 2122205), which is co-located with IMC's SCL2 gauging site, but has a longer record and, based on comments from ALS, relies on higher accuracy monitoring equipment.

This data was then assessed based on the quality of record provided before some further processing was conducted. A discussion of this assessment is provided below. As is standard, data is available to agencies on request.

2.3.1 Re-rating of flow records

ALS update the rating curves of flow monitoring sites as new manual gaugings are taken and added to the dataset that correlates ‘stage’ (water level at a monitoring site) and flow at the site. In recent times, WaterNSW has granted limited access to the Special Area during wetter periods in order to improve the moderate/high flow sections of the rating curves. This has meant that historical records of estimated flow can change when a rating curve is updated. This issue was identified for DCU in the EOP for Longwall 15, but affects more sites in the current EOP due to more gaugings at a greater range of flows being available.

It is apparent from review of recent data obtained from WaterNSW for O’Hares Creek (213200) that a similar re-rating process occurs for WaterNSW data, raised in emails with WaterNSW staff, although this was not confirmed. That is, data provided for the previous Longwall 15 EOP was slightly different (but systematically so) to that provided for the current EOP.

There are two implications of the re-rating process:

- Estimates of flow included in previous EOP reports may be different to that reported in the current (or future) EOP report. For example, median flow for sub-catchment WWU for the period May-2016 to June-2020 was 0.068 ML/d in the EOP for Longwall 15, but has been revised to 0.202 ML/d in this current EOP due to recent changes to the rating curve.
- Hydrographers ALS took over the contract for flow monitoring at Dendrobium on 11/05/2016. ALS provide the record of daily flow for each IMC site based on the latest rating curve and the historical record of stage (level) at each site. Despite a request to do so, ALS do not provide re-rated data from before their contract date, i.e. before 11/05/2016. For sites commencing after this time, there is no problem, however for sites where monitoring commenced before that date, we have had to make an approximation of the flow using the ‘old’ flow data and the new rating curve in order to derive a flow record that is consistent across the periods before 11/05/2016 and after that.

2.3.2 Data quality assessment

An analysis of the data received from ALS was performed to assess the reliability and continuity of data collected at each flow gauge. The data quality code recorded by ALS for flow measurements was used for this purpose. A summary of these data quality codes has been provided in Table C2 of Appendix C, alongside the data quality assessment of each flow gauge.

Each daily flow recorded is the average flow determined from multiple sub-daily (typically 15-minute interval) stage measurements. The Hydstra database maintained by ALS will assign the 'worst' data quality code from any of the sub-daily records to the aggregated or averaged daily record. It is for this reason that Hydstra will sometimes assign quality code 140 ("Level below cease-to-flow") to days where there is a small, non-zero average flow.

For each flow gauge the percentage of available daily flow measurements was calculated. This value indicates the number of measurements that exist between the first date of data collection and the last available date. From this the percentage of ‘suspect’ data was calculated. Based on the ALS quality codes, suspect data refers to any flow data with a code that falls between 104 and 255. A summary of the data quality assessment for each flow gauge is included in Table C3 and C4 of Appendix C.

Data processing was then undertaken for flow data where entries were blank or entered as text and these could be confidently infilled. These entries were associated with the following quality codes:

- 151 (“data not yet available”): associated with comments of ‘rating exceeded’, commonly following high regional rainfall events;
- 161 (“poor quality data from debris affecting sensor”): occurred only at flow gauge WWU for the period 23/01/2019 to 27/02/2019;
- 205 (“data lost”): associated with comments such as ‘logger dead’, ‘data lost’;
- 255 (“no data exists”): associated with comments of ‘rating exceeded’, ‘logger dead’.

For these entries an infilling procedure was used to estimate the flow value, if the record could be confidently estimated (e.g. flows were consistent through time and compared to other gauging stations, especially at higher flows when the “rating exceeded” flag was assigned. Flow estimates were calculated using either the average flow from the preceding and following days, or the flow recorded at another gauged sub-catchment for the same day, scaled by catchment size. The percentage of infilled data is recorded for the relevant gauges in Appendix C. The results of processing, with comparison against ‘raw’ data are illustrated on charts in Appendix C.

2.4 Shallow Groundwater Monitoring

Figure 2 shows Longwall 16 in relation to the locations of shallow groundwater monitoring sites in

Areas 3B and 3A. Typically, these sites are piezometers approximately 1 - 3 m deep that monitor groundwater levels within the swamp deposits located around the Dendrobium area.

Figure 2 also shows swamp areas: broadly mapped by NSW Office of Environment and Heritage (OEH) and refined through site-scale mapping for Illawarra Coal carried out by Biosis. Note that the TARP assessment relates only to those piezometers that are located within swamp sub-communities mapped as Banksia Thicket, Sedgeland-heath complex and Tea Tree Thicket; being listed as Costal Upland Swamp Endangered Ecological Community (EEC). Piezometers located within other areas, such as fringing Eucalypt Woodland, are excluded from the TARP assessment as per the advice from OEH (17/01/2014).

A summary of the shallow groundwater monitoring sites is presented in Table 5.

Table 5. Summary of Swamp Monitoring

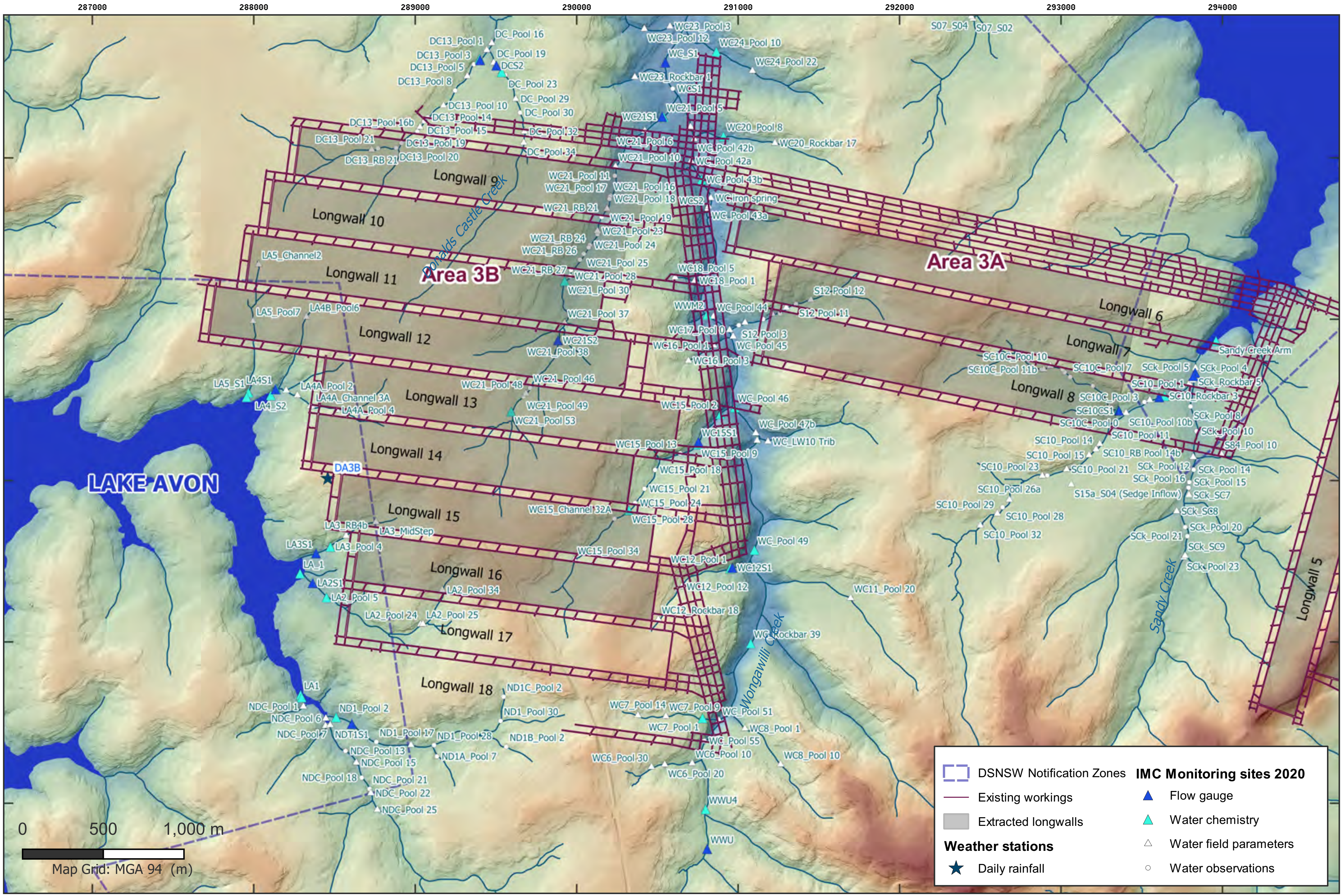
Swamp	Site type	Number of piezometers		Mined under or within mining area (400 m)	Comment
		Total	TARP (Within Coastal Upland Swamp EEC		
01a	Impact	9	6	Longwall 9, Longwall 10	Limited baseline data for 5 piezometers
01b	Impact	7	6	Longwall 9	Limited baseline data for 5 piezometers
02	Reference	1	n/a	No	900 m from Longwall 9
03	Impact	1	1	Pillar 11/12	3_01 Undermined by Longwall 12 on 2/4/2016
05	Impact	9	6	Longwall 9 to Longwall 12	Longwall 12 passed piezometer 5_05 within 400 m on 24/5/2016.

Swamp	Site type	Number of piezometers		Mined under or within mining area (400 m)	Comment
		Total	TARP (Within Coastal Upland Swamp EEC		
07	Reference	2	n/a	No	1.2 km from Longwall 6
08	Impact	6	0	Longwall 9, Longwall 10 Longwall 11	Limited baseline data for 1 piezometer, insufficient recent data for 1 piezometer
10	Impact	1	1	Longwall 12	Piezometer 10_01 undermined by Longwall 12 on 15/11/2016
11	Impact	3	3	Longwall 13, Longwall 14	Partially mined under by Longwall 13 and by Longwall 14
13	Impact	1	1	Longwall 13, Longwall 14, Longwall 15, Longwall 16	Partially mined under by Longwall 13, Longwall 14 and Longwall 15.
14	Impact	2	2	Longwall 15, Longwall 16	Piezometer 14_02 mined under on 24/11/2019; 14_01 mined under on 7/8/2020.
15a	Impact (lower section within 400m mining area)	16	7	Longwall 8, Longwall 19	Limited baseline data for 1 piezometer, yet to be mined under
15b	Impact	23	10	Longwall 7 & 8	
22	Reference	2	n/a	No; Elouera Colliery	Limited baseline data
23	Impact	2	2	Longwall 15, Longwall 16	23_01 mined under on 20/5/2019; 23_02 passed within 40 m by both Longwalls 15 and 16.
25	Reference	1	n/a	No	1.4 km from Longwall 5
33	Reference	2	n/a	No	1 km from Longwall 16
84	Reference	1	n/a	No	500 m from Longwall 5
85	Reference	2	n/a	No	900 m from Longwall 9
86	Reference	2	n/a	No	3 km from Longwall 9
87	Reference	2	n/a	No; Avon Colliery	Limited baseline data
88	Reference	2	n/a	No; Huntley Colliery	Limited baseline data
Notes:	Blue shading are reference swamps; Pink shading are swamp piezometers within 400 m of Longwall 16				

2.5 Soil moisture monitoring

Soil moisture profiles are monitored at most swamps, with sensor arrays typically positioned near shallow piezometers (where possible). Where possible the monitoring arrays are numbered according to the corresponding piezometer (if present) with the addition of an 'S' prefix. At most locations, five sensors are installed at 20 cm depth intervals up to a maximum depth of 1.2 m.

Soil moisture is measured using Sentek sensors which monitor changes in the dielectric constant within a cylinder of soil extending to a radial distance of 10 cm from the access tube. Soil moisture is reported as mm water per 100 mm soil depth (or volumetric % water) at each monitored depth (Sentek, 2017). The most recent installations are equipped with automated data loggers set to record moisture levels every hour. The remaining installations are recorded manually during scheduled site visits.



Dendrobium Mine End of Panel Surface Water Assessment

Surface water field monitoring sites

Figure 1

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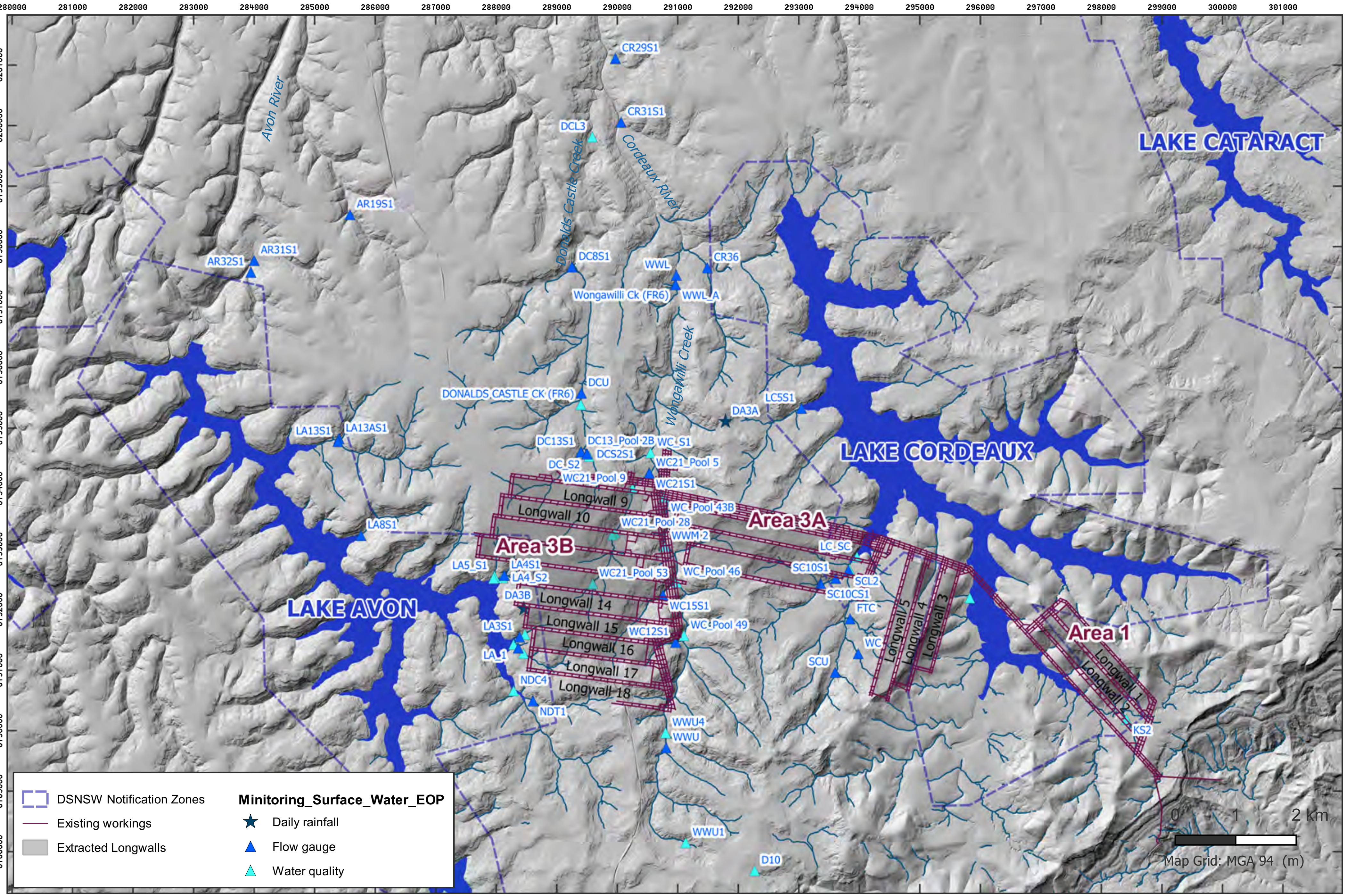

Dendrobium Mine End of Panel Surface Water Assessment

Water level, flow and chemistry monitoring sites

Figure 2

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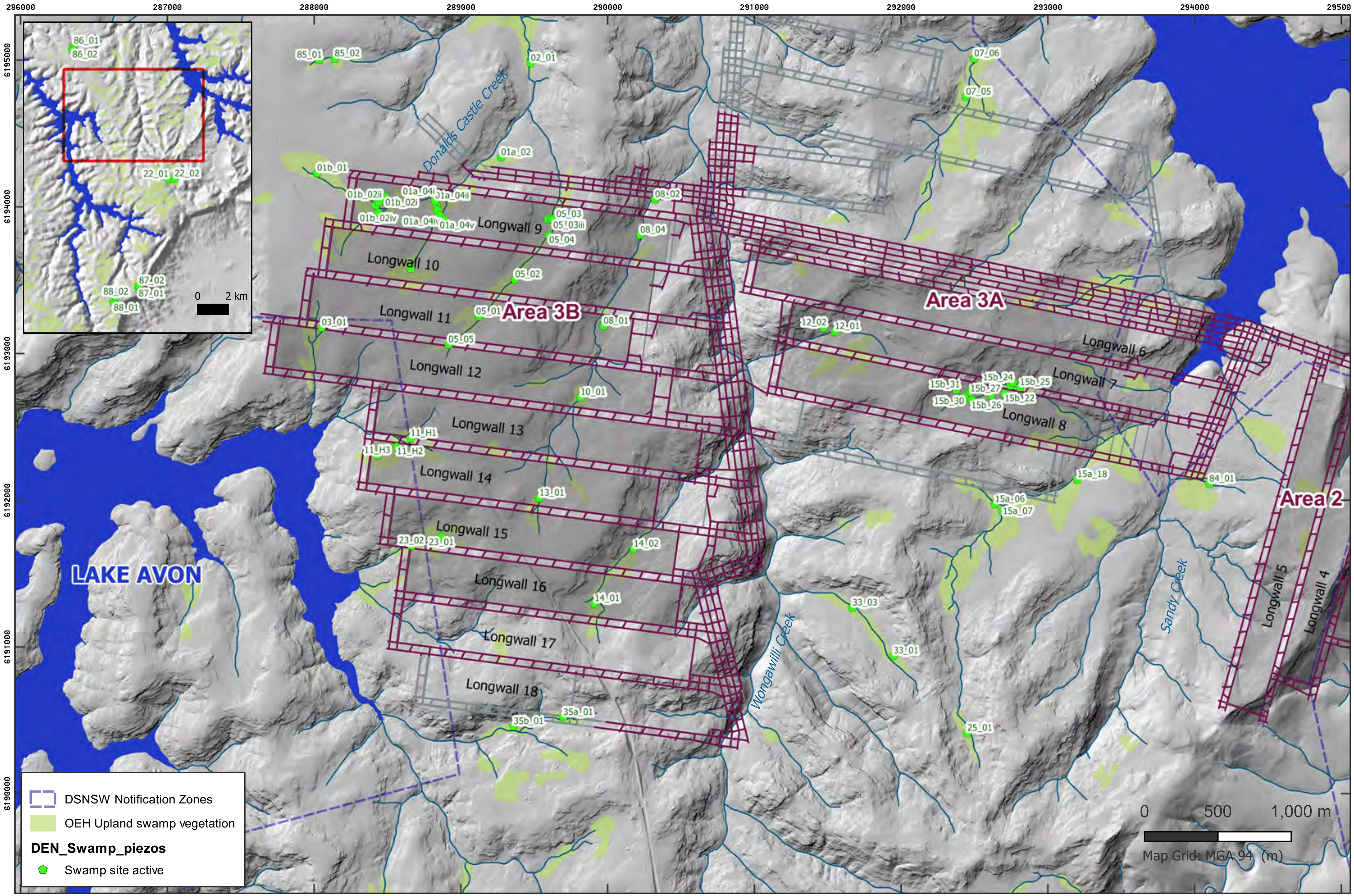

Dendrobium Mine End of Panel Surface Water Assessment

Swamp monitoring sites

Figure 3

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2.6 Weather conditions during the assessment period

Rainfall data are collected from several gauging stations across the mining lease. Weather observations at Area 3B since the start of Longwall 9 are summarized in Figure 4. Potential evapotranspiration (EVT) is calculated from SILO data (DSITI, 2011) derived for Dendrobium Area 3B, using the FAO Penman-Monteith formula (Allen et al., 1998). The average annual rainfall for Dendrobium is 1029 mm (2002 – 2010; Dendrobium site data). Rainfall events occur year-round but tend to be more frequent in the summer and early autumn months. It is common for a substantial proportion of the annual rainfall to be delivered in a small number of large rainfall events, during which significant surface water runoff and groundwater recharge is generated.

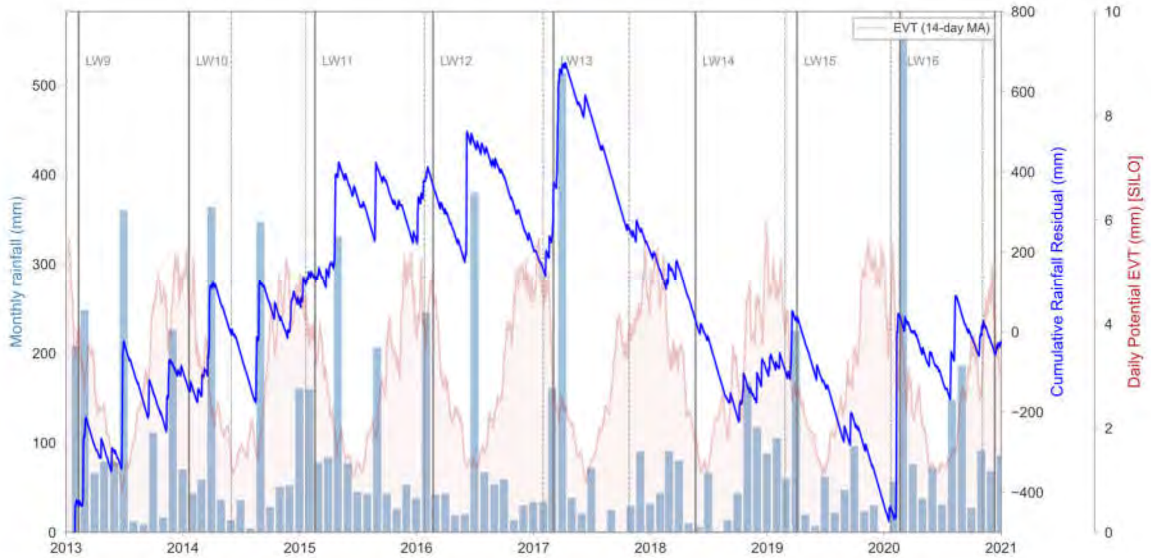


Figure 4. Rainfall and potential evapotranspiration (EVT) at Area 3 for the reporting period

Maximum daily temperature varies seasonally from approximately 20 °C in the winter months (June – August) to 40 °C or higher in the summer (December – February). Evapotranspiration varies seasonally in line with temperature and solar radiation, peaking during the summer months.

Rainfall has been relatively consistent throughout of 2020 and during Longwall 16 extraction, totalling 1436 mm, well above the long-term average and the highest rainfall year since the start of mining at Dendrobium. A large rainfall event in early February (554 mm in one month) marked the end of a severe drought period between April 2017 and January 2020.

Soil moisture levels derived from the Australian Water Resources Assessment Landscape model (AWRA-L) are published by the Bureau of Meteorology (BOM). A timeseries of estimated soil moisture storage for the Woronora Plateau in the vicinity of Dendrobium Mine is shown in Figure 5. The model calculated severely depleted soil moisture conditions during 2017-2019 drought period, with significant recovery during 2020.

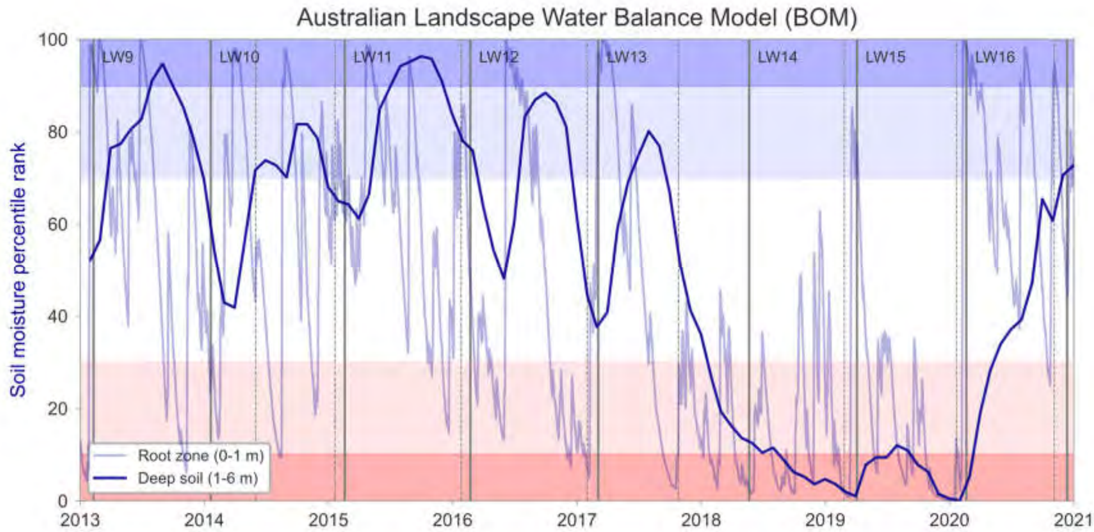


Figure 5. Calculated soil moisture from BOM's AWRA Landscape Model

Longer term rainfall trends for the plateau are shown in Figure 6 which is based on data from SILO (slightly different from site measurements). Since 1960 there have been four periods of drought on the plateau (yellow shading), the most severe being the Millennium Drought which ended in 2004. Severe drought conditions returned between 2017-2019. The plot shows that, in general, below average rainfall conditions prevailed since about 1991. The period from 2002 for which rainfall data have been collected at Dendrobium (vertical black line) is slightly below the long-term average (~1120 mm), accounting for the difference in appearance of the cumulative rainfall trends in Figure 4 (based on site data) and Figure 6 (based on long term SILO data).

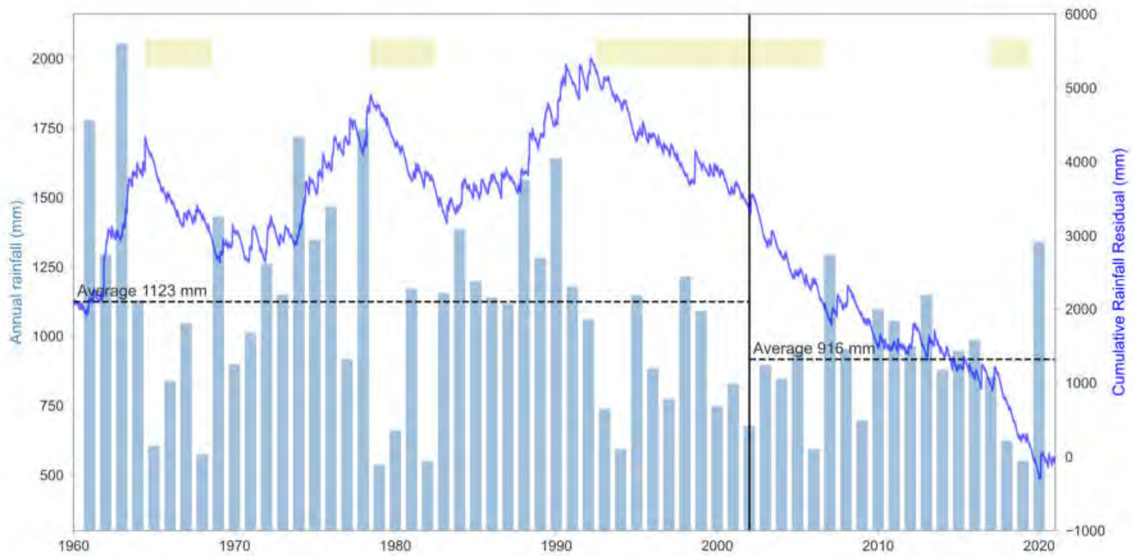


Figure 6. Long-term rainfall trends at Dendrobium (1960-2020)

3. Longwall subsidence effects

Figure 7 presents the total subsidence predicted by MSEC (2015) above Area 3B longwalls. This shows that Wongawilli Creek is outside the main area of subsidence (above the mains), although its tributaries WC21 and WC15 lie directly across the area of predicted maximum subsidence (from recent or future longwalls). The upper reaches of Donalds Castle Creek, its tributary DC13 as well as Lake Avon tributary LA4 lie across some or all of Longwalls 9-13, although are slightly westward of the area with the greatest predicted subsidence.

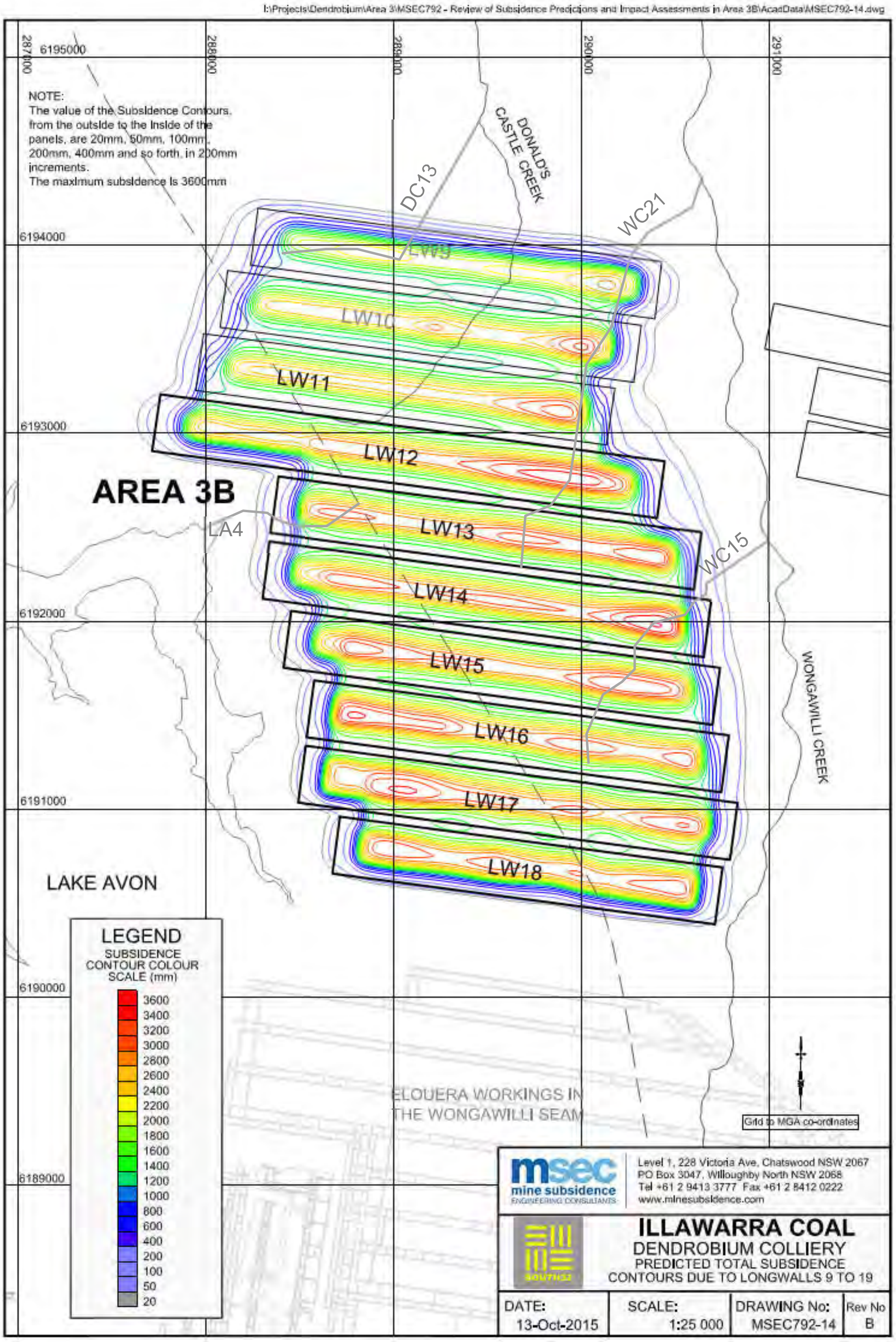


Figure 7. Predicted Subsidence above Area 3B (from MSEC, 2015)

3.1 Measured subsidence

Observed mine subsidence movements due to the extraction of Longwall 16 were reviewed by MSEC (2021). Mine subsidence effects were measured using the Wongawilli Creek closure lines, Avon Dam closure lines, Area 3B and Avon Dam 3D monitoring points, tributary cross lines, Donalds Castle Creek cross lines, swamp cross lines and airborne laser scans.

The review concluded that measured ground movements after the extraction of Longwall 16 were generally similar to or less than the predicted values based on the re-calibrated subsidence model outlined in reports MSEC792 (MSEC, 2015) and MSEC865 (MSEC, 2016). MSEC (2021) considered that the observed surface impacts on natural and built features resulting from the extraction of Longwall 16 are consistent with predictions.

3.2 Observed surface impacts

Surface watercourses and catchments undermined by Longwall 16 are listed in Table 6.

Table 6. Surface water features mined under by Longwall 16

Catchment / location	Approximate dates	Monitoring locations (level and chemistry)	
		Upstream	Downstream
LA3 (upper reaches)	Longwall 16 passed within 40 m to 100 m of the upper watercourse between the start of the panel to 24/3/2020.	-	LA3_Pool 4, LA3S1
LA2 (close approach)	Longwall 16 passed beneath the upper reaches between 3/5/2020 and 24/5/2020.	-	LA2_Pool 34
WC15 tributary	Longwall 16 passed beneath the watercourse between 27/10/2019 and 1/8/2020 and 18/8/2020.	-	WC15_Pool 34, WC15_Pool 28, WC15_Pool 24, WC15_S1
WC12 tributary	Longwall 16 terminated within 40 m of WC12_Rockbar 18 and within 155 m of WC12_Pool 12 on 4/11/2020.	-	WC12_Rockbar 18 WC12_Pool 12 WC12_Pool 1
Swamp 23	Longwall 16 passed beneath the southern fringes of the swamp between 10/3/2020 and 23/3/2020. The swamp was previously mined under by Longwall 15 during the first half of 2019.	23_02 (Longwall 16 passed within 20 m) 23_01 (Longwall 16 passed within 108 m)	
Swamp 14	Longwall 16 passed beneath the swamp between 2/8/2020 and 21/8/2020. The northern extension of the swamp was previously mine4d under by Longwall 15 during the latter half of 2019.	14_02 (Longwall 16 passed within 200 m) 14_01 (mined under on 7/8/2020)	

Observed subsidence impacts on the landscape, including surface fracturing and iron staining are monitored by the IMCEFT and reported separately in the EoP Landscape Report (South32, 2020b). A total of 58 new (or updated) surface impacts attributed to the extraction of Longwall 16 were recorded, of which **5** were in stream beds within the zone of mining influence (Table 7).

An increase in iron staining was noted along the lower reaches of SC10C, a tributary to Sandy Creek, well outside the zone of mining influence for Longwall 16. Iron staining was recorded at the same location during Longwall 8 which passed directly beneath SC10C. As discussed later in this report, the increase in iron staining at SC0C is unlikely to be related to Longwall 16 and may be related to increasing shallow groundwater levels and discharge following higher than average rainfall in 2020.

Table 7. Reported subsidence impacts to stream beds during Longwall 16

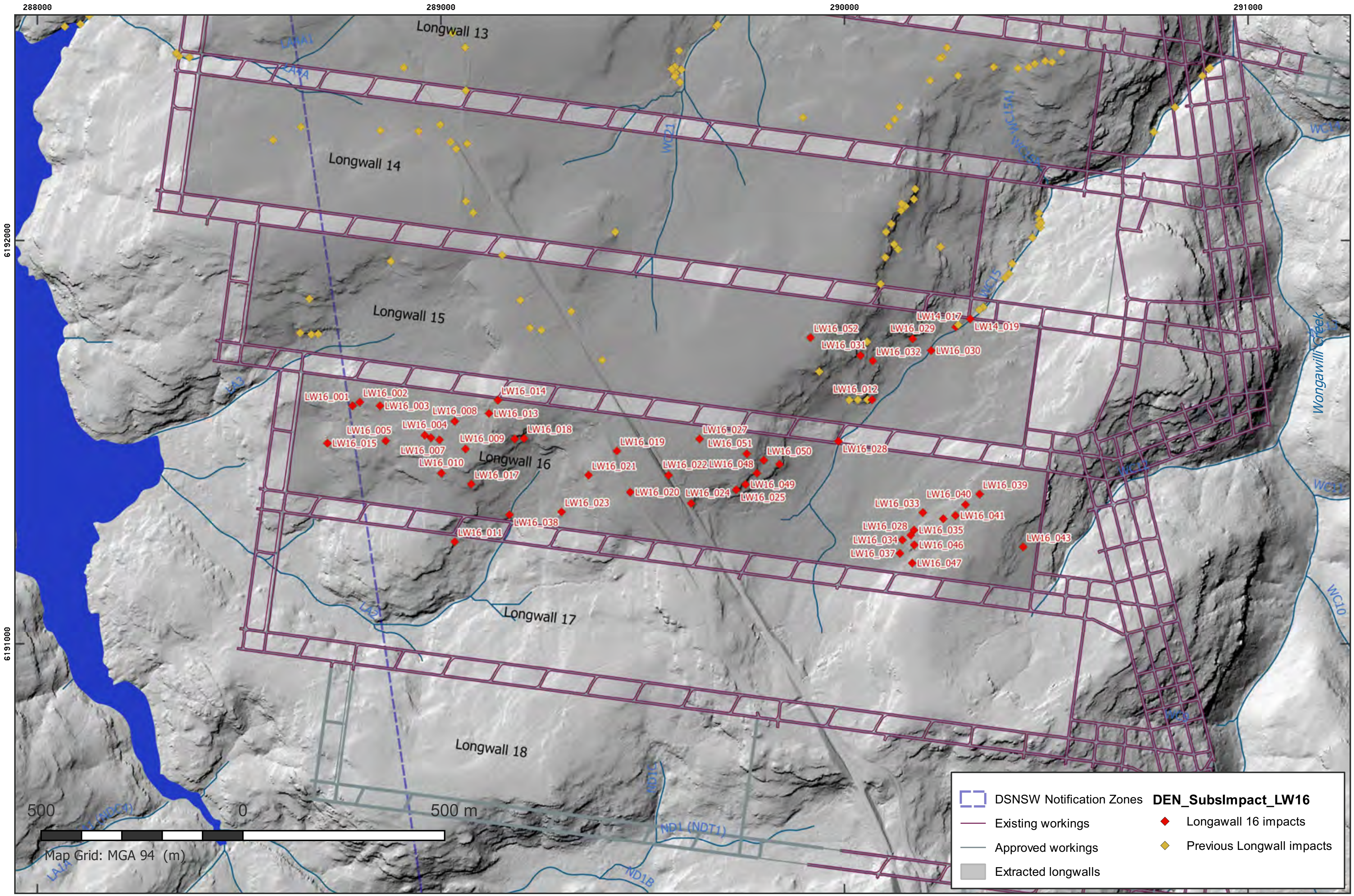
Site ID	Watercourse	Date reported	Description	Tarp Level
DA3B_LW16_028	WC15	1/09/2020	Rock fracture running across rockbar, above step directly upstream of WC15_Pool 34. Fracture is up to 2.1m long, 0.01m wide and up to 0.255m deep. Slight flow diversion evident.	2
DA3B_LW16_030	WC15	1/09/2020	Localised erosion, adjacent to drainage line of WC15. Hole is 1.8m long, 1.1m deep and 0.5m wide. Additional impact noted 9/9/2020 and reported 14/9/2020	n/a
DA3B_LW16_038	LA2	30/09/2020	Iron staining present at LA2_Pool 34	1
DA3B_LW14_017 (update)	WC15	14/09/2020	Additional rock fracturing and displacement on tributary WC15	2
DA3B_LW14_019 (update)	WC15	14/09/2020	Additional rock fracturing, uplift and displacement near tributary WC15	2
DA3_LW8_158 (update)	Sandy Creek	19/10/2020	Increase in iron staining for >2 consecutive months in Sandy Creek	2

MSEC (2021) reported that:

- *Surface water diversion (i.e. Type 3 impact) was observed at one new site along WC15 due to the mining of LW16. Iron staining was also recorded along LA2; however, fracturing was not identified along the alignment of this stream. It was assessed that surface water diversions could occur along the streams that are directly mined beneath.*
- *There were no new surface water diversions identified outside the mining area due to the mining of LW16.*

Subsidence impacts of TARP Level 2 or above require specialist advice in relation to possible Corrective Management Actions (CMAs), reporting and/or monitoring. Advice in relation to subsidence impacts to watercourses is as follows:

- Based on the assessment by MSEC (2021), the observed impacts in the sandstone channel of tributaries WC15, LA2 and Sandy Creek are in line with predicted subsidence effects associated with Longwall 16, being above, or within 400 m of, the extracted longwall. Routine monitoring is continuing, and no additional actions are recommended.



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Dendrobium Mine End of Panel Surface Water Assessment

Observed surface impact sites

Figure 8

file: Dendrobium4.qgz

4. Assessment of surface water quality effects

Trigger values for water quality field parameters are defined in the Watercourse Impact Monitoring Management and Contingency Plan (WIMMCP) Attachment 1 (South32, 2020a). Trigger thresholds (TARPs) have been defined for three locations downstream of the mining area for which there is adequate high-quality baseline information (Wongawilli Creek (at Fire Road 6 [FR6]) and Donalds Castle Creek (at FR6) and Lake Avon (tributary site LA4_S1). The TARPs are based on the field parameters pH, EC and DO and defined by the value three standard deviations (SD) from the baseline mean (mean plus 3SD for EC and mean minus 3SD for pH and Dissolved Oxygen). TARP levels are defined as follows:

- Level 1: One exceedance during the monitoring period
- Level 2: Two exceedances during the monitoring period
- Level 3: Three exceedances during the monitoring period
- Exceeding prediction: Mining results in two consecutive exceedances during the monitoring period. Predicted impacts are summarised in the WIMMCP.

During the 12-month reporting period between the start of Longwall 16 (26/2/2020) and one month after the end of Longwall 16 (4/12/2020), monitoring was carried out at 231 sites. Sites were monitored on an approximately weekly or monthly basis, as per the WIMMCP.

TARP triggers for the monitoring period are summarised in Table 8.

Table 8. Summary of Water Quality TARPs for the monitoring period

DATE	CATCHMENT / LOCATION	PARAMETER	VALUE	TARP	TRIGGER LEVEL
20/5/2020 to 21/7/2020	Donalds Castle Ck (FR6) (Note: 5 occasions including consecutive sampling events)	EC	186 to 196	185.8	Level 3
3/08/2020	LA4_S1	EC	233	129.8	Level 2
1/09/2020	LA4_S1	EC	177	129.8	
3/08/2020	LA4_S1	pH	4.0	4.9	Level 2
1/09/2020	LA4_S1	pH	3.9	4.9	
3/08/2020	LA4_S1	DO	59.7	69.5	Level 1

Assessment of surface water quality effects is presented by catchment (watercourse) in the following subsections. Key figures are included in the text here, while a selection of plots (hydrographs) is available for all sites in **Appendix A**.

4.1 Donalds Castle Creek Catchment

Time series plots of key field parameters measured at Donalds Castle Ck (FR6) (DCC FR6) are shown in Figure 9, Figure 10 and Figure 11. Stream salinity (EC) and pH at DCC_FR6 have decreased significantly during the LW16 reporting period following a sharp increase in both parameters during 2019. Although EC returned to levels similar to baseline over the second half of the year, it remained slightly elevated in the first half of the year, triggering the water quality TARP on five occasions (Level 3). The recovery in EC and pH is likely due to the significant increase in rainfall and runoff during 2020. Dissolved oxygen remained within the baseline range during the Longwall 16 reporting period.

Concentrations of dissolved metals Mn, Zn and sulfate also spiked during 2019. Concentrations declined during 2020, but have not yet returned to baseline levels at DCC_FR6.

A longitudinal survey of water quality in pools along Donalds Castle Creek was carried out during Longwall 14 to identify the source of high salinity in the creek (Figure 12). The survey included several pools that are not routinely monitored and identified the highest EC values in DC_Pool 9 (647 µS/cm). Pool 9 is located 320 m downstream of the confluence between Donalds Castle Creek and tributary DC13, and near the shallow groundwater piezometer 02_01 in Swamp 2. The survey has been repeated quarterly (when accessible) since that time. The most recent two surveys carried out in September 2020 and January 2021 show a return of EC to baseline levels (and below the TARP trigger level for DCC_FR6) in all monitored pools including Pool 9.

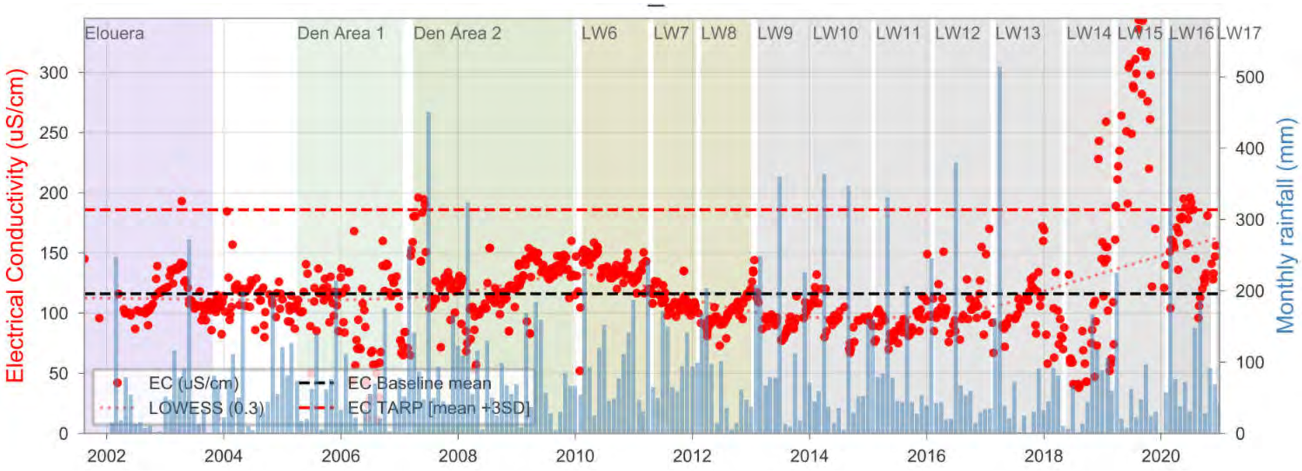

Figure 9. Field measured Electrical Conductivity (EC) at Donalds Castle Creek (FR6)

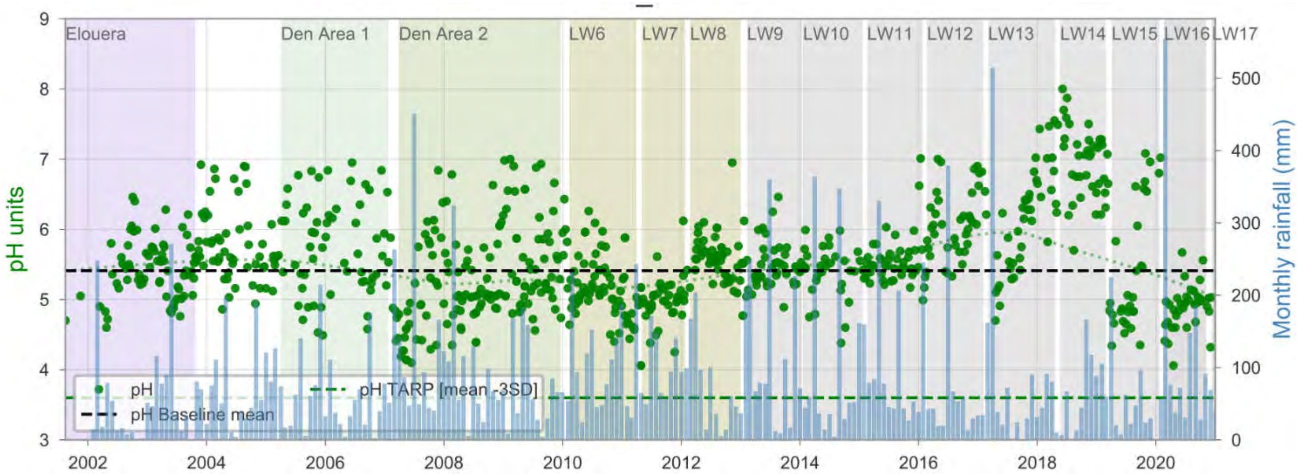

Figure 10. Field measured pH at Donald's Castle Creek (FR6)

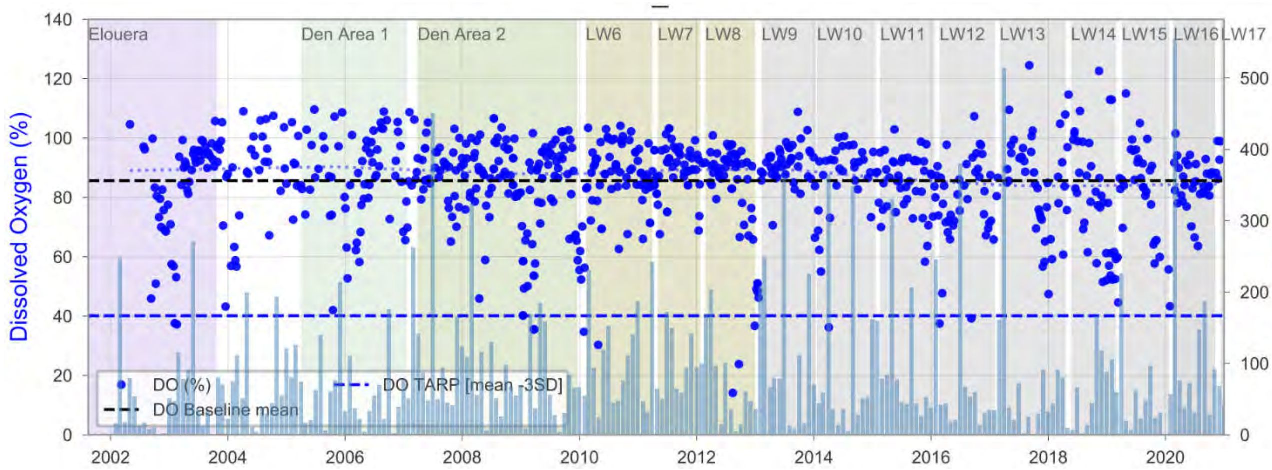

Figure 11. Field measured pH at Donald's Castle Creek (FR6)

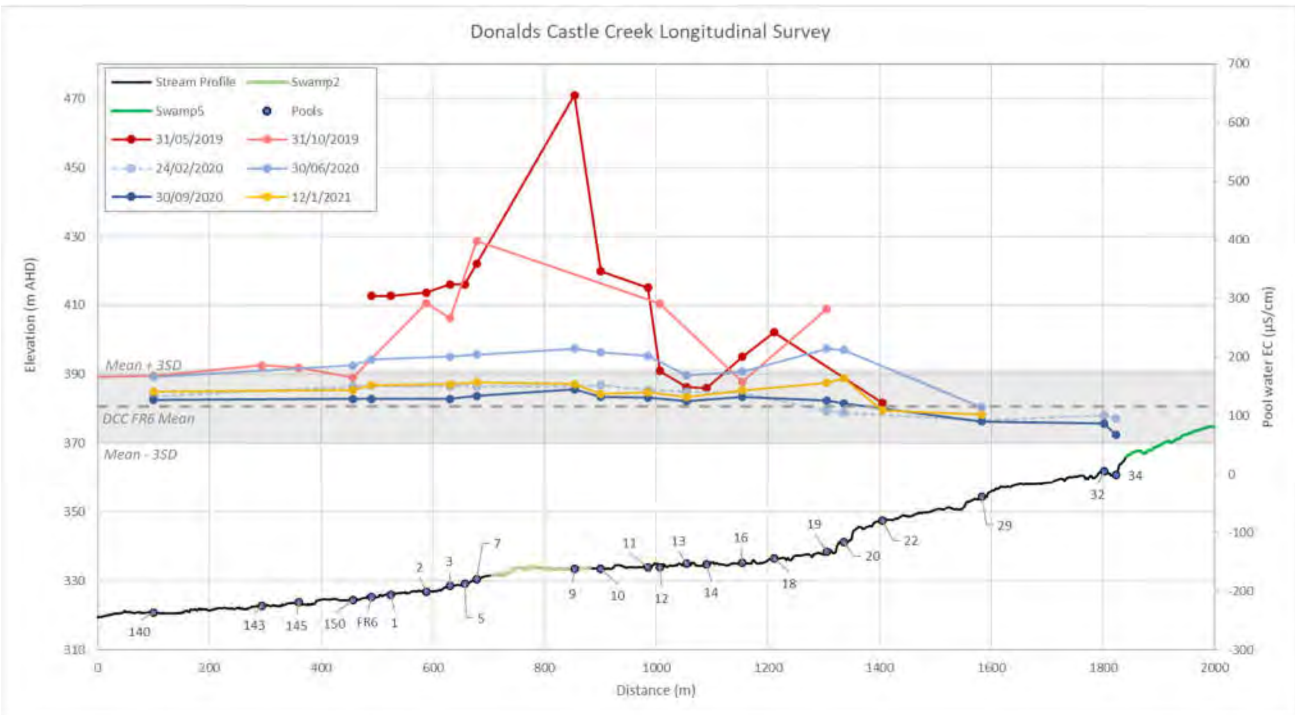

Figure 12. Longitudinal survey of EC in Donalds Castle Creek

4.1.1 Donalds Castle Creek tributaries

Many of the monitoring sites on first- and second-order tributaries of Donalds Castle Creek show an increase in EC over the period 2017-2019 compared with baseline conditions, with EC returning to to near baseline during 2020. The EC increase was associated with low or intermittently dry pool conditions, a trend towards lower pH and lower DO during the drought period. An example is DC Pool 19 (Figure 13).

Similar trends are seen in DC8_S1 and DC10_S1, the catchments of which are outside the zone of mining influence for Area 3B, suggesting that they are related to drought conditions rather than mining effects.

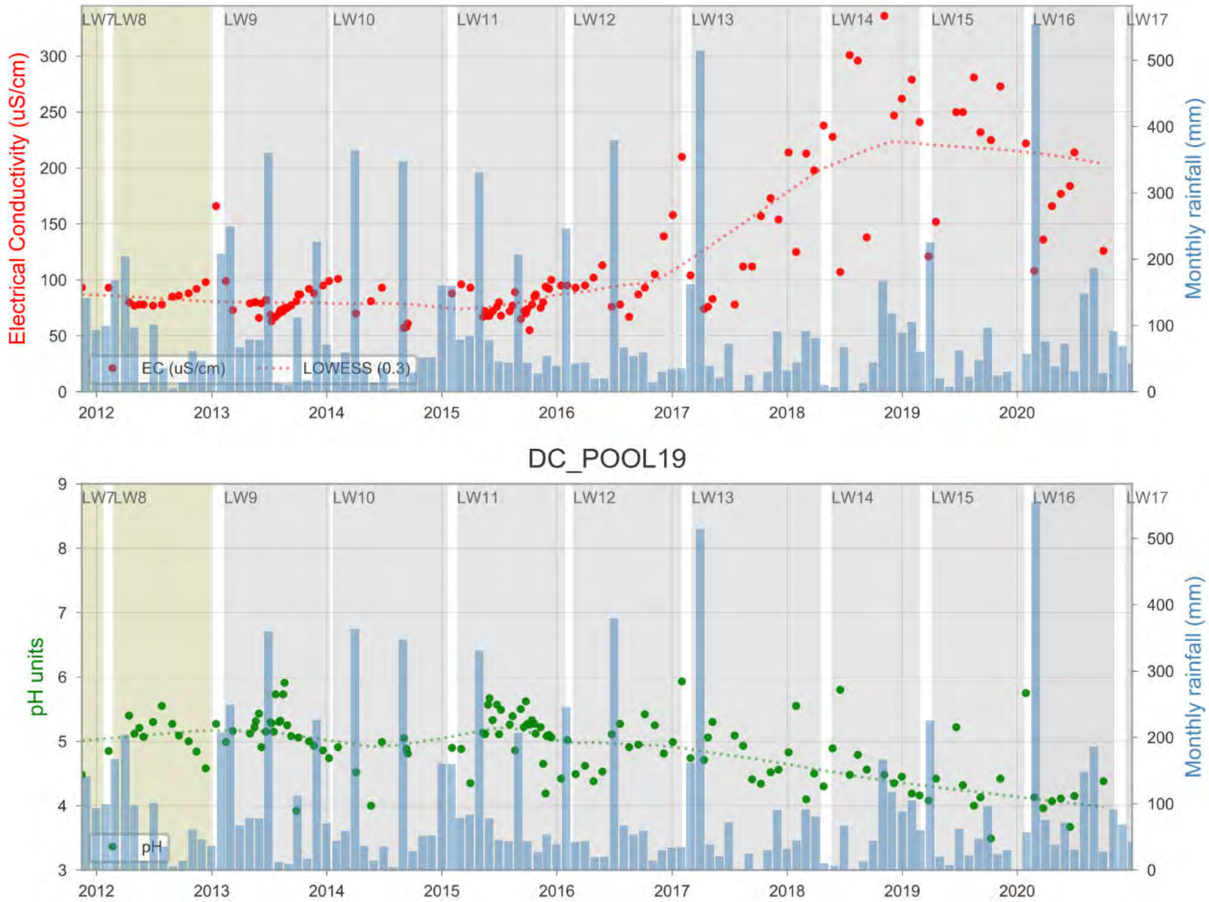

Figure 13. Pool water EC and pH at Donald's Castle Creek Pool 19

4.2 Wongawilli Creek Catchment

Plots of key field parameters from Wongawilli Creek at FR6 are shown in Figure 14, Figure 15 and Figure 16. Water EC increased and DO decreased during 2017 and 2018 in response to drought conditions. EC has trended downward since 2018 and was well-within the baseline range during 2020. There were no water quality TARP triggers for the Longwall 16 reporting period.

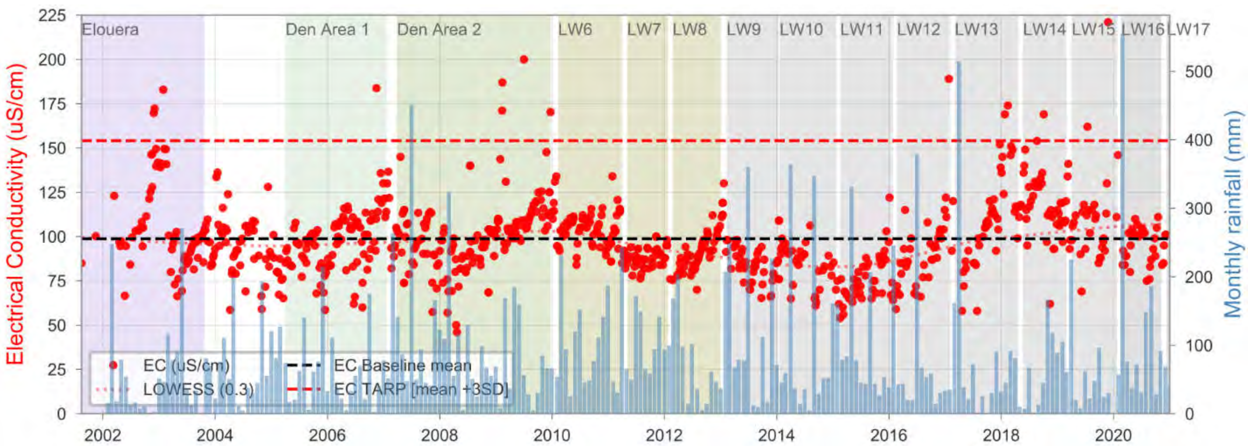

Figure 14. Field measured Electrical Conductivity (EC) at Wongawilli Creek (FR6)

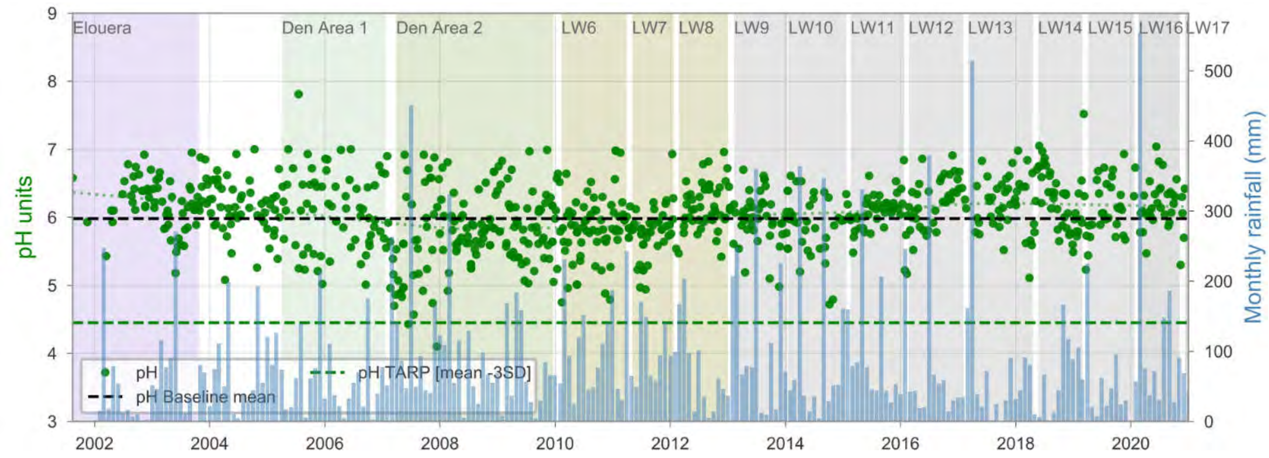

Figure 15. Field measured pH at Wongawilli Creek (FR6)

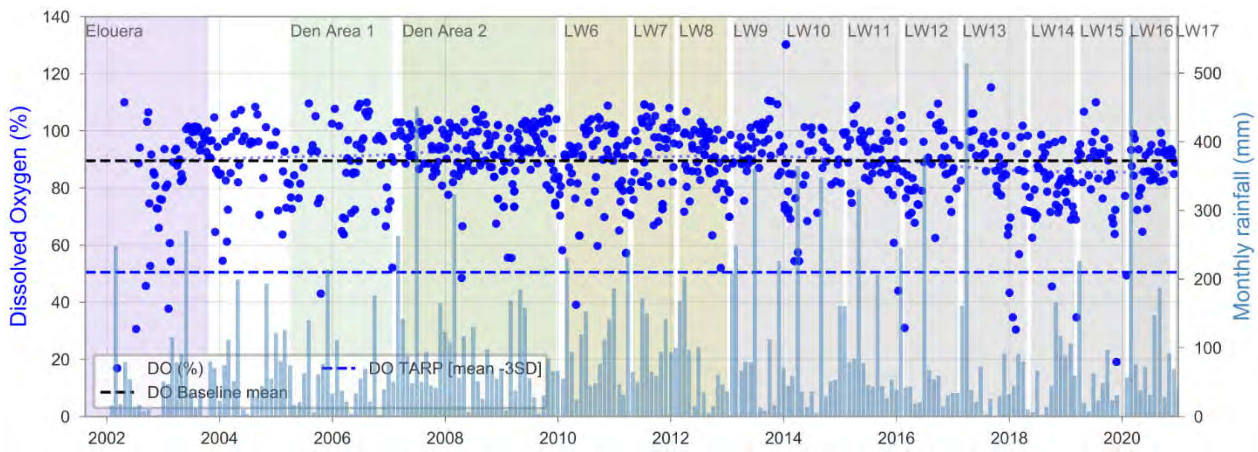

Figure 16. Field measured DO at Wongawilli Creek (FR6)

No adverse trends in dissolved metal concentrations compared with baseline conditions are noted at WC FR6.

Several pools along Wongawilli Creek (WC Pool 41, Pool 42a&b, WC_S1, WWU1 and WWU4) showed a trend of increasing EC during the 2017-2019 dry period. During 2020, the EC in Wongawilli Creek pools was similar to baseline conditions, with many pools showing a downward trend.

4.2.1 Subcatchment WC21

Wongawilli Creek tributary WC21 was affected by subsidence associated with Longwalls 9 to 14 which passed beneath the watercourse. Subsidence related fracturing of the stream bed resulted in diversion of flow from channels and pools that overlie the extracted panels. Pools 10, 6 and 5, downstream of Longwall 9 have retained water allowing continuous monitoring during mining at Area 3B.

At WC21 Pool 5, water EC has remained slightly elevated relative to the mean baseline EC since Longwall 11 (Figure 17) and is trending higher. Similar trends are noted in Pools 6 and 10. The increasing EC trend contrasts with the decline in EC seen in many pools following the end of the 2017-2019 drought and it is likely that subsidence impacts and redirection of water through fracture networks is contributing to the elevated EC in the lower pools of WC21. Water pH in Pools 5, 6 and 10 increased during Longwall 10 and have remained elevated relative to the baseline mean since that time (but within the near-neutral range; Figure 18). Dissolvd metals and sulphate at Pool 5 have been highly variable following Longwall 11, with elevated concentrations common after heavy rainfall events.

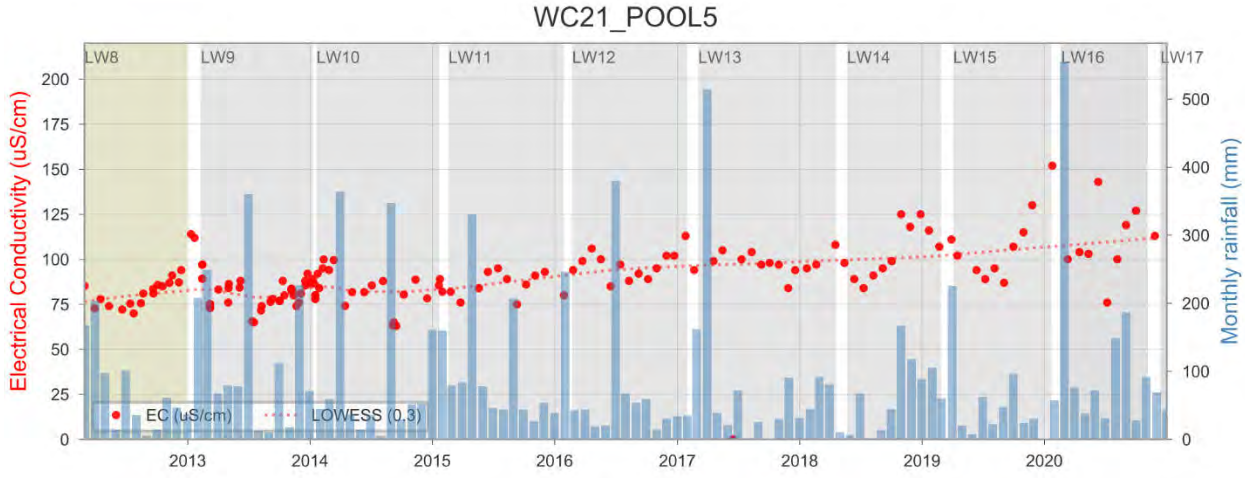

Figure 17. Field measured EC at WC21 Pool 5, downstream of Area 3B

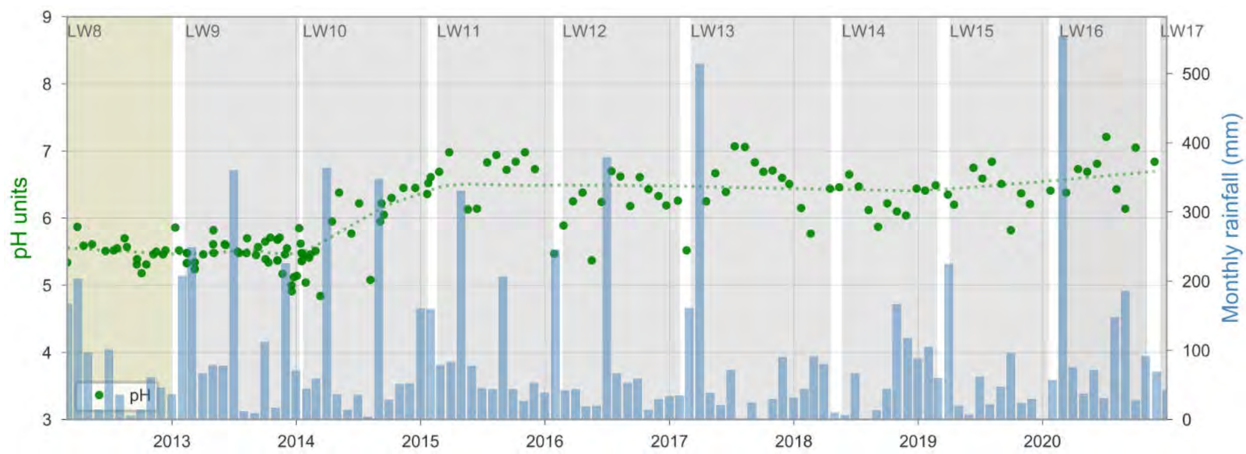

Figure 18. Field measured pH at WC21 Pool 5, downstream of Area 3B

4.2.2 Subcatchment WC15

Longwall 16 mined beneath WC15 in August 2020. Previously, Longwall 15 mined beneath the watercourse (late 2019) and Longwalls 13 and 14 were extracted to within 40 m of the tributary in April 2018 and February 2019, respectively.

The IMCEFT has recorded 21 impacts within or near the creek bed associated with subsidence from Longwalls 13 to 16, two of which are associated with Longwall 16 (LW16_028, LW16_030). Most records relate to fracturing of the sandstone in the creek bed or rockbars. Diversion of flows through the fracture network is observed at some locations (e.g. LW16_028) and is implied by the decline in pool levels and flow at most pools upstream of Pool 13 (Section 5.6.2).

Despite diversions of flow along the watercourse there is no evidence for a significant decline in water quality at the downstream monitoring locations. Pool 9 has the longest monitoring record of locations along WC15. Hydrographs for pool water EC and pH are shown in Figure 19. Electrical conductivity increased slightly during the 2017-2019 drought period and has returned to within the baseline range during 2020. Water pH remains at a similar level to baseline on average (~ pH 5), although there has been a greater range in pH levels since about 2015.

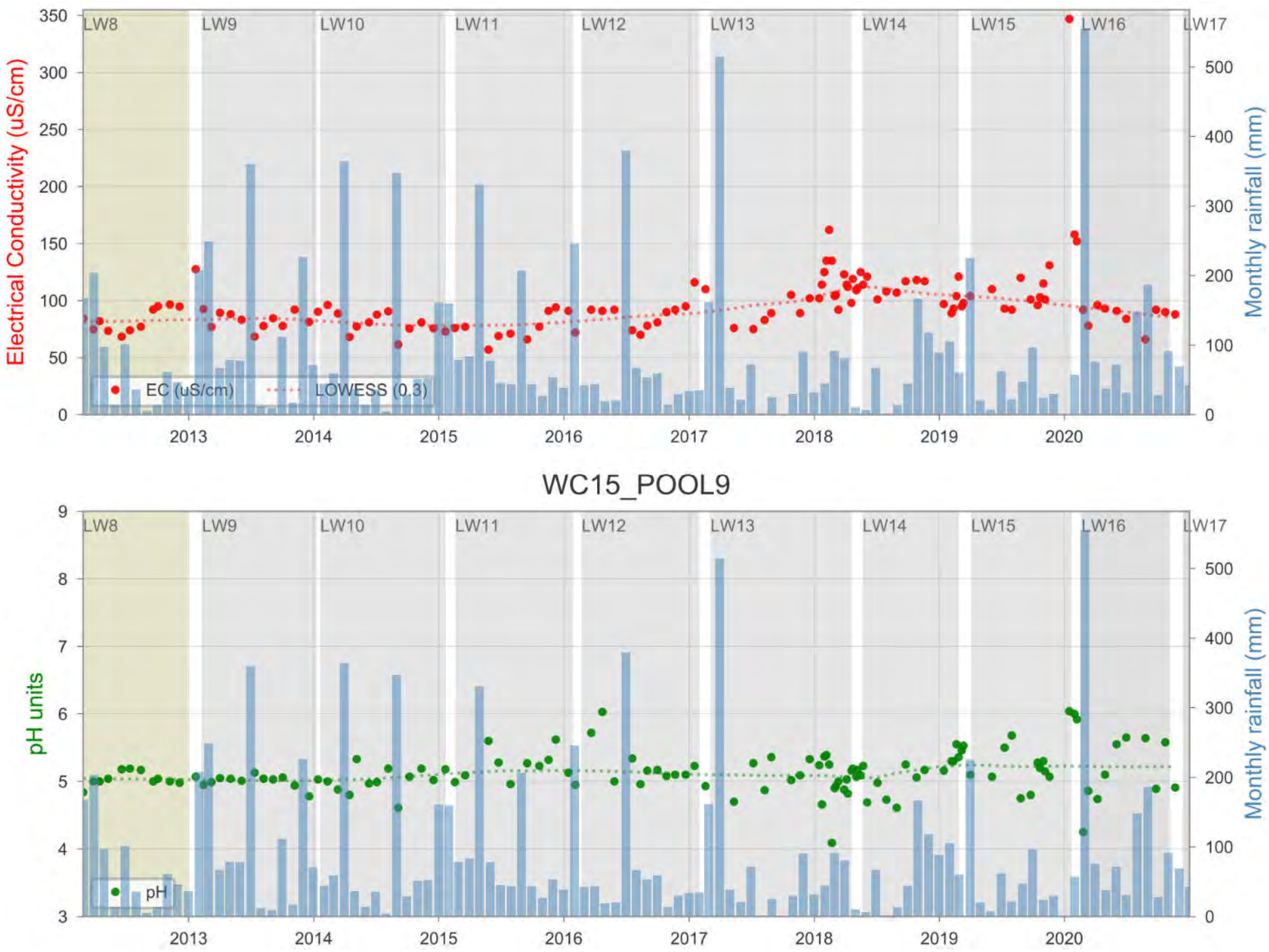

Figure 19. Water EC and pH in WC15 Pool 9

4.3 Lake Avon

Ground subsidence associated with Longwall 12 to 15 resulted in the development of surface cracking of the stream bed of LA4 at 9 locations, including near the gauging station weir LA4S1.

Fracturing of the creek bed near LA4S1 resulted in the diversion of flows just upstream of the LA4S1 gauge and measurable reduction in flow at the gauge, as reported previously (HGEO, 2017; South32, 2017), and in this report. Most pools on LA4 are typically dry during monitoring. LA4_S1 was able to be sampled three times during the reporting period. TARP levels for EC and pH were triggered on two occasions (Level 2 trigger) and DO was triggered once (Level 1).

Pool 3 on LA4A is typically full water and has a relatively uninterrupted water sampling record (Figure 20). The pool shows a decline in water levels during periods of low rainfall that last more than 3 to 4 months. More generally there has been a declining trend in pool levels despite the hight rainfall in 2020. Pool 3 EC increased from late 2016 / early 2017, corresponding to the start of Longwall 13 and the onset of drought conditions in late 2017. During 2020, pool EC remained elevated (~125 µS/cm) compared with baseline (~75 µS/cm). Pool pH ranged between pH 5 to 6.

Dissolved metals are analysed from LA4_S1. Due to subsidence fracturing, LA4_S1 is typically dry and no samples were collected between mid-2017 and mid-2020. Three samples were collected in 2020 which indicate elevated Sulphate and metals, including Al and Zn relative to baseline sampling.

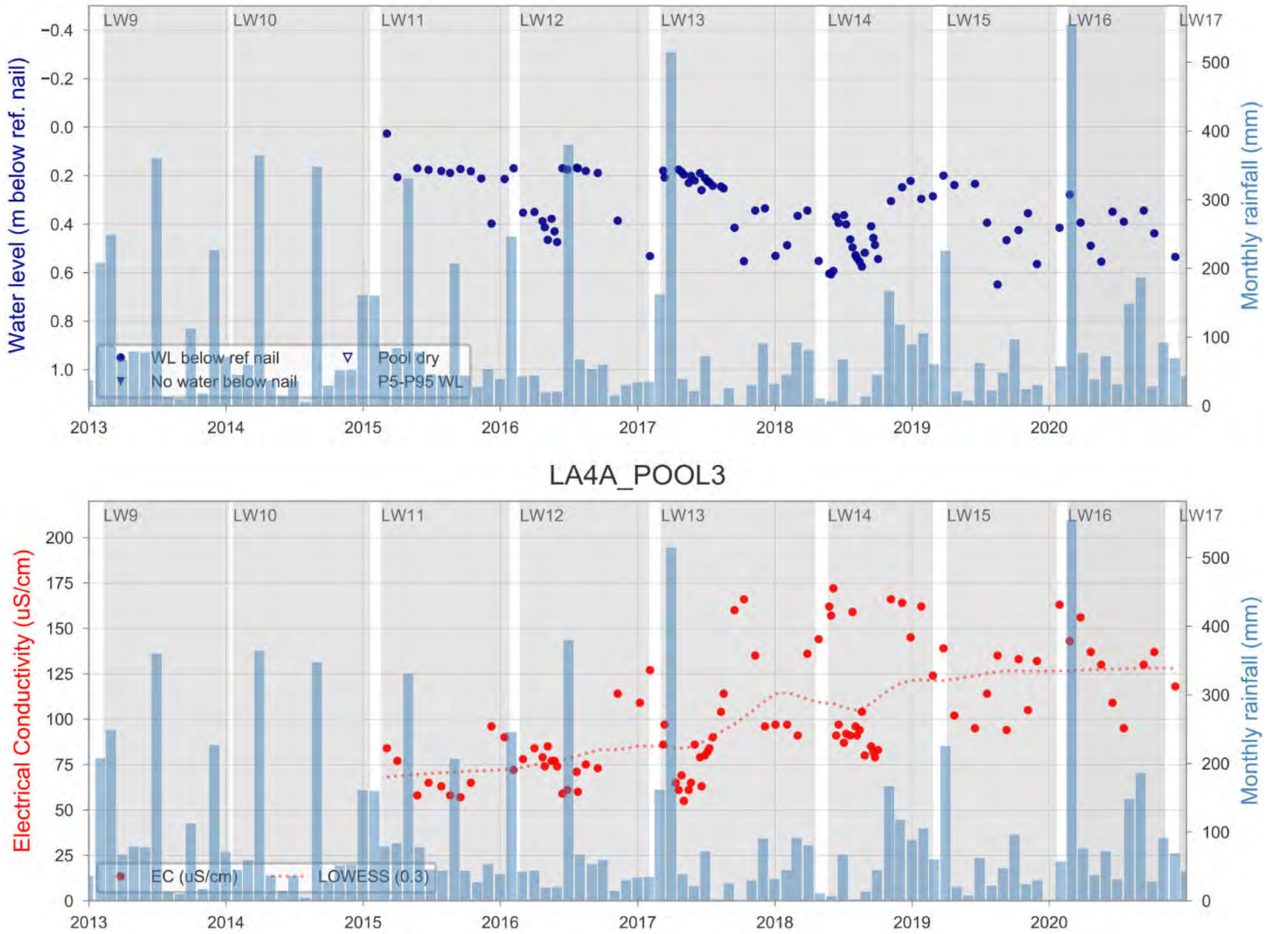

Figure 20. Field measured EC at Lake Avon tributary (LA4A_Pool 3)

The water quality in Lake Avon adjacent to the outlet from LA4 varies slightly in response to long-term weather patterns but remains within a narrow range of EC (Figure 21).

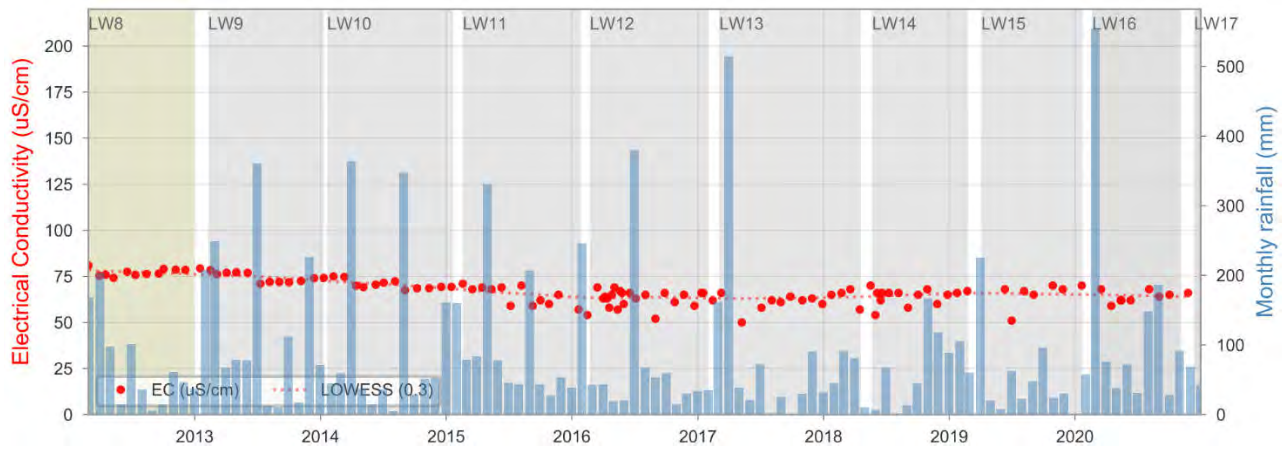

Figure 21. Field measured EC in Lake Avon at tributary outlet (LA4_S2)

At LA5_S1, water EC trended higher and DO lower than baseline during the 2017-2019 drought; however, both have returned to baseline levels during 2020 (Appendix A).

Other tributaries to Lake Avon have been monitored since 2016 as mining has progressed south. Those include NDT1 (Native Dog Creek), LA2 and LA3.

4.3.1 Lake Avon tributary LA3

The upper catchment and headwaters of tributary LA3 overlap with the western end of Longwall 15 which was extracted in April-May 2019. The headwaters start within Swamp 23 which also overlaps Longwall 15.

Pool 4 on tributary LA3 shows an increase in EC and decrease in DO starting in early to mid-2018 (Figure 22), corresponding with the extraction of Longwalls 13 to 15 (reported previously), but also corresponding to the drought period. During 2020, EC and DO returned to within or close to the baseline range. Although EC remains slightly elevated compared with the baseline.

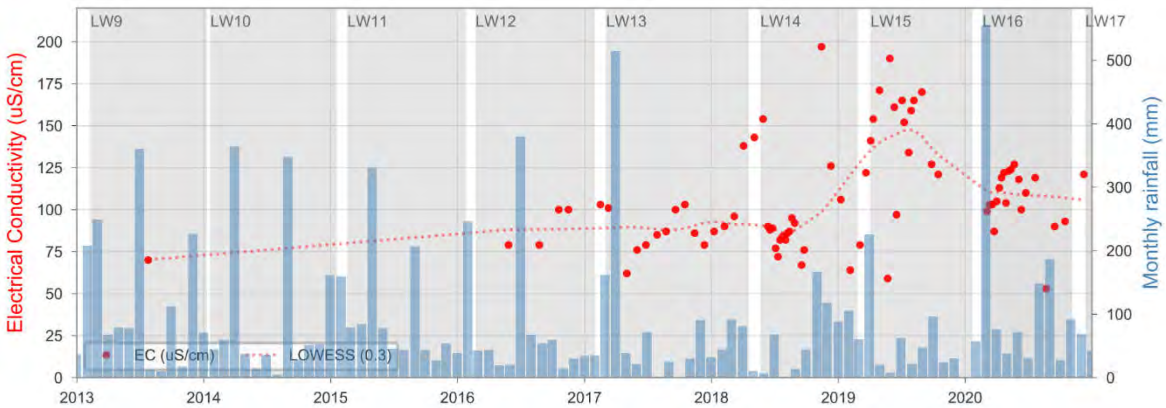

Figure 22. Field measured EC in Lake Avon tributary LA3 (Pool 4)

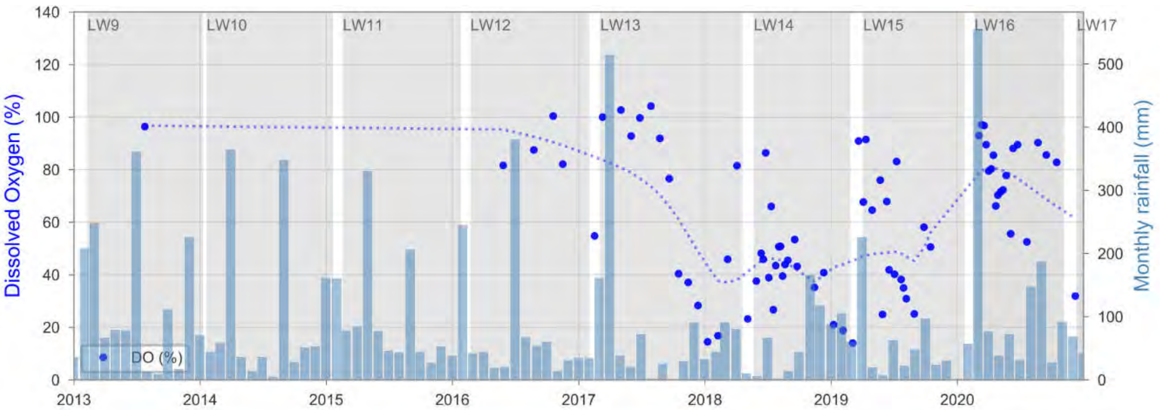

Figure 23. Field measured DO in Lake Avon tributary LA3 (Pool 4)

4.4 Sandy Creek

Sandy Creek catchment overlaps Dendrobium Areas 2 and 3A in which longwalls were extracted between 2007 and 2012. The Sandy Creek Catchment is well outside the mining zone of influence of Area 3B (> 1.4 km at its closest point). Hydrographs of field and laboratory parameters for the Sandy Creek tributaries are included in Appendix A.

On 19/10/2020 additional iron staining was noted in Sandy Creek tributary SC10C, with iron colouration extending downstream to the SC10 confluence and the Sandy Creek entrance to Cordeaux Reservoir. Staining was first report at SC10C on 11/3/2013, following extraction of Longwall 8 (Impact reference LW8_158). The increase in staining represents a Level 2 TARP trigger. No staining was observed within the reservoir.

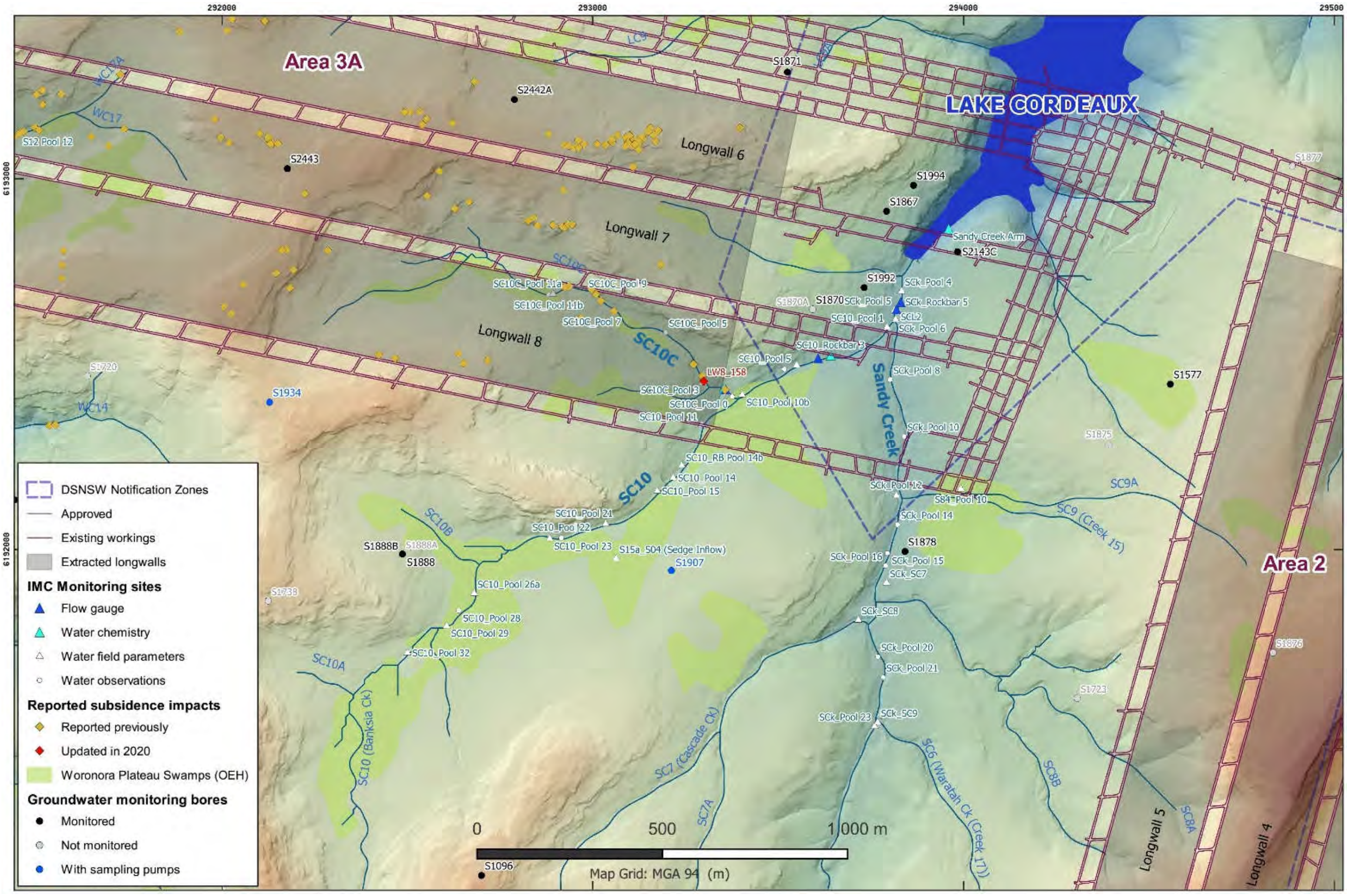

Figure 24. Location of Sandy Creek relative to extracted longwalls

Water quality trends in Sandy Creek vary between the tributaries; in general:

- Sandy Creek (main tributary): The main watercourse is outside the (400 m) zone of influence for mining in Areas 2 and 3A. Since monitoring started in 2009, EC has decreased and since ~2015 has remained stable at ~ 75 µS/cm (e.g., SCK_Pool12; Appendix A).

- SC10. Upstream of the confluence with SC10C, there has been a general increasing trend in EC since ~2015 with EC values remaining within the historical range. Although monitoring events in this tributary are now sparse, the same increasing trend is seen at nine monitored pools. The trend is associated with a slight downward trend in pH, with values typically in the range pH 4.8 to 5.2 in 2020. These trends are not considered to be related to mining activities, as much of the upper reaches of the tributary are beyond the mining zone of influence.

- SC10C. This tributary was directly mined under by Longwall 8, resulting in impacts to the creek bed, effects on water quality and localised iron staining. At the down-stream monitoring point (Pool 1) EC increased and was highly variable from the end of Longwall 8 (2013). EC has remained elevated (at ~270 µS/cm) through to the current monitoring period. The increase in EC was accompanied by a decrease in pH, commonly to between pH 3 and 4 between 2014 and

2018 (Figure 25). However, pH recovered rapidly to ~pH 6.2 during 2019 and 2020. DO has trended slightly lower since the end of Longwall 8. Trace metals and sulphate increased in concentration following Longwall 8 and have remained variable but generally elevated though to the current monitoring period. Dissolved iron was consistently high during 2020 (13 to 26 mg/L).

- SC10, downstream of the confluence with SC10C (e.g. SCK_Rockbar 5), EC is slightly elevated compared with upstream SC10, although pH and DO have remained consistent (Figure 26). Dissolved trace metals increased in concentration following Longwall 8, reflecting contributions from the SC10C tributary. Concentrations of trace metals such as Fe, Mn and Zn remain elevated and highly variable relative to baseline conditions (Figure 27).

- At Lake Cordeaux (Sandy Creek Arm), water quality generally fluctuates with long-term weather patterns, with EC gradually rising during dry periods and declining during high rainfall periods (Figure 28). Over 14 years of monitoring, EC has ranged between ~75 and 110 µS/cm with a near-neutral pH. Trace metal concentrations are low, although slightly elevated Fe and Mn were recorded towards the end of the 2017-2019 drought period, returning to baseline levels in 2020. Trends in EC and the spike in metals do not correlate with trends observed in tributary SC10C.

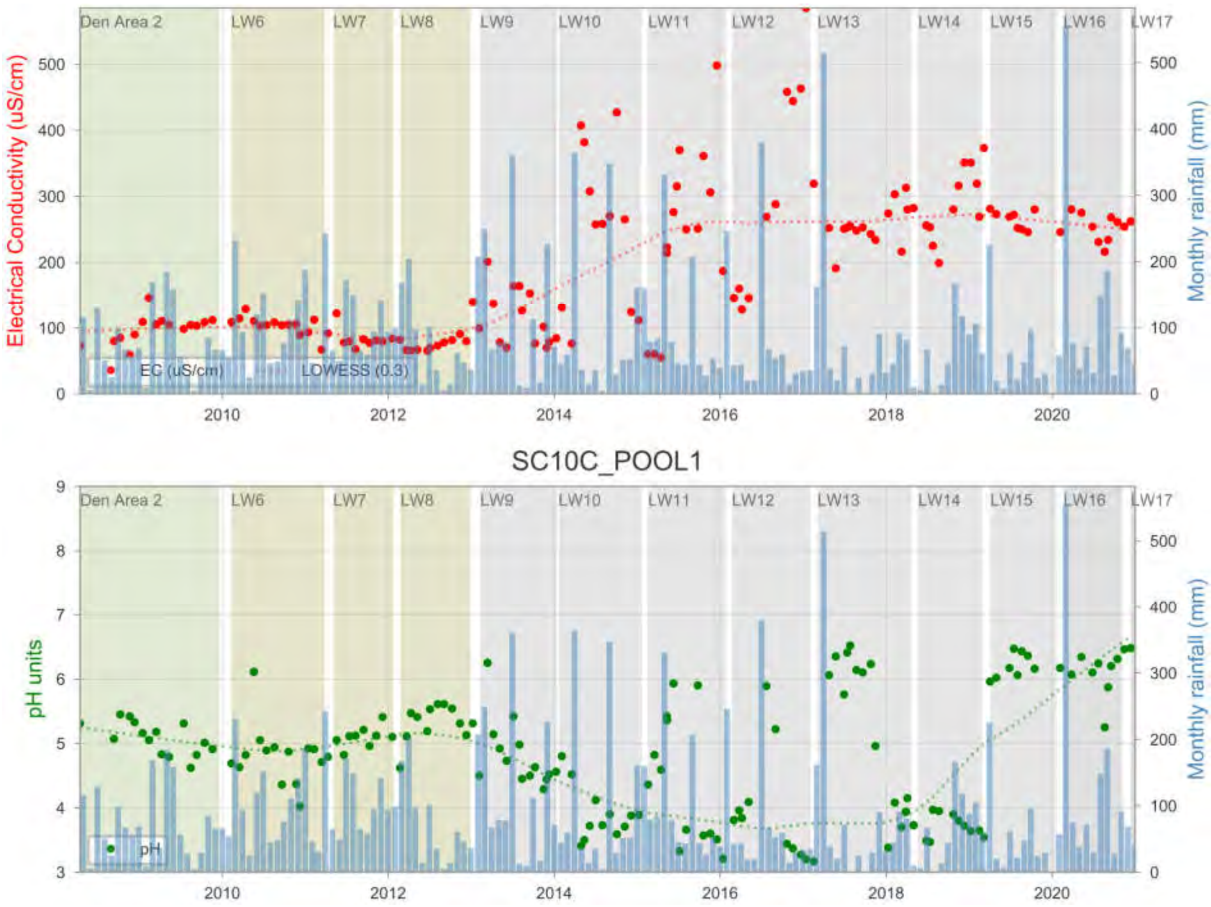

Figure 25. Field measured EC and pH in SC10C Pool 1

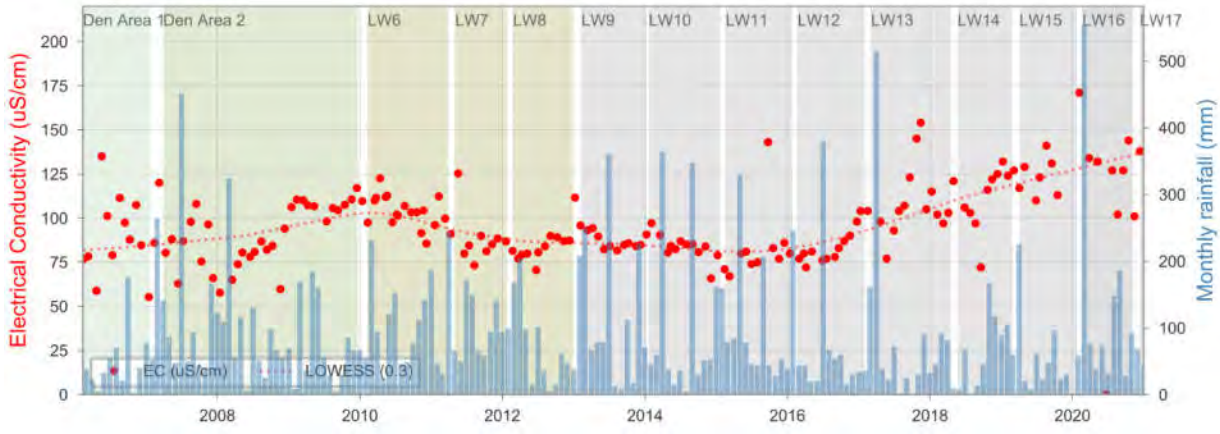

Figure 26. Field measured EC in Sandy Creek at Rockbar 5

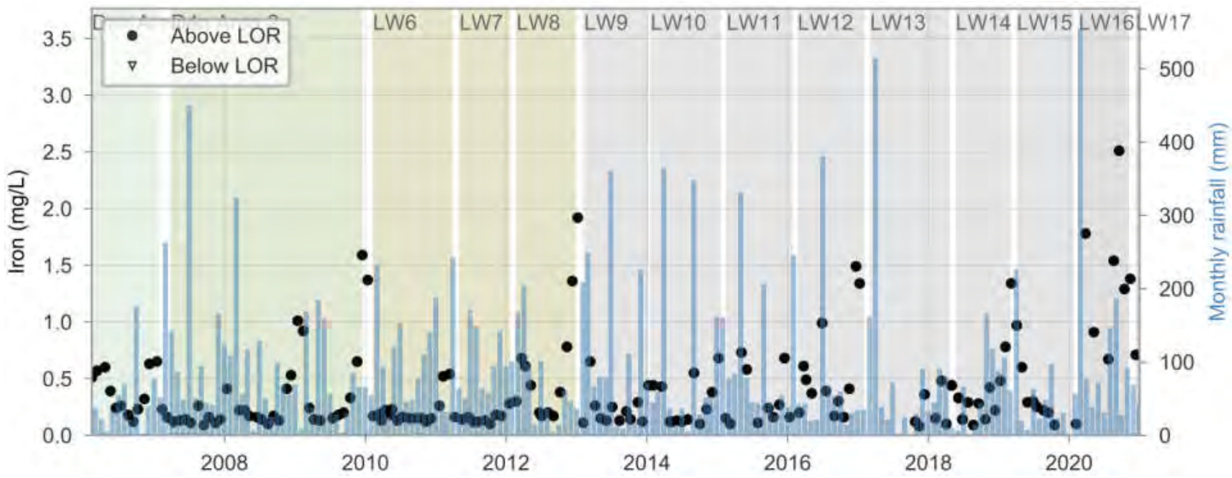

Figure 27. Dissolved iron in Sandy Creek at Rockbar 5

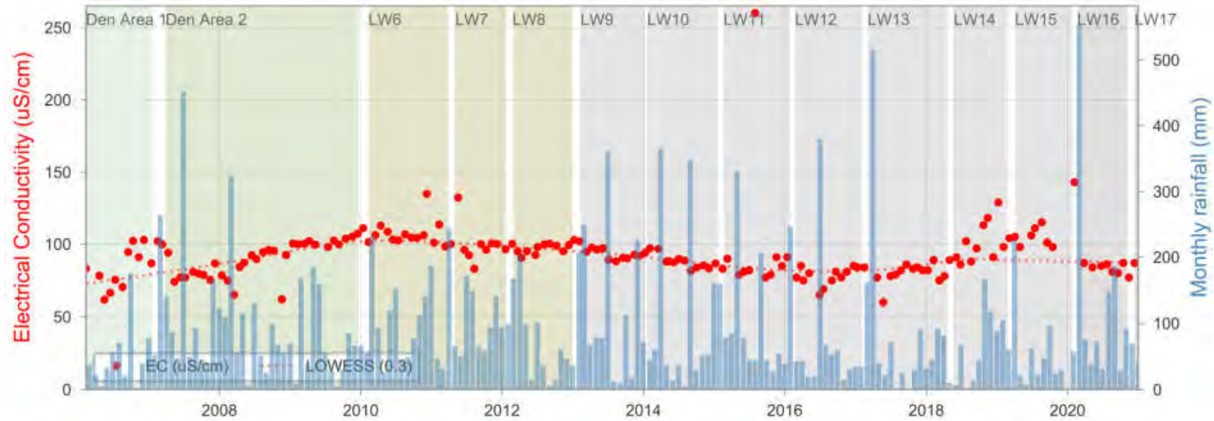

Figure 28. Field measured EC in Lake Cordeaux, Sandy Creek Arm

The incidence of altered water quality and iron staining is most likely related to groundwater discharge to the creeks via natural and subsidence induced fracture networks. Some of the discharge will be derived from surface water that was diverted through upstream fractures, and some will be derived from rainfall recharge and groundwater storage beyond the watercourse. Subsidence fractures expose fresh, unweathered rock surfaces that react with percolating groundwater (in the presence of oxygen and CO_2), resulting in dissolution of minerals and transport of solutes to discharge points. Changes to groundwater chemistry as a result of interactions with silicate rocks and sulphides minerals is well described (Appelo and Postma, 2005). Weathering of silicate minerals typically results in liberation of Si, Ca^{2+}, Na^{+}, K^{+} and Mg^{2+} ions and formation of clay minerals and iron oxides. Oxidation of sulphide minerals results in the release of Fe^{2+}, SO_4^{2-} and H^{+} ions, acidification of the groundwater, which in turn can mobilise metal ions.

4.4.1 The role of groundwater recovery

The recent recording of iron staining at SC10C seven years after the first occurrence is likely the result of recovering groundwater flooding previously drained fractures in the vicinity of SC10C. Groundwater monitoring bores were recently installed above extracted Longwalls 6 and 7 (bores S2442A and S2443) as part of an investigation into fracturing above longwall goafs (HGEO, 2020a, 2020b). The bores provide insights into the groundwater conditions beneath mined-under watercourses such as SC10C. The following observations are relevant to conditions at SC10C Pool 1 which is at an elevation of 344 m AHD:

- S2442A (Longwall 6) has three VWP sensors within the Hawkesbury sandstone (which underlies SC10C) at depths of 15 m, 49 m and 80 m. All three sensors record recovery of groundwater levels in perched aquifers within the Hawkesbury Sandstone during 2020 (Figure 29):
    - S2442A_15m: Increased from 0 to 2.13 m pressure head[1] (total head 394.76 m AHD), peaking on 14/8/2020, following heavy rain in late July/August 2020.
    - S2442A_49m: Increased from 0 to 0.45 m pressure head (total head 359.08 m AHD), peaking on 18/9/2020, following heavy rain in late July/August 2020.
    - S2442A_80m: Increase from 4.41 m to 9.89 m (to total head 337.52), still increasing as of 30/11/2020.
- S2443 (Longwall 7) has three VWP sensors within the Hawkesbury sandstone at depths of 14 m, 65 m and 113.5 m. All three sensors record recovery of groundwater levels in perched aquifers within the Hawkesbury Sandstone during 2020:
    - S2443_14m: Increased from 0.28 to 1.64 m pressure head (total head 414.29 m AHD), peaking on 26/8/2020, following heavy rain in late July/August 2020.
    - S2443_65m: Increased from 0 to 2.16 m pressure head (total head 363.81 m AHD), peaking on 18/9/2020, following heavy rain in late July/August 2020.
    - S2443_113.5m: Increase from 19.09 m to 23.60 m (to total head 336.75), still increasing as of 20/11/2020.

Both monitoring holes located above extracted longwalls in Area 3A show evidence for development of perched aquifers within Hawkesbury Sandstone above the elevation of SC10C Pool 1. At both holes groundwater levels increased throughout the Hawkesbury Sandstone in response to heavy rainfall in February 2020 and in late July/August 2020, with lag times increasing with depth. These data support

[1] Note that *pressure head* is the pressure measured by the sensor due to the column of groundwater above it, expressed as m of water. A pressure head of ~zero (or negative) implies unsaturated conditions at the sensor. *Total head* is the pressure head + the elevation of the sensor.

the mechanism whereby subsidence fractures that were previously unsaturated, have become flooded due to groundwater recovery following high rainfall in 2020, and possibly for the first time since longwall extraction. The appearance of iron staining in October 2020 is consistent with observed lags in groundwater response to large rainfall events.

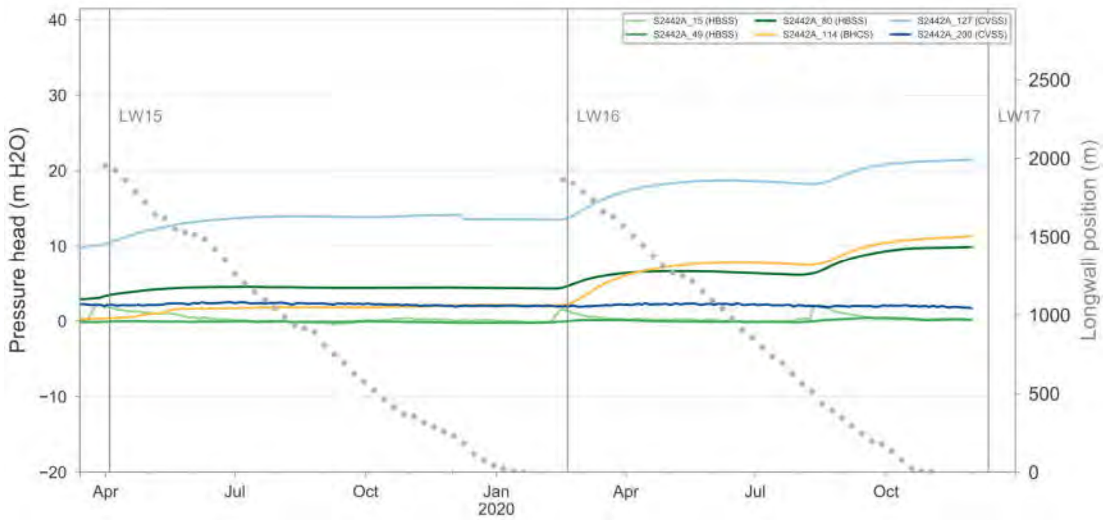

Figure 29. Groundwater hydrograph of pressure head at monitoring bore S2442A

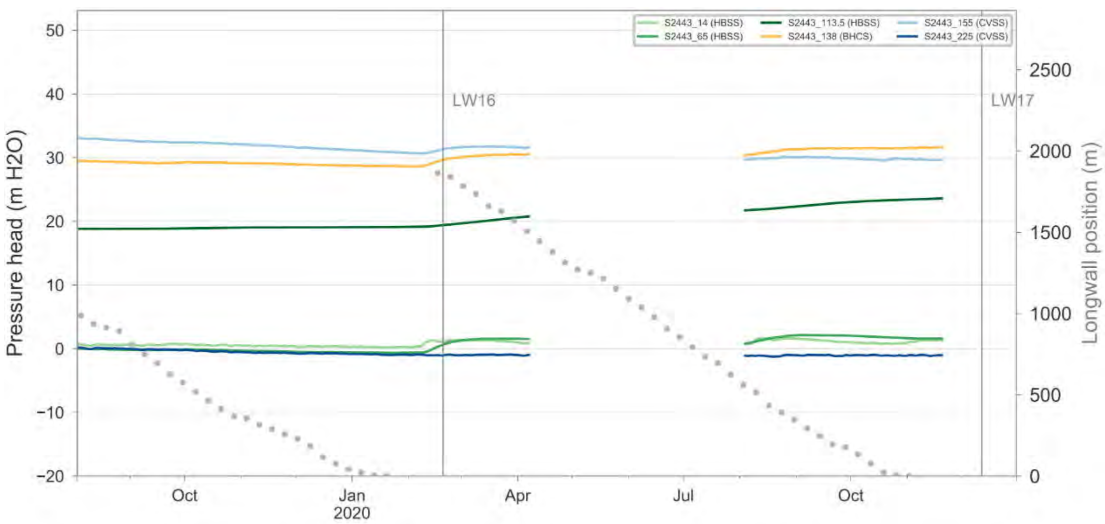

Figure 30. Groundwater hydrograph of pressure head at monitoring bore S2443

5. Assessment of surface water flow effects

5.1.1 Surface Water Flow TARPs

The surface water flow assessment and relevant TARPs have been modified from those used previously for Area 3B End of Panel reports. Consultation with agencies during 2018-2019 led to final agreement in early 2020 of new TARPs, as outlined in the WIMMCP (South32, 2020).

This assessment of surface water flow in this End of Panel report relies on comparison against flows at Reference Sites, as recommended by the IEPMC (IEPMC, 2019, 2018). The revised and agreed assessment methods are described in more detail in (Watershed Hydrogeo, 2019a). Other recommendations of the IEPMC are addressed in this assessment, as listed in Table 9.

Table 9. Recommendations of the IEPMC (2018) (revised as IEPMC, 2019a)

RECOMMENDATION / COMMENT	RESPONSE / ACTION
Assessment of impacts to be made against the full post-mining period, not longwall by longwall.	**Implemented.** Assessment of effects is now reported for the complete post-mining period at each site, rather than for each longwall. This provides an assessment of cumulative effects.
The EOP reports to provide more information on the data sources for rainfall, evaporation and the monitoring sites.	**Implemented.** This is presented Appendix B and C, noting that rainfall and evaporation are not required for assessment against Reference Sites.
Document the specific sources of rainfall and evaporation data used in the rainfall-runoff modelling.	**Implemented.** The rainfall and evaporation data sources are document ed in Appendix B, noting that rainfall and evaporation are not required for assessment against Reference Sites.
Discussion of flow monitoring errors and their impact on assessing compliance should be published and peer reviewed.	**Implemented** (On-going). Illawarra Metallurgical Coal are progressing with a review of gauging station accuracy. This report has been issued (EnviroMon, 2019) but will be extended in the near future to include other sites.
Use techniques to supplement the rainfall-runoff modelling. This has been done in some EOP reports, including for LW11 but has been excluded from the LW12 and LW13 EOP reports	**Implemented**. The use of Reference Sites, as documented in WatershedHG (2019a) and agreed by agencies, is now adopted for this assessment.
There is no validation on flow measurements from outside the calibration period.	**Not yet implemented:** The use of Reference Sites as the basis for assessment was agreed by agencies in the approved WIMCCP. More recent feedback by IAPUM recommended that comparison against rainfall-runoff modelling should be re-instated (Section 1.3). This has been done so for a limited number of sites (Section 5.3.1), and if deemed necessary can be expanded in future.
Given the criticality of low flows for this project, attempts to improve the low flow modelling should continue, and should be reported and peer reviewed.	**Not yet implemented:** As above.

The agreed Assessments A, B, and C are respectively focussed on assessing:

A. general hydrological behaviour compared with Reference Sites,

B. the frequency and duration of ecologically-significant cease-to-flow events compared with Reference Sites; and

C. changes to median flow compared with Reference Sites which is now the agreed measure of the water resource availability in each sub-catchment.

A further assessment, Assessment D is specific to Wongawilli Creek, relies on comparison of qualitative flow data from gauging stations and semi-quantitative field observations by IMCEFT along the “middle reach” of Wongawilli Creek, which has been shown in the recent past (e.g. in Watershed HydroGeo, (2018)) to be subject to baseflow loss due to depressurisation of groundwater systems as a result of mining activity.

5.1.2 Performance Measures

Performance Measures have also been agreed and are documented in the WIMMCP. These are outlined in Table 10. The assessment of these is presented in Section 5.3.

Table 10. Area 3B Surface flow Performance Measures

PERFORMANCE MEASURE	AGREED MEASURE
Wongawilli Creek – minor environmental consequences	Assessment Methods C and D, to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability “exceed prediction”.
Donalds Castle Creek – minor environmental consequences	Assessment Method C to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability “exceed prediction”.
Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon	Surface water inflows calculation = [Impacts at gauged catchments (LA2 + LA3 + LA4 + NDT1) + estimated impacts at ungauged but undermined catchments (e.g. LA5)] / [total inflow to LA].
Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek	Flow reduction as determined from measured at flow gauging station WWL_A (or WWL, whichever gauge is being used).

5.2 Assessment for Longwall 16

The following sections present the analysis and results of the agreed Assessments A, B, and C for each sub-catchment relevant to Area 3B. This is followed by Assessment D for the mid-reach of Wongawilli Creek and then followed by assessment against the agreed Performance Measures. The detail and criteria for each assessment are outlined in the WIMMCP (South32, 2020a), as described in Section 5.1.1.

At the gauged sub-catchments around Area 3B, the assessment consists of a three-step approach (A, B, and C as listed below) to identify and assess any changes in hydrology at the assessment sites in relation to the agreed reference sites. A fourth assessment (D) is carried out for Wongawilli Creek.

The four assessment methods are as follows:

(A) Change in flow exceedance (“Q%ile”) behaviour compared to Reference Sites. In essence, this aims to quantify an otherwise visual or qualitative assessment of flow behaviour (compared to normalised Reference Site flow). This test is considered a broad indicator of hydrological behaviour.

Greater proportion of time with lower flow than expected based on Reference Q%	Trigger level (Inference)
Proportion of time increased by < 10%	Not triggered – no evidence of impact (or impact below detection)
Proportion of time increased by >= 10%	Level 1
Proportion of time increased by >= 15%	Level 2
Proportion of time increased by >= 20%	Level 3

(B) Relative change in the frequency of cease-to-flow days compared to that at Reference Sites. This assessment is focussed on changes that are likely to be significant to ecological values.

Greater proportion (%) of time that cease-to-flow conditions occur	Inference
<= "natural variability" + 5%	No evidence of impact (or impact below detection)
> "natural variability" + 5%	Level 1
> "natural variability" + 10%	Level 2
> "natural variability" + 20%	Level 3

(C) Relative change in median flow ("Q50") compared to Reference Site flows. This assessment is focussed on a measure of the water resource potential of each sub-catchment, noting that 'average' flow is not used due to the high uncertainty associated with high flows. The uncertainty is less at moderate flows (EnviroMon, 2020), and the calculation of median flow is much less sensitive to uncertainties; and

Relative change in Q50	Inference
<= "natural variability" + 10%	No evidence of impact (or impact below detection)
> "natural variability" + 10%	Level 1
> "natural variability" + 15%	Level 2
> "natural variability" + 20%	Level 3

(D) Assess whether observed dry pools and 'cease-to-flow' conditions along Wongawilli Creek between WWU and WWL gauging stations are anomalies, and indicative of mining-related drawdown along that valley (as described in Watershed HydroGeo, 2018).

Observations of no flow	Inference
Observation that the subject Creek has ceased to flow at spatially consecutive observation sites.	Level 2 → Carry out Assessment D.

If any of these indicate an impact is likely to have occurred, then the EOP will describe the Impact as it relates to one or more of the broad hydrological behaviours, a reduction in the water resource Indicator, or an effect that could modify or impact upon the ecological values of the stream.

5.3 Assessment against surface water flow TARPs

The following sub-sections (Sections 5.3.1 to 5.3.11) summarise the TARP Assessments A, B and C for each relevant sub-catchment using the criteria outlined in the previous section. A secondary check for sites that do not Trigger Level 3 for Assessment C is presented in Section 5.3.13.

TARP Assessment D for flow conditions along Wongawilli Creek is presented in Section 5.4.

5.3.1 DC13S1 – tributary of Donalds Castle Creek

This tributary lies across the centre of several Area 3B panels. The catchment to DC13S1 was first mined under at the commencement of Longwall 9, and again by Longwalls 10 and 11. Longwalls 12 to 16 did not directly mine under this sub-catchment.

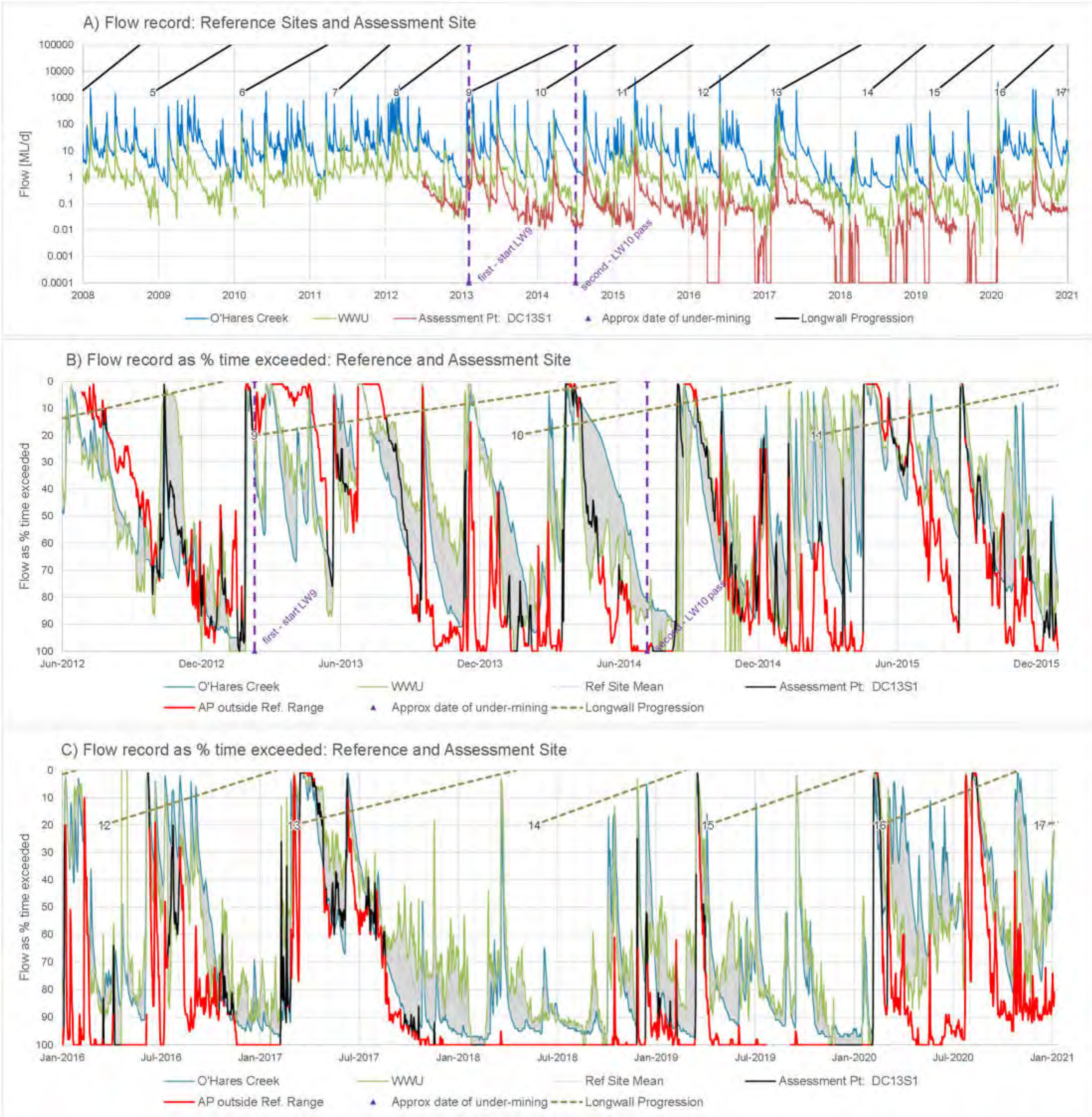

Figure 31. Comparison of DC13S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the DC13 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 11. Flow assessments A, B and C for the sub-catchment to DC13S1

DC13S1	Pre-mining	Post-mining	
	to start LW9	end LW16 + 30 days	
	27/06/2012	10/02/2013	
	9/02/2013	04/12/2020	
Method A:	**Assessment of flow variability:**		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining	14%	59%	of the time
Post-mining	72%	9%	of the time
Change	59%	-50%	of the time
		Assessment A:	Level 3

Method B:	Change in cease-to-flow frequency:		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	10.1%	5.6%	-4.5%
Bomaderry Creek	33.8%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			-1.8%
DC13S1	0.0%	17.3%	17.3%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		19.6%
		Assessment B:	Level 2

Method C:	Change to median flow (Q50):		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	5.46	5.94	9%
WWU	0.40	0.37	-8%
Bomaderry Creek	3.27	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	-18%	n/a	n/a
excluding Bomaderry Ck	-8%	1%	9%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
DC13S1	0.126	0.048	-62%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	-54.2%	-62.3%	-70.5%
ML/d change, excl. Bomaderry	-0.068	-0.078	-0.088
		Assessment C:	Level 3

5.3.2 DCS2 – Donalds Castle Creek

The upper reach of Donalds Castle Creek lies across several Area 3B panels. This sub-catchment was first mined under by Longwall 9 (July 2013), then by Longwalls 10-12. Longwall 13 passed within 250 m of the creek in May-2017. Longwalls 14-16 have not mined directly under this catchment.

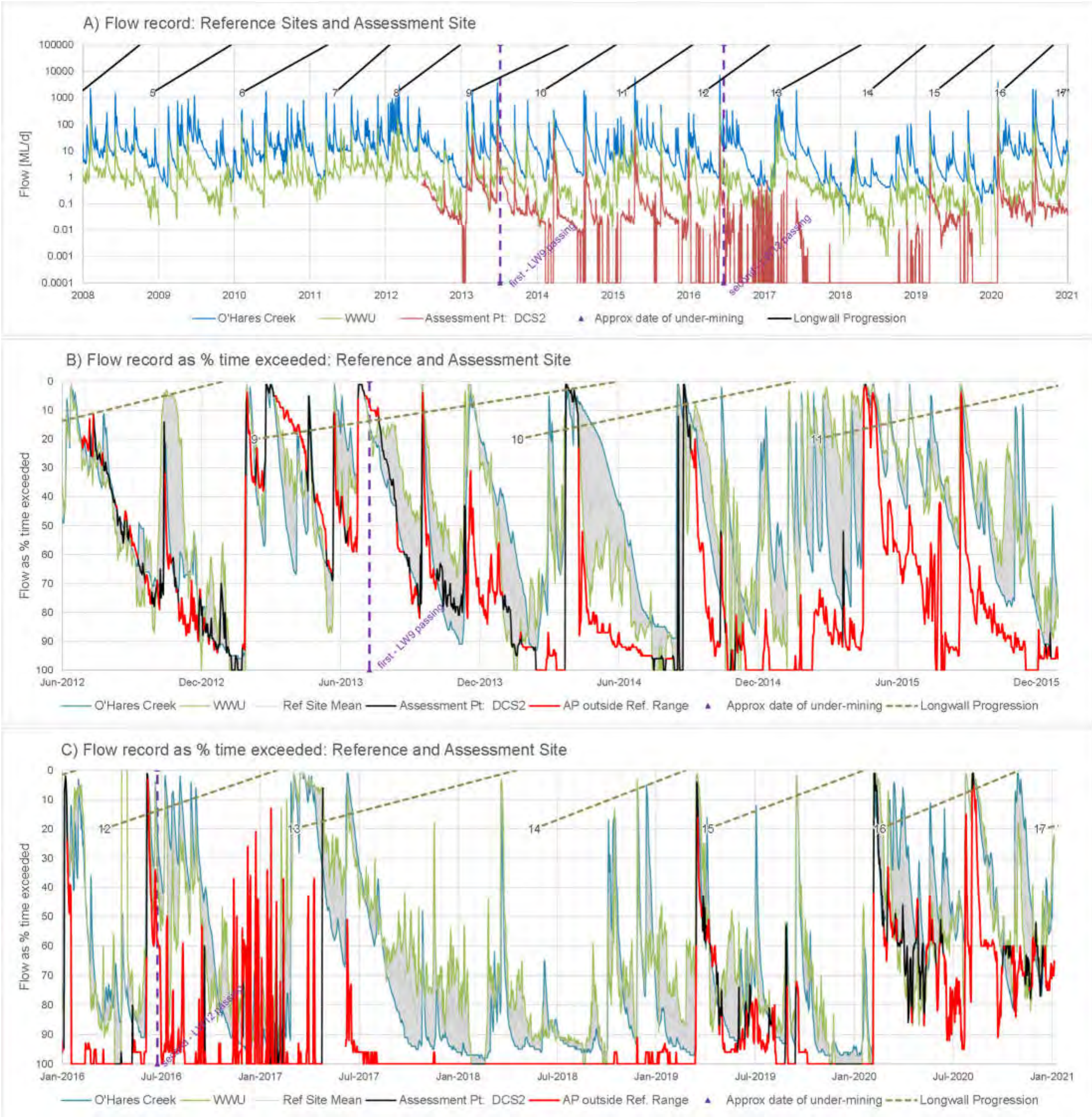

Figure 32. Comparison of DCS2 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the DCS2 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 12. Flow assessments A, B and C for the sub-catchment to DCS2

DCS2	Pre-mining	Post-mining	
	to LW9 passing	end LW16 + 30 days	
	27/06/2012	11/07/2013	
	10/07/2013	04/12/2020	

Method A:	Assessment of flow variability:		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)		higher flow (lower Q%ile)
Pre-mining	14%	59%	of the time
Post-mining	72%	9%	of the time
Change	59%	-50%	of the time
		Assessment A:	Level 3

Method B:	Change in cease-to-flow frequency:	DCS2	
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	6.1%	5.9%	-0.2%
Bomaderry Creek	20.3%	n/a	n/a
		Average Ref Site change, inc. Bomaderry Creek:	n/a
		Average Ref. Site change ex. Bomaderry Creek (= natural variability):	-0.1%
DCS2	2.9%	42.8%	39.9%
		no. of cease-to-flow days increased: (inc. Bomaderry Creek):	n/a
		no. of cease-to-flow days increased: (ex. Bomaderry Creek):	40.0%
		Assessment B:	Level 3

Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	8.52	5.25	-38%
WWU	0.82	0.33	-60%
Bomaderry Creek	4.70	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	-60%	-49%	-38%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
DCS2	0.164	0.010	-94%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	-33.8%	-44.7%	-55.5%
ML/d change, excl. Bomaderry	-0.055	-0.073	-0.091
		Assessment C:	Level 3

5.3.3 DCU – Donalds Castle Creek

This catchment incorporates the headwater sub-catchments DC13 and DCS2, and was mined under at the commencement of Longwall 9, and again by Longwalls 10-12, and marginally by Longwall 13. Longwalls 14 -16 are beyond it (to the south). About 60% of the DCU catchment is not mined under.

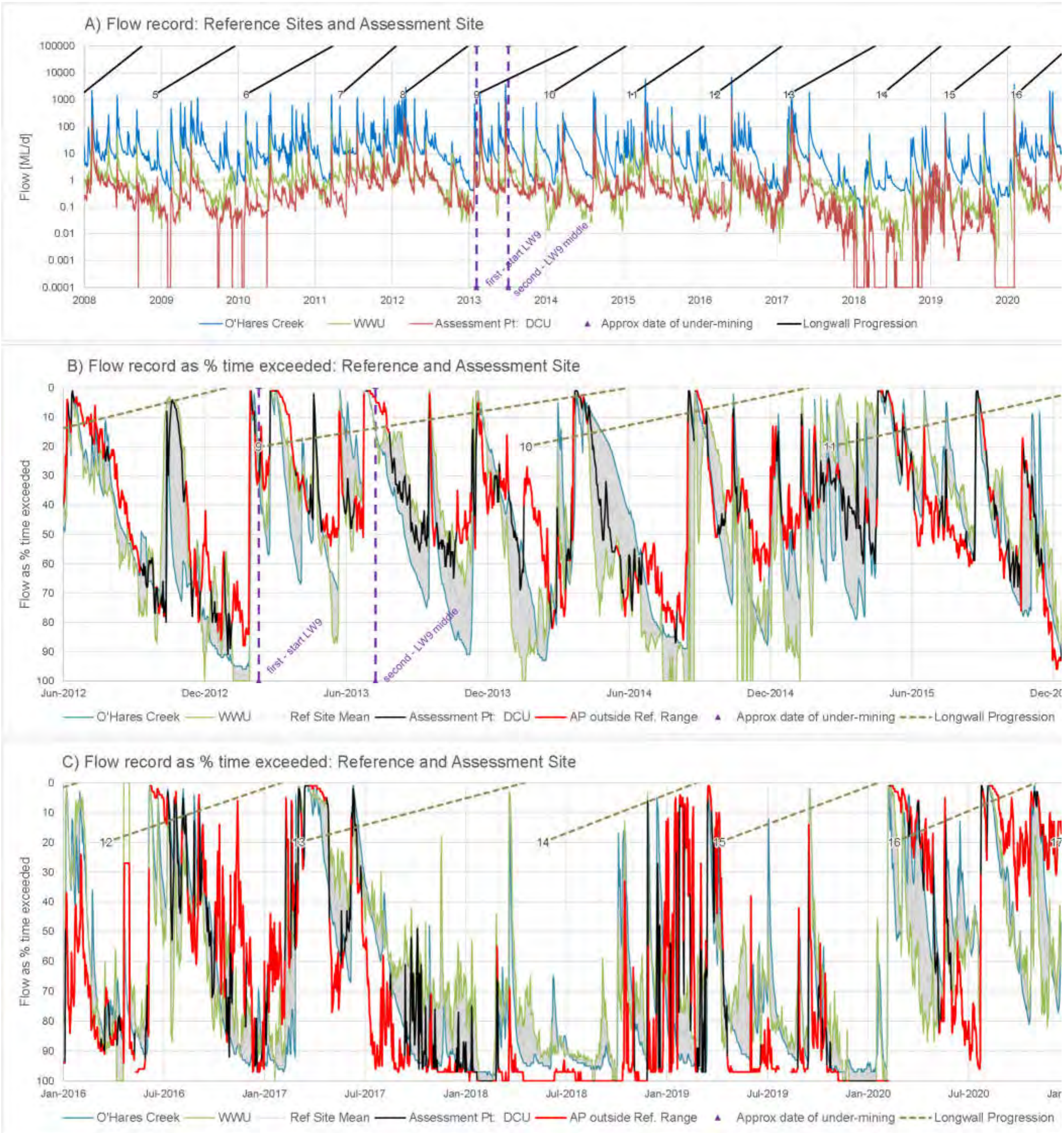

Figure 33. Comparison of DCU against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the DCU Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 13. Flow assessments A, B and C for the sub-catchment to DCU

DCU	Pre-mining	Post-mining	
	to start LW9	end LW16 + 30 days	
	1/01/2008	10/02/2013	
	9/02/2013	04/12/2020	

Method A:	Assessment of flow variability		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining	48%	25%	of the time
Post-mining	41%	31%	of the time
Change	-6%	6%	of the time
		Assessment A:	Not triggered

Method B:	Change in cease-to-flow frequency		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	5.2%	5.6%	0.3%
Bomaderry Creek	8.7%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			-1.8%
DCU	1.8%	10.4%	8.6%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		8.5%
		Assessment B:	Level 1

Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	11.64	5.94	-49%
WWU	1.03	0.37	-64%
Bomaderry Creek	6.21	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	-64%	-57%	-49%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
DCU	0.368	0.271	-26%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	+38.0%	+30.3%	+22.6%
ML/d change, excl. Bomaderry	0.140	0.112	0.083
		Assessment C:	Not triggered

5.3.4 WC12S1 – Wongawilli Creek tributary

The end of Longwall 15 skirted the north-western edge of this sub-catchment and to within 250 m of the watercourse itself. Longwall 16 mined under this sub-catchment, and within 40 m of the watercourse. No landscape impacts (cracking, iron-staining) have been reported by IMCEFT.

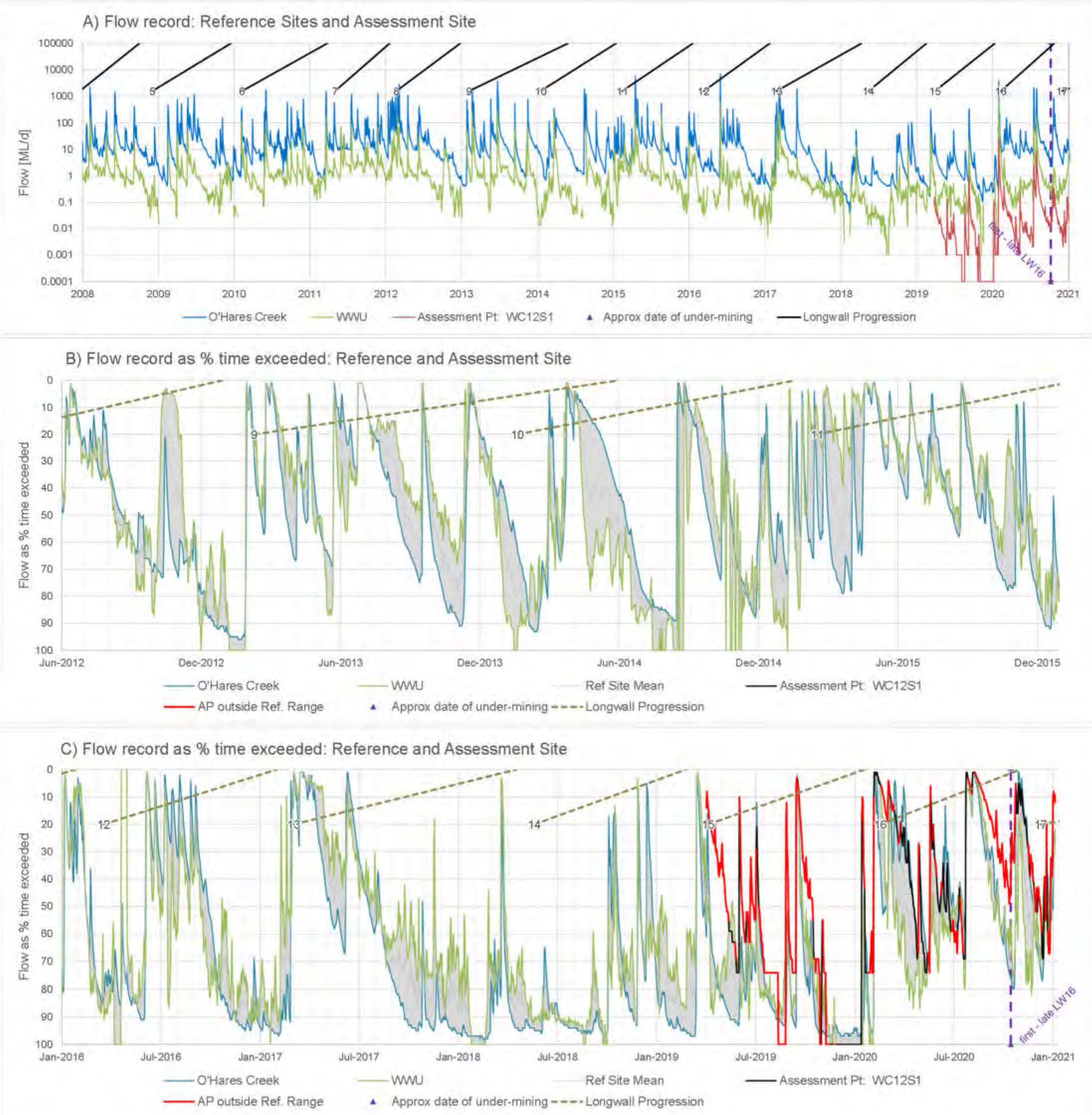

Figure 34. Comparison of WC12S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WC12S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 14. Flow assessments A, B and C for the sub-catchment to WC12S1

WC12S1		Pre-mining	Post-mining	
		to current date	end LW16 + 30 days	
		5/04/2019	19/10/2020	
		18/10/2020	4/12/2020	
Method A:	Assessment of flow variability:			
Period		Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining		9.9%	56.5%	of the time
Post-mining		0.0%	53.2%	of the time
Change		-9.9%	-3.3%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency:			
		Cease to flow as % of daily record during	pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		11.2%	0.0%	-11.2%
Bomaderry Creek		54.5%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:				n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):				-5.6
WC12S1		14.7%	0.0%	-14.7%
		no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
		no. of cease-to-flow days increased: (ex. Bomaderry Creek):		-9.1%
			Assessment B:	Not triggered
Method C:	Change to median flow (Q50):			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		5.09	18.56	265%
WWU		0.24	0.32	35%
Bomaderry Creek		n/a	n/a	n/a
Natural variability		Min	Mean	Max
including Bomaderry Ck		n/a	n/a	n/a
excluding Bomaderry Ck		35%	150%	265%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
WC12S1		0.009	0.035	289%
Change beyond natural		Min	Mean	Max
% change, including Bomaderry.		n/a	n/a	n/a
% change, excluding Bomaderry		+253.6%	+138.8%	+24.0%
ML/d change, excl. Bomaderry		0.023	0.012	0.002
			Assessment C:	Not triggered

5.3.5 WC15S1 – Wongawilli Creek tributary

Longwall 12 came within 100 m of the sub-catchment. Longwall 13 mined under this catchment and approached to within about 20 m of this watercourse, and directly under the WC15A tributary). Longwall 14 approached to within 40 m of the watercourse. Longwalls 15-16 mined under WC15.

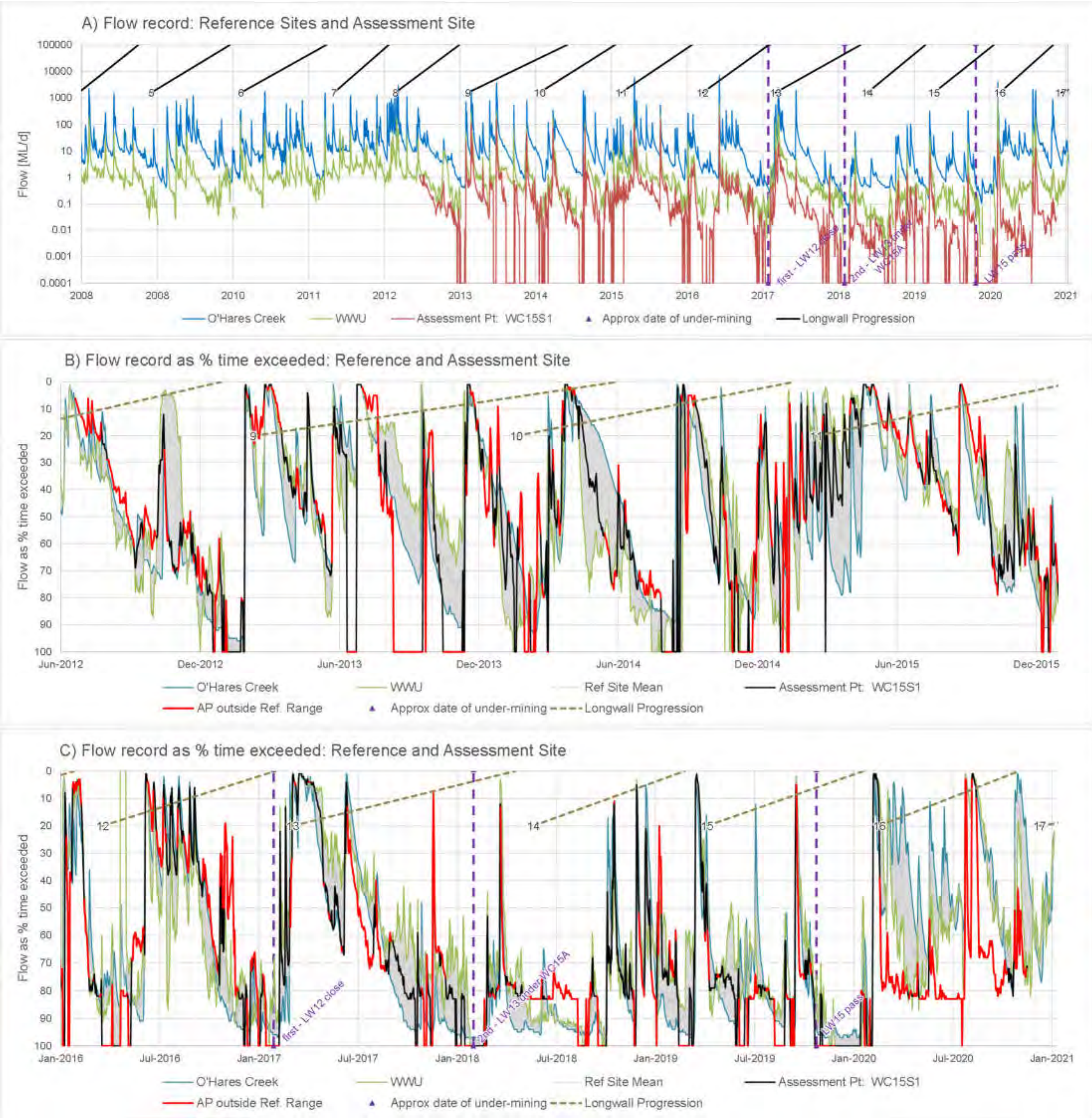

Figure 35. Comparison of WC15S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WC15S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 15. Flow assessments A, B and C for the sub-catchment to WC15S1

WC15S1	Pre-mining	Post-mining	
	to LW12 close	end LW16 + 30 days	
	20/06/2012	29/01/2017	
	28/01/2017	4/12/2020	
Method A:	Assessment of flow variability		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining	24%	36%	of the time
Post-mining	44%	14%	of the time
Change	20%	-22%	of the time
		Assessment A:	Level 3

Method B:	Change in cease-to-flow frequency		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.00%
WWU	4.8%	7.3%	2.5%
Bomaderry Creek	7.4%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			1.3%
WC15S1	15.3%	0.0%	-15.3%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		-17.0%
		Assessment B:	Not triggered

*As per Section 5.4, if based on other data or a change in the frequency of flow <0.001 ML/d → Level 1

Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	8.46	2.55	-70%
WWU	0.58	0.24	-59%
Bomaderry Creek	5.47	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	-70%	-64%	-59%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
WC15S1	0.124	0.014	-89%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	-18.9%	-24.5%	-30.1%
ML/d change, excl. Bomaderry	-0.023	-0.030	-0.037
		Assessment C:	Level 3

5.3.6 WC21S1 – Wongawilli Creek tributary

WC21, a tributary to Wongawilli Creek, was mined under late in Longwall 9, has since been mined under by Longwalls 10 to 15, and Longwall 16 skirted the southern edge of this subcatchment.

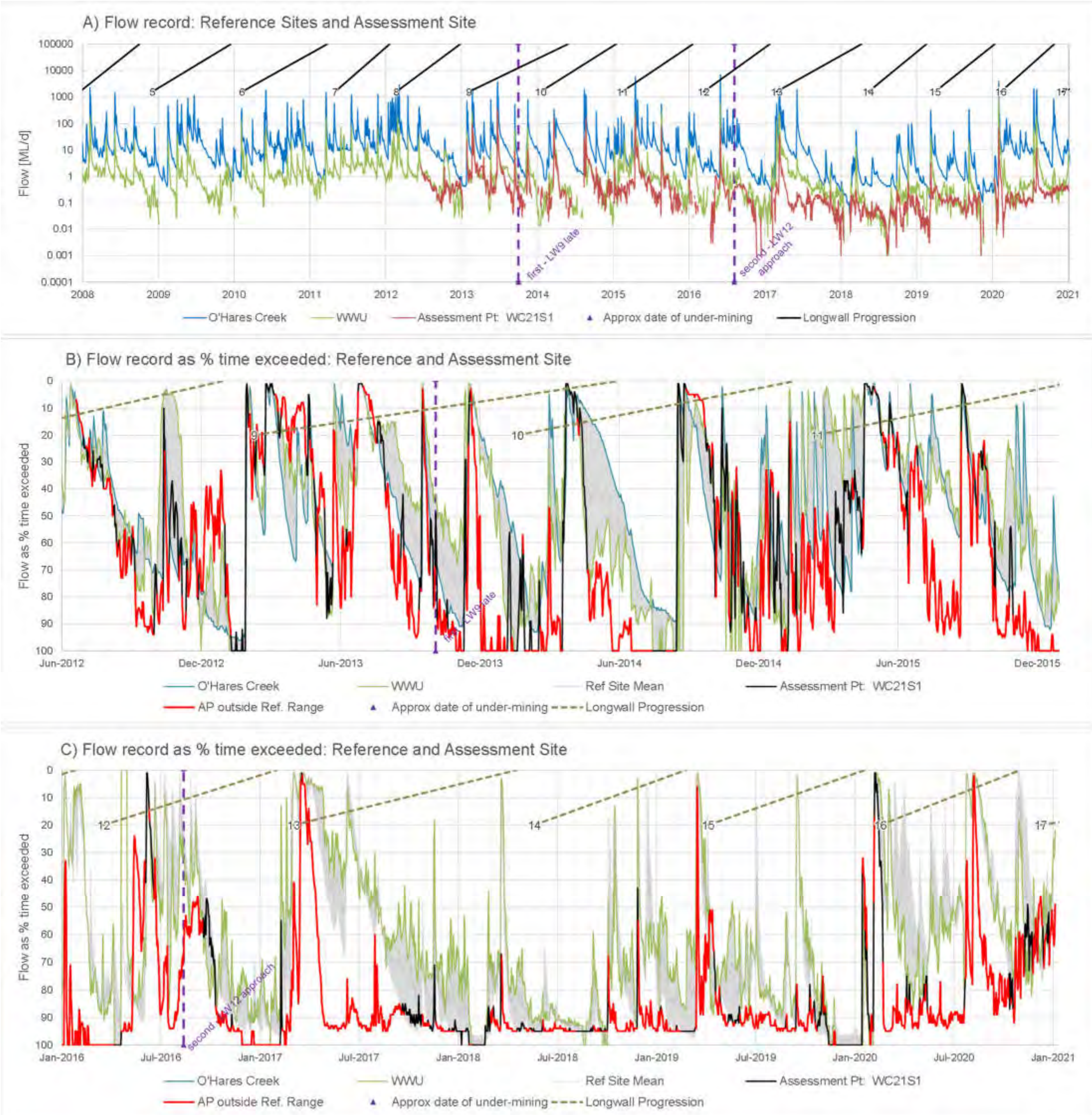

Figure 36. Comparison of WC21S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WC21S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 16. Flow assessments A, B and C for the sub-catchment to WC21S1

WC21S1		Pre-mining	Post-mining	
		to LW9 late	end LW16 + 30 days	
		20/06/2012	6/10/2013	
		5/10/2013	04/12/2020	
Method A:	Assessment of flow variability			
Period		Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining		42%	33%	of the time
Post-mining		71%	5%	of the time
Change		30%	-28%	of the time
			Assessment A:	Level 3

Method B:	Change in cease-to-flow frequency		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	4.9%	6.1%	1.2%
Bomaderry Creek	16.3%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			0.6%
WC21S1	3.6%	16.5%	12.9%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		12.3%
		Assessment B:	Level 2

Method C:	Change to median flow (Q50)		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	8.90	5.03	-44%
WWU	0.90	0.31	-65%
Bomaderry Creek	6.81	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	-65%	-54%	-44%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
WC21S1	0.482	0.017	-76%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	-10.5%	-21.4%	-32.2%
ML/d change, excl. Bomaderry	-0.051	-0.103	-0.155
		Assessment C:	Level 3

5.3.7 WWL – Wongawilli Creek (lower)

Wongawilli Creek lies between Areas 3A and 3B. The watercourse is not directly mined under by longwalls, but some tributaries (e.g. WC21, WC15 etc) have been mined under by Area 3A and 3B longwalls, including by Longwall 16. Landscape impacts, e.g. cracking at Pool 43a, have been identified in the past.

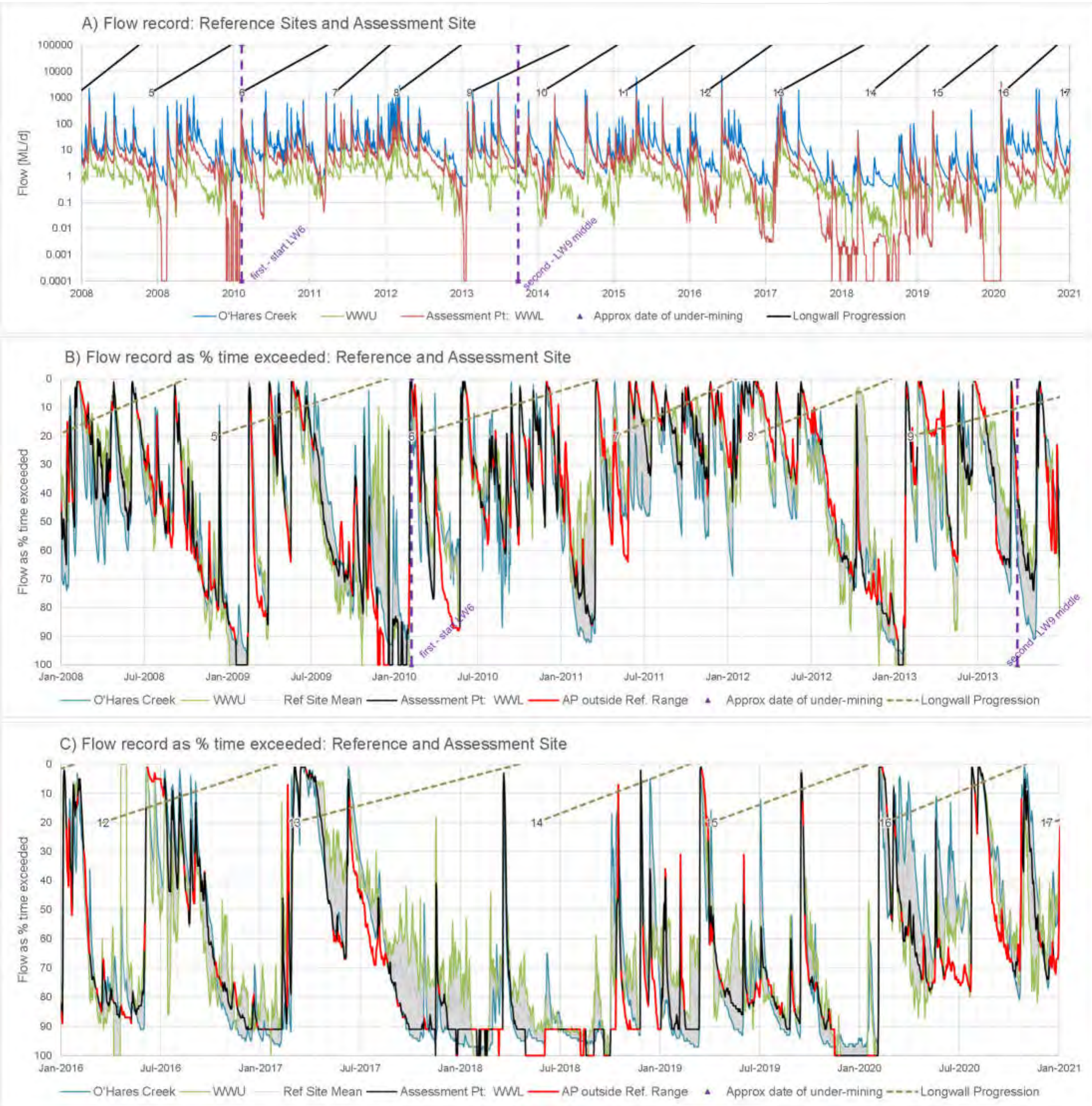

Figure 37. Comparison of WWL against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WWL Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 17. Flow assessments A, B and C for the sub-catchment to WWL

WWL		Pre-mining	Post-mining	
		to start LW6 (Area 3A)	end LW16 + 30 days	
		1/01/2008	10/02/2010	
		9/02/2010	04/12/2020	
Method A:	Assessment of flow variability			
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)			higher flow (lower Q%ile)
Pre-mining	23%		21%	of the time
Post-mining	22%		28%	of the time
Change	-1%		6%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O'Hares Creek	0.0%		0.0%	0.0%
WWU	9.7%		4.6%	-5.1%
Bomaderry Creek	10.9%		n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:				n/a%
Average Ref. Site change ex. Bomaderry Creek (= natural variability):				-2.6%
WWL	8.3%		4.4%	-3.9%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):			n/a %
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):			-1.3%
			Assessment B:	Not triggered
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		9.50	8.25	-13%
WWU		0.75	0.55	-26%
Bomaderry Creek		5.29	n/a	n/a
Natural variability		Min	Mean	Max
including Bomaderry Ck		n/a	n/a	n/a
excluding Bomaderry Ck		-26%	-20%	-13%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
WWL		3.37	2.90	-14%
Change beyond natural		Min	Mean	Max
% change, including Bomaderry.		n/a	n/a	n/a
% change, excluding Bomaderry		+11.9%	+5.4%	-1.0%
ML/d change, excl. Bomaderry		0.40	0.18	0.03
			Assessment C:	Not triggered

5.3.8 LA4S1 – Lake Avon tributary

LA4, a tributary to Lake Avon, lies above the western ends of Longwalls 11-14, but was not mined under by Longwalls 15-16. The gauging site was directly impacted during Longwall 13 with fractures and flow diversion at the pool. The logger failed in mid-2019 and was not replaced due to highly intermittent flow (a result of mining/subsidence).

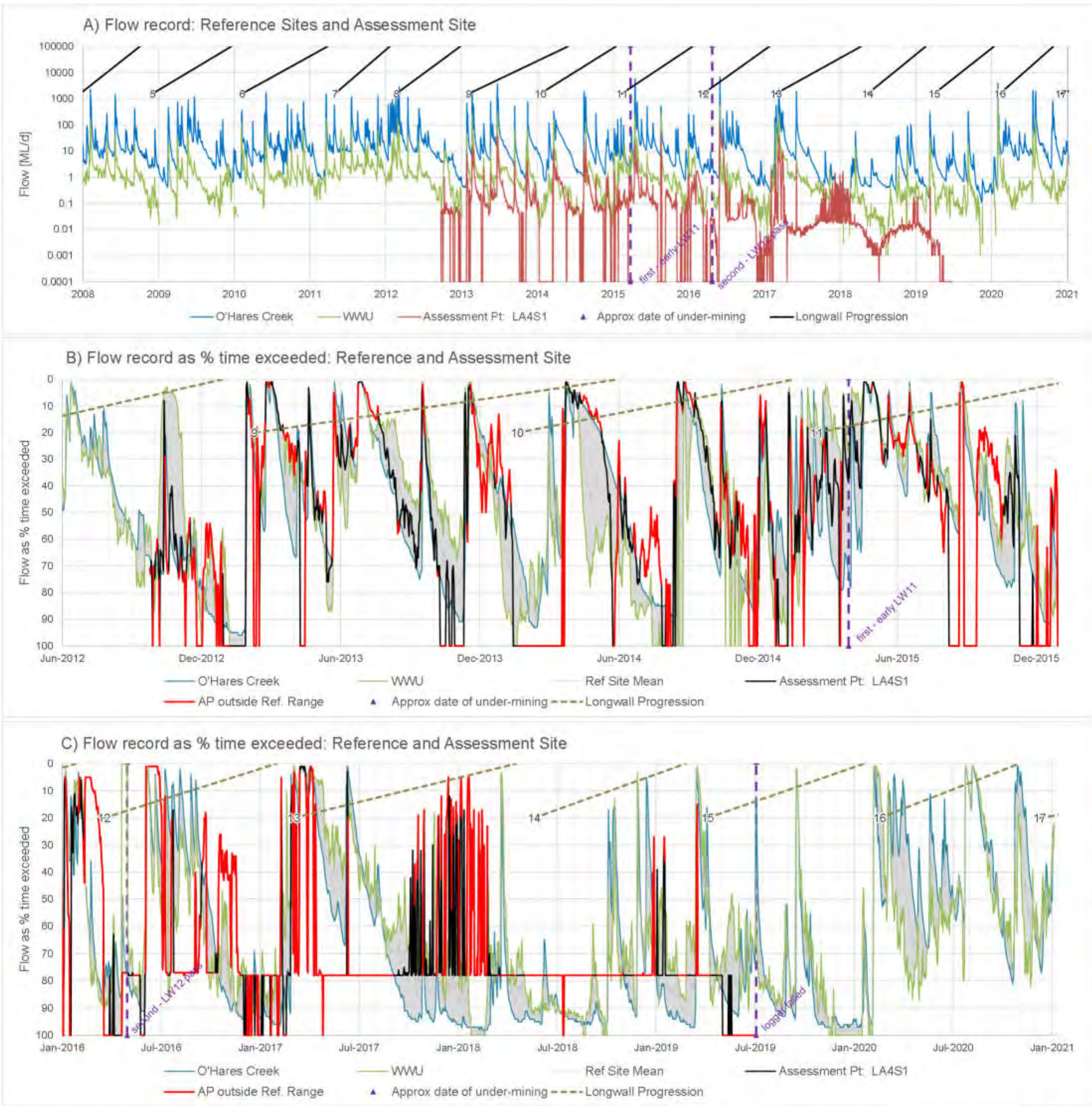

Figure 38. Comparison of LA4S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the LA4S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 18. Flow assessments A, B and C for the sub-catchment to LA4S1

LA4S1	Pre-mining	Post-mining	
	to early LW11	end LW16 + 30 days	
	24/09/2012	2/04/2015	
	1/04/2015	04/12/2020	
Method A:	**Assessment of flow variability**		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)		higher flow (lower Q%ile)
Pre-mining	28%	29%	of the time
Post-mining	39%	33%	of the time
Change	11%	4%	of the time
		Assessment A:	Level 1*
Method B:	**Change in cease-to-flow frequency**		
	Cease to flow as % of daily record	pre- and post- mining	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	0.0%	0.0%
WWU	7.2%	5.6%	-1.6%
Bomaderry Creek	11.7%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			-0.8%
LA4S1	21.1%	9.8%	-11.2%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		-10.4%
		Assessment B:	Not triggered *
*As per Section 5.4, If based on other data or a change in the frequency of flow <0.01 ML/d →			**Level 3**
Method C:	**Change to median flow (Q50)**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	7.71	3.80	-51%
WWU	0.58	0.29	-49%
Bomaderry Creek	4.74	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	-51%	-50%	-49%
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
LA4S1	0.08	0.02	-81%
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	-30.3%	-31.2%	-32.1%
ML/d change, excl. Bomaderry Ck	-0.024	-0.025	-0.025
		Assessment C:	Level 3*

- * Cessation of monitoring in mid-2019 means there is no way of reliably assessing flow effects – Longwall 15 results are assumed to persist. The logger is being reinstated at the site.

5.3.9 LA3S1 – Lake Avon tributary

LA3 is a tributary to Lake Avon. The upstream end of the watercourse was directly mined under by the western end of Longwall 15, and Longwall 16 approached within 40 m. As shown in Table C4 in Appendix C, the pre-mining baseline period is only 2 months, and so the statistical assessment of impacts is considered somewhat unreliable, however mining effects on flows are obvious

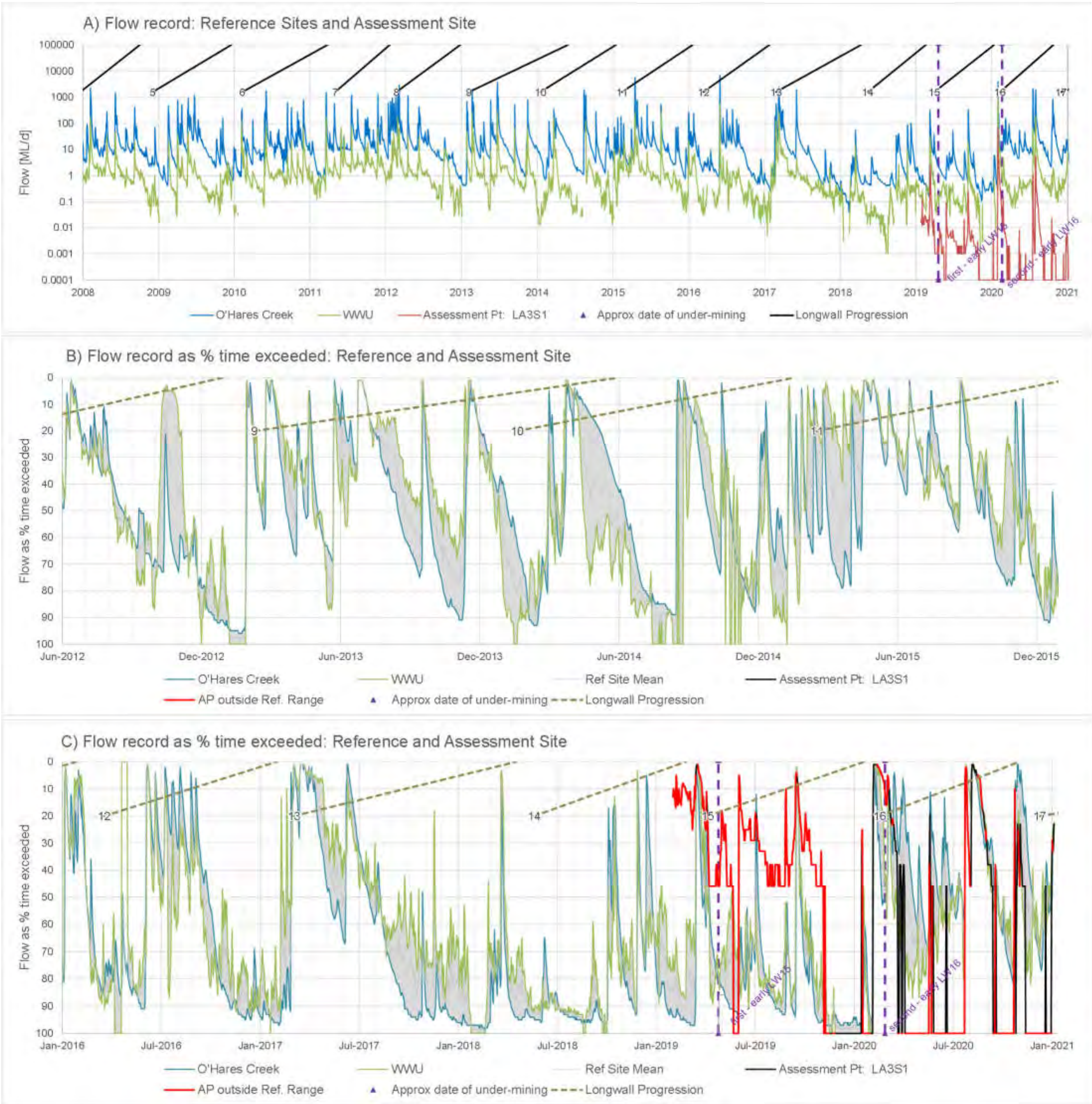

Figure 39. Comparison of LA3S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the LA3S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 19. Flow assessments A, B and C for the sub-catchment to LA3S1

LA3S1		Pre-mining	Post-mining	
		to early LW15	end LW16 + 30 days	
		3/02/2019	29/04/2019	
		28/04/2019	04/12/2020	
Method A:	Assessment of flow variability			
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)		higher flow (lower Q%ile)	
Pre-mining	0%		96%	of the time
Post-mining	38%		39%	of the time
Change	38%		-58%	of the time
			Assessment A:	Level 3
Method B:	Change in cease-to-flow frequency			
	Cease to flow as % of daily record during		pre- and post- mining periods	
Site	Pre-mining		Post-mining	Change
O'Hares Creek	0.0%		0.0%	0.0%
WWU	0.0%		10.8%	10.8%
Bomaderry Creek	18.8%		n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:				n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):				5.4%
LA3S1	0.0%		44.7%	44.7%
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):			n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):			39.3%
			Assessment B:	Level 3
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		1.24	5.93	379%
WWU		0.21	0.25	18%
Bomaderry Creek		1.08	n/a	n/a
Natural variability		Min	Mean	Max
including Bomaderry Ck		n/a	n/a	n/a
excluding Bomaderry Ck		18%	198%	379%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
LA3S1		0.015	0.001	-93%
Change beyond natural		Min	Mean	Max
% change, including Bomaderry.		n/a	n/a	n/a
% change, excluding Bomaderry		-111.1%	-291.5%	-471.9%
ML/d change, excl. Bomaderry		-0.017	-0.044	-0.071
			Assessment C:	Level 3

5.3.10 LA2S1 – Lake Avon tributary

LA2, a tributary to Lake Avon, is yet to be mined under by longwalls. Longwall 15 approached to within approx. 160 m of the watercourse and skirted the northern edge of this sub-catchment. Longwall 16 mined beneath the headwaters of LA2, and iron-staining in Pool 34 were observed in mid-2020. During 2021, Longwall 17 will mine under a greater length of LA2.

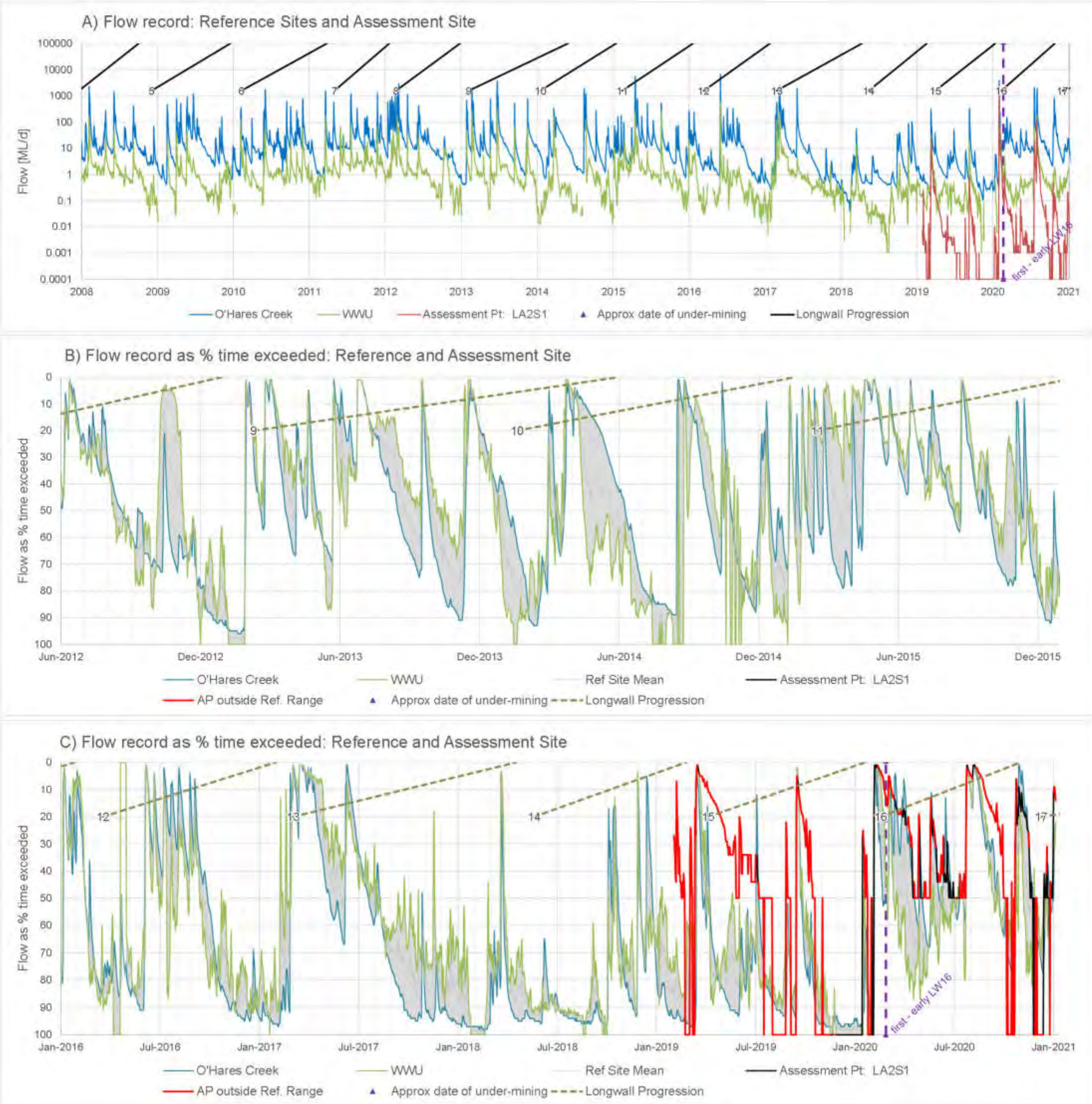

Figure 40. Comparison of LA2S1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the LA2S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 20. Flow assessments A, B and C for the sub-catchment to LA2S1

LA2S1		Pre-mining	Post-mining	
		to end LW15	end LW16 + 30days	
		4/02/2019	2/03/2020	
		1/03/2020	04/12/2020	
Method A:	Assessment of flow variability			
Period		Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining		22.4%	59.2%	of the time
Post-mining		7.9%	60.1%	of the time
Change		-14.5%	0.9%	of the time
			Assessment A:	Not triggered
Method B:	Change in cease-to-flow frequency			
		Cease to flow as % of daily record during	pre- and post- mining periods	
Site		Pre-mining	Post-mining	Change
O'Hares Creek		0.0%	0.0%	0.0%
WWU		16.1%	0.0%	-16.1%
Bomaderry Creek		36.5%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:				n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):				-8.0%
LA2S1		36.7%	5.8%	-31.0%
		no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
		no. of cease-to-flow days increased: (ex. Bomaderry Creek):		-22.9
			Assessment B:	Not triggered
Method C:	Change to median flow (Q50)			
Reference Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek		1.24	14.50	1066%
WWU		0.13	0.43	223%
Bomaderry Creek		0.62	n/a	n/a
Natural variability		Min	Mean	Max
including Bomaderry Ck		n/a	n/a	n/a
excluding Bomaderry Ck		223%	644%	1066%
Assessment Site Q50 [ML/d]		Q50 (pre-)	Q50 (post-)	% Change
LA2S1		0.002	0.009	350%
Change beyond natural		Min	Mean	Max
% change, including Bomaderry.		n/a	n/a	n/a
% change, excluding Bomaderry		127.4%	-294.0%	-715.5%
ML/d change, excl. Bomaderry		0.003	-0.006	-0.014
			Assessment C:	Level 3

This result is reported conservatively as Level 3, but given the short baseline and wide range in 'natural variability' calculated here, and therefore significant uncertainty in the possible effects. It is unusual for a site to trigger Level 3 on this indicator alone.

5.3.11 ND1 – Native Dog Creek tributary

ND1 is a tributary to Native Dog Creek, which flows into Lake Avon. Elouera Colliery longwalls are within or close to this sub-catchment, but were not directly beneath this watercourse or its tributaries. ND1 is yet to be mined under by Dendrobium longwalls, but Longwall 16 approached to 300 m of the watercourse. Longwall 17 will be the first Area 3B panel directly under this sub-catchment.

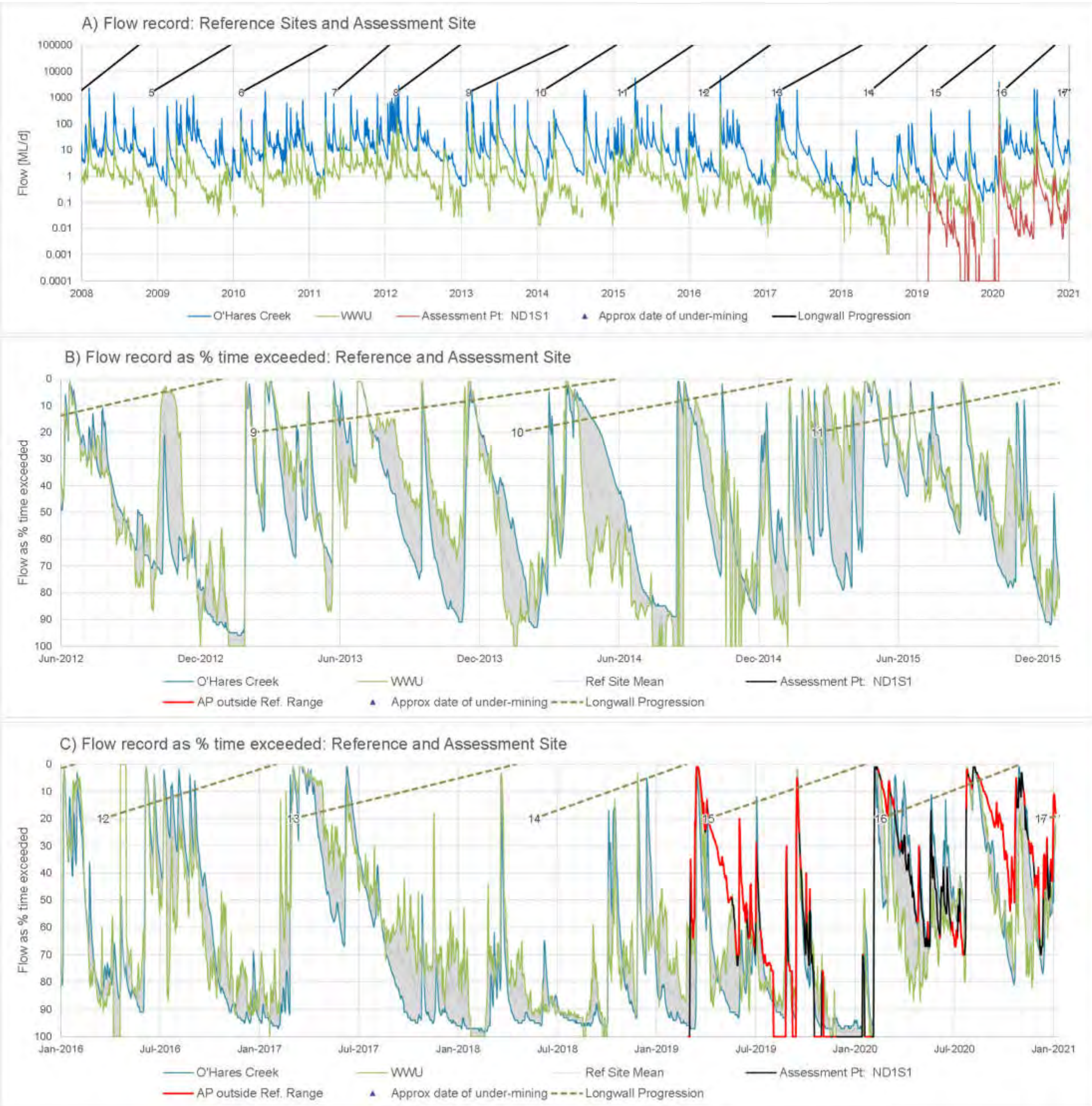

Figure 41. Comparison of ND1 against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the NDT1S1 Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment 'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 21. Flow assessments A, B and C for the sub-catchment to ND1S1

ND1S1	Pre-mining	Post-mining	
	to current date	n/a	
	3/03/2019		
	04/12/2020		
Method A:	**Assessment of flow variability**		
Period	Compared to Reference Sites, gauge is at: lower flow (higher Q%ile)		higher flow (lower Q%ile)
Pre-mining	17.4%	45.7%	of the time
Post-mining	n/a	n/a	of the time
Change	n/a	n/a	of the time
		Assessment A:	Not yet mined under
Method B:	**Change in cease-to-flow frequency**		
	Cease to flow as % of daily record during	pre- and post- mining periods	
Site	Pre-mining	Post-mining	Change
O'Hares Creek	0.0%	n/a	n/a
WWU	9.8%	n/a	n/a
Bomaderry Creek	57.1%	n/a	n/a
Average Ref Site change, inc. Bomaderry Creek:			n/a
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			
ND1S1	21.2%	n/a	n/a
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		n/a
		Assessment B:	Not yet mined under
Method C:	**Change to median flow (Q50)**		
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
O'Hares Creek	5.77	n/a	n/a
WWU	0.26	n/a	n/a
Bomaderry Creek	1.19	n/a	n/a
Natural variability	Min	Mean	Max
including Bomaderry Ck	n/a	n/a	n/a
excluding Bomaderry Ck	n/a	n/a	n/a
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change
ND1S1	0.016	n/a	n/a
Change beyond natural	Min	Mean	Max
% change, including Bomaderry.	n/a	n/a	n/a
% change, excluding Bomaderry	n/a	n/a	n/a
ML/d change, excl. Bomaderry	n/a	n/a	n/a
		Assessment C:	Not yet mined under

5.3.12 Discussion of flow assessments A, B, C.

Comments are made here on specific sub-catchments and assessments where the above assessments required some further explanation.

LA4 (Section 5.3.8): there is an apparent modification to the accuracy in the estimation and/or reporting of low flows from 2016, approximately coincidental with pre- and post-mining periods. This includes a number of suspected ‘false zeroes’ from earlier in the record that we could not confidently ‘process’ or ‘infill’. Our review of visual inspection records (“flow observations”) by IMCEFT, such those summarised on the maps presented in Appendix G and the considering changes to the frequency of low flows above cease-to-flow (e.g. frequency of flow <0.01 ML/d) suggests that the finding of Assessment B at this site is not completely reliable. Hence, while the statistical analysis indicates “Not triggered”, a high Level 2 or Level 3 (the higher level is selected for conservatism) is considered a more appropriate assessment. A similar behaviour is apparent at WC15, and based on assessment of recorded flows of 0.001 ML/d and 0.01 ML/d, a Level 1 TARP was considered more likely than ‘not triggered’.

5.3.13 Comparison against rainfall-runoff modelling

Up until Longwall 14, effects of surface water flow quantity were assessed via comparison of observed flow against rainfall-runoff modelling, either the RUNOFF-2005 model (used by Ecoengineers up until 2015) and then AWBM (used for Longwalls 13 and 14). As discussed in Section 5.1.1, this was superseded in consultation with agencies, with comparison against Reference Sites preferred. The IAPUM (Section 1.3) has recently requested that this be re-instated, and the most conservative result (of the new, agreed TARPs and the rainfall-runoff comparison) be adopted as the finding.

While the use of rainfall-runoff modelling itself is valid (especially so if appropriate Reference Sites are not available), the issue with this is that the pre-Longwall 15 and now-agreed TARPs have multiple differences, including:

- assessment period (longwall by longwall or cumulatively since mining);
- the choice of indicator, being changes to ‘catchment yield’ expressed as a percentage of long-term average rainfall (as per the calculation recommended by Ecoengineers (2011) or changes to other flow indicators such as cease-to-flow frequency and median flow.

Therefore, while the rainfall-runoff method is used here for limited sites, as per IAPUM’s request, this is only as a secondary check until further discussion with IAPUM and agencies has occurred.

Appendix H presents a summary of rainfall-runoff modelling using the superseded assessment methods. This is done specifically for those subcatchments where Assessment C (for median flow) does not already trigger TARP Level 3, and so provides a secondary check on effects.

DCU: Section H1 presents a summary of rainfall-runoff modelling. Hydrographs and ratios for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. The flow duration curves suggest the possibility that low flows were reduced (i.e. below modelled) during Longwall 16. The calculation of catchment yield did not trigger the former TARP. This finding, and the suggestion that low-flows might be reduced in the recent period, is consistent with the agreed TARPs.

WC12: Section H2 presents a summary of rainfall-runoff modelling. Hydrographs, ratios and flow duration curves for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. The calculation of catchment yield did not trigger the former TARP. These findings are consistent with the findings of agreed TARP Assessments B and C.

WWL: Section H3 presents a summary of rainfall-runoff modelling. Hydrographs, ratios and flow duration curves for the pre- and post-mining periods do not clearly indicate a systematic or significant change in catchment behaviour. Using the calculation of 'catchment yield' derived by Ecoengineers (2011) suggests that there could be a mild reduction in flow following mining and during Longwall 16 but both periods still fall just short of triggering Level 1 (4% for the full post-mining period and 5% for Longwall 16; compared to the trigger of 6%).

5.4 Assessment D: flow reduction Wongawilli Creek

Surface water flow observations made by IMCEFT are recorded in a semi-qualitative fashion. At each field site (such as at the upstream or downstream end of a pool), an observation of flow conditions is made as follows:

0	No flow visible
1	Subsurface flow observed
2	Surface seepage observed
3	Surface trickle observed
4	Surface flow observed

Field surveys typically make an observation at each of the nominated sites around Area 3A and 3B over the period of a month. The "Outflow" results of IMCEFT's surveys are plotted on the maps in Appendix G for each month during the period covering the extraction of Longwall 16. As noted on the maps, observations are limited in one month (August-2020) during Longwall 16 due to the heavy rainfall conditions.

Of the completed surveys along the main trunk of Wongawilli Creek (which is the watercourse that is subject of Assessment D), all months are "Not triggered" except for February 2020 - this is the same month that resulted in a trigger of this TARP in the Longwall 15 End of Panel. February 2020 was the last month of the assessment period for the previous longwall, and Longwall 16 commenced on 26/02/2020, hence it being included in both assessments.

For the months other than February 2020, while there are often "no flow" observations on the tributaries which flow into Wongawilli Creek, there are consistent observations of flow along Wongawilli Creek itself. The reason that February 2020 triggers to Level 2 are the three spatially-consecutive "no flow" observations (red circles) located on Wongawilli Creek between Longwalls 6 and 9. These three sites were surveyed on 04/02/2020 (before the commencement of Longwall 16). Heavy rain in the middle of the month then forced the catchment to close again, interrupting the survey. Sites to the south of the "no flow" observations, at which there is a record of some surface flow (blue circles), were surveyed later in February, following the heavy rainfall.

The calculation of Assessment D for the month that triggers Level 2 (February 2020) is presented in Section 5.4.

Table 22. Assessment D for Wongawilli Creek: February 2020

Assessment D		Feb-20	Level 2
Date(s) of relevant no flow observations			
Pool 42a	4/02/2020		
Pool 43a	4/02/2020		
Pool 43b	4/02/2020		
Catchment area upstream of relevant "no flow" sites			
	12.55	km^2	
Monitored flow at upstream and tributary sites			
	Catch. area km^2	4/02/2020	
WWU	3.211	0	ML/d
WC12	2.434	0.005	ML/d
WC15	1.192	0	ML/d
Total	6.837	**0.005**	ML/d
Factored up by catchment area		**0.01**	ML/d
Flow at downstream sites			(context)
	Catch. area km^2	4/02/2020	
WC21	2.434	0.154	ML/d
WWL_A	19.602	0	ML/d
WWL	20.079	0	ML/d
Inferred flow loss for middle reach, i.e. to "no flow" sites			
	Min	Max	
Daily	0.008	0.001	ML/d
Annualised	1.8	3.4	ML/yr

The inferred loss of flow is then used in assessing compliance against Performance Measures for Wongawilli Creek. The flows at upstream (including Reference site WWU) and downstream sites for the relevant date indicate that the "no flow" observations occur during a period when flows across the catchment are very low, consistent with prevailing dry (severe bushfire risk) conditions at that time.

5.5 Assessment against surface water flow Performance Measures

There are four agreed Performance Measures for surface water flows in the Area 3B WIMMCP.

Wongawilli Creek – minor environmental consequences	
Agreed measure:	*Methods C, D, to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".*

Assessment C at WWL does not indicate a discernible reduction beyond natural variability in Q50 (Table 17). Therefore, this Performance Measure is met.

Assessment D for flows along the middle of Wongawilli Creek (Table 22) suggests that flow reductions are in the order of 0.005 to 0.01 ML/d (equivalent to 1.8 to 3.4 ML/yr). These estimates are:

- 1% of predicted losses for Wongawilli Creek made by groundwater modelling (1.09 ML/d or 398 ML/yr) from the approved Longwall 17 SMP Application; and
- 1% of predicted losses for the whole of Wongawilli Creek made by recent groundwater modelling (0.27-0.94 ML/d or 100-343 ML/yr from the approved Longwall 18 SMP Application).
- Up to 4% of the predicted losses along the mid-Wongawilli reach as made by recent groundwater modelling (40-84 ML/yr from the approved Longwall 18 SMP Application).
- <u>Therefore, the estimated losses are “within prediction”, and this Performance Measure is met.</u>

Donalds Castle Creek – minor environmental consequences

Agreed measure:	*Method C to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability “exceed prediction”.*

Assessment C at DCU does not indicate a discernible reduction beyond natural variability in Q50 (Table 13). Therefore, this Performance Measure is met.

Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek

Agreed measure:	- -	*Flow reduction as determined from measured at flow gauging station WWL_A.*

Assessment C at WWL does not indicate a reduction in Q50 (Table 17). Therefore, this Performance Measure is met.

Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon

Agreed measure:	-	*Surface water inflows calculation = [Impacts at gauged catchments (LA2 + LA3 + LA4 + NDT1) + estimated impacts at ungauged but undermined catchments (e.g. LA5)] / [total inflow to LA].*

The calculation is presented as follows. In mined-under but un-monitored catchments, “inferred” losses are calculated as the same % reduction as a nearby monitored and mined-under catchment. If not mined under directly, but adjacent or neighbouring mining, then 25% of the % loss in the nearest mined under catchment is applied as the inferred loss.

Sub-catchment	Gauged?	Mined under?	Catch area [km2]		"measured" loss at Q50	"inferred" loss at Q50	
LA1	N	N	0.29*			0	
LA2	Y	Y	0.824		-0.006		
LA3	Y	Y	0.375		-0.044		
LA4	Y	Y	0.817		-0.025		
LA5	N	Y	0.53*			-0.016	
LA6	N	Neighbour	0.97*			-0.007	
ND1	Y	Neighbour	1.13				
ND	N	Elouera	3.85*				
Total for mined-under or neighbouring catchments			**3.214**			**-0.098**	**ML/d**

Sub-catchment	Gauged?	Mined under?	Catch area [km2]	"measured" loss at Q50	"inferred" loss at Q50	
Lake Avon	N	142^	2.3%		Q50	Qmean
Inflow from catchment	(WaterNSW estimate)				18	124
Inferred mining loss as % of	total inflow				-0.54%	-0.08%

* catchment area estimated by WatershedHG from GIS.
^ catchment area from https://www.waternsw.com.au/supply/visit/avon-dam

The sub-catchments where mining effects related to Dendrobium are present or inferred constitute about 2.3% of the total catchment to Lake Avon. The “measured” + “inferred” reduction in Q50 flow in these LA catchments = 0.098 ML/d (35 ML/yr). This is 0.54% of median Lake Avon inflow or 0.08% of average Lake Avon inflow for the period 2015-2020, based on WaterNSW lake inflow data.

The estimated losses are equivalent to:

- 13% of predicted losses for the Lake Avon catchment made by groundwater modelling (281 ML/yr) from the approved Longwall 17 SMP Application); and
- 90% of low-end predicted losses for Lake Avon catchment made by groundwater modelling (39 ML/yr) and 26% of the high-end losses (137 ML/yr) from the approved Longwall 18 SMP Application).
- Therefore, the estimated losses are “within prediction”, and this Performance Measure is met.

5.6 Assessment of pool water levels

5.6.1 Wongawilli Creek Pool 43a

This section summarizes observations at Wongawilli Creek Pool 43a. Pool 43a is located on Wongawilli Creek, 348 m east of Longwall 9 in Area 3B (extracted between 9/2/2013 and 2/6/2014) and 315 m northwest of Longwall 6 in Area 3A (9/2/2010 - 28/3/2011). Pool 43a is controlled by a rock bar.

On 20/11/2017, it was noted during a site visit that water levels in Pool 43a on Wongawilli Creek were below the baseline (impact number DA3B_Longwall 13_015, dated 28/11/2017). The observation triggered a TARP Level 3 because a previously reported fracture (first observed on 18/12/2013) is present in the sandstone forming the pool base. No significant changes to the downstream control were noted by the IMCEFT at Pool 43a. In response to the trigger, an assessment was carried out into the cause of the declining water levels in Pool 43a by Watershed (2018). The assessment concluded that:

- The decline in pool levels does not appear to be related to the formation of the fracture itself. Pool level decline started prior to the formation of the fracture (Figure 42) and the pool level recession rate has not changed significantly since.
- Groundwater levels in the lower Hawkesbury Sandstone (HBSS) (including the Newport Formation, NPFM) in the vicinity of Pool 43a of Wongawilli Creek have declined since the extraction of Longwall 6 (Area 3A) with the decline continuing during mining in Area 3B (Figure 43).
- Low rainfall associated with the 2017-2019 drought contributed to low-flows in all catchments to the extent that mining effects are now obvious.

Water levels in Pool 43A have remained steady during the Longwall 16 reporting period at ~15 cm below the average levels recorded in 2010-2012.

There is evidence that piezometric levels in the sandstone substrate adjacent to Wongawilli Creek are starting to recover as mining in Area 3B moves south and away from Pool 43A. Hydrographs for piezometers in the lower HBSS closest to the pool (Figure 43) shows recovery over the last two years with the trend continuing during Longwall 16.

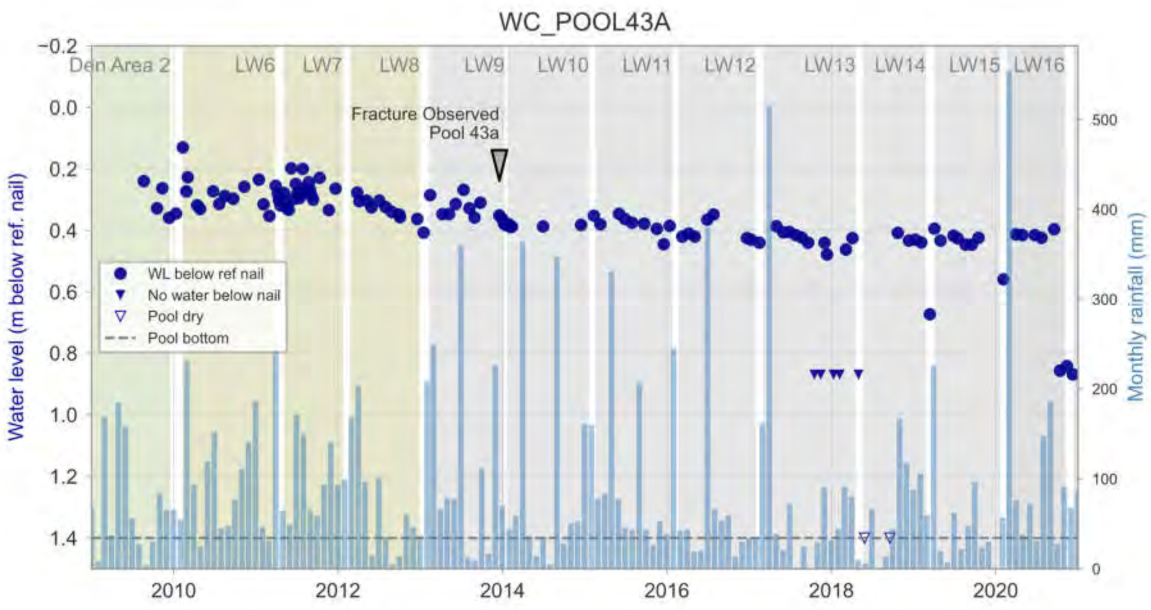

Figure 42. Time series plot of water level observations in Pool 43a

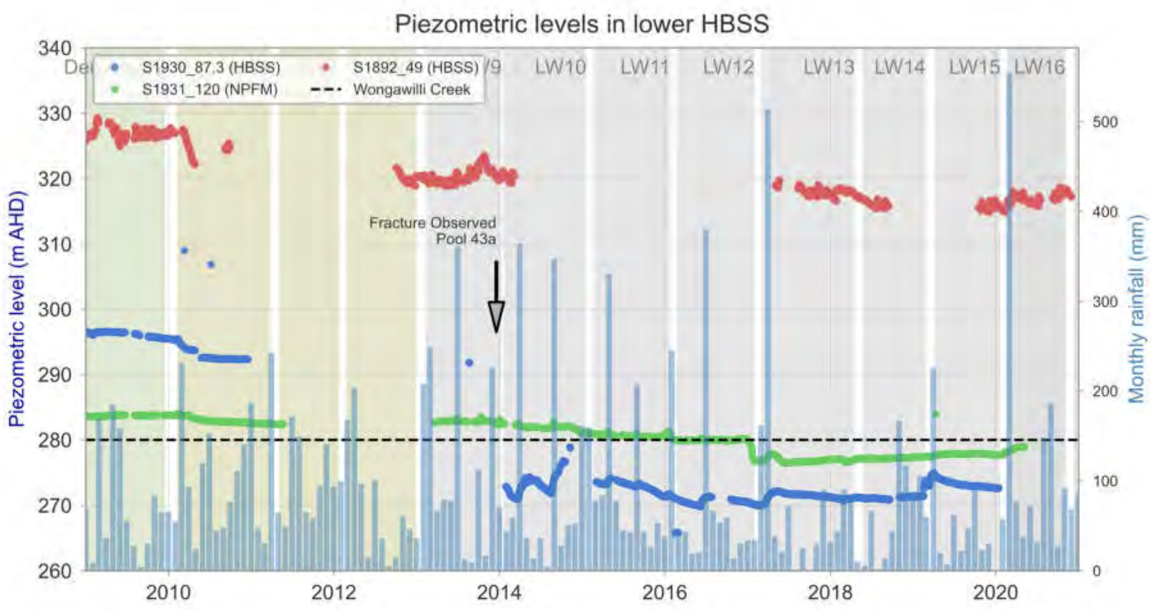

Figure 43. Groundwater hydrographs for lower HBSS adjacent to Wongawilli Creek

5.6.1.1 Pool level dataloggers in WC Pool 43A

Pool level dataloggers are installed in seven pools along Wongawilli Creek adjacent to Area 3A and 3B: WWU, Waterfall 54, Pool 36, Pool 35A, Pool 35B, Pool 43A (WCS2), Pool 32 (WCS1). The dataloggers measure the water level at hourly intervals relative to a surveyed benchmark at the respective sites. Hydrographs for the loggers are included in Appendix F.

Most of the loggers were installed in 2020 and therefore have limited baseline data. Loggers at Pools 43A and 32 were installed in 2018. The hydrographs for those pools show different recession characteristics that are related to the geometry of the pools and their control points:

- Pool 32 shows recession rates that are typically <25 mm/day, with a slightly higher recession rate noted after heavy rainfall.
- Pool 43a shows recession rates of up to 100 mm/day during the low rainfall period of early 2018. From late 2018 recession rates have declined to (typically) <30 mm/day.

Recession rates represent a combination of flow through the pool outlet, seepage losses through the sandstone substrate and evaporative losses from the pool surface. The average potential evaporation rate is ~3.5 mm/day, ranging between 1.3 mm/day in winter and 5.8 mm/day in the summer months.

No adverse trends related to mining are evident as of the end of the current reporting period.

5.6.2 Wongawilli Creek tributary WC15

WC15 is a second order stream that flows in a north-easterly direction across the eastern part of Area 3B and joins Wongawilli Creek at WC Pool 46. The watercourse was approached within 40 m by Longwalls 13 and 14, and the upper reaches of WC15 were mined under by Longwalls 15 and 16.

Nine pools are routinely monitored along the WC15 watercourse. Figure 44 summarises observations of flow status of each pool for monthly monitoring periods prior to and following the passage or close approach of Longwalls 13 to 15 (red lines). Pools are arranged from upstream (bottom of the plot) to downstream (top), to correspond geographically if looking at a plan view of WC15. Observations are semi-quantitative, ranging from no observable flow through to observable outflow from the pool. In addition, observations of “no water in the pool” are overlain as “-“ symbols. Where more than one monitoring round was carried out in a month, the minimum condition was used in the figure. Baseline data, prior to Longwall 13 and the 2017-2018 drought, show that all monitored pools are filled and overflow for several months following large rainfall events (and near-continuously at Pool 9). All pools ceased to flow or became dry during prolonged low-rainfall conditions. As with other watercourses, pool levels and flow were affected by the 2017-2019 drought such that all pools were observed to have no flow and/or were dry on several occasions during the drought.

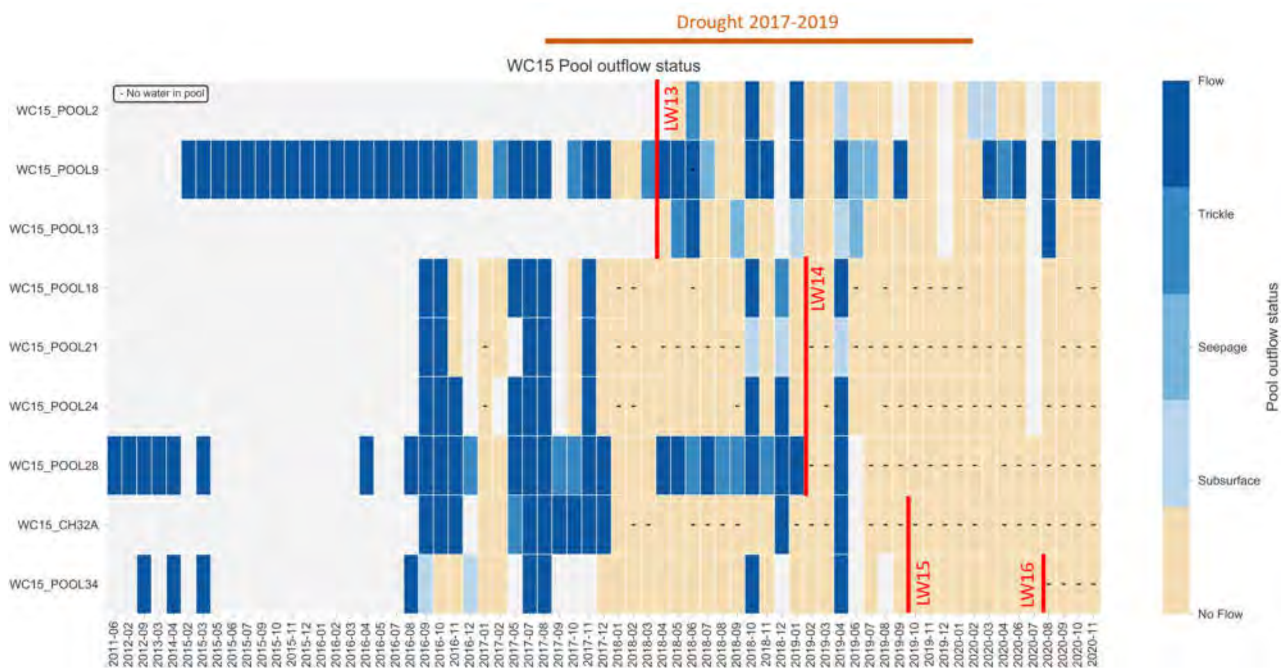

Figure 44. Flow status of pools on the WC15 watercourse

From observations shown in Figure 44, it is expected that all pools on WC15 would fill and overflow in 2020 due to the higher-than-average rainfall. It is apparent that the pool level and flow status in all monitored pools upstream of Pool 13 during 2020 is different from baseline conditions and likely impacted by Longwalls 14 to 16.

5.6.2.1 Pool level dataloggers in WC15

Water level dataloggers are installed in WC15 Pools 2, 28 and 34. Rapid changes in average water level and recession rate were noted in Pools 28 and 2 following the passage of Longwall 14 and 15 and were reported previously.

A water level hydrograph for Pool 34 (Figure 45) shows an abrupt decrease in water level and an increase in recession rate on 24/8/2020. Pool levels did not respond to subsequent rainfall events. The change occurs shortly after the passage of Longwall 16 beneath the watercourse (14/8/2020). Baseline data indicate that, under the prevailing rainfall conditions, the pool would previously have retained water for several months following the August 2020 rainfall event and responded to minor subsequent rainfall events. The observed changes are consistent with impacts to pool levels and flow as a result of Longwall 16 subsidence.

Fracturing of the rockbar directly upstream of Pool 34 and minor flow diversion were noted on 31/8/2020 (Impact record LW16_028). The impact is consistent with predictions for watercourses directly overlying the longwall footprint.

Monthly monitoring is currently being undertaken at the site in accordance with the SMP and no further actions are recommended.

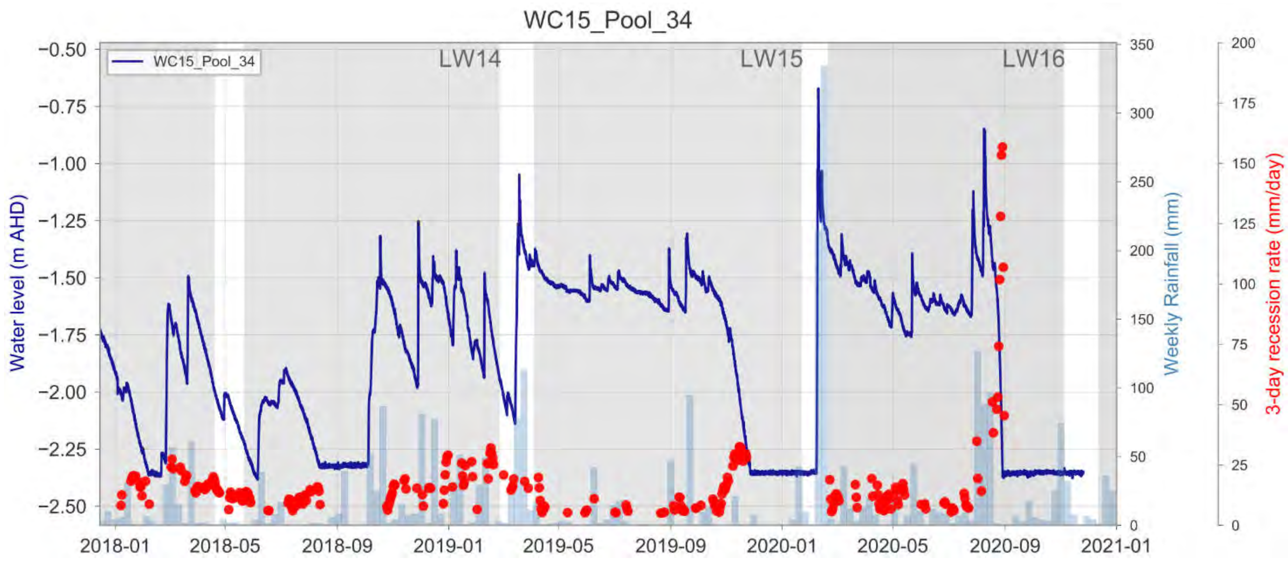

Figure 45. Water level in WC15 Pool 34

6. Assessment of shallow groundwater (swamps)

6.1 Shallow groundwater levels

Trigger values for subsidence-induced decreases in groundwater levels, at surface and near-surface monitoring sites at Area 3B swamps, have been established within the Swamp Impact Monitoring Management and Contingency Plan (SIMMCP) for Area 3B (South32, 2020a). Shallow groundwater level has been identified as an indicator of potential changes in ecosystem functionality of the swamps. TARPS are defined as follows:

Table 23. Performance criteria related to shallow groundwater levels at swamp monitoring sites

TARP Level	Criteria	Response
1	Groundwater **level** lower than baseline level at **any** monitoring site within a swamp (in comparison to reference swamps); and/or; **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **any** monitoring site (measured as average mm/ day during the recession curve).	Increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars
2	Groundwater **level** lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps); and/or **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **50%** of monitoring sites (within 400 m of mining) within the swamp.	
3	Groundwater **level** lower than baseline level at **>80%** of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or **Rate** of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at **>80%** of monitoring sites (within 400 m of mining) within the swamp.	

Groundwater level hydrographs for each shallow piezometer are presented in **Appendix D**. The hydrograph is plotted together with ground elevation and the elevation of the piezometer base, longwall timing, groundwater level recession rate (in mm/day), and the dates that longwalls pass under (if relevant) a piezometer. Assessment of mining effects is based on these hydrographs.

A summary of the hydrograph responses at Area 3B swamps is included in Table 24 for Impact Sites and Table 25 for Reference Sites. An overview of shallow groundwater levels is shown in Figure 46 as the monthly median % saturation at each reference and impact swamp piezometer. In accordance with the definition of the TARPs, the sites within 400 m of mining *and* within the mapped swamp areas are assessed for triggers related to mining impacts.

6.1.1 Reference swamp sites

IMC maintains shallow groundwater monitoring sites at reference swamps located well outside the mining zone of influence. Those sites provide an important comparison when assessing swamp sites closer to the mine for possible shallow groundwater impacts. Shallow groundwater conditions at reference sites during the assessment period are summarised in Table 25. Shallow groundwater at all reference sites recovered in 2020 following low shallow groundwater levels, including unsaturated conditions, during the 2017-2019 drought.

A review of shallow groundwater hydrographs for reference swamps in Appendix D (and evident in Figure 46) indicate two main hydrological end-member types:

- Near-continuously saturated swamp sediments. Examples include Swamps 7, 22 and 25. Swamp sediments at these locations remain saturated during periods of prolonged drought. It is assumed that at these locations, groundwater levels within the swamp are sustained by discharge from adjacent and underlying sandstone substrate (groundwater-connected swamps).

- Intermittently saturated swamp sediments. Examples include Swamps 33, 84, 85, 86 and 88. Swamp sediments at these locations saturate, typically to the ground surface, following large rainfall events and remain saturated for several weeks to months as shallow groundwater levels recede to below the base of the swamp. The duration of saturation and rate of recession vary between locations and likely depend on the characteristics of the swamp substrate, controlling rock-bar and contributions from adjacent or up-gradient perched sandstone aquifers. It is assumed that at these locations, the swamp sediments are typically perched above the water table in the sandstone substrate.

There is no consistent relationship between position on the catchment and degree of saturation; however, the continuously saturated locations tend to be within deep valleys where adjacent ridges rise ≥ 50 m above the swamp level. Intermittently saturated swamp locations tend to reside in shallow valleys where the adjacent ridges rise ≤ 20 m above the swamp level.

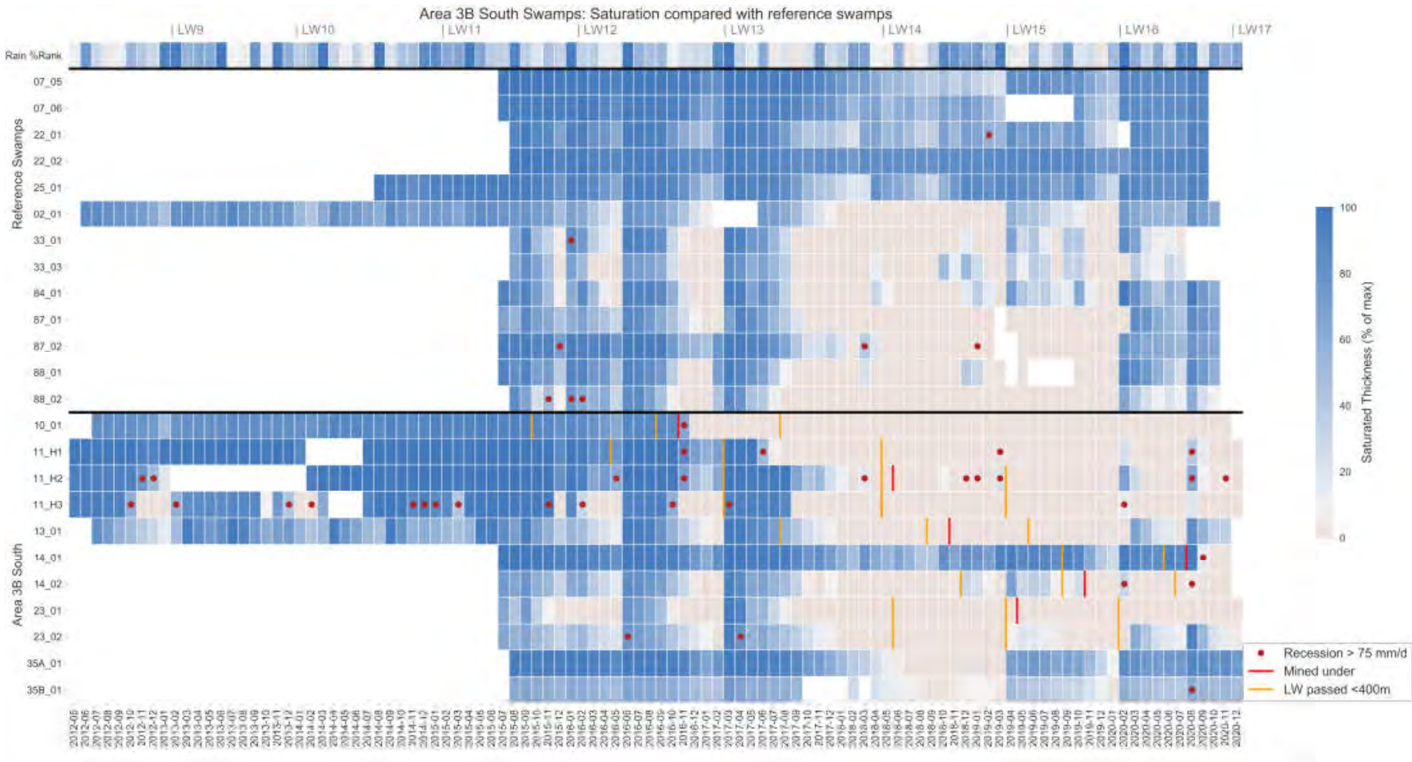

Figure 46. Overview of swamp saturation levels by month, Area 3B (south)

6.1.2 Impact swamp sites

During Longwall 16 passed beneath or within 400 m of:

- **Swamp 14**: Longwall 16 passed beneath the swamp between 2/8/2020 and 21/8/2020. The northern extension of the swamp was previously mined under by Longwall 15 during the latter half of 2019.
- **Swamp 23**: Longwall 16 passed beneath the southern fringes of the swamp between 10/3/2020 and 23/3/2020. The swamp was previously mined under by Longwall 15 during the first half of 2019.
- **Add Swamp 13:** Longwall 16 passed within 400m of the swamp in early June 2020; however, piezometer 13_01 is located just beyond the mining zone of influence at 450 m from Longwall 16.

Observed effects on shallow groundwater levels within these swamps is described below.

6.1.2.1 Swamp 14

This section presents a cumulative impact assessment of Swamp 14 as requested by WaterNSW in an email to South32 dated 26/11/2020.

Swamp 14 consists of ~5.9 ha of upland swamp vegetation, mostly Teatree and Banksia thicket and Cyperoid heath (sedgeland) surrounding the upper reaches of tributary WC15. The swamp vegetation is discontinuous along WC15 and consists of two main areas. Piezometer 14_01 is located between two minor watercourses within the upper Swamp 14 area which was mined beneath by Longwall 16 in August 2020. Piezometer 14_02 is located within the lower Swamp 14 area which was previously mined beneath by Longwall 15 in October-November 2019. The piezometers intersect 1.5 to 1.75 m of swamp sediment which overlies Hawkesbury Sandstone.

The WC15 watercourse hosts numerous pools within and downstream of the swamp and it is likely that drainage from the swamp, together with direct groundwater discharge from Hawkesbury Sandstone, sustains baseflow and pool levels for extended periods after rain. Previous longwalls terminated within 20 m and 40 m of the watercourse in April 2018 (Longwall 13) and February 2019 (Longwall 14), respectively. Subsidence related to those longwalls resulted in fracturing of rock bars within the watercourse, reduction in water levels at some pools and a decrease in stream flow at the downstream gauge (WC15S1). Changes in streamflow in WC15 are discussed in Section 5.3.5 and pool water levels in Section 5.6.2, above.

Hydrographs for piezometers 14_01 and 14_02, screened within swamp sediments are shown in Figure 47 and Figure 48. Hydrographs for VWP sensors within the deeper sandstone substrate at monitoring bores S2354 and SW2351, located near Swamp 14, are shown in Figure 49 and Figure 50, respectively. The shallow groundwater hydrographs show slightly different baseline groundwater conditions within the two swamp areas prior to the approach of Longwalls 15 and 16. Piezometer 14_01 in the upper swamp area shows that sediments were continuously saturated since the start of monitoring in July 2015, including during the 2017-2019 drought. Hydrographs for the deeper sandstone substrate (at S2351; Figure 50) show that piezometric levels within the HBSS were typically above the base of the swamp sediments, implying that the upper swamp was sustained by groundwater (not perched).

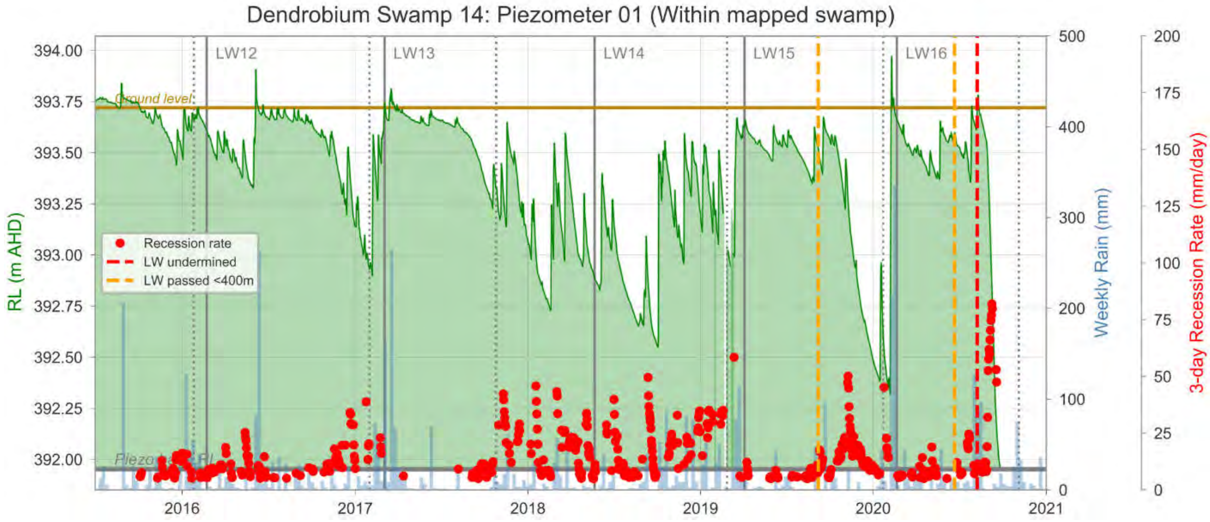

Figure 47. Shallow groundwater hydrograph for Swamp 14, piezometer 01

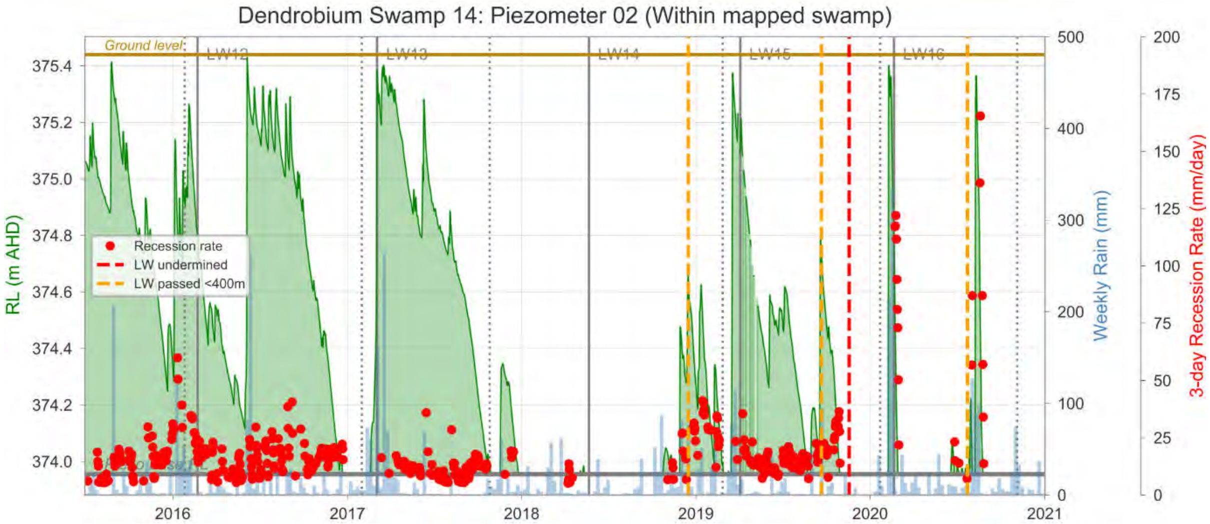

Figure 48. Shallow groundwater hydrograph for Swamp 14, piezometer 02

Piezometer 14_02 in the lower Swamp 14 area shows saturated conditions most of the time between July 2015 and late 2017 and, like several reference sites, recorded groundwater levels below the base of the piezometer for more than 50% of the time during the 2017-2019 drought period. This behaviour indicates that lower swamp area groundwater levels were not sustained by groundwater in the sandstone substrate to the same extent as in the upper swamp area, despite being at a lower elevation (367 – 387 m AHD).

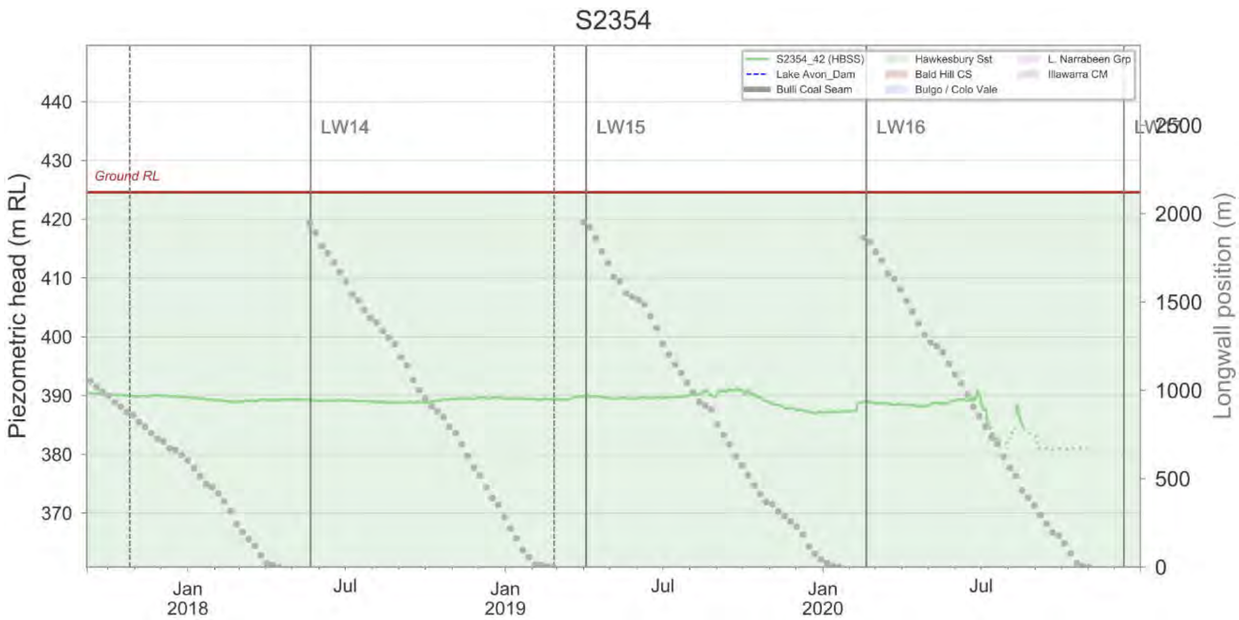

Figure 49. Groundwater hydrograph for S2354 (215 m from Swamp 14 piezo 01)

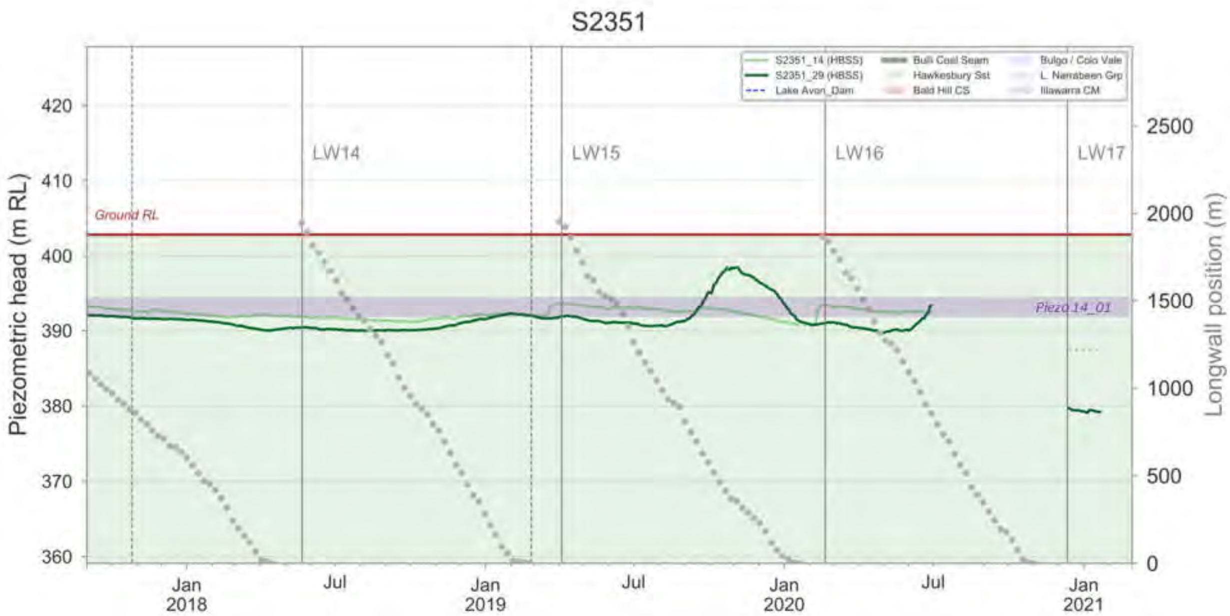

Figure 50. Groundwater hydrograph for S2351 (180 m from Swamp 14 piezo 01)

Both swamp piezometers show evidence for shallow groundwater impact after being directly mined under:

- Piezometer 14_01 (upper Swamp 14) was mined under in August 2020 by Longwall 16. Following the passage of Longwall 16 shallow groundwater levels declined rapidly to below the base of the piezometer for the first time since the start of monitoring. By contrast, hydrologically similar control swamps (22, 25 and 87) remained saturated over the same period. The rate of recession after the passage of Longwall 16 exceeded baseline recession rates. Previously, Longwall 15 passed within 400m of the piezometer in October 2019. Shallow groundwater levels were affected by the 20-17-2019 drought at the time and there were no obvious effects related to Longwall 15.

- Piezometer 14_02 (lower Swamp 14) was mined under in late November 2019 by Longwall 15. Following the passage of Longwall 15, the swamps sediments remained largely unsaturated apart from brief periods following two heavy rainfall events in 2020. In both cases the duration of saturation was much shorter and the recession rate higher than during the baseline period. By contrast, the hydrologically similar reference Swamp 88 which remained saturated throughout 2020. Due to the effects of the 2017-2019 drought, there are no obvious effects related to the passage of Longwall 14 within ~200 m of the piezometer in January 2019.

The above effects represent a Level 3 TARP trigger at swamp 14.

6.1.2.2 Swamp 23

Swamp 23 consists of ~3.9 ha of upland swamp vegetation, mostly Tea-tree and Banksia thicket and minor Cyperoid heath (sedgeland) surrounding the upper reaches of tributary LA3. Two shallow groundwater piezometers are installed in the Swamp; Piezometers 23_01 (headwater) and 23_02 (mid-slope). The piezometers intersect 1.1 to 2.25 m of swamp sediment (respectively) which overlies Hawkesbury Sandstone.

Both piezometers were intermittently saturated prior to Longwall 15. Piezometer 23_01 retained saturation for ~5 to 6 months following large rainfall events, whereas piezometer 23_02 remained partly saturated for longer periods (8 to 12 month) such that sediments became unsaturated only during prolonged low rainfall periods such as the 2017-2019 drought. Shallow groundwater conditions Conditions appear analogous to those at reference swamps 84, 85 and 88.

Longwall 15 passed beneath Swamp 23 between April and June 2019 and was within 400 m of both piezometer from the start of the longwall. Piezometer 23_02 was mined under on 27/4/2019 and Longwall 15 passed 30 m from piezometer 23_01 on 20/5/219. Longwall 16 started less than 20 m from piezometer 23_02 and passed within 110 m of 23_01 on 21/5/2021.

Following the approach and passage of Longwall 15 beneath 23_01, the piezometer records very short periods of saturation compared with the pre-mining baseline (Figure 51), and contrasts with the longer duration of saturation observed at analogous reference swamps (84, 85 and 88). This change represents an impact at this site.

Piezometer 23_02 records partial re-saturation of swamp sediments following large rainfall events in 2020, such that the sediments were continuously saturated throughout the year (Figure 52). The peaks in shallow groundwater level are similar to pre-mining peaks although the duration of saturation may be reduced. There is no apparent change in recession rates compared with baseline. Therefore, based on available data it is not yet clear whether shallow groundwater levels at 23_02 have been impacted by subsidence associated with Longwalls 14 to 16.

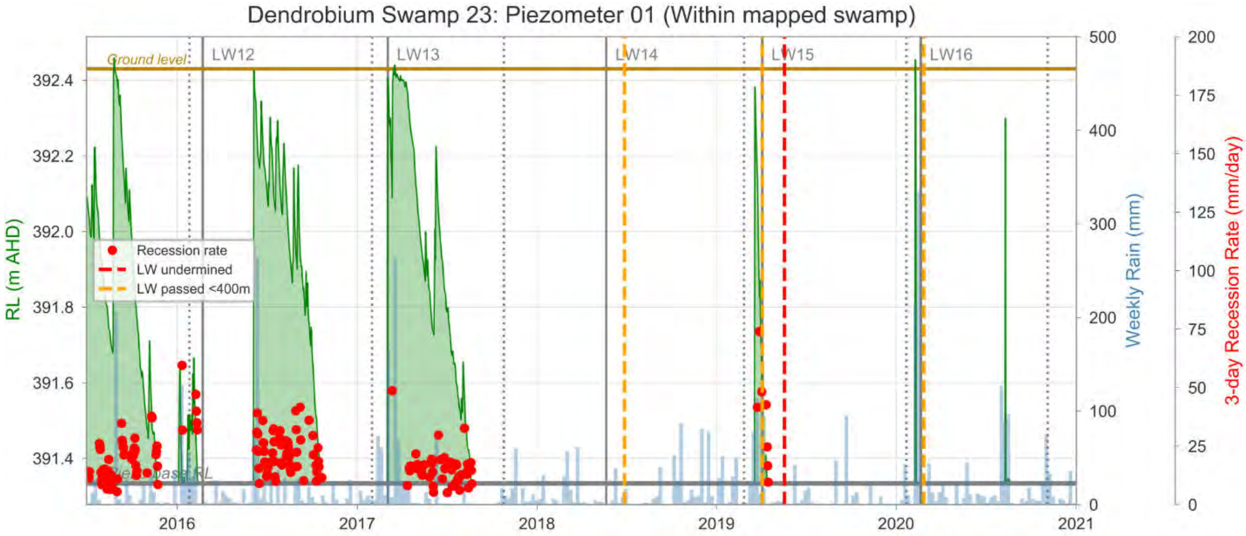

Figure 51. Shallow groundwater hydrograph for Swamp 23, piezometer 01

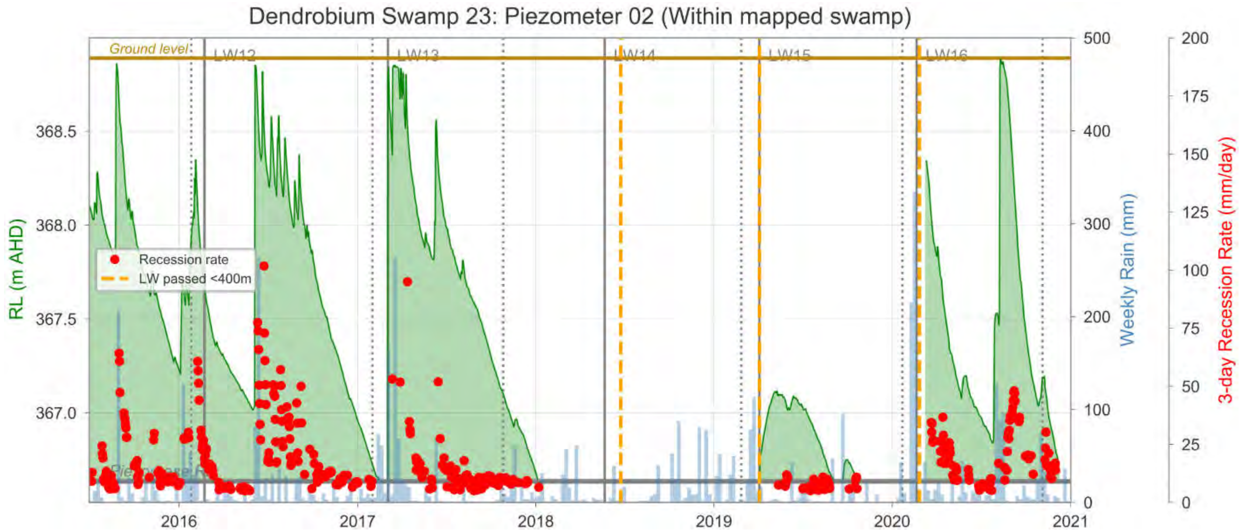

Figure 52. Shallow groundwater hydrograph for Swamp 23, piezometer 02

Swamp 13

Swamp 13 piezometer 1 was mined beneath by Longwall 14 in November 2018 and was again passed at the closest distance of 100 m by Longwall 15 on 12/8/2019. Longwall 16 passed within 400m of the swamp in early June 2020; however, piezometer 13_01 is located just beyond the mining zone of influence at 450 m from Longwall 16.

The effects of Longwalls 14 and 15 on shallow groundwater levels in Swamp 13 were obscured by the effects of the 2017-2019 drought. Heavy rainfall events in February and August 2020 resulted in brief saturation of swamp sediments with the peak groundwater level and the duration of saturation being somewhat less than similar rainfall events prior to the drought. It is likely that the hydrology of Swamp 13 at piezometer 01 was affected by the passage of Longwall 14. However dure to the effects of the drought it is unclear whether the swamp was further impacted by Longwalls 15 or 16. Because 13_01 is the only piezometer at Swamp 13, the impact is a TARP Level 3 (as previously assessesd).

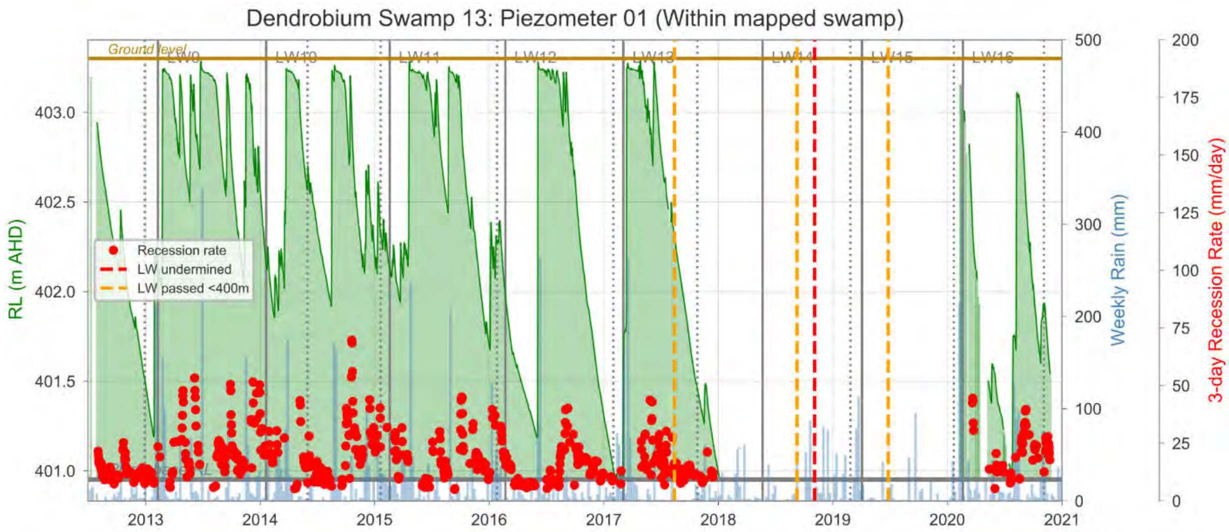

Figure 53. Shallow groundwater hydrograph for Swamp 13, piezometer 01

6.1.3 Spatial distribution of impacted swamps

Swamps that have been mined under commonly display hydrological changes shortly following the passage of the longwall beneath the monitoring site. An assessment of hydrological change at Upland Swamps was carried out at Dendrobium by Watershed (2019b). The study concluded that there was no evidence for hydrological change in shallow groundwater piezometers located more than 60 m from the extracted longwall margin. Although it is possible that impacts at greater distances from the mine may be caused by depressurisation along geological structures such as faults (as has been observed at the Springvale Mine in the Western Coalfield; Galvin *et al.* 2016), the Watershed assessment found no evidence for anomalous impacts associated with lineaments at Dendrobium.

Shallow groundwater responses to Longwall 16 discussed in the previous section are consistent with the Watershed review.

Table 24. Summary of shallow groundwater level TARP status at *Impact Sites*

SWAMP	TARP SITES	RELEVANT LONGWALLS	PIEZOMETERS WITH AN OBSERVED RESPONSE			OBSERVED BEHAVIOUR	COMMENT	TARP LEVEL
			YES	UNCLEAR	NO			
01a	6	Longwall 9, Longwall 10	01, 04, 04i, 04ii, 04iii, 04iv, 04v		02	Groundwater levels lower than baseline and recession rate greater than baseline at greater than 50% to 90% of monitoring sites	Limited baseline data for five piezometers.	Level 3
01b	5	Longwall 9	02, 02iii	02ii, 02iv	01	Groundwater levels lower than baseline and recession rate greater than baseline at greater than 50% of monitoring sites.	Limited baseline data for five piezometers	Level 2
03	1	Pillar 11/12	01			Possible increase in recession rate and apparently reduced response to rainfall after Longwall 11 passed and Longwall 12 undermined.	Rapid recession after rain during Longwall 13 supports impact at Swamp 3	Level 3
05	6	Longwall 9, Longwall 10, Longwall 11	01, 02, 03, 03ii, 04	05		Groundwater levels lower than baseline and recession rate greater than baseline at >80% of monitoring sites	Unclear if piezometer 5_05 impacted by either Longwall 11 or 12 due to limited baseline.	Level 3
08	0	Longwall 9, Longwall 10 Longwall 11	*01, 04*	*02*		Groundwater levels lower than baseline and recession rate greater than baseline at a number of piezometers, not within swamp boundary.	Outside swamp boundary (Not subject to TARP)	n/a
10	1	Longwall 12	01			Sharp decline in groundwater levels below base of the piezometer after Longwall 12. Level and rate of decline anomalous compared with baseline.	Mined under by Longwall 12	Level 3
11	3	Longwall 13, Longwall 14	H1, H2, H3			All three piezometers show mostly desaturated conditions following the passage of Longwall 14 with only brief periods of saturation following rainfall events.	Partially mined under by Longwall 13 and by Longwall 14	Level 3
13	1	Longwall 14	01			Groundwater level below the piezometer base since early 2018; Impact apparent as of Longwall 15. Swamp re-saturated during 2020 but not to the same level as previously.	Partially mined under by Longwall 13 and by Longwall 14	**Level 3**
14	2	Longwall 15, Longwall 16	01, 02			Evidence for impact to swamp groundwater levels at 14_01 and 14_02 following Longwalls 16 and 15 respectively (decreased level and duration of saturation and recession rate above baseline.	Partially mined under by Longwalls 15 and 16	**Level 3**
23	2	Longwall 15, Longwall 16	01	02		Evidence for impact to swamp groundwater levels and duration of saturation at 23_01 following Longwall 15; Possible effects at 23_02 but unclear as of Longwall 16 end.	Partially mined under by Longwall 15, passed within 400 m by Longwall 16.	**Level 2**
35a	1	Longwall 18			01	n/a	Yet to be mined under	n/a

35b	1	Longwall 18			01	n/a	Yet to be mined under	n/a

Note: " i " in site name (e.g. 04i) indicates installation during Longwall 9 extraction. * at these swamps which are located away from active or recent mining areas the data has been logged (recorded) at the piezometer, but not collected since that time.

Table 25. Summary of shallow groundwater level trends at *Reference Sites*.

SWAMP	NUMBER OF PIEZO-METERS	PIEZOMETERS	PROXIMITY TO LONGWALLS	COMMENT	OBSERVATIONS
02	1	01	900 m north of Longwall 9	900 m from Longwall 9	Swamp permanently saturated 2013-2017. Water level below piezometer for >60% of time between 2017 and 2019; saturated throughout 2020.
07	2	05, 06	1.2 km from Longwall 6	1.2 km from Longwall 6	Water level above base of piezometers for entire record including dry period between 2017 and 2019. Saturated throughout 2020.
15a	3	06, 07	0.5 km south of Longwall 8, 130 m south of Longwall 19	0.5 km from Longwall 8	n/a
22	2	01, 02	Elouera Colliery	Limited baseline data	Water level above base of piezometers for entire record including dry period between 2017 and 2019. Saturated throughout 2020.
25	1	01	1.4 km from Longwall 5	1.4 km from Longwall 5	Water level above base of piezometers for entire record including dry period between 2017 and 2019. Data gap 2012-2014.
33	2	01, 03	1 km from Longwall 16	1 km from Longwall 16	Transient but short duration peaks in water level following rain. Shorter duration peaks during 2018-2019 dry period.
84	1	01	500 m from Longwall 5	500 m from Longwall 5	Swamp 84 has typically been saturated 80-90% of time, except for the 2017-2019 dry period (<50%). Saturated most of 2020.
85	2	01, 02	900 m from Longwall 9	900 m from Longwall 9	Piezometers record saturation of swamp sediments for several months after heavy rainfall events. Swamp unsaturated late 2017 to early 2020 Saturated most of 2020
86	2	01, 02	3 km from Longwall 9	3 km from Longwall 9	Piezometer 01 has similar characteristics to swamp 85. Piezometer 02 typically records saturated conditions except during 2019. Returned to saturated conditions throughout 2020.
87	2	01, 02	Avon Colliery	Limited baseline data	Piezometer 01 saturated >90% of time and piezometer 02 100% of time prior to 2018. Piezometers dry most of 2018 to 2020. Saturated throughout 2020.
88	2	2	Huntley Colliery	Limited baseline data	Both piezometers record WL above base for >80% of time prior to 2017. Both piezometers mostly dry 2017 – 2019. Mostly saturated in 2020.

6.2 Soil moisture

Significant changes in soil moisture characteristics compared with baseline monitoring is identified as an indicator of potential changes in ecosystem functionality of the swamps. Response trigger conditions related to soil moisture at swamp monitoring sites are listed in the SIMMCP (South32, 2020c), and reproduced in Table 26.

Table 26. TARP trigger conditions related to soil moisture at swamp monitoring sites

TARP Level	Trigger conditions	Response
1	Soil moisture level lower than baseline level at **any** monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	Increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars
2	Soil moisture level lower than baseline level at **50%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	
3	Soil moisture level lower than baseline level at **>80%** of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).	

The TARP has been assessed by comparing the average moisture content of the soil profile during the longwall assessment period against that of the baseline period. If the average soil moisture level drops below the minimum level recorded during the baseline period, a TARP is triggered. The TARP level increases according to the proportion of monitoring sites that exceed this criterion at each swamp within the area of mine influence (Table 26). This is the same approach used by the IMCEFT for regular impact reporting. The baseline period is the period of monitoring before the site is first mined under or passed within 400 m.

Soil moisture hydrographs for all active monitoring locations are presented in **Appendix E**. Assessment of soil moisture hydrographs for locations within Areas 3A and 3B zone of influence (< 400 m) are presented in Table 27. Longwall 16 passed beneath or within 400 m of:

- **Swamp 14**: Longwall 16 passed beneath the swamp between 2/8/2020 and 21/8/2020. The northern extension of the swamp was previously mined under by Longwall 15 during the latter half of 2019.
- **Swamp 23**: Longwall 16 passed beneath the southern fringes of the swamp between 10/3/2020 and 23/3/2020. The swamp was previously mined under by Longwall 15 during the first half of 2019.
- **Swamp 13:** Longwall 16 passed within 400m of the swamp in early June 2020; however, piezometer 13_01 is located just beyond the mining zone of influence at 450 m from Longwall 16.

Average soil moisture declined at all swamp soil moisture sensors during the 2017-2019 drought, often to their lowest levels on record. Soil moistures decline during the drought complicated interpretation of longwall subsidence effects over that period. Reassessment in this review, following above-average rainfall in 2020, has resulted in revision of TARP triggers at Swamp 13 and 23 (Table 27).

At Swamp 14 there is evidence for a decline in moisture levels at S14_S01 following passage of Longwall 16 which contrasts with the recovery in soil moisture at reference swamps. Soil moisture recovered at S14_S02 during 2020 with a range similar to baseline. A mining effect is not clear at S14_S02. Observed effects at both sensors represent a TARP level 2 trigger.

At Swamp 23, soil moisture levels recovered 2020 following the 2017-2019 drought, to a range similar to the baseline period. On this basis, the TARP is not triggered (revised from Level 2 in the previous assessment).

At Swamp 13, soil moisture levels recovered 2020 following the 2017-2019 drought, to a range similar to the baseline period at sensor S13_S03. However, the average soil moisture content at sensors S13_S01 and S13_S02 remained below pre-drought levels and is likely impacted by mining. TARP trigger revised to Level 2 (Level 3 in previous assessment).

Table 27. Assessment of soil moisture hydrographs in Areas 3A and 3B

Swamp	Longwall	Sensors and TARP triggers			Comment	TARP Level
		Not triggered	Triggered	Not within mine influence		
05	LW9 – LW12		S05_S05, S05_S01, S05_S02, S05_S08		All four sites show soil moisture decline below baseline after LW passes; baseline <2 y)	3
08	LW12	S08_S05			Soil moisture falls below baseline after undermining. *Not within mapped swamp boundary.*	n/a
11	LW13, LW14		S11_S01, S11_S02, S11_S05		Soil moisture at all sensors dropped to lowest levels following LW13 and LW14. Likely mining effect, exacerbated by dry conditions. (Previously triggered Level 3)	3
13	LW14	S13_S03	S13_S01, S13_S02,		Revised in 2020 to Tarp level 2 (Previously 3): Soil moisture at all sensors dropped to lowest levels during 2017-2019. Apparent recovery in 2020 at S03. Other sensors record lower moisture levels than baseline.	2
14	LW15	S14_S02	S14_S01		Soil moisture at S01 below baseline (except for drought) in 2020 in contrast to recovery at reference swamps 22, 85 and 86. S02 shows recovery from drought in 2020. Mining effect at S02 possible but not yet clear.	**2**
15a	-			S15a_Piezo, S15a_S03, S15a_S01, S15a_S04, S15a_S06	Outside Area 3A Longwalls; Soil moisture in 3 sensors dropped below baseline due to dry conditions	-
23	LW15	S23_S01 S23_S02			Revised in 2020: No TARP trigger (previously Level 2). Both sensors show recovery in 2020 after effects of 2017-2019 drought. Moisture levels in 2020 similar to baseline.	**-**
35a	LW18			S35a_S01	Not yet mined under	-

Note: * Sites for which there are too few data points for a statistically valid assessment (<10)

7. Conclusions

Longwall 16 is the eighth panel to be extracted from Dendrobium Area 3B. Extraction of Longwall 16 commenced on 26/2/2020 and was completed on 4/11/2020. Rainfall in 2020 totalled 1436 mm, well above the long-term average and the highest rainfall year since the start of mining at Dendrobium. Rainfall was relatively consistent throughout the year with two large events in February and August. The high rainfall in 2020 marks the end of a severe drought period between 2017 and 2019 and has resulted in significant recovery of stream flows, shallow groundwater and soil moisture levels and improvements in stream water quality.

7.1 Effects on surface water quality

At many stream monitoring sites including reference sites, water EC declined during 2020 following a period of increased EC during the 2017-2019 drought period. Water EC remained elevated at several locations on Donalds Castle Creek, LA4 and in Sandy Creek (SC10C and SC10). Elevated EC at LA4 and Sandy Creek reflect subsidence impacts on the watercourses, whereas mining effects at Donalds Castle Creek are not clear.

Water quality TARPs were triggered at:

- Donalds Castle Creek (FR6) – Level 3 (EC)
- LA4 – Level 2 (EC, pH); Level 1 (DO)

TARP triggers for Donalds castle Creek relate to the first half of 2020, after which EC levels declined. Elevated EC conditions were observed in the upper tributaries of Donalds Castle Creek during 2018 and 2019. The high EC was accompanied by low DO and elevated sulfate, Zn and Mn compared with baseline concentrations. A longitudinal survey of pools along Donalds Castle Creek has been carried out quarterly since May 2019. The last two surveys (Sept 2020, Jan 2021) show that EC in all pools has returned to within the baseline range as a result of higher rainfall in 2020.

Fracturing of the creek bed near LA4_S1 associated with Longwalls 12 to 15 resulted in the diversion of flows just upstream of LA4_S1 such that sampling has not been possible since 2017. Higher rainfall in 2020 resulted in intermittent filling of LA4_S1. EC was elevated and pH and DO low compared with baseline, likely as a result of flow diversion through fractures. The water quality in Lake Avon remains unaffected.

On 19/10/2020 iron staining was noted in Sandy Creek tributary SC10C (Level 2 TARP), extending downstream to the Sandy Creek. Staining was first reported at SC10C on 11/3/2013, following extraction of Longwall 8. The recent recurrence of staining at SC10C seven years after the first occurrence is likely the result of recovering groundwater flooding previously drained fractures in the vicinity of SC10C. This is supported by groundwater monitoring data.

7.2 Effects on surface water flow

Surface water flow TARPs were reviewed in 2019 in consultation with relevant government agencies and based on recommendations of the IEPMC (Watershed HydroGeo, 2019a). Key features of the updated TARPs are:

- A move to rely on comparison of flows recorded at relevant sub-catchment monitoring sites around the Dendrobium mining area against selected reference sites, rather than relying on rainfall-runoff modelling.

- Assessment of sub-catchment hydrology against a number of different indicators that are considered appropriate to identifying and quantifying potential effects on the broad hydrological behaviour within each sub-catchment, effects on cease-to-flow conditions that may be significant to ecological values, and effects on median flow which is a proxy for the water resource potential.
- A further assessment has been implemented to analyse the mining effects on low-flows that are known to occur along the "middle reach" of Wongawilli Creek, between Area 3A and 3B.

The results of Assessments A, B and C are summarised on Table 28.

The assessments indicate that sub-catchments in the upper part of the Donalds Castle Creek catchment (i.e. DC13S1 and DCS2) have been and continue to be affected by mining, as is the tributary LA4 of Lake Avon (at LA4S1) [this is evident from IMCEFT field inspection, even though continuous monitoring was not available during Longwall 16] and in the neighbouring tributary LA3. The findings for DC13S1, DCS2 (both at Level 3 for all three flow assessments), and are similar to those for the EoP report for Longwall 15, as presented in Watershed HydroGeo (2019). LA2 has been affected by mining for the first time by Longwall 16.

Similarly, the flow characteristics at WC21S1 and WC15S1 within the Wongawilli Creek catchment have altered as a result of mining, with these sites at Levels 2 or 3 for the three assessments. As with the sub-catchments above, the effects at WC21 and WC15 are similar to those for the previous longwall. Despite Longwall 16 terminating within 50 m of WC12, no mining-related effects are discernible beyond natural variability/method accuracy.

As in recent EoP reports, analysis indicates that mining effects are probable at the Donalds Castle Creek downstream monitoring site (DCU). Specifically, the newly designed TARP assessments indicate that the general pattern of flow (Assessment A) and the median flows (Assessment C) do not trigger, which suggest that any mining effects or impacts on those indicators are of similar magnitude or less than natural variability. However, the new Assessment B, which examines cease-to-flow duration and frequency, indicates that the watercourse at DCU has been experiencing a mild increase in the number of cease-to-flow days compared to the Reference sites (TARP Level 1).

Changes to stream flow characteristics are not evident at the downstream gauge on Wongawilli Creek Lower (WWL), despite mining-related effects being clear and significant at upstream tributaries (e.g. WC21, WC15). This is even more relevant at DCU, where the losses identified in upstream sites DC13S1 and DCS2 are 40-60% of median flow at Q50. Such losses should be clearly apparent at DCU if they were transmitted downstream, but the assessment has not detected a change in median flow at Q50 beyond natural variability (i.e. variability at two Reference sites). This suggests that some or all flow lost in headwater catchments is returned downgradient, or that upstream diversions or losses are not significant in relation to the larger catchment water balance given the natural variability and the accuracy of flow measurements.

Analysis of available surface water flow observation records for Wongawilli Creek triggered a Level 2 TARP in February 2020 (the month in which Longwall 16 commenced, although specifically, this occurred two weeks prior to Longwall 16). Assessment D was carried out, and indicated that flow reductions due to mining were in the order of 0.005 to 0.01 ML/d. This then led to assessment against the relevant Performance Measure (see below).

Table 28. Watercourse flow assessment summary

Site	Watercourse	Area	Date mining occurred under sub-catchment	A) Low flow Q%ile outside Reference Site Q%ile		B) Change in cease-to-flow frequency (beyond natural)		C) Change Q50 (beyond natural) as % of pre-mining Q50			Rainfall-runoff model comparison	Comment
				Change %	TARP Level	Change %	TARP Level	Change ML/d	Change %	TARP Level		
DC13S1	DC13	A3B	9/02/2013	59%	Level 3	20%	Level 2	-0.08	-62%	Level 3	n/a	Effects are similar to those in LW14,15
DCS2	Donalds Castle Creek	A3B	10/07/2013	54%	Level 3	40%	Level 3	-0.07	-45%	Level 3	n/a	Effects are similar to those in LW14,15
DCU	Donalds Castle Creek	A3B	9/02/2013	-6%	Not triggered	8%	Level 1	0.11	30%	Not triggered	Not triggered	Effects are similar to those in LW14,15. This is consistent with findings from rainfall-runoff model.
WC21S1	WC21	A3B	5/10/2013	30%	Level 3	12%	Level 2	-0.10	-21%	Level 3	n/a	Effects are similar to those in LW14,15
WC15S1	WC15	A3B	28/01/2017	20%	Level 3	7%	Not triggered* (Level 1)	-0.03	-25%	Level 3	n/a	Similar to LW15. * However, changes to low flow accuracy means that Method B not completely reliable. Level 1 is likely.
WC12S1	WC12	A3B	18/10/2020	-9.9%	Not triggered	-9%	Not triggered	0.012	139%	Not triggered	Not triggered	First panel under catchment. No discernible effect This is consistent with findings from rainfall-runoff model.
WWL	Wongawilli Creek	d/s A3B	9/02/2010	-1%	Not triggered	-1%	Not triggered	0.18	5%	Not triggered	Not triggered	Effects are similar to those in LW14,15. Rainfall-runoff model suggests possible small effect, but insufficient to trigger former TARP – in agreement.
WWLA	Wongawilli Creek	d/s A3B	9/02/2010									No pre-mining baseline record. To be assessed in future EoP report.
LA4S1	LA4	A3B	1/04/2015	11%	Level 1	-10%	Not triggered* (Level 3)	-0.02	-31%	Level 3	n/a	Logger failed, not yet replaced. Effects considered to be the same as for Longwall 15. *.Low flows are reported to greater accuracy in post-mining period, so Method B not treated as completely reliable →Level 3 is likely.
LA3S1	LA3	A3B	28/04/2019	38%	Level 3	39%	Level 3	-0.04	-292%	Level 3	n/a	Effects are similar to those following LW15, Similar to LW15, but increase in CTF frequency.
LA2S1	LA2	A3B	01/03/2020	-15%	Not triggered	-23%	Not triggered	-0.006	-294%	Level 3	n/a	LW16 mined under upper part of watercourse. Reduction in Q50.
NDS1	ND1	A3B	Not yet (LW17 or LW18)									To be assessed in future EoP report.
			E:\DENDROBIUM\Tech\SurfaceWater\EOP_Analysis\EoP16_Analysis\Ref_v_Monitored_BACI_LW16v3.xlsx									

7.2.1 Performance Measures

The four Performance Measures for surface water flow were assessed (Section 5.5) as follows:

Wongawilli Creek – minor environmental consequences
This Performance Measure is met.

Donalds Castle Creek – minor environmental consequences
This Performance Measure is met.

Lake Avon – negligible reduction in the quantity of surface water inflows to Lake Avon
This Performance Measure is met.

Cordeaux River – negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek
This Performance Measure is met.

7.3 Effects on swamps

It was predicted that Swamps 01a, 01b, 03, 04, 05, 08, 10, 11, 13, 14, 23, 35a and 35b would be affected by mine subsidence due to mining in Area 3B (South32, 2020c). The assessment of shallow groundwater levels indicates that TARPs have been triggered at the following swamps, most of which, were triggered during previous longwalls:

- Swamp 01a Level 3
- Swamp 01b Level 2
- Swamp 03 Level 3 (because the only piezometer is affected)
- Swamp 05 Level 3
- Swamp 10 Level 3 (because the only piezometer is affected)
- Swamp 11 Level 3
- Swamp 13 Level 3 (because the only piezometer is affected)
- Swamp 14 Level 3 (**this assessment**)
- Swamp 23 Level 2 (**this assessment**)

Both shallow groundwater levels and soil moisture levels in reference swamps recovered in 2020 following the 2017-2019 drought period.

Longwall 16 passed beneath parts of Swamps 23, 13 and 14 during 2020. Swamps were partially mined under by Longwall 15 also. At Swamp 23, one piezometer (23_01) out of two installed in the swamp records a change in saturation duration following rainfall and represents a Level 2 TARP. At Swamp 14, both piezometers installed in the swamp record a decrease in saturation and an increase in recession rate following the passage of Longwall 15 and 16, representing a Level 3 TARP. The observed effects at both swamps are in line with impacts anticipated in the SMP.

At Swamp 14 there is evidence for a decline in moisture levels at S14_S01 following passage of Longwall 16 which contrasts with the recovery in soil moisture at reference swamps. Soil moisture recovered at S14_S02 during 2020 with no clear evidence of a mining effect. Observed effects represent a TARP level 2 trigger. At Swamp 23, soil moisture levels recovered 2020 following the 2017-2019 drought, to a range similar to the baseline period. On this basis, a soil moisture TARP is not triggered (revised from Level 2 in the previous assessment). Similarly, the soil moisture TARP level at Swamp 13 has been revised down to Level 2 due to recovery in 2020 at one piezometer.

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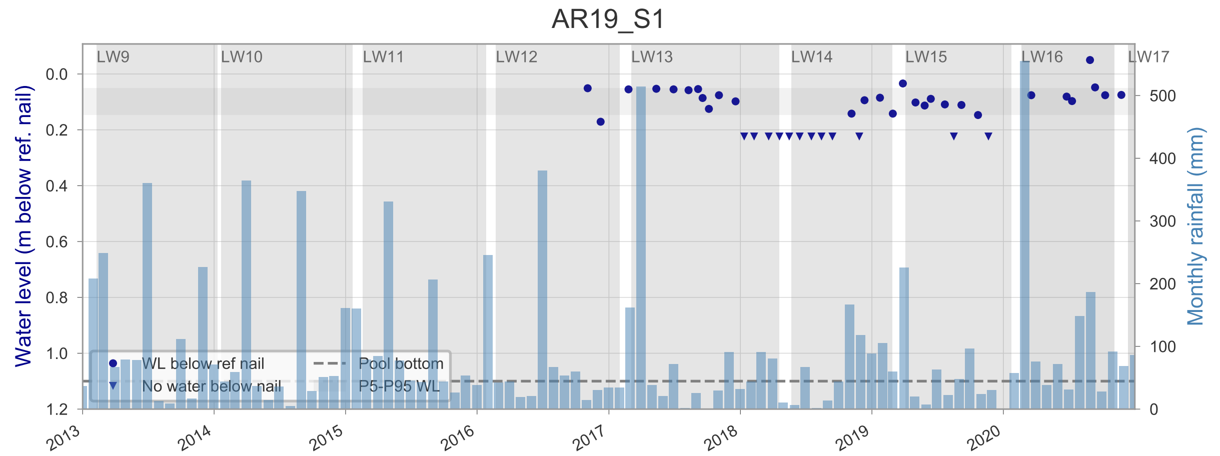
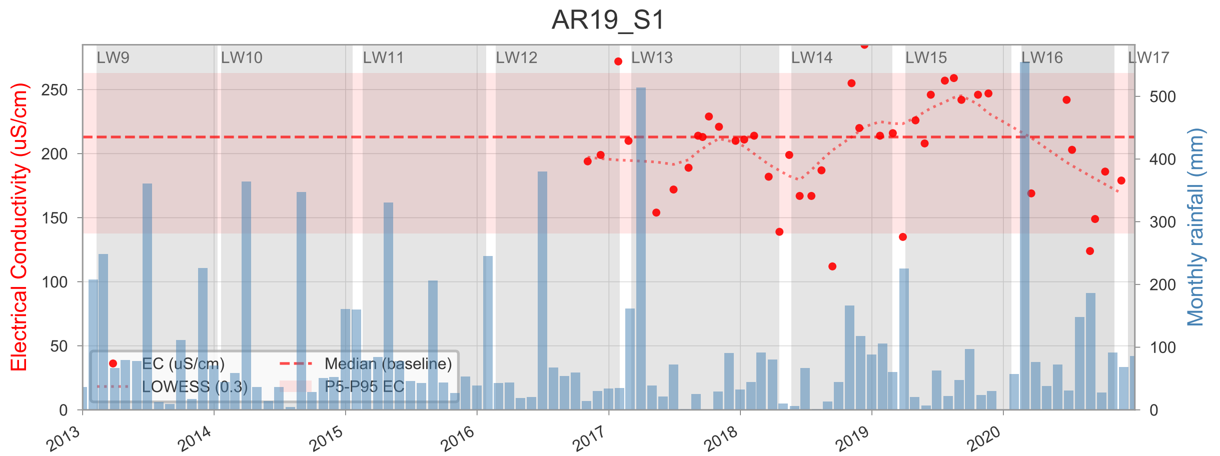
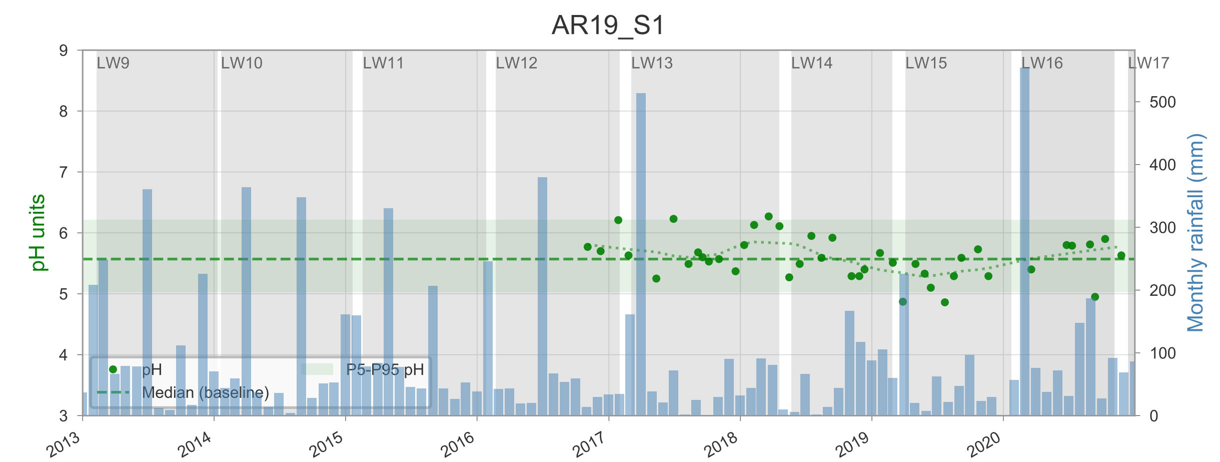
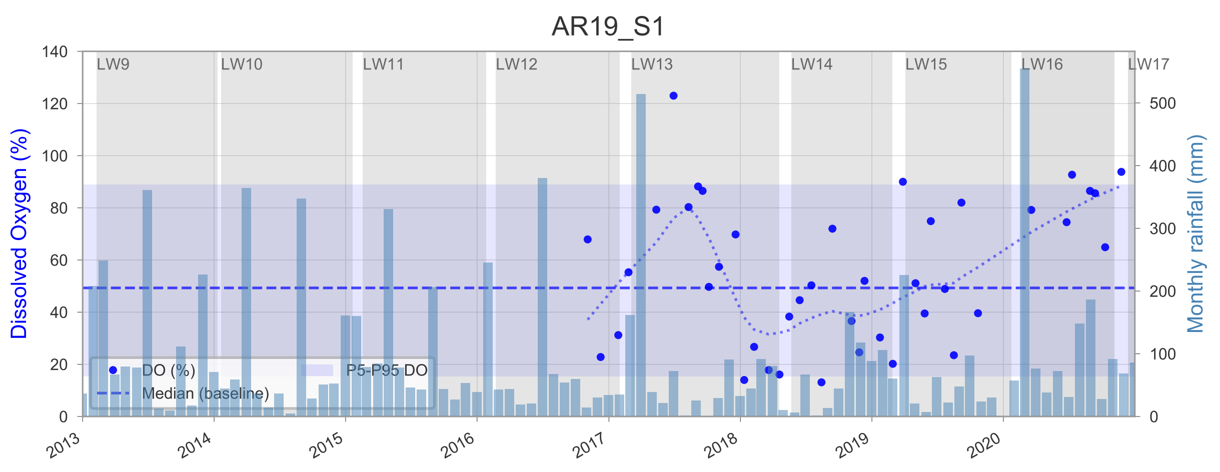
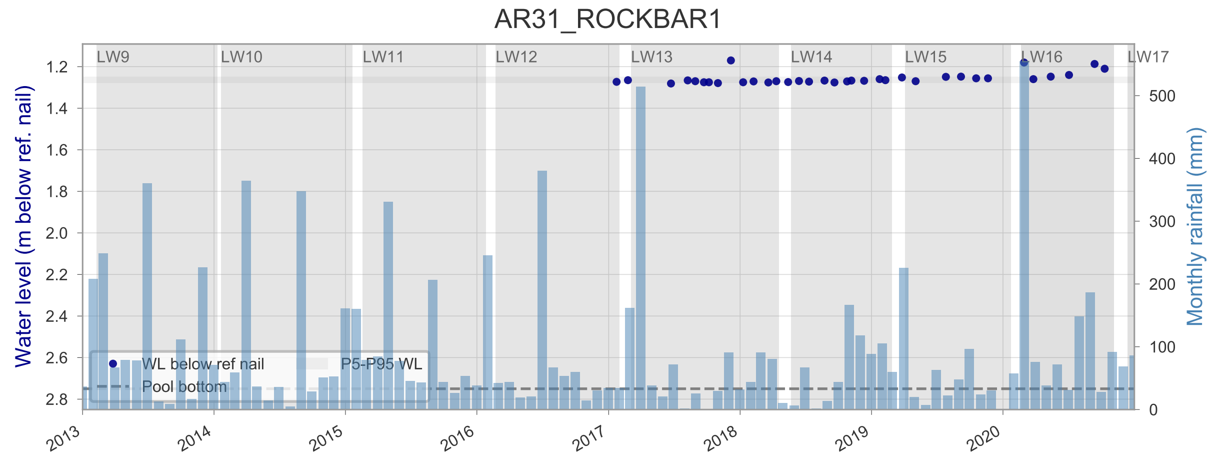
Appendix A: Water quality hydrographs

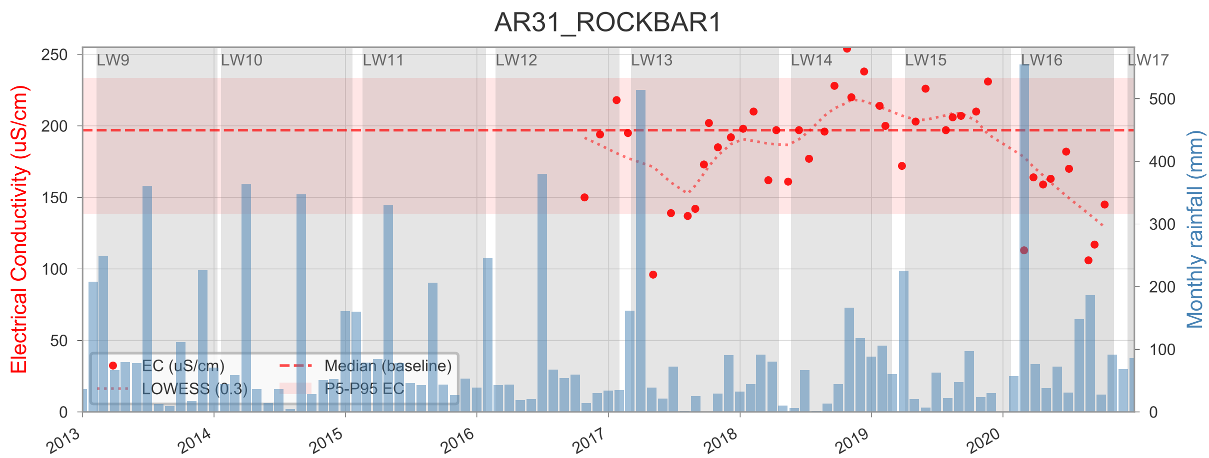

AR19_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

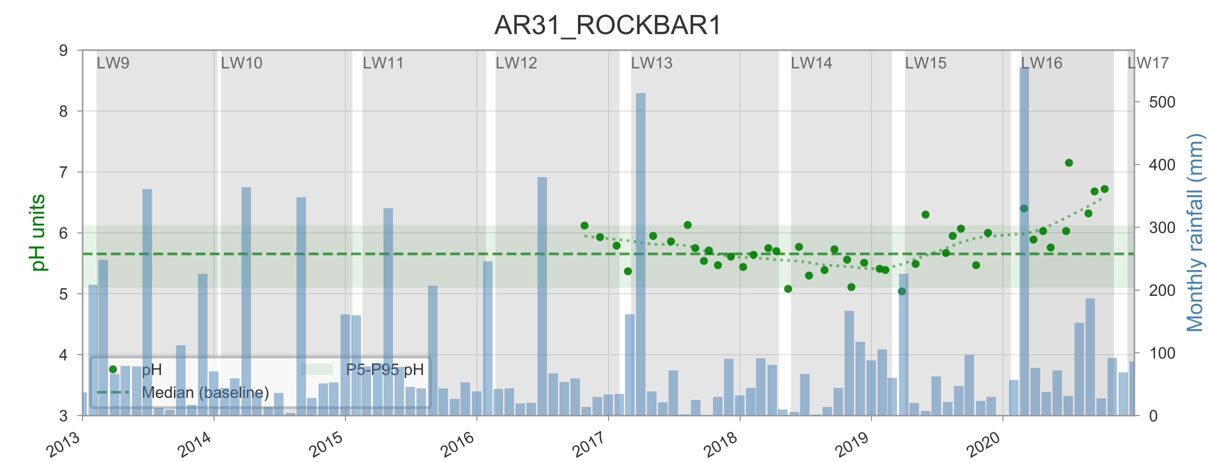

AR19_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

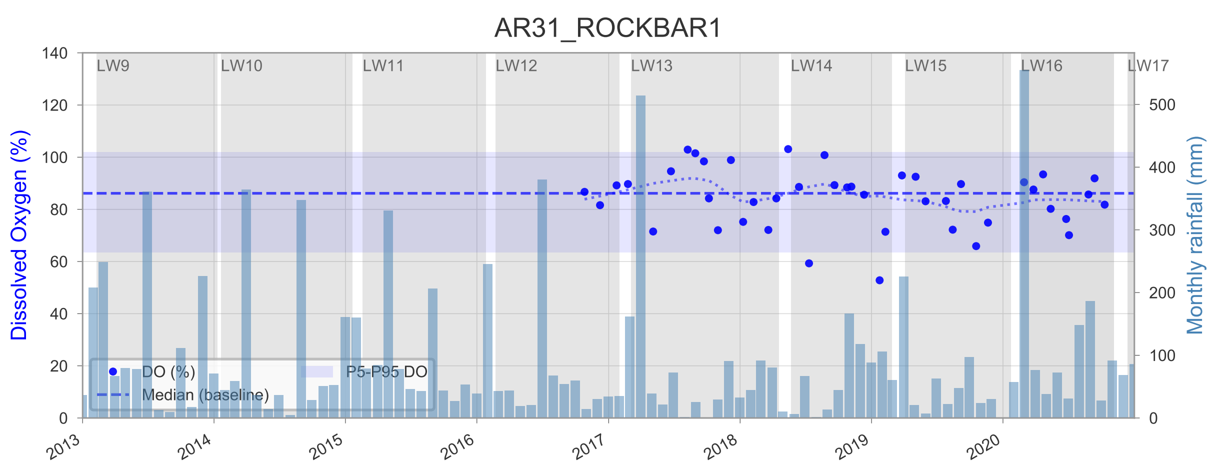

AR19_S1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

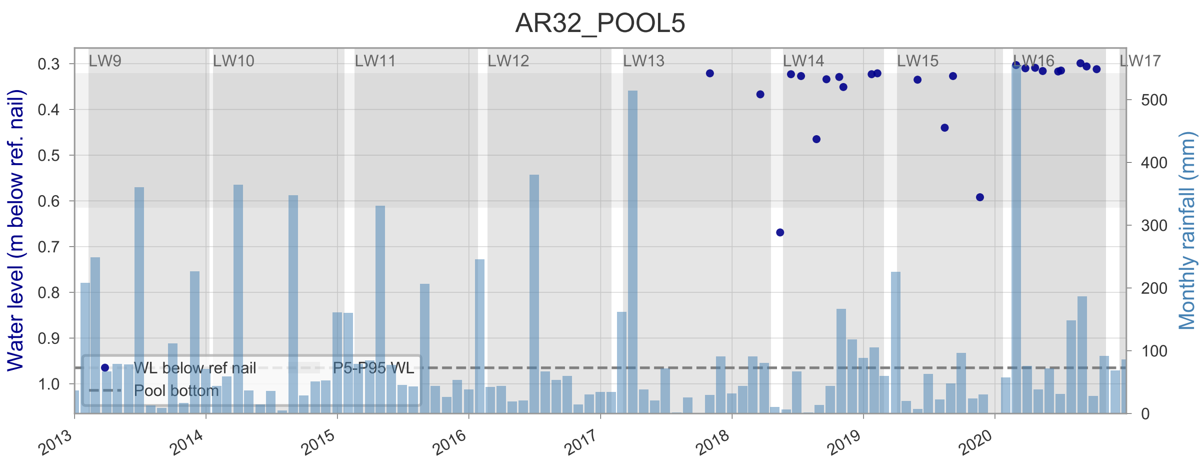

AR19_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

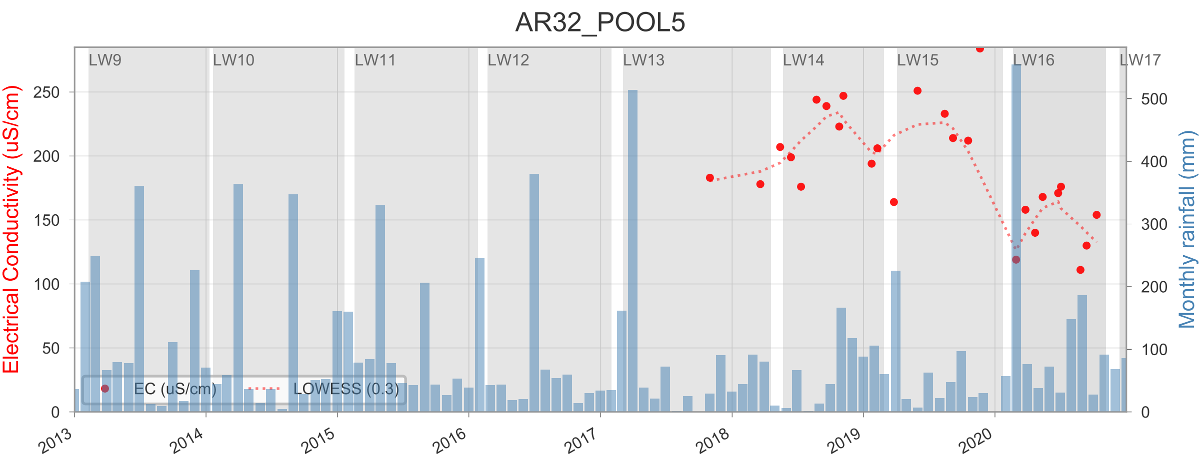

AR31_ROCKBAR1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom
2013
2014
2015
2016
2017
2018
2019
2020

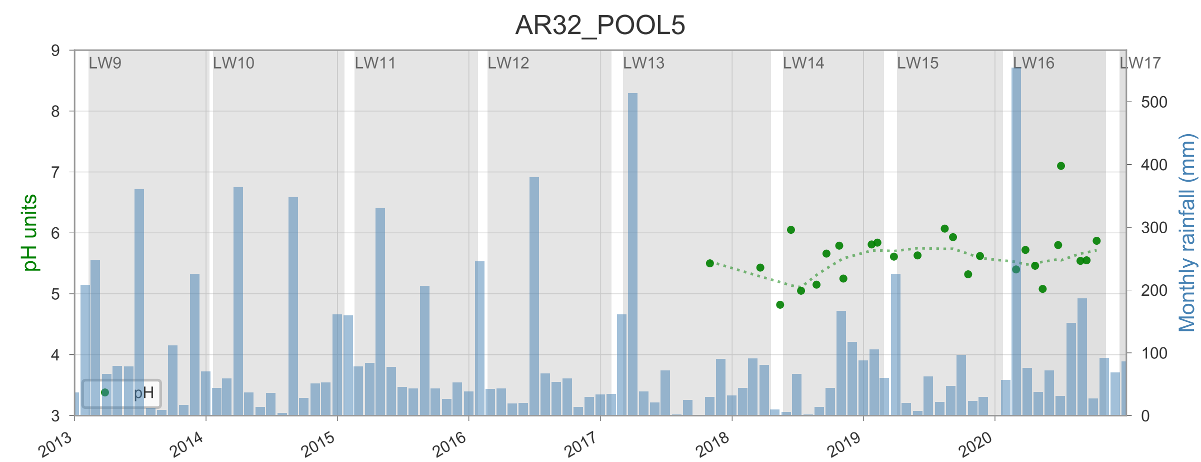

AR31_ROCKBAR1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

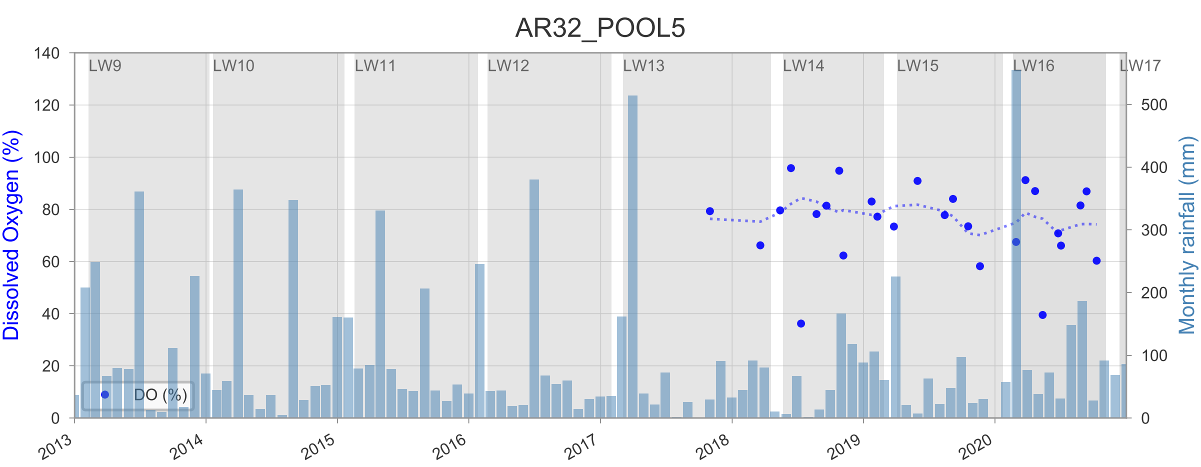

AR31_ROCKBAR1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
P5-P95 pH
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

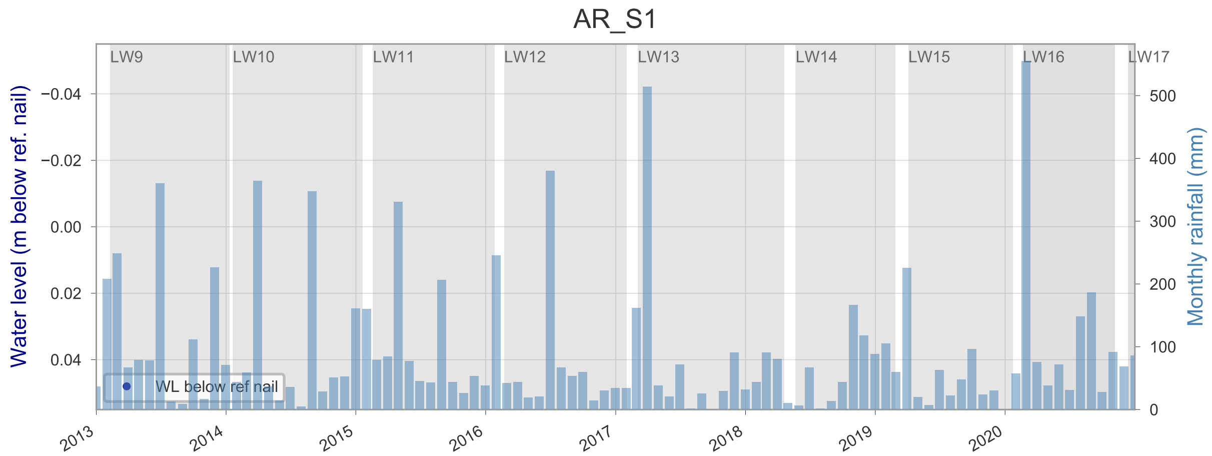

AR31_ROCKBAR1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
P5-P95 DO
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

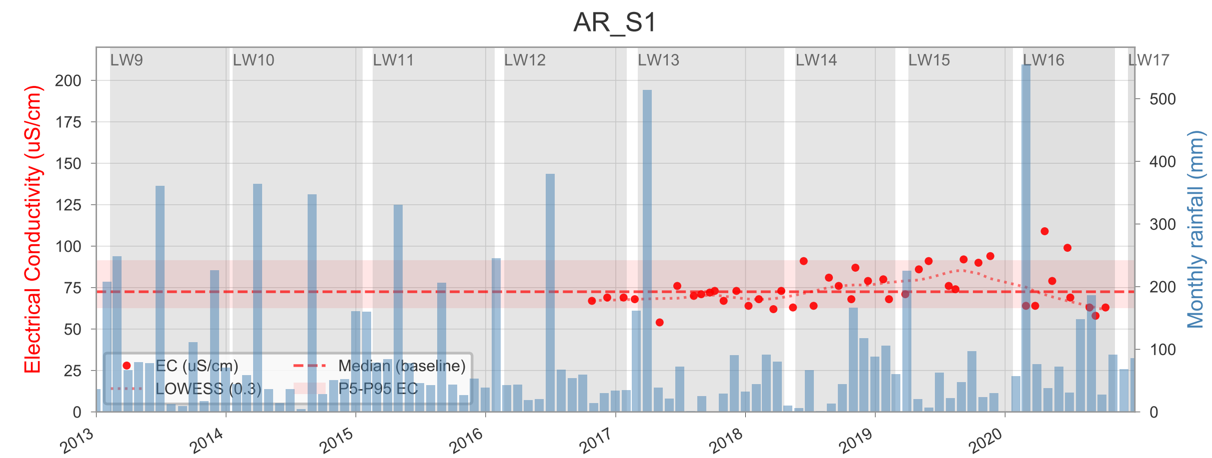

AR32_POOL5
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom

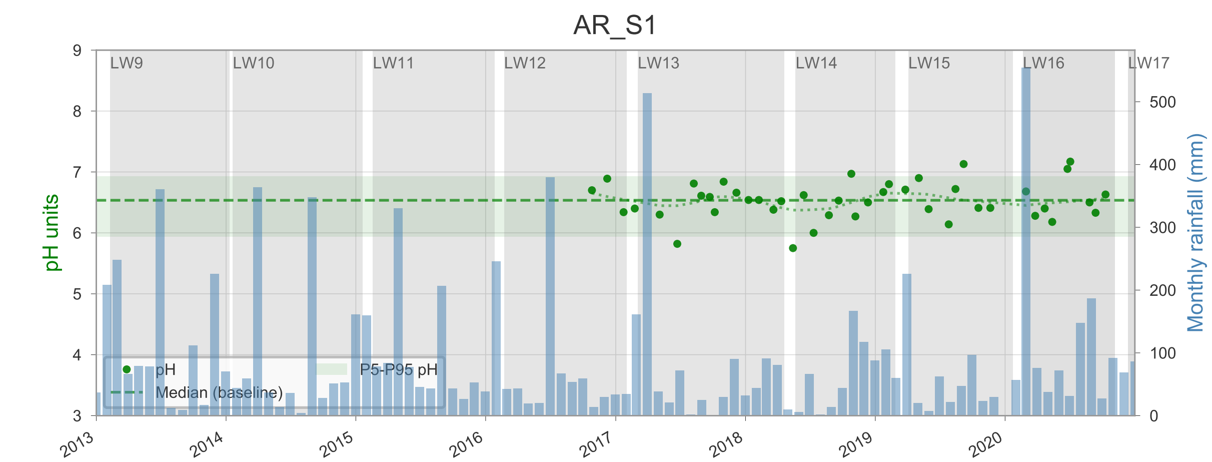

AR32_POOL5
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

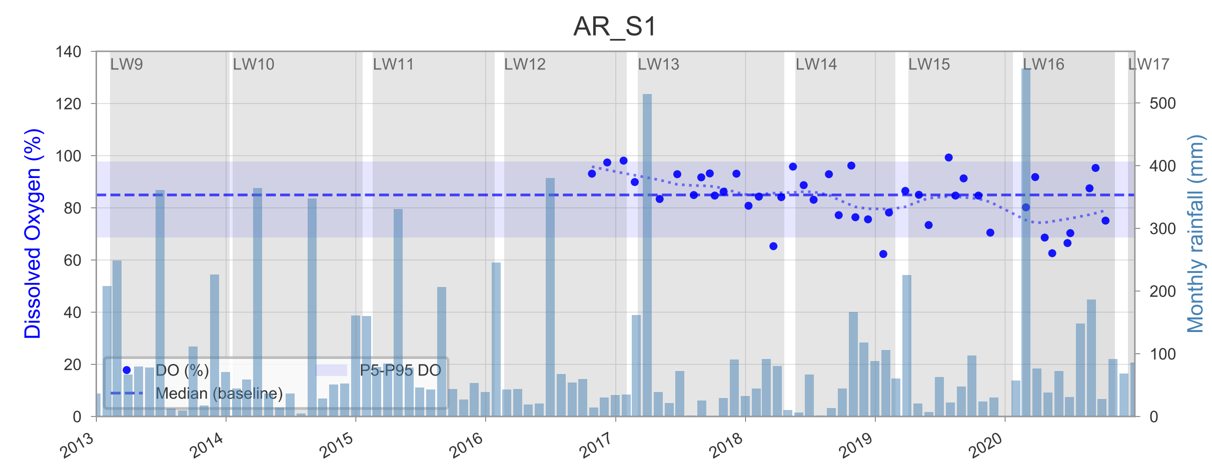

AR32_POOL5
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

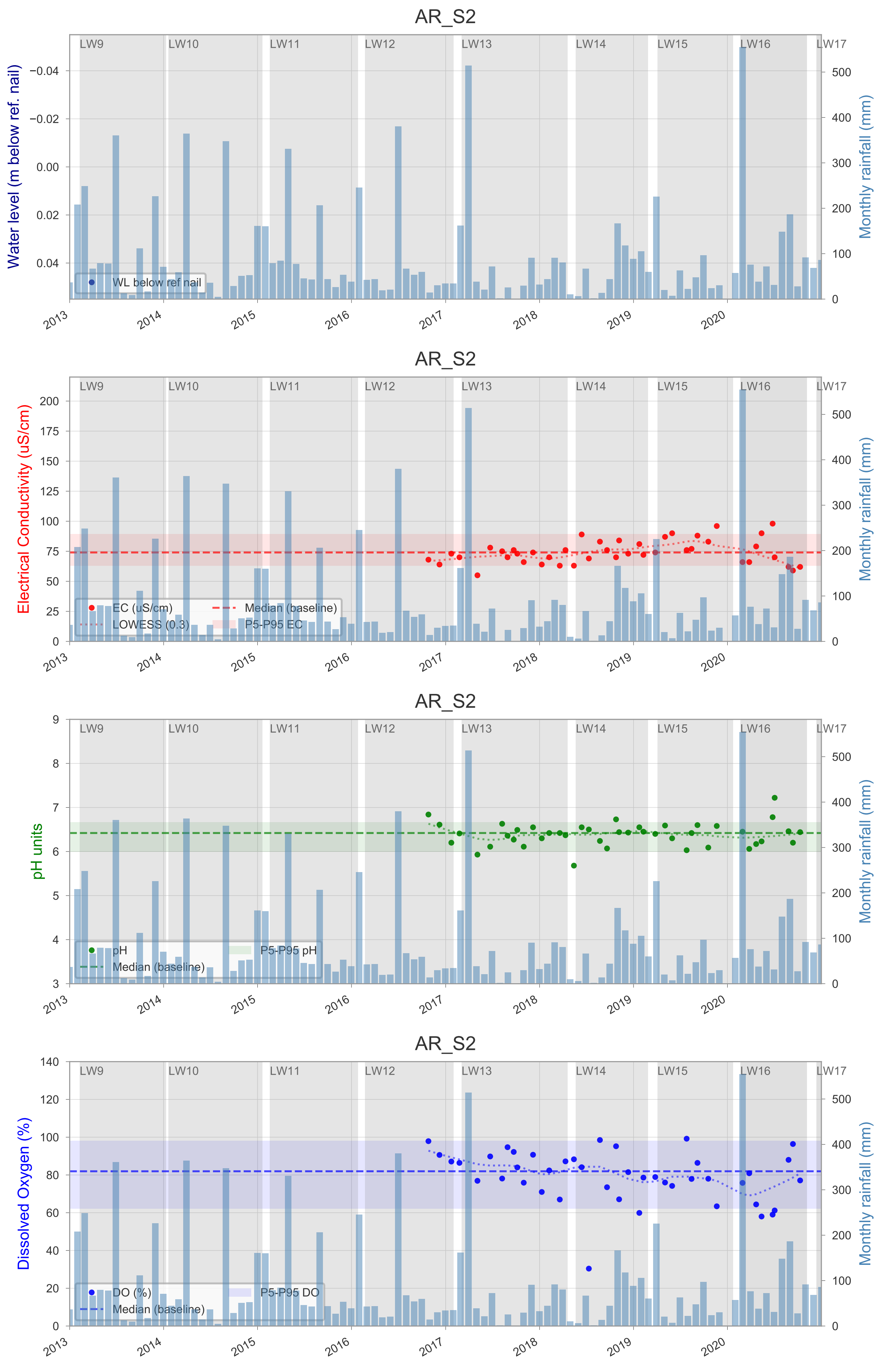

AR32_POOL5
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)


AR_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
2013
2014
2015
2016
2017
2018
2019
2020

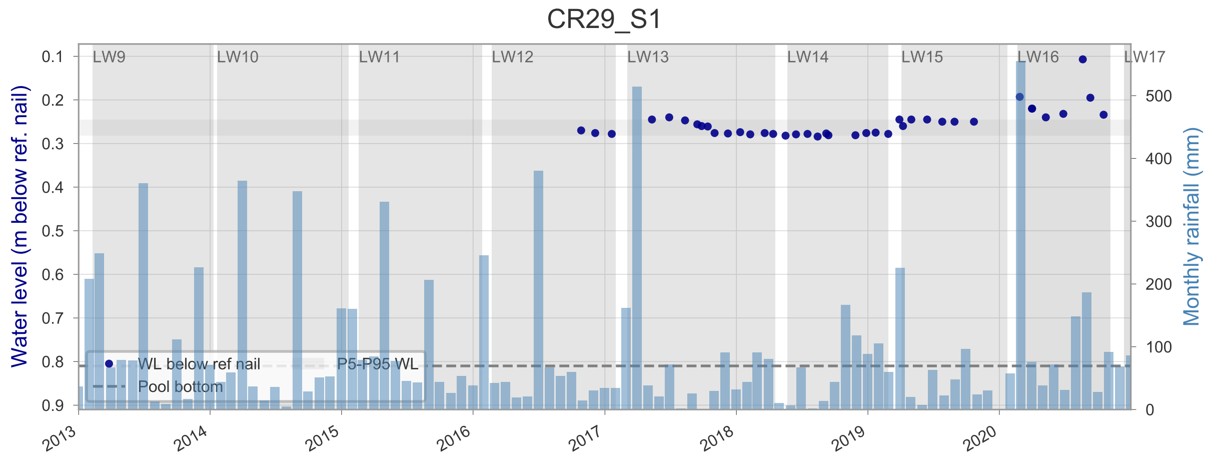

AR_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

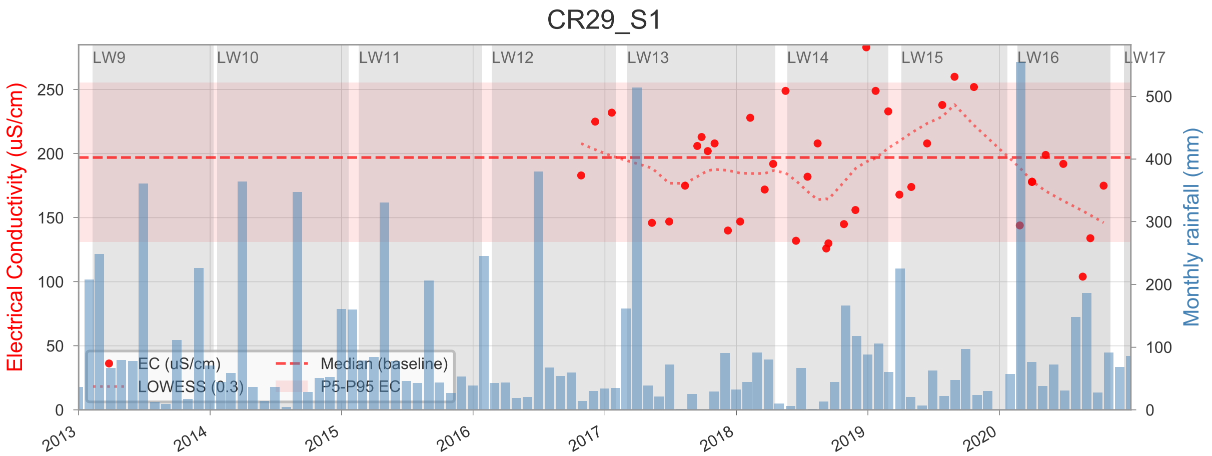

AR_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

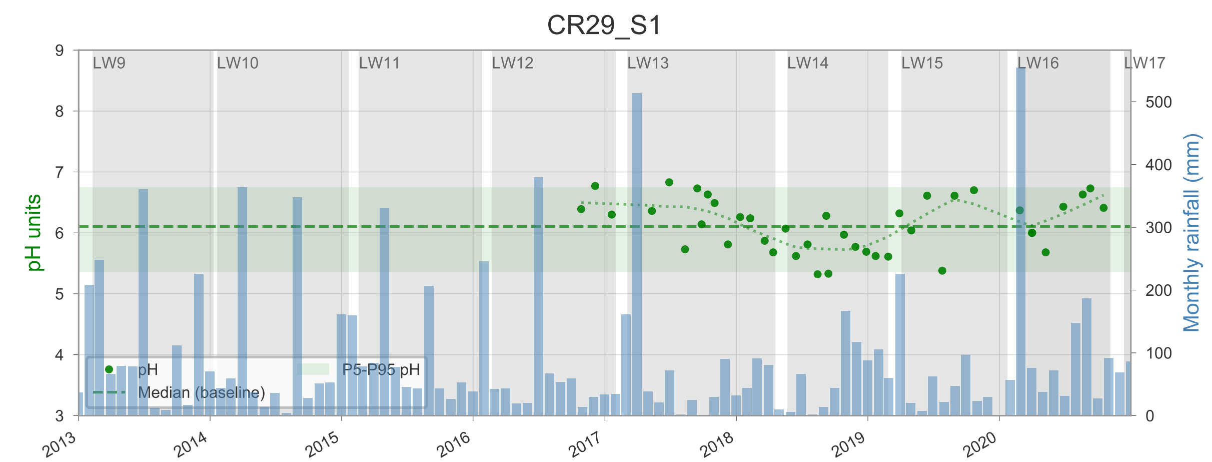

AR_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

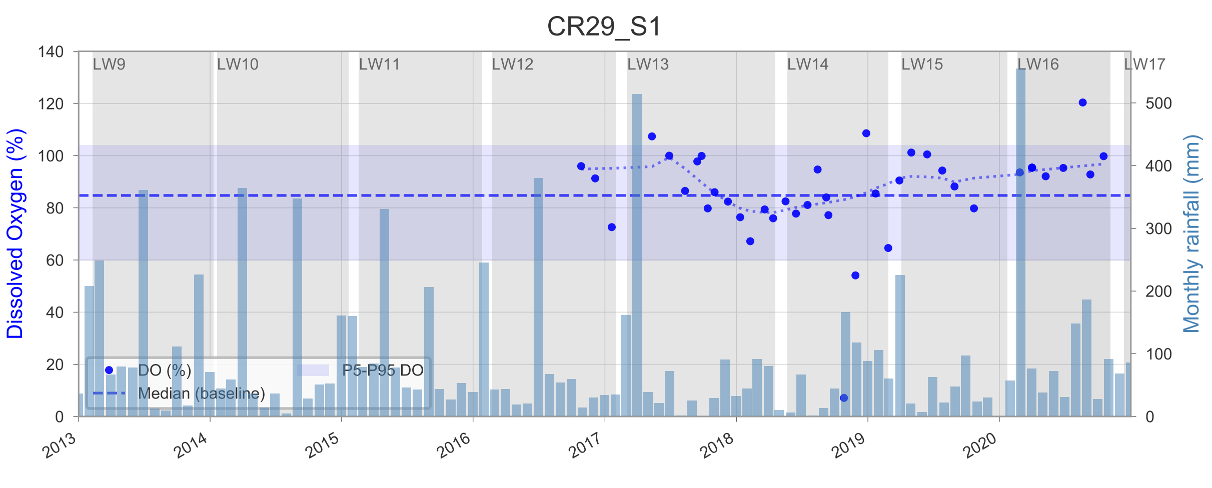


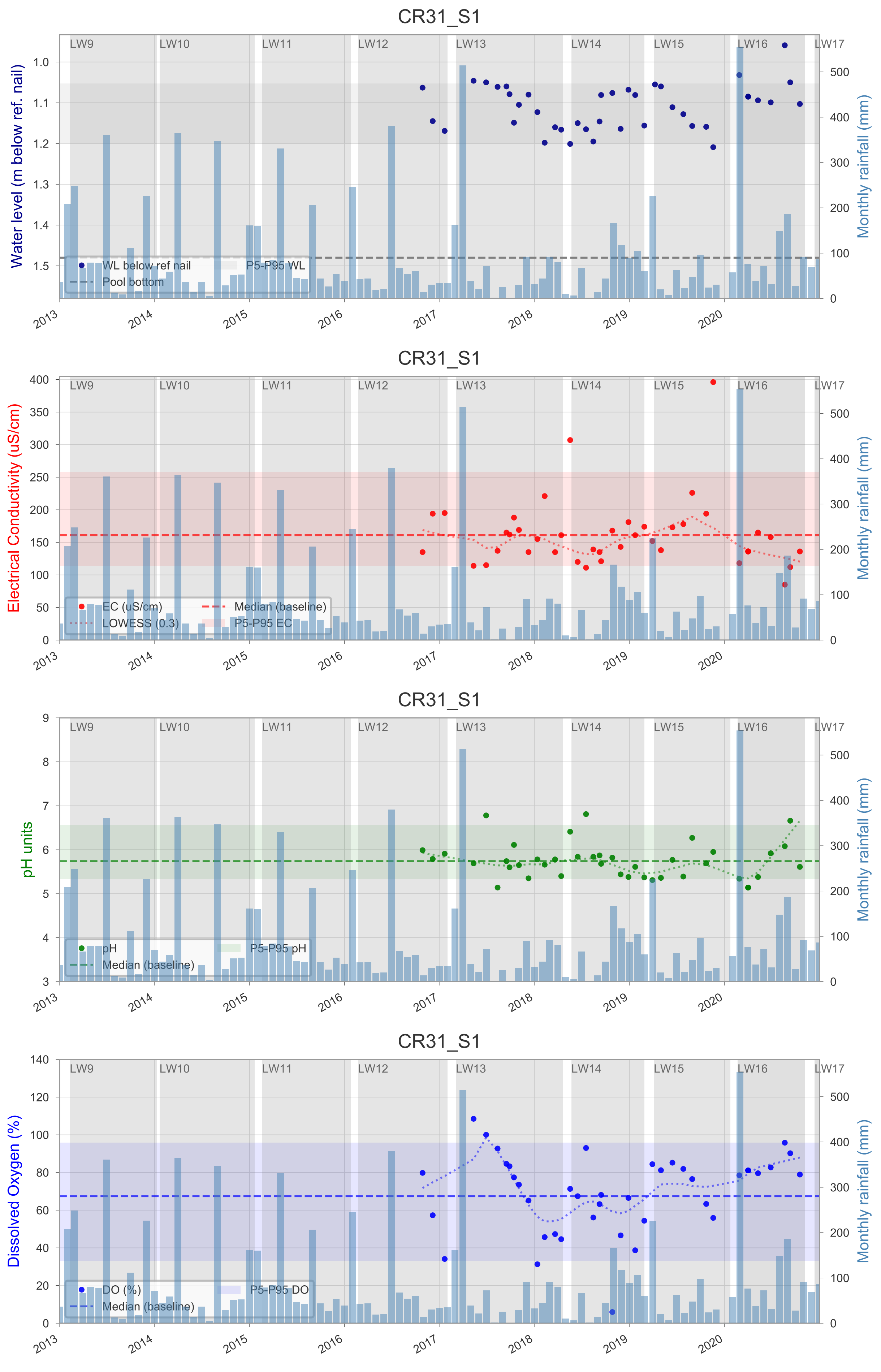
AR_S2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
pH units
pH
P5-P95 pH
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

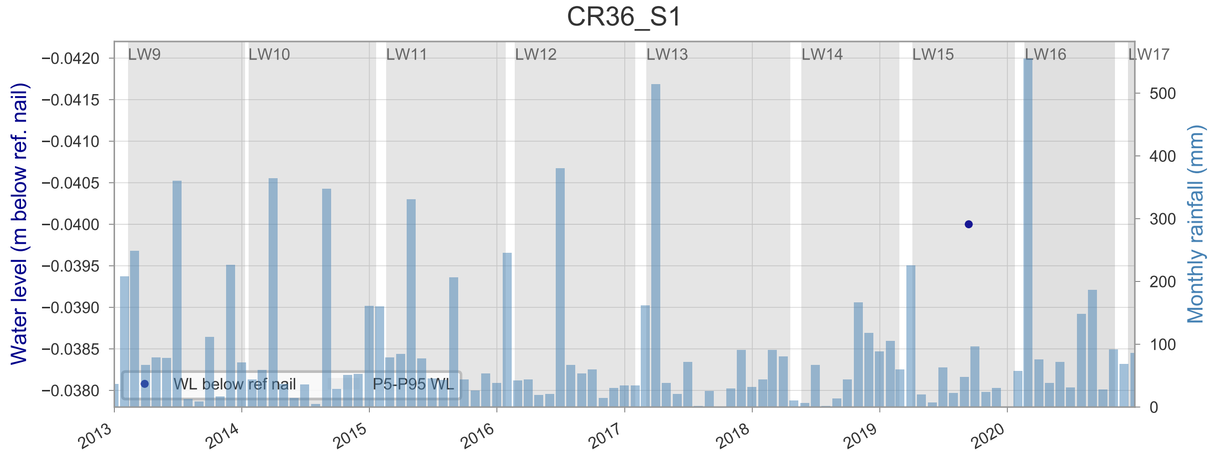

CR29_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
2013
2014
2015
2016
2017
2018
2019
2020

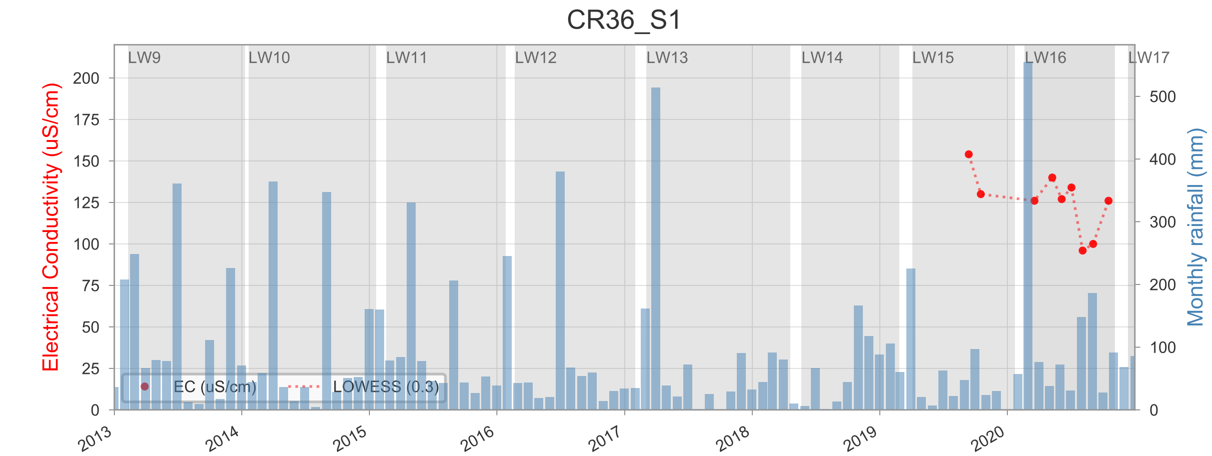

CR29_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

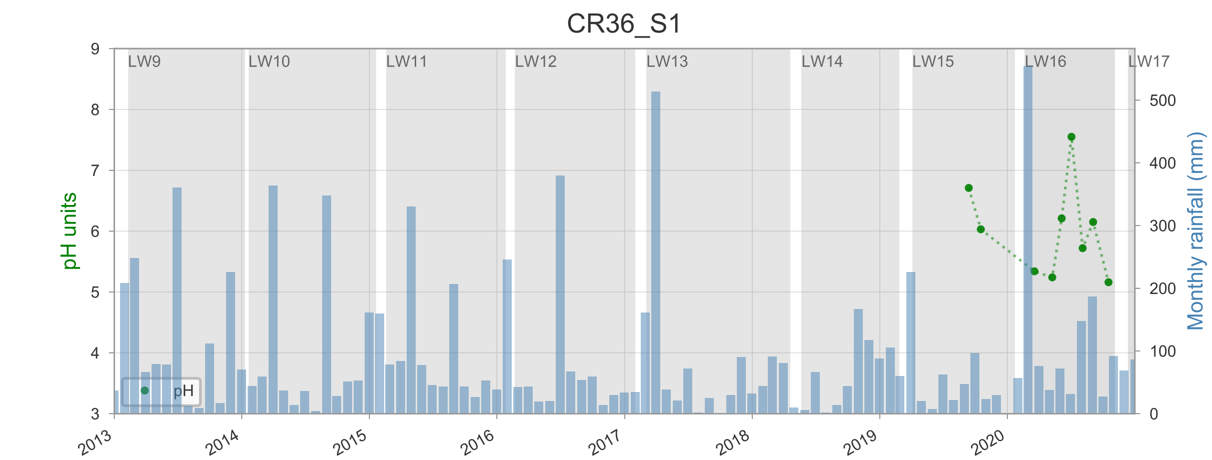

CR29_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
P5-P95 pH
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

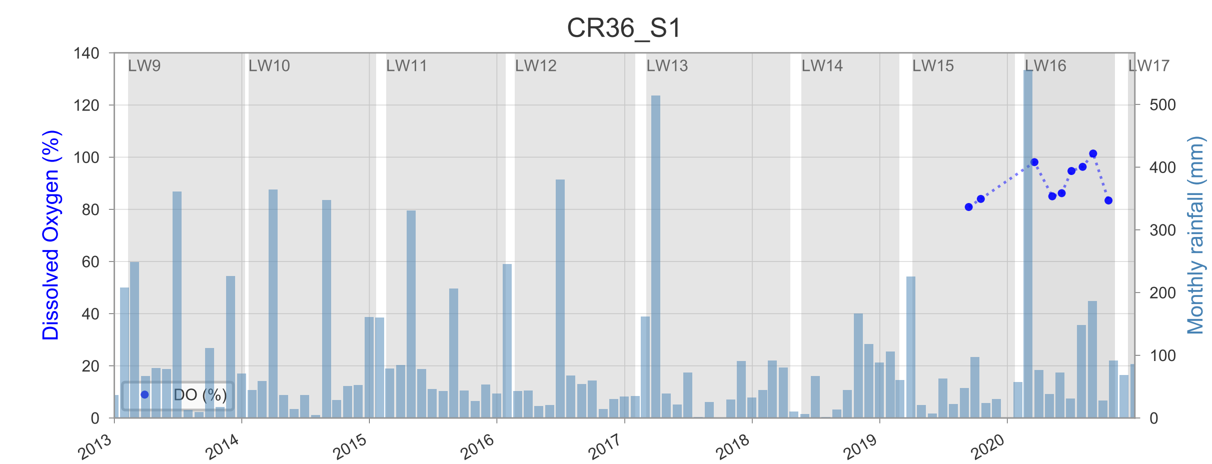

CR29_S1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
P5-P95 DO
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

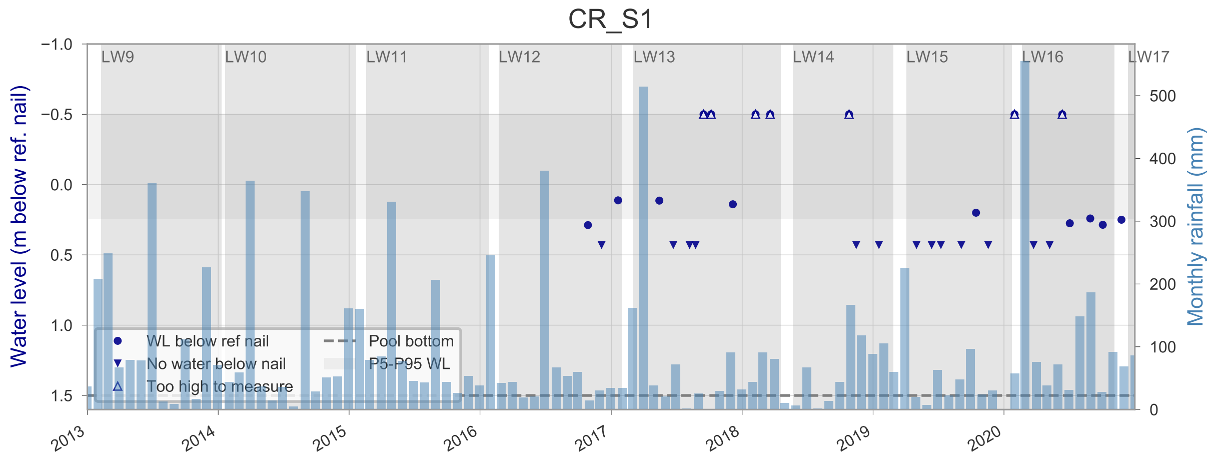

CR31_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL
CR31_S1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
CR31_S1
pH units
pH
Median (baseline)
P5-P95 pH
CR31_S1
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

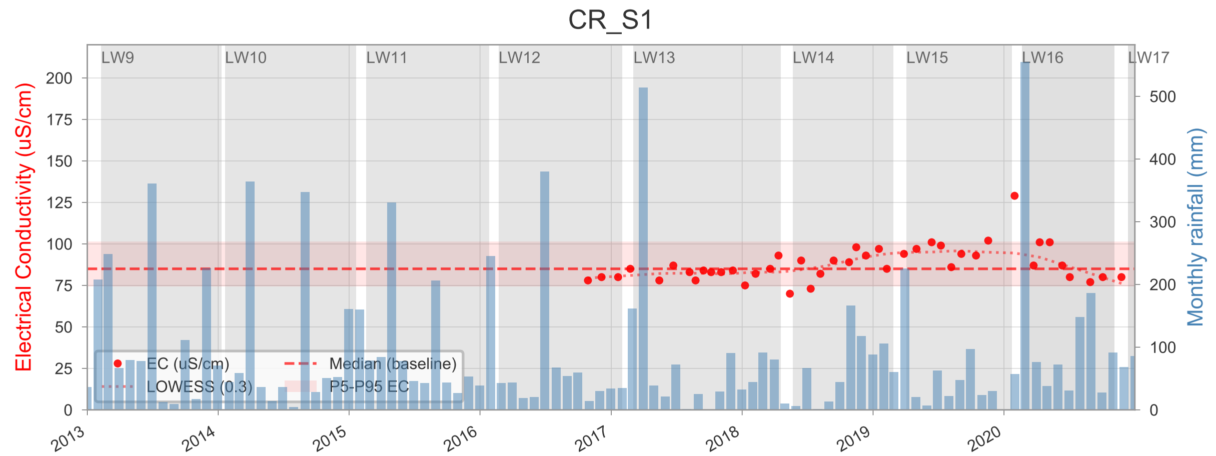

CR36_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL

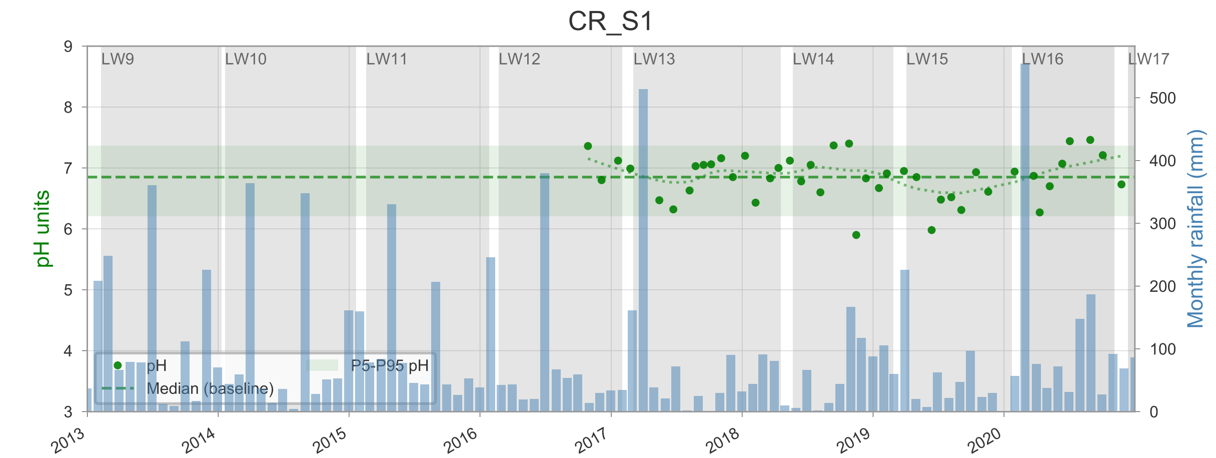

CR36_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

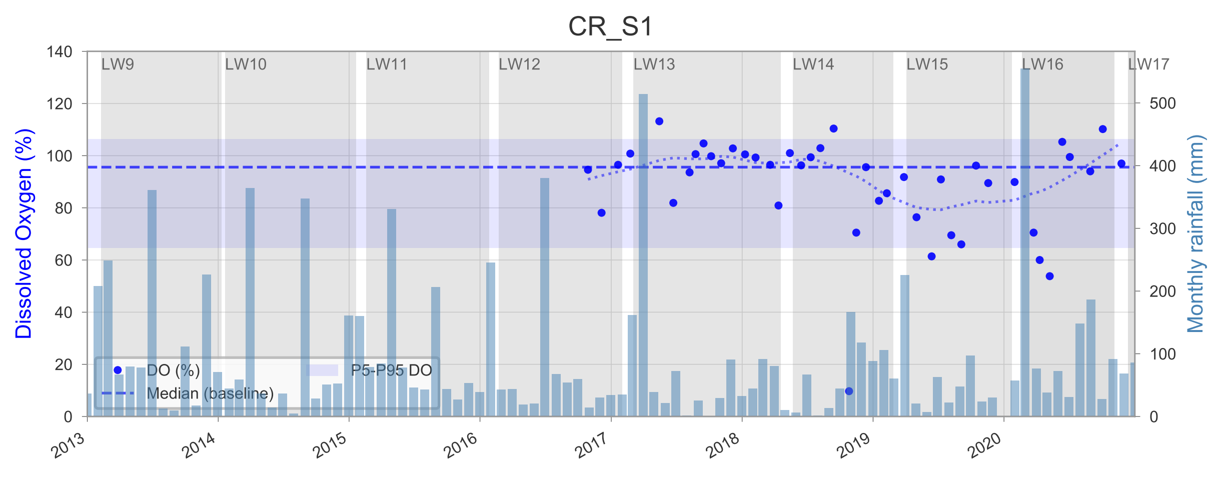

CR36_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

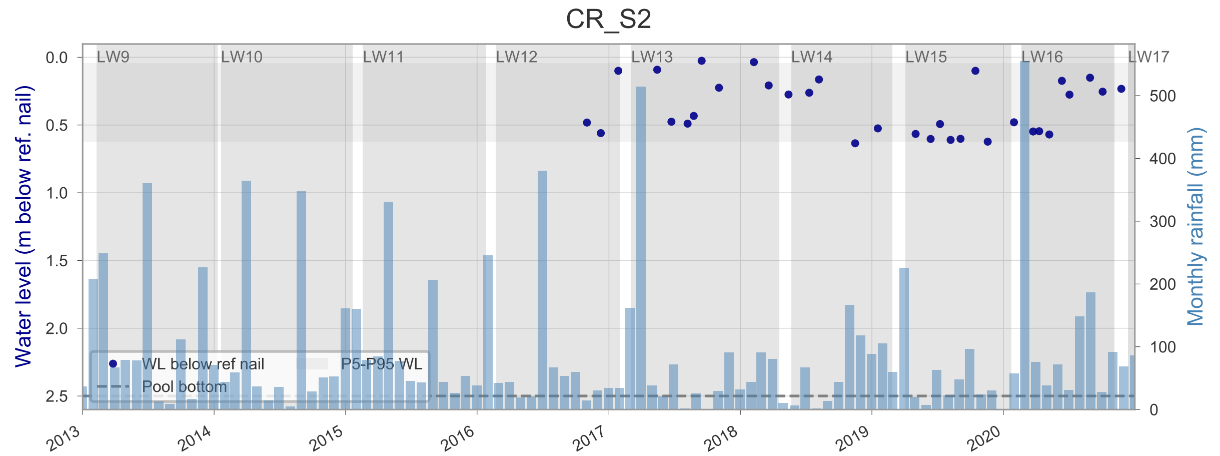

CR36_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

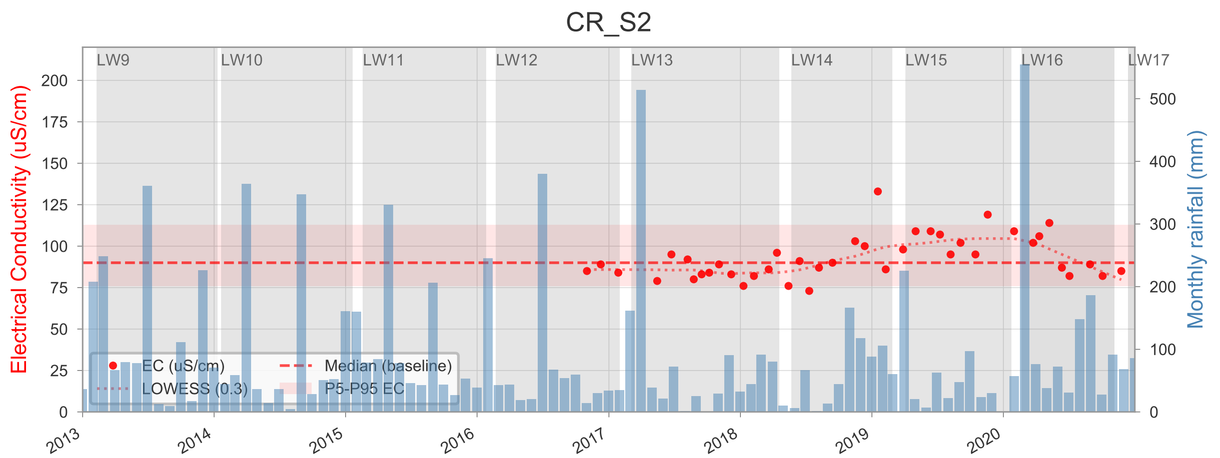

CR_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Too high to measure
Pool bottom
P5-P95 WL

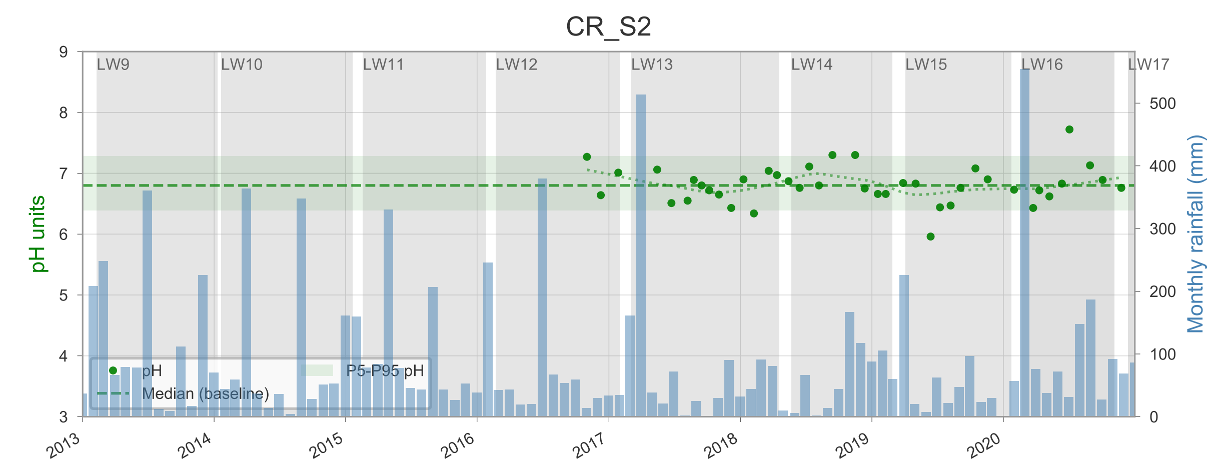

CR_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

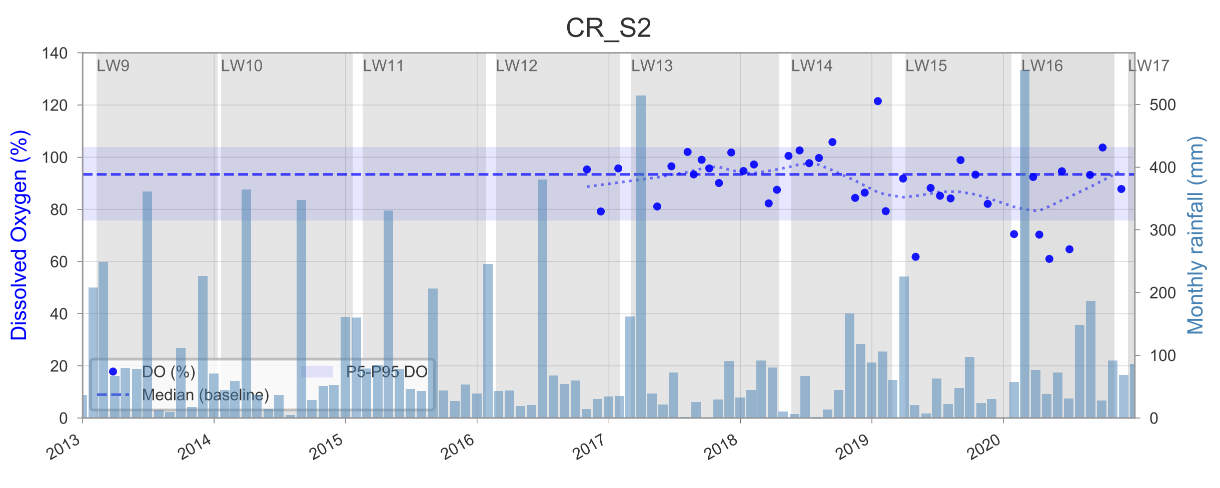

CR_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH


CR_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

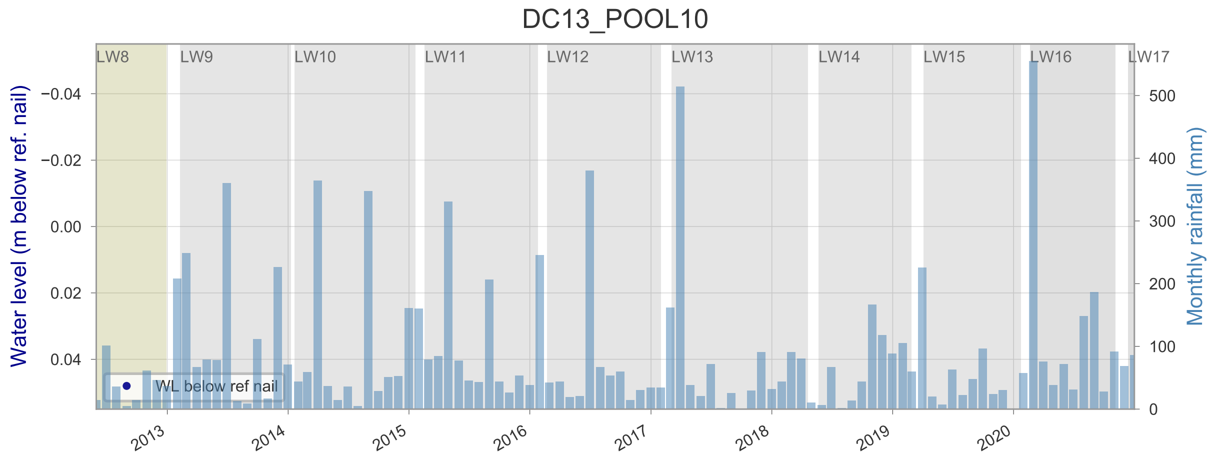

CR_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

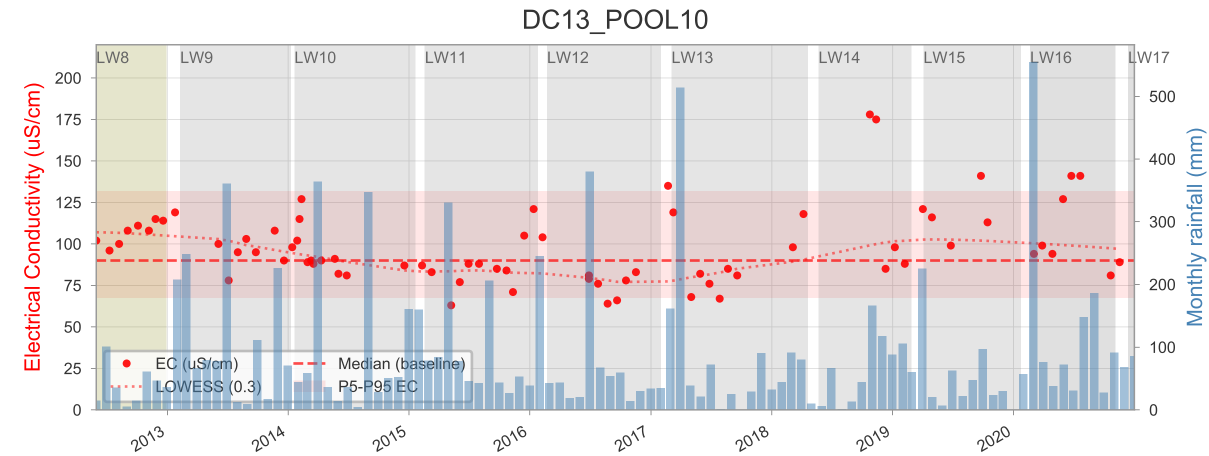

CR_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

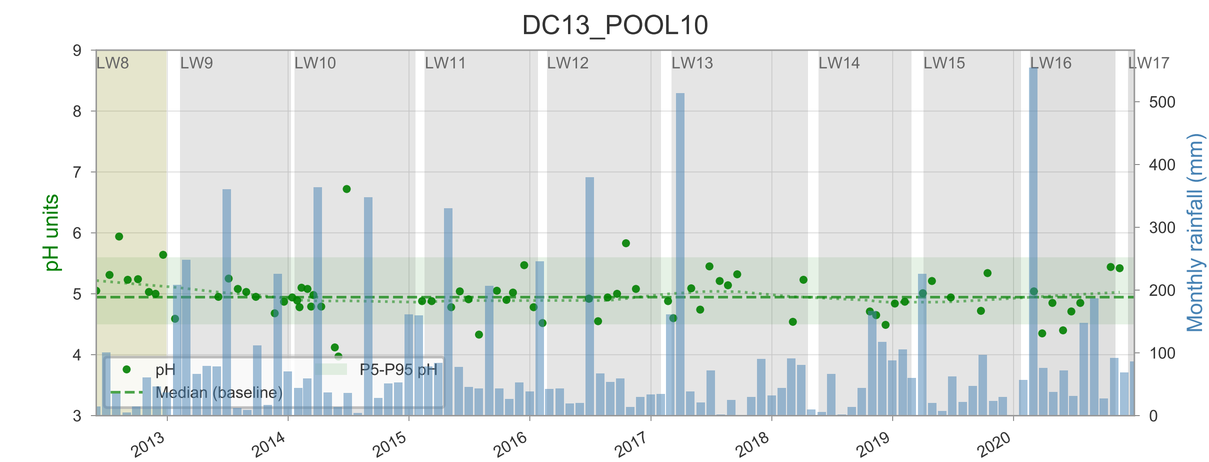

CR_S2
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

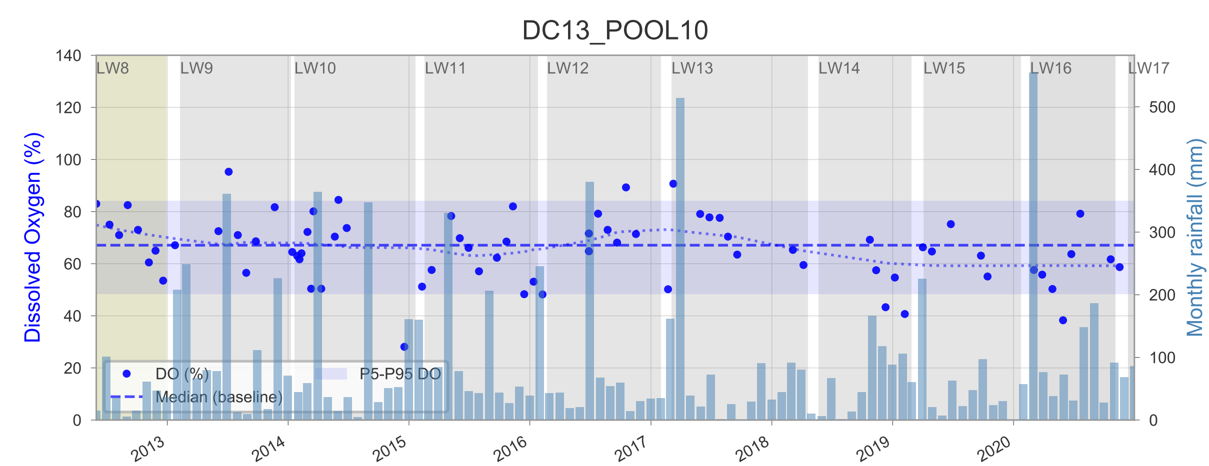

CR_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

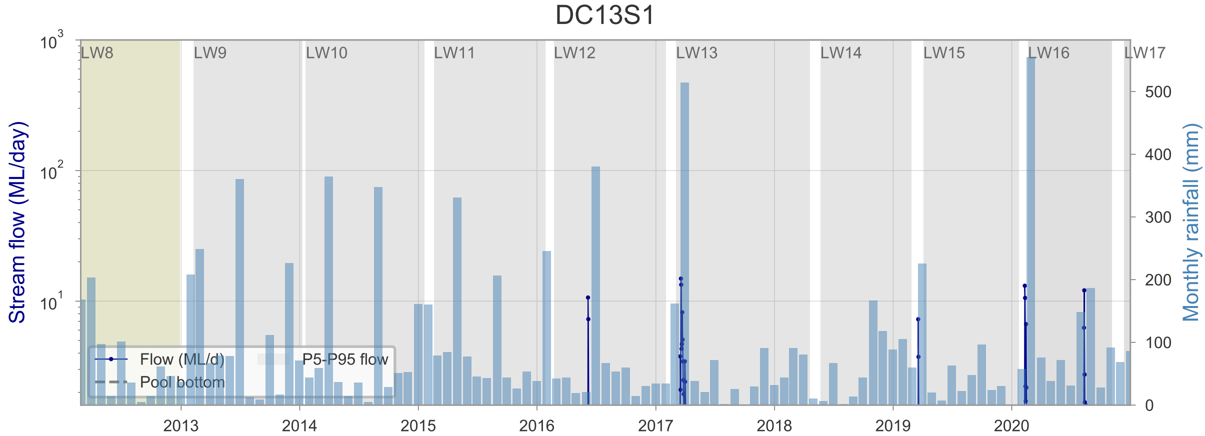
DC10_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool dry
Pool bottom
P5-P95 WL
DC10_S1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC10_S1
pH units
pH
Median (baseline)
P5-P95 pH
DC10_S1
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

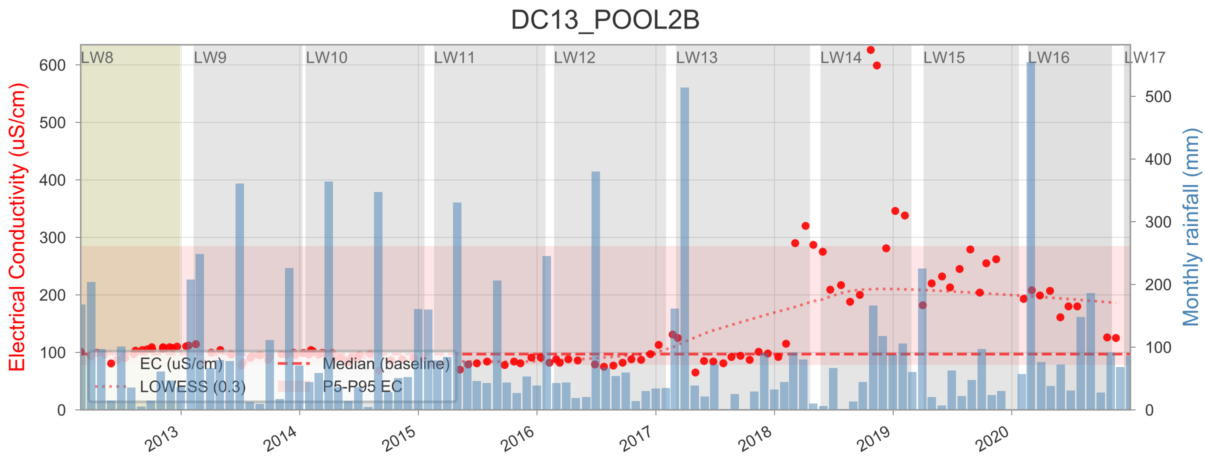

DC13_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
−0.04
−0.02
0.00
0.02
0.04
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

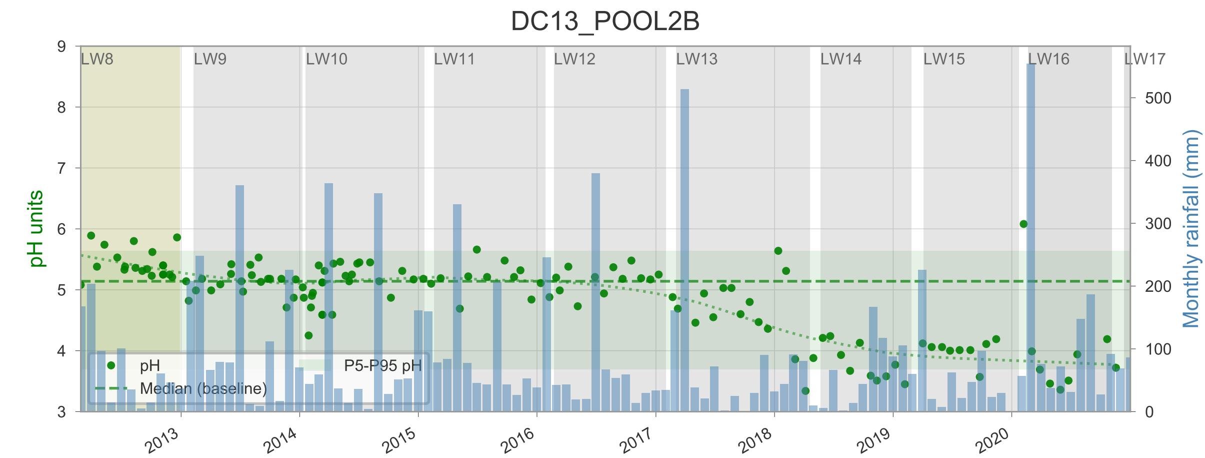

DC13_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

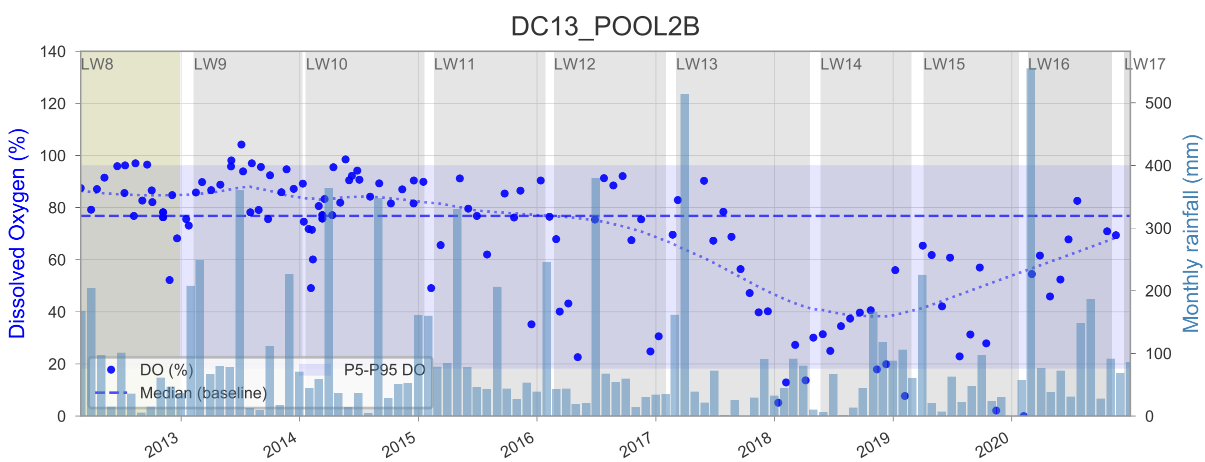

DC13_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

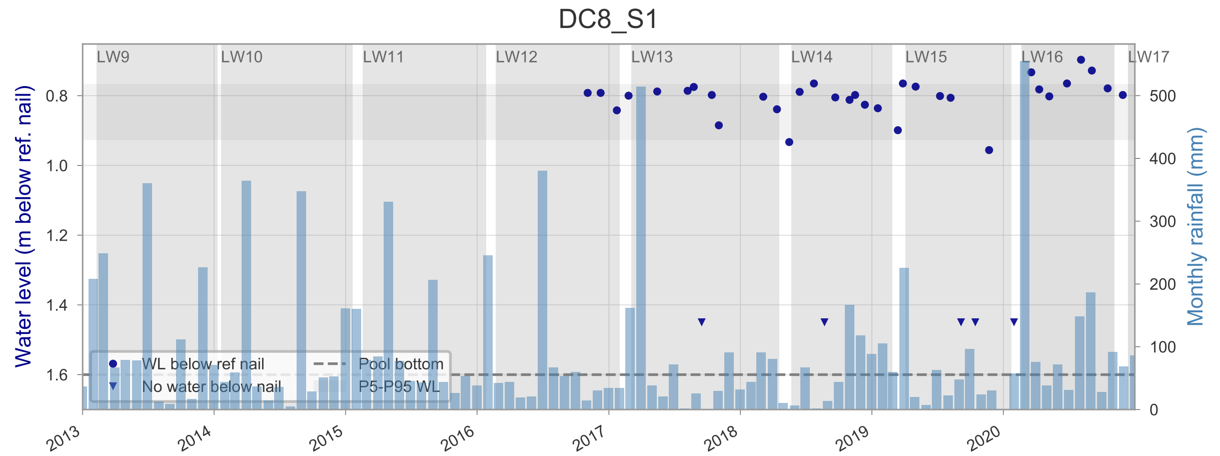

DC13_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

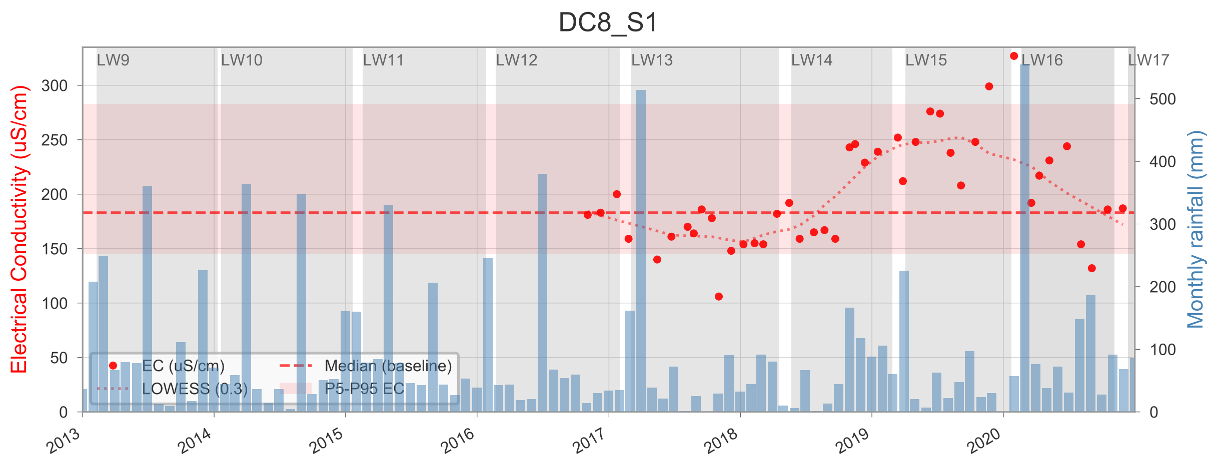

DC13S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
Pool bottom
P5-P95 flow

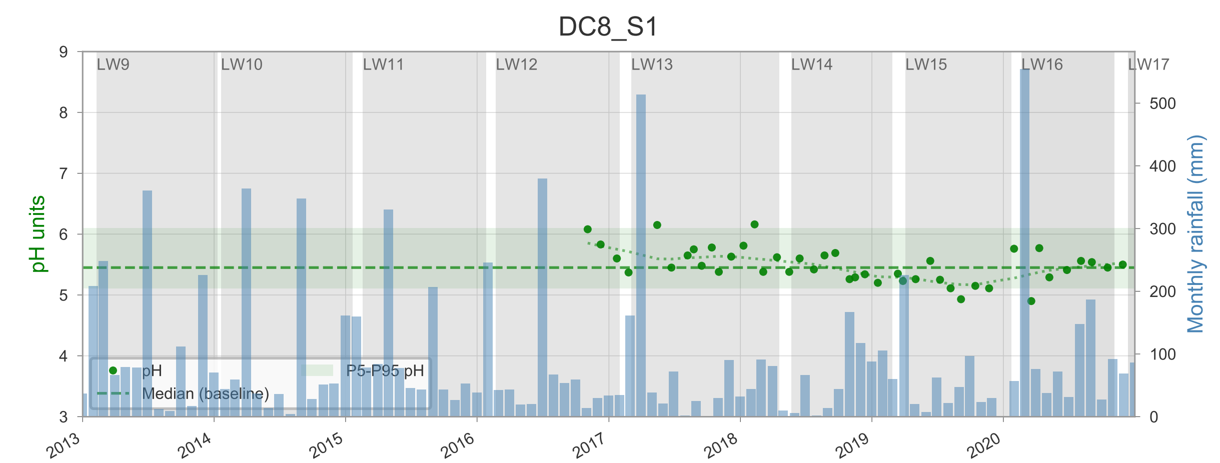

DC13_POOL2B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

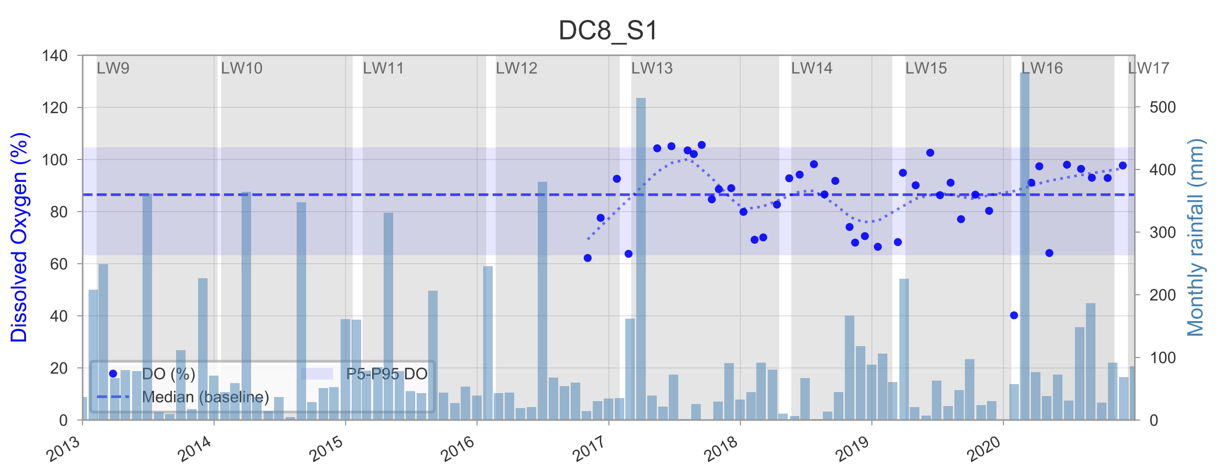

DC13_POOL2B
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

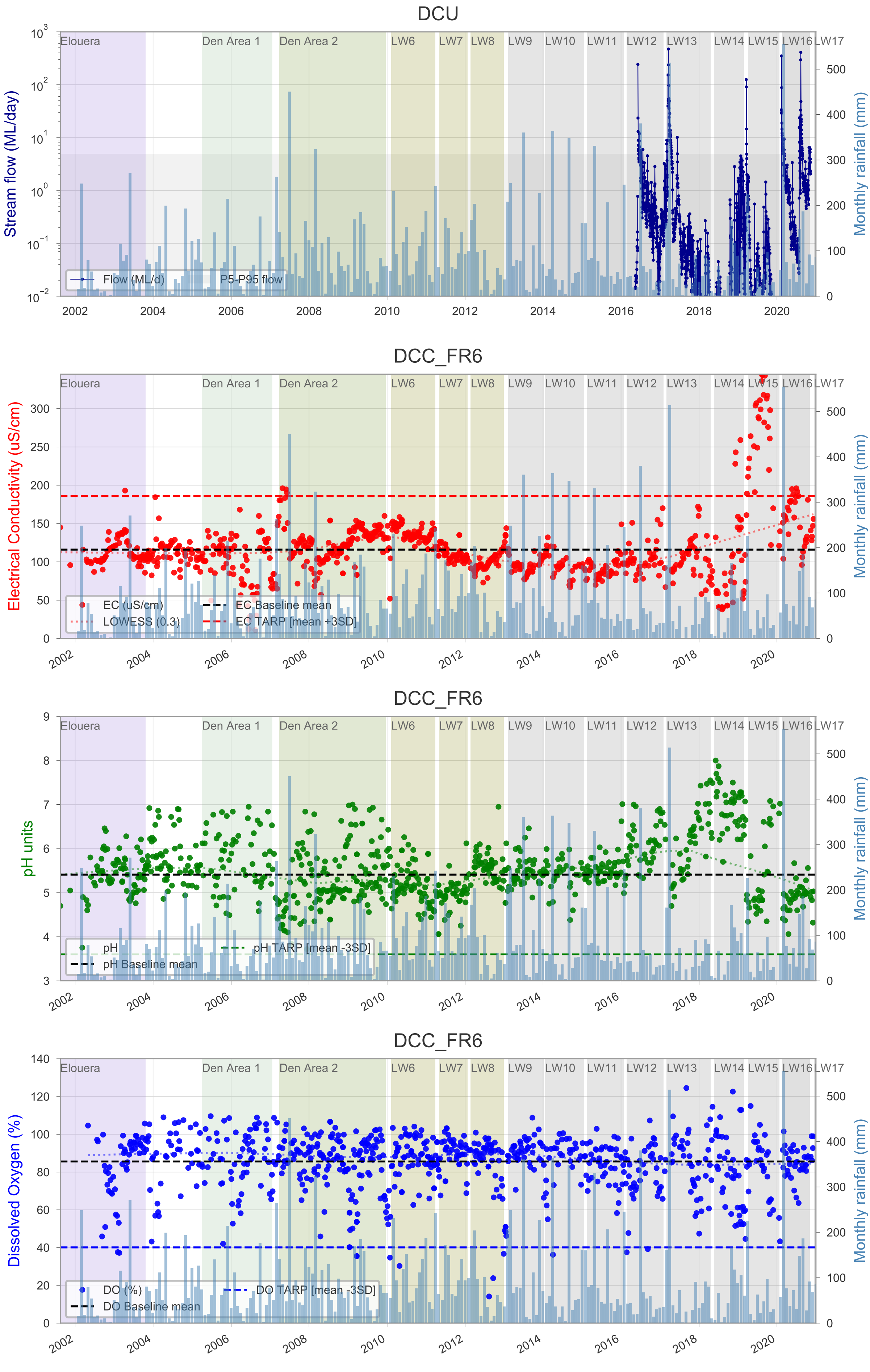

DC13_POOL2B
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO


DC8_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

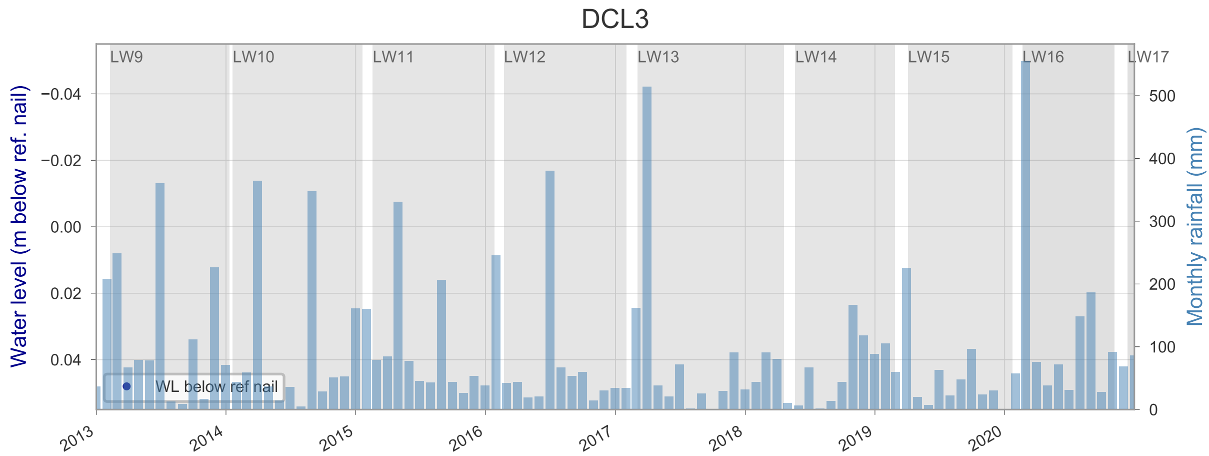

DC8_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

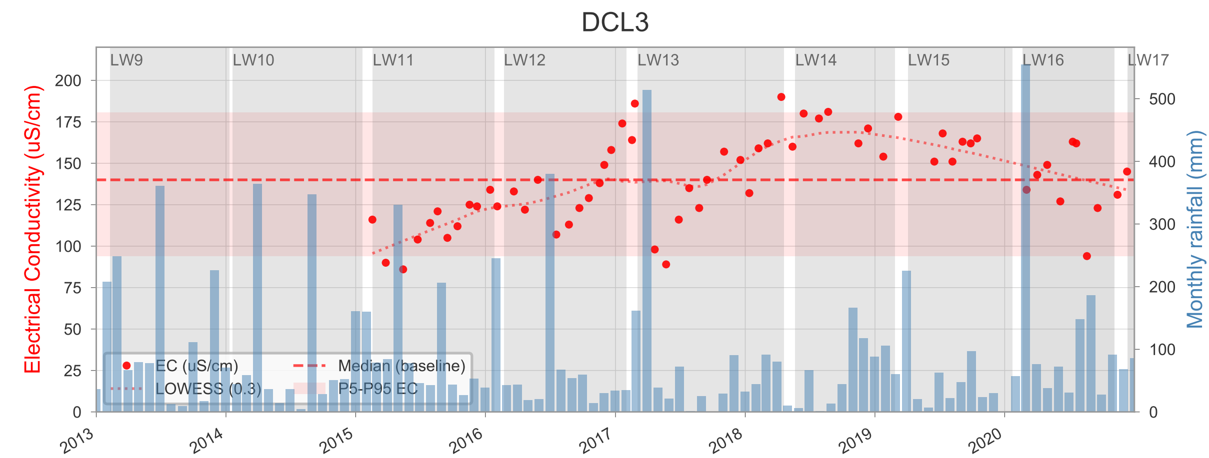

DC8_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

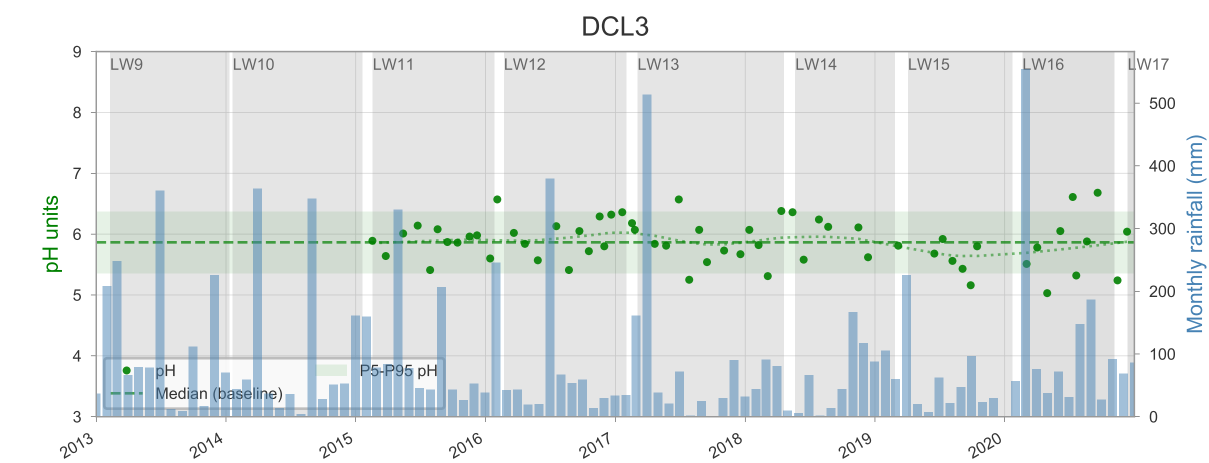

DC8_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

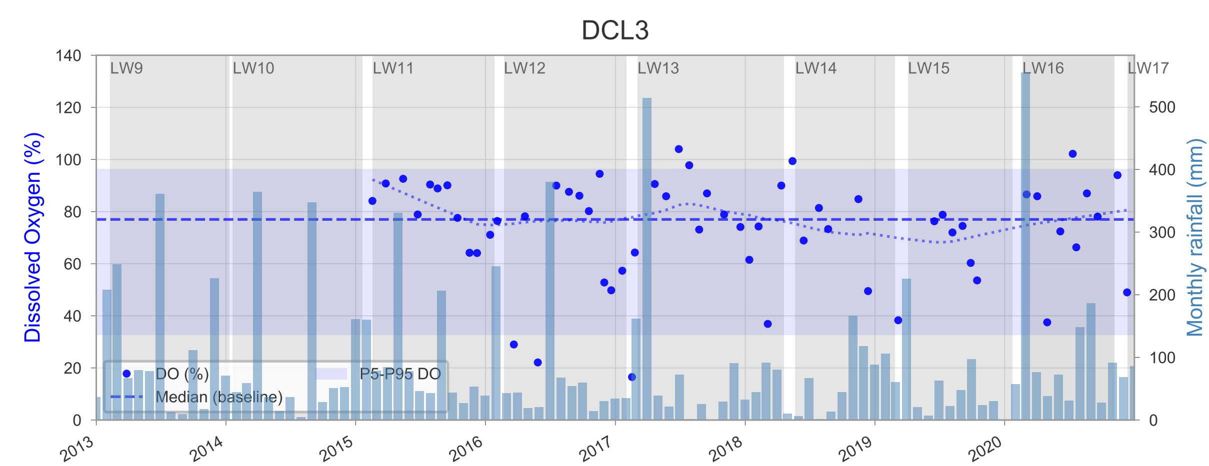


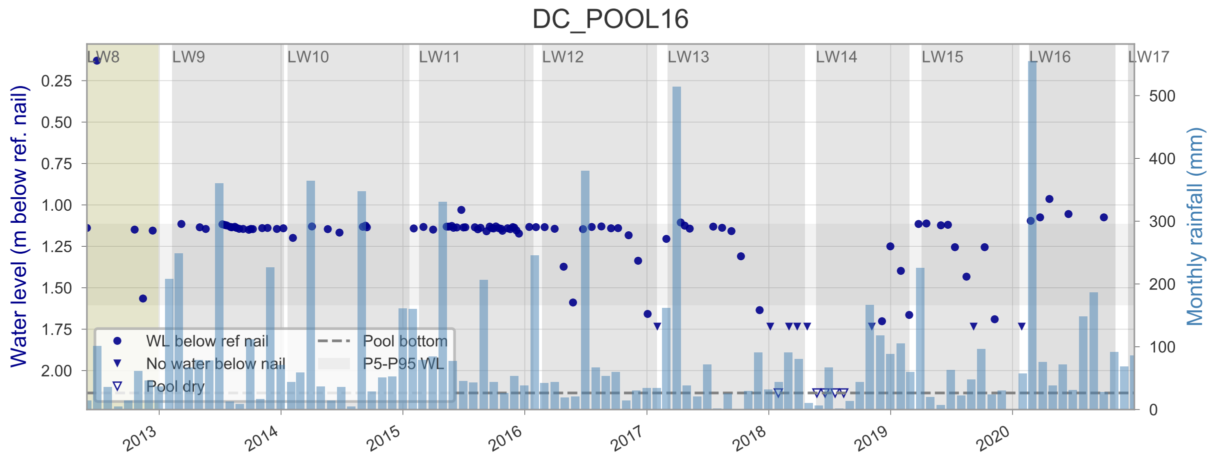
DCU
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
P5-P95 flow
DCC_FR6
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]
DCC_FR6
pH units
pH
pH Baseline mean
pH TARP [mean -3SD]
DCC_FR6
Dissolved Oxygen (%)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]

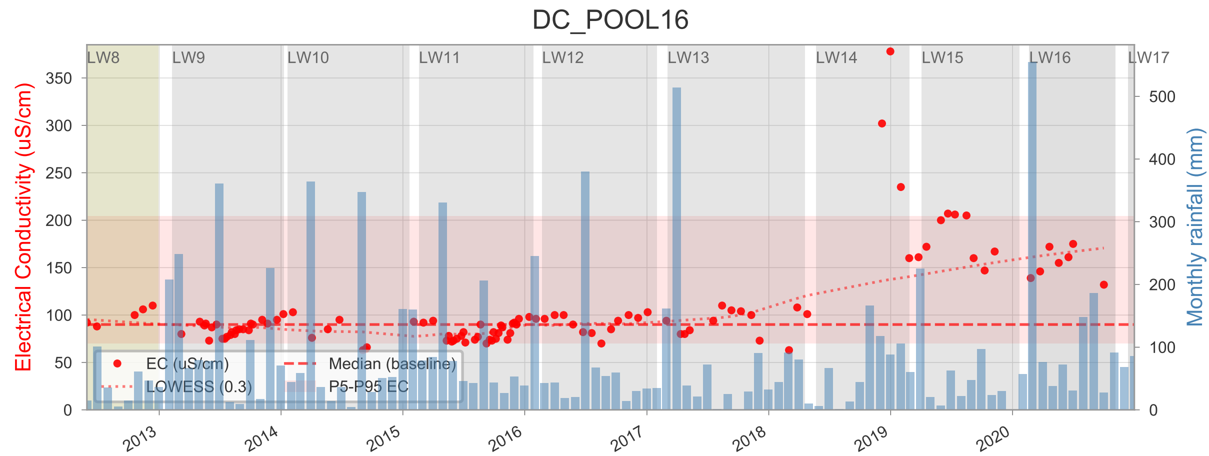

DCL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
−0.04
−0.02
0.00
0.02
0.04
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

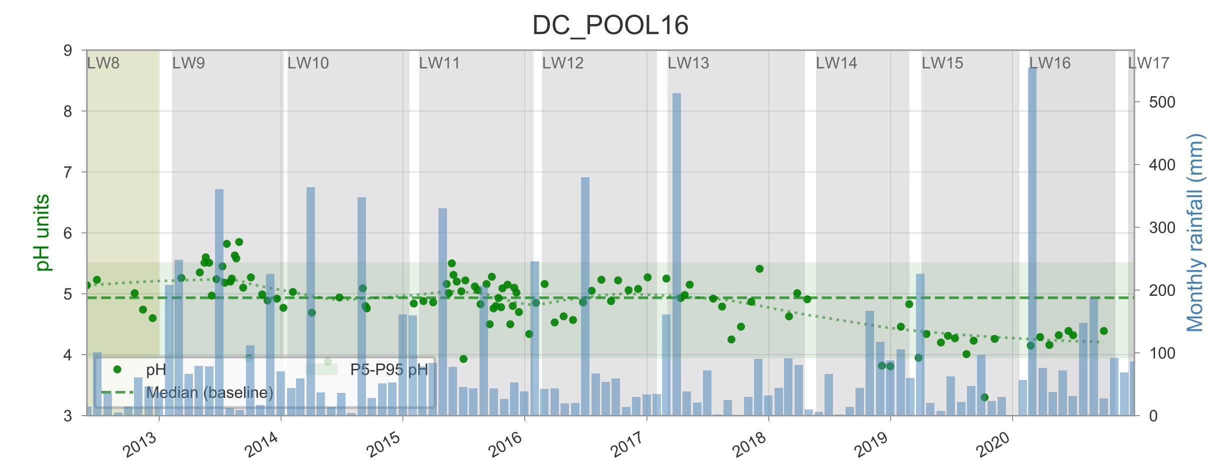

DCL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

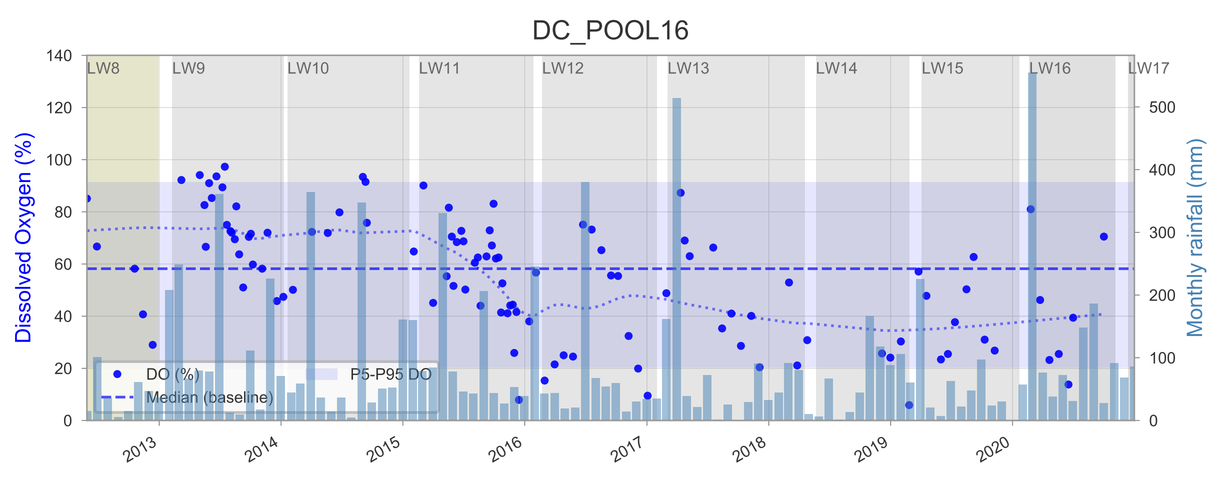

DCL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020


DCL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

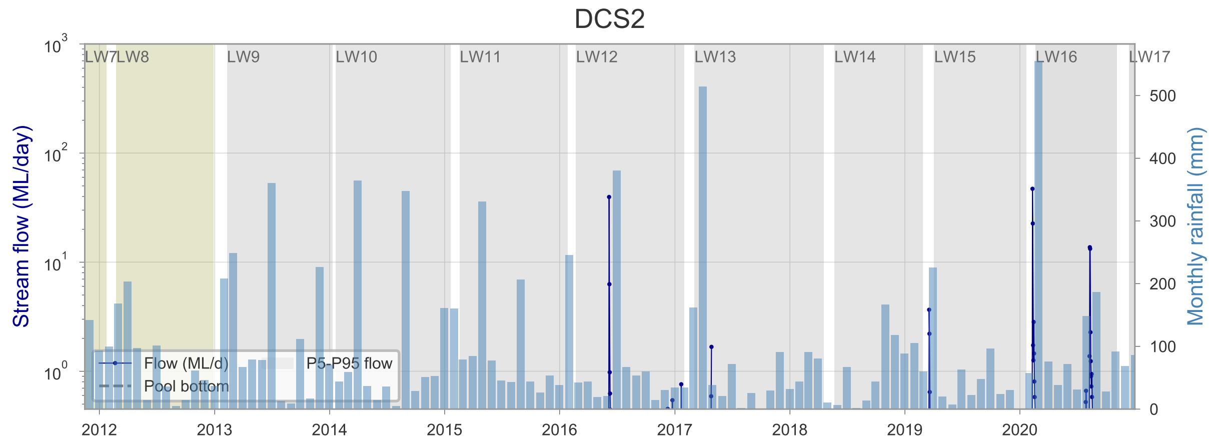

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

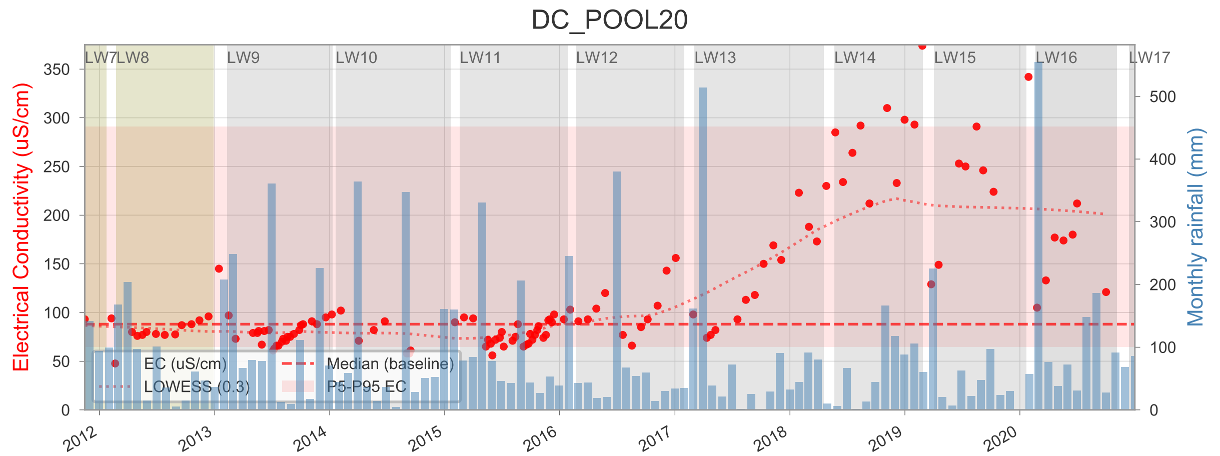

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

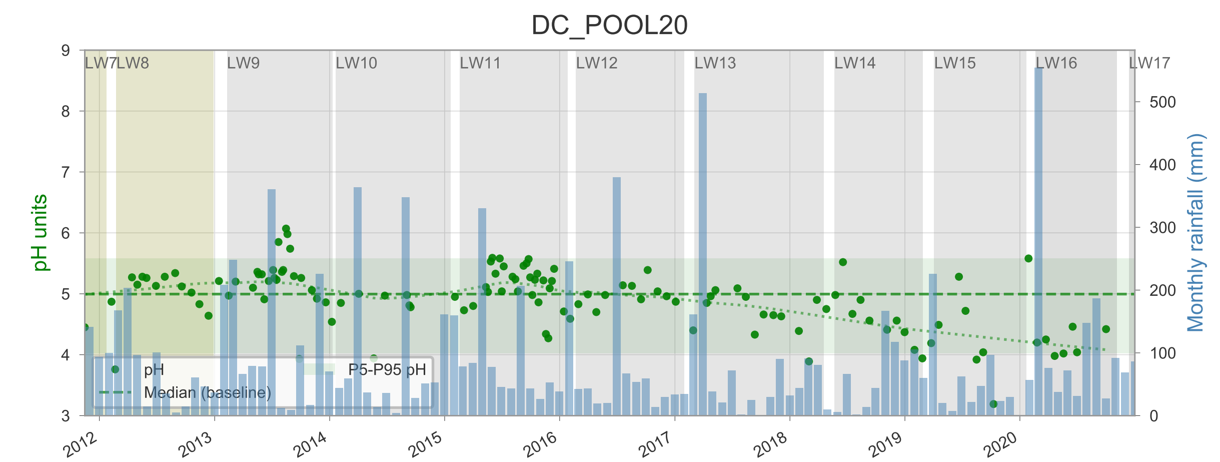

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

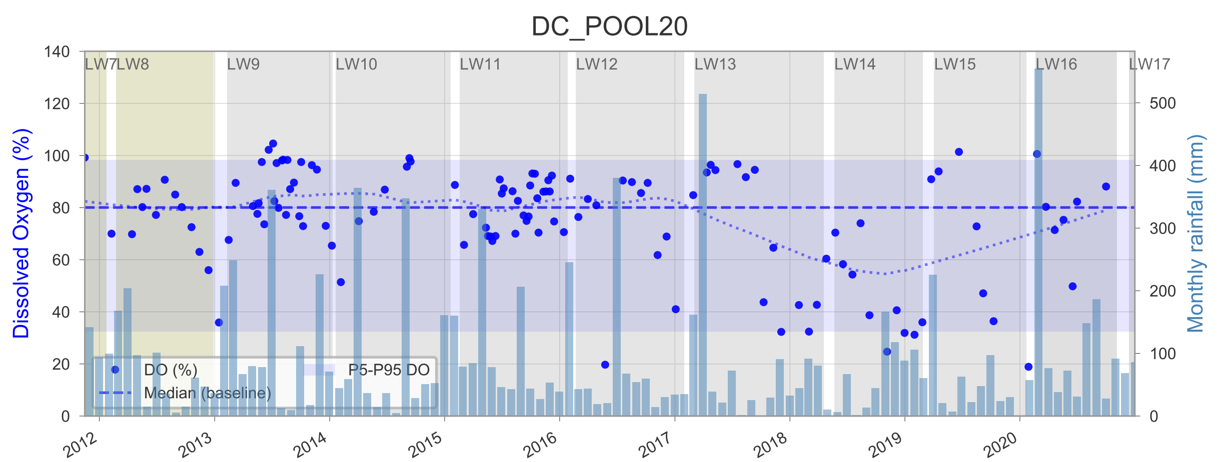

DC_POOL16
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

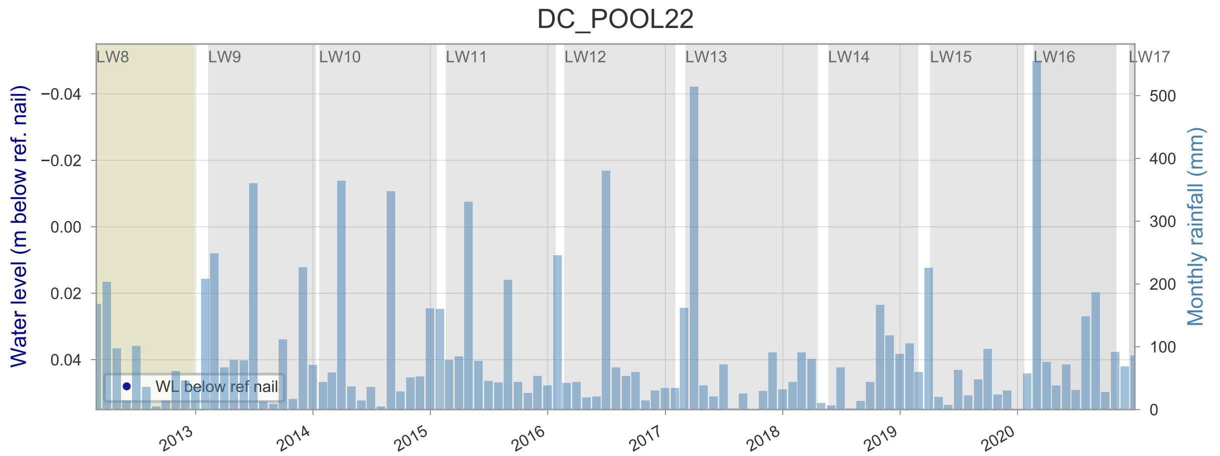
DC_POOL19
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
DC_POOL19
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC_POOL19
pH units
pH
Median (baseline)
P5-P95 pH
DC_POOL19
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2012
2013
2014
2015
2016
2017
2018
2019
2020

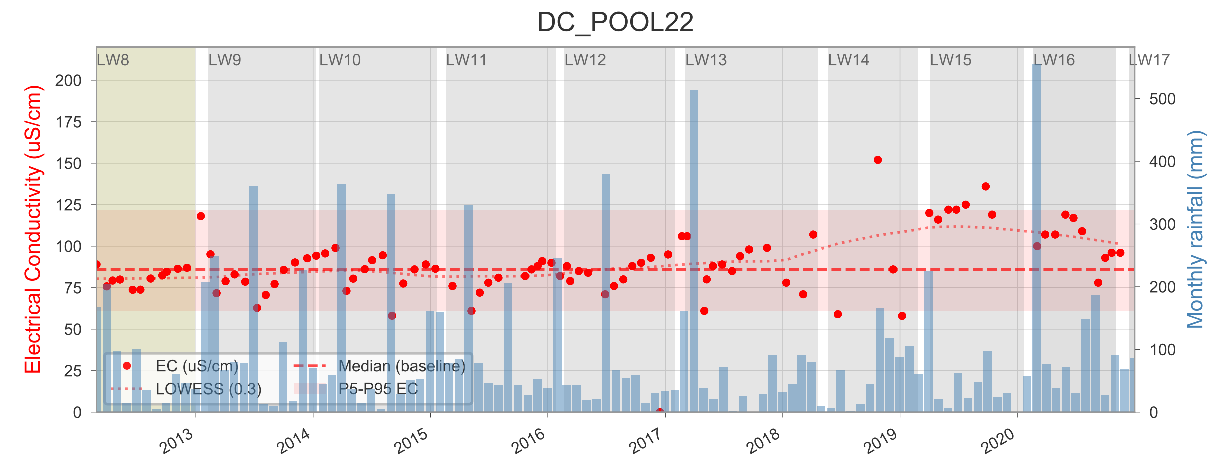

DCS2
Stream flow (ML/day)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Flow (ML/d)
Pool bottom
P5-P95 flow
2012 2013 2014 2015 2016 2017 2018 2019 2020

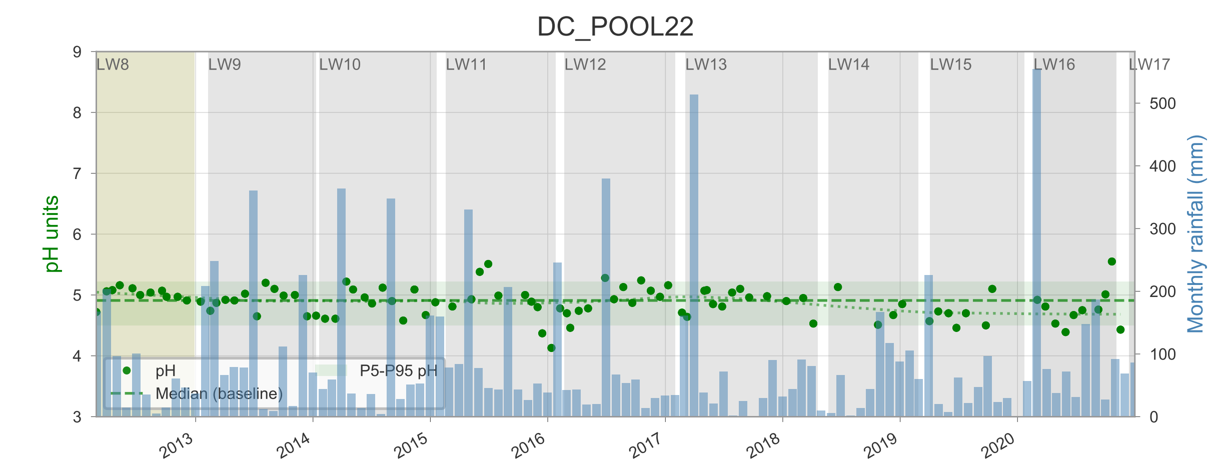

DC_POOL20
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2012 2013 2014 2015 2016 2017 2018 2019 2020

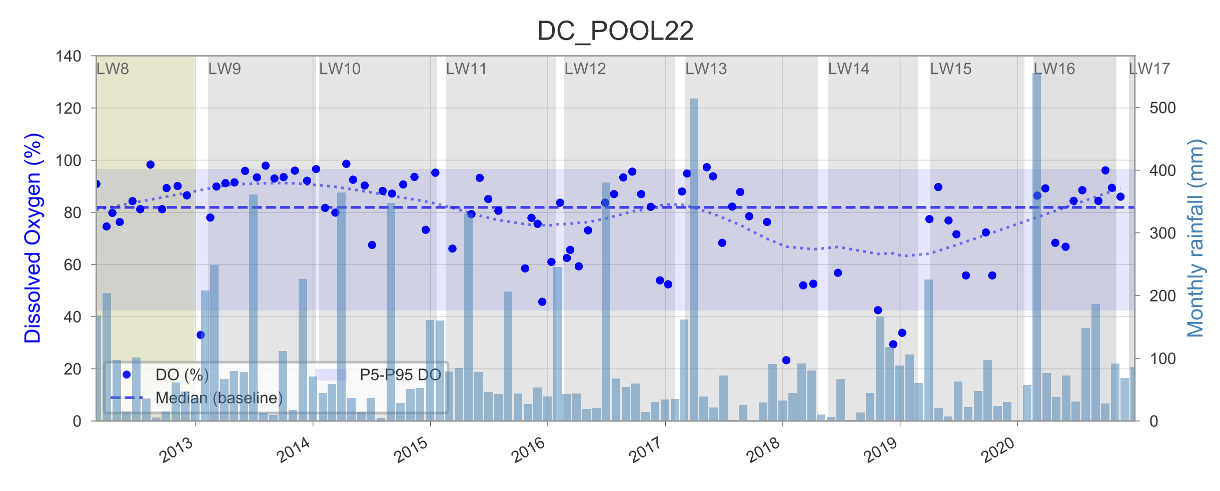

DC_POOL20
pH units
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
pH
Median (baseline)
P5-P95 pH
2012 2013 2014 2015 2016 2017 2018 2019 2020

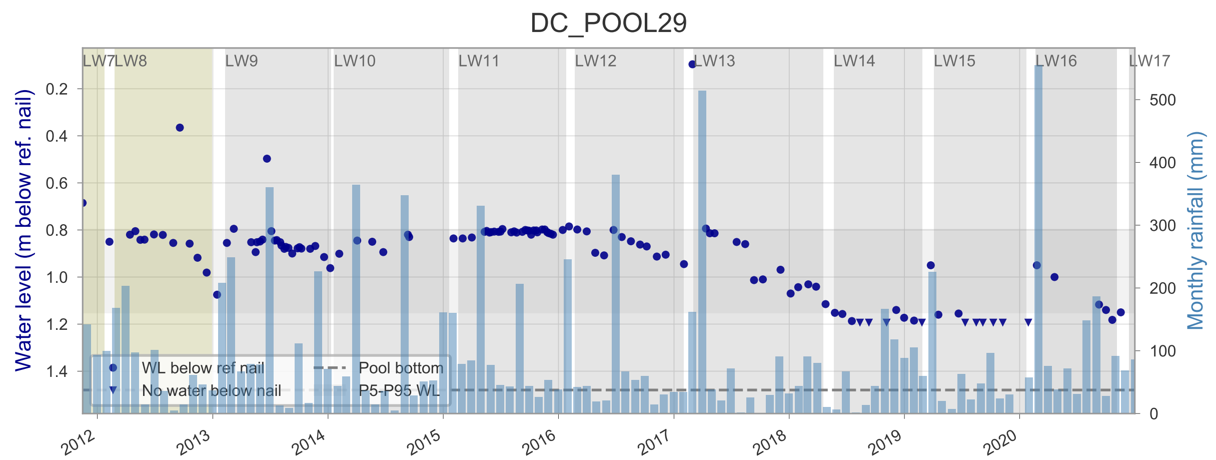

DC_POOL20
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
DO (%)
Median (baseline)
P5-P95 DO
2012 2013 2014 2015 2016 2017 2018 2019 2020

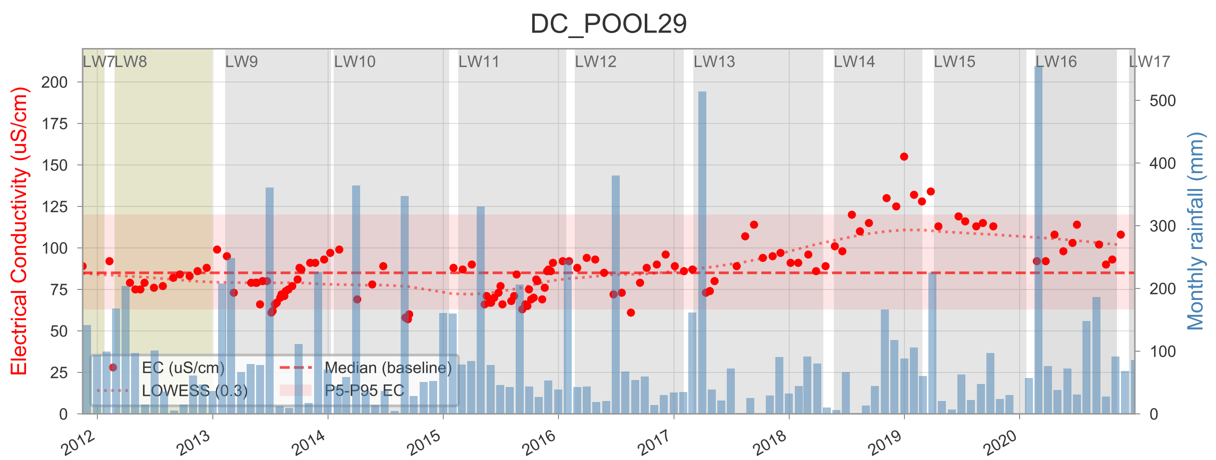

DC_POOL22
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
-0.04
-0.02
0.00
0.02
0.04
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

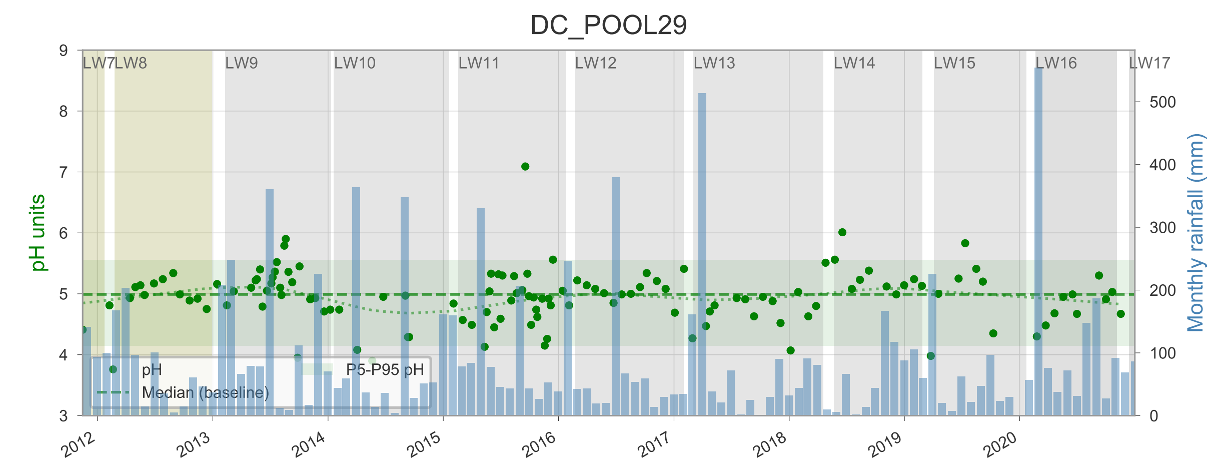

DC_POOL22
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

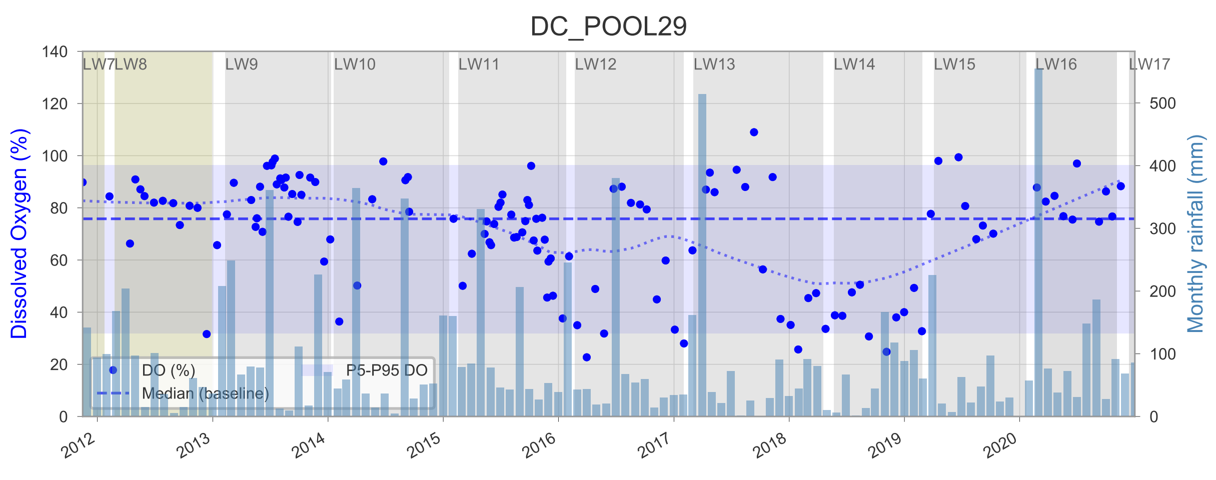

DC_POOL22
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

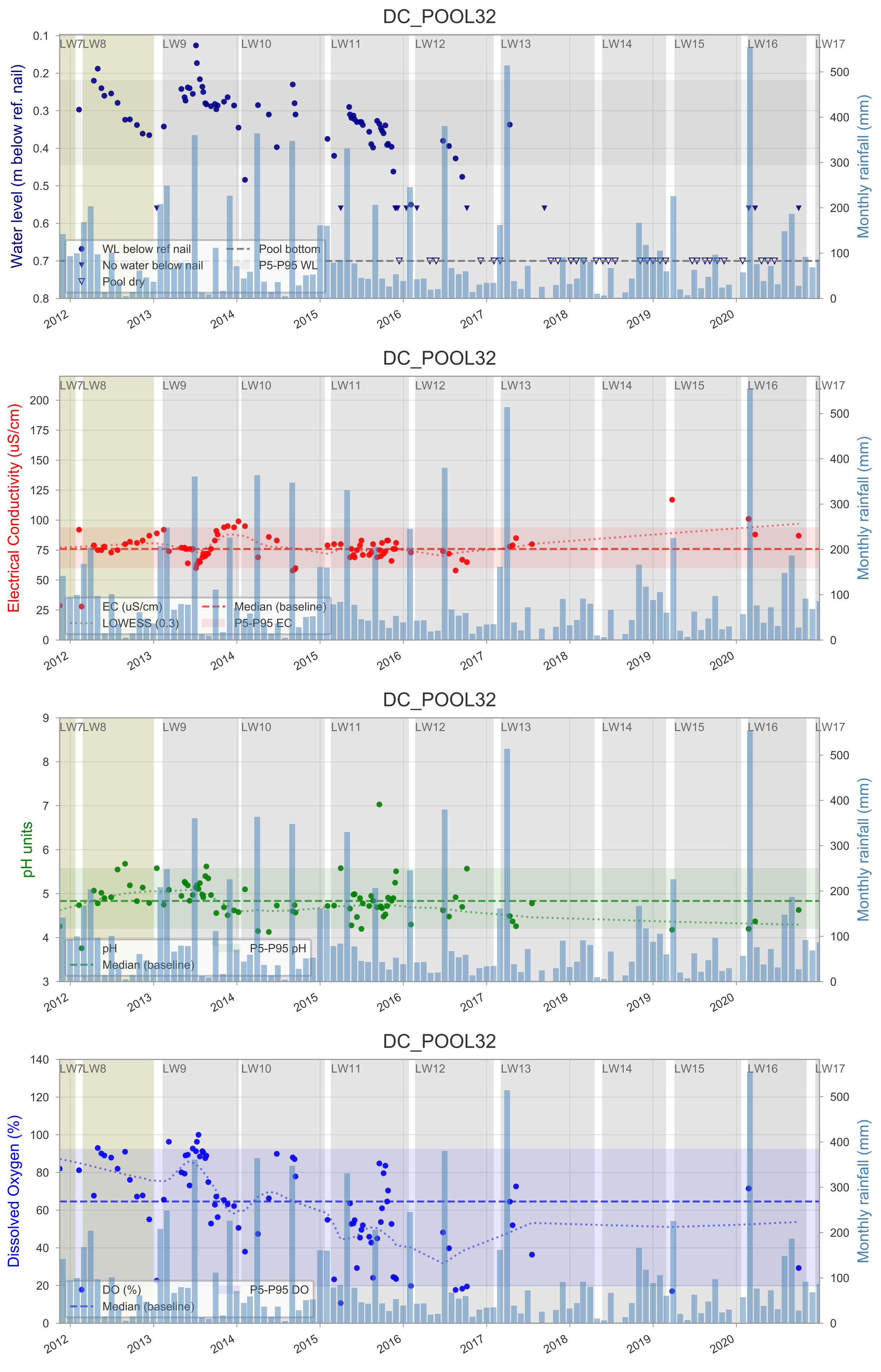

DC_POOL22
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

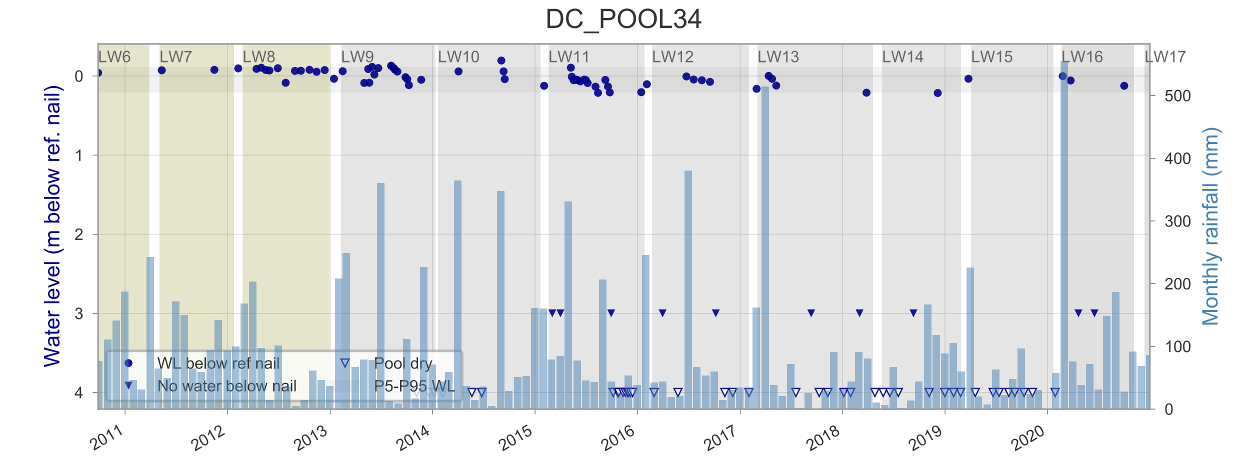

DC_POOL29
Water level (m below ref. nail)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

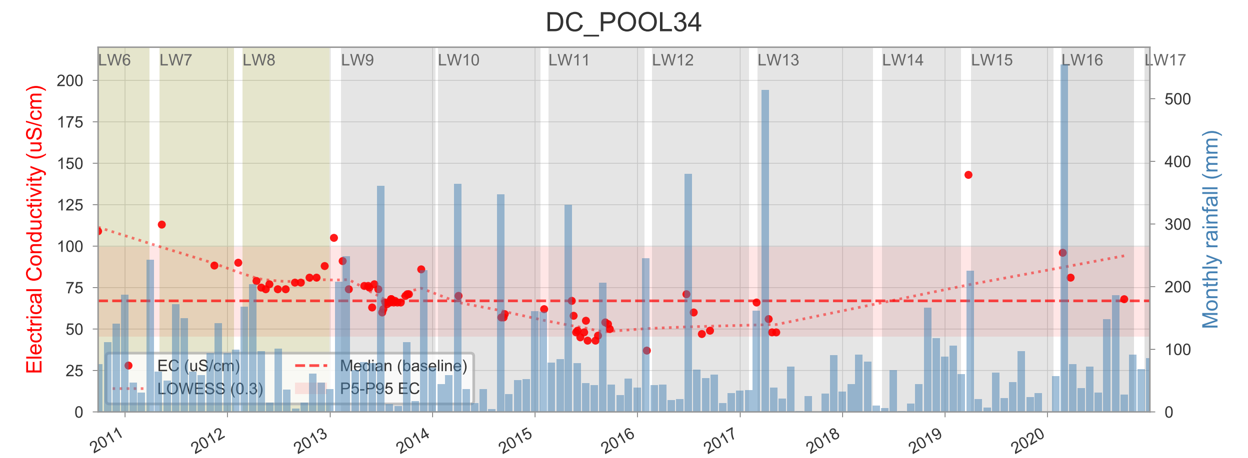

DC_POOL29
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

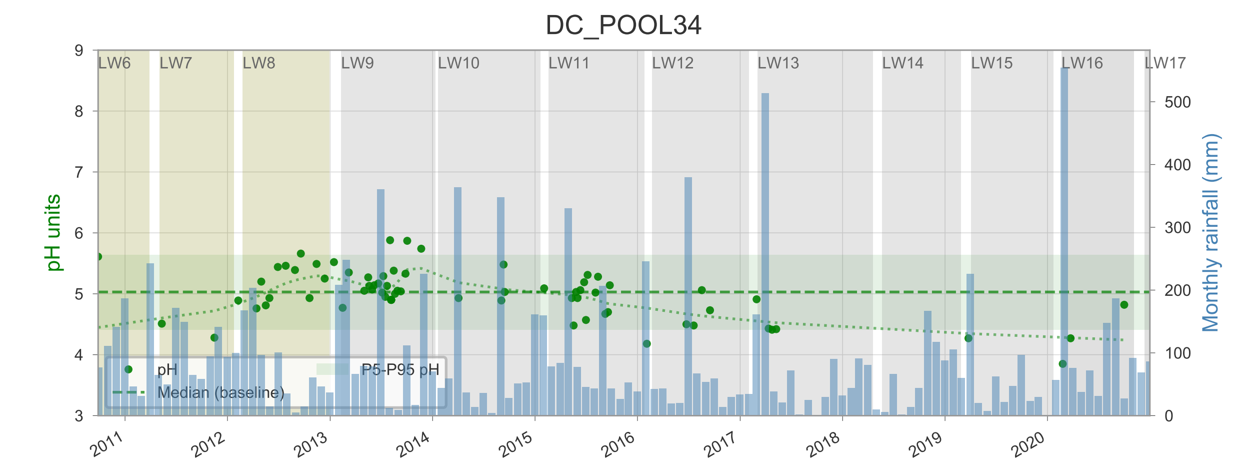

DC_POOL29
pH units
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
pH
Median (baseline)
P5-P95 pH

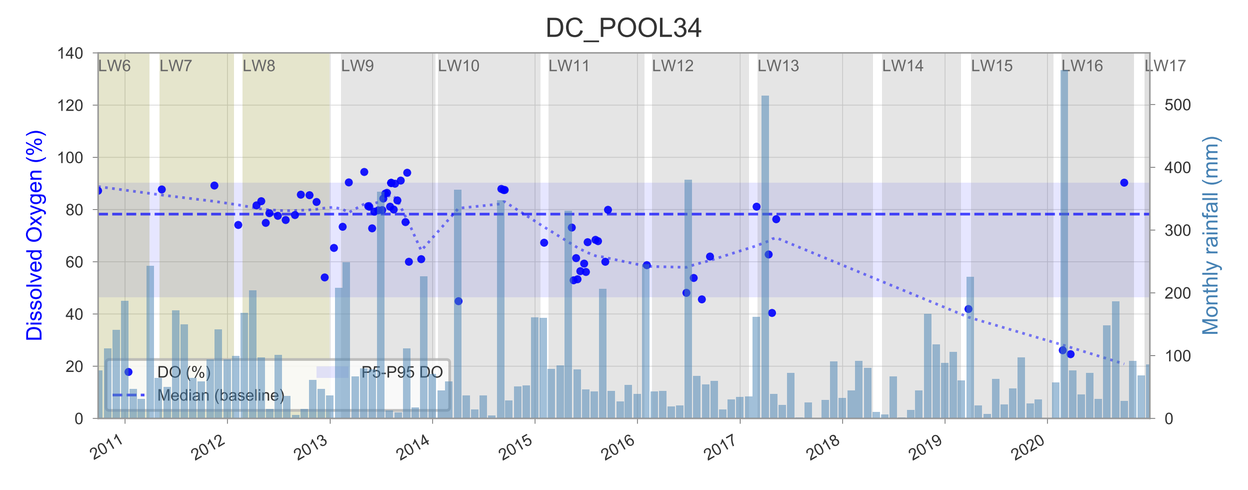

DC_POOL29
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
DO (%)
Median (baseline)
P5-P95 DO

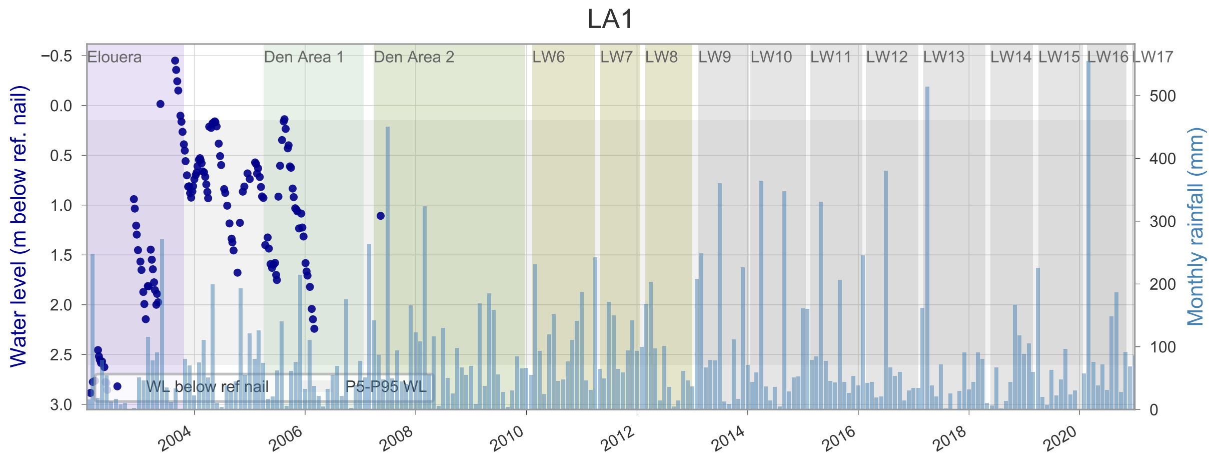

DC_POOL32
Water level (m below ref. nail)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
DC_POOL32
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
DC_POOL32
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
DC_POOL32
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2012
2013
2014
2015
2016
2017
2018
2019
2020

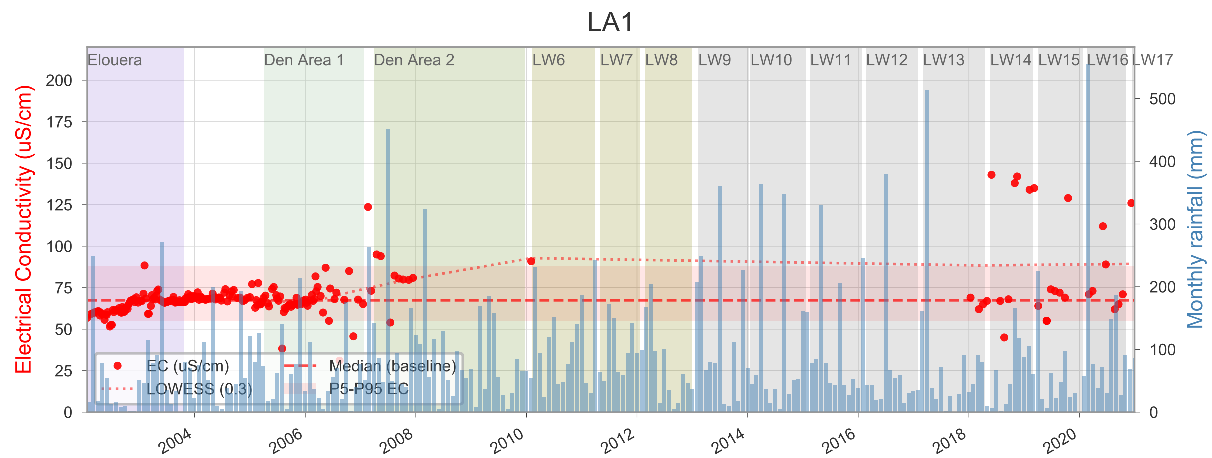

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

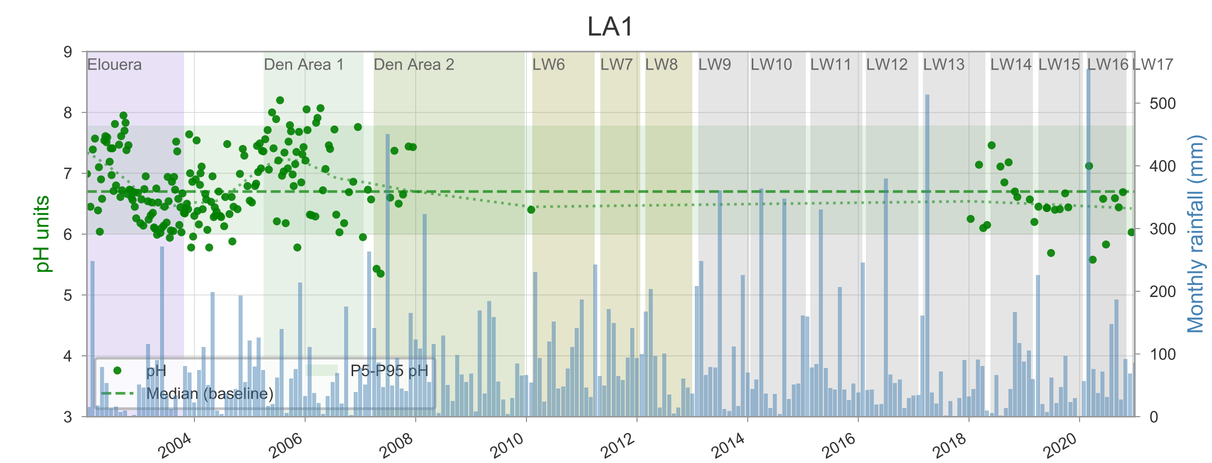

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

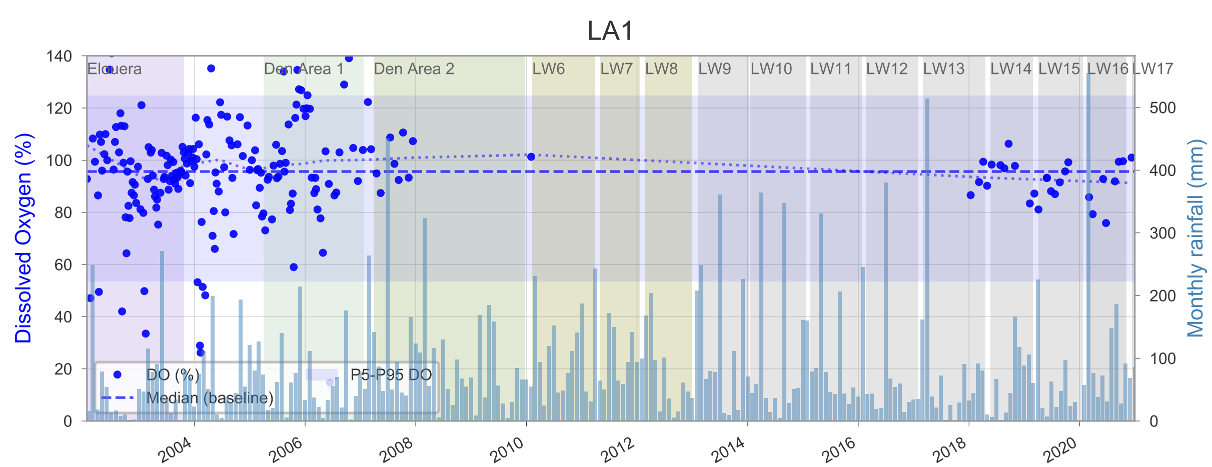

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

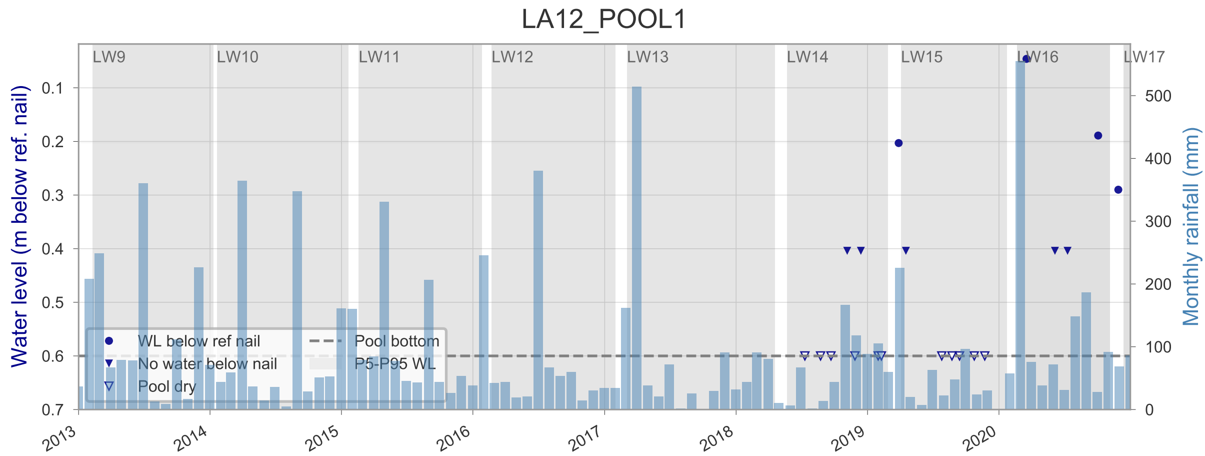

DC_POOL34
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

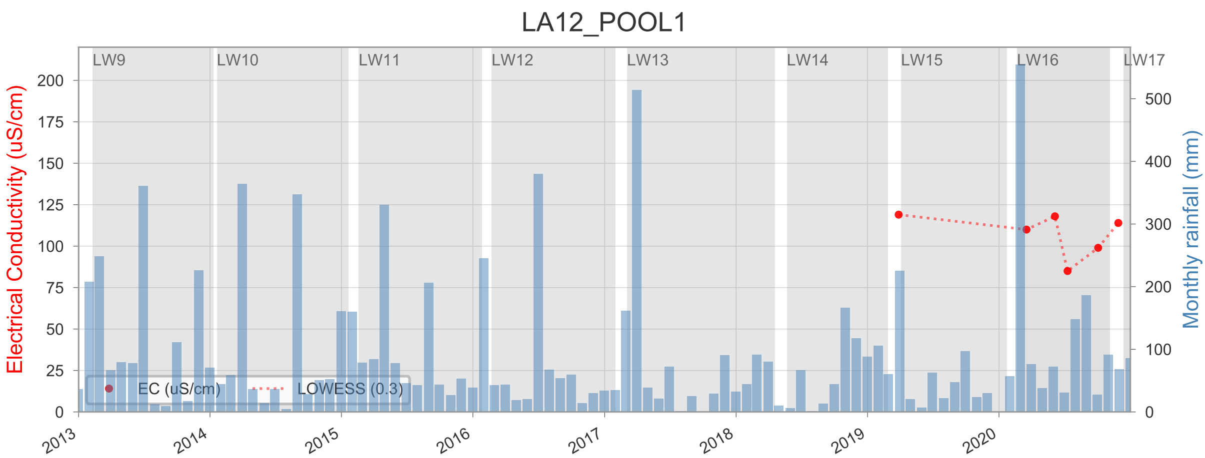

LA1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
2004
2006
2008
2010
2012
2014
2016
2018
2020

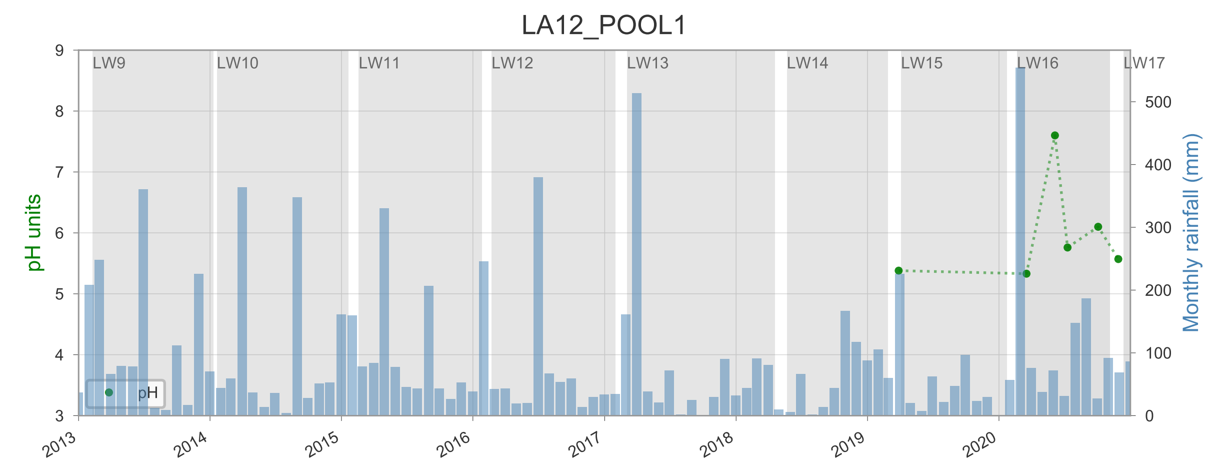

LA1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2004
2006
2008
2010
2012
2014
2016
2018
2020

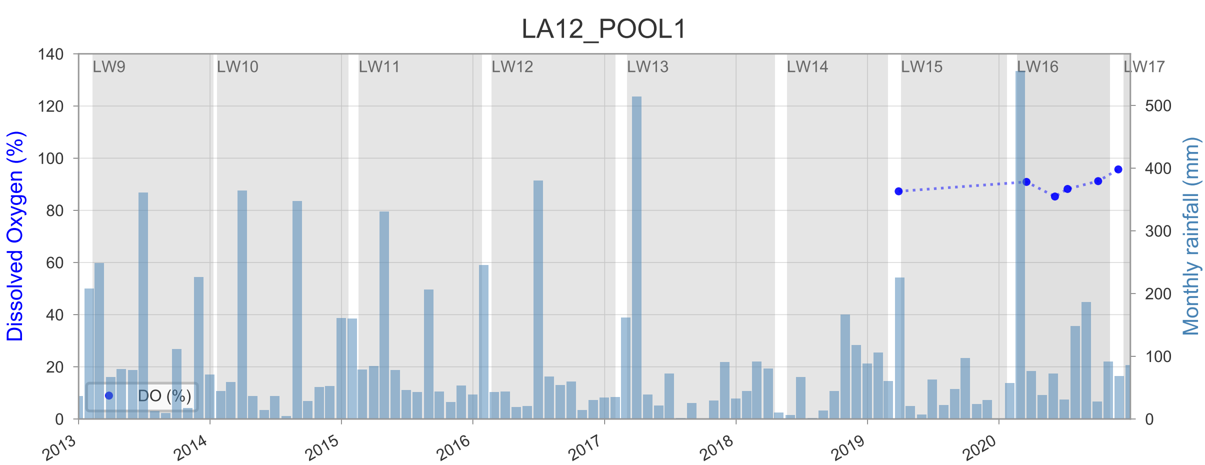

LA1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2004
2006
2008
2010
2012
2014
2016
2018
2020

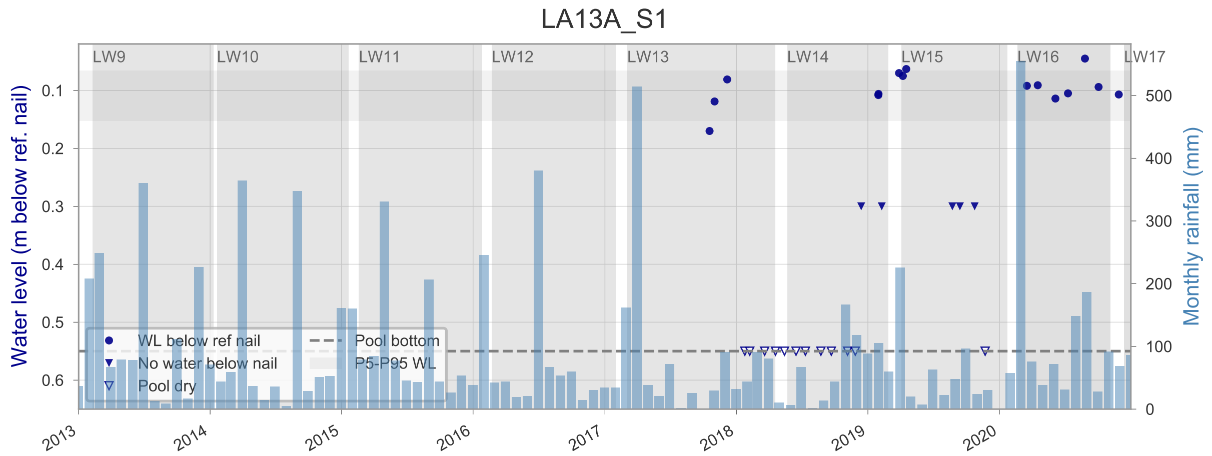

LA1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2004
2006
2008
2010
2012
2014
2016
2018
2020

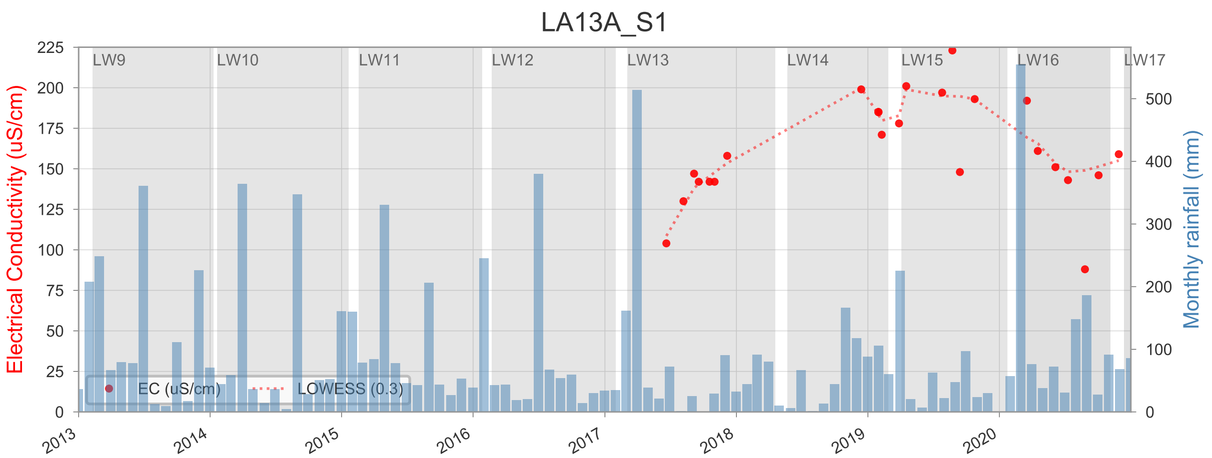

LA12_POOL1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

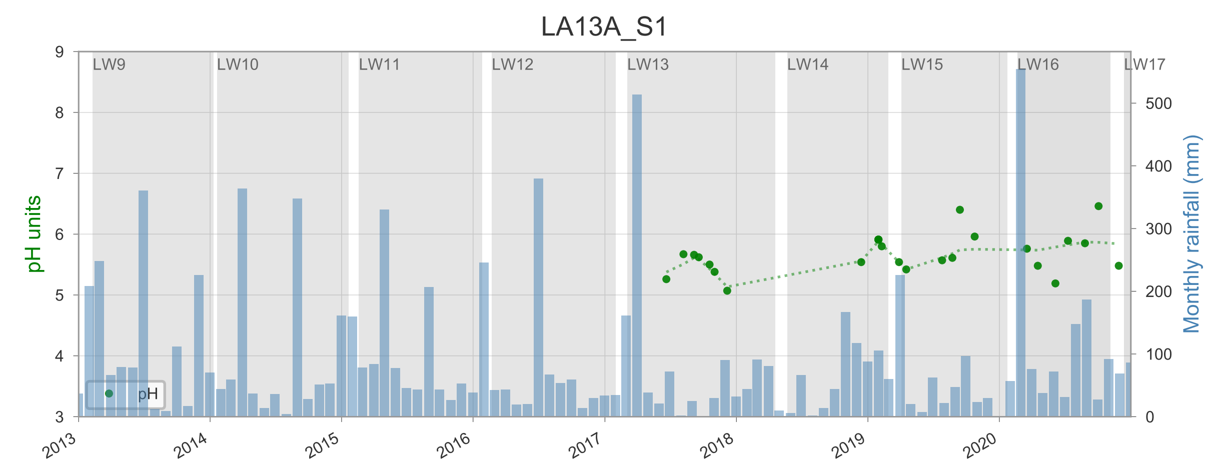

LA12_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

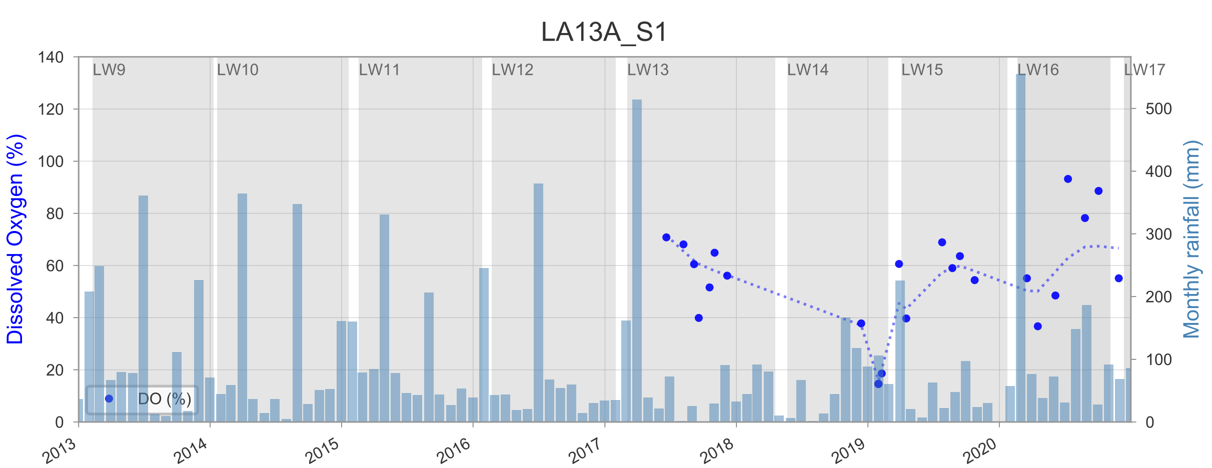

LA12_POOL1
pH units
Monthly rainfall (mm)
pH

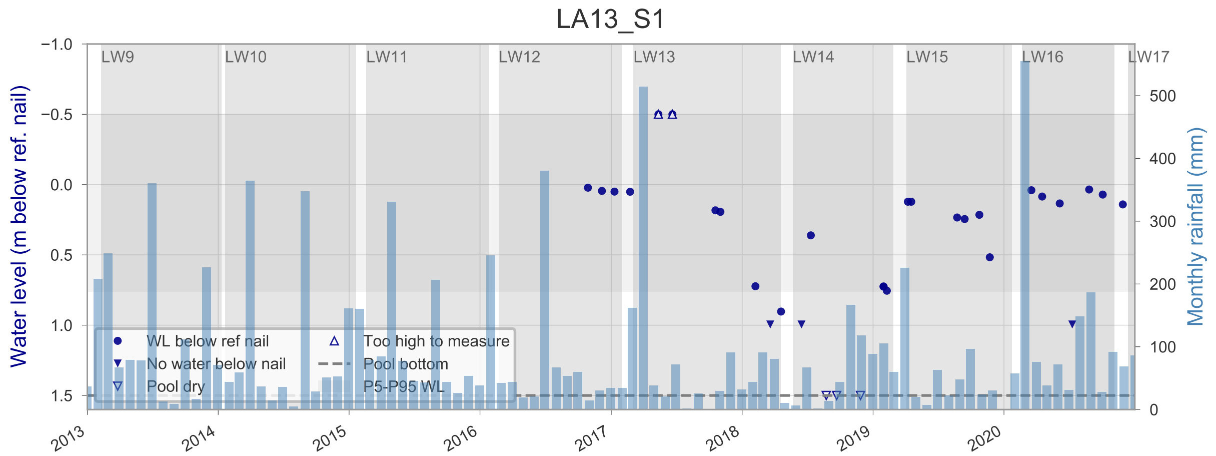

LA12_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

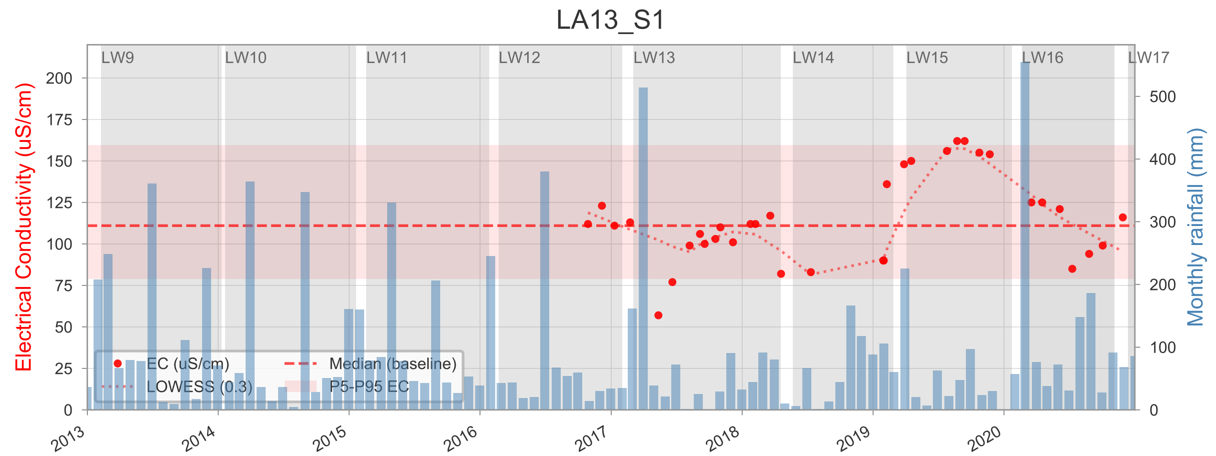

LA13A_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
0.1
0.2
0.3
0.4
0.5
0.6
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

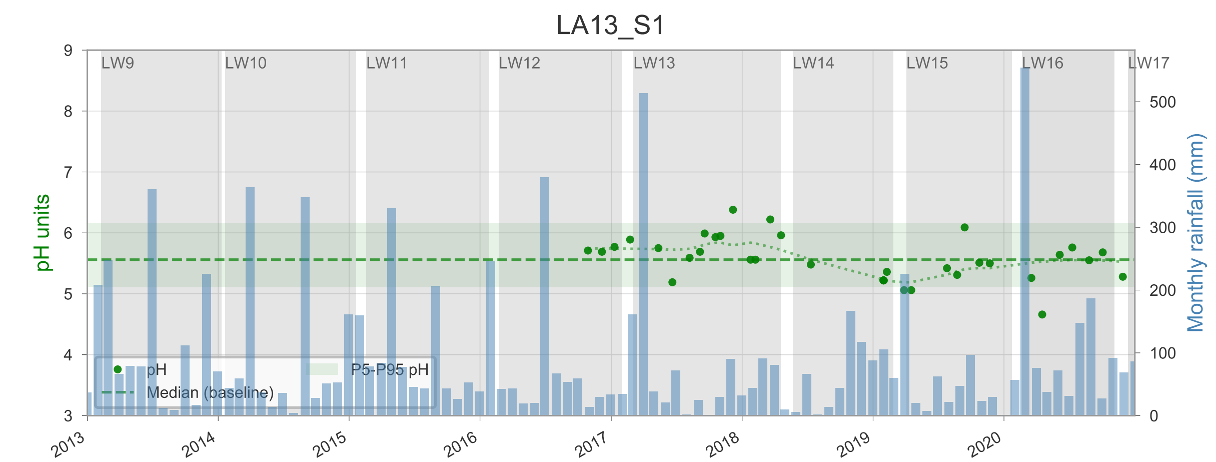

LA13A_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
225
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

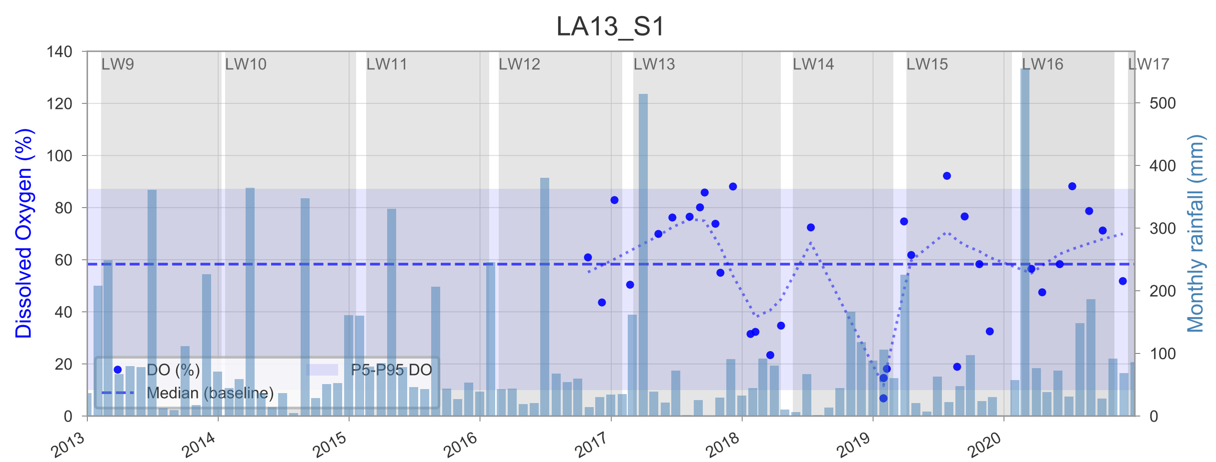

LA13A_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

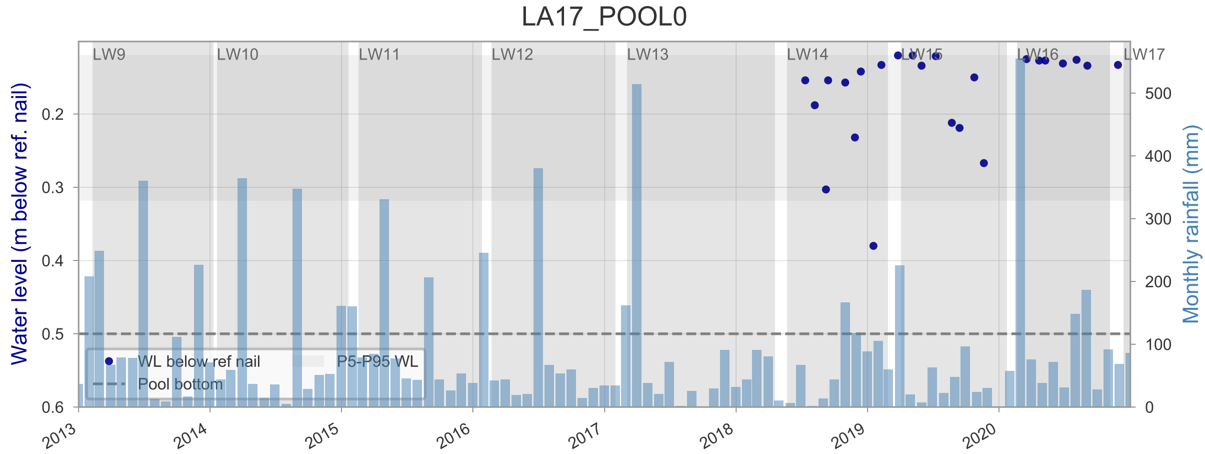

LA13A_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

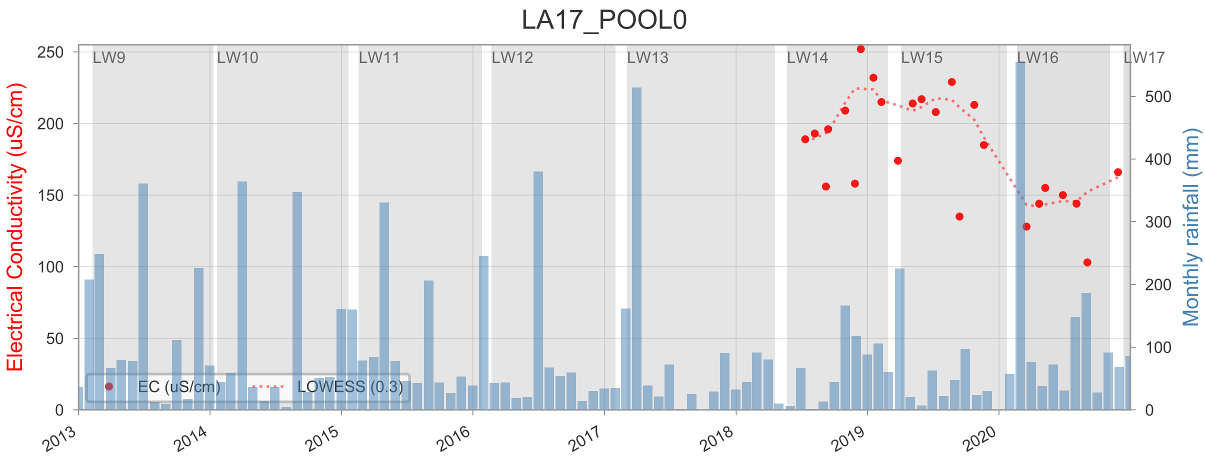

LA13_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Too high to measure
Pool bottom
P5-P95 WL

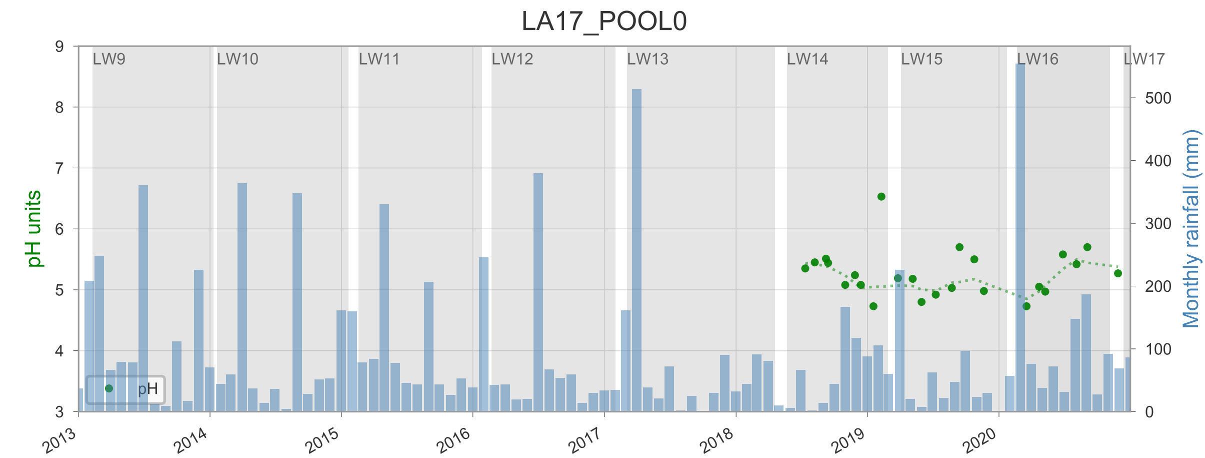

LA13_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

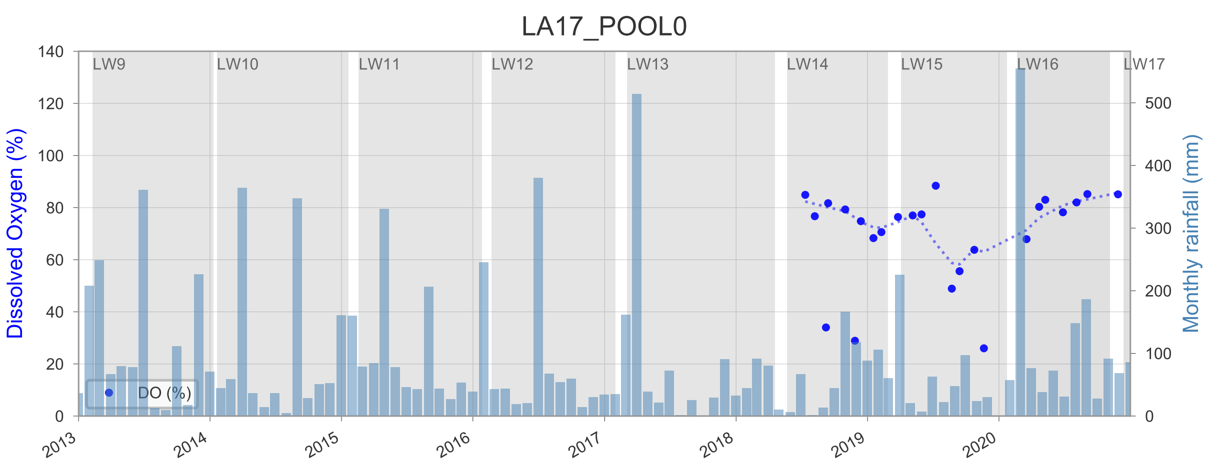

LA13_S1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

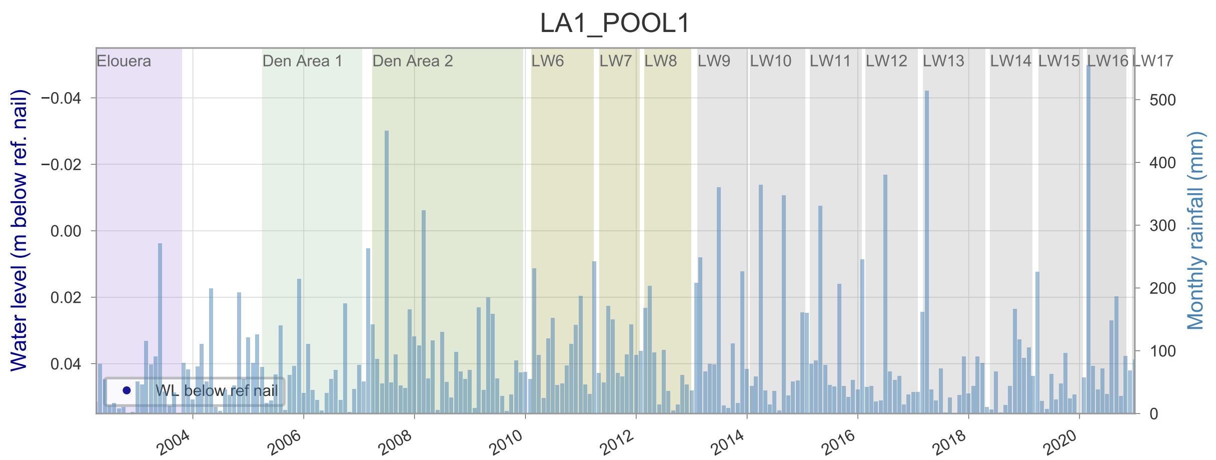

LA13_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

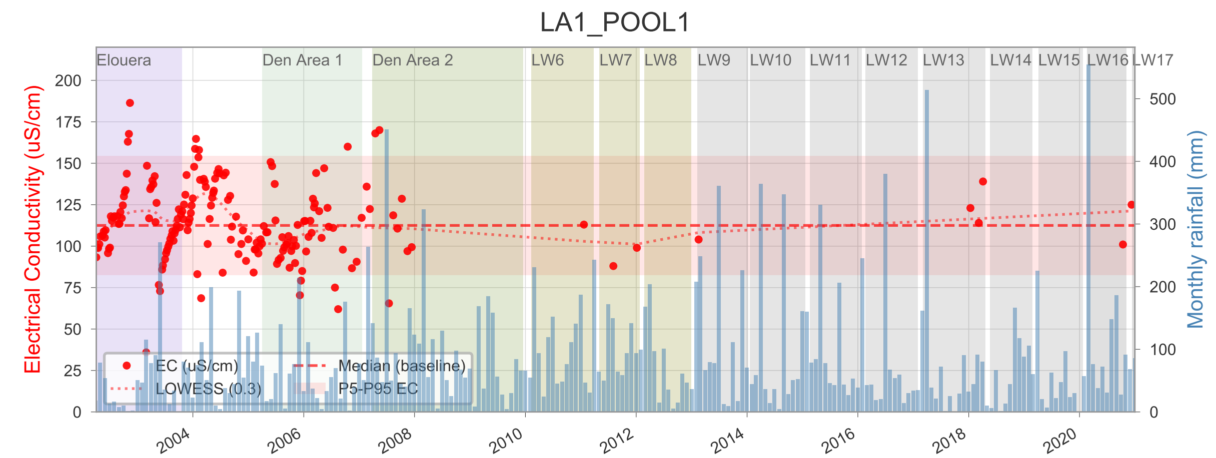

LA17_POOL0
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom

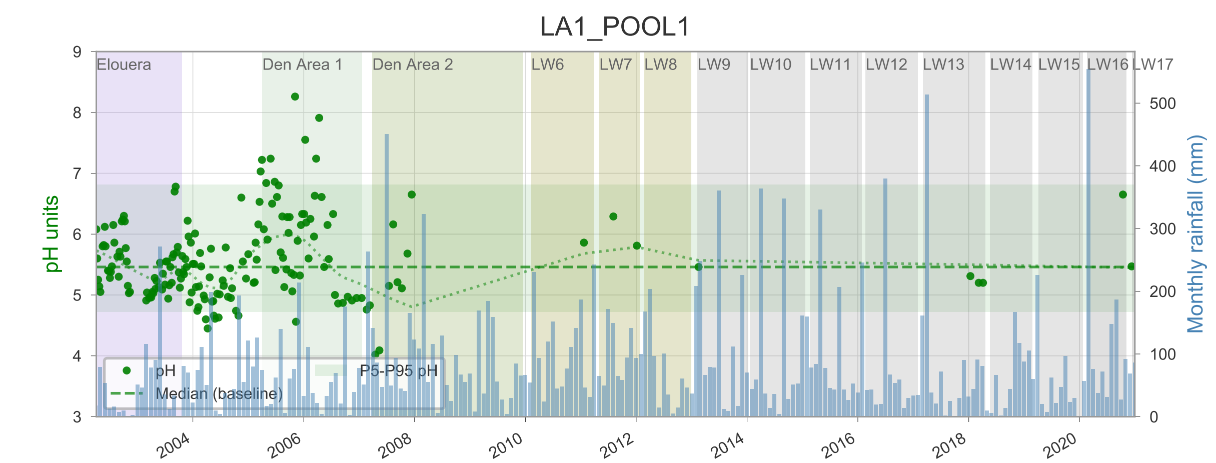

LA17_POOL0
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

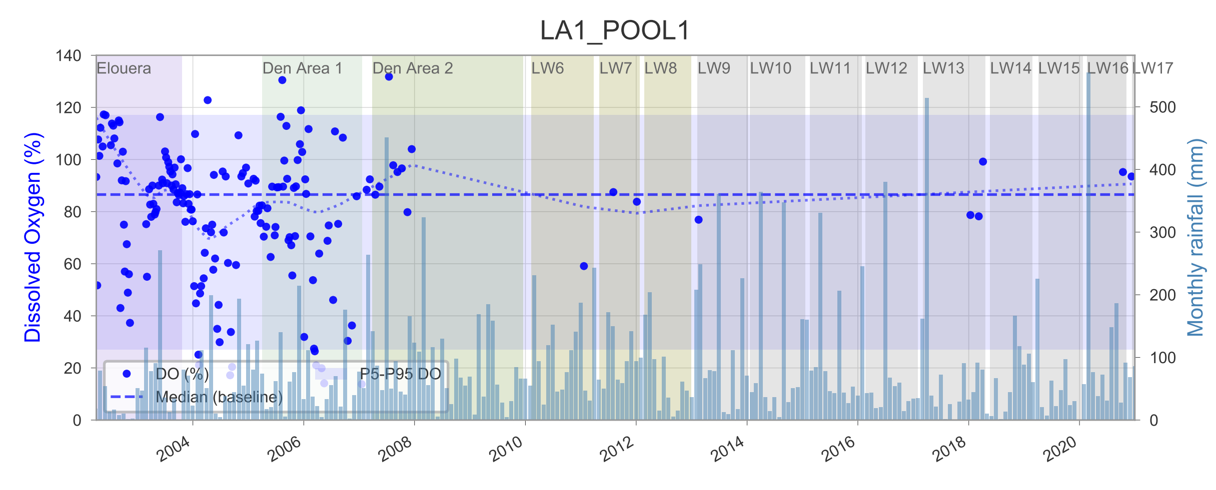

LA17_POOL0
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

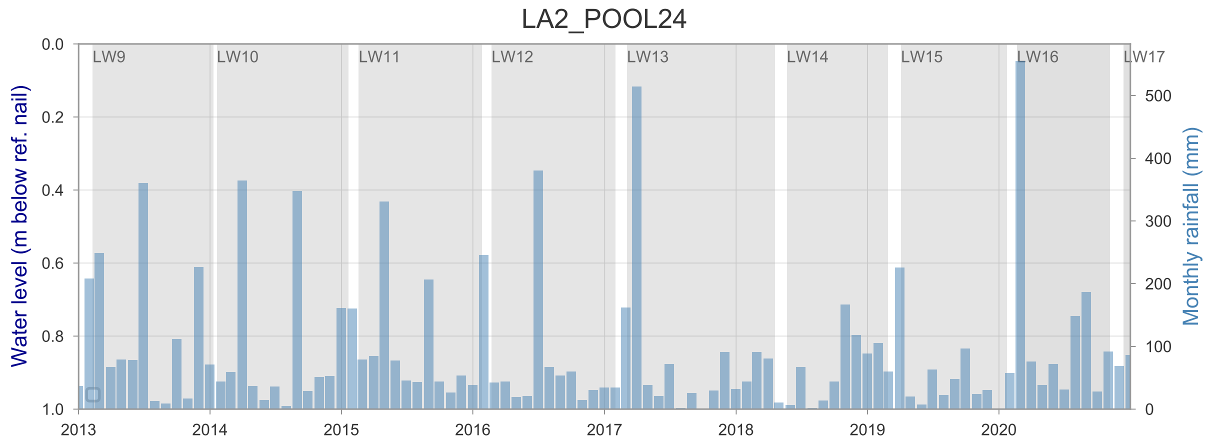

LA17_POOL0
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

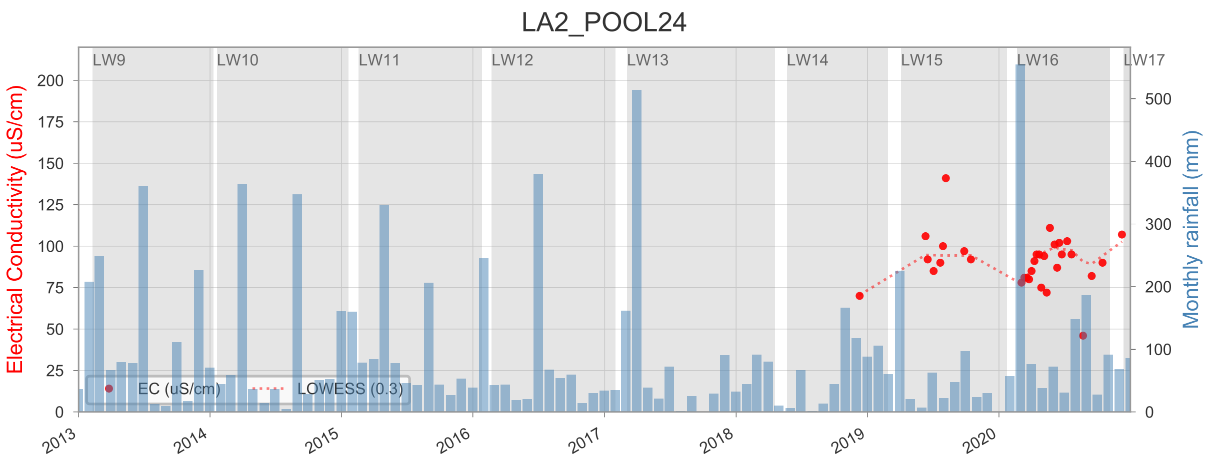

LA1_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail

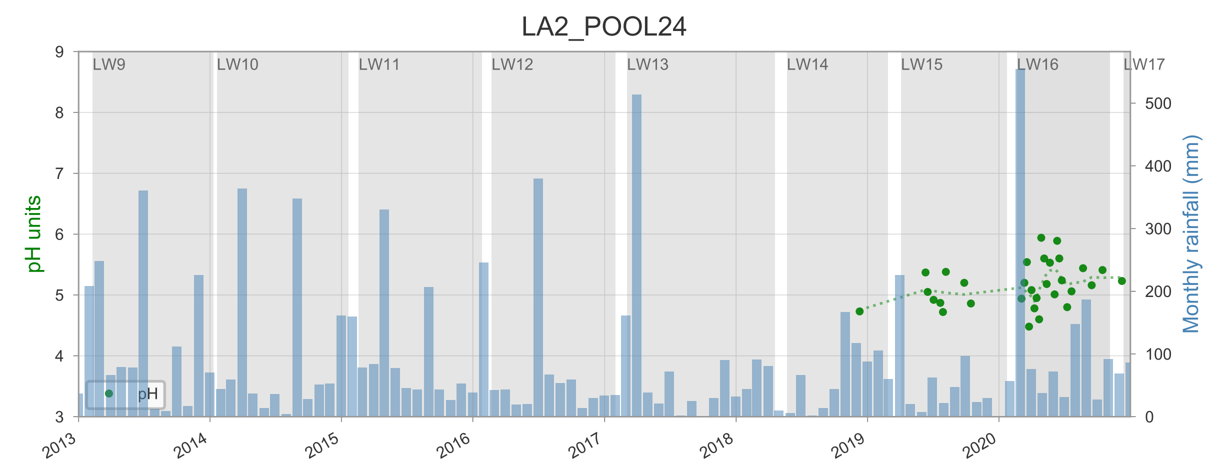

LA1_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

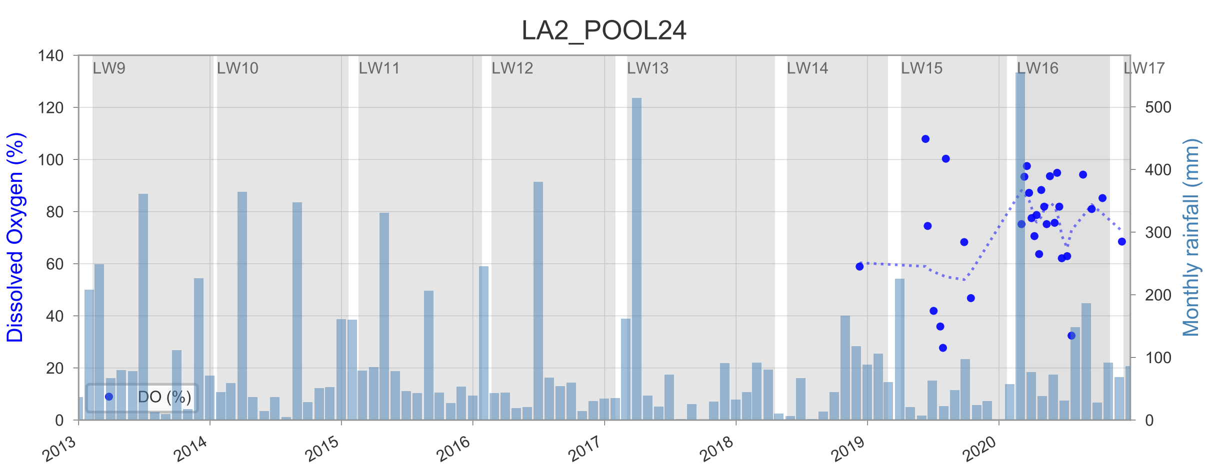

LA1_POOL1
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

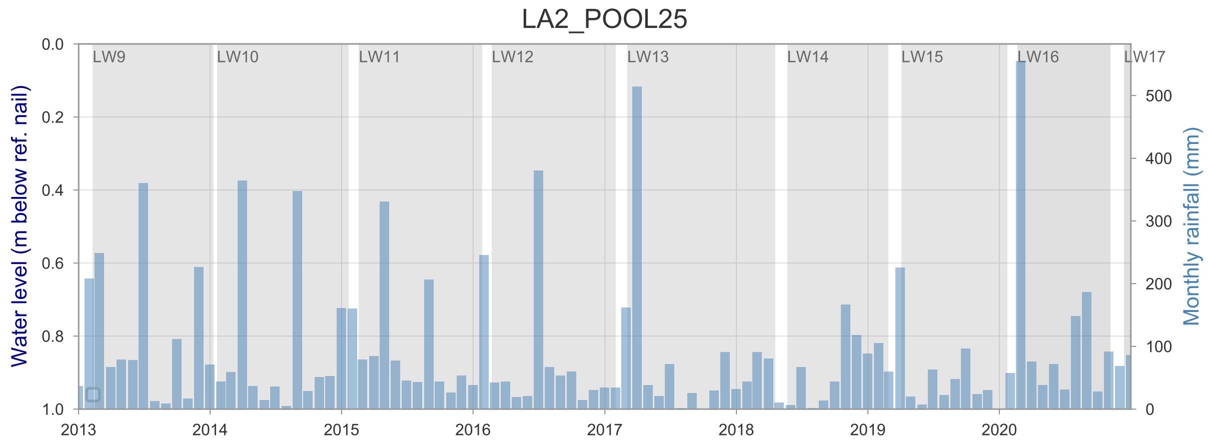

LA1_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

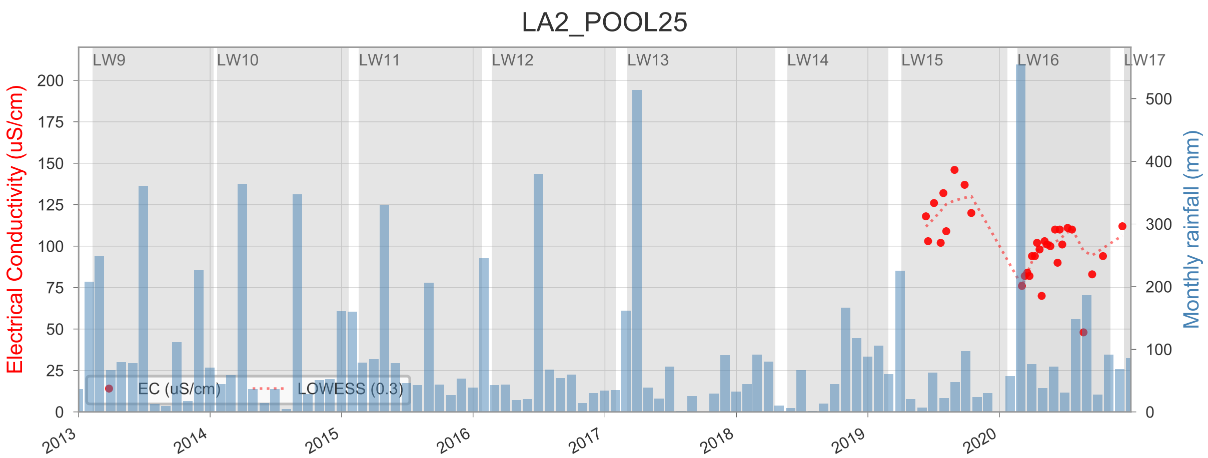

LA2_POOL24
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

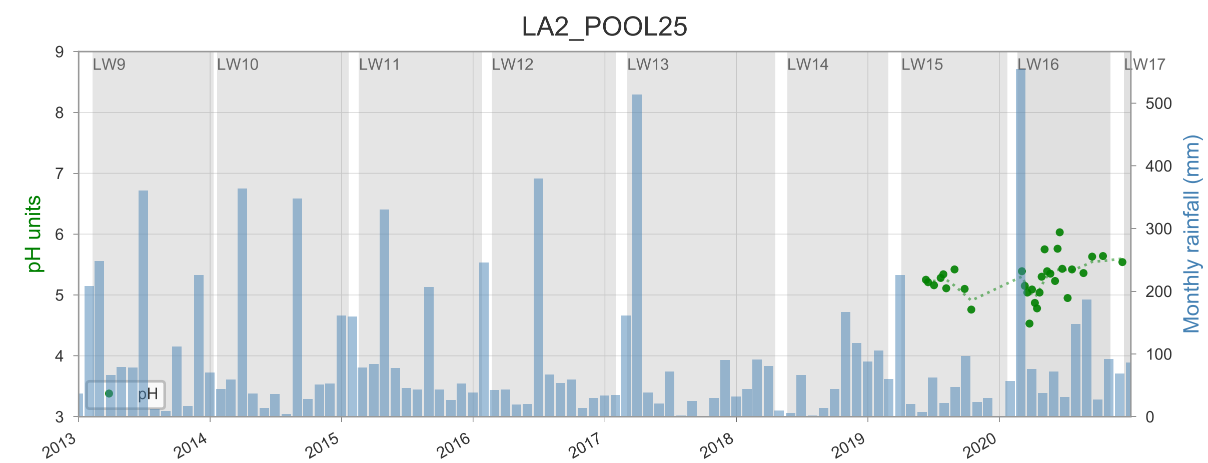

LA2_POOL24
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

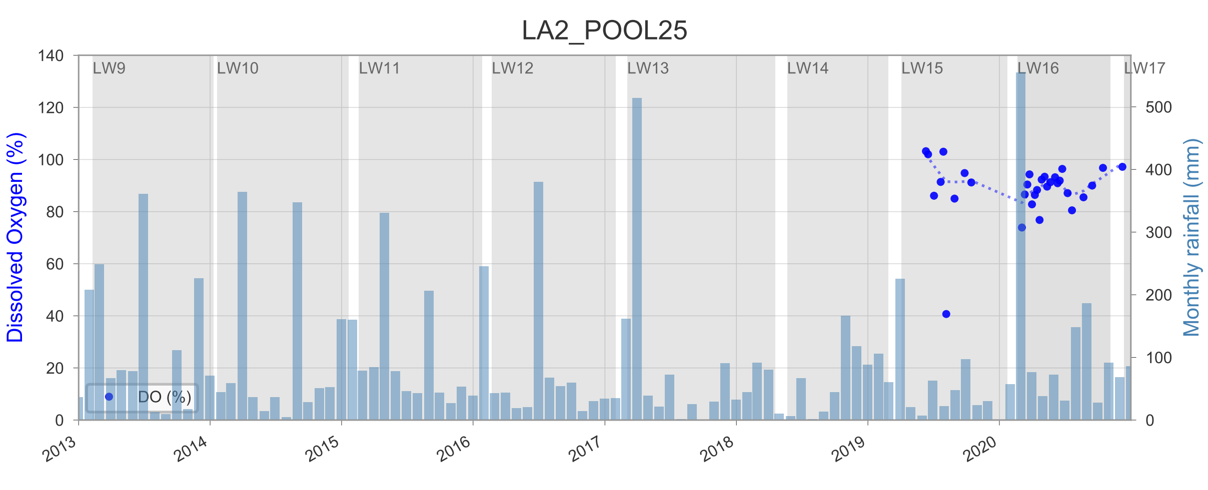

LA2_POOL24
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

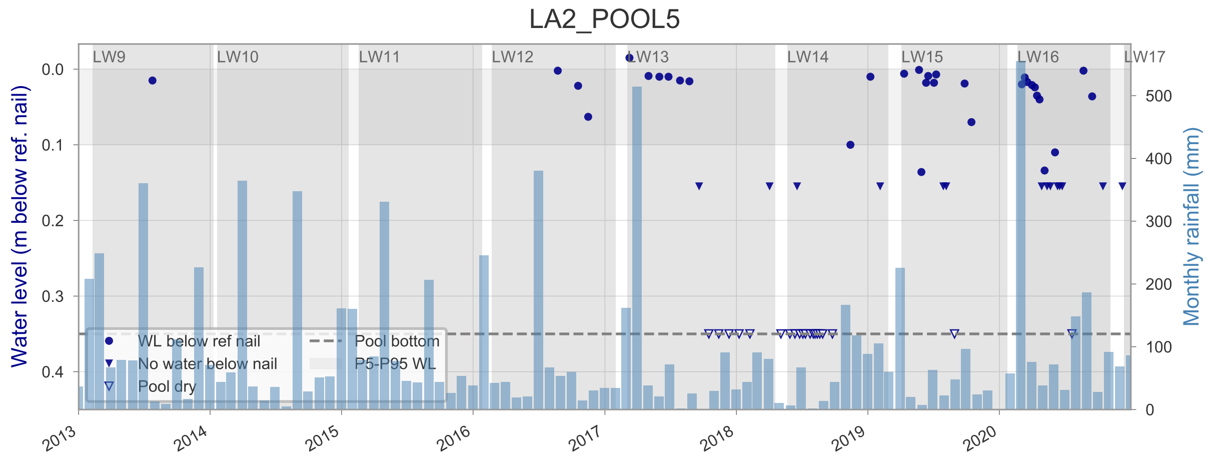

LA2_POOL24
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

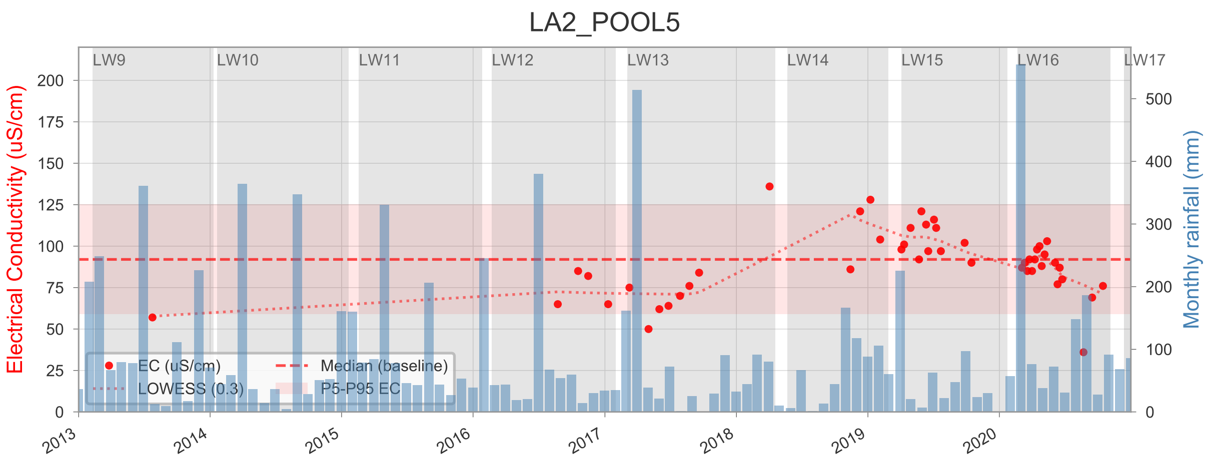

LA2_POOL25
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

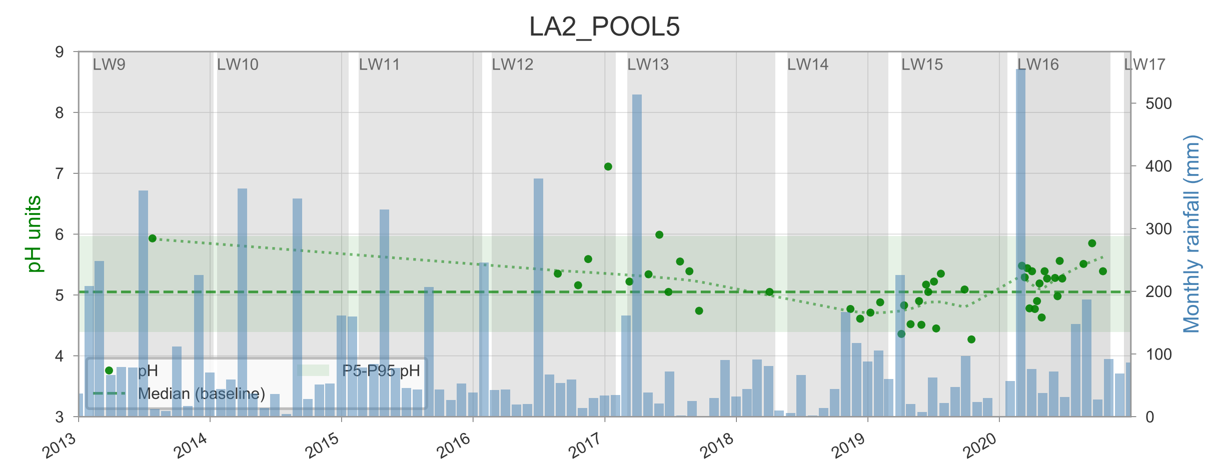

LA2_POOL25
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

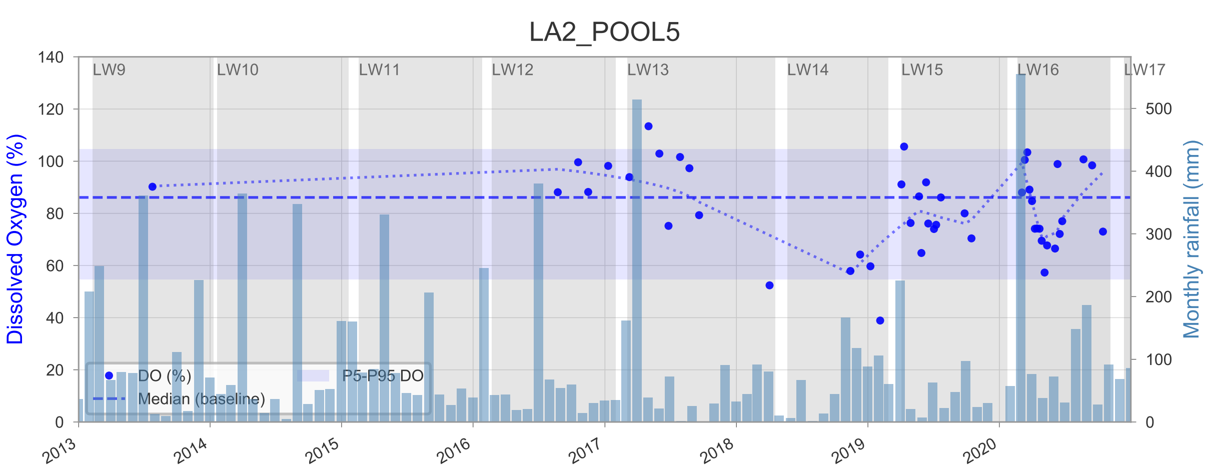

LA2_POOL25
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

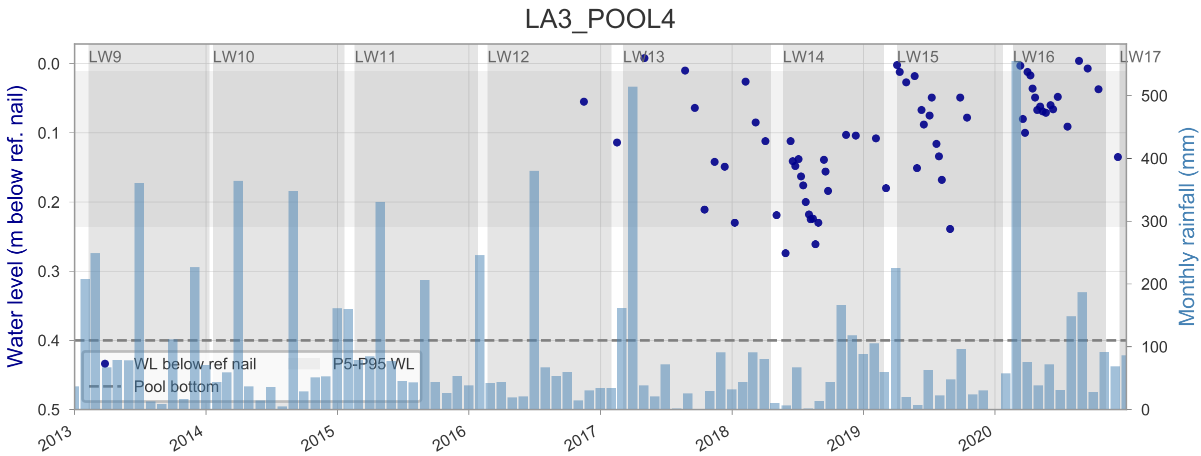

LA2_POOL25
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

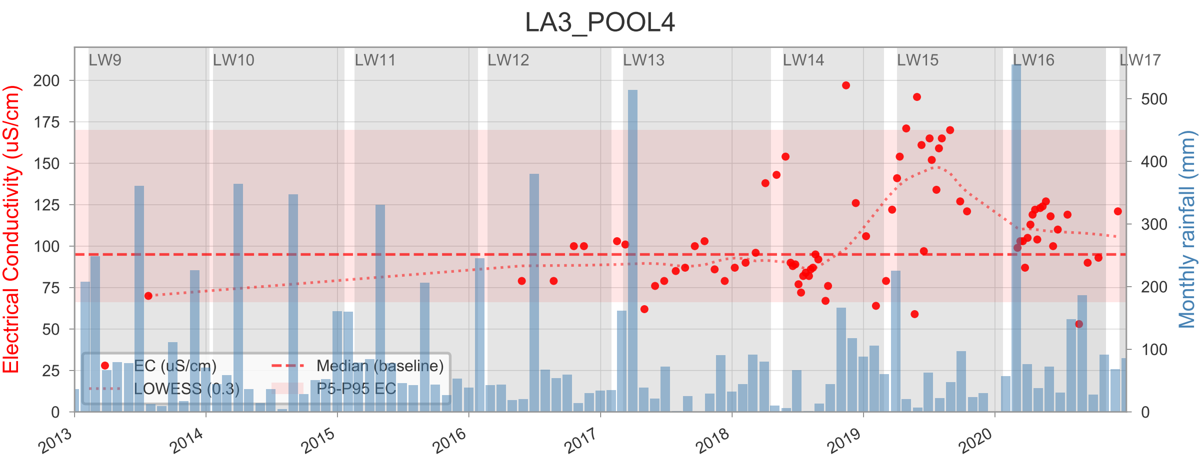

LA2_POOL5
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

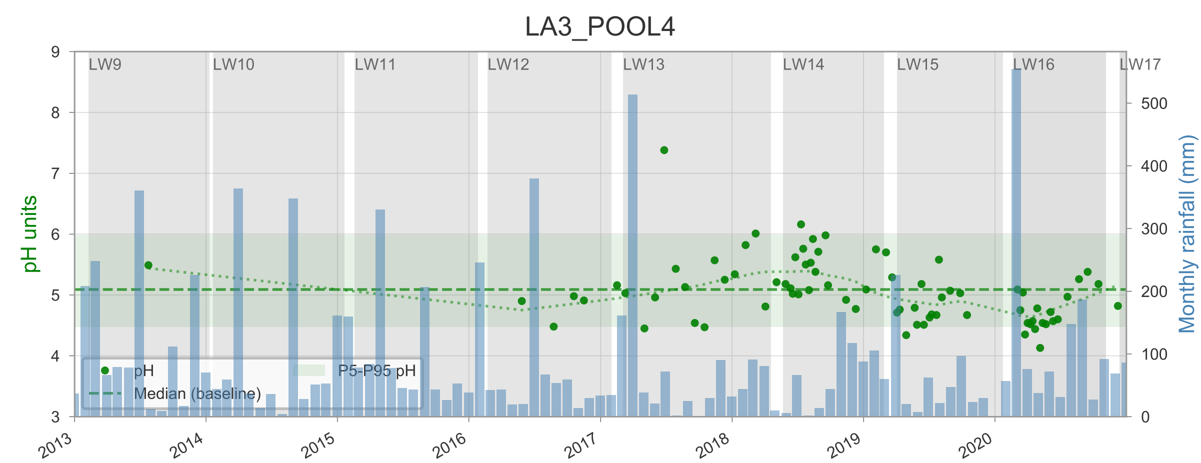

LA2_POOL5
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

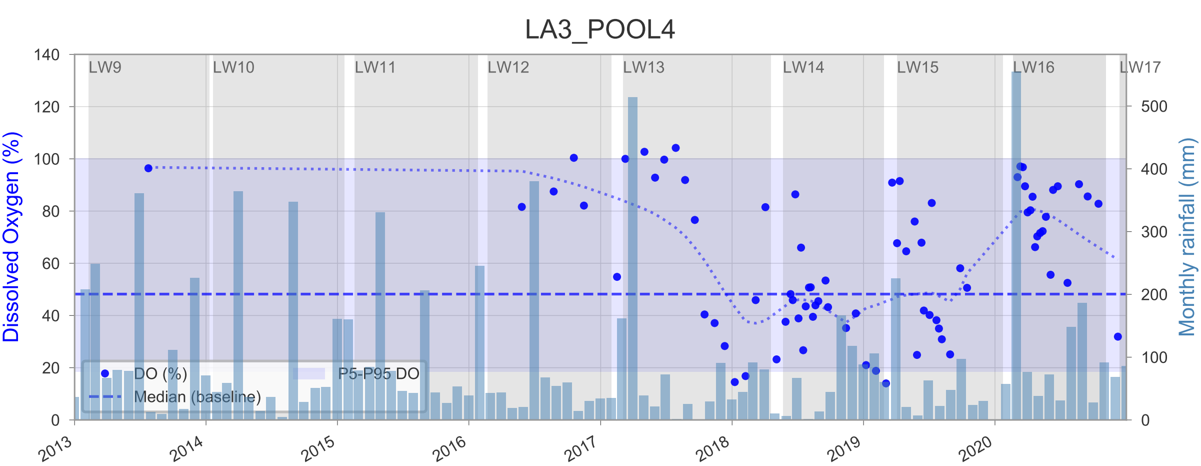

LA2_POOL5
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

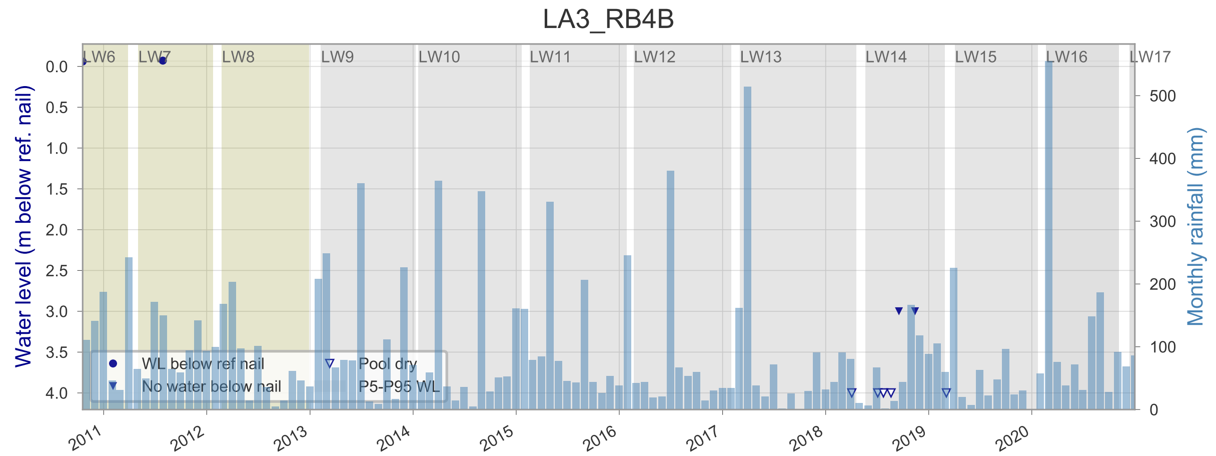

LA2_POOL5
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

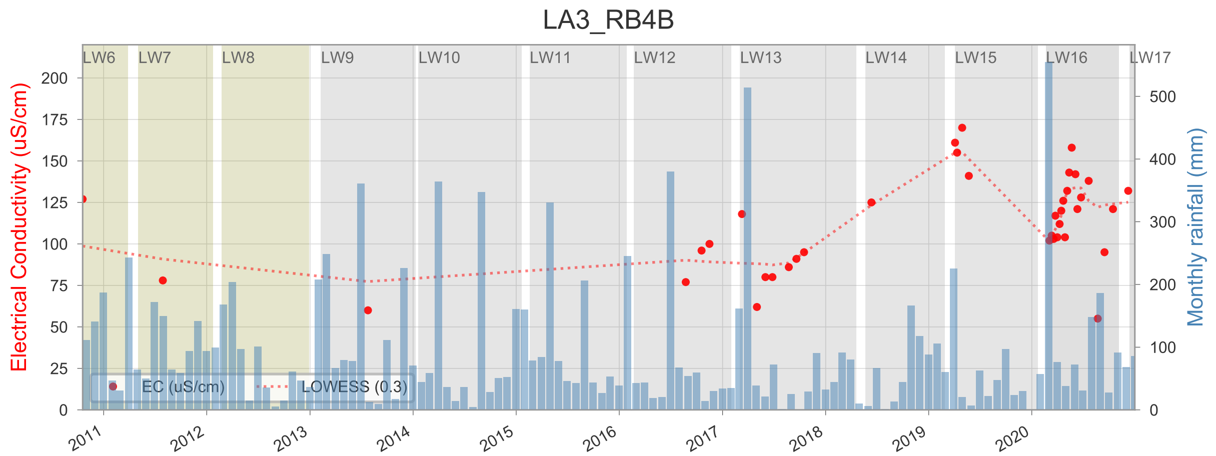

LA3_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

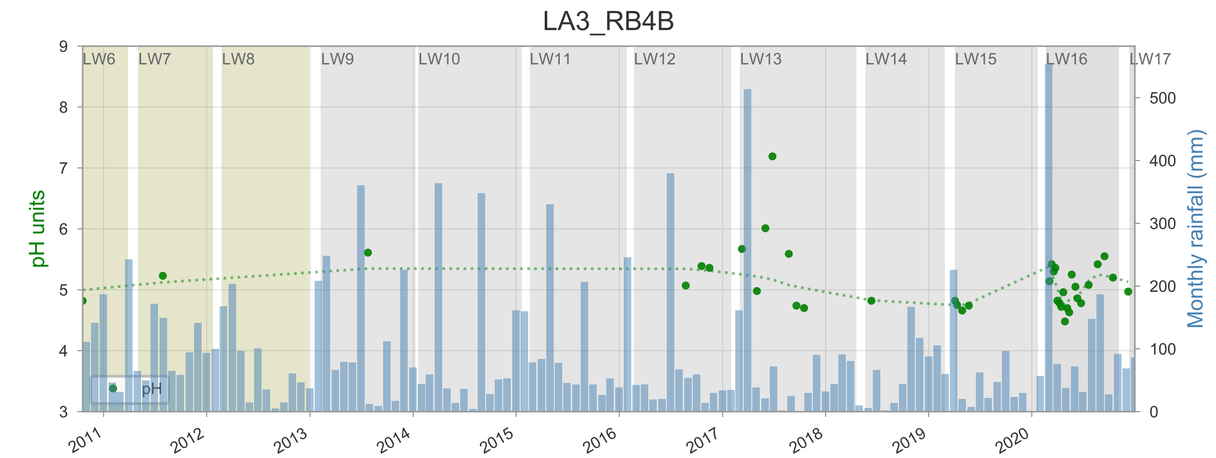

LA3_POOL4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

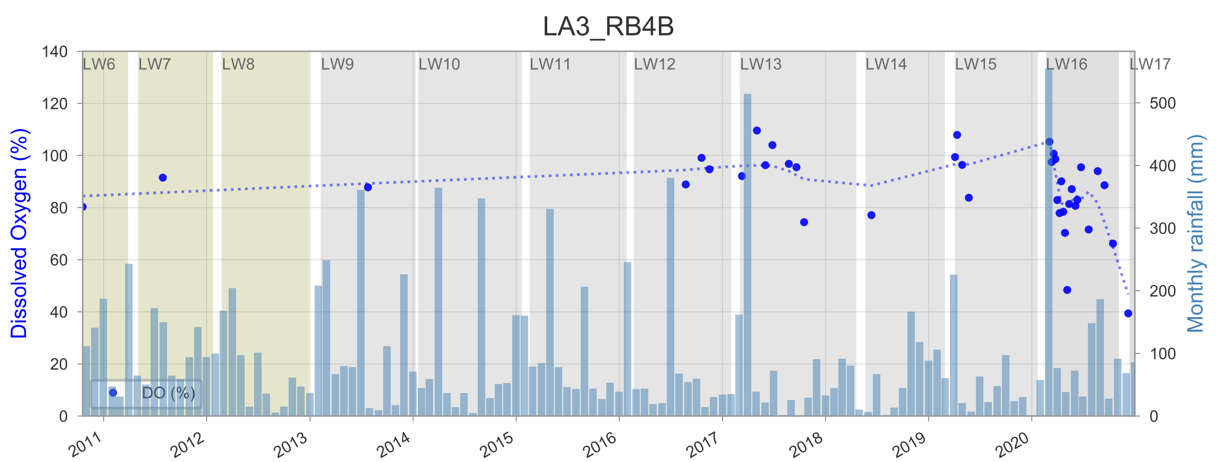

LA3_POOL4
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

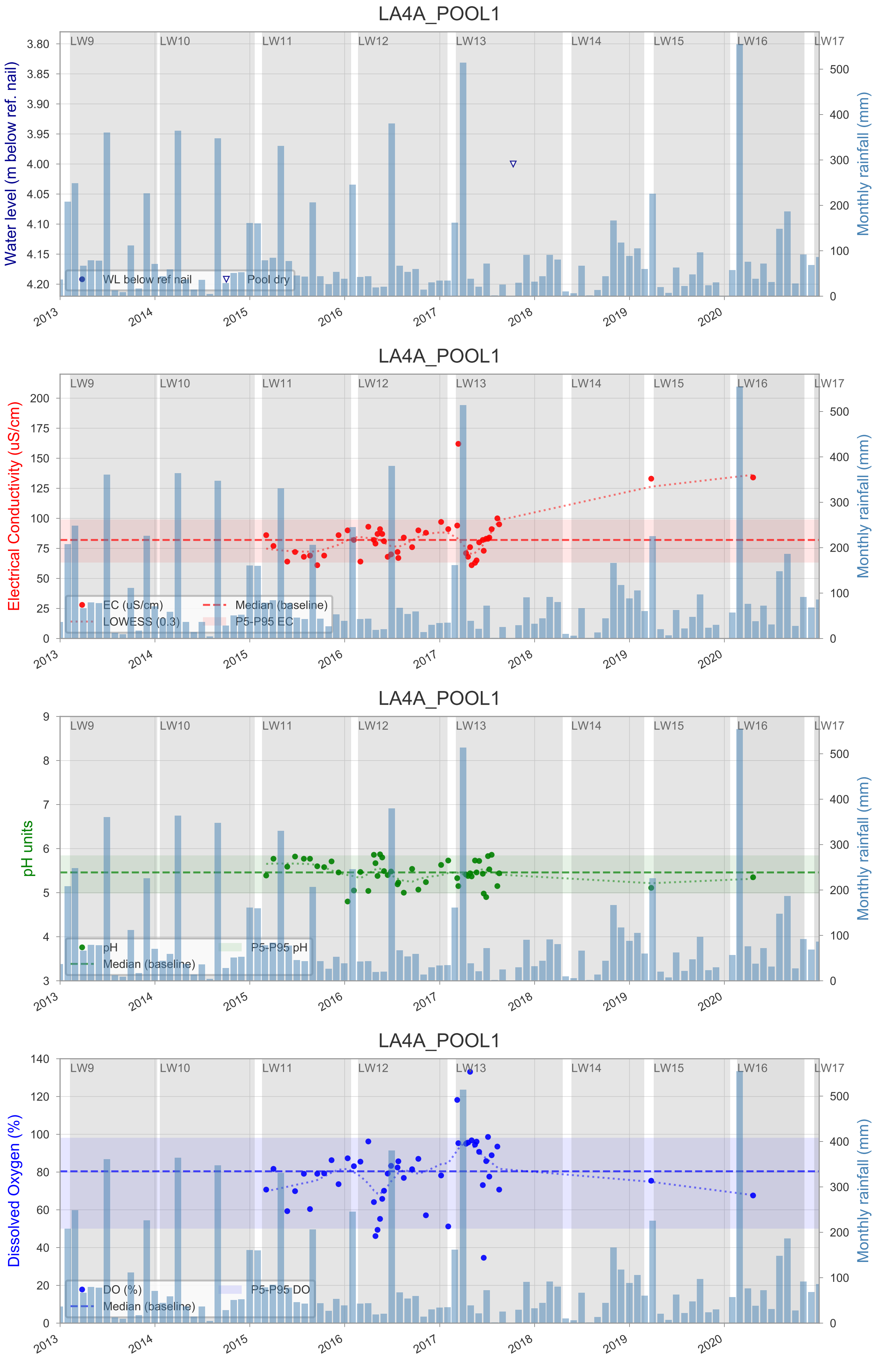

LA3_POOL4
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020


LA3_RB4B
Water level (m below ref. nail)
Monthly rainfall (mm)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
P5-P95 WL

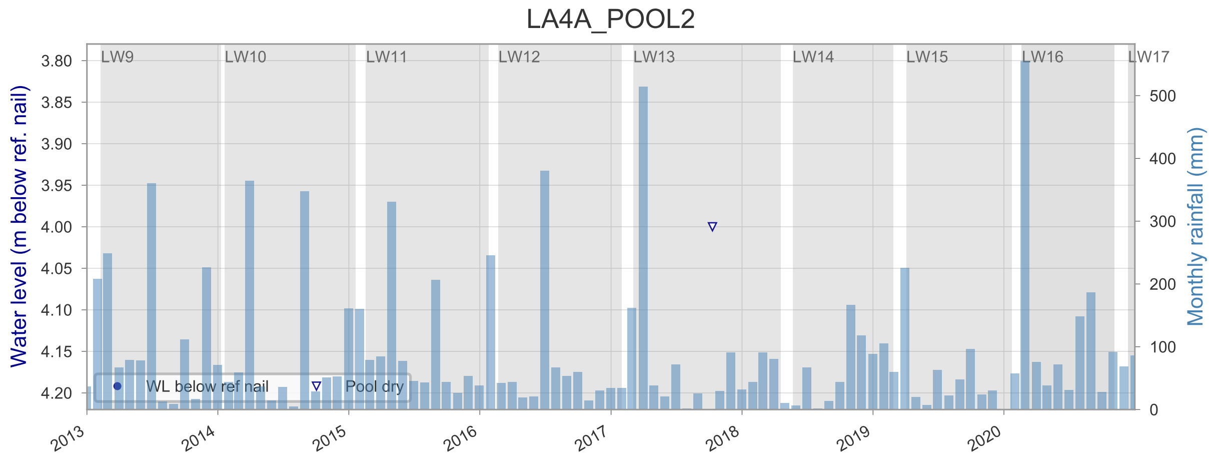

LA3_RB4B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

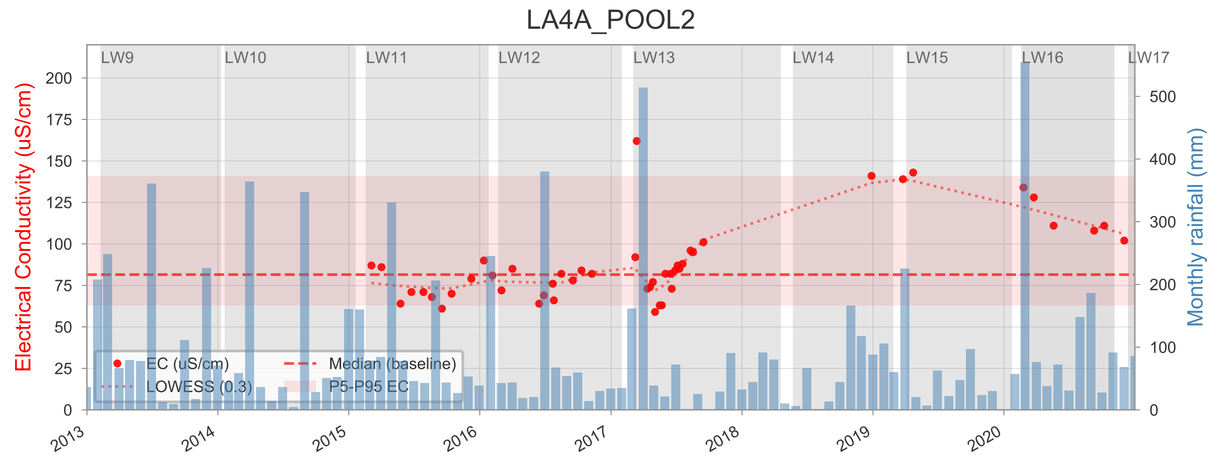

LA3_RB4B
pH units
Monthly rainfall (mm)
pH

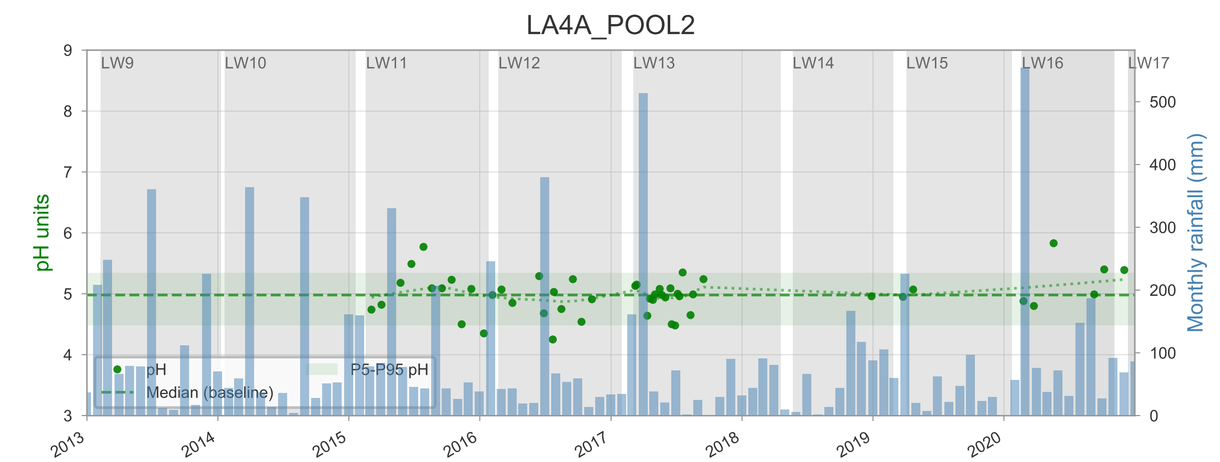

LA3_RB4B
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)

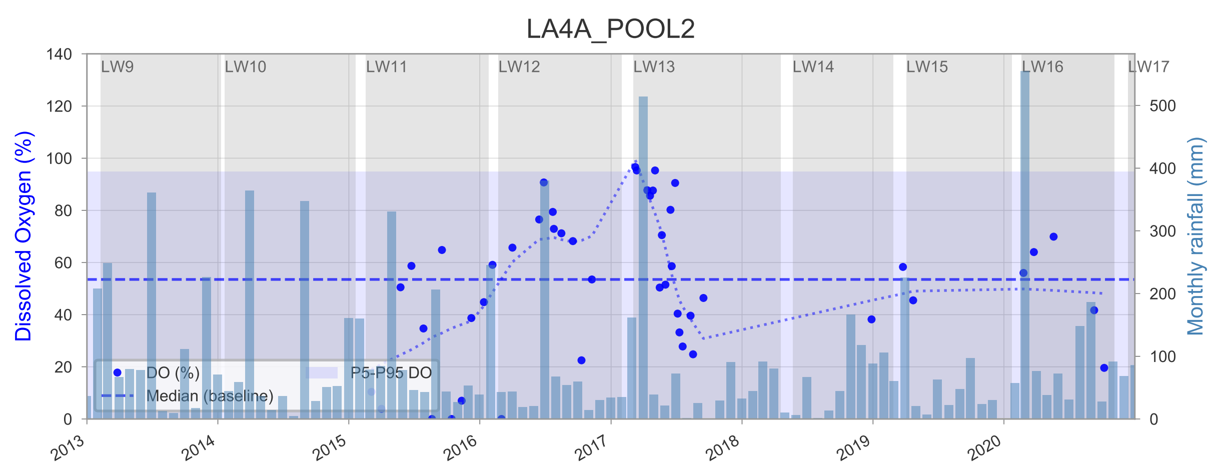


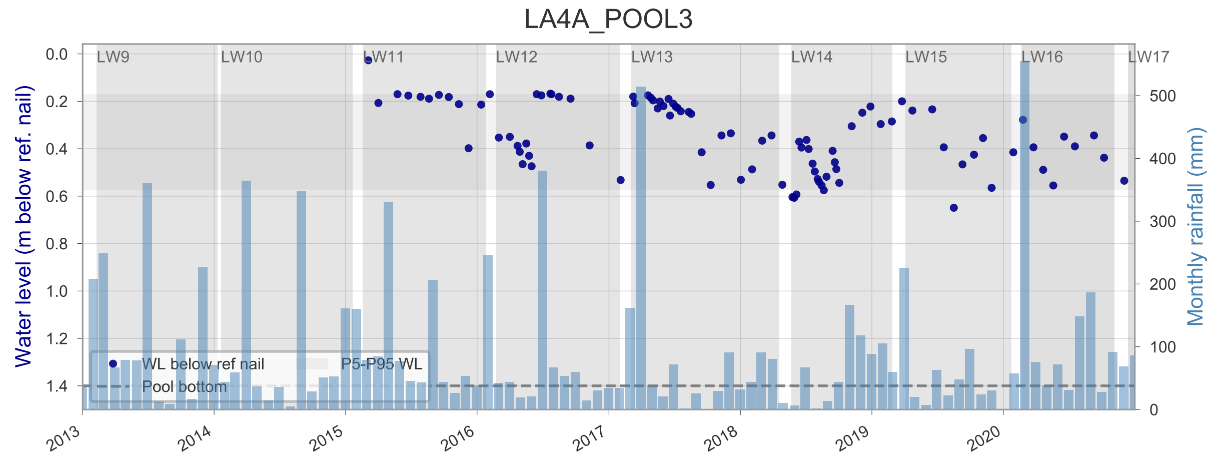
LA4A_POOL1
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool dry
LA4A_POOL1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LA4A_POOL1
pH units
pH
Median (baseline)
P5-P95 pH
LA4A_POOL1
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

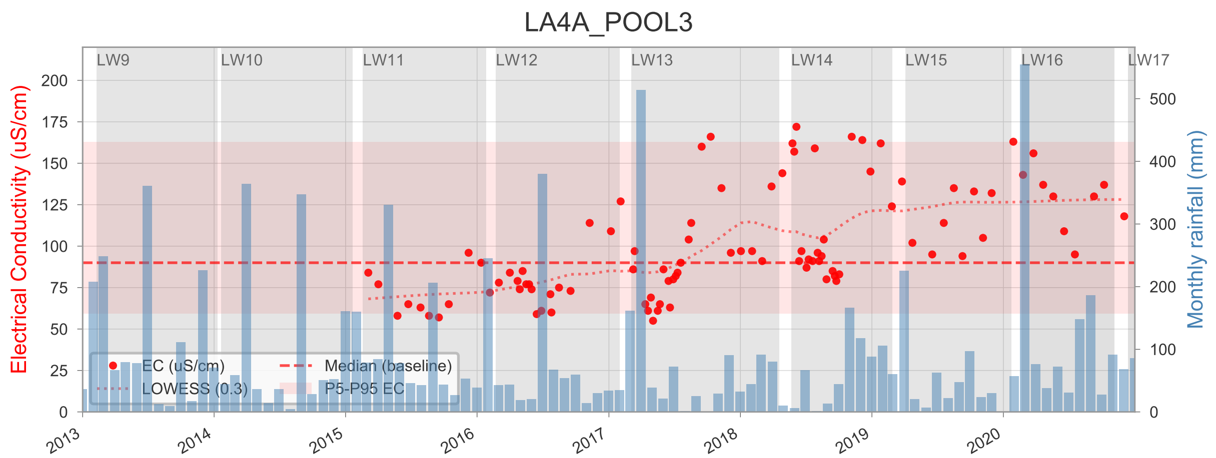

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool dry

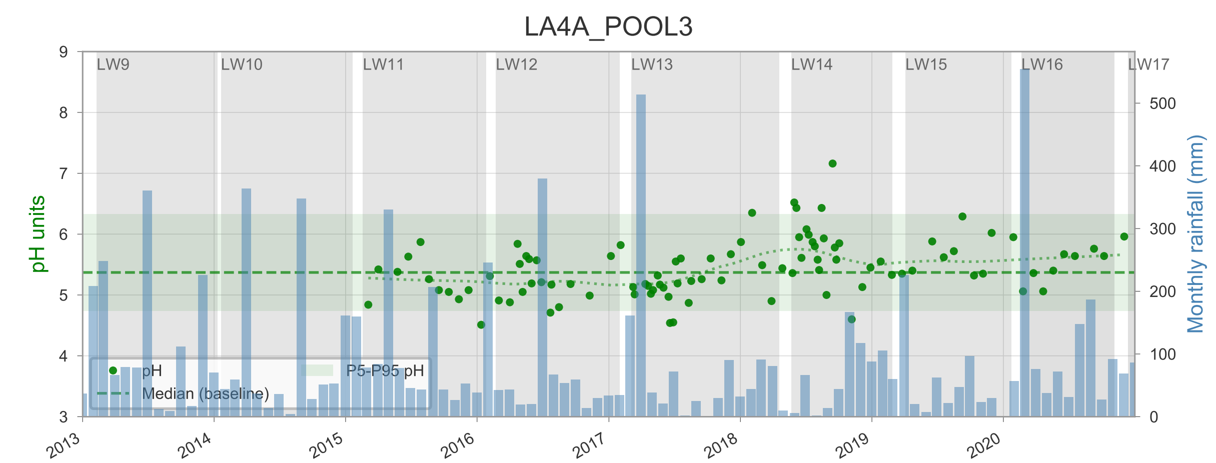

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

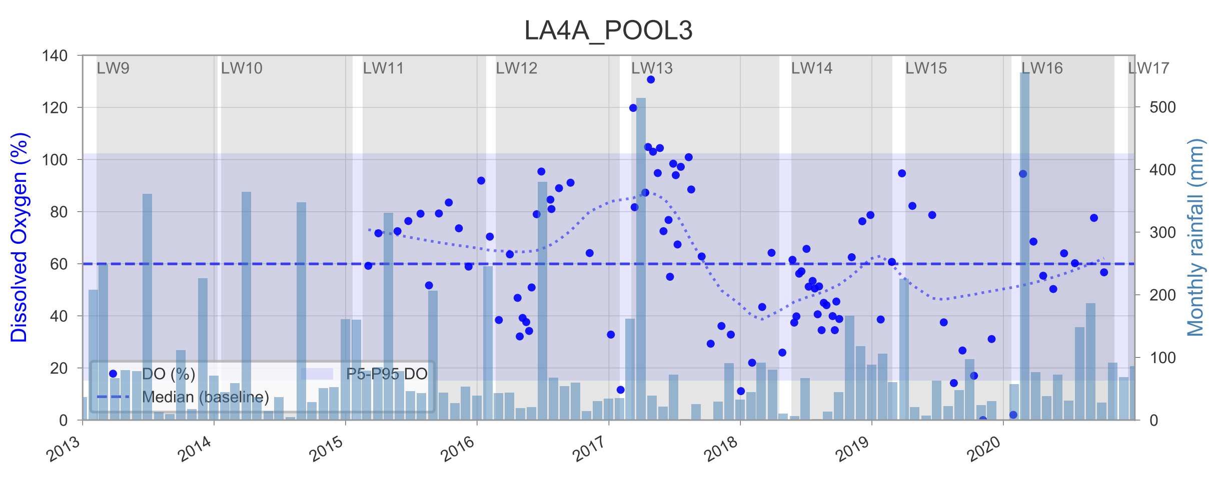

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

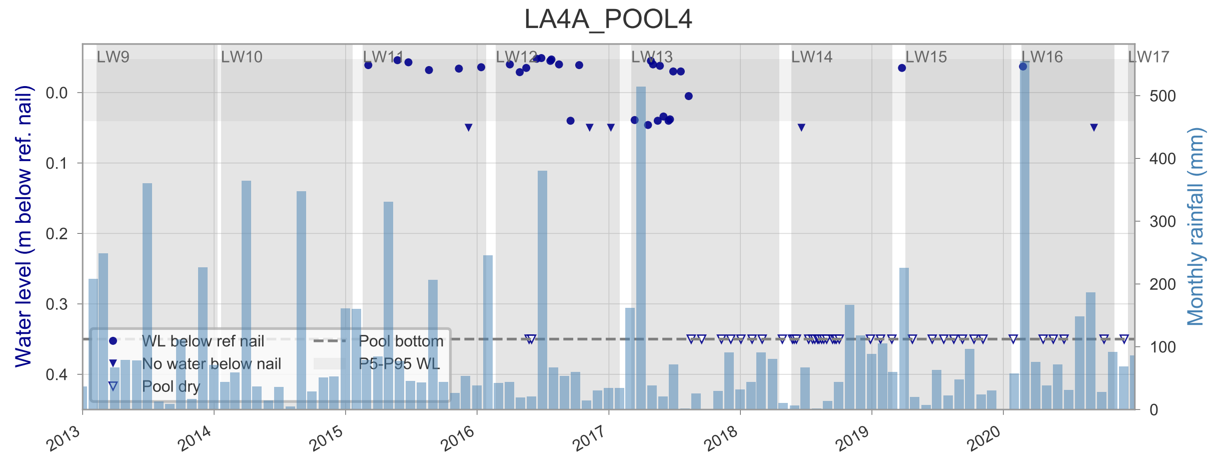

LA4A_POOL2
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

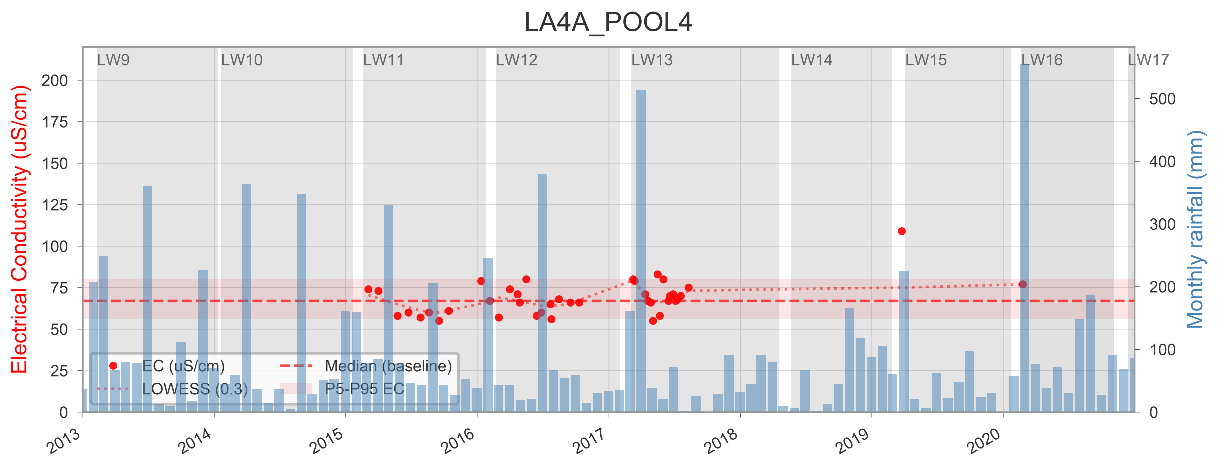

LA4A_POOL3
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

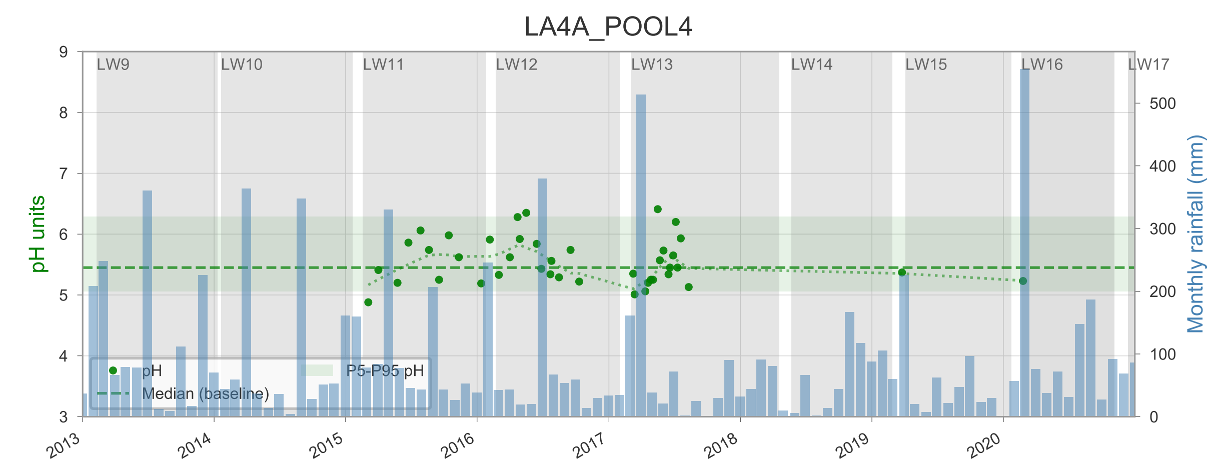

LA4A_POOL3
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

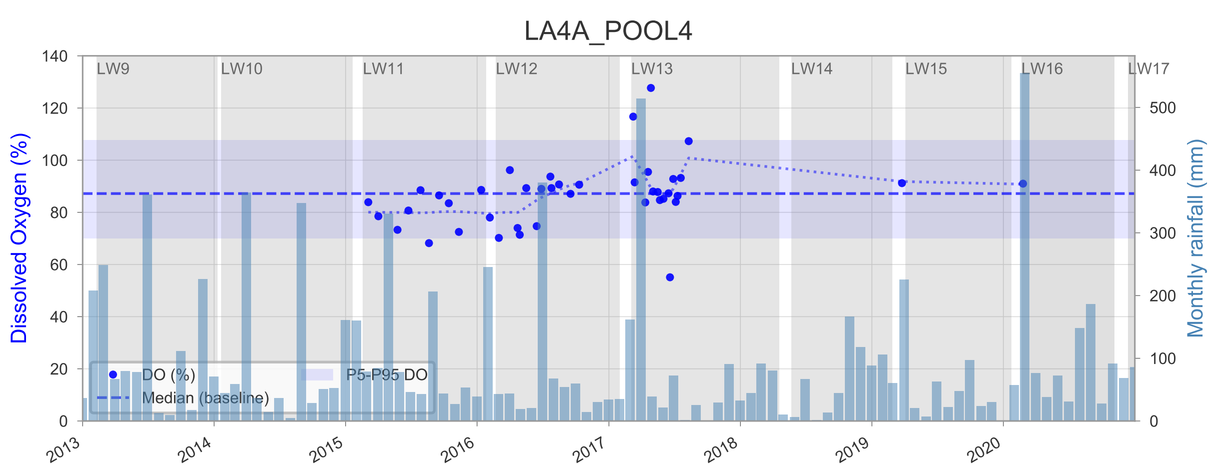

LA4A_POOL3
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

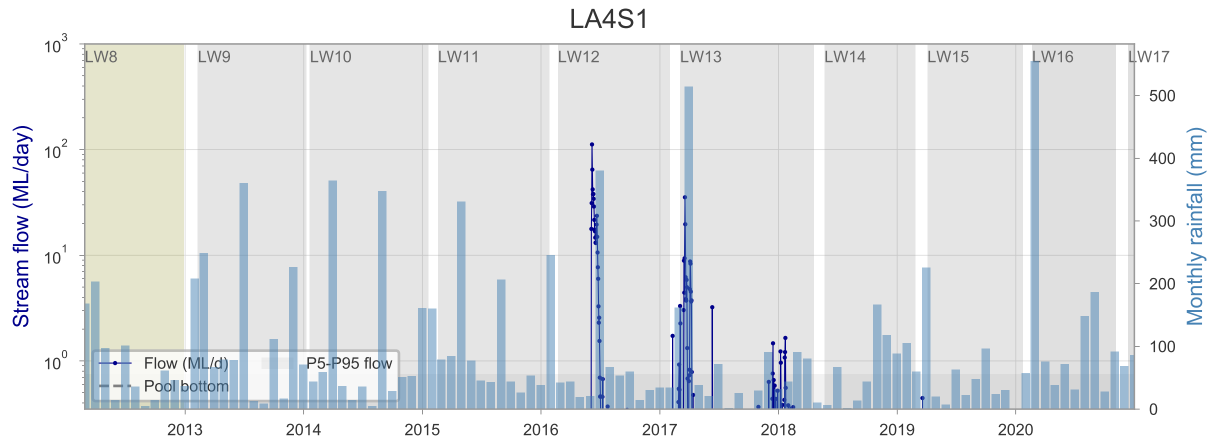

LA4A_POOL3
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

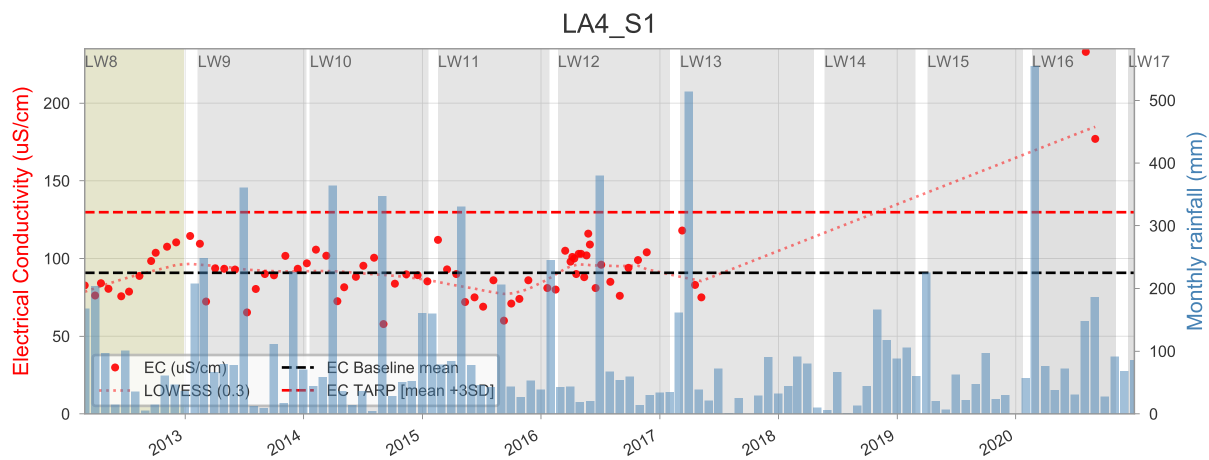

LA4A_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
0.0
0.1
0.2
0.3
0.4
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

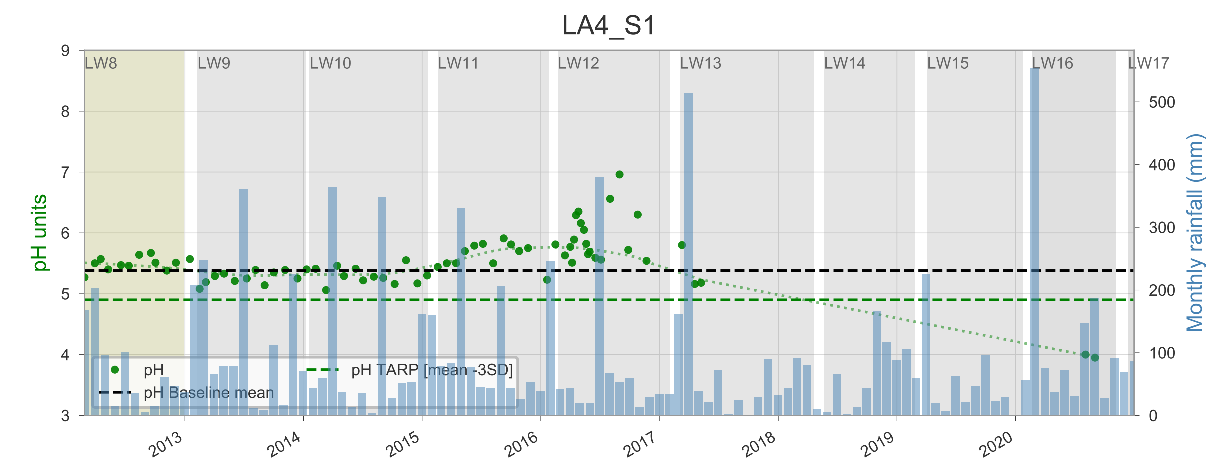

LA4A_POOL4
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

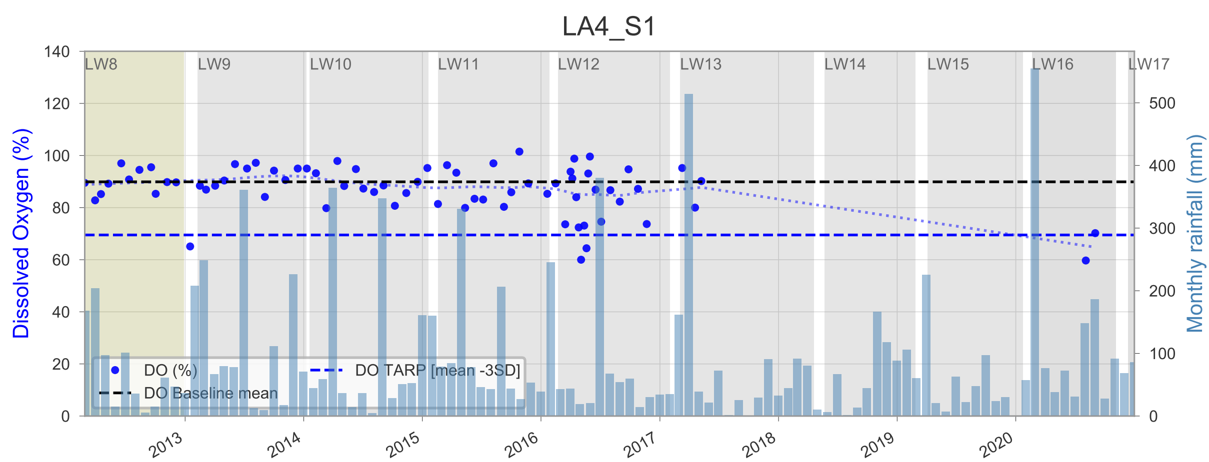

LA4A_POOL4
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

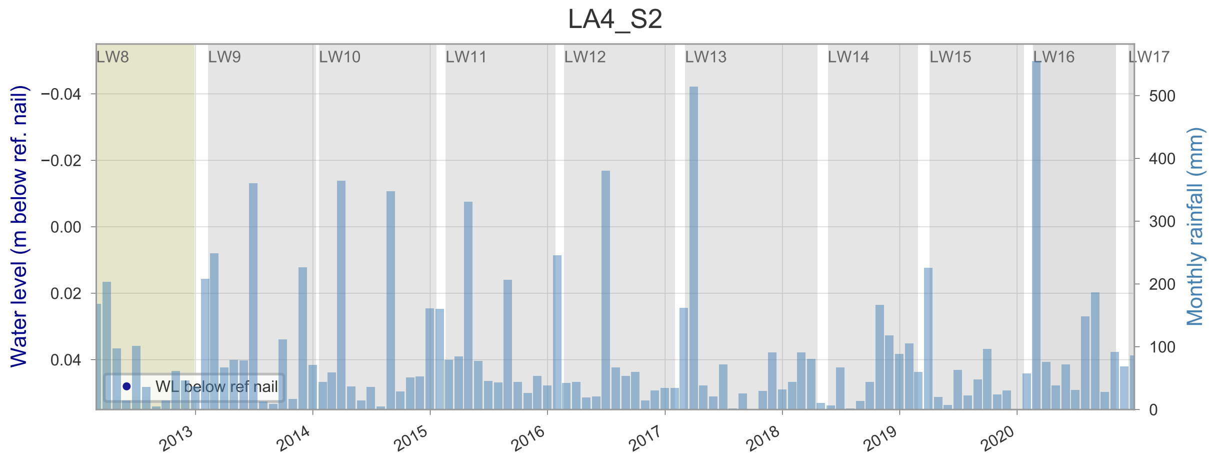

LA4A_POOL4
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020


LA4S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
Pool bottom
P5-P95 flow

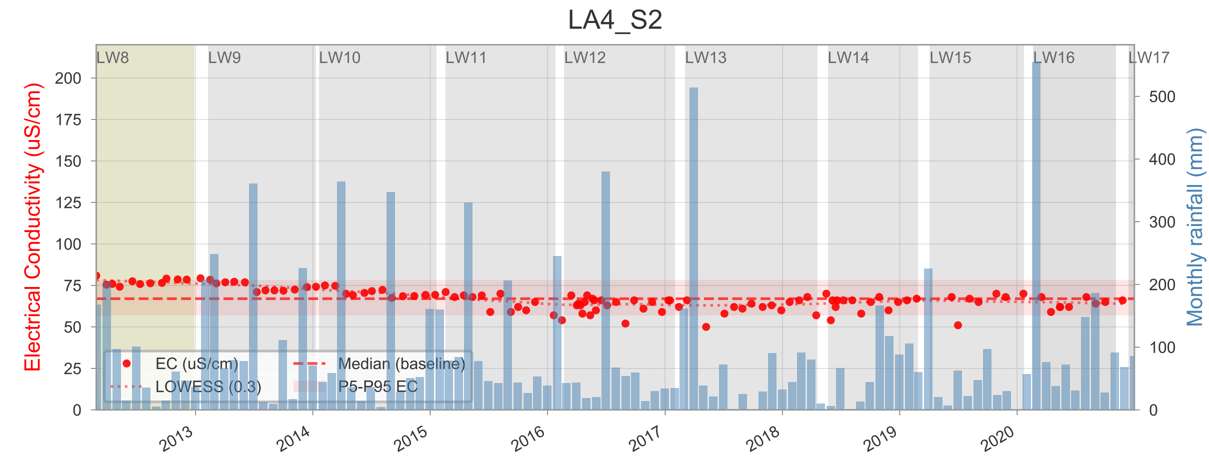

LA4_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]


LA4_S1
pH units
Monthly rainfall (mm)
pH
pH Baseline mean
pH TARP [mean -3SD]

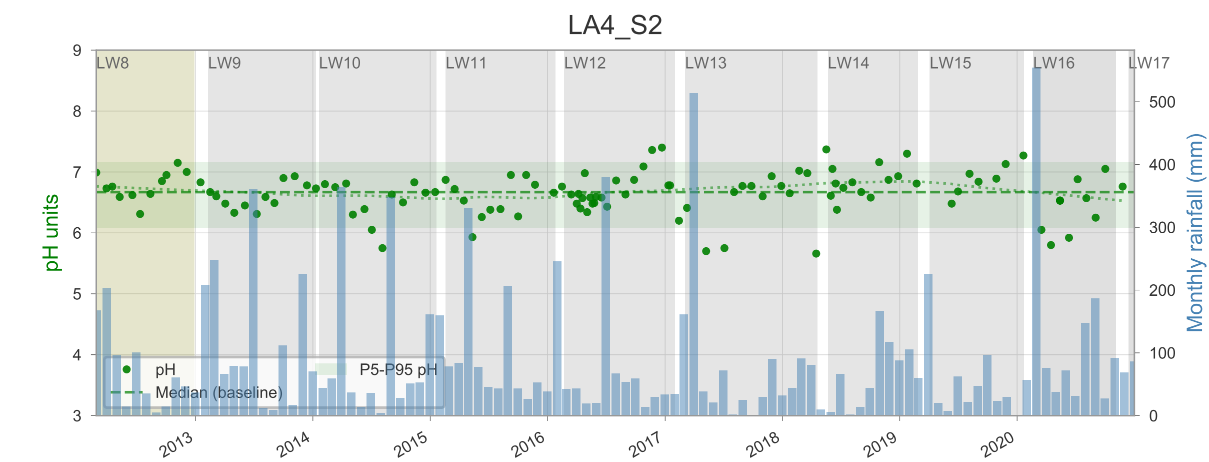

LA4_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
DO Baseline mean
DO TARP [mean -3SD]



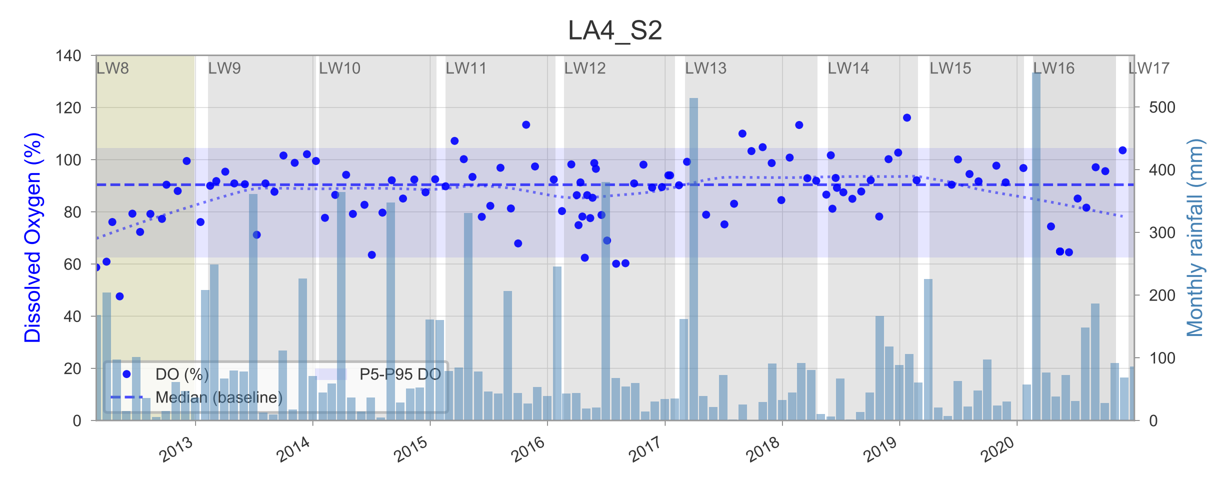
LA4_S2
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail



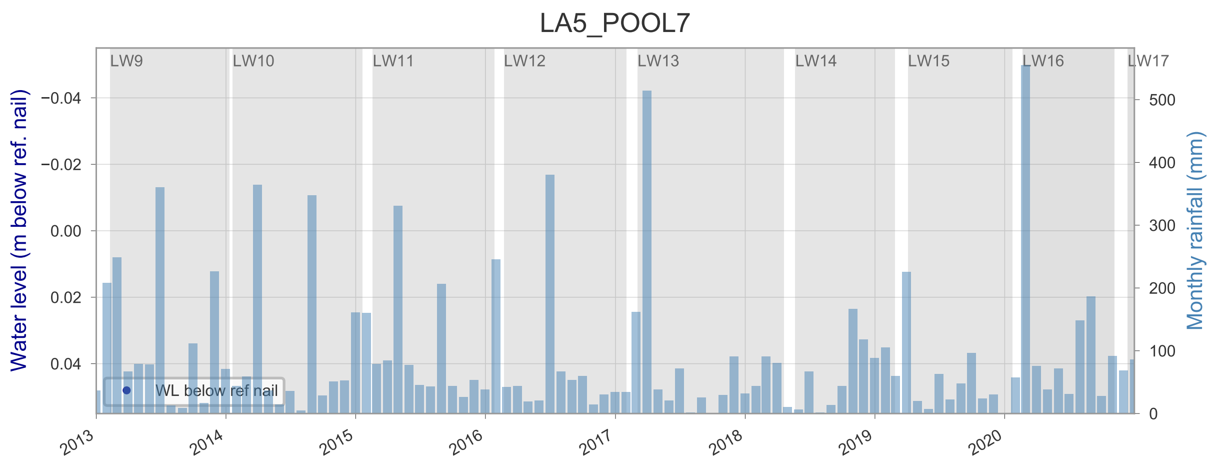
LA4_S2
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC



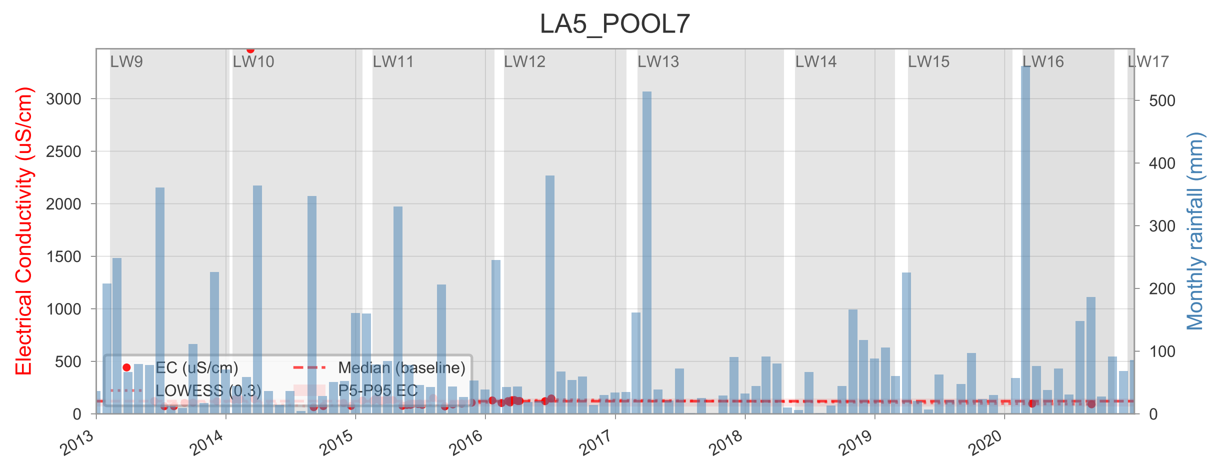
LA4_S2
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH



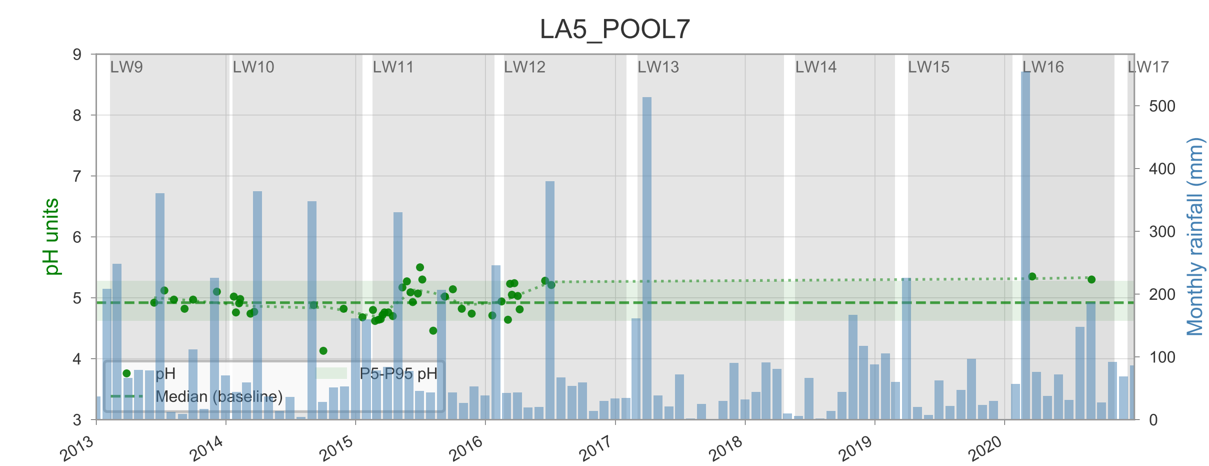
LA4_S2
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO



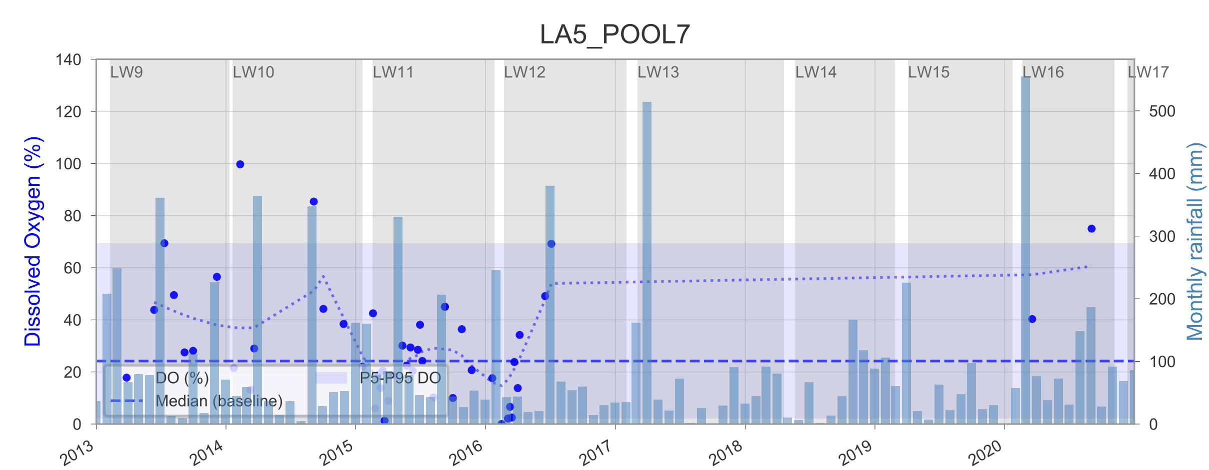
LA5_POOL7
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail



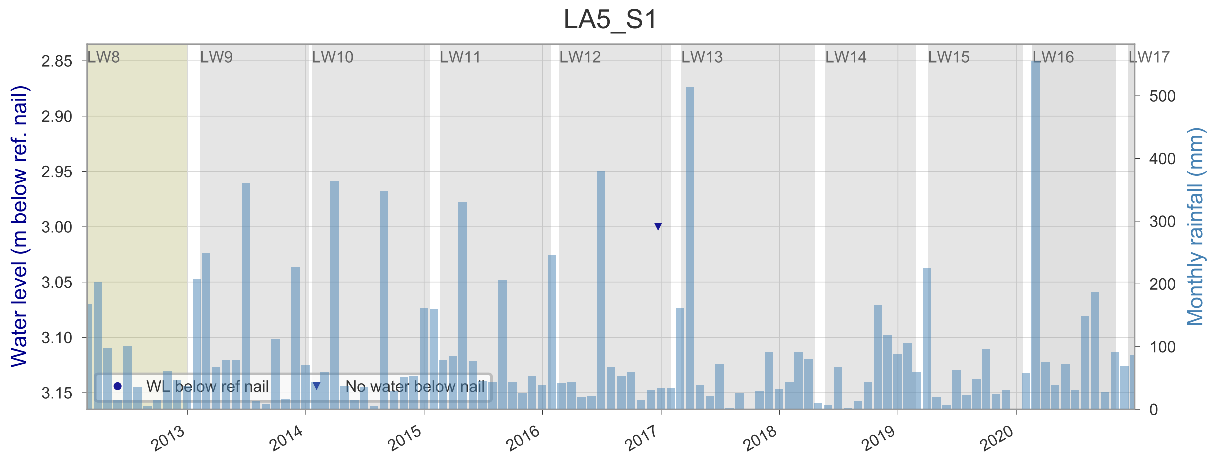
LA5_POOL7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

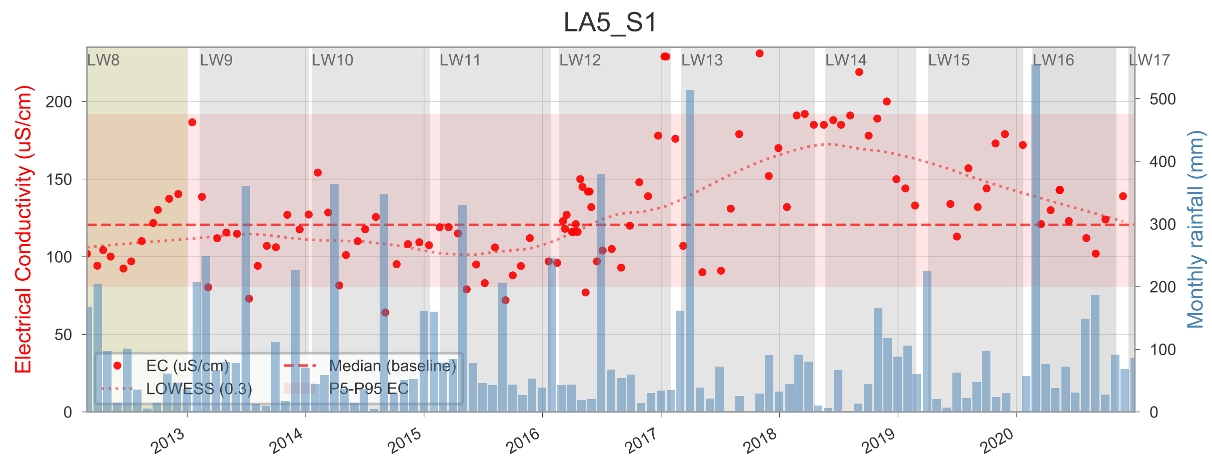


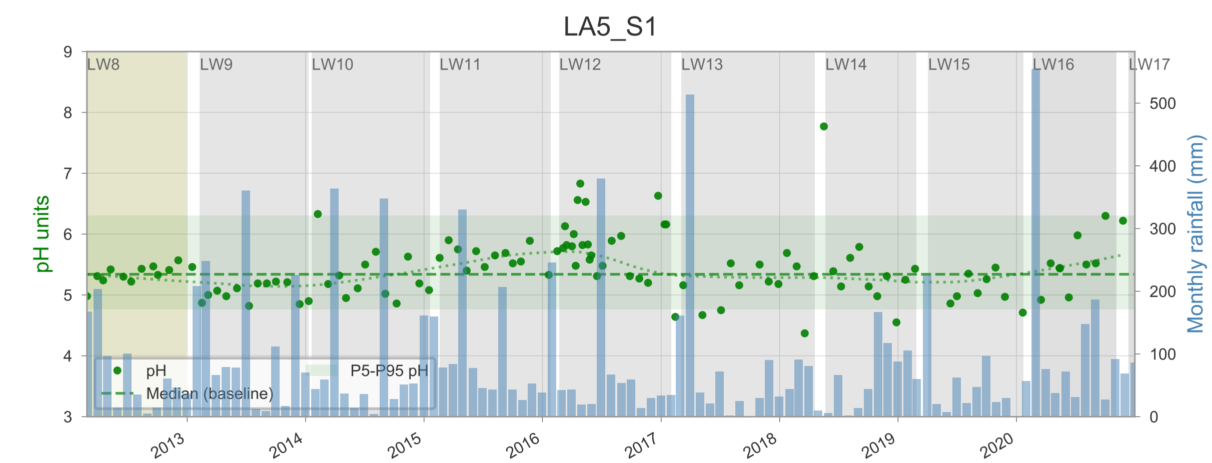
LA5_POOL7
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

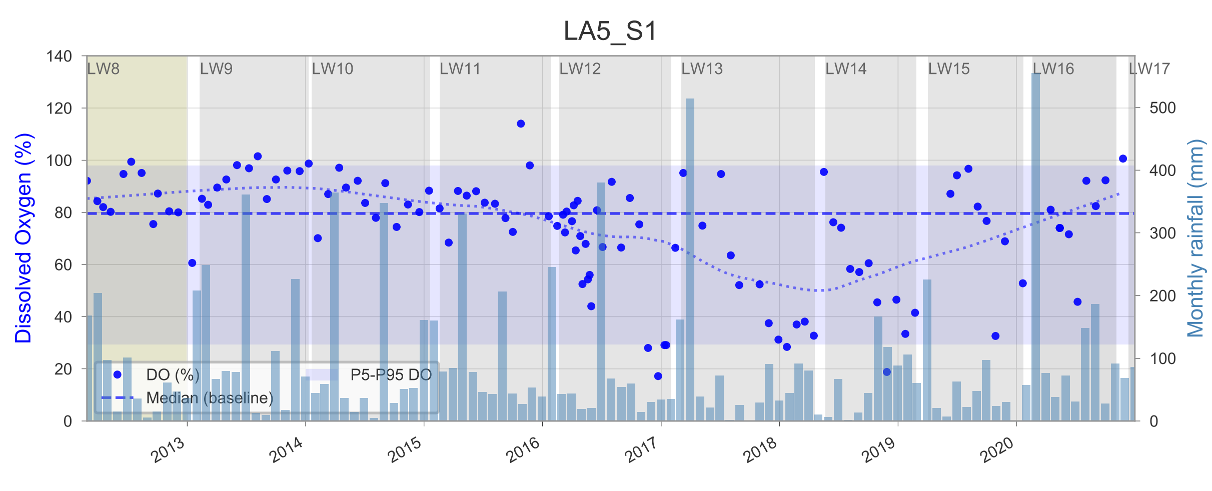


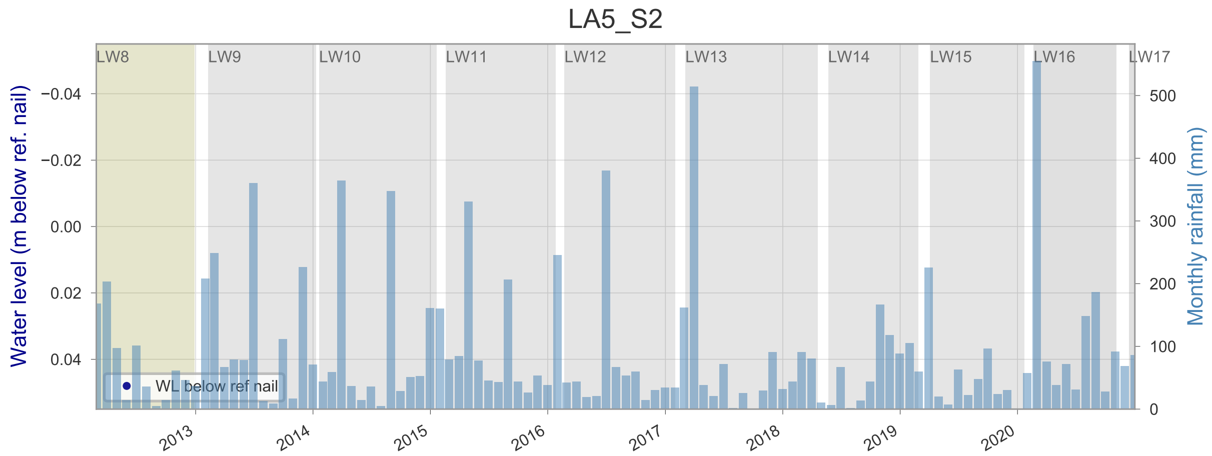
LA5_POOL7
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

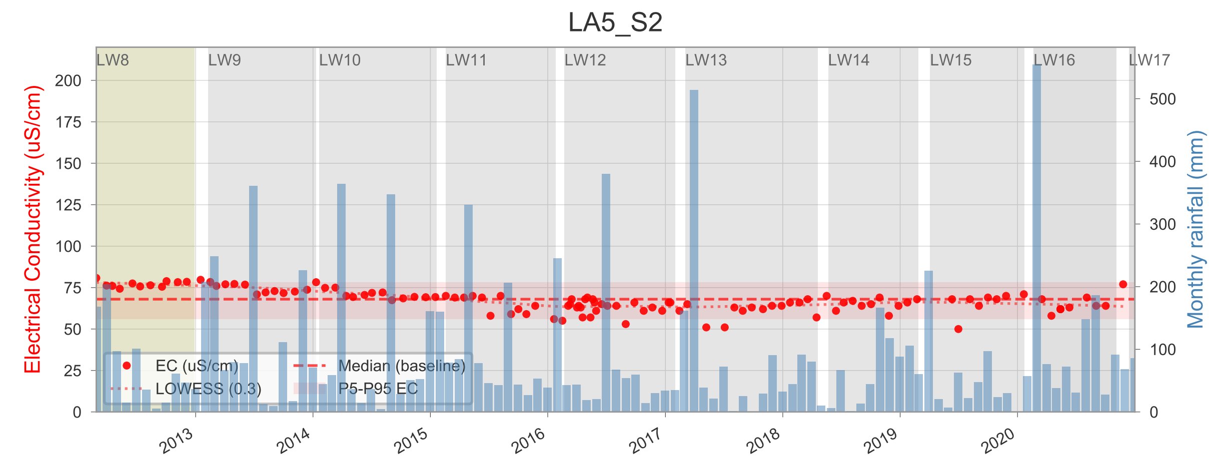

LA5_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail

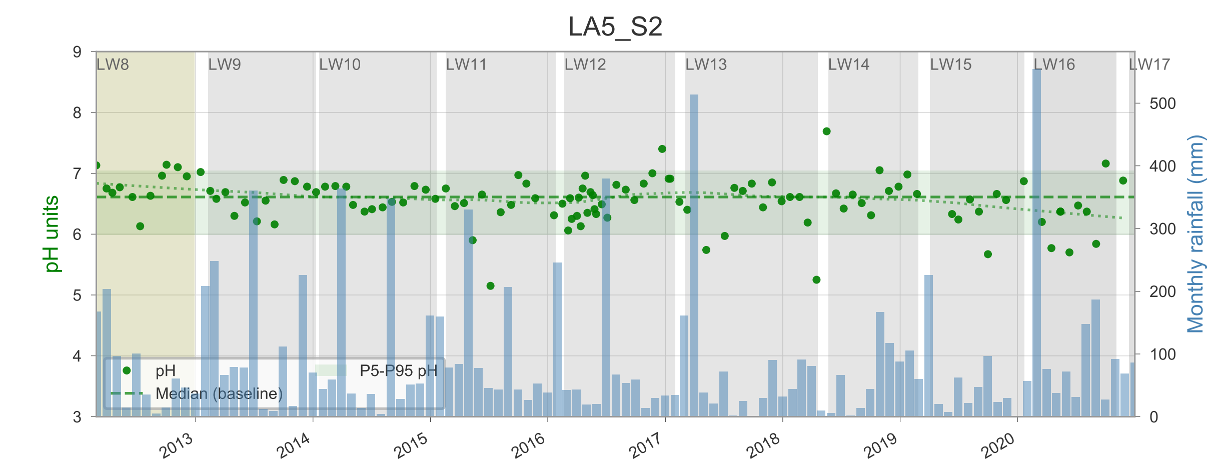

LA5_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

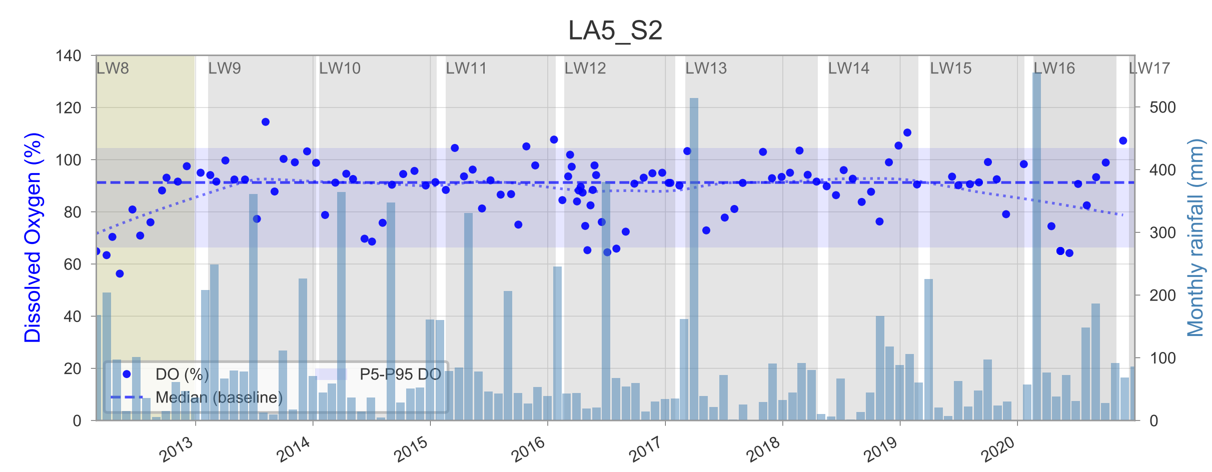

LA5_S1
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

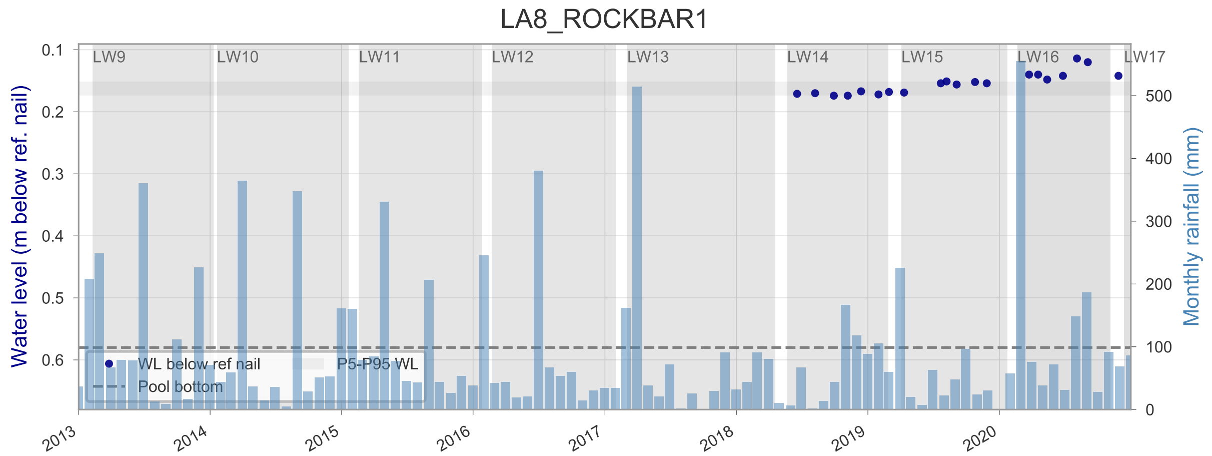

LA5_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

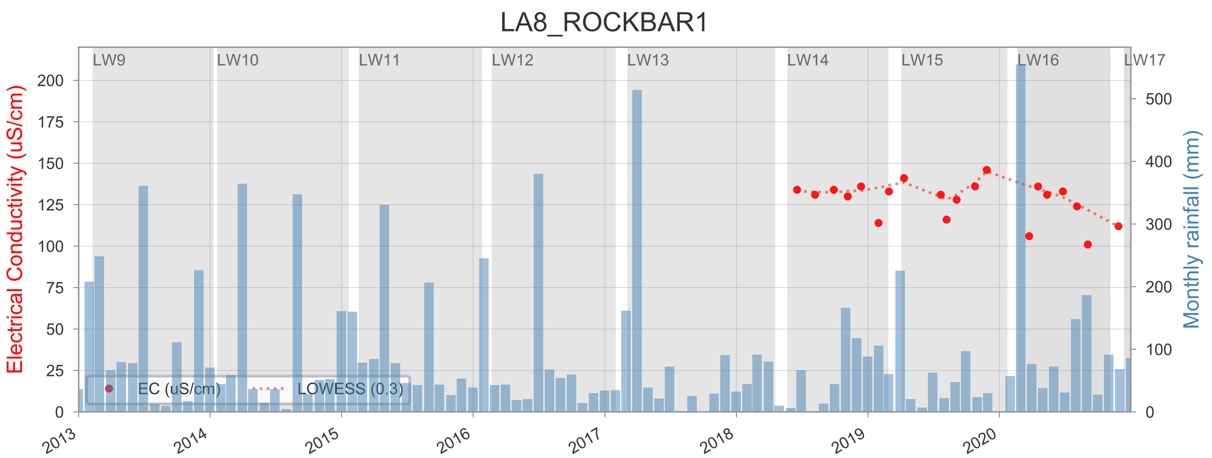

LA5_S2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
2013
2014
2015
2016
2017
2018
2019
2020

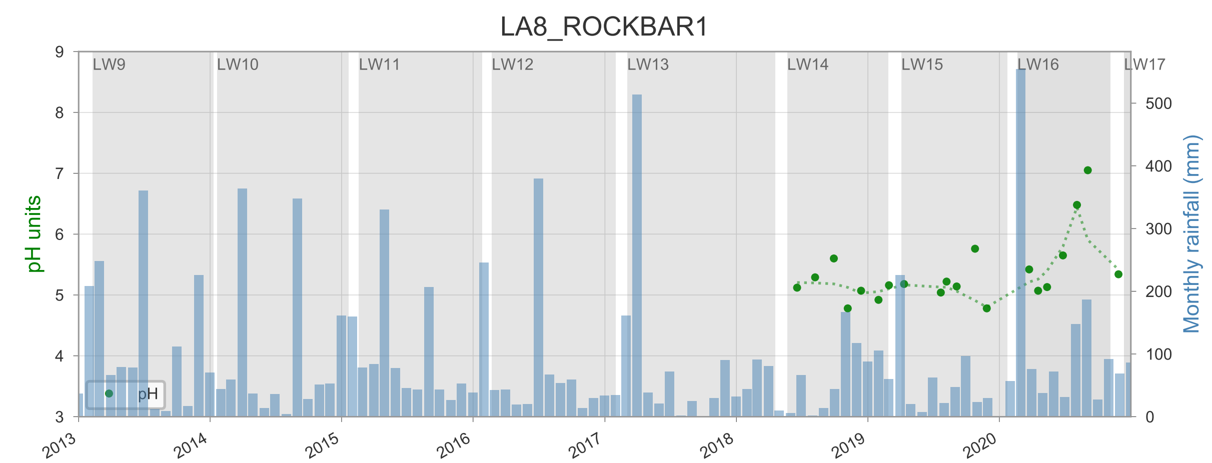

LA5_S2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

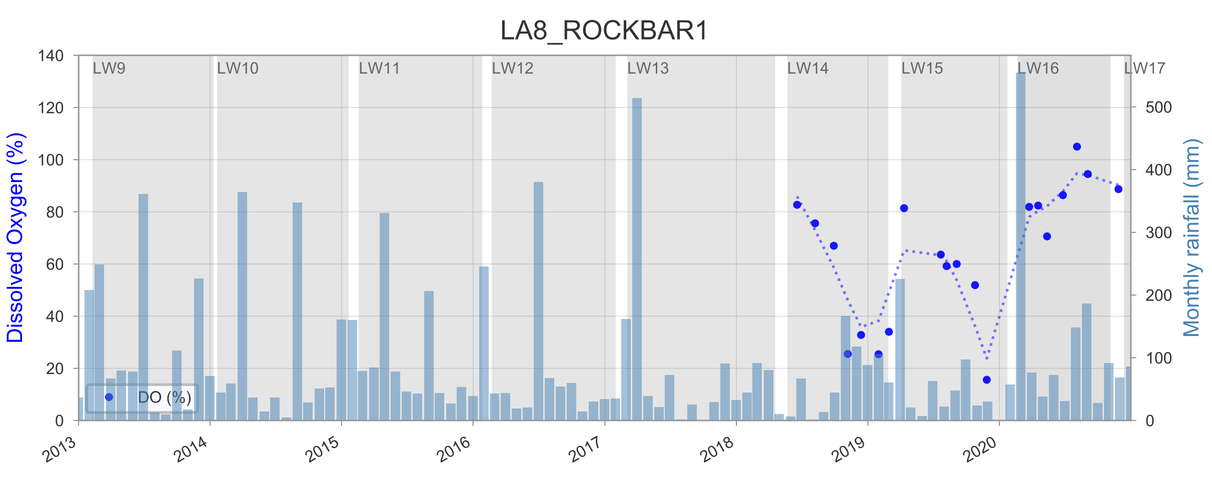

LA5_S2
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

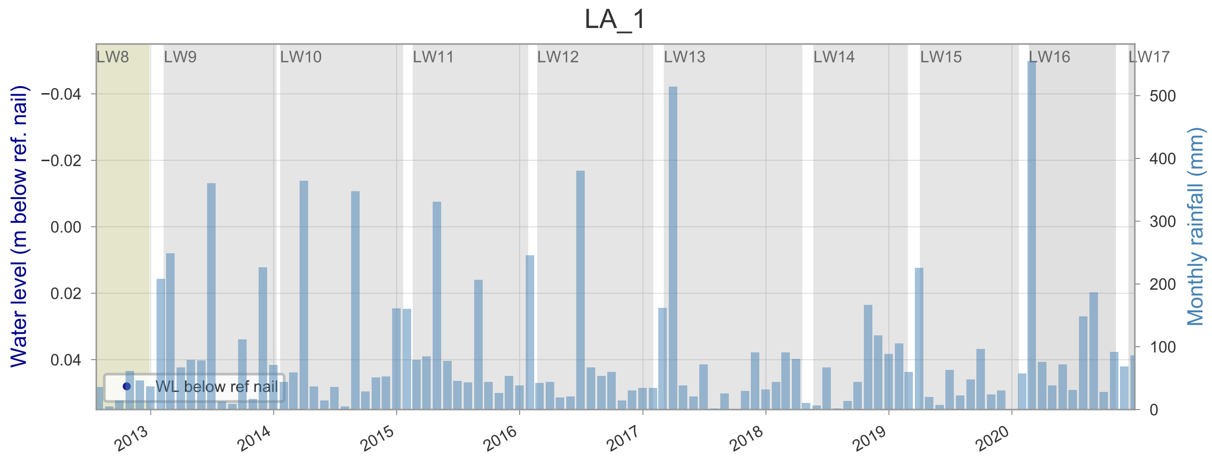

LA5_S2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

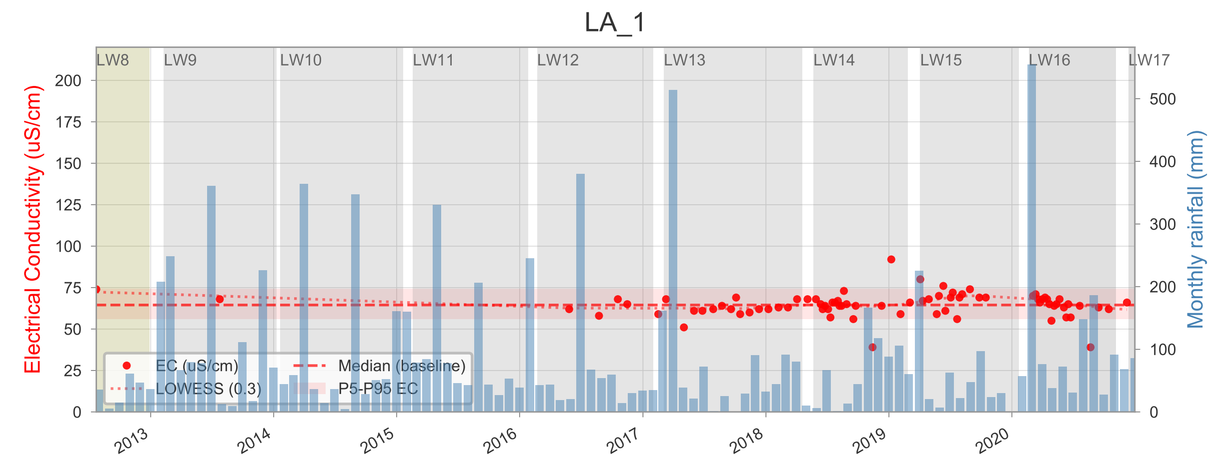

LA8_ROCKBAR1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom
2013
2014
2015
2016
2017
2018
2019
2020

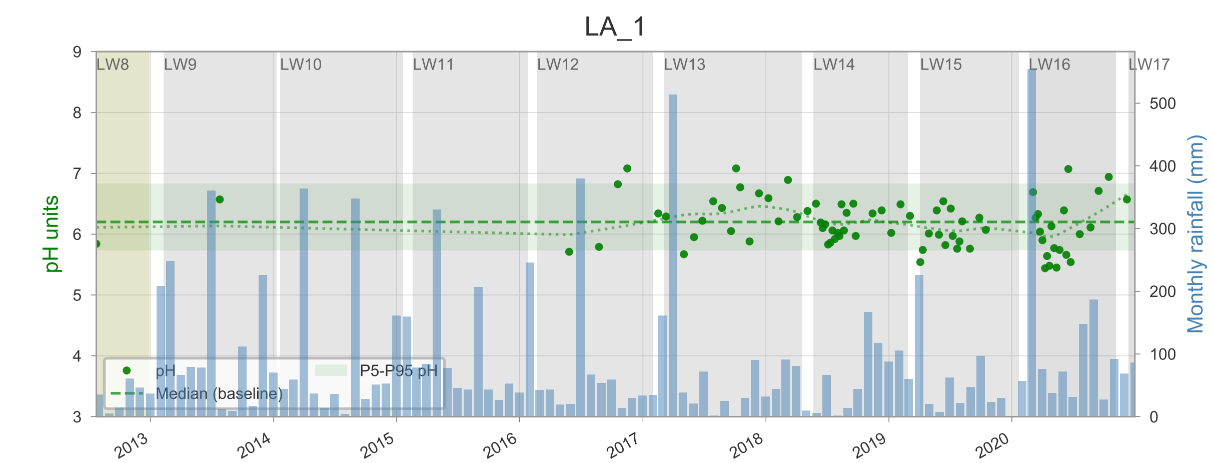

LA8_ROCKBAR1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020

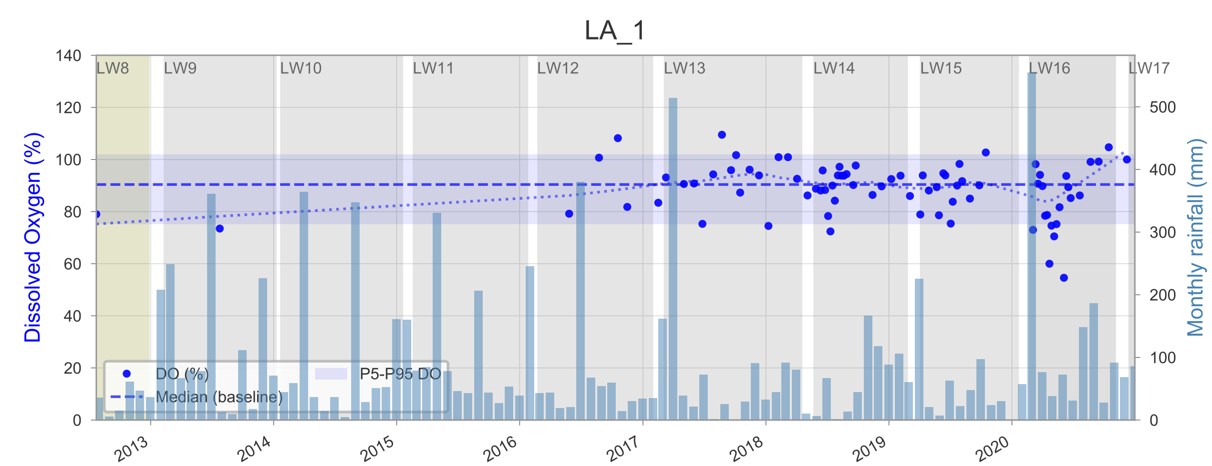

LA8_ROCKBAR1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
2013
2014
2015
2016
2017
2018
2019
2020

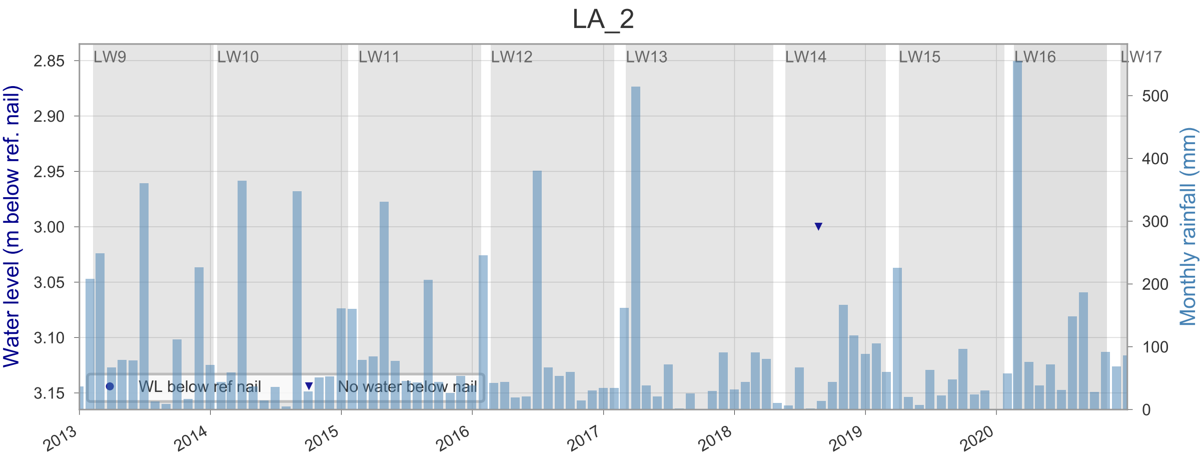

LA8_ROCKBAR1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020


LA_1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
2013
2014
2015
2016
2017
2018
2019
2020

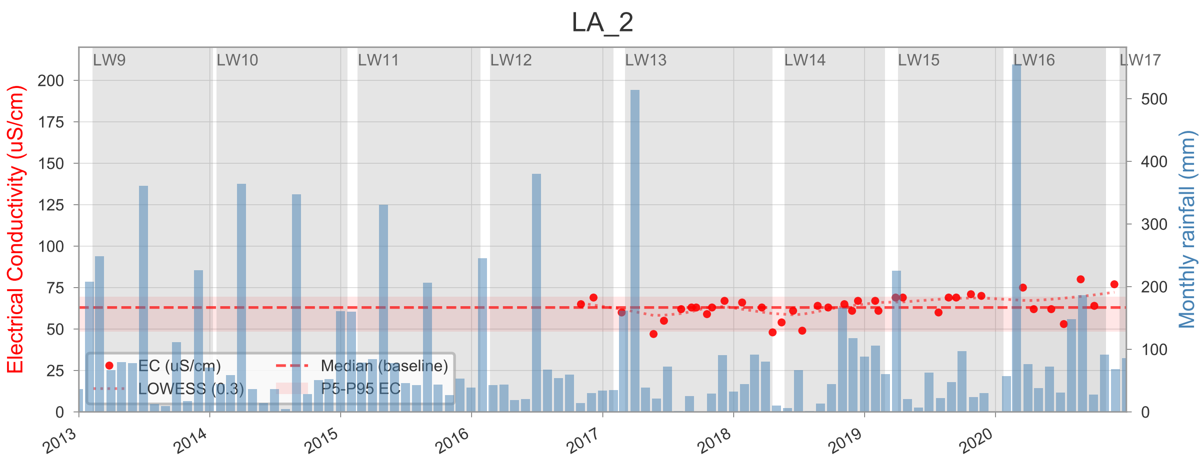

LA_1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020


LA_1
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

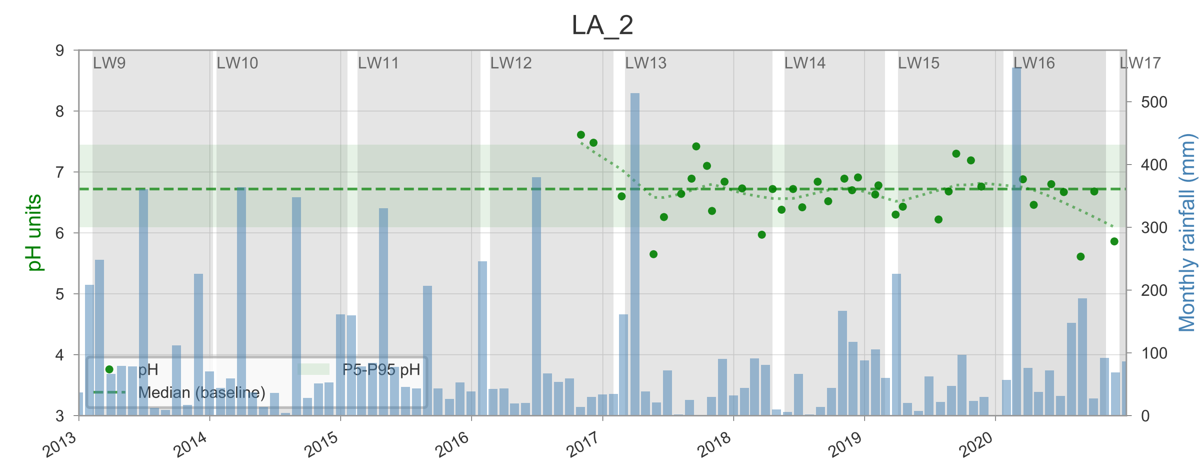

LA_1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020



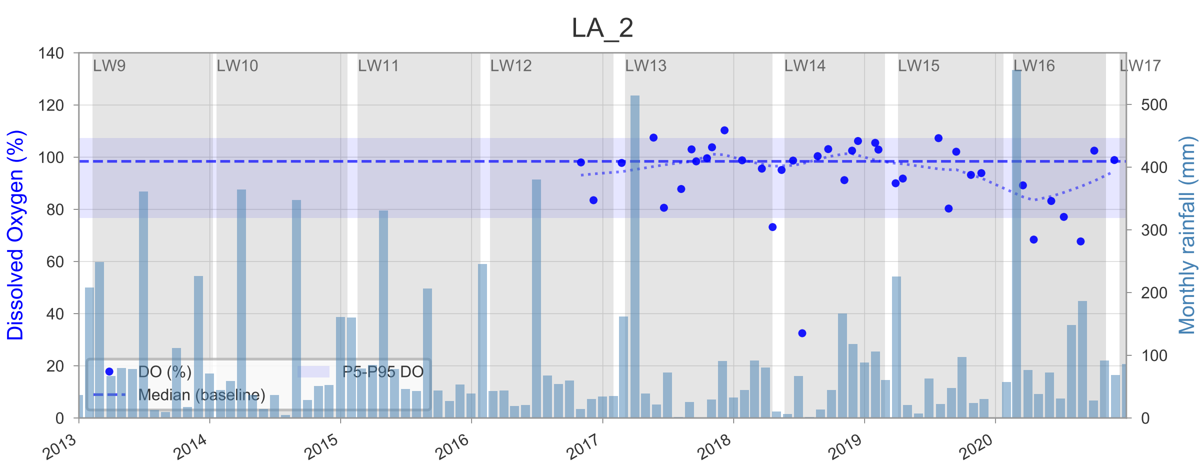
LA_2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail



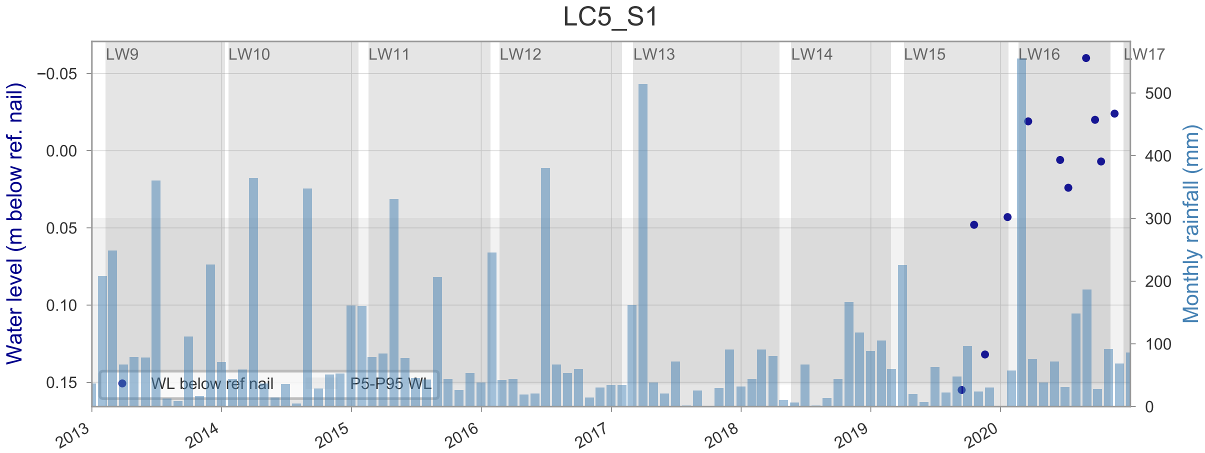
LA_2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

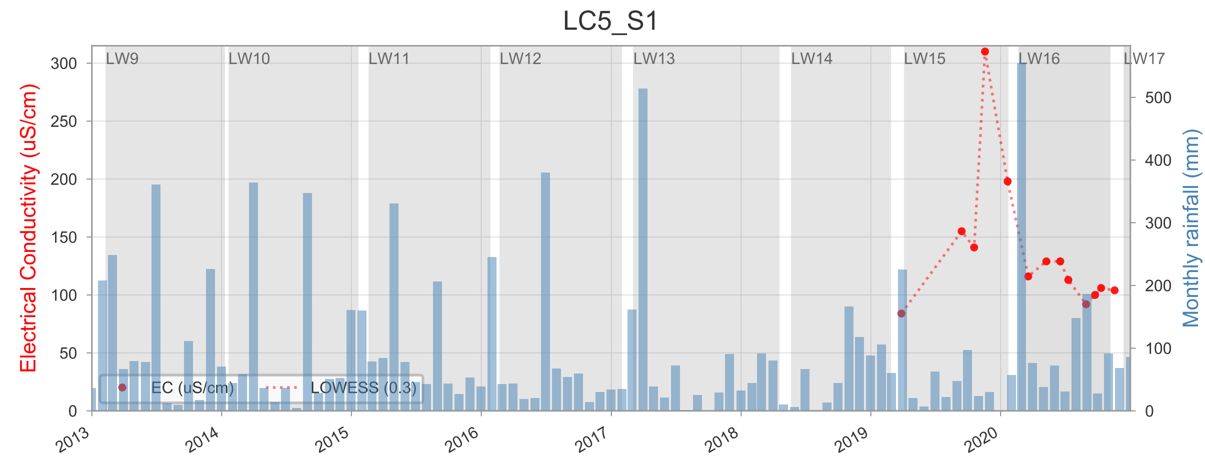


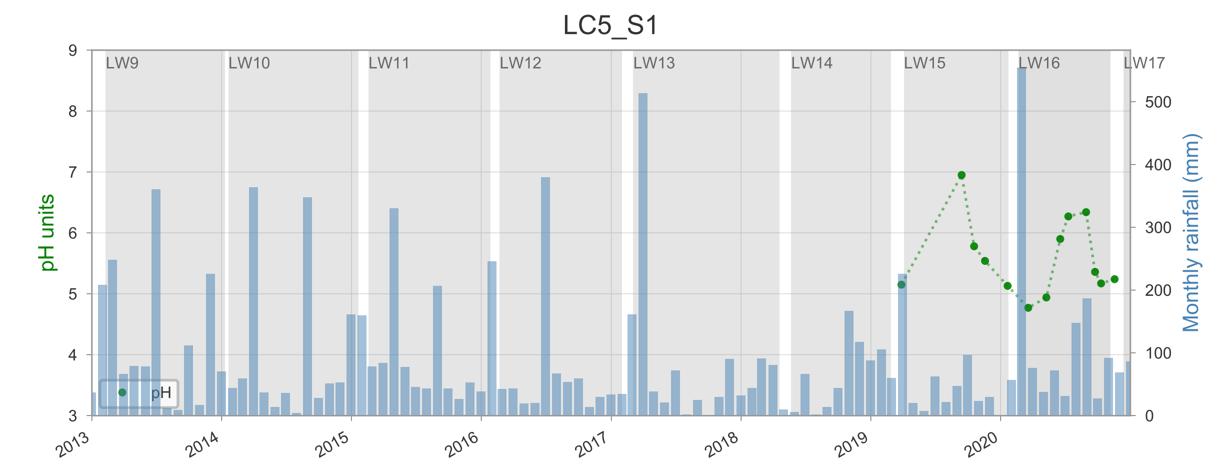
LA_2
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

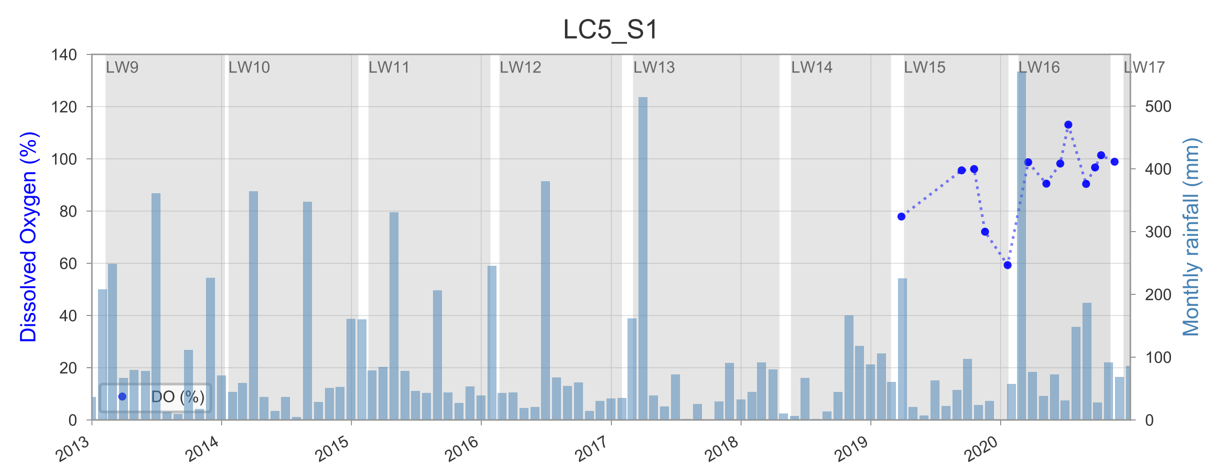


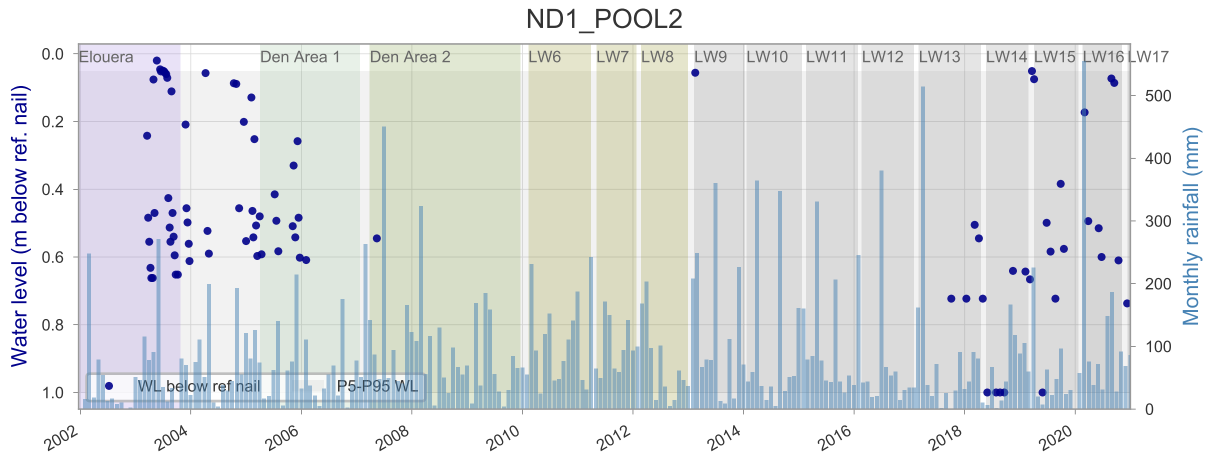
LA_2
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

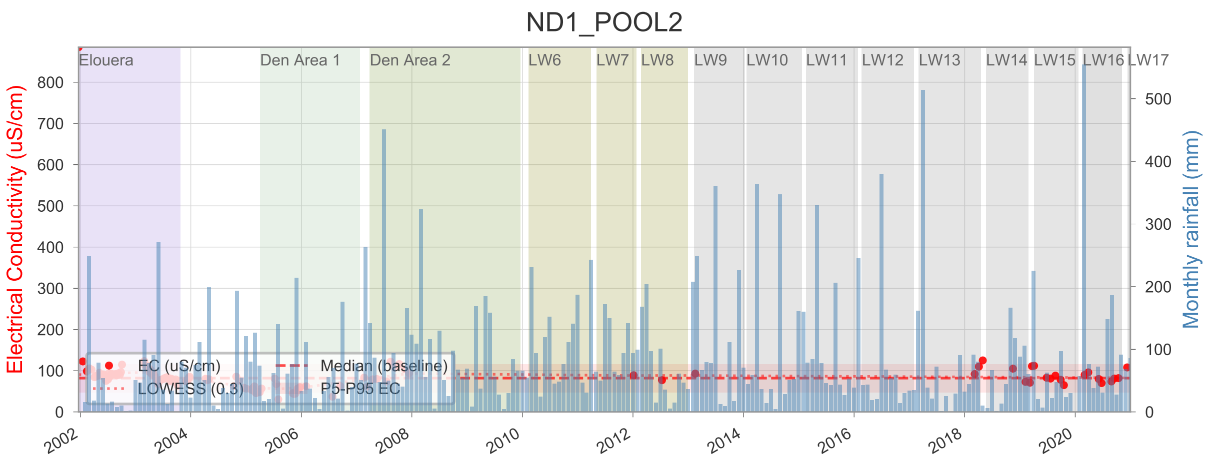

LC5_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
−0.05
0.00
0.05
0.10
0.15
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

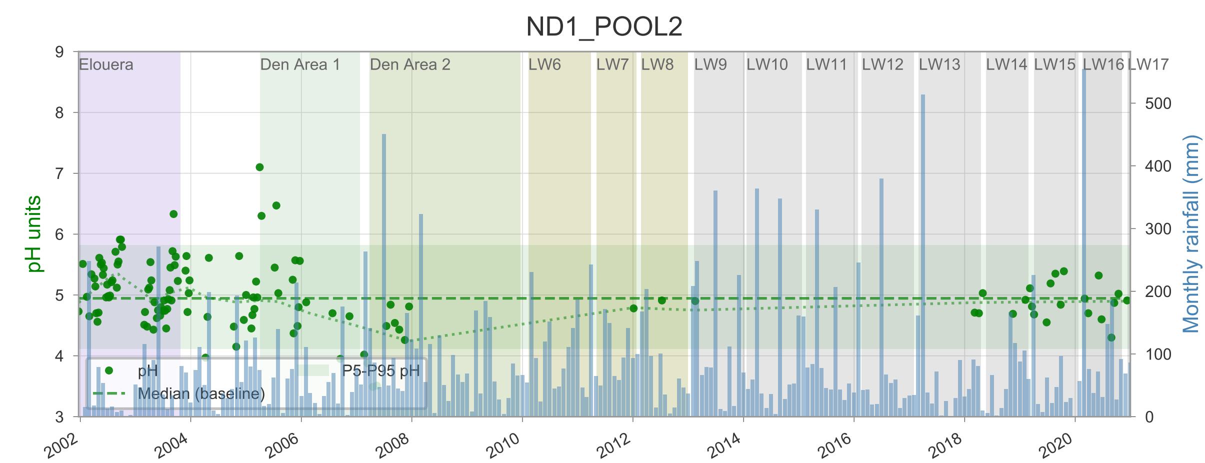

LC5_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
0
50
100
150
200
250
300
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

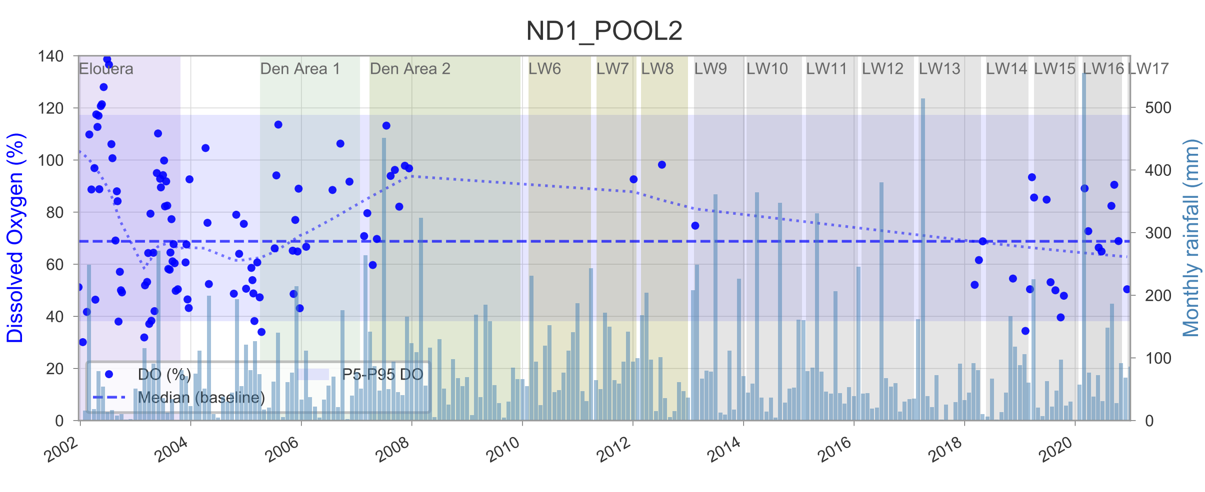

LC5_S1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

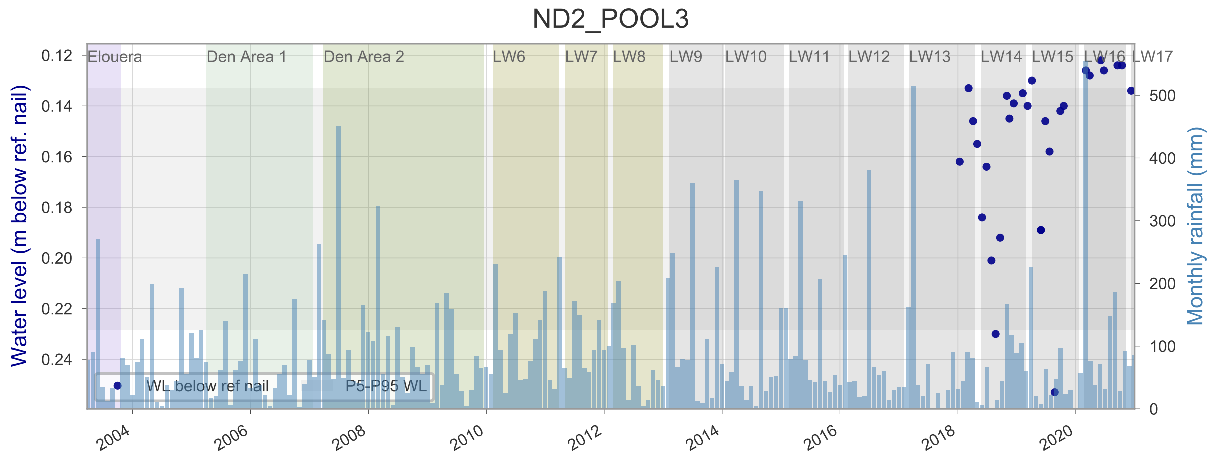

LC5_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

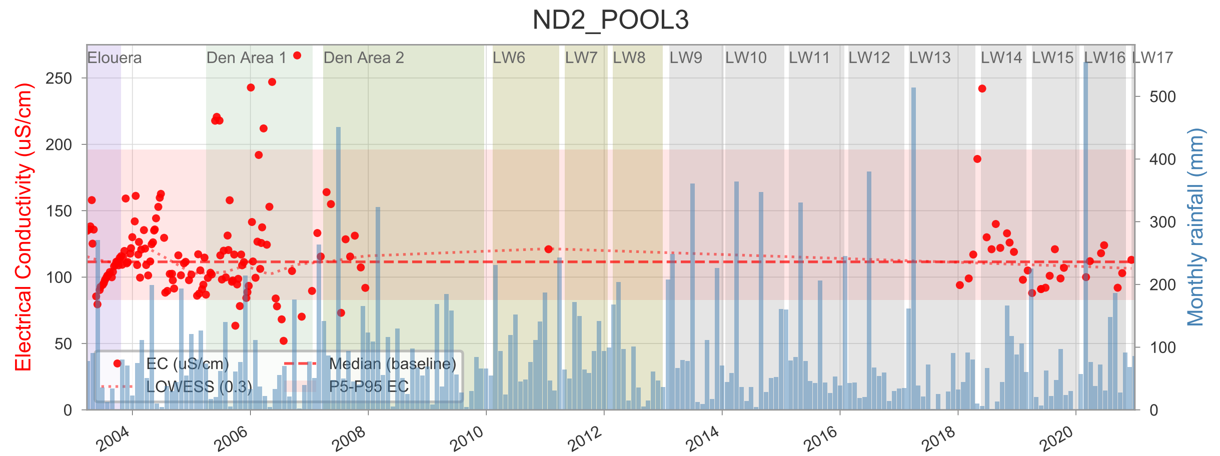

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

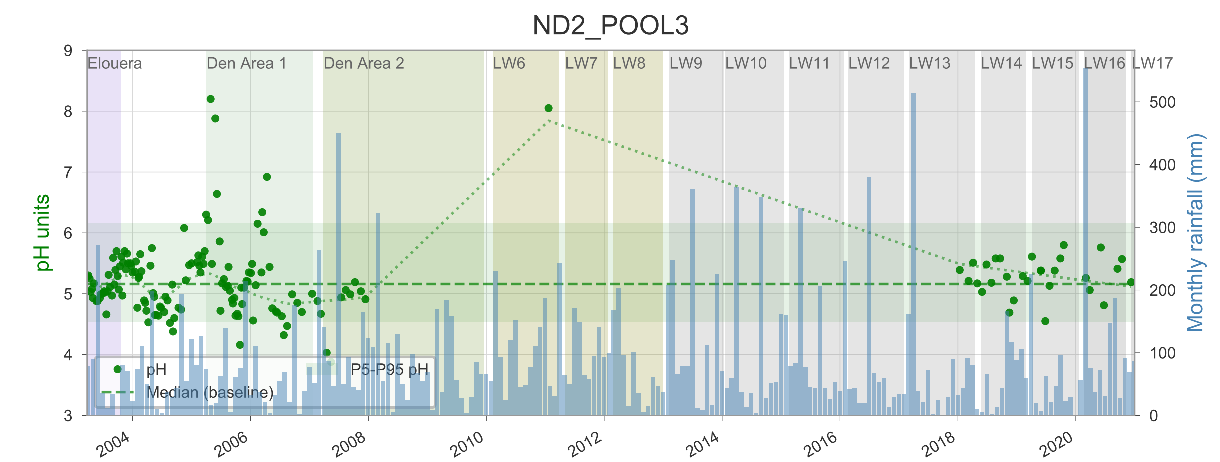

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

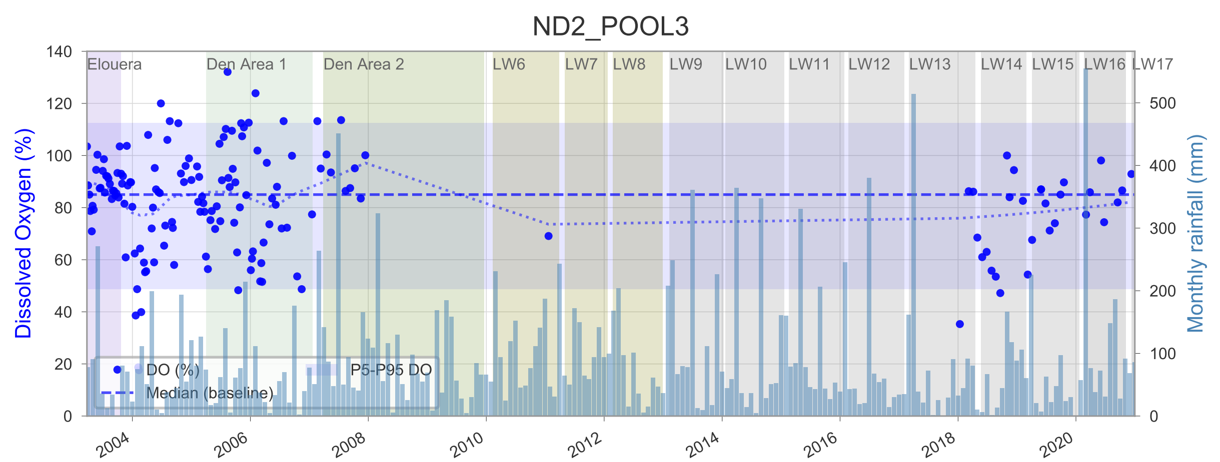

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

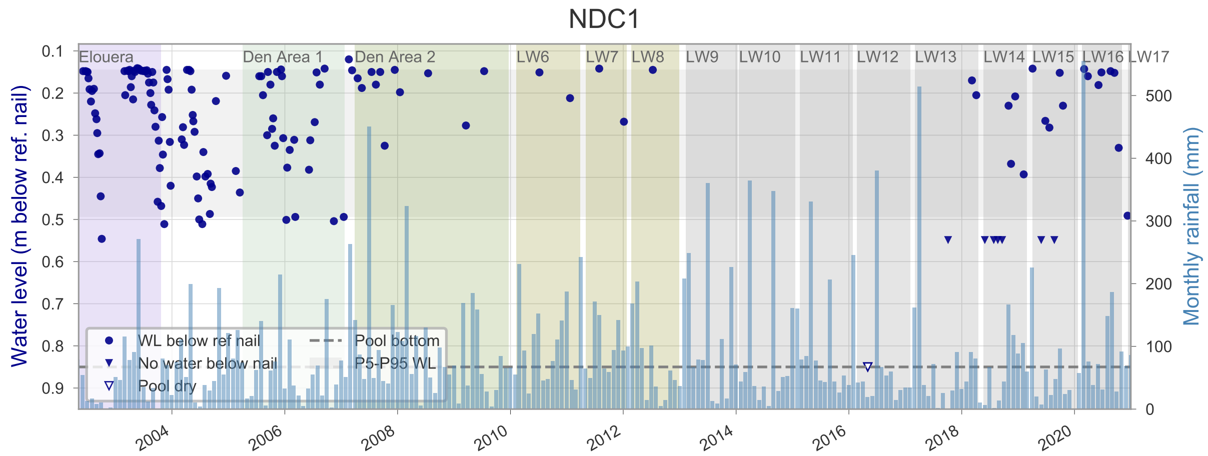

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

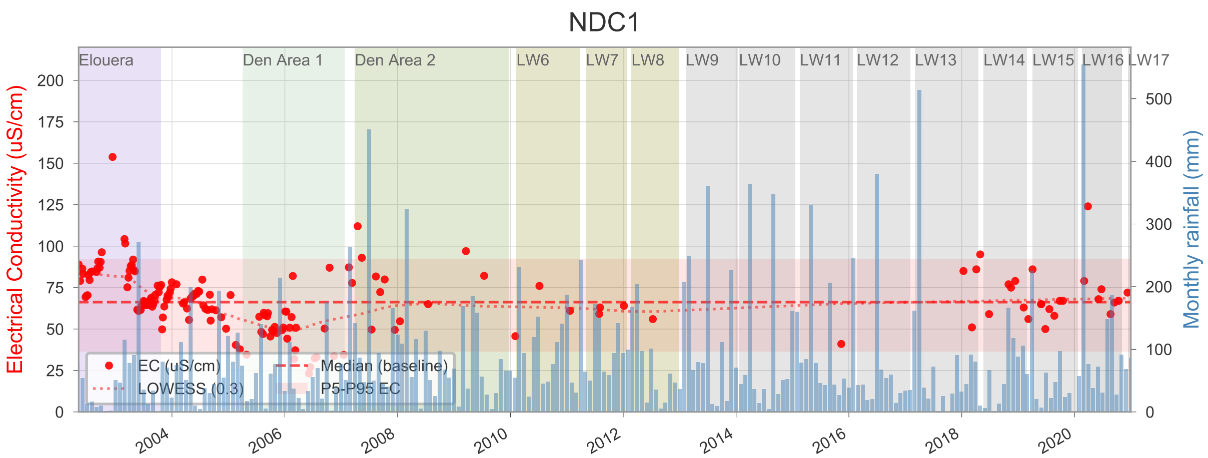

ND2_POOL3
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

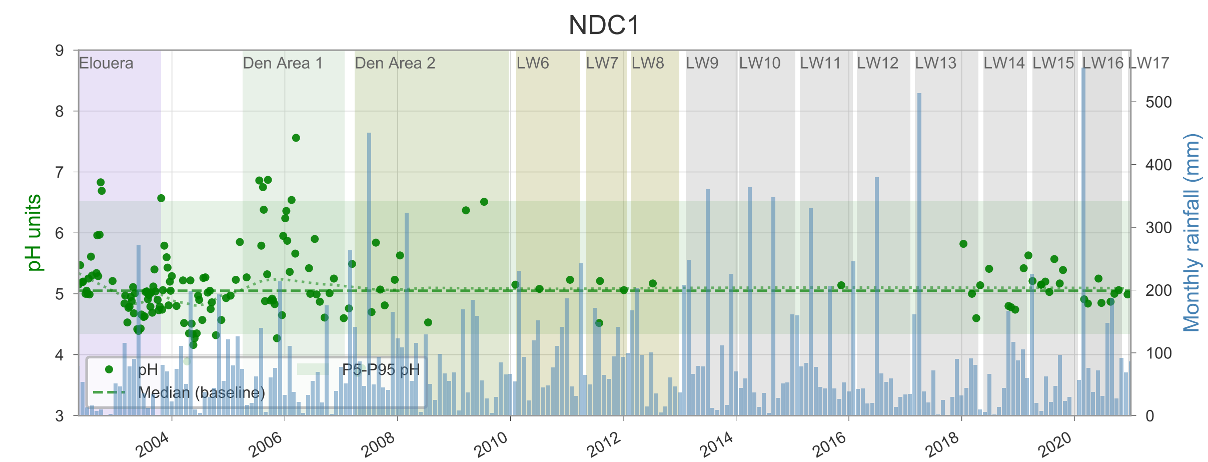

ND2_POOL3
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

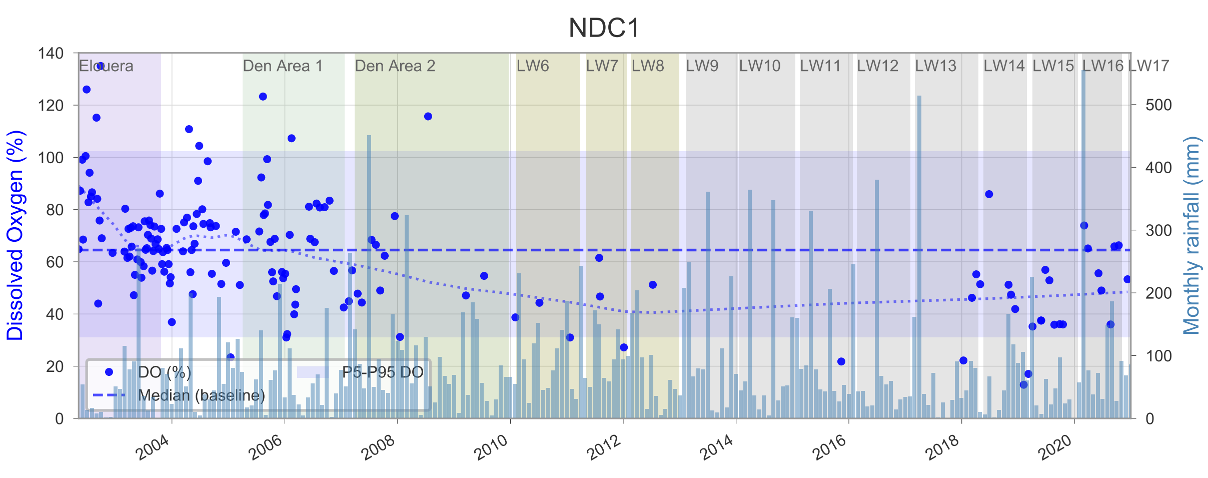

ND2_POOL3
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

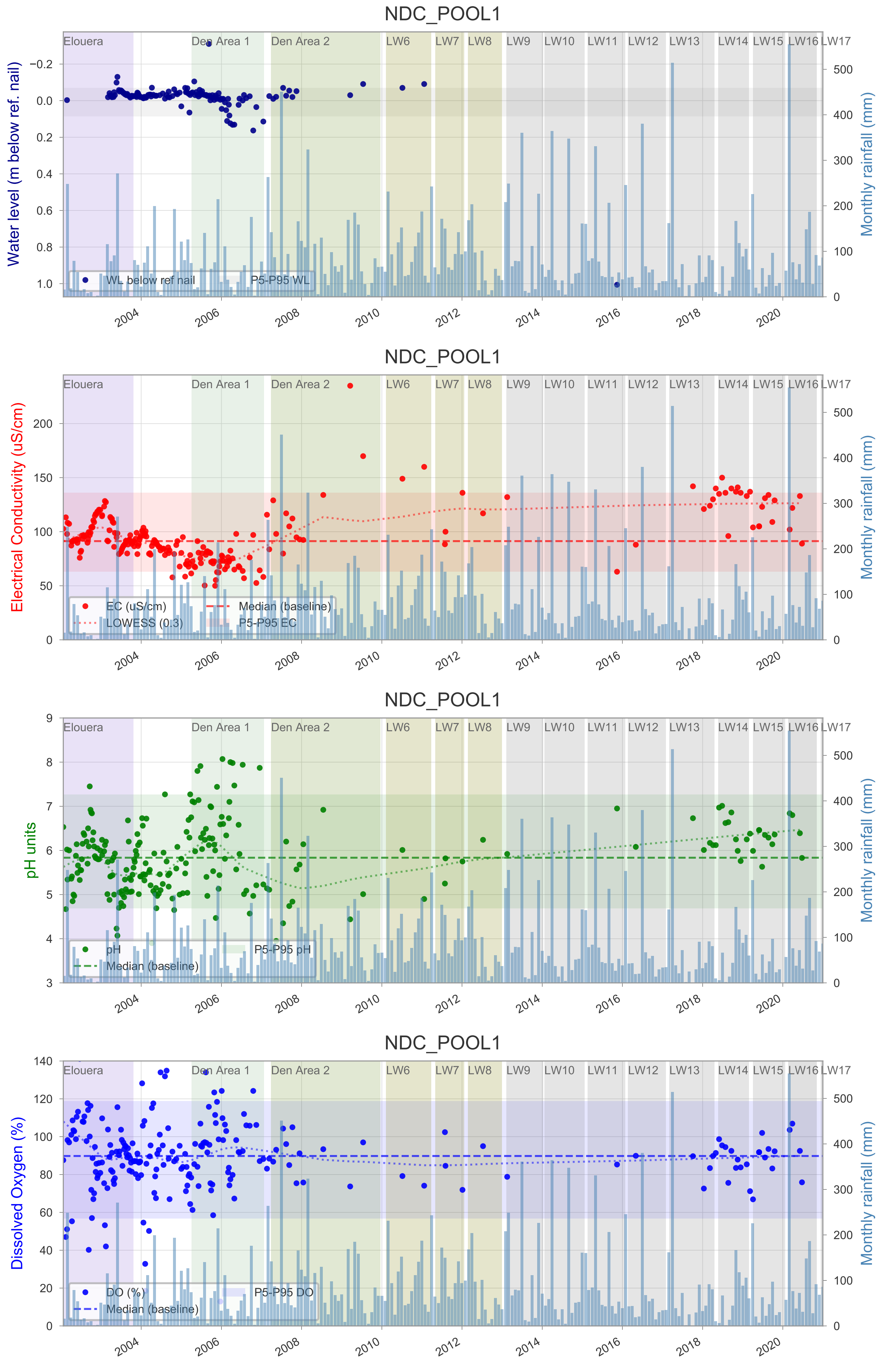

ND2_POOL3
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

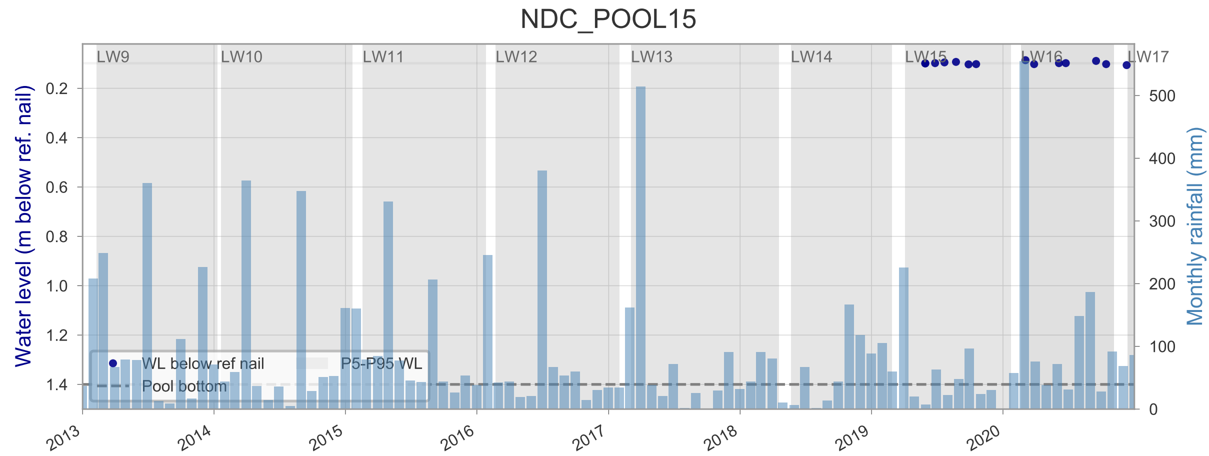

NDC1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2004
2006
2008
2010
2012
2014
2016
2018
2020

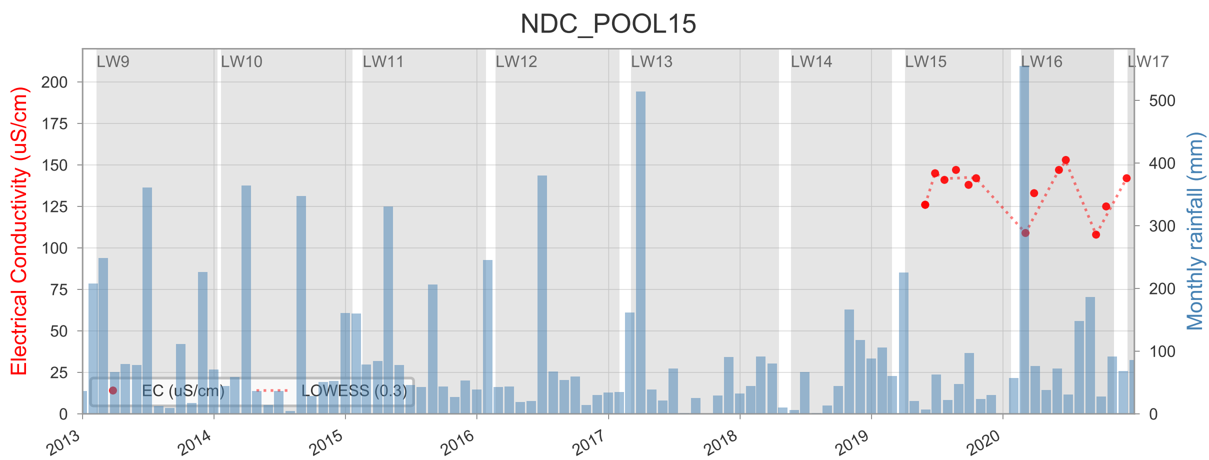

NDC1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2004
2006
2008
2010
2012
2014
2016
2018
2020

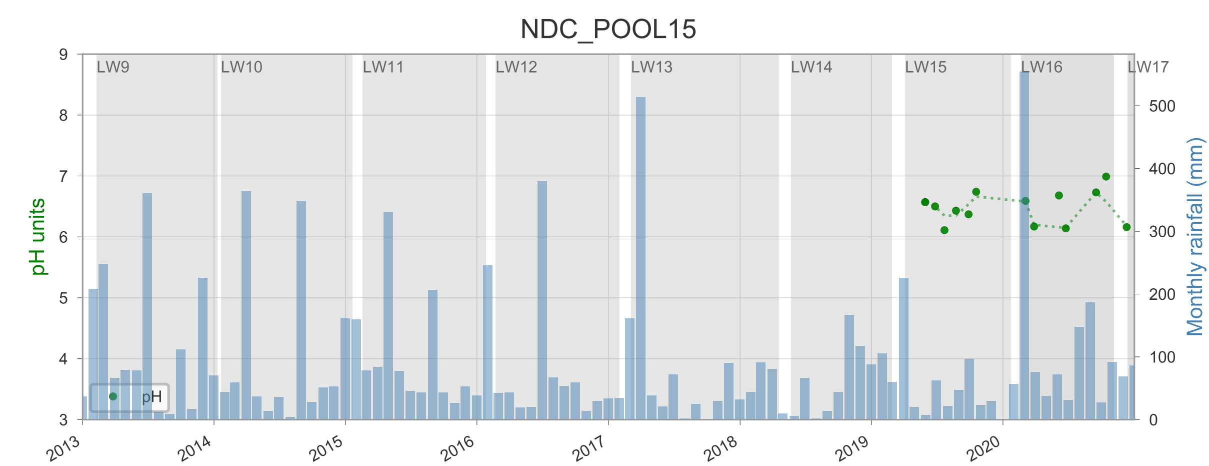

NDC1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2004
2006
2008
2010
2012
2014
2016
2018
2020

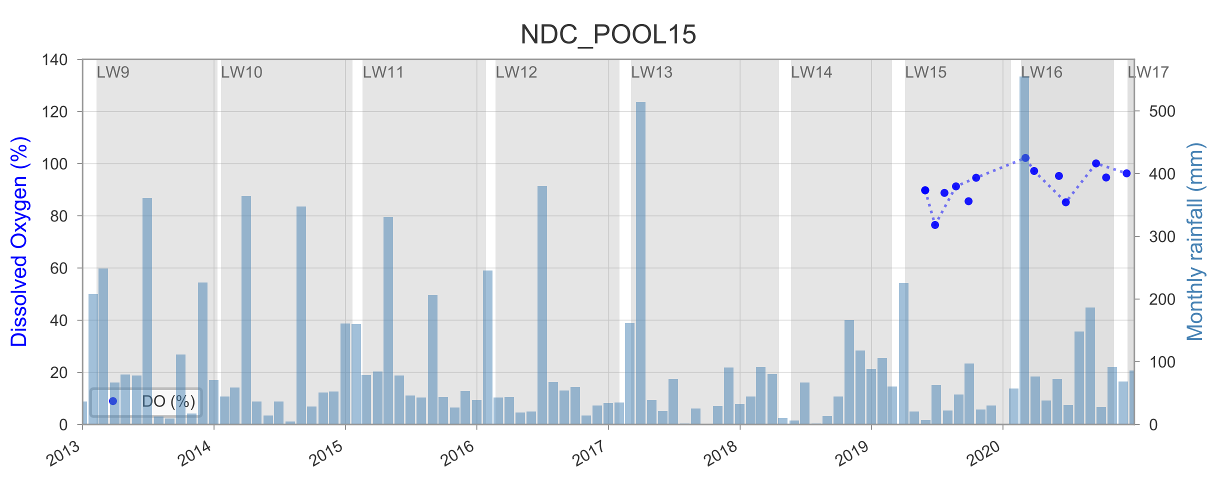

NDC1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2004
2006
2008
2010
2012
2014
2016
2018
2020

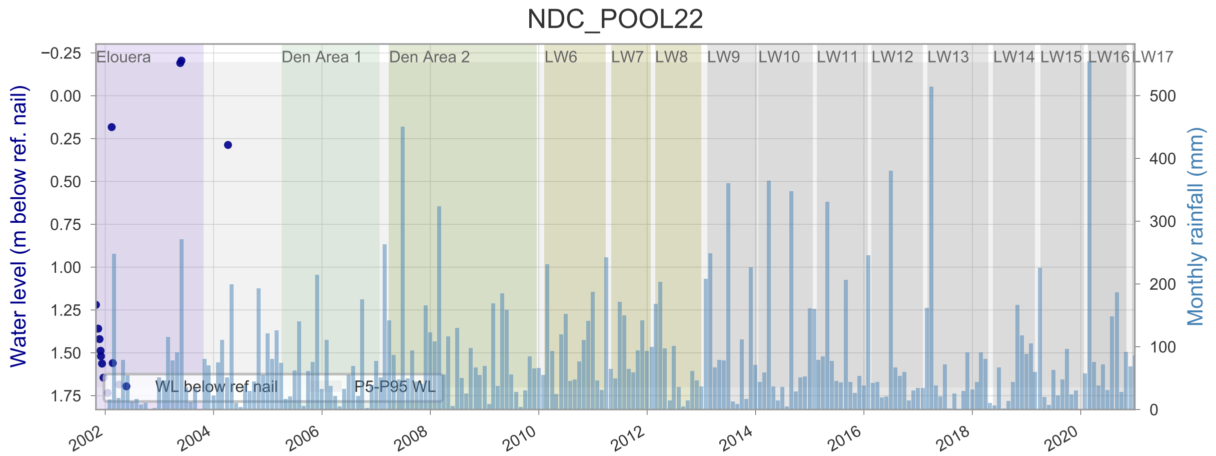

NDC_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
NDC_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC
NDC_POOL1
pH units
Monthly rainfall (mm)
pH
P5-P95 pH
Median (baseline)
NDC_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
P5-P95 DO
Median (baseline)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2004
2006
2008
2010
2012
2014
2016
2018
2020

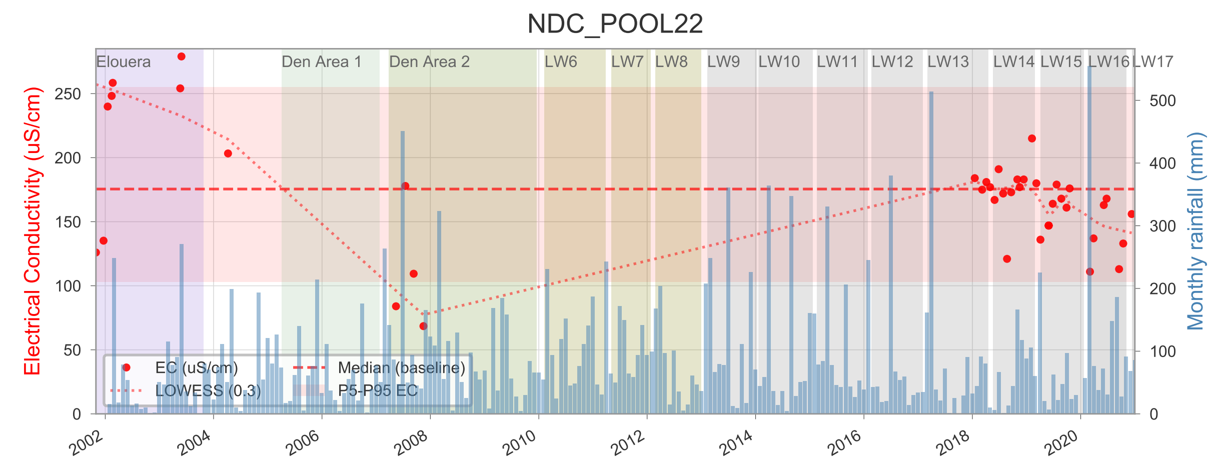

NDC_POOL15
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

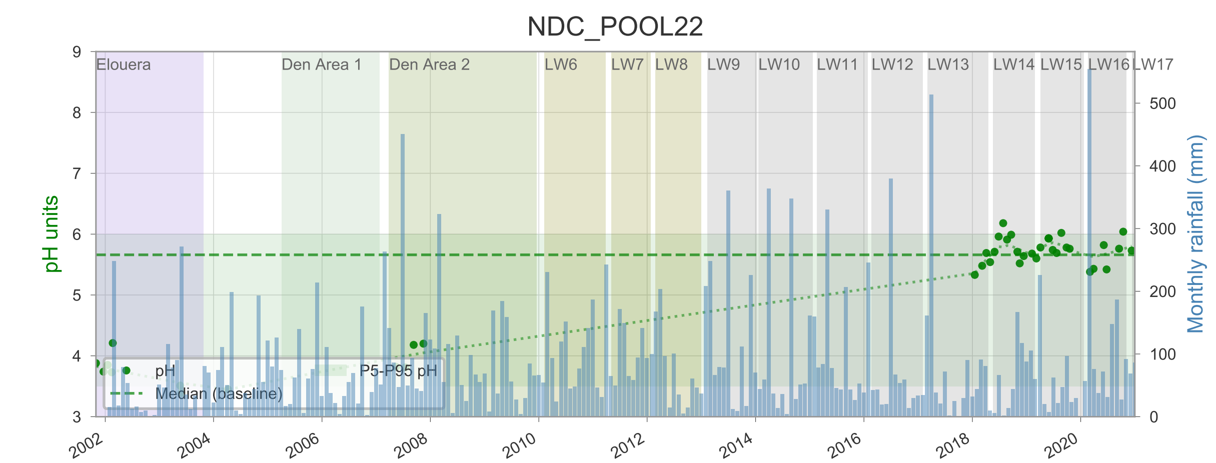

NDC_POOL15
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

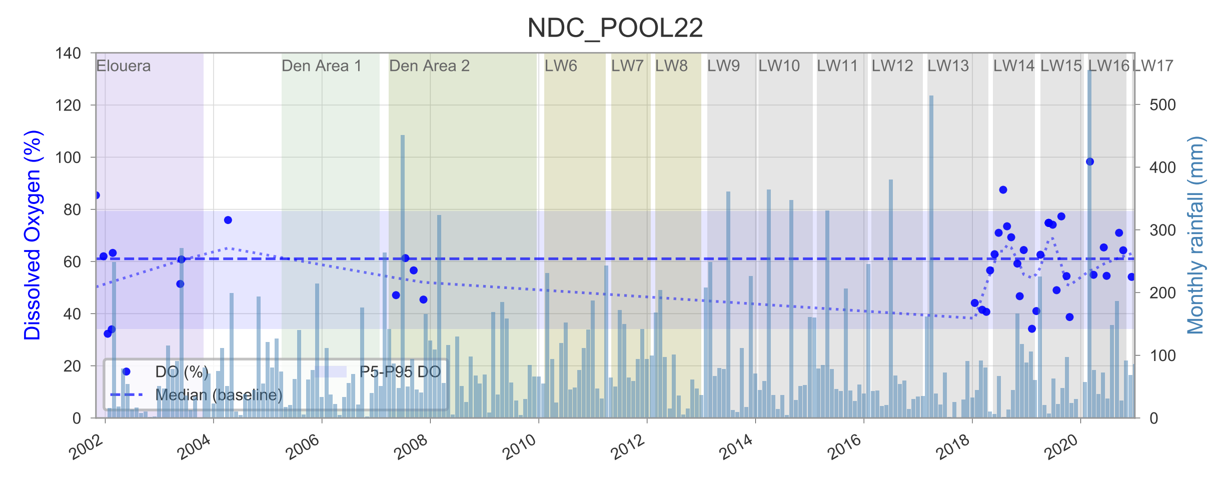

NDC_POOL15
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

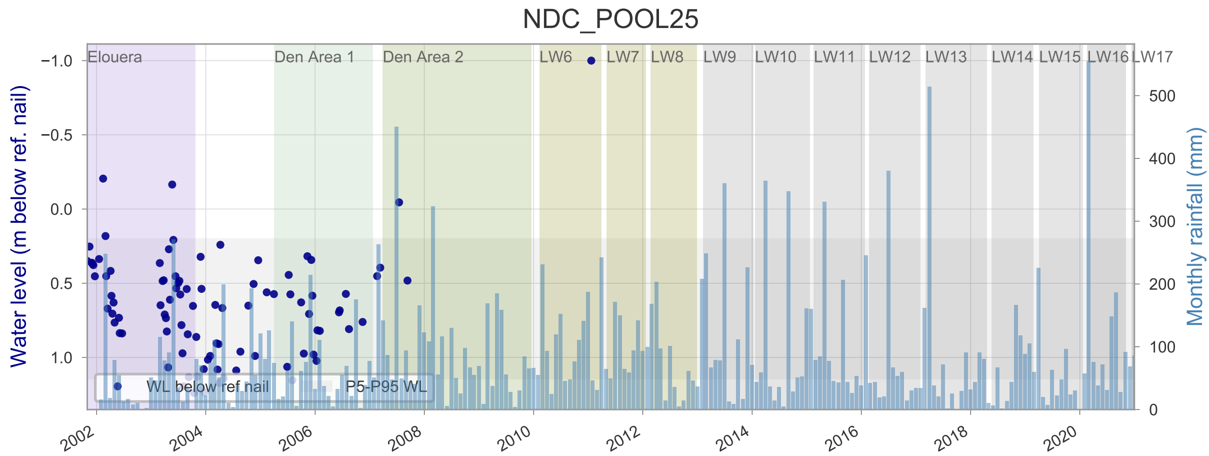

NDC_POOL15
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

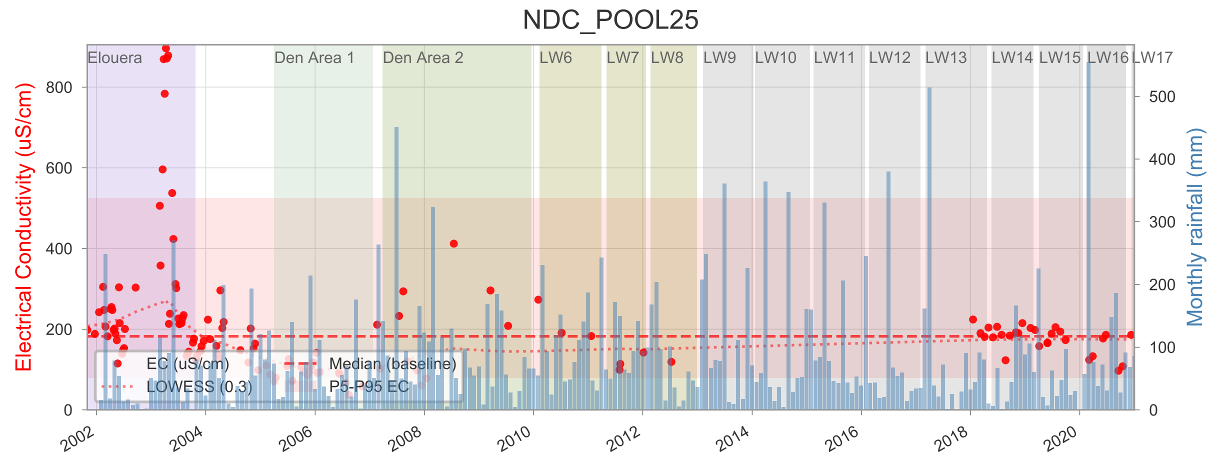

NDC_POOL22
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

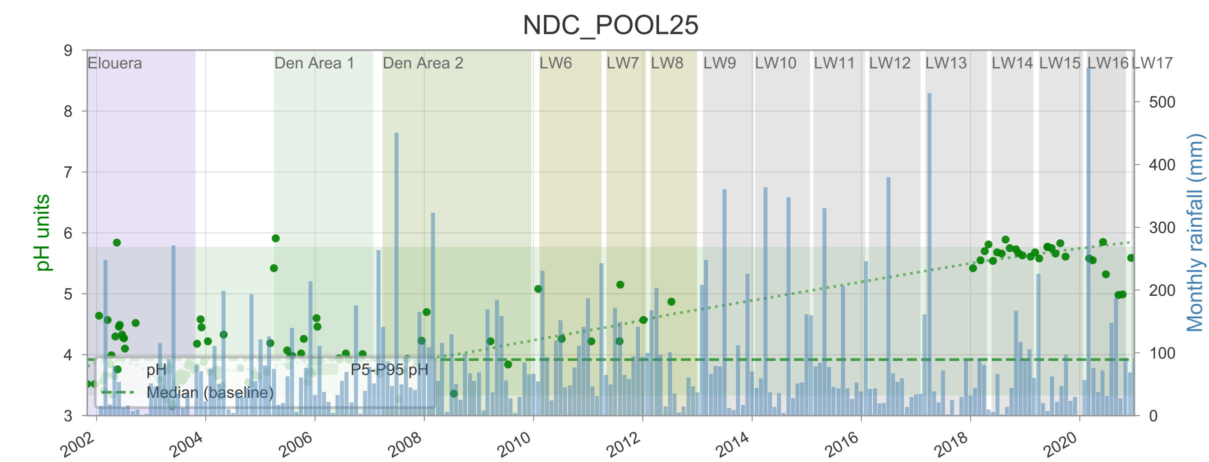

NDC_POOL22
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
50
100
150
200
250
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

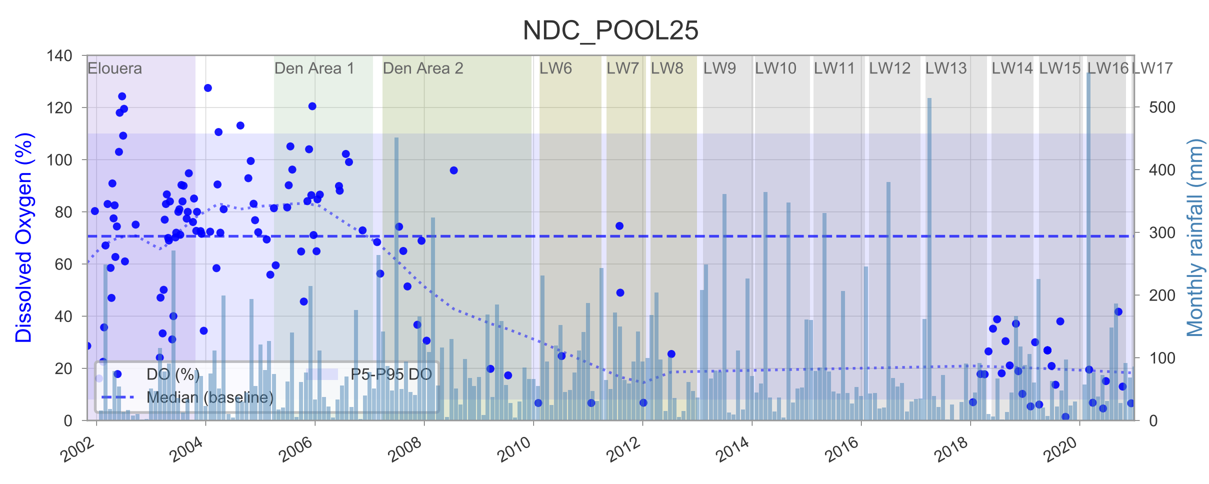

NDC_POOL22
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

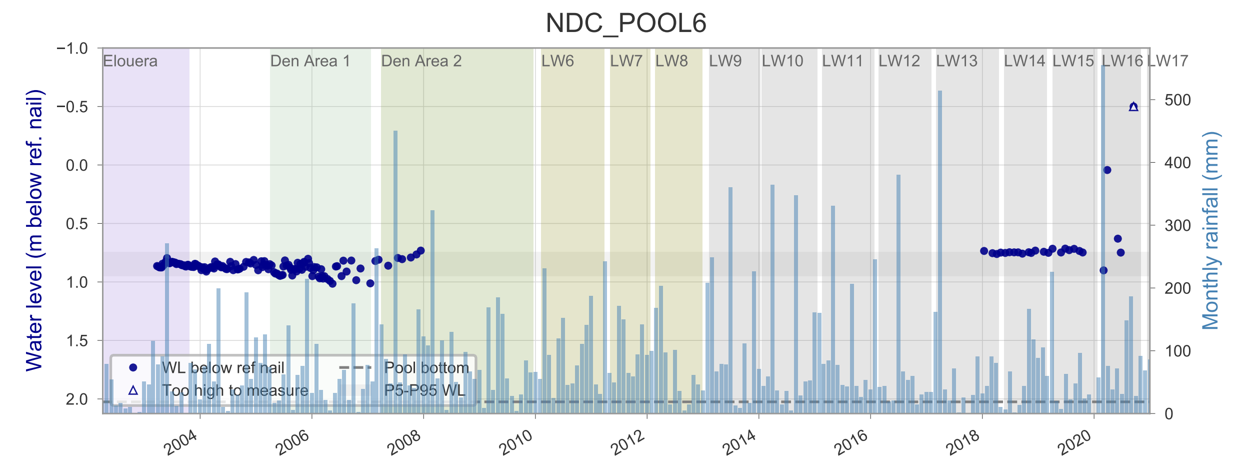

NDC_POOL22
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

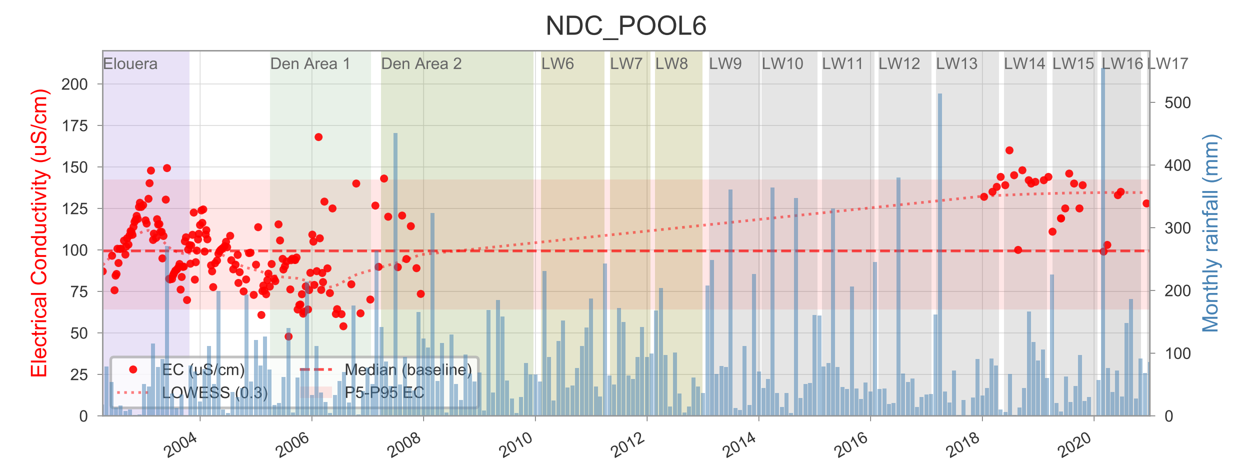

NDC_POOL25
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

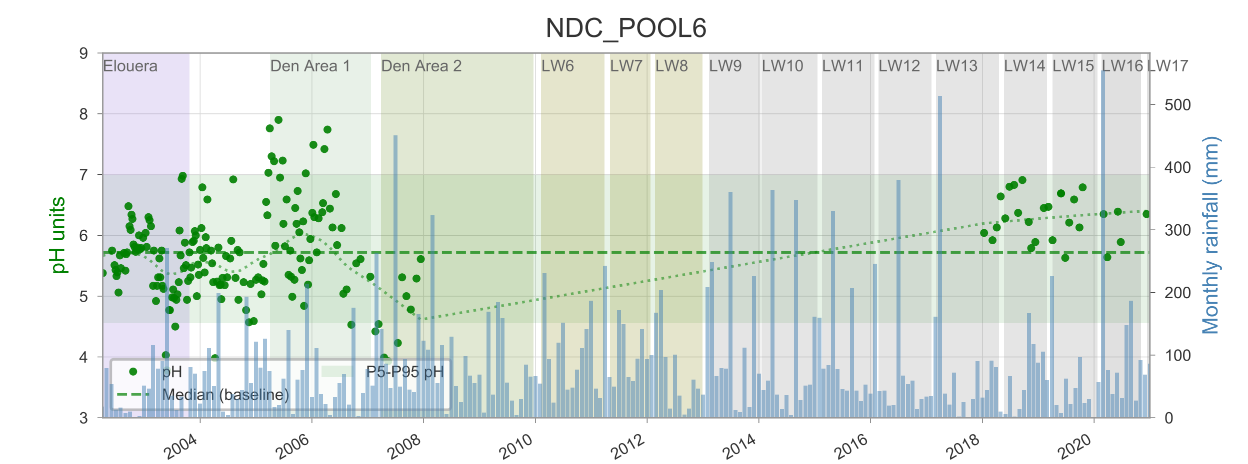

NDC_POOL25
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

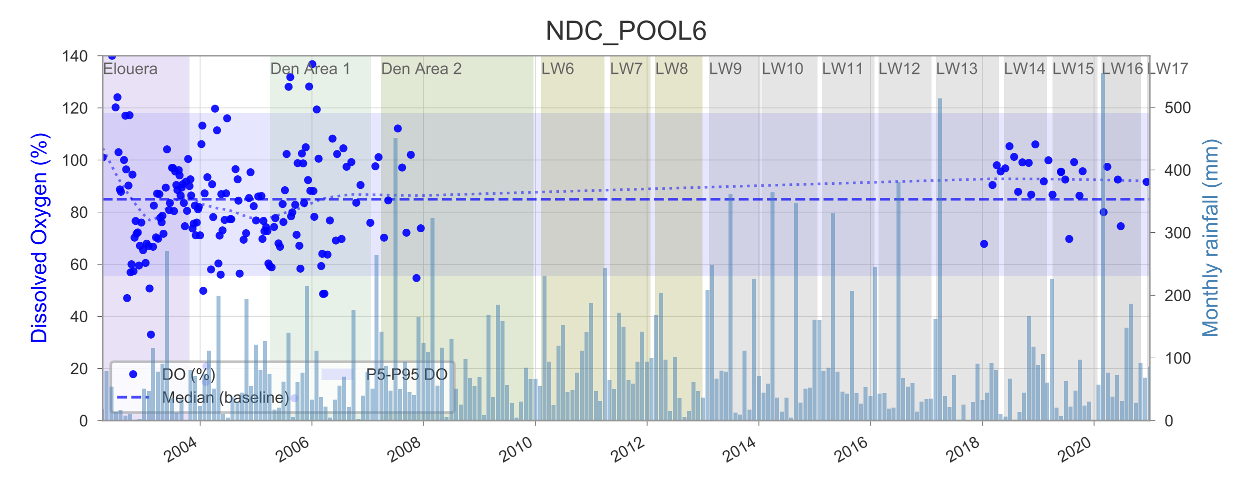

NDC_POOL25
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

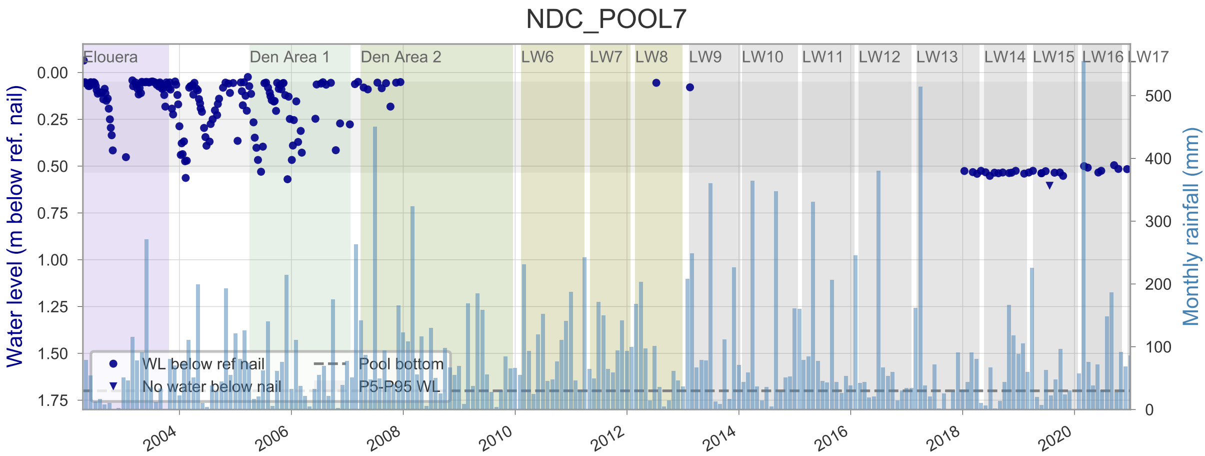

NDC_POOL25
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


NDC_POOL6
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Too high to measure
Pool bottom
P5-P95 WL

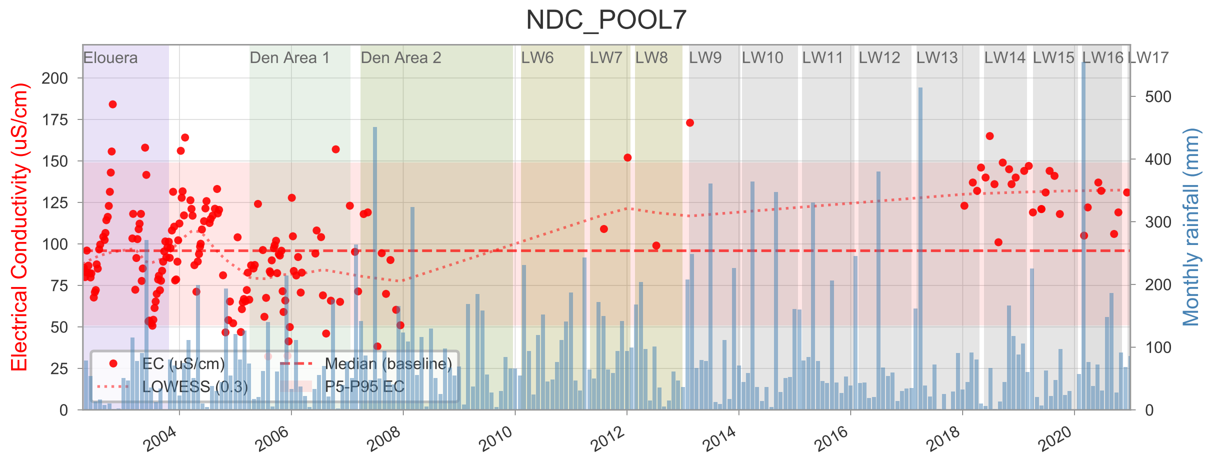

NDC_POOL6
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC


NDC_POOL6
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

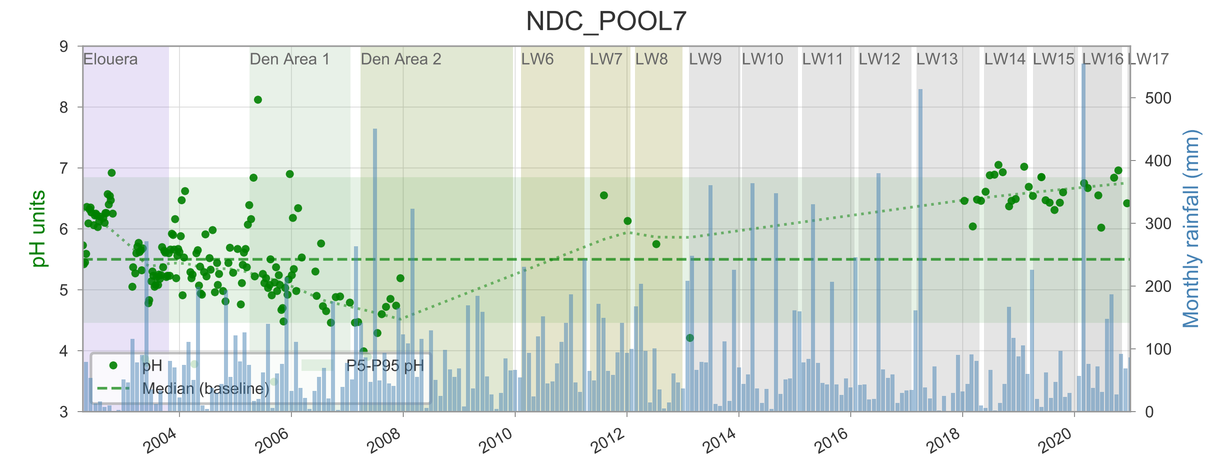

NDC_POOL6
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO



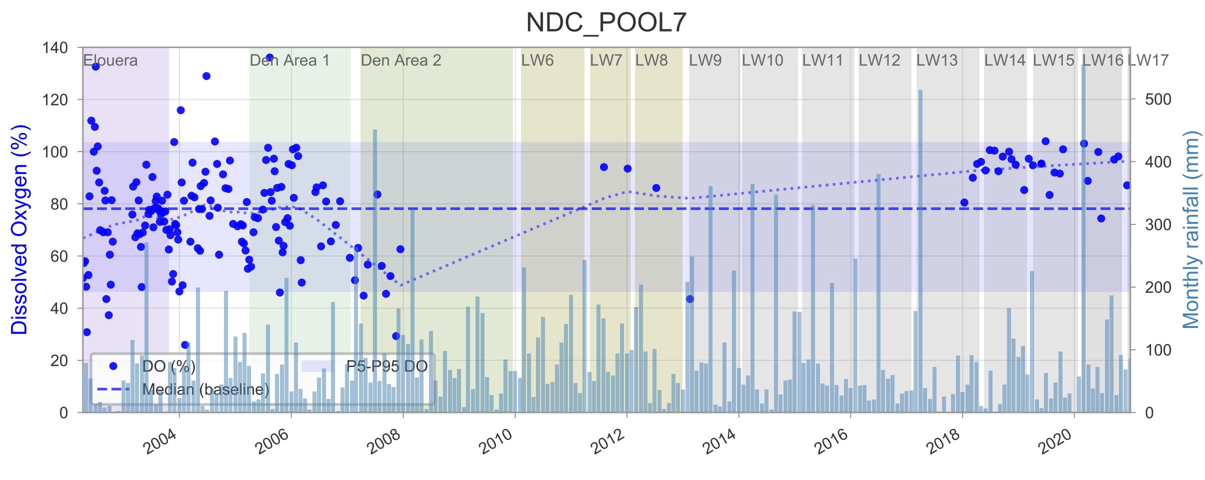
NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL



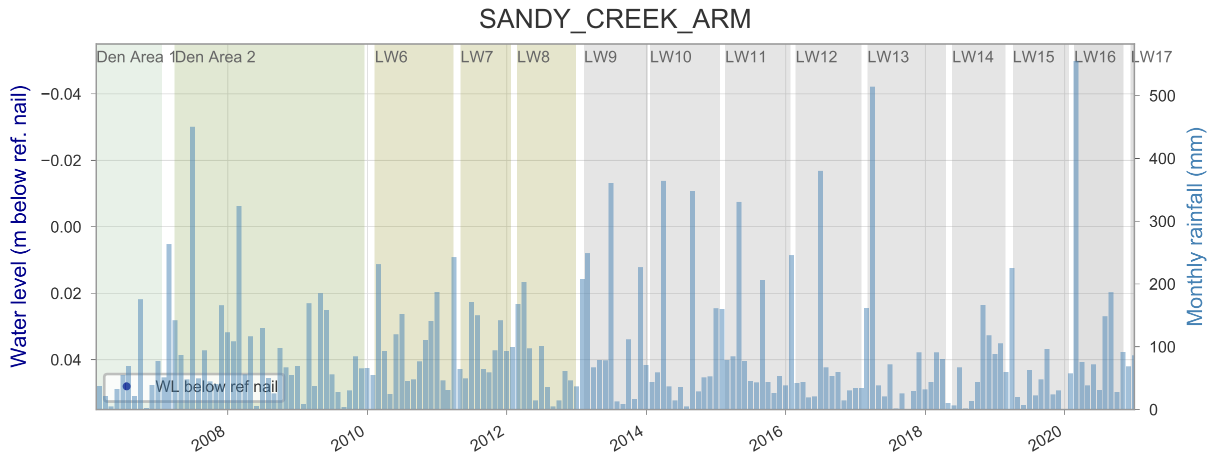
NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

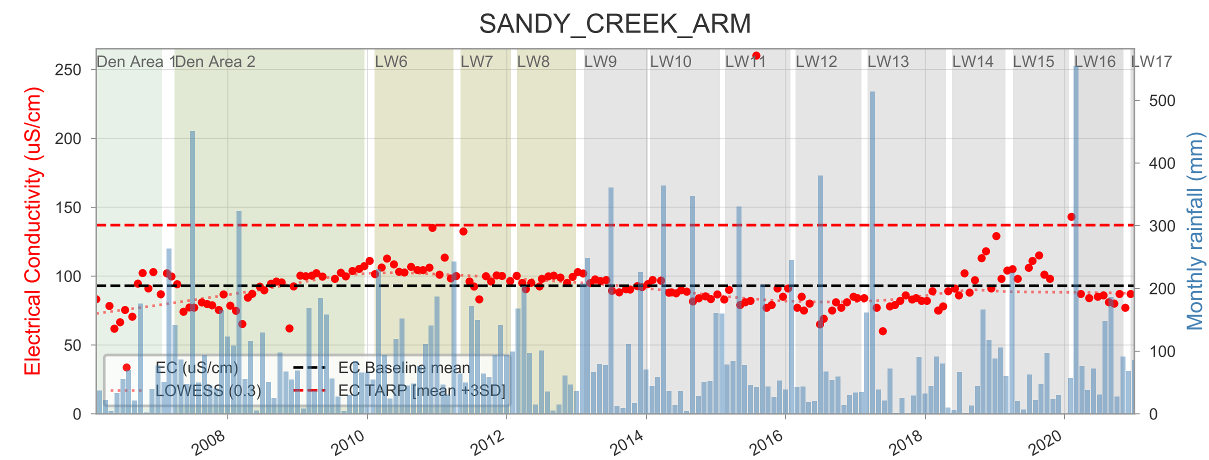


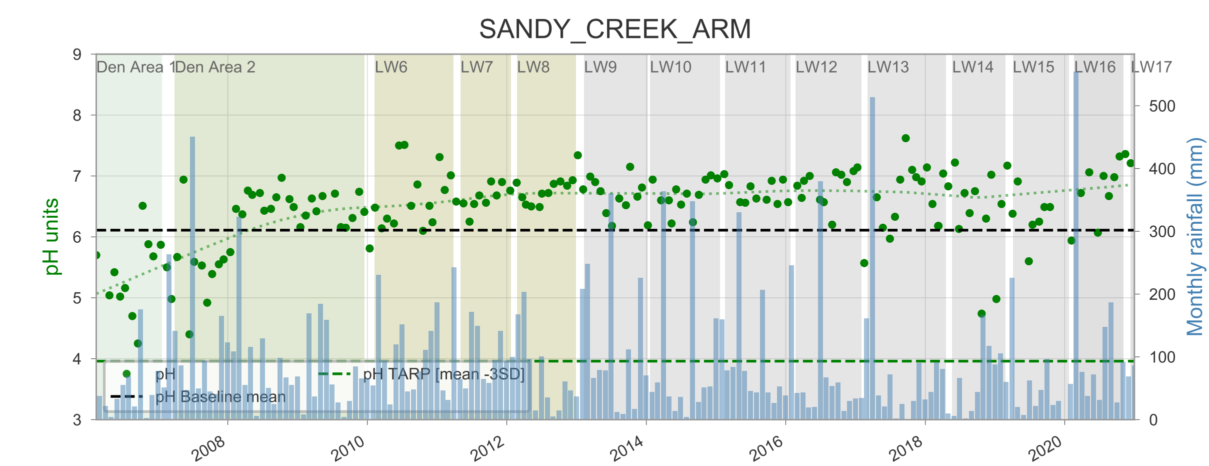
NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

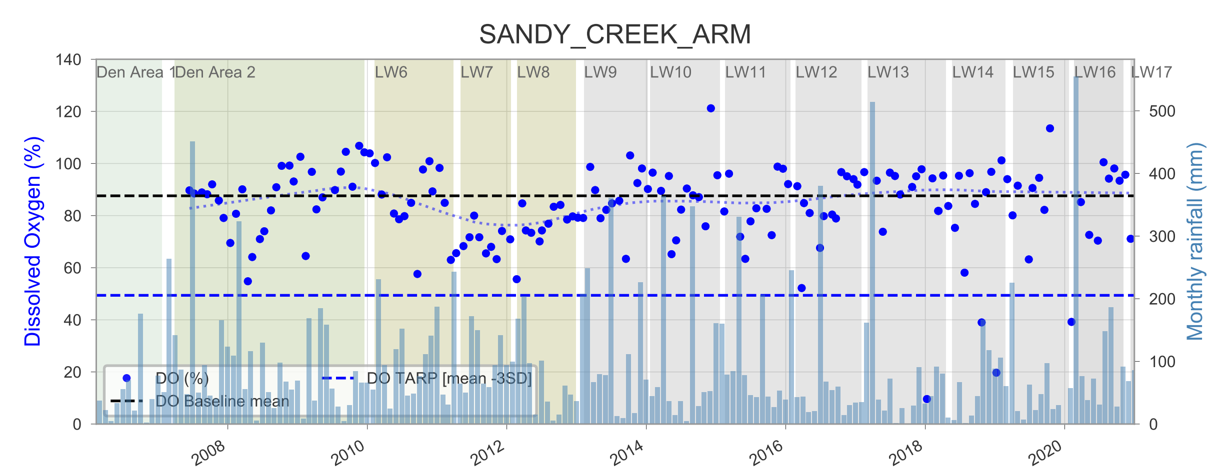


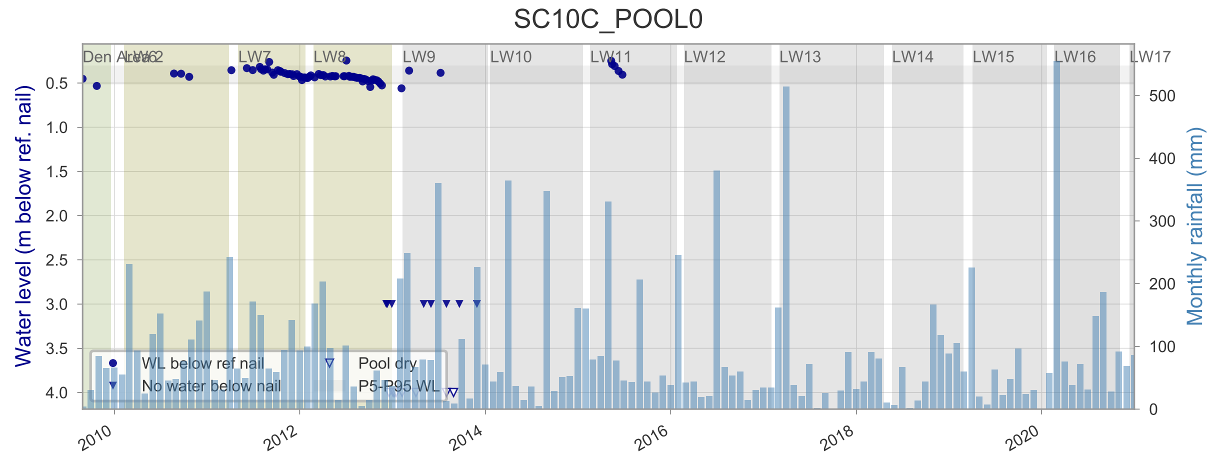
NDC_POOL7
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

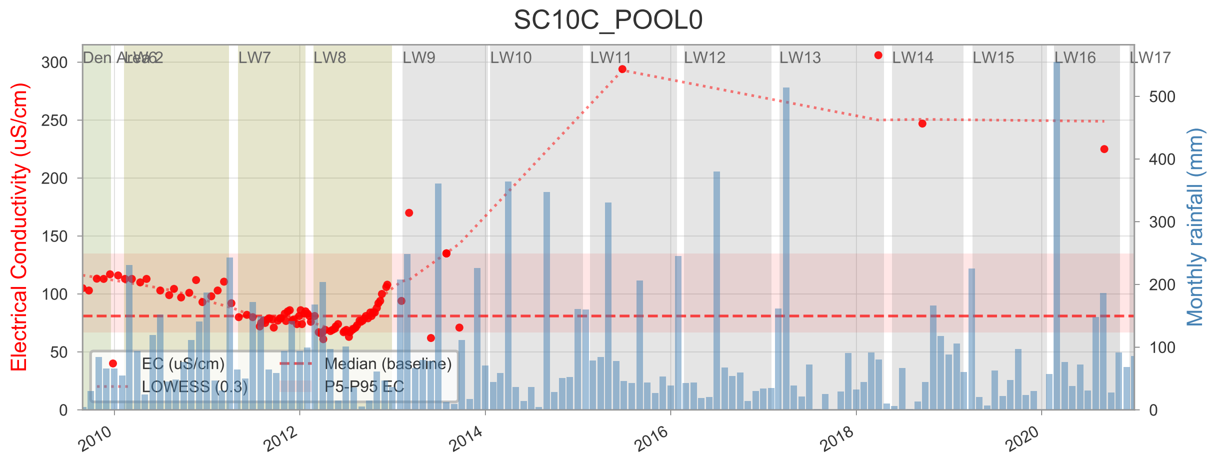

SANDY_CREEK_ARM
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail

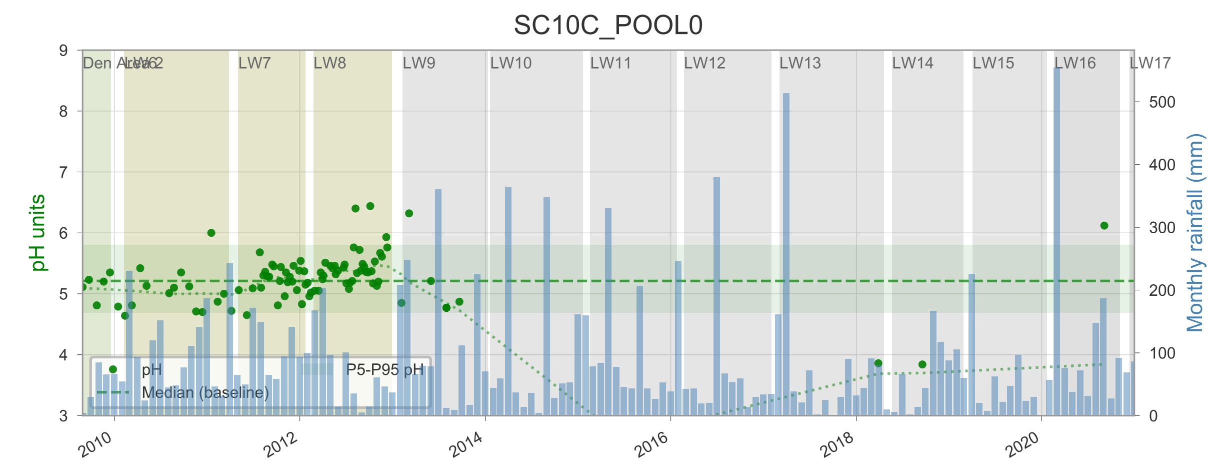

SANDY_CREEK_ARM
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]

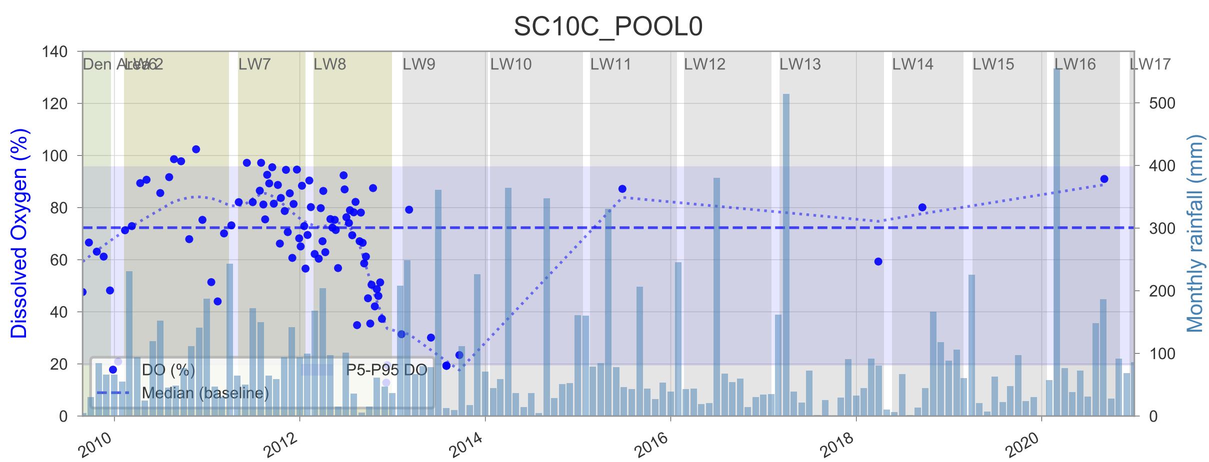

SANDY_CREEK_ARM
pH units
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
pH Baseline mean
pH TARP [mean -3SD]

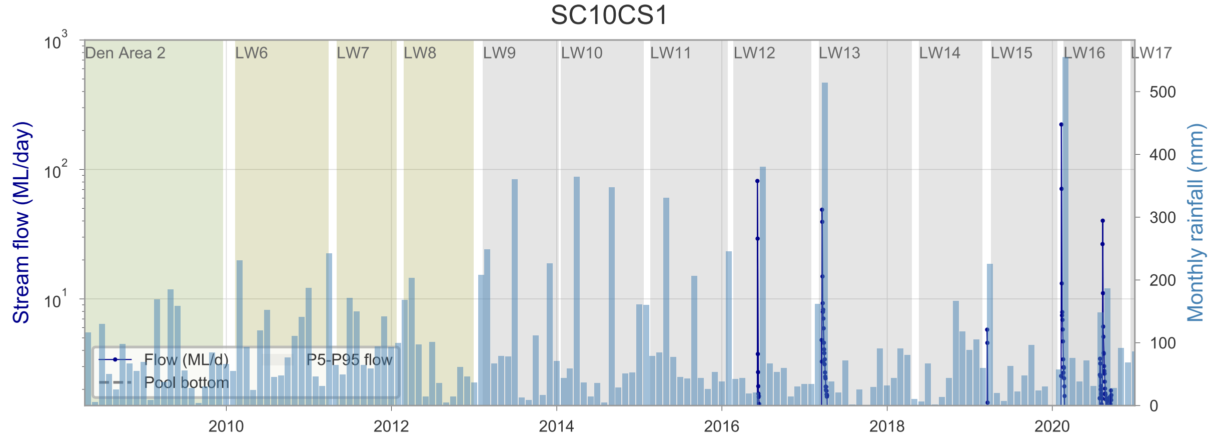

SANDY_CREEK_ARM
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
DO Baseline mean
DO TARP [mean -3SD]


SC10C_POOL0
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL

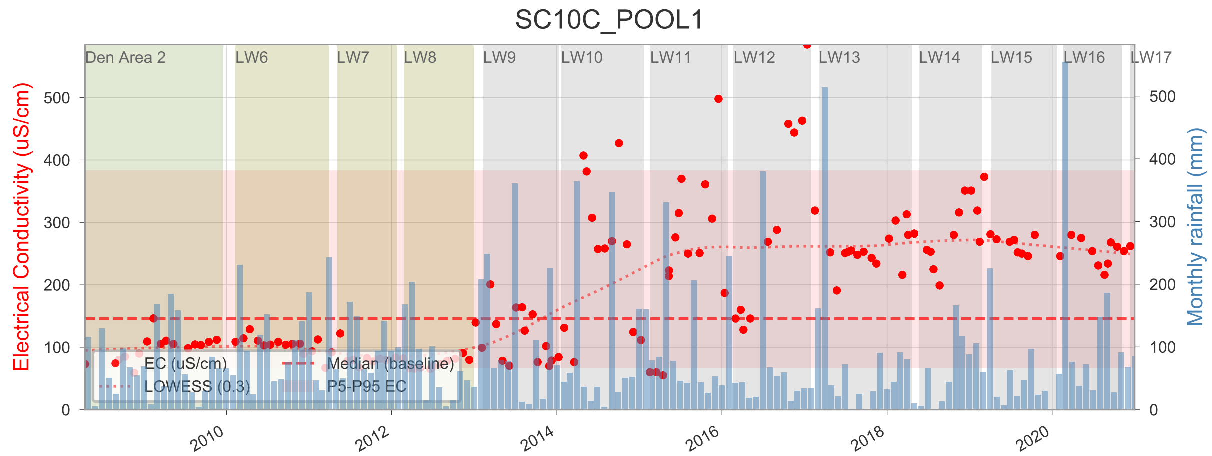

SC10C_POOL0
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC


SC10C_POOL0
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

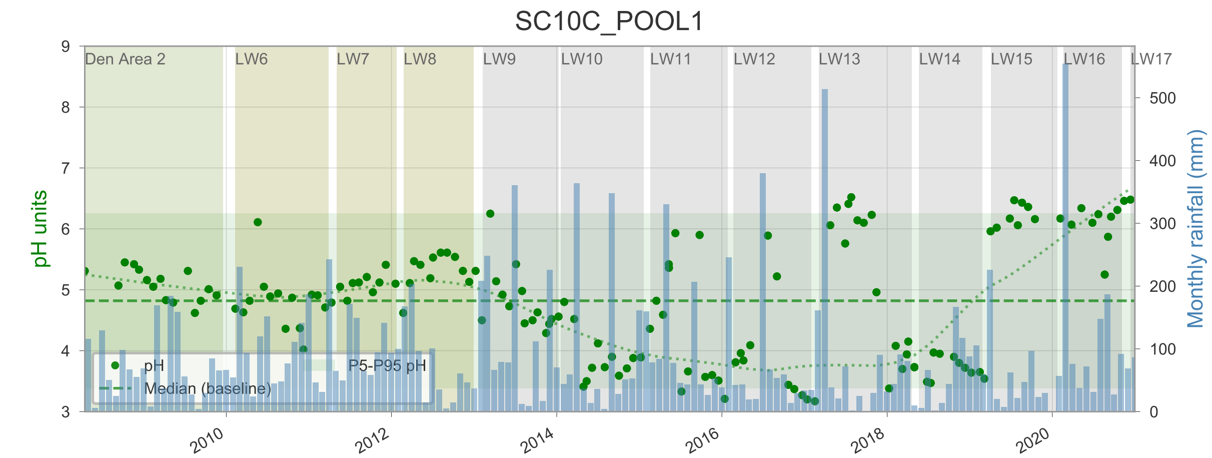

SC10C_POOL0
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO



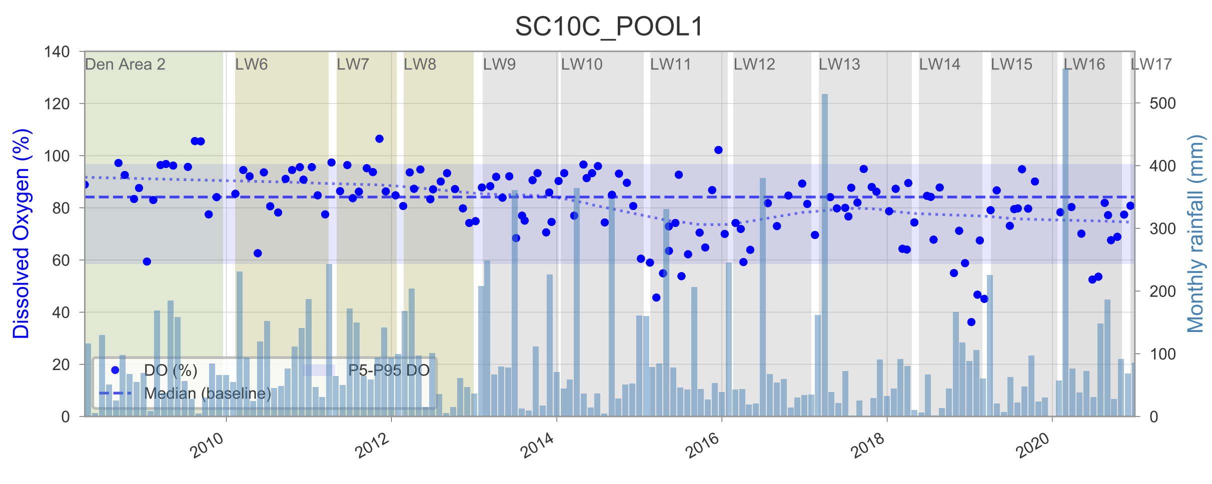
SC10CS1
Stream flow (ML/day)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
Pool bottom
P5-P95 flow
2010
2012
2014
2016
2018
2020



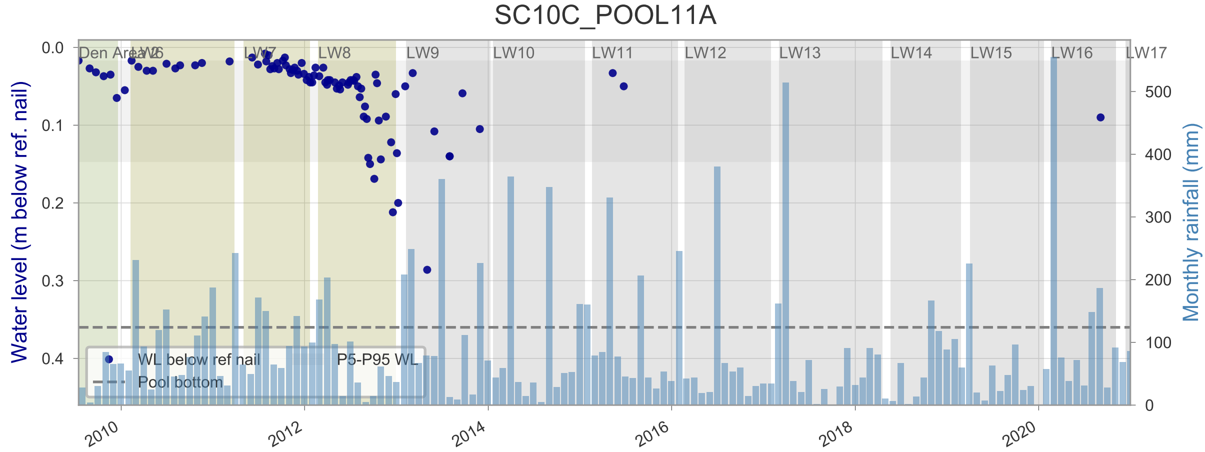
SC10C_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

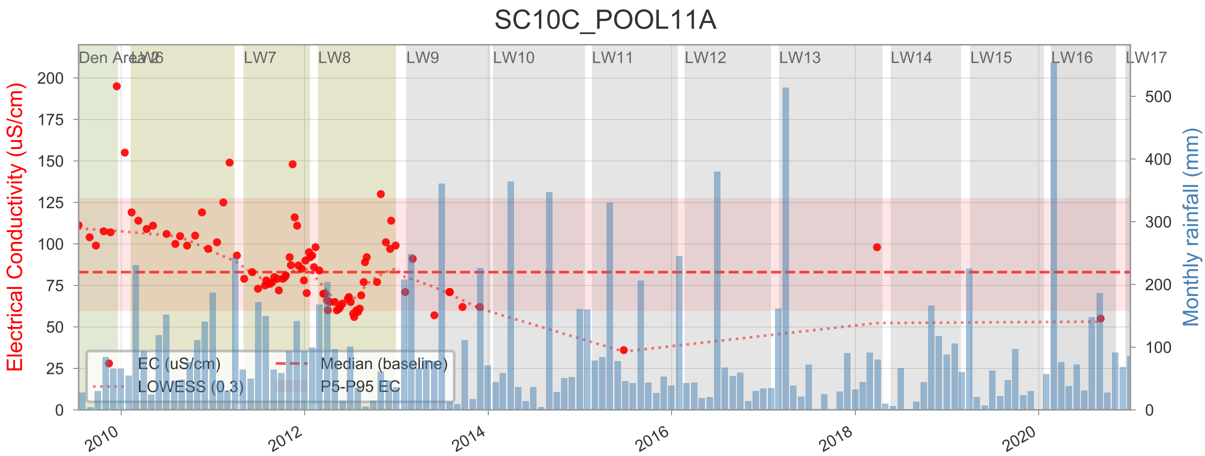


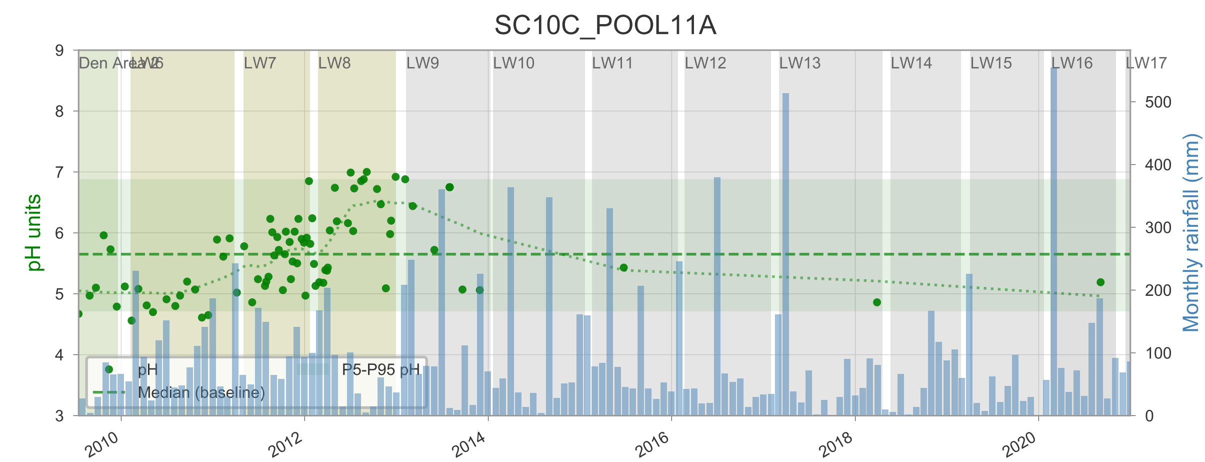
SC10C_POOL1
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

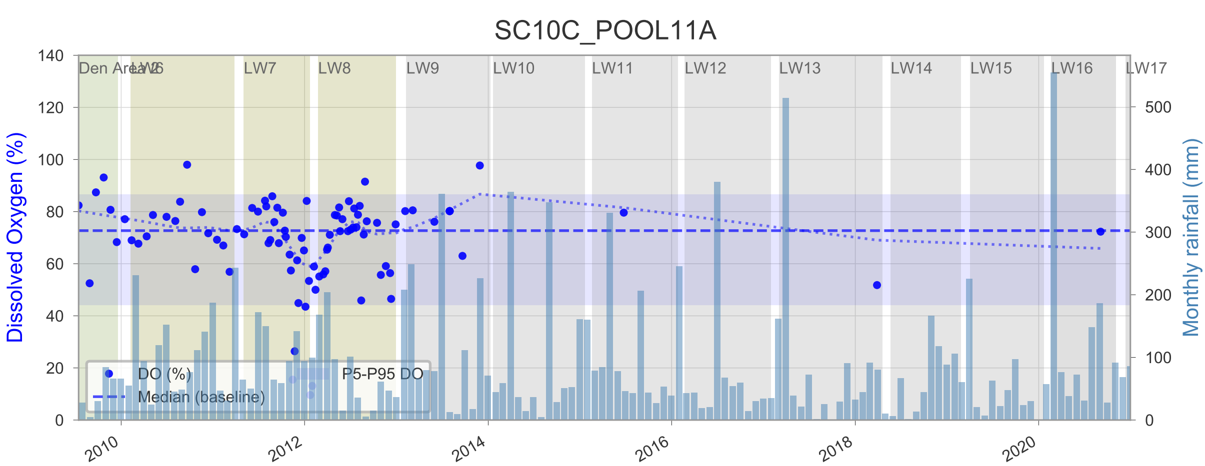


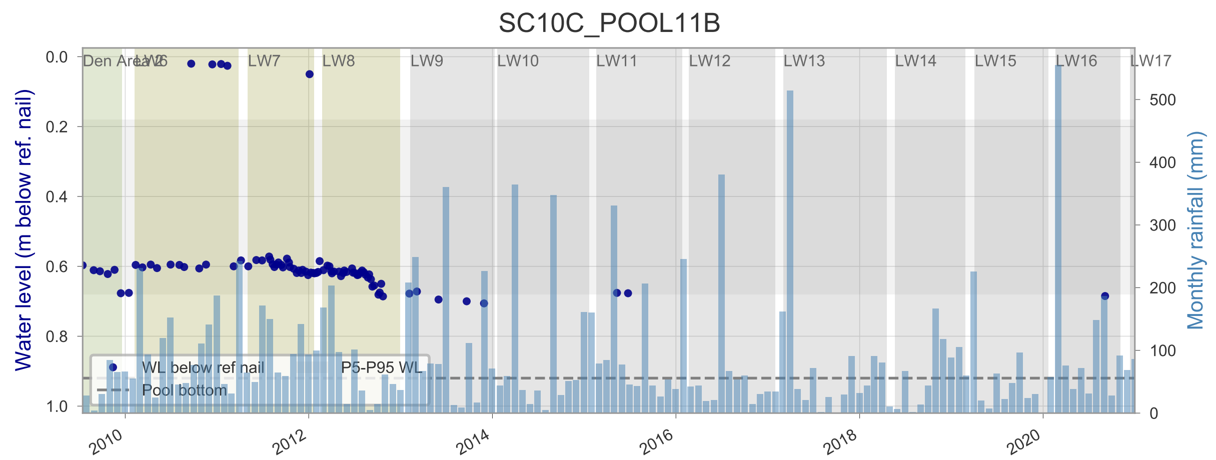
SC10C_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

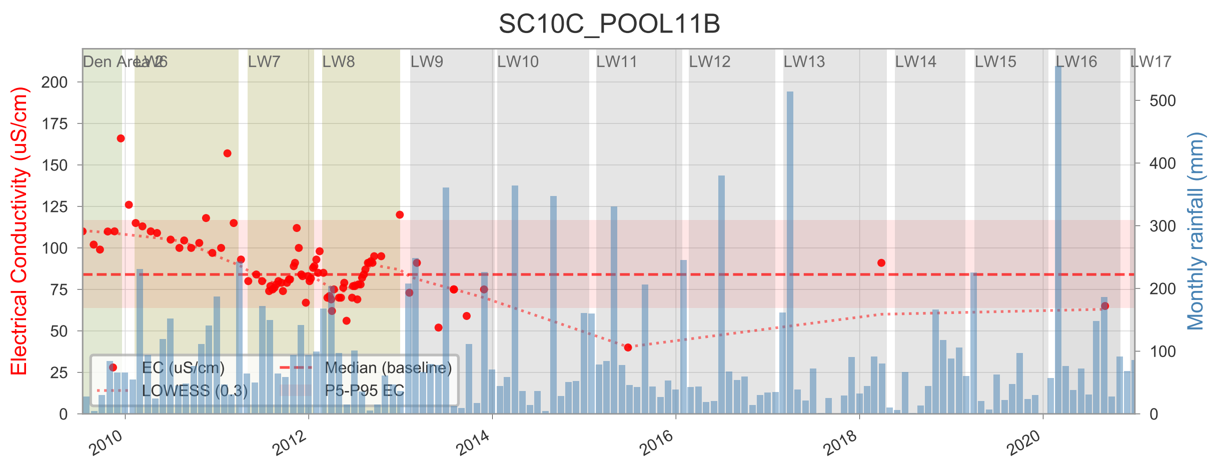

SC10C_POOL11A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom

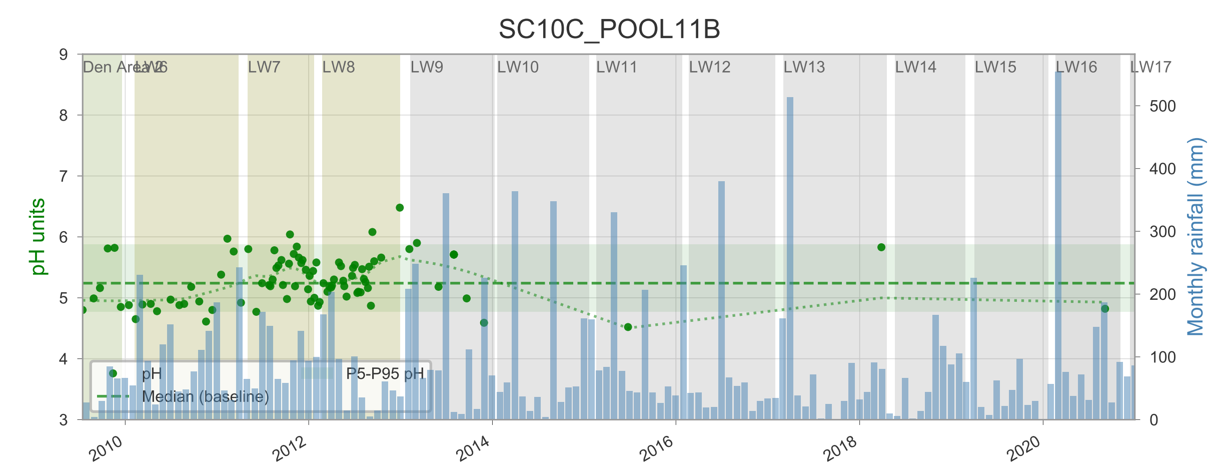

SC10C_POOL11A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC

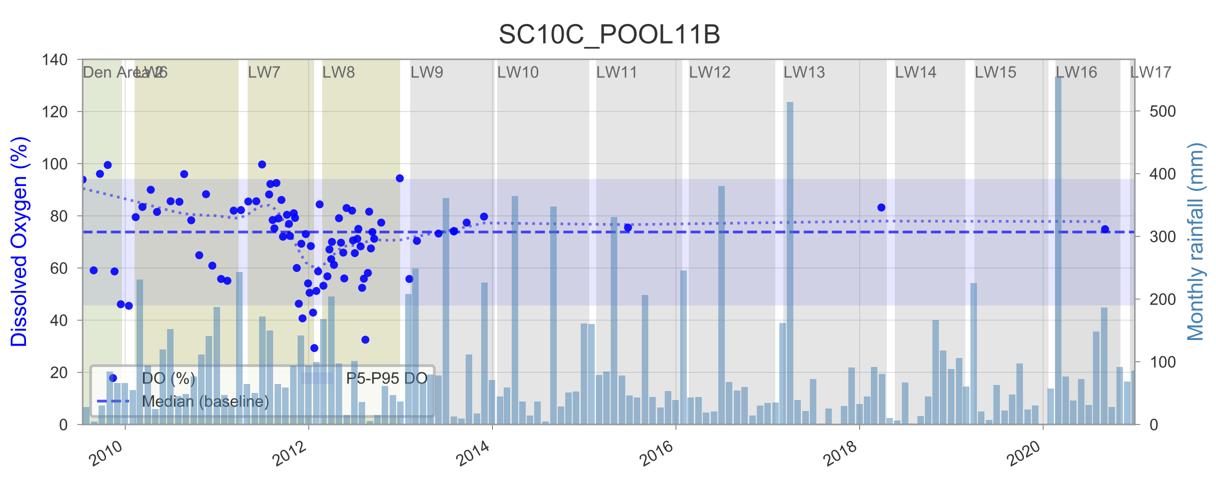

SC10C_POOL11A
pH units
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
P5-P95 pH
Median (baseline)

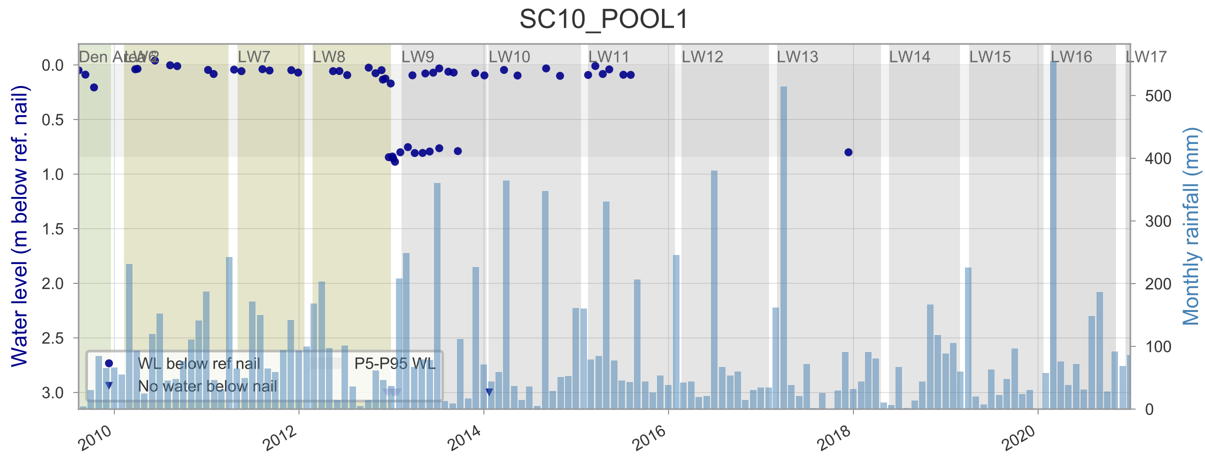

SC10C_POOL11A
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
P5-P95 DO
Median (baseline)


SC10C_POOL11B
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL

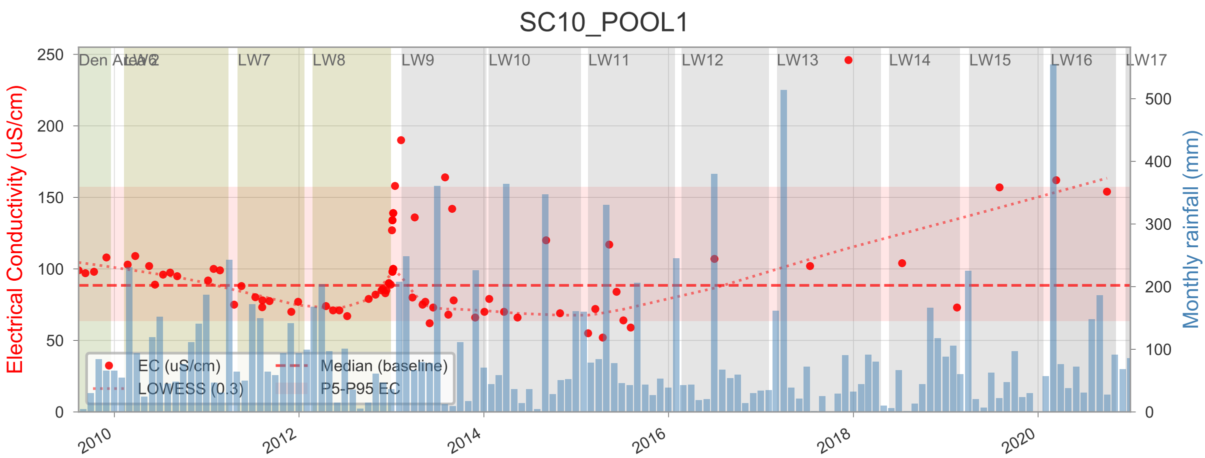

SC10C_POOL11B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC


SC10C_POOL11B
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

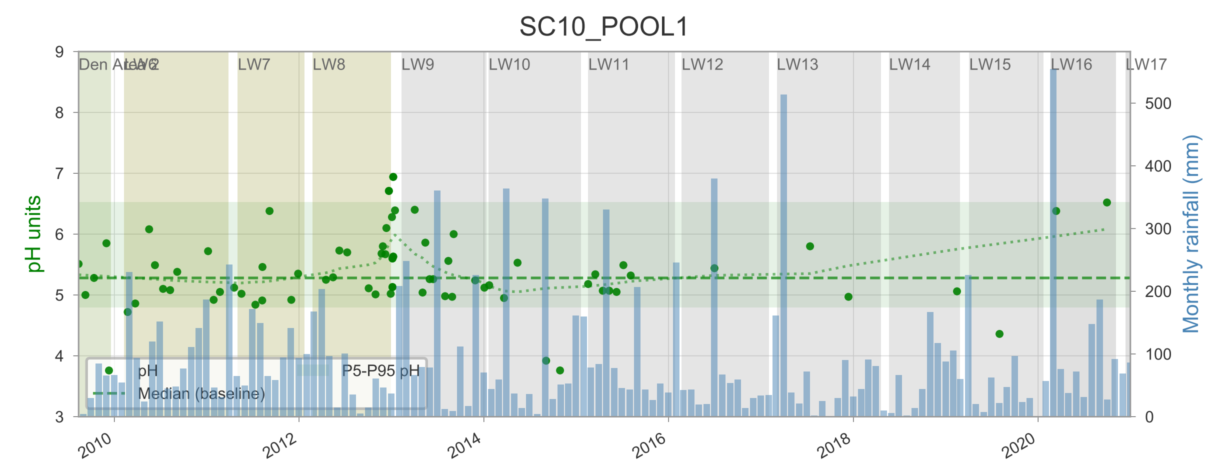

SC10C_POOL11B
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO



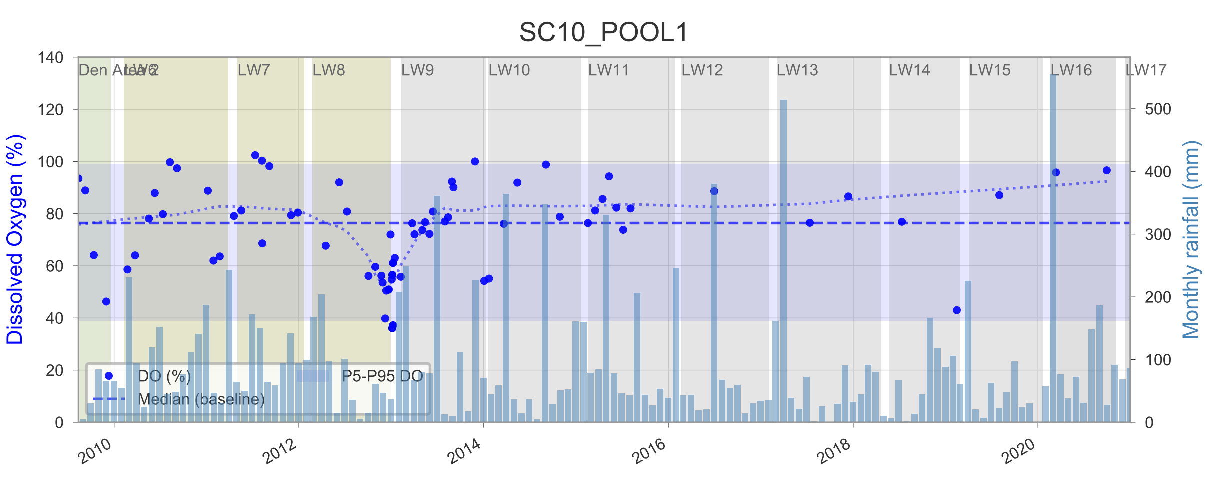
SC10_POOL1
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
P5-P95 WL



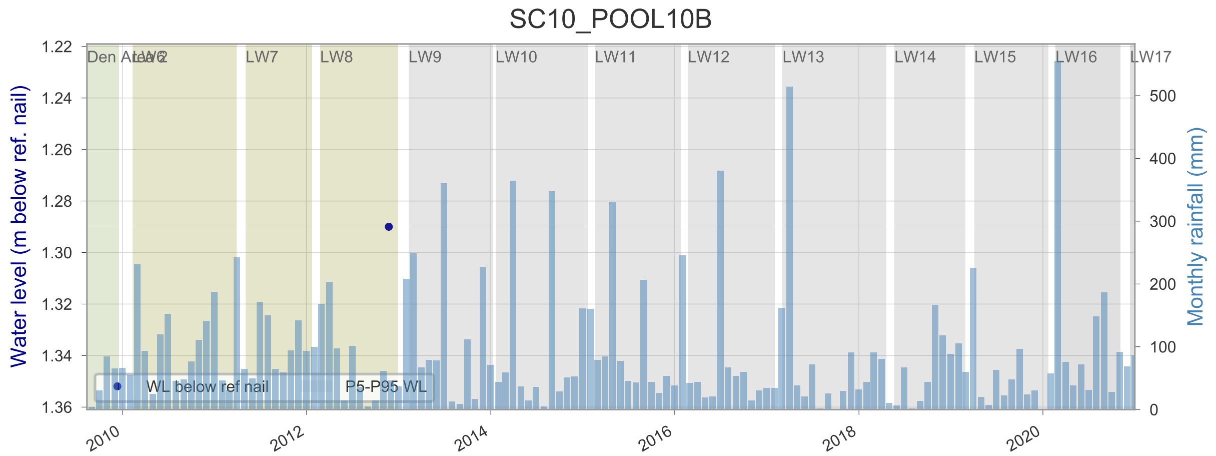
SC10_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

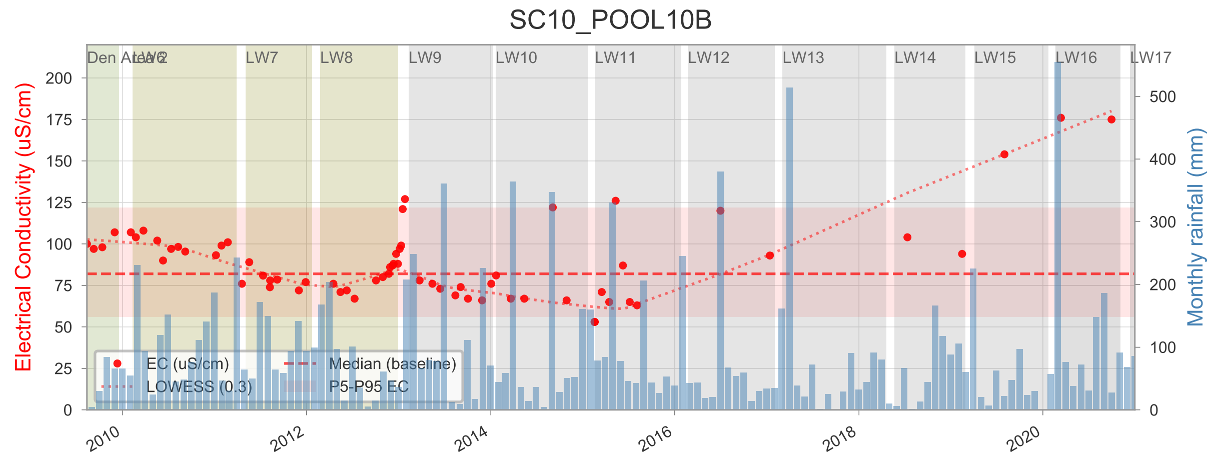


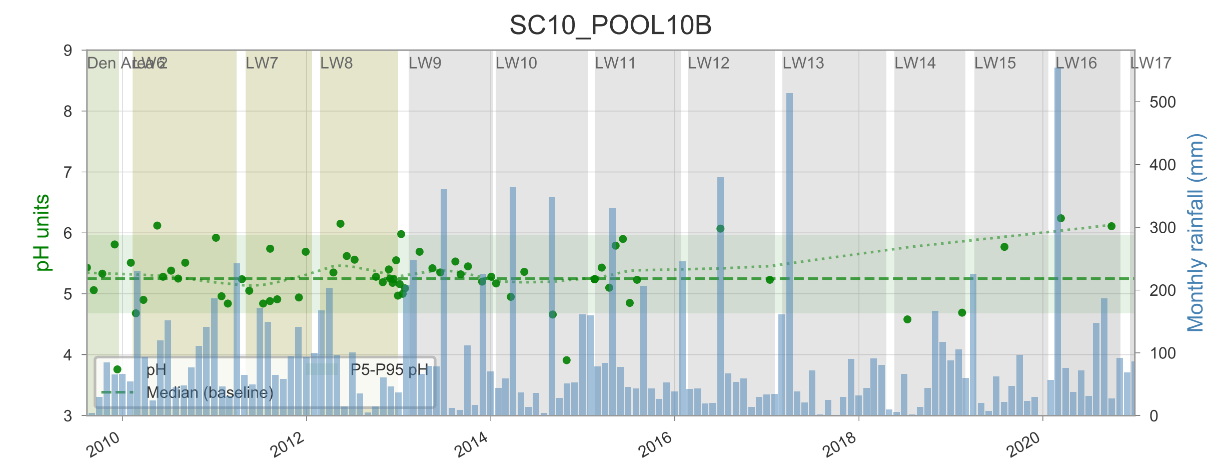
SC10_POOL1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

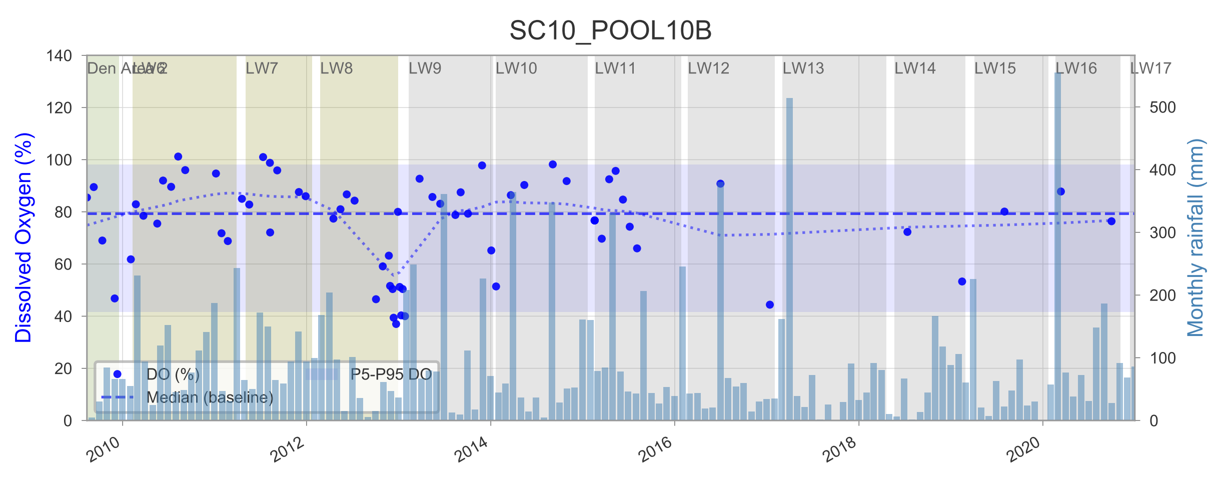


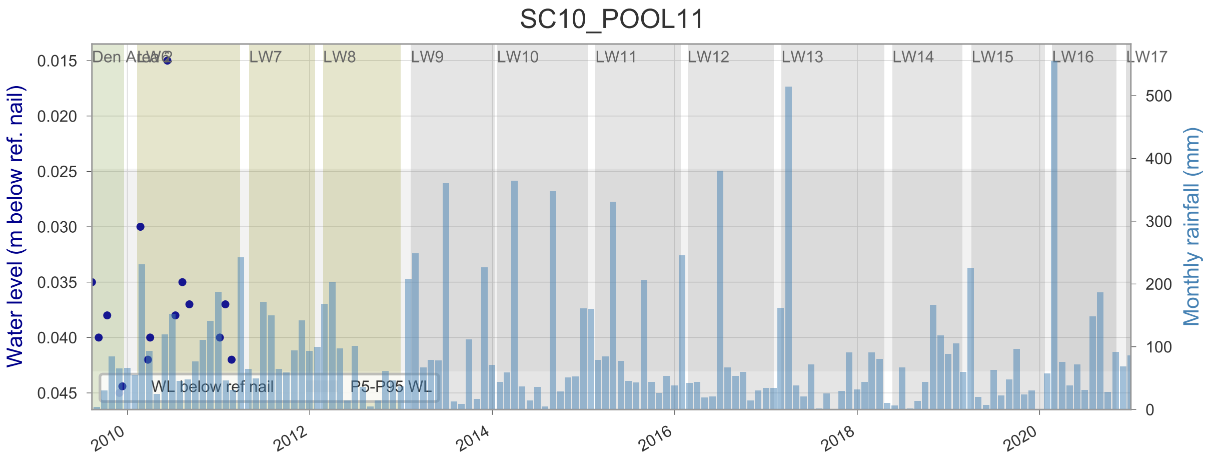
SC10_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

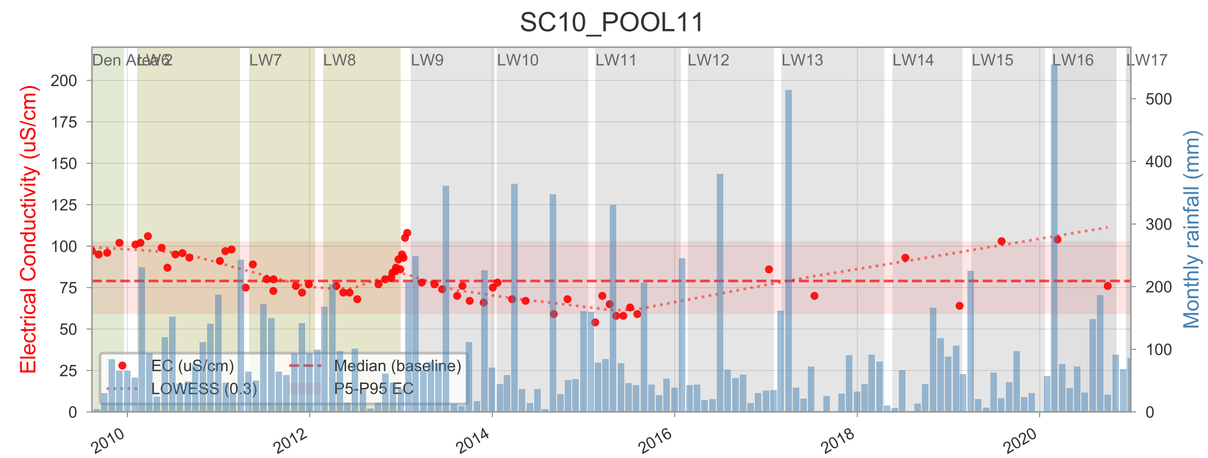

SC10_POOL10B
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL

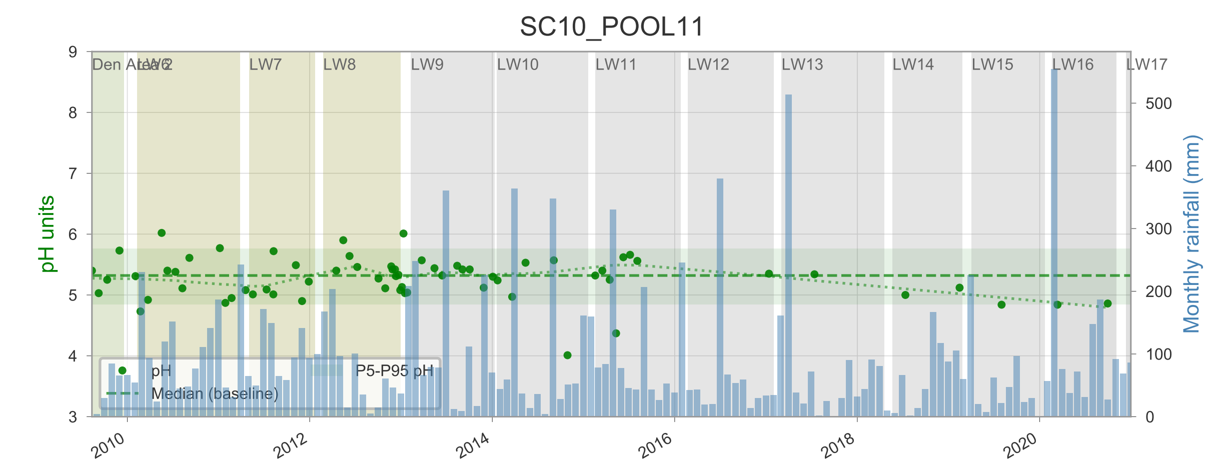

SC10_POOL10B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

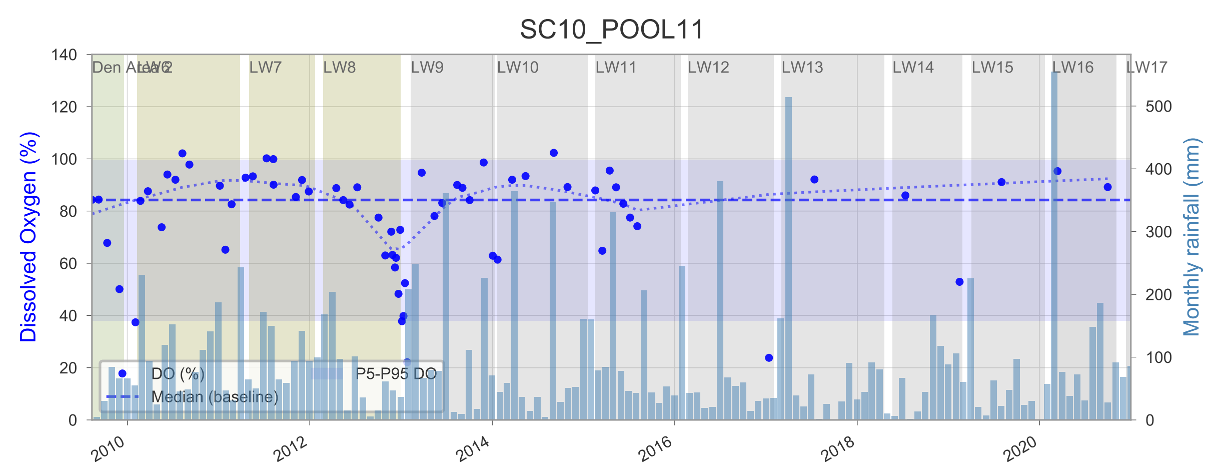

SC10_POOL10B
pH units
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

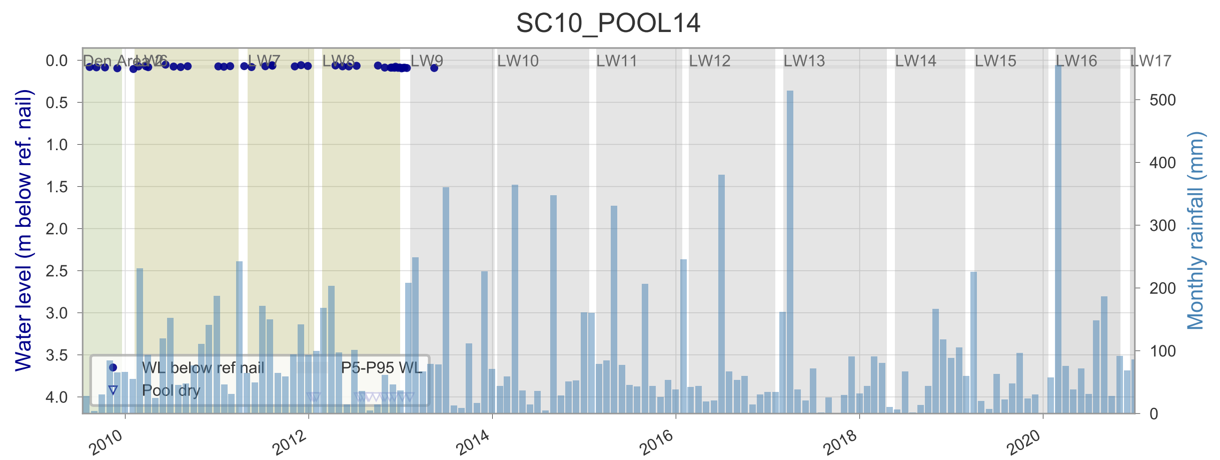

SC10_POOL10B
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

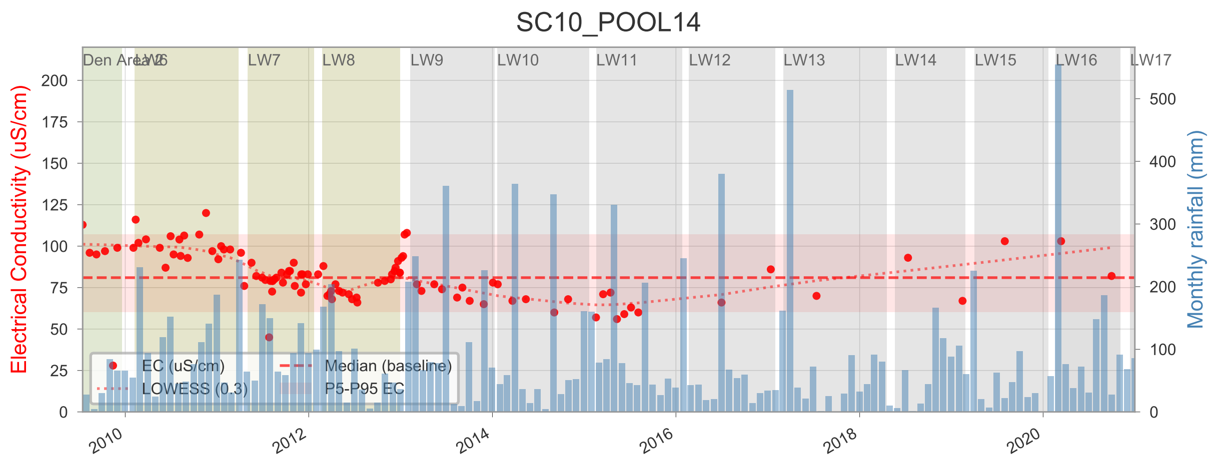

SC10_POOL11
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

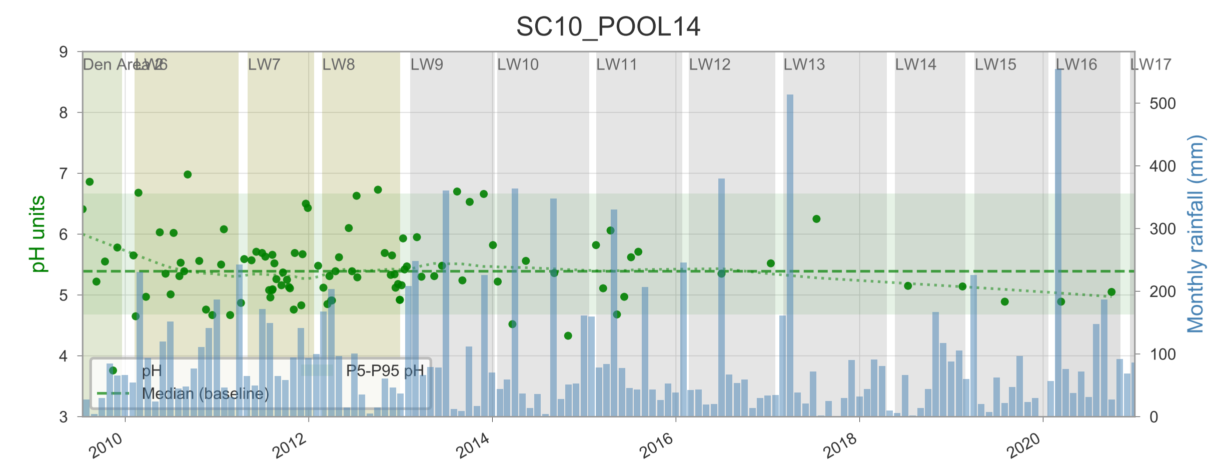

SC10_POOL11
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

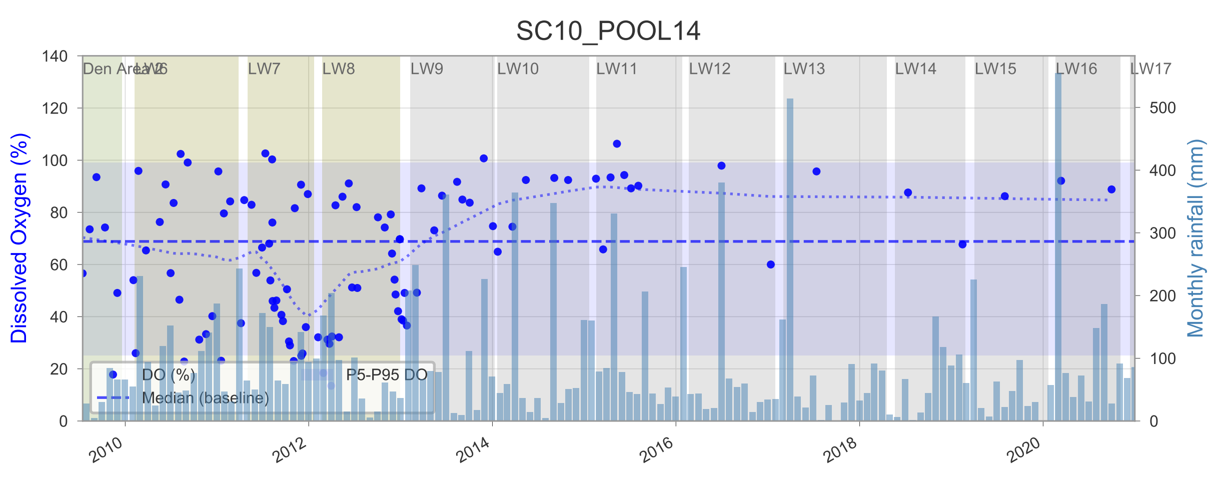

SC10_POOL11
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

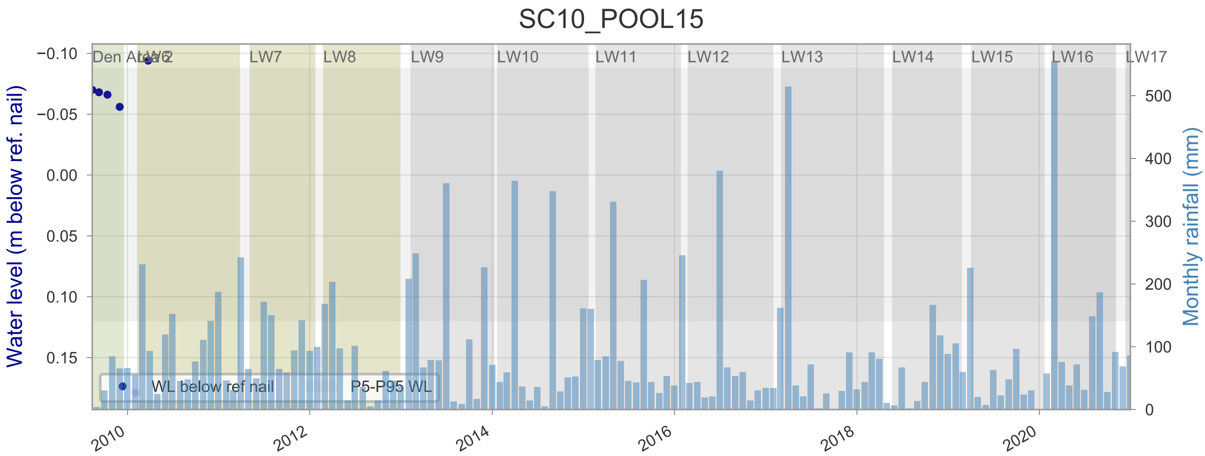

SC10_POOL11
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


SC10_POOL14
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool dry
P5-P95 WL
2010
2012
2014
2016
2018
2020

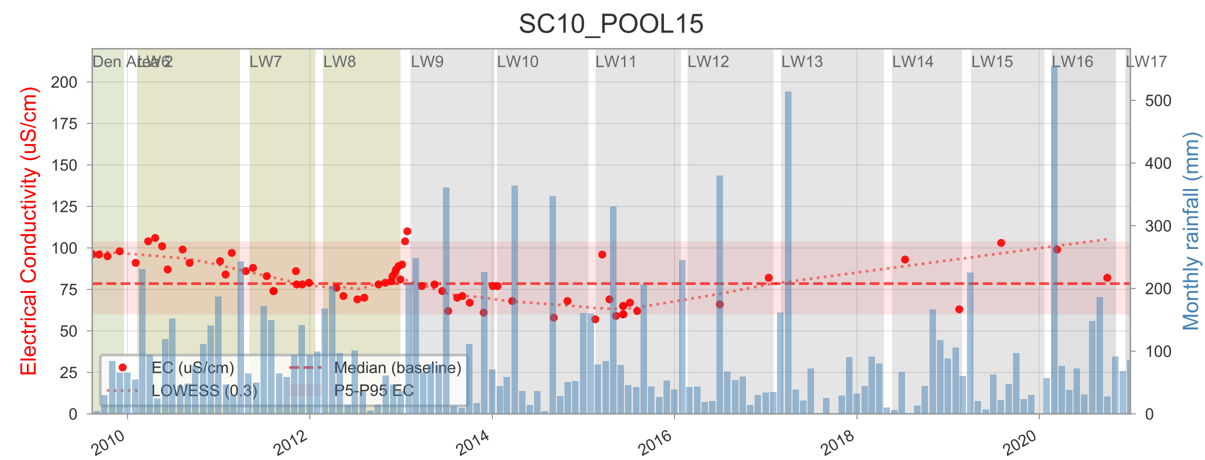

SC10_POOL14
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020


SC10_POOL14
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

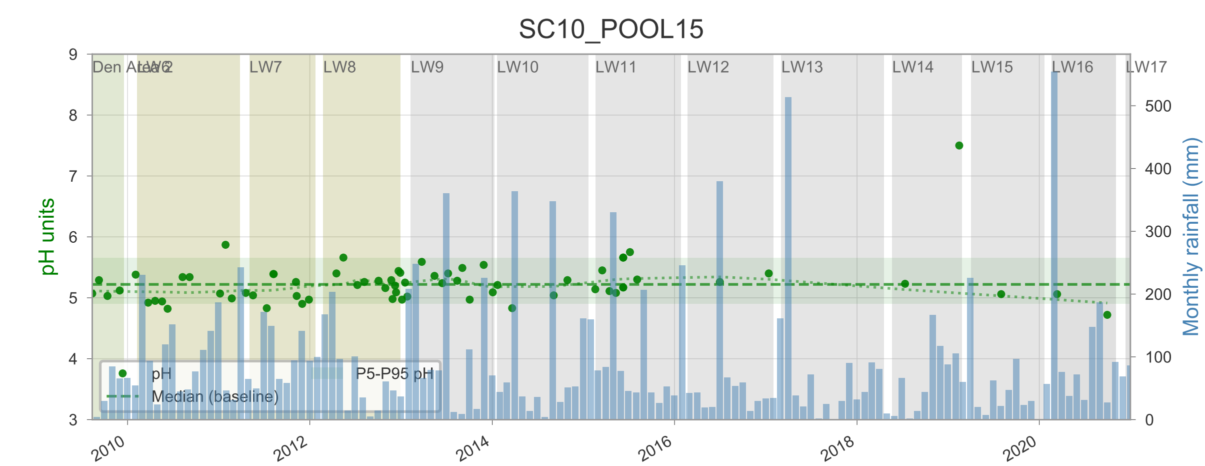

SC10_POOL14
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020



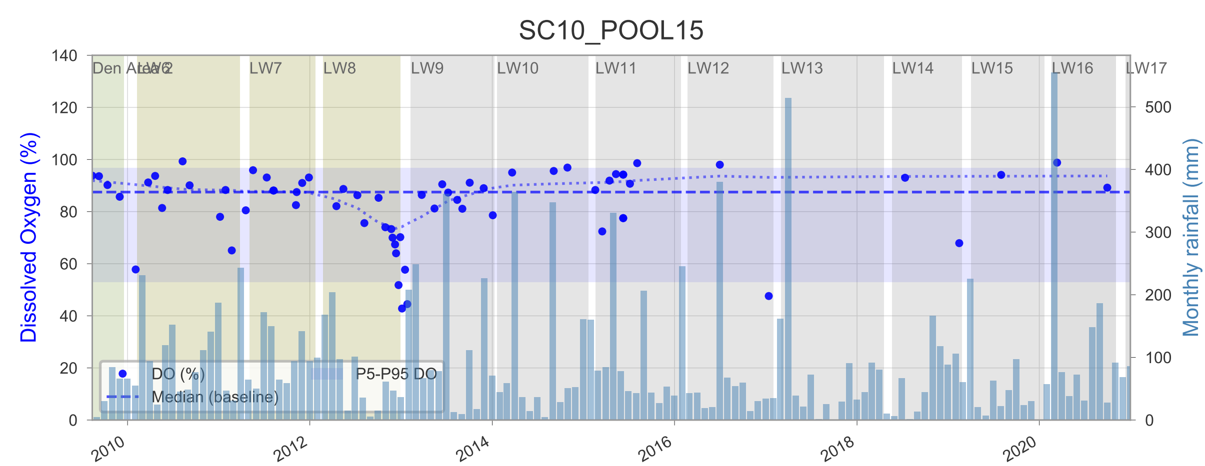
SC10_POOL15
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL



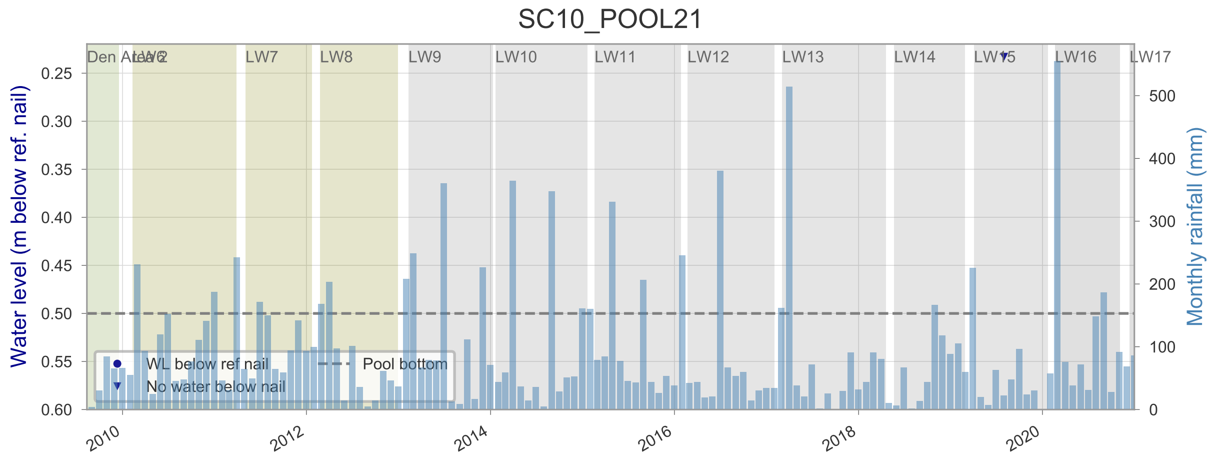
SC10_POOL15
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

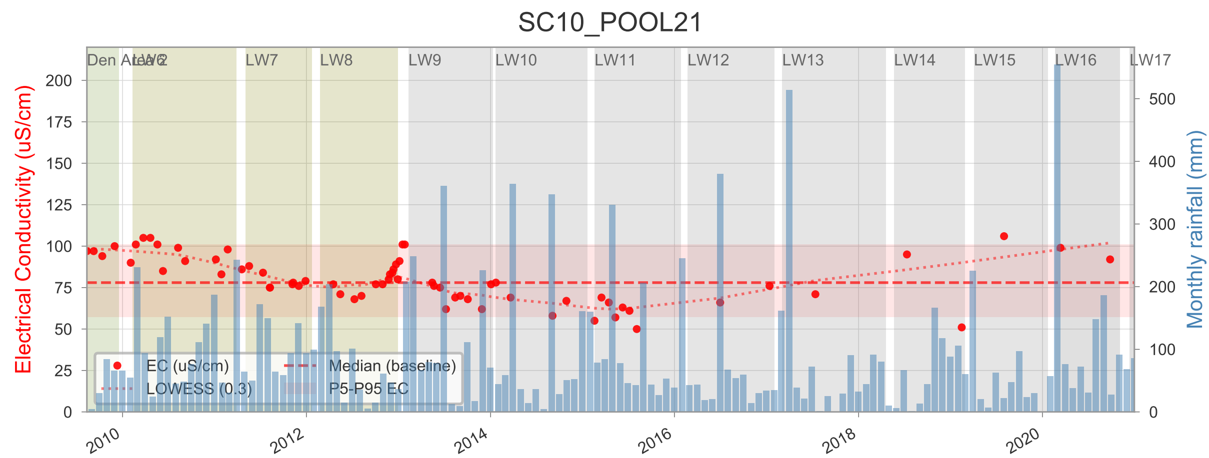


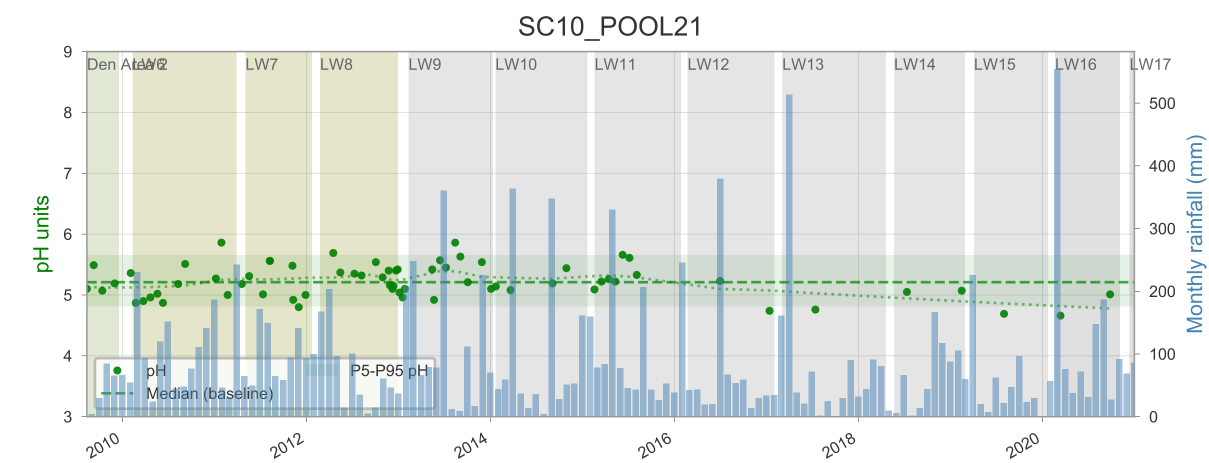
SC10_POOL15
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

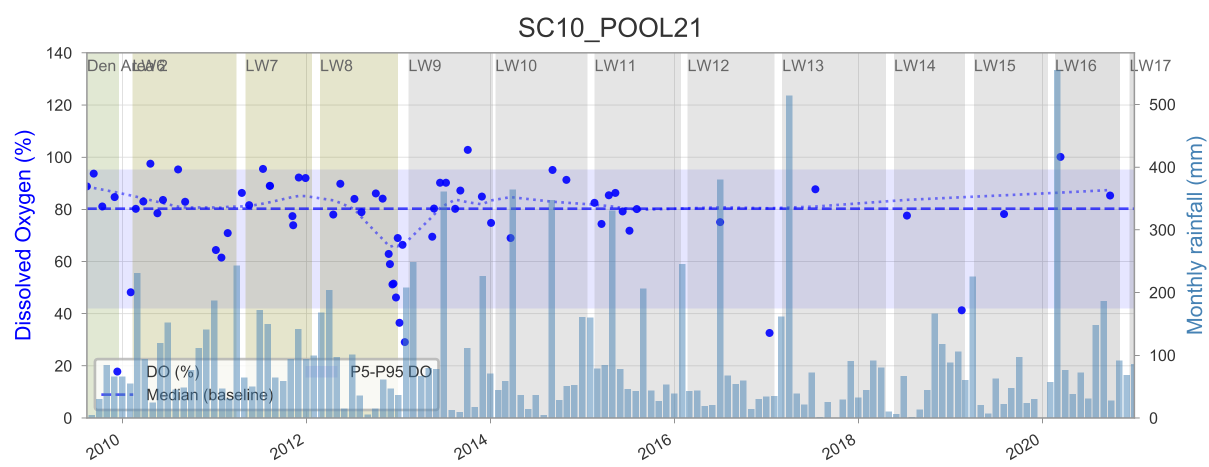


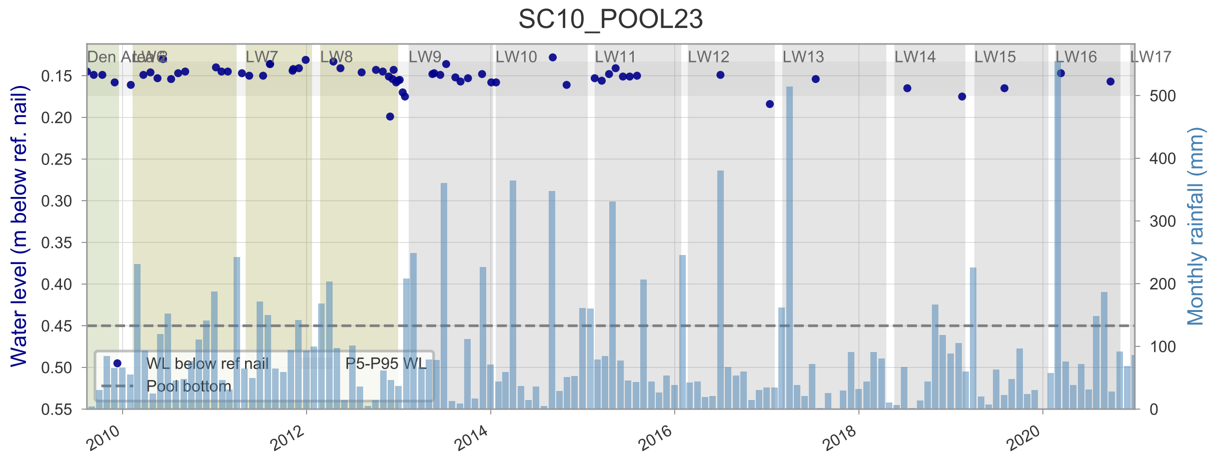
SC10_POOL15
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

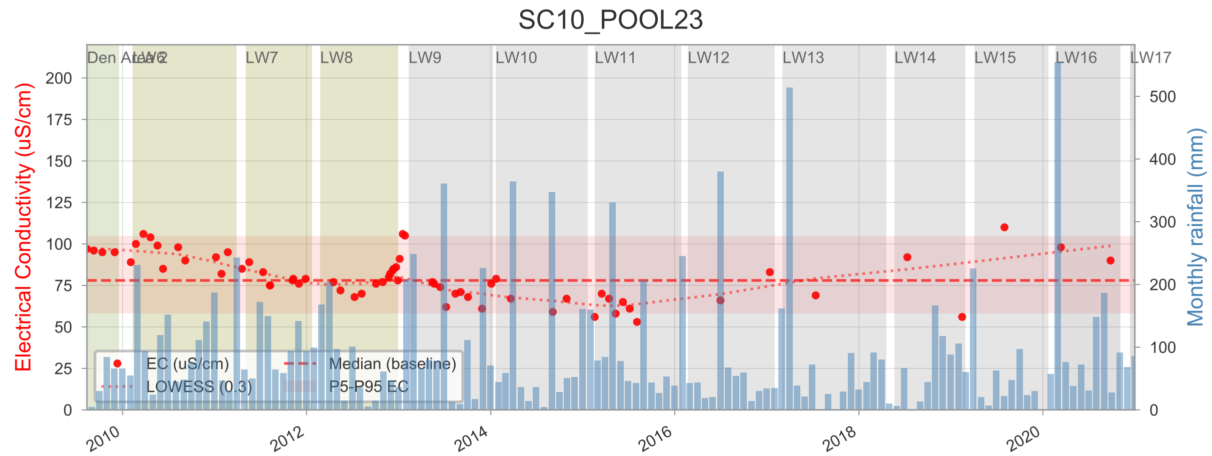

SC10_POOL21
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool bottom
2010
2012
2014
2016
2018
2020

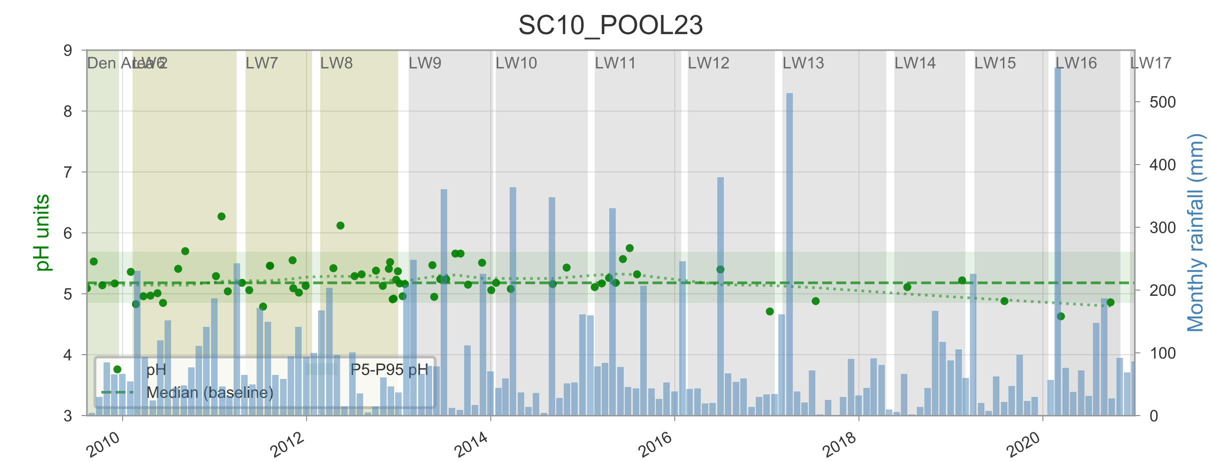

SC10_POOL21
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

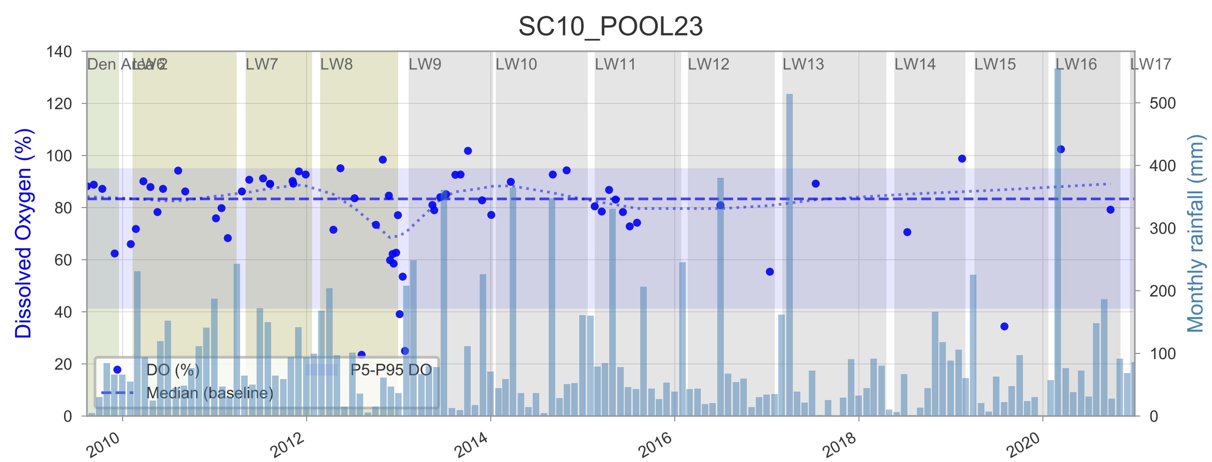

SC10_POOL21
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

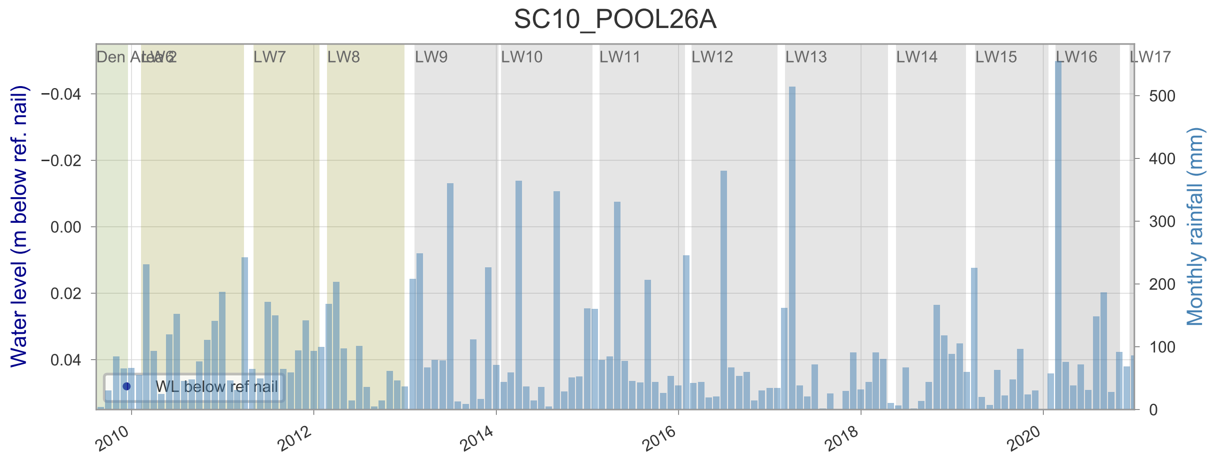

SC10_POOL21
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

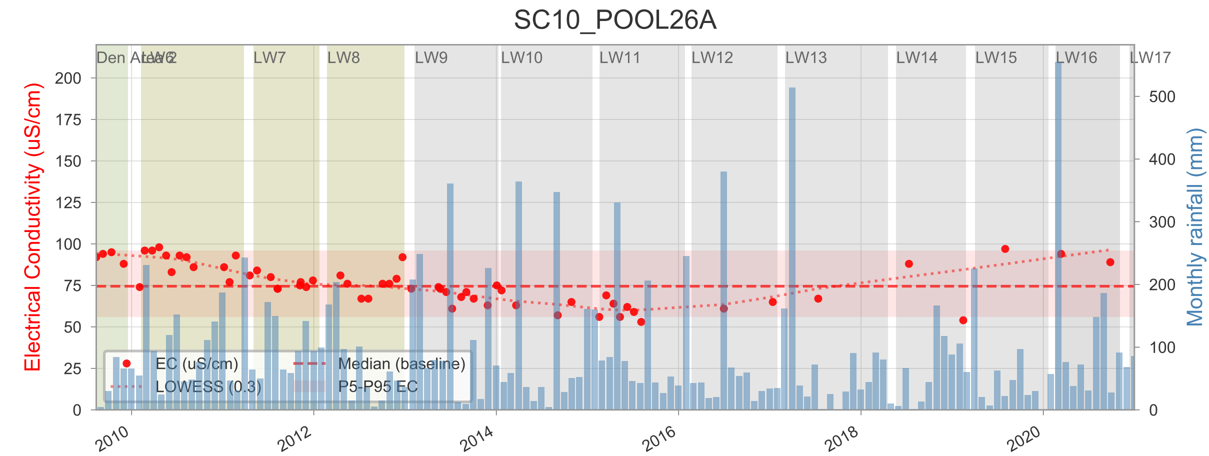

SC10_POOL23
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL

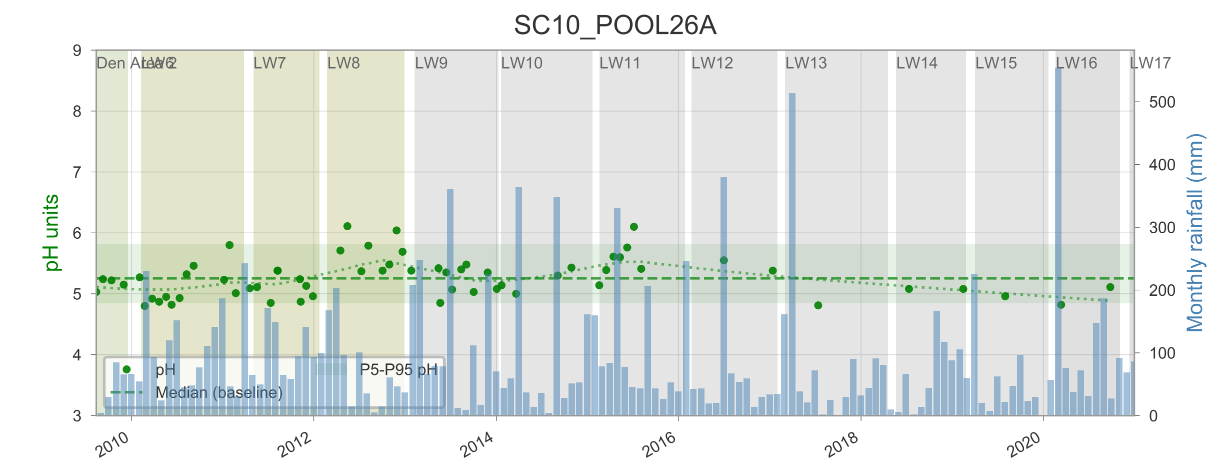

SC10_POOL23
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

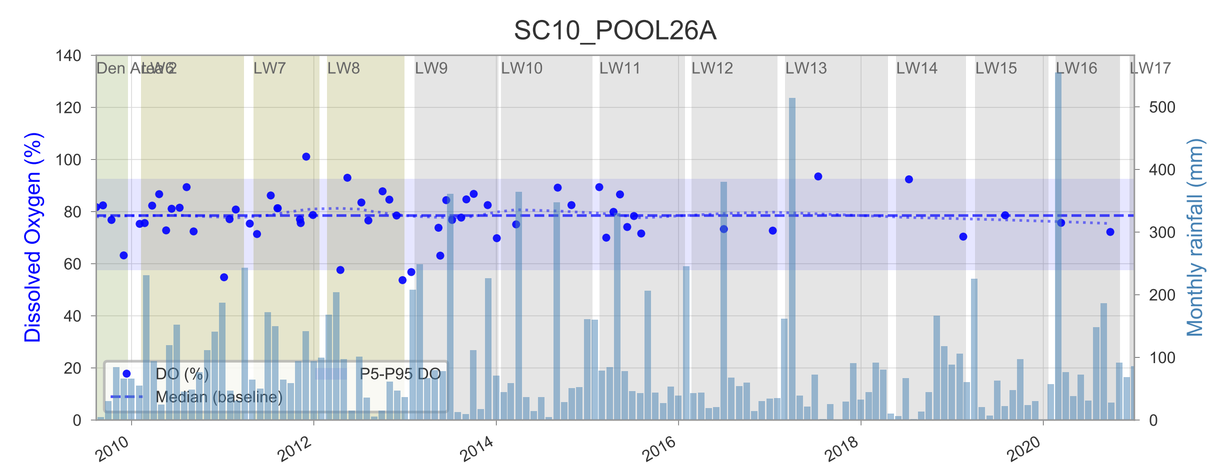

SC10_POOL23
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

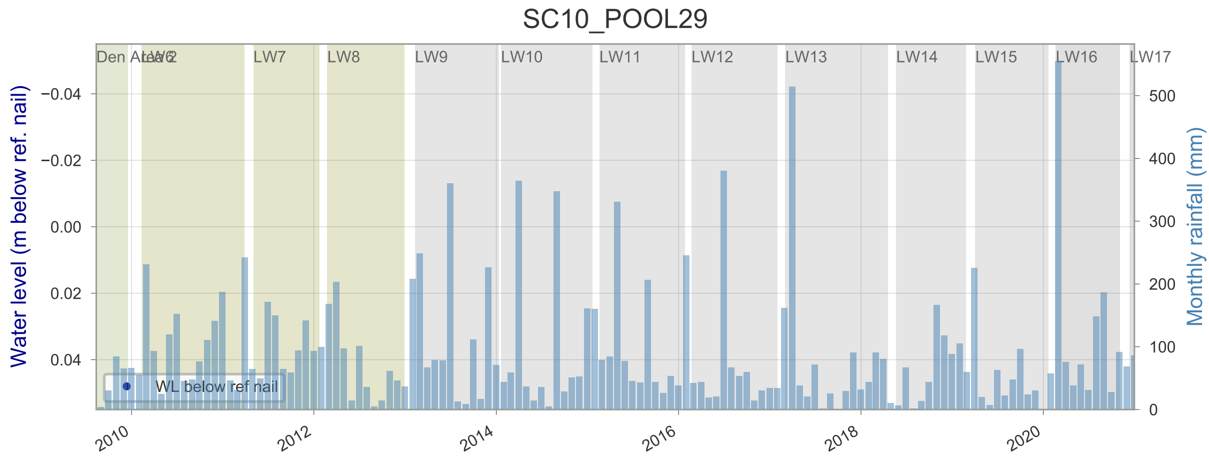

SC10_POOL23
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

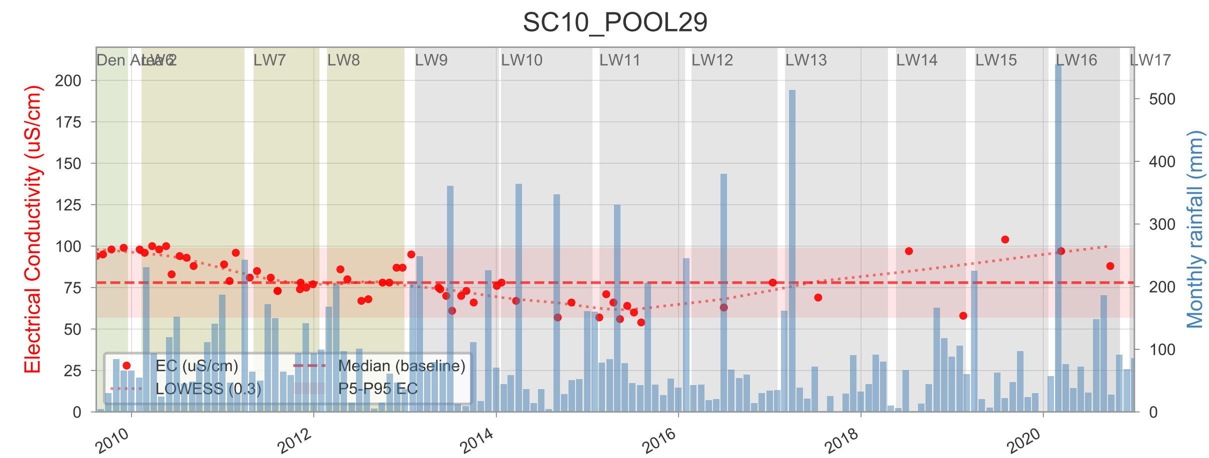

SC10_POOL26A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail

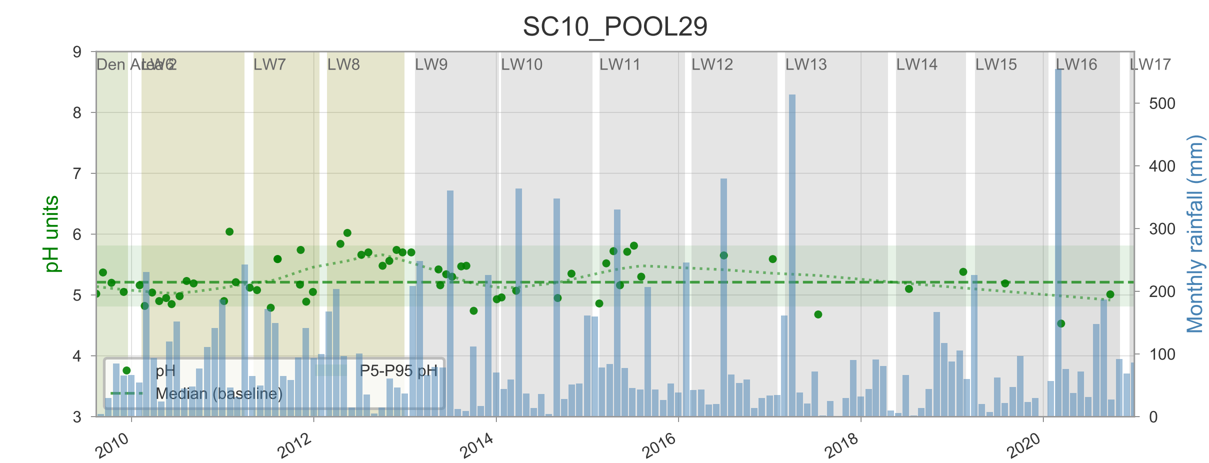

SC10_POOL26A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

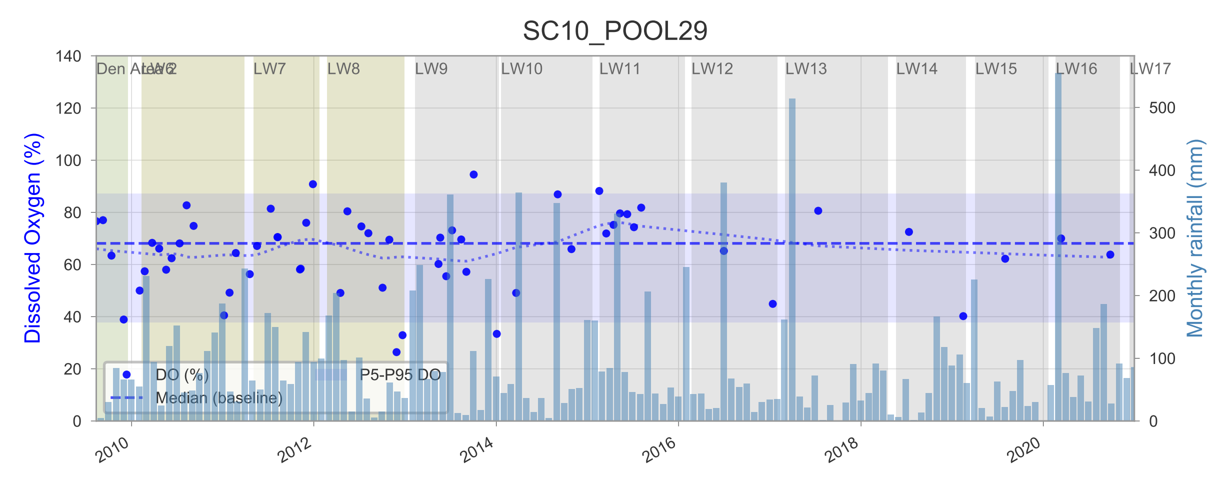

SC10_POOL26A
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

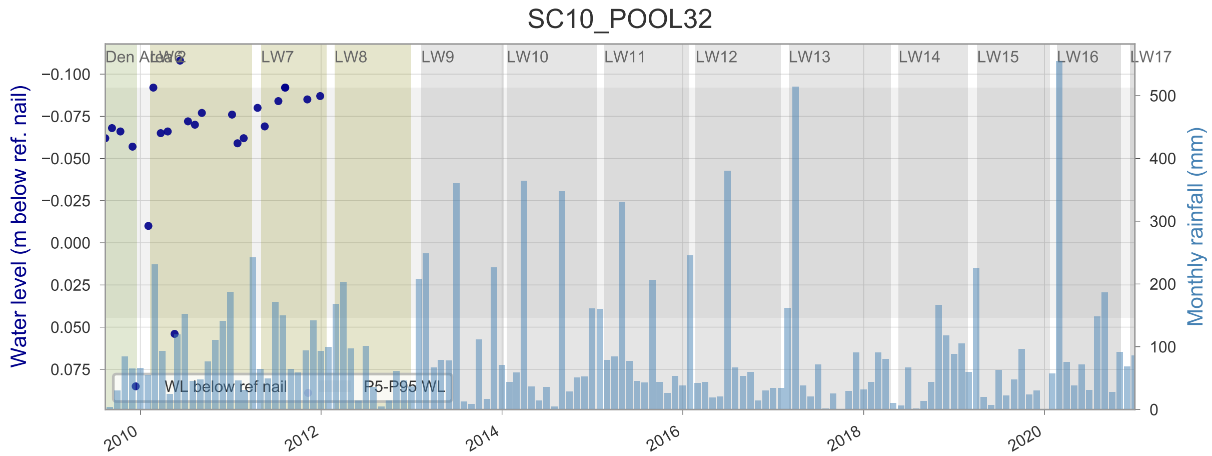

SC10_POOL26A
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

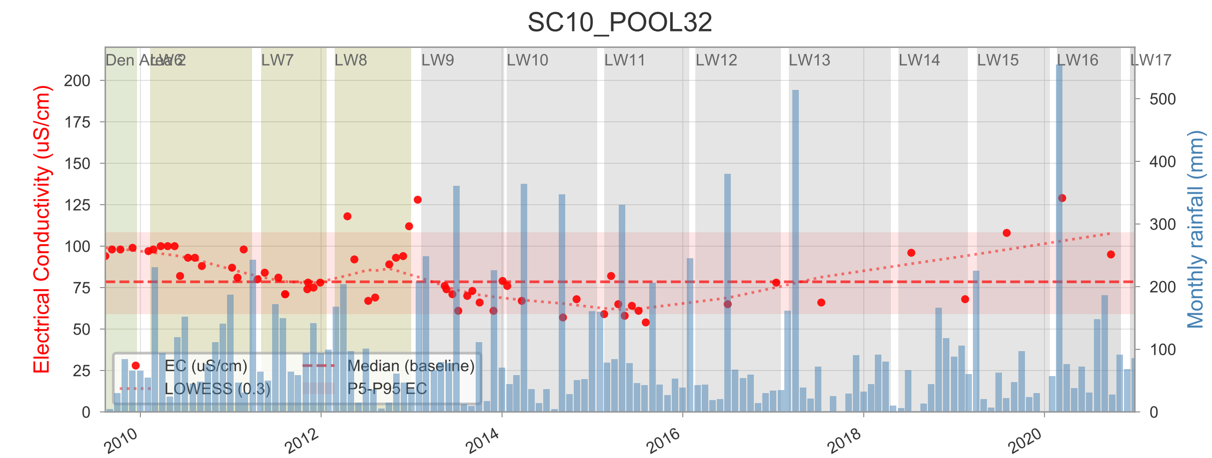

SC10_POOL29
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

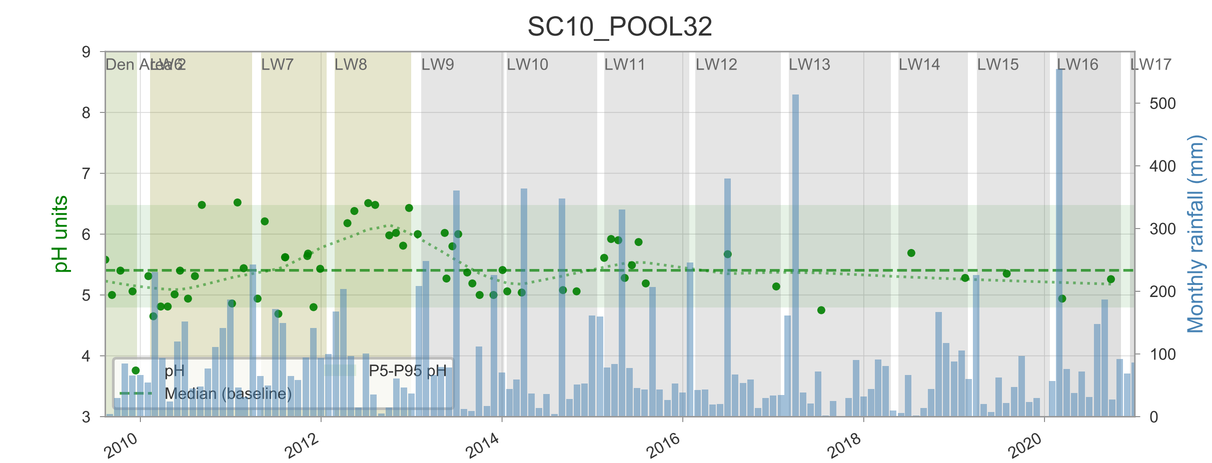

SC10_POOL29
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

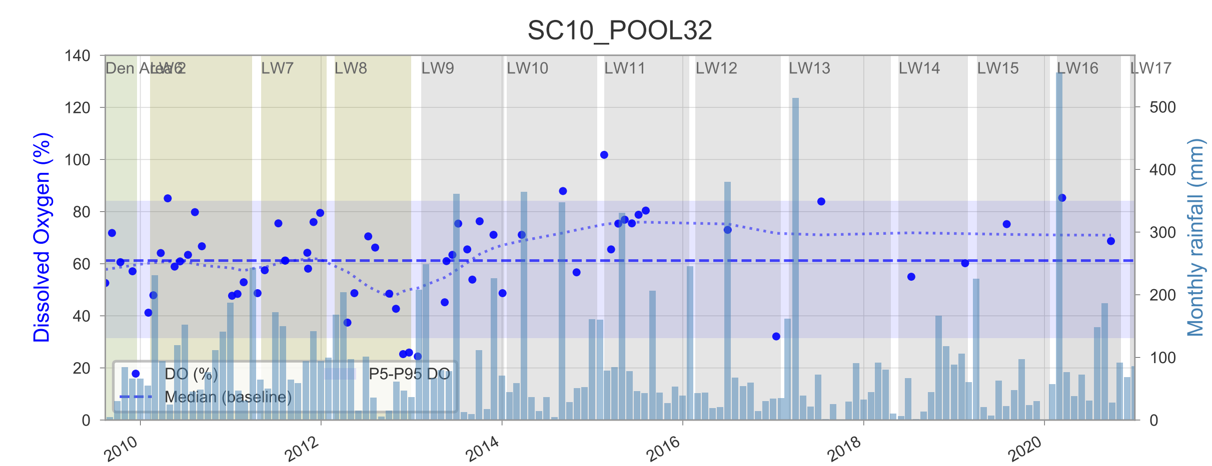

SC10_POOL29
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17


SC10_POOL29
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

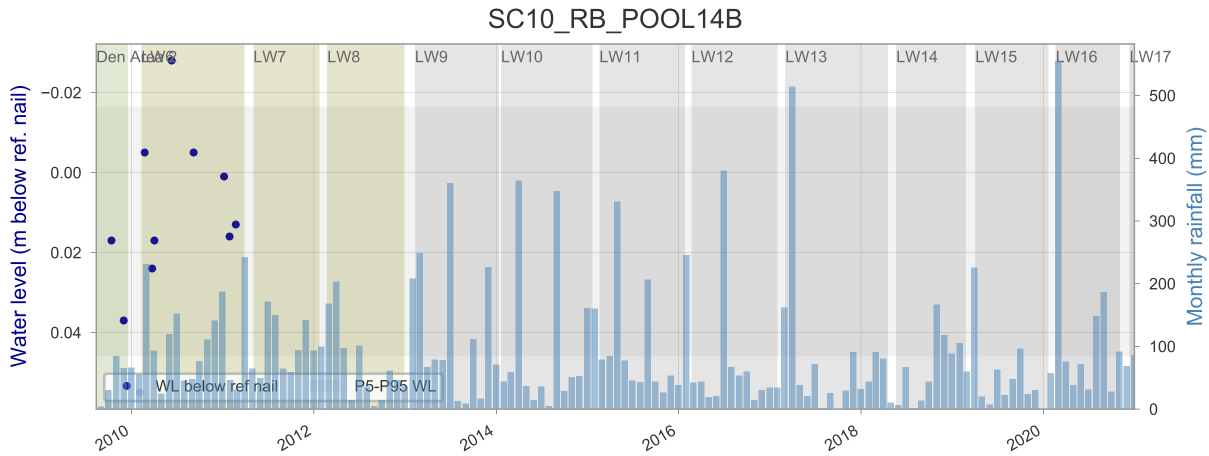

SC10_POOL32
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
2010
2012
2014
2016
2018
2020

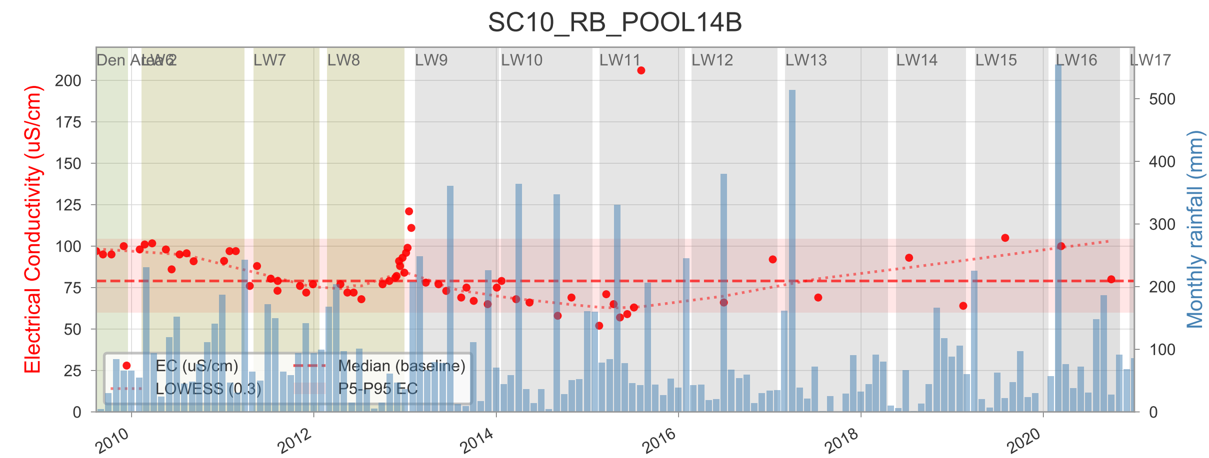

SC10_POOL32
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

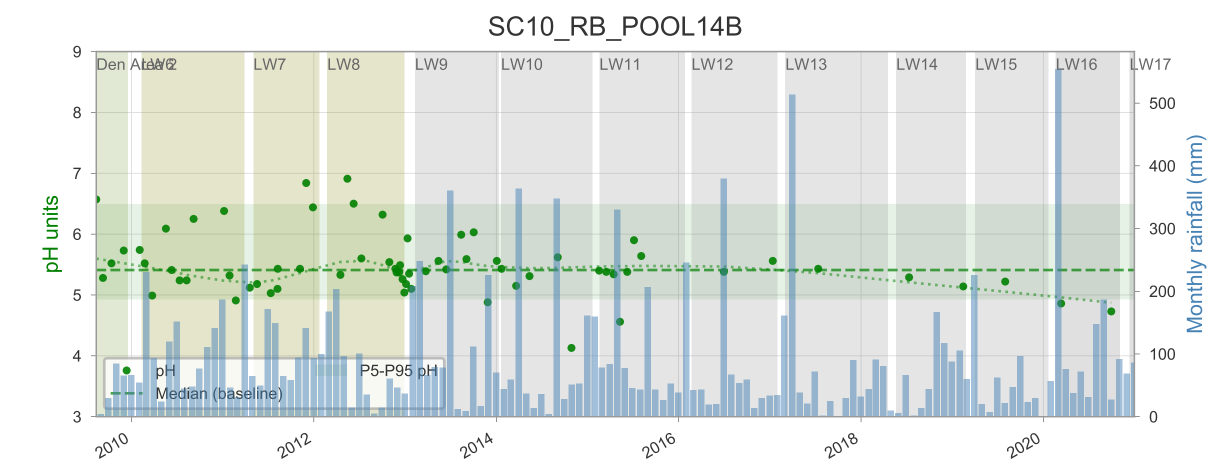

SC10_POOL32
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

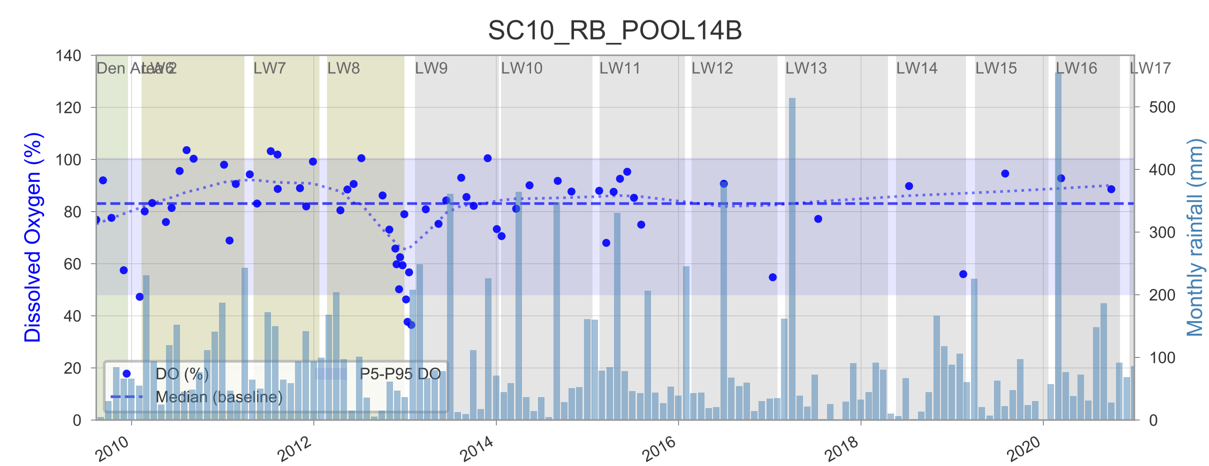

SC10_POOL32
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

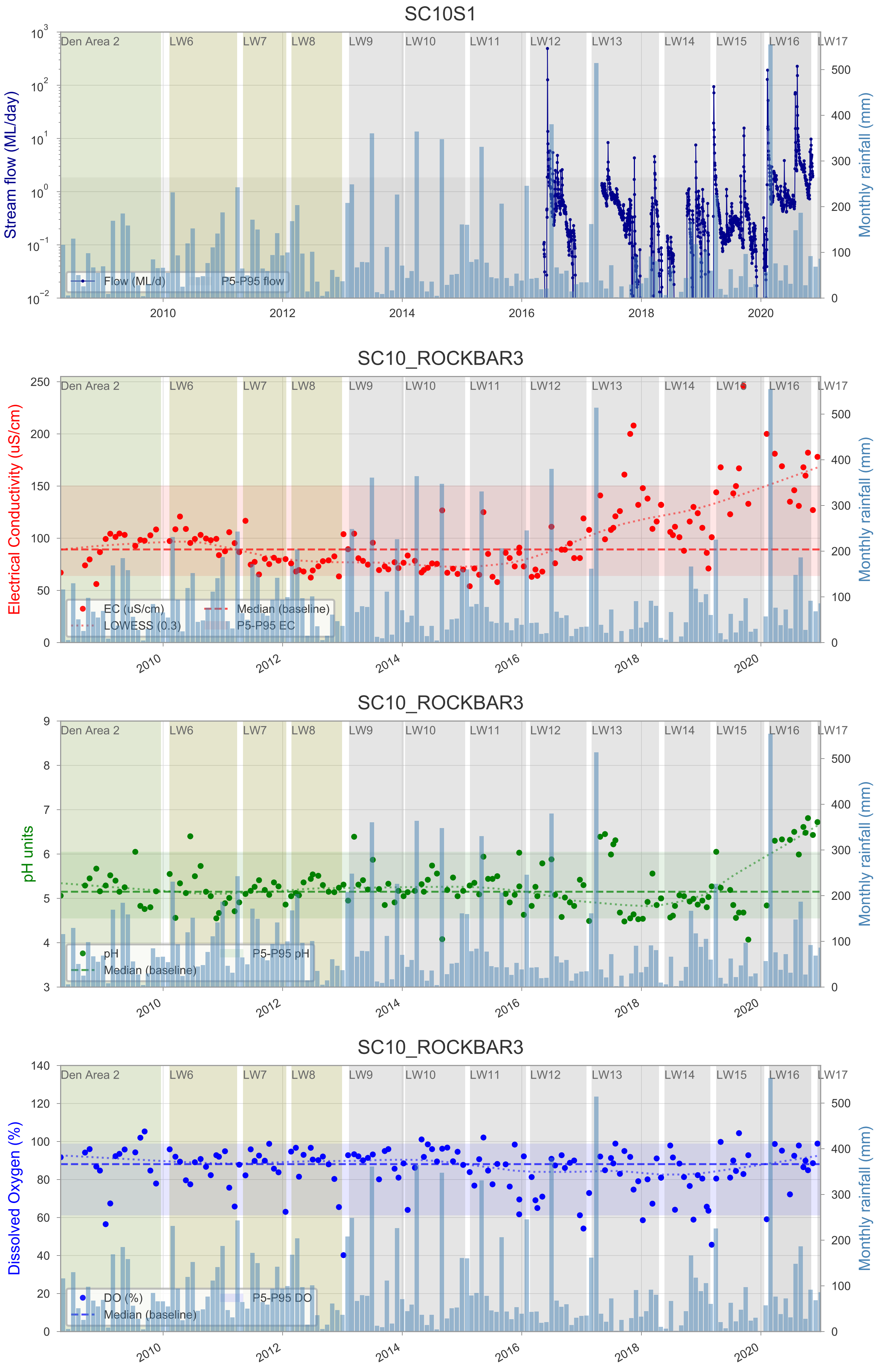

SC10_POOL4
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
SC10_POOL4
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SC10_POOL4
pH units
pH
Median (baseline)
P5-P95 pH
SC10_POOL4
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

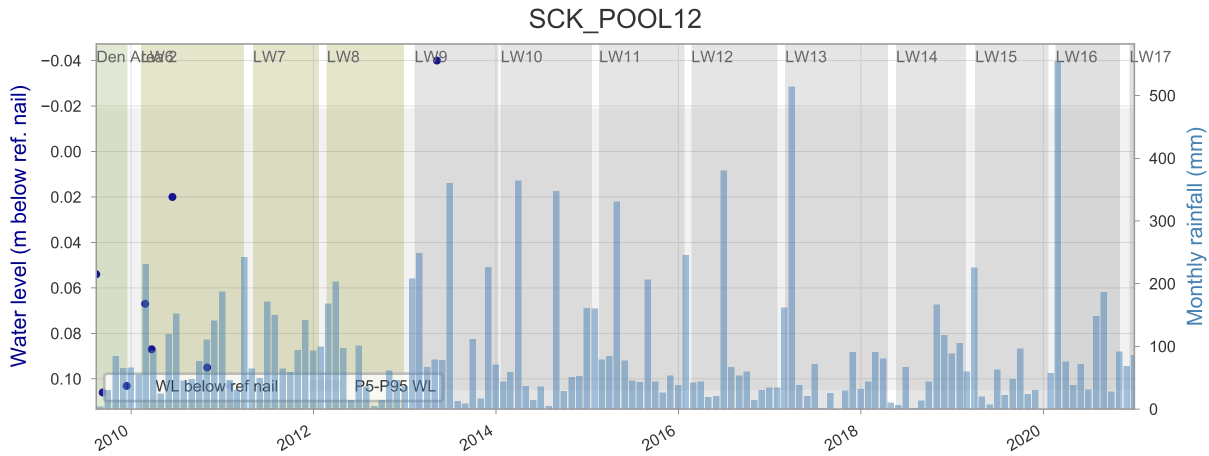

SC10_RB_POOL14B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

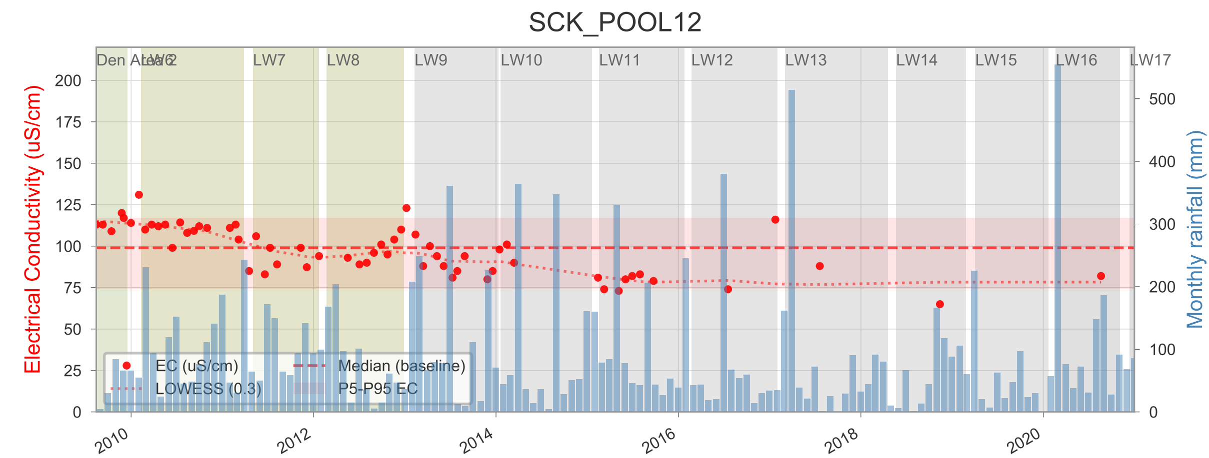

SC10_RB_POOL14B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

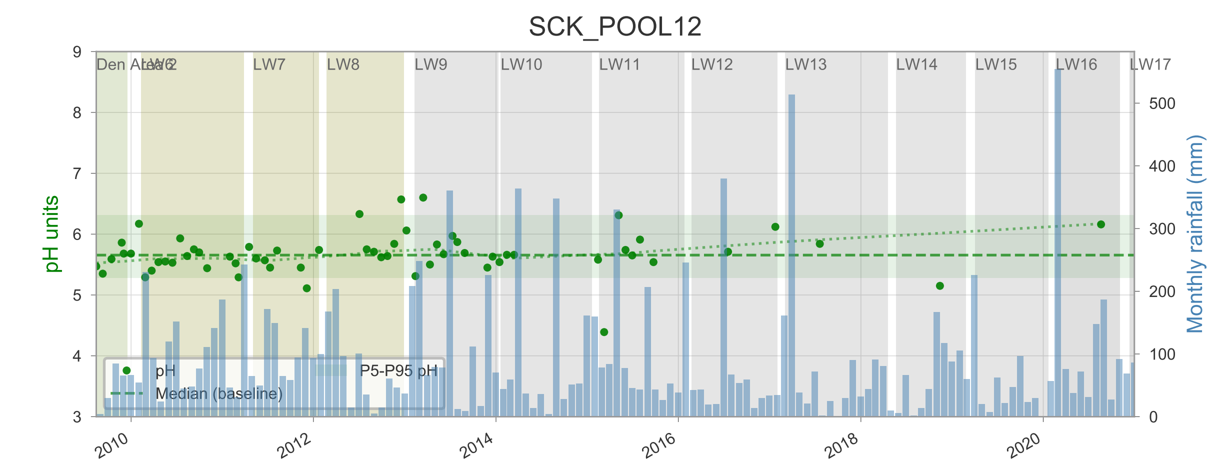

SC10_RB_POOL14B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

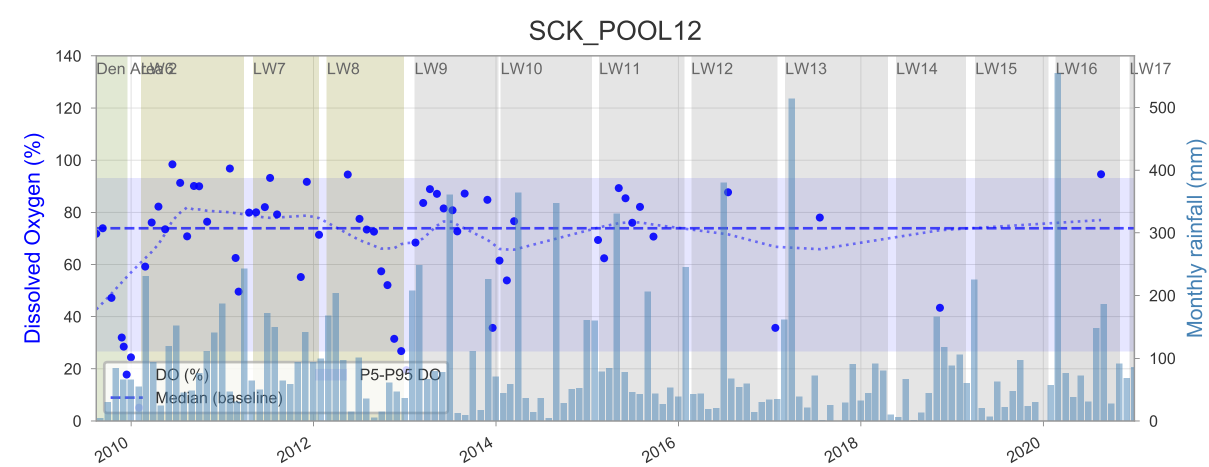

SC10_RB_POOL14B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

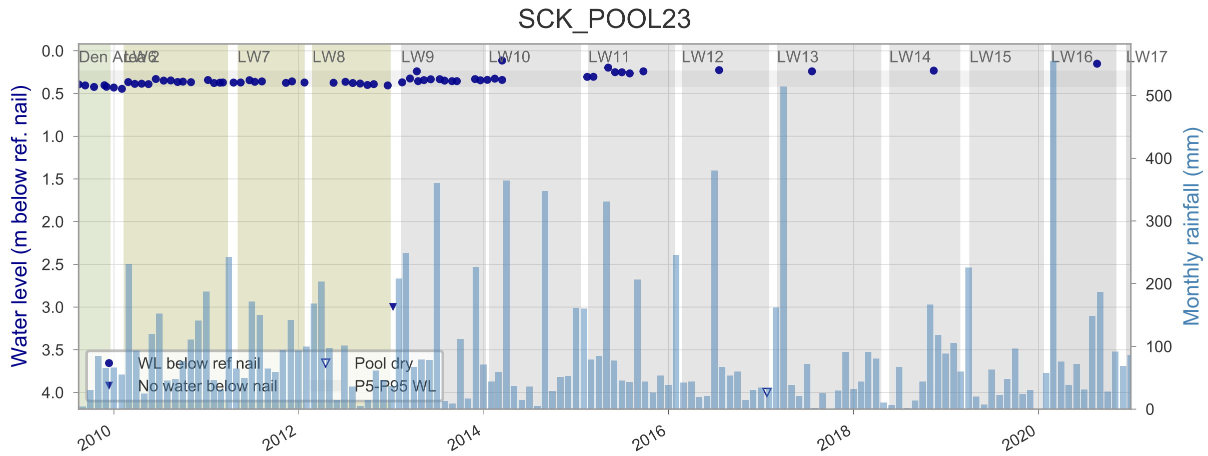

SC10S1
Stream flow (ML/day)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
P5-P95 flow
SC10_ROCKBAR3
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SC10_ROCKBAR3
pH units
pH
Median (baseline)
P5-P95 pH
SC10_ROCKBAR3
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

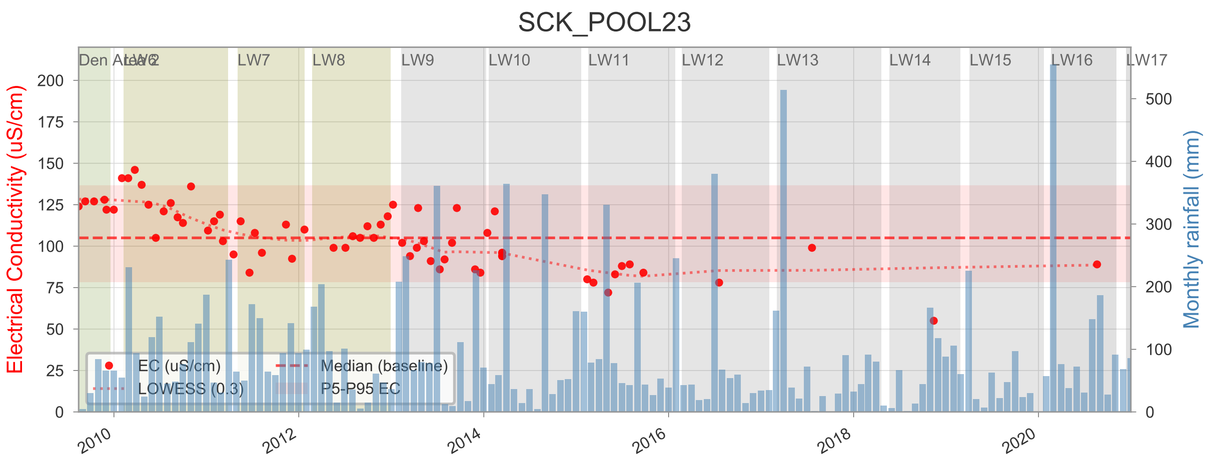

SCK_POOL12
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
2010
2012
2014
2016
2018
2020

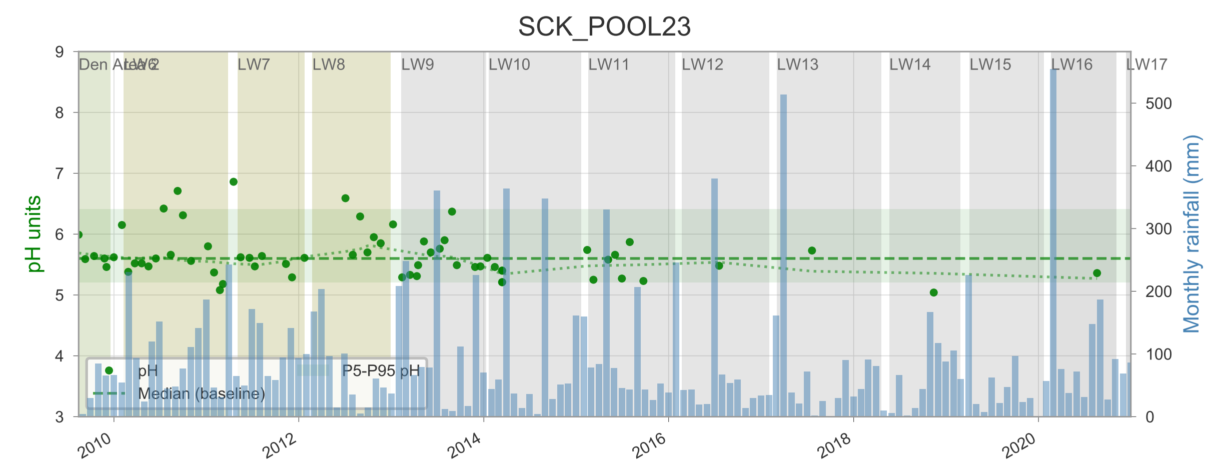

SCK_POOL12
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

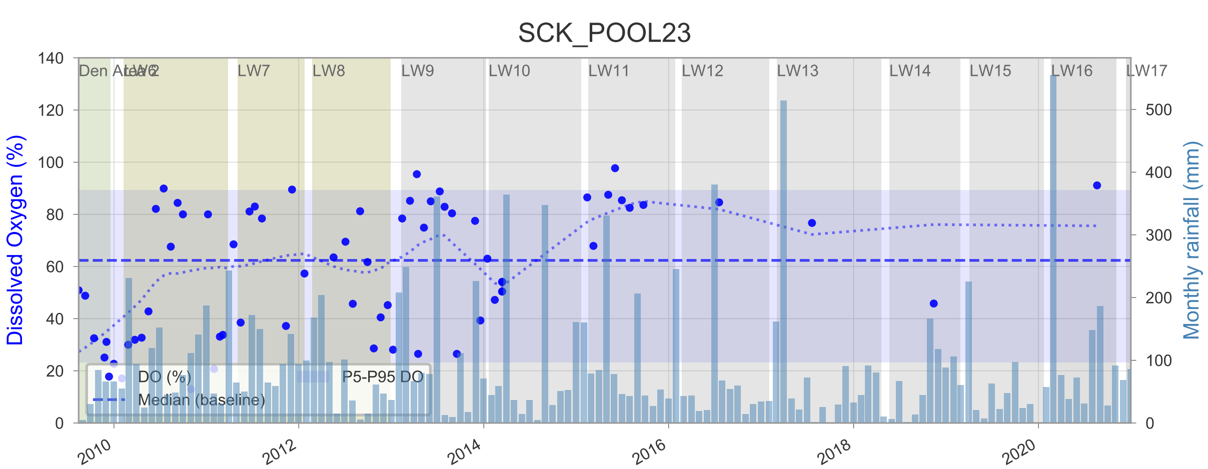

SCK_POOL12
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

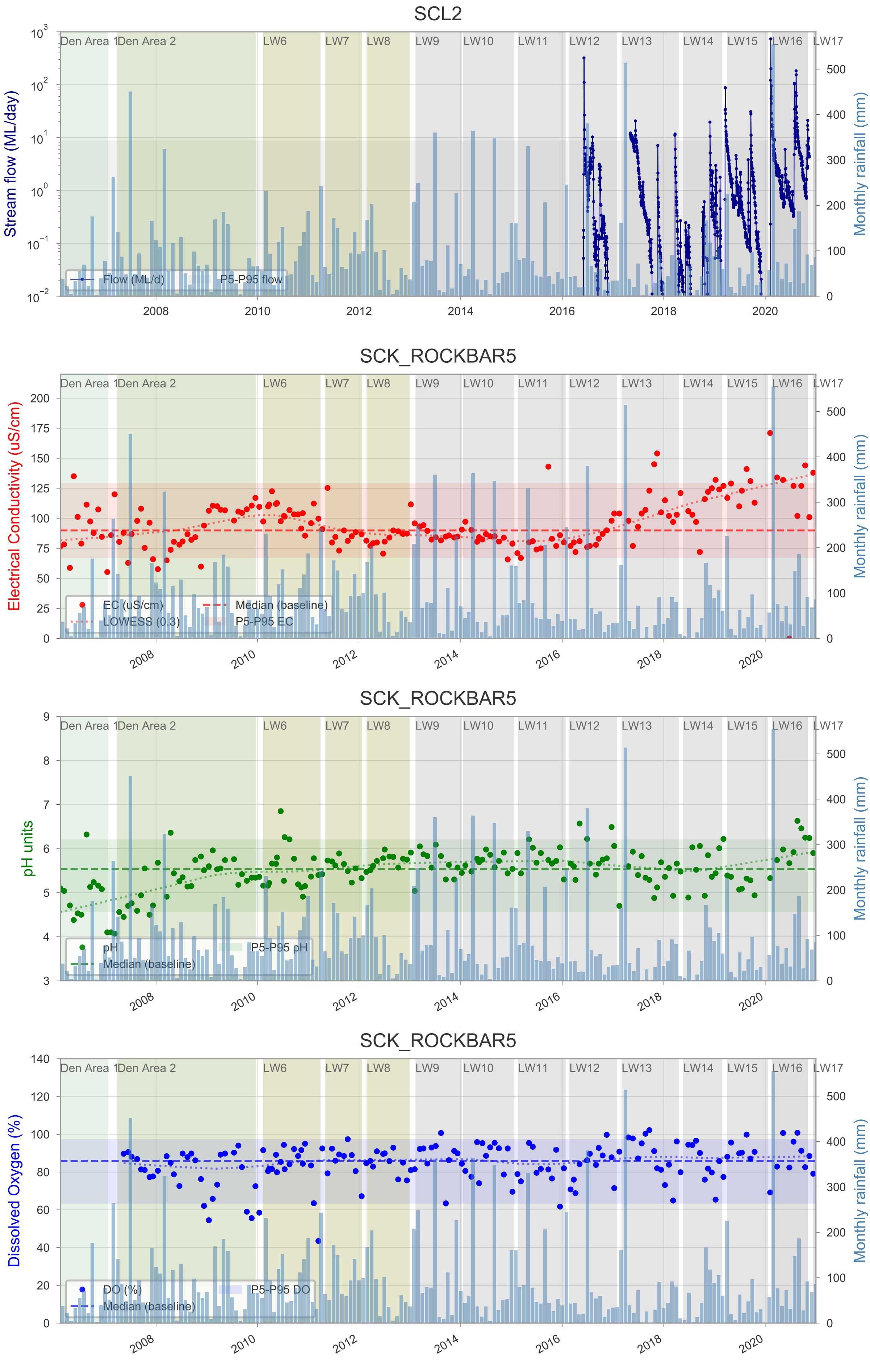

SCK_POOL12
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


SCK_POOL23
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
P5-P95 WL
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

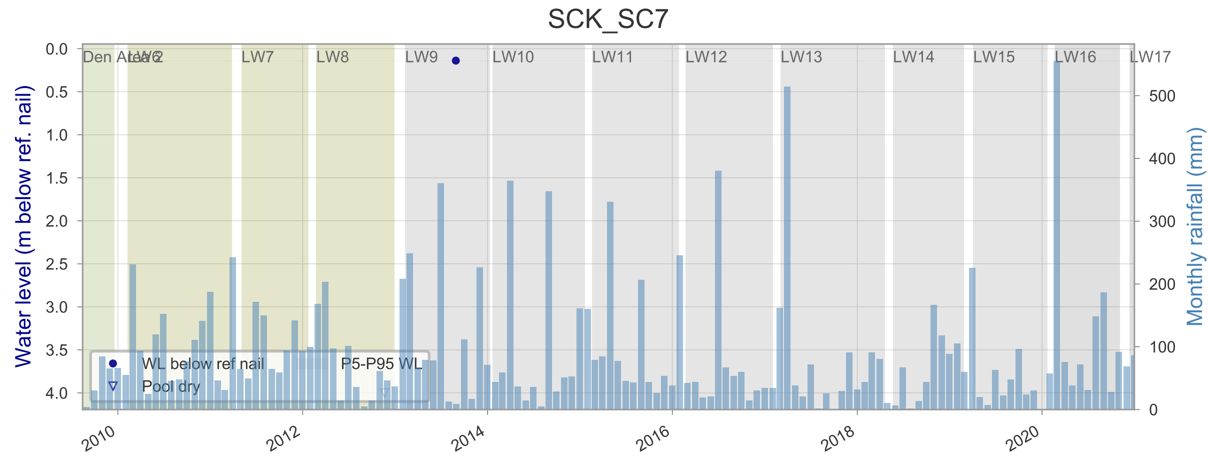

SCK_POOL23
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

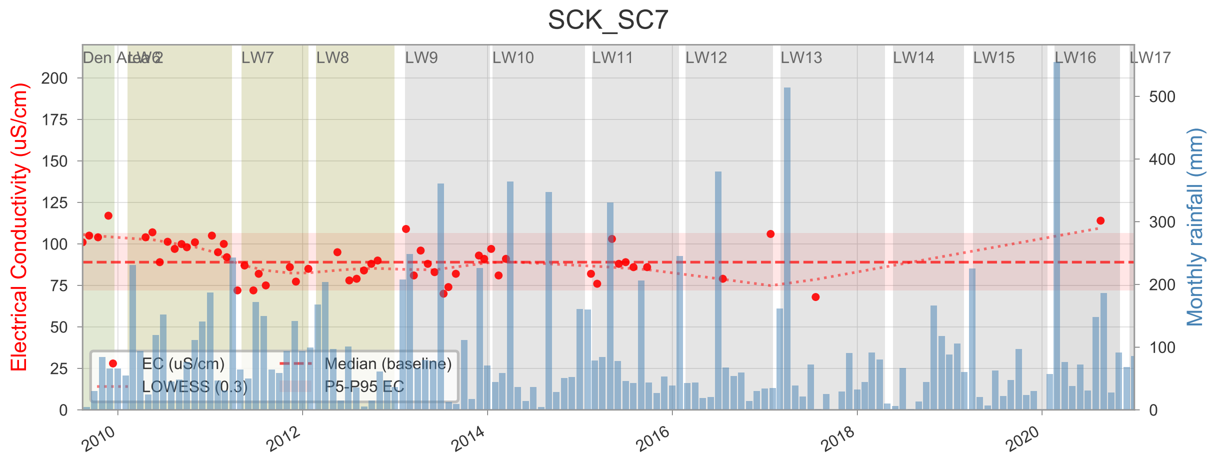

SCK_POOL23
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

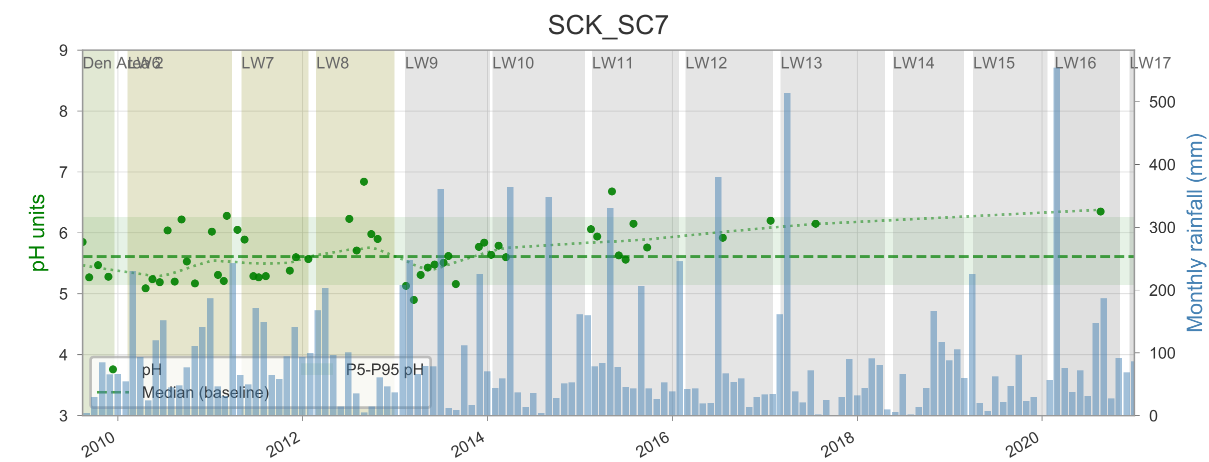

SCK_POOL23
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

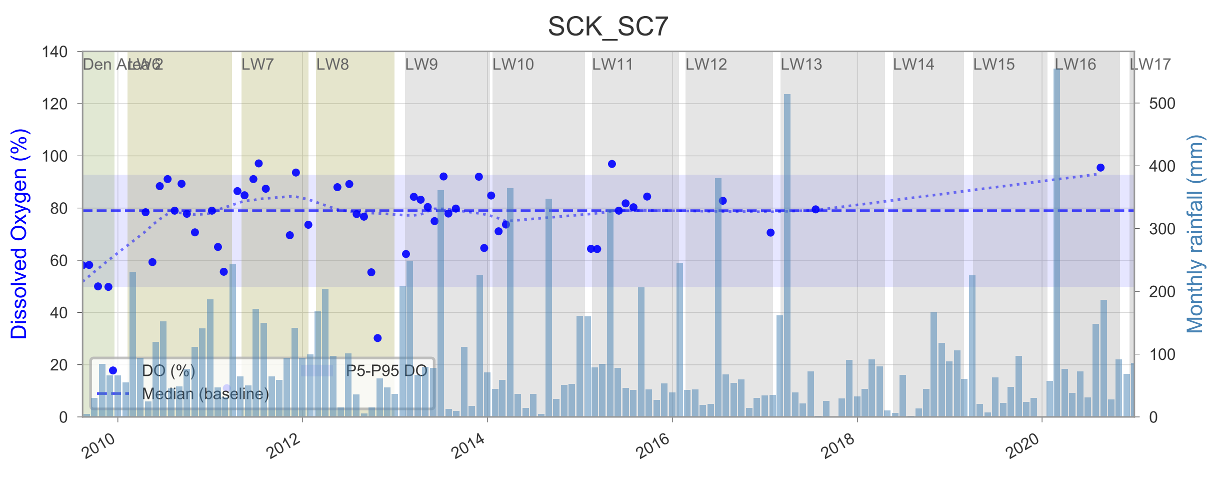


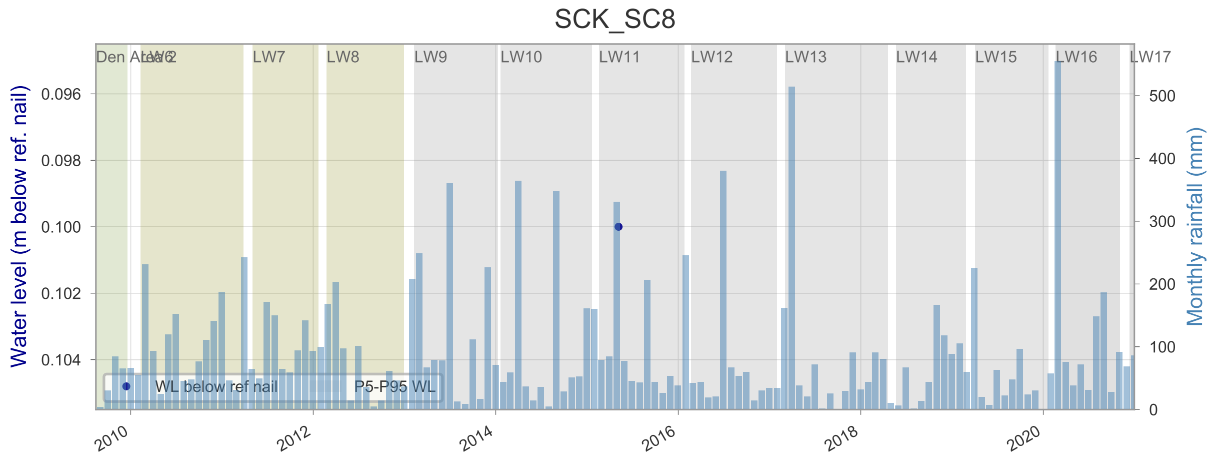
SCL2
Stream flow (ML/day)
Monthly rainfall (mm)
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
P5-P95 flow
SCK_ROCKBAR5
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
SCK_ROCKBAR5
pH units
pH
Median (baseline)
P5-P95 pH
SCK_ROCKBAR5
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

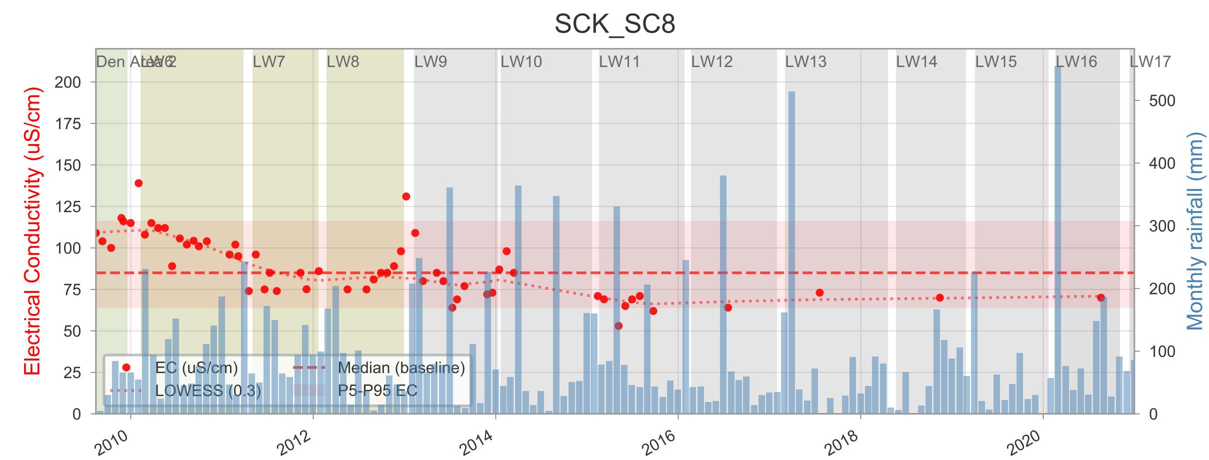

SCK_SC7
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool dry
P5-P95 WL
2010
2012
2014
2016
2018
2020

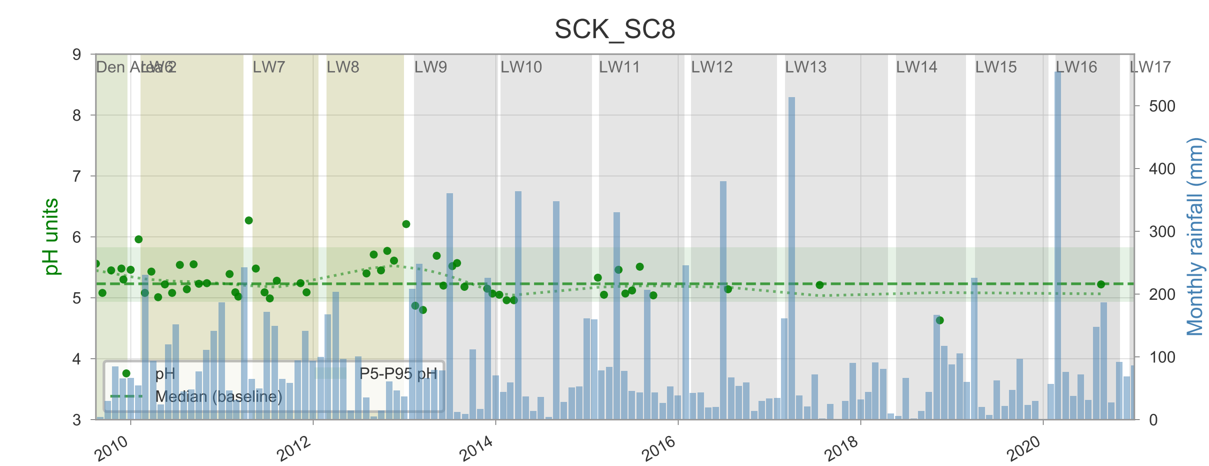

SCK_SC7
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

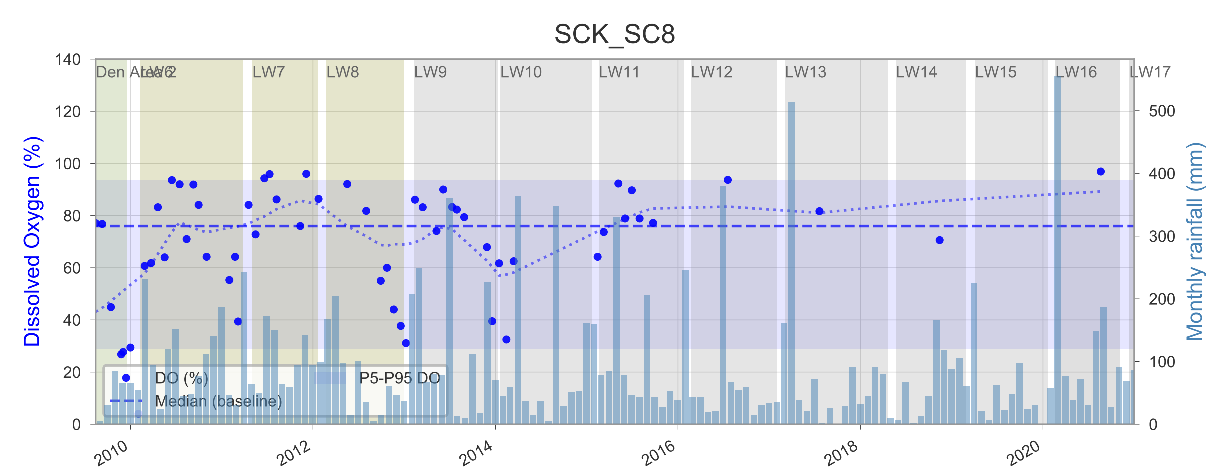

SCK_SC7
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

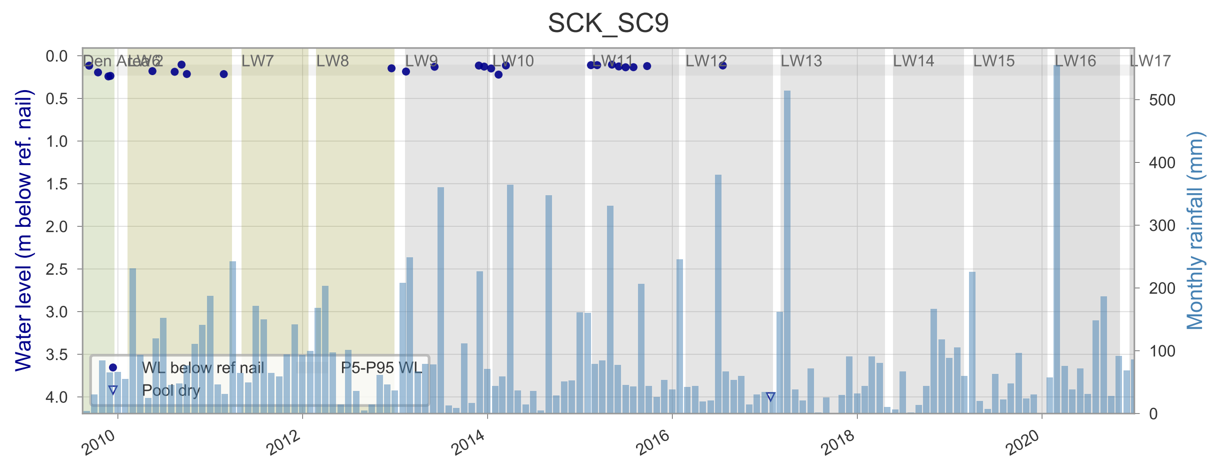

SCK_SC7
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

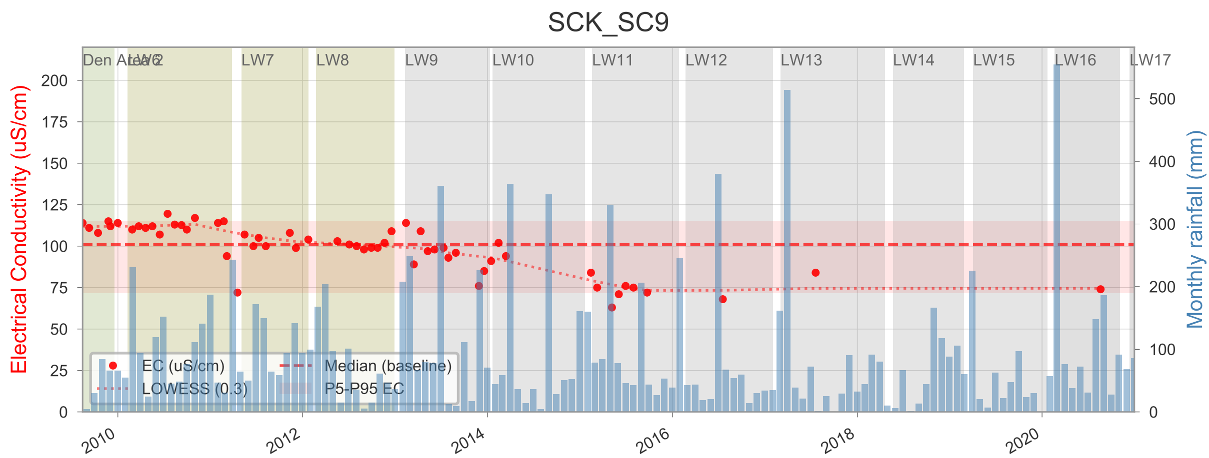

SCK_SC8
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
0.096
0.098
0.100
0.102
0.104
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

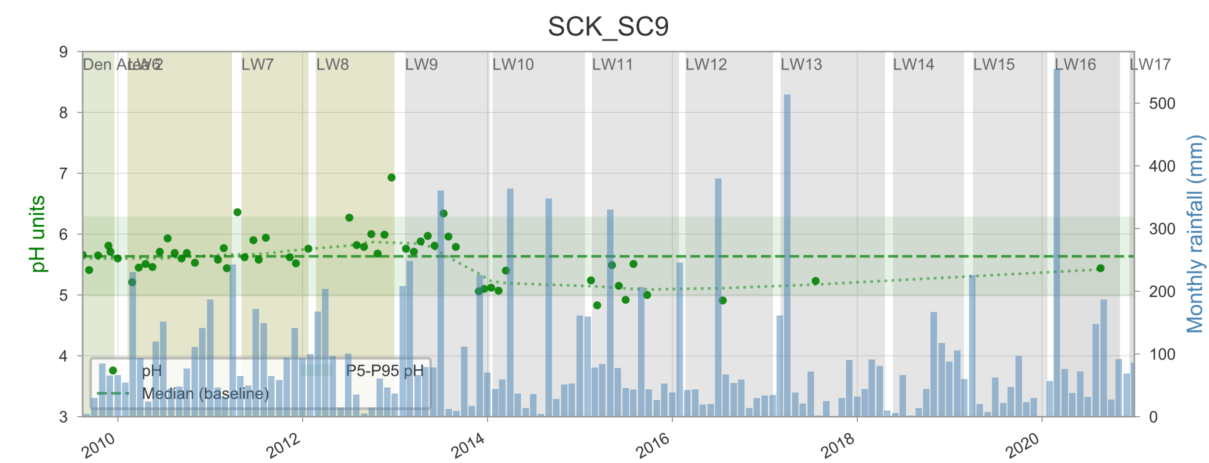

SCK_SC8
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

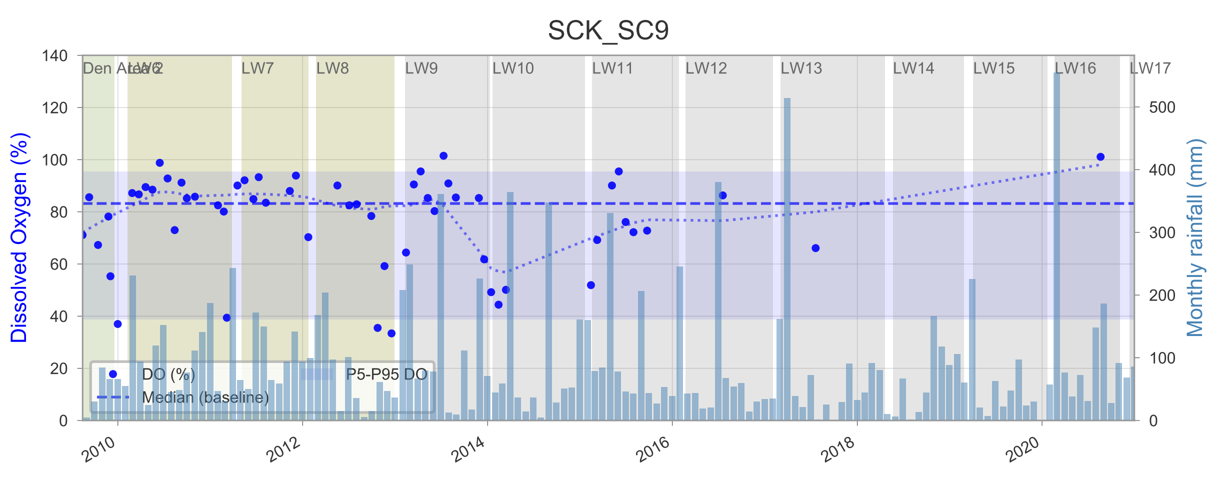

SCK_SC8
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

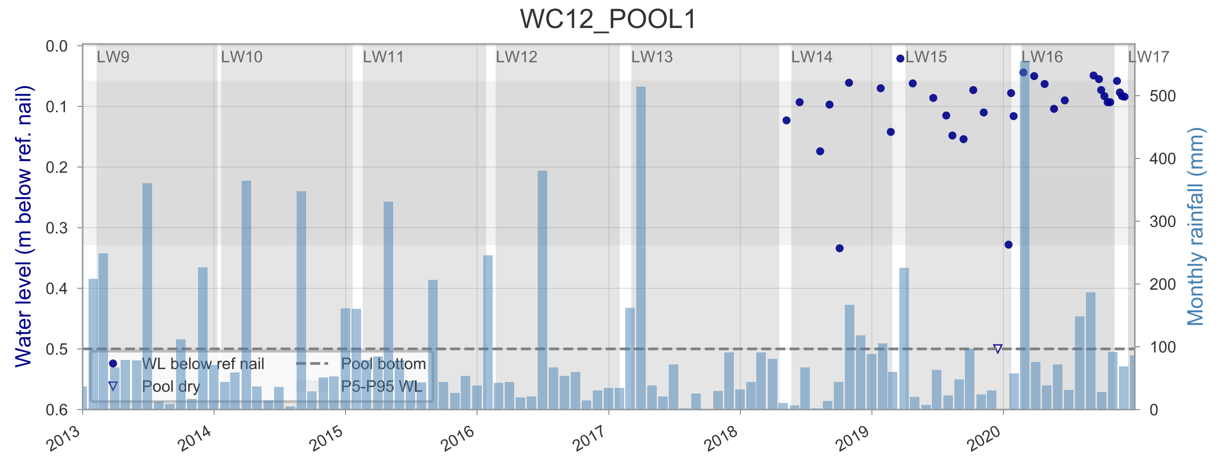

SCK_SC8
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020


SCK_SC9
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool dry
P5-P95 WL
2010
2012
2014
2016
2018
2020

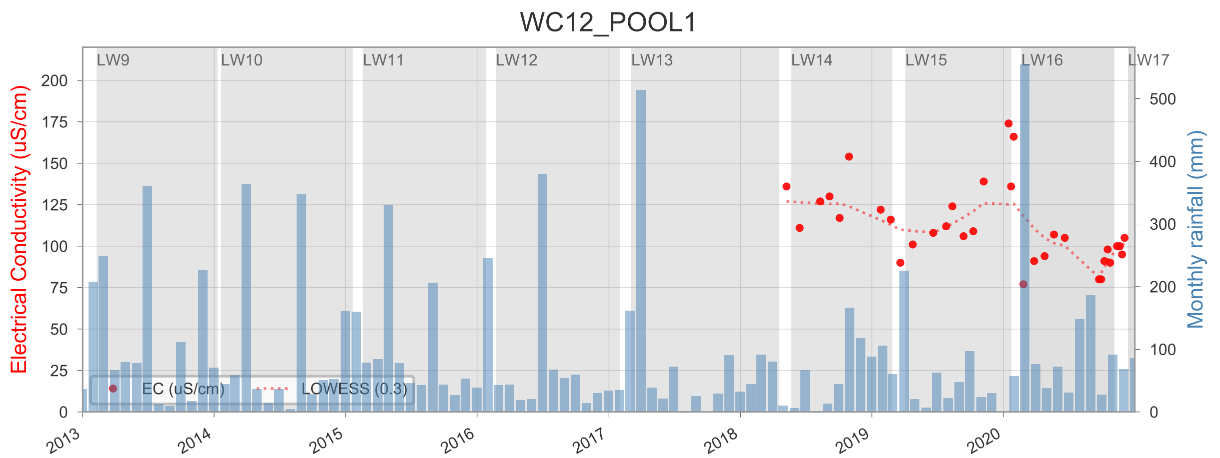

SCK_SC9
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020


SCK_SC9
pH units
Monthly rainfall (mm)
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

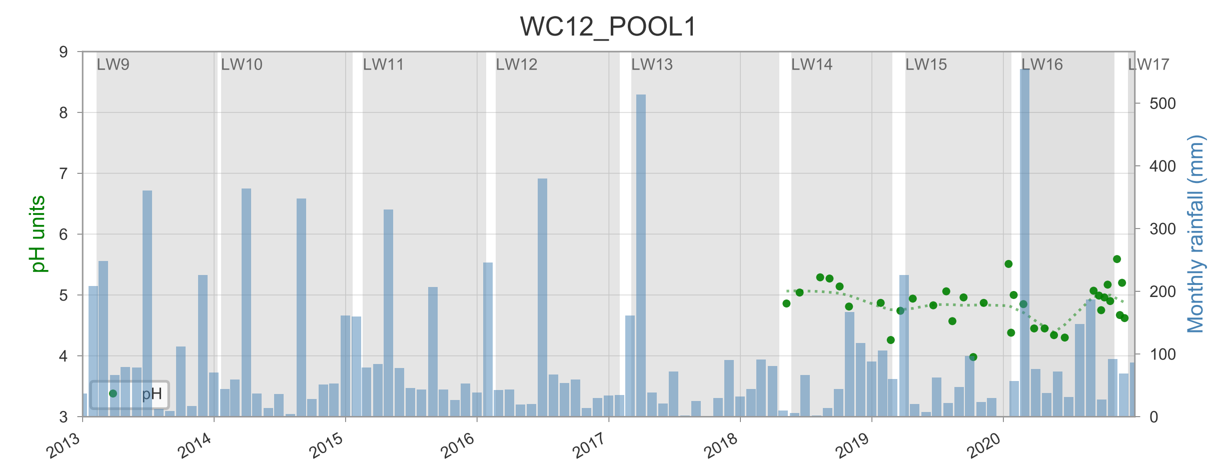

SCK_SC9
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020



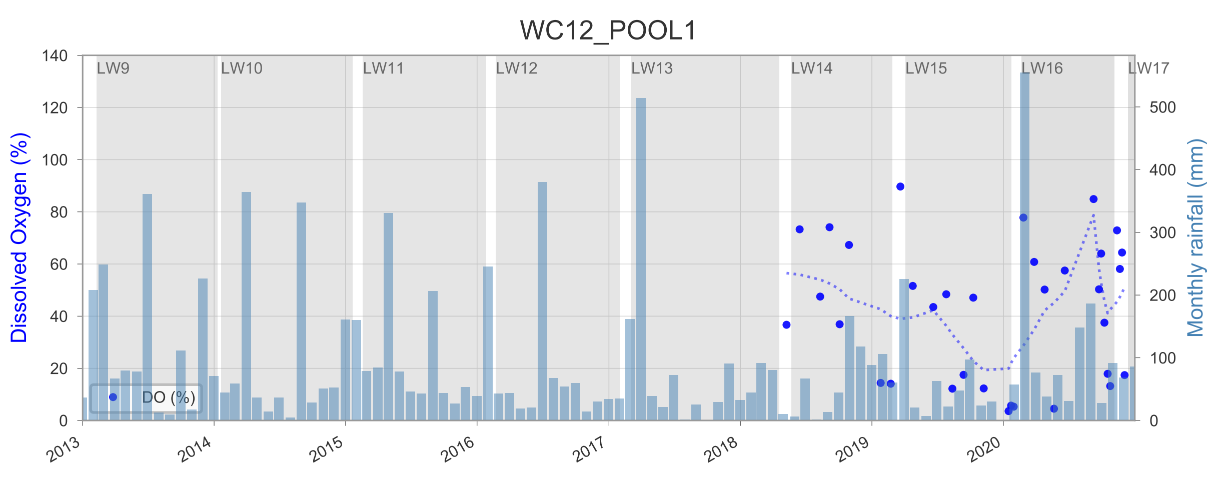
WC12_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool dry
Pool bottom
P5-P95 WL



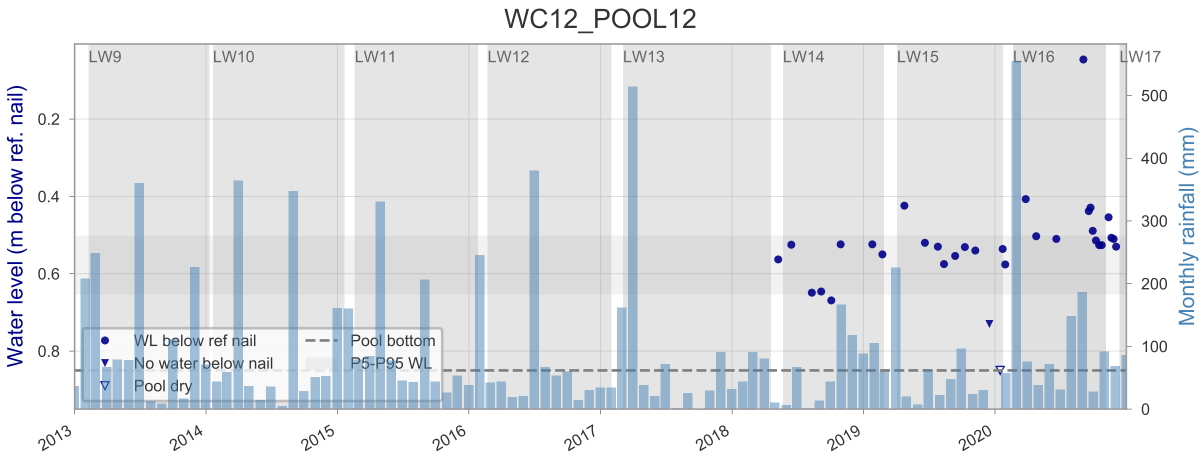
WC12_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

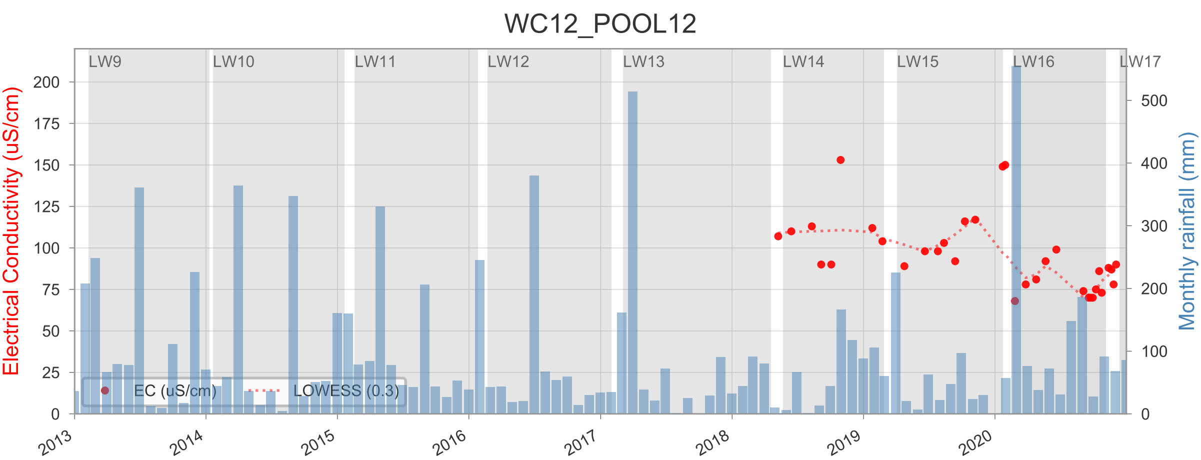


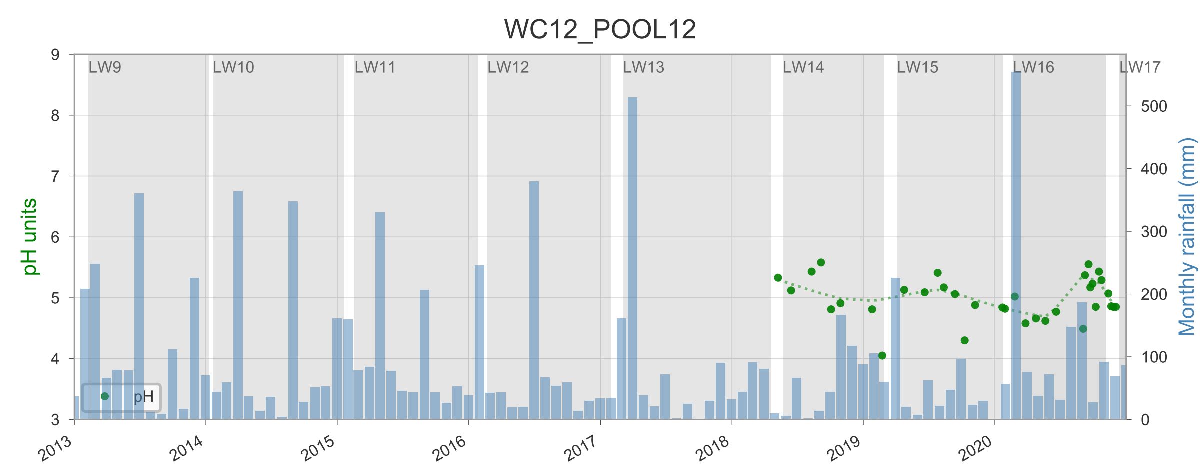
WC12_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

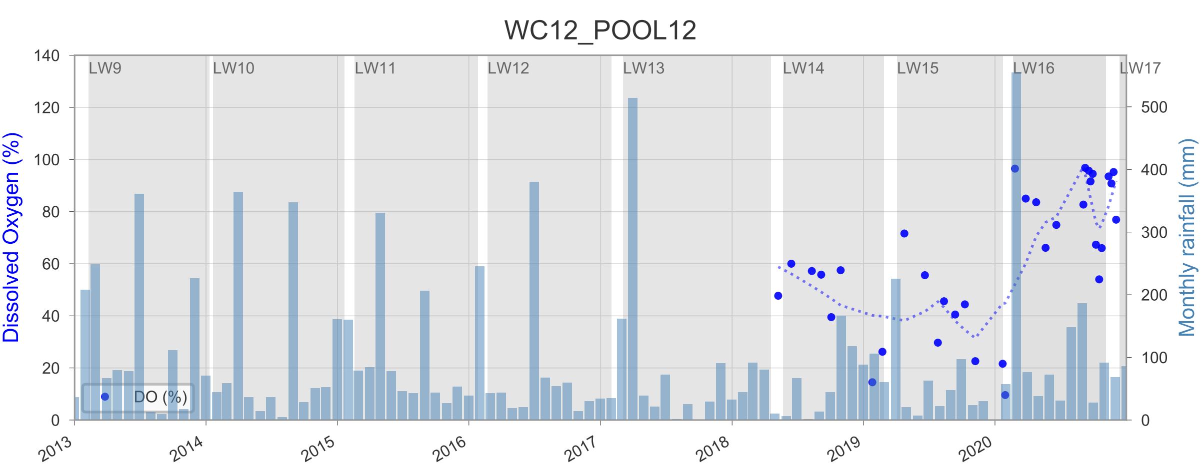


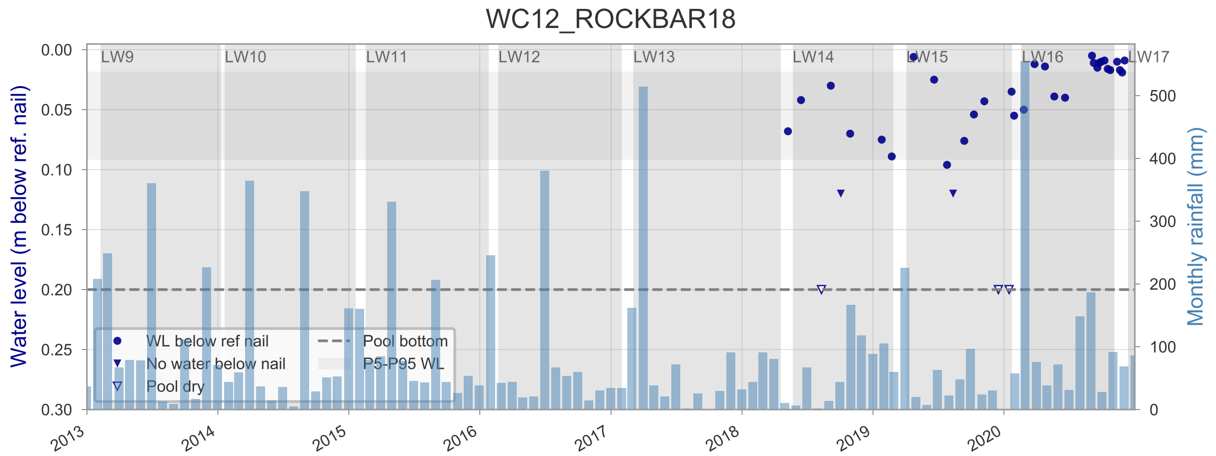
WC12_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

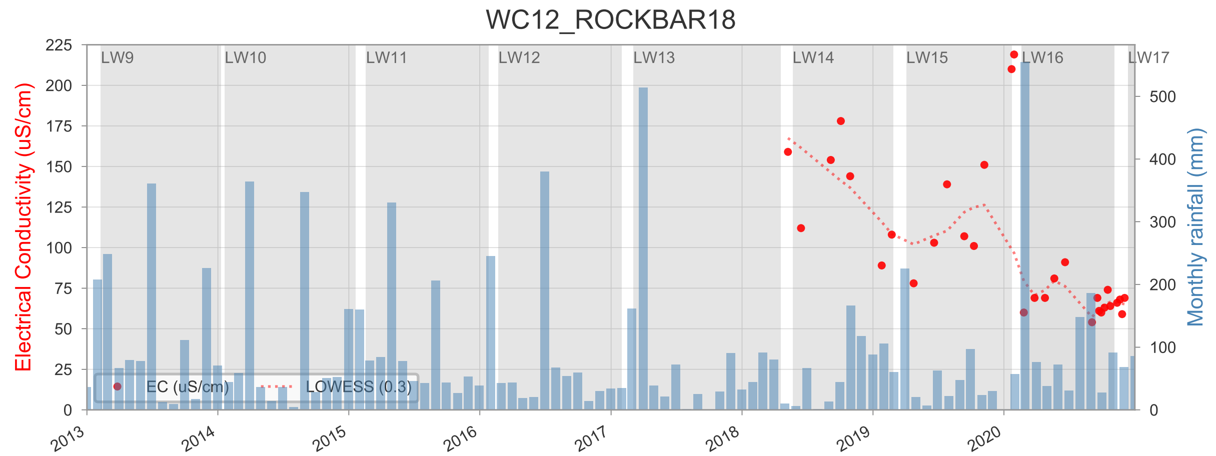

WC12_POOL12
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

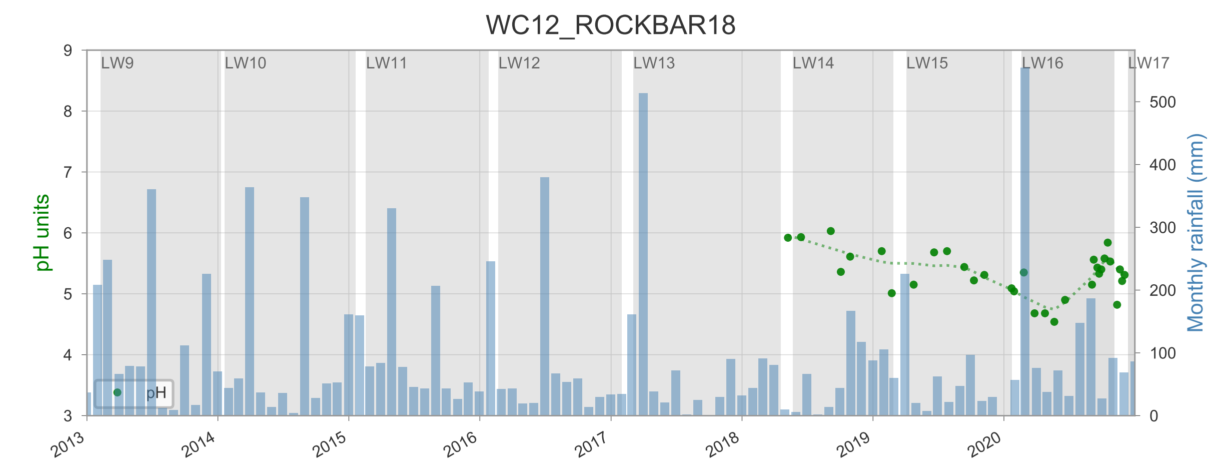

WC12_POOL12
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

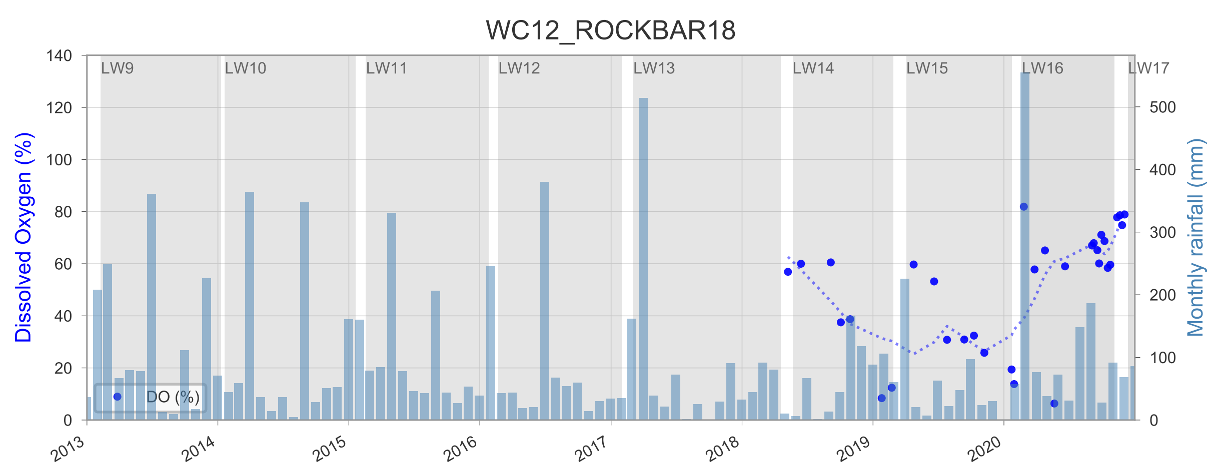

WC12_POOL12
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

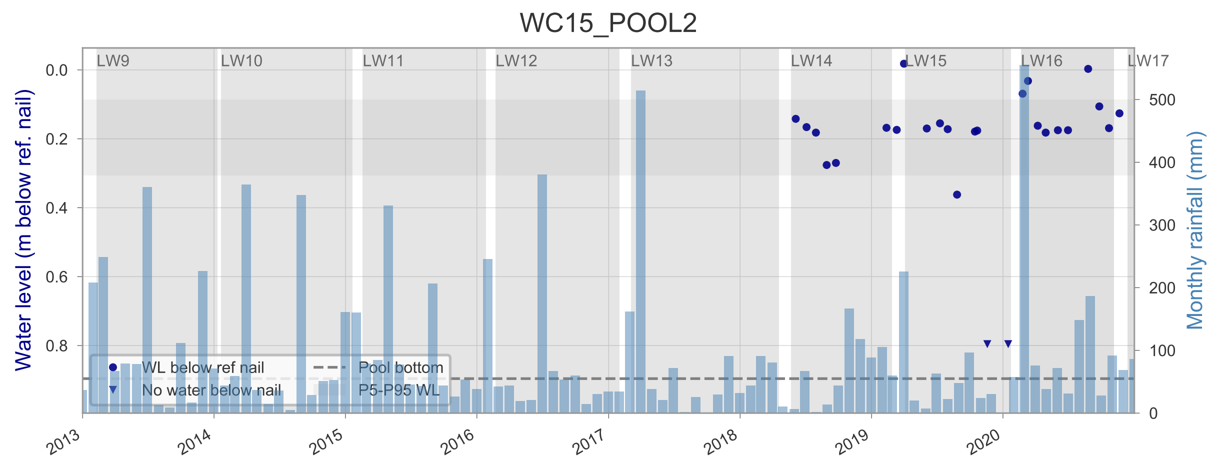

WC12_POOL12
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

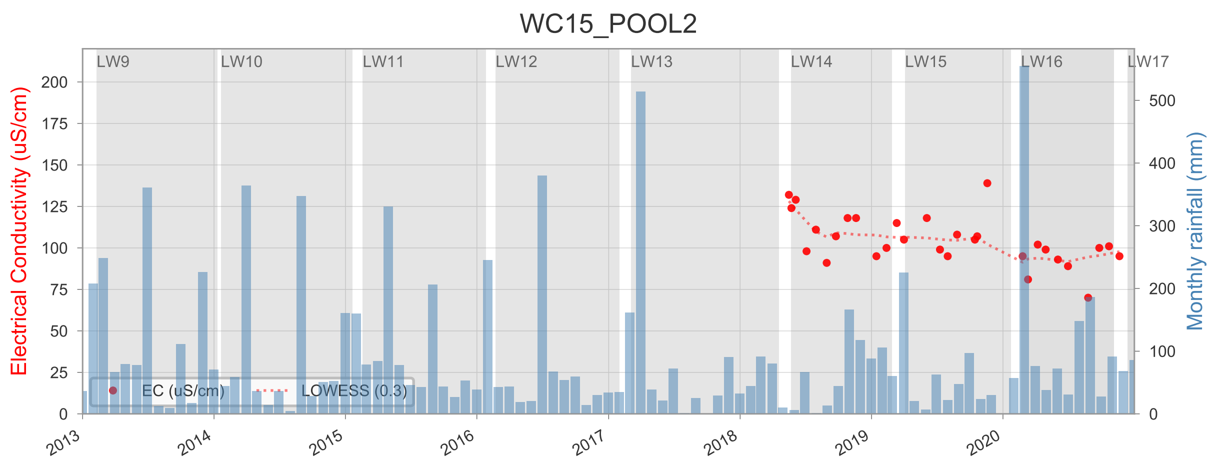

WC12_ROCKBAR18
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

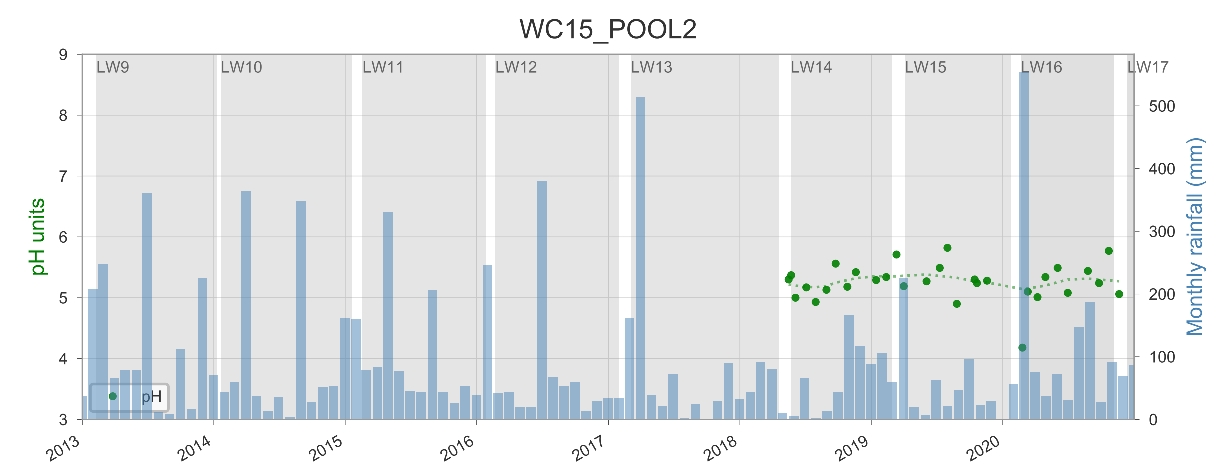

WC12_ROCKBAR18
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

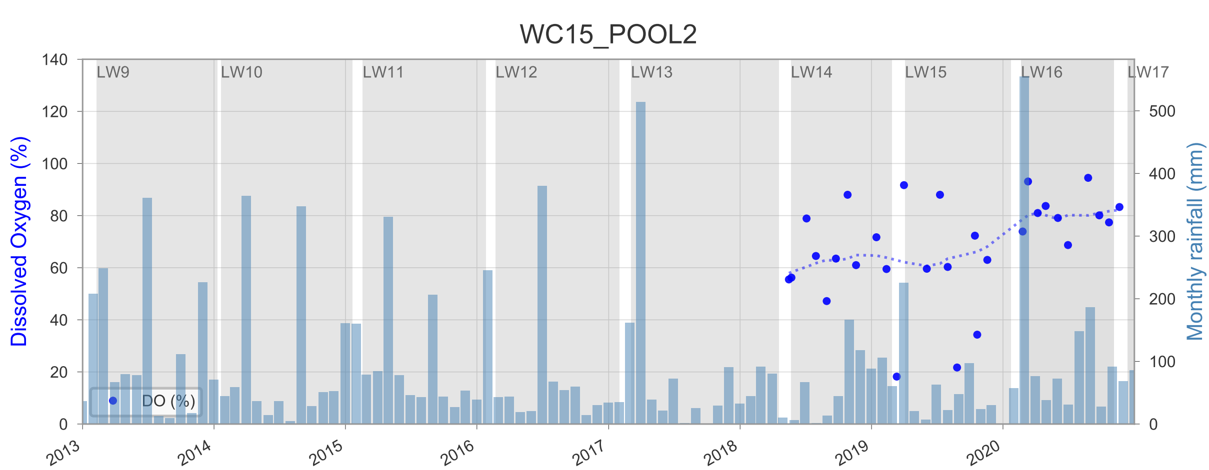

WC12_ROCKBAR18
pH units
Monthly rainfall (mm)
pH

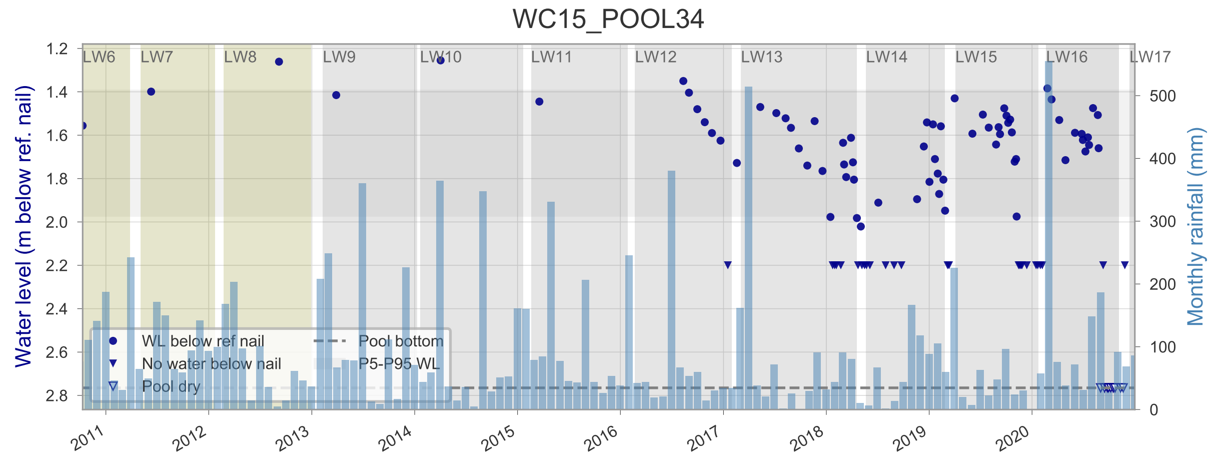

WC12_ROCKBAR18
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)


WC15_POOL2
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

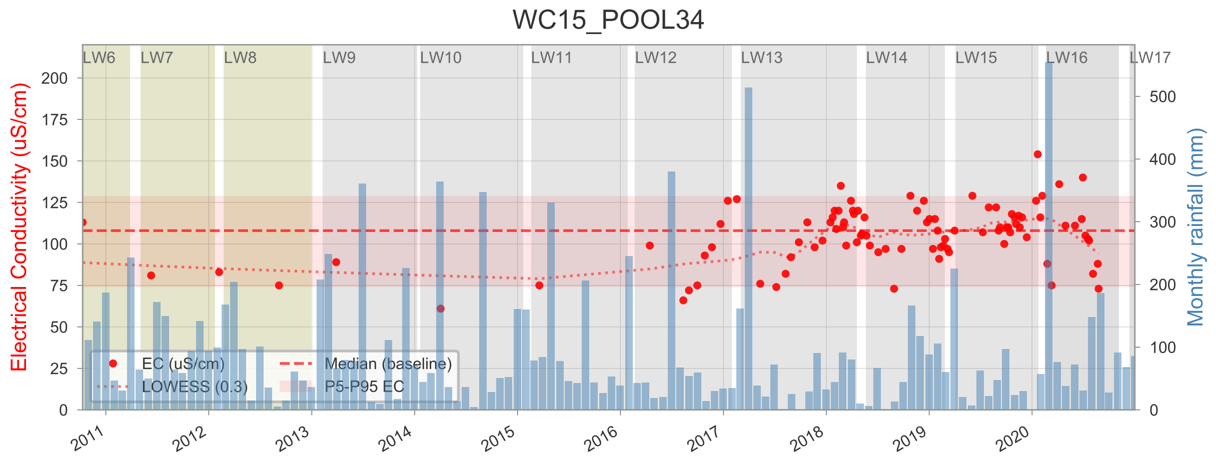

WC15_POOL2
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)


WC15_POOL2
pH units
Monthly rainfall (mm)
pH

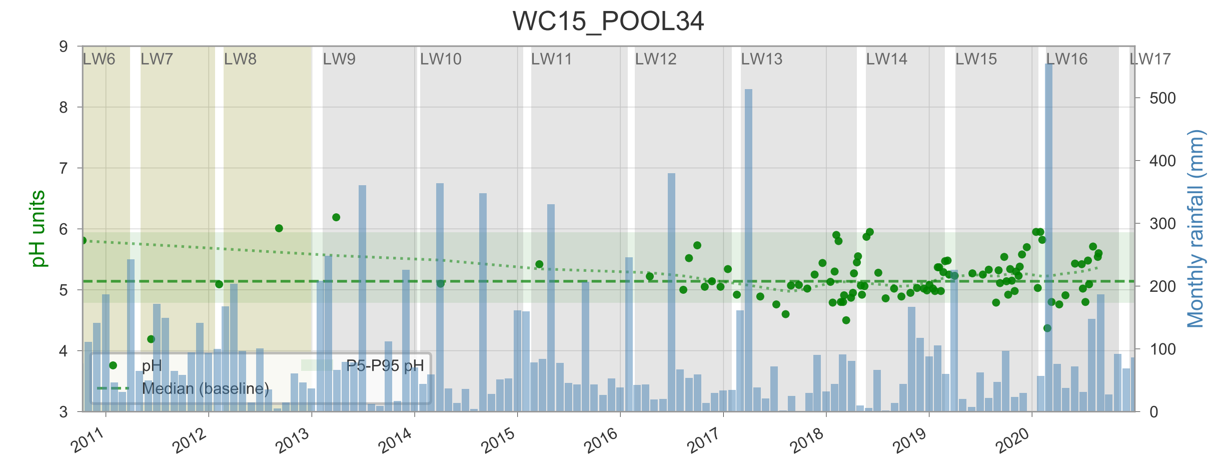

WC15_POOL2
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)



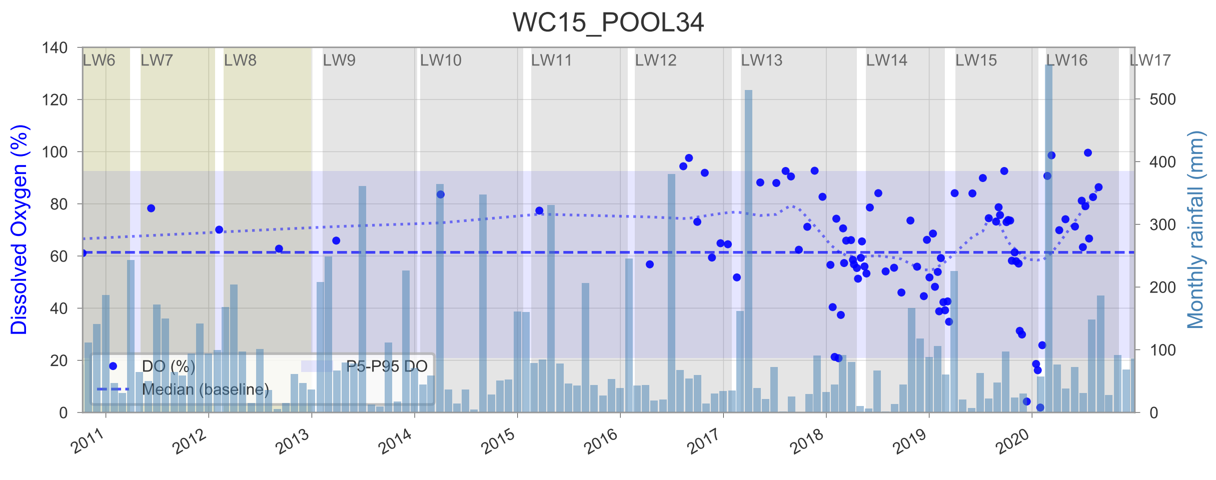
WC15_POOL34
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17



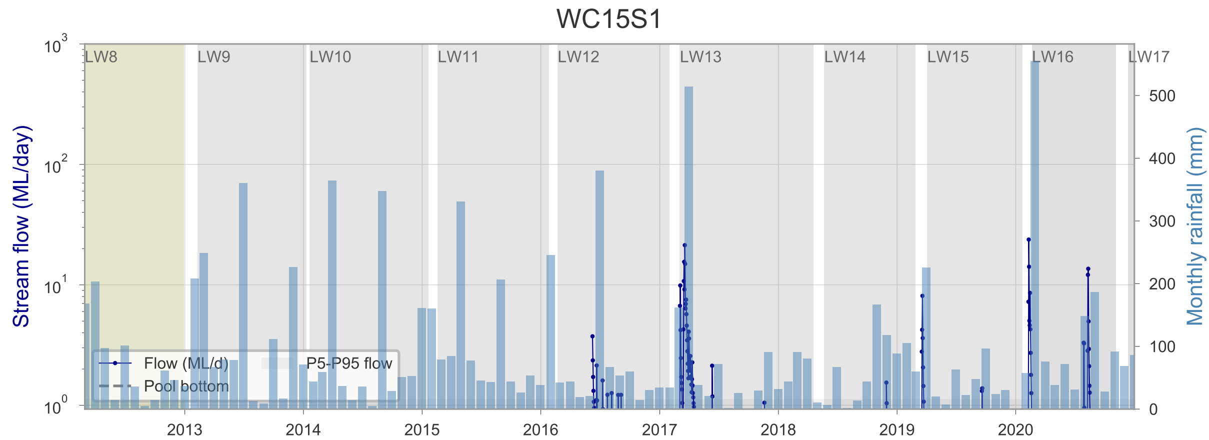
WC15_POOL34
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

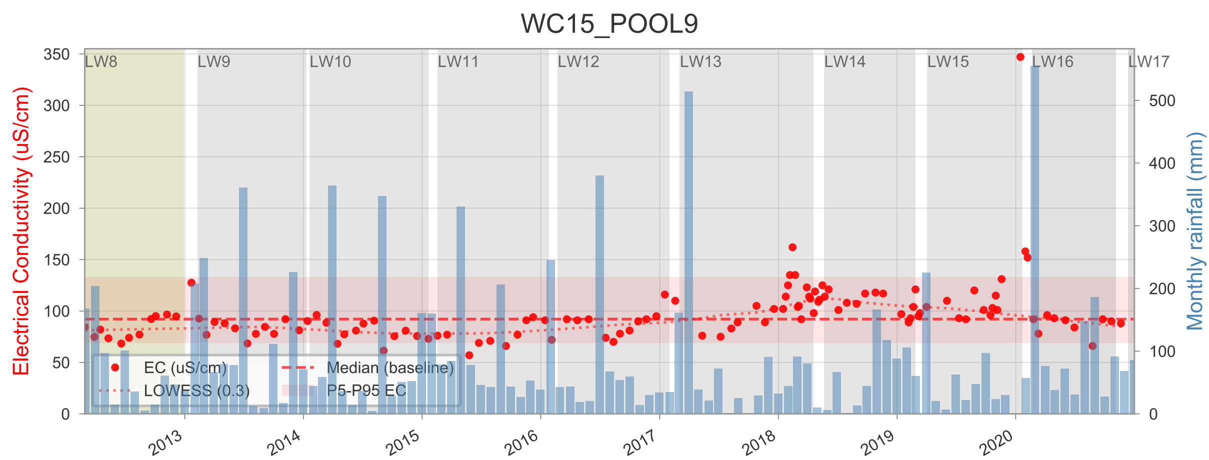


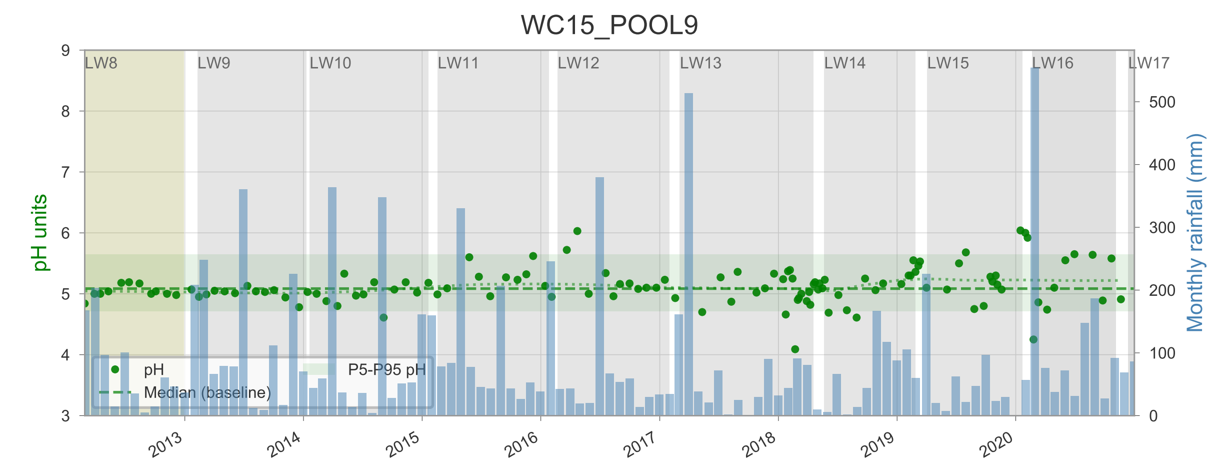
WC15_POOL34
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

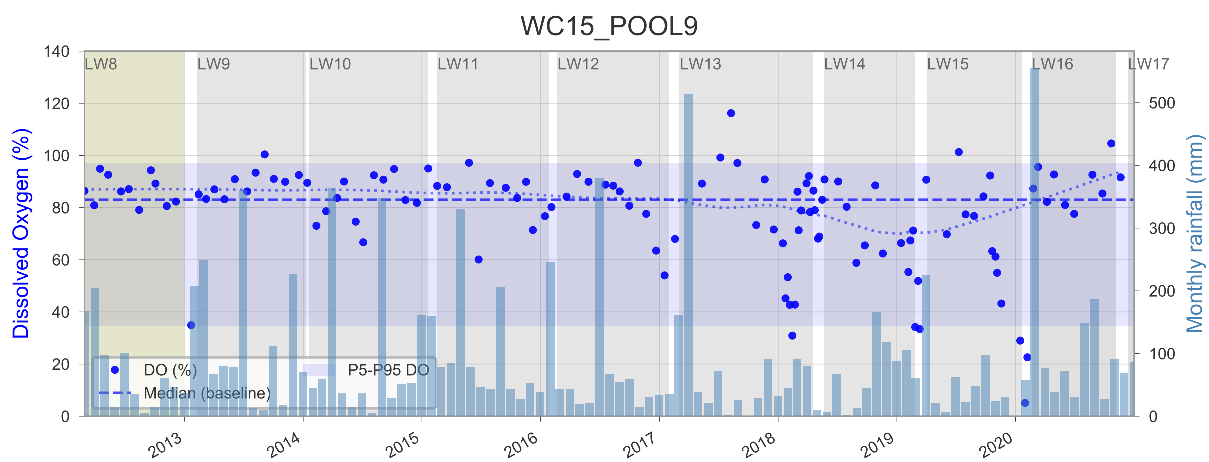


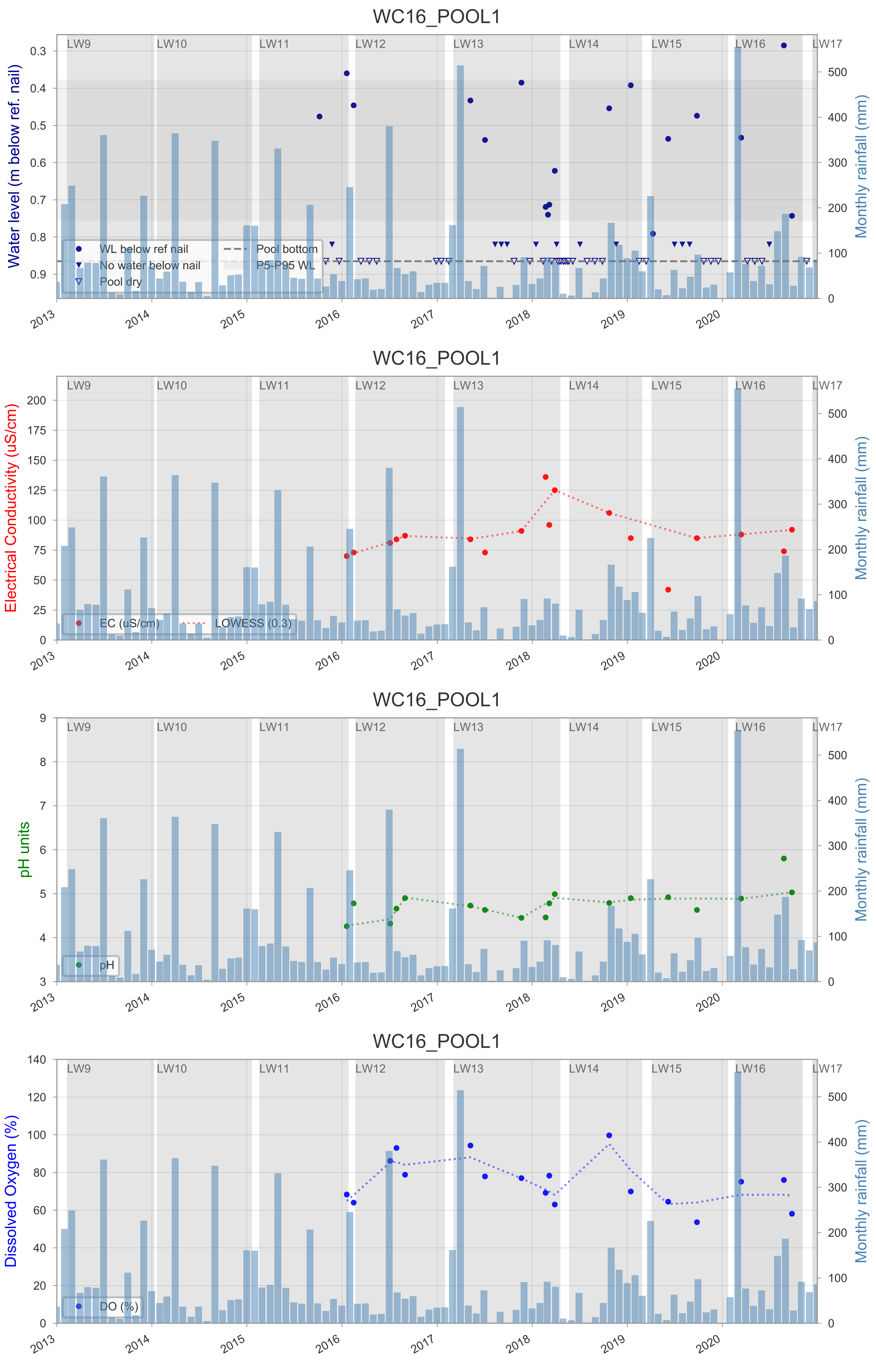
WC15_POOL34
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


WC15S1
Stream flow (ML/day)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
Pool bottom
P5-P95 flow

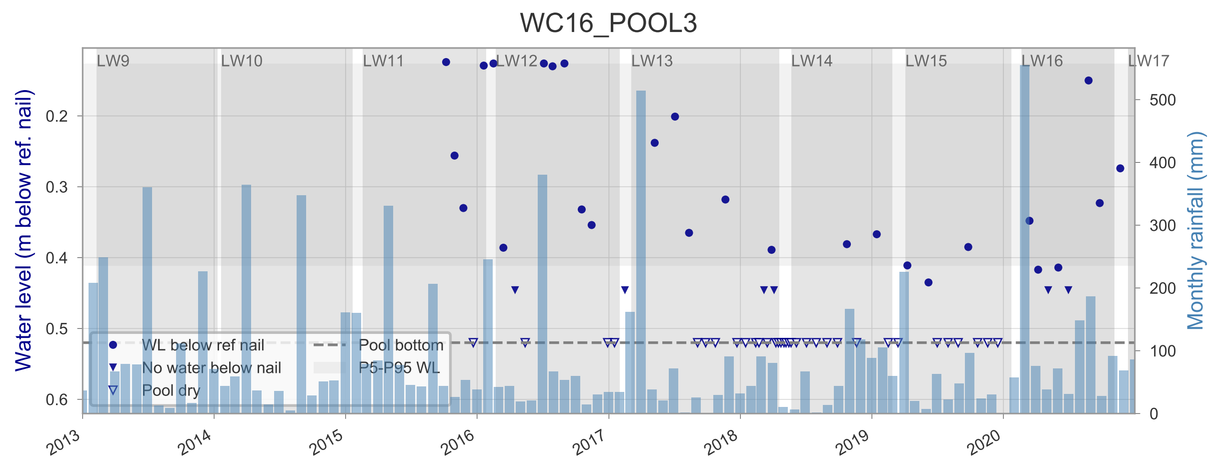

WC15_POOL9
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

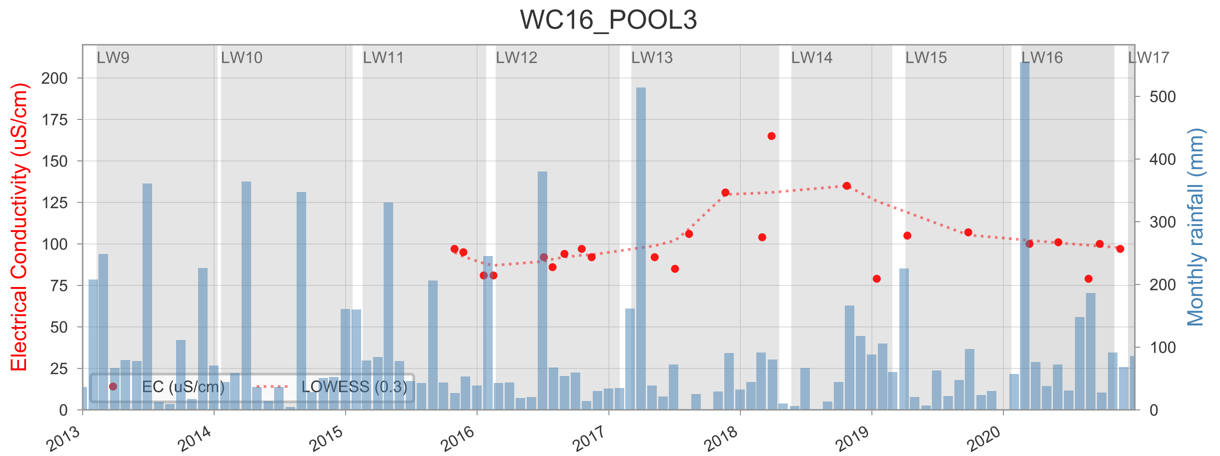

WC15_POOL9
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

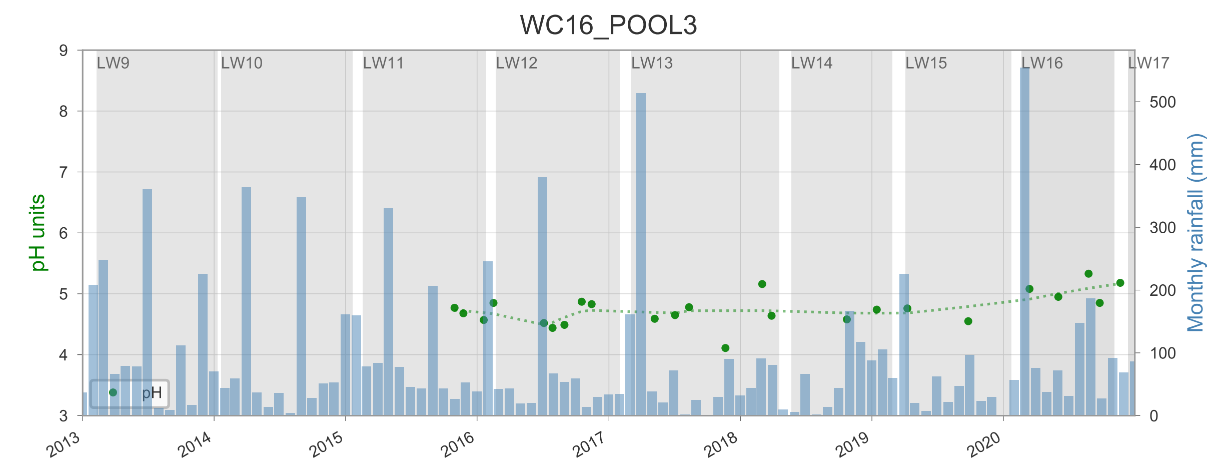

WC15_POOL9
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

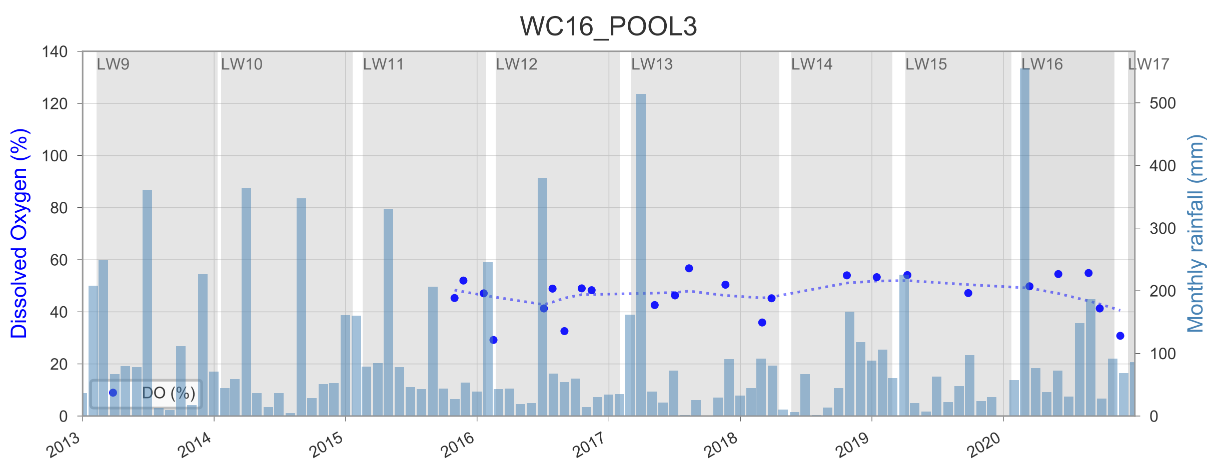


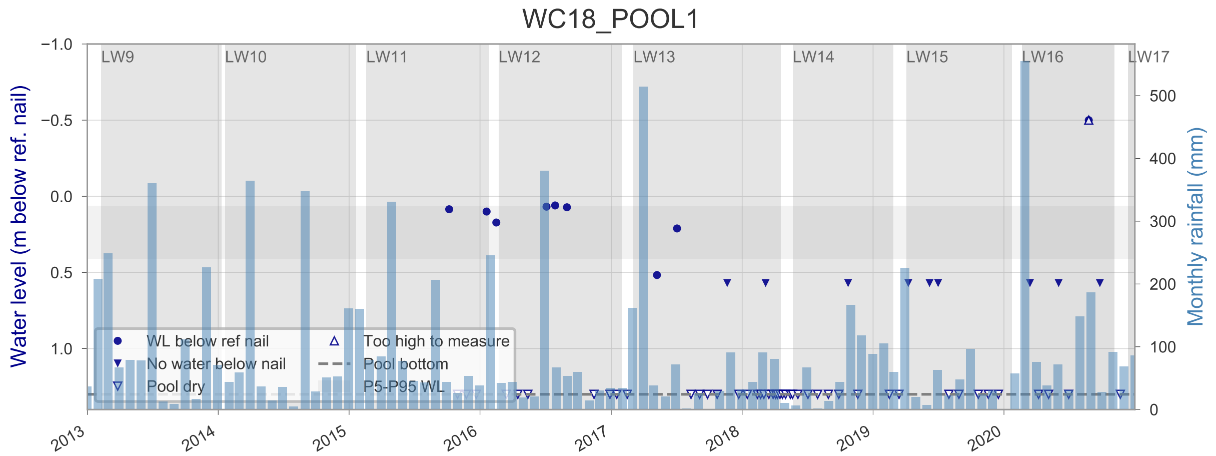
WC16_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
WC16_POOL1
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
WC16_POOL1
pH units
pH
WC16_POOL1
Dissolved Oxygen (%)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020

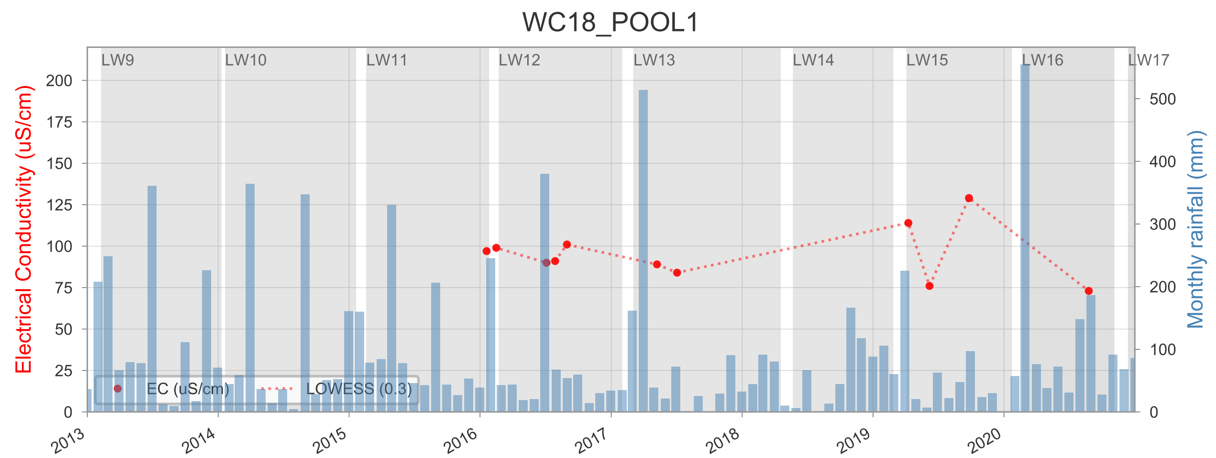

WC16_POOL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

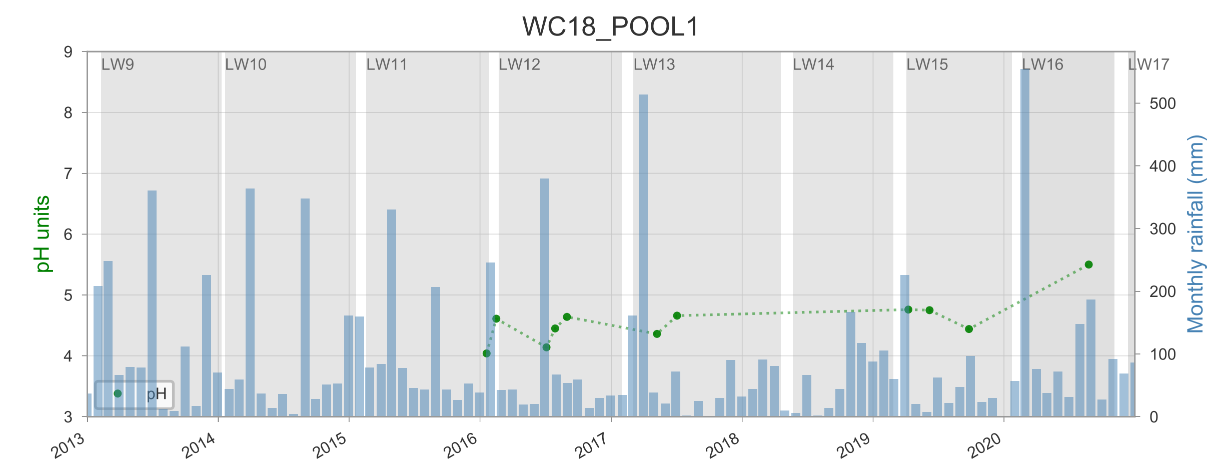

WC16_POOL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

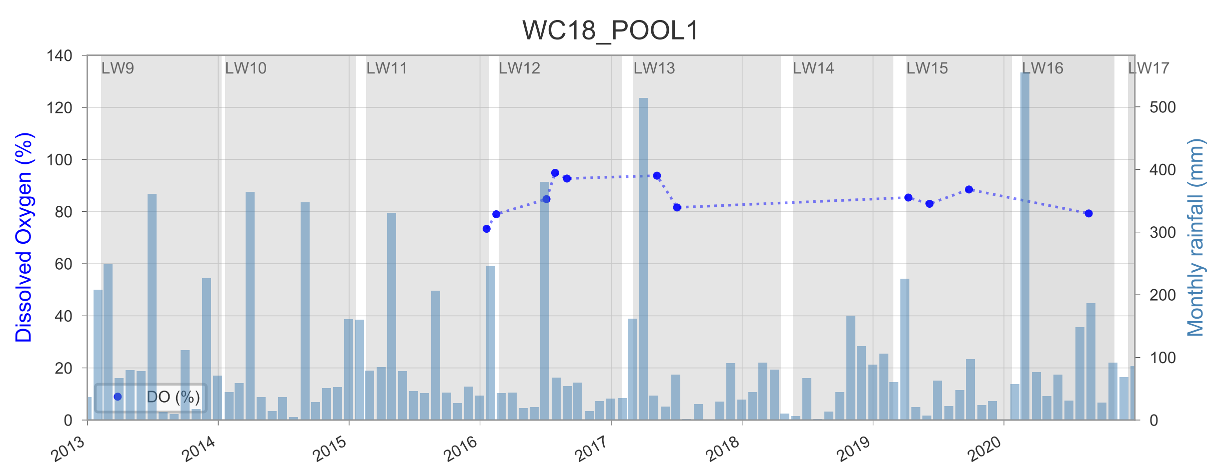

WC16_POOL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH

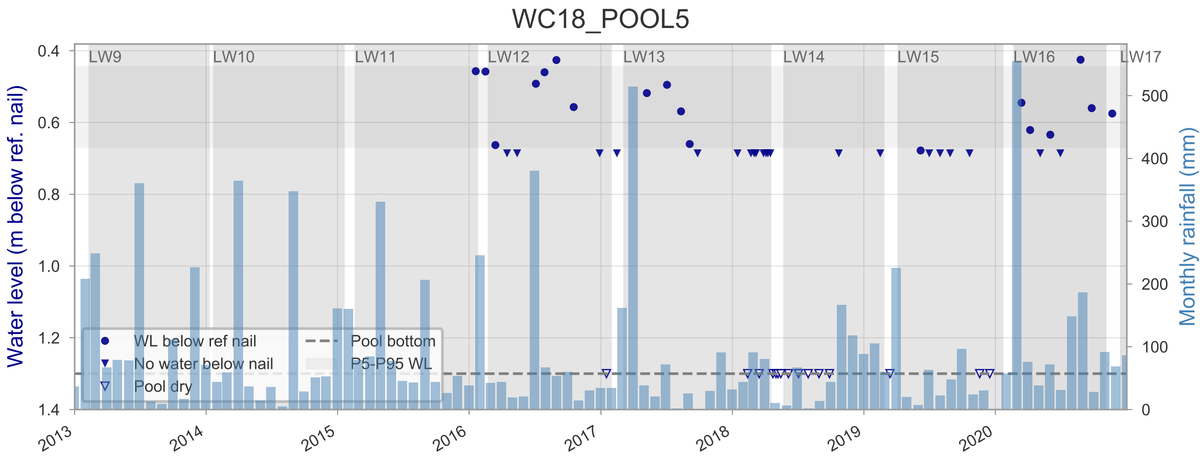

WC16_POOL3
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)


WC18_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Too high to measure
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

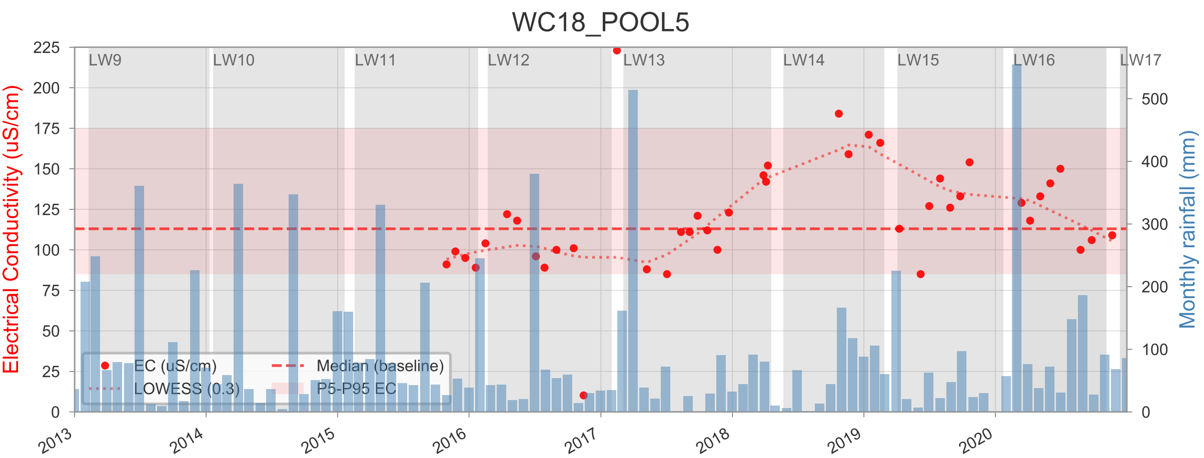

WC18_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020


WC18_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
2013
2014
2015
2016
2017
2018
2019
2020

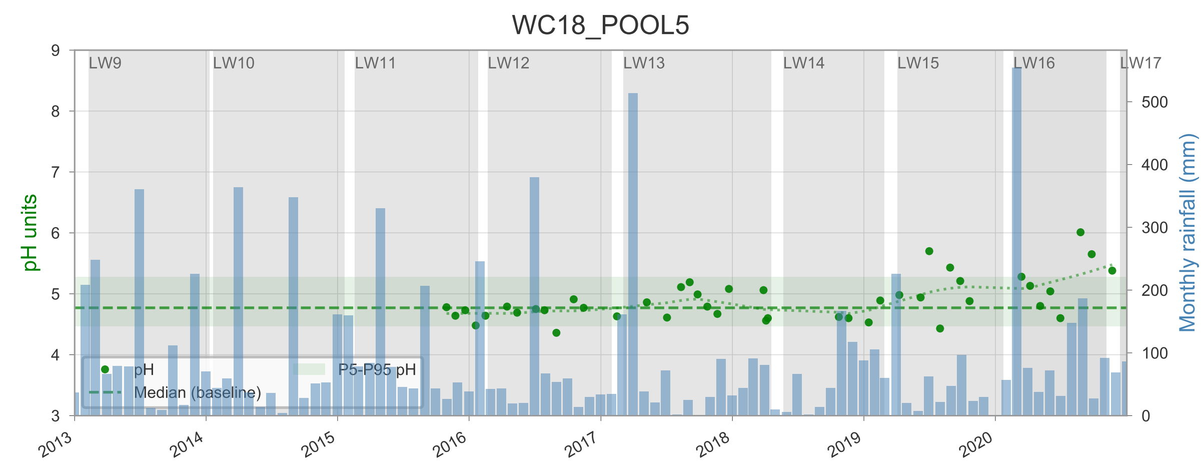

WC18_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020



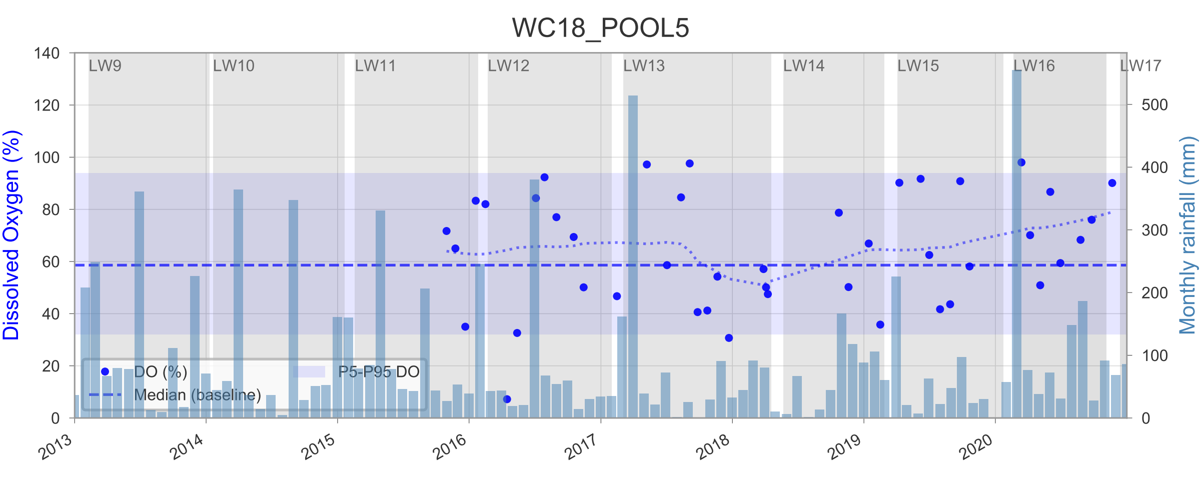
WC18_POOL5
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL



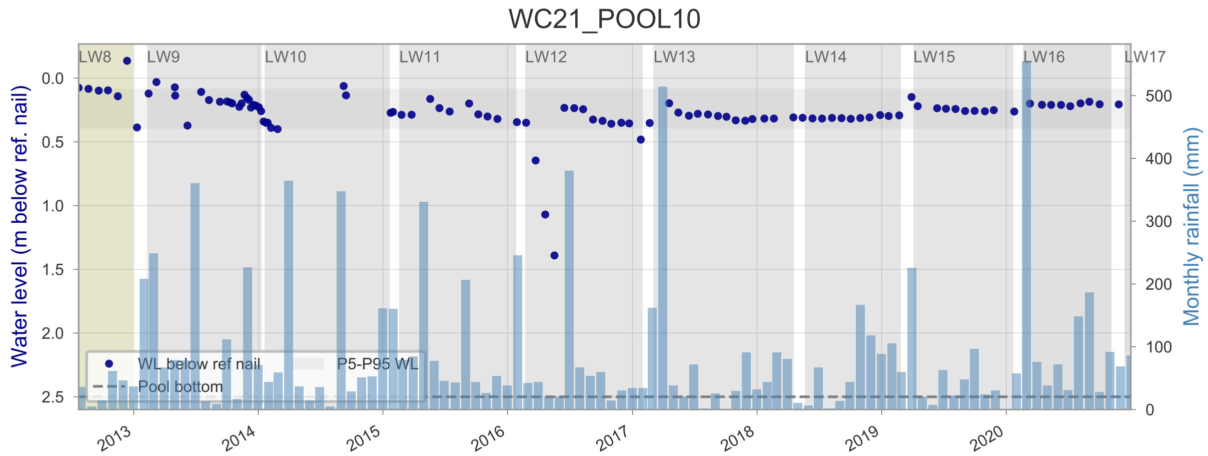
WC18_POOL5
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

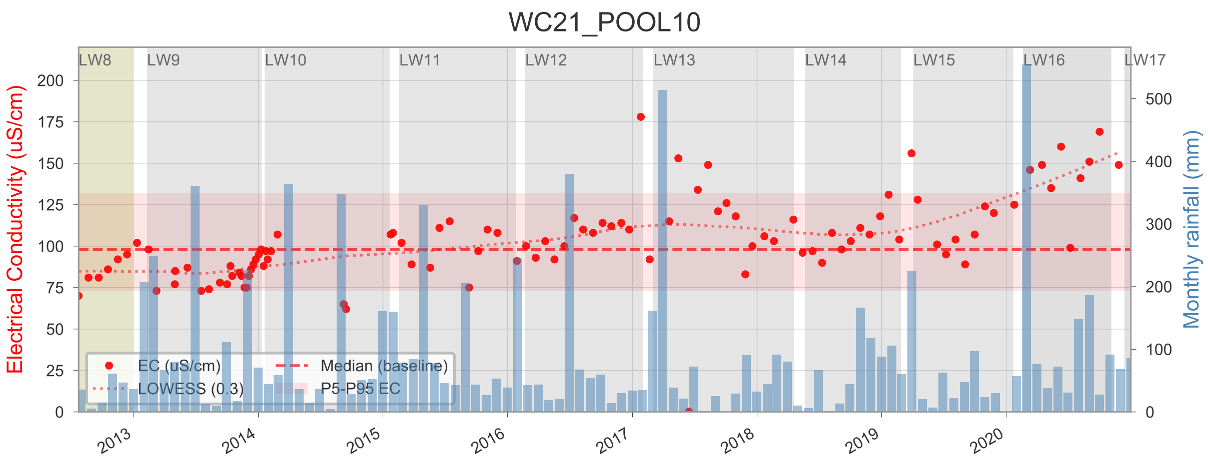


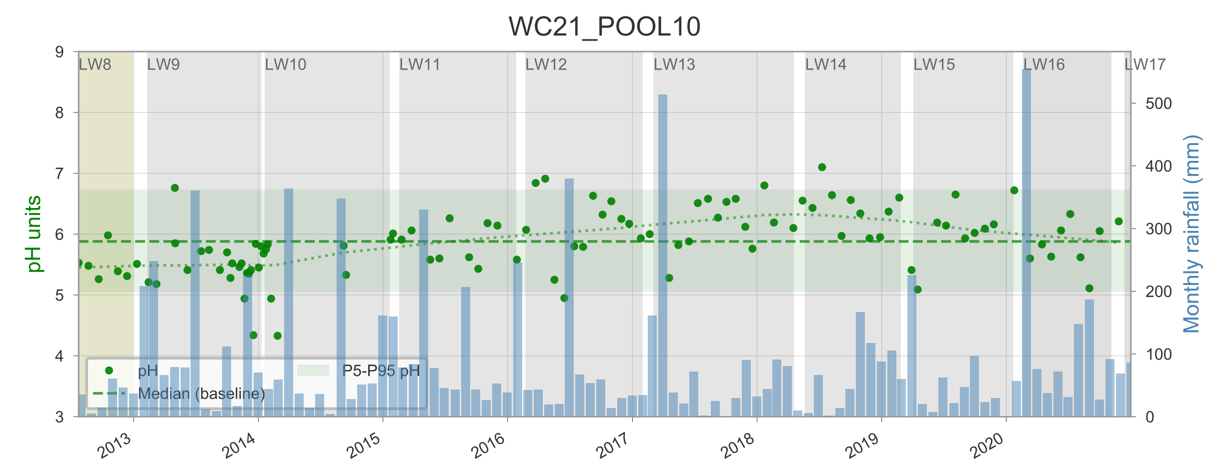
WC18_POOL5
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

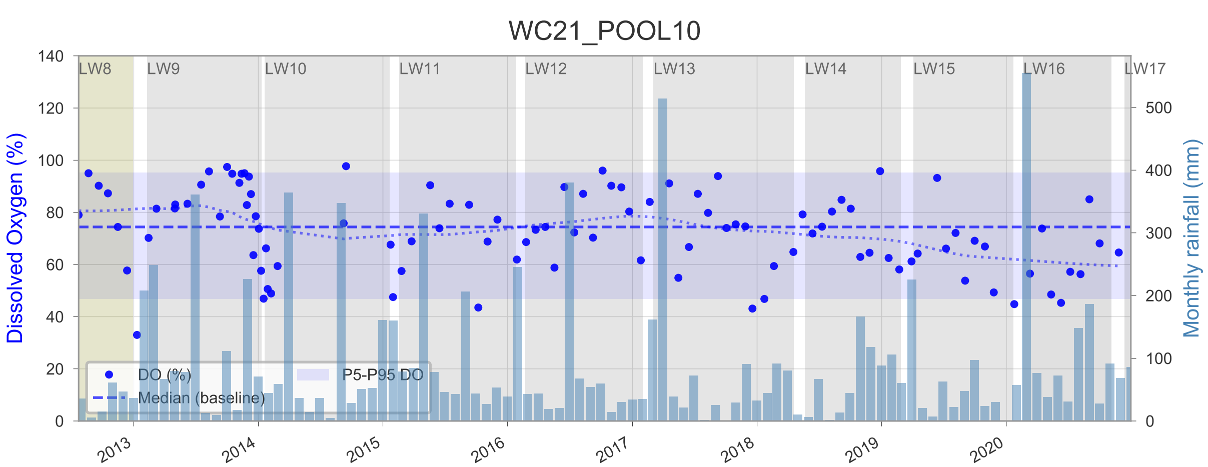


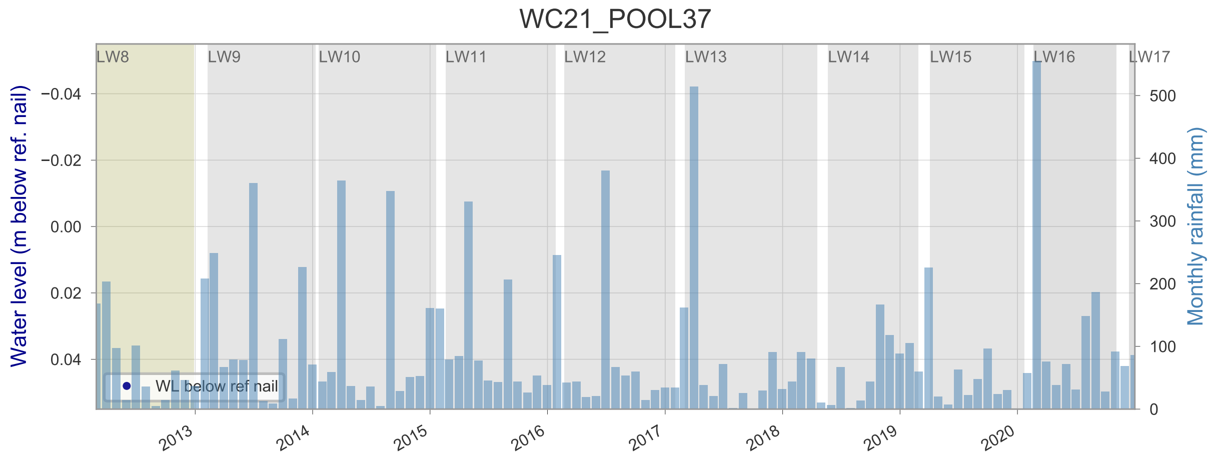
WC18_POOL5
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO

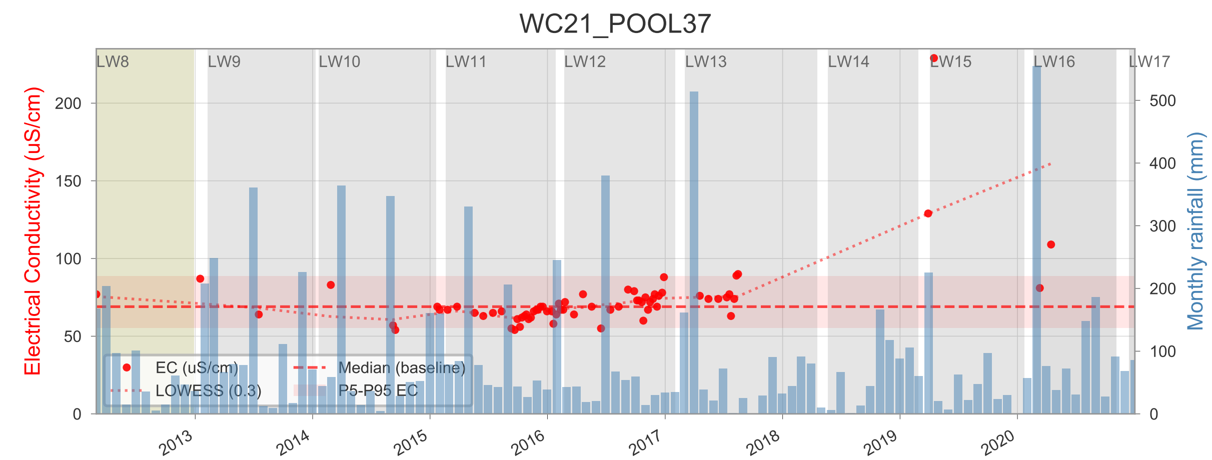

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
2013
2014
2015
2016
2017
2018
2019
2020

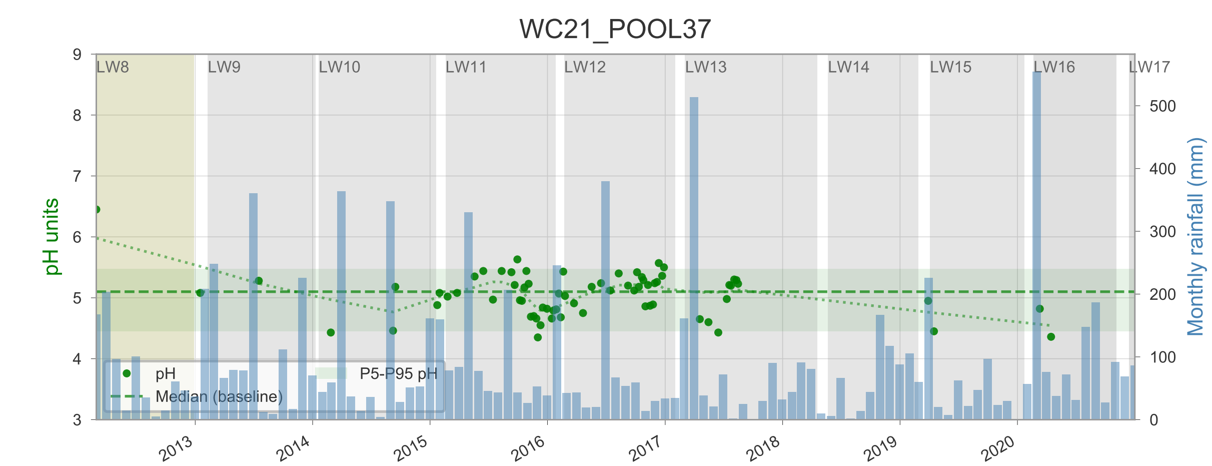

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

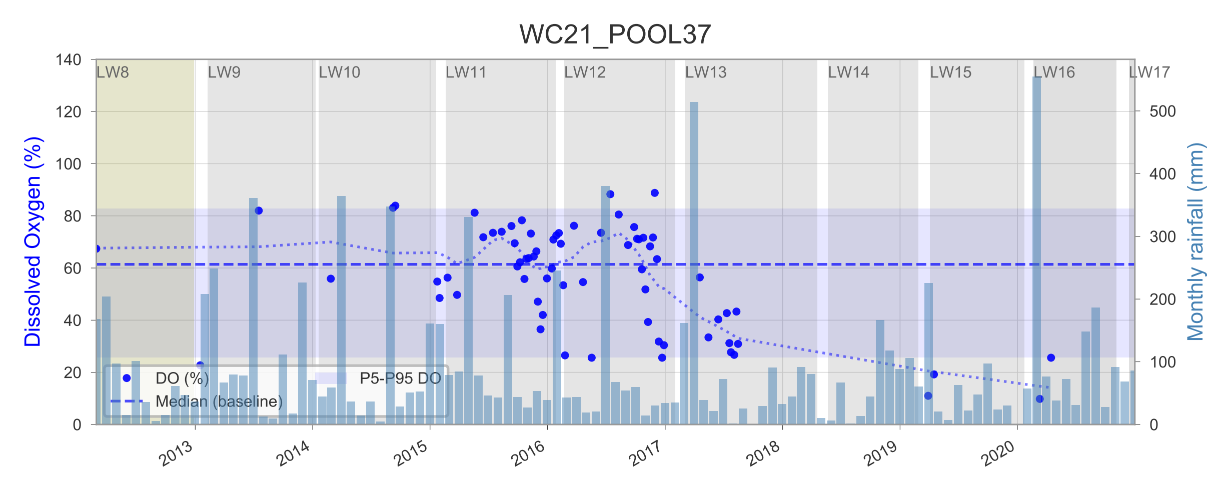

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
P5-P95 pH
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

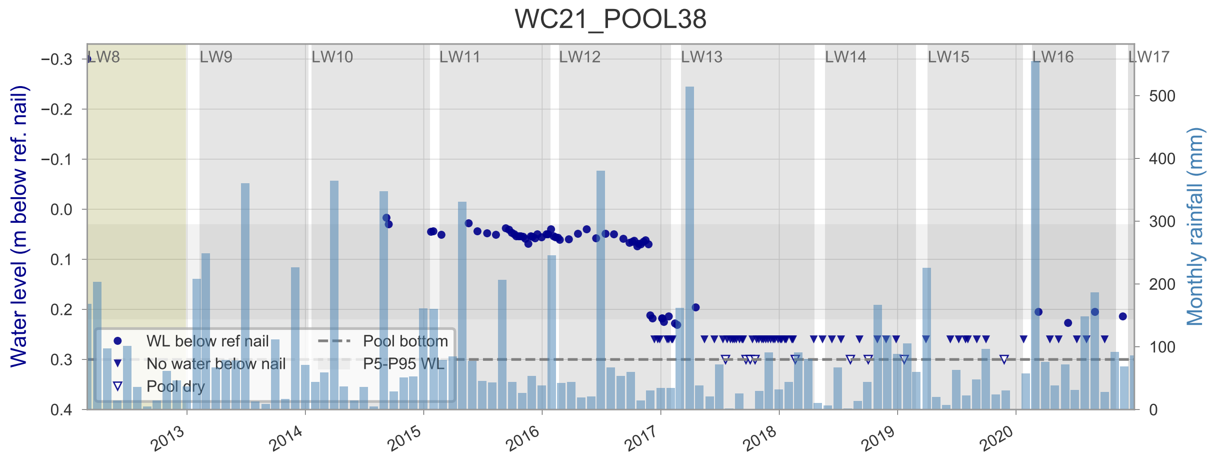

WC21_POOL10
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
P5-P95 DO
Median (baseline)
2013
2014
2015
2016
2017
2018
2019
2020

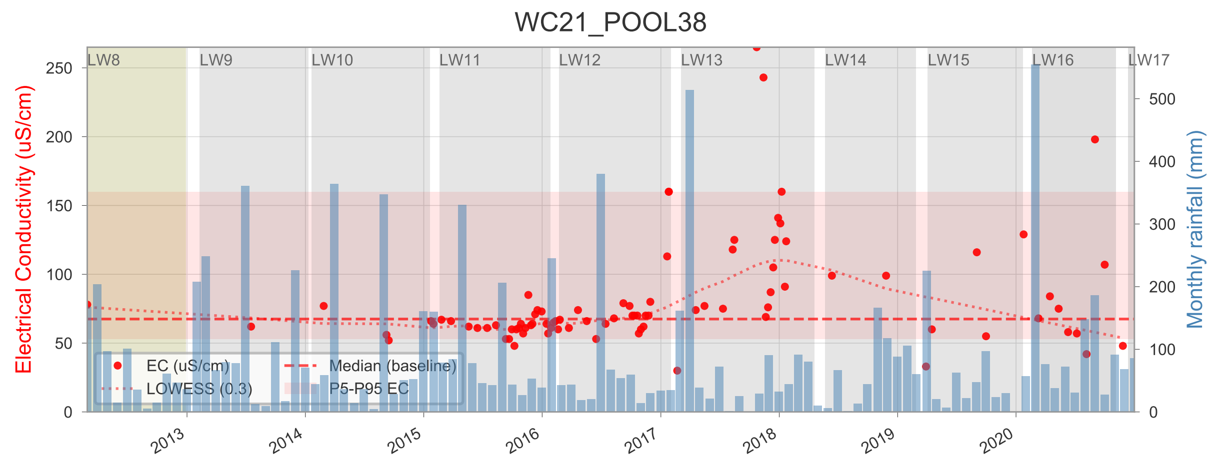

WC21_POOL37
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail

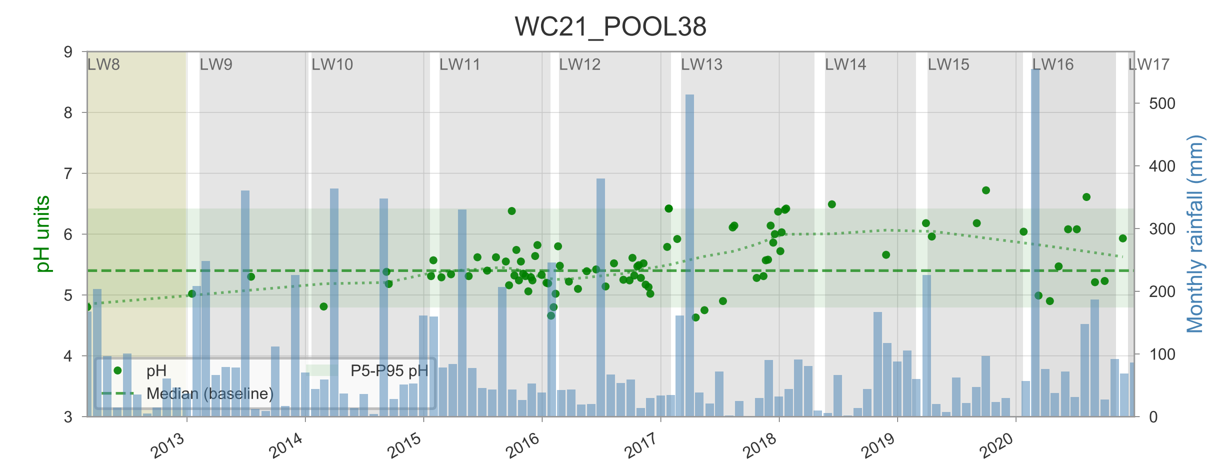

WC21_POOL37
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

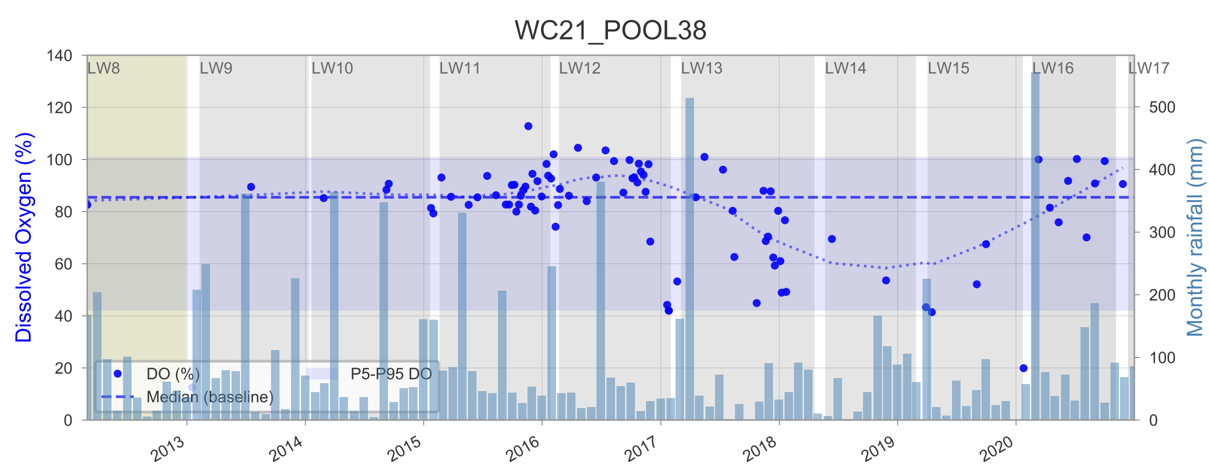

WC21_POOL37
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH


WC21_POOL37
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

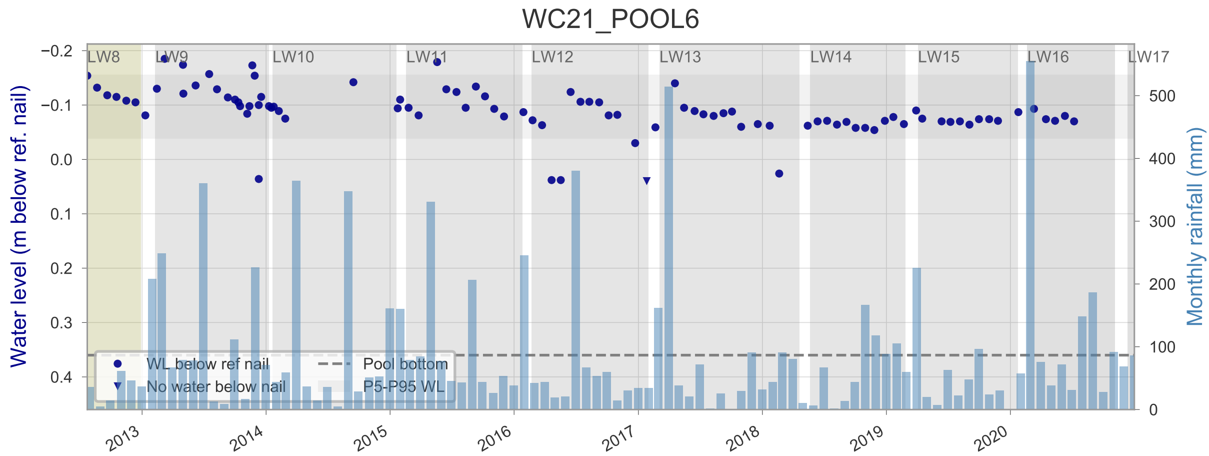

WC21_POOL38
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

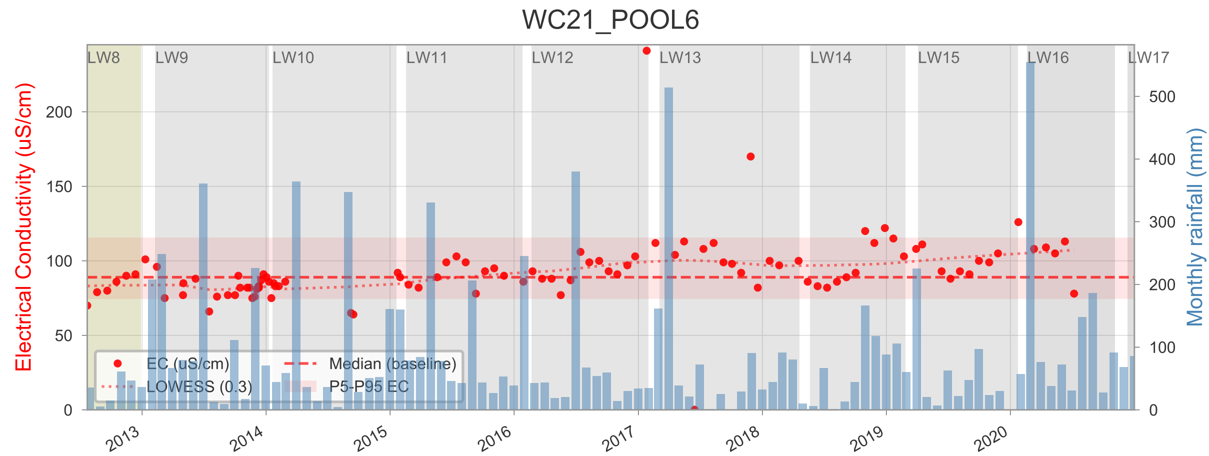

WC21_POOL38
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

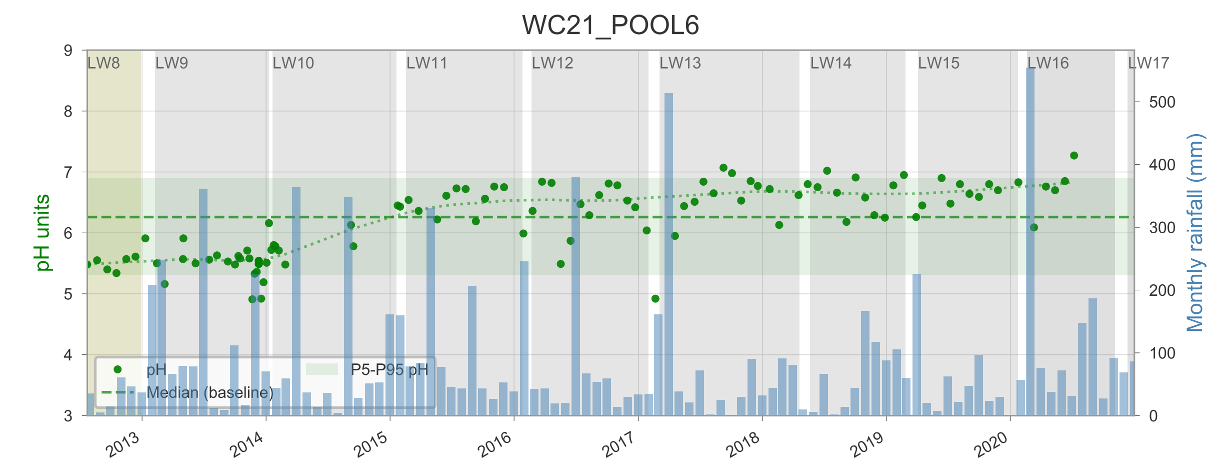

WC21_POOL38
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

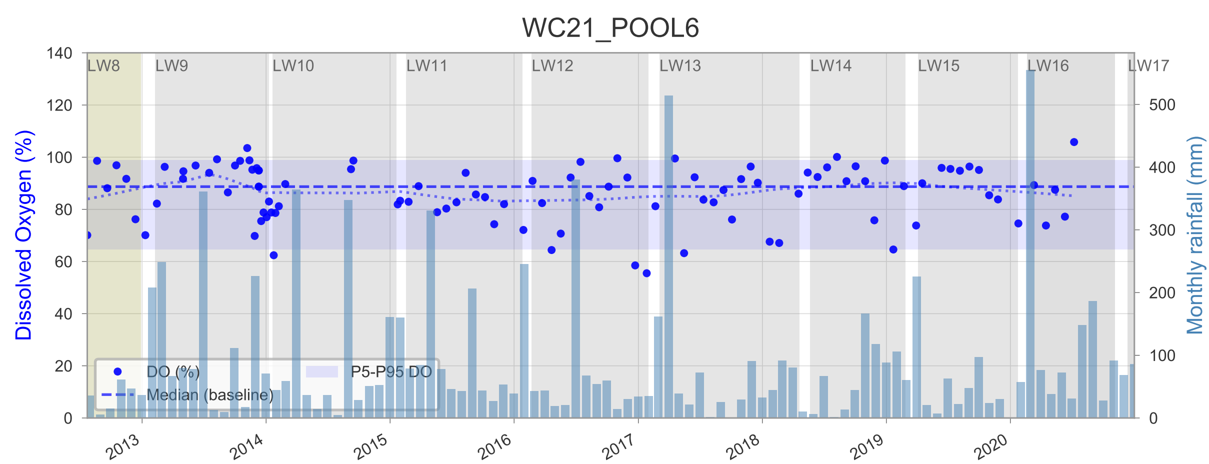

WC21_POOL38
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

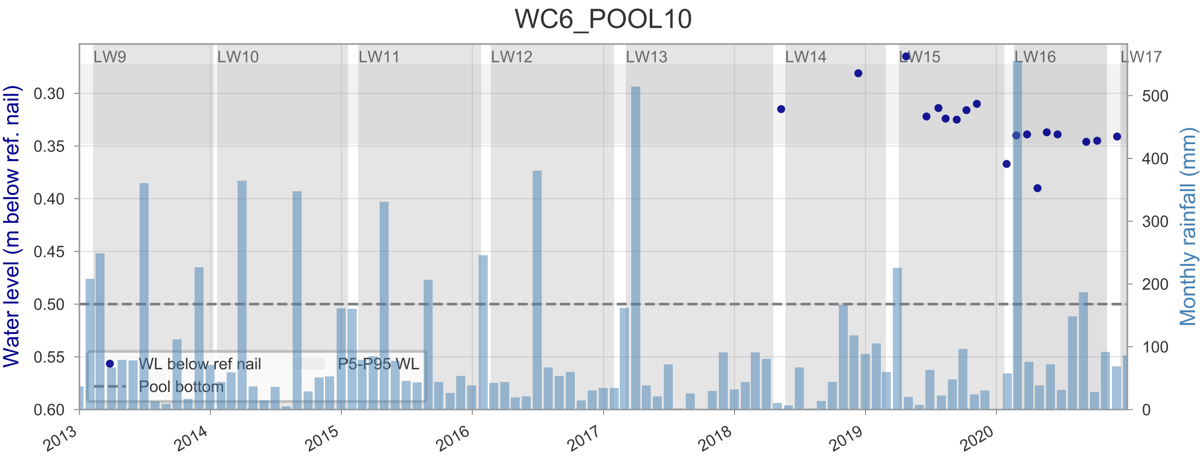

WC21S1
Stream flow (ML/day)
Monthly rainfall (mm)
Flow (ML/d)
Pool bottom
P5-P95 flow
WC21_POOL5
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC21_POOL5
pH units
pH
Median (baseline)
P5-P95 pH
WC21_POOL5
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

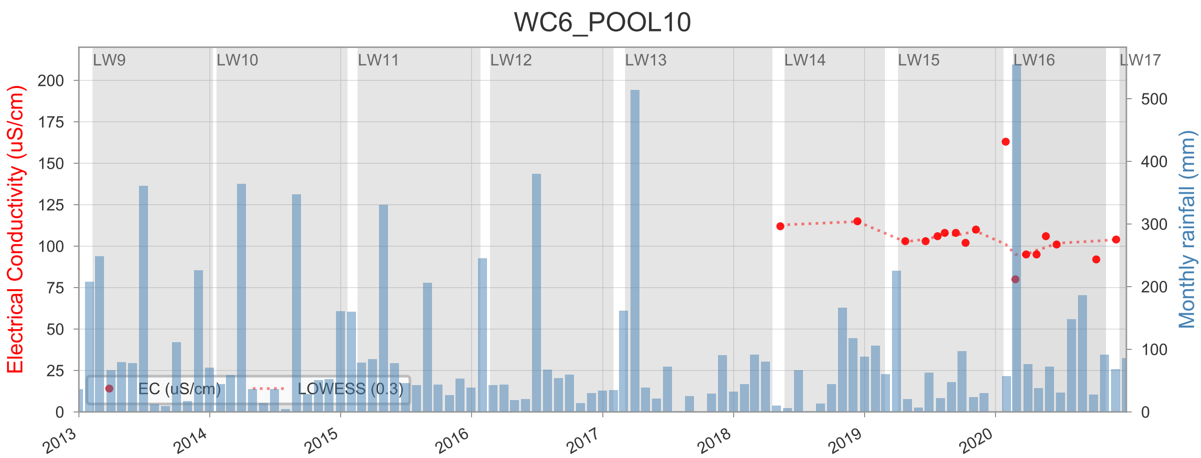

WC21_POOL6
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

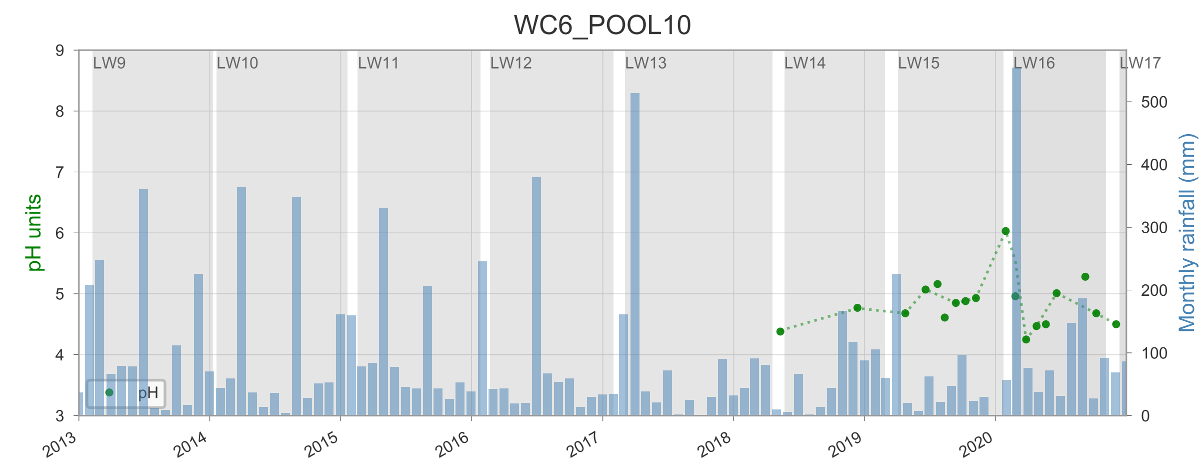

WC21_POOL6
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2013
2014
2015
2016
2017
2018
2019
2020

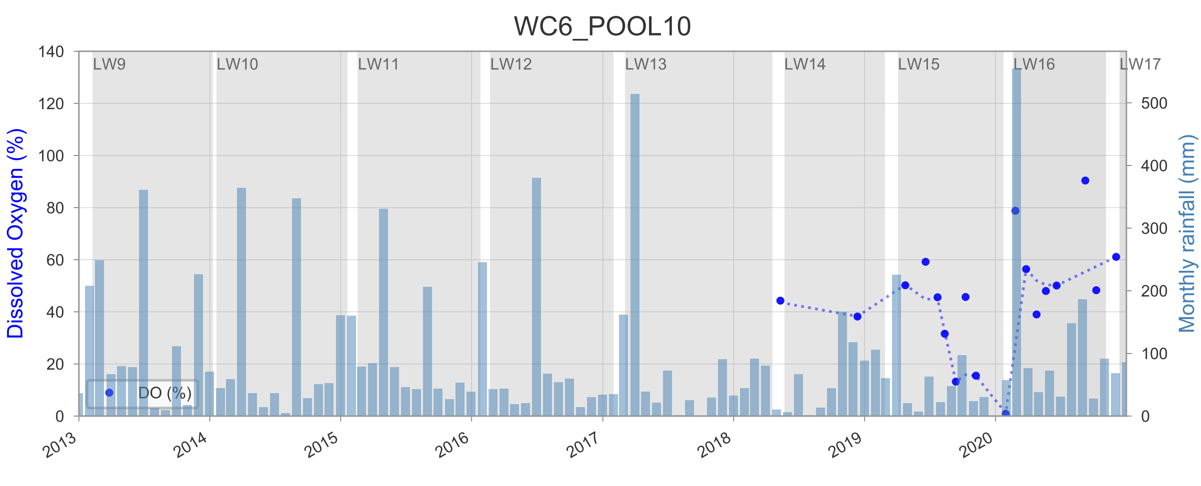

WC21_POOL6
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2013
2014
2015
2016
2017
2018
2019
2020

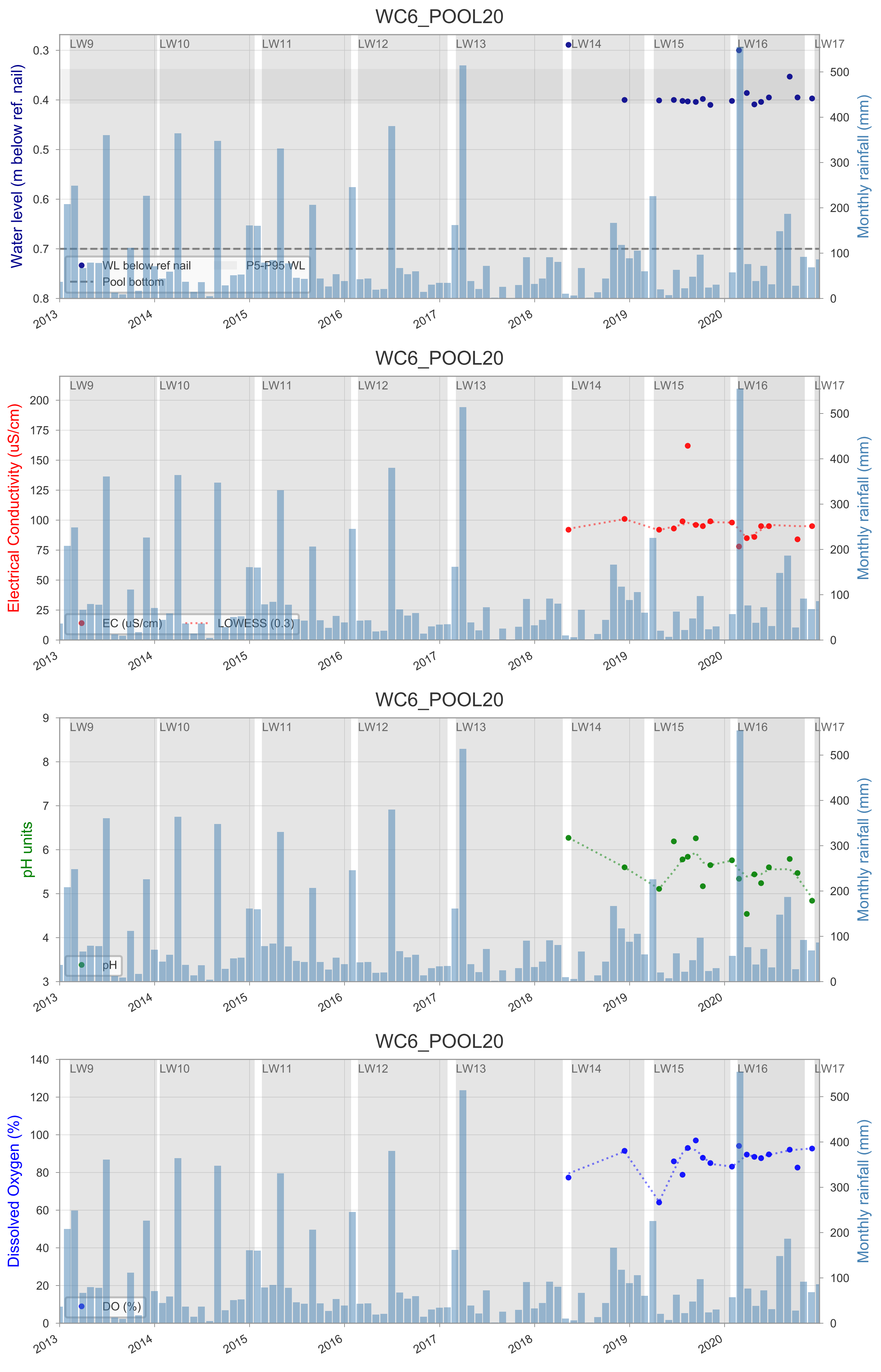

WC21_POOL6
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2013
2014
2015
2016
2017
2018
2019
2020

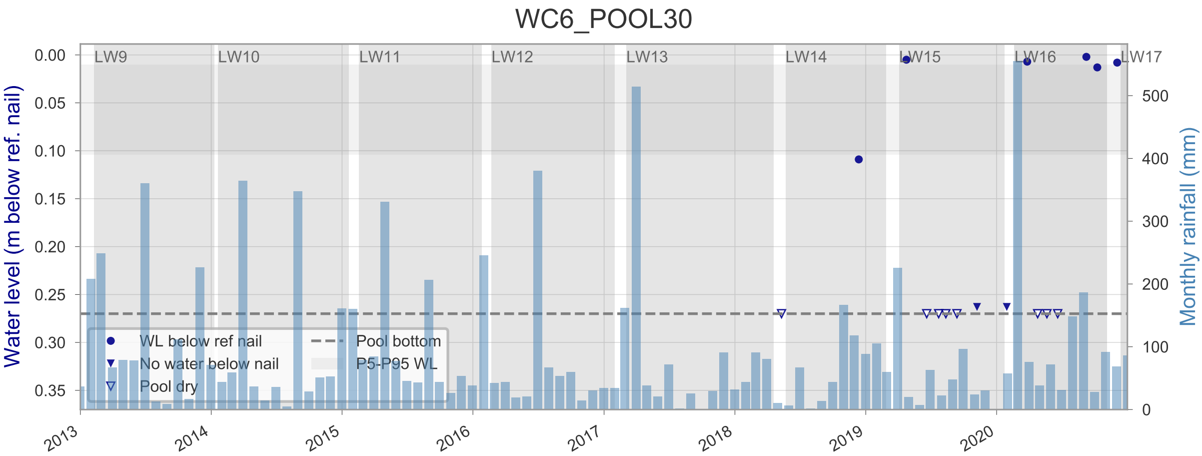

WC6_POOL10
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
2013 2014 2015 2016 2017 2018 2019 2020

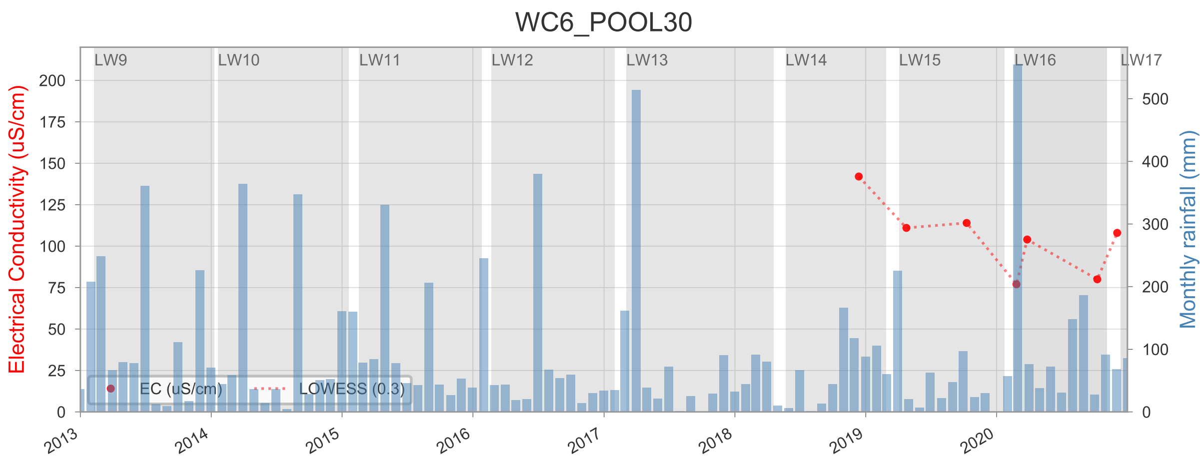

WC6_POOL10
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
2013 2014 2015 2016 2017 2018 2019 2020

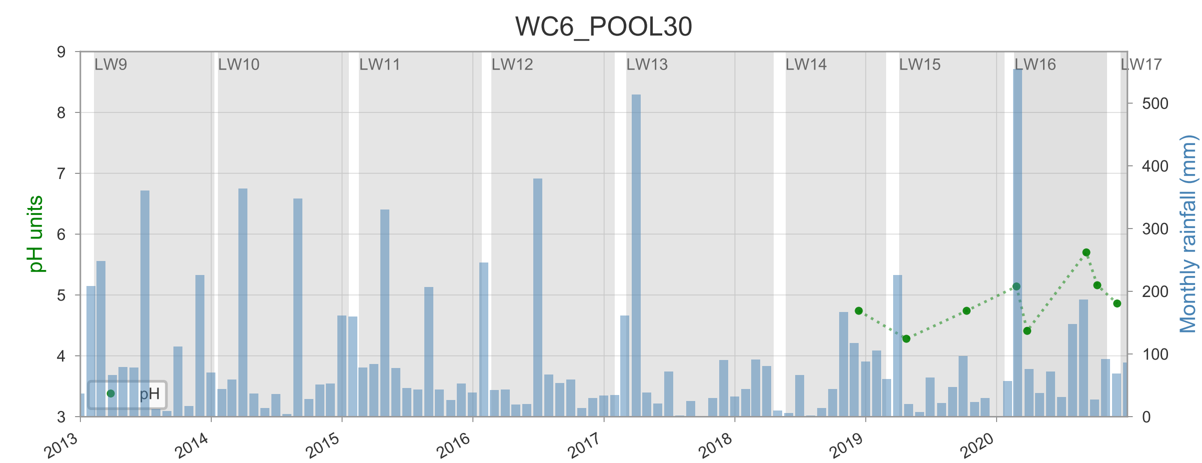

WC6_POOL10
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
pH units
Monthly rainfall (mm)
pH
2013 2014 2015 2016 2017 2018 2019 2020

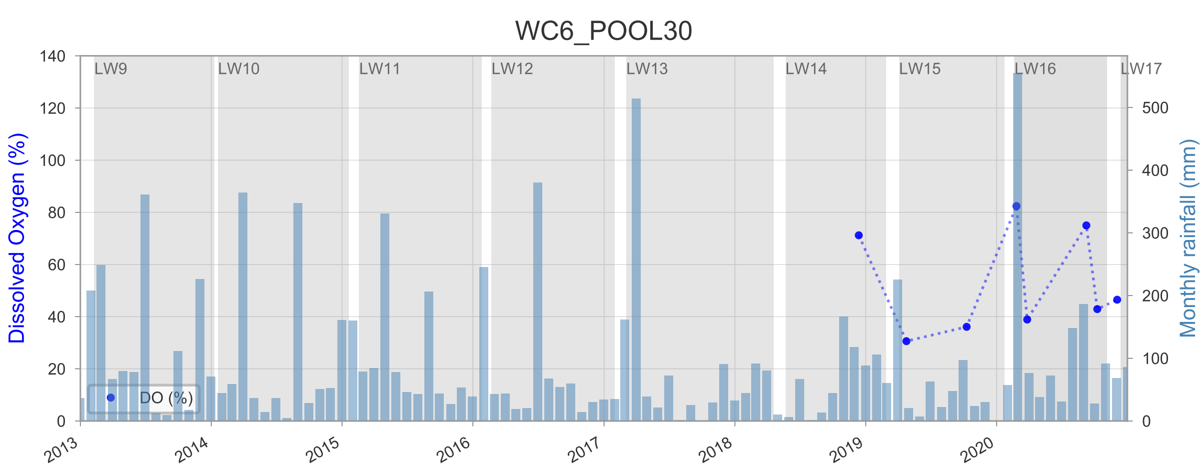

WC6_POOL10
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
2013 2014 2015 2016 2017 2018 2019 2020

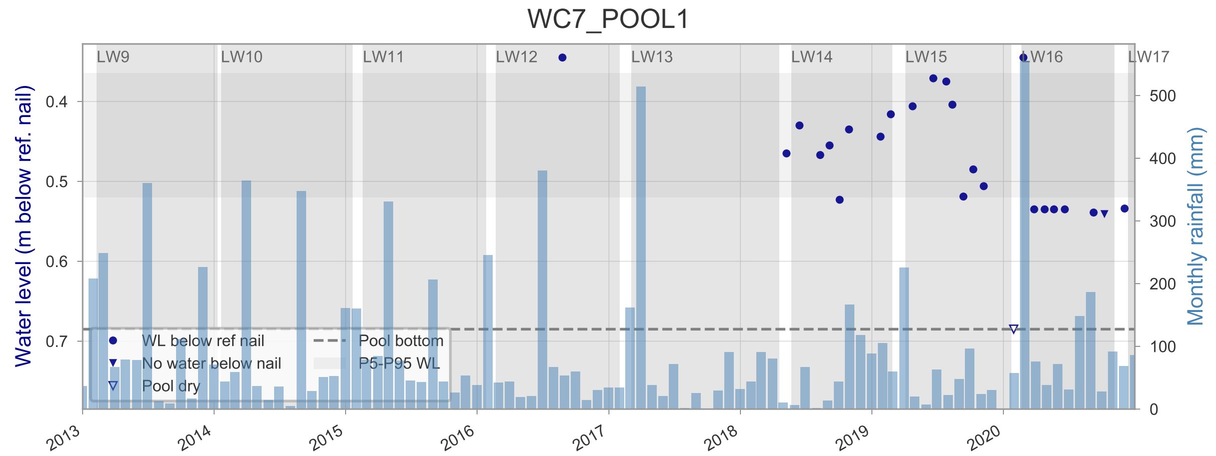

WC6_POOL20
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WC6_POOL20
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
WC6_POOL20
pH units
pH
WC6_POOL20
Dissolved Oxygen (%)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020

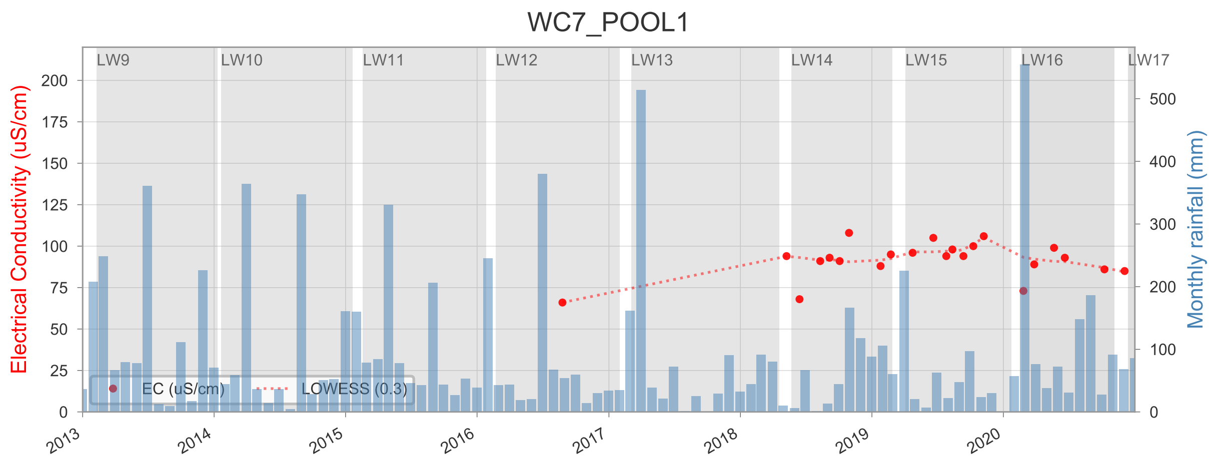

WC6_POOL30
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

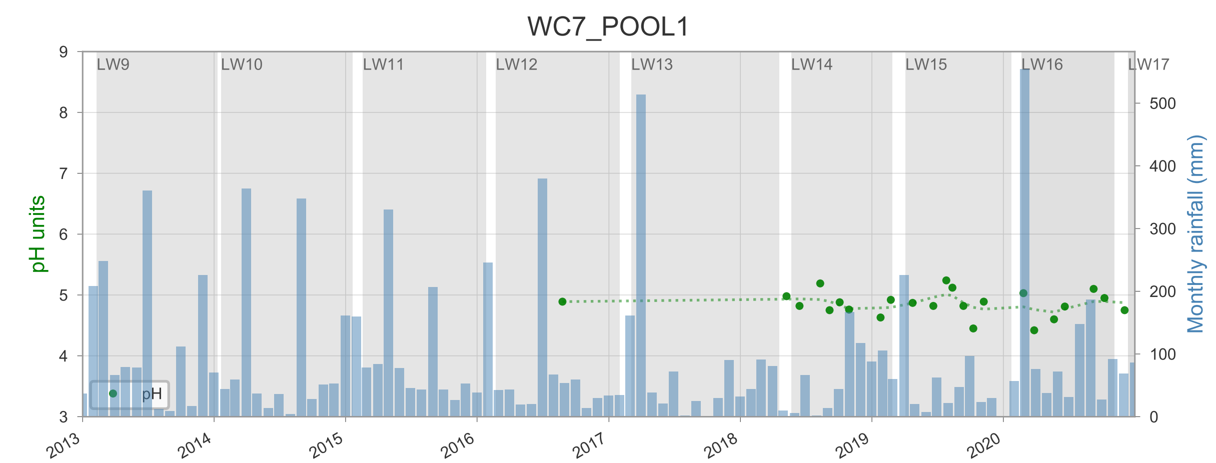

WC6_POOL30
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

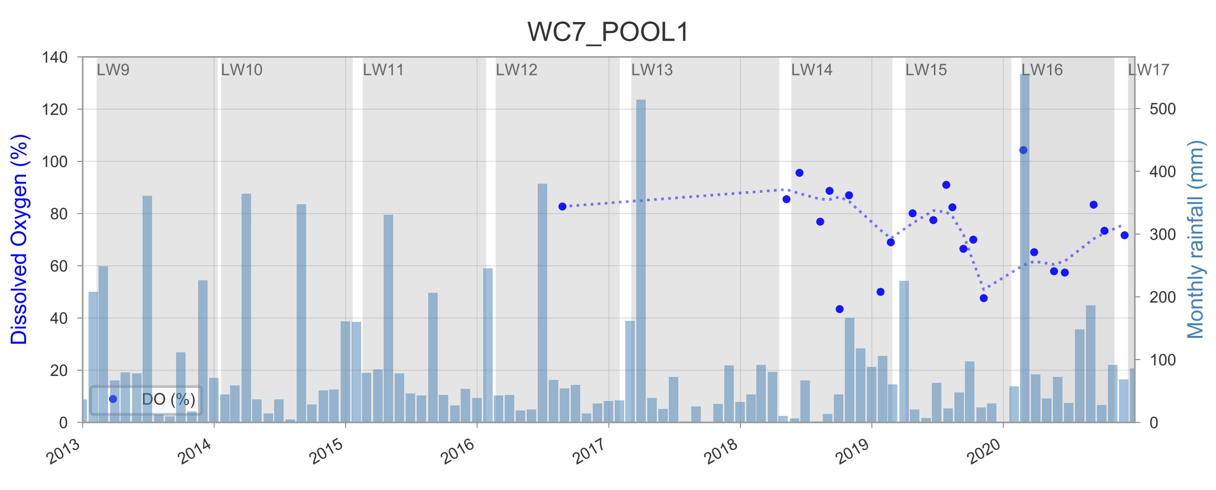

WC6_POOL30
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

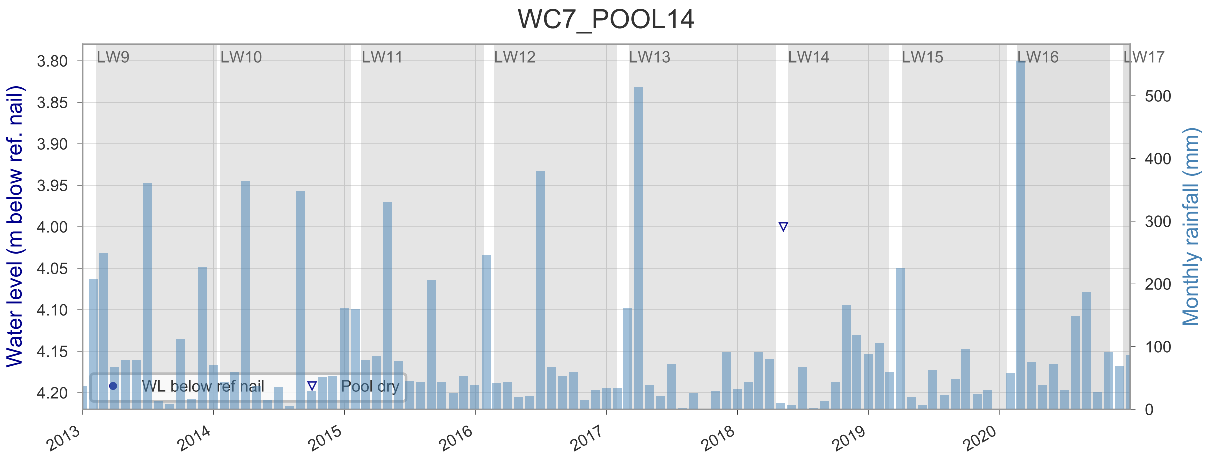

WC6_POOL30
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

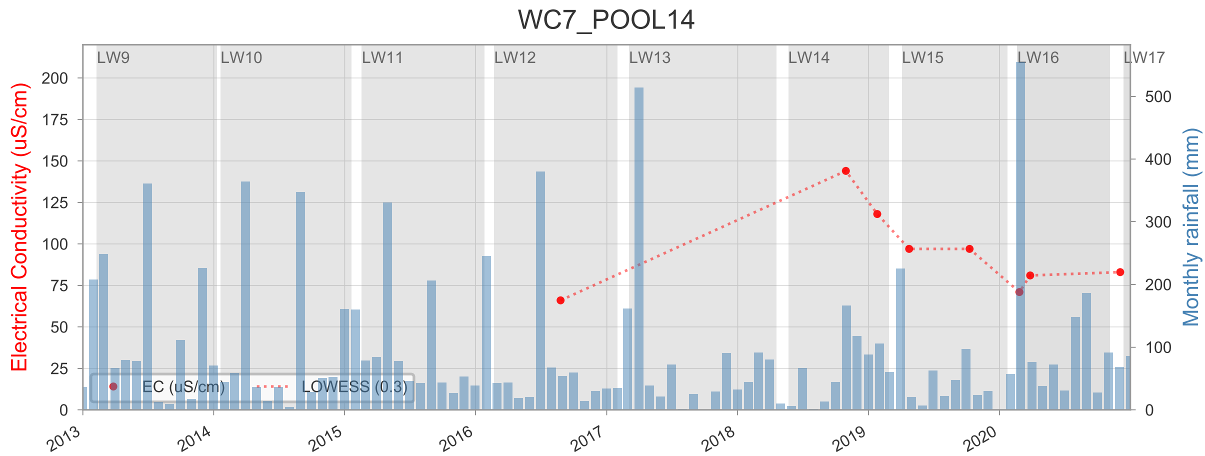

WC7_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

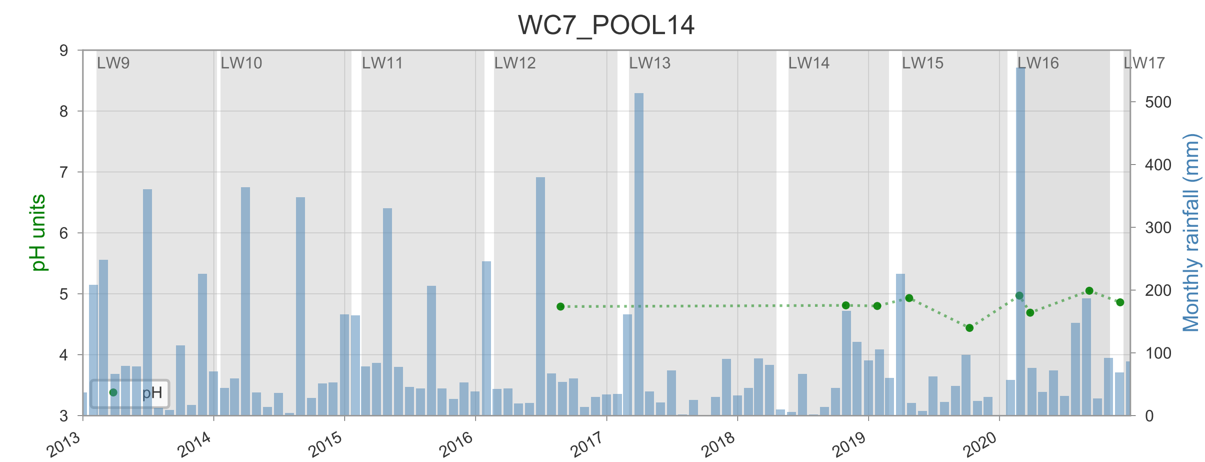

WC7_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

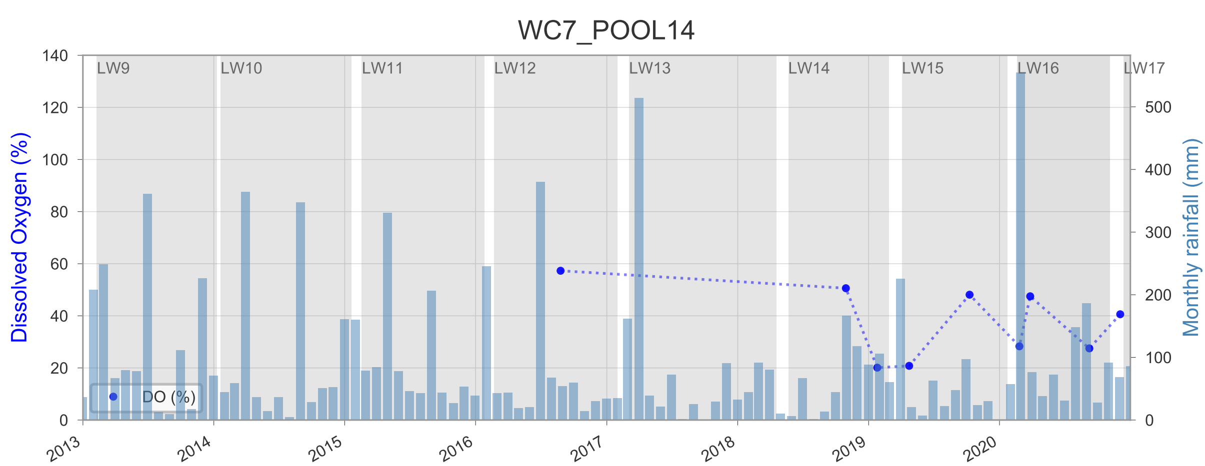

WC7_POOL1
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

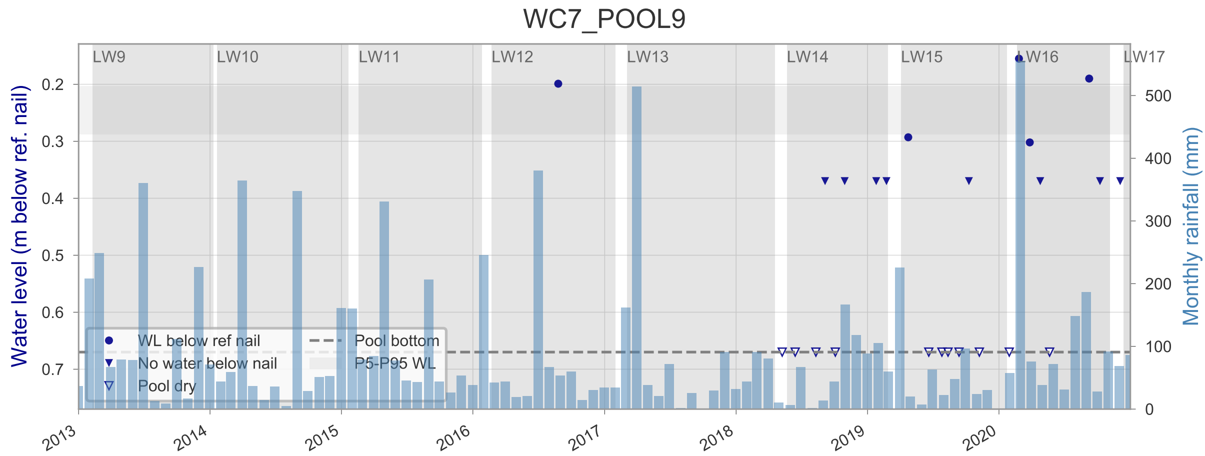

WC7_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

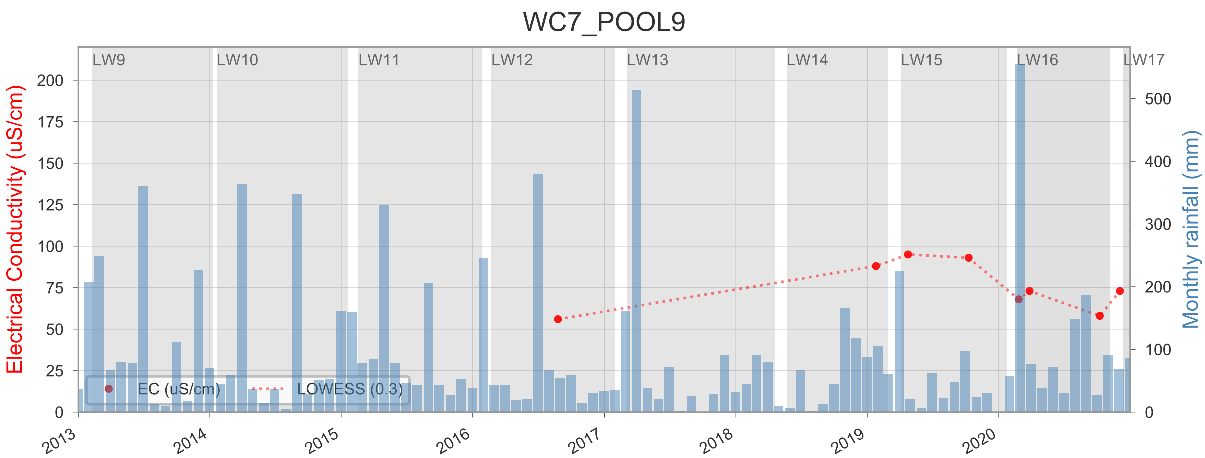

WC7_POOL14
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool dry

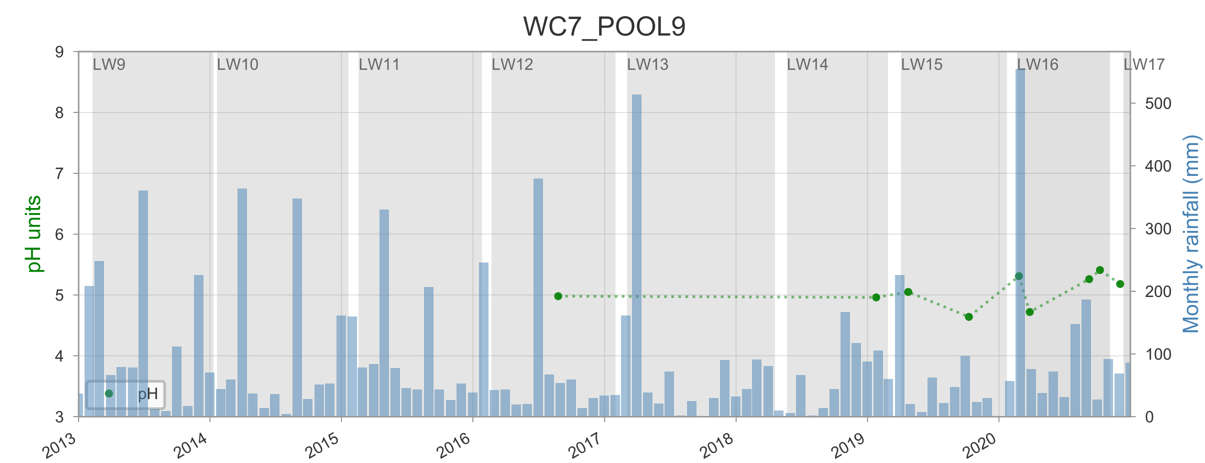

WC7_POOL14
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)

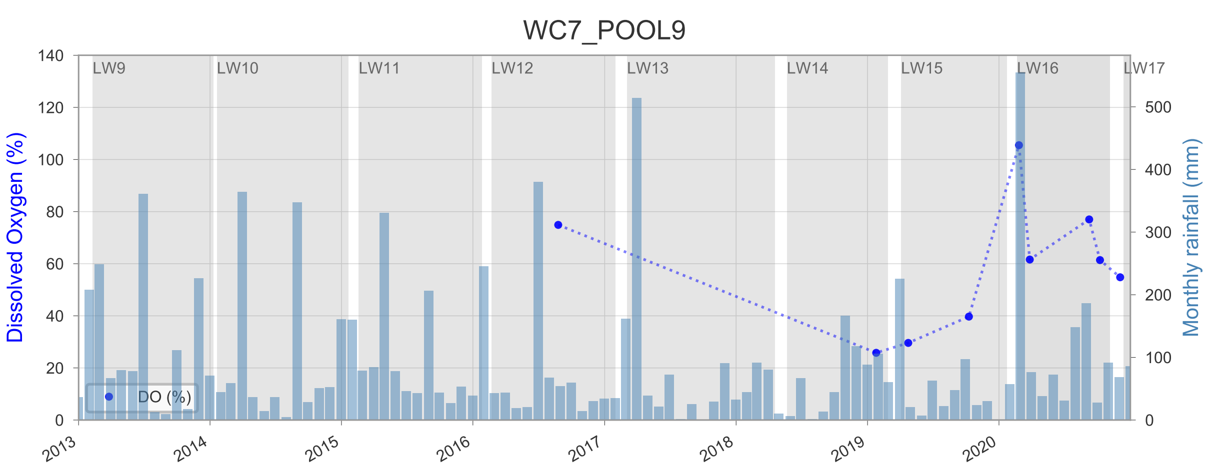

WC7_POOL14
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH

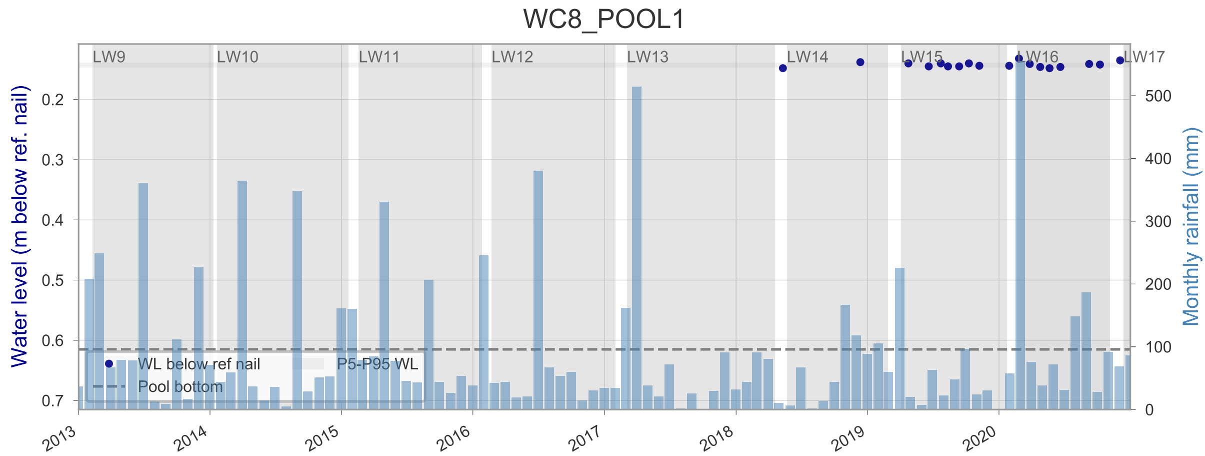

WC7_POOL14
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)

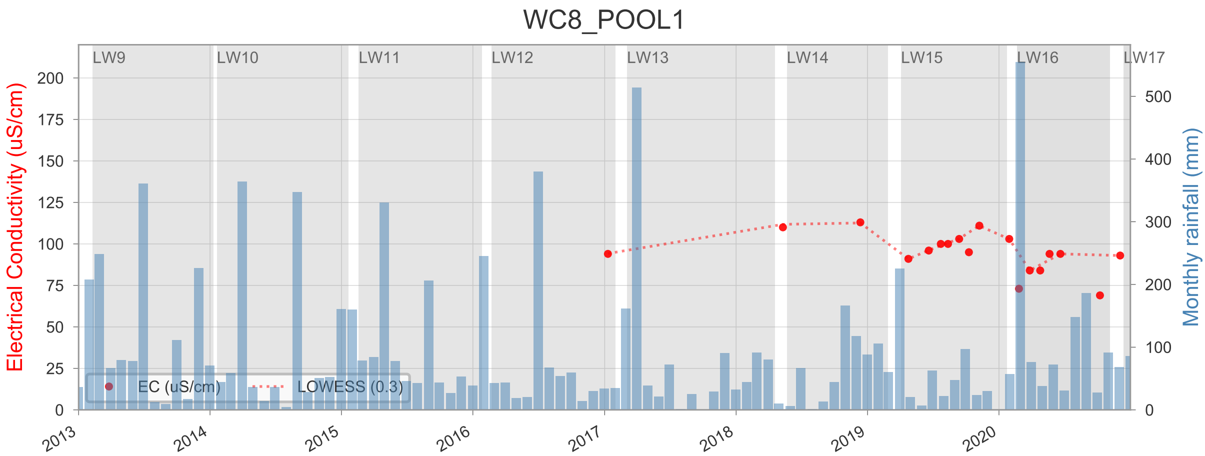

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL
2013
2014
2015
2016
2017
2018
2019
2020

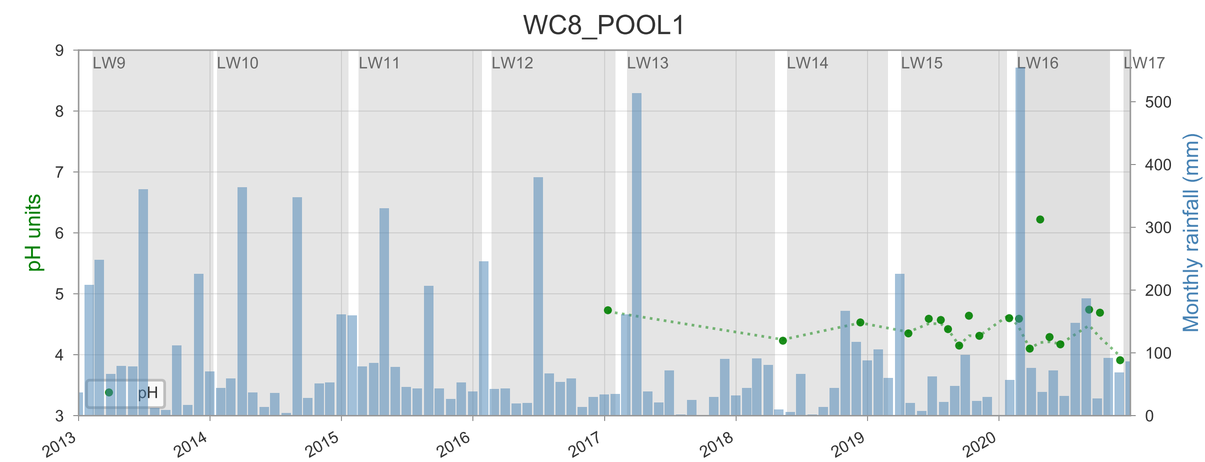

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
2013
2014
2015
2016
2017
2018
2019
2020

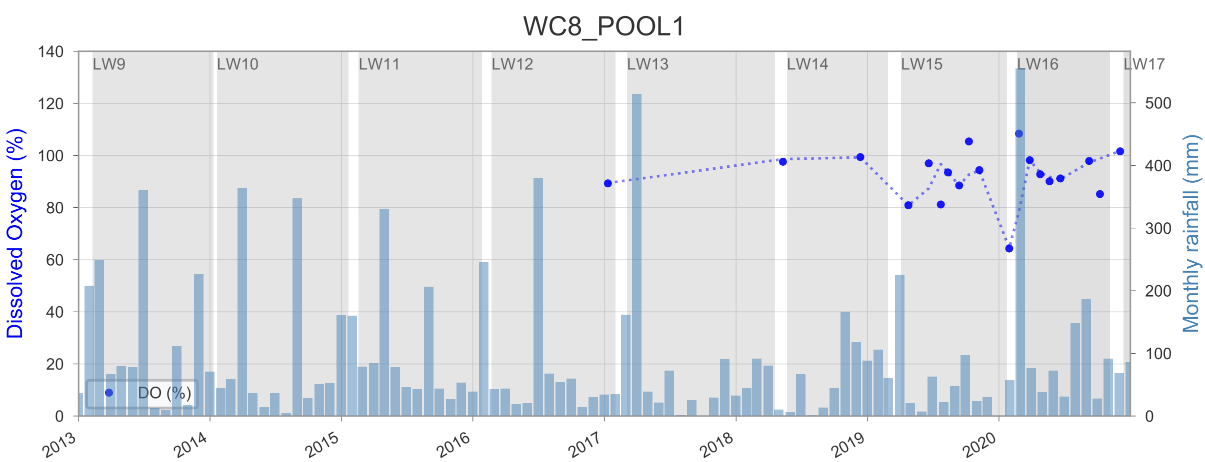

WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
2013
2014
2015
2016
2017
2018
2019
2020


WC7_POOL9
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
2013
2014
2015
2016
2017
2018
2019
2020

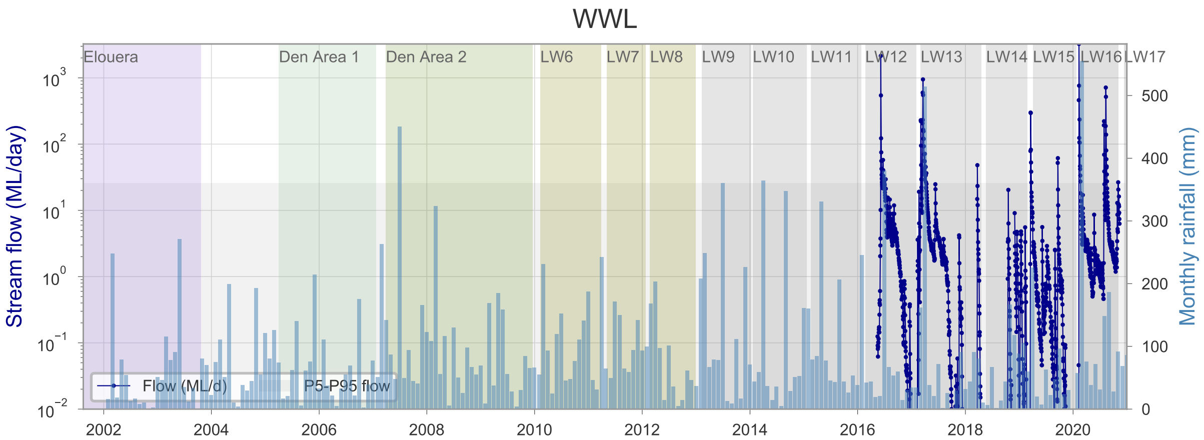

WC8_POOL1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom

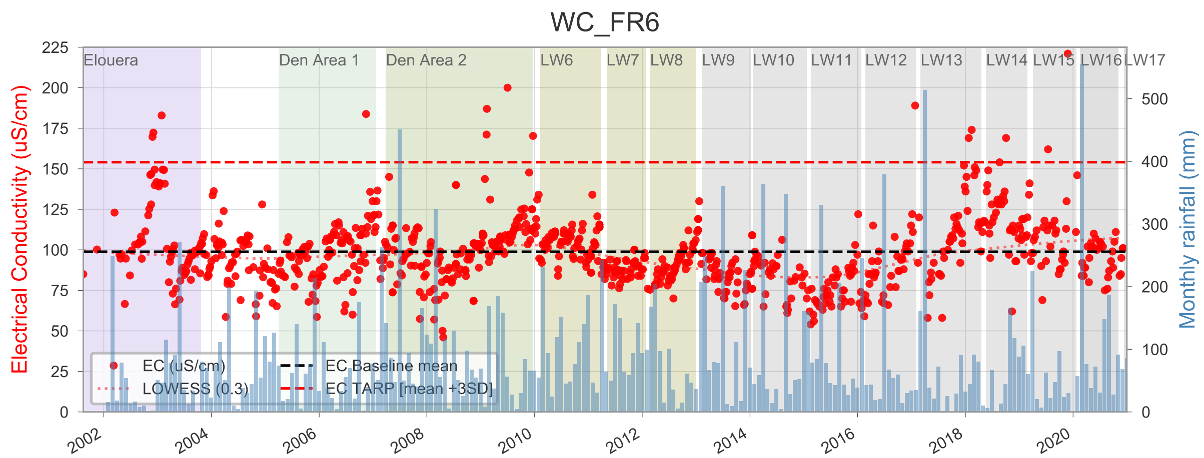

WC8_POOL1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)

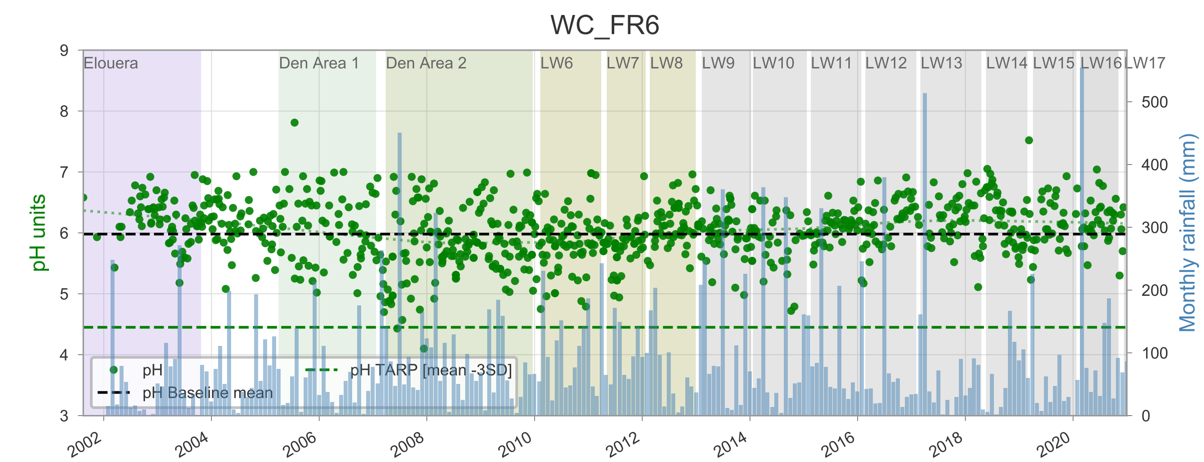

WC8_POOL1
pH units
Monthly rainfall (mm)
pH

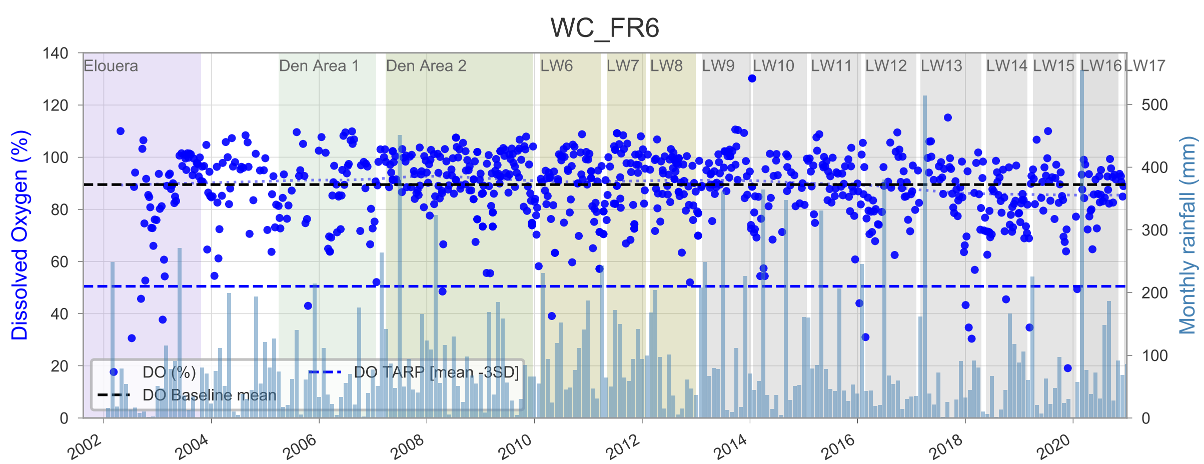

WC8_POOL1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)


WC8_POOL10
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WC8_POOL10
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
WC8_POOL10
pH units
pH
WC8_POOL10
Dissolved Oxygen (%)
DO (%)

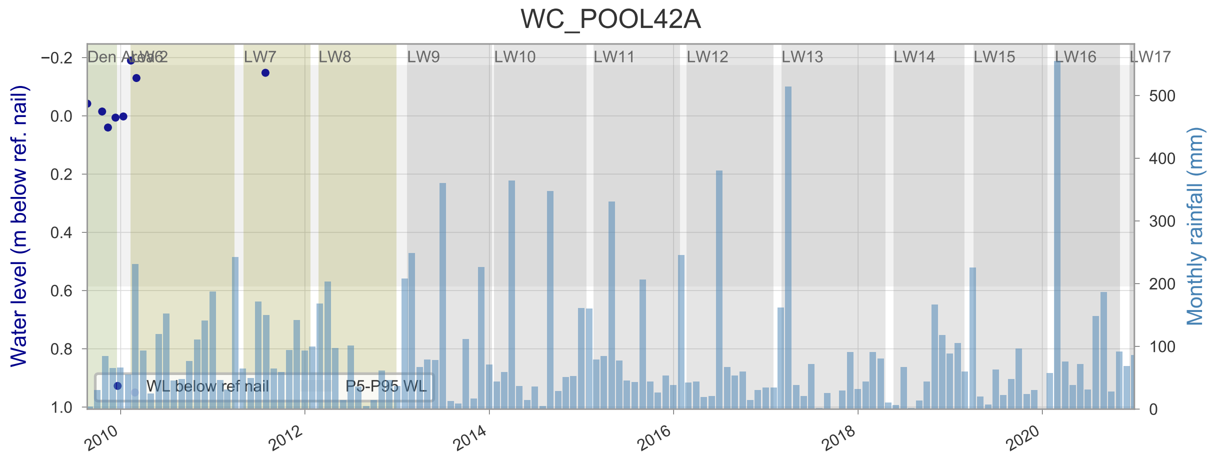

WWL
Stream flow (ML/day)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
P5-P95 flow

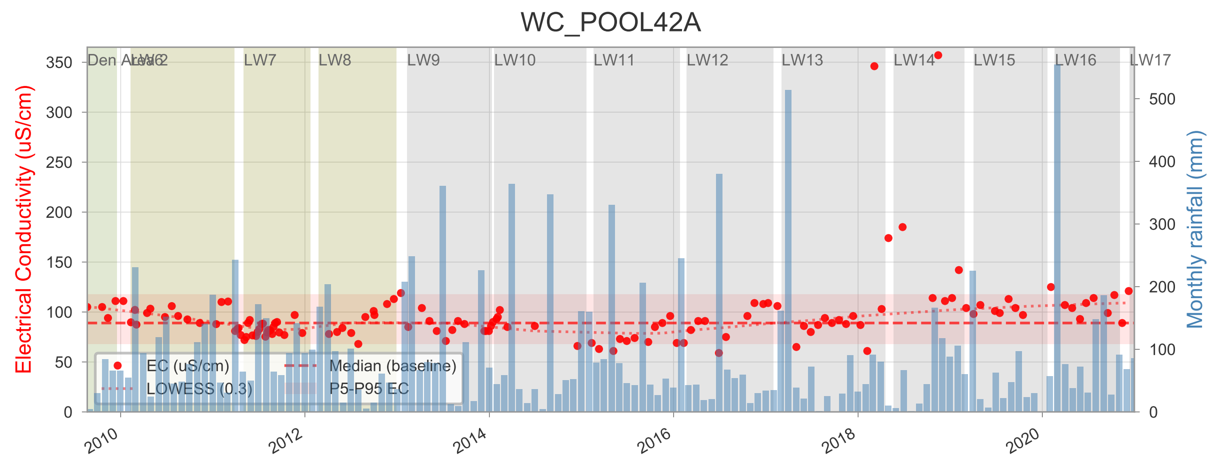

WC_FR6
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
EC Baseline mean
EC TARP [mean +3SD]

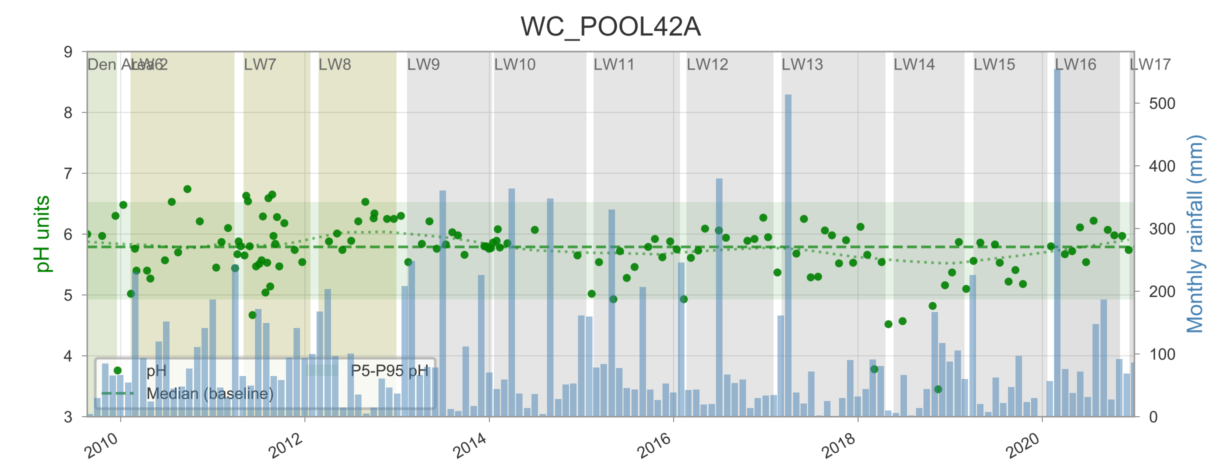

WC_FR6
pH units
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
pH Baseline mean
pH TARP [mean -3SD]

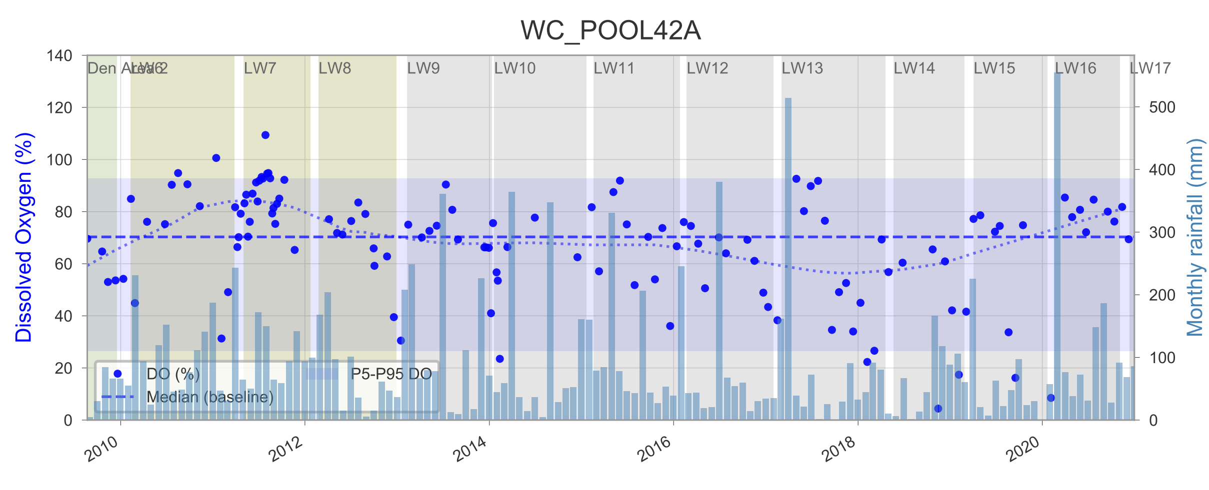

WC_FR6
Dissolved Oxygen (%)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
DO Baseline mean
DO TARP [mean -3SD]

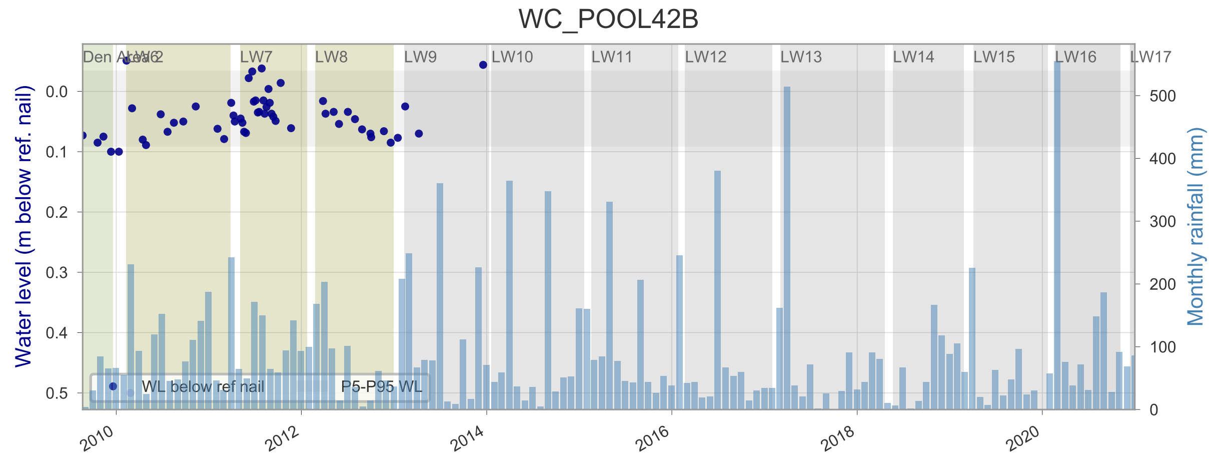
WC_POOL41
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
WC_POOL41
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC_POOL41
pH units
pH
Median (baseline)
P5-P95 pH
WC_POOL41
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

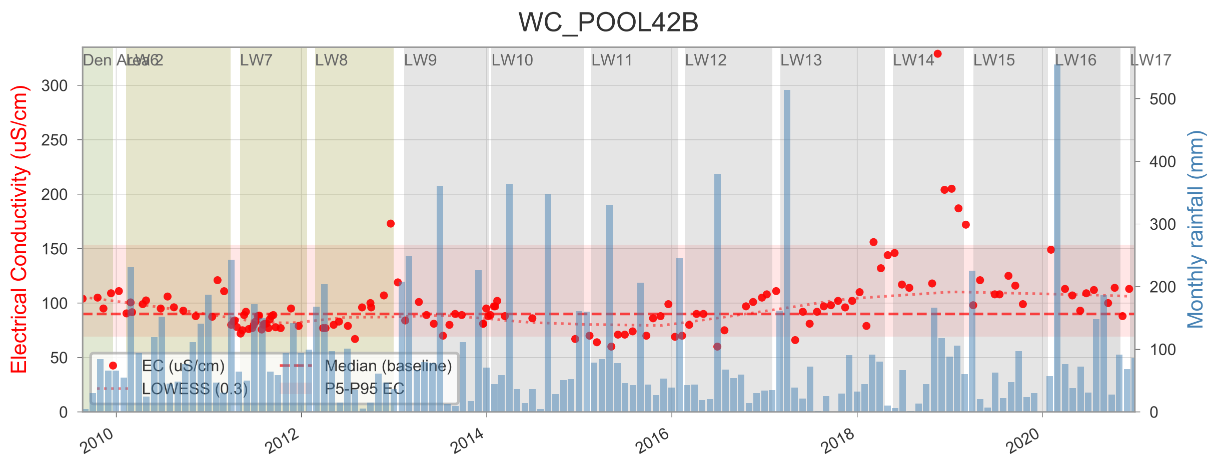

WC_POOL42A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
2010
2012
2014
2016
2018
2020

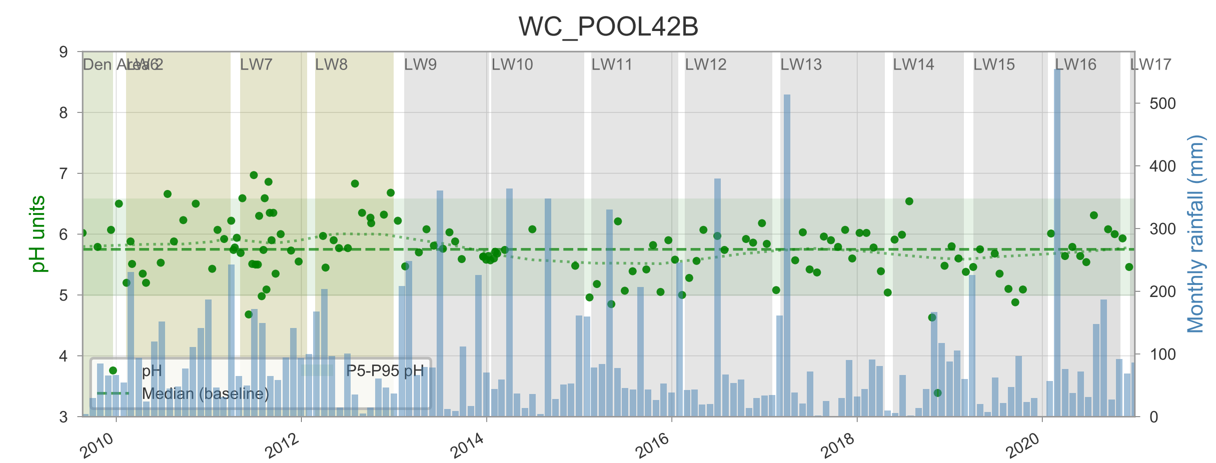

WC_POOL42A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
2010
2012
2014
2016
2018
2020

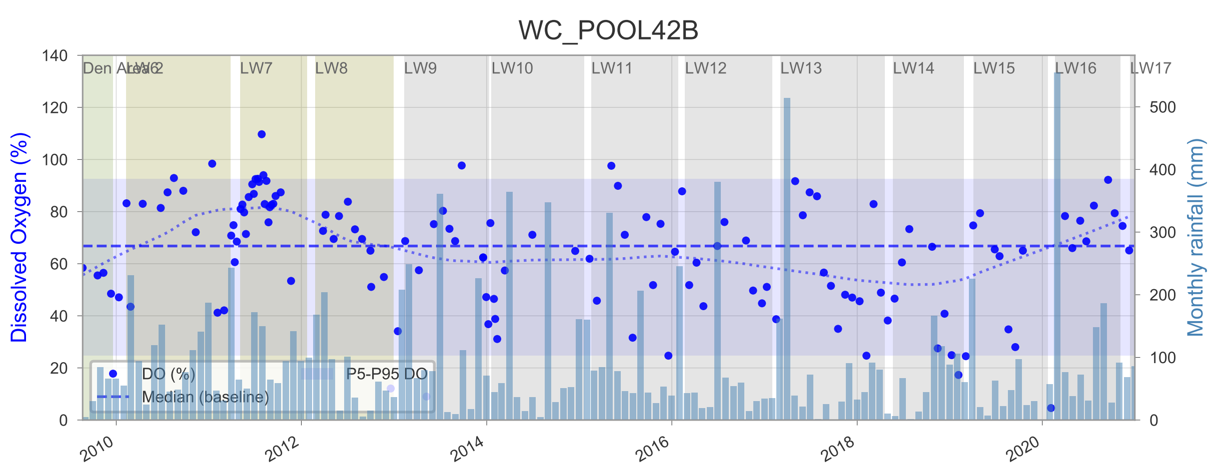

WC_POOL42A
pH units
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
2010
2012
2014
2016
2018
2020

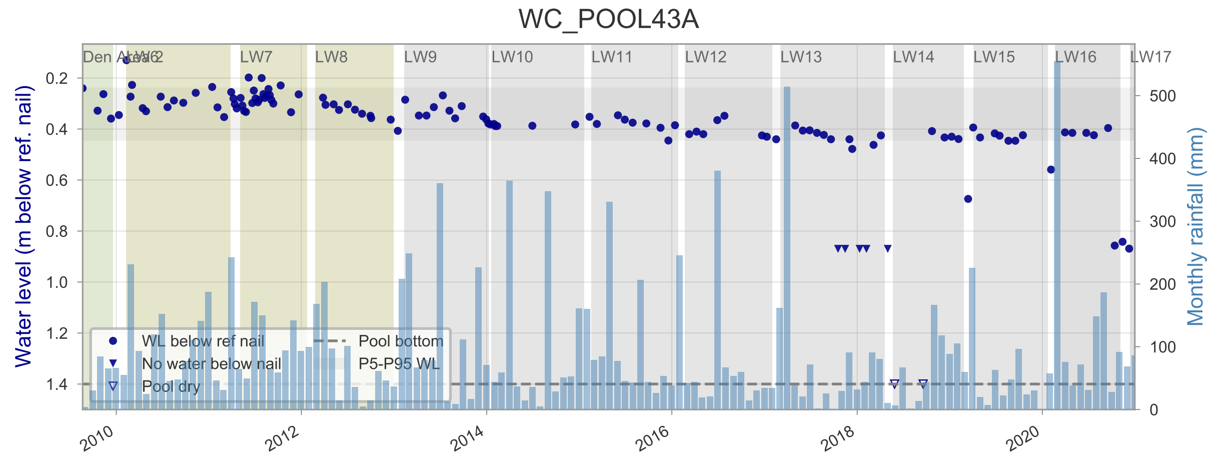

WC_POOL42A
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
2010
2012
2014
2016
2018
2020

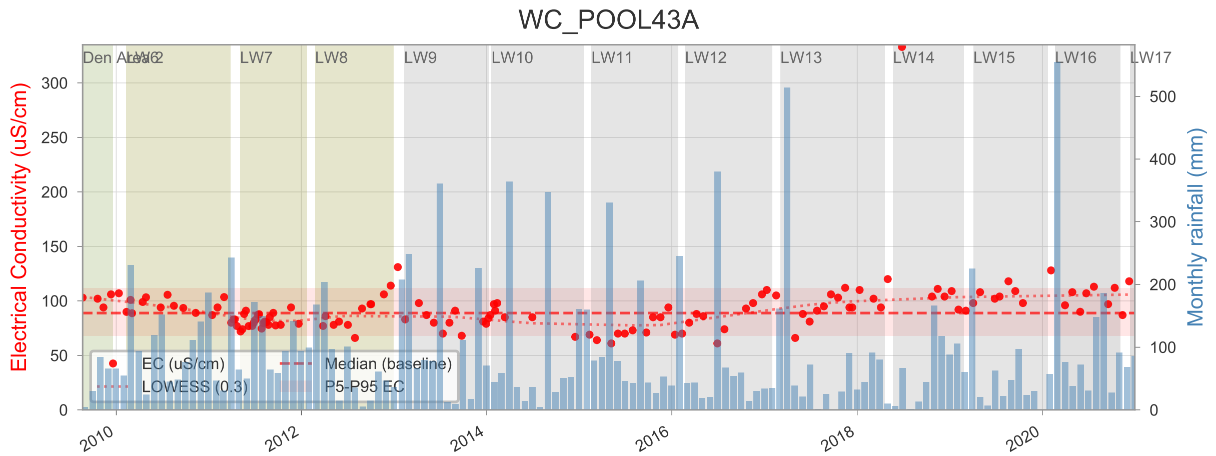

WC_POOL42B
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

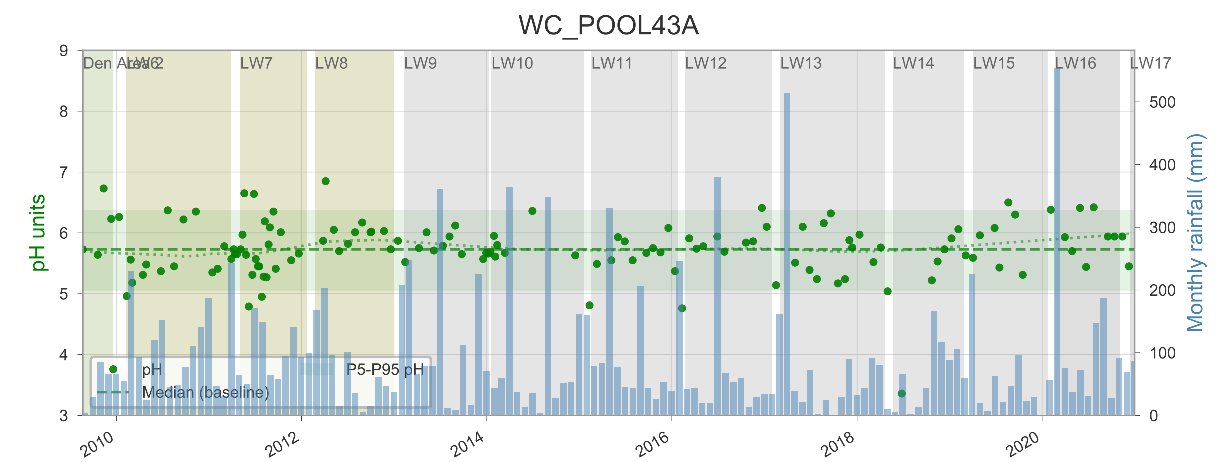

WC_POOL42B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

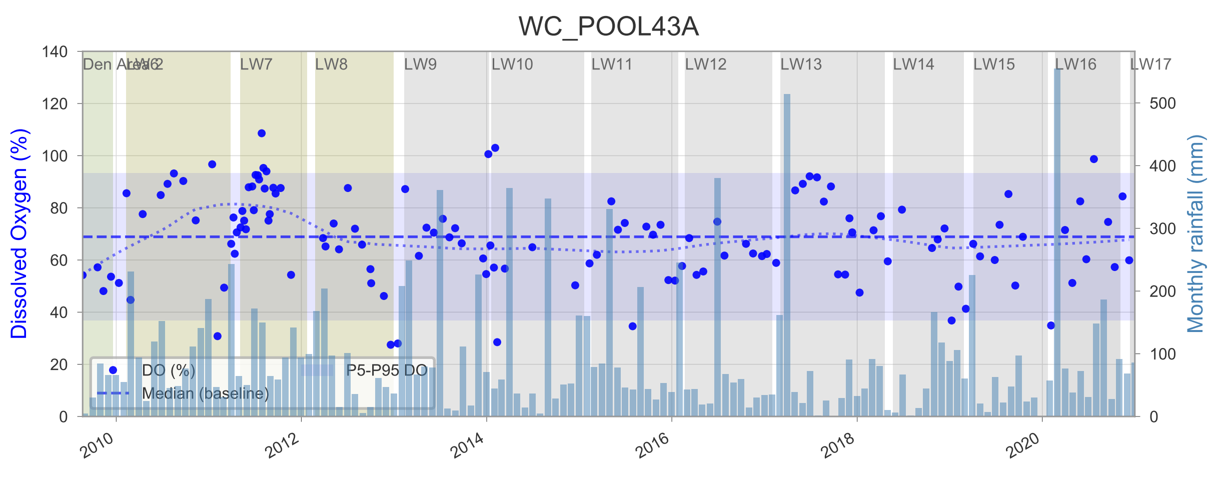

WC_POOL42B
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

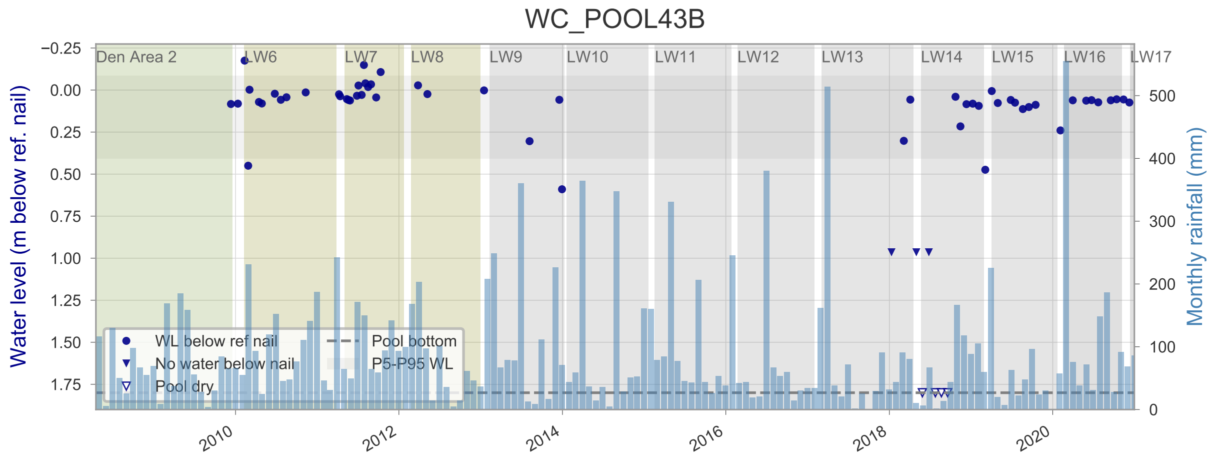

WC_POOL42B
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

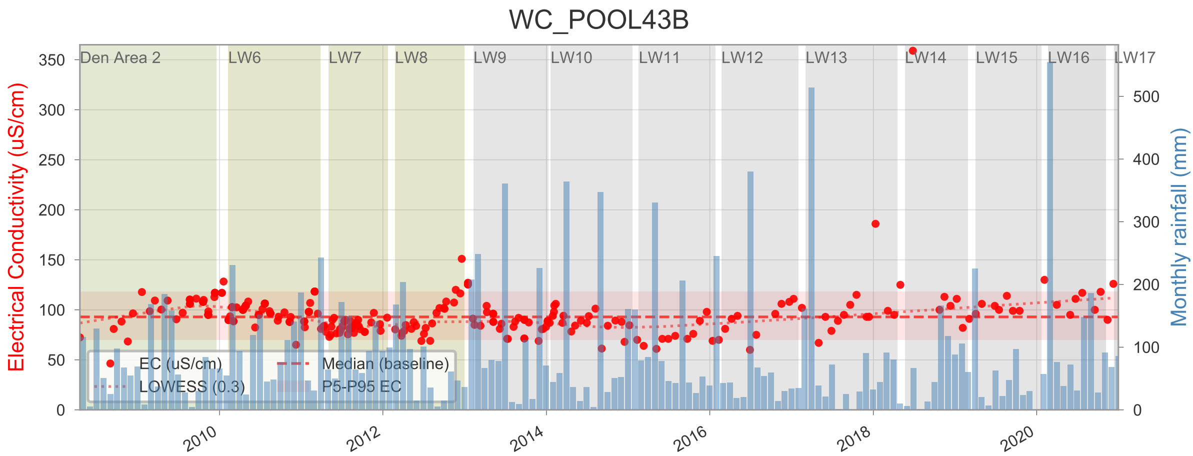

WC_POOL43A
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 6
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

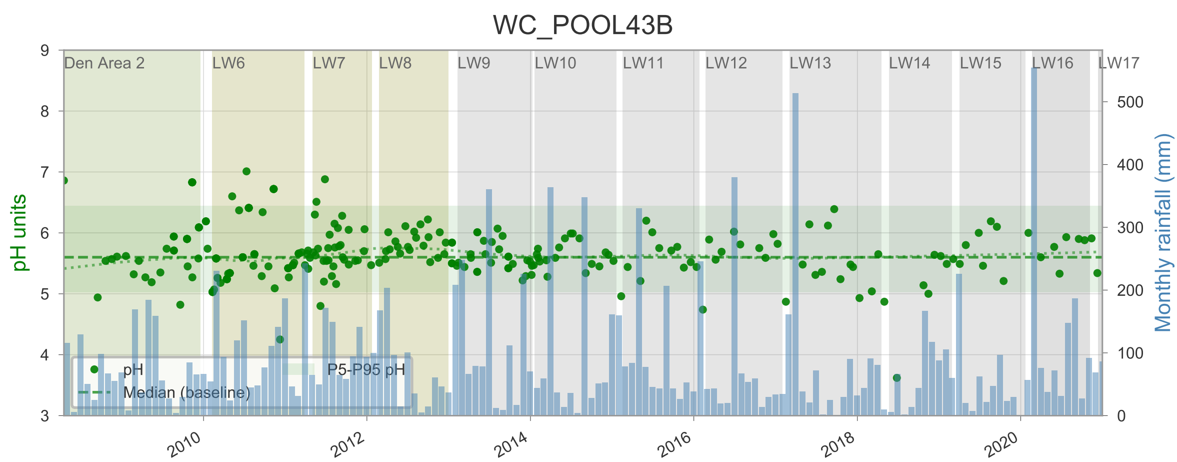

WC_POOL43A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

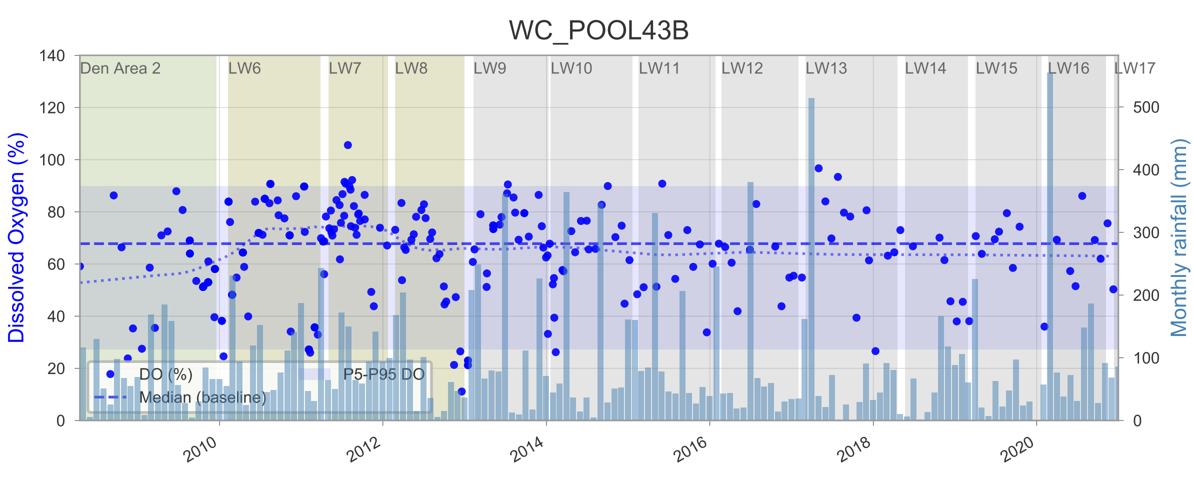

WC_POOL43A
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

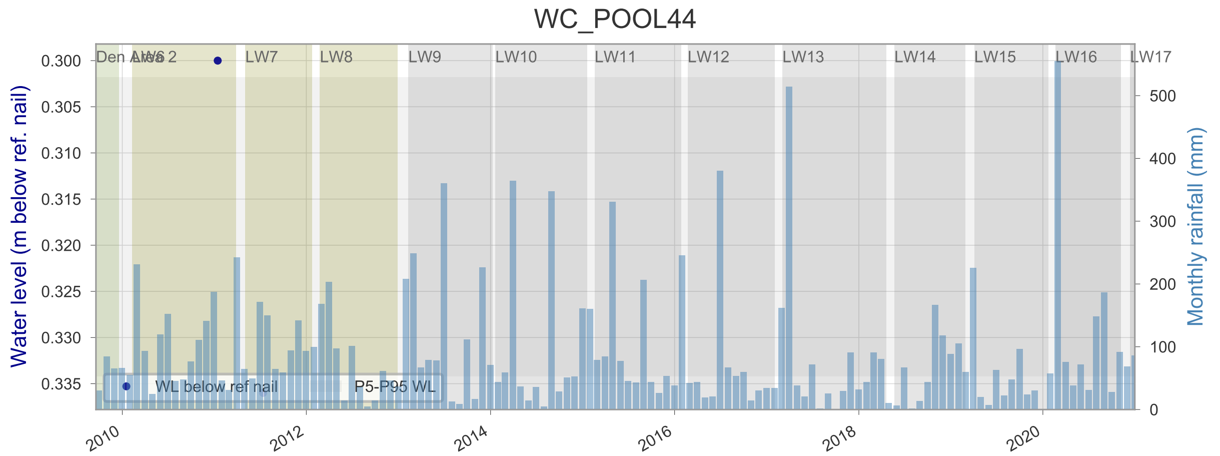

WC_POOL43A
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

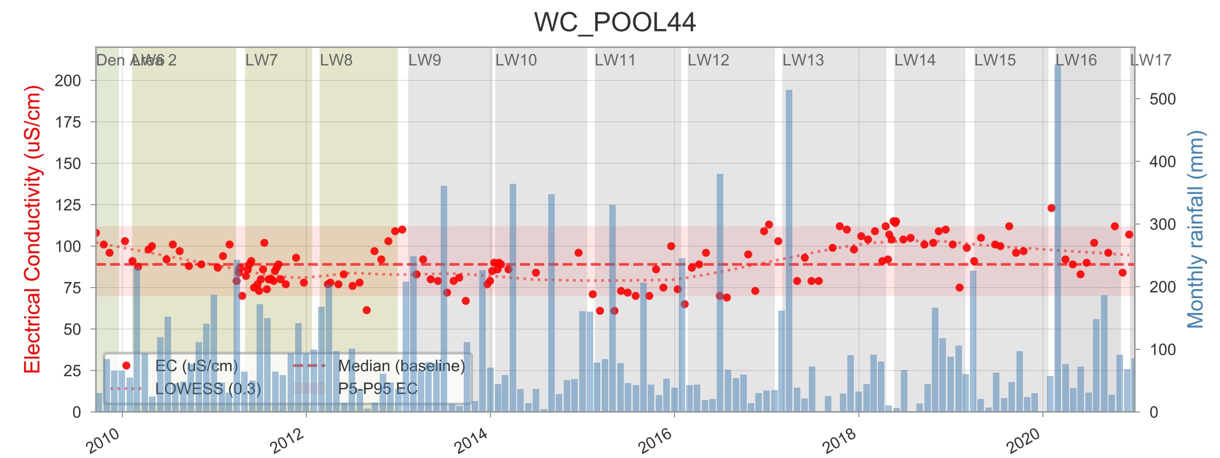

WC_POOL43B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool dry
Pool bottom
P5-P95 WL

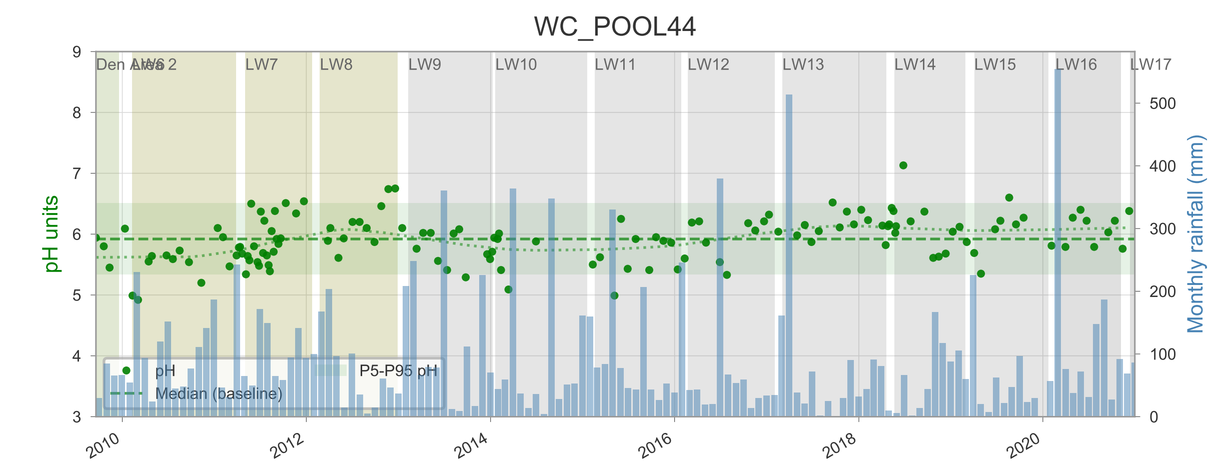

WC_POOL43B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

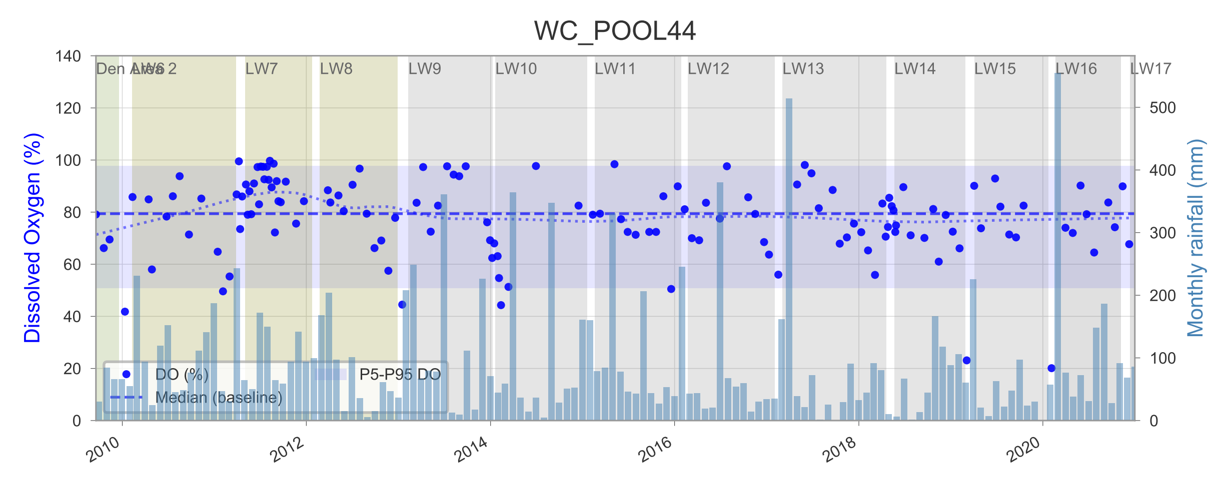

WC_POOL43B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

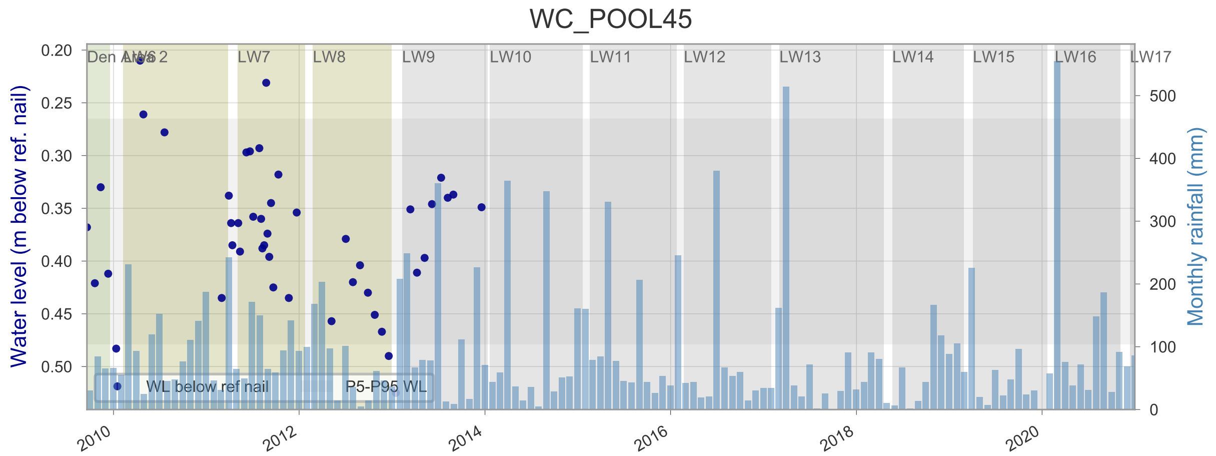

WC_POOL43B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO


WC_POOL44
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

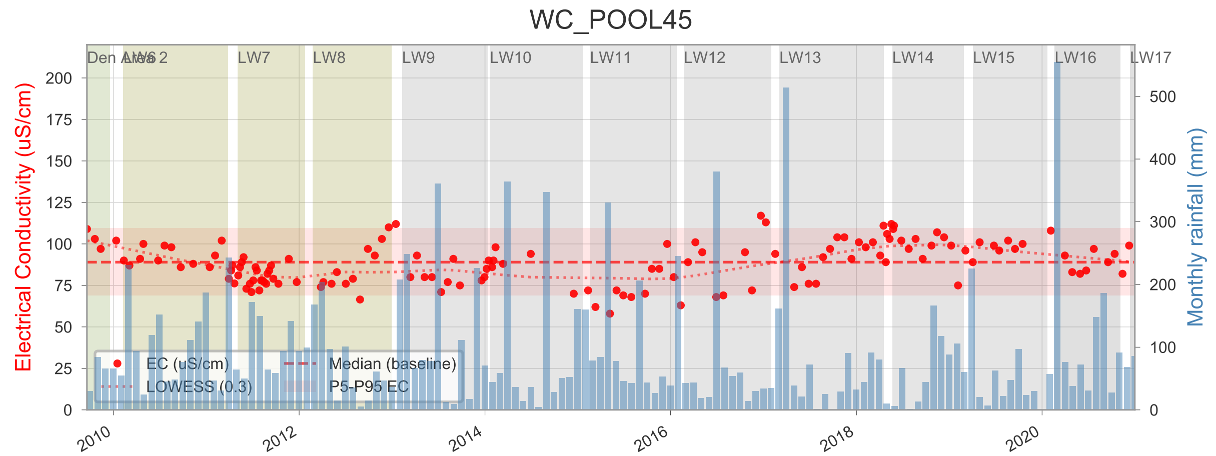

WC_POOL44
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC


WC_POOL44
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

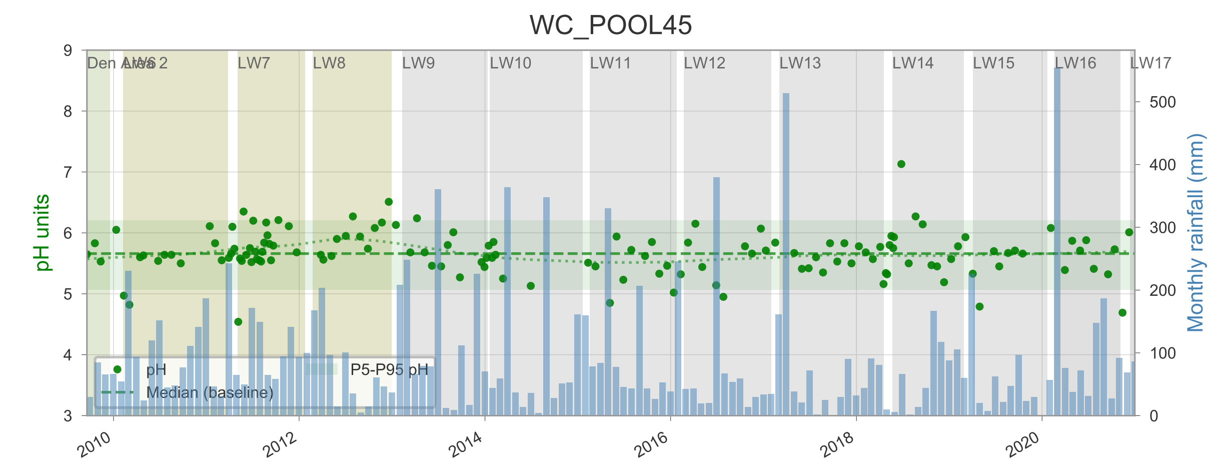

WC_POOL44
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO



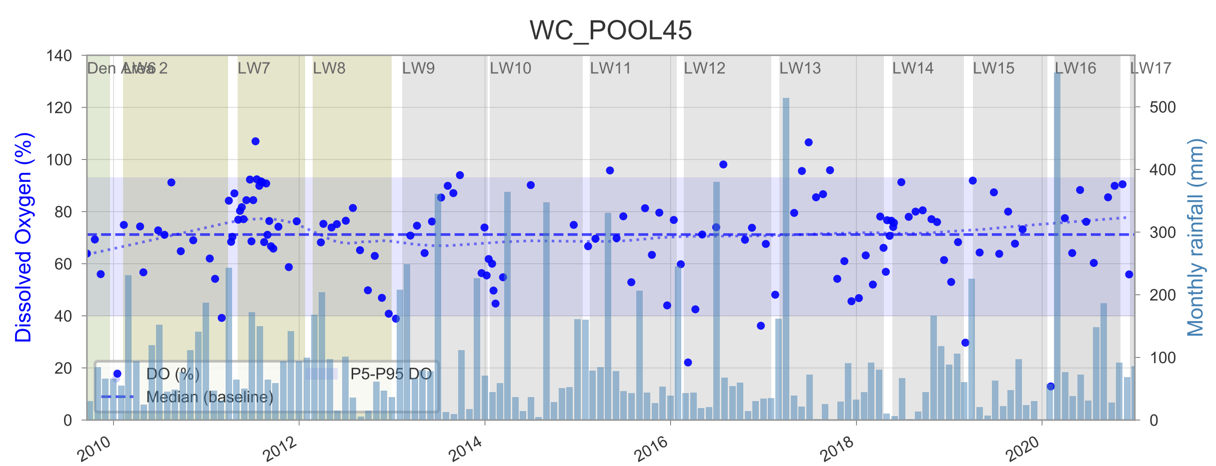
WC_POOL45
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL



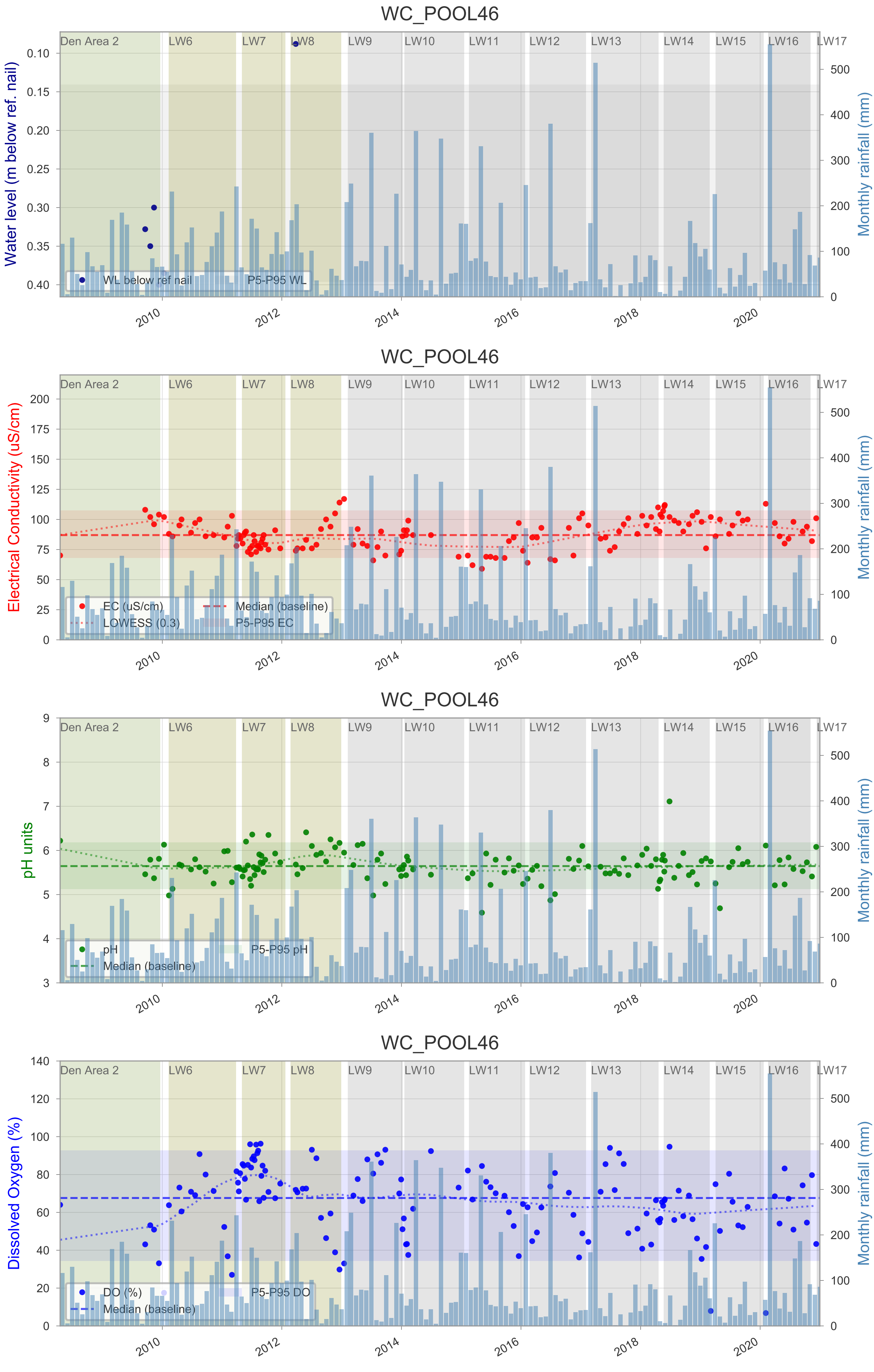
WC_POOL45
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

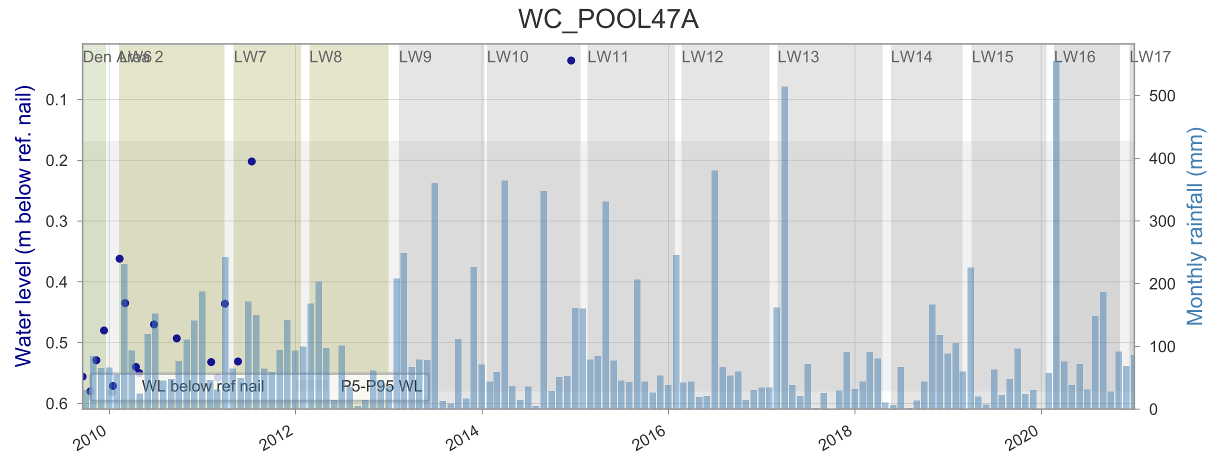


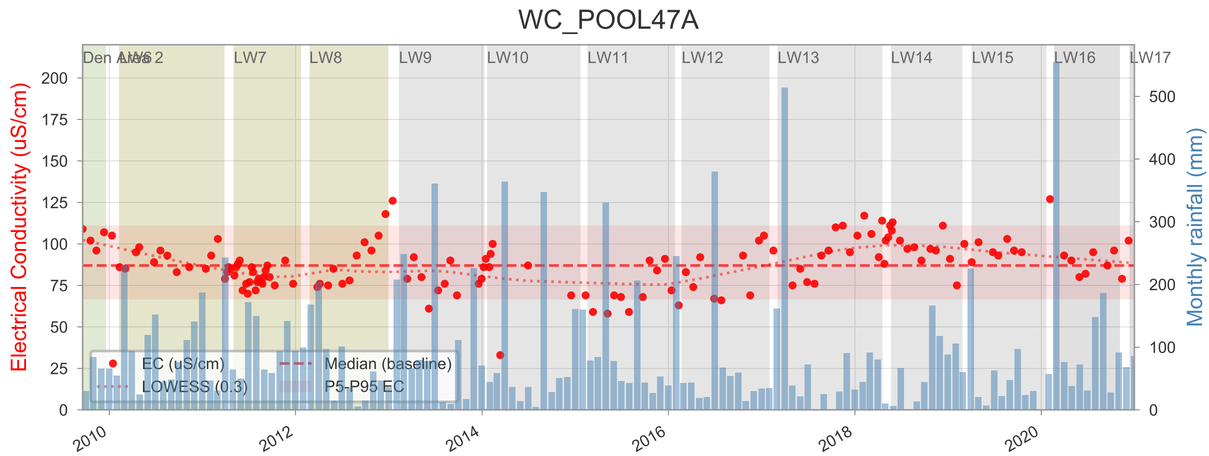
WC_POOL45
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

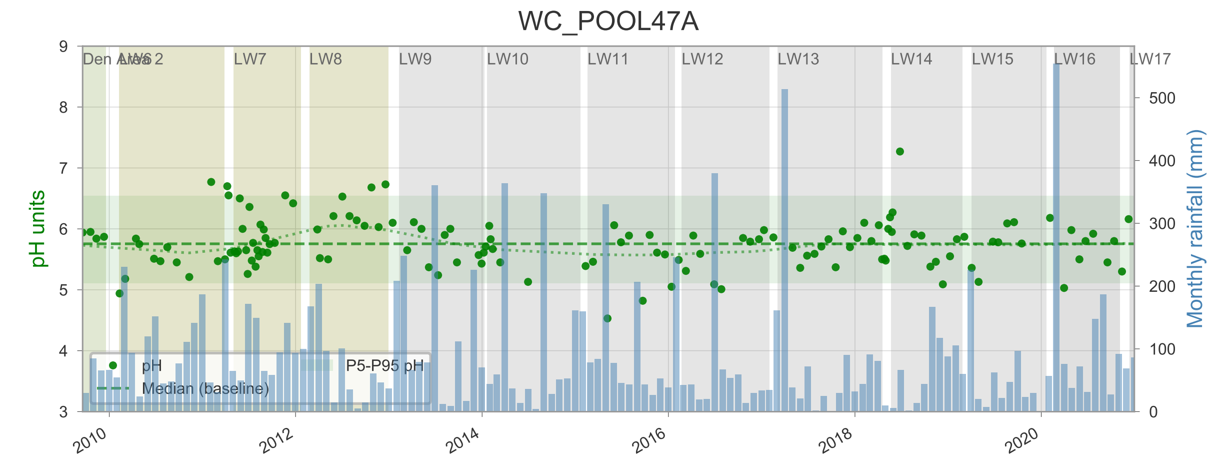


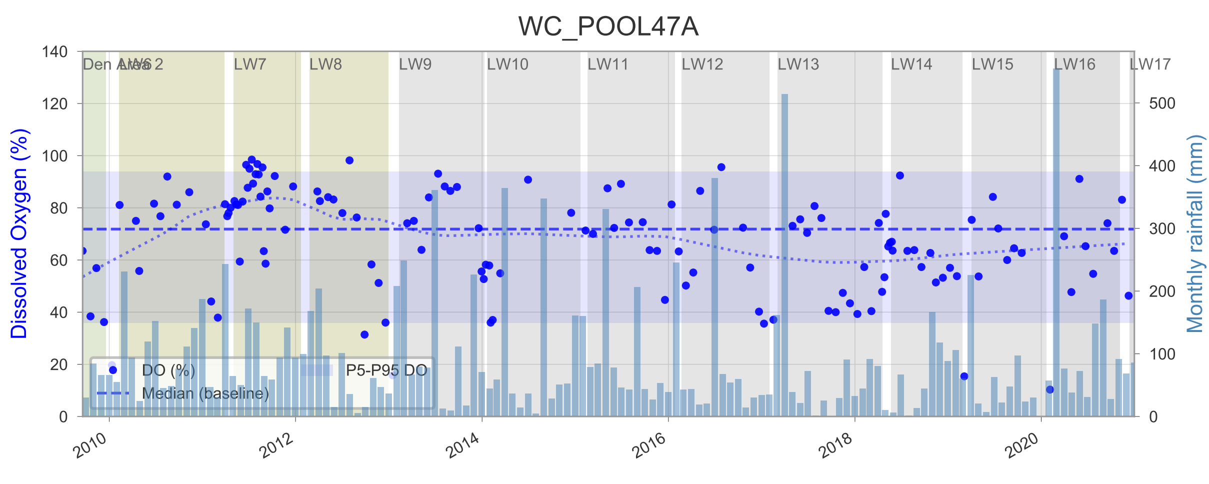
WC_POOL45
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

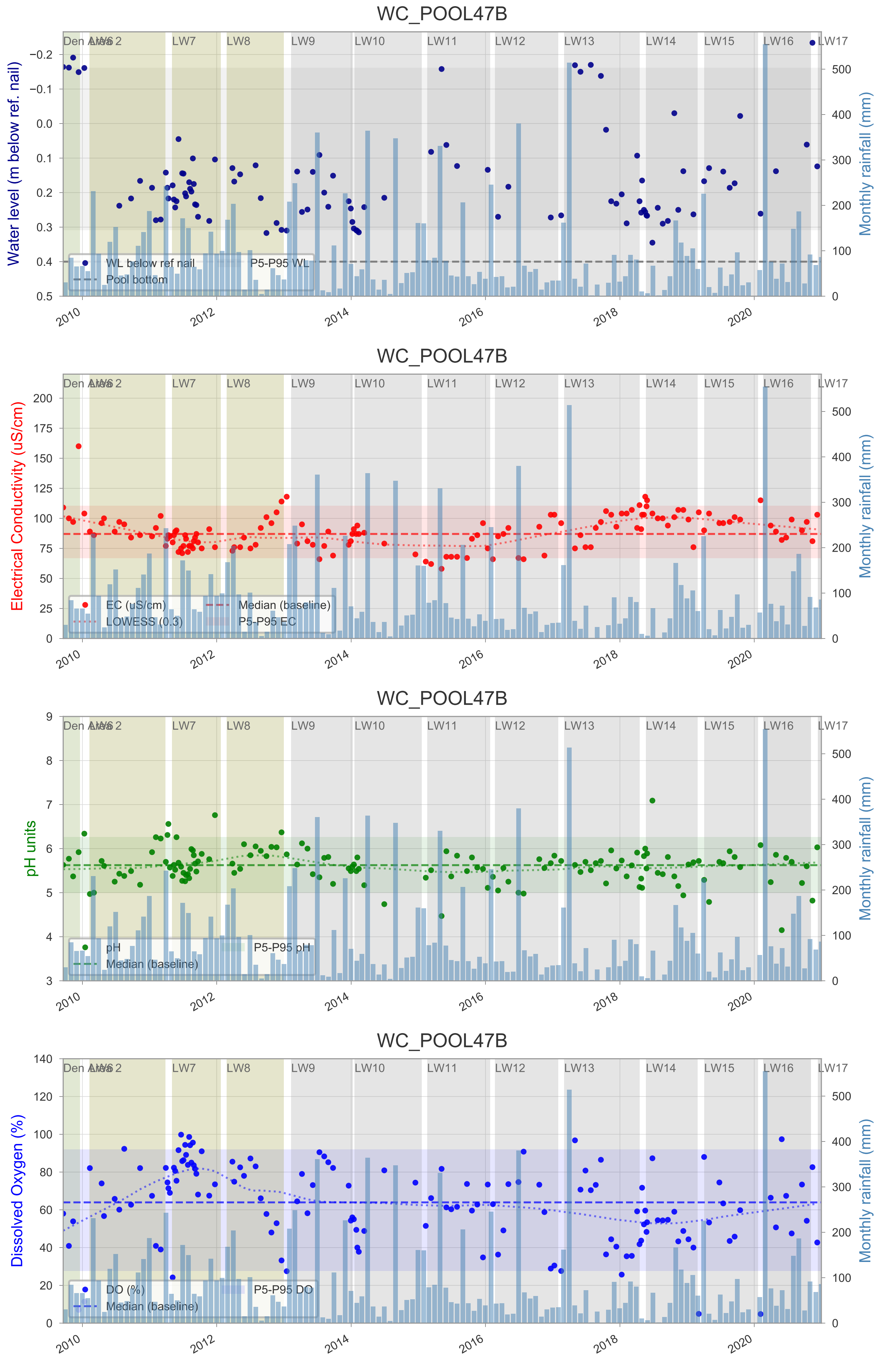

WC_POOL46
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
pH units
pH
P5-P95 pH
Dissolved Oxygen (%)
DO (%)
P5-P95 DO
2010
2012
2014
2016
2018
2020


WC_POOL47A
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL

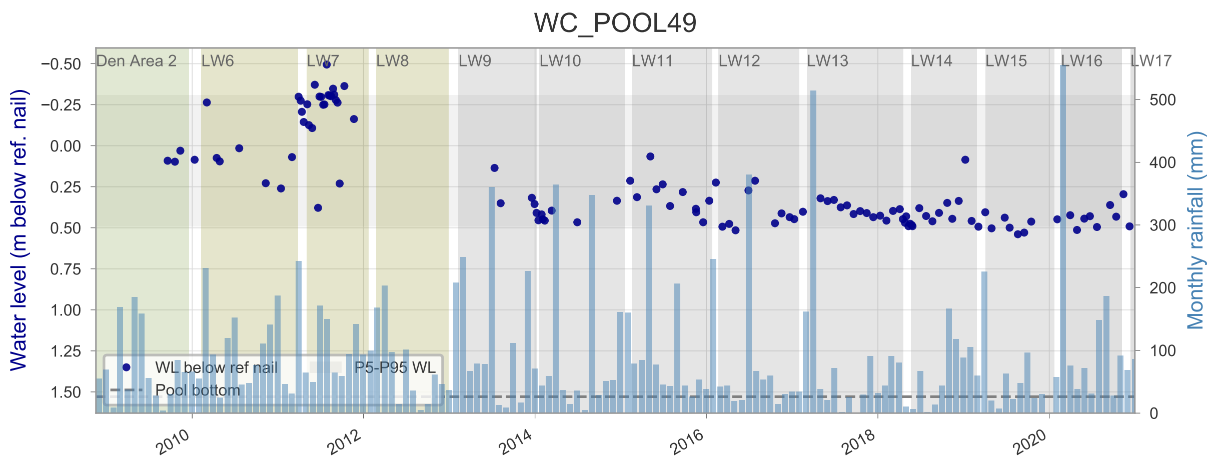

WC_POOL47A
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

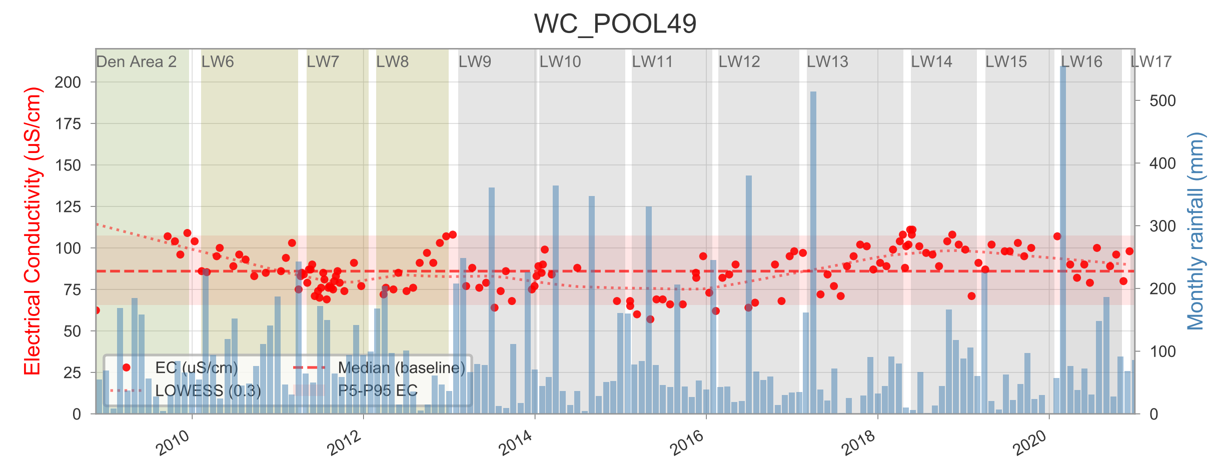

WC_POOL47A
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

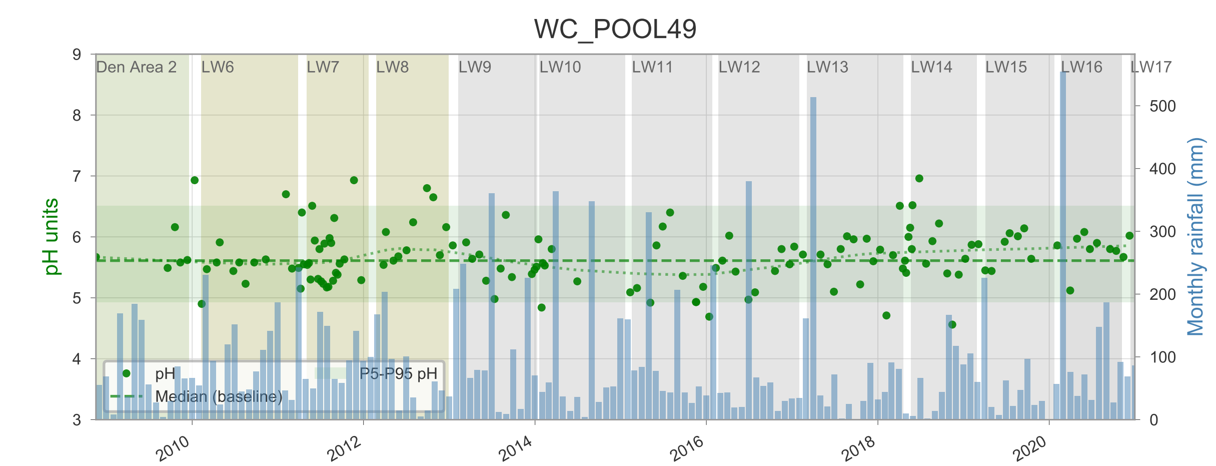

WC_POOL47A
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

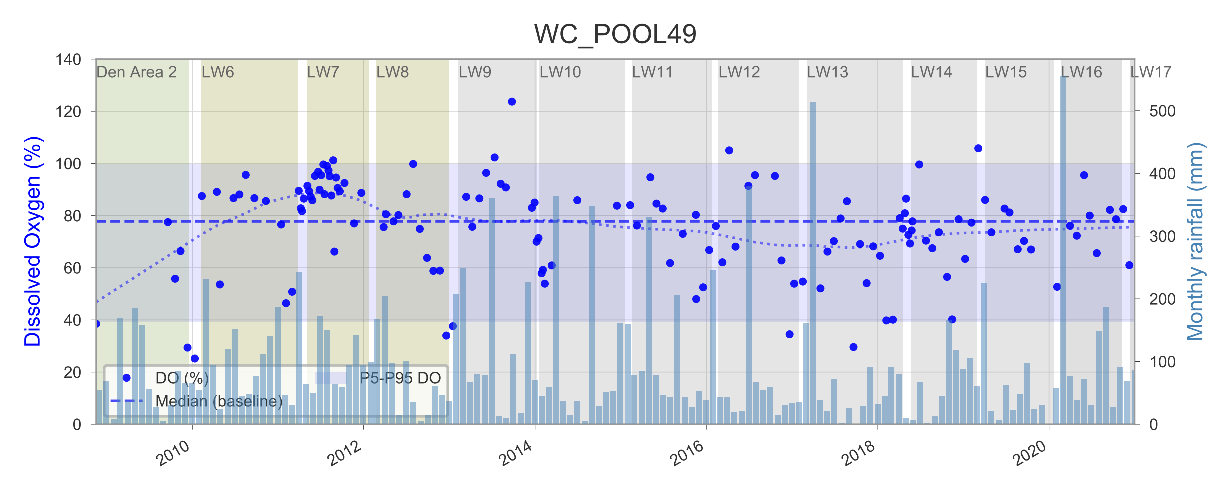


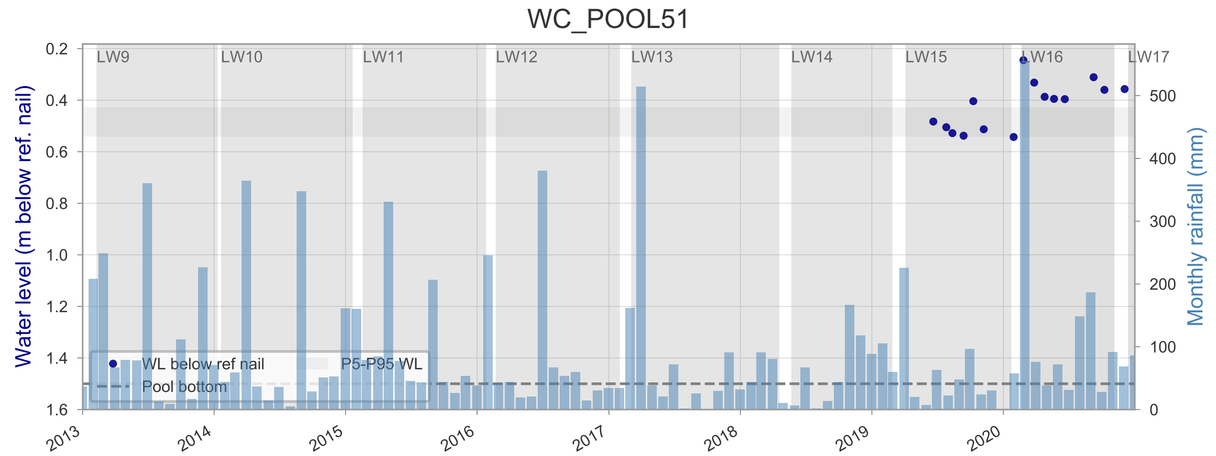
WC_POOL47B
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
Pool bottom
P5-P95 WL
WC_POOL47B
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WC_POOL47B
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH
WC_POOL47B
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

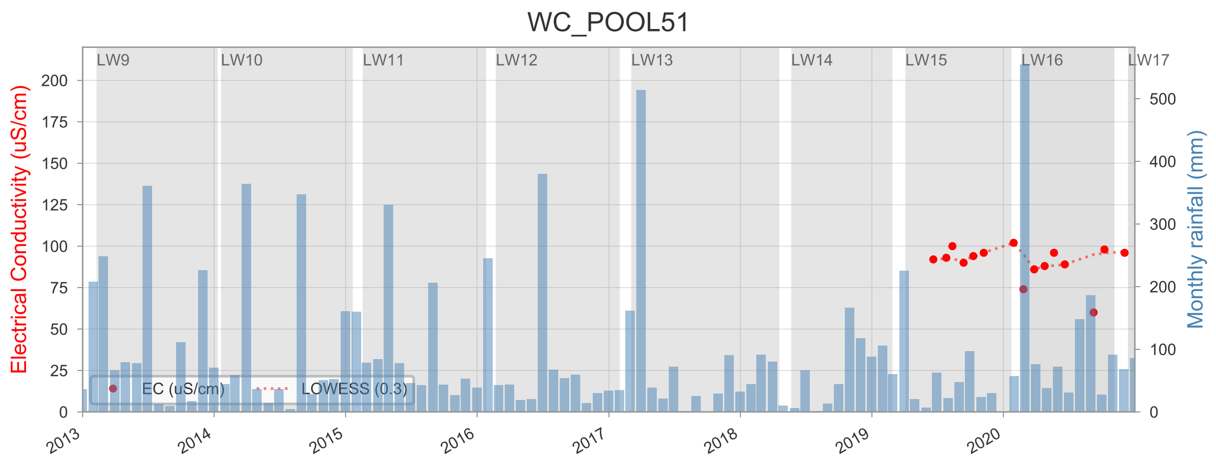

WC_POOL49
Water level (m below ref. nail)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
Pool bottom
P5-P95 WL

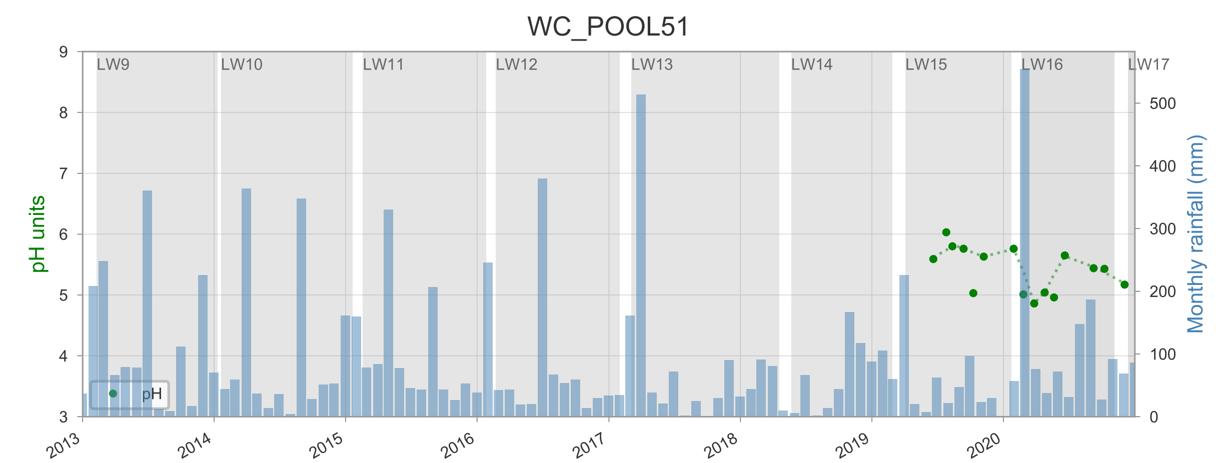

WC_POOL49
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

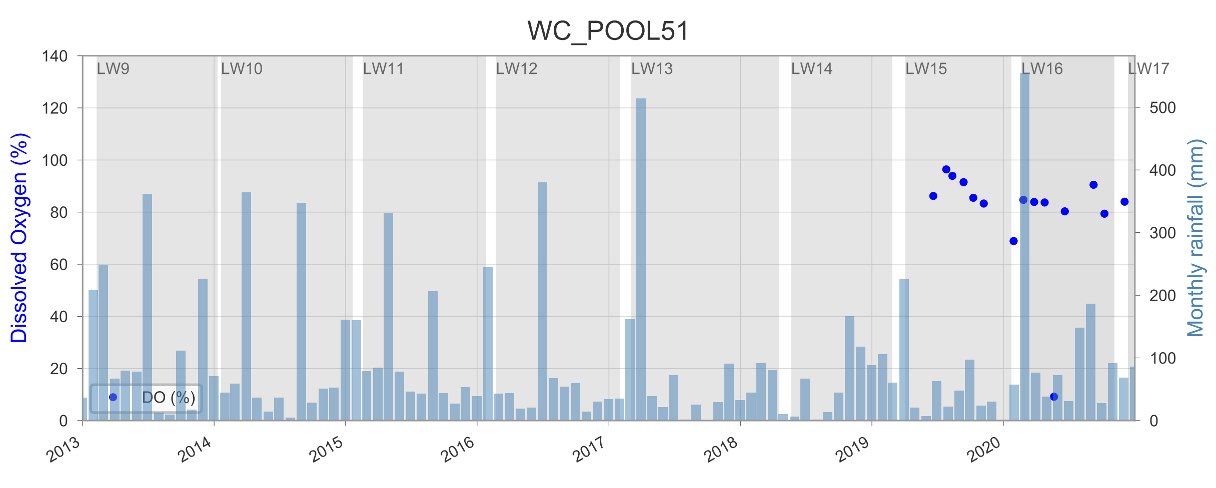

WC_POOL49
pH units
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH

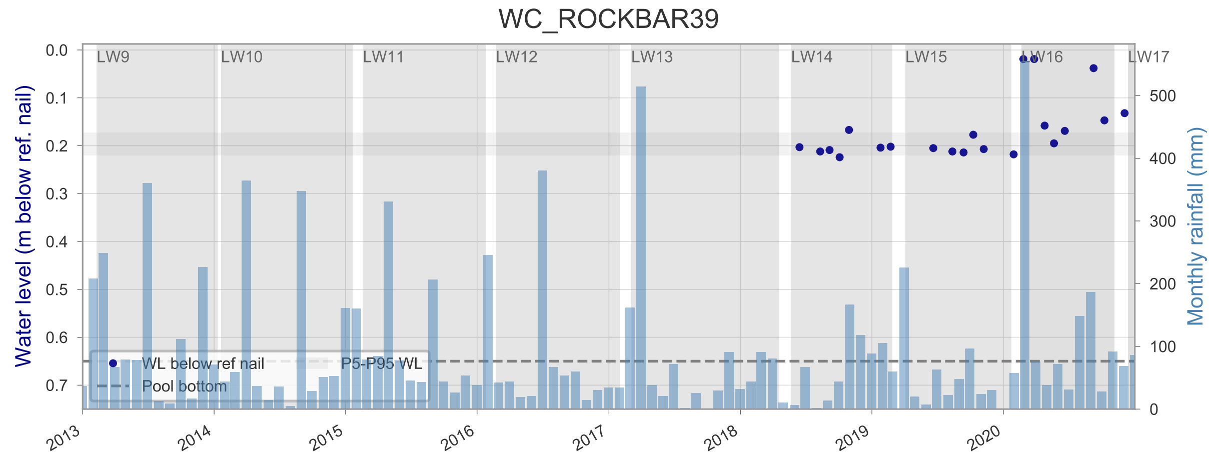

WC_POOL49
Dissolved Oxygen (%)
Monthly rainfall (mm)
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO


WC_POOL51
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
P5-P95 WL
Pool bottom
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

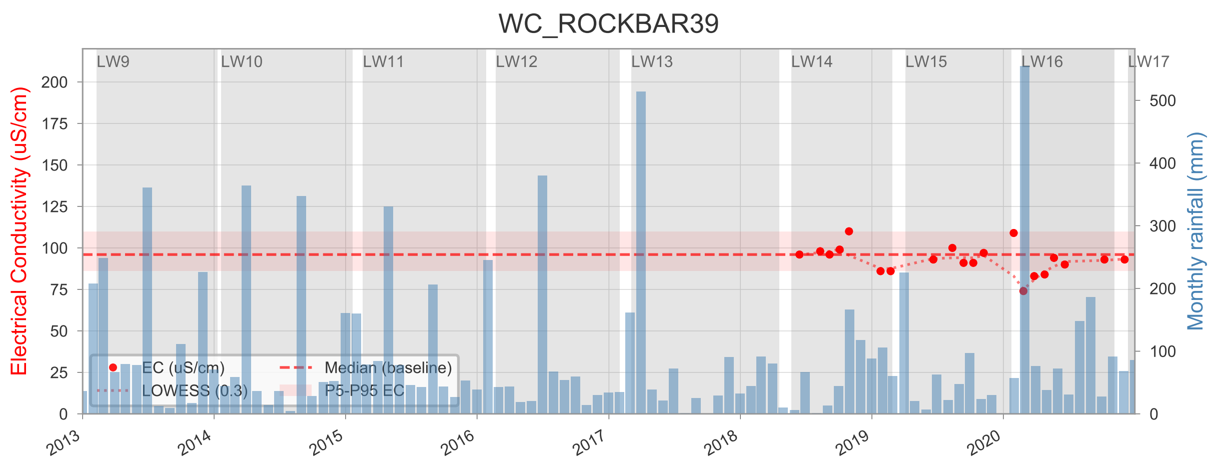

WC_POOL51
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17


WC_POOL51
pH units
Monthly rainfall (mm)
pH
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

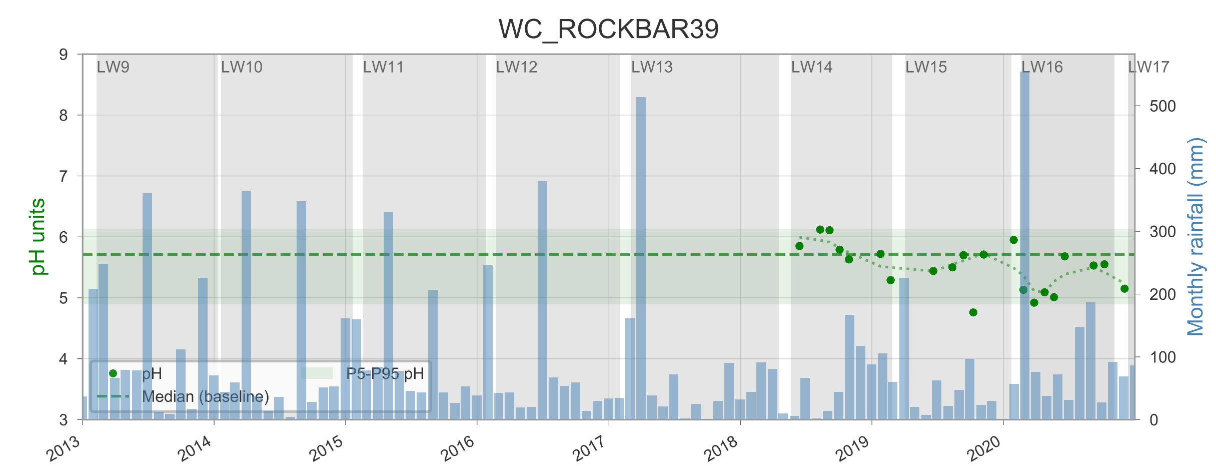

WC_POOL51
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17



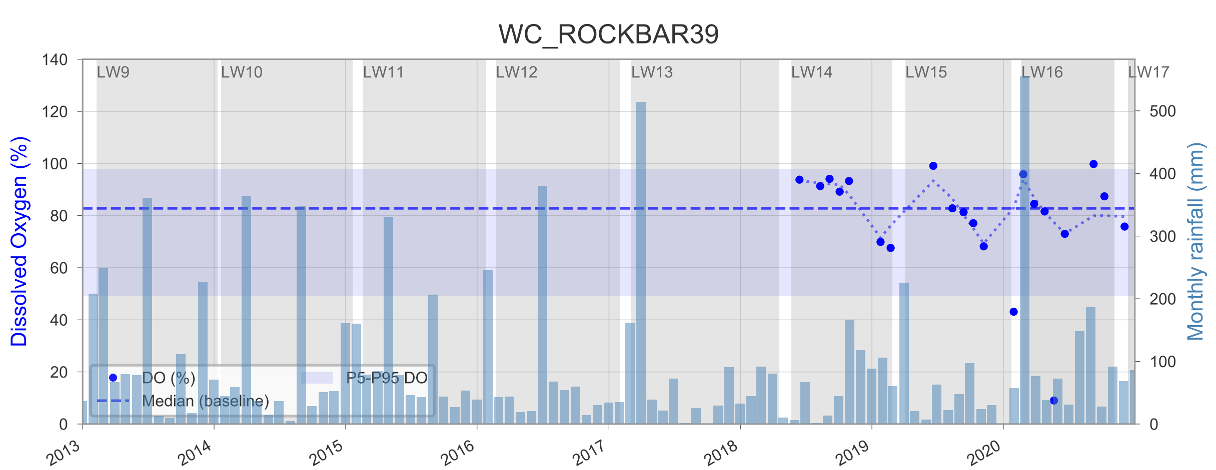
WC_ROCKBAR39
Water level (m below ref. nail)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
Pool bottom



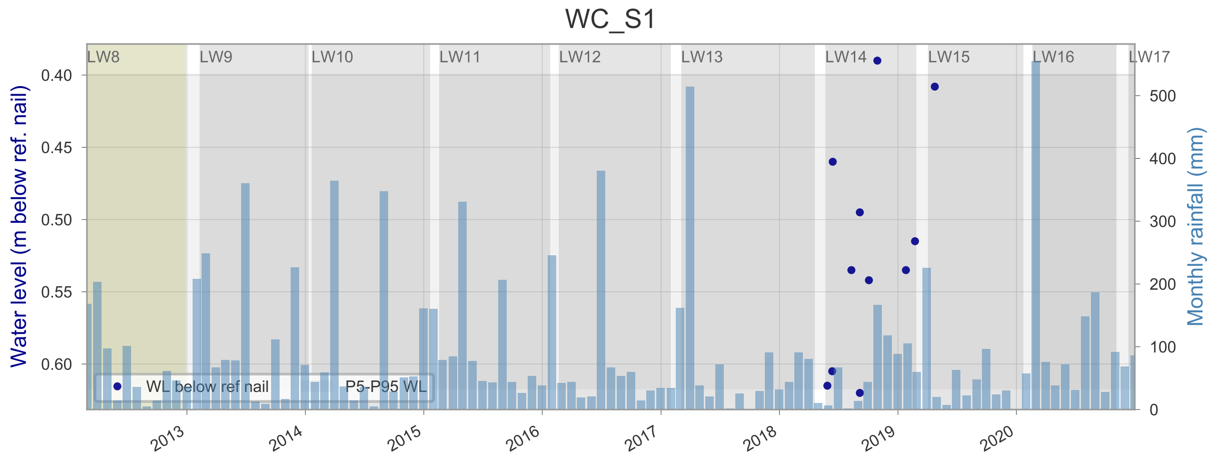
WC_ROCKBAR39
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
Median (baseline)
LOWESS (0.3)
P5-P95 EC

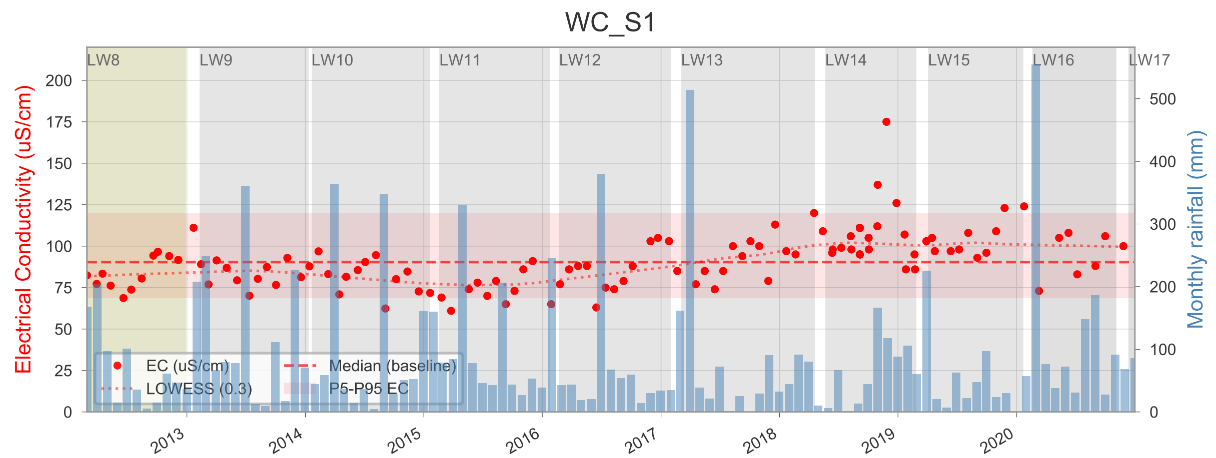


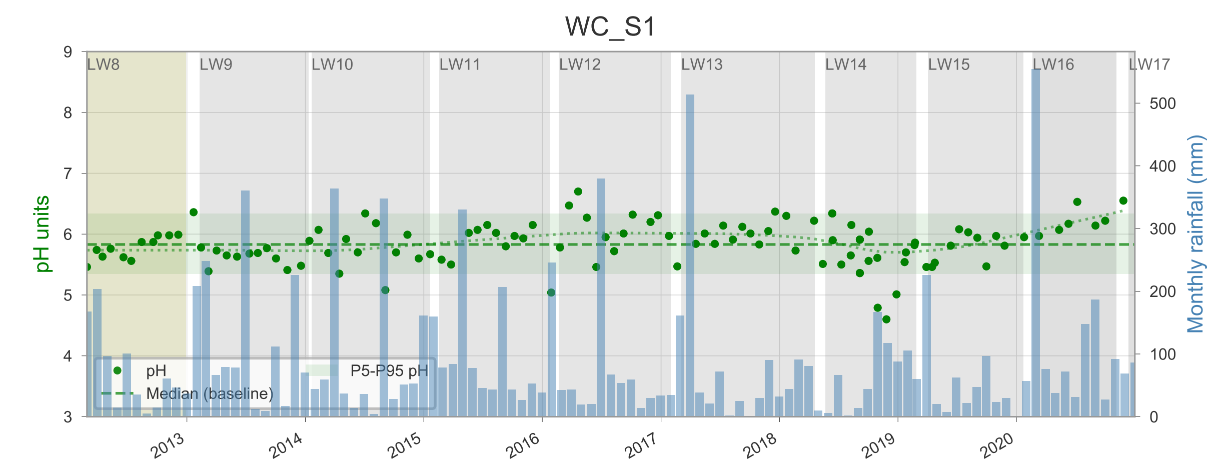
WC_ROCKBAR39
pH units
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
P5-P95 pH
Median (baseline)

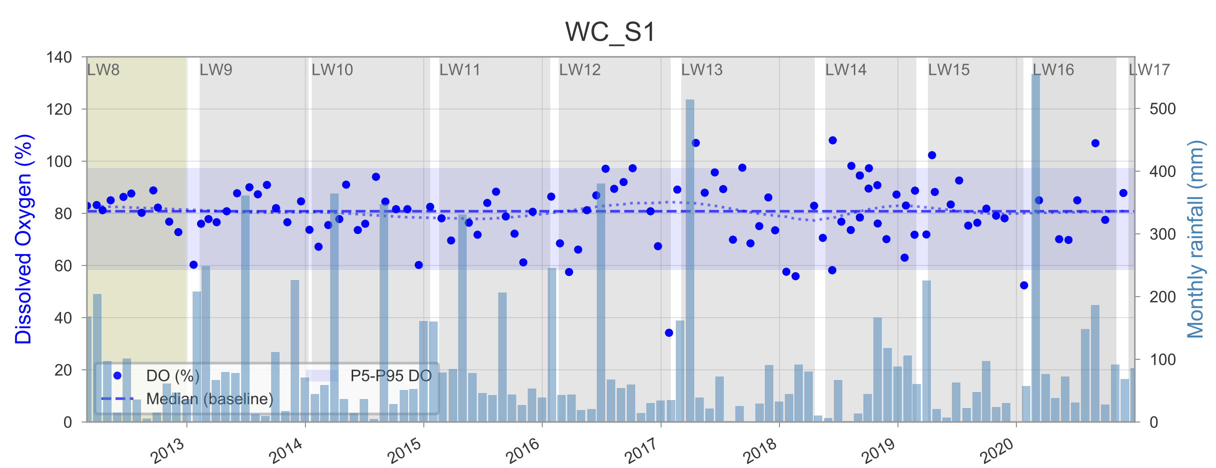


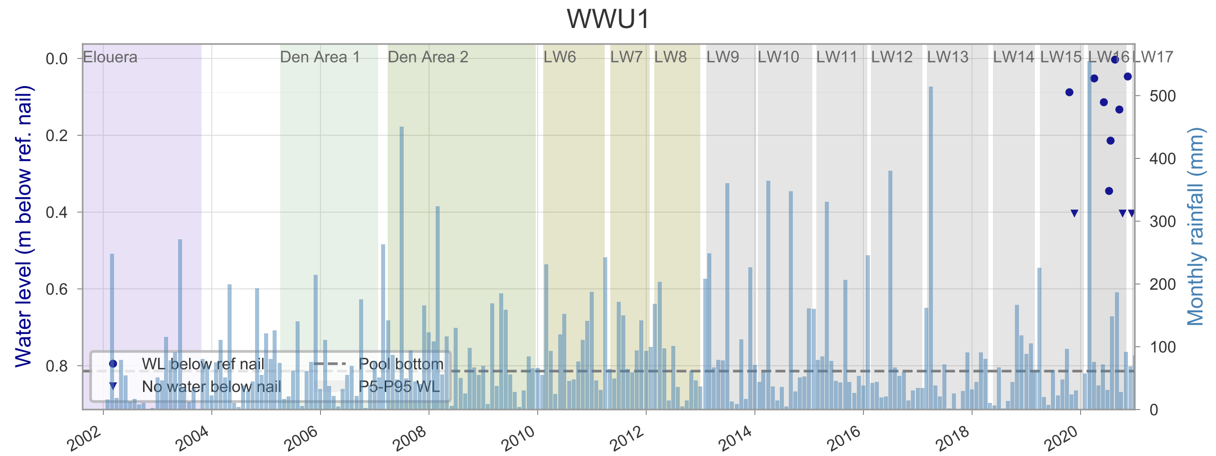
WC_ROCKBAR39
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
P5-P95 DO
Median (baseline)

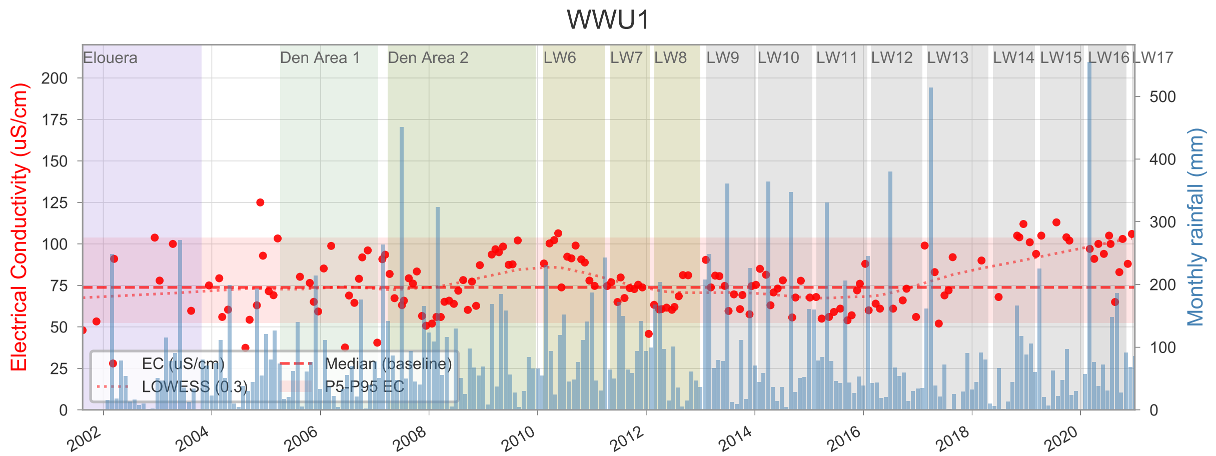

WC_S1
Water level (m below ref. nail)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
WL below ref nail
P5-P95 WL
0.40
0.45
0.50
0.55
0.60
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018
2019
2020

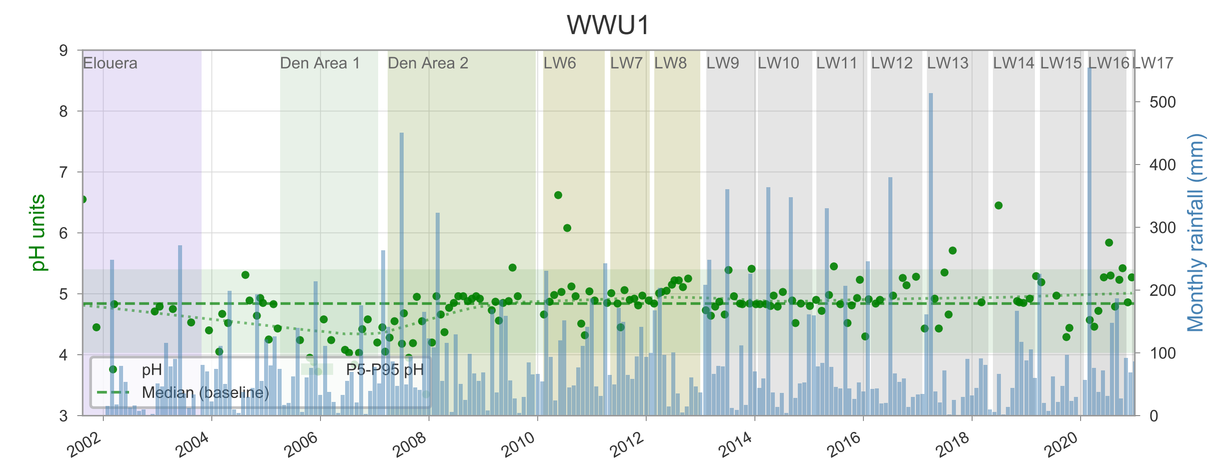

WC_S1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
0
25
50
75
100
125
150
175
200
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018
2019
2020

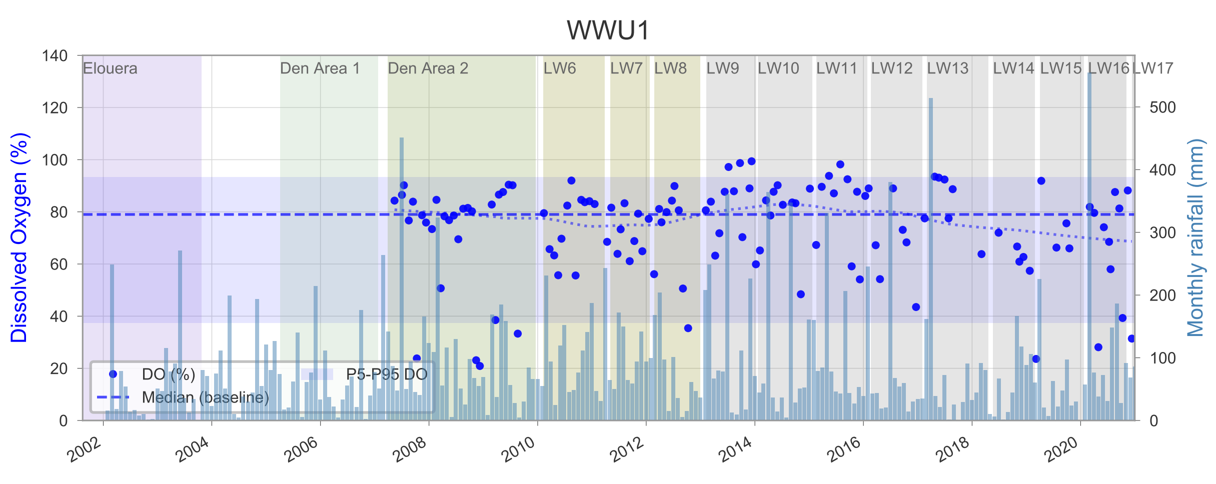

WC_S1
pH units
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
pH
Median (baseline)
P5-P95 pH
3
4
5
6
7
8
9
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018
2019
2020

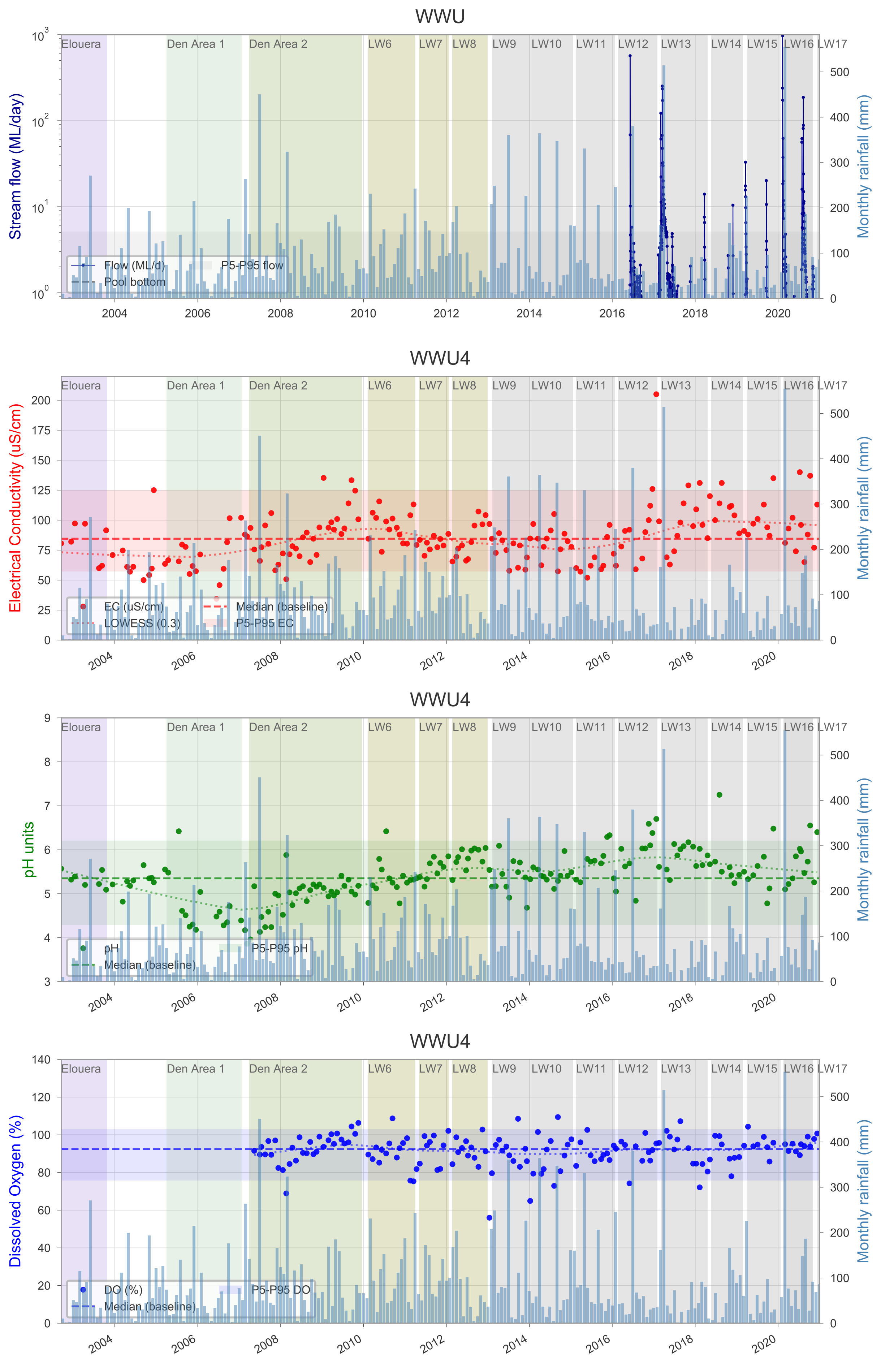

WC_S1
Dissolved Oxygen (%)
Monthly rainfall (mm)
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DO (%)
Median (baseline)
P5-P95 DO
0
20
40
60
80
100
120
140
500
400
300
200
100
0
2013
2014
2015
2016
2017
2018
2019
2020


WWU1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Water level (m below ref. nail)
Monthly rainfall (mm)
WL below ref nail
No water below nail
Pool bottom
P5-P95 WL

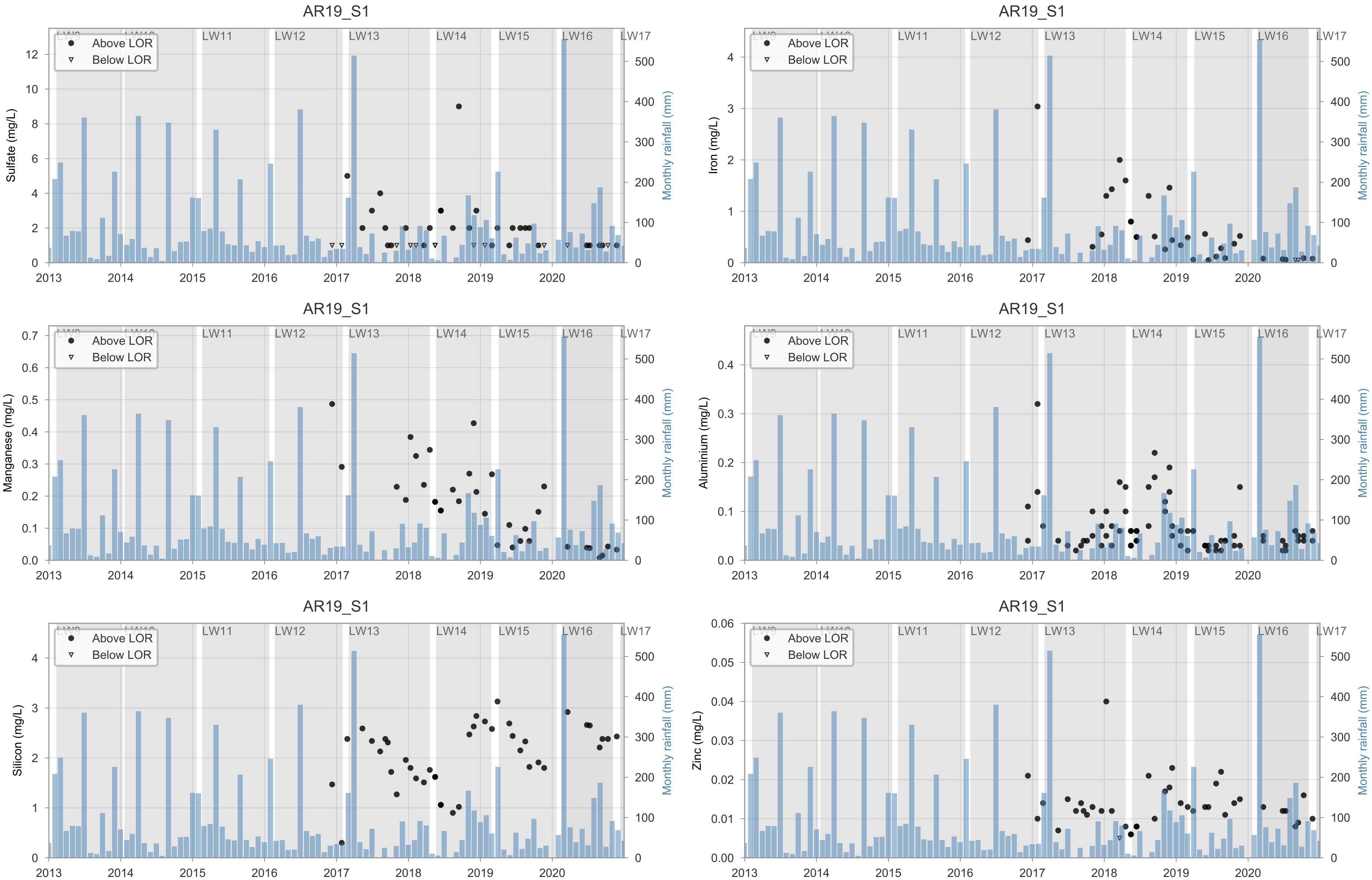

WWU1
Electrical Conductivity (uS/cm)
Monthly rainfall (mm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC

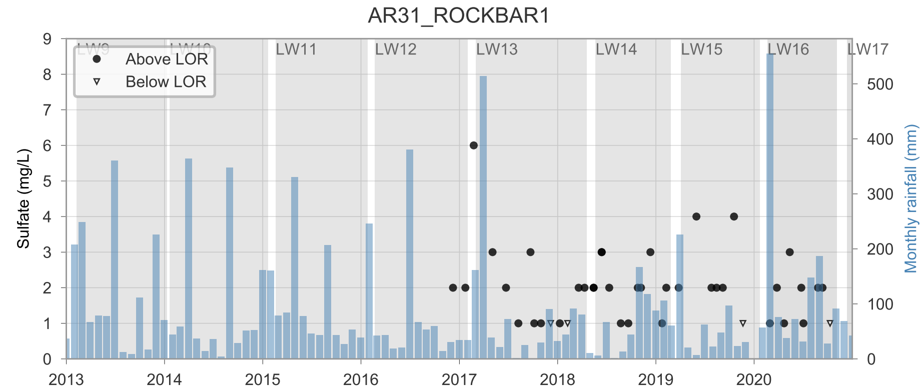

WWU1
pH units
Monthly rainfall (mm)
pH
Median (baseline)
P5-P95 pH

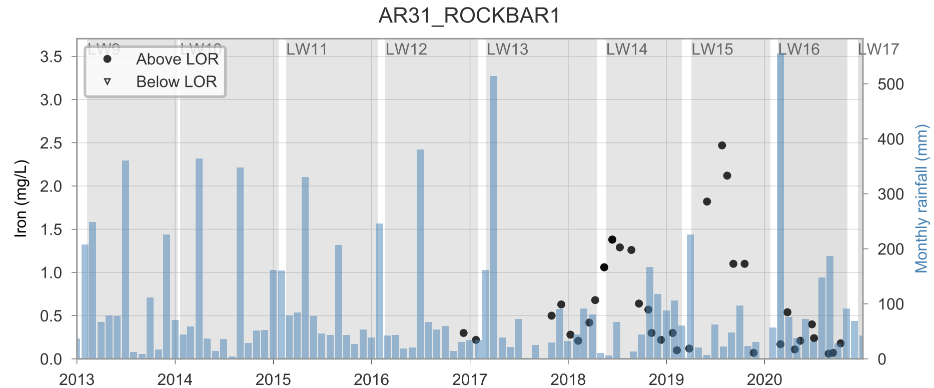

WWU1
Dissolved Oxygen (%)
Monthly rainfall (mm)
DO (%)
Median (baseline)
P5-P95 DO

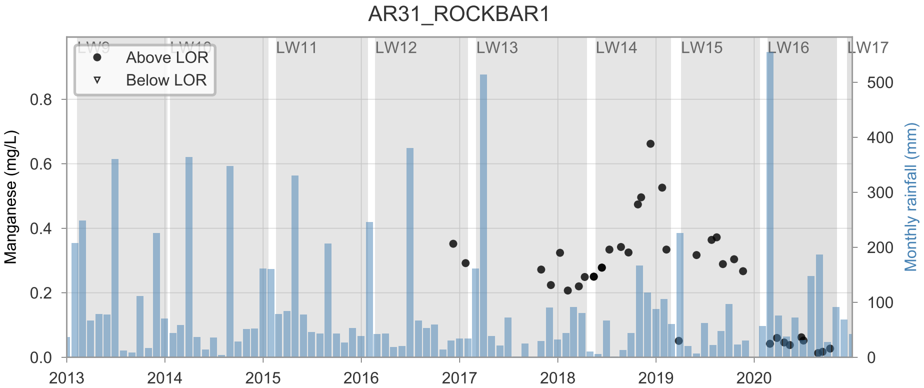


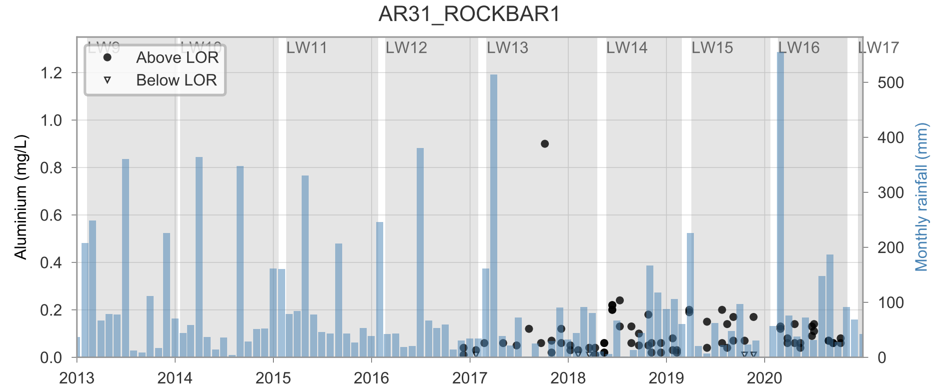
WWU
Stream flow (ML/day)
Monthly rainfall (mm)
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Flow (ML/d)
Pool bottom
P5-P95 flow
WWU4
Electrical Conductivity (uS/cm)
EC (uS/cm)
LOWESS (0.3)
Median (baseline)
P5-P95 EC
WWU4
pH units
pH
Median (baseline)
P5-P95 pH
WWU4
Dissolved Oxygen (%)
DO (%)
Median (baseline)
P5-P95 DO

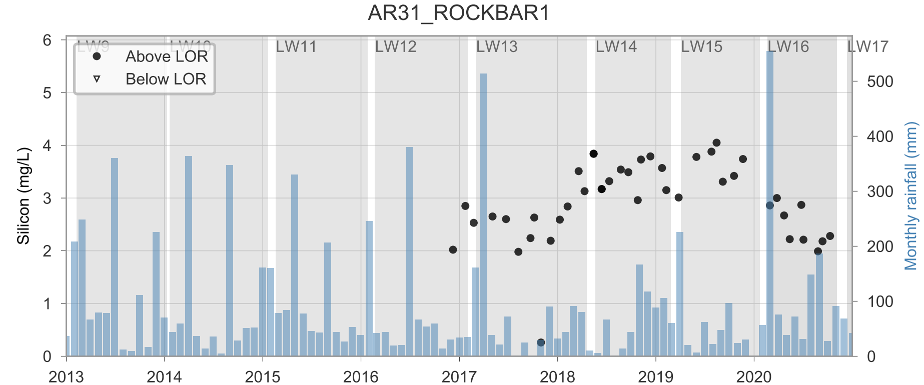

AR19_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
AR19_S1
Iron (mg/L)
Monthly rainfall (mm)
AR19_S1
Manganese (mg/L)
Monthly rainfall (mm)
AR19_S1
Aluminium (mg/L)
Monthly rainfall (mm)
AR19_S1
Silicon (mg/L)
Monthly rainfall (mm)
AR19_S1
Zinc (mg/L)
Monthly rainfall (mm)

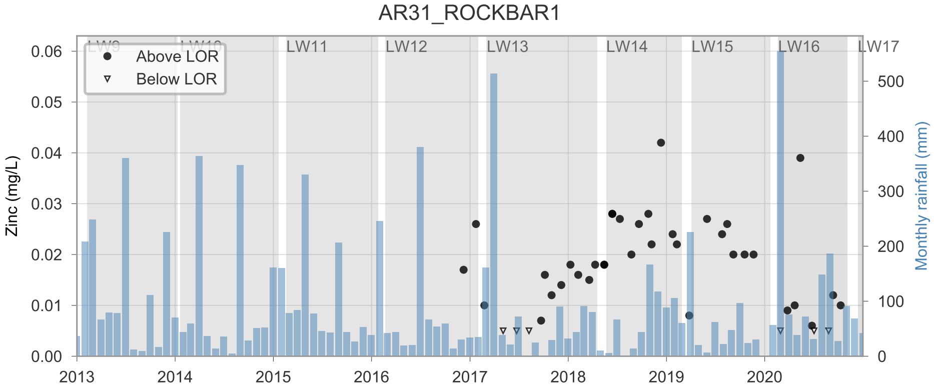

AR31_ROCKBAR1
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

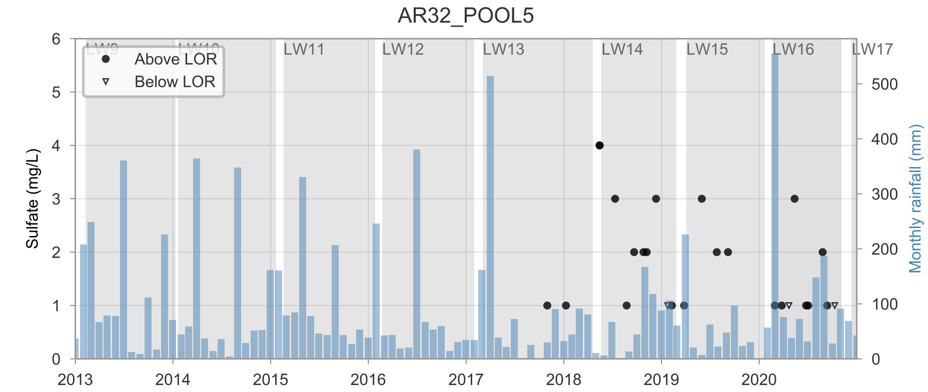

AR31_ROCKBAR1
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

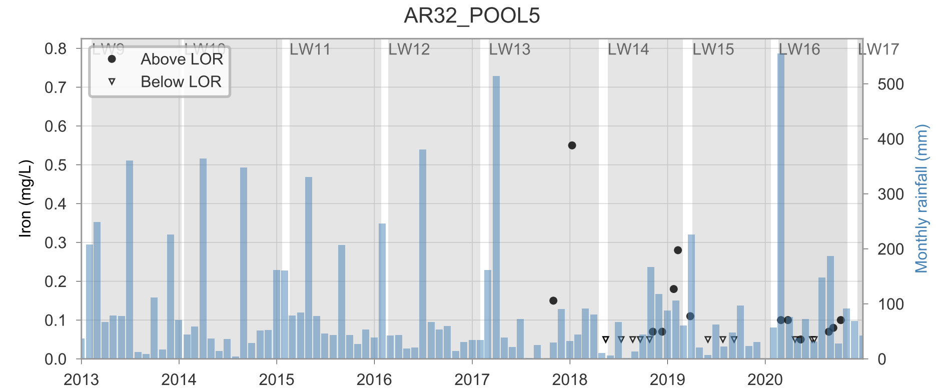

AR31_ROCKBAR1
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

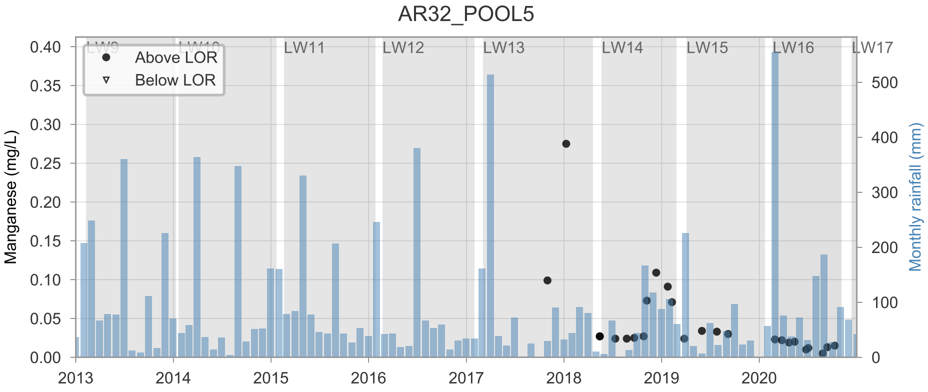

AR31_ROCKBAR1
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

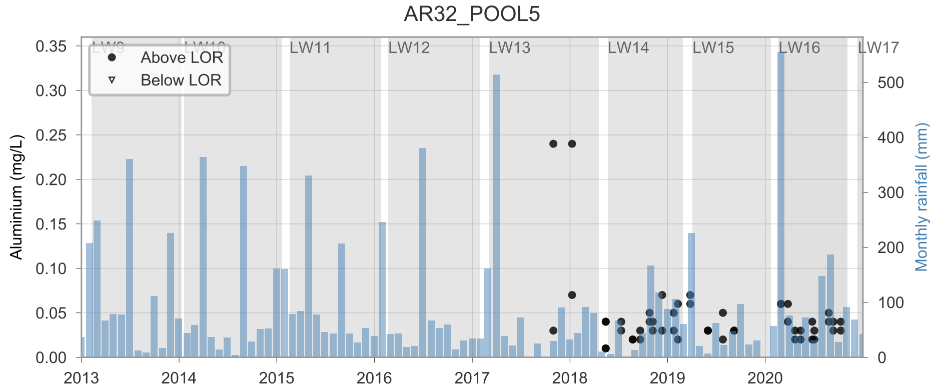

AR31_ROCKBAR1
Above LOR
Below LOR
Silicon (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

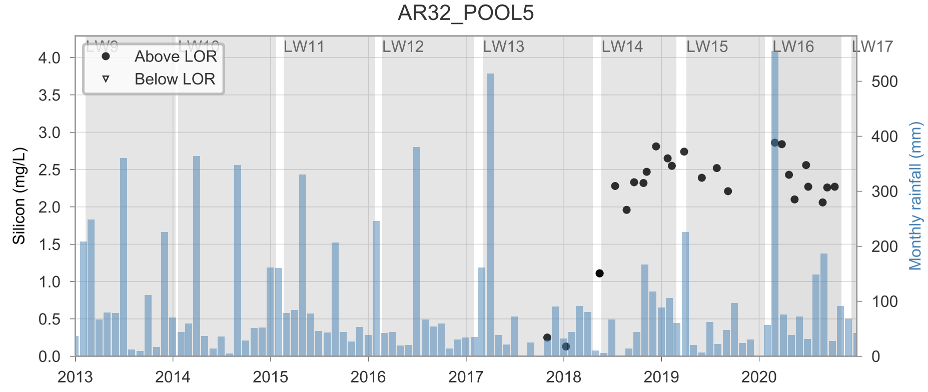

AR31_ROCKBAR1
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

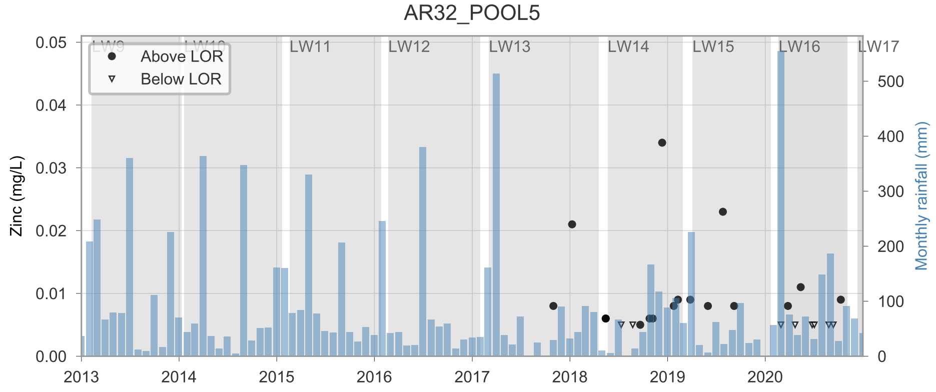

AR32_POOL5
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

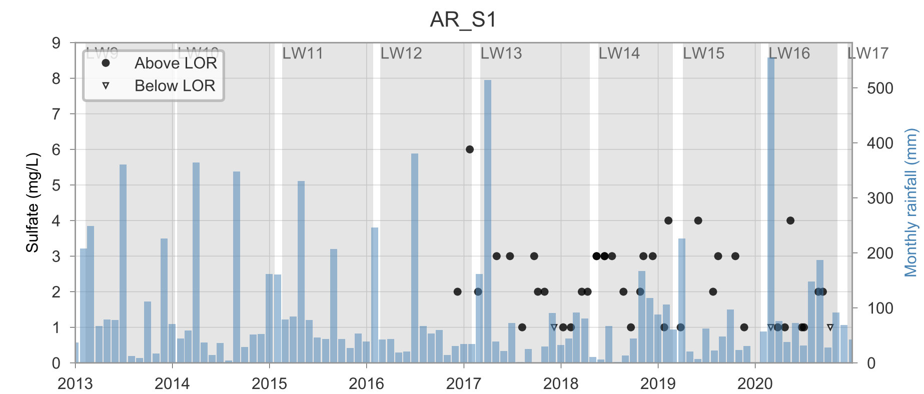

AR32_POOL5
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

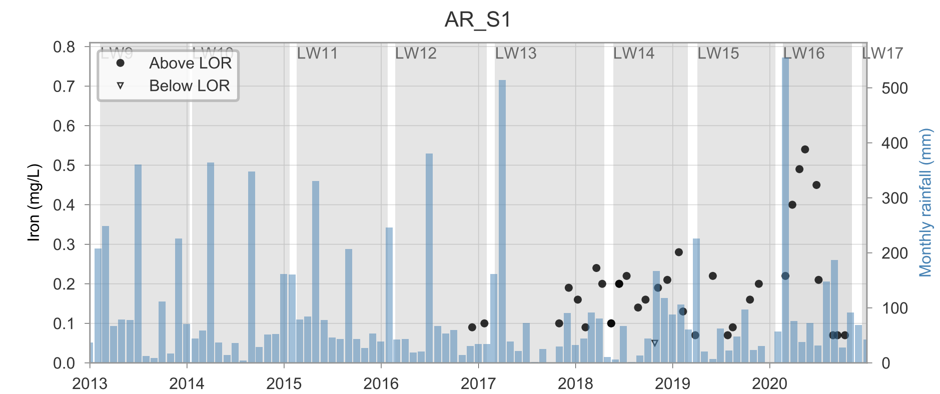

AR32_POOL5
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

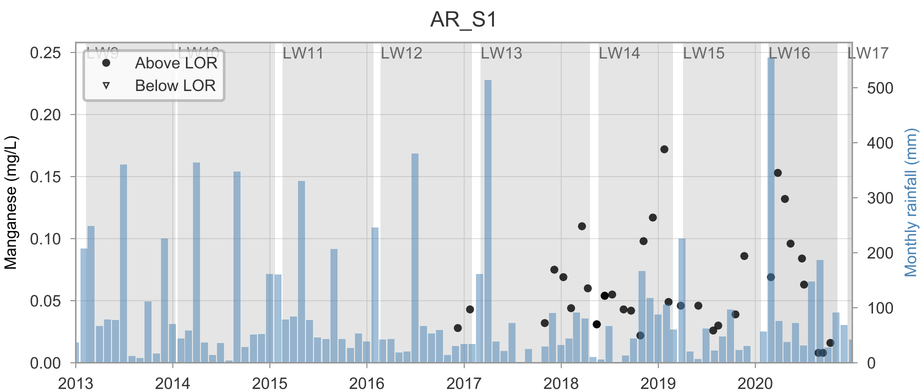

AR32_POOL5
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

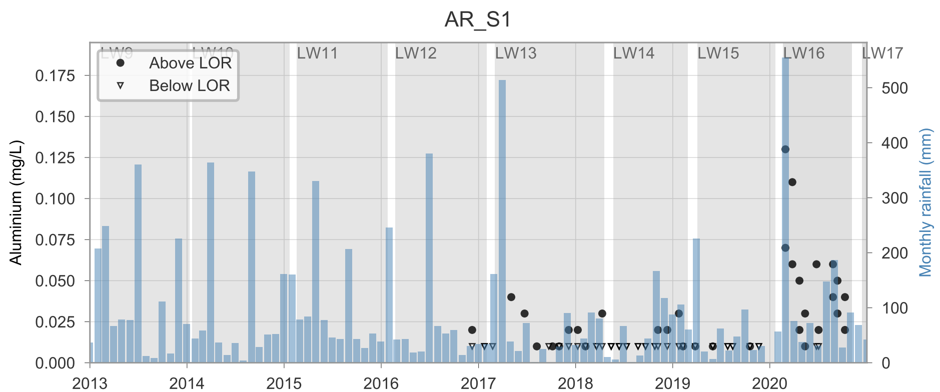

AR32_POOL5
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

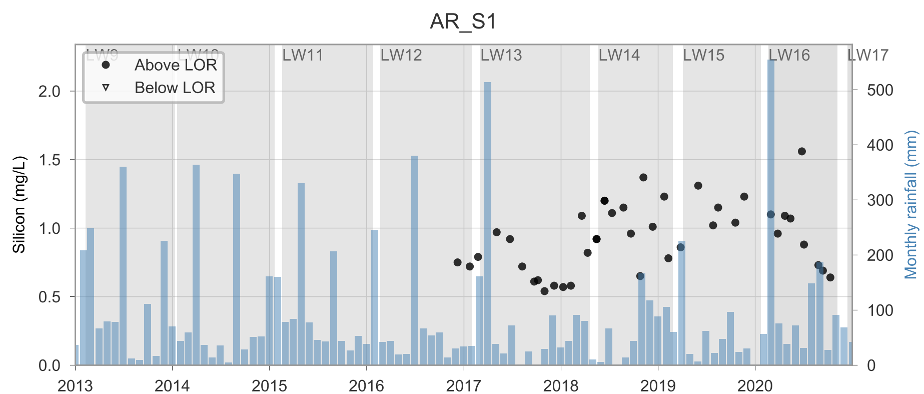

AR32_POOL5
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

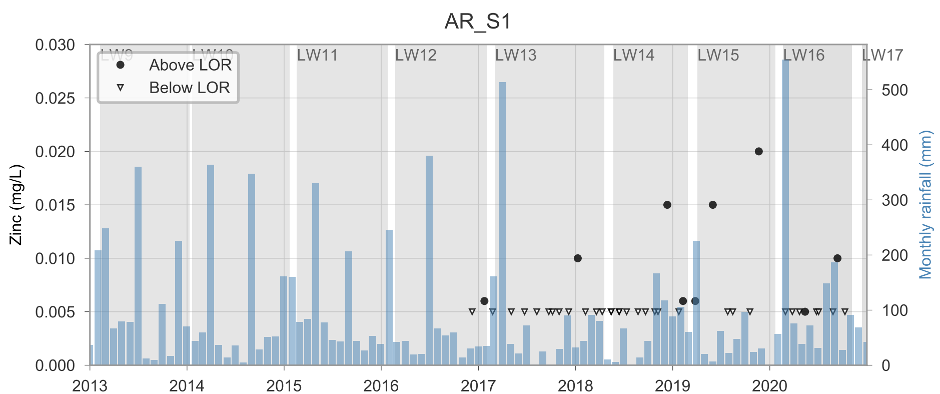

AR_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

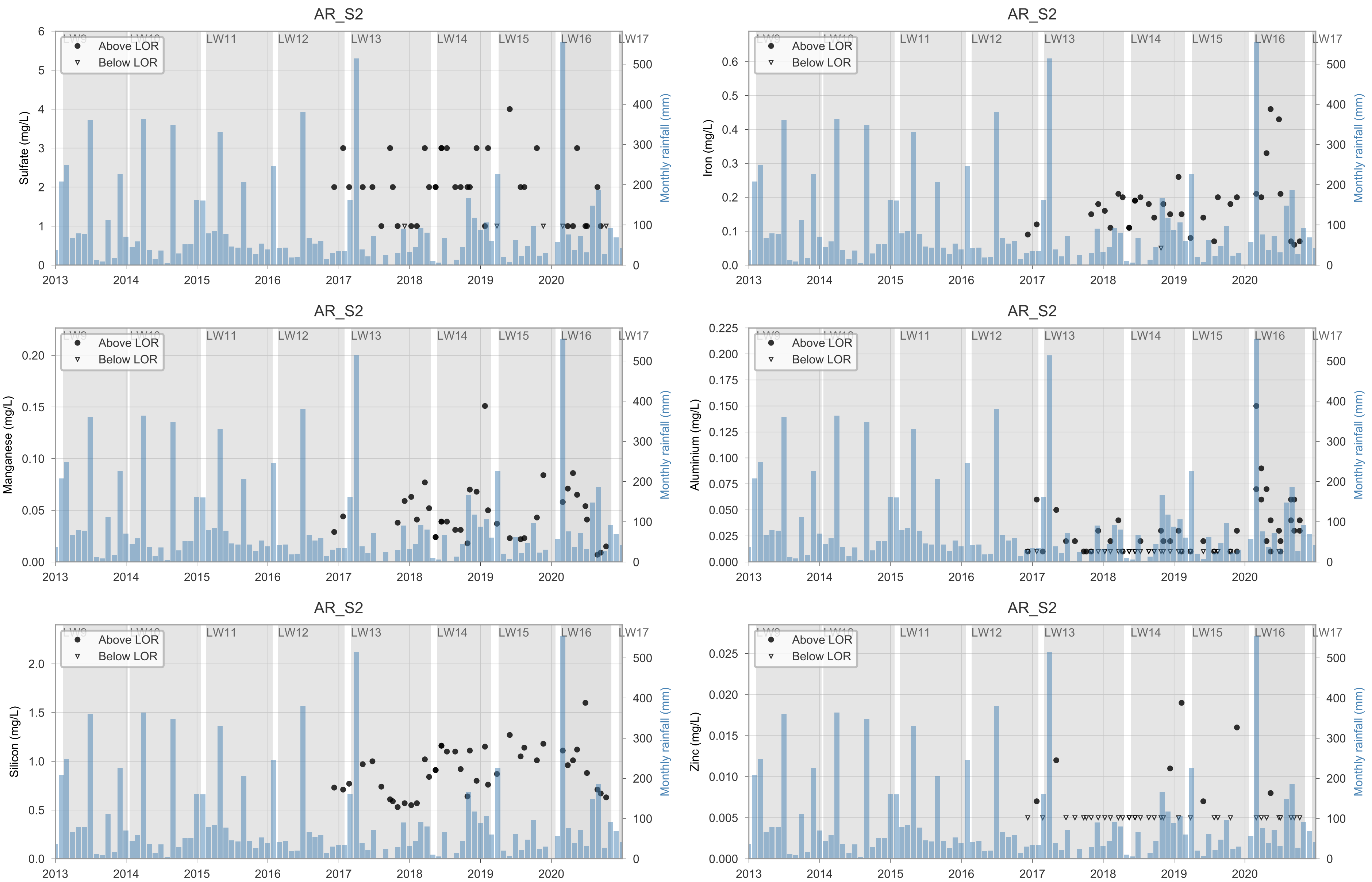

AR_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17


AR_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

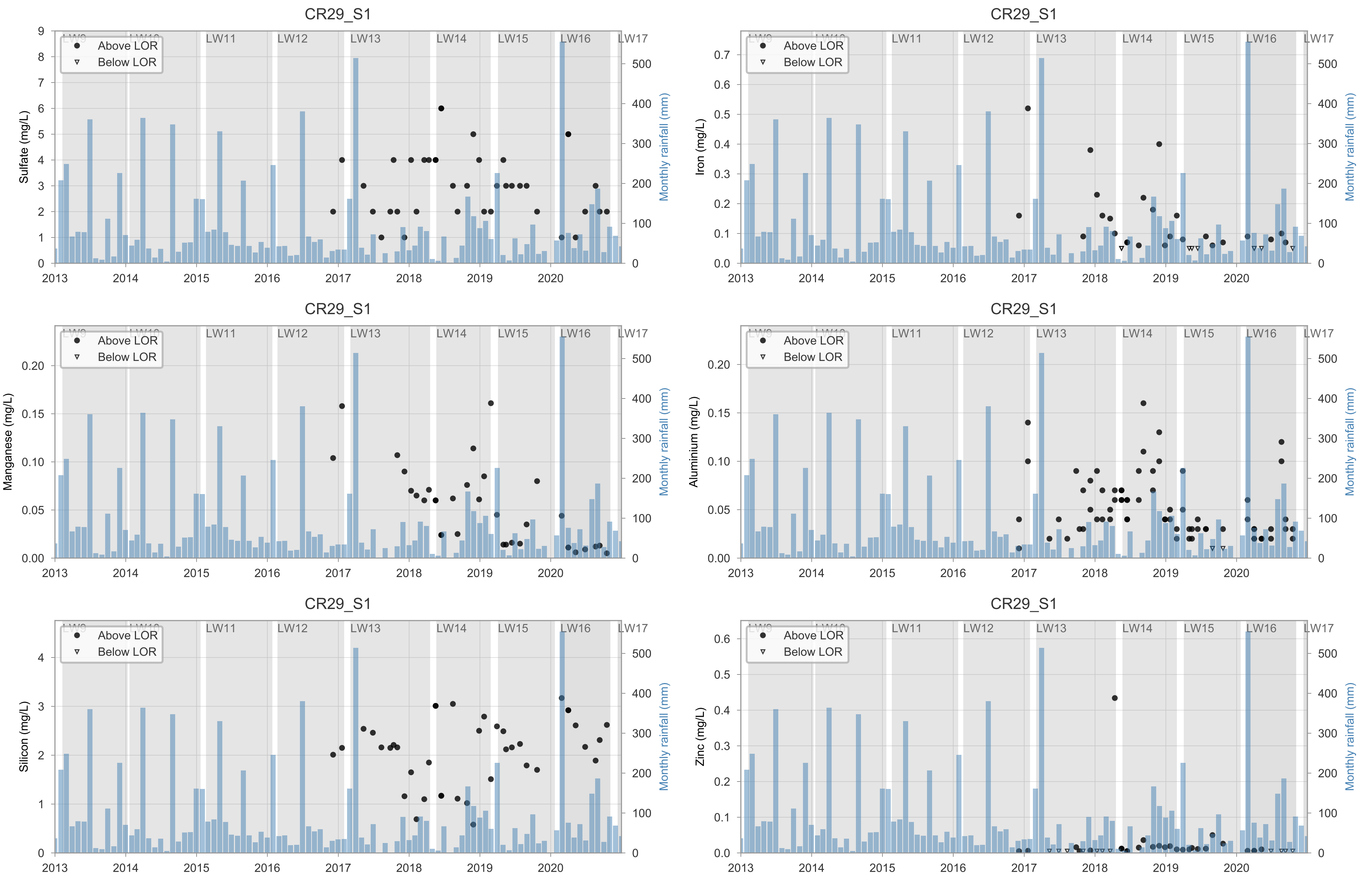

AR_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

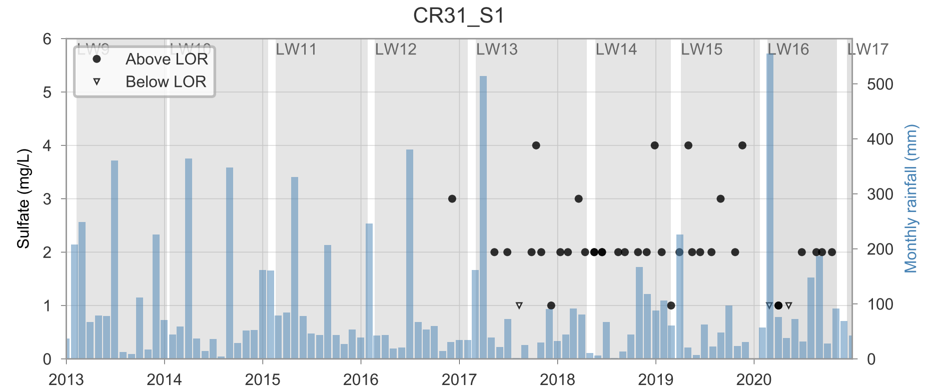

AR_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

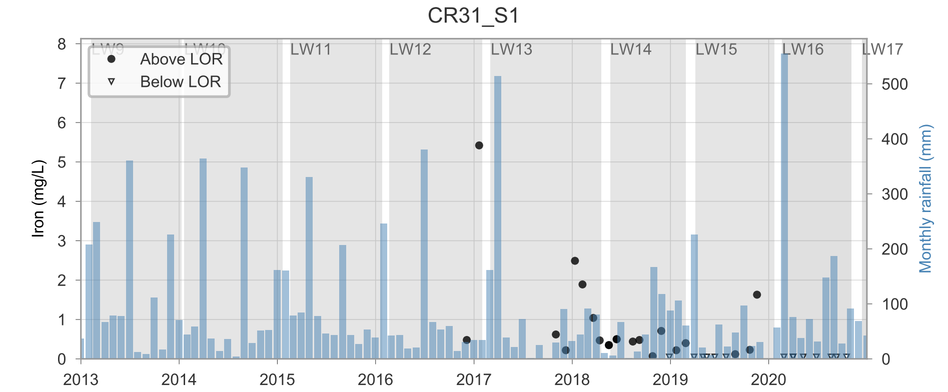

AR_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

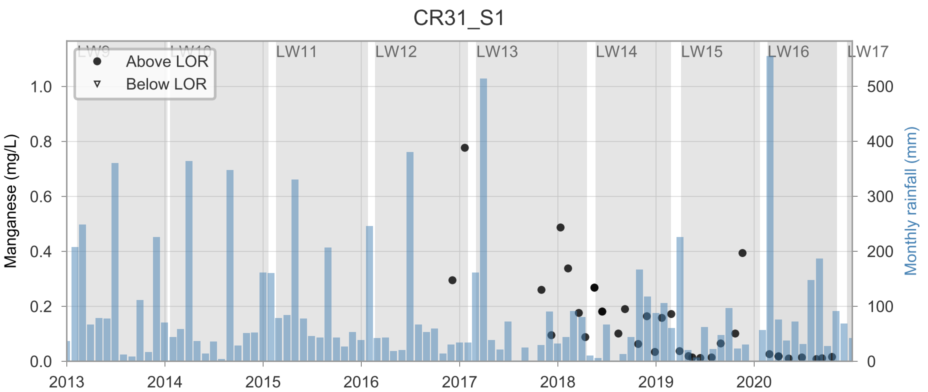


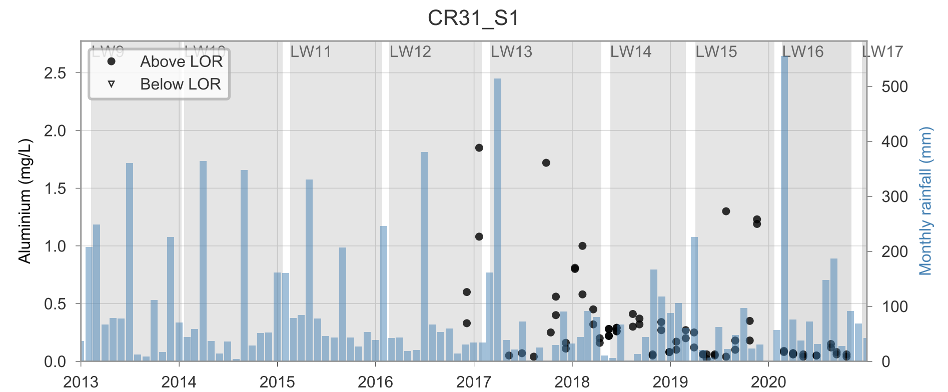
AR_S2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

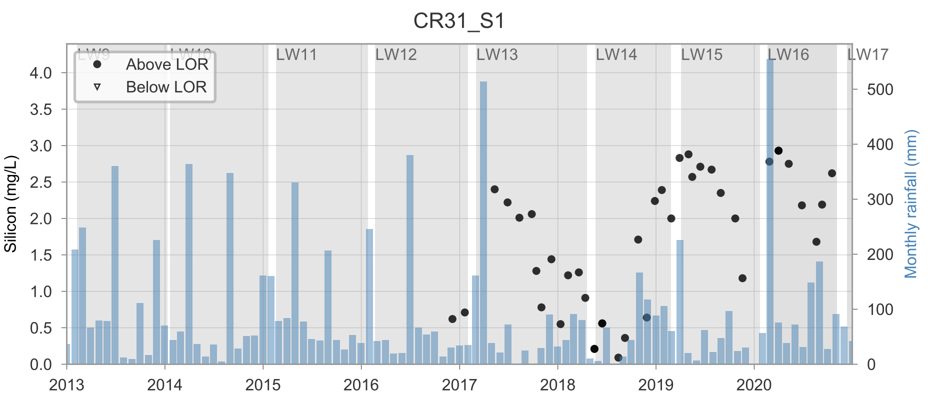

CR29_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020
CR29_S1
Iron (mg/L)
Monthly rainfall (mm)
CR29_S1
Manganese (mg/L)
Monthly rainfall (mm)
CR29_S1
Aluminium (mg/L)
Monthly rainfall (mm)
CR29_S1
Silicon (mg/L)
Monthly rainfall (mm)
CR29_S1
Zinc (mg/L)
Monthly rainfall (mm)

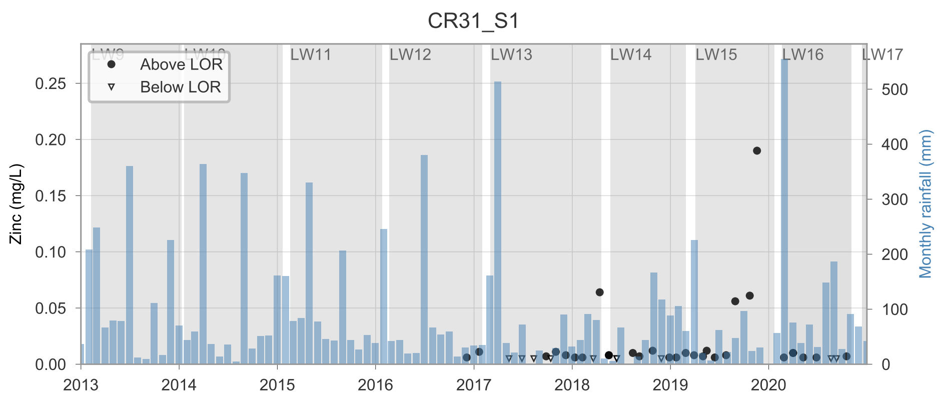

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)

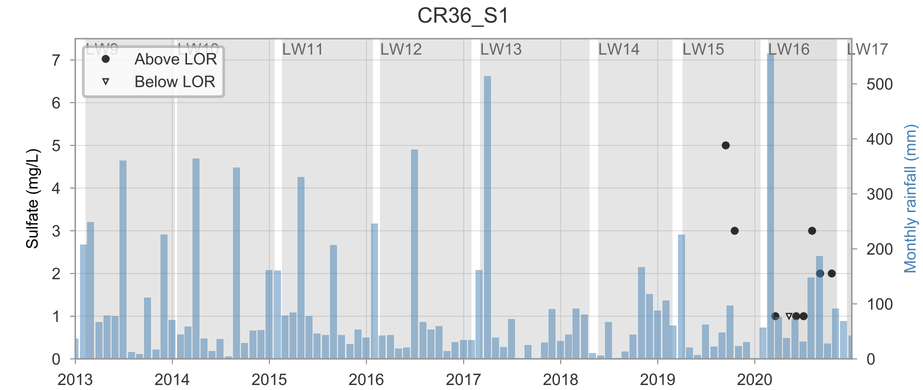

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)

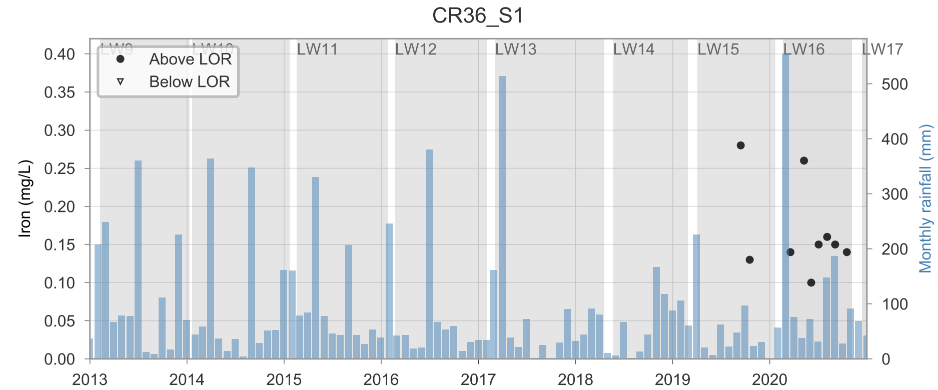

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)

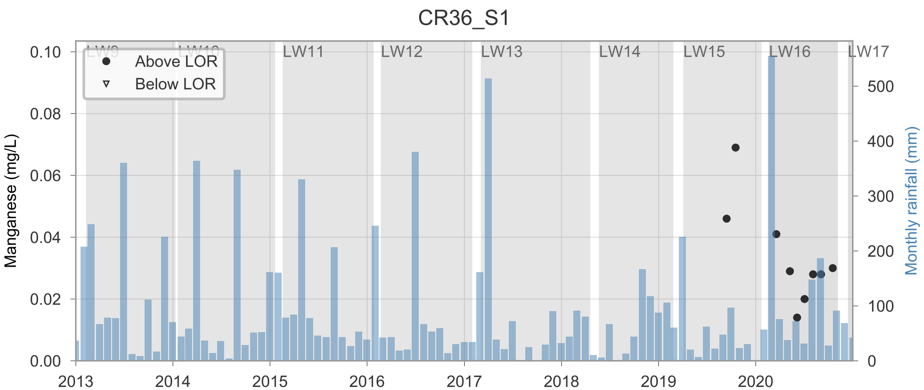

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)

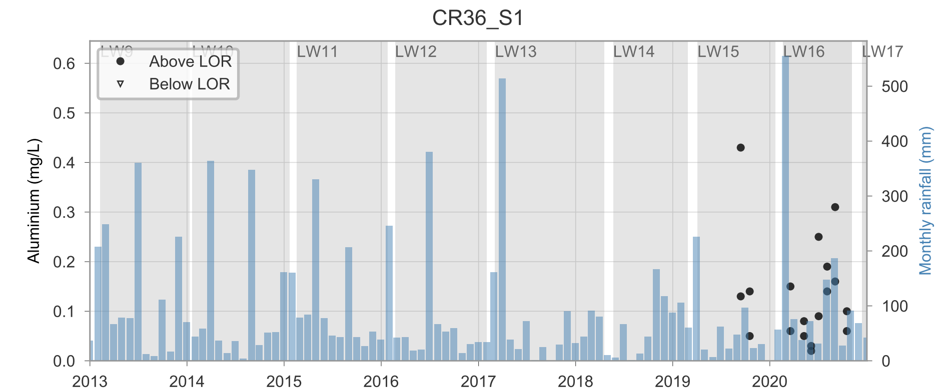

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)

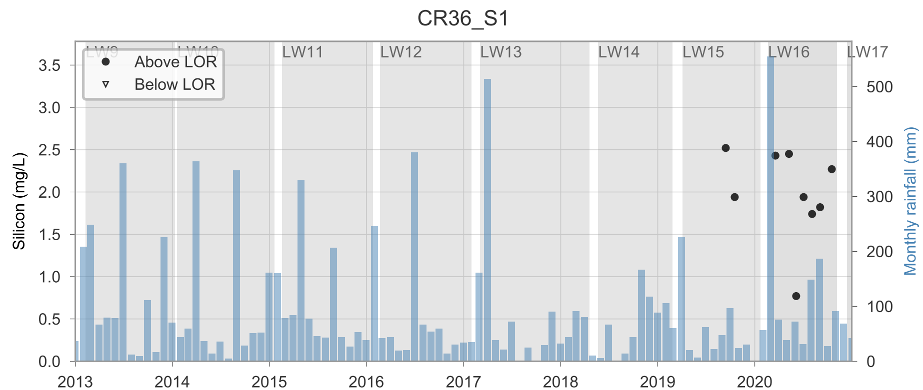

CR31_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)

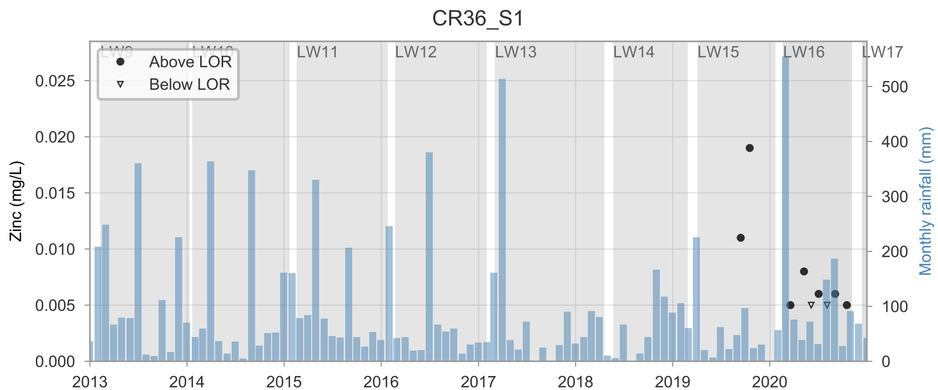

CR36_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

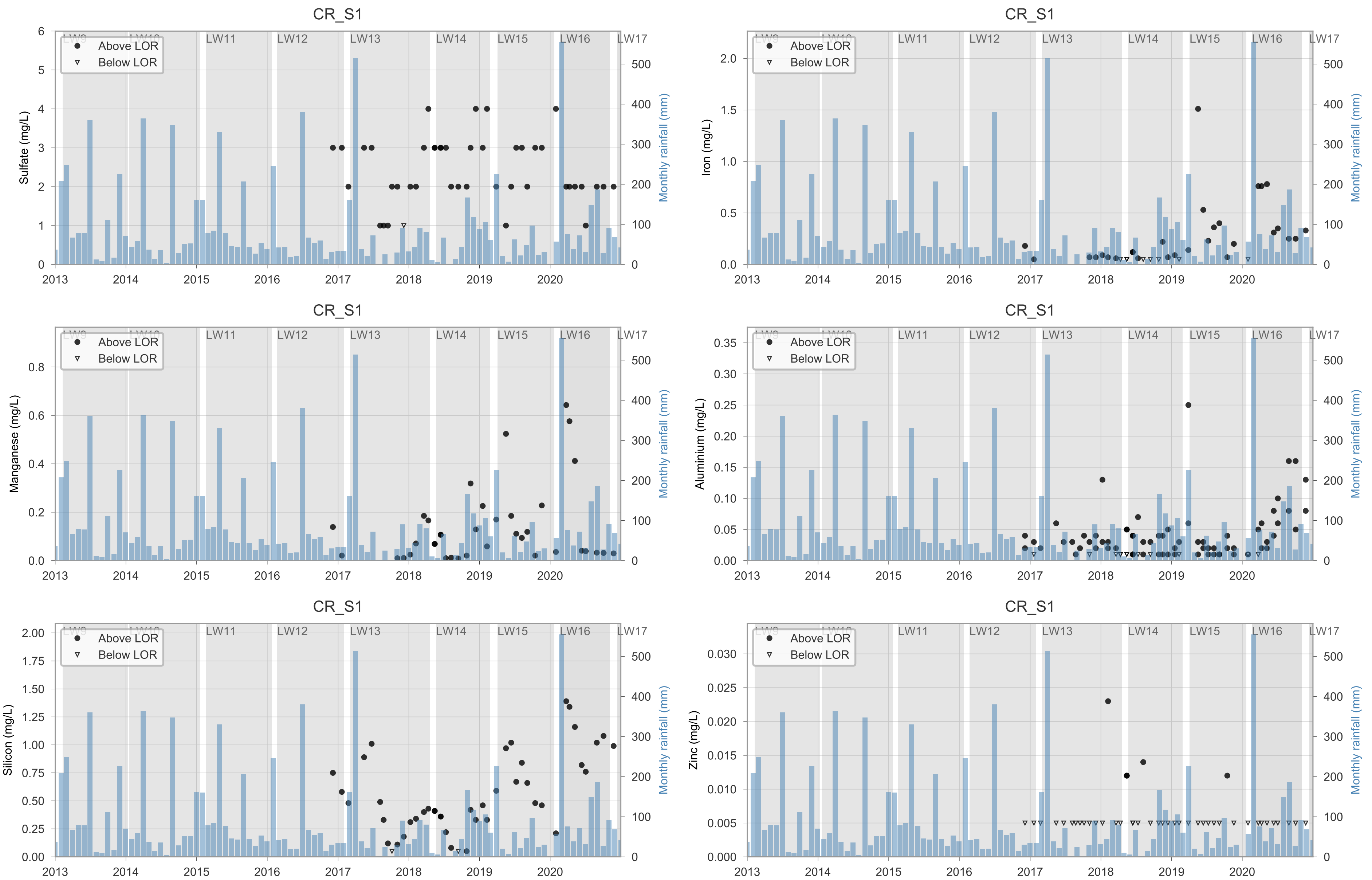

CR36_S1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

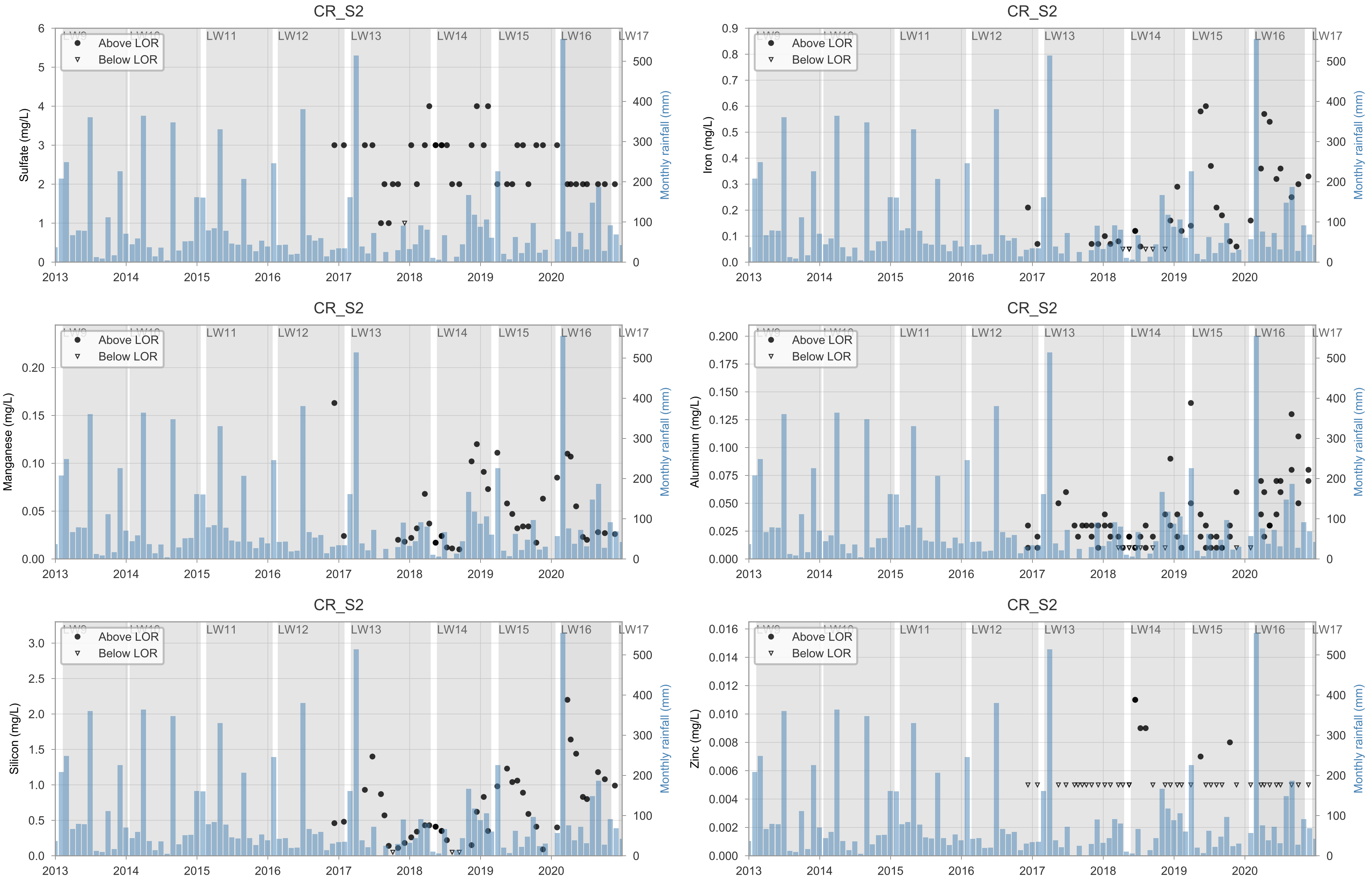

CR36_S1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

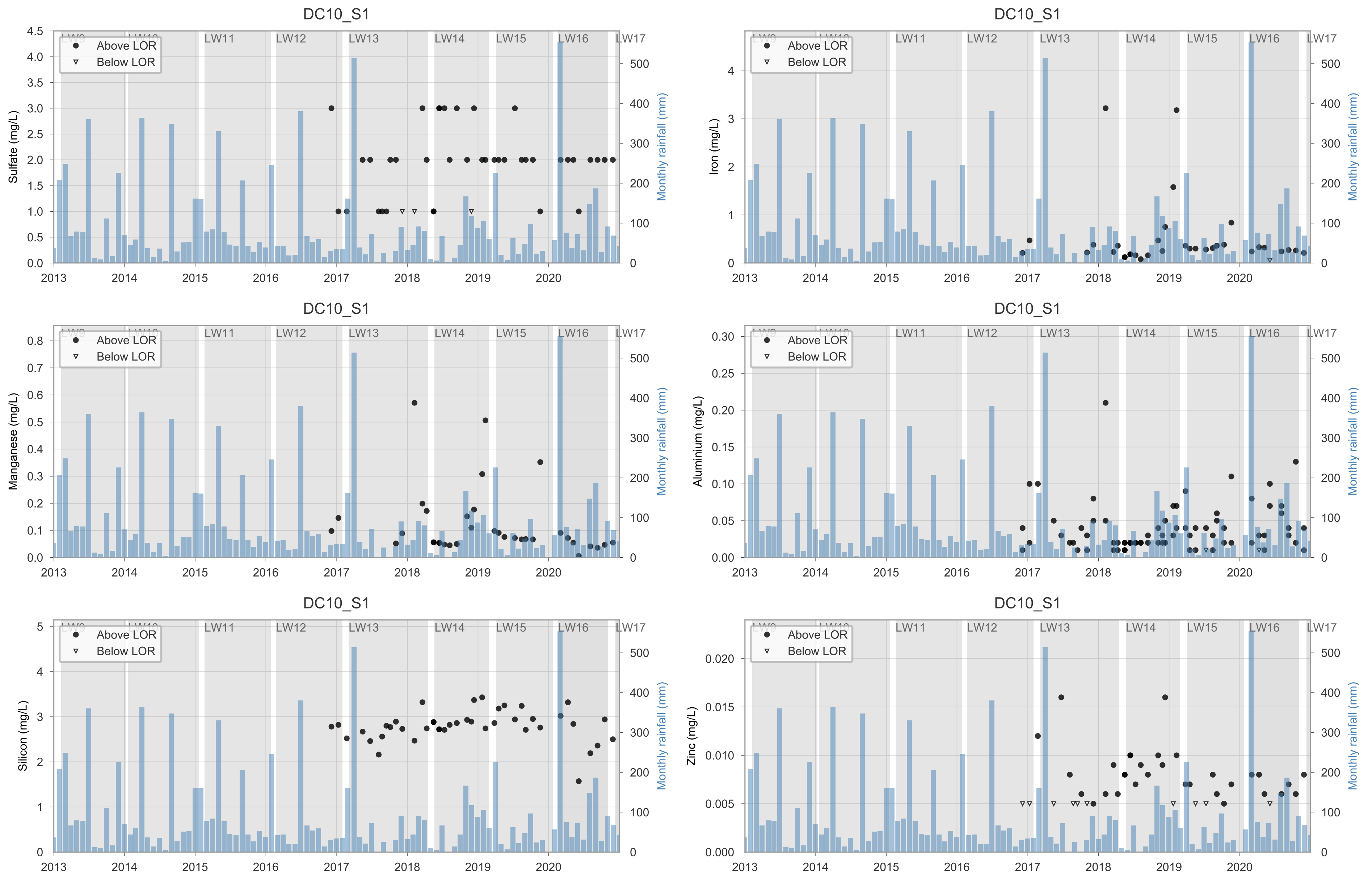

CR36_S1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

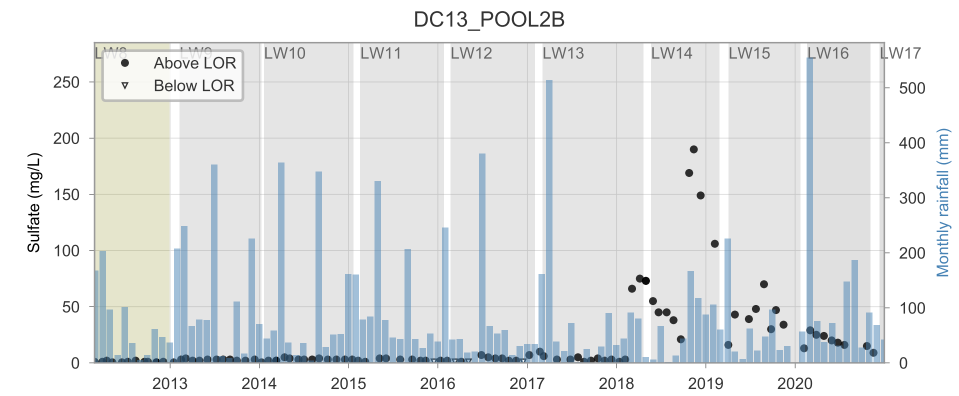

CR36_S1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

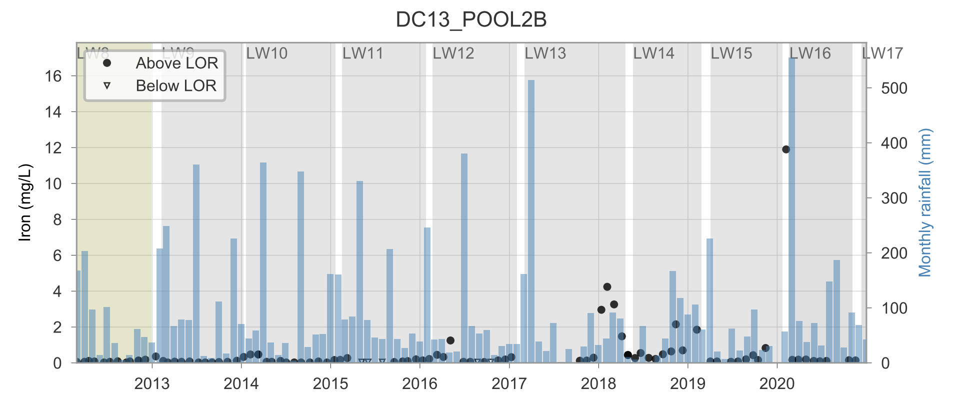

CR36_S1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

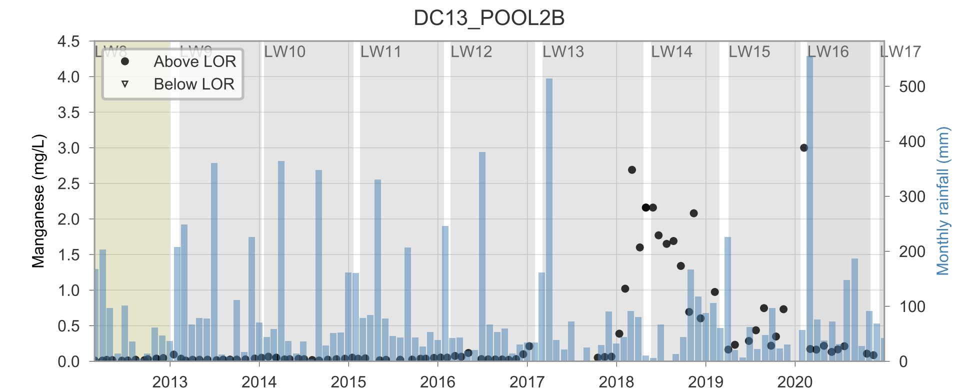

CR_S1
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

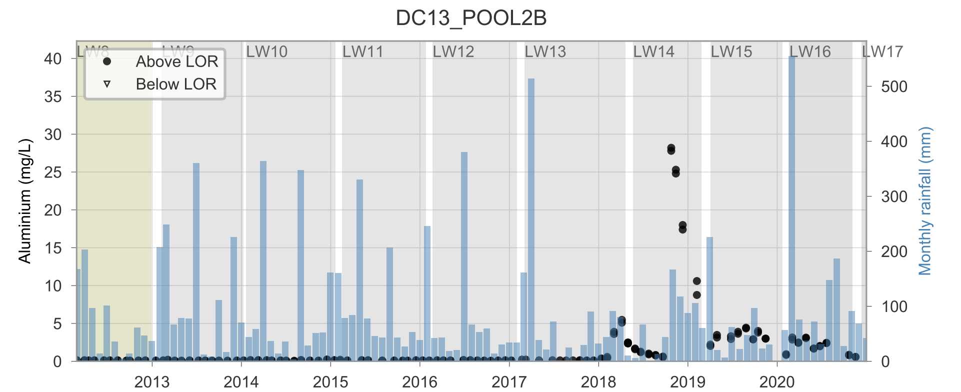

CR_S2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

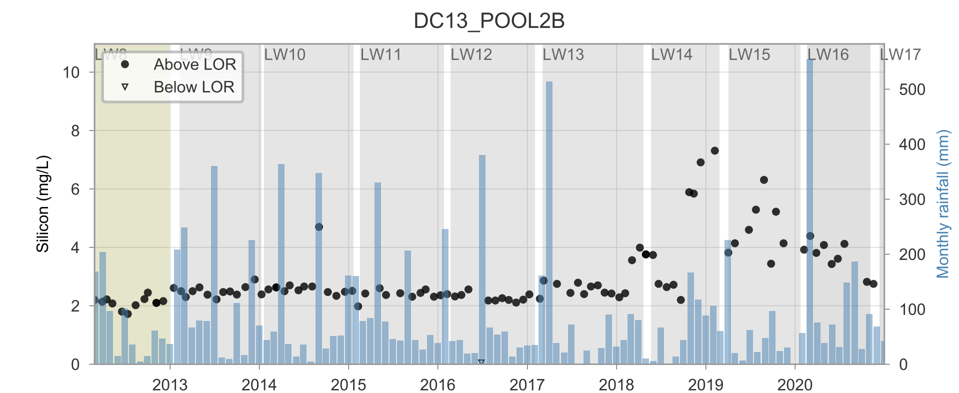

DC10_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DC10_S1
Iron (mg/L)
DC10_S1
Manganese (mg/L)
DC10_S1
Aluminium (mg/L)
DC10_S1
Silicon (mg/L)
DC10_S1
Zinc (mg/L)
2013
2014
2015
2016
2017
2018
2019
2020

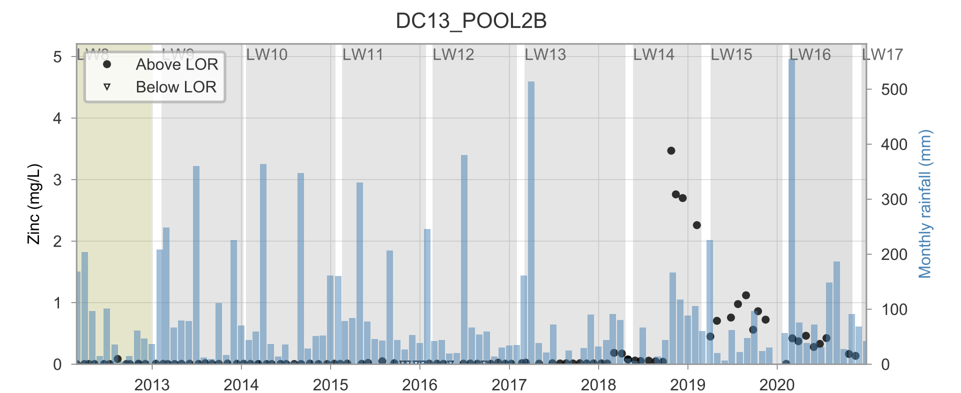

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

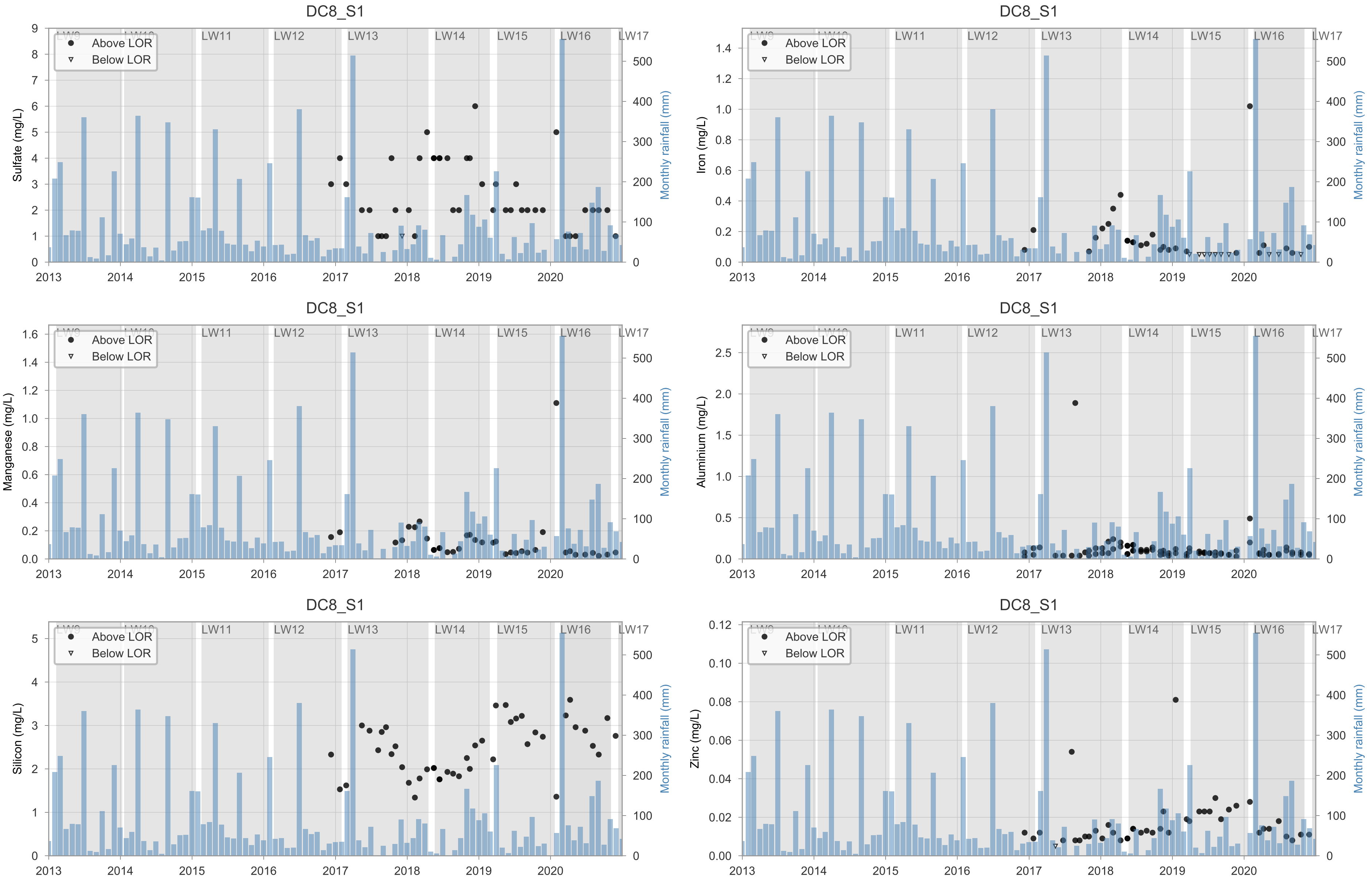

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

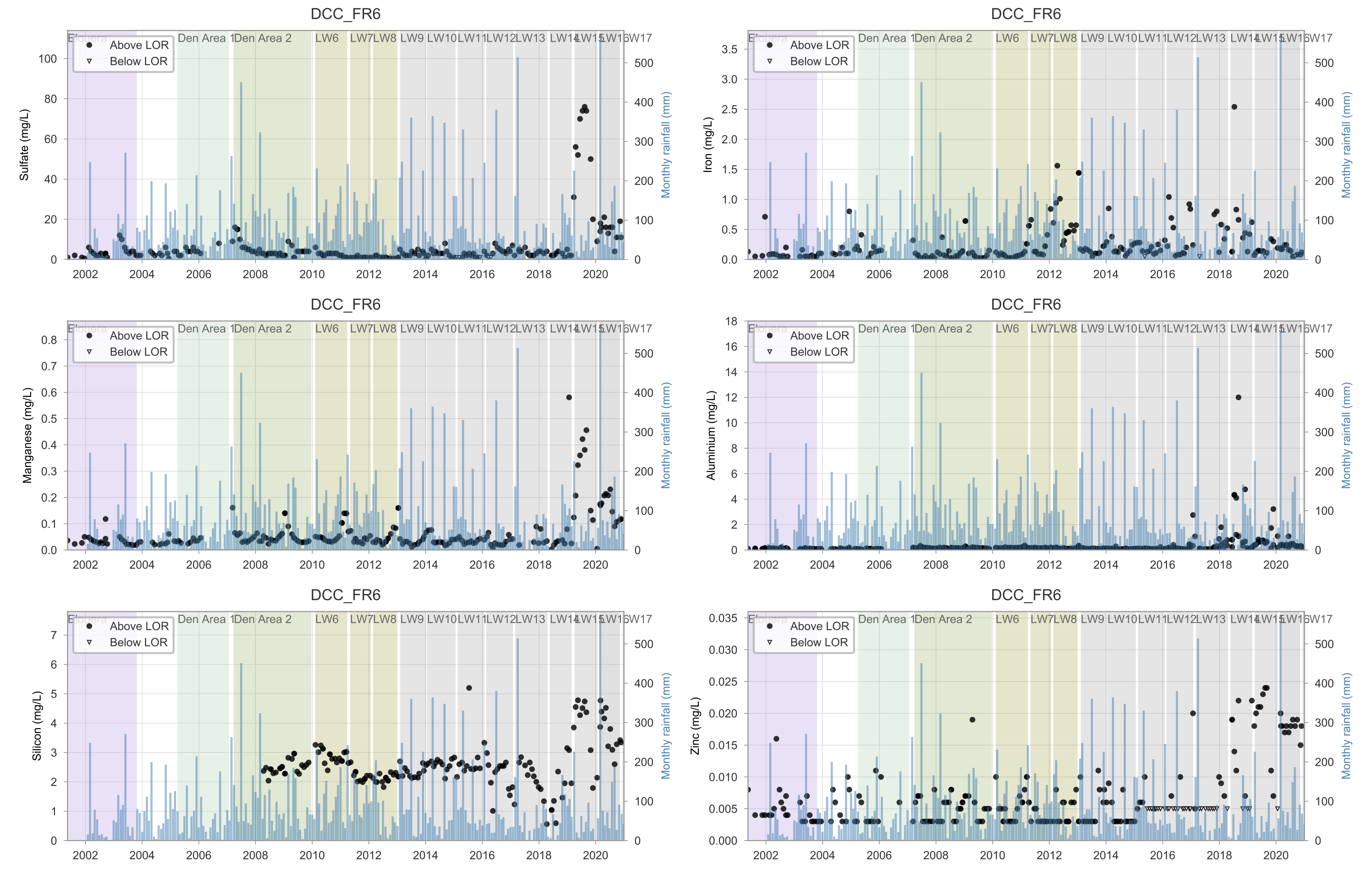

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

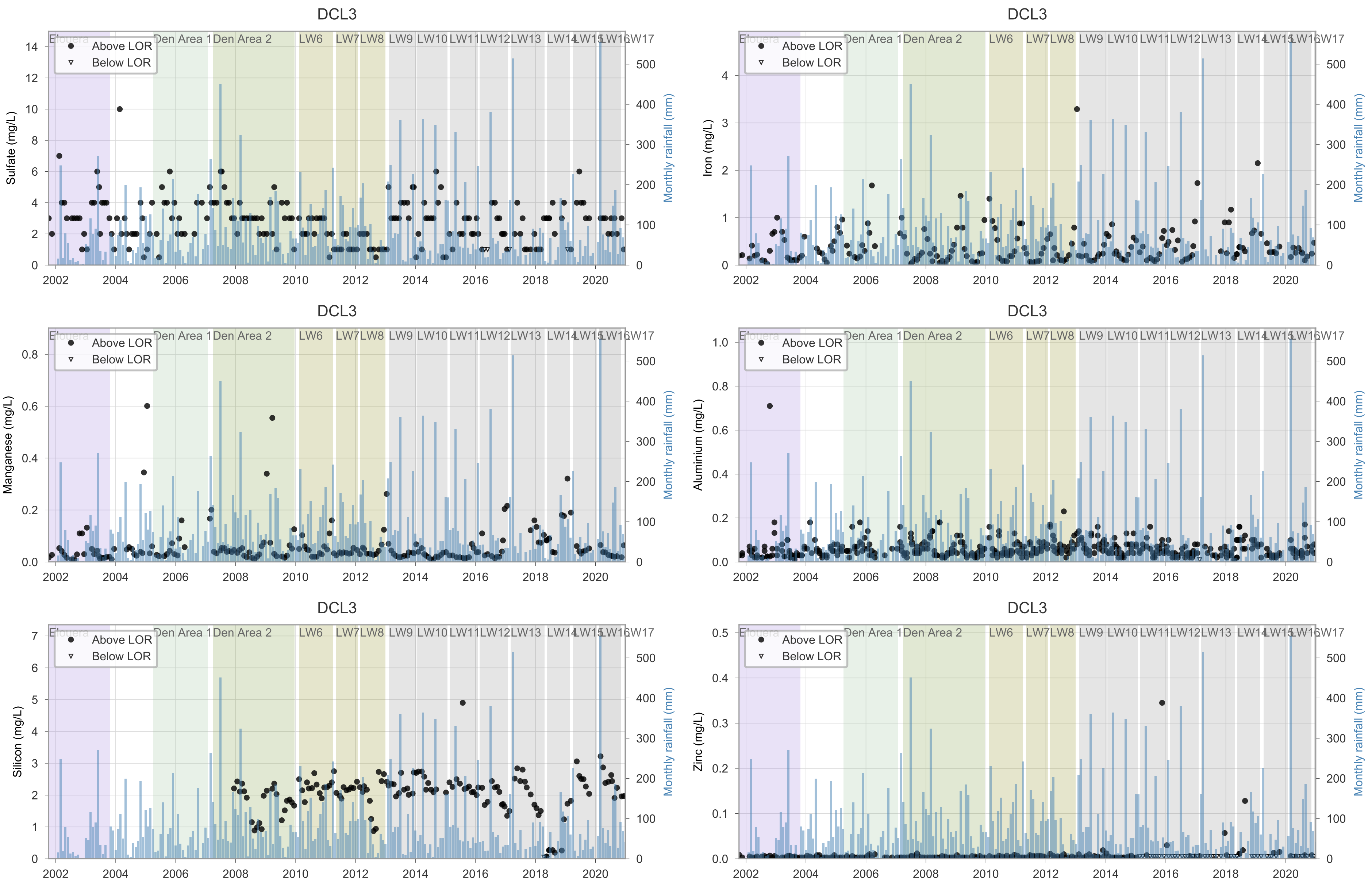

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

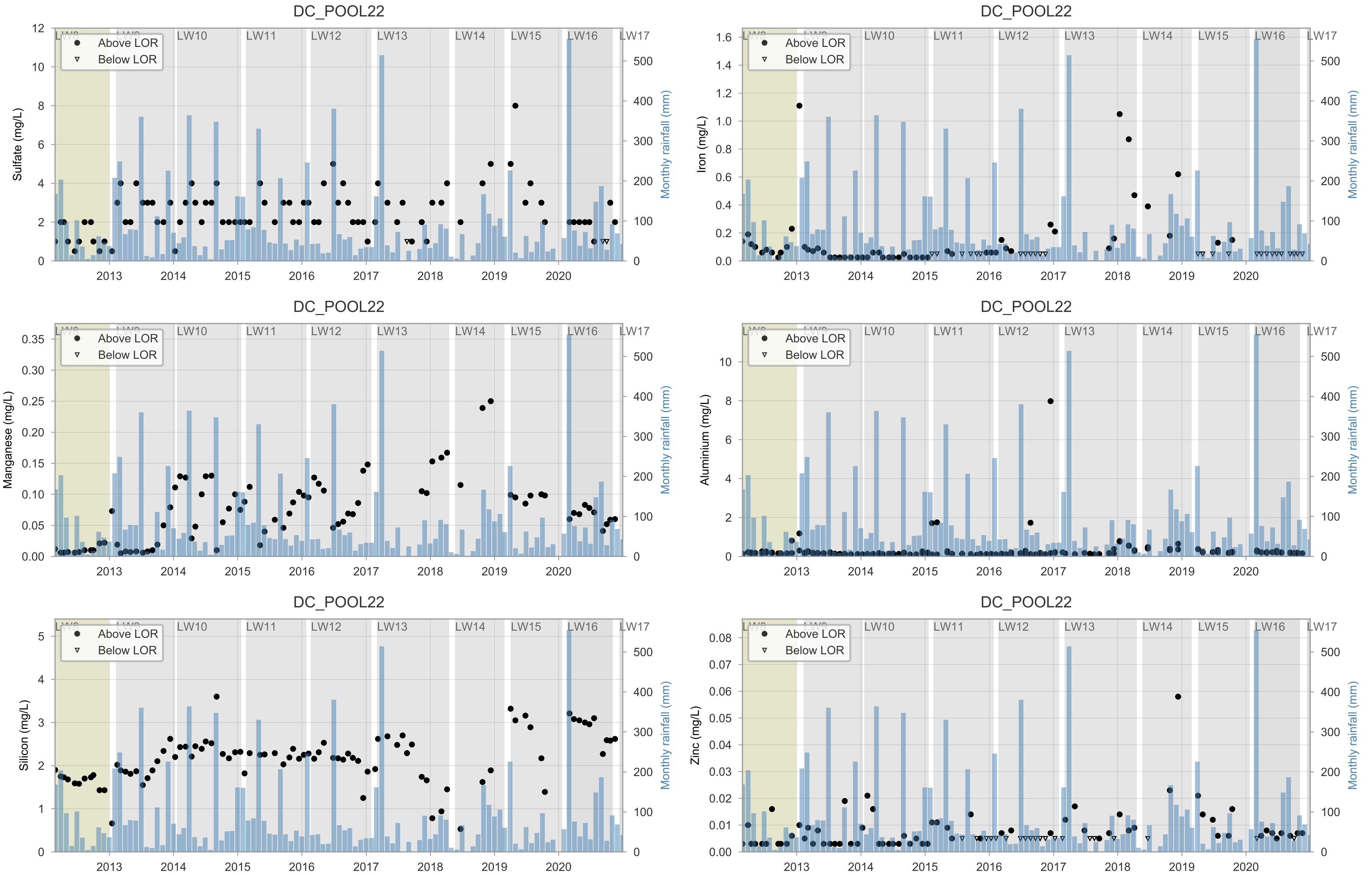

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

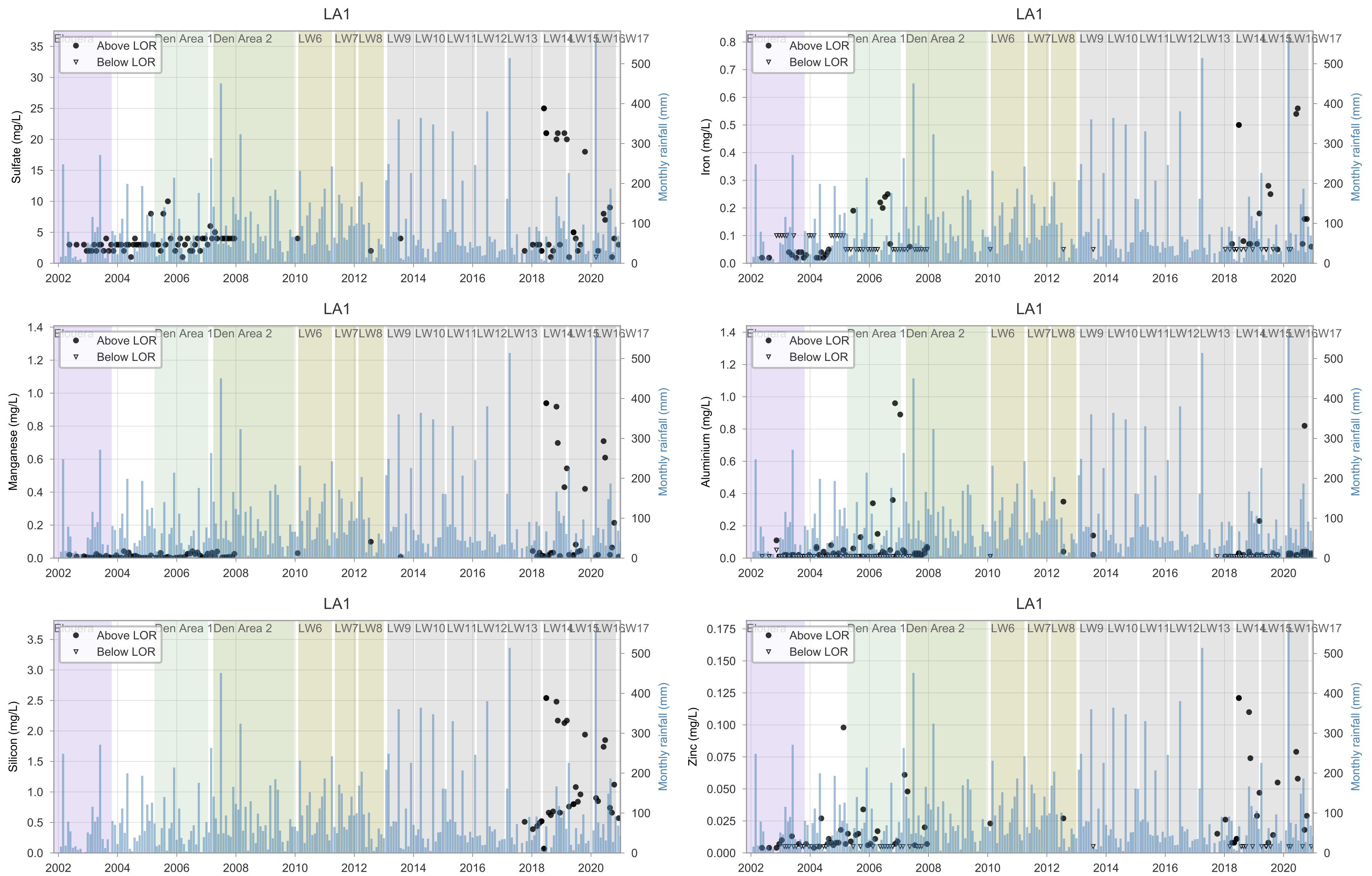

DC13_POOL2B
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

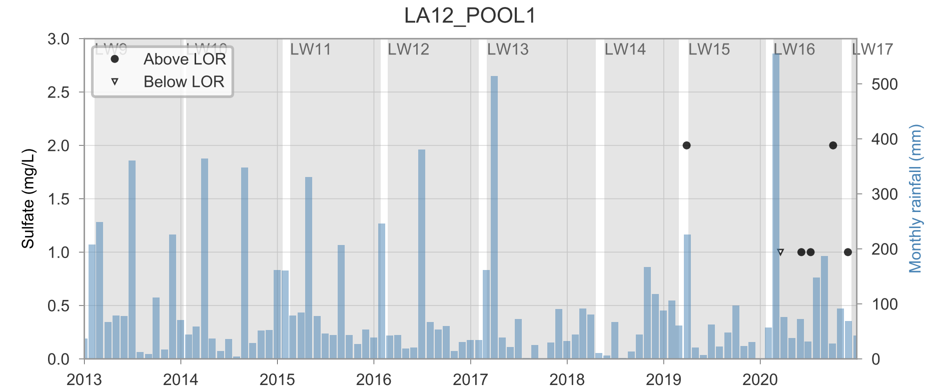

DC8_S1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

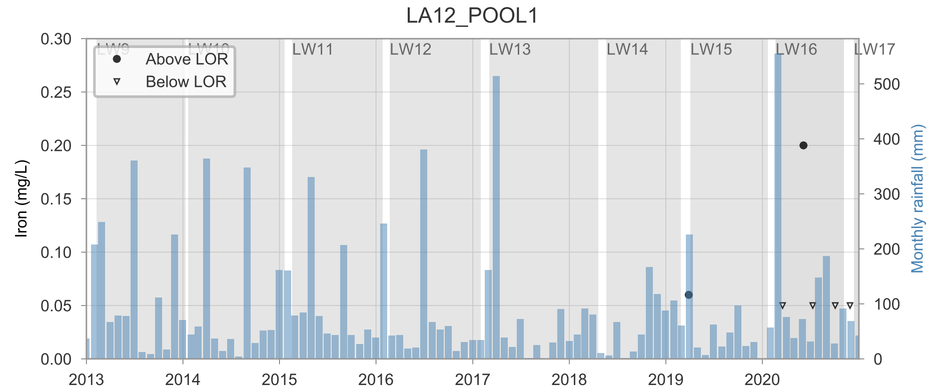

DCC_FR6
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
W17
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

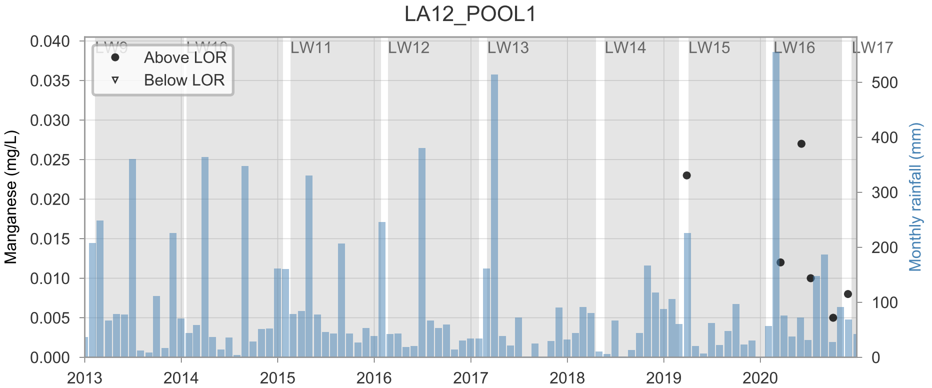

DCL3
Sulfate (mg/L)
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Monthly rainfall (mm)
DCL3
Iron (mg/L)
Above LOR
Below LOR
Monthly rainfall (mm)
DCL3
Manganese (mg/L)
Above LOR
Below LOR
Monthly rainfall (mm)
DCL3
Aluminium (mg/L)
Above LOR
Below LOR
Monthly rainfall (mm)
DCL3
Silicon (mg/L)
Above LOR
Below LOR
Monthly rainfall (mm)
DCL3
Zinc (mg/L)
Above LOR
Below LOR
Monthly rainfall (mm)
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

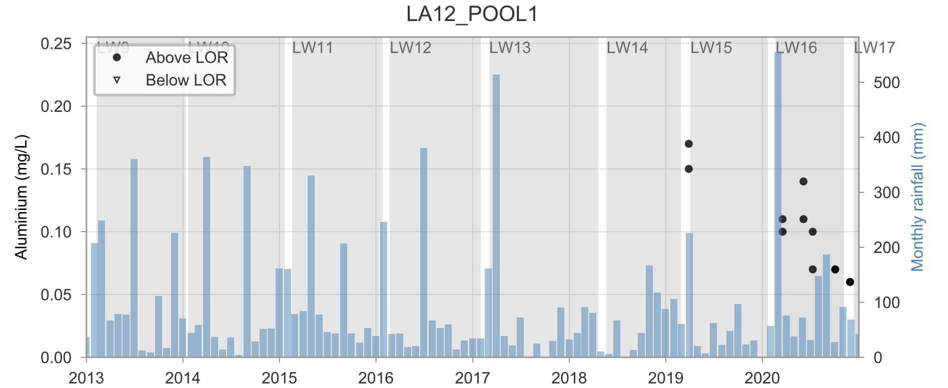

DC_POOL22
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
DC_POOL22
Iron (mg/L)
Monthly rainfall (mm)
DC_POOL22
Manganese (mg/L)
Monthly rainfall (mm)
DC_POOL22
Aluminium (mg/L)
Monthly rainfall (mm)
DC_POOL22
Silicon (mg/L)
Monthly rainfall (mm)
DC_POOL22
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

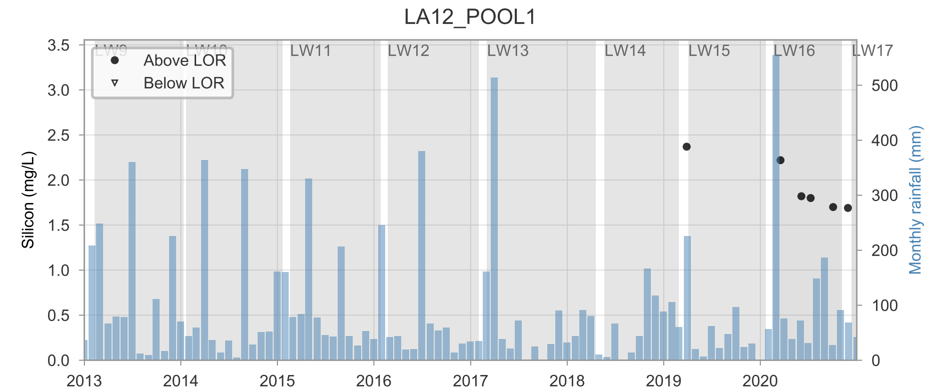

LA1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

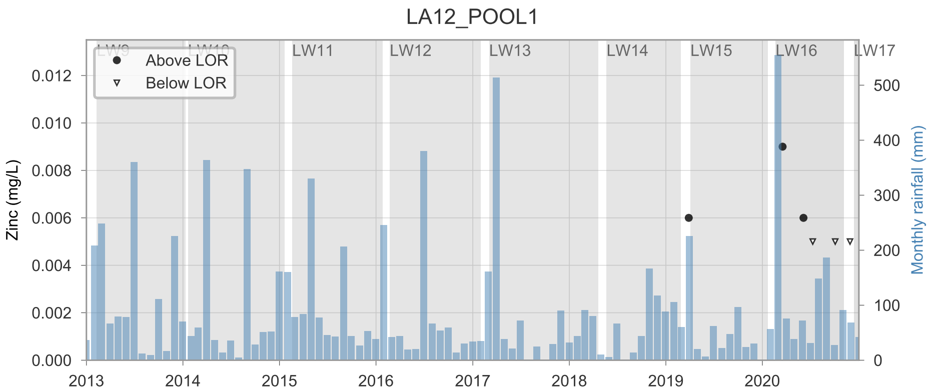

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Sulfate (mg/L)
Monthly rainfall (mm)

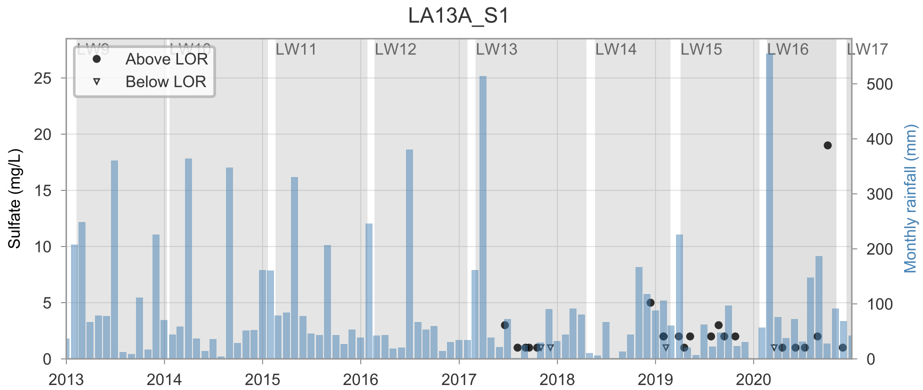

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Iron (mg/L)
Monthly rainfall (mm)

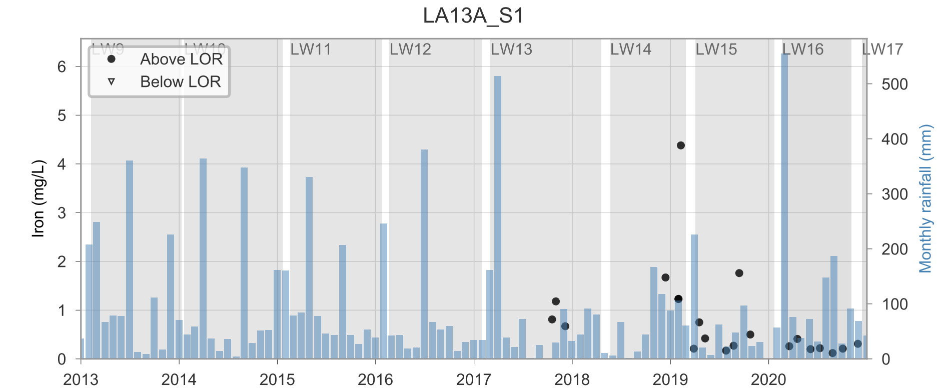

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Manganese (mg/L)
Monthly rainfall (mm)

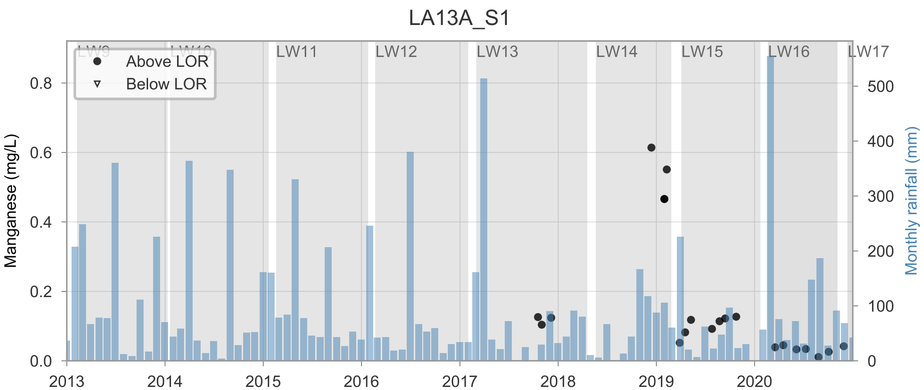

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Aluminium (mg/L)
Monthly rainfall (mm)

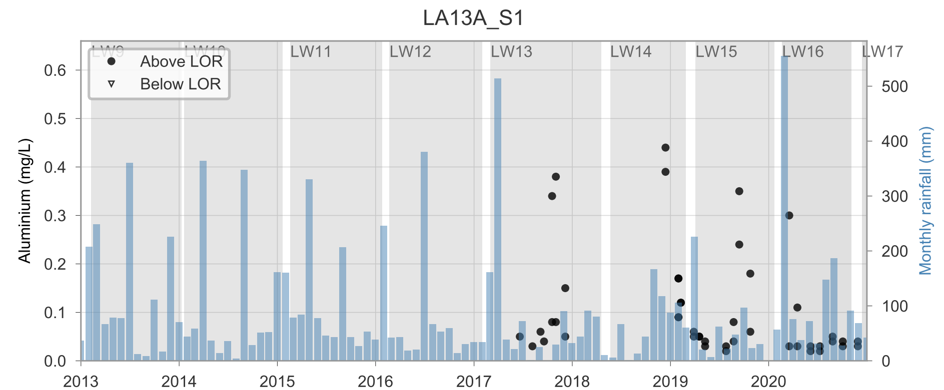

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Silicon (mg/L)
Monthly rainfall (mm)

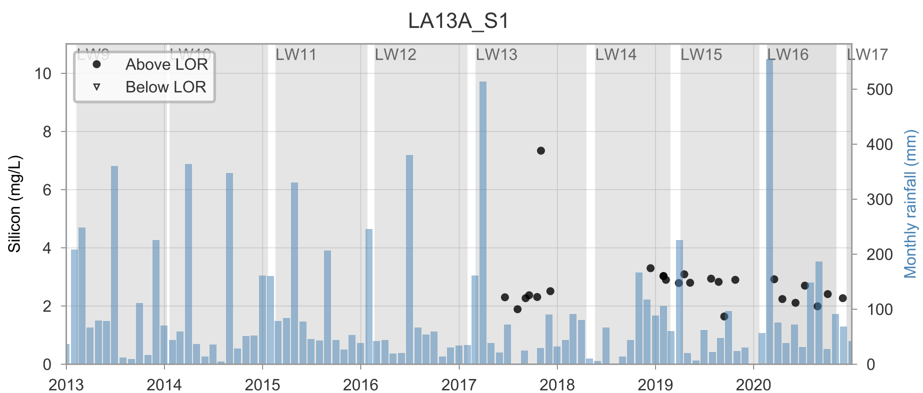

LA12_POOL1
Above LOR
Below LOR
LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Zinc (mg/L)
Monthly rainfall (mm)

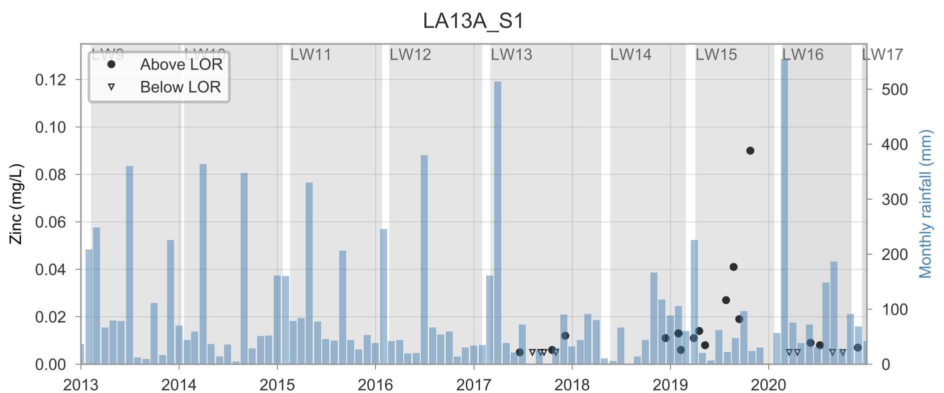

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

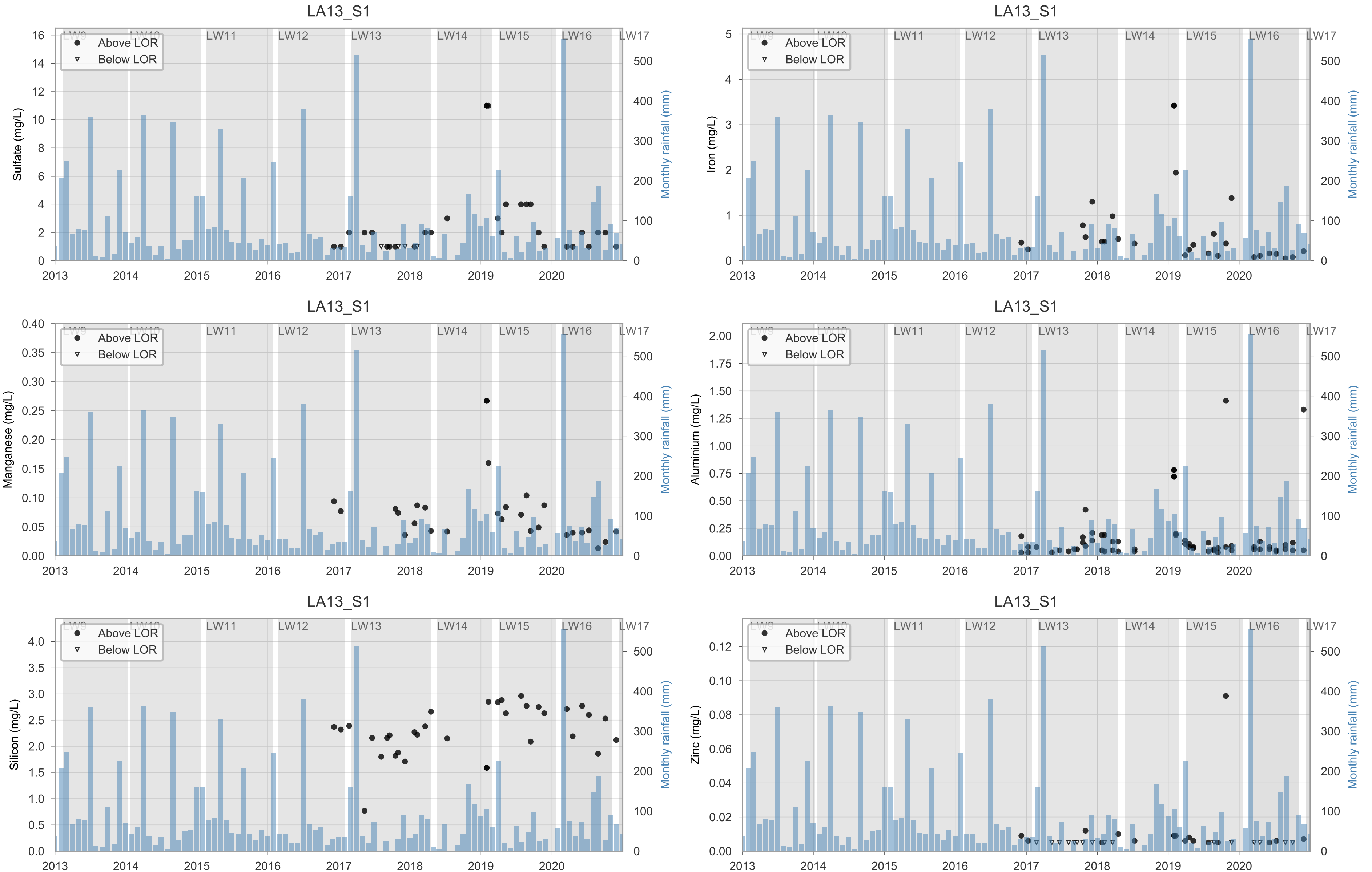

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

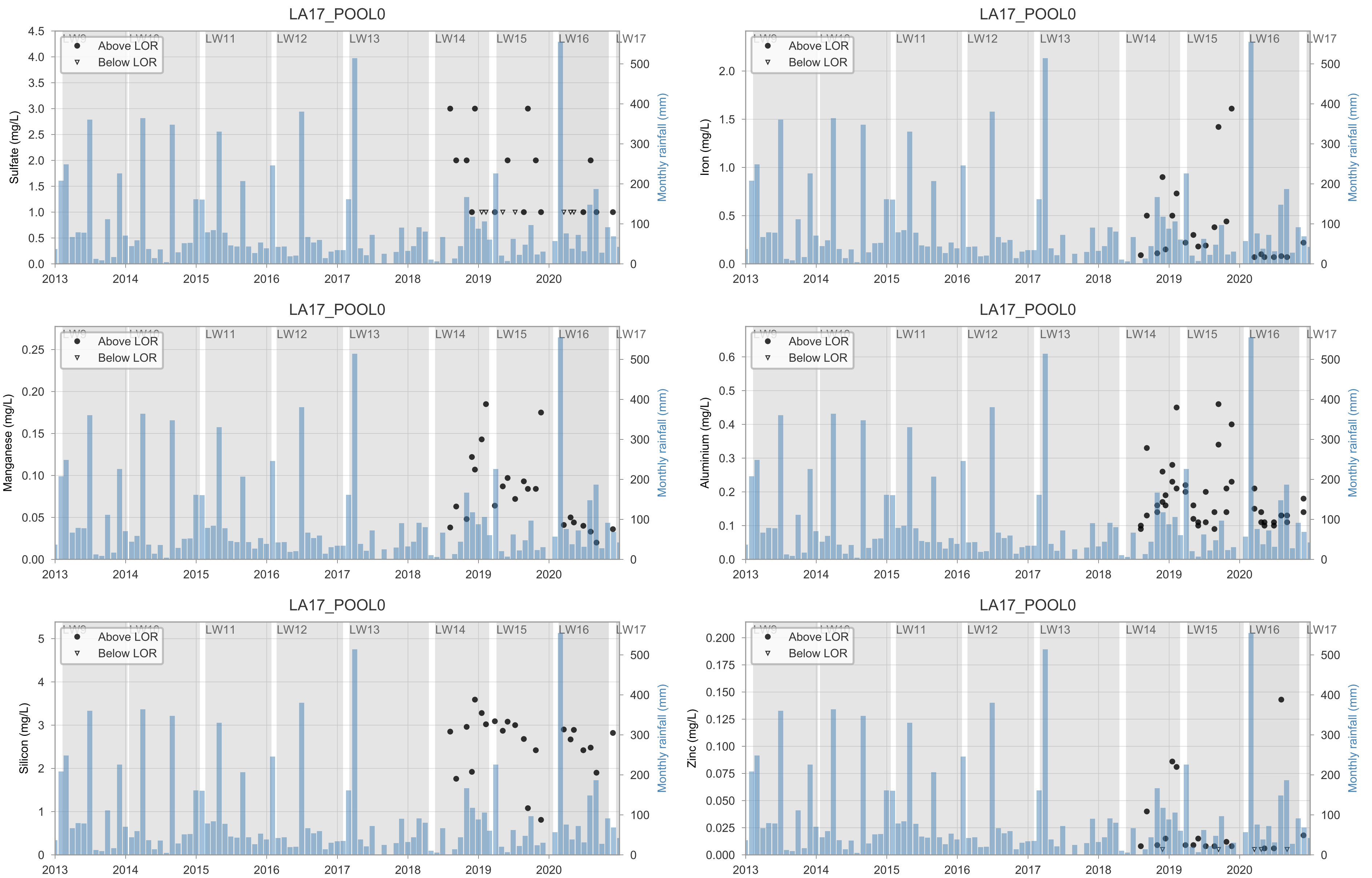

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

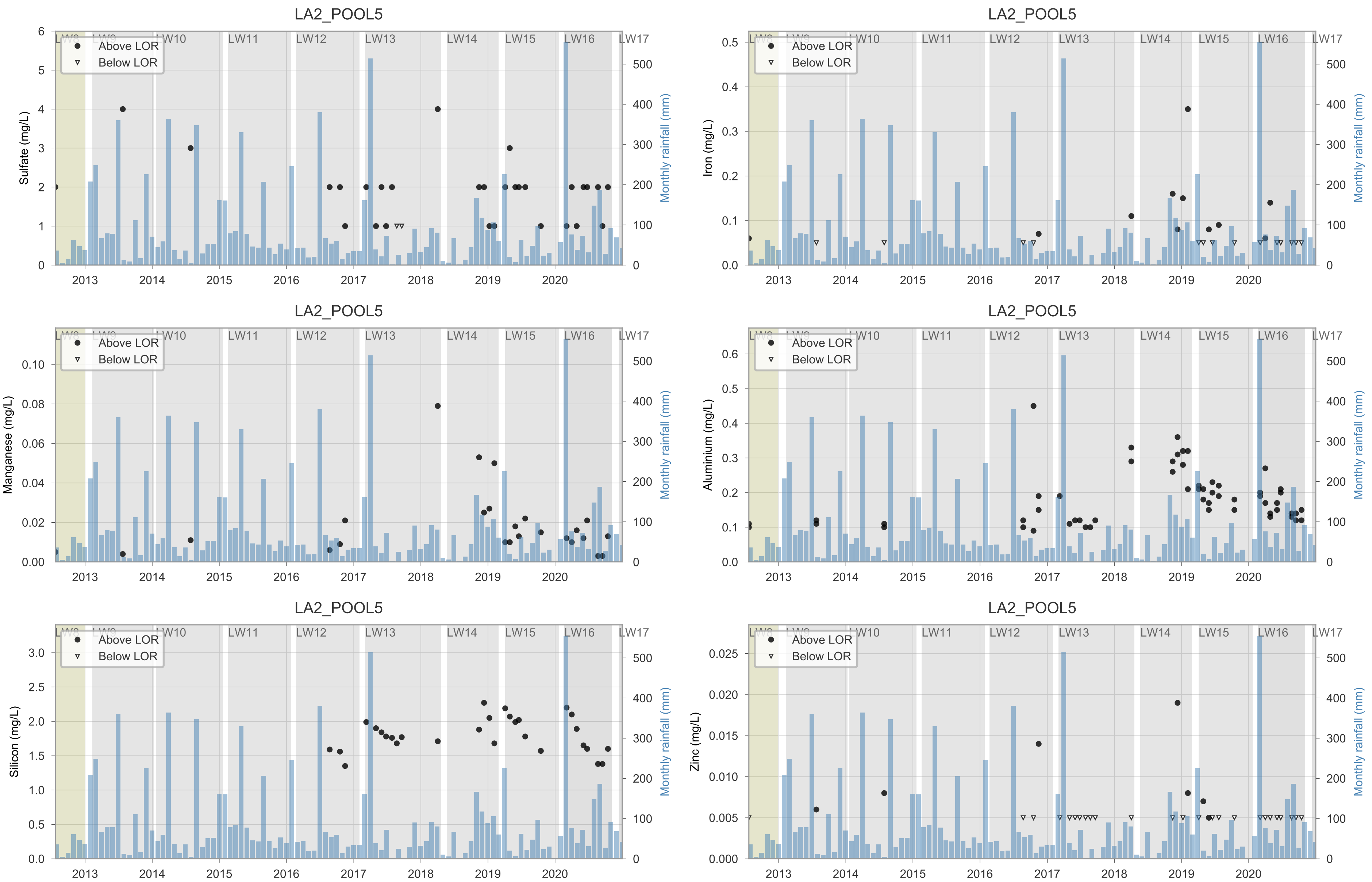

LA13A_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020



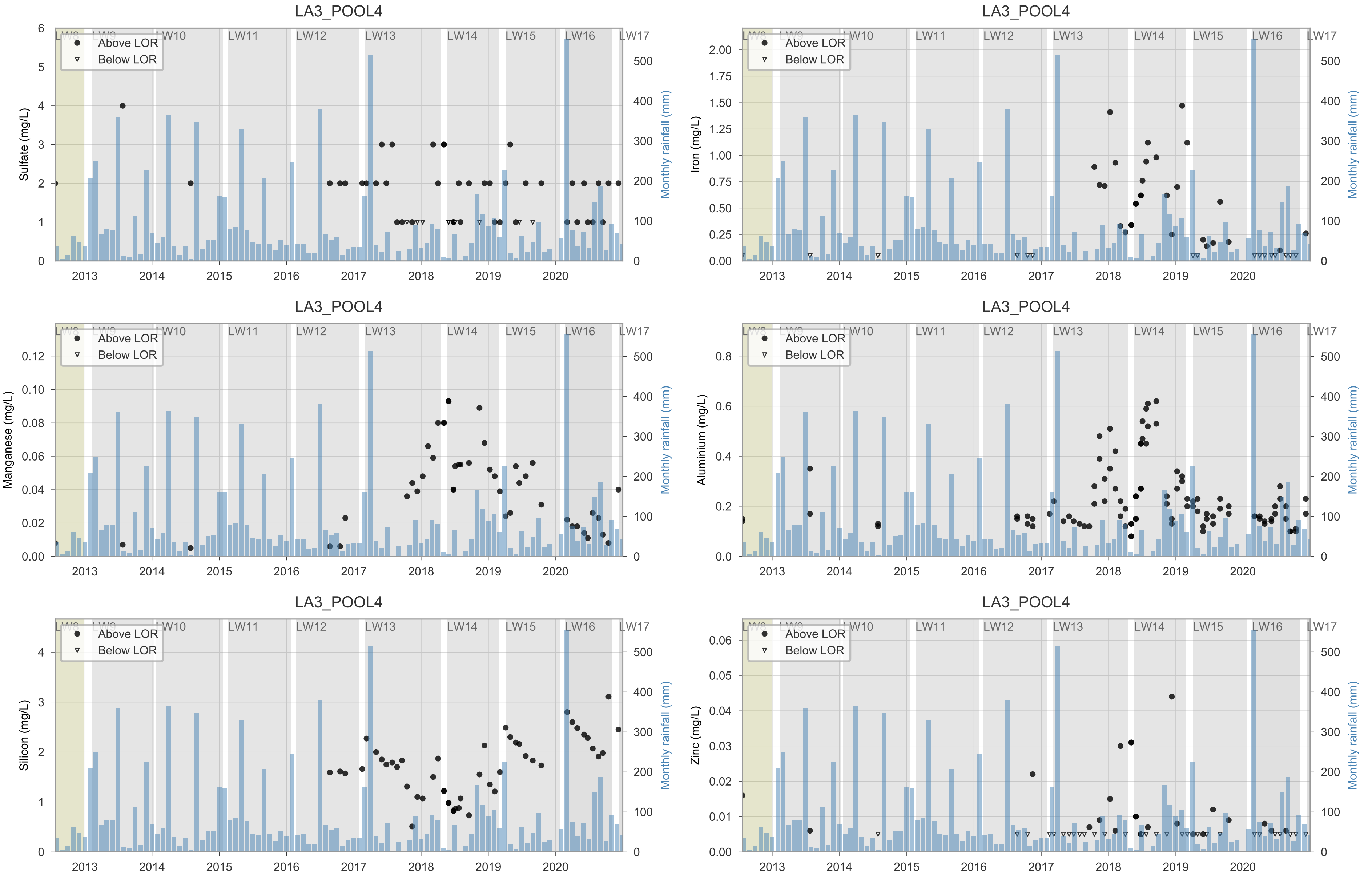
LA13_S1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

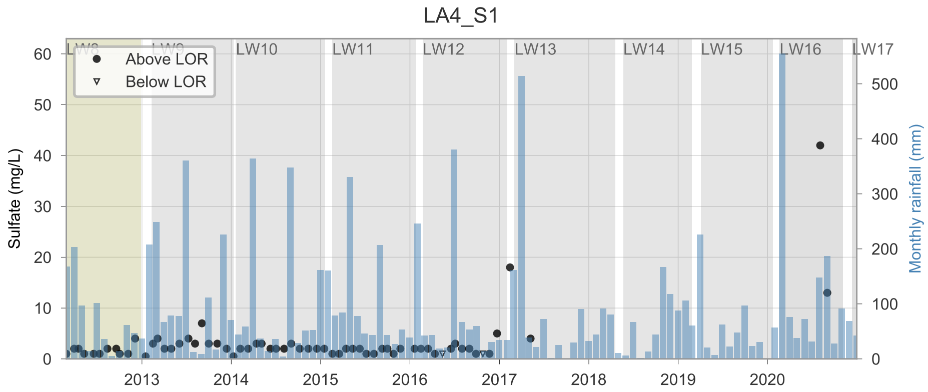


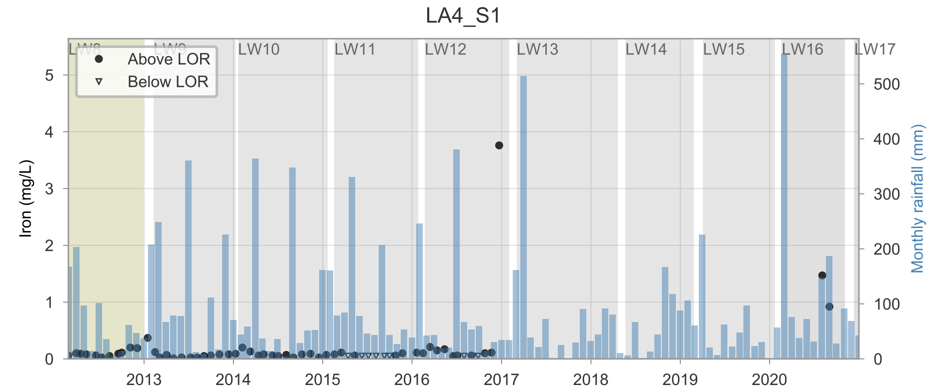
LA17_POOL0
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

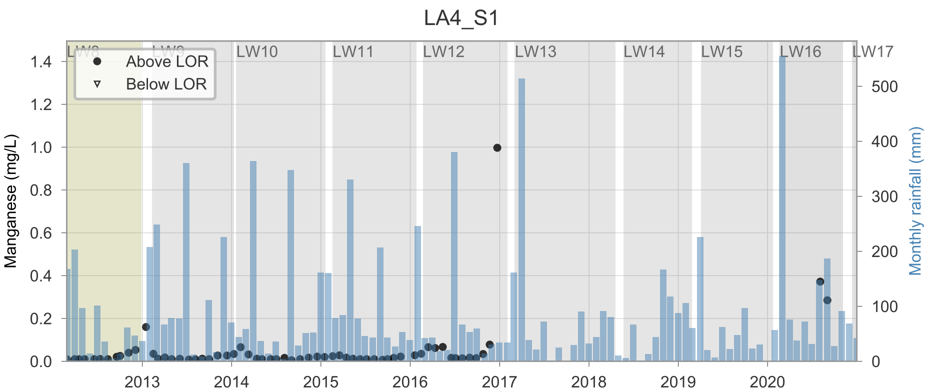


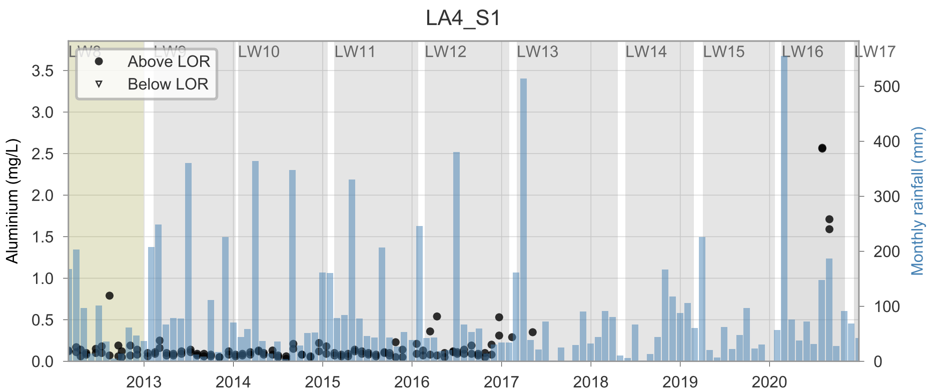
LA2_POOL5
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

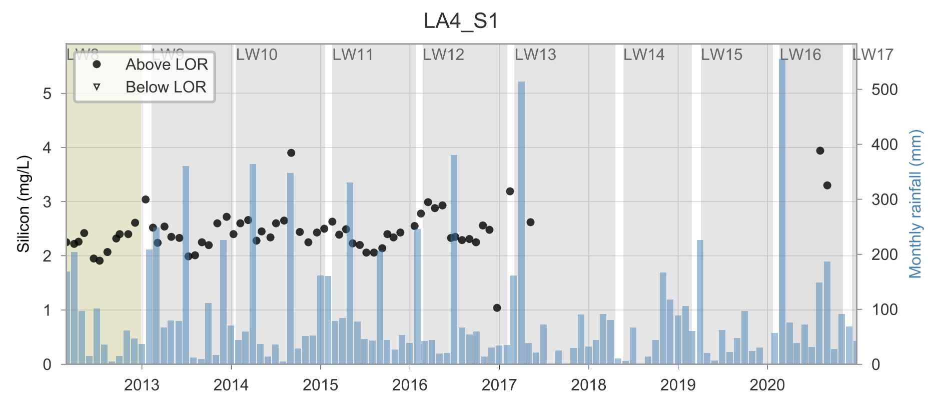

LA3_POOL4
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020
LA3_POOL4
Iron (mg/L)
Monthly rainfall (mm)
LA3_POOL4
Manganese (mg/L)
Monthly rainfall (mm)
LA3_POOL4
Aluminium (mg/L)
Monthly rainfall (mm)
LA3_POOL4
Silicon (mg/L)
Monthly rainfall (mm)
LA3_POOL4
Zinc (mg/L)
Monthly rainfall (mm)

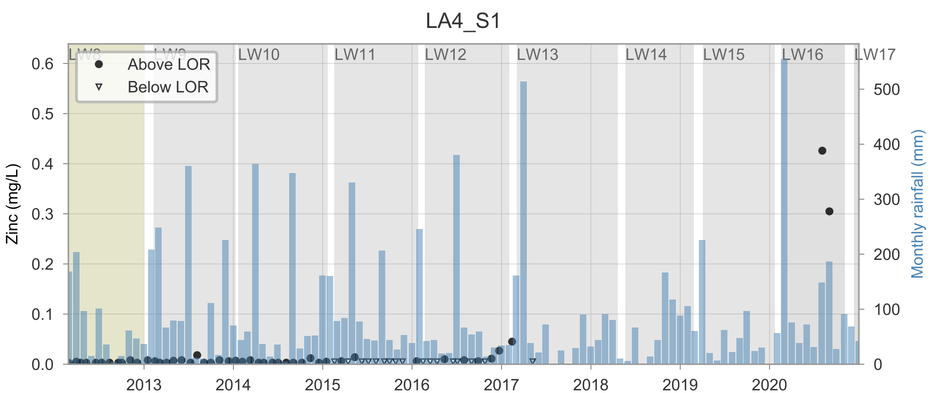

LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

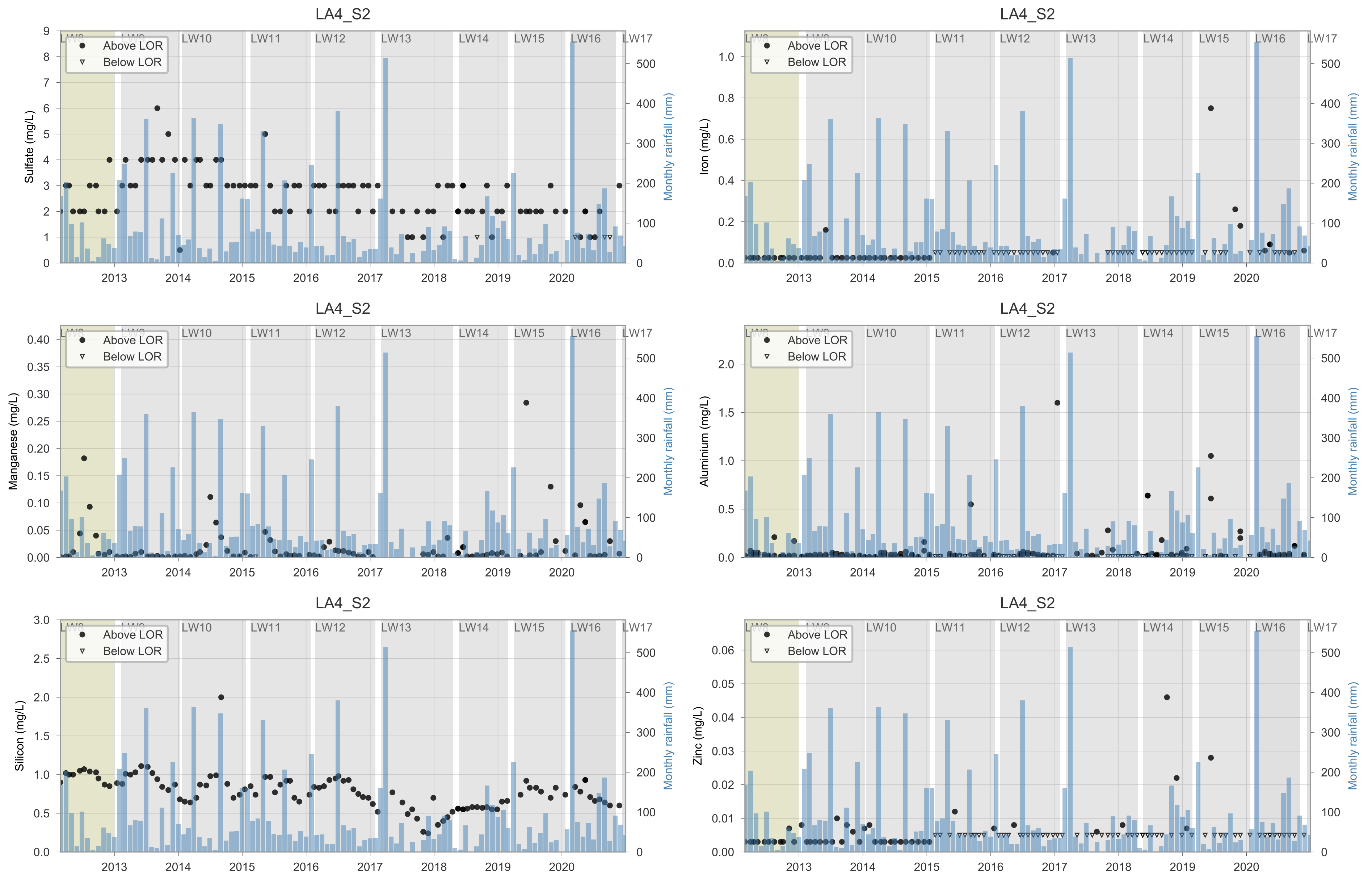

LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

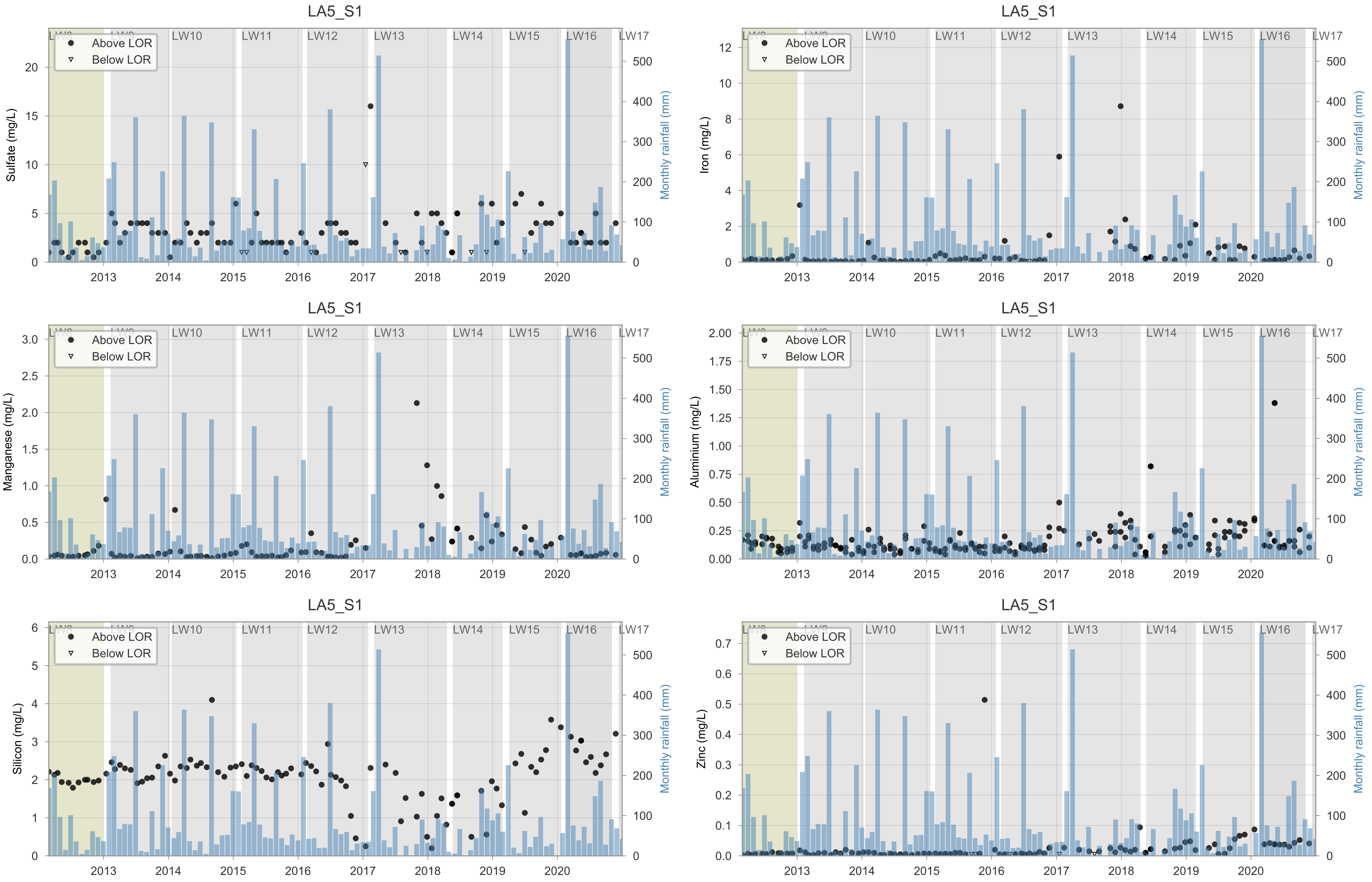

LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

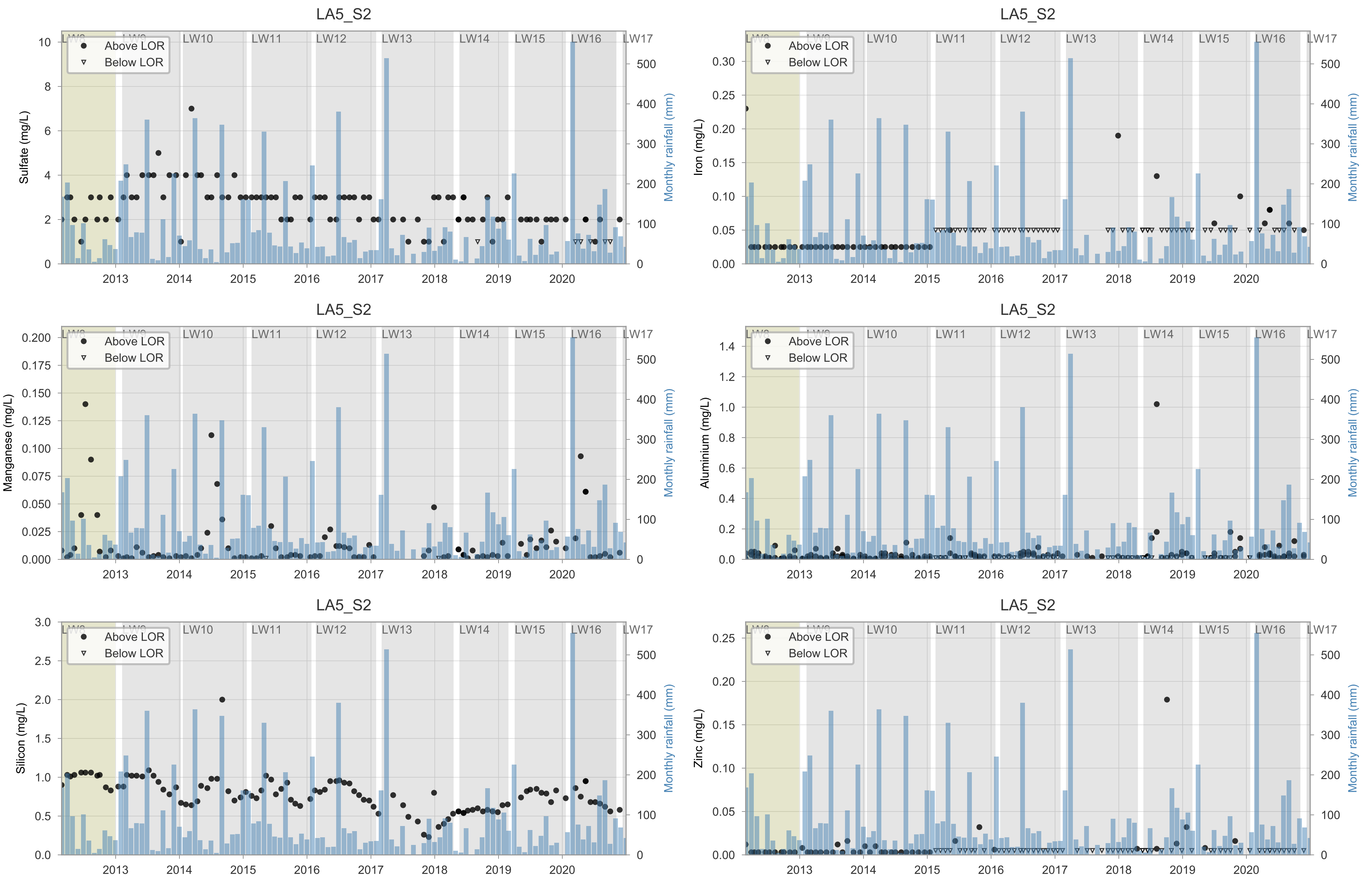

LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


LA4_S1
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

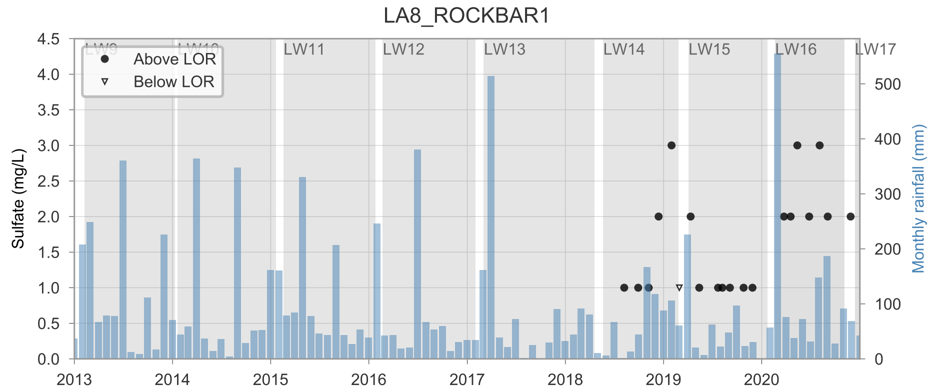


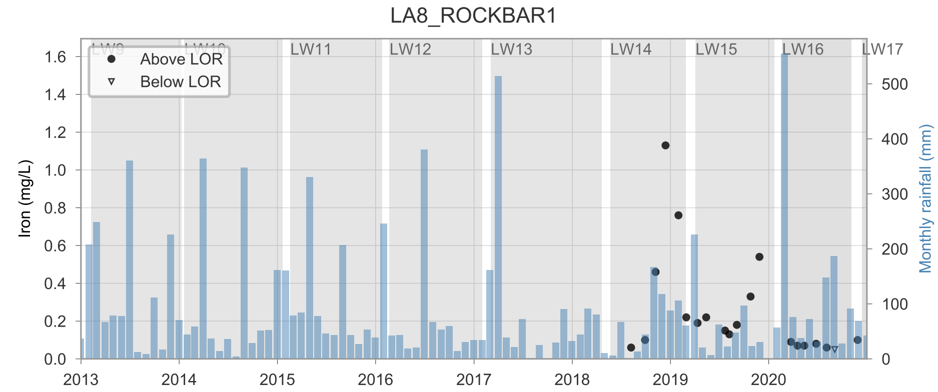
LA4_S2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

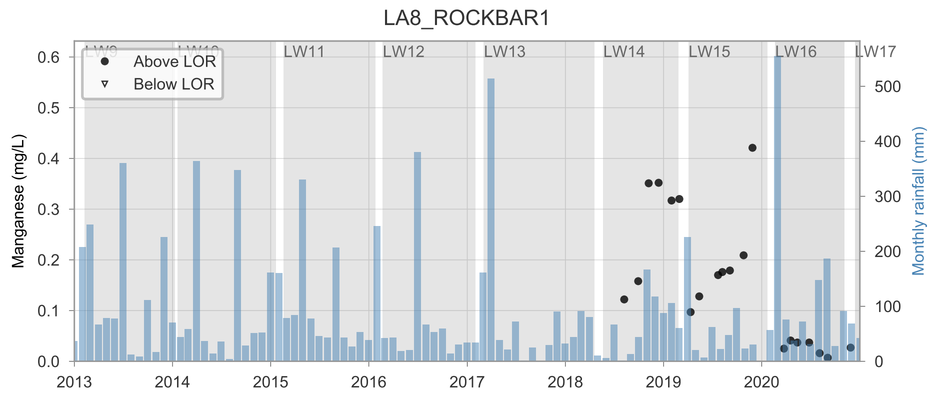

LA5_S1
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

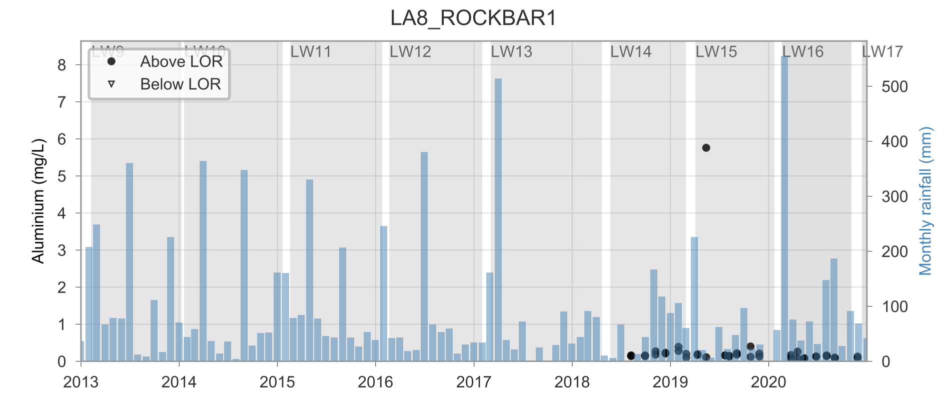


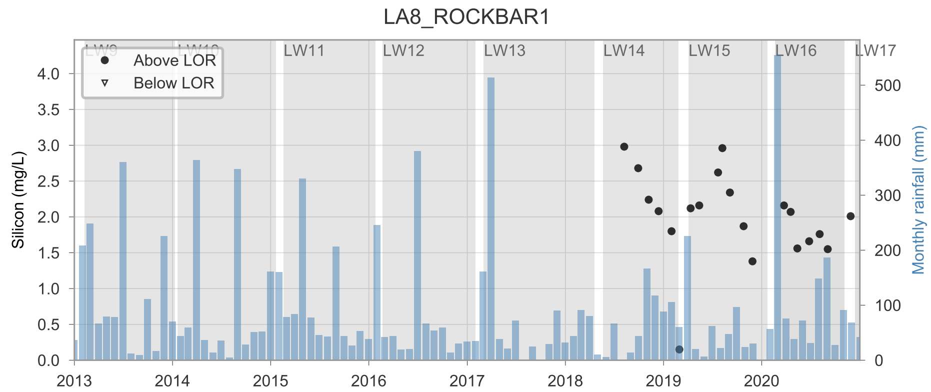
LA5_S2
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020

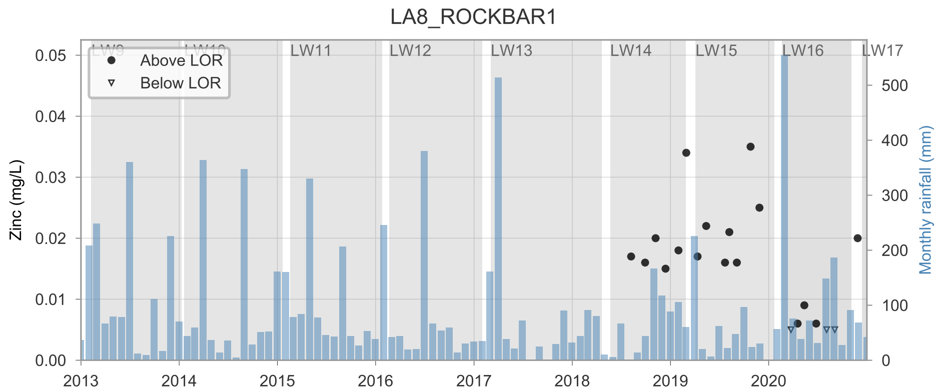

LA8_ROCKBAR1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

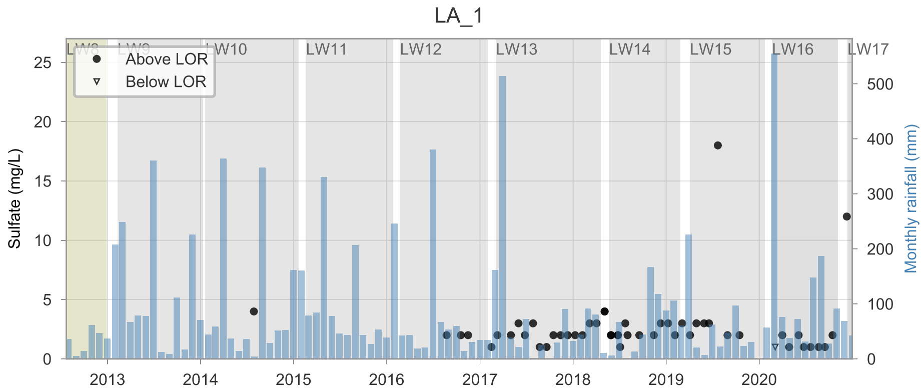

LA8_ROCKBAR1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

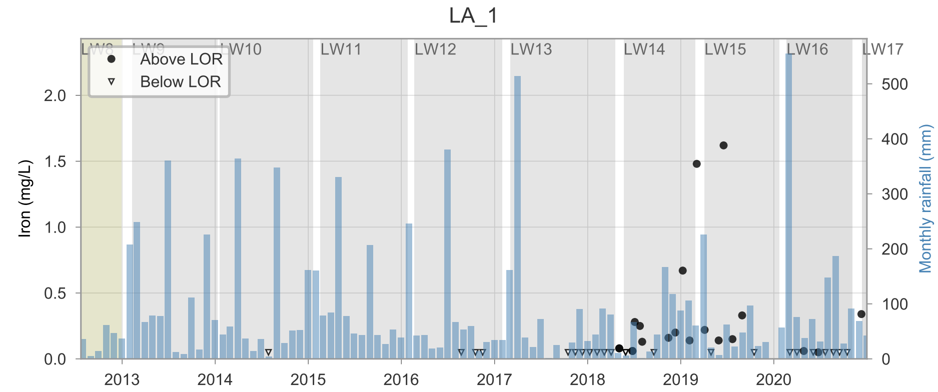

LA8_ROCKBAR1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

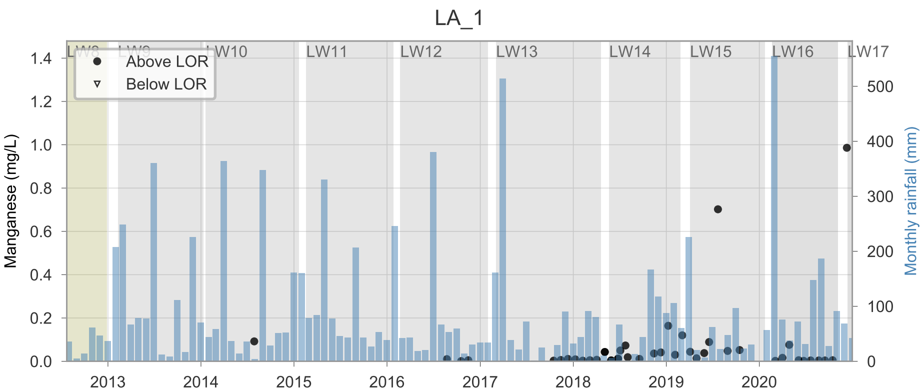

LA8_ROCKBAR1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

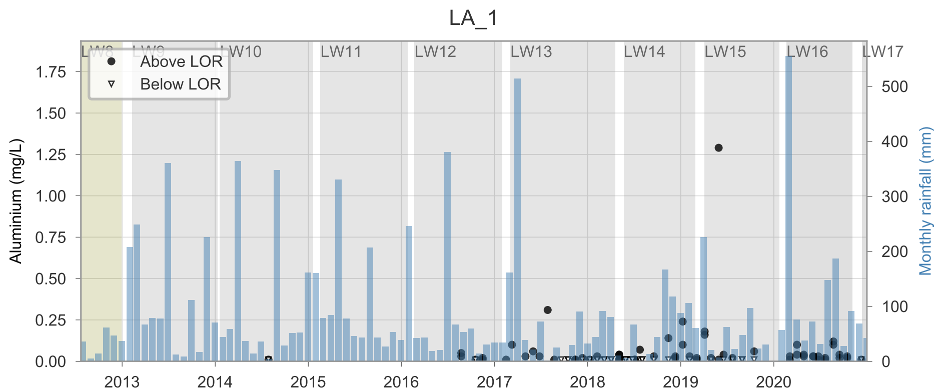

LA8_ROCKBAR1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

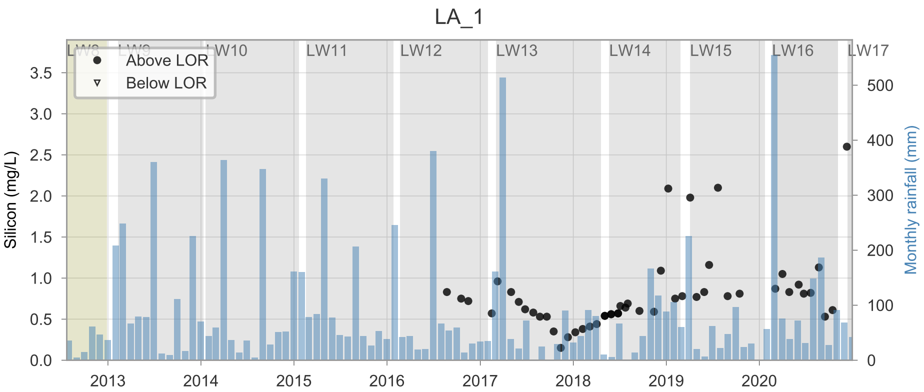

LA8_ROCKBAR1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

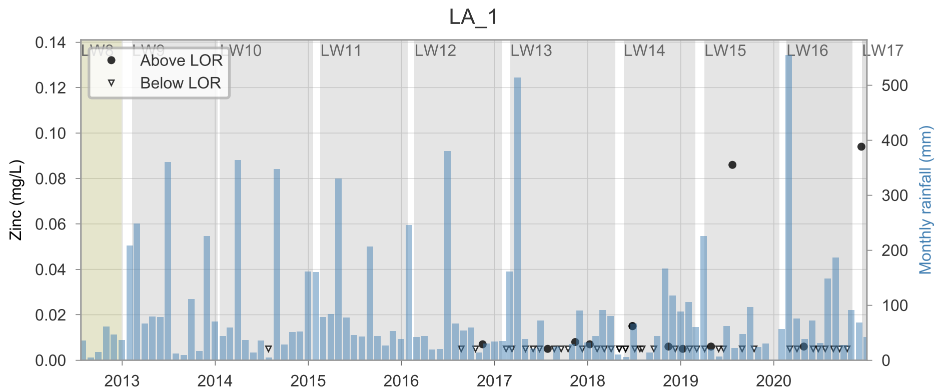

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

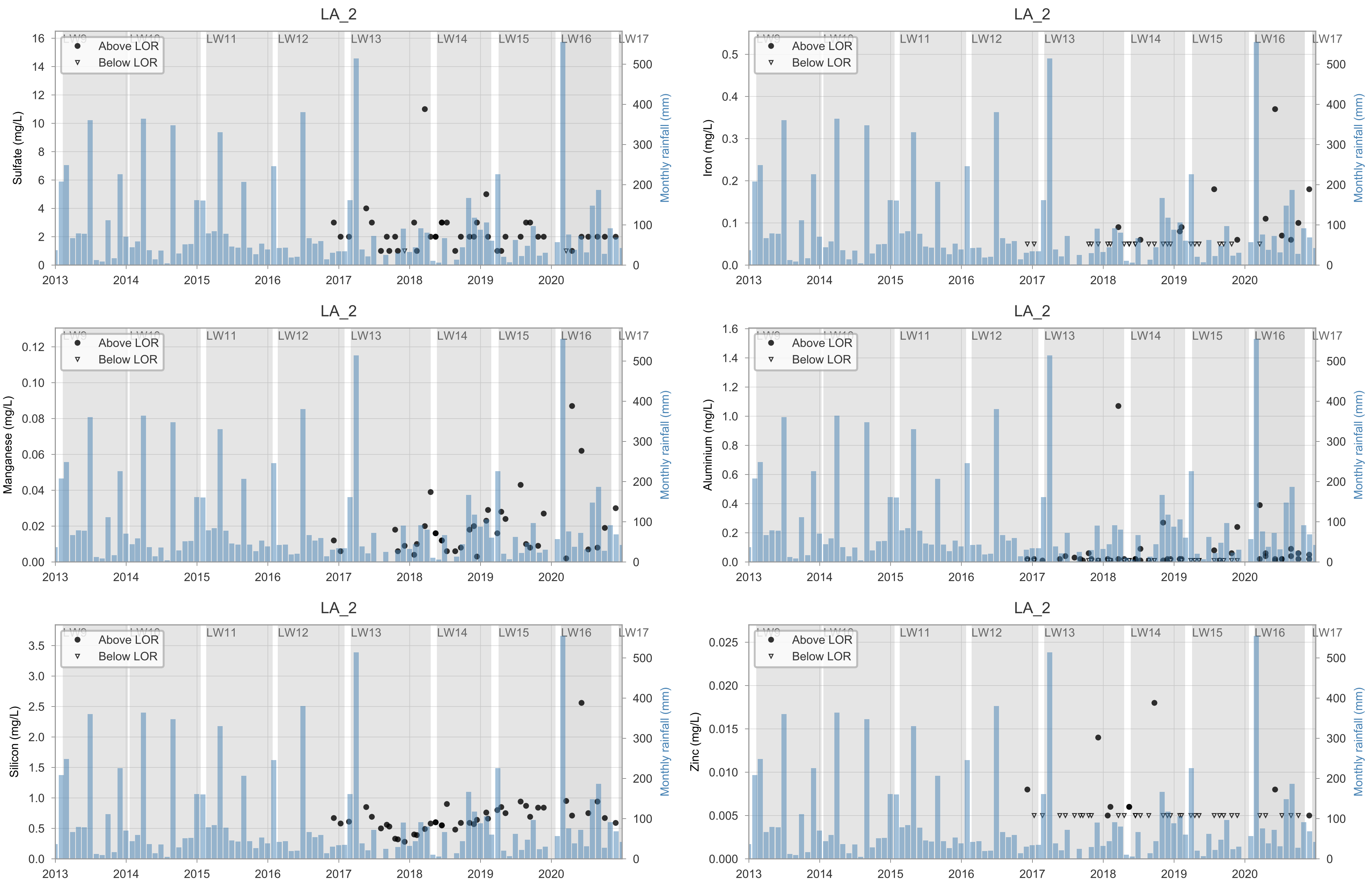

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Iron (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

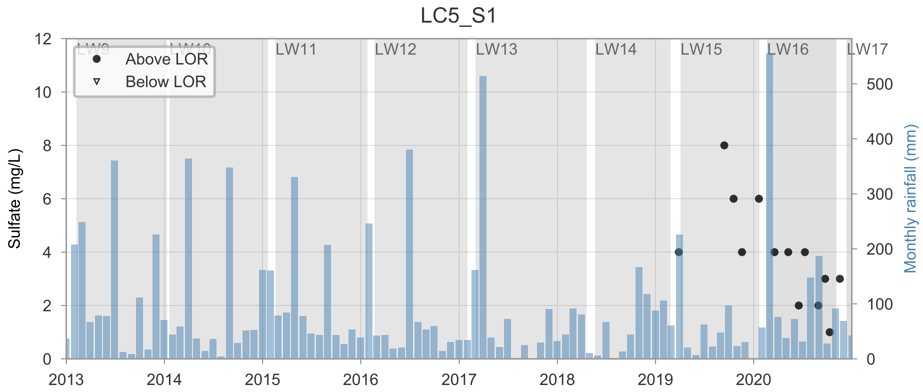

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Manganese (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

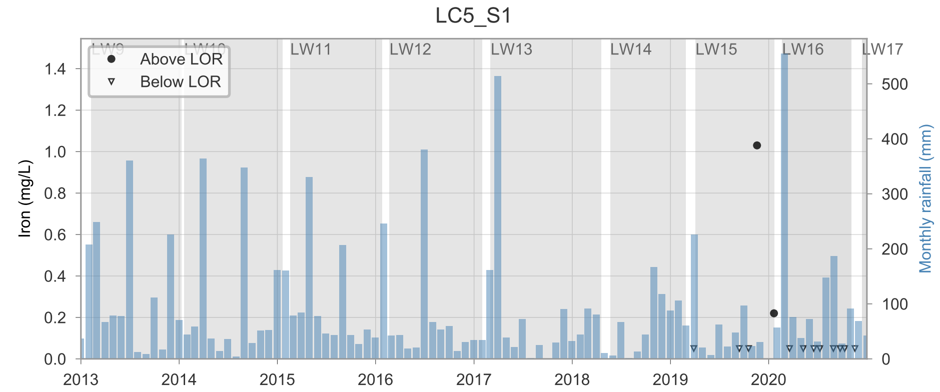

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

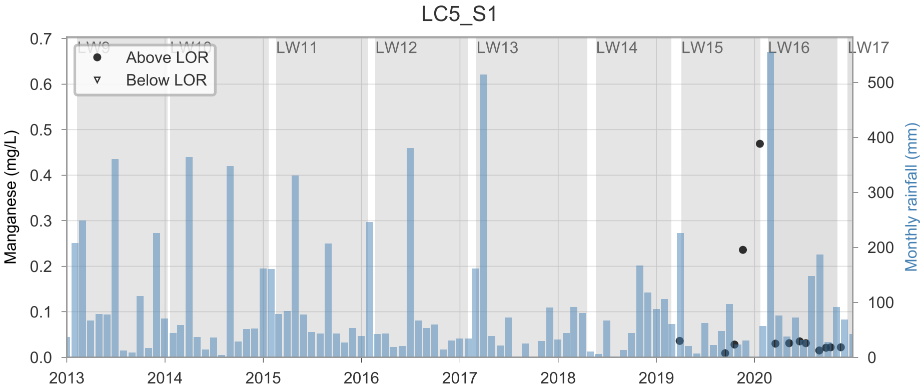

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Silicon (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

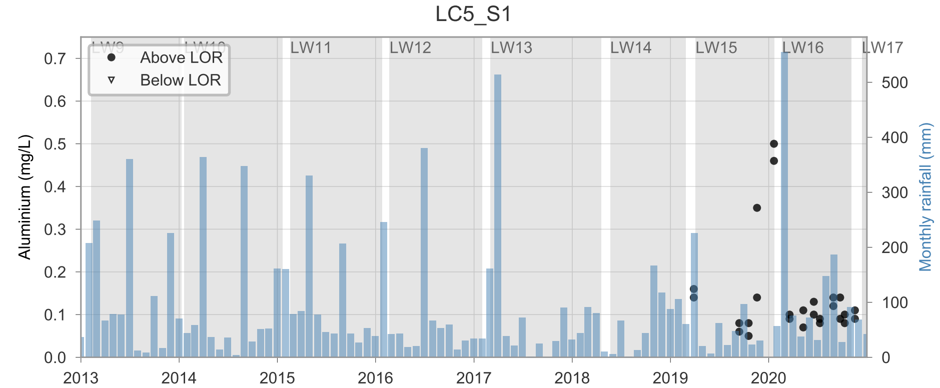

LA_1
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Zinc (mg/L)
Monthly rainfall (mm)
2013 2014 2015 2016 2017 2018 2019 2020

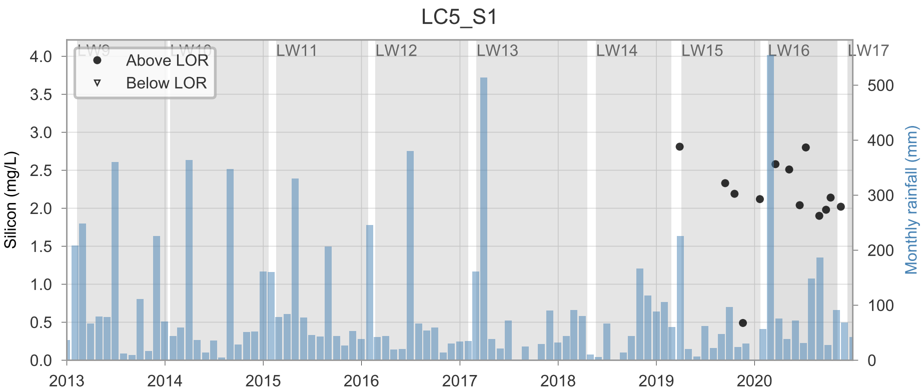

LA_2
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

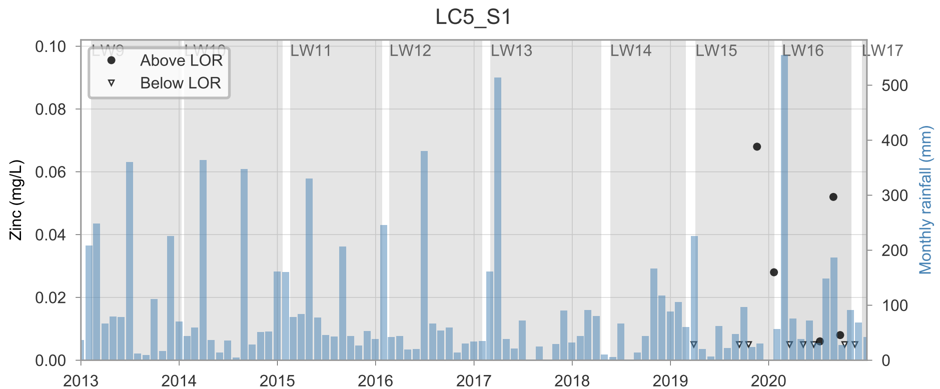

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
0
2
4
6
8
10
12
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

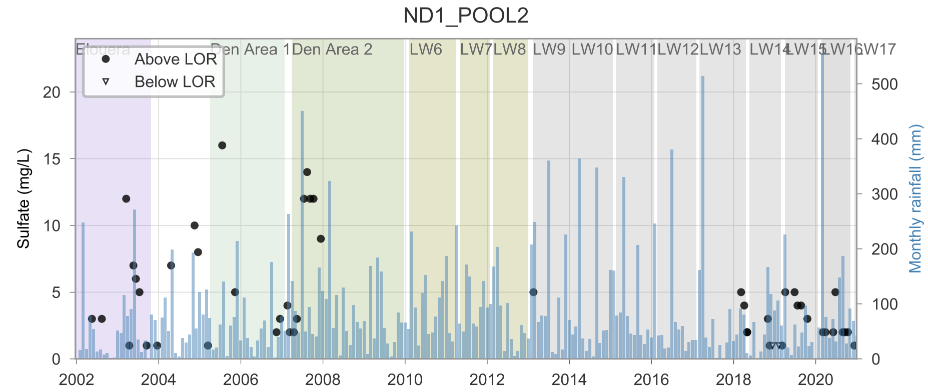

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

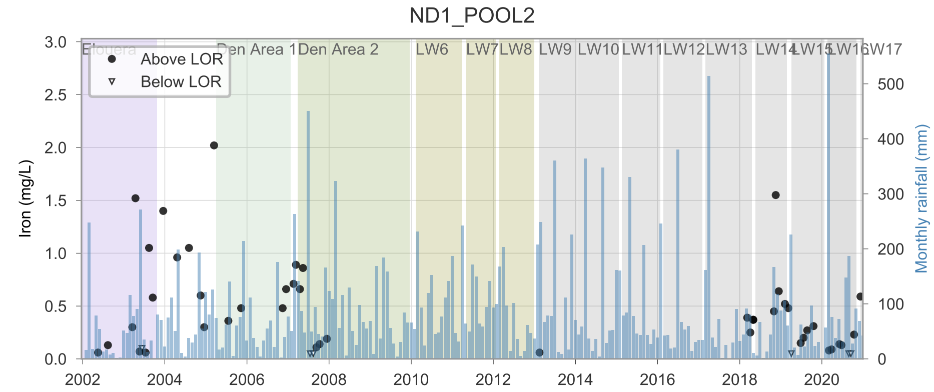

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

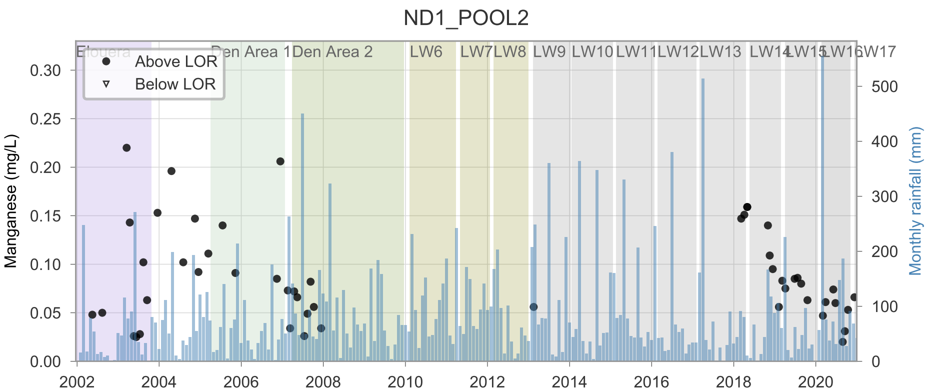

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

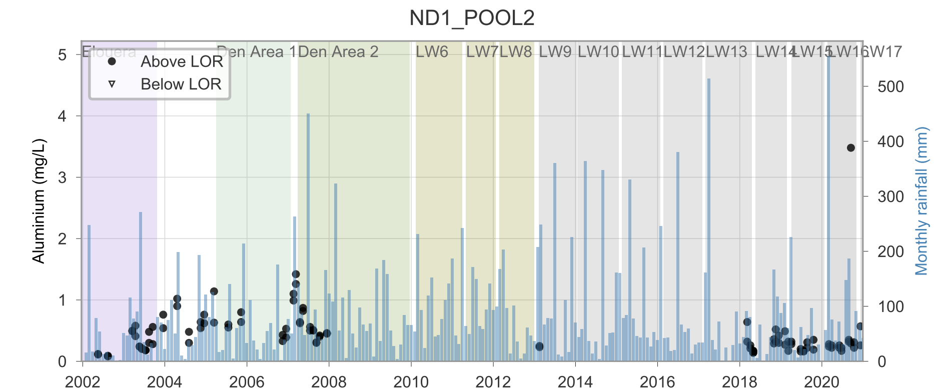

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

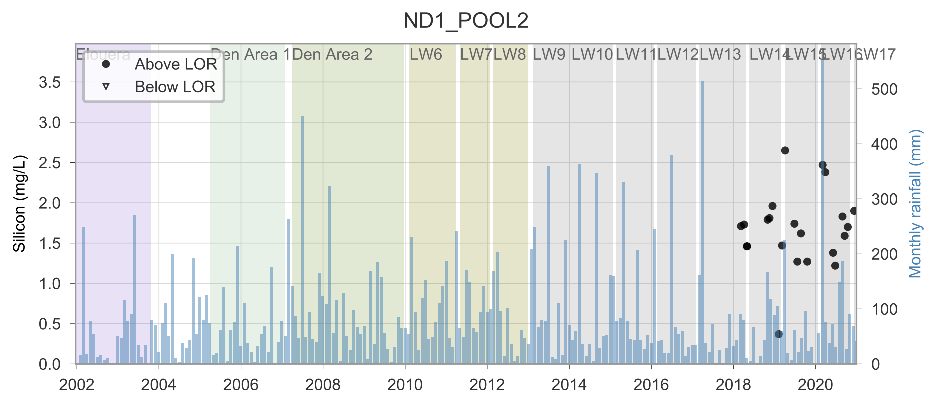

LC5_S1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

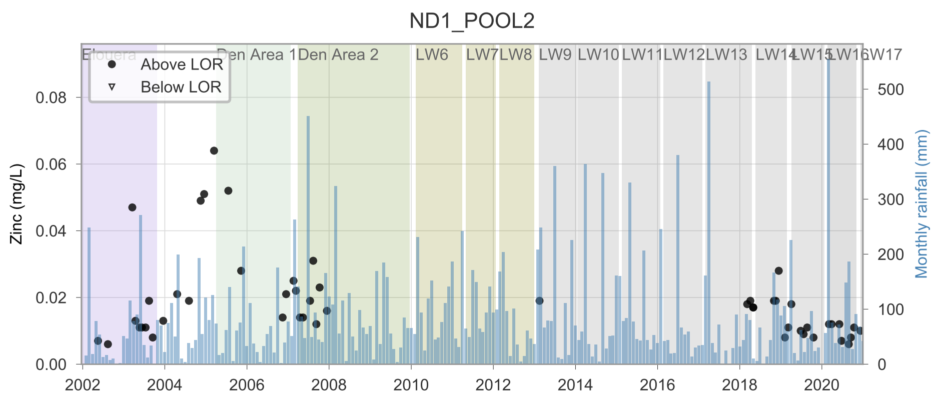

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)

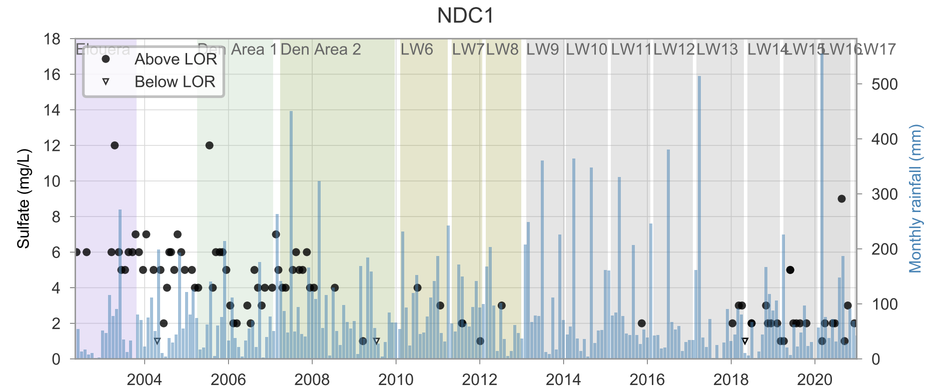

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)

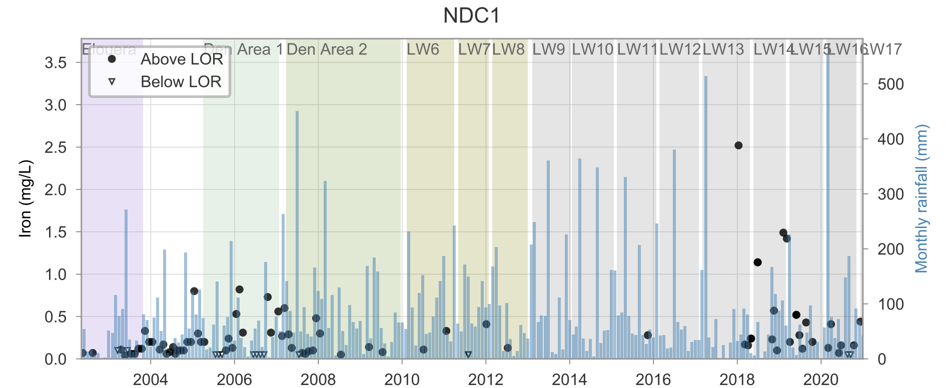

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)

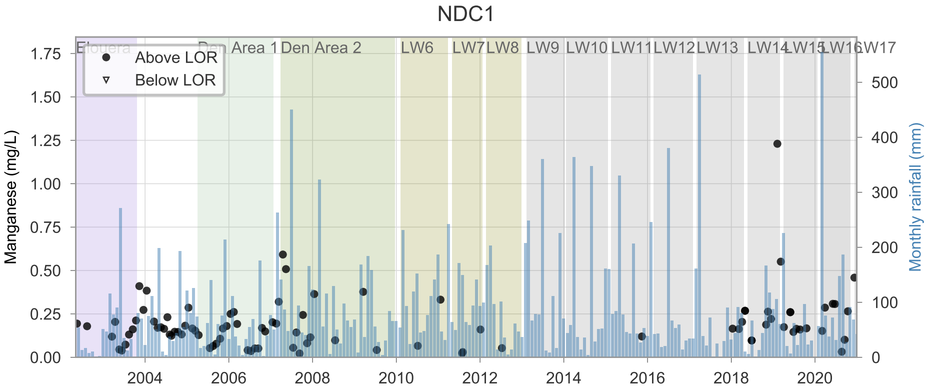

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)

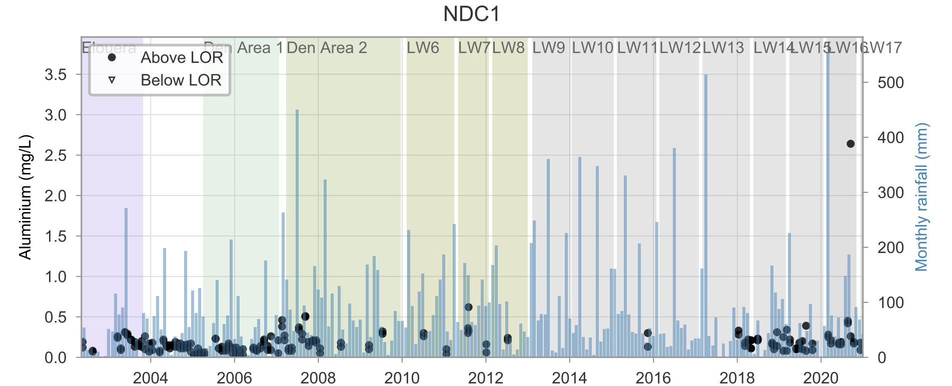

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Silicon (mg/L)
Monthly rainfall (mm)

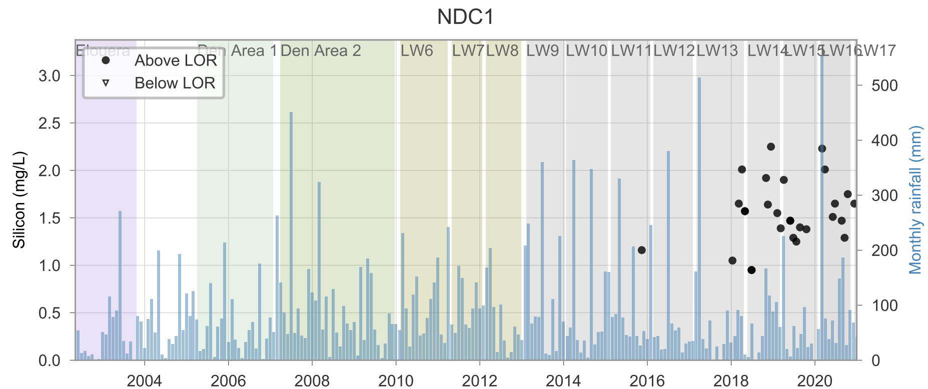

ND1_POOL2
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)

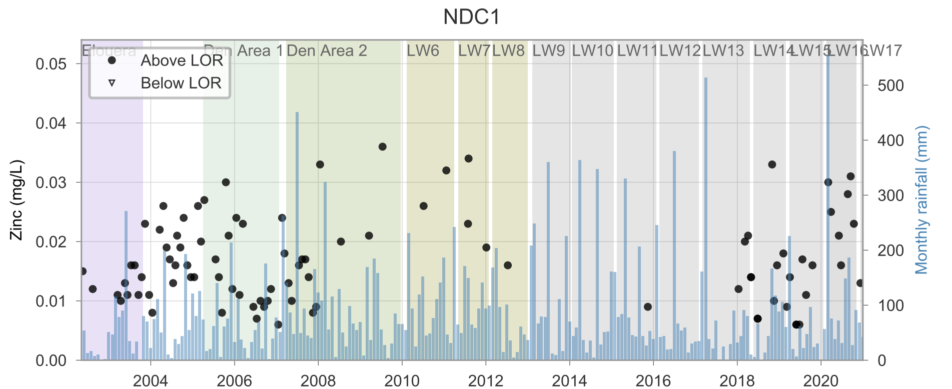

NDC1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

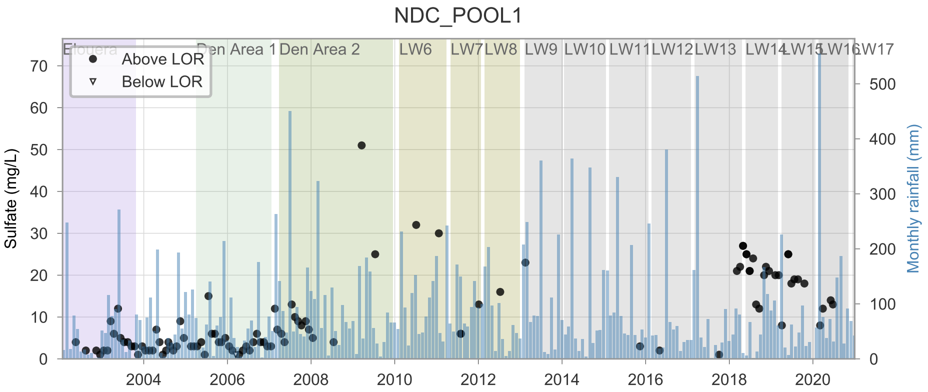

NDC1
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

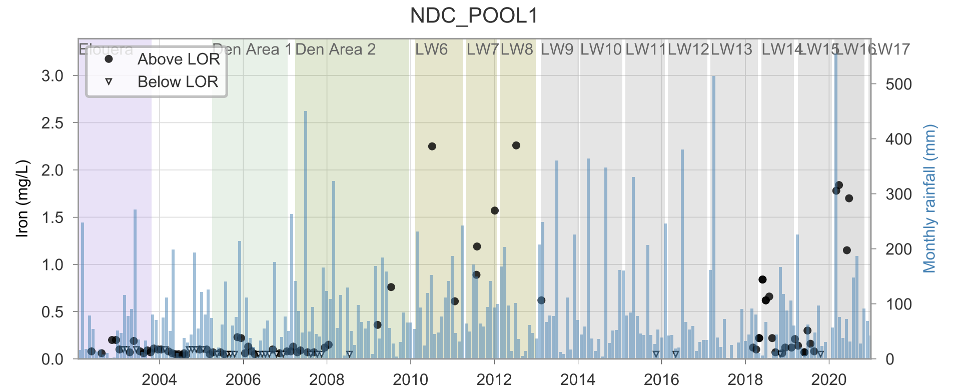

NDC1
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

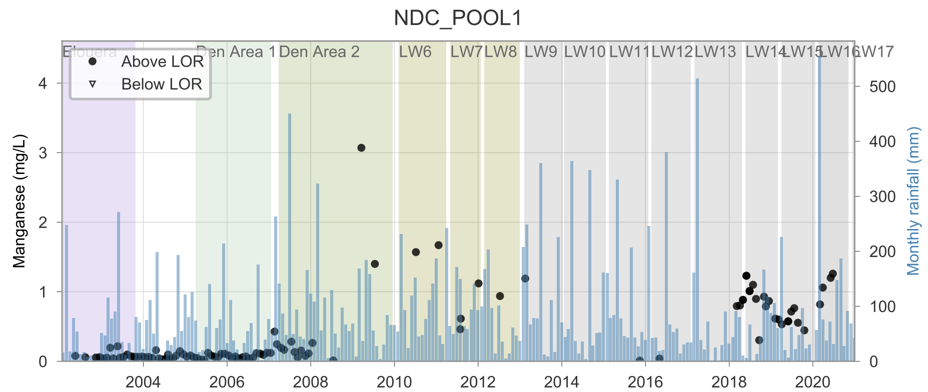

NDC1
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

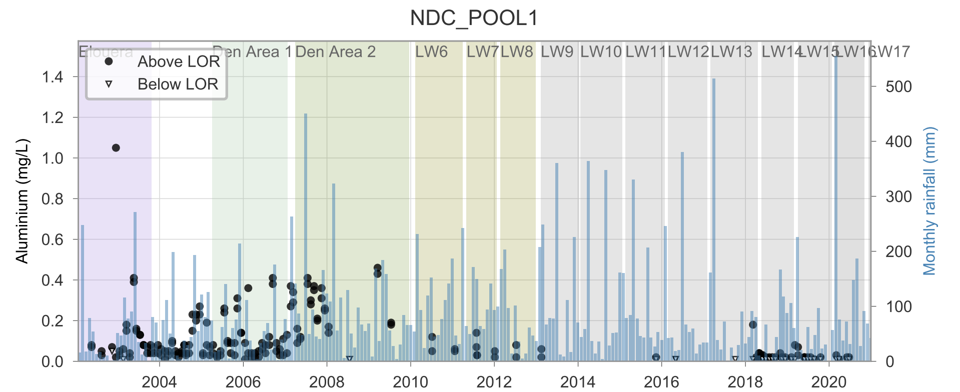

NDC1
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

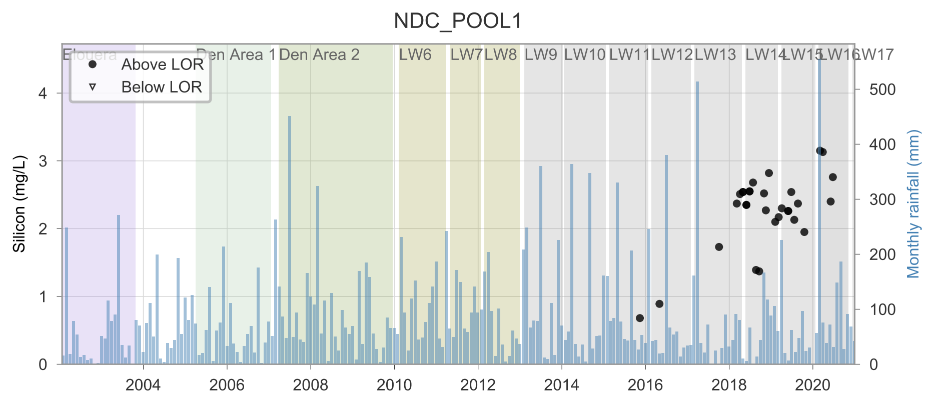

NDC1
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR

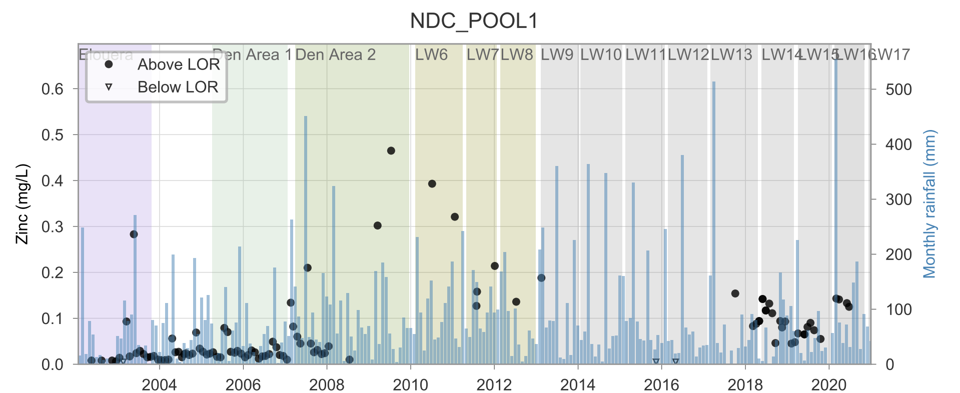

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)

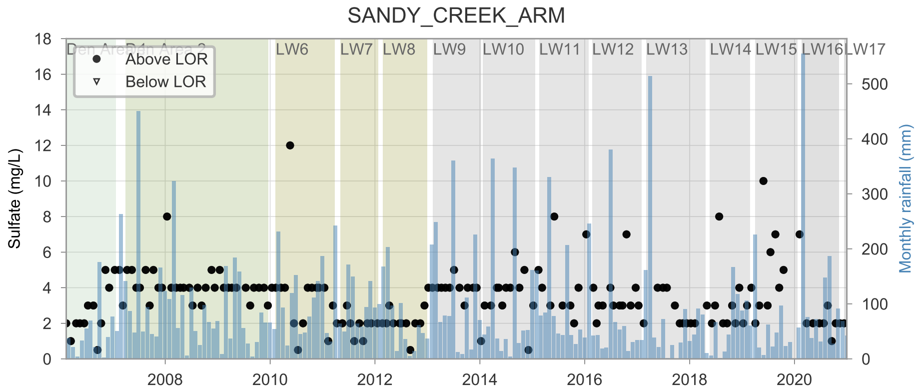

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)

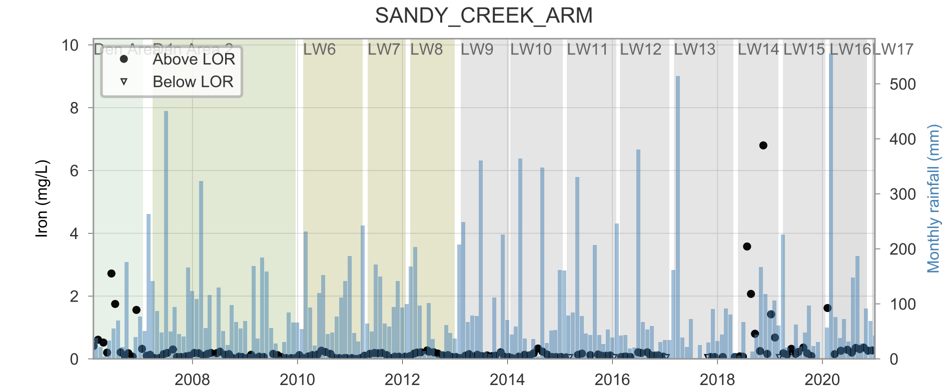

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)

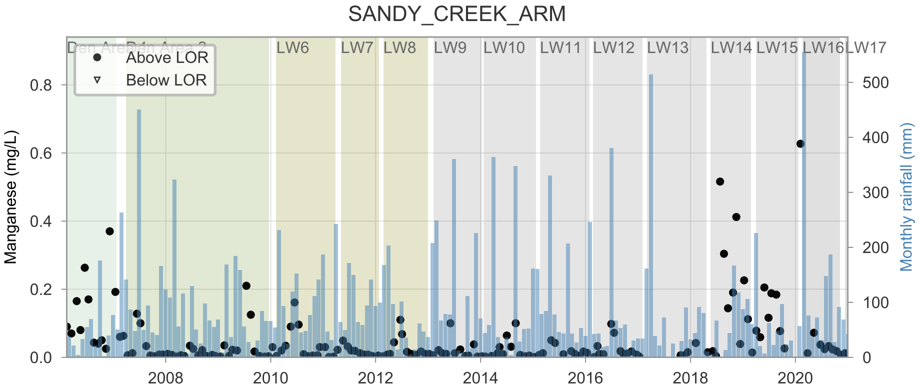

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)

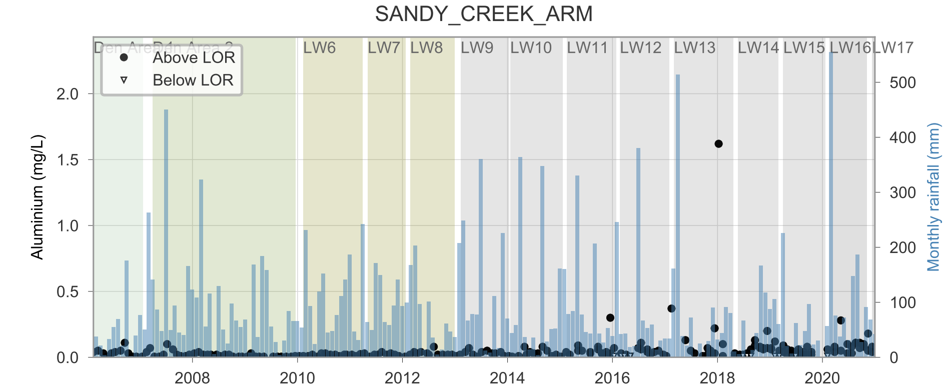

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Silicon (mg/L)
Monthly rainfall (mm)

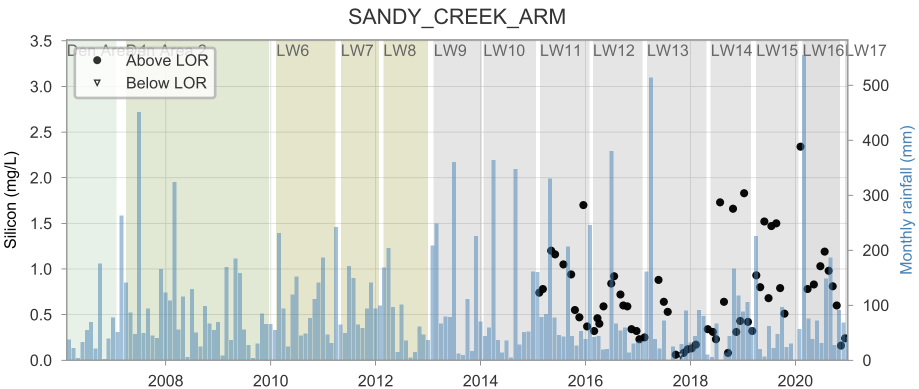

NDC_POOL1
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)

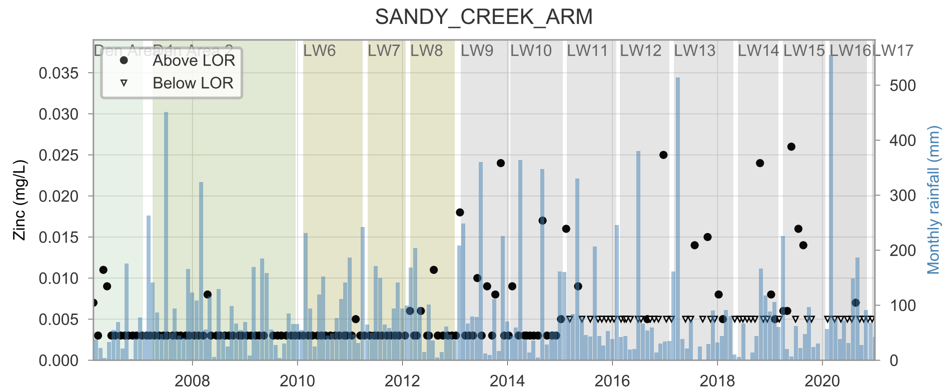

SANDY_CREEK_ARM
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

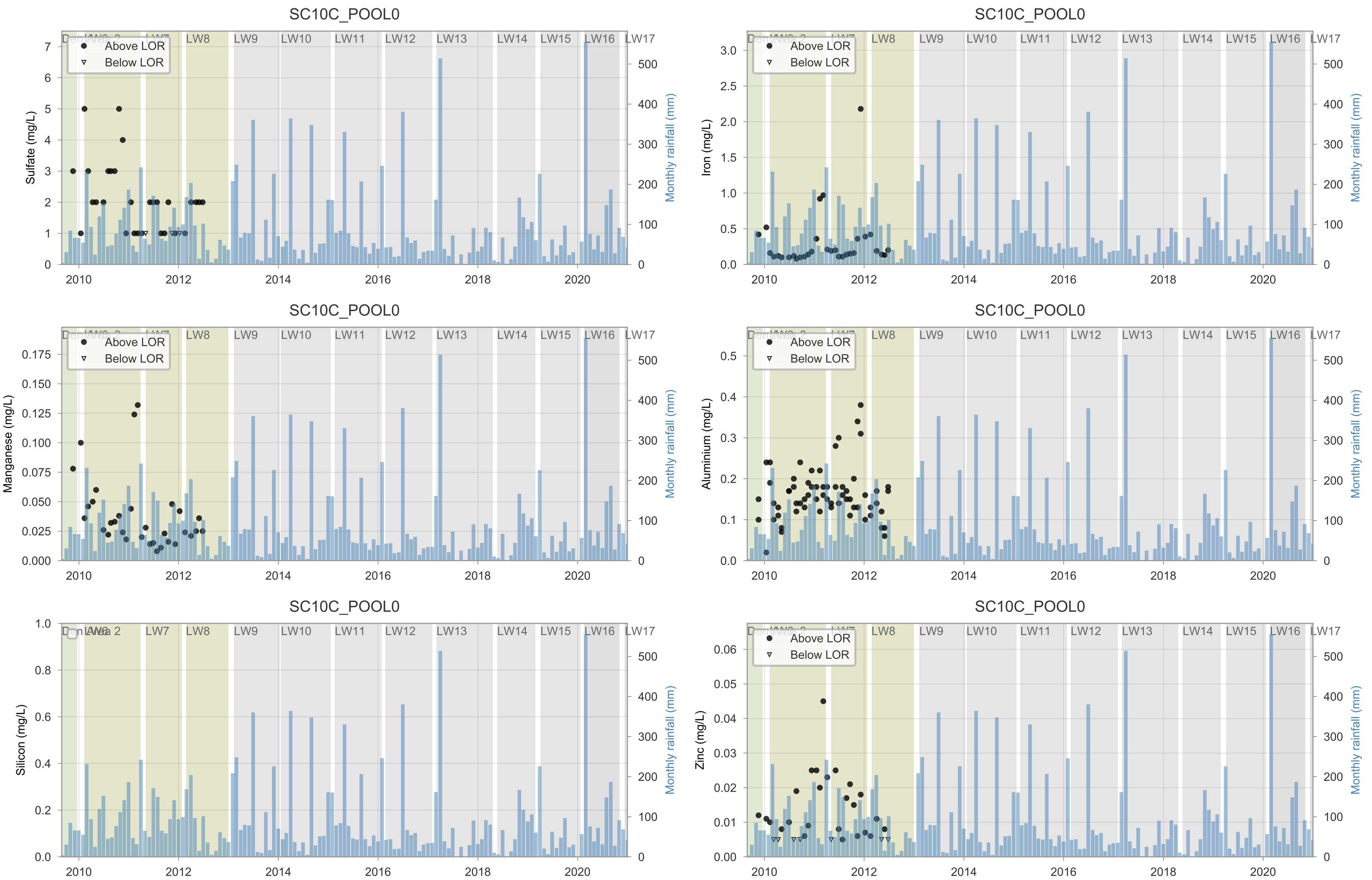

SANDY_CREEK_ARM
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

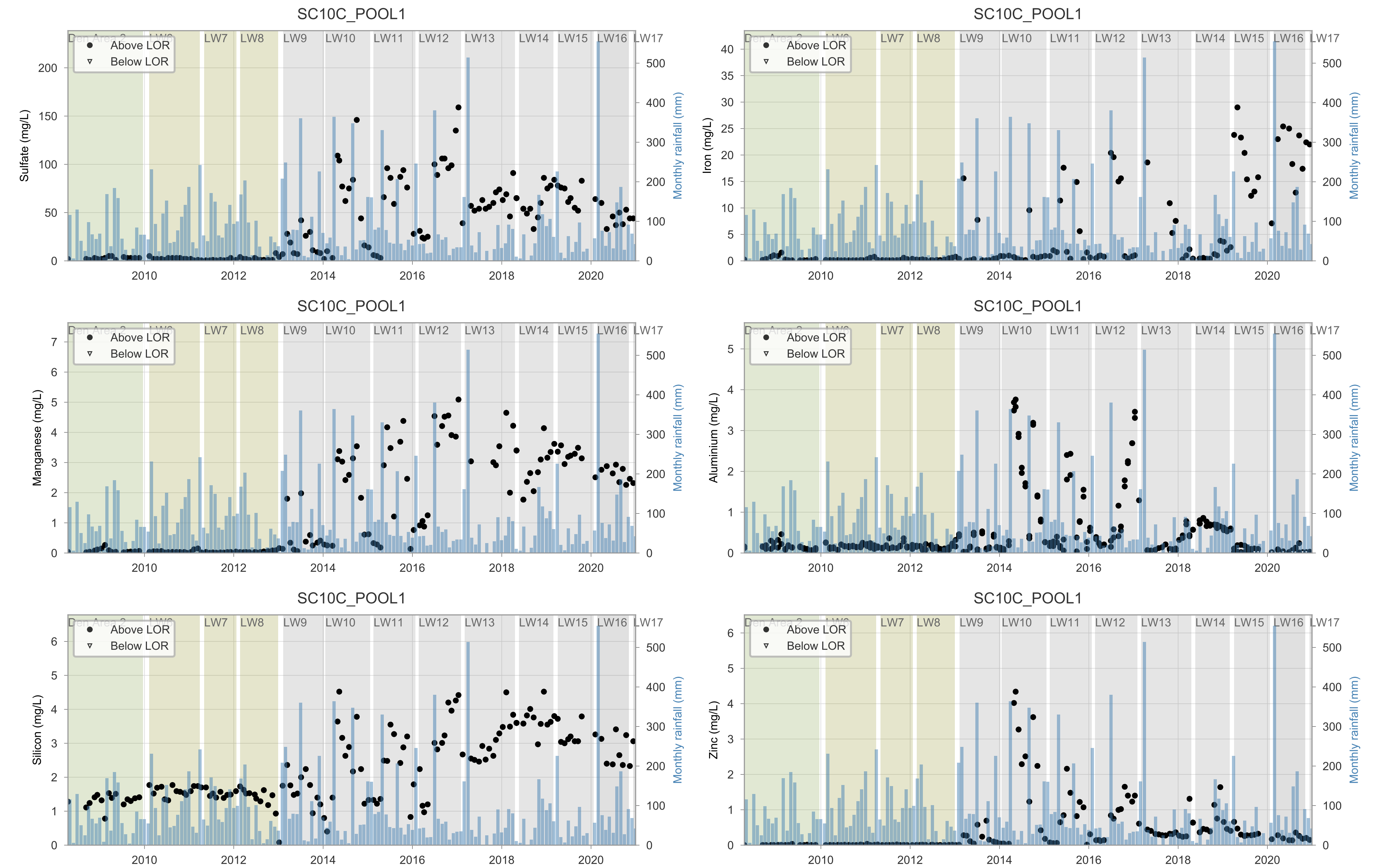

SANDY_CREEK_ARM
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

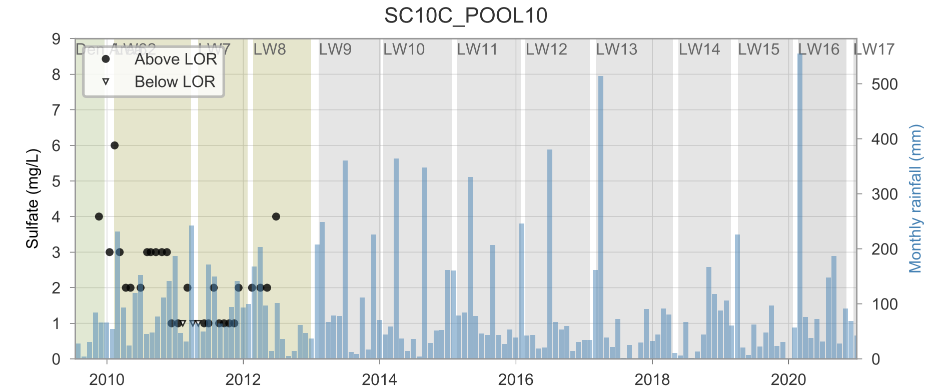

SANDY_CREEK_ARM
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

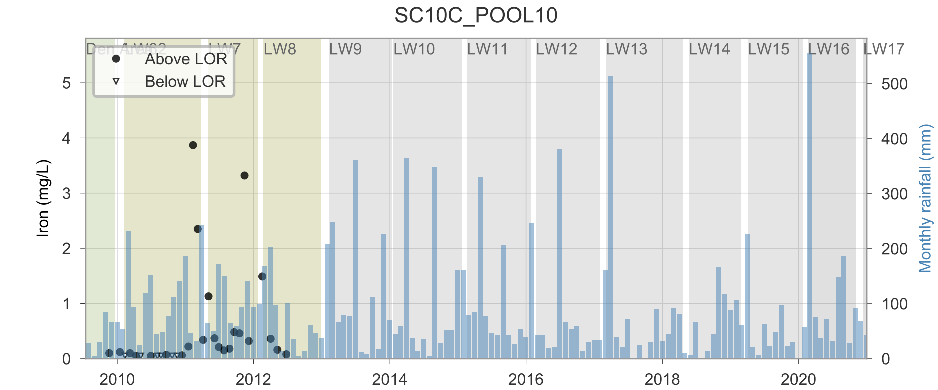

SANDY_CREEK_ARM
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

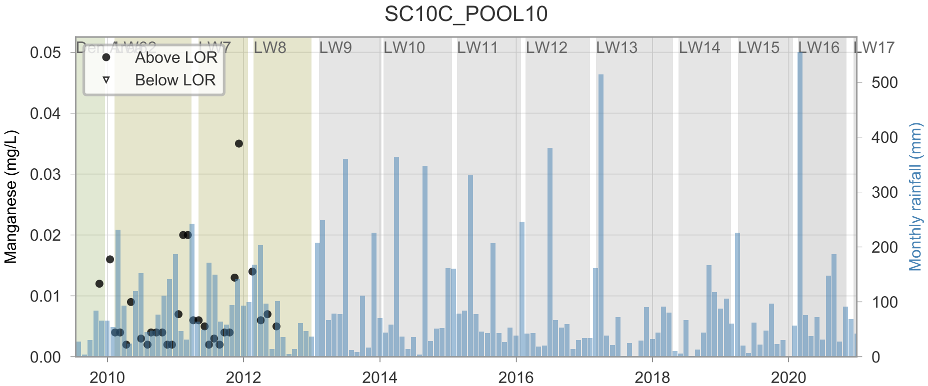

SANDY_CREEK_ARM
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2008
2010
2012
2014
2016
2018
2020

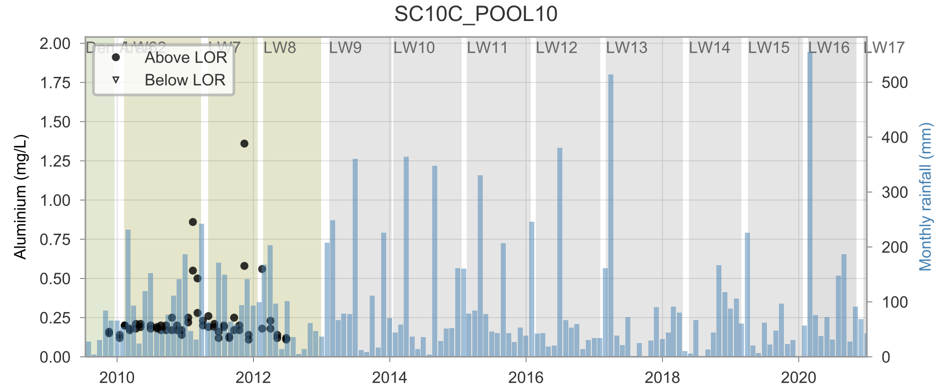

SC10C_POOL0
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

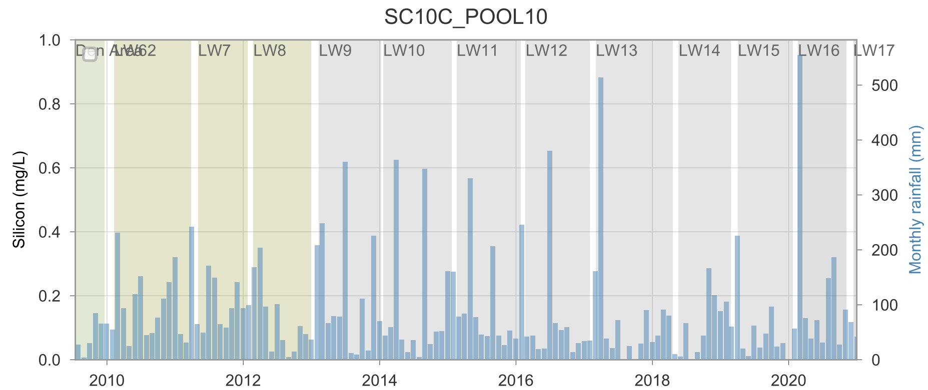

SC10C_POOL1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

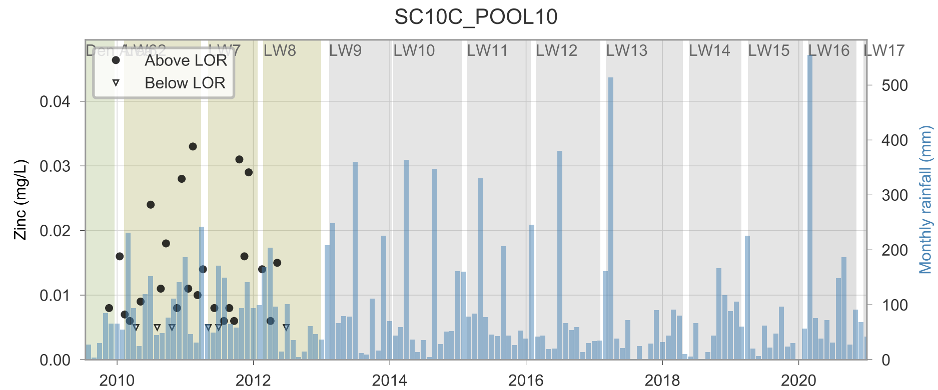

SC10C_POOL10
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

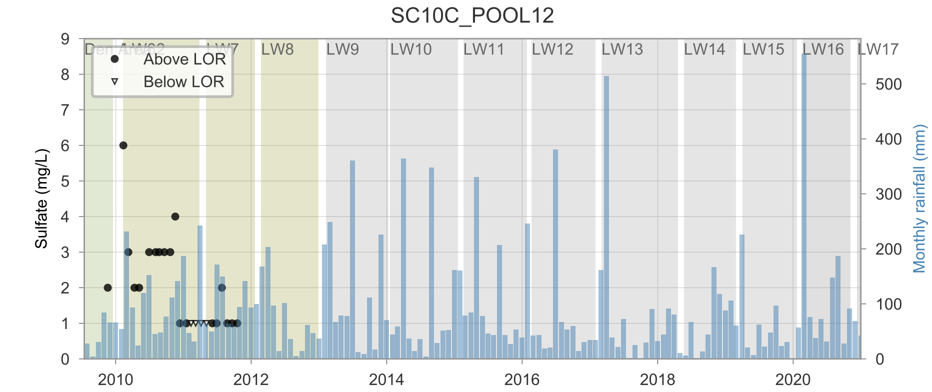

SC10C_POOL10
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

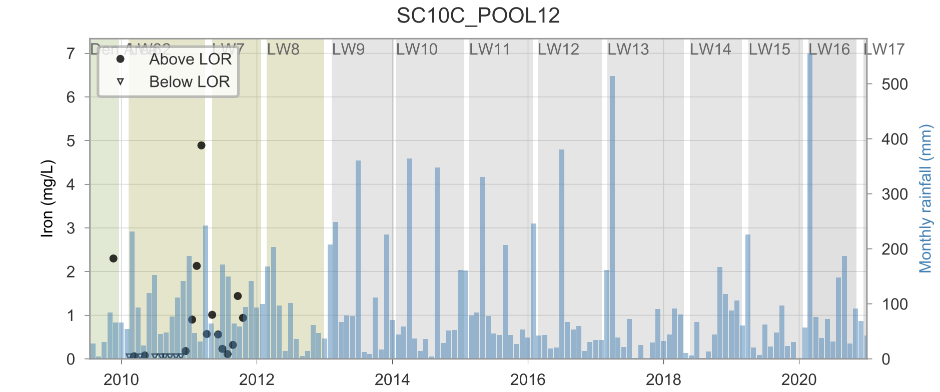

SC10C_POOL10
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

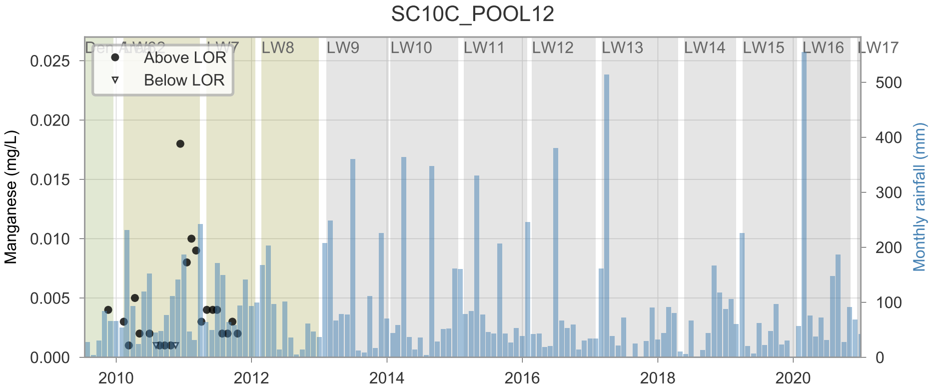

SC10C_POOL10
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

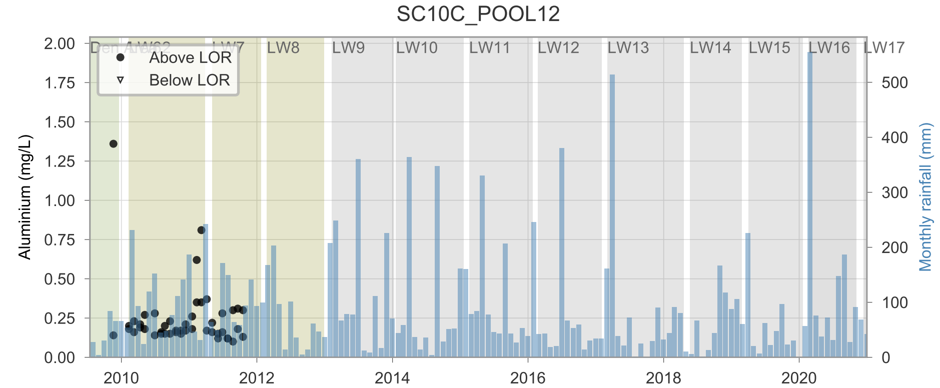

SC10C_POOL10
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

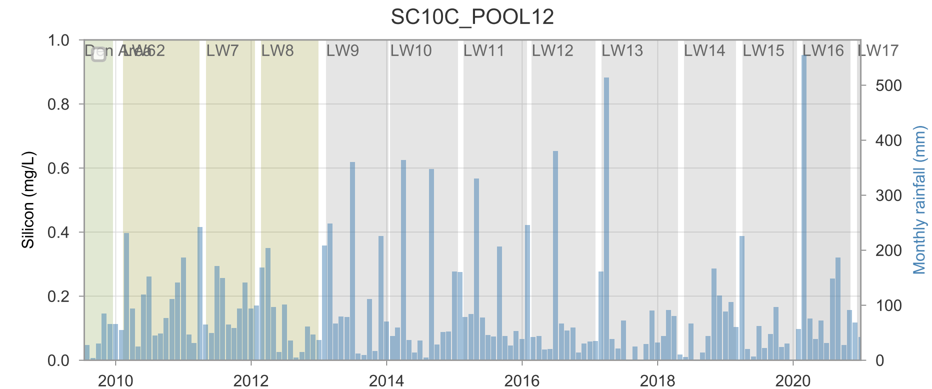

SC10C_POOL10
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

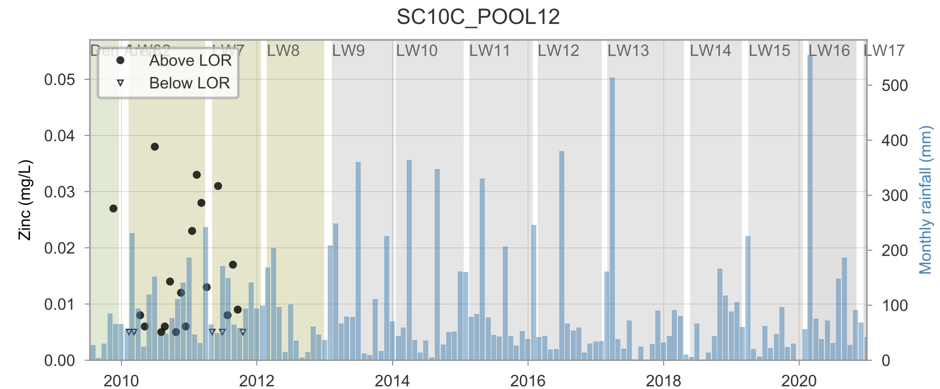

SC10C_POOL12
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

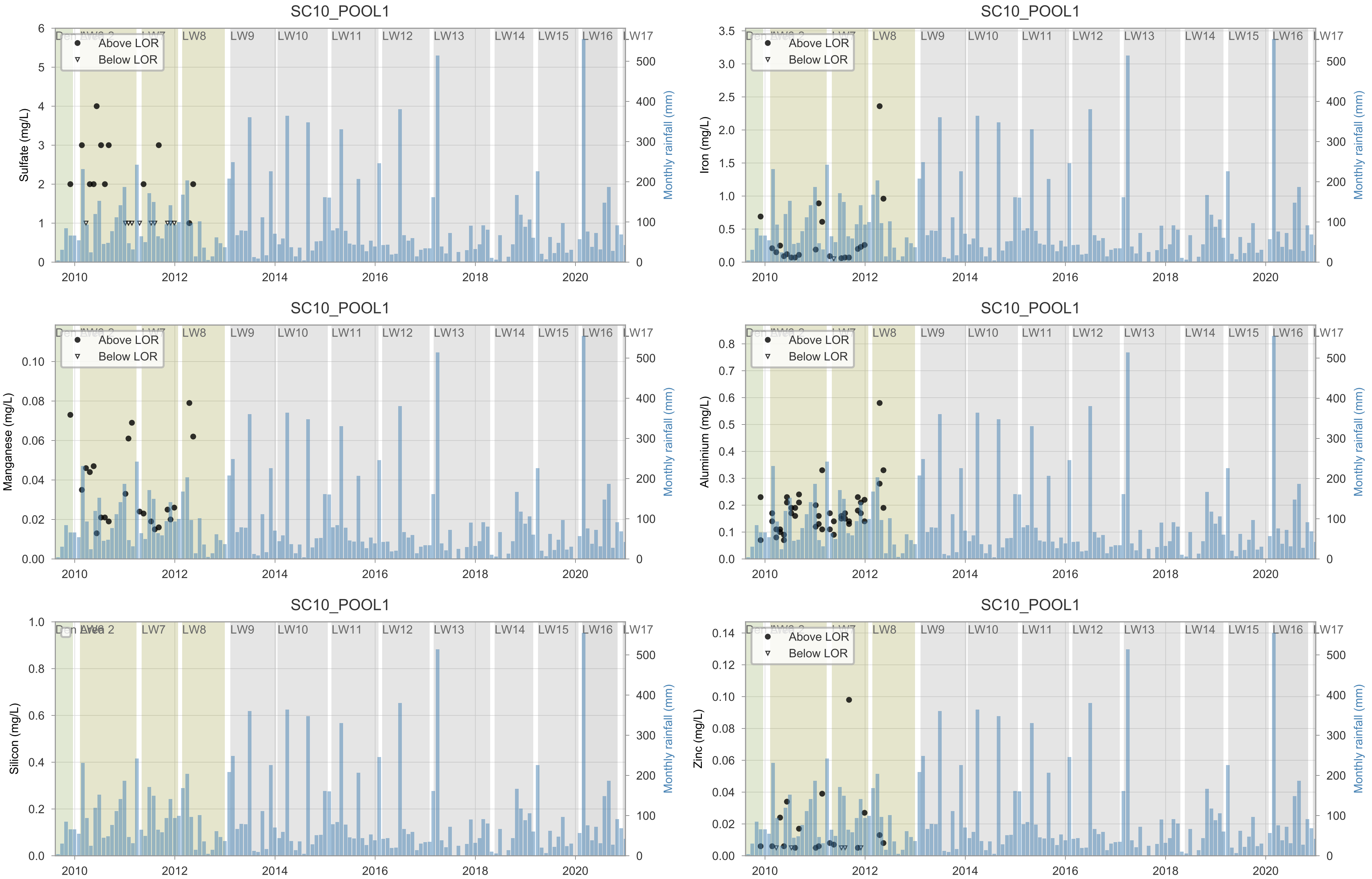

SC10C_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020


SC10C_POOL12
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

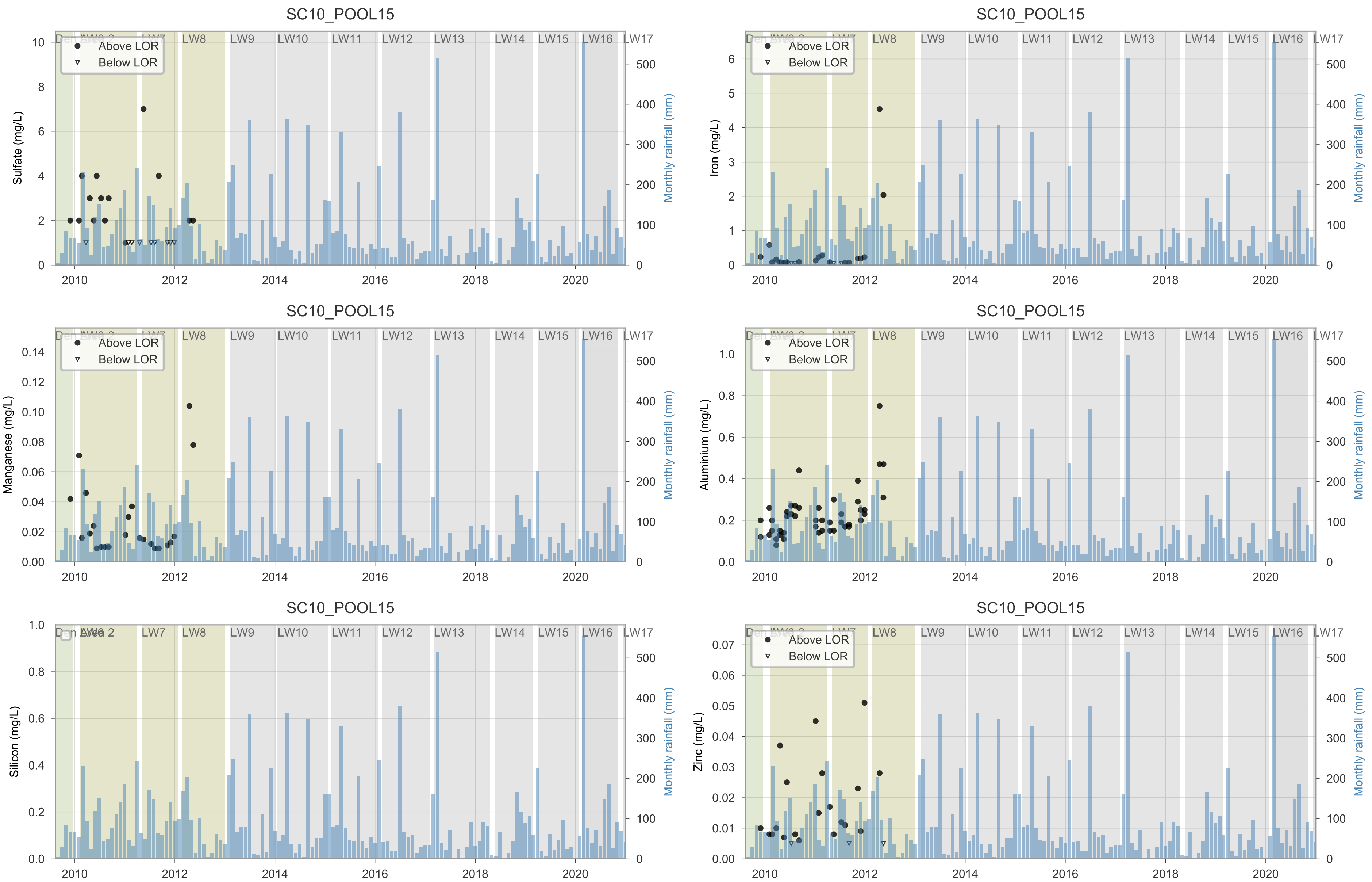

SC10C_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

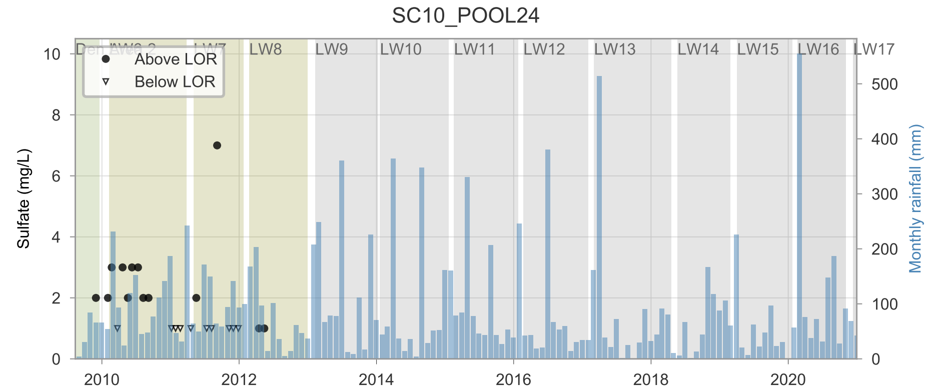

SC10C_POOL12
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

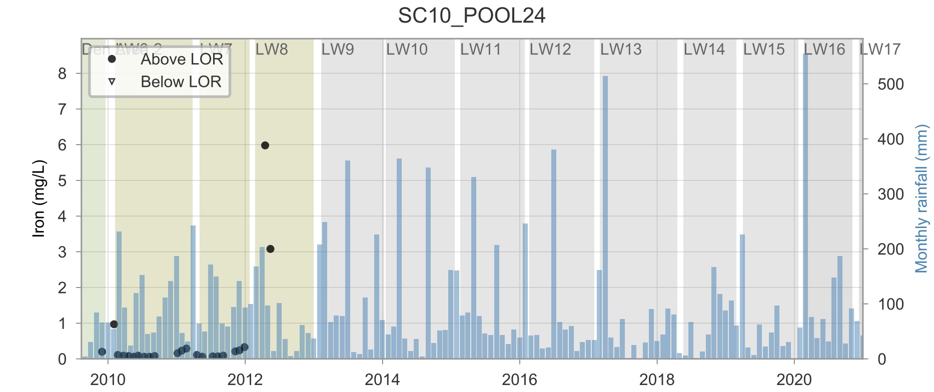

SC10C_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

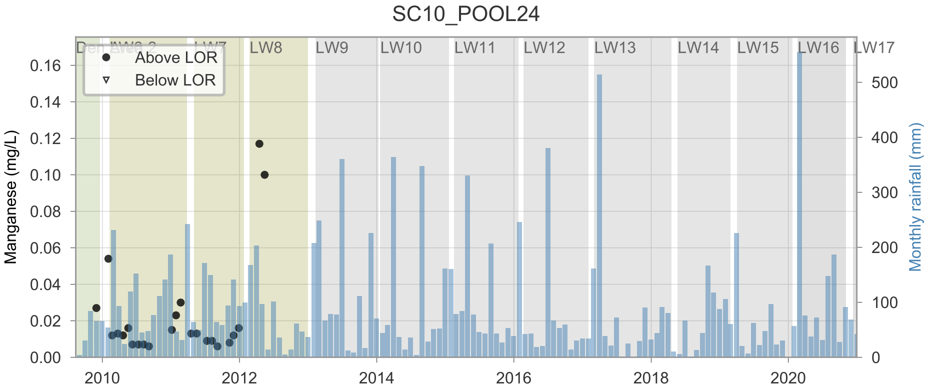


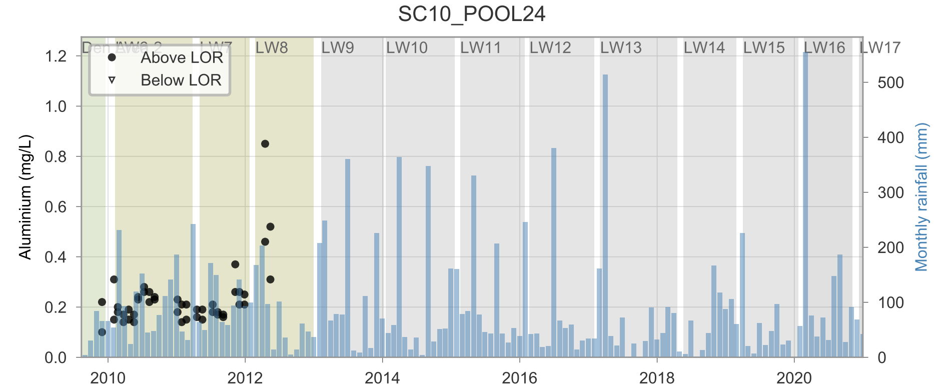
SC10_POOL1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020
SC10_POOL1
Iron (mg/L)
SC10_POOL1
Manganese (mg/L)
SC10_POOL1
Aluminium (mg/L)
SC10_POOL1
Silicon (mg/L)
LW6 2
SC10_POOL1
Zinc (mg/L)

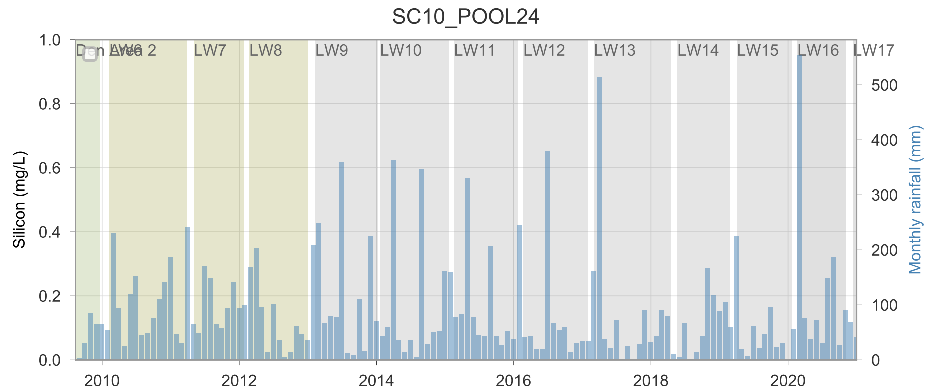

SC10_POOL15
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

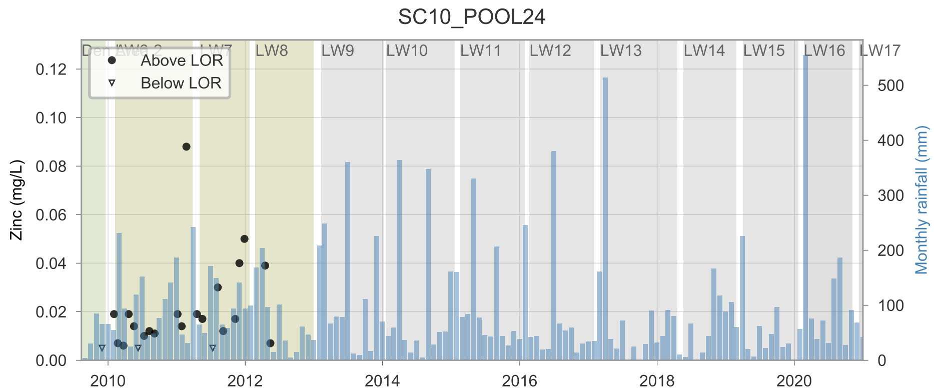

SC10_POOL24
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0 2 4 6 8 10
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020

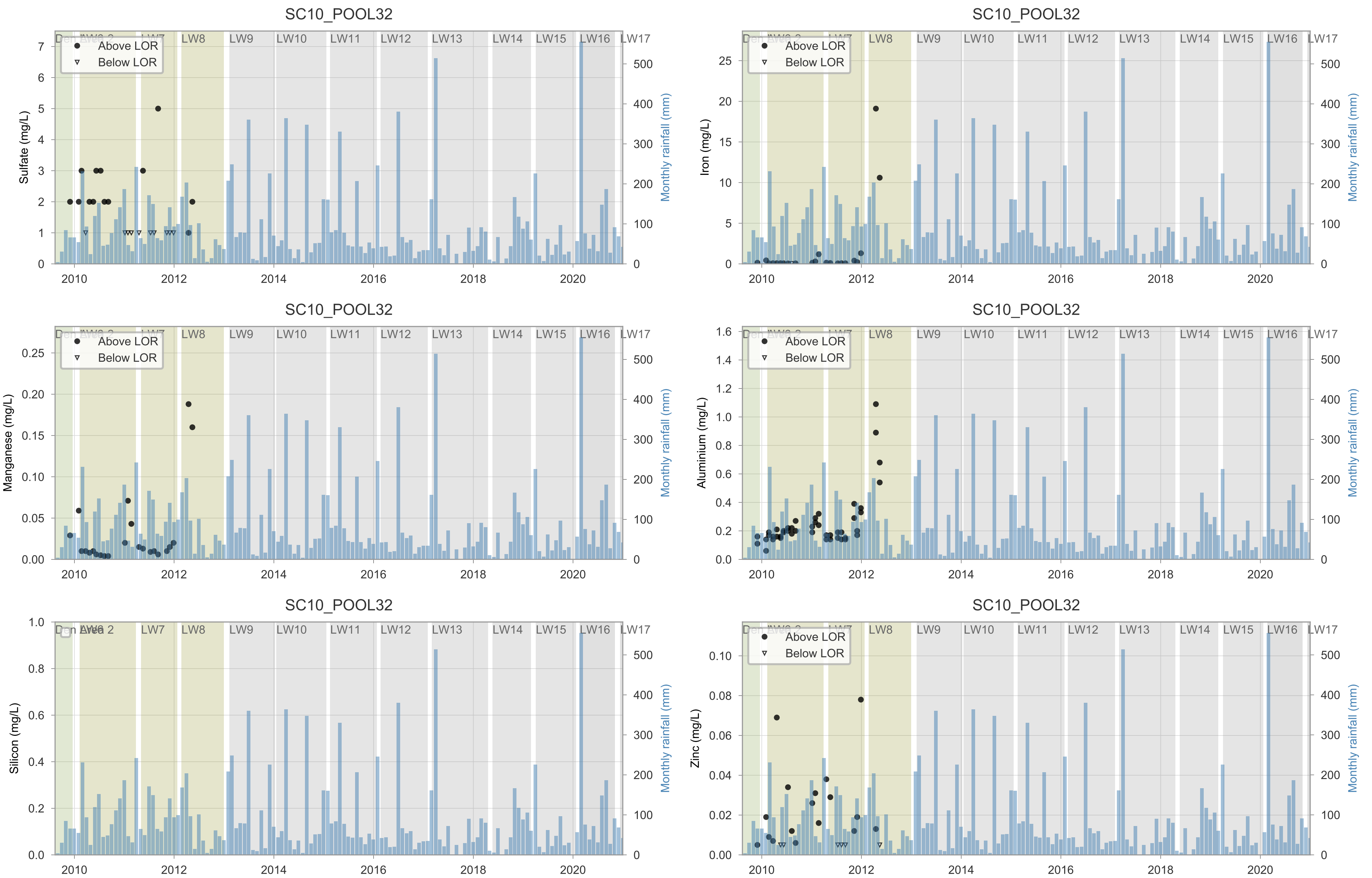

SC10_POOL24
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0 1 2 3 4 5 6 7 8
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020


SC10_POOL24
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020

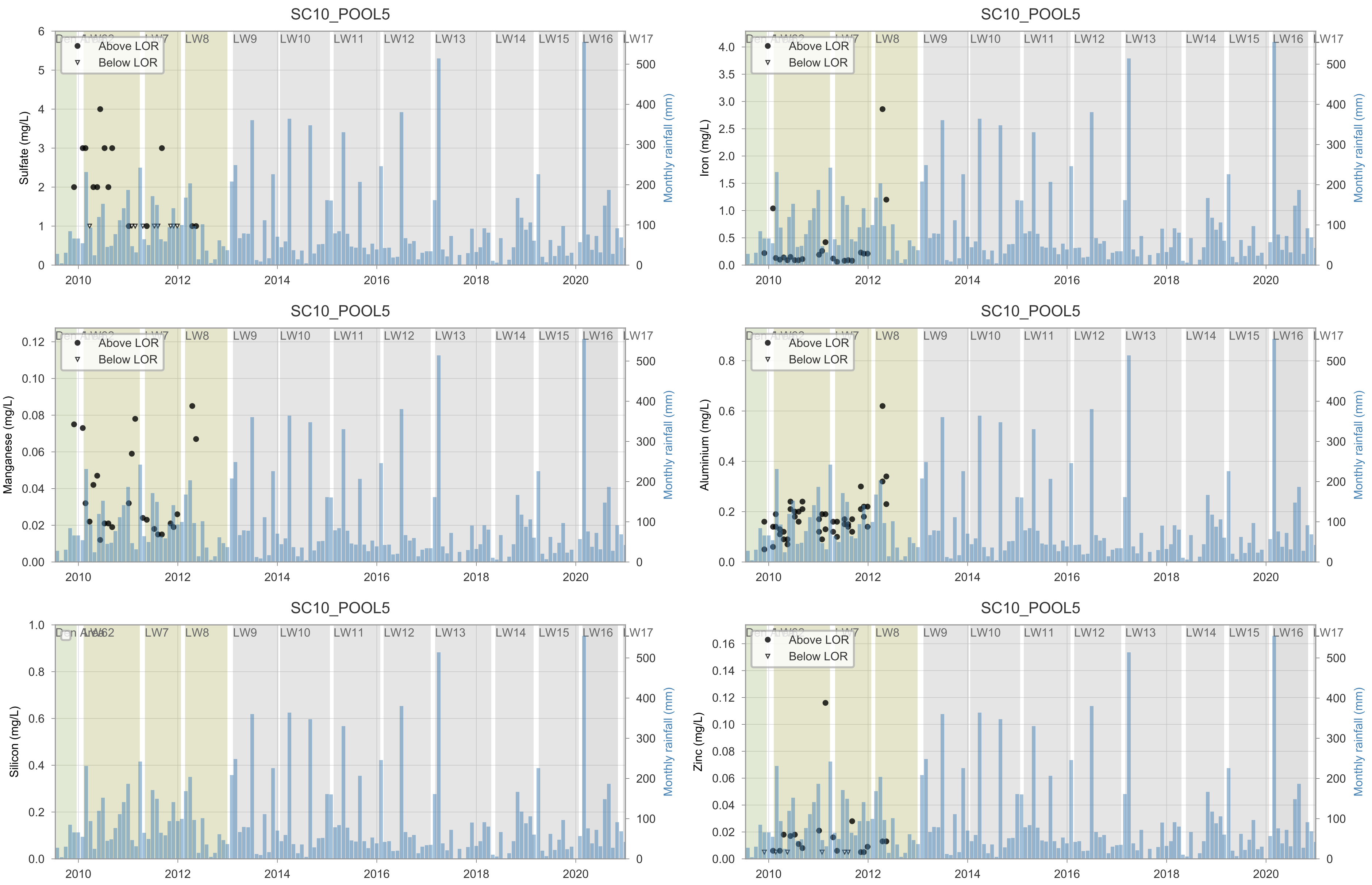

SC10_POOL24
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0.0 0.2 0.4 0.6 0.8 1.0 1.2
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020


SC10_POOL24
Silicon (mg/L)
Monthly rainfall (mm)
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0.0 0.2 0.4 0.6 0.8 1.0
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020

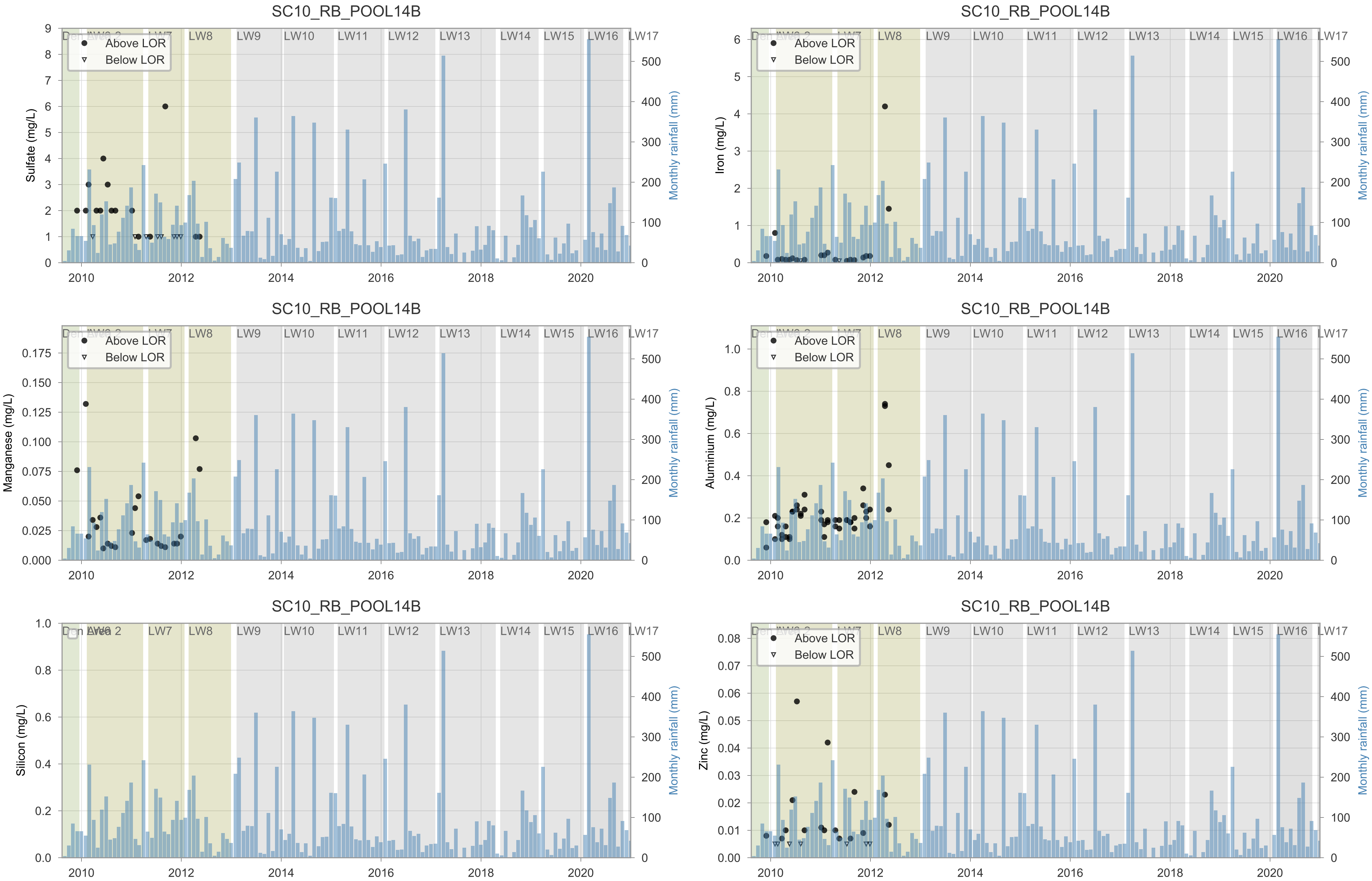

SC10_POOL24
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
0.00 0.02 0.04 0.06 0.08 0.10 0.12
0 100 200 300 400 500
2010 2012 2014 2016 2018 2020

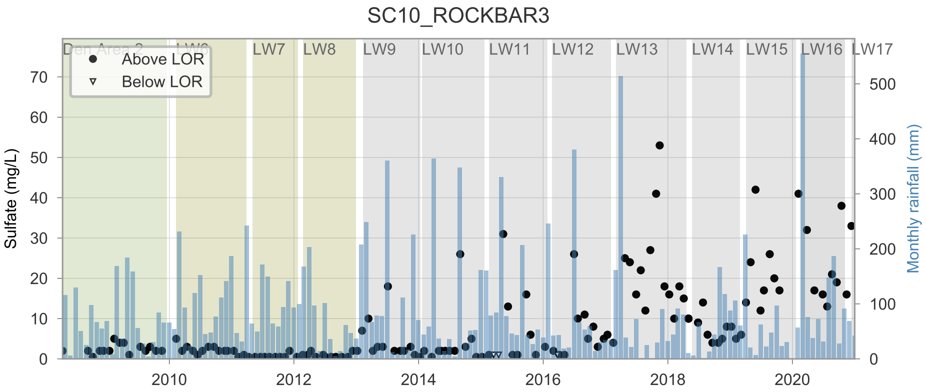


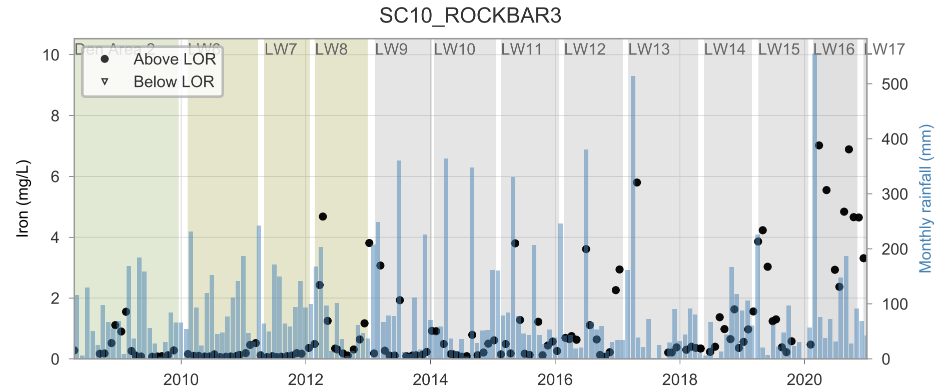
SC10_POOL32
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

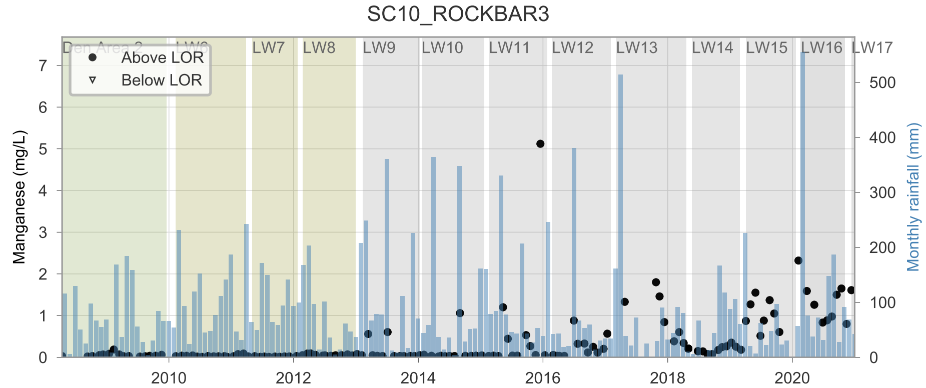


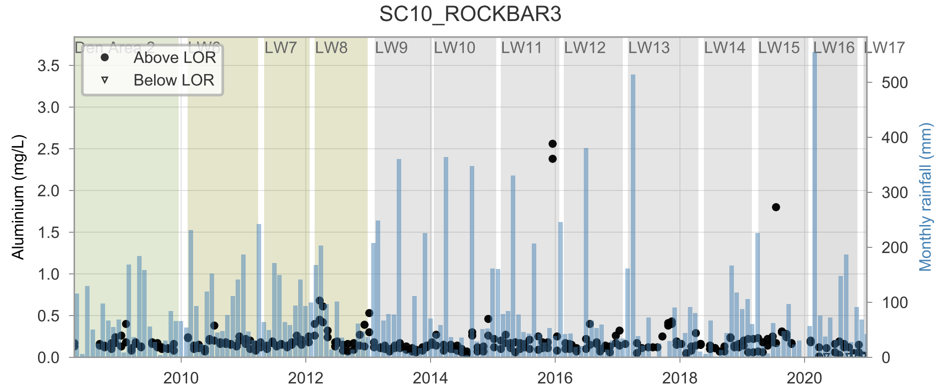
SC10_POOL5
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
SC10_POOL5
Iron (mg/L)
Monthly rainfall (mm)
SC10_POOL5
Manganese (mg/L)
Monthly rainfall (mm)
SC10_POOL5
Aluminium (mg/L)
Monthly rainfall (mm)
SC10_POOL5
Silicon (mg/L)
Monthly rainfall (mm)
SC10_POOL5
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

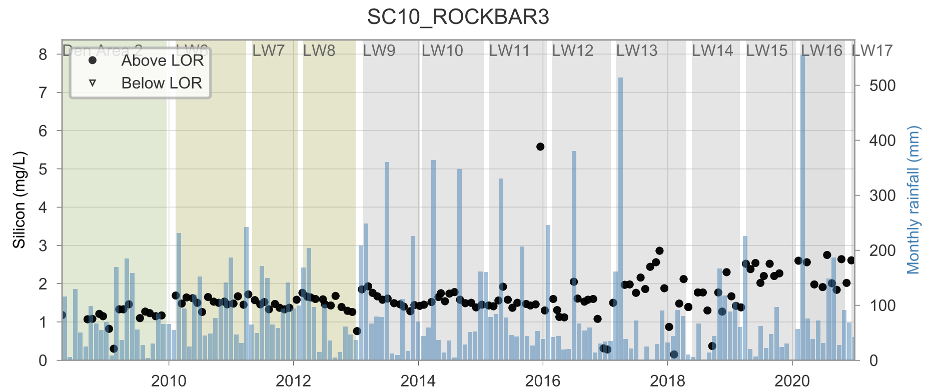

SC10_RB_POOL14B
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
LW7
Sulfate (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)

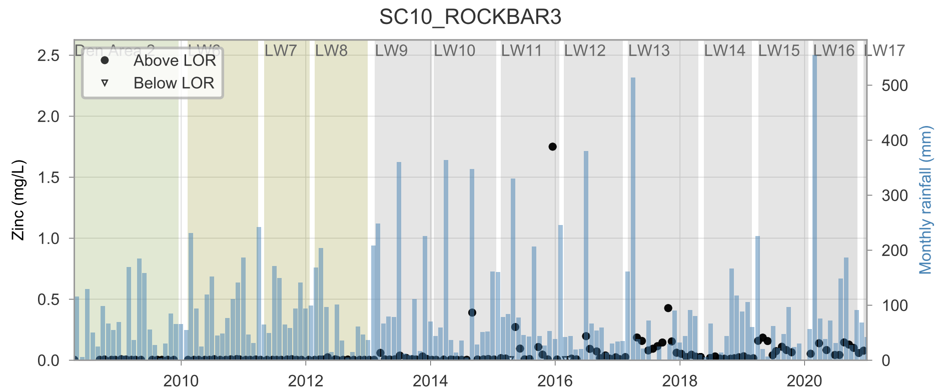

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

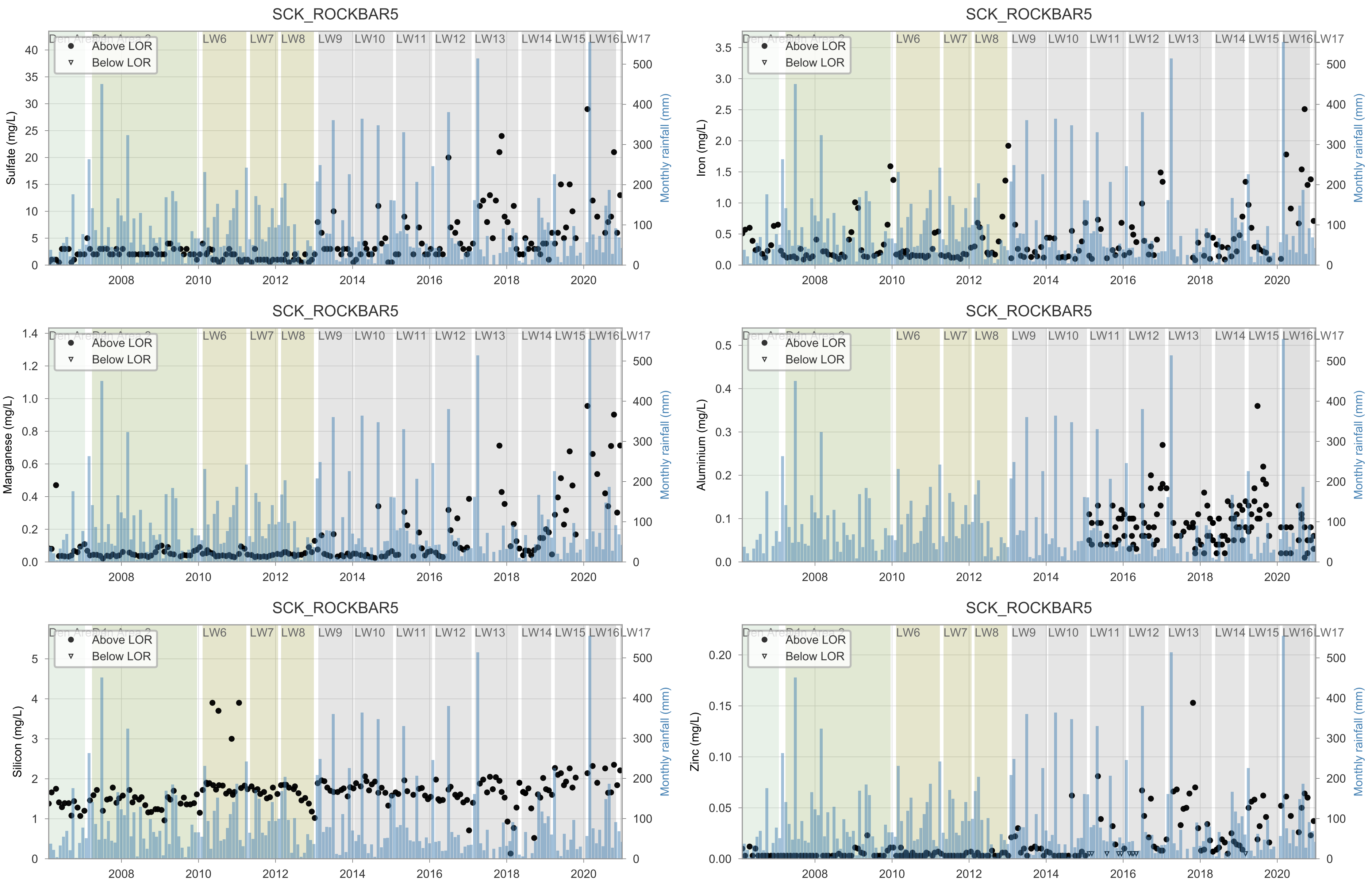

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Iron (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

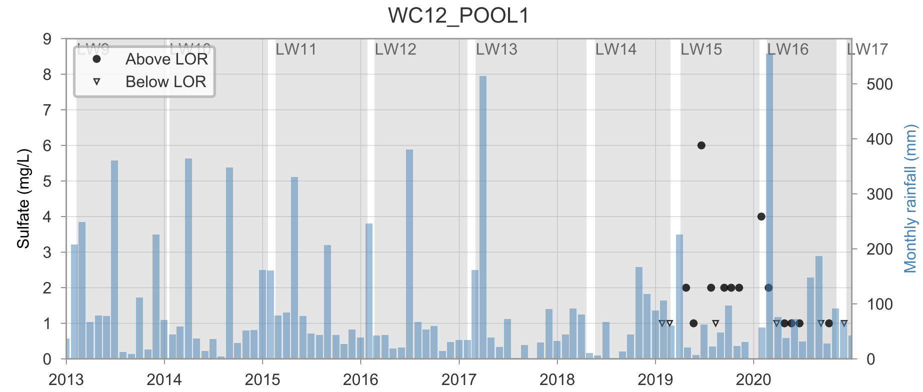

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Manganese (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

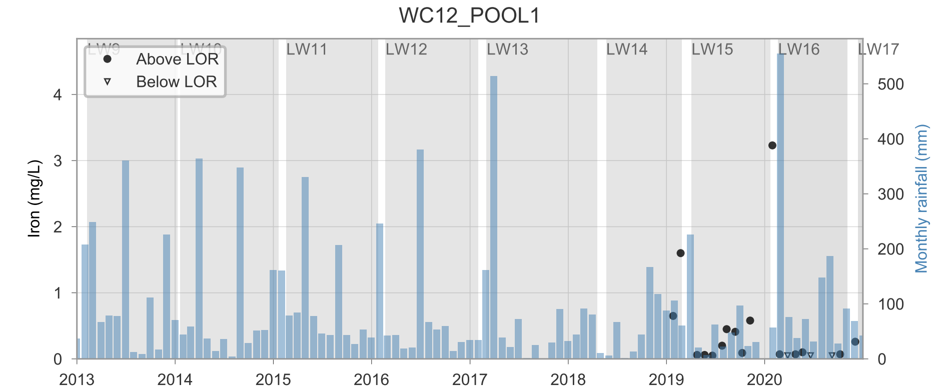

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

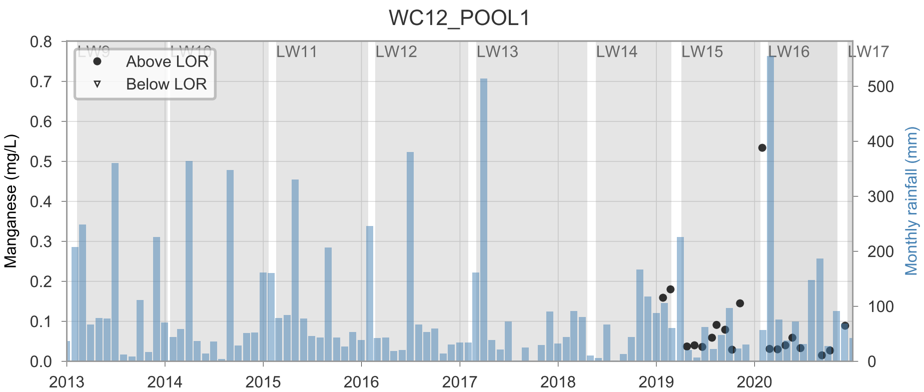

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Silicon (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

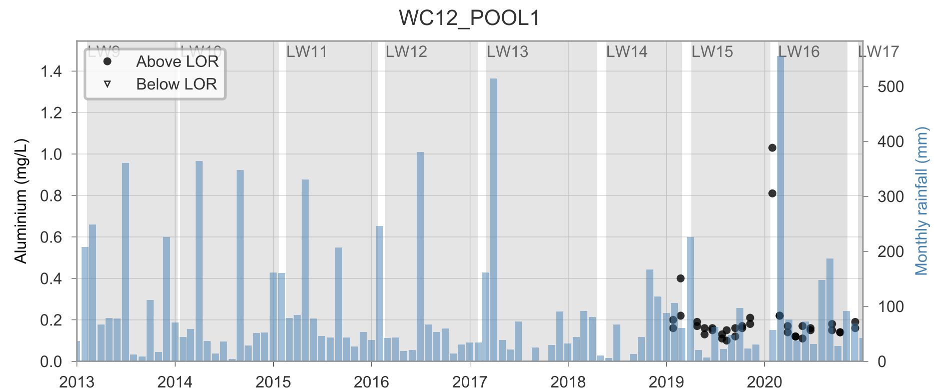

SC10_ROCKBAR3
Above LOR
Below LOR
LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17
Zinc (mg/L)
Monthly rainfall (mm)
2010 2012 2014 2016 2018 2020

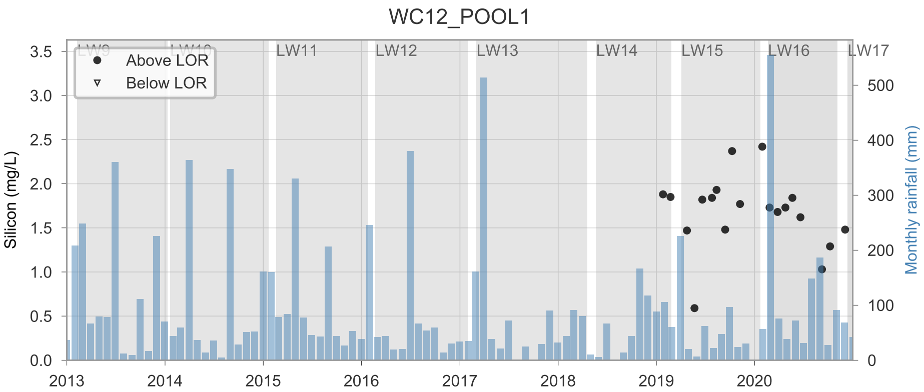

SCK_ROCKBAR5
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2008
2010
2012
2014
2016
2018
2020

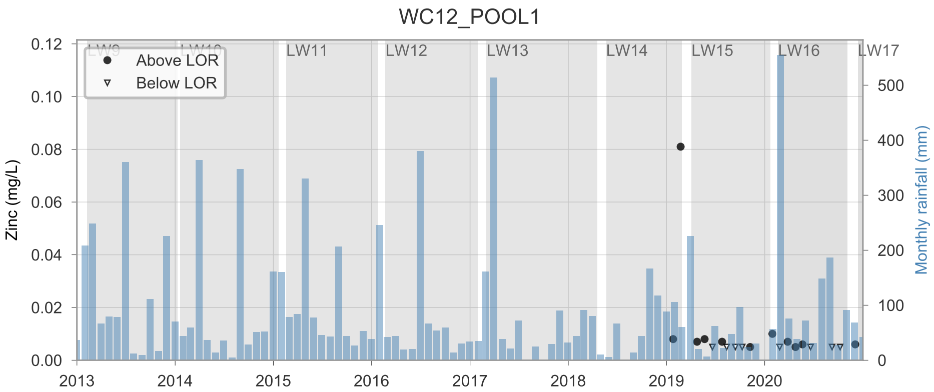

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

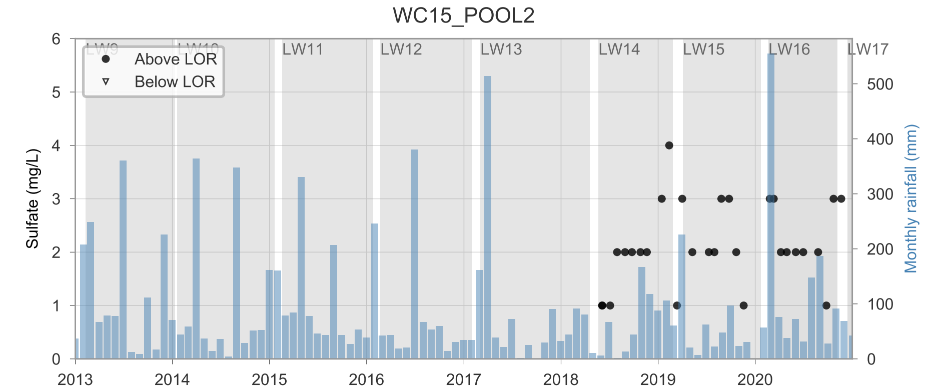

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

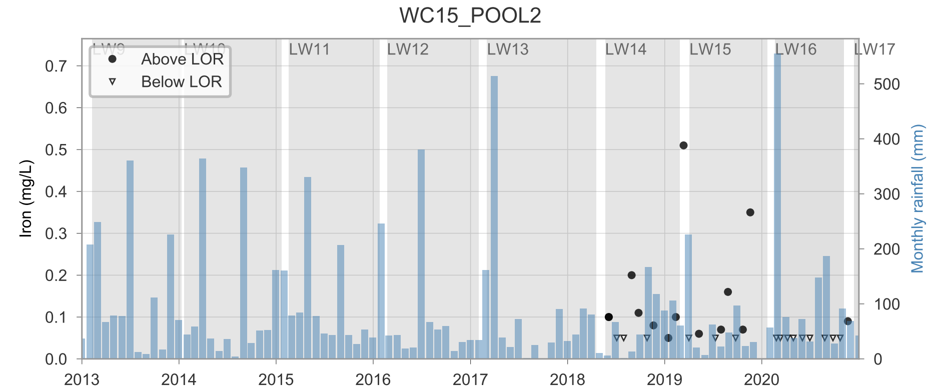

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

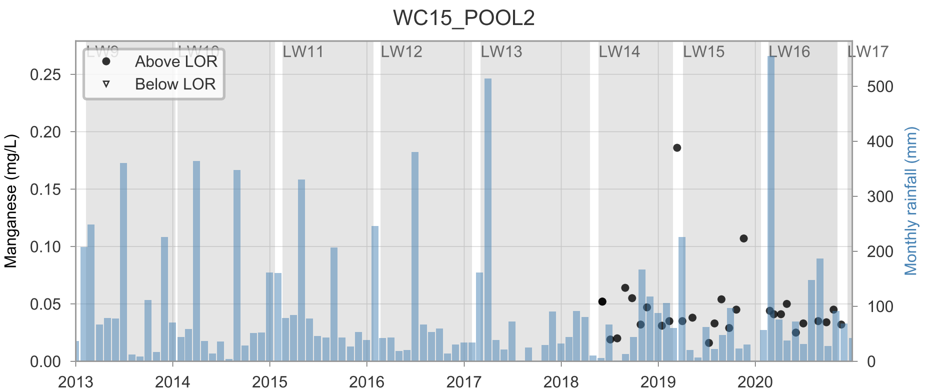

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

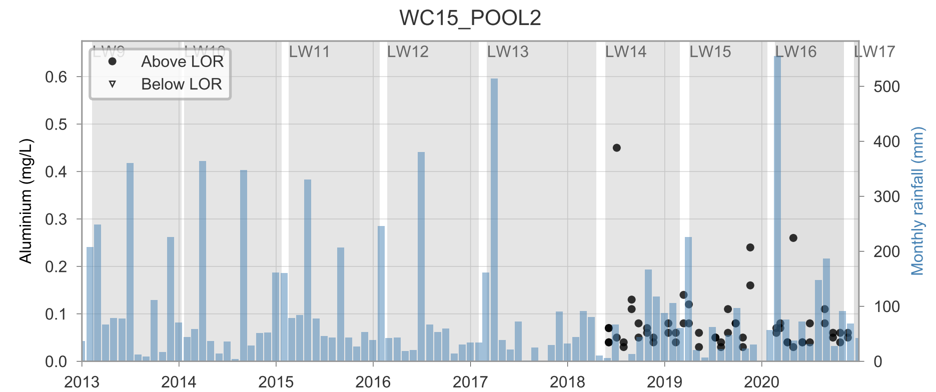

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

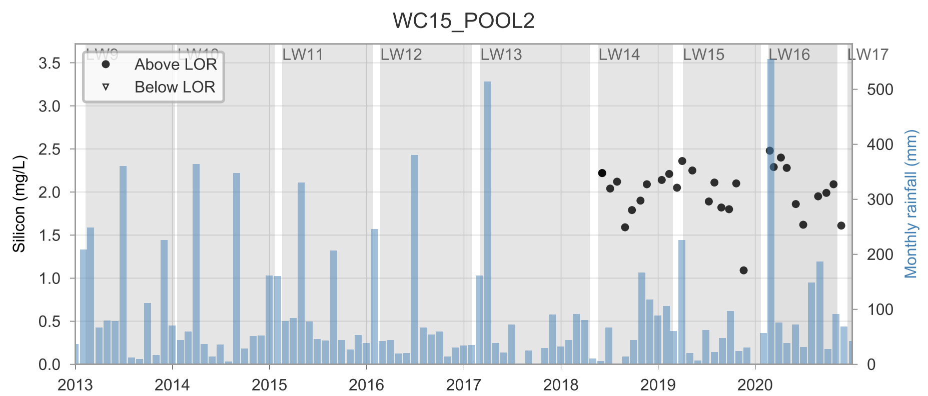

WC12_POOL1
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Above LOR
Below LOR
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

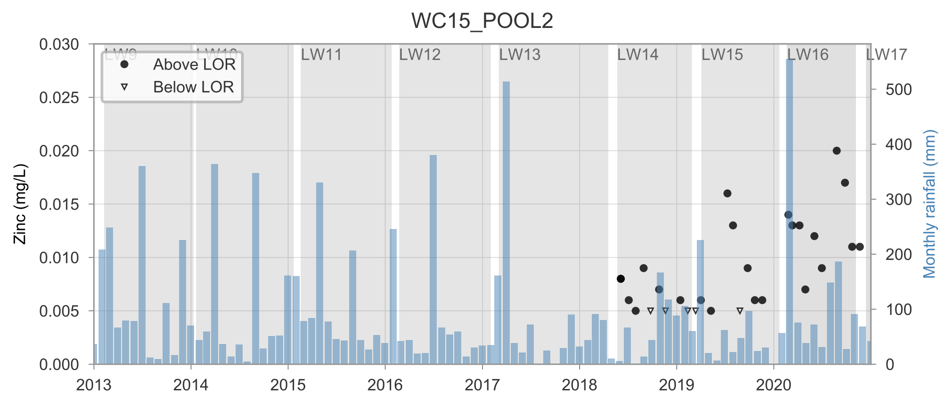

WC15_POOL2
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

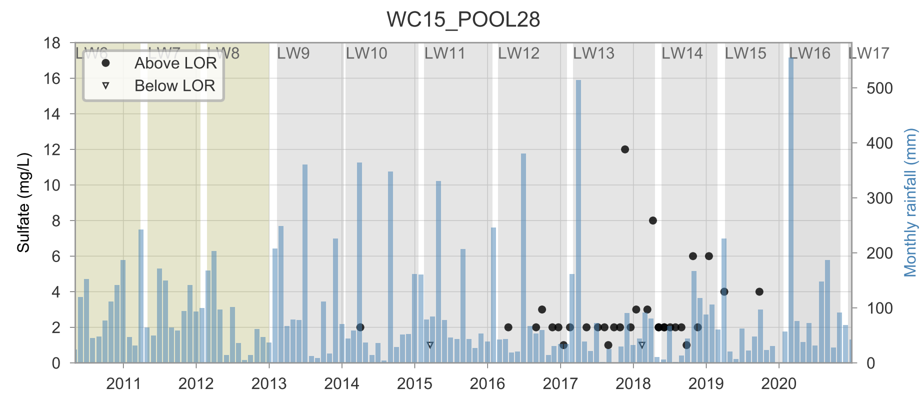

WC15_POOL2
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

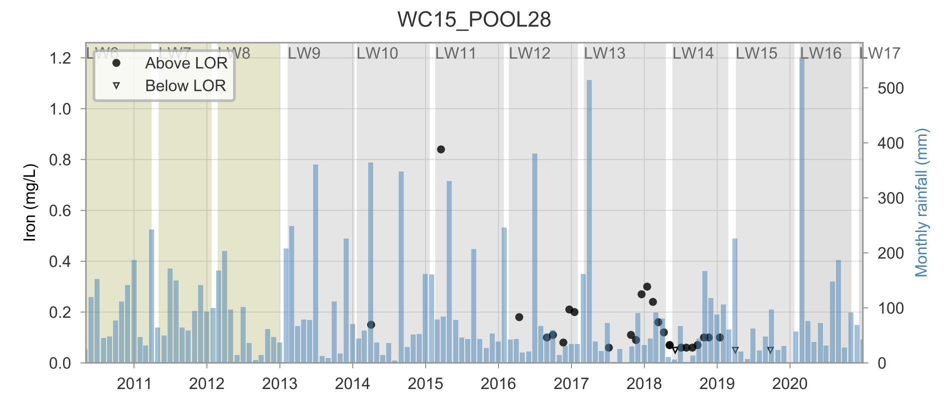

WC15_POOL2
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

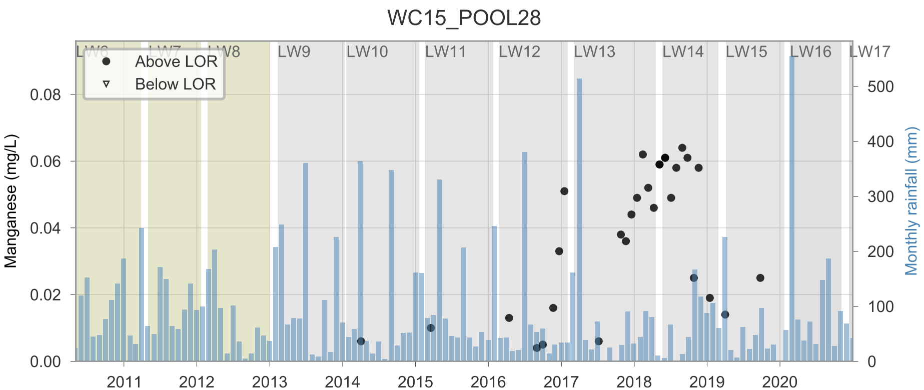

WC15_POOL2
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

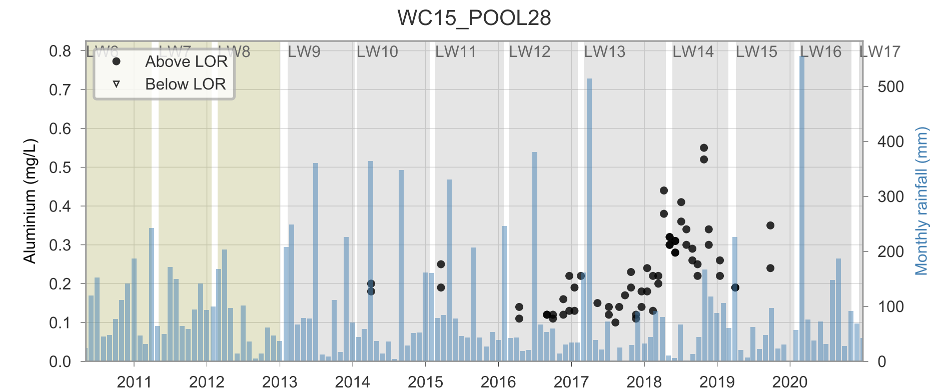

WC15_POOL2
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

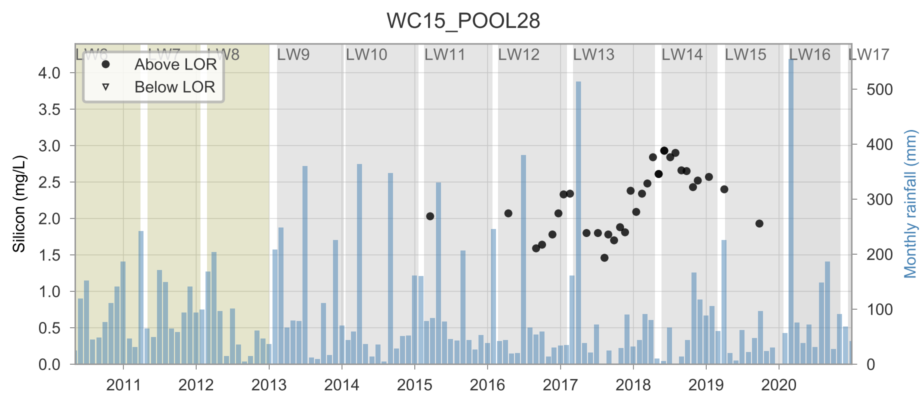

WC15_POOL2
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17

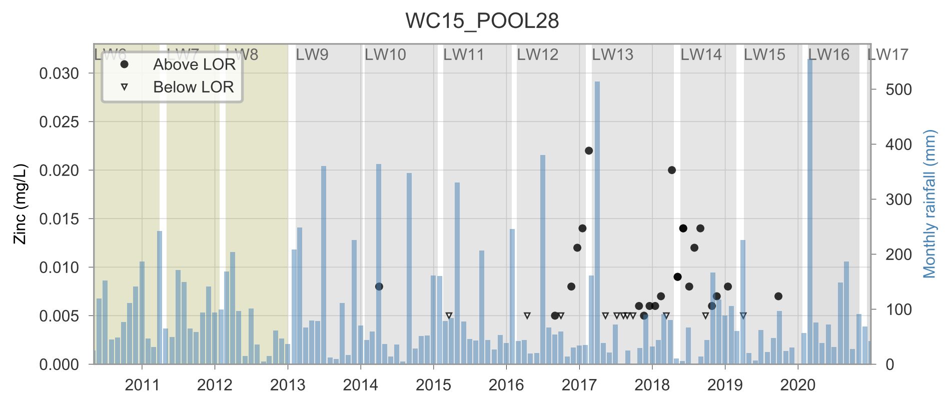

WC15_POOL28
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

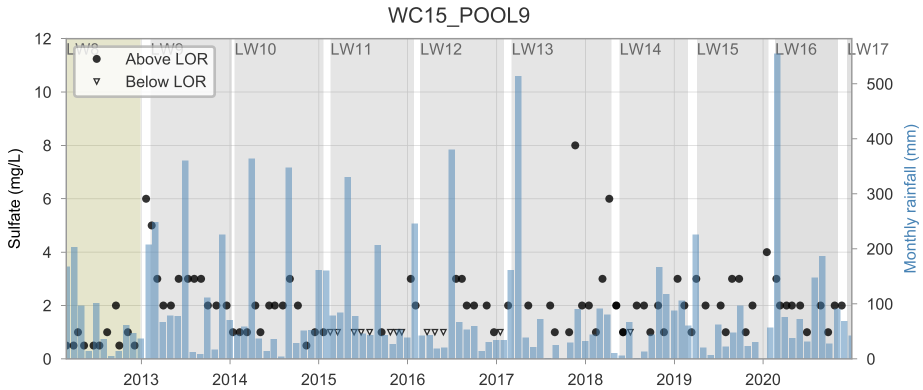

WC15_POOL28
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

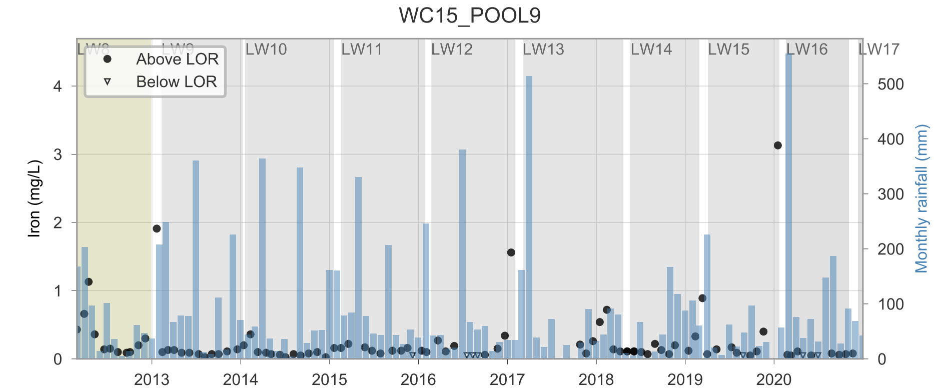

WC15_POOL28
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

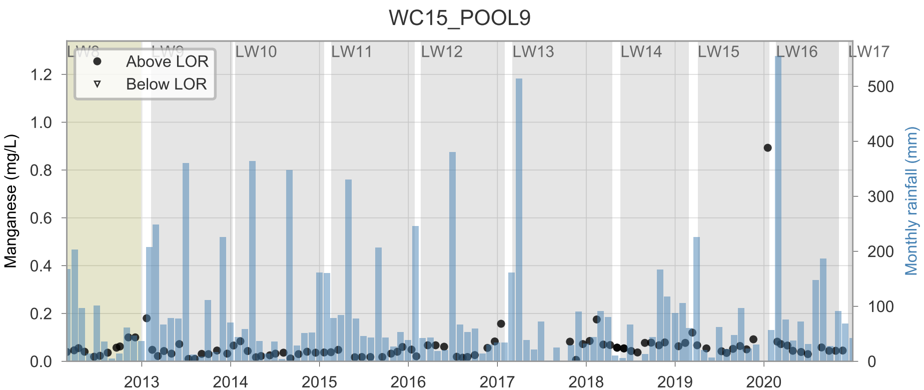

WC15_POOL28
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

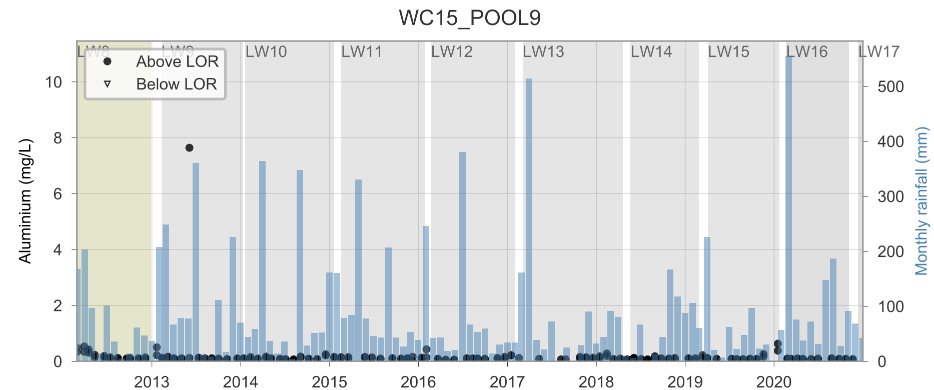

WC15_POOL28
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

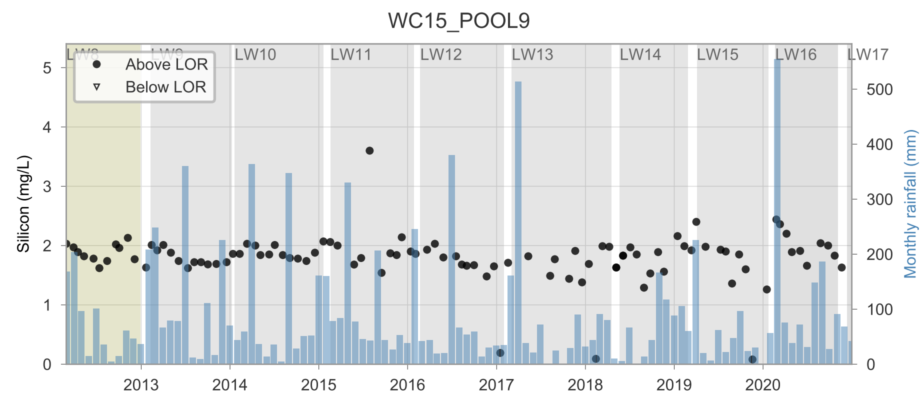

WC15_POOL28
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

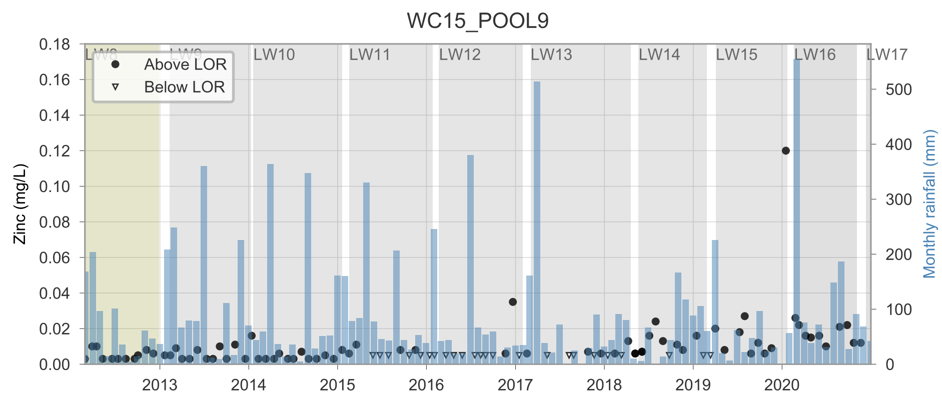

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

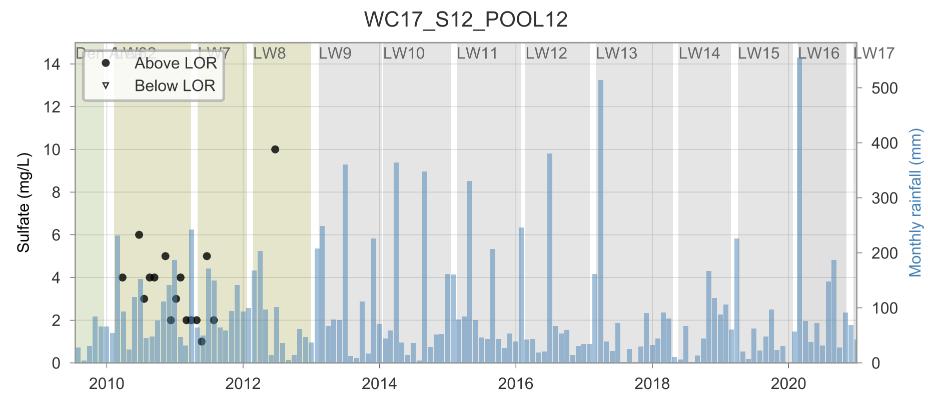

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

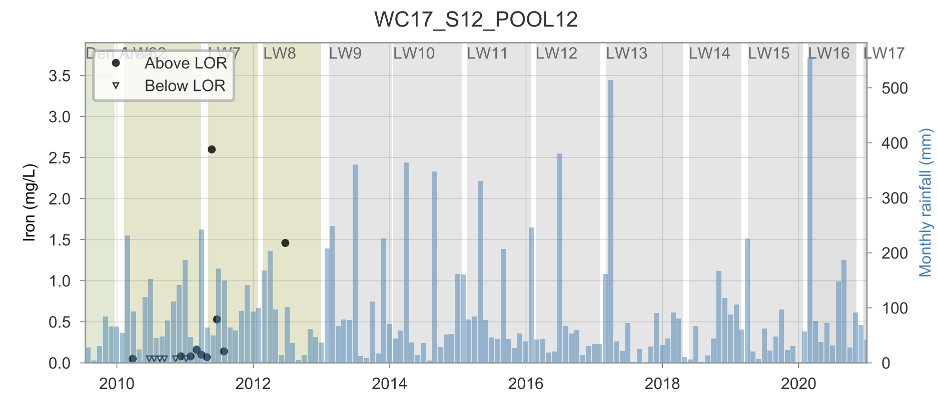

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

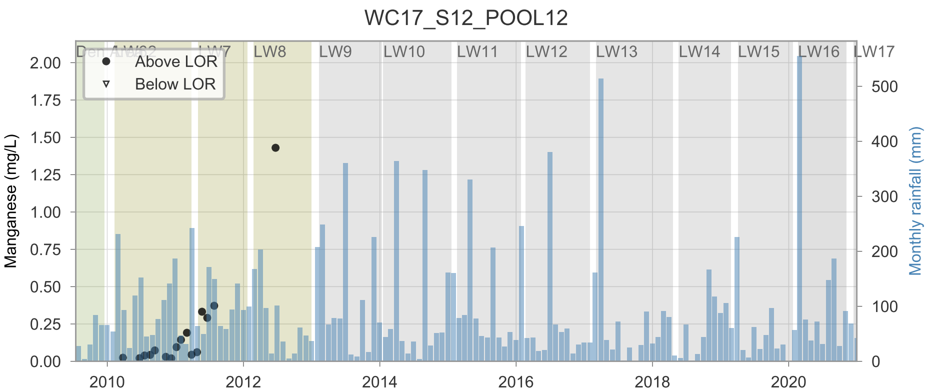

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

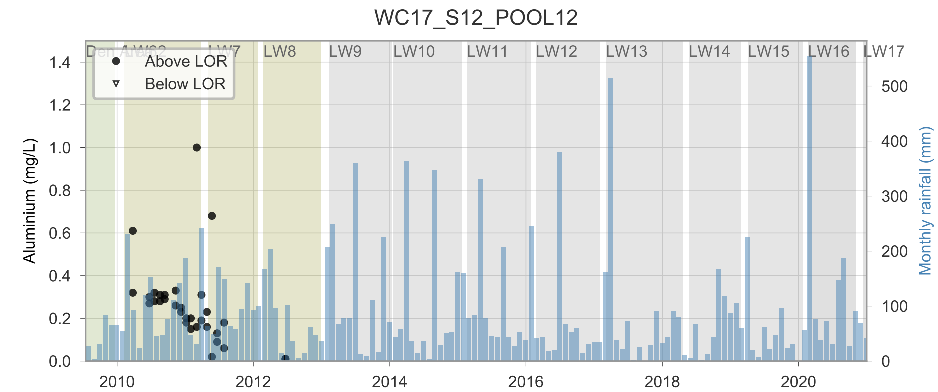

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

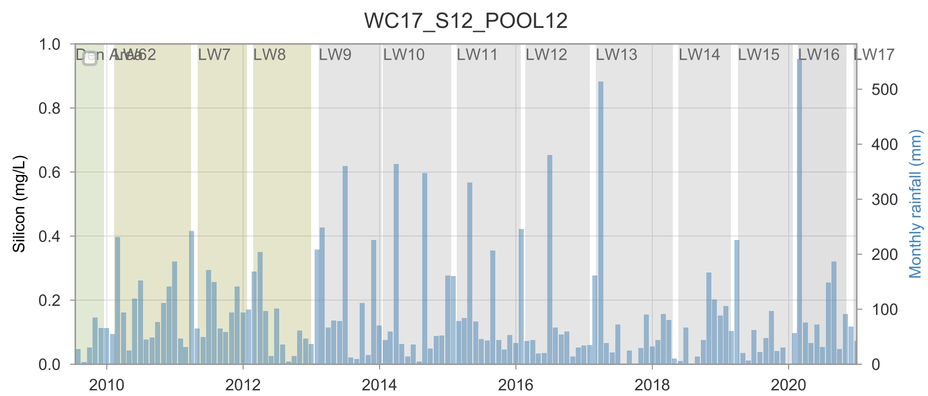

WC15_POOL9
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

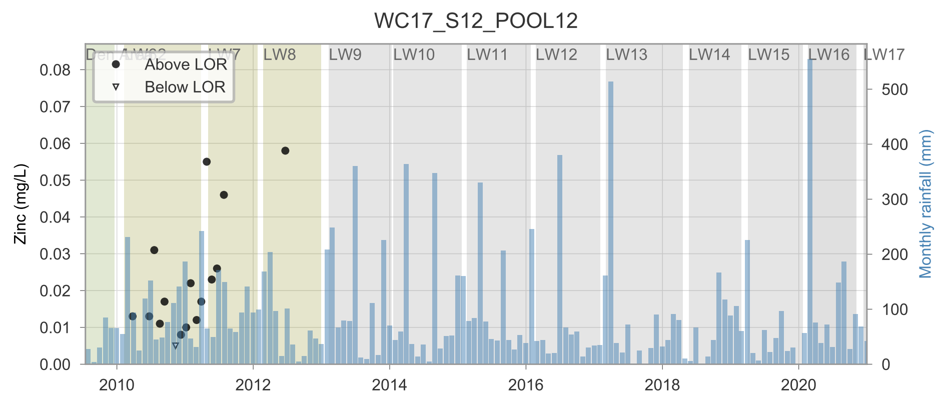

WC17_S12_POOL12
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

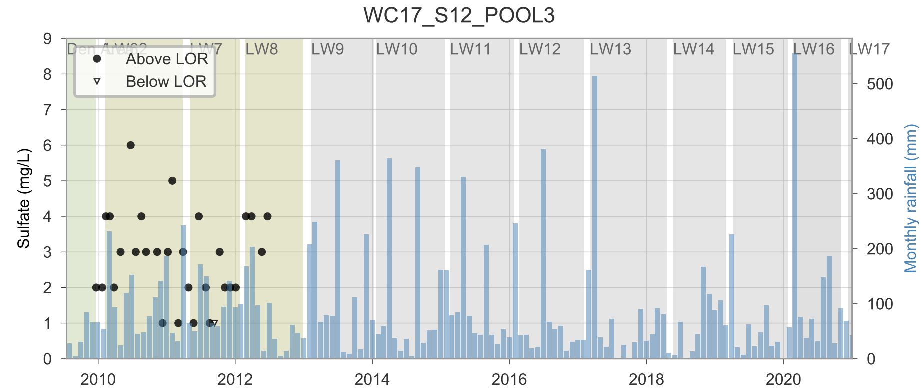

WC17_S12_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

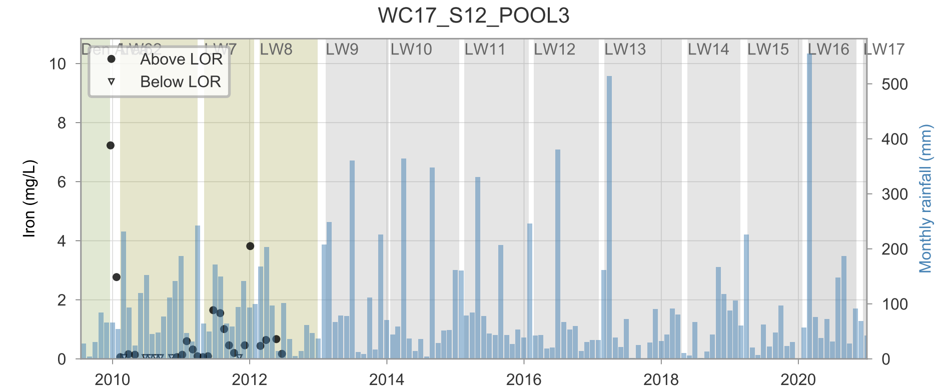

WC17_S12_POOL12
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

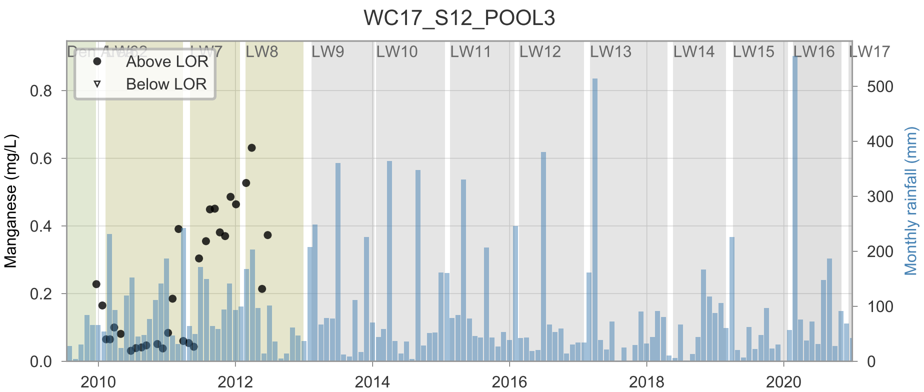

WC17_S12_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

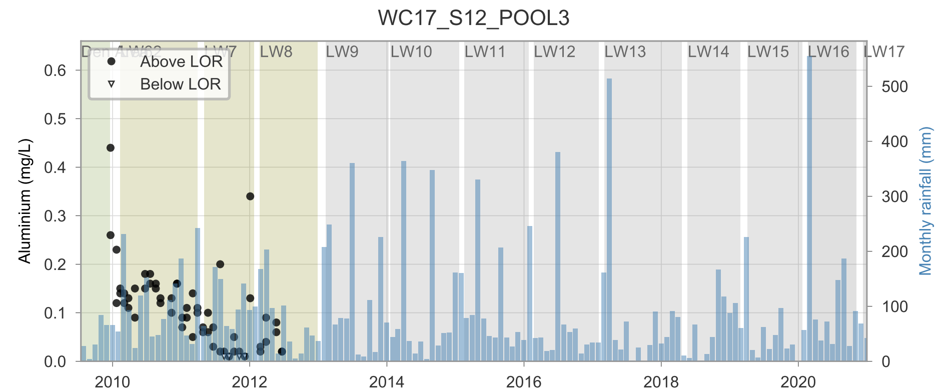

WC17_S12_POOL12
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

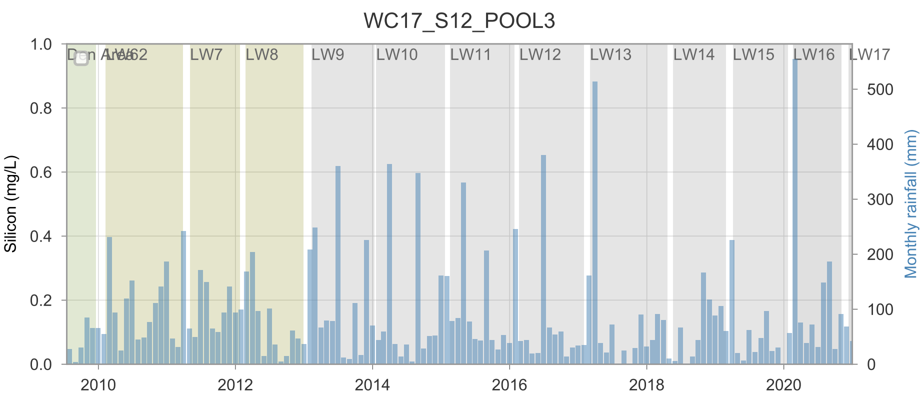

WC17_S12_POOL12
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2010
2012
2014
2016
2018
2020

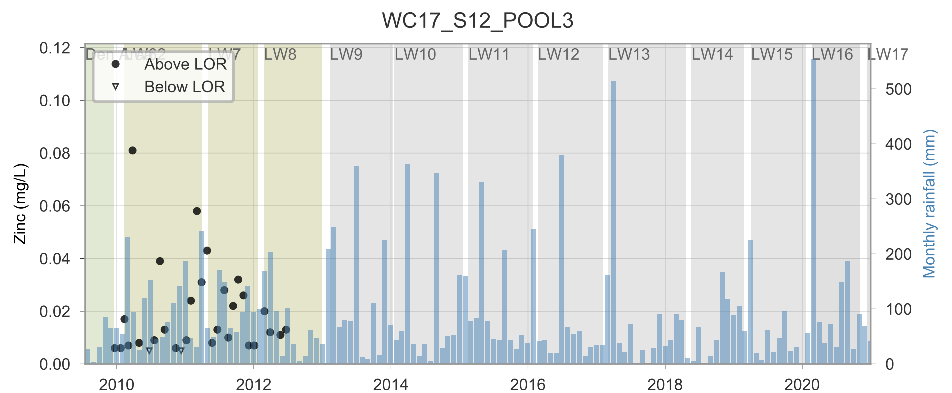

WC17_S12_POOL3
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

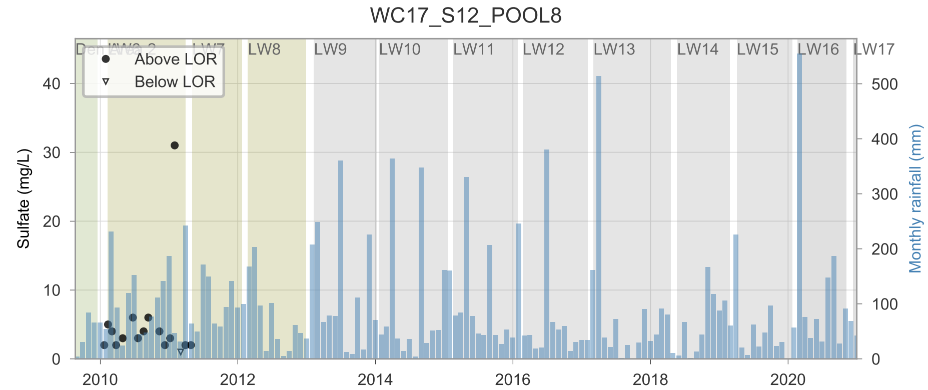

WC17_S12_POOL3
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

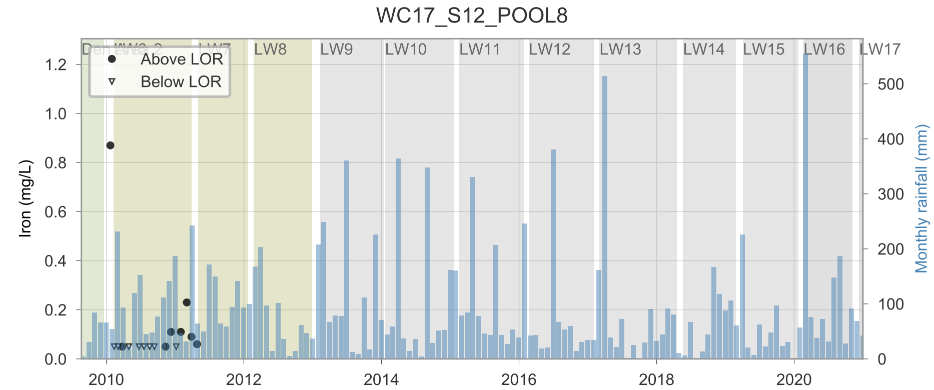

WC17_S12_POOL3
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

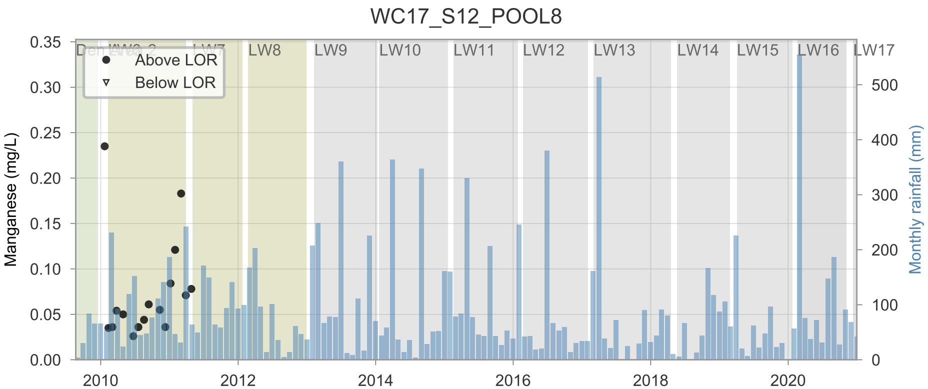

WC17_S12_POOL3
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

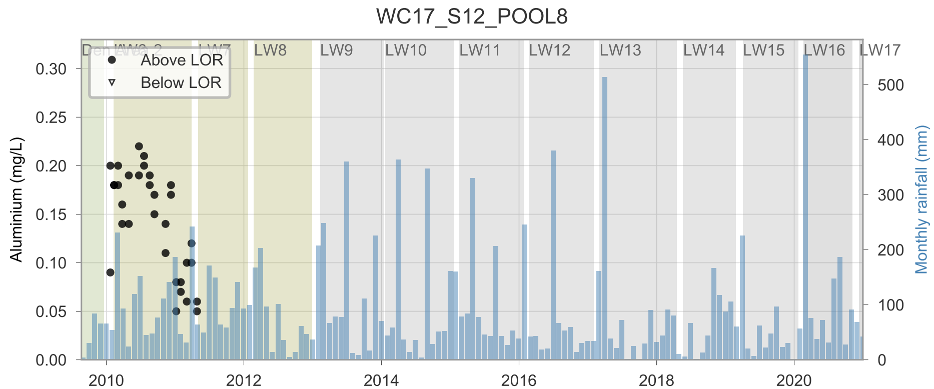

WC17_S12_POOL3
Silicon (mg/L)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

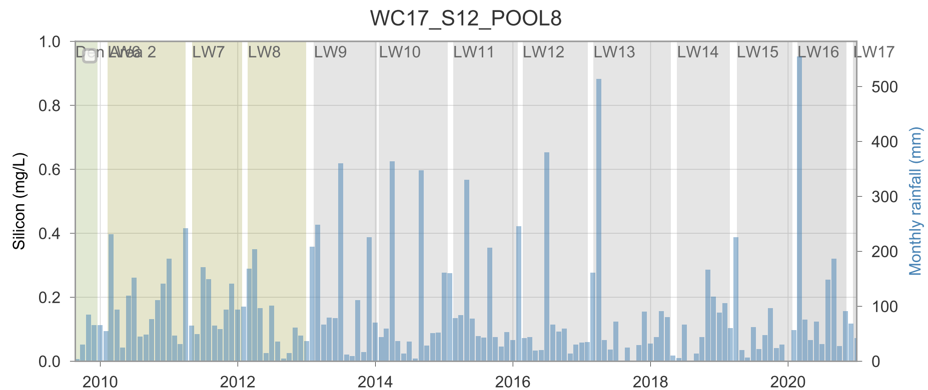

WC17_S12_POOL3
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

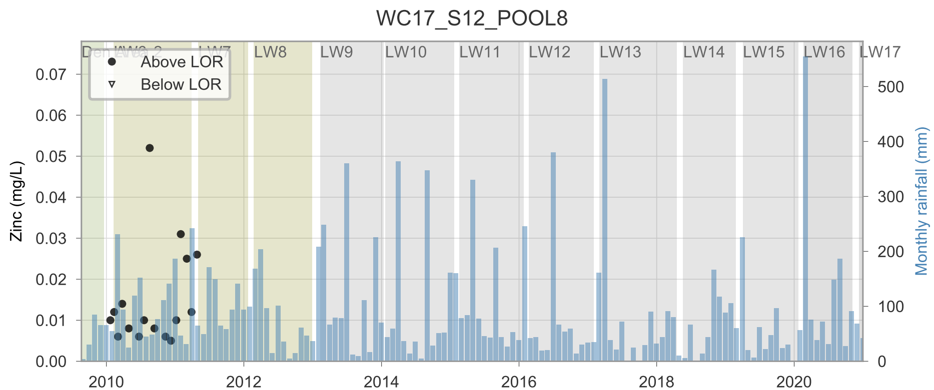

WC17_S12_POOL8
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

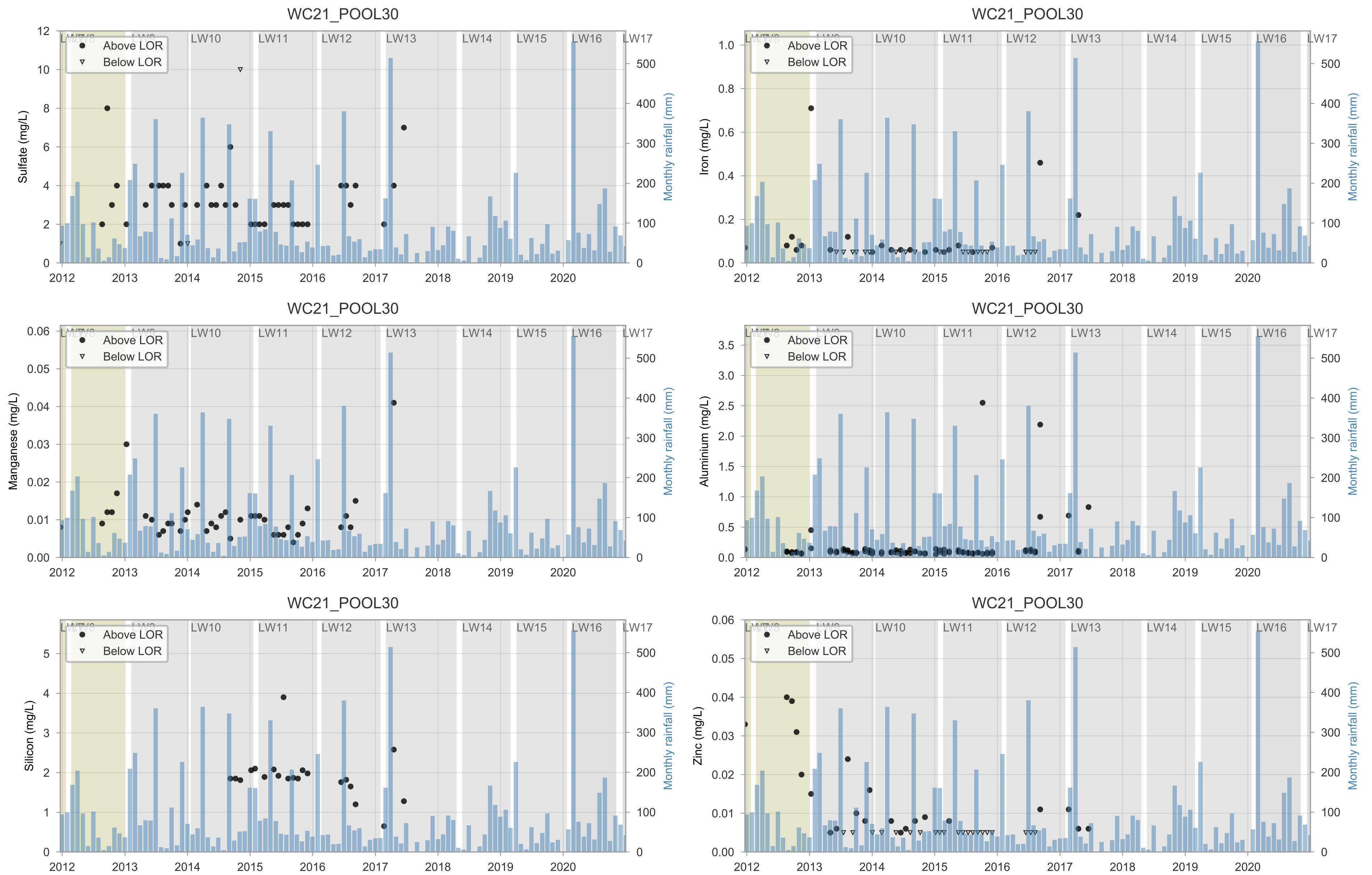

WC17_S12_POOL8
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020


WC17_S12_POOL8
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

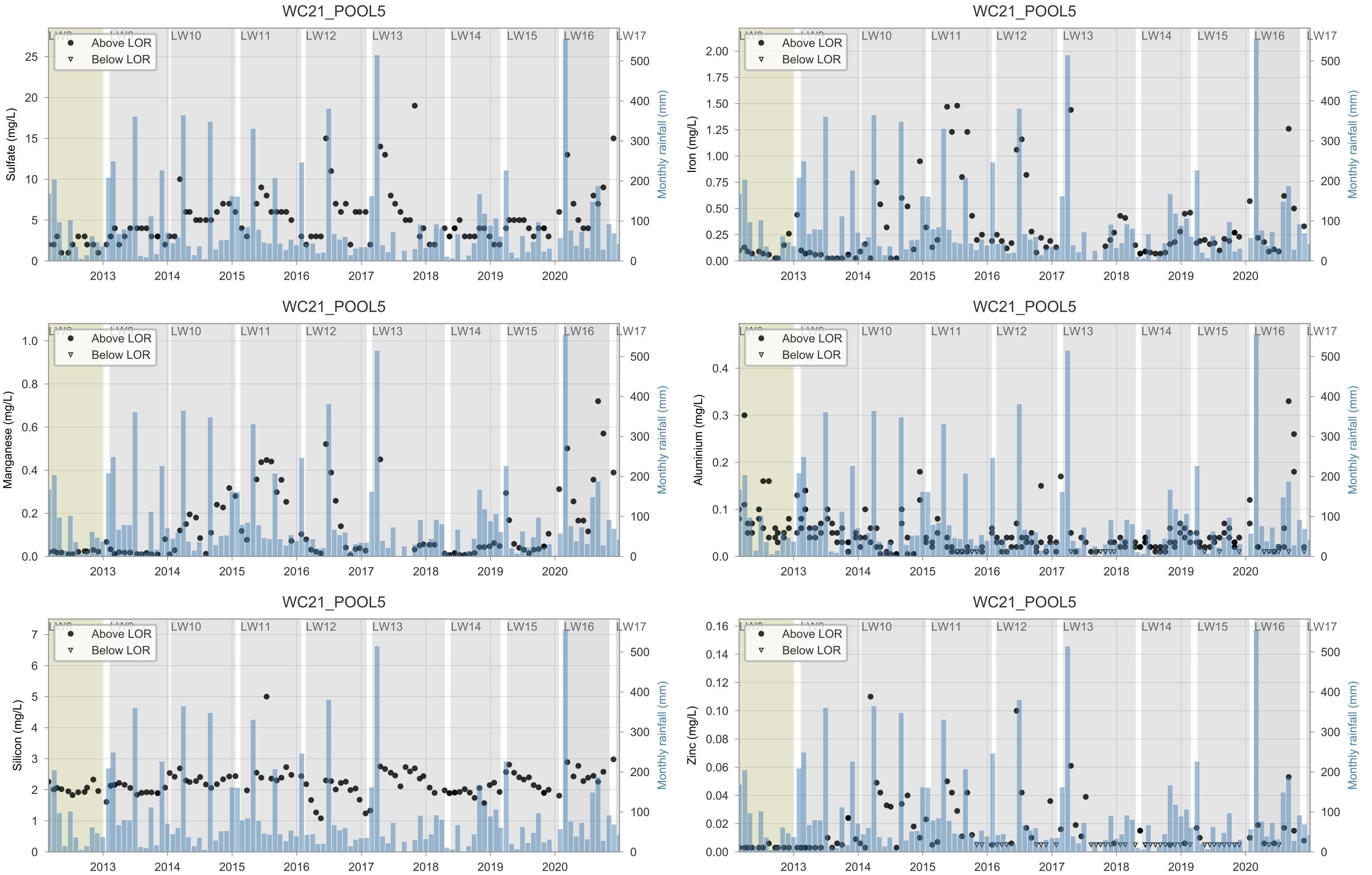

WC17_S12_POOL8
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

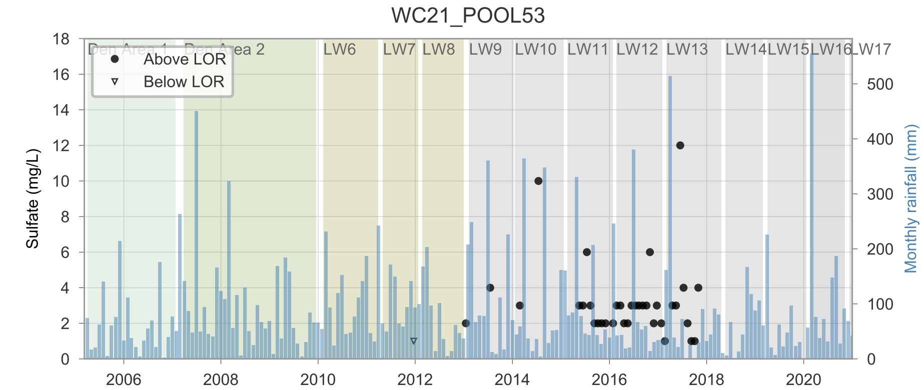

WC17_S12_POOL8
Silicon (mg/L)
Monthly rainfall (mm)
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

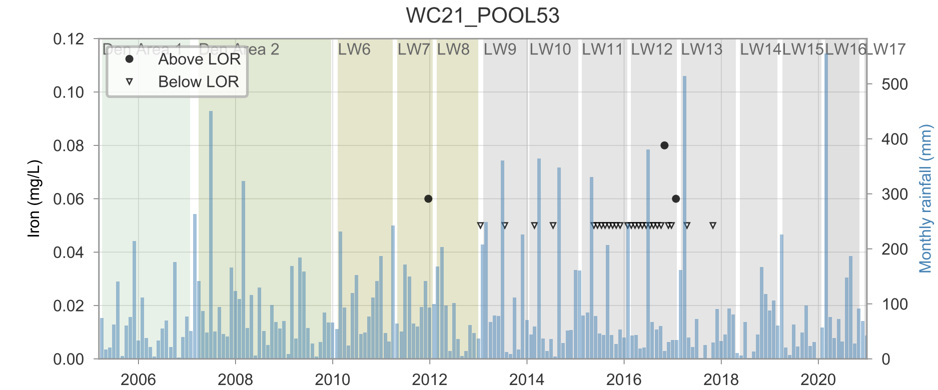

WC17_S12_POOL8
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

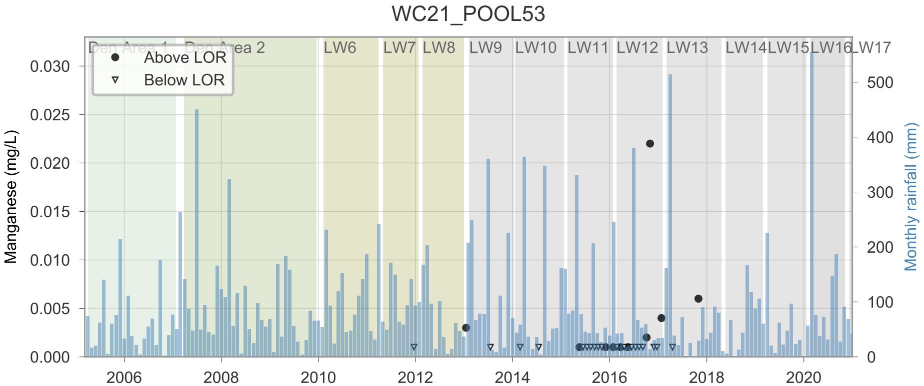


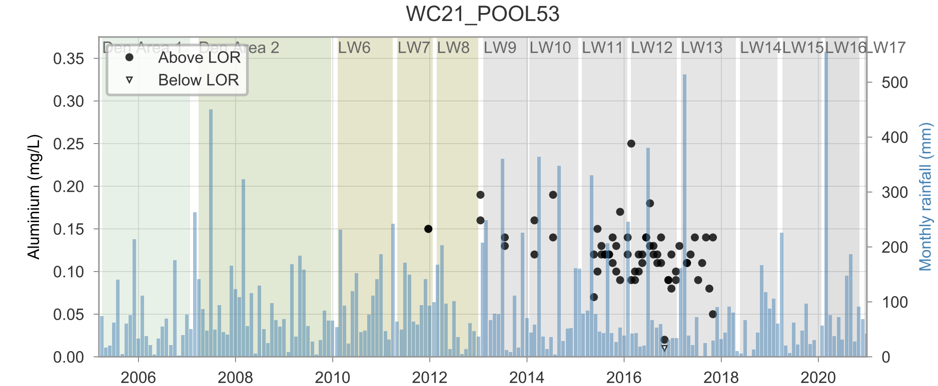
WC21_POOL30
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2012
2013
2014
2015
2016
2017
2018
2019
2020

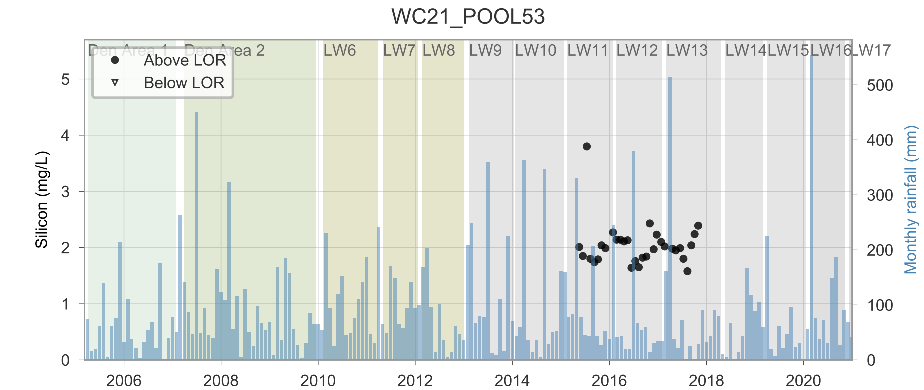

WC21_POOL5
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020
WC21_POOL5
Iron (mg/L)
Monthly rainfall (mm)
WC21_POOL5
Manganese (mg/L)
Monthly rainfall (mm)
WC21_POOL5
Aluminium (mg/L)
Monthly rainfall (mm)
WC21_POOL5
Silicon (mg/L)
Monthly rainfall (mm)
WC21_POOL5
Zinc (mg/L)
Monthly rainfall (mm)

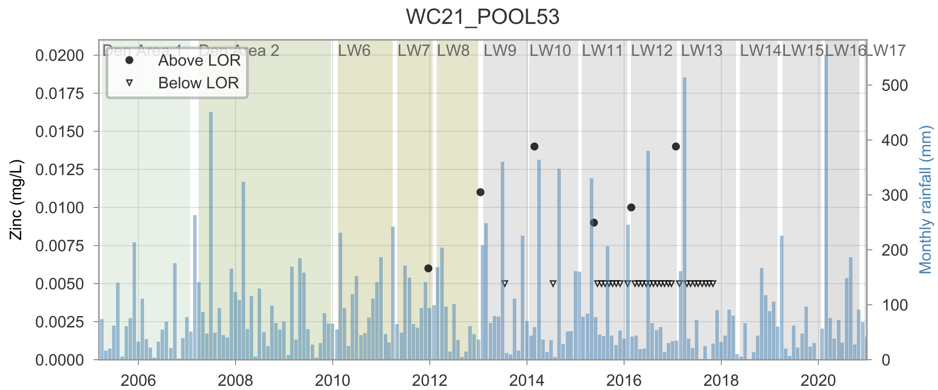

WC21_POOL53
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

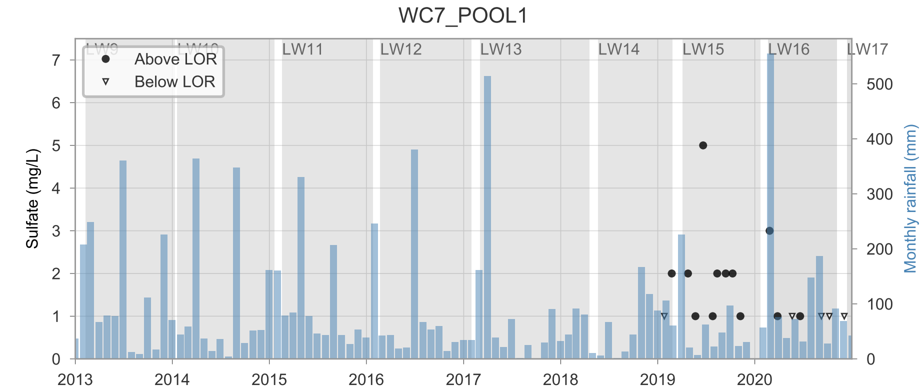

WC21_POOL53
Iron (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

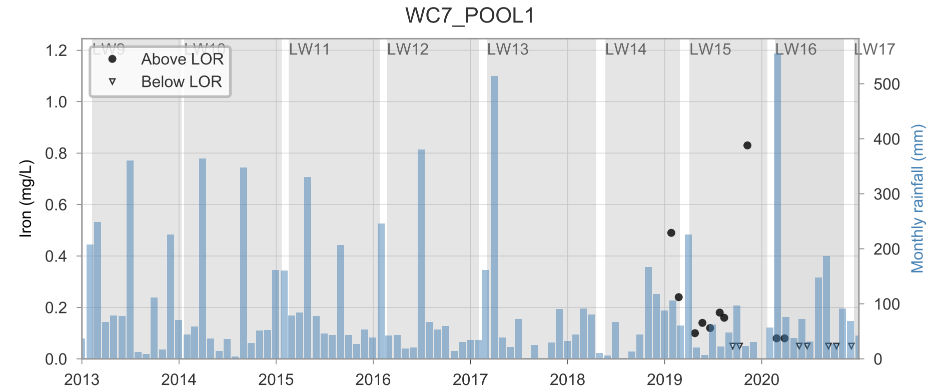

WC21_POOL53
Manganese (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

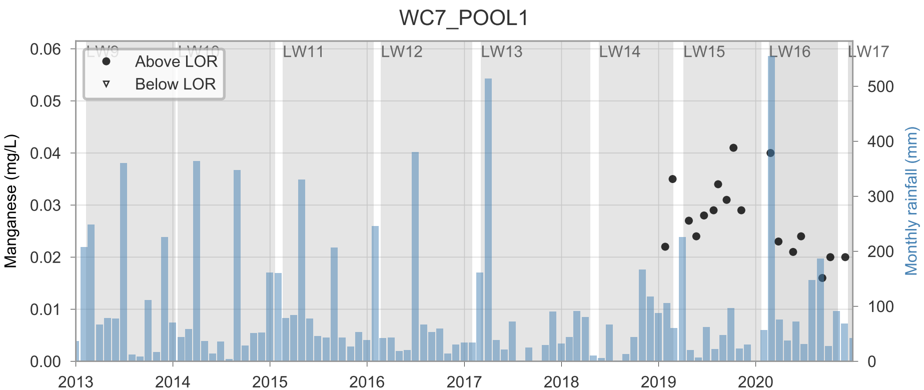

WC21_POOL53
Aluminium (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

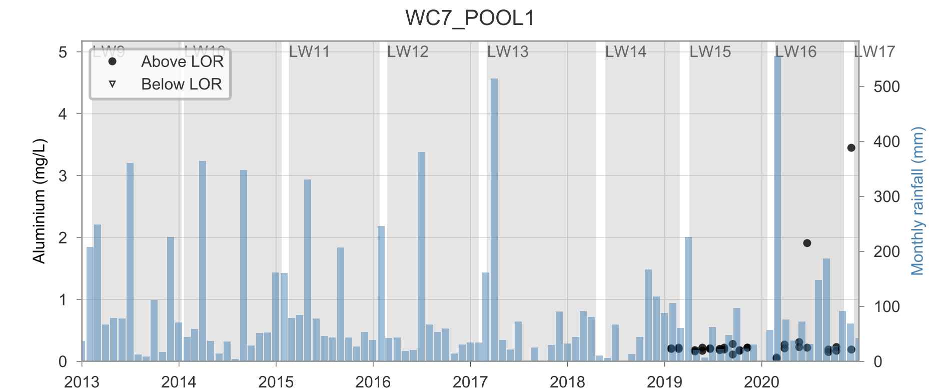

WC21_POOL53
Silicon (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

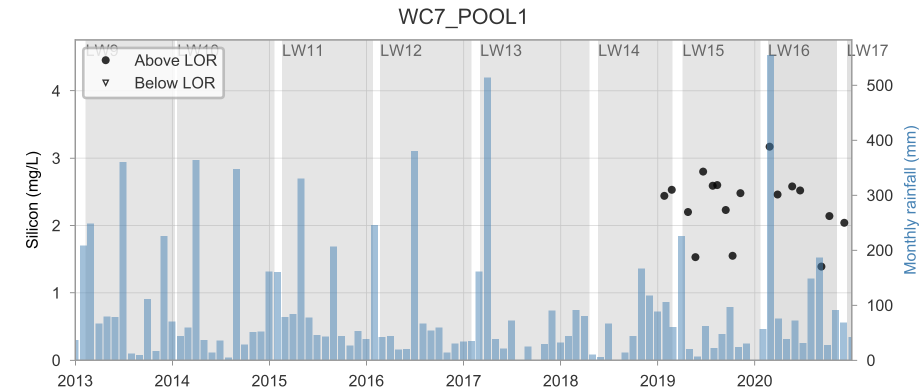

WC21_POOL53
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17

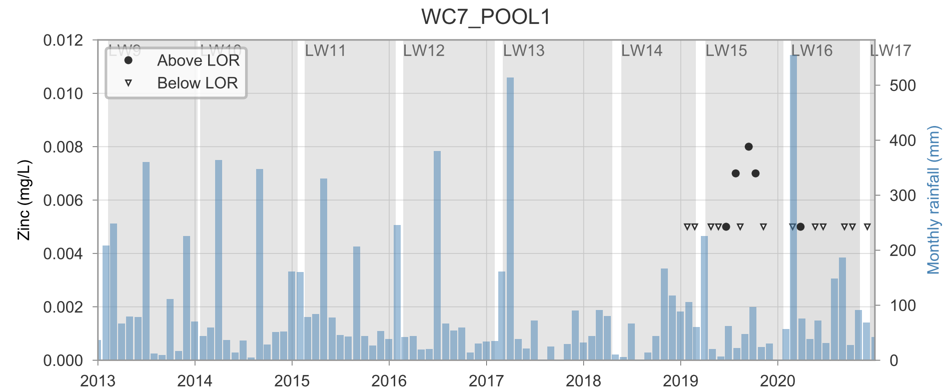

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
6
7
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

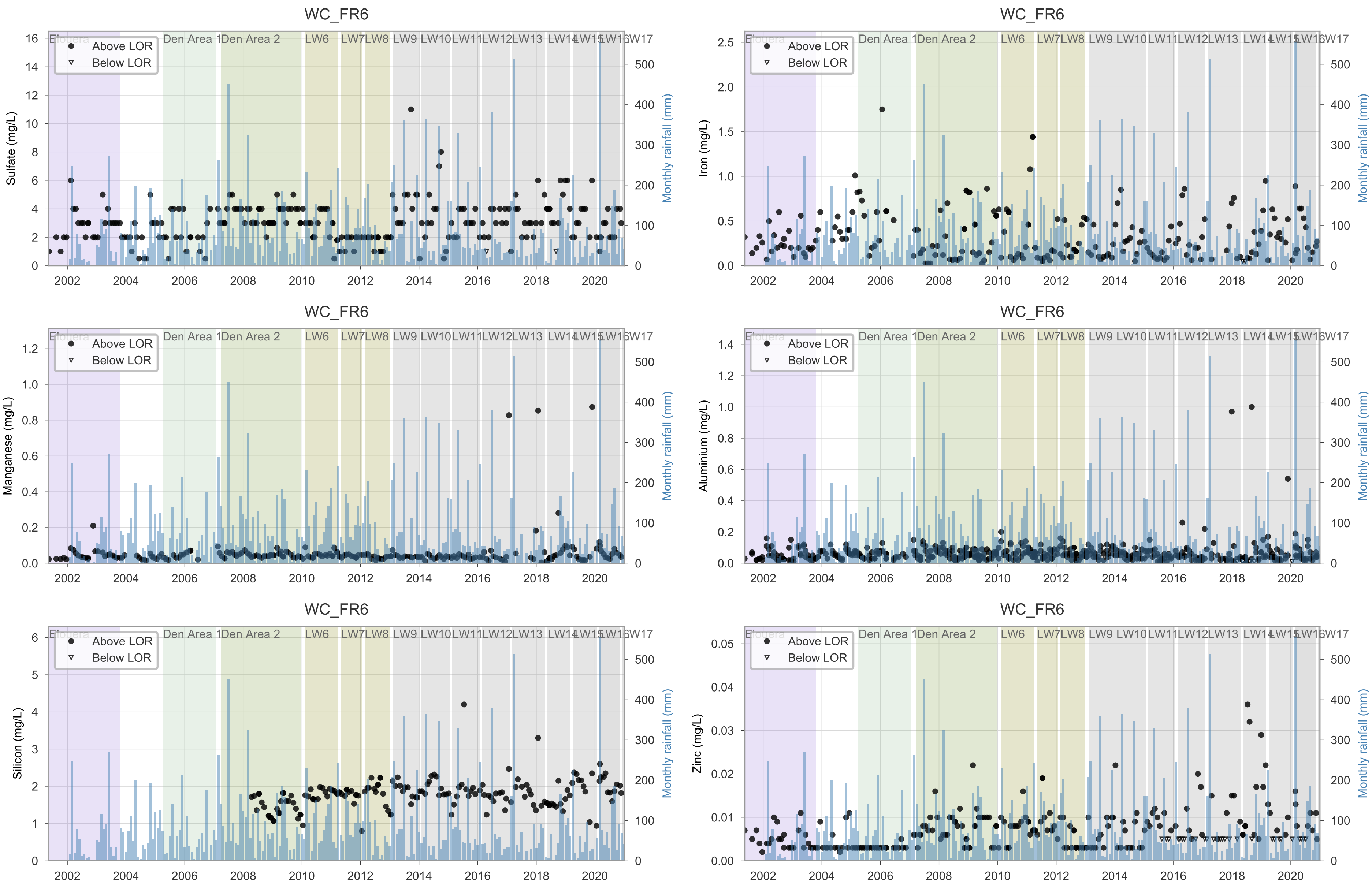

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020


WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

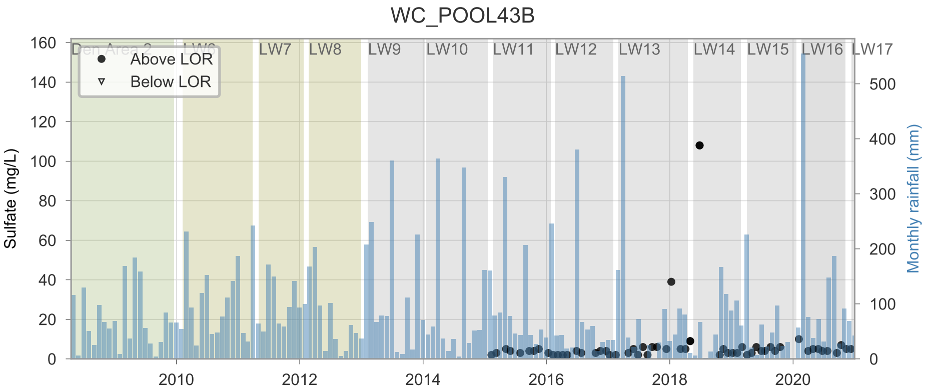

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

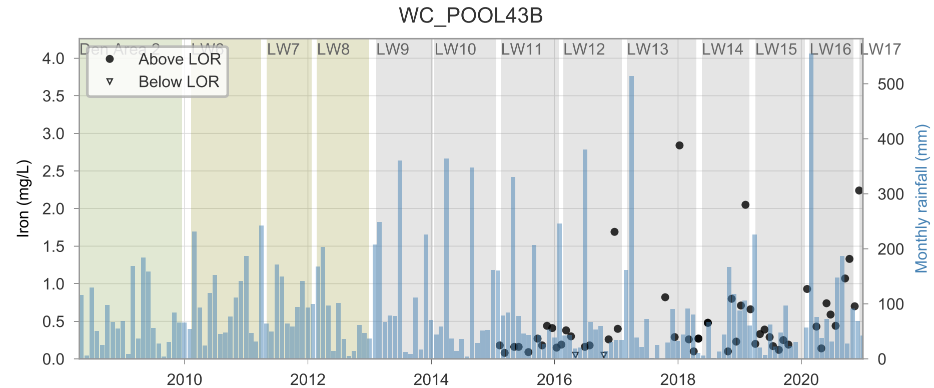

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

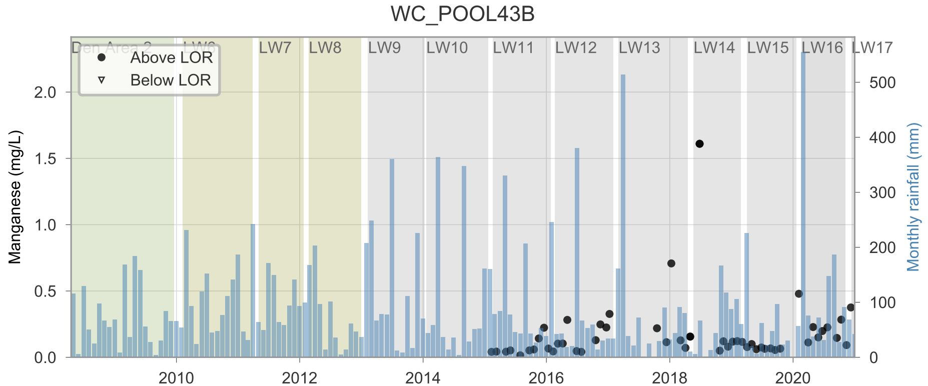

WC7_POOL1
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0
100
200
300
400
500
2013
2014
2015
2016
2017
2018
2019
2020

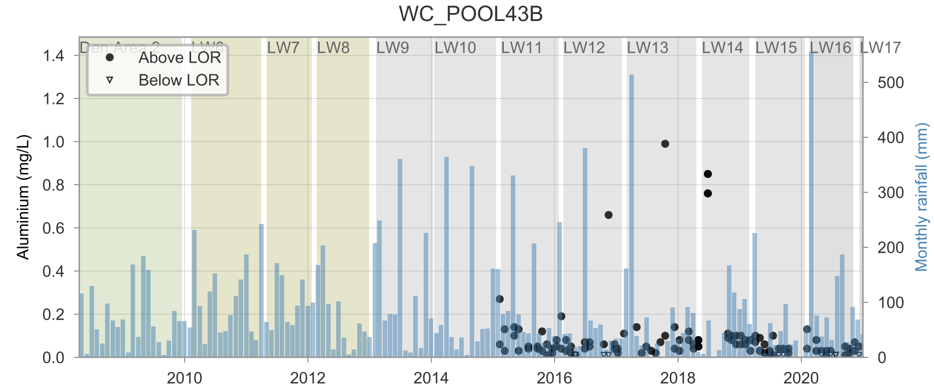


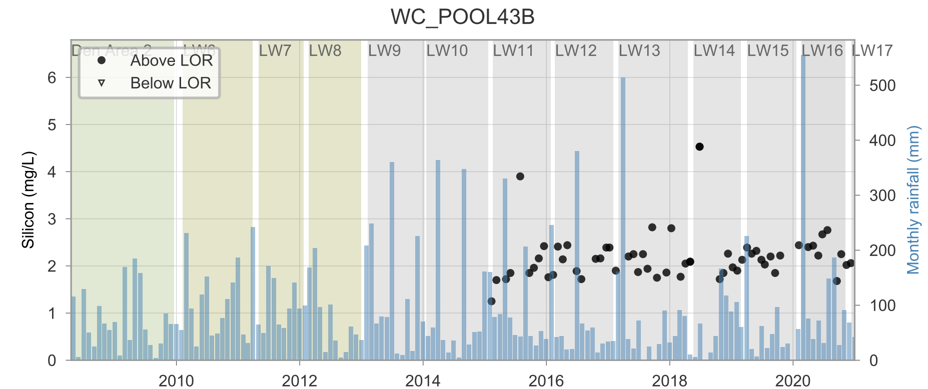
WC_FR6
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Above LOR
Below LOR
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

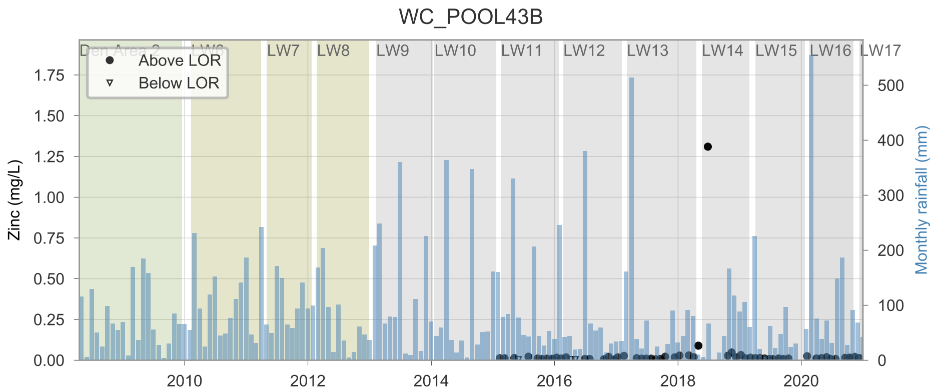

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)

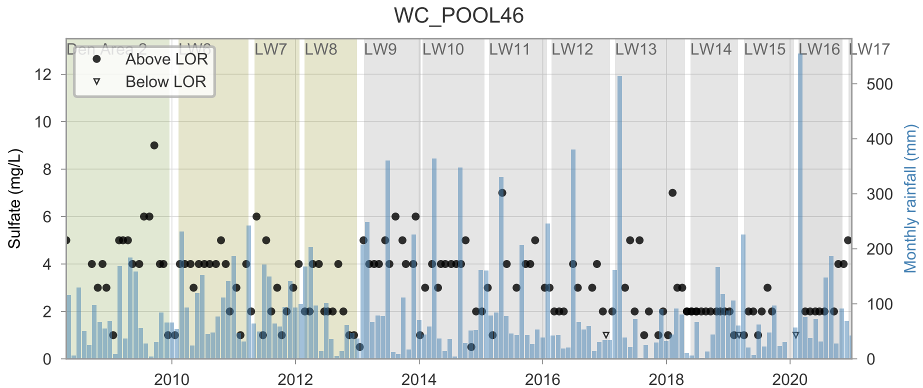

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)

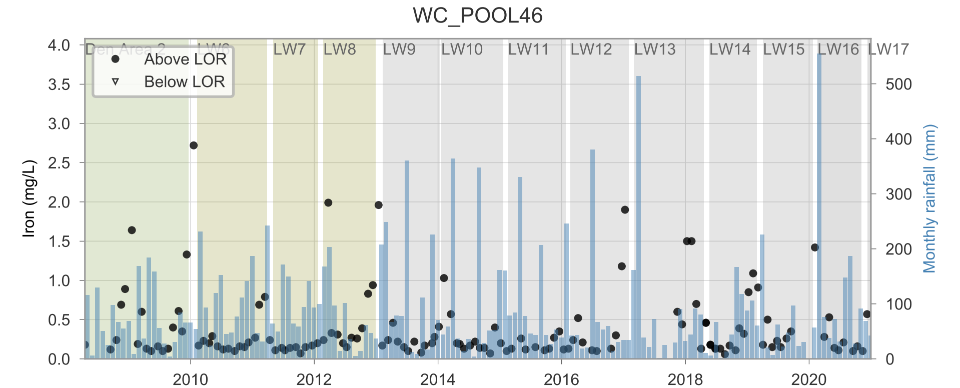

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)

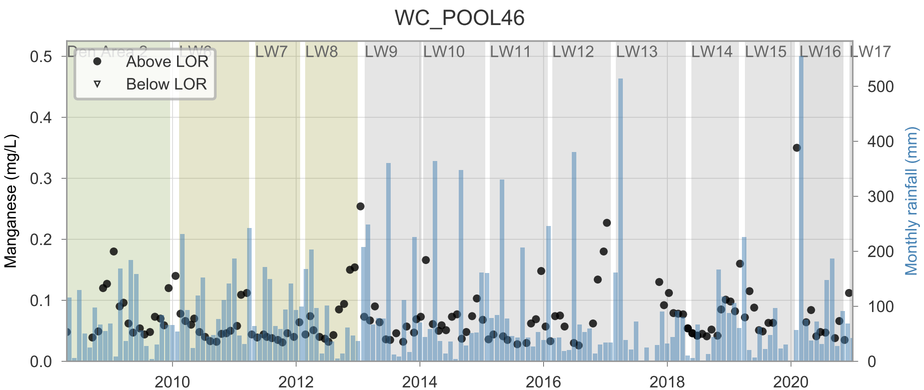

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)

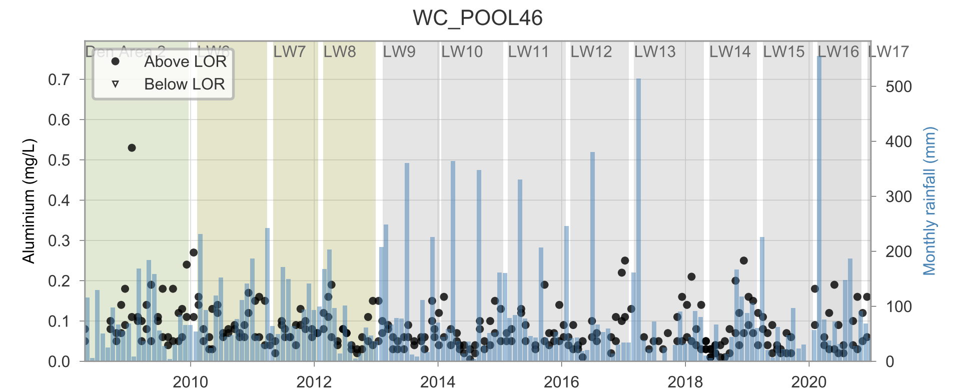

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)

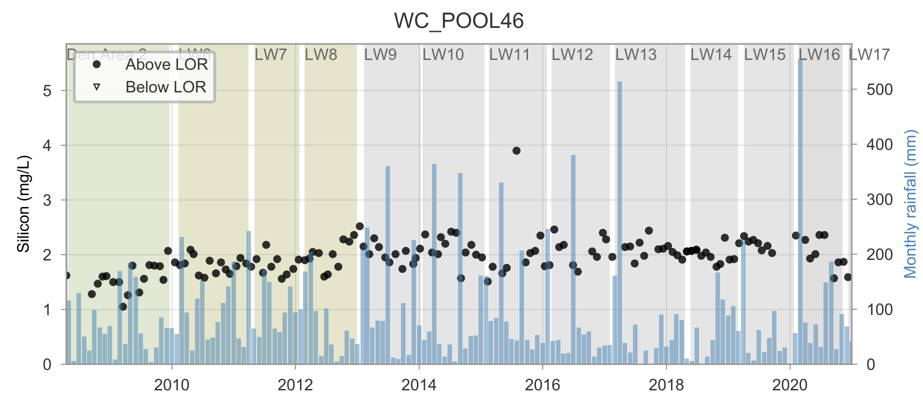

WC_POOL43B
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)

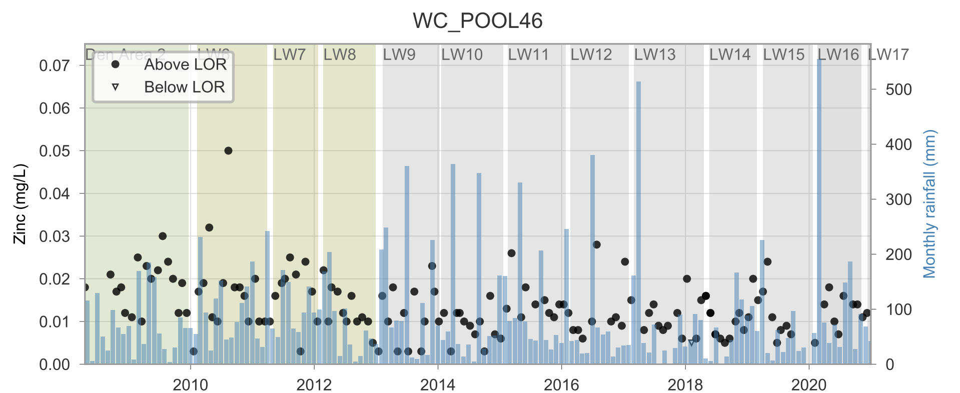

WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
0
2
4
6
8
10
12
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

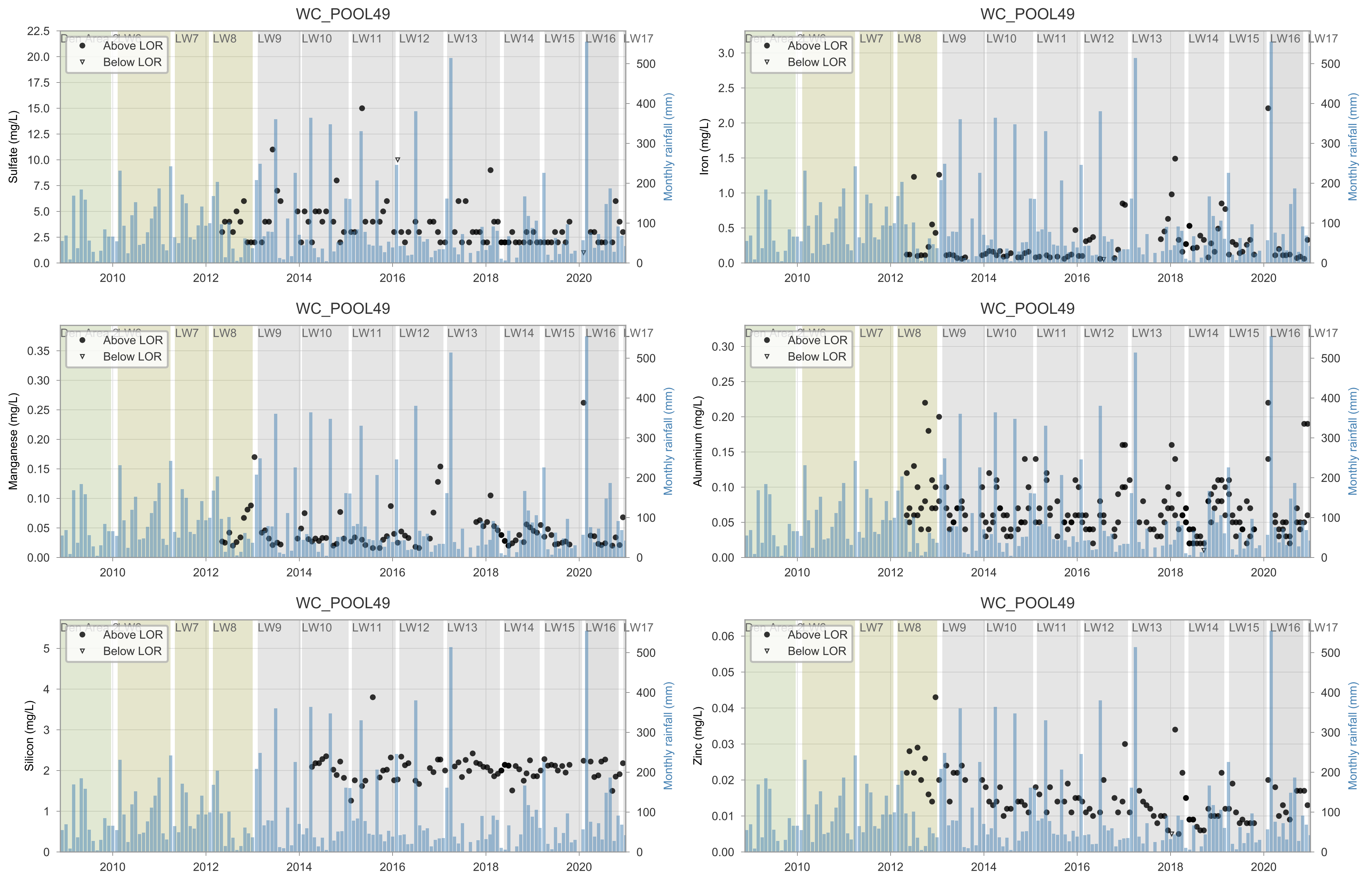

WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020


WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

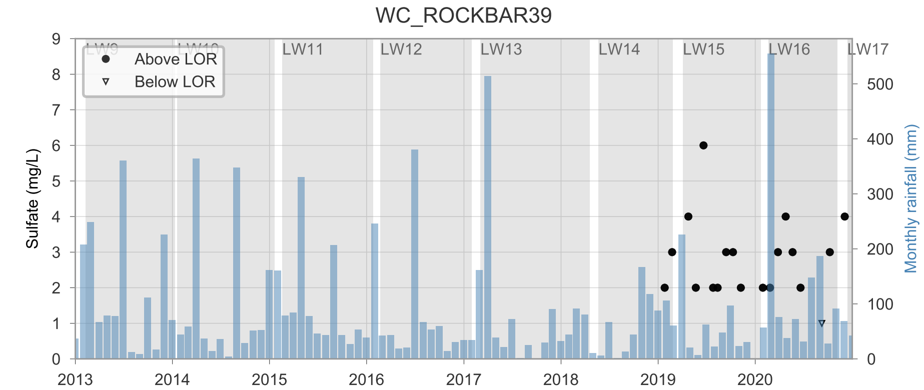

WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

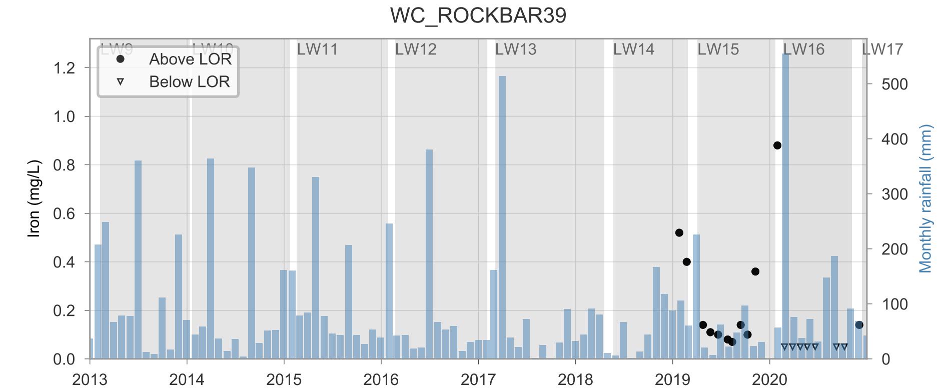

WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
0
1
2
3
4
5
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

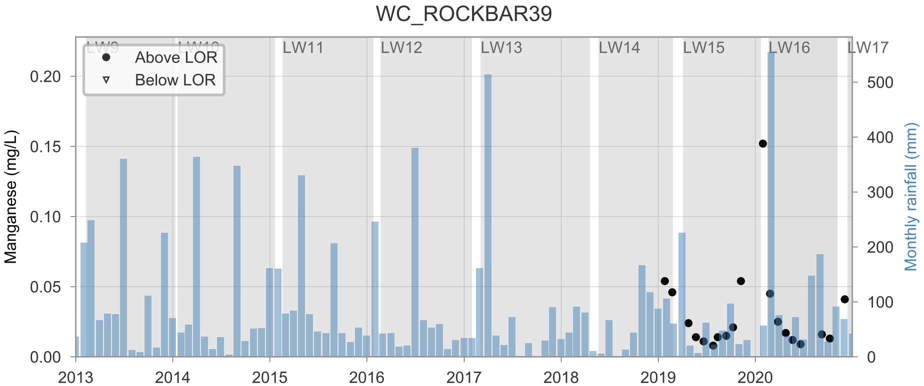

WC_POOL46
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0
100
200
300
400
500
2010
2012
2014
2016
2018
2020

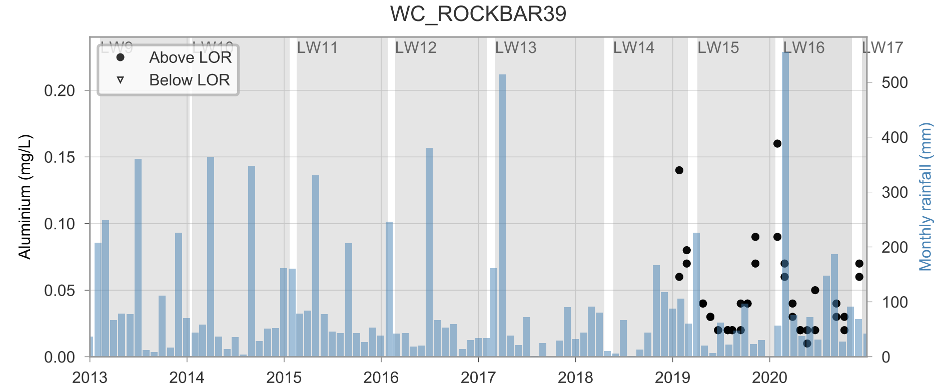


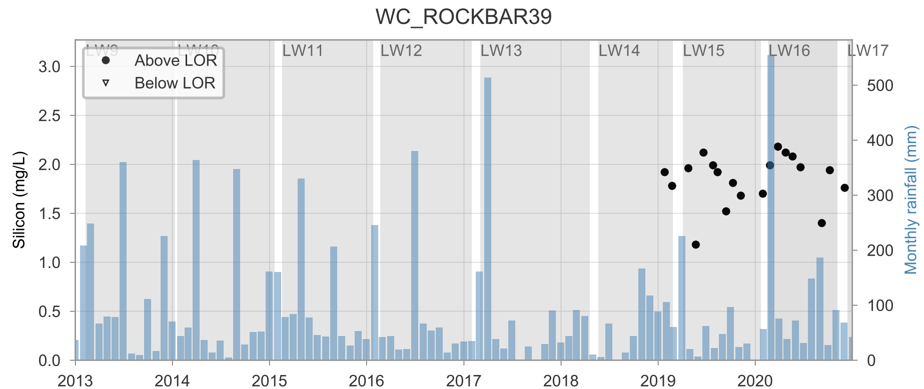
WC_POOL49
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2010
2012
2014
2016
2018
2020

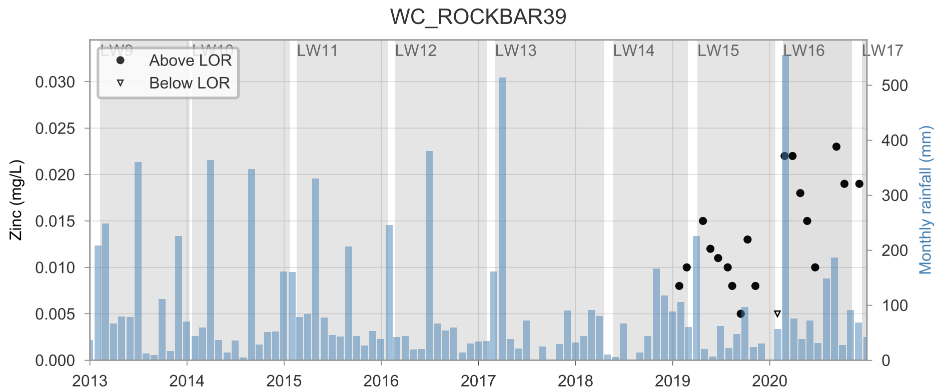

WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Sulfate (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

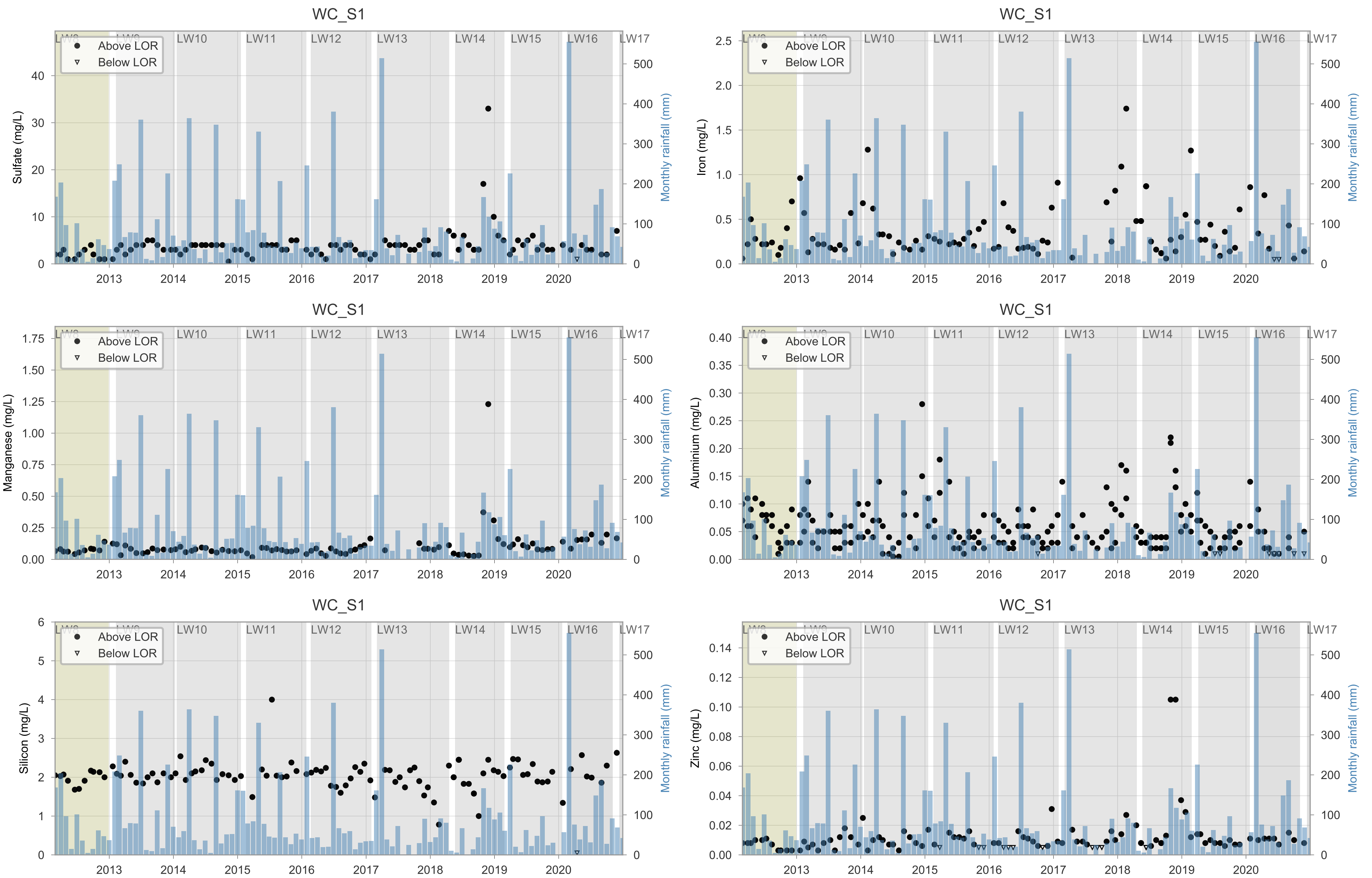

WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Iron (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

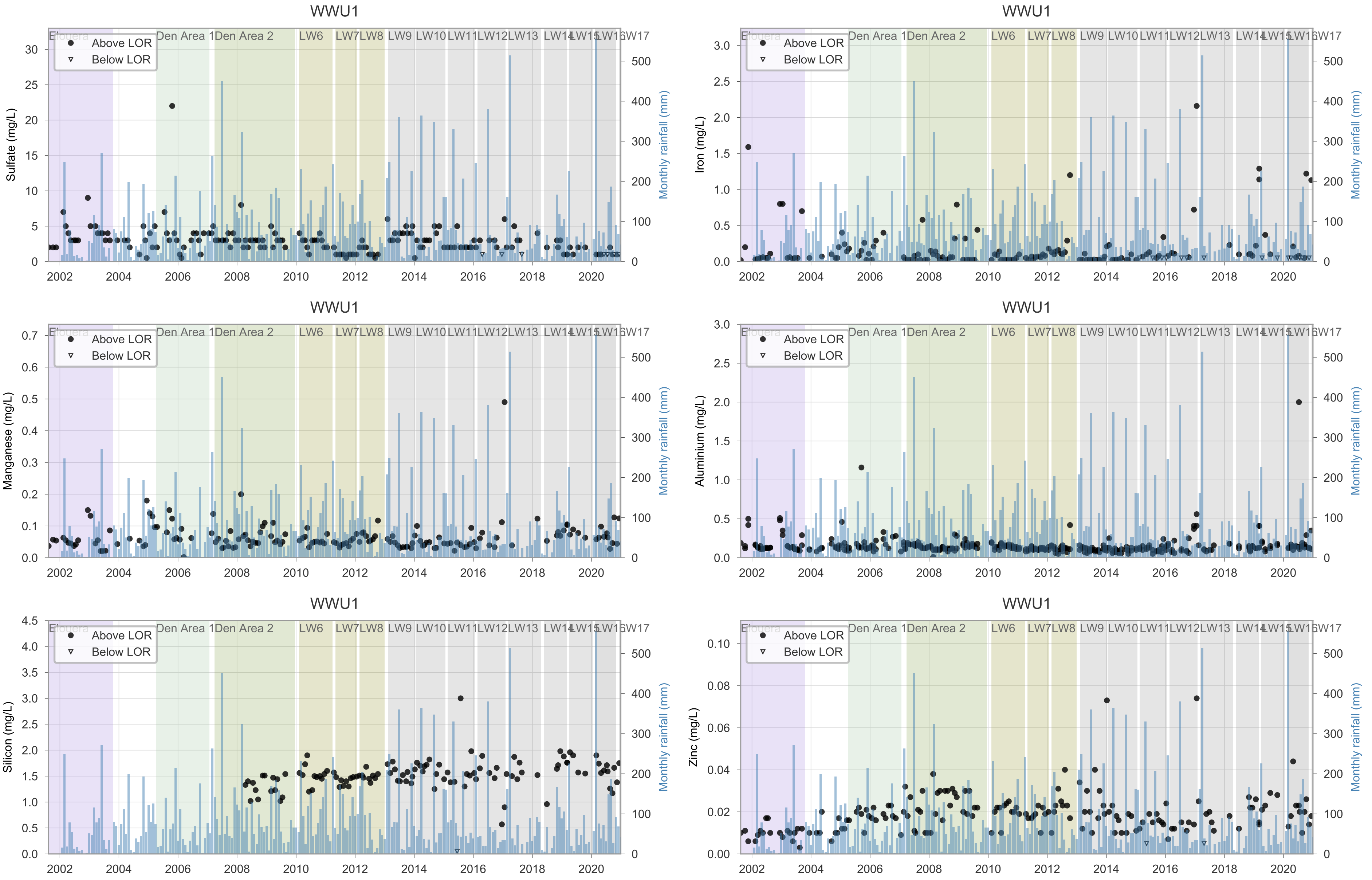

WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Manganese (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020

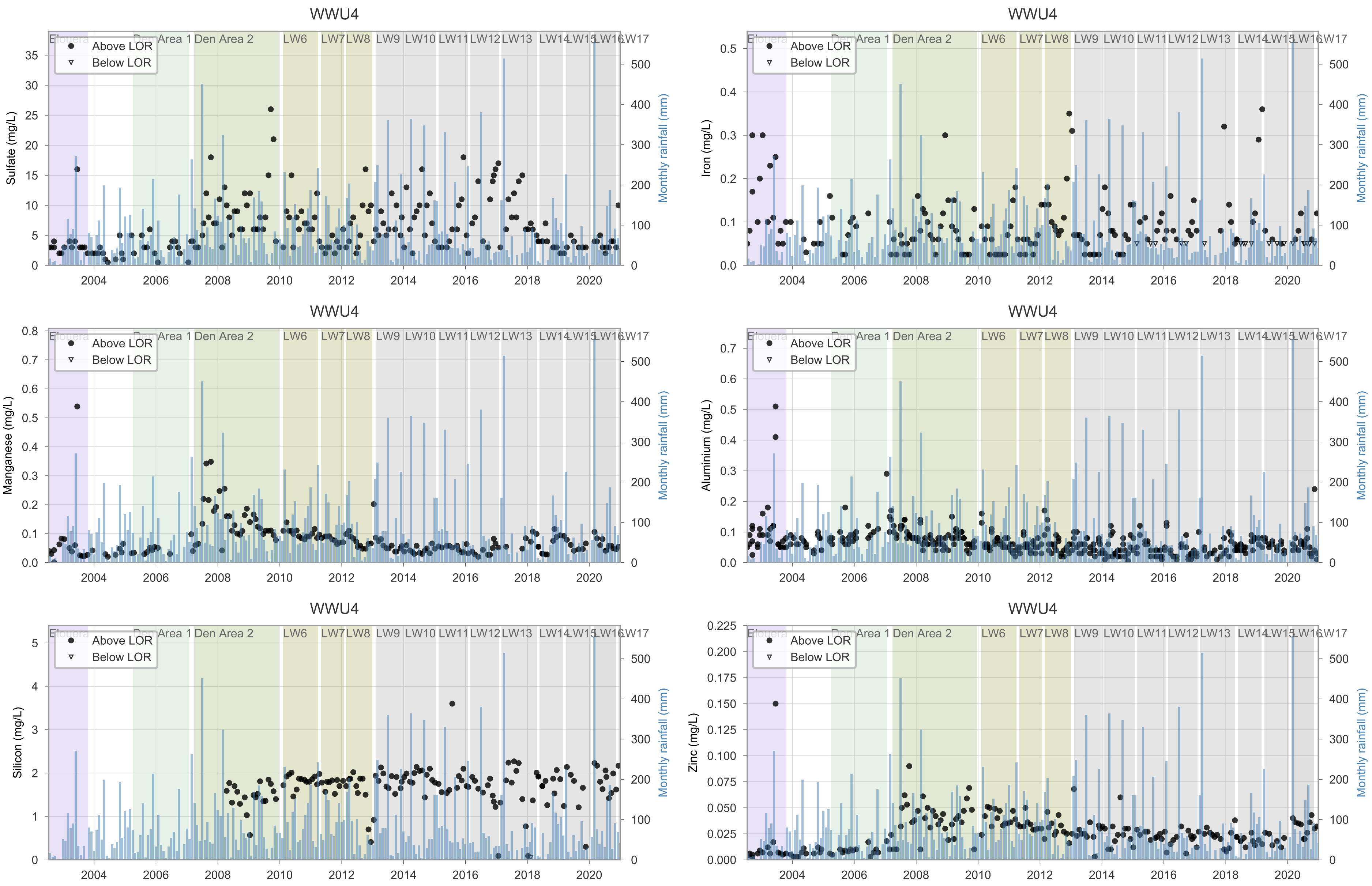

WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Aluminium (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Silicon (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


WC_ROCKBAR39
Above LOR
Below LOR
LW11
LW12
LW13
LW14
LW15
LW16
LW17
Zinc (mg/L)
Monthly rainfall (mm)
2013
2014
2015
2016
2017
2018
2019
2020


WC_S1
Sulfate (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2013
2014
2015
2016
2017
2018
2019
2020
WC_S1
Iron (mg/L)
Monthly rainfall (mm)
WC_S1
Manganese (mg/L)
Monthly rainfall (mm)
WC_S1
Aluminium (mg/L)
Monthly rainfall (mm)
WC_S1
Silicon (mg/L)
Monthly rainfall (mm)
WC_S1
Zinc (mg/L)
Monthly rainfall (mm)


WWU1
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Elouera
Den Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


WWU4
Sulfate (mg/L)
Iron (mg/L)
Manganese (mg/L)
Aluminium (mg/L)
Silicon (mg/L)
Zinc (mg/L)
Monthly rainfall (mm)
Above LOR
Below LOR
Elouera
Area 1
Den Area 2
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
LW17
2004
2006
2008
2010
2012
2014
2016
2018
2020

Appendix B: Rainfall data

Monitoring Data

The geographic distribution of the various data sources at which rainfall and stream flow is measured around Dendrobium are shown on Figure B1.

Rainfall data

Rainfall data for the Dendrobium area is available from three primary sources (Figure B1):

- A series of rainfall gauges owned by Illawarra Coal ("site data") and currently operated by the hydrographic consultants ALS;
- A rainfall gauge ("Browns Road") operated by WaterNSW (located within Area 3B); and
- Series of "infilled" data available from the SILO service, a cooperative initiative of the Queensland Government's Department of Environment and Science (DES) and the Australian Bureau of Meteorology (BoM).

The details of the various data sources is summarised in Table B1.

Measurement uncertainty

Based on manufacturers specifications[2], "*the Hyquest Solutions TB3 Model Tipping Bucket Rain Gauge is recognised as the world standard for measuring rainfall and precipitation in remote and unattended locations. The TB3 is the rain gauge of choice to the Australian Bureau of Meteorology and other organisations world wide*."

ALS have instructed that the manufacturer's stated accuracy is:

Rainfall intensity	Accuracy
0-250 mm per hour	+/-2%
250-500 mm per hour	+/-3%
Measurement range	700 mm per hour

These accuracies are independent of the siting of the gauge itself. ALS have stated that the siting of the gauges has been carried out consistent with RMS, 2016[3], which is itself compiled from Australian Standards. ALS can provide further information on request.

[2] https://www.hyquestsolutions.com/products-services/products-hardware/meteorology/model-tb3-tipping-bucket-rain-gauge/

[3] NSW RMS, 2016. Automatic weather stations: QA specification R272. Edition 1, rev 1, May 2016.

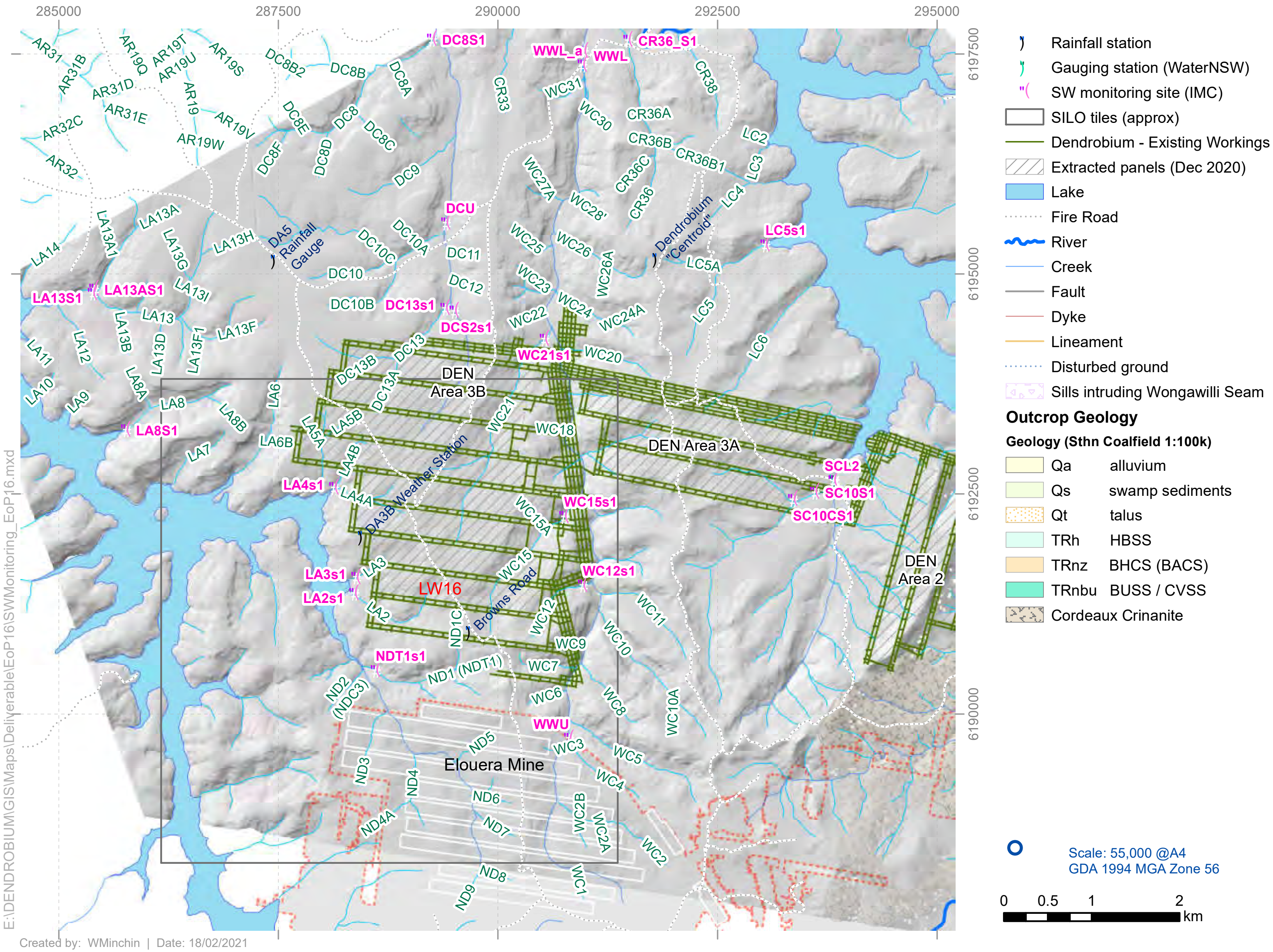


Figure B1 Location of rainfall and flow data sources

Table B1 Rainfall data sources

SITE_NAME	ID	EASTING (Z56)	NORTHING (Z56)	Z_ELEVATION [MAHD]	OPERATOR	START DATE	MEASUREMENT FREQUENCY	GAUGE TYPE	LOGGER
Dendrobium "Centroid" A3A		291815	6195170	403.1	Illawarra Coal	28/10/2007	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
DA3B Weather Station		288458	6192012	413.4	Illawarra Coal	1/06/2012	event based and midnight timestamp, 15 minute on CR800	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog and Campbells Scientific CR800
DA5 Rainfall Gauge		287468	6195153	401.6	Illawarra Coal	19/07/2017	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
DA6 Rainfall Gauge		291749	6200383	352.4	Illawarra Coal	17/06/2017	event based and midnight timestamp	Hyquest Tipping Bucket Rain Gauge model TB3 / 0.5mm	Hyquest Minilog
Cordeaux Site Rain Gauge		294658	6199531	373.5	Illawarra Coal	1/01/2002	data recorded @ 00:00 for previous 24 hrs		
Browns Road	568061	289690	6190930	442.0	WaterNSW	31/03/1983	data recorded @ 00:00 for previous 24 hrs		
SILO Data drill - **"South"**		Long: 150.70	Lat: -34.40		SILO	1/01/1900	24hr total to 9am, interpolated and averaged for 0.05x0.05 degree tile		

Notes:

Illawarra Coal sites maintained by ALS.

Browns Road data obtained from WaterNSW.

SILO data from https://www.longpaddock.qld.gov.au/silo/datadrill/

A comparison of the recent data from these sources is presented below.

Figure B2 shows recent annual totals. For these, the SILO and Dendrobium site records are 100% complete, while the Browns Road record is 96% complete.

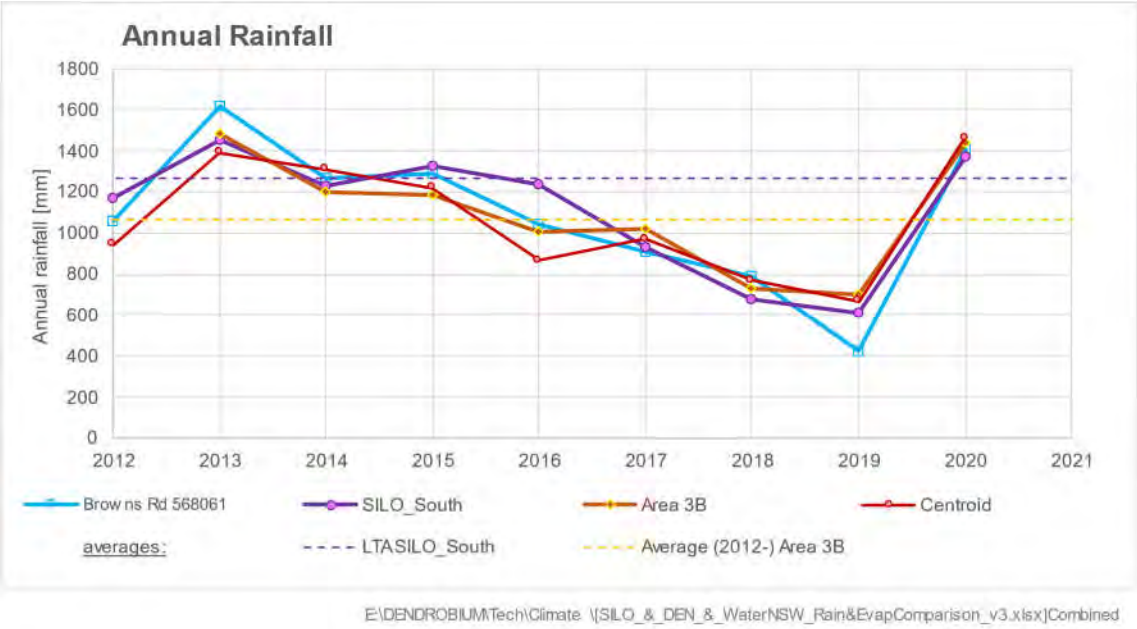


Figure B2 Annual rainfall totals

Figure B2 shows that the different records show some variability in annual totals. 2013 and 2020 were the wettest of the past 9 calendar years. In those two wet years, the variability between the different monitoring records shown above, from minimum to maximum, was 14% and 11% in 2013 and 2020 respectively. In 2019 (the driest of the selected years), the variability was 36%. All stations show the same broad trends across those selected years, including the severe and persistent rainfall deficit in 2017-2019, and the high rainfall in 2020.

There was variation in which station or data source was wettest or driest in each year but in terms of cumulative rainfall 2013-2020 (excluding 2012 because the Area 3B gauge did not commence until May that year), there is only a 4% difference between the four monitoring records shown on Figure B2.

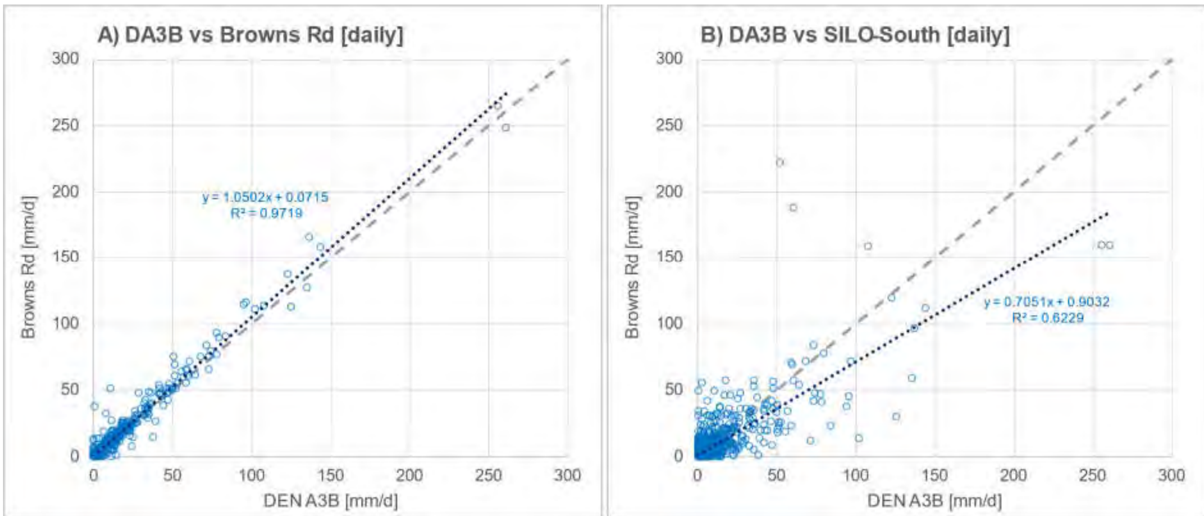


Figure B3 Correlation of daily rainfall around Area 3B

Figure B3 shows a comparison of daily totals for the three stations most relevant to Area 3B.

Figure B3a shows that the A3B station and the Browns Road station, which are 1.6 km apart, are highly correlated (R^2 = 0.97). Figure B3b shows that there is a substantially weaker correlation between the local SILO record and the Browns Road station (and therefore, also with the A3B record) (R^2 = 0.62).

To assess this further, the accumulated rainfall for the available record during the period 2005-2020 is plotted on Figure B4. The A3B rainfall is not included here due to that record beginning in 2012.

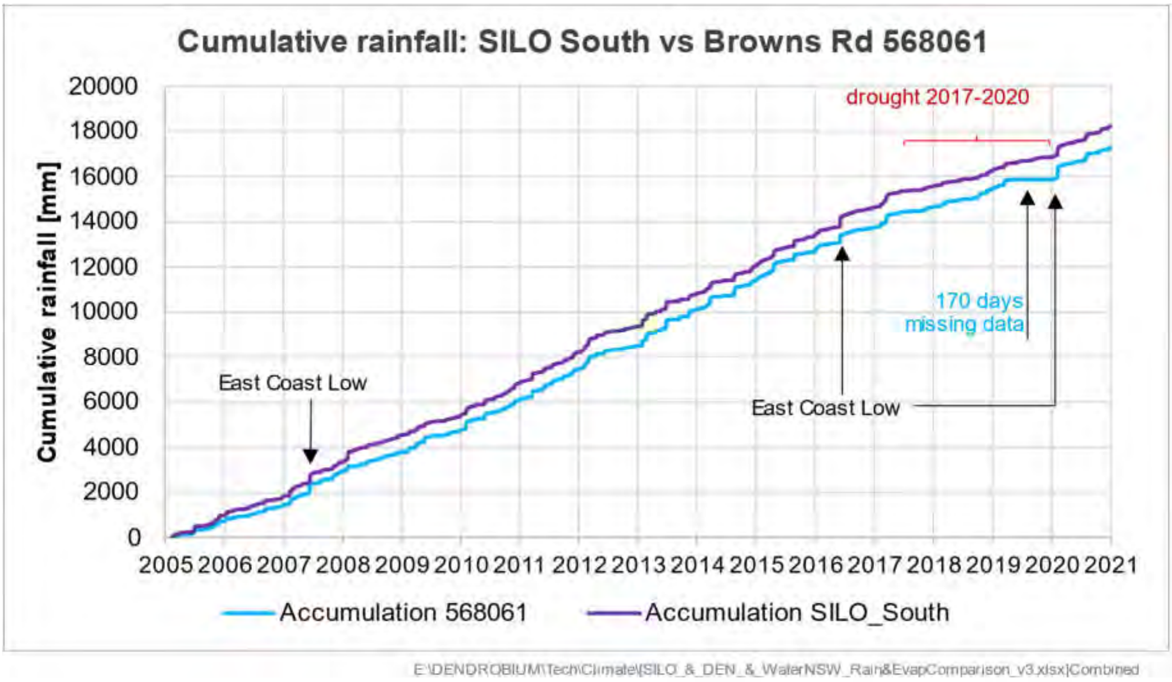


Figure B4 Rainfall accumulation near to the Area 3B domain

Figure B4 indicates that while there is a weaker correlation on a daily basis, and some significant variances in total rainfall on specific days (Figure B3b), the correlation is strong overall. That is, the accumulation shows very similar trends through the 16 year record, and the overall total accumulated rainfall varies by 4.5%.

This analysis of the data indicates that broadly there is general agreement in the data on a monthly or annual timeframe, but that short-term differences exist. These differences may be due to:

- Measurement error (in the case of the site data, Browns Road and the raw BoM data behind the SILO “Data Drill” record);
- Mismatch in timing between totals to midnight (site and Browns Road data) versus totals to 9am (BoM / SILO records);
- Interpolation or infilling errors due to temporal or spatial infilling or averaging (in the SILO data);
- True variations in rainfall in space and time due to weather patterns, e.g. topographic effects and/or the effects of localised weather systems.

These measurement errors or true variations will propagate into any rainfall-runoff modelling and simulation of daily flow around Area 3B. Smaller catchments will be less prone to spatial variation in rainfall across the catchment, but maybe affected by not having a truly local rainfall record. Therefore, while the rainfall gauging network at Dendrobium (including SILO and WaterNSW data) is considered adequate, the potential localisation of rainfall patterns will result in some unavoidable discrepancies between modelled and observed flows.

Appendix C: Flow gauge data

Flow data for the Dendrobium area is available from a series of flow gauges owned by Illawarra Coal and currently operated by the hydrographic consultants ALS. The details of these are summarised in Table C1.

These gauging stations provide estimates of stream flow via:

- A structure behind which water pools and flows over. Structures can be:
  - natural, e.g. a rock bar, or
  - man-made, e.g. a half-pipe flume.
- A sensor and logger that measure and record the water level ("stage") in the pool at 15-minute intervals
- A "rating curve" which is a chart or graph of discharge (flow) versus stage for each gauging station. The rating curve is developed via periodic measurements of flow in the channel at a known water level.
- Estimates of mean daily flow are then provided.

Illawarra Metallurgical Coal commissioned an independent hydrologist (Enviromon) to systematically identify and quantify the accuracy or error involved in each part of the process (Enviromon, 2019 and Enviromon, 2020).

Table C1 Flow gauge information

Watercourse	Site	Area	Easting (z56)	Northing (z56)	Z_Elevation [mAHD]	Catchment area [km^2]	Installation	Structure type		Logger
Wongawilli Ck	WWU	u/s A3B	290808	6189716	352.94	3.211	Stainless Steel housing	Natural control		Diver
Wongawilli Ck	WWL	d/s A3A,B	290975	6197526	261.86	20.079	Stainless Steel housing	Natural control		Diver
Wongawilli Ck	WWL_A	d/s A3A,B	290962	6197370	263.22	19.602	PVC housing	To be upgraded – Half pipe	225 mm	Orpheus
WC21	WC21S1	A3B	290529	6194255	283.07	2.434	Stainless Steel housing	Natural control		Diver
WC15	WC15S1	A3B	290754	6192239	324.71	1.192	PVC housing	Natural control		Diver
WC12	WC12S1	A3B	290964	6191459	322.34	0.380	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA2	LA2S1	A3B	288364	6191364	324.65	0.824	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA3	LA3S1	A3B	288385	6191548	323.82	0.375	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA4	LA4S1	A3B	288134	6192565	322.98	0.817	Stainless Steel housing	Modified control	150 mm	Diver
ND1	ND1S1	A3B	288607	6190491	325.11	1.130	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
DC13	DC13S1	A3B	289401	6194605	339.50	1.638	PVC housing	Natural control		Diver
Donalds Castle	DCS2	A3B	289502	6194572	341.27	1.084	PVC housing	Natural control		Diver
Donalds Castle	DCU	A3B	289407	6195577	322.42	6.219	Stainless Steel housing	Natural control		Diver
SC10	SC10S1	A3A	293608	6192516	333.03	2.771	Stainless Steel housing	Natural control		Diver
SC10C	SC10CS1	A3A	293358	6192433	340.78	0.817	Stainless Steel housing	Natural control		Diver
Sandy Ck	SCL2	A3A	293819	6192648		7.029	Stainless Steel housing	Modified control		Diver
	2022205	A3A	293819	6192648		7.029	WaterNSW site	Modified control		Unknown
LC5	LC5S1	A3A,C	293043	6195327	318.10	1.861	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus
LA8	LA8S1	A5	285764	6193225	331.56	0.93	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus
LA13A	LA13AS1	A5	285401	6194826	319.93	1.04	Polypipe housing	Weir and half pipe flume	150 mm	Orpheus level, Diver EC
LA13	LA13S1	A5	285384	6194777	320.35	2.79	PVC housing	Natural control – to be upgraded	225 mm	Diver

Watercourse	Site	Area	Easting (z56)	Northing (z56)	Z_Elevation [mAHD]	Catchment area [km^2]	Installation	Structure type		Logger
AR31	AR31S1	A5	283999	6197770	270.70	2.96	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
AR32	AR32S1	A5	283945	6197576	266.10	1.5	PVC housing	Natural control – to be upgraded	150 mm	Diver
AR19	AR19S1	A5	285584	6198528	382.91	3.53	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
DC8	DC8S1	A5	289249	6197663	301.20	2.61	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR29	CR29S1	A6	289969	6201109	257.13	2.33	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR31	CR31S1	A6	290062	6200056	248.33	2.55	Polypipe housing	Weir and half pipe flume	225 mm	Orpheus level, Diver EC
CR36 (proposed)	CR36S1	A3C	291487	6197650		1.7	PVC housing	To be upgraded – Half pipe	TBC	Orpheus
Reference Sites										
O'Hares Ck	213200	Wedderburn	300657	6217589	166.87	73.0		V-notch		
alternative Reference Sites										
Bomaderry Ck	215016	Bomaderry	279354	6142065	25.822	31.0	Vandalised, stolen 2019	Natural rock bar and boulders		Vandalised, stolen 2019*
Cordeaux R	2122204	Cordeaux Dam No.1	295413	6188702		9.3^				

Notes:

IMC gauging stations operated by ALS.

Reference gauge data from WaterNSW.

* WaterNSW advise that Bomaderry Creek gauging site repeatedly vandalised, equipment stolen (2019-20) and not yet replaced.

^ not from WaterNSW) - estimated in GIS

Table C2 ALS data quality codes

DATA QUALITY CODE	DESCRIPTION	
1	Good continuous records	Notes:
2	Reliable Edited Data	Negative values of these codes may be shown on the data quality charts shown later in this Appendix. These indicate where a record has been processed or infilled.
3	Unreliable Edited Data	
5	Non-Continuous Data	
55	Fair quality data	
69	Fair Quality Rating Extrapolated	
104	Records estimated	
109	Poor quality data	
140	Level below CTF (cease-to-flow)	
145	Discharge not reliable Rating under review	
150	Rating table extrapolated due to inadequate gauging information	
151	Data not yet available	
160	Water level below sensor	
161	Poor quality data from debris affecting sensor	
205	Data lost	
255	No data exists	

Table C3 Data quality assessment for Reference Gauges

WATERCOURSE	GAUGE ID	GAUGE NAME	Start Date	End Date	No. of Records	% available	% suspect	% infilled	Status
Wongawilli Ck	300024	WWU	2/11/2007	08/01/2021	4817	99.7	2.1%	1.0%	Primary Reference
O'Hares Creek	213200	O'Hares at Wedderburn (213200)	2/02/1978	5/02/2020	15709	99.9%	0.1%	0.1%	Primary Reference
Bomaderry Creek	215016	Bomaderry Creek at Bomaderry (215016)	4/07/2003	10/05/2020*	6156	99.0%	1.0%		Alternative Reference
Woronora River	2132101	Woronora River Fire Rd (2132101)	21/02/2007	27/03/2020	4784	81.3%	35.9%		Alternative Reference (low quality)
LC5	300094	LC5S1	4/04/2019	11/01/2021	649	100.0%	2.6%	0.0%	Future Reference site

* WaterNSW advise that Bomaderry Creek gauging site repeatedly vandalised, equipment stolen (2019-20) and after May-2020, not yet replaced.

Table C4 Data quality assessment for Area 3B and relevant Assessment Sites

Assessment Sites			Summary - Pre-Mining						Summary - Post-Mining					
Watercourse	Hydstra No.	Gauge Name	Start Date	End Date	No. of Records	% available	% suspect	% infilled	Start Date	End Date	No. of Records	% available	% suspect	% infilled
Donalds Castle Creek	300023	DCU	2/11/2007	8/02/2013	1926	100.0%	0.0%	0.0%	9/02/2013	15/01/2020	2532	99.0%	10.5%	0.0%
DC13	300067	DC13S1	27/06/2012	8/02/2013	227	100.0%	0.0%	0.0%	9/02/2013	26/02/2020	2574	95.6%	4.7%	4.4%
Donalds Castle Creek	300068	DCS2	27/06/2012	9/07/2013	378	100.0%	0.0%	0.0%	10/07/2013	26/02/2020	2423	95.8%	12.8%	4.2%
Wongawilli Creek	300022	WWL	2/11/2007	8/02/2010	830	96.4%	3.8%	3.6%	9/02/2010	18/02/2020	3662	100.0%	0.7%	0.1%
Wongawilli Creek	300022A	WWLA			0				23/08/2018	18/02/2020	545	100.0%	4.0%	2.8%
WC21	300069	WC21S1	20/06/2012	4/10/2013	472	99.8%	0.2%	0.2%	5/10/2013	26/02/2020	2336	100.0%	0.2%	0.0%
WC15	300071	WC15S1	20/06/2012	27/01/2017	1683	91.0%	10.3%	8.9%	28/01/2017	24/01/2020	1092	99.8%	2.8%	0.5%
WC12	300092	WC12S1	5/04/2019	26/02/2020	328	100.0%	3.4%	0.0%						
LA4	300070	LA4S1	24/09/2012	31/03/2015	919	100.0%	0.0%	0.0%	1/04/2015	26/02/2020	1793	93.6%	14.5%	13.5%
LA3	300091	LA3S1	3/02/2019	27/04/2019	84	100.0%	2.4%	0.0%	28/04/2019	28/02/2020	307	99.4%	17.1%	0.7%
LA2	300090	LA2S1	4/02/2019	28/02/2020	390	100.0%	14.6%	0.3%						
NDT	300093	NDTS1	3/03/2019	28/02/2020	363	100.0%	3.6%	0.0%						
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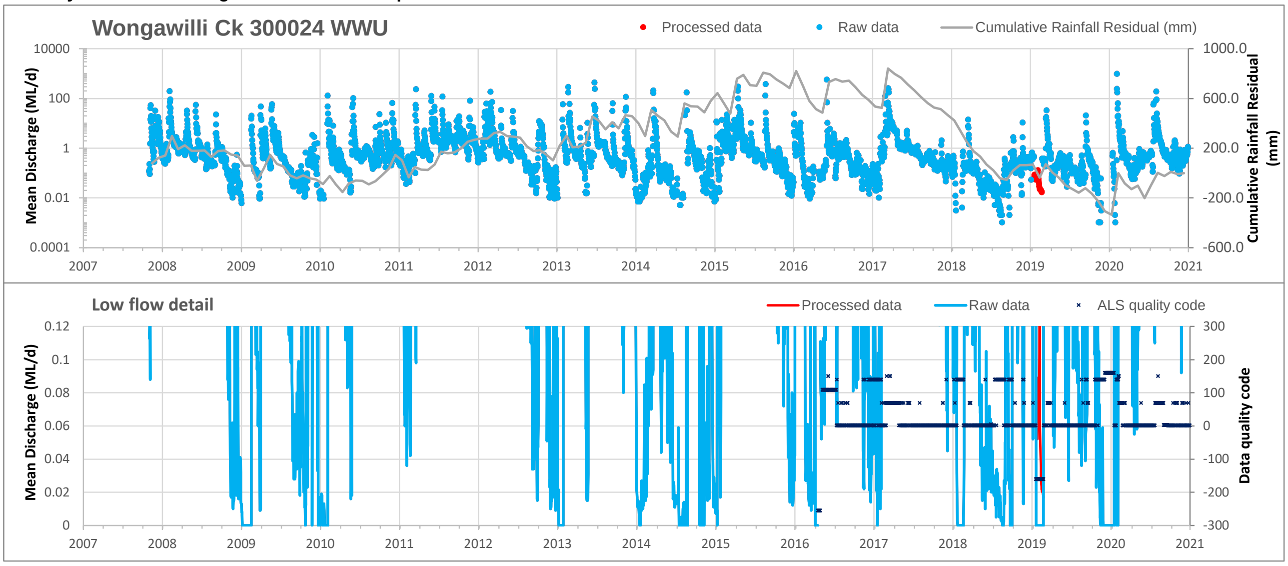
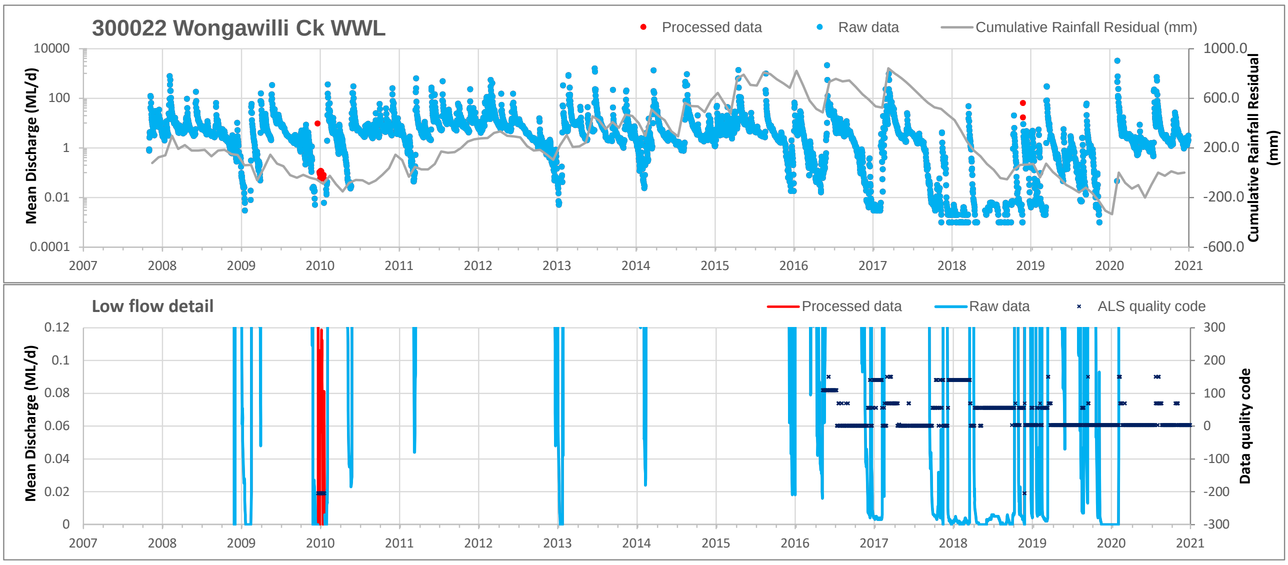
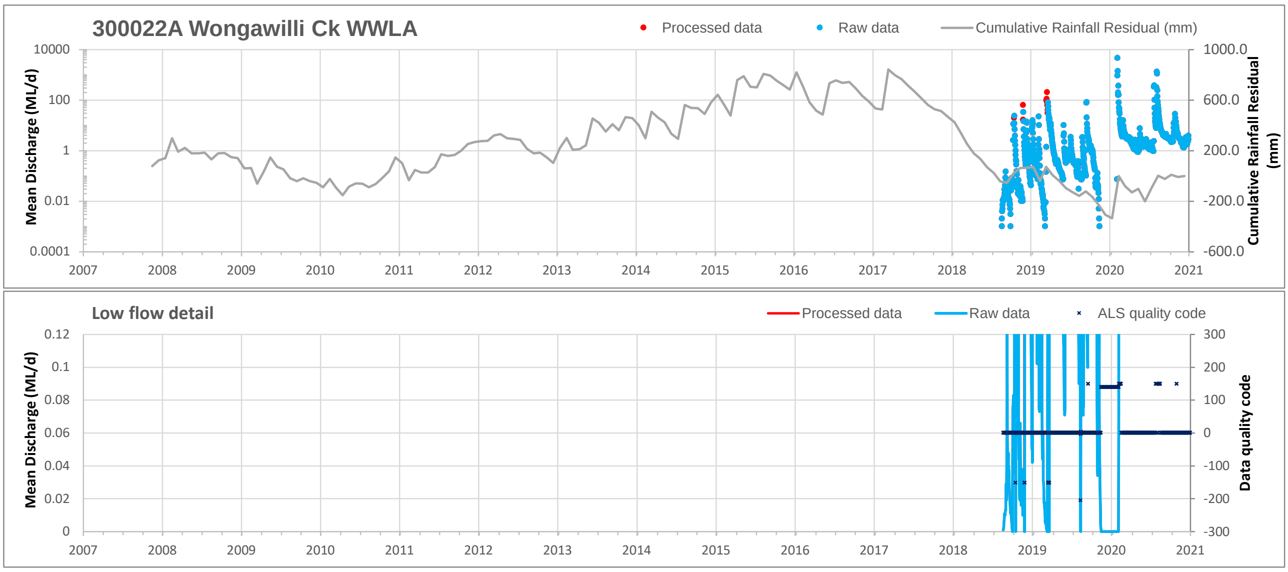
“Suspect” data based on raw data assigned ALS quality codes >-145.

Summary charts illustrating 'raw' flow data and processed or infilled flow data used for TARP Assessments







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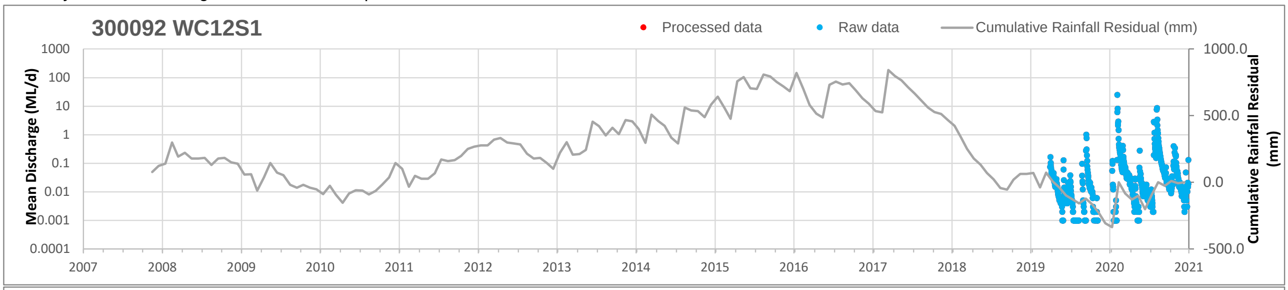
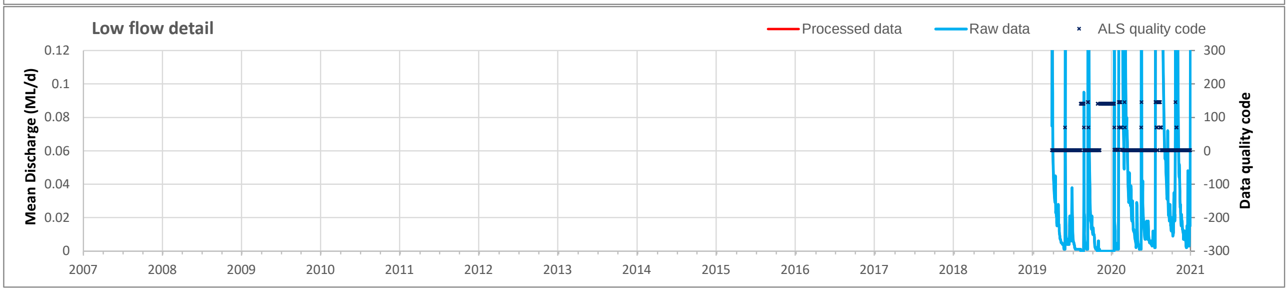
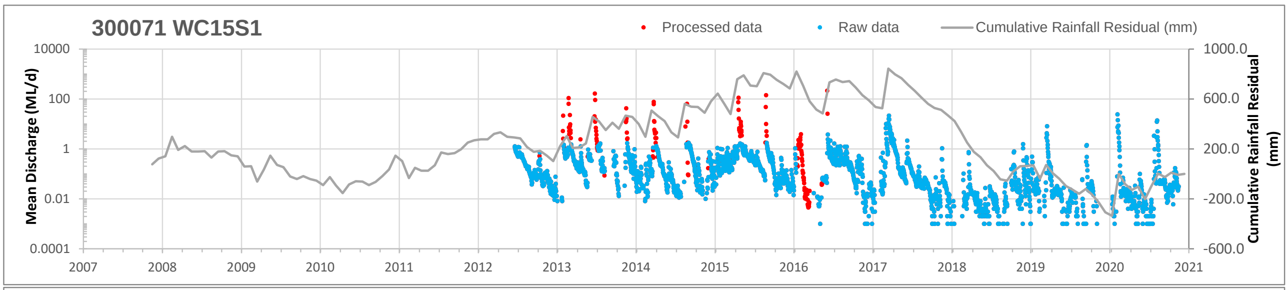
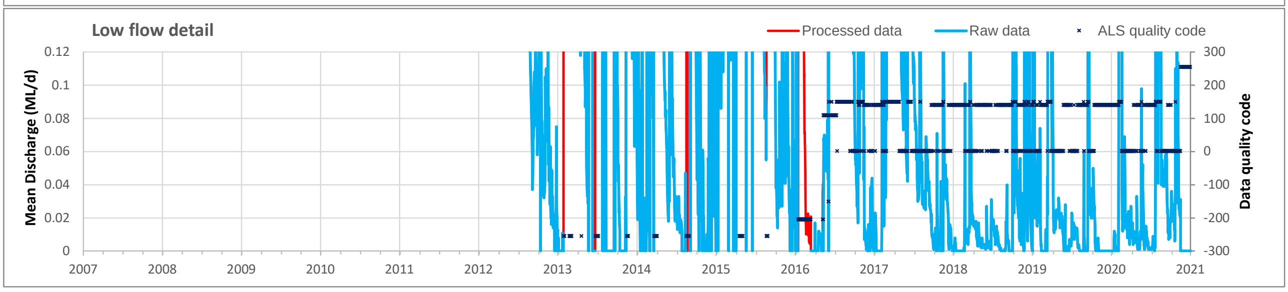
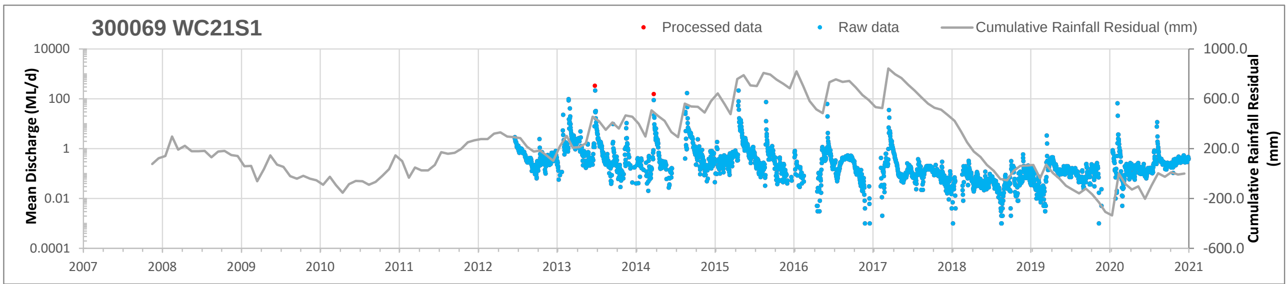
Summary charts illustrating 'raw' flow data and processed or infilled flow data used for TARP Assessments

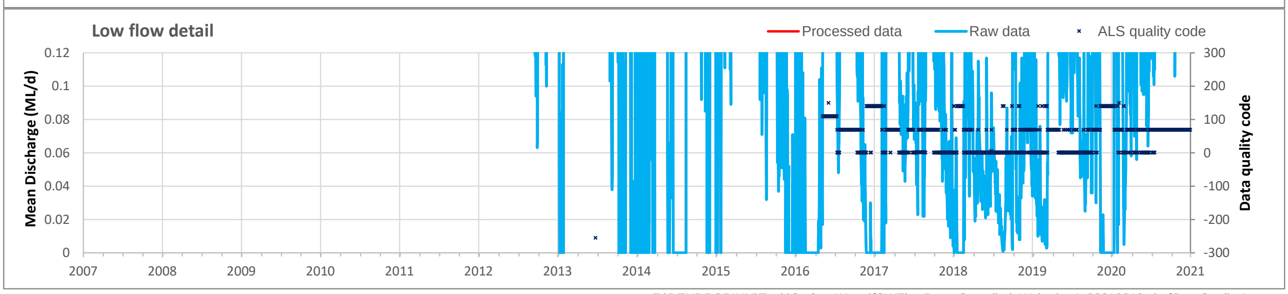












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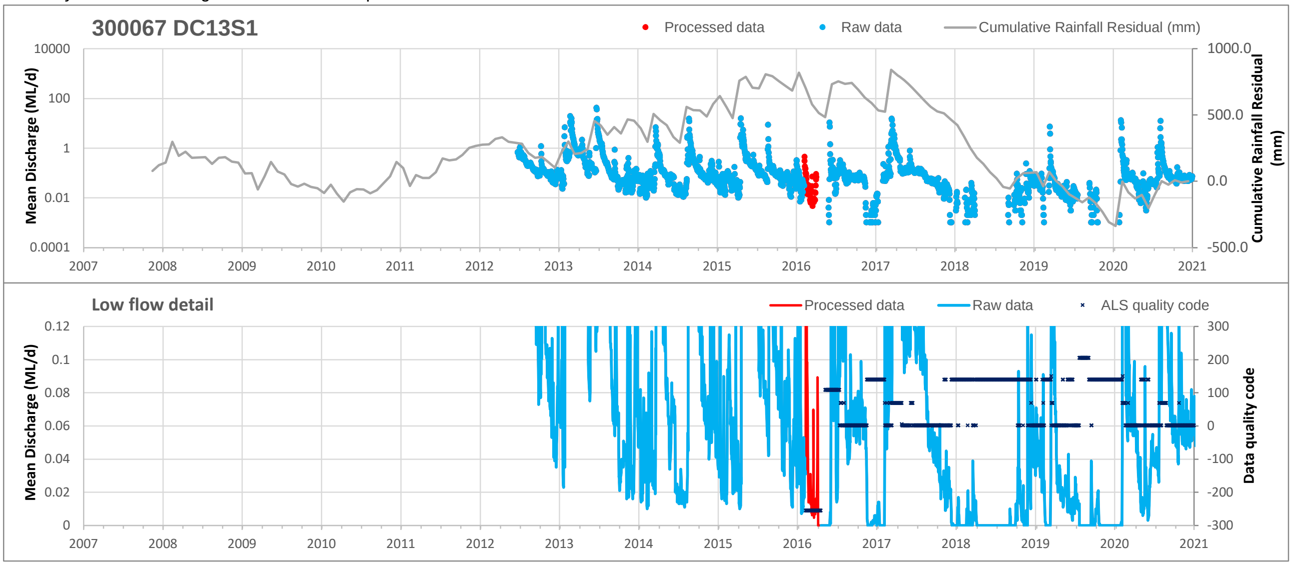
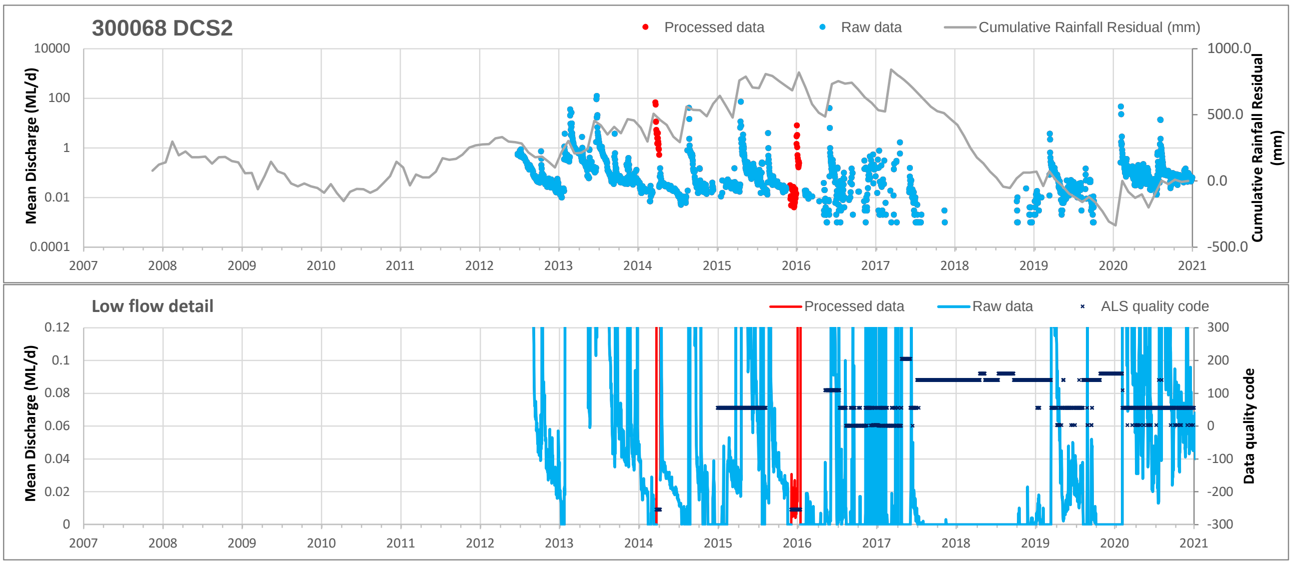
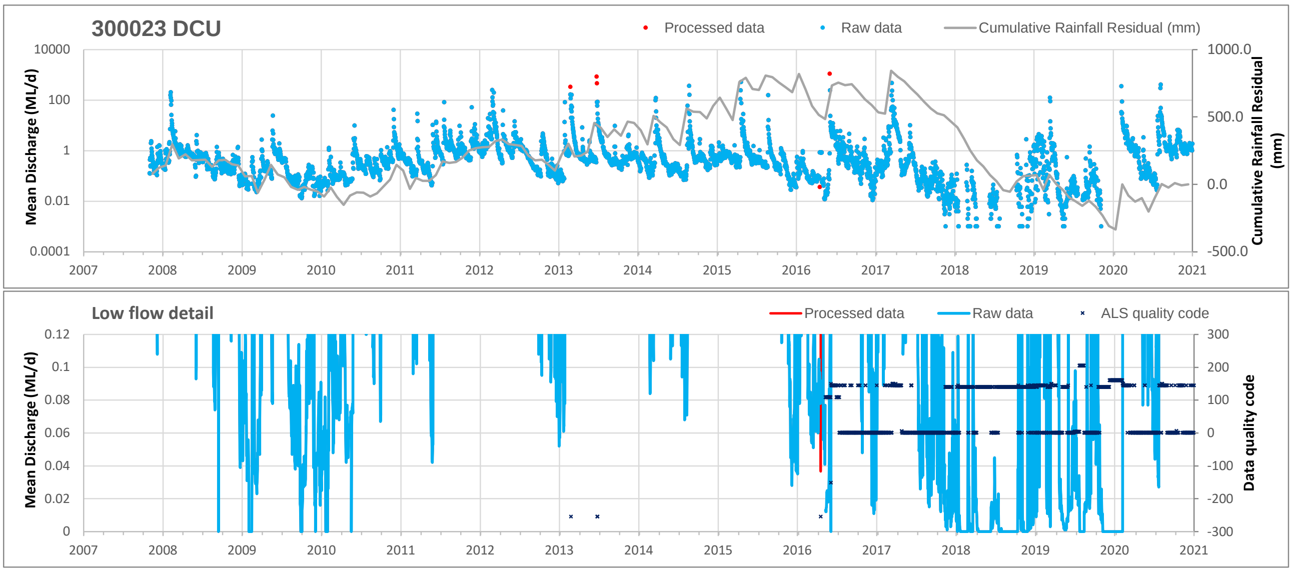
Summary charts illustrating ‘raw’ flow data and processed or infilled flow data used for TARP Assessments







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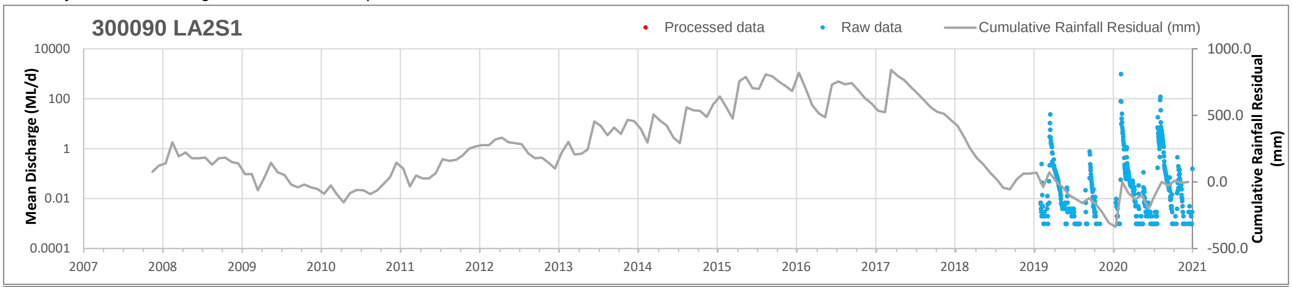

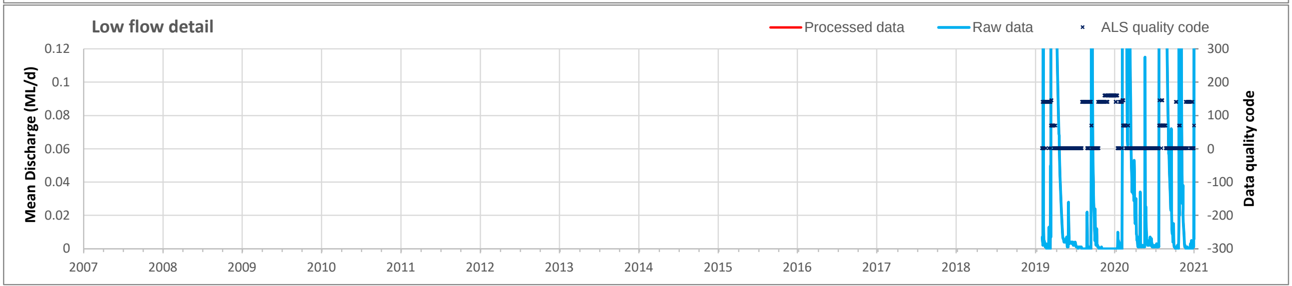

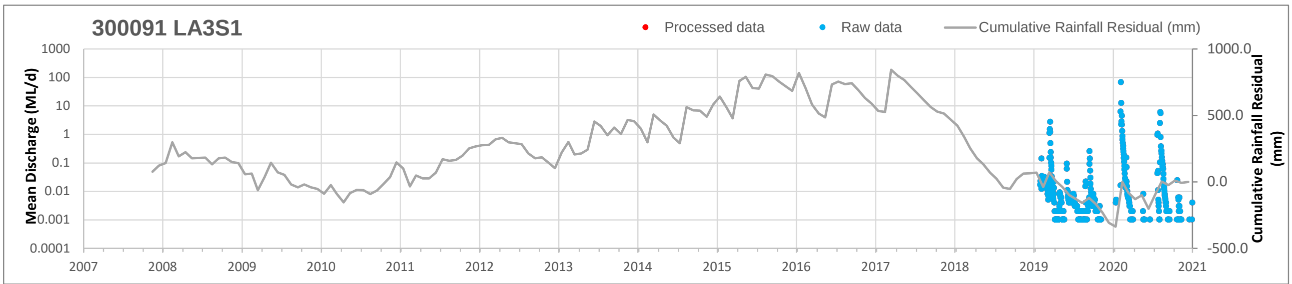

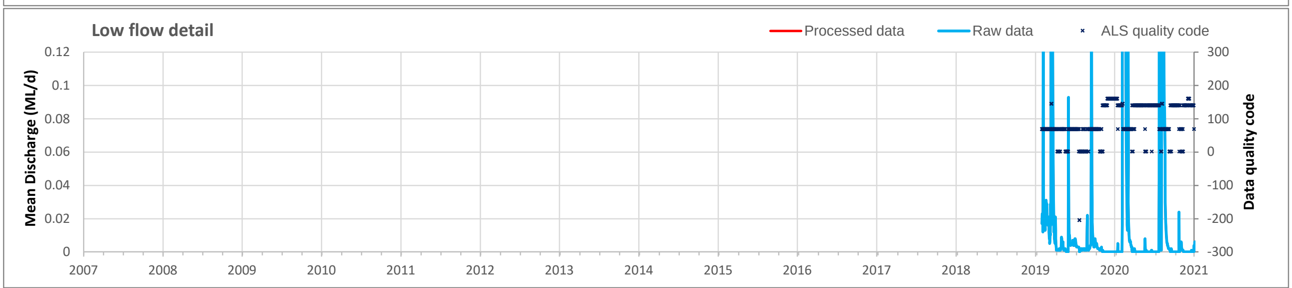

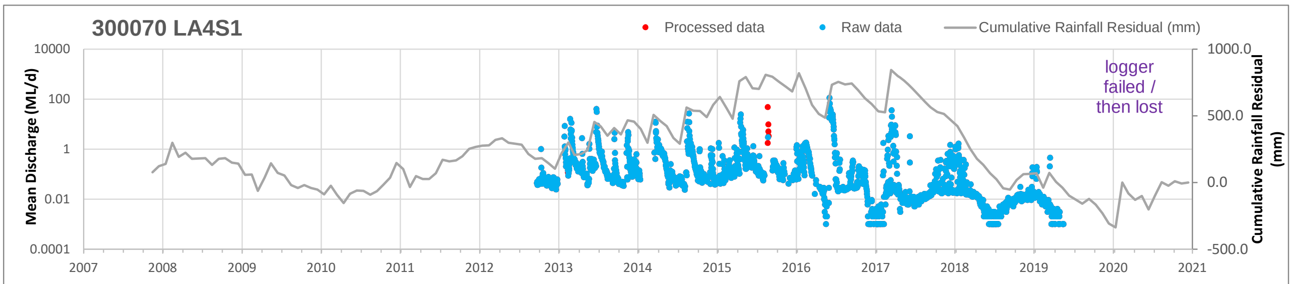

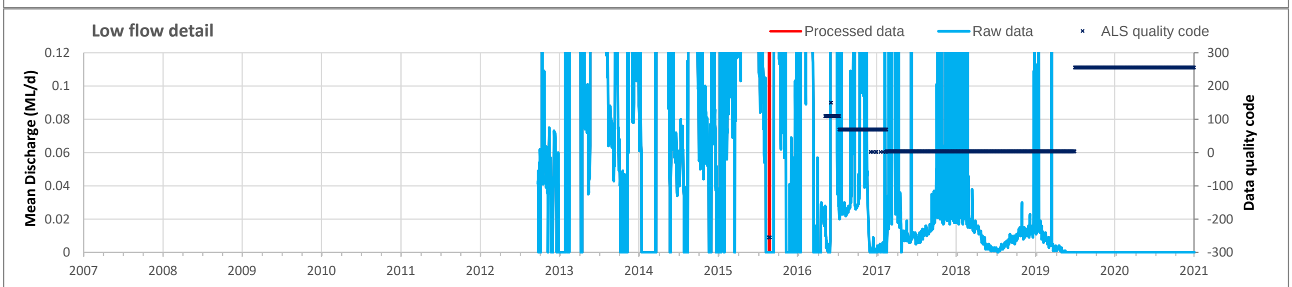

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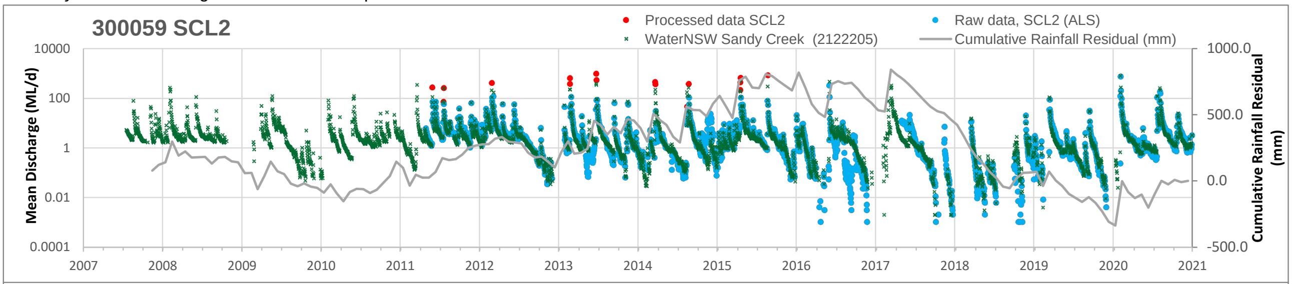
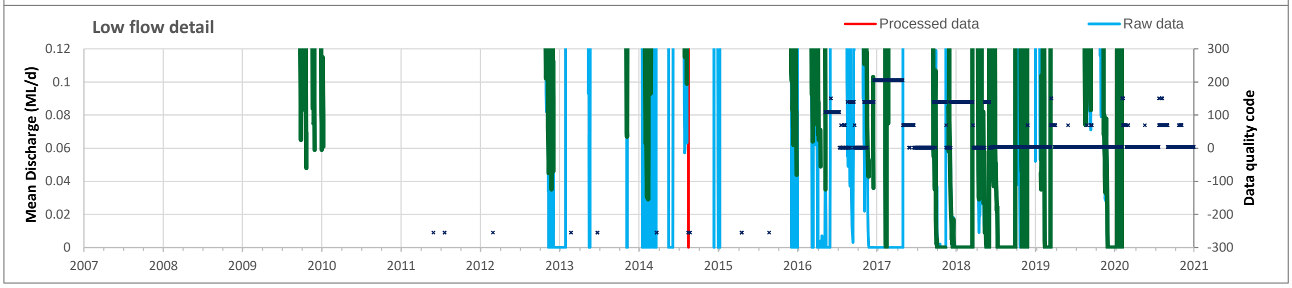
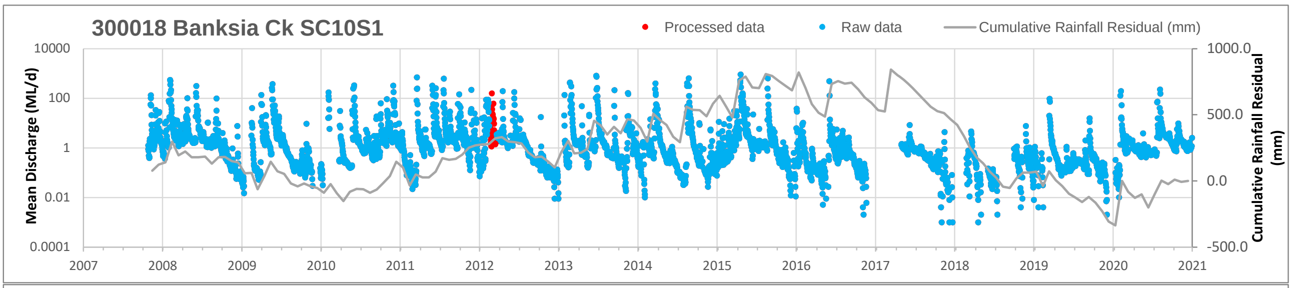
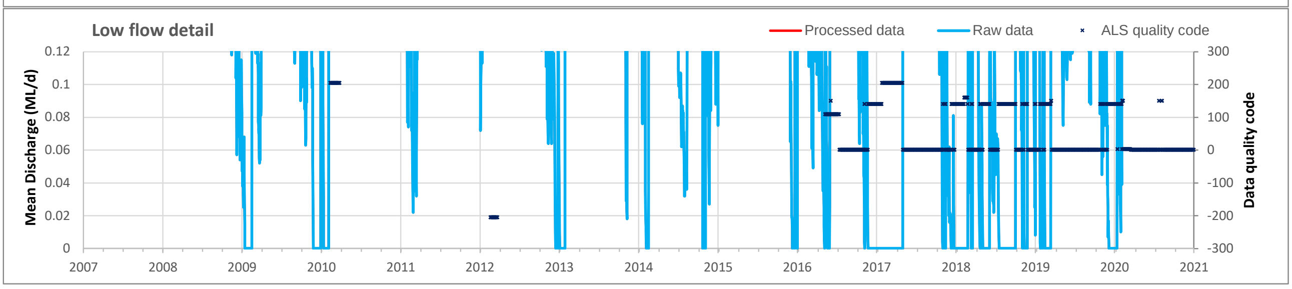
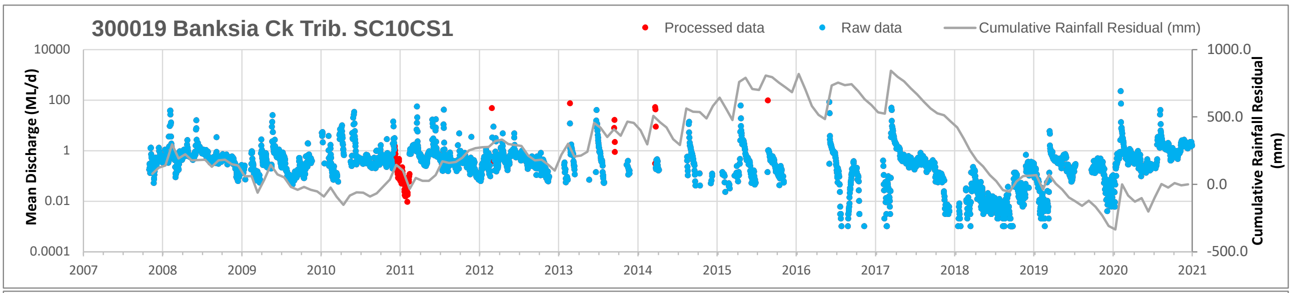
Summary charts illustrating ‘raw’ flow data and processed or infilled flow data used for TARP Assessments

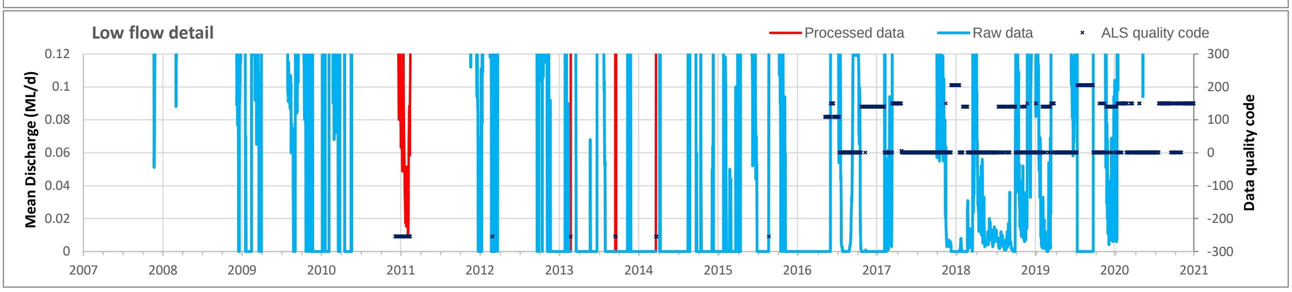






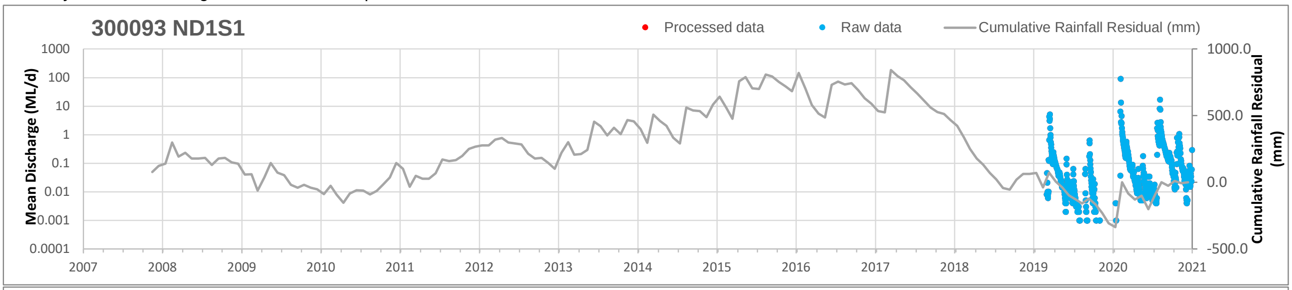


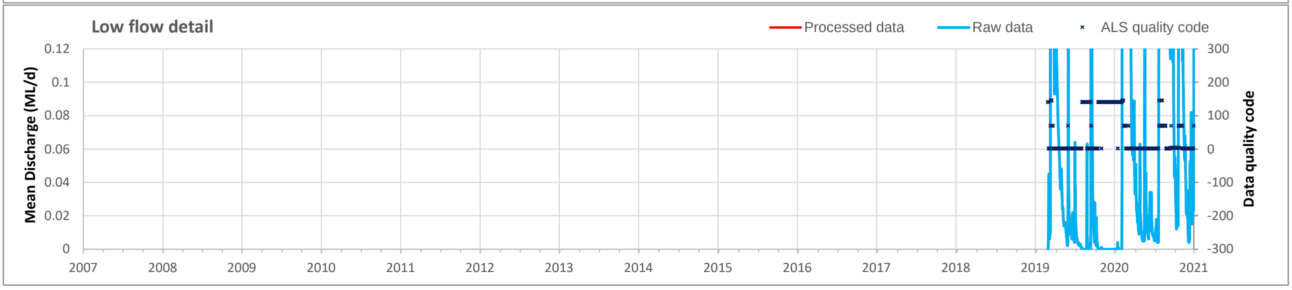


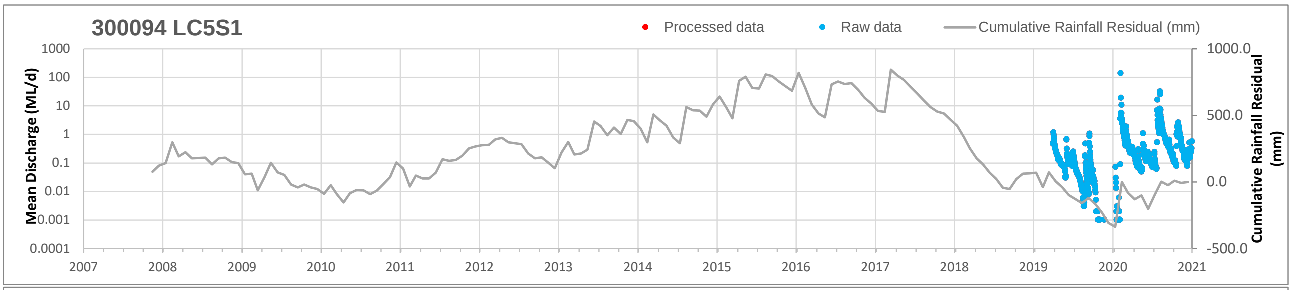


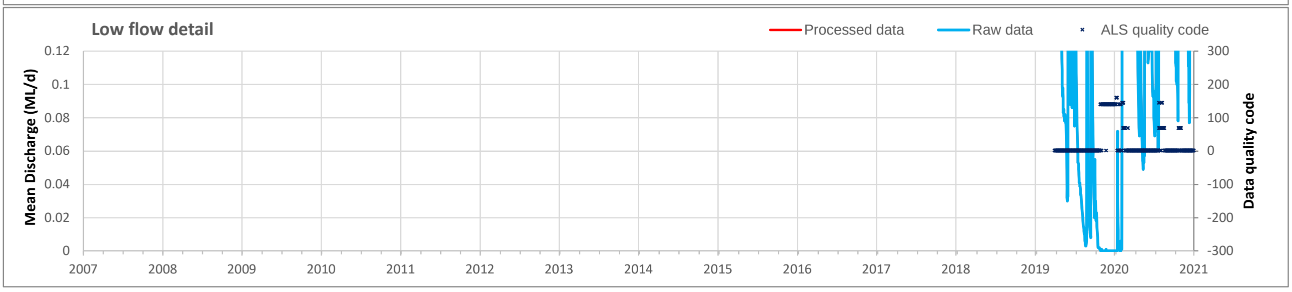
E:\DENDROBIUM\Tech\SurfaceWater\[SWFlowData_Compiled_Wshed_v4_20210219.xlsx]DataQualityAssessment

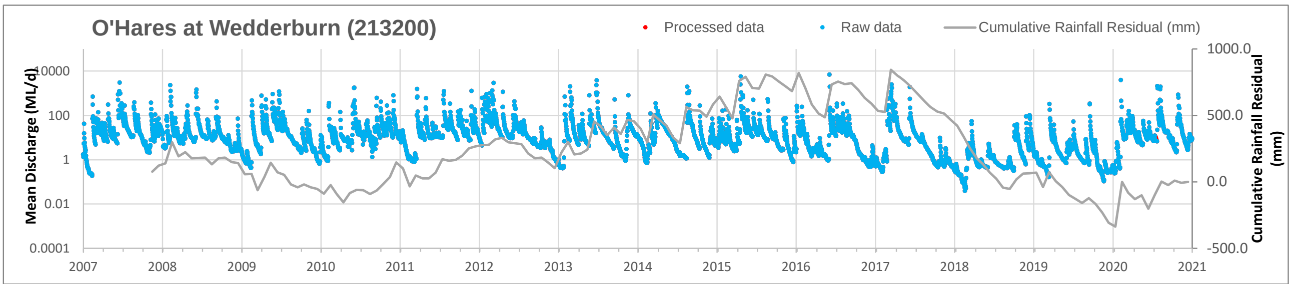
Summary charts illustrating 'raw' flow data and processed or infilled flow data used for TARP Assessments

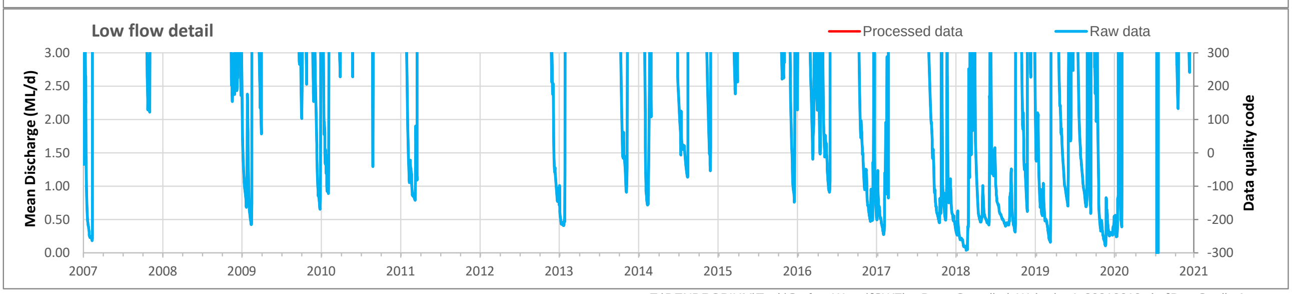






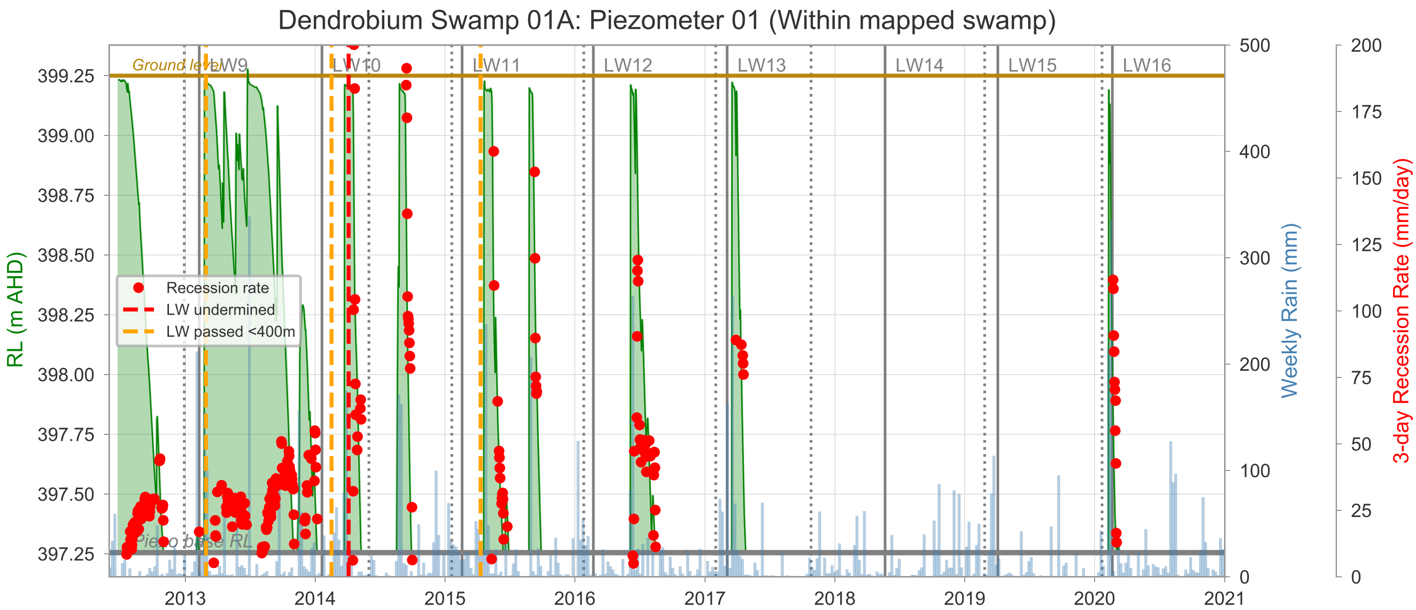


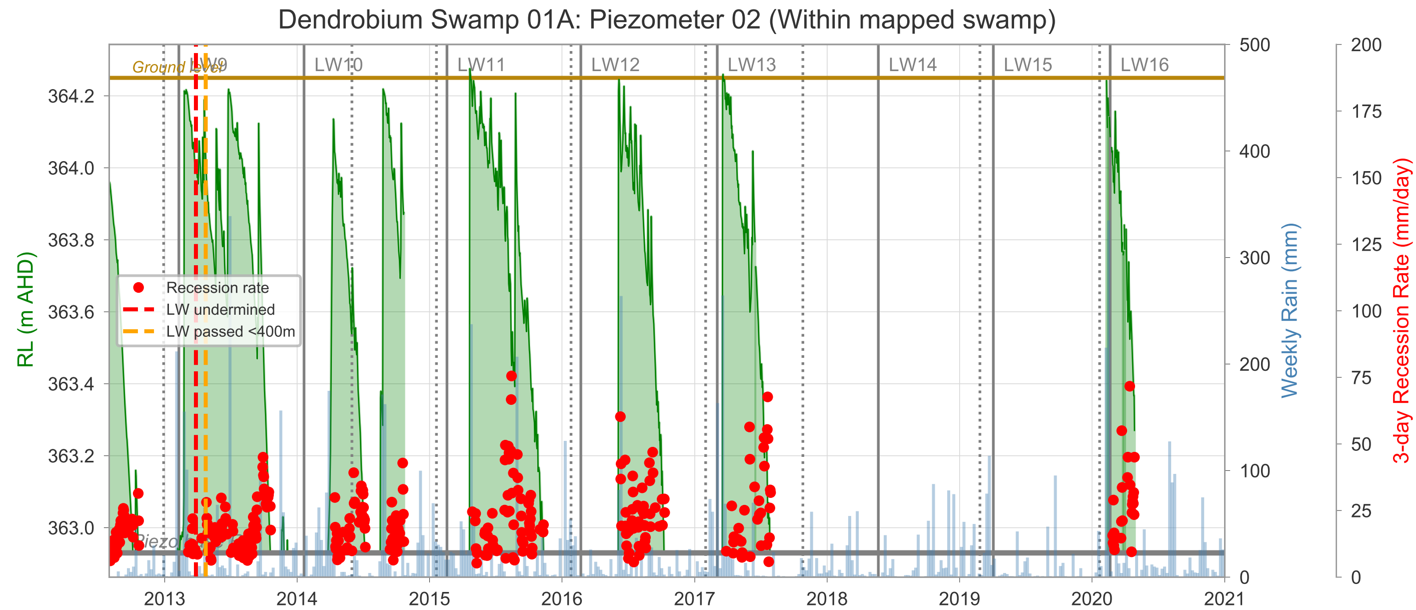


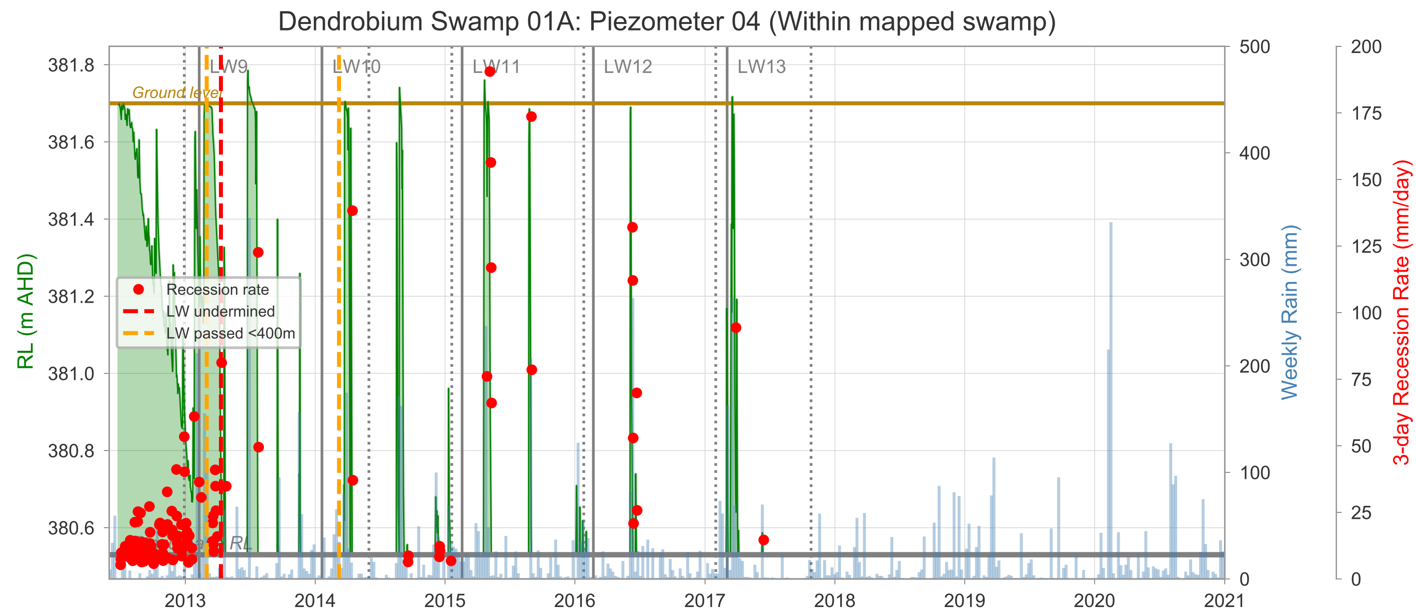


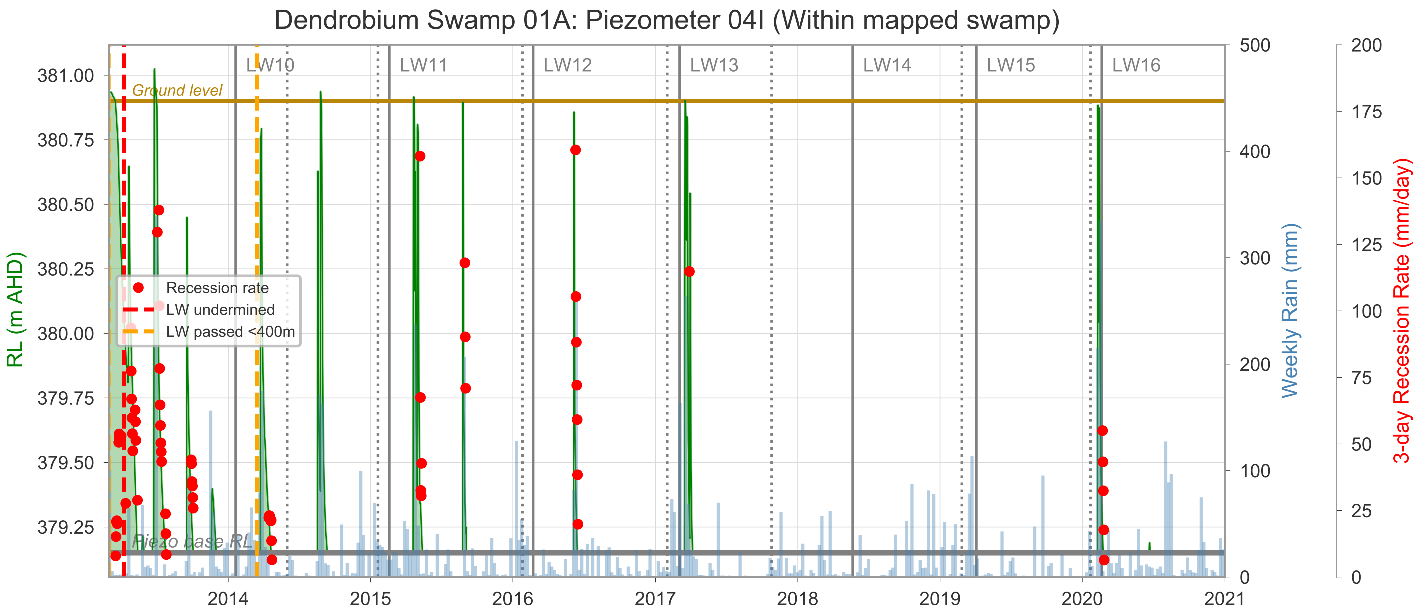
E:\DENDROBIUM\Tech\SurfaceWater\[SWFlowData_Compiled_Wshed_v4_20210219.xlsx]DataQualityAssessment

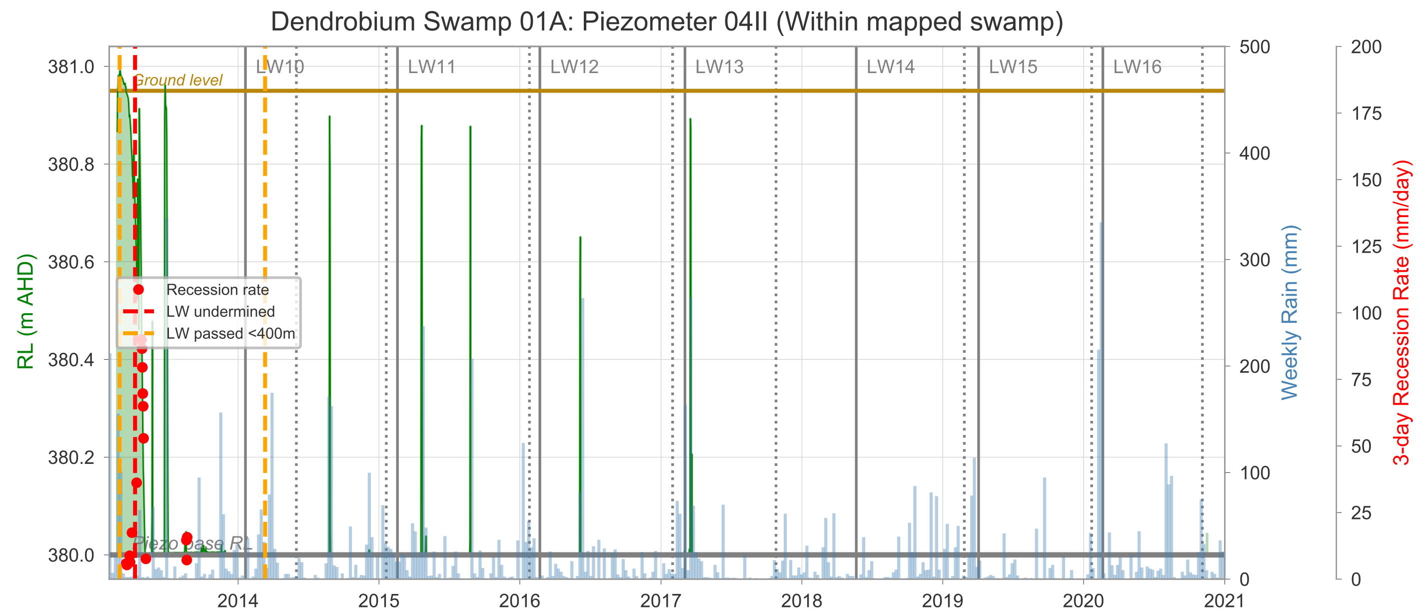
Appendix D: Shallow groundwater hydrographs

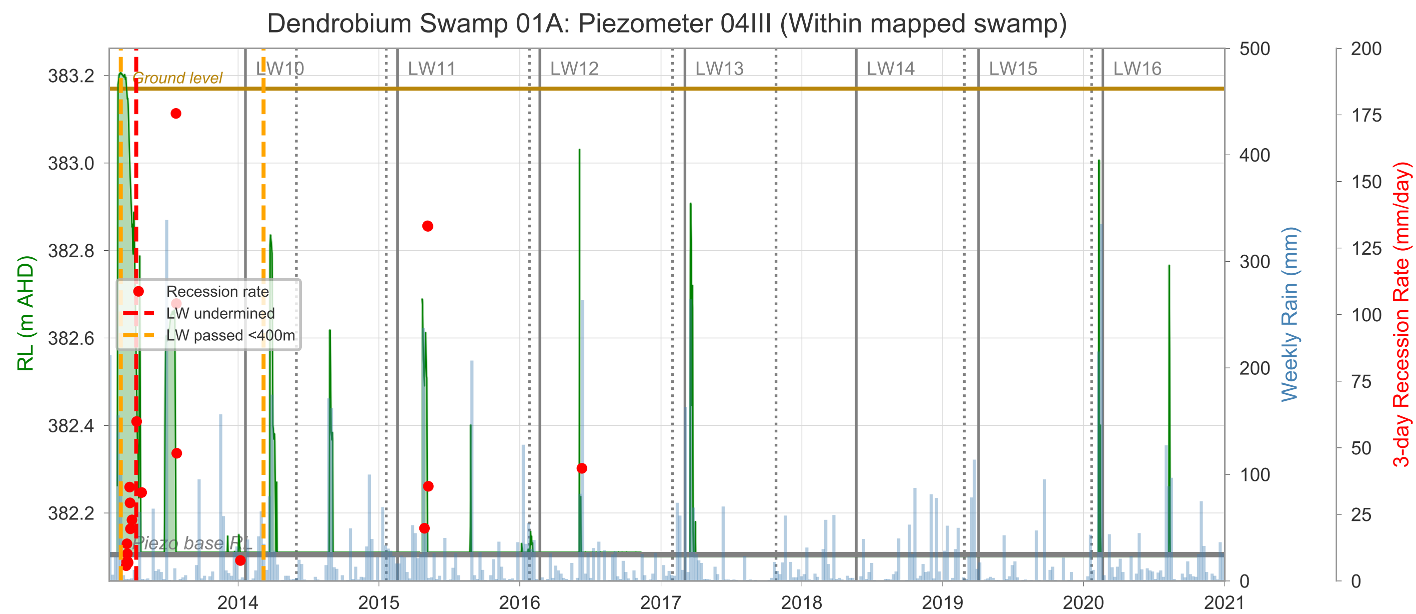

Dendrobium Swamp 01A: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
399.25
399.00
398.75
398.50
398.25
398.00
397.75
397.50
397.25
2013
2014
2015
2016
2017
2018
2019
2020
2021
0
100
200
300
400
500
0
25
50
75
100
125
150
175
200

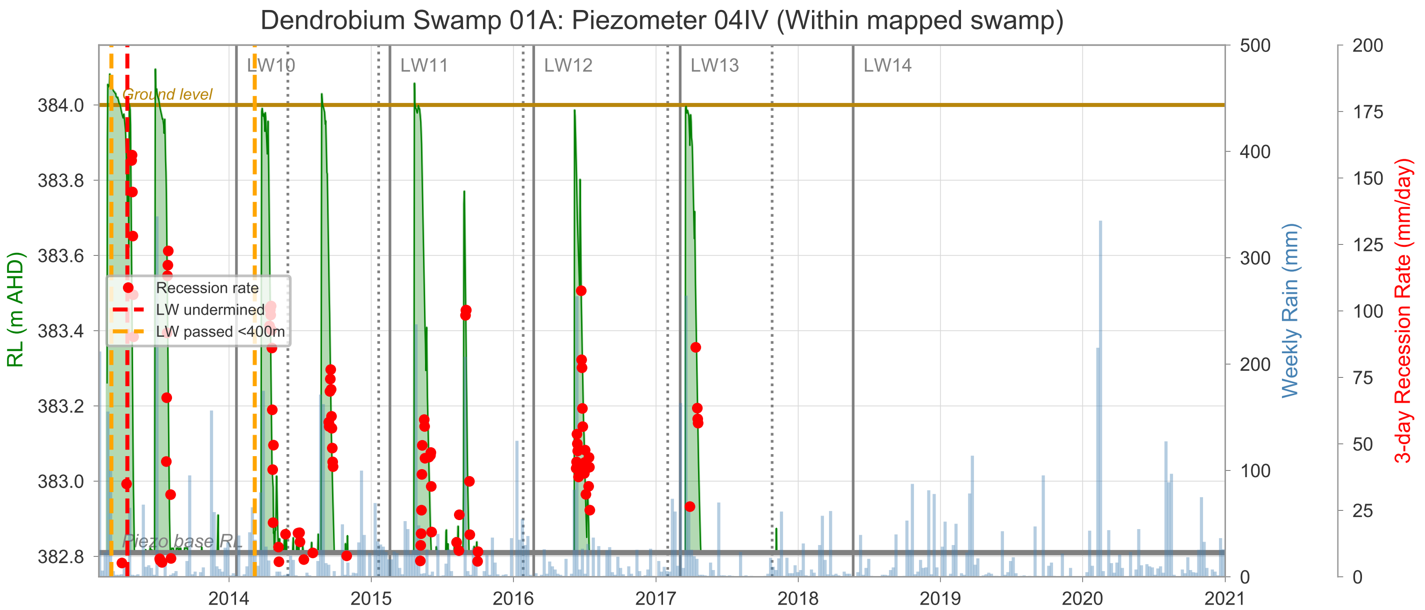

Dendrobium Swamp 01A: Piezometer 02 (Within mapped swamp)
Ground level
Piezo
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
364.2
364.0
363.8
363.6
363.4
363.2
363.0
2013
2014
2015
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 01A: Piezometer 04 (Within mapped swamp)
Ground level
RL
LW9
LW10
LW11
LW12
LW13
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
381.8
381.6
381.4
381.2
381.0
380.8
380.6
2013
2014
2015
2016
2017
2018
2019
2020
2021

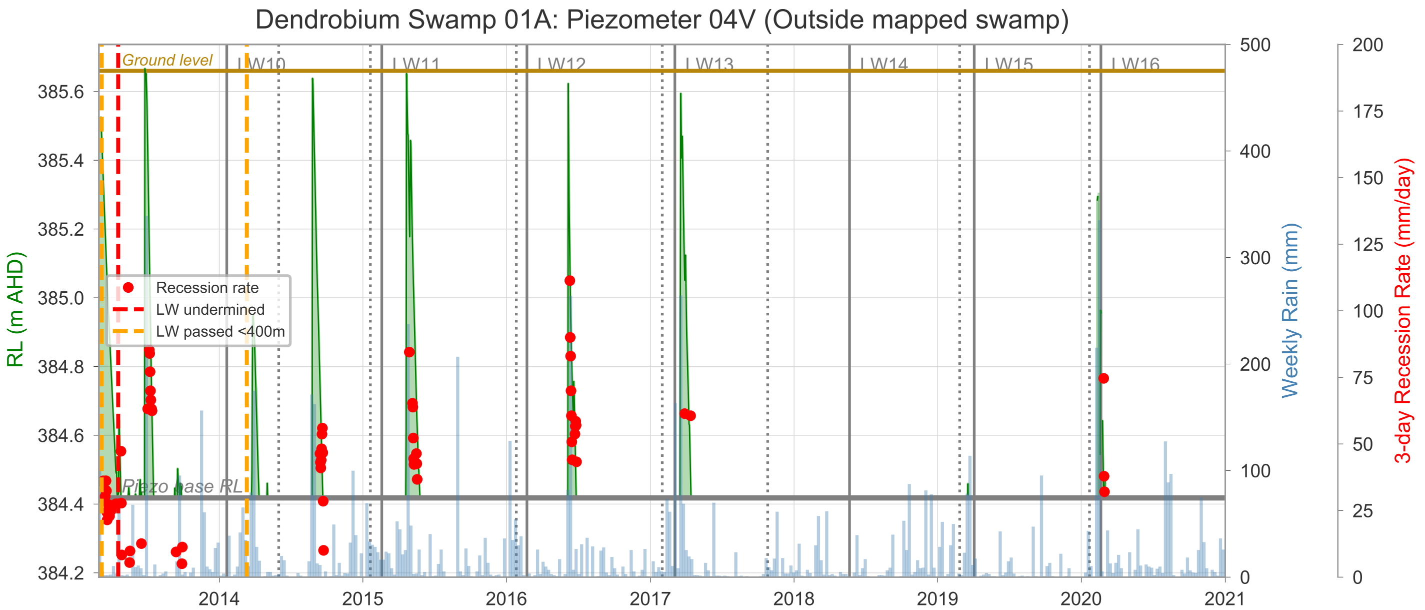

Dendrobium Swamp 01A: Piezometer 04I (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 01A: Piezometer 04II (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

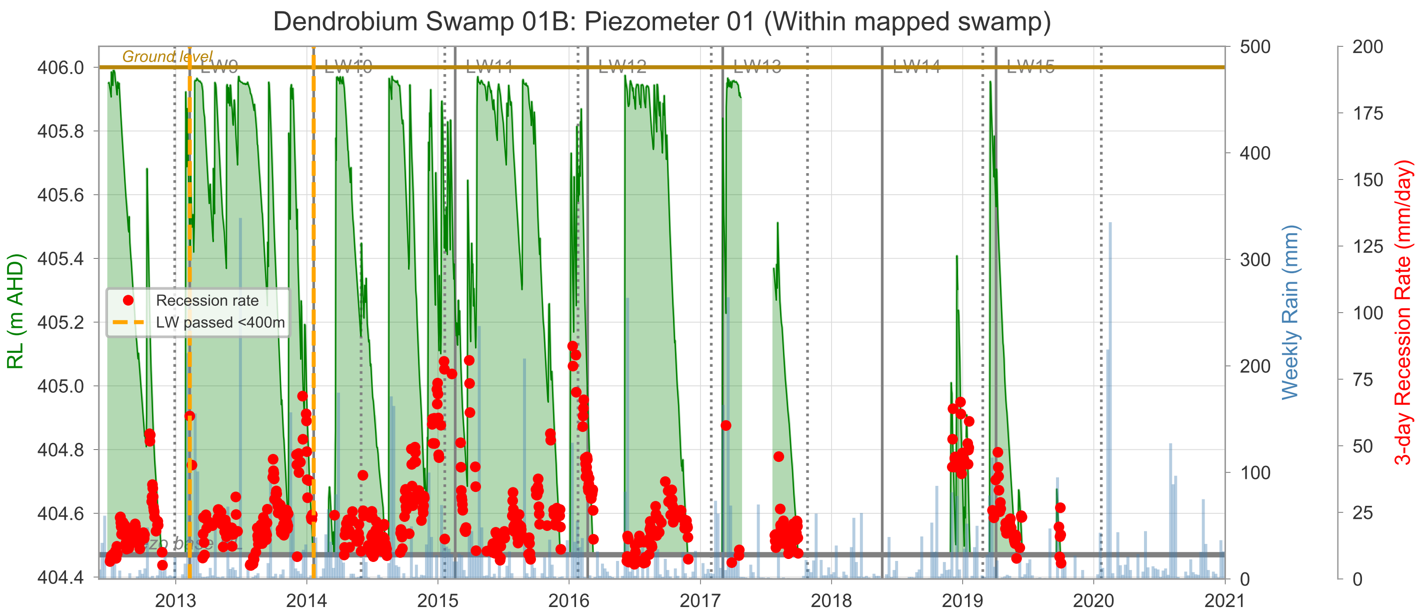

Dendrobium Swamp 01A: Piezometer 04III (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



Dendrobium Swamp 01A: Piezometer 04IV (Within mapped swamp)
LW10
LW11
LW12
LW13
LW14
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
384.0
383.8
383.6
383.4
383.2
383.0
382.8
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

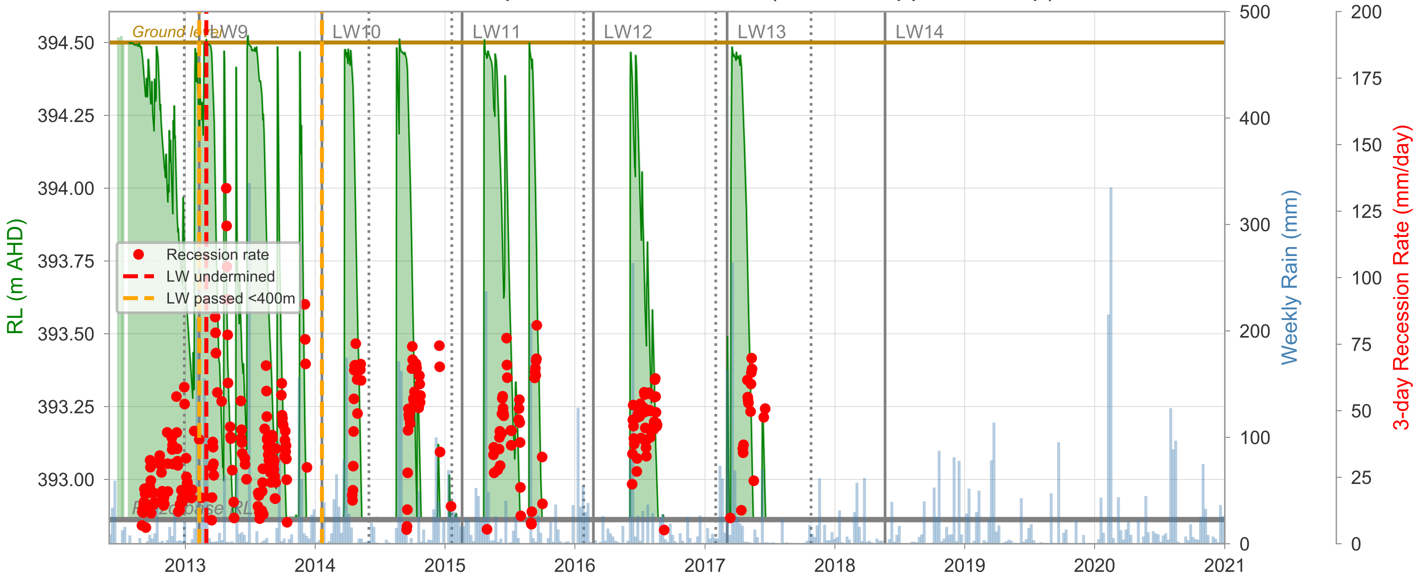


Dendrobium Swamp 01A: Piezometer 04V (Outside mapped swamp)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
385.6
385.4
385.2
385.0
384.8
384.6
384.4
384.2
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021

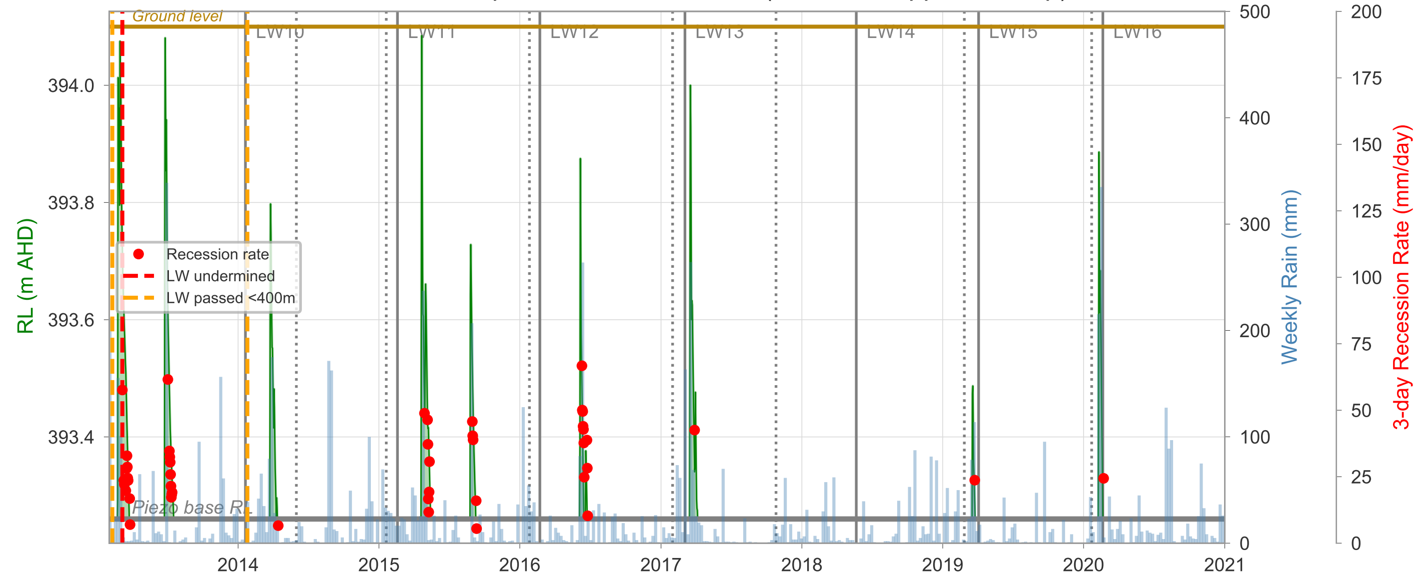


Dendrobium Swamp 01B: Piezometer 01 (Within mapped swamp)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
Ground level
Piezo base
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
406.0
405.8
405.6
405.4
405.2
405.0
404.8
404.6
404.4
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2013
2014
2015
2016
2017
2018
2019
2020
2021

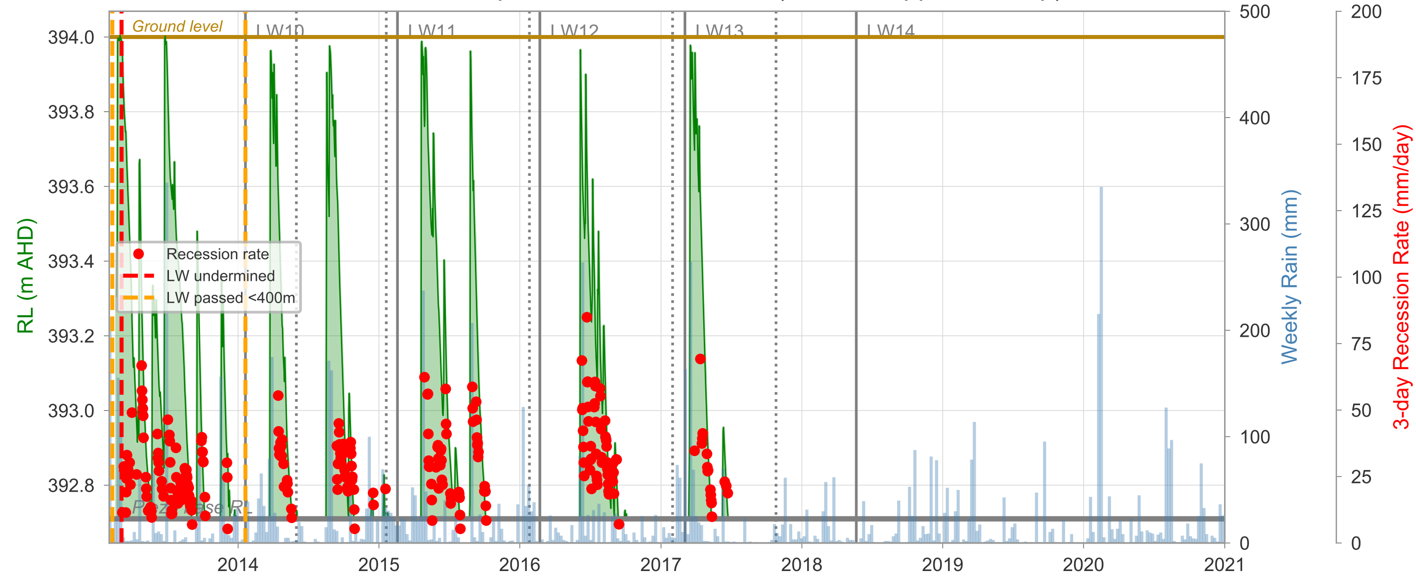
Dendrobium Swamp 01B: Piezometer 02 (Within mapped swamp)

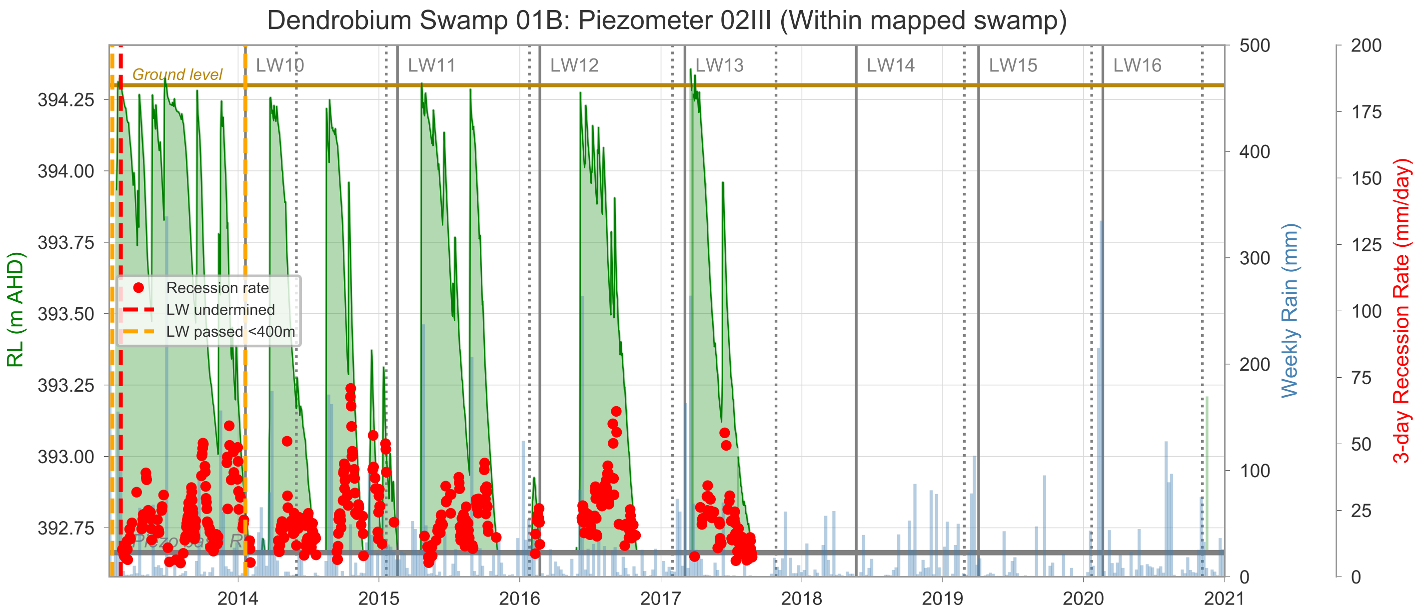


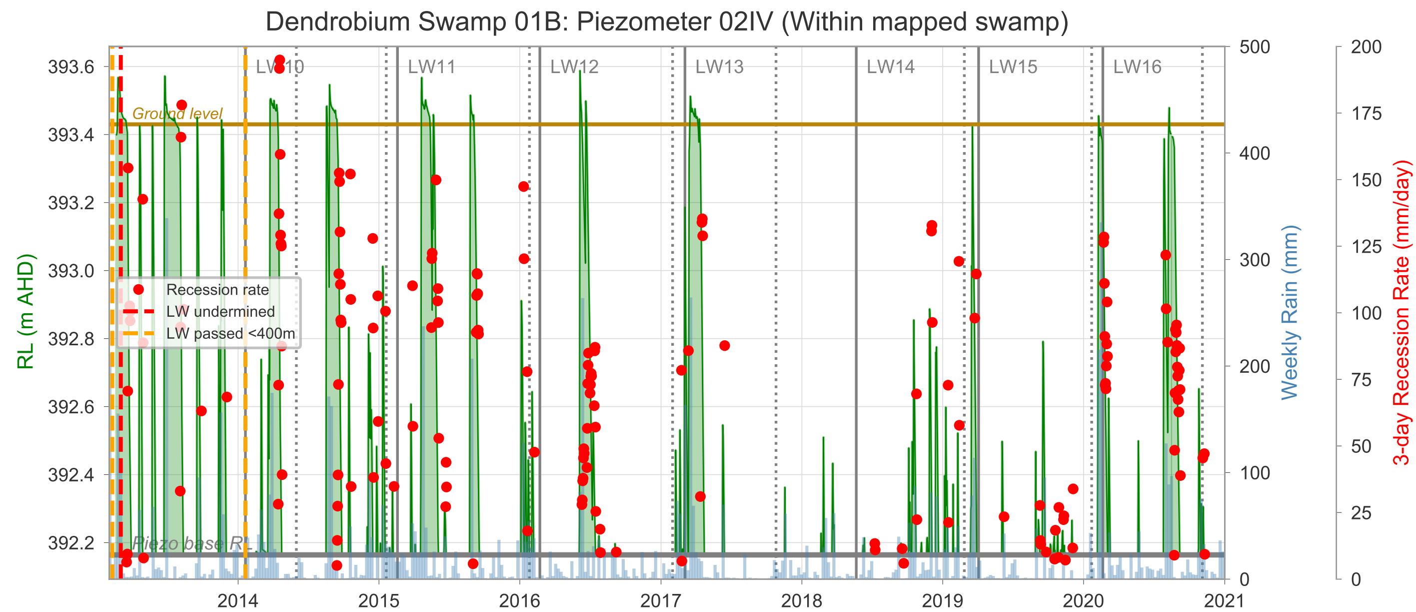
Dendrobium Swamp 01B: Piezometer 02I (Outside mapped swamp)

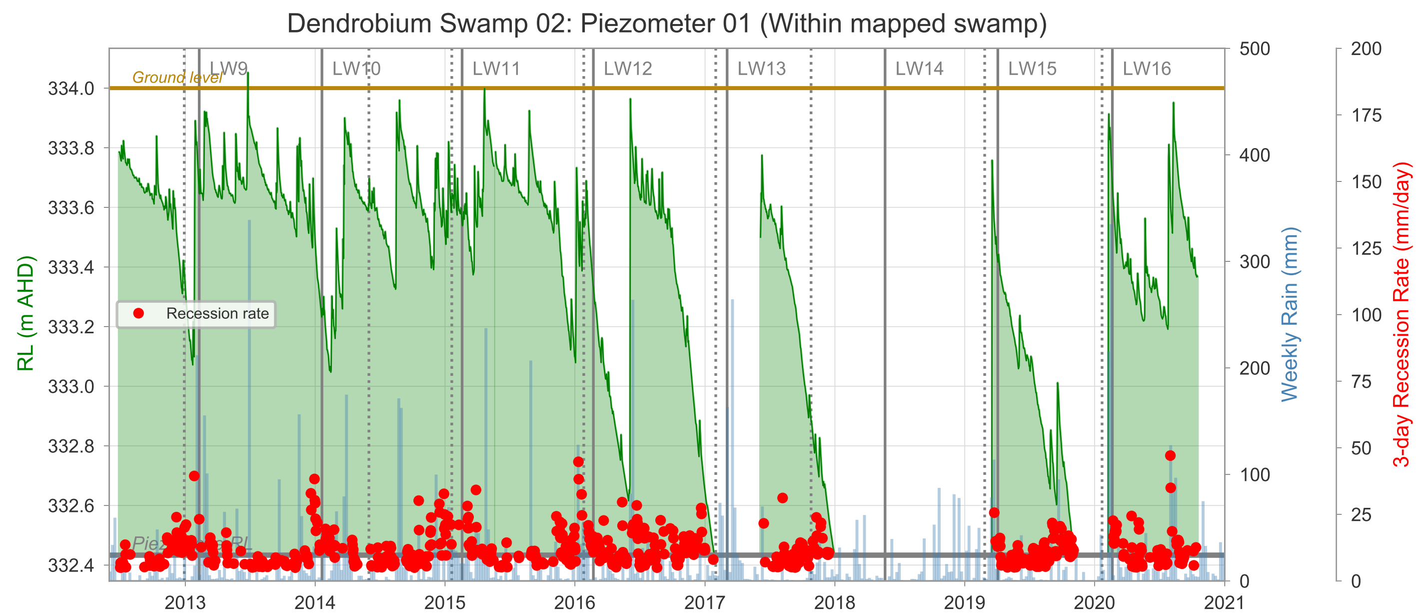


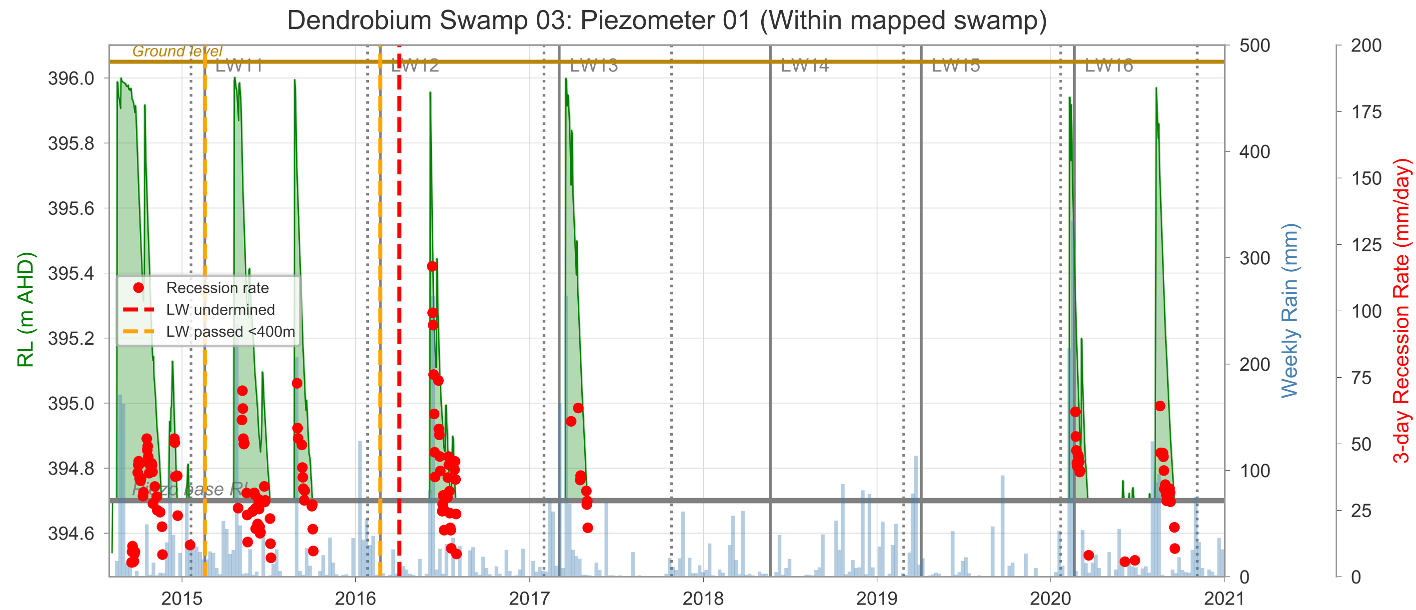
Dendrobium Swamp 01B: Piezometer 02II (Within mapped swamp)



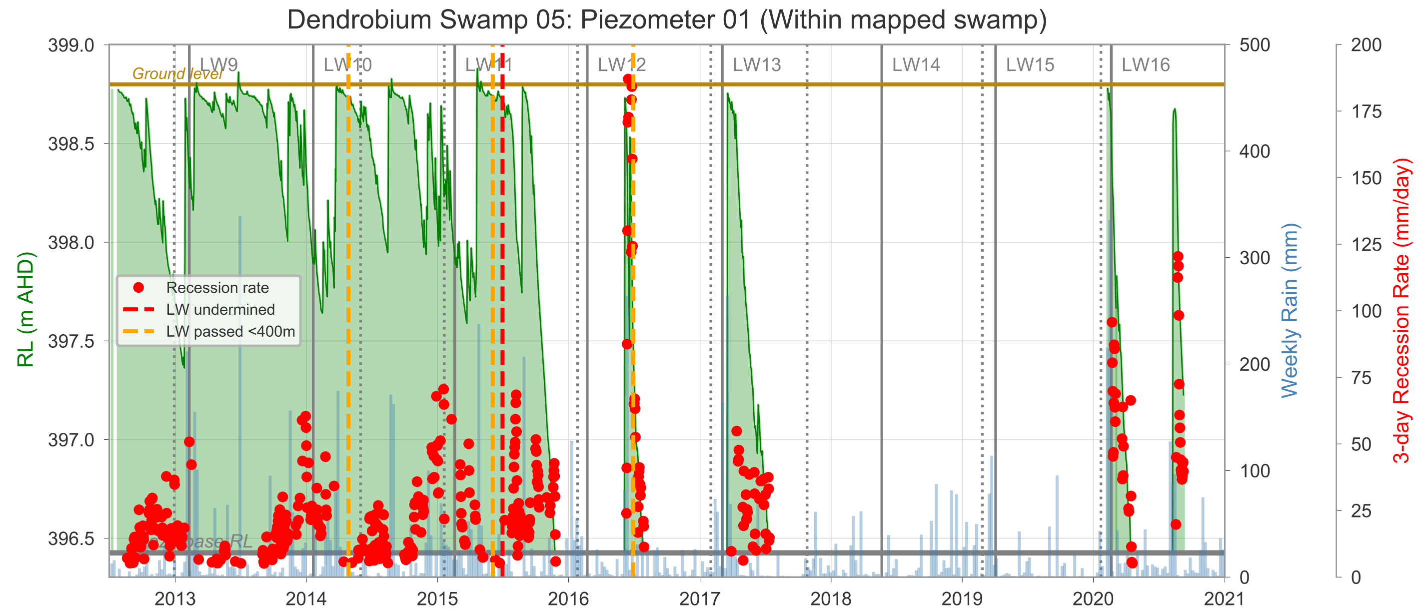

Dendrobium Swamp 01B: Piezometer 02III (Within mapped swamp)
Ground level
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2014
2015
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 01B: Piezometer 02IV (Within mapped swamp)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2014
2015
2016
2017
2018
2019
2020
2021

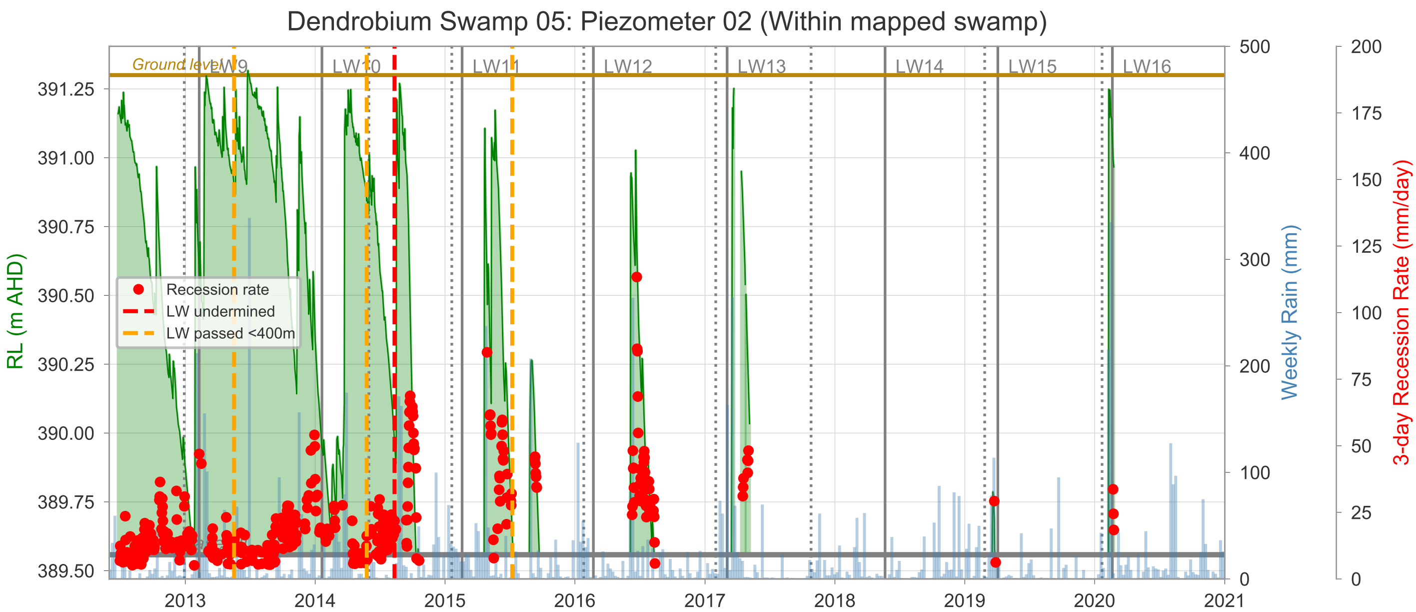

Dendrobium Swamp 02: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2013
2014
2015
2016
2017
2018
2019
2020
2021



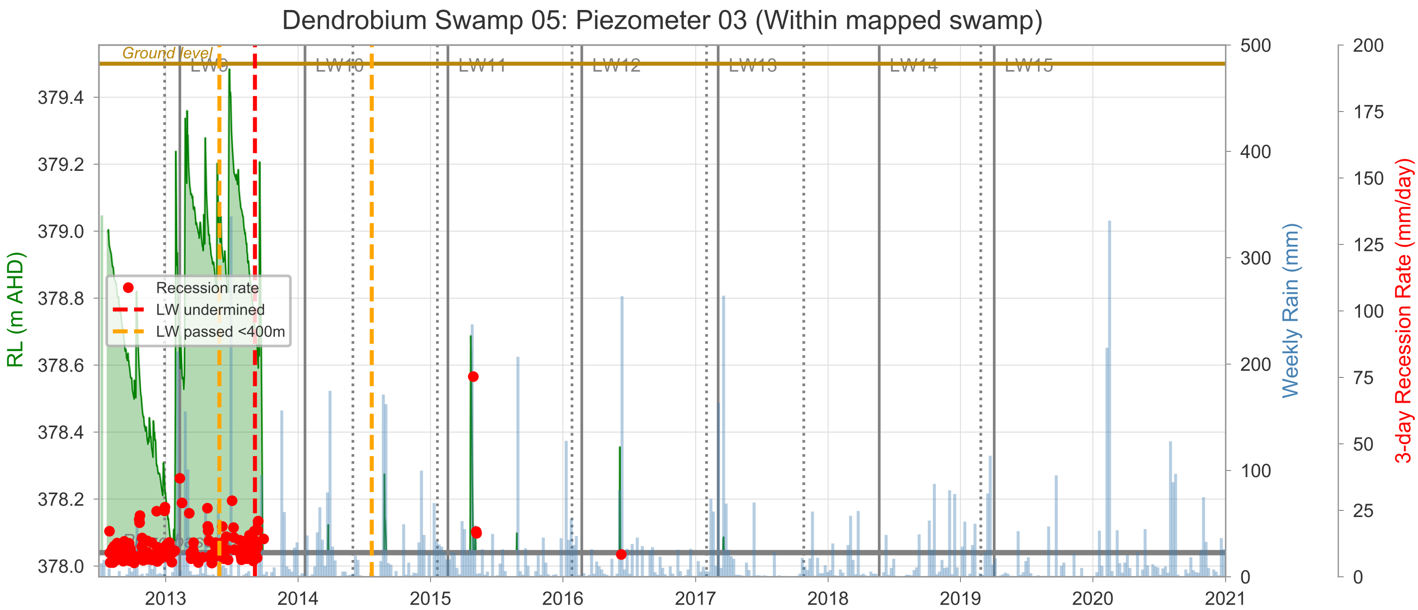
Dendrobium Swamp 03: Piezometer 01 (Within mapped swamp)
Ground level
LW11
LW12
LW13
LW14
LW15
LW16
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



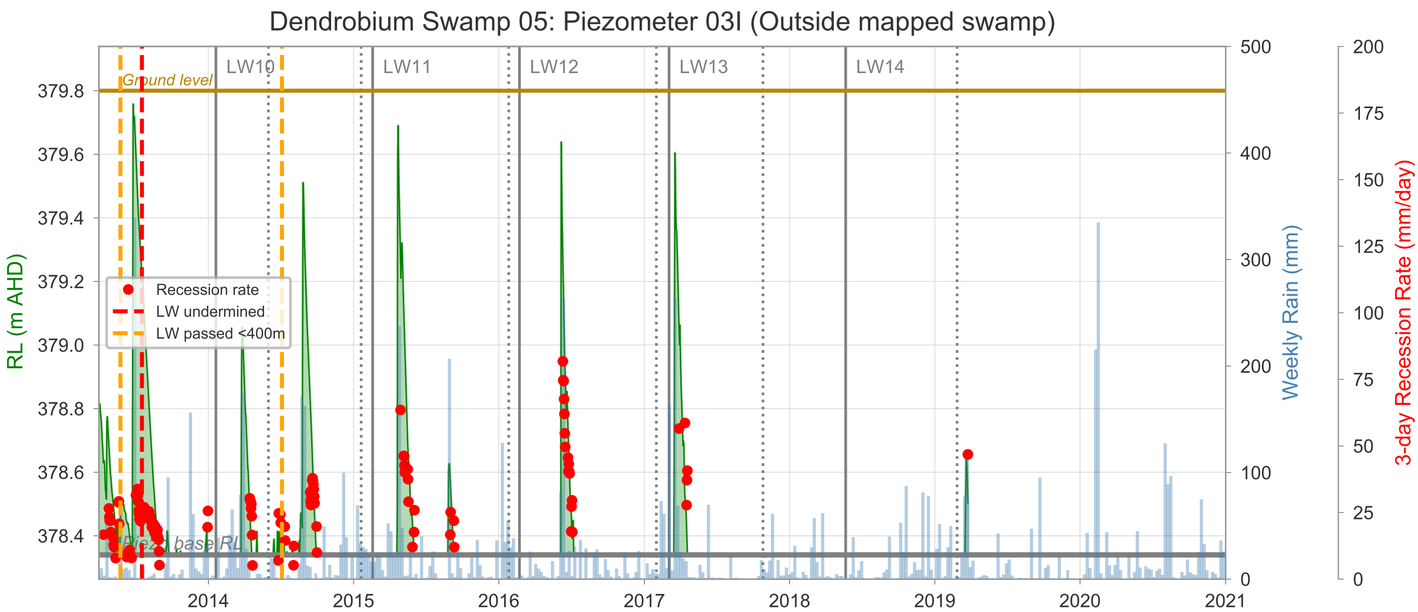
Dendrobium Swamp 05: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



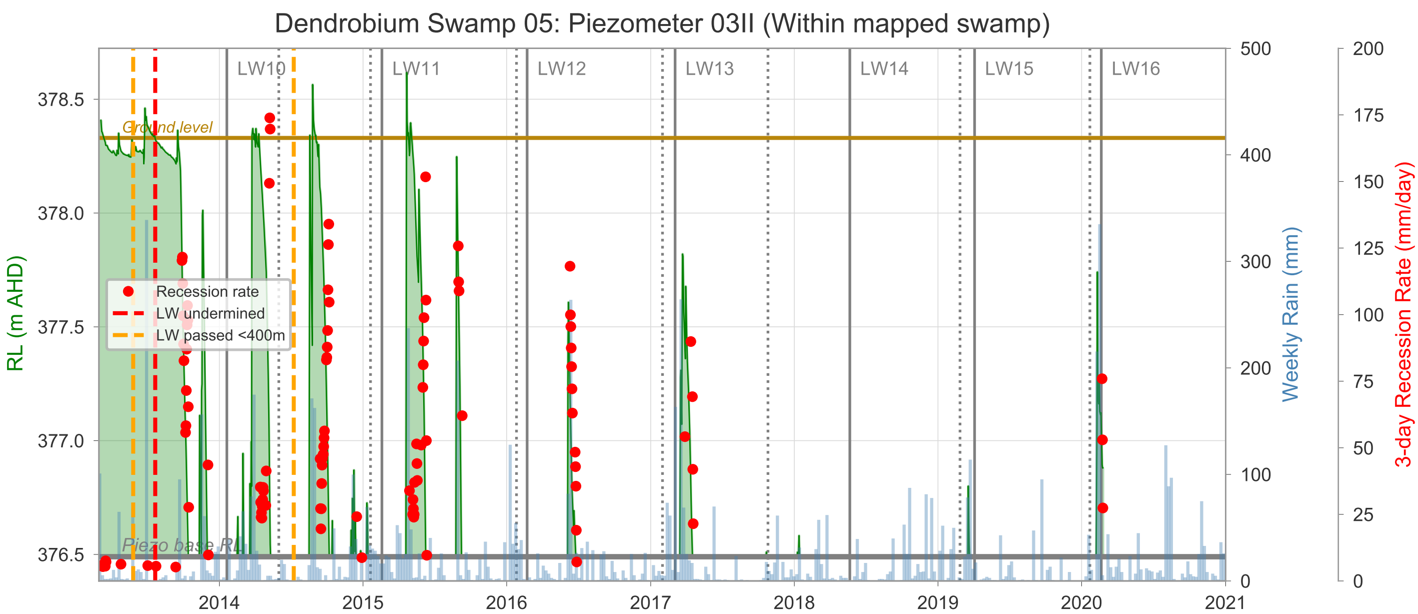
Dendrobium Swamp 05: Piezometer 02 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



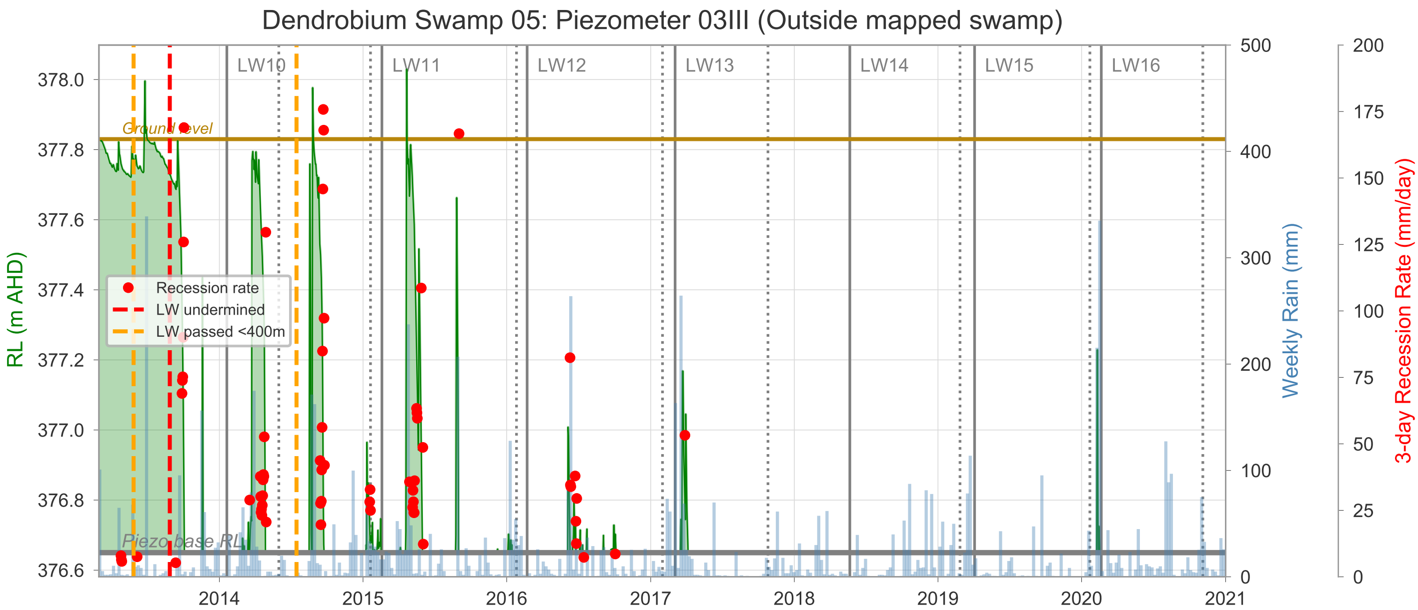
Dendrobium Swamp 05: Piezometer 03 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



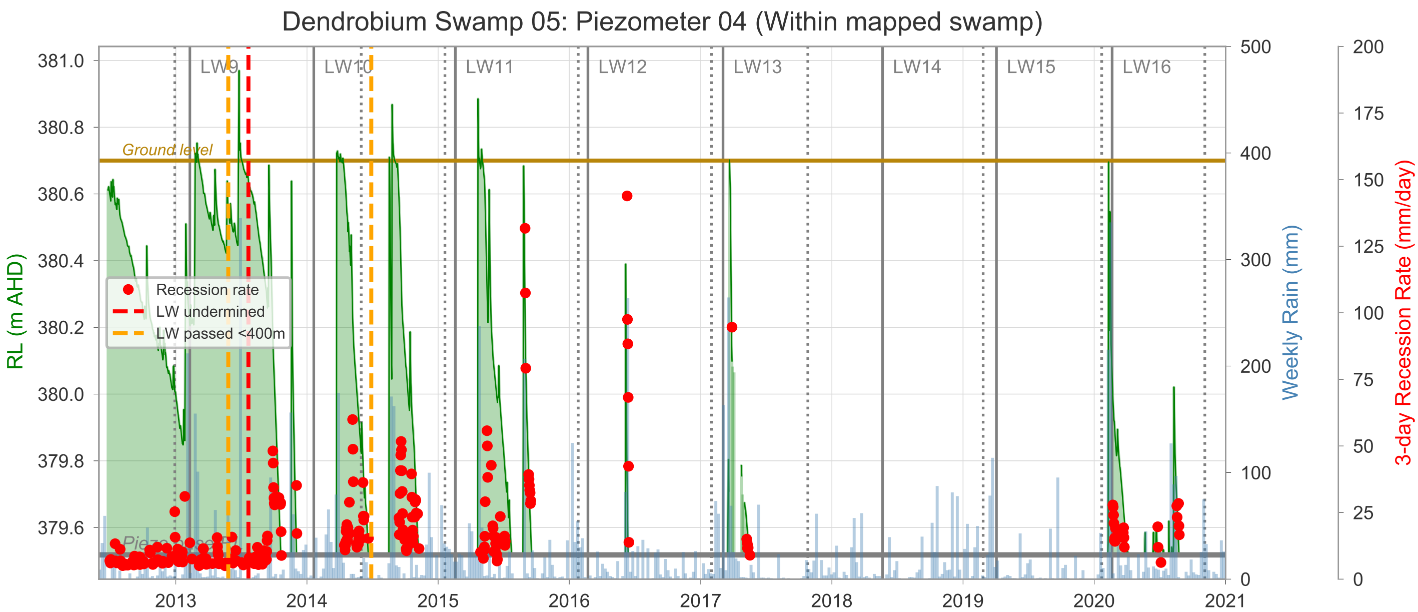
Dendrobium Swamp 05: Piezometer 03I (Outside mapped swamp)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



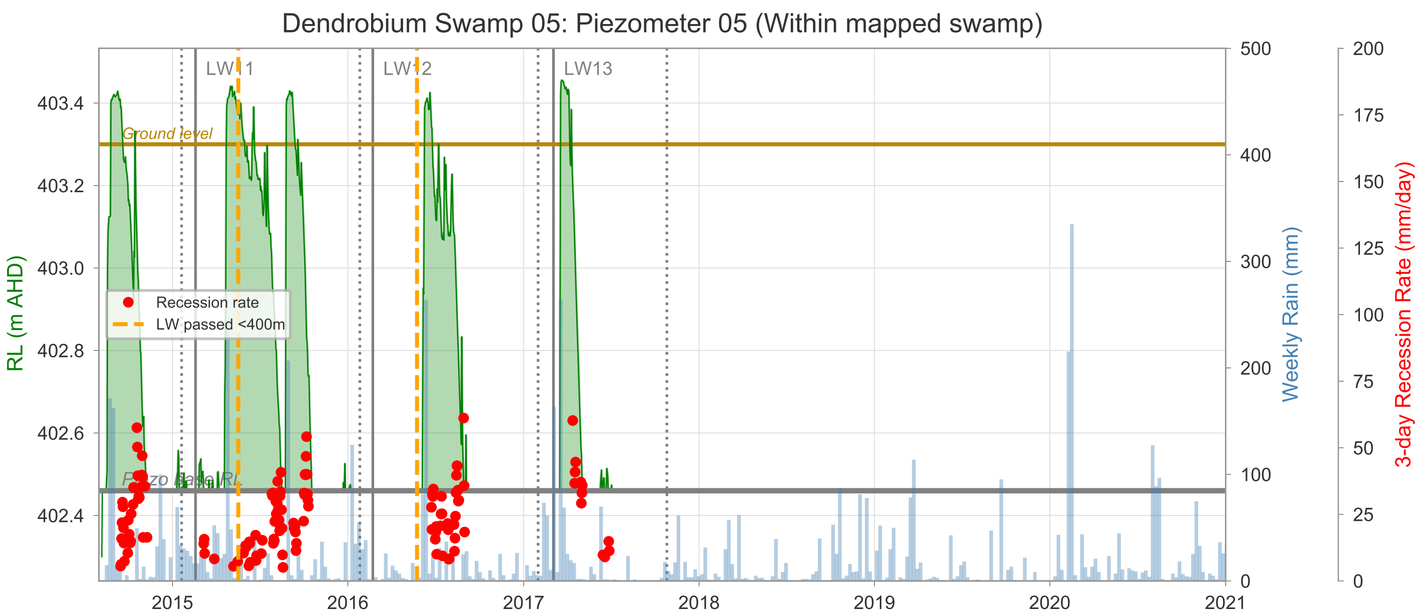
Dendrobium Swamp 05: Piezometer 03II (Within mapped swamp)
Ground level
Piezo base RL
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



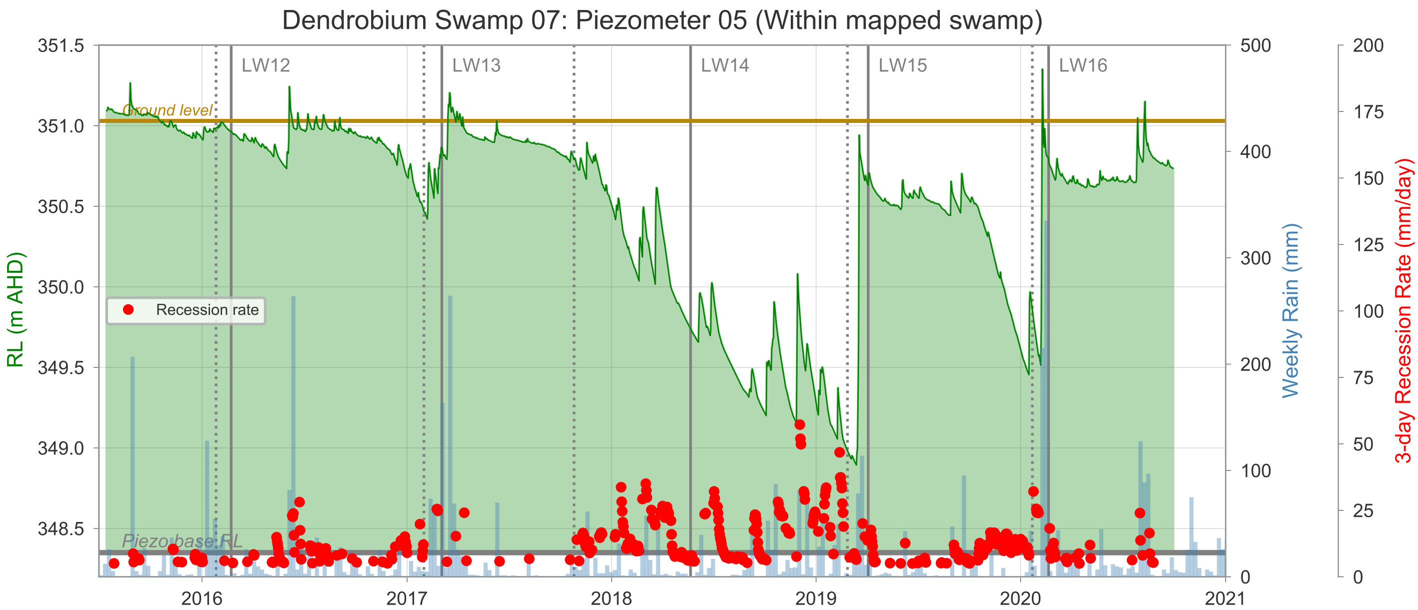
Dendrobium Swamp 05: Piezometer 03III (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m



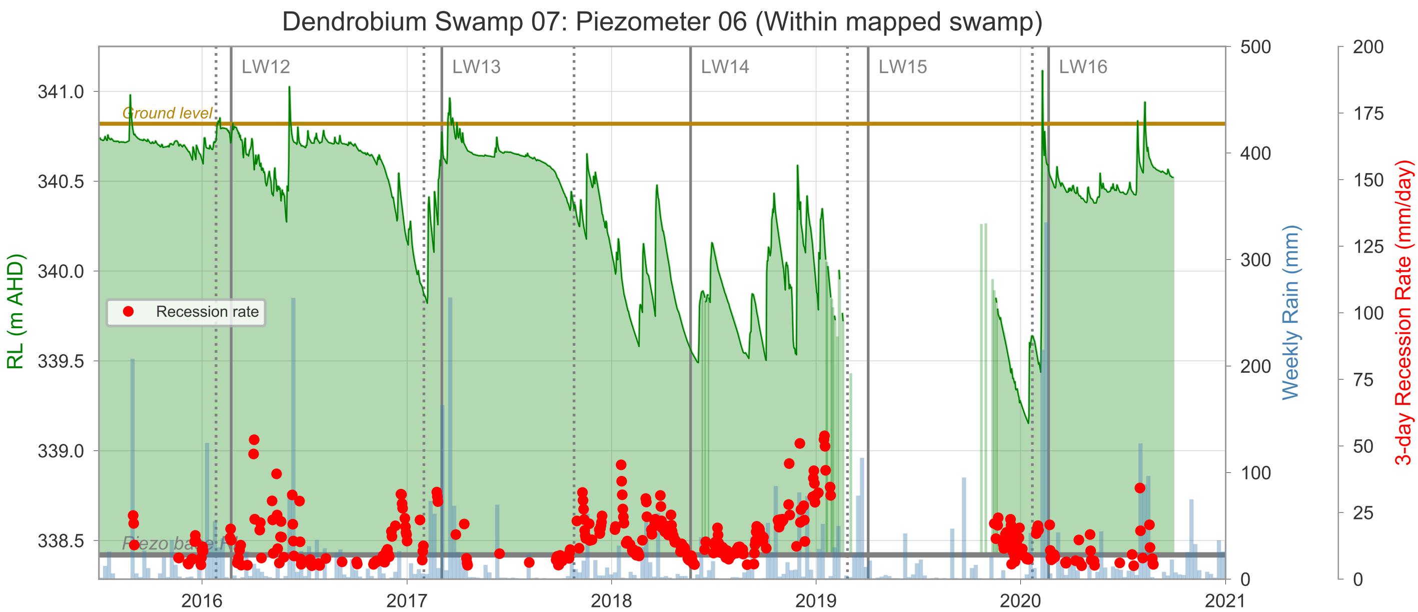
Dendrobium Swamp 05: Piezometer 04 (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Recession rate
LW undermined
LW passed <400m



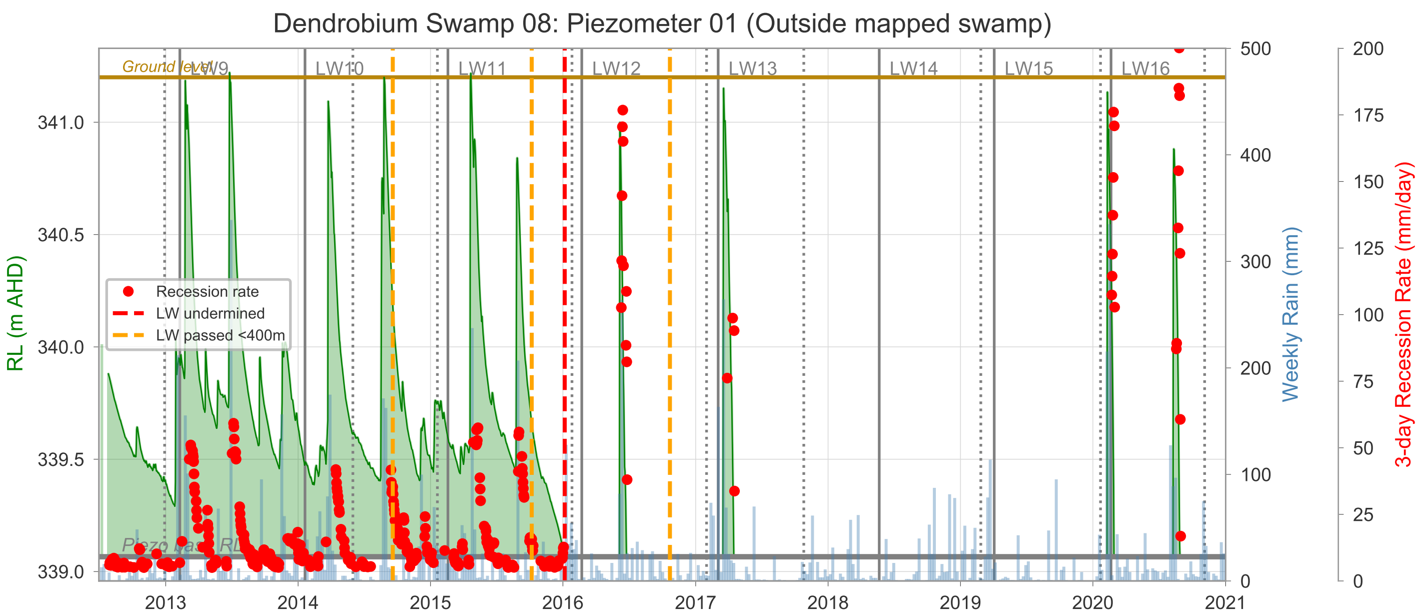
Dendrobium Swamp 05: Piezometer 05 (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
LW11
LW12
LW13
Ground level
Piezo base RL
Recession rate
LW passed <400m



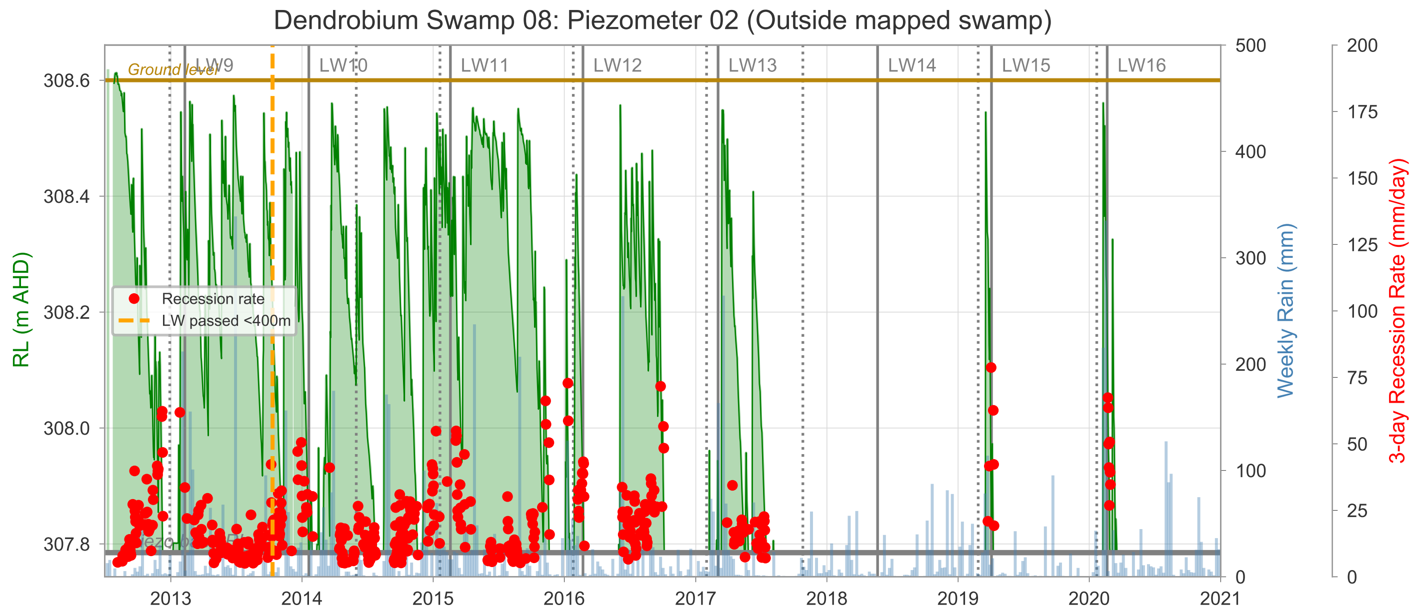
Dendrobium Swamp 07: Piezometer 05 (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
Recession rate
LW12
LW13
LW14
LW15
LW16



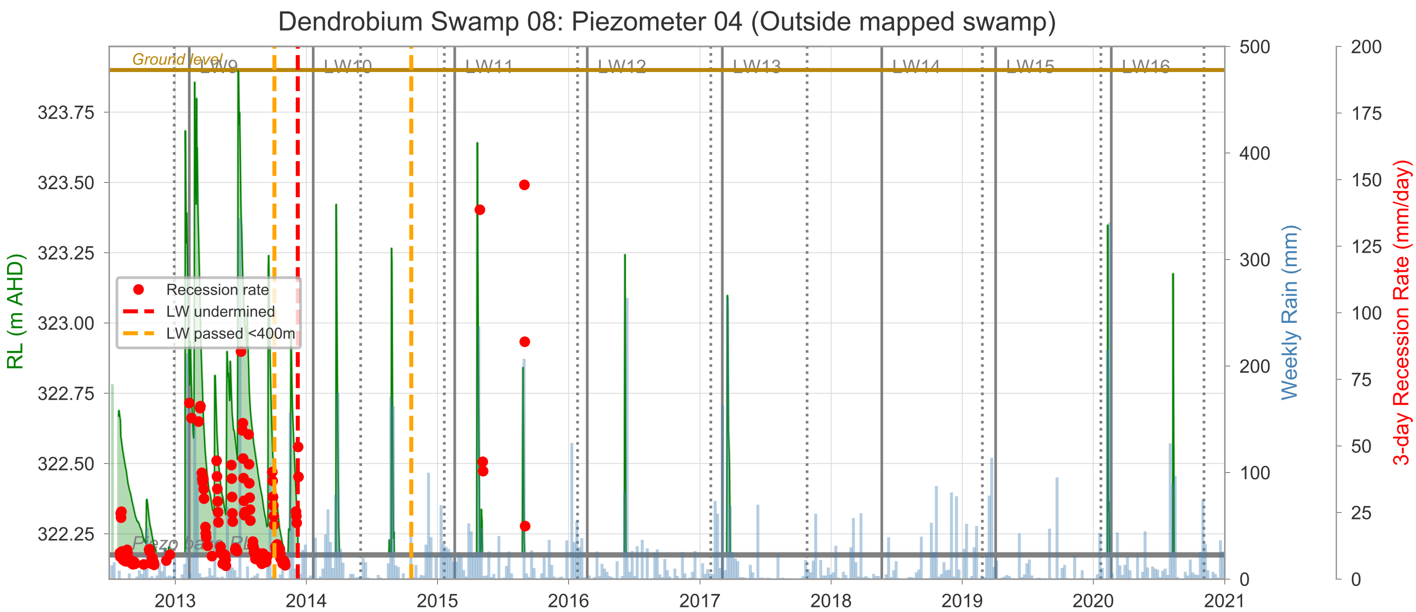
Dendrobium Swamp 07: Piezometer 06 (Within mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
Recession rate
LW12
LW13
LW14
LW15
LW16



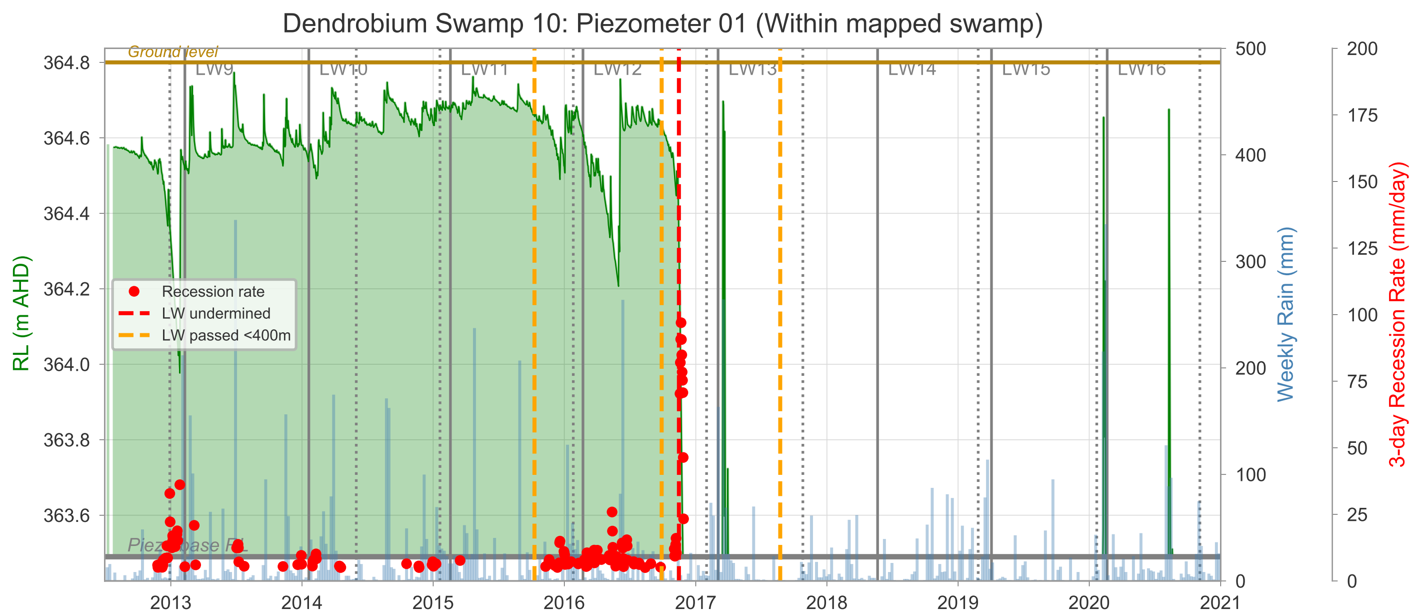
Dendrobium Swamp 08: Piezometer 01 (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16



Dendrobium Swamp 08: Piezometer 02 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

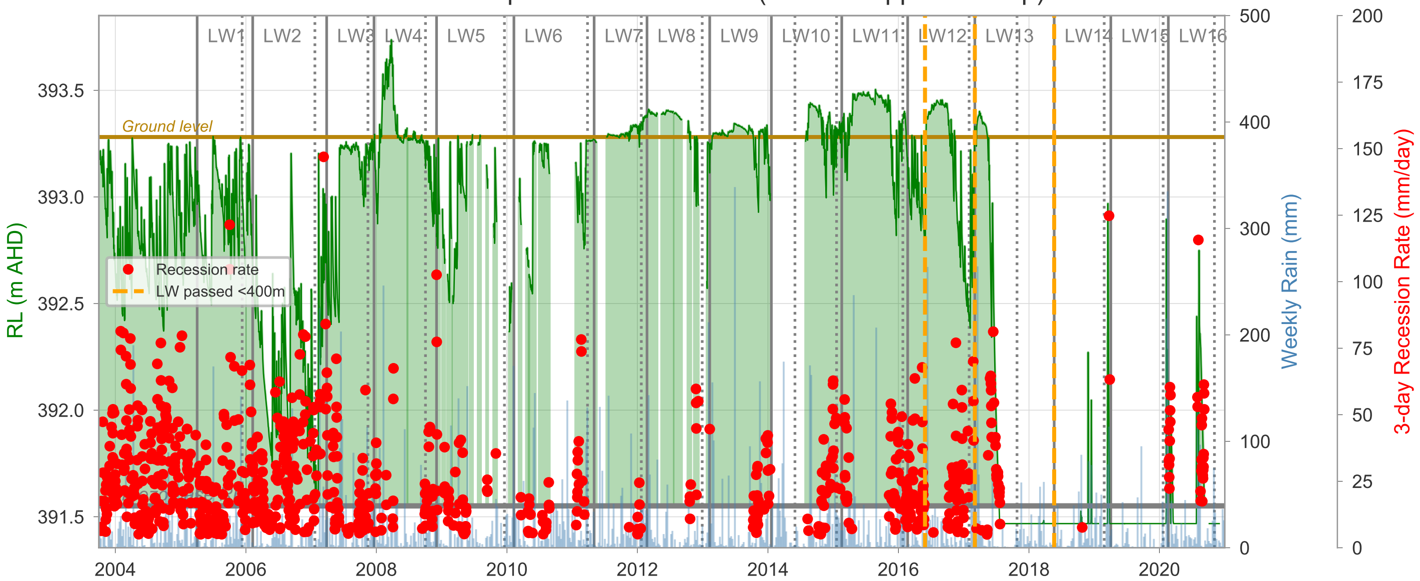


Dendrobium Swamp 08: Piezometer 04 (Outside mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

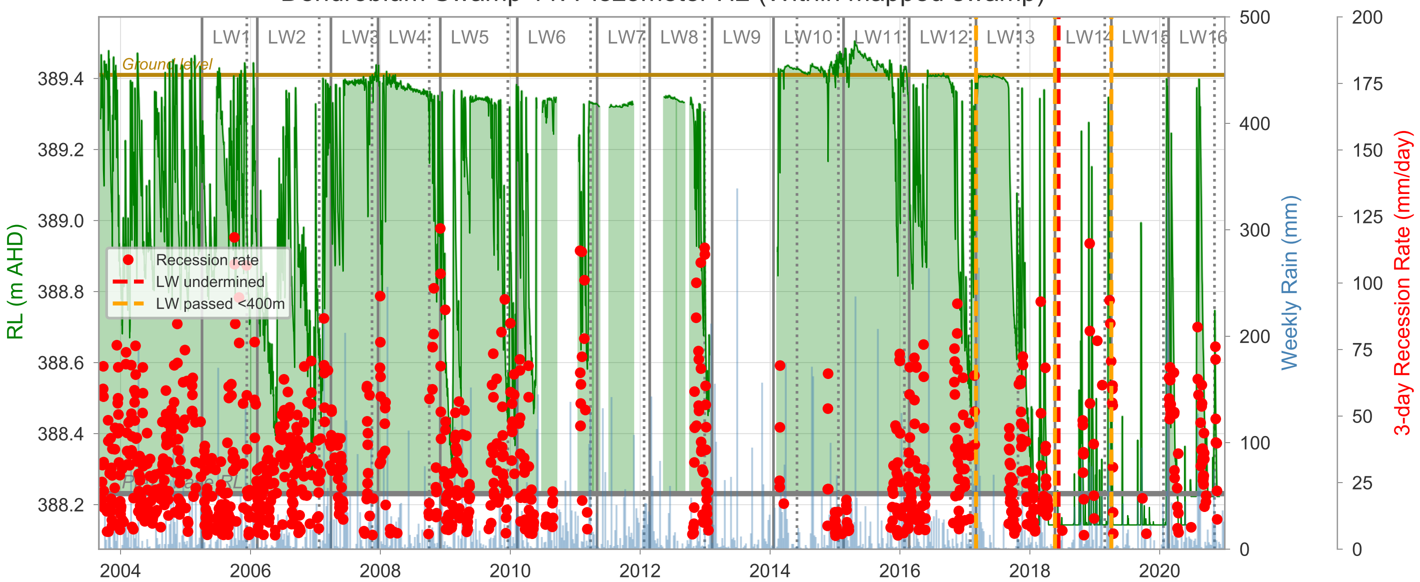


Dendrobium Swamp 10: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

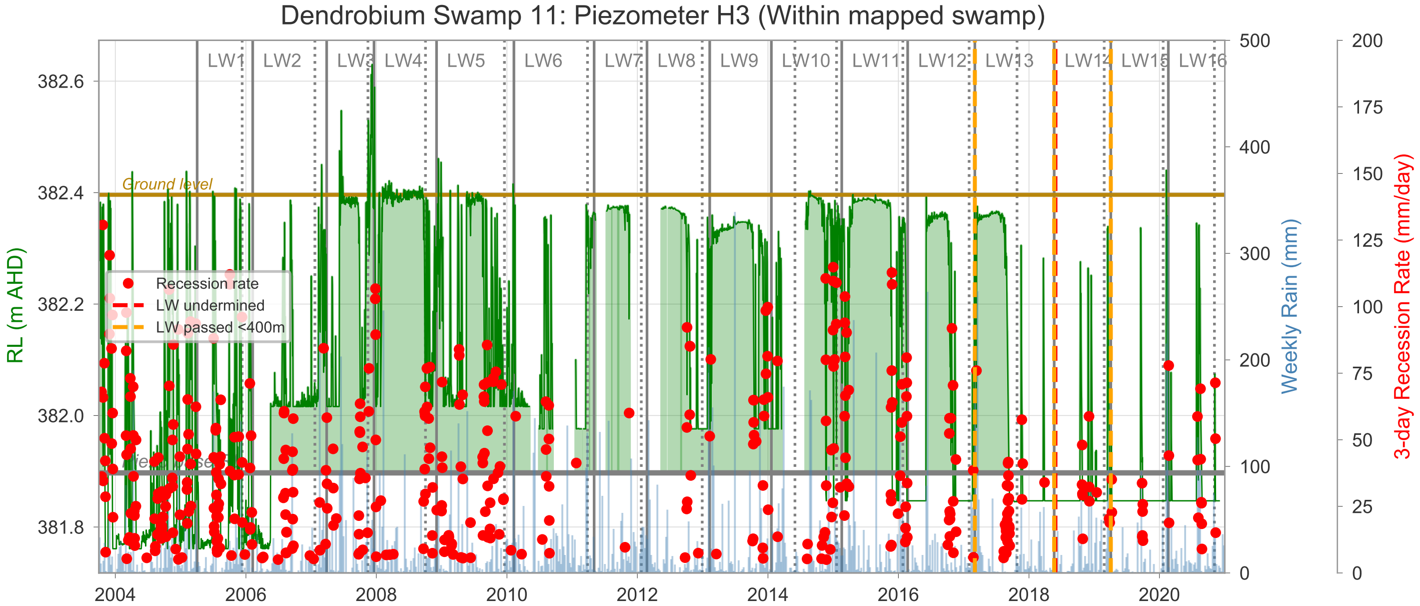
Dendrobium Swamp 11: Piezometer H1 (Within mapped swamp)

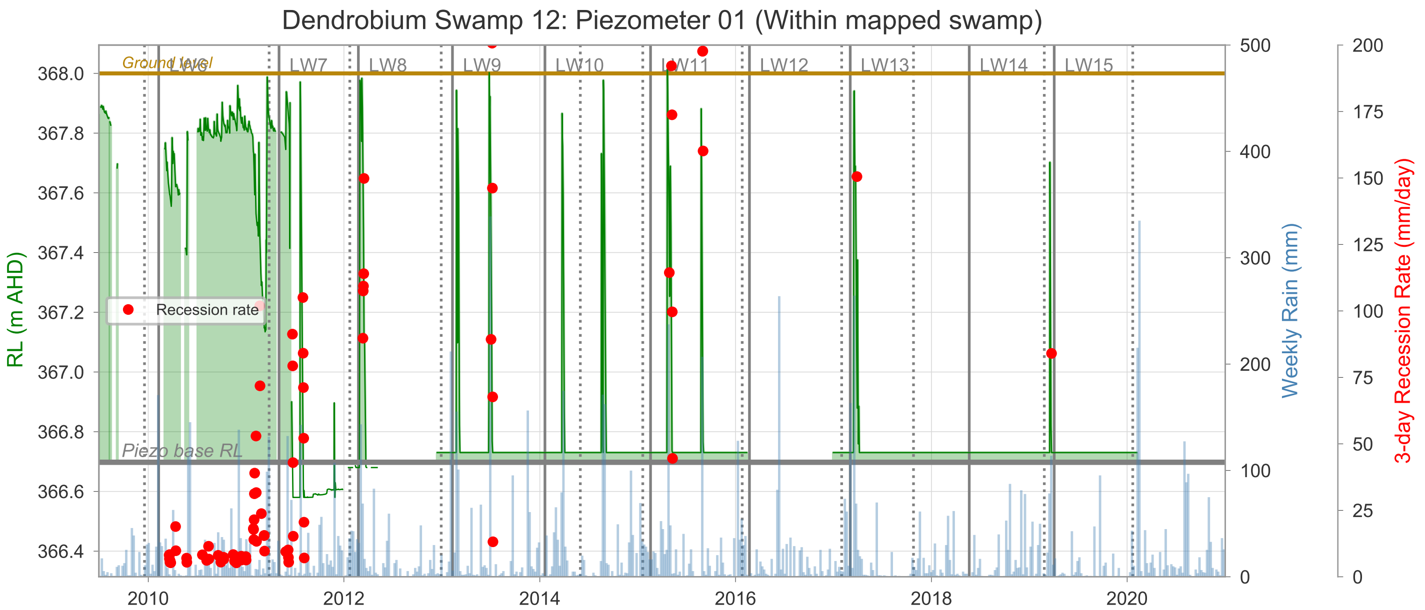


Dendrobium Swamp 11: Piezometer H2 (Within mapped swamp)

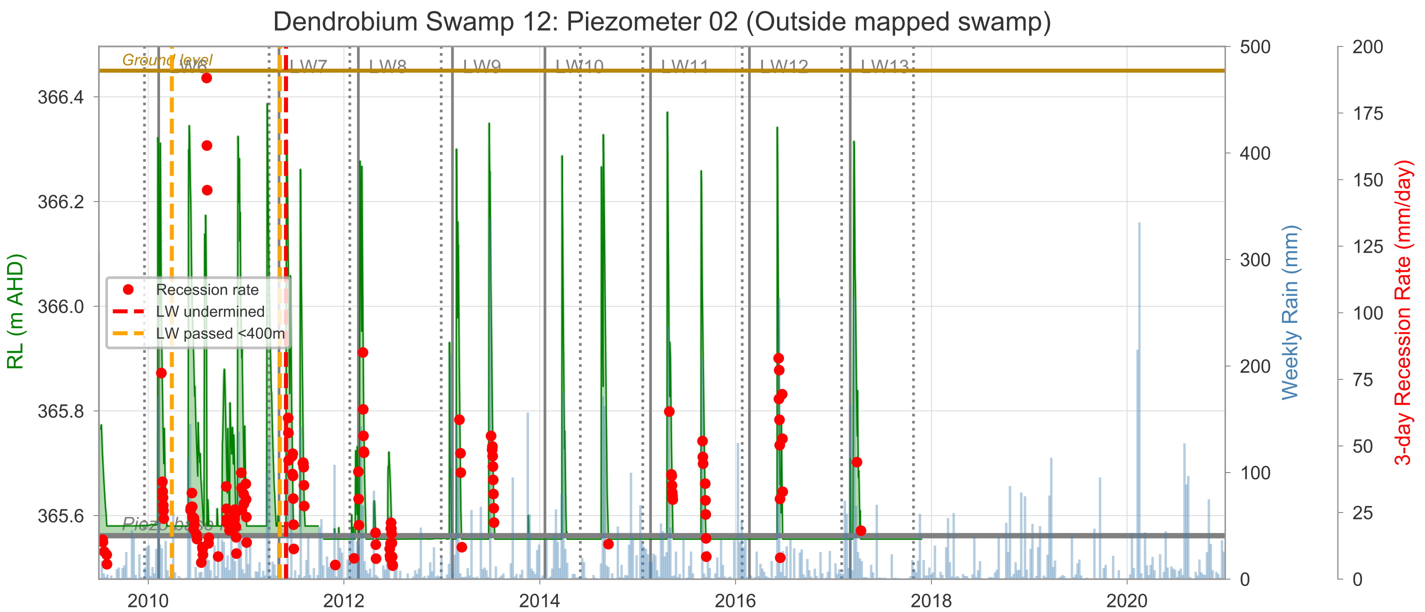


Dendrobium Swamp 11: Piezometer H3 (Within mapped swamp)

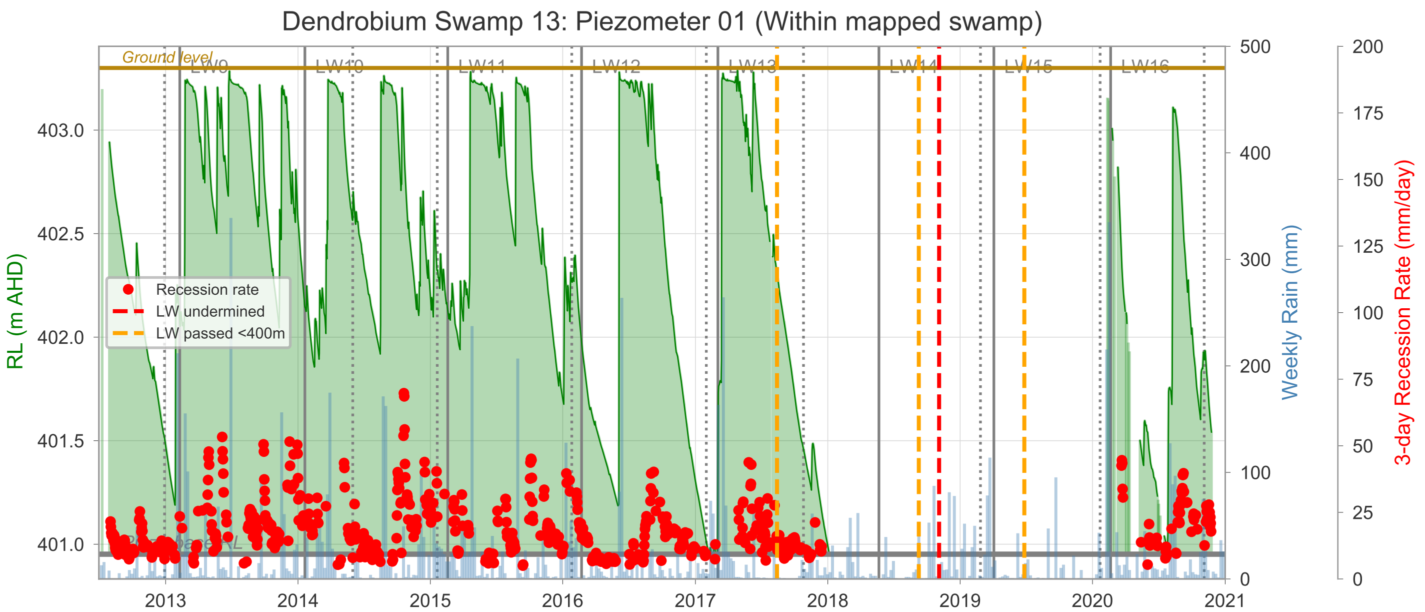




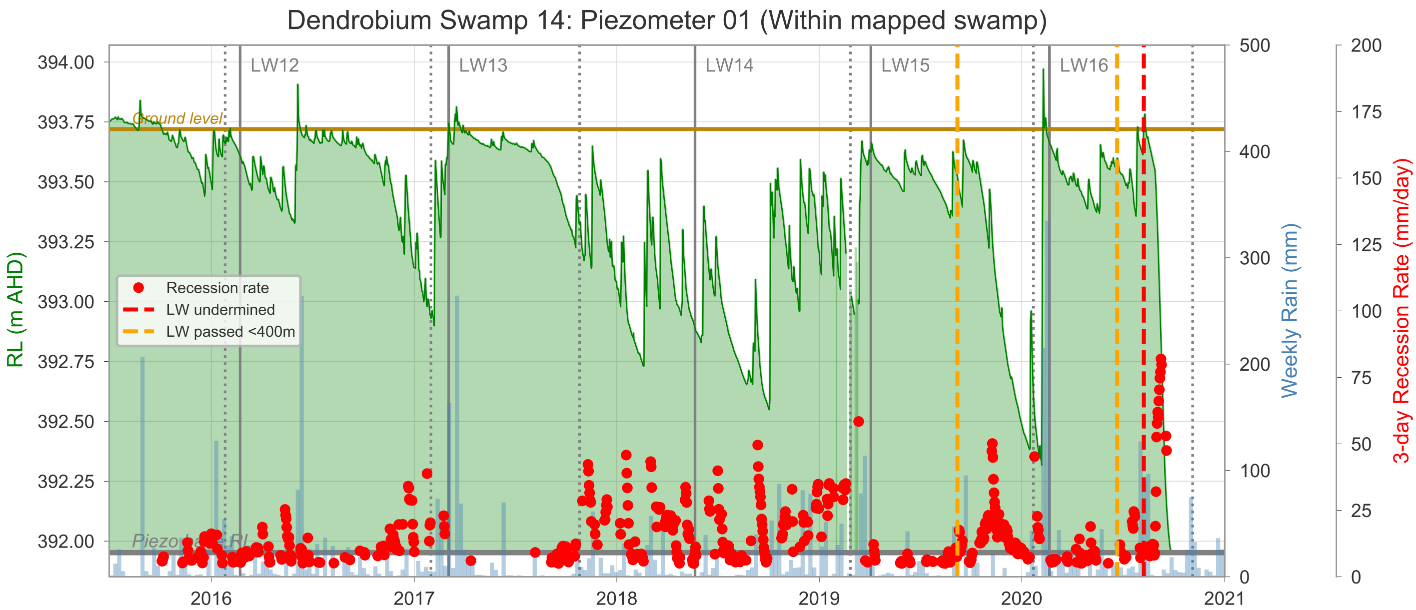
Dendrobium Swamp 12: Piezometer 01 (Within mapped swamp)
Ground level
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
Piezo base RL
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

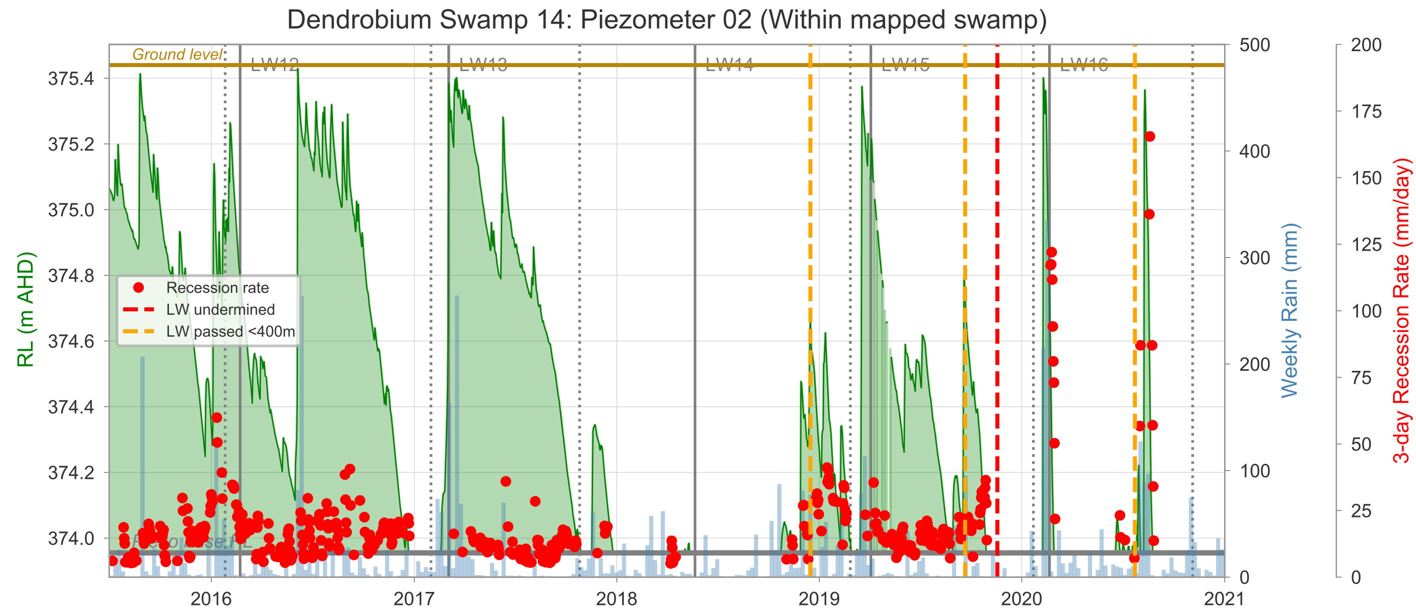


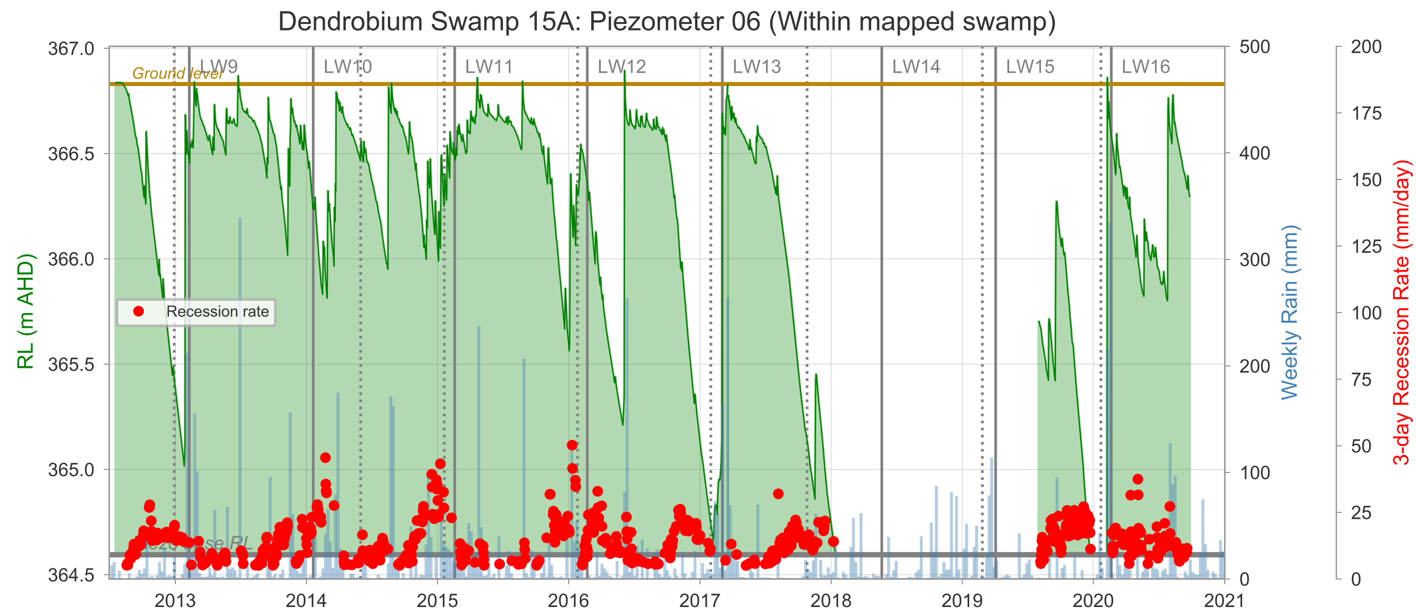
Dendrobium Swamp 12: Piezometer 02 (Outside mapped swamp)
Ground level
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

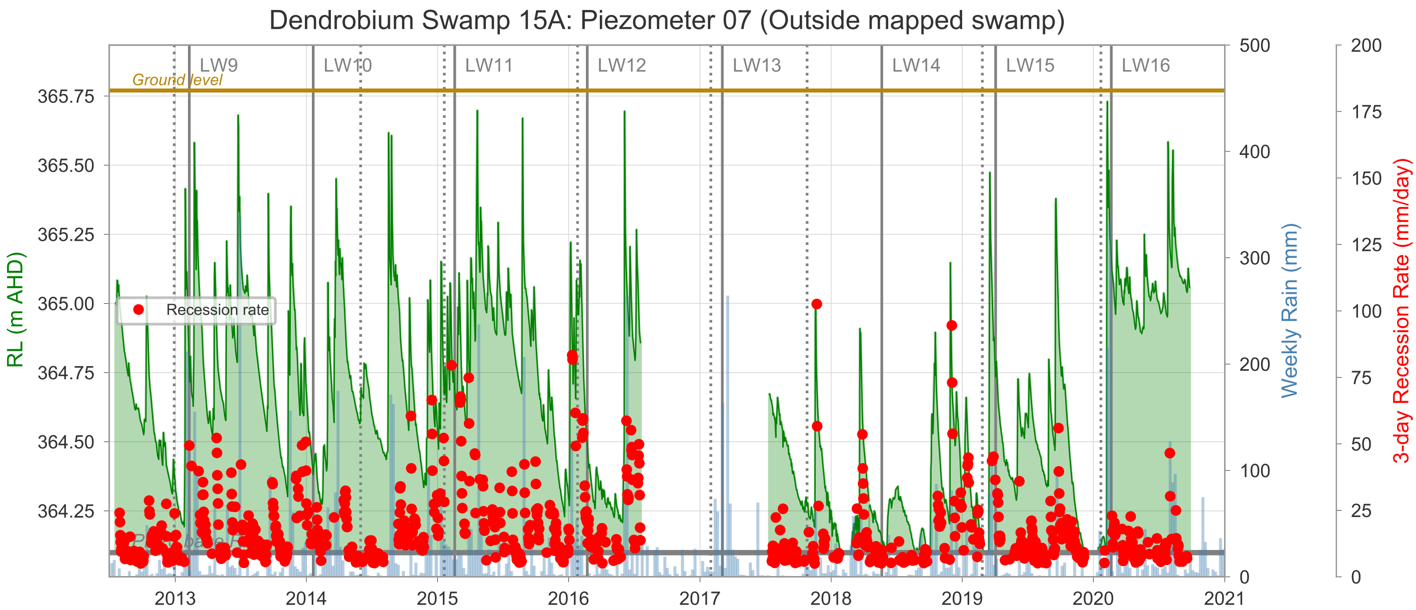


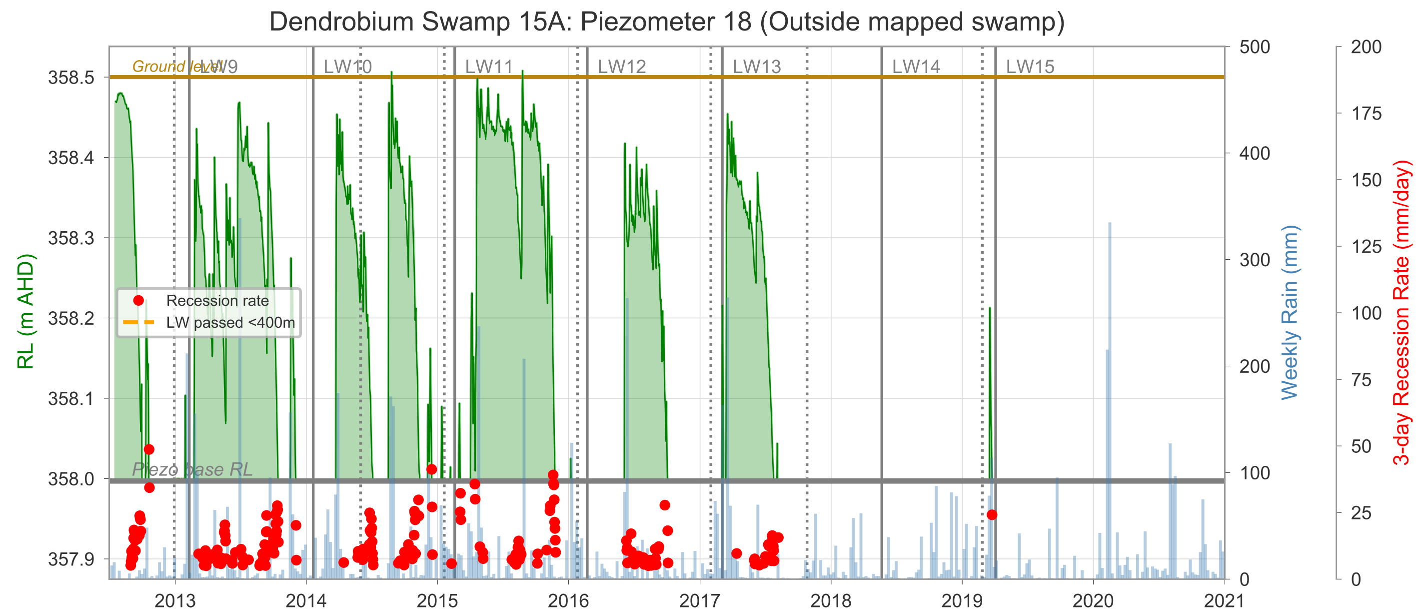
Dendrobium Swamp 13: Piezometer 01 (Within mapped swamp)
Ground level
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

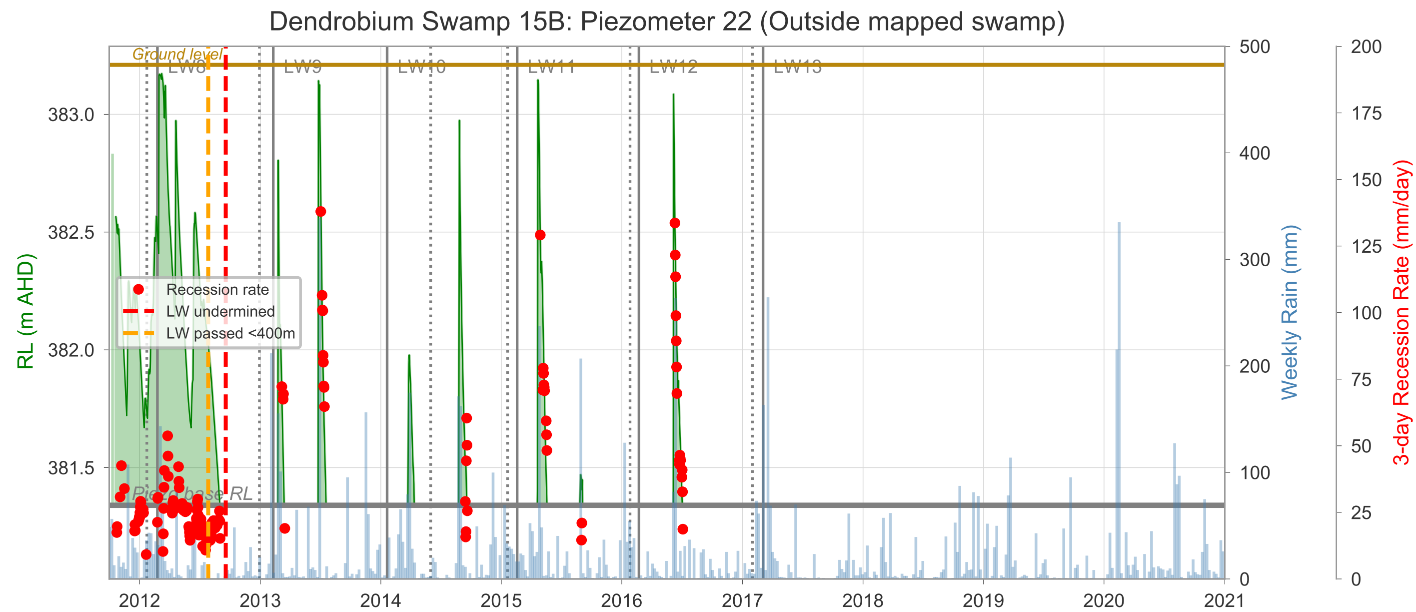

Dendrobium Swamp 14: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

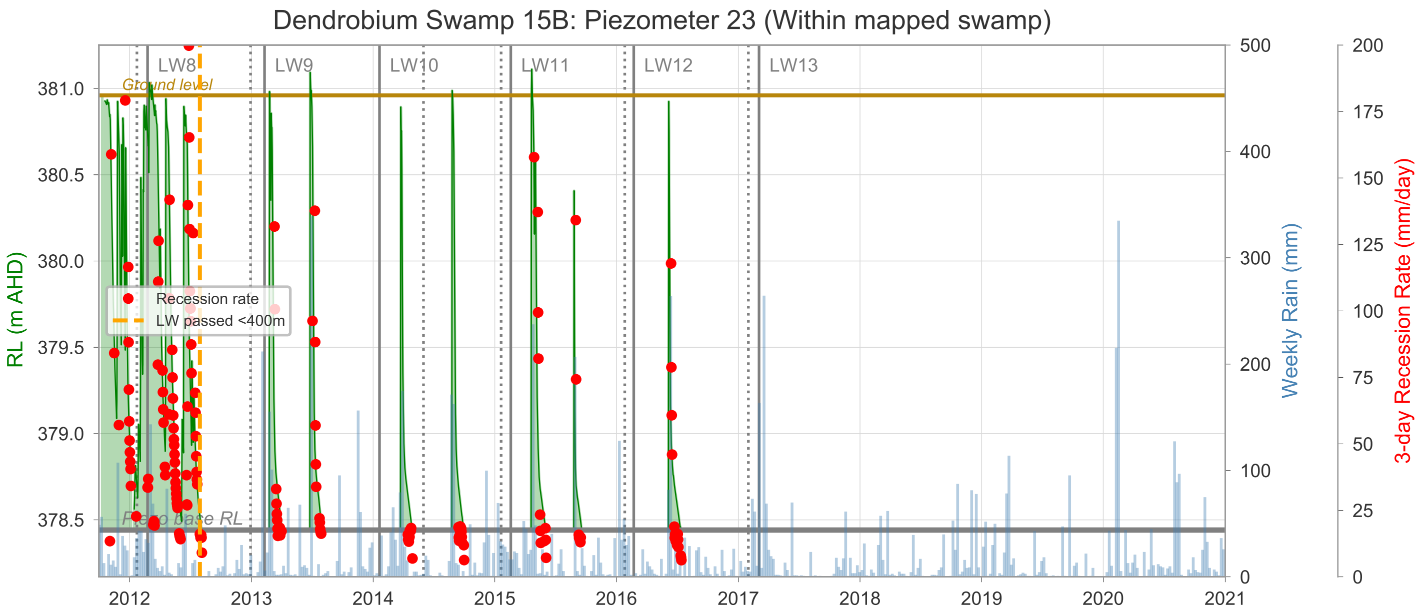

Dendrobium Swamp 14: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

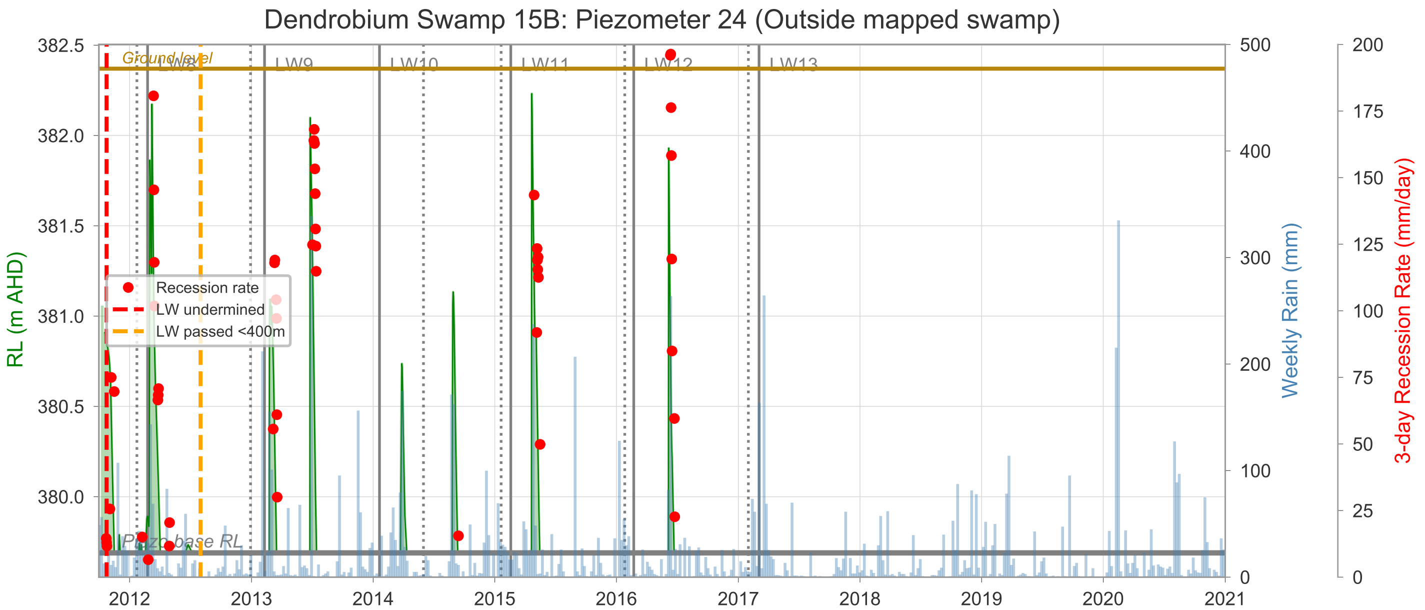

Dendrobium Swamp 15A: Piezometer 06 (Within mapped swamp)
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

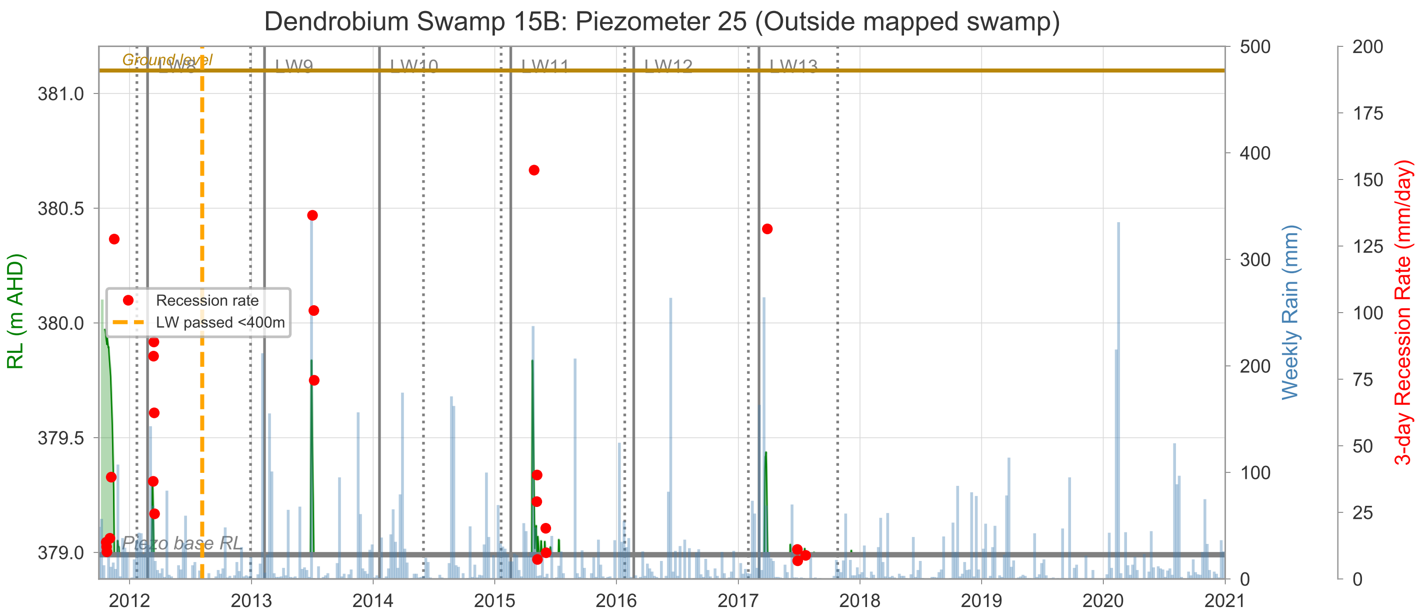

Dendrobium Swamp 15A: Piezometer 07 (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Recession rate
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16


Dendrobium Swamp 15A: Piezometer 18 (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Recession rate
LW passed <400m
Ground level
Piezo base RL
LW9
LW10
LW11
LW12
LW13
LW14
LW15

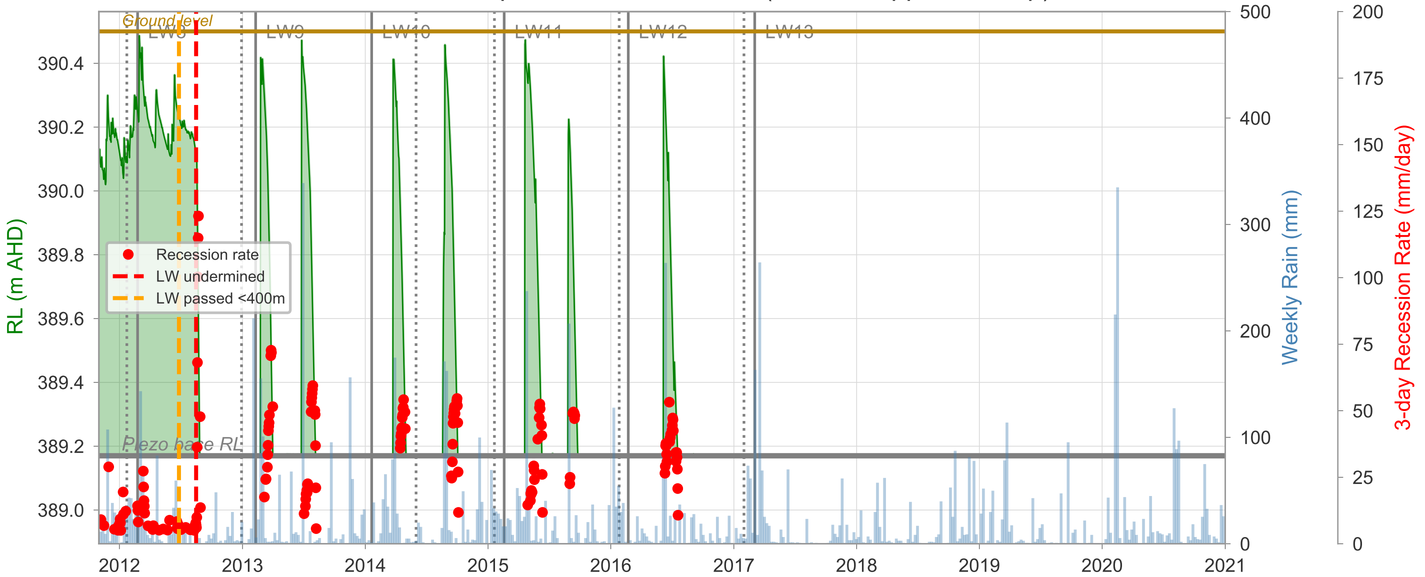

Dendrobium Swamp 15B: Piezometer 22 (Outside mapped swamp)
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
Recession rate
LW undermined
LW passed <400m
Ground level
Piezo base RL
LW8
LW9
LW10
LW11
LW12
LW13


Dendrobium Swamp 15B: Piezometer 23 (Within mapped swamp)
LW8
LW9
LW10
LW11
LW12
LW13
Ground level
Piezo base RL
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

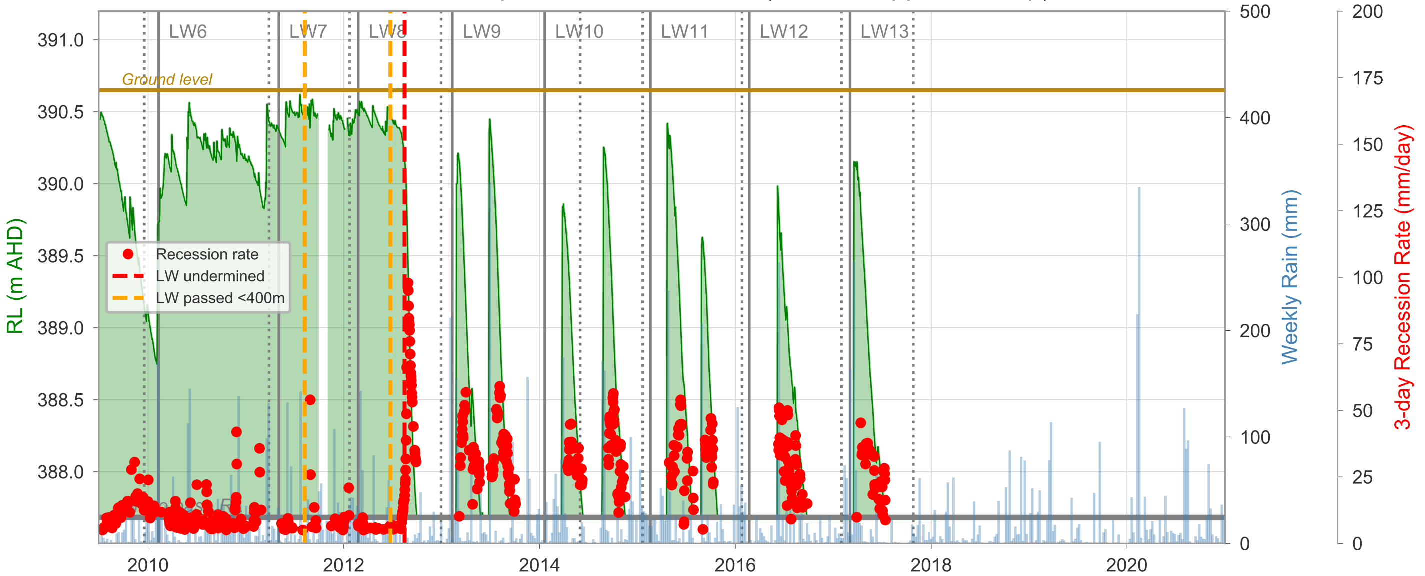

Dendrobium Swamp 15B: Piezometer 24 (Outside mapped swamp)
Ground level
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)


Dendrobium Swamp 15B: Piezometer 25 (Outside mapped swamp)
Ground level
Piezo base RL
Recession rate
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)

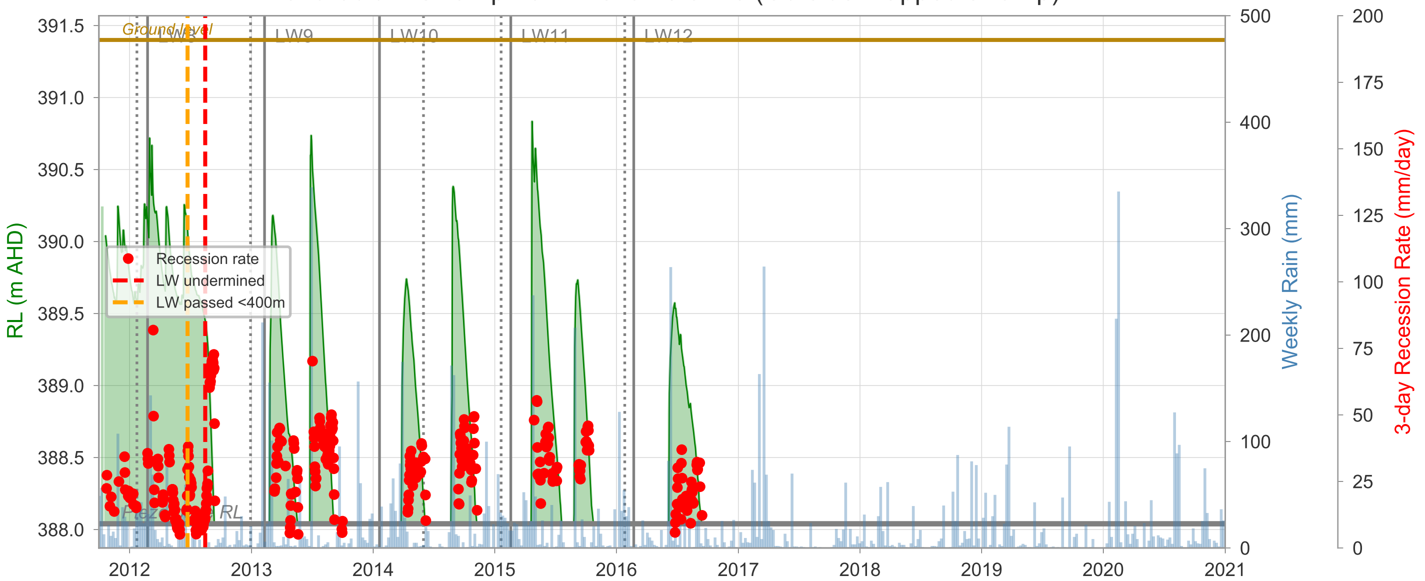
Dendrobium Swamp 15B: Piezometer 26 (Within mapped swamp)

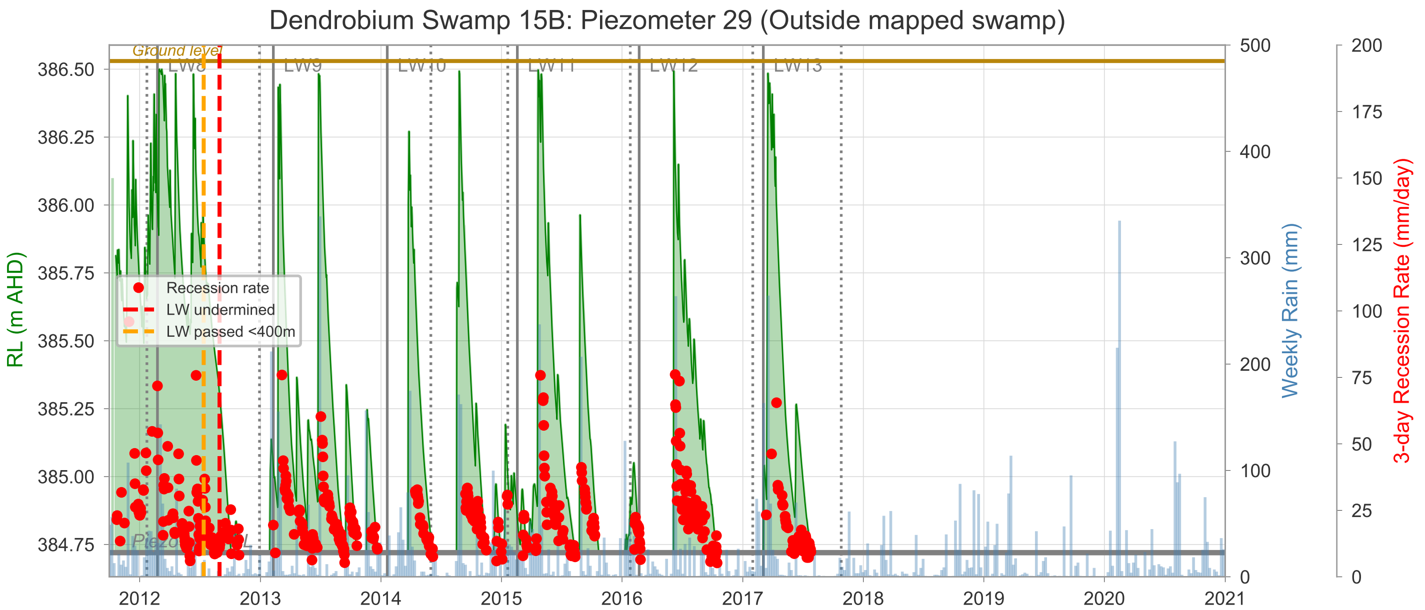


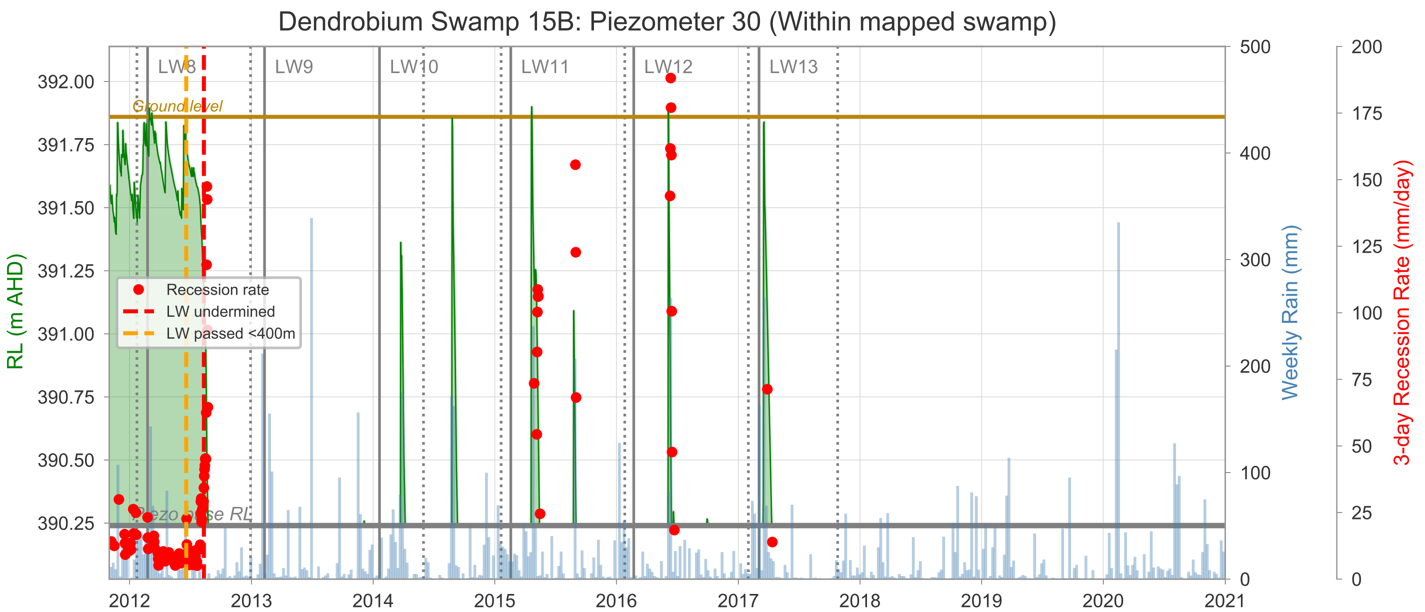
Dendrobium Swamp 15B: Piezometer 27 (Within mapped swamp)

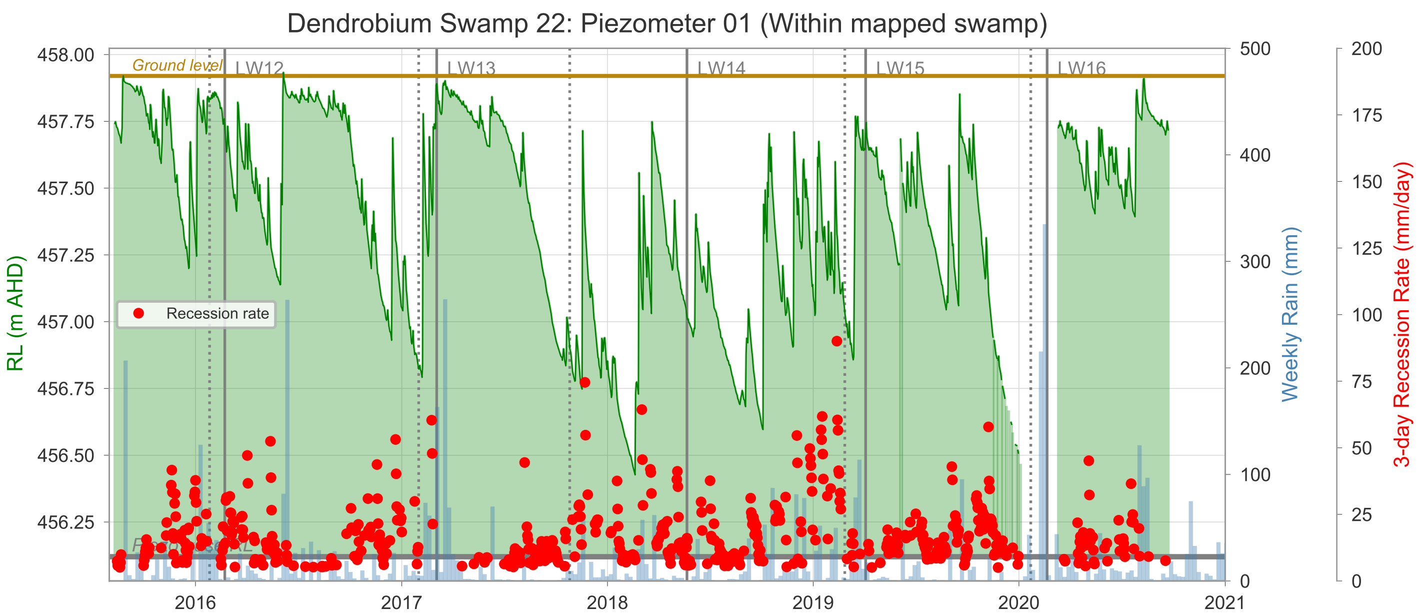


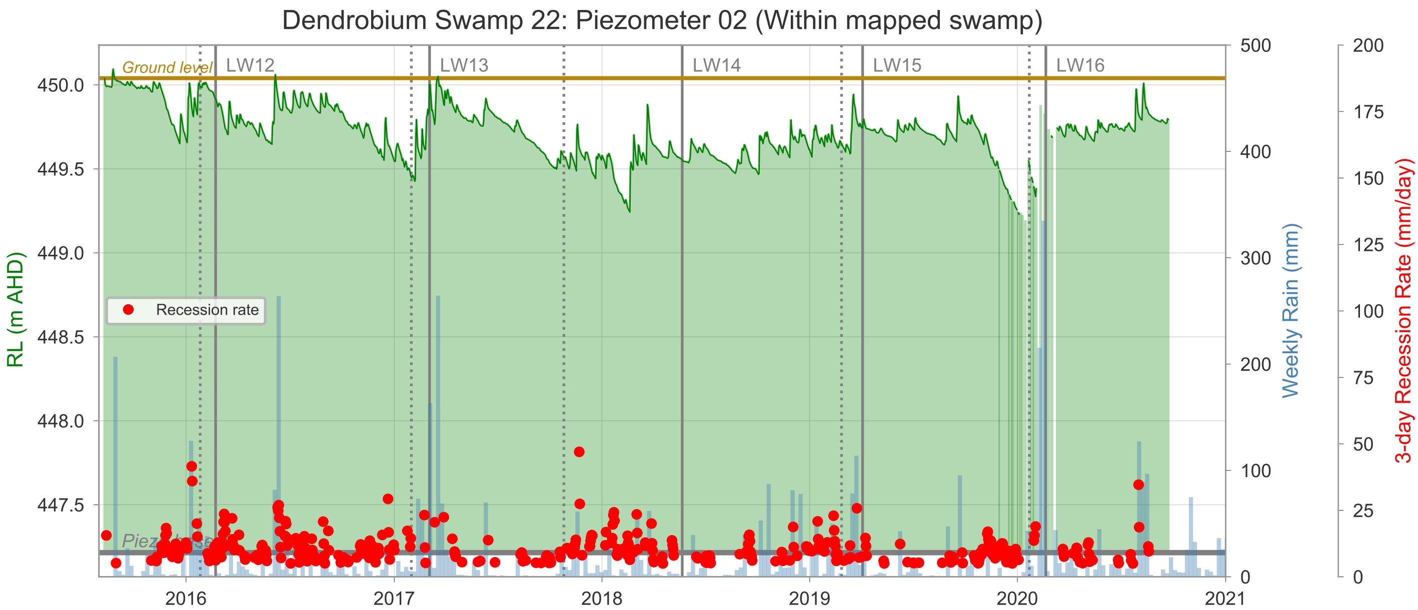
Dendrobium Swamp 15B: Piezometer 28 (Outside mapped swamp)

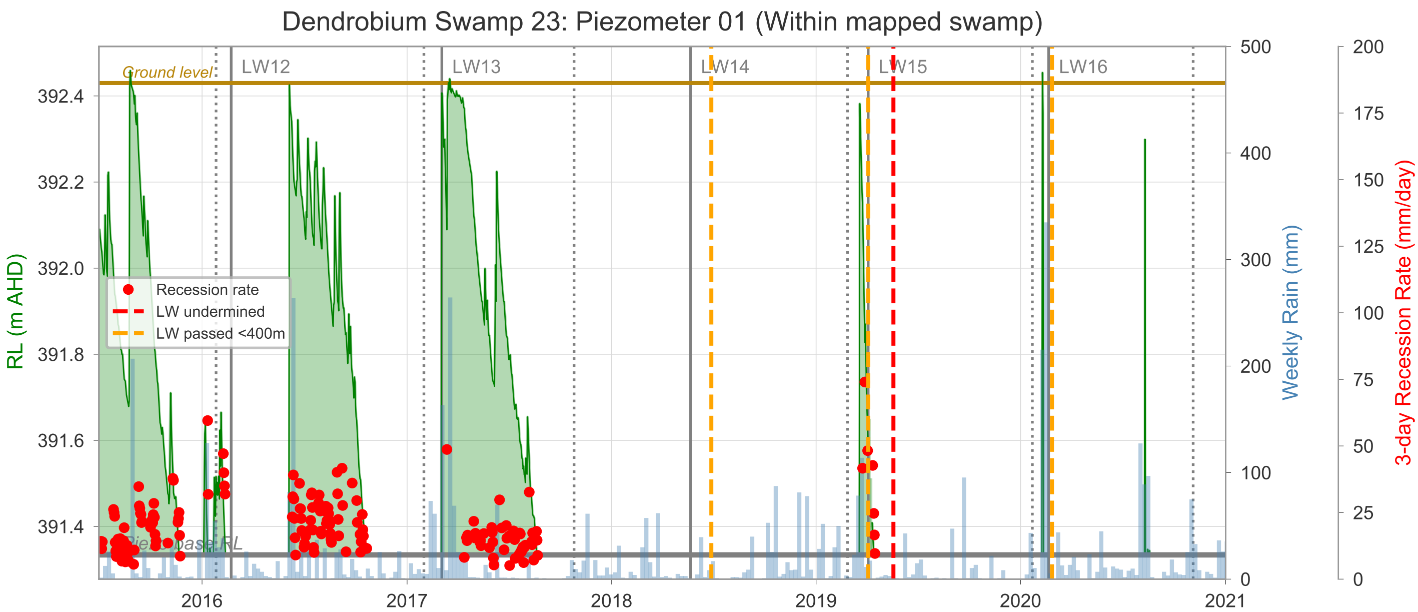


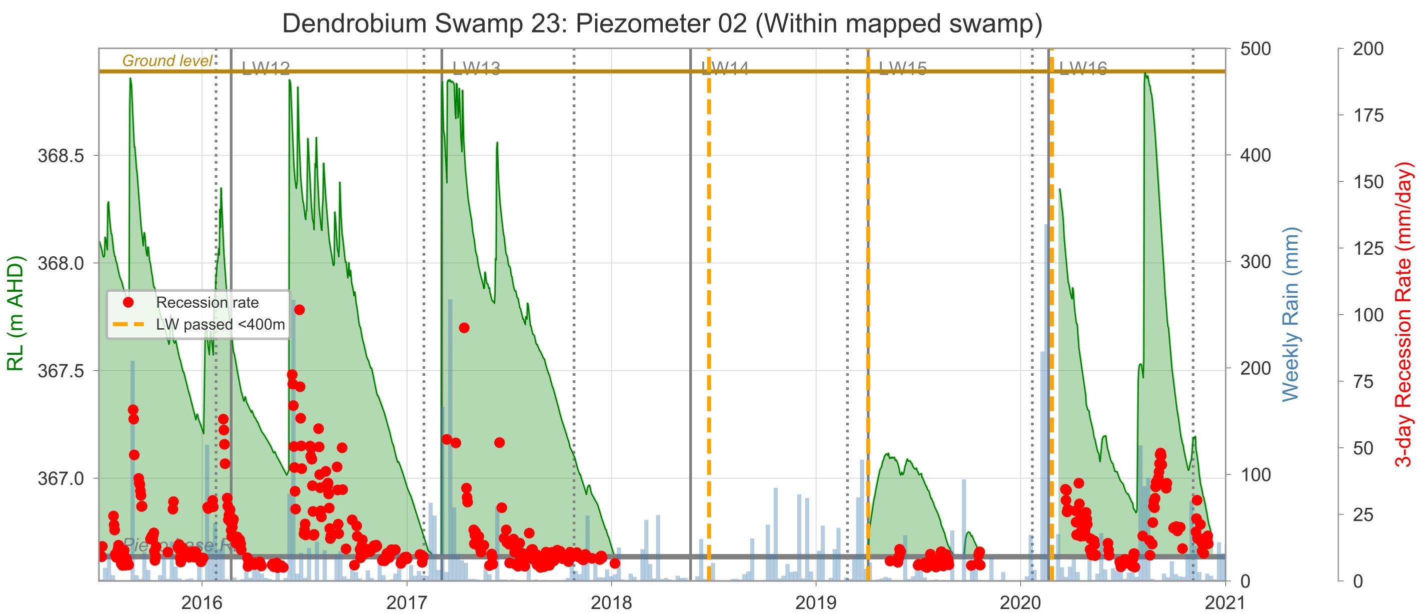

Dendrobium Swamp 15B: Piezometer 29 (Outside mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

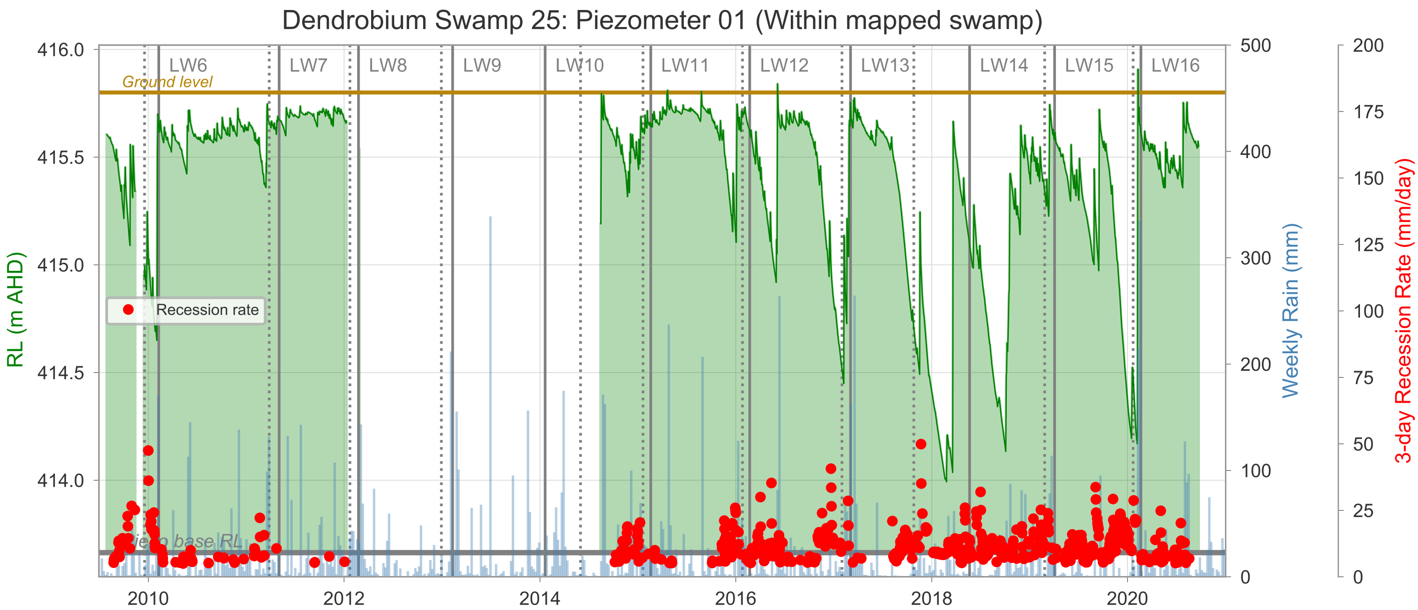

Dendrobium Swamp 15B: Piezometer 30 (Within mapped swamp)
Ground level
LW8
LW9
LW10
LW11
LW12
LW13
Piezo base RL
Recession rate
LW undermined
LW passed <400m
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 22: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
2016
2017
2018
2019
2020
2021

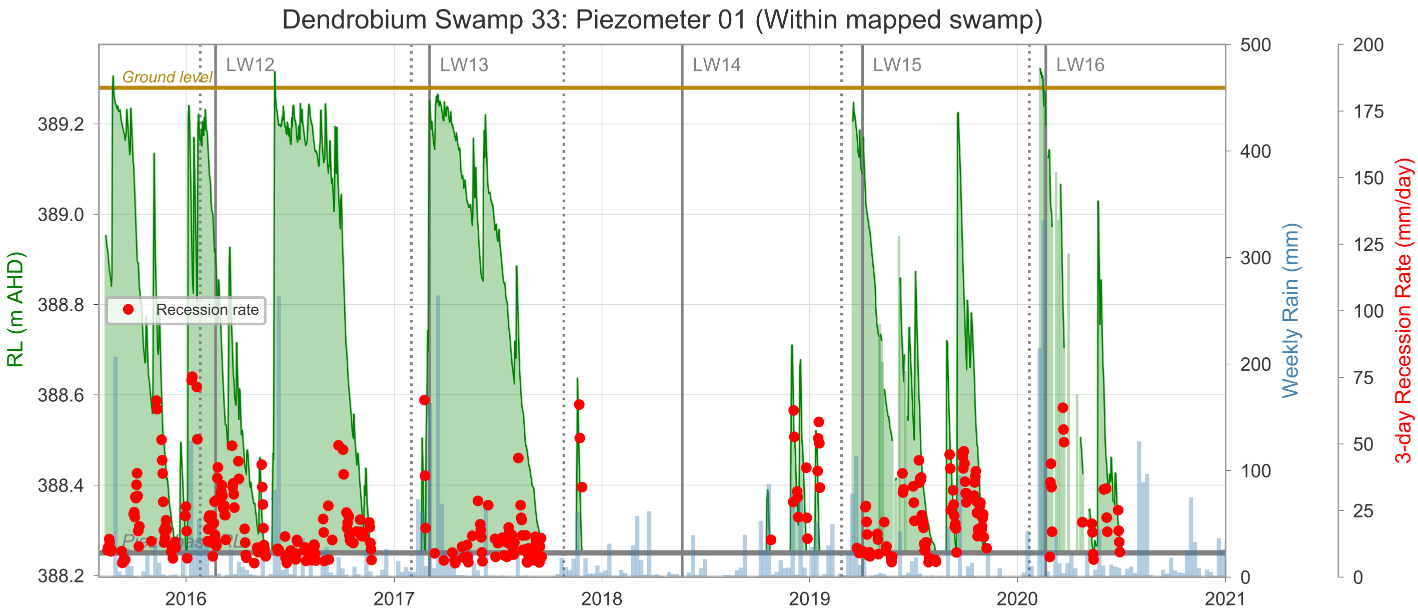

Dendrobium Swamp 22: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
450.0
449.5
449.0
448.5
448.0
447.5
500
400
300
200
100
0
200
175
150
125
100
75
50
25
0
2016
2017
2018
2019
2020
2021


Dendrobium Swamp 23: Piezometer 01 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
Recession rate
LW undermined
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
392.4
392.2
392.0
391.8
391.6
391.4
2016
2017
2018
2019
2020
2021

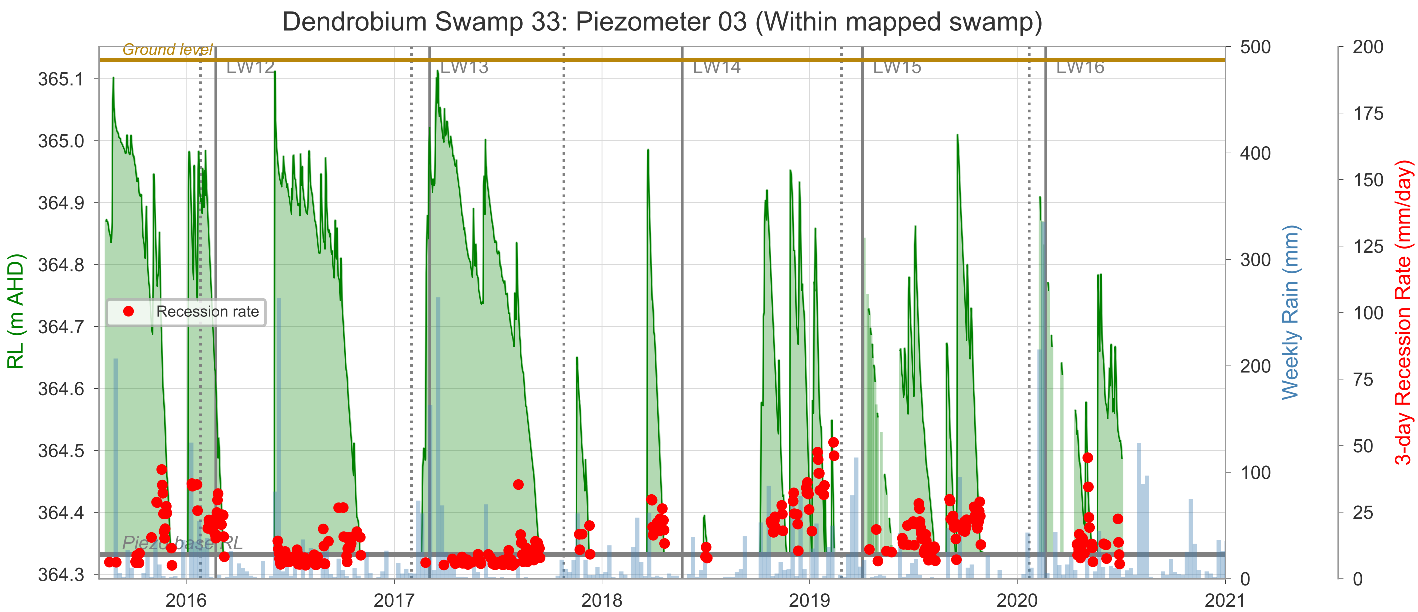

Dendrobium Swamp 23: Piezometer 02 (Within mapped swamp)
Ground level
LW12
LW13
LW14
LW15
LW16
Recession rate
LW passed <400m
Piezo base RL
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
368.5
368.0
367.5
367.0
2016
2017
2018
2019
2020
2021



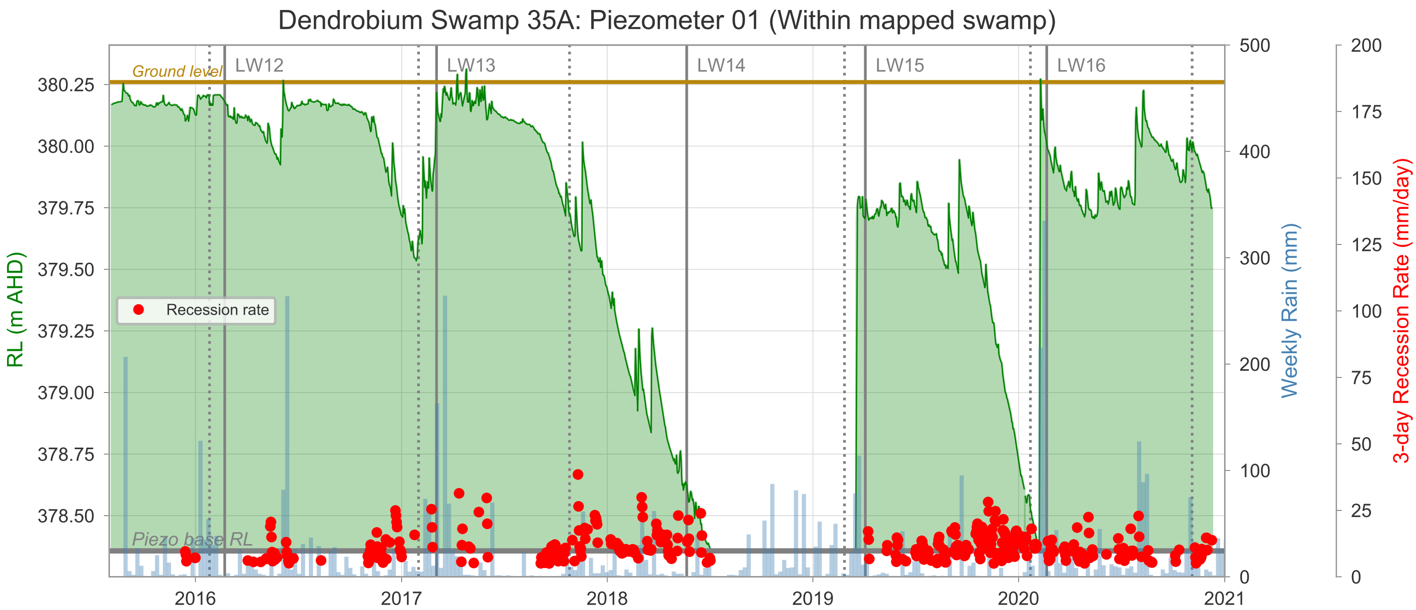
Dendrobium Swamp 25: Piezometer 01 (Within mapped swamp)
LW6
LW7
LW8
LW9
LW10
LW11
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



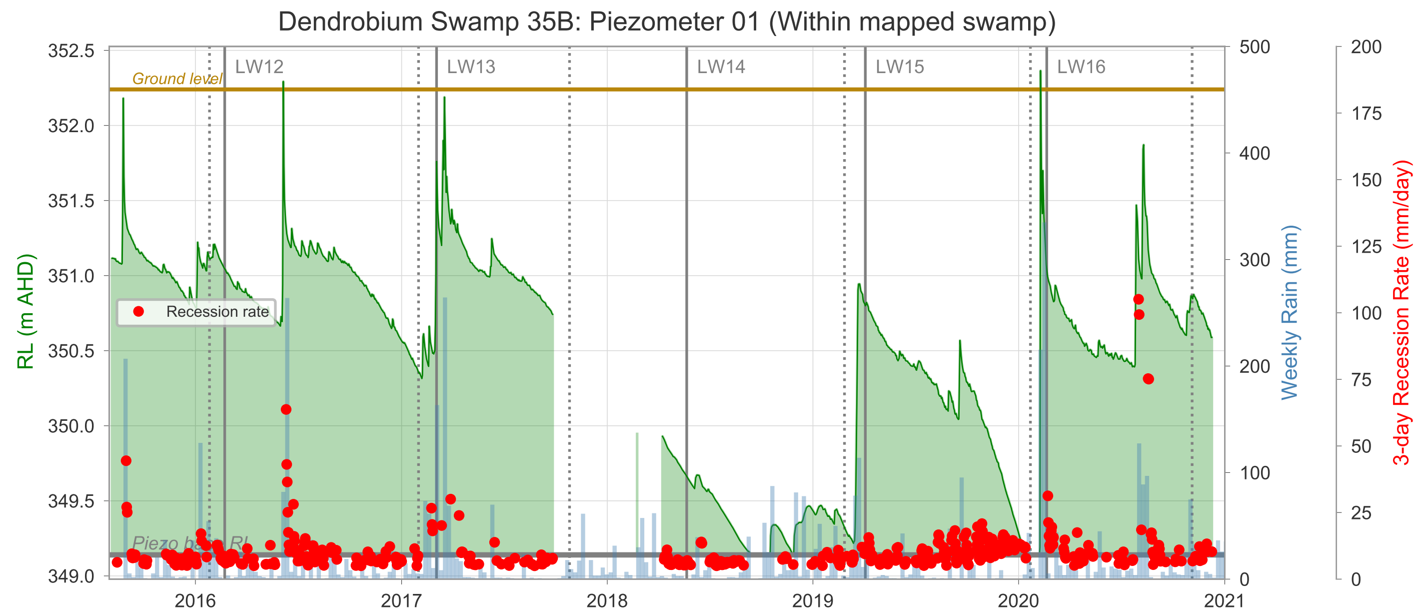
Dendrobium Swamp 33: Piezometer 01 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



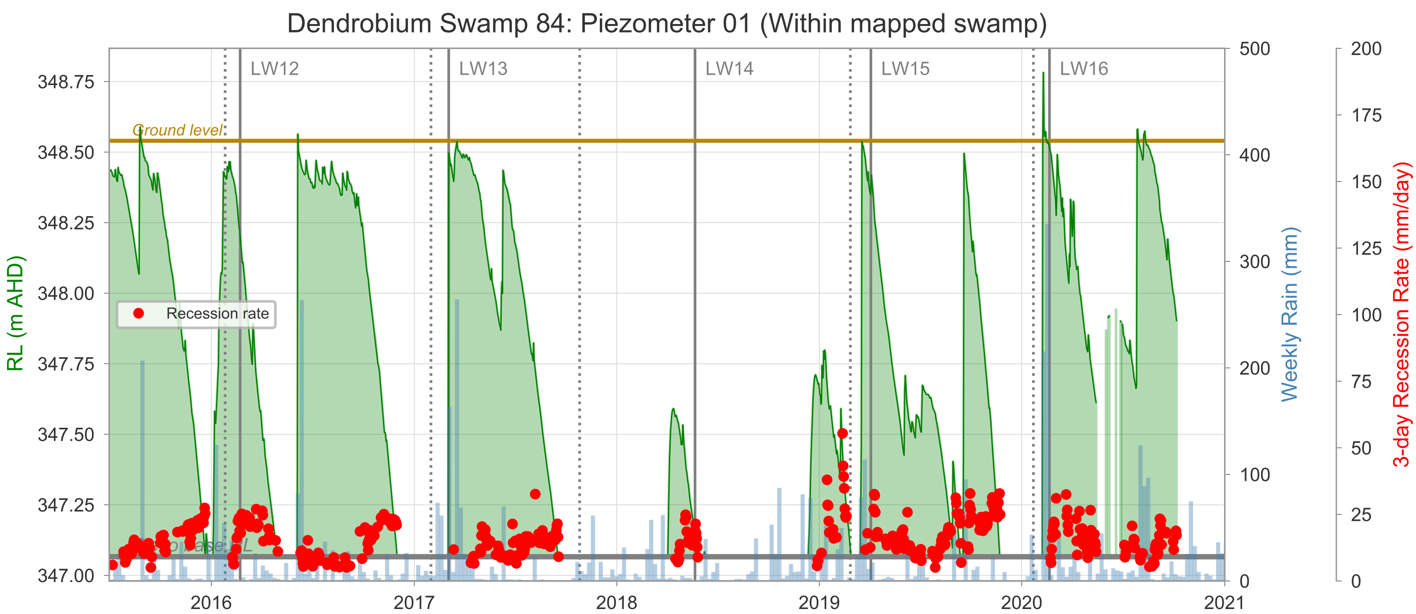
Dendrobium Swamp 33: Piezometer 03 (Within mapped swamp)
LW12
LW13
LW14
LW15
LW16
Ground level
Piezo base RL
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)



Dendrobium Swamp 35A: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
380.25
380.00
379.75
379.50
379.25
379.00
378.75
378.50
2016
2017
2018
2019
2020
2021

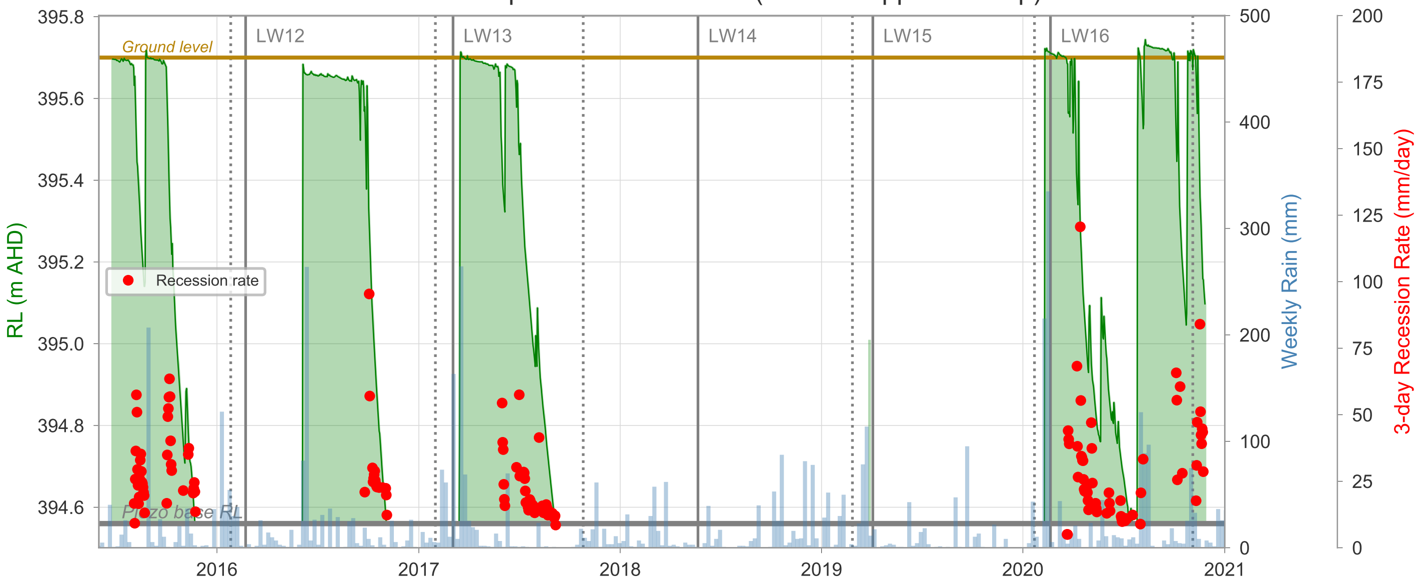


Dendrobium Swamp 35B: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
352.5
352.0
351.5
351.0
350.5
350.0
349.5
349.0
2016
2017
2018
2019
2020
2021

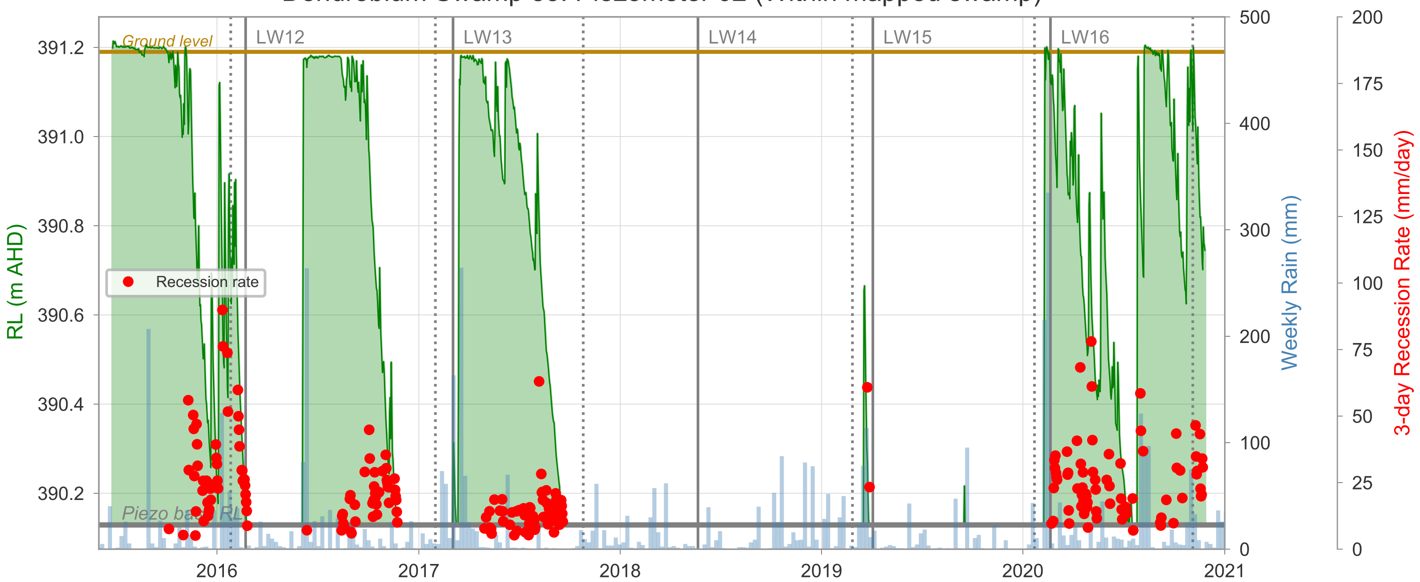


Dendrobium Swamp 84: Piezometer 01 (Within mapped swamp)
Ground level
Piezo base RL
LW12
LW13
LW14
LW15
LW16
Recession rate
RL (m AHD)
Weekly Rain (mm)
3-day Recession Rate (mm/day)
348.75
348.50
348.25
348.00
347.75
347.50
347.25
347.00
2016
2017
2018
2019
2020
2021

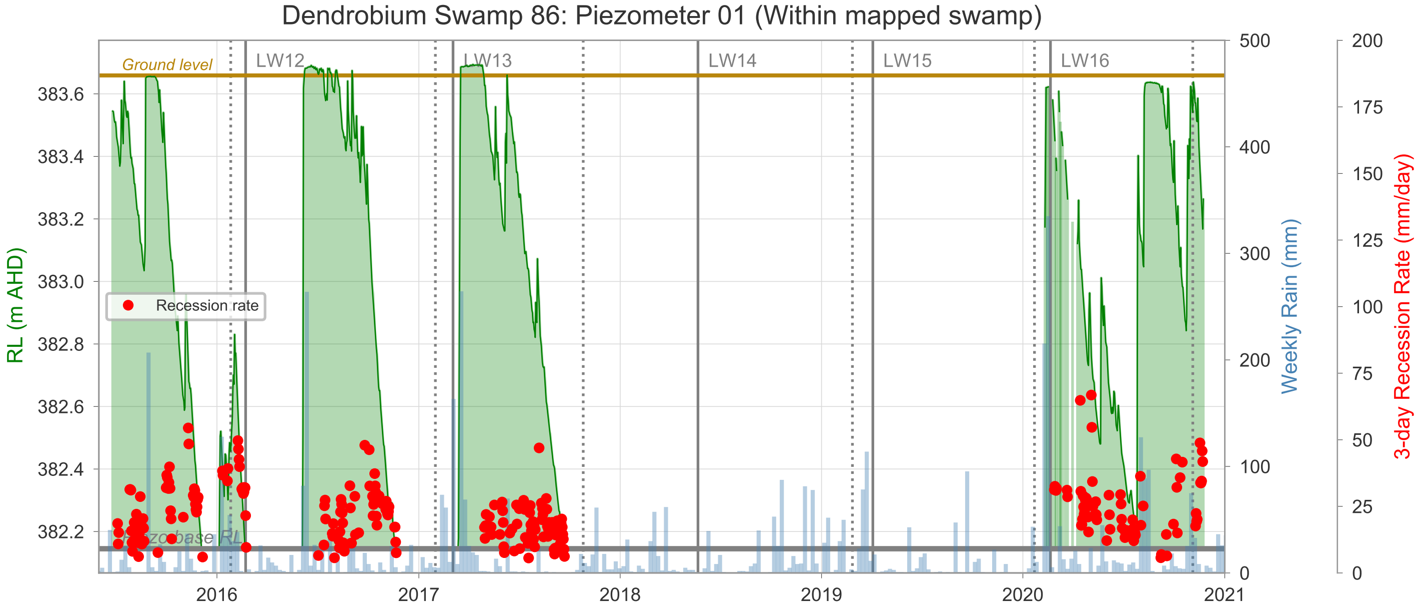
Dendrobium Swamp 85: Piezometer 01 (Within mapped swamp)



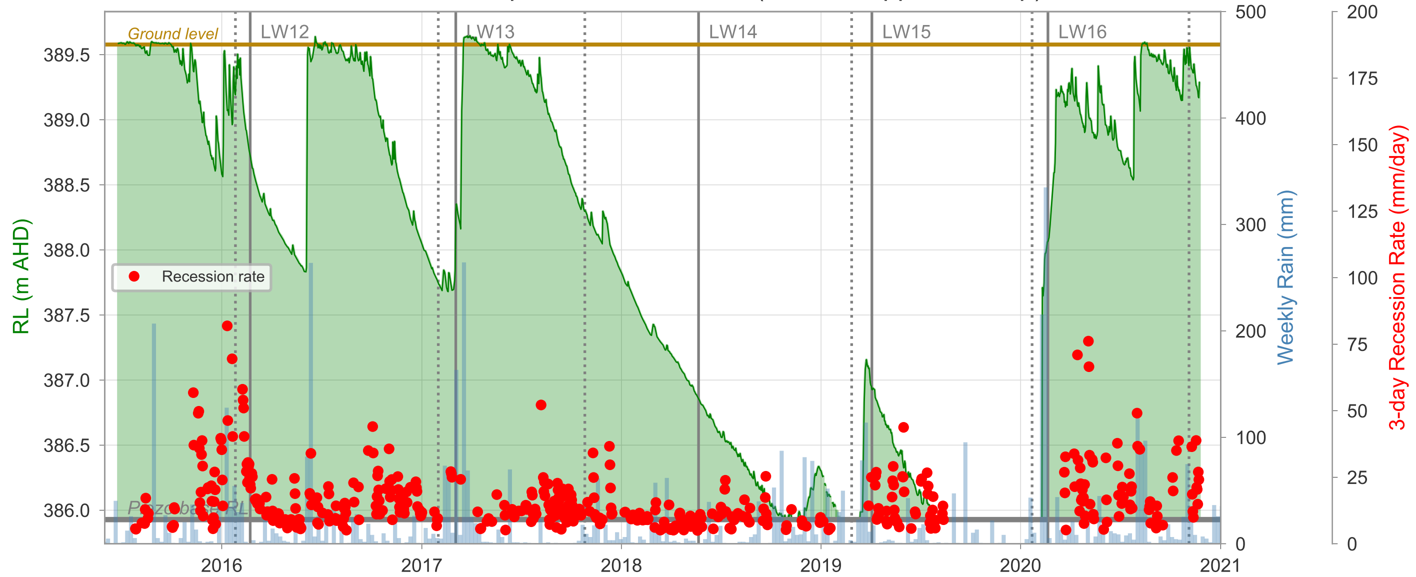
Dendrobium Swamp 85: Piezometer 02 (Within mapped swamp)



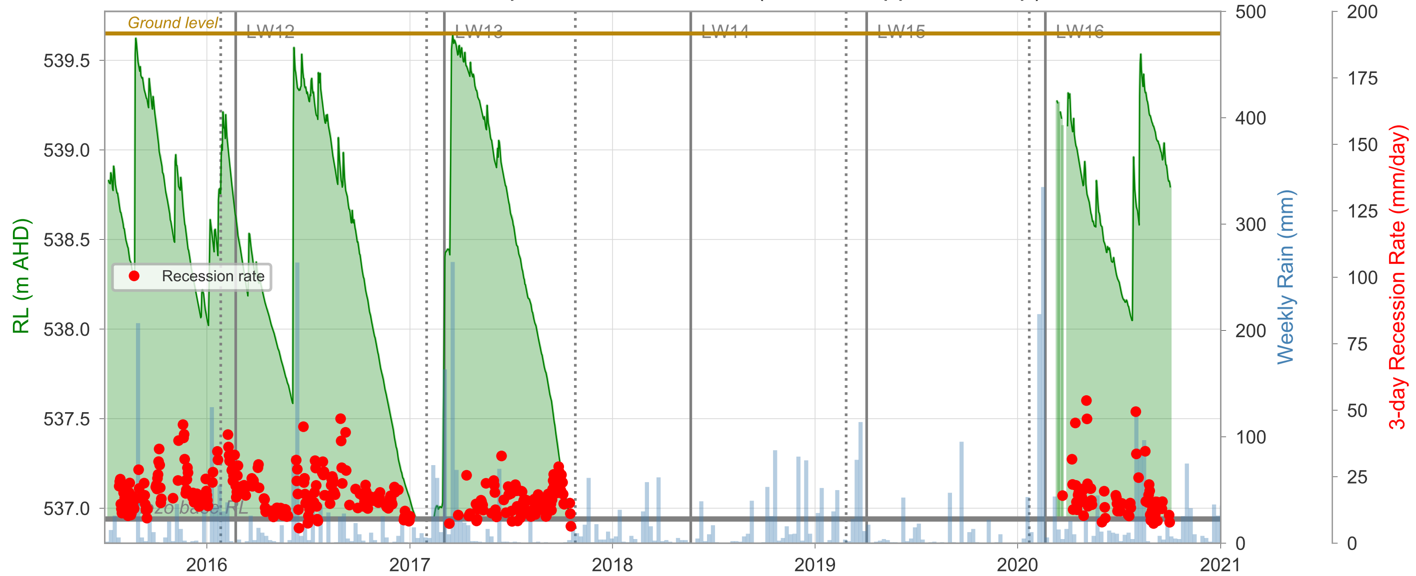
Dendrobium Swamp 86: Piezometer 01 (Within mapped swamp)



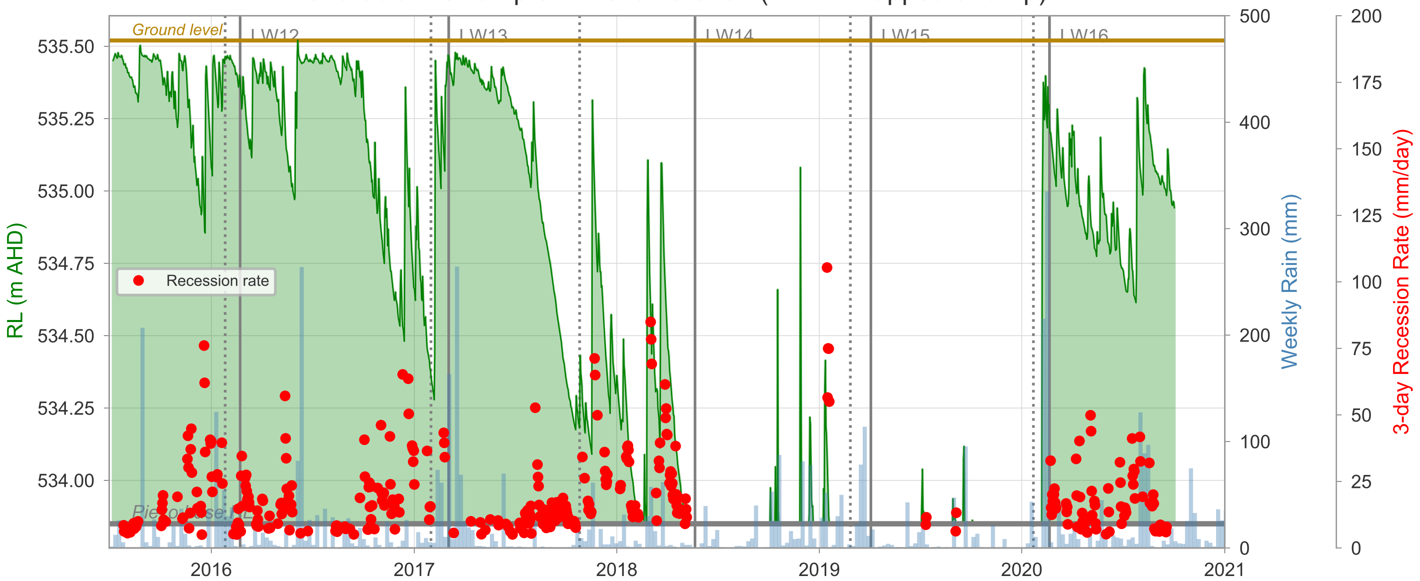
Dendrobium Swamp 86: Piezometer 02 (Within mapped swamp)



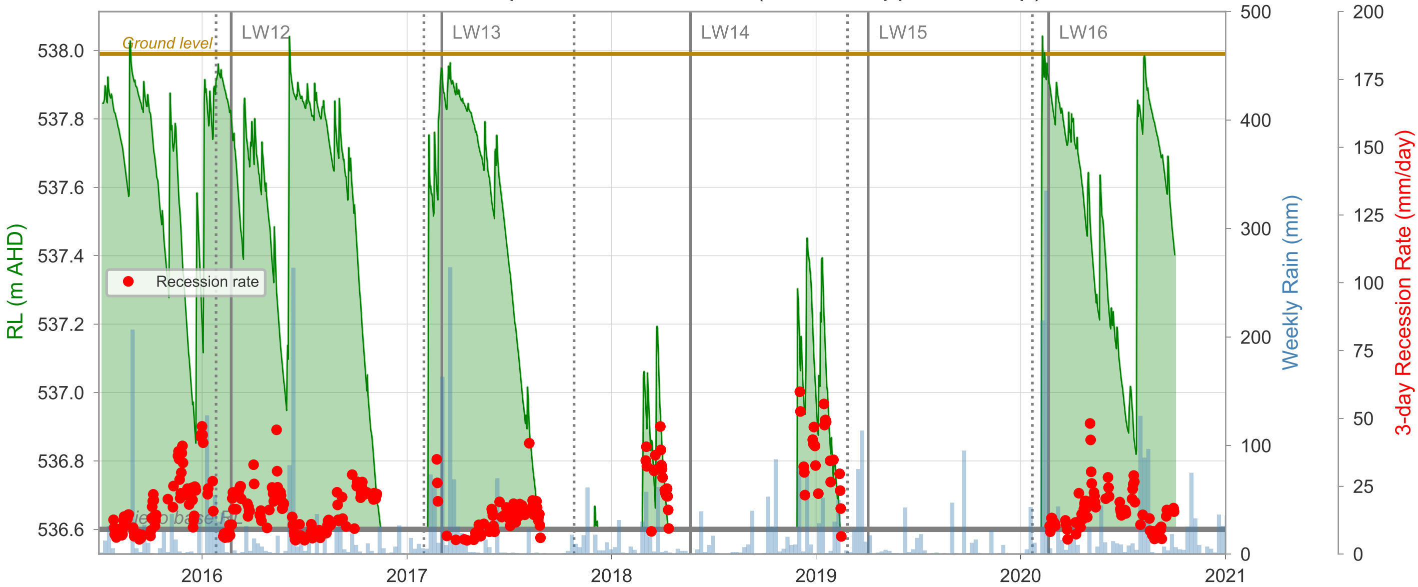
Dendrobium Swamp 87: Piezometer 01 (Within mapped swamp)



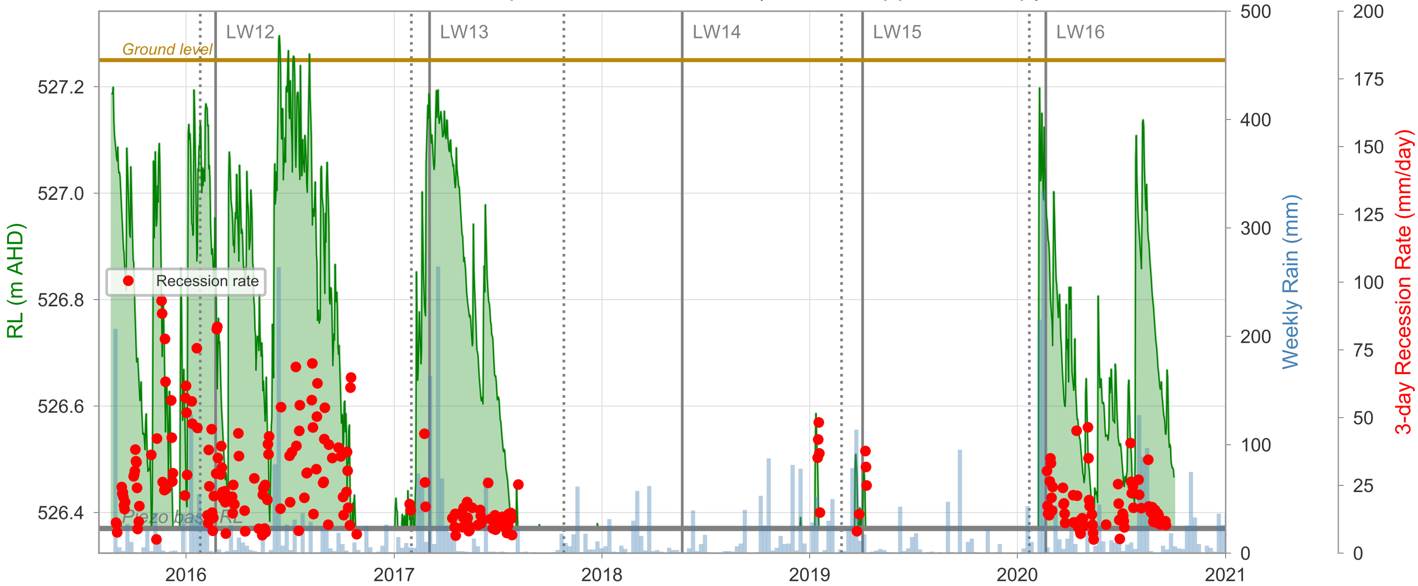
Dendrobium Swamp 87: Piezometer 02 (Within mapped swamp)



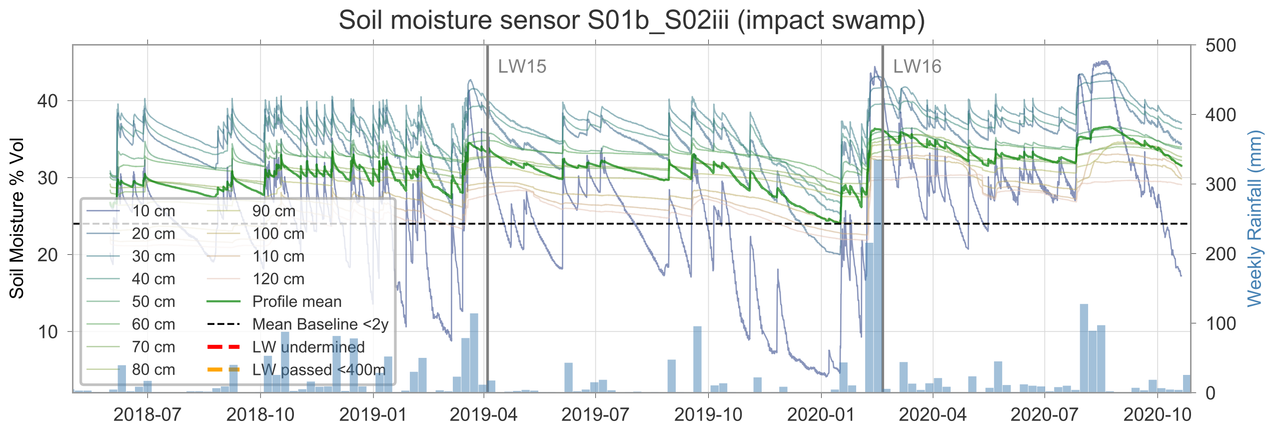
Dendrobium Swamp 88: Piezometer 01 (Within mapped swamp)

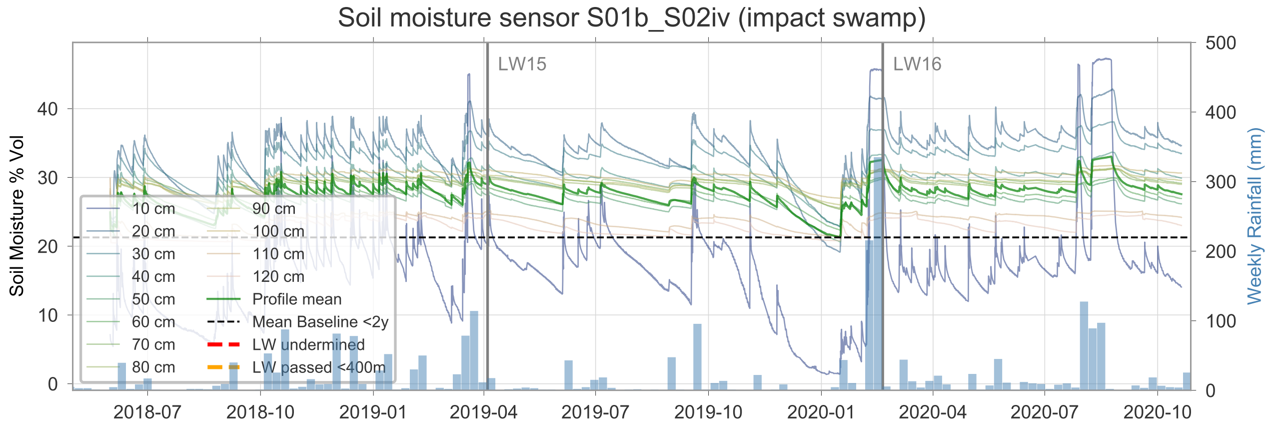


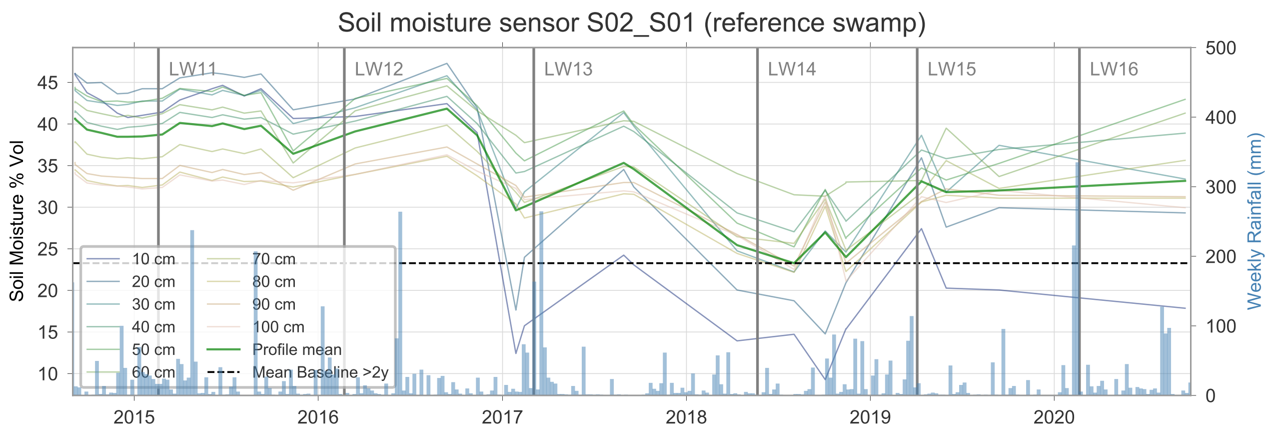
Dendrobium Swamp 88: Piezometer 02 (Within mapped swamp)

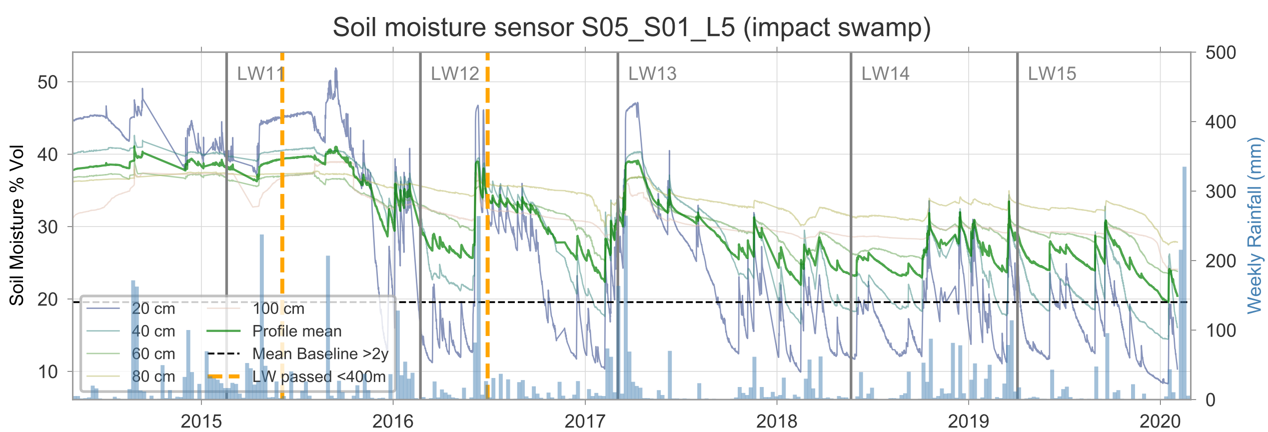


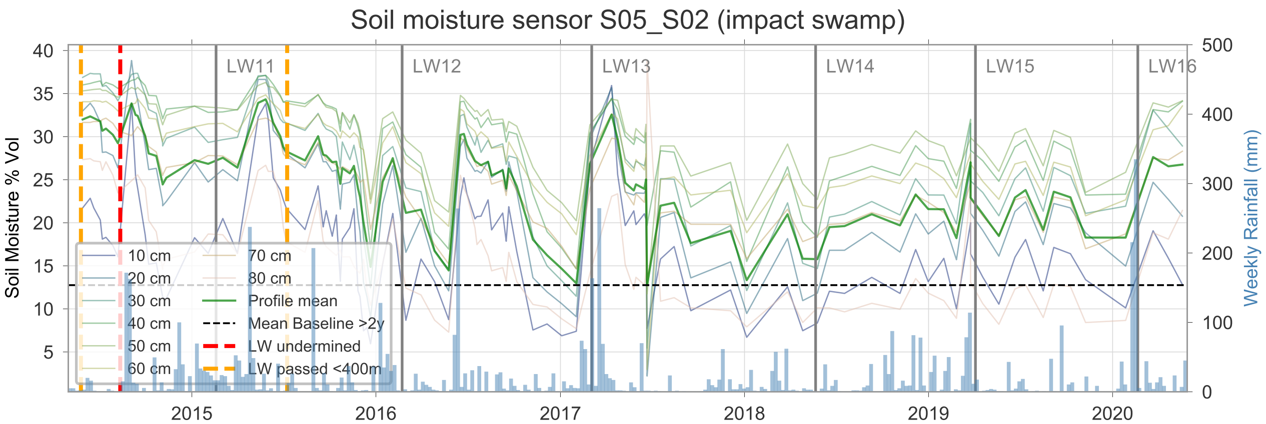
Appendix E: Soil moisture hydrographs


Soil moisture sensor S01b_S02iii (impact swamp)
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline <2y
LW undermined
LW passed <400m
2018-07
2018-10
2019-01
2019-04
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10

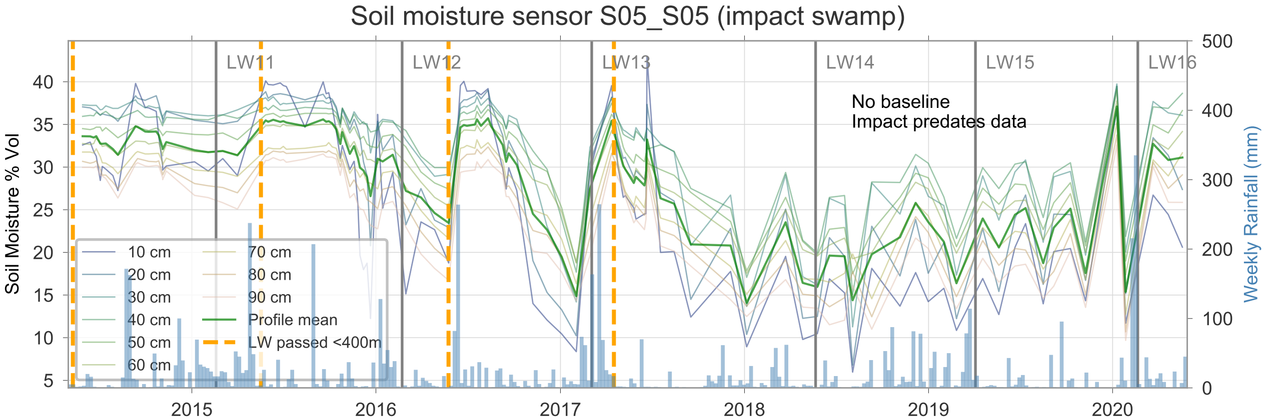

Soil moisture sensor S01b_S02iv (impact swamp)
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline <2y
LW undermined
LW passed <400m
2018-07
2018-10
2019-01
2019-04
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10


Soil moisture sensor S02_S01 (reference swamp)
LW11
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2015
2016
2017
2018
2019
2020

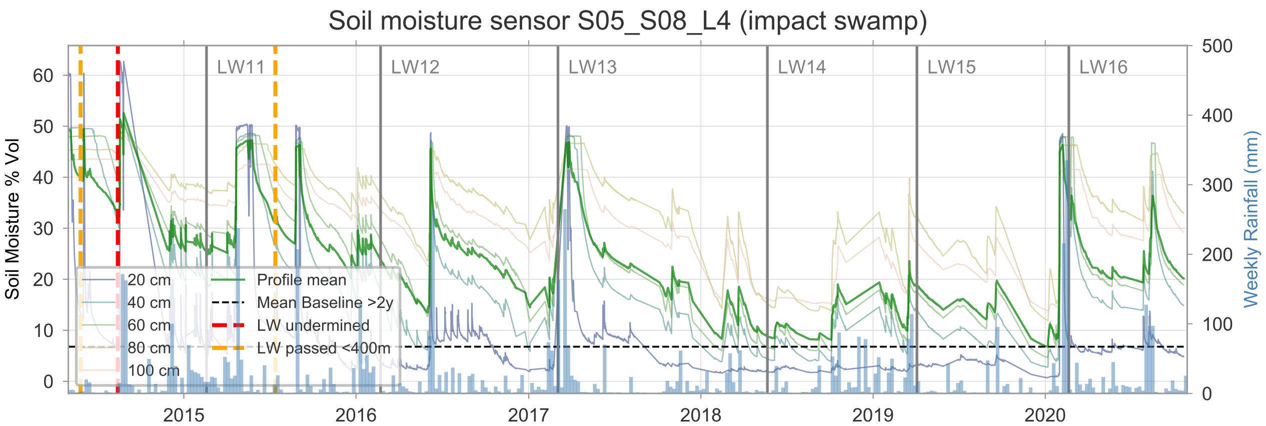

Soil moisture sensor S05_S01_L5 (impact swamp)
LW11
LW12
LW13
LW14
LW15
Soil Moisture % Vol
Weekly Rainfall (mm)
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline >2y
LW passed <400m
2015
2016
2017
2018
2019
2020



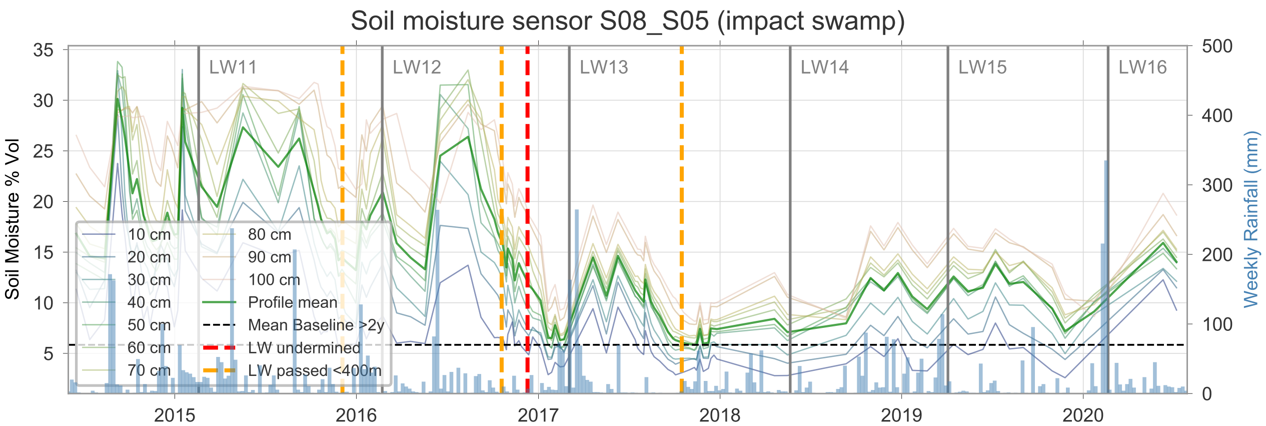
Soil moisture sensor S05_S02 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020



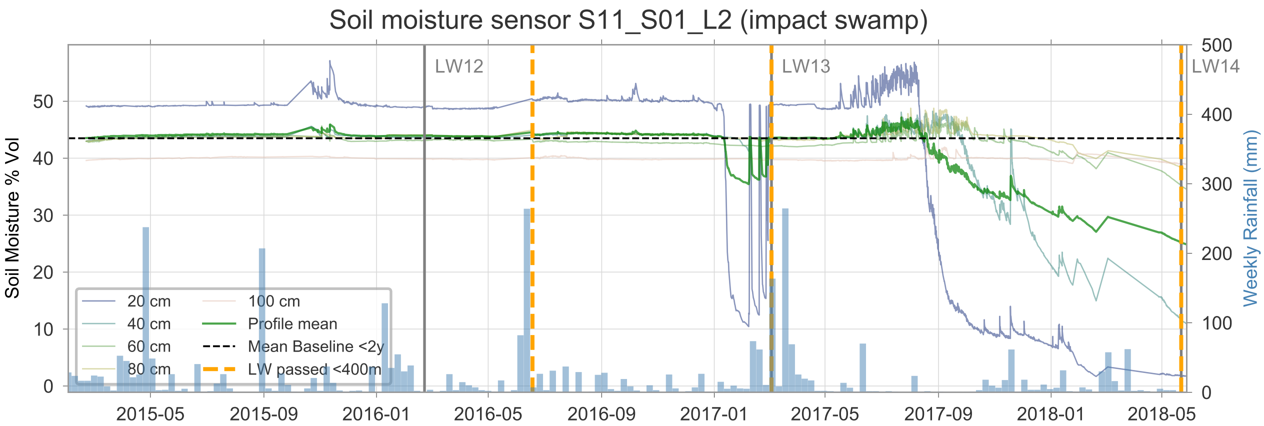
Soil moisture sensor S05_S05 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
No baseline
Impact predates data
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
Profile mean
LW passed <400m
2015
2016
2017
2018
2019
2020

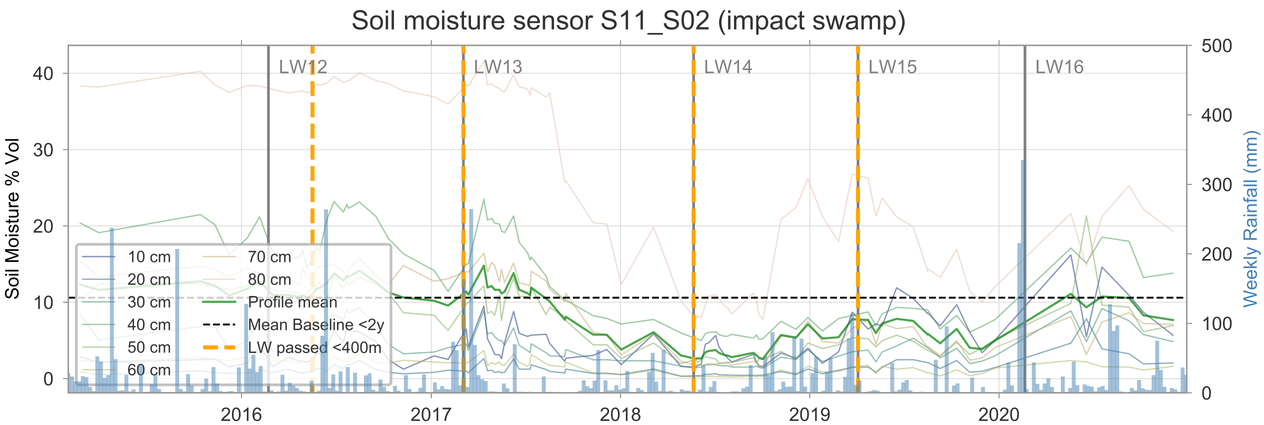


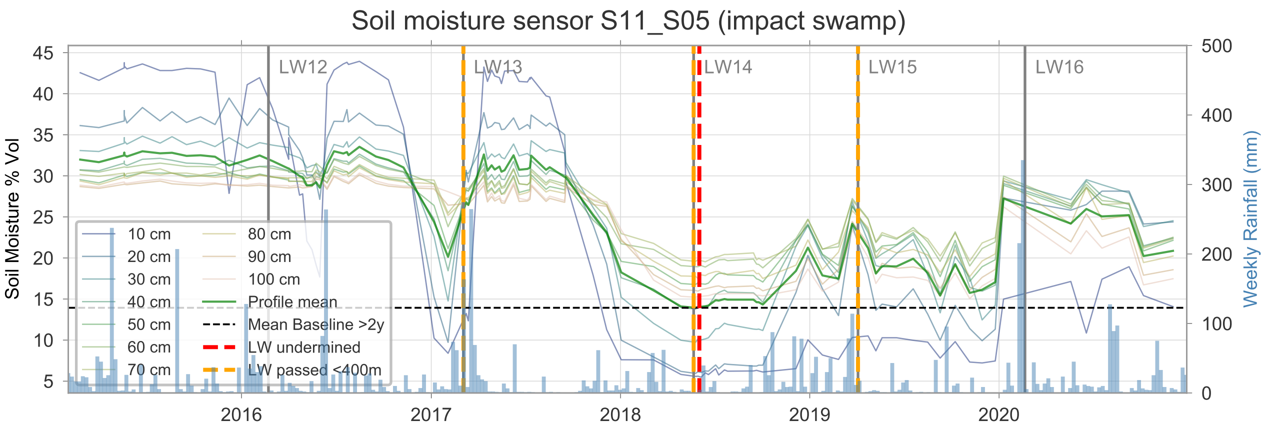
Soil moisture sensor S05_S08_L4 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020

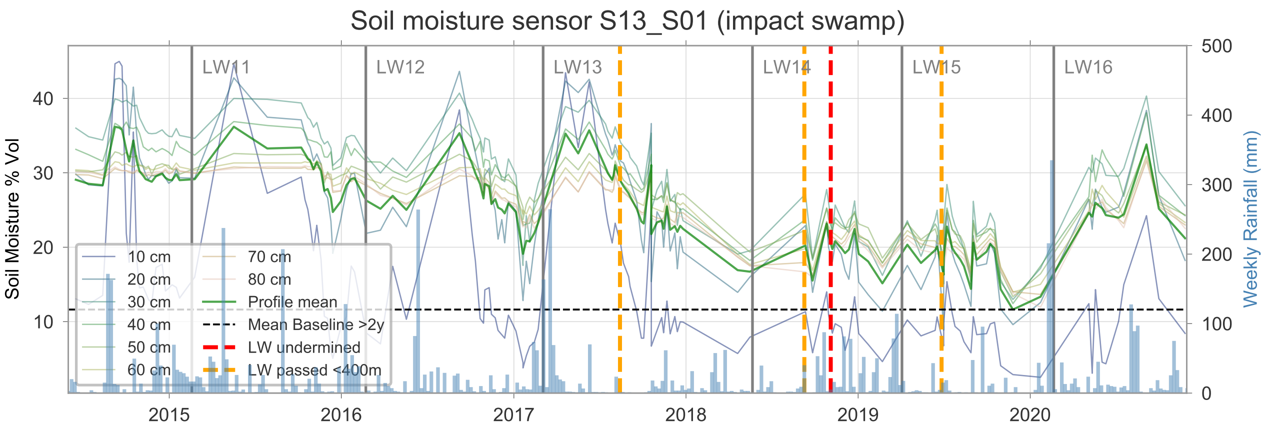


Soil moisture sensor S08_S05 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020

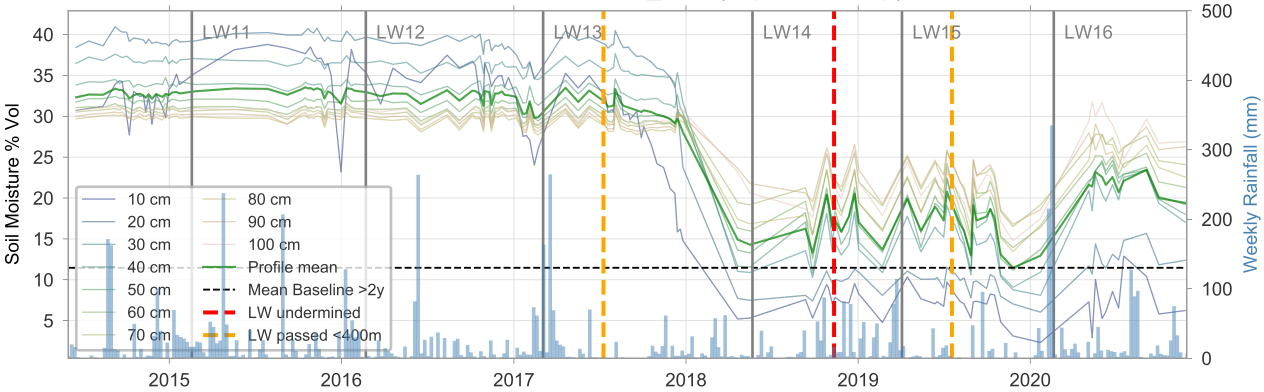

Soil moisture sensor S11_S01_L2 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW12
LW13
LW14
20 cm
40 cm
60 cm
80 cm
100 cm
Profile mean
Mean Baseline <2y
LW passed <400m
2015-05
2015-09
2016-01
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05


Soil moisture sensor S11_S02 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline <2y
LW passed <400m
2016
2017
2018
2019
2020

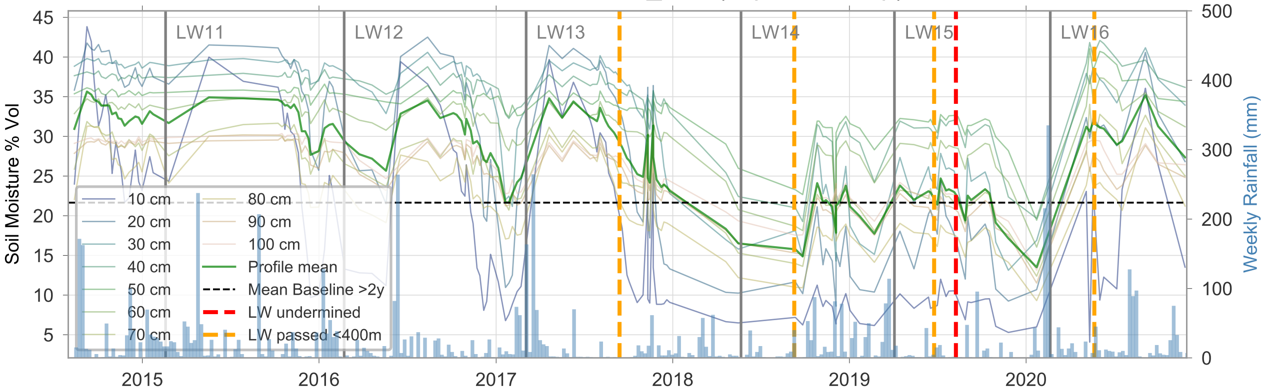

Soil moisture sensor S11_S05 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2016
2017
2018
2019
2020


Soil moisture sensor S13_S01 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW11
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2015
2016
2017
2018
2019
2020

Soil moisture sensor S13_S02 (impact swamp)

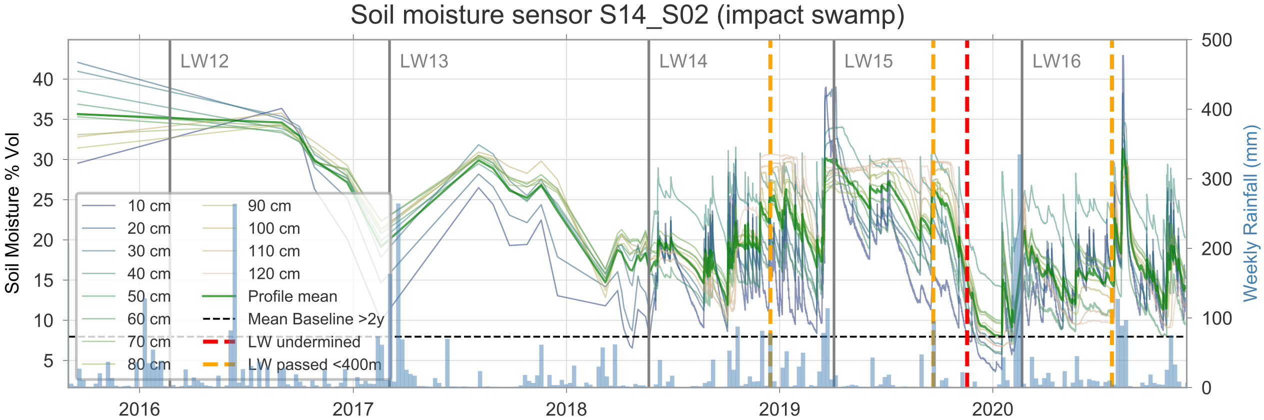


Soil moisture sensor S13_S03 (impact swamp)

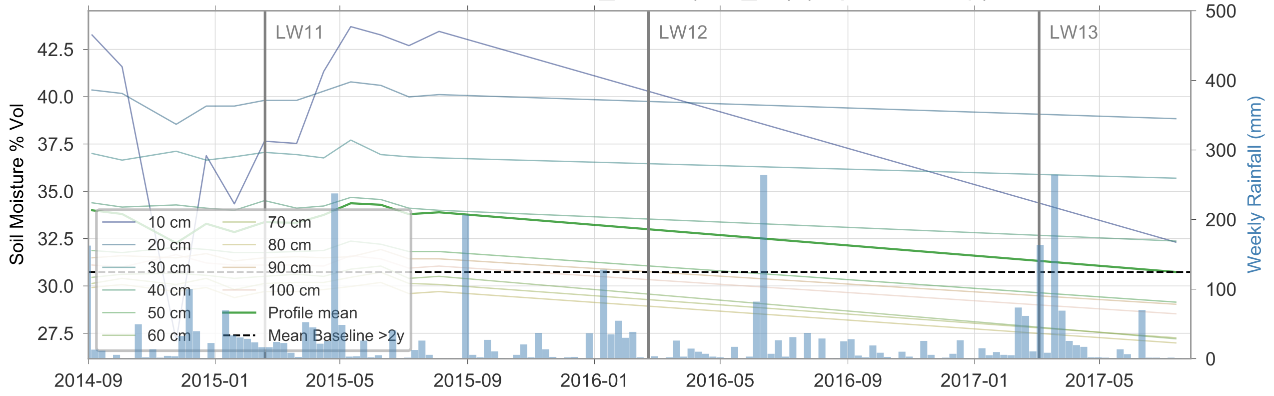


Soil moisture sensor S14_S01_L3 (impact swamp)

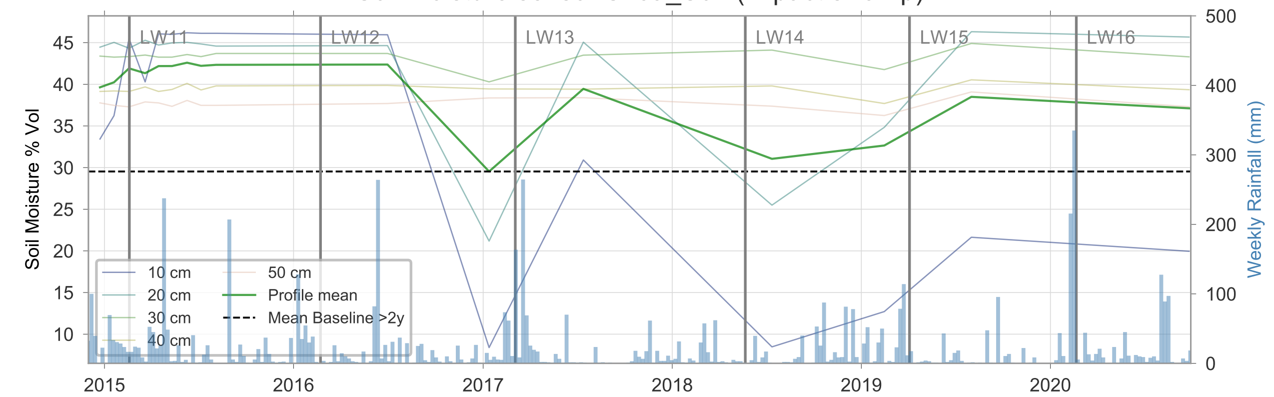
Soil moisture sensor S14_S02 (impact swamp)



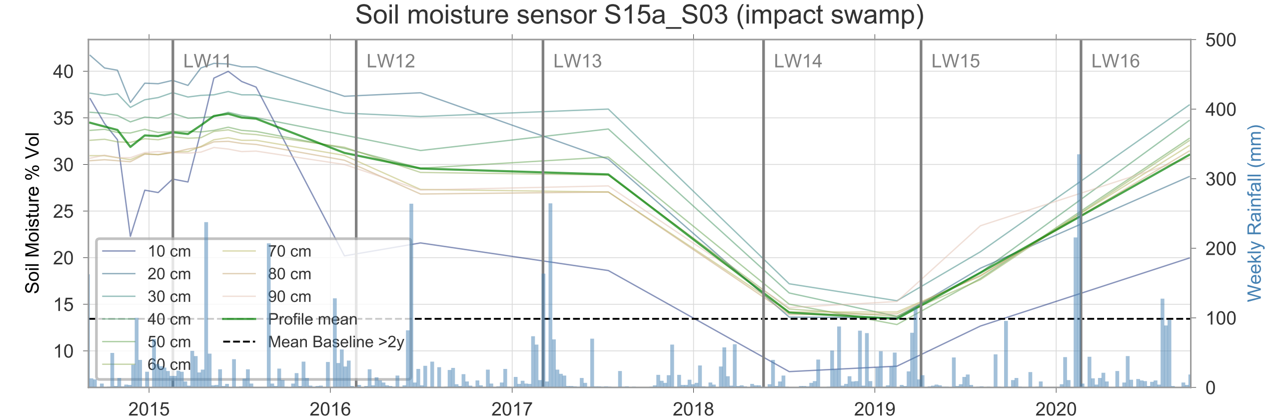
Soil moisture sensor S15a_Piezo (15a_12) (impact swamp)



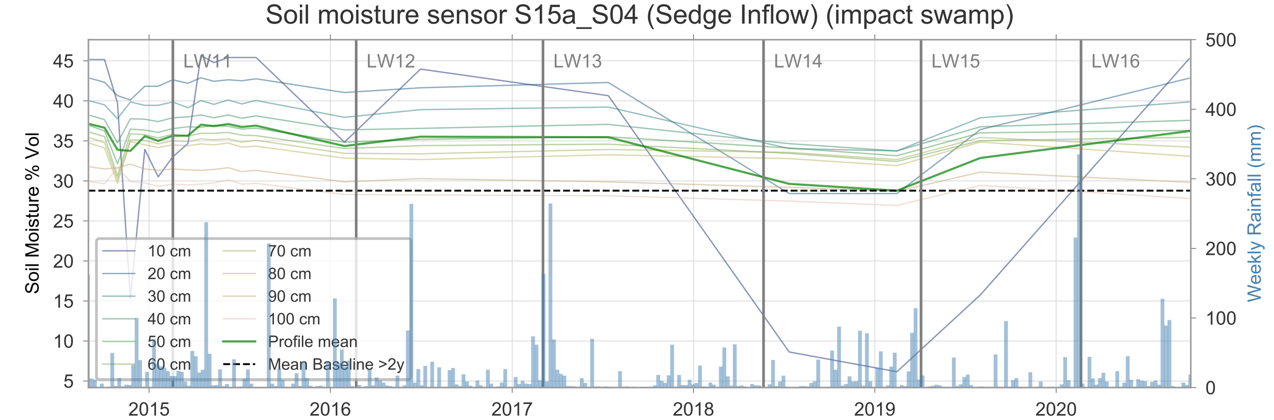
Soil moisture sensor S15a_S01 (impact swamp)

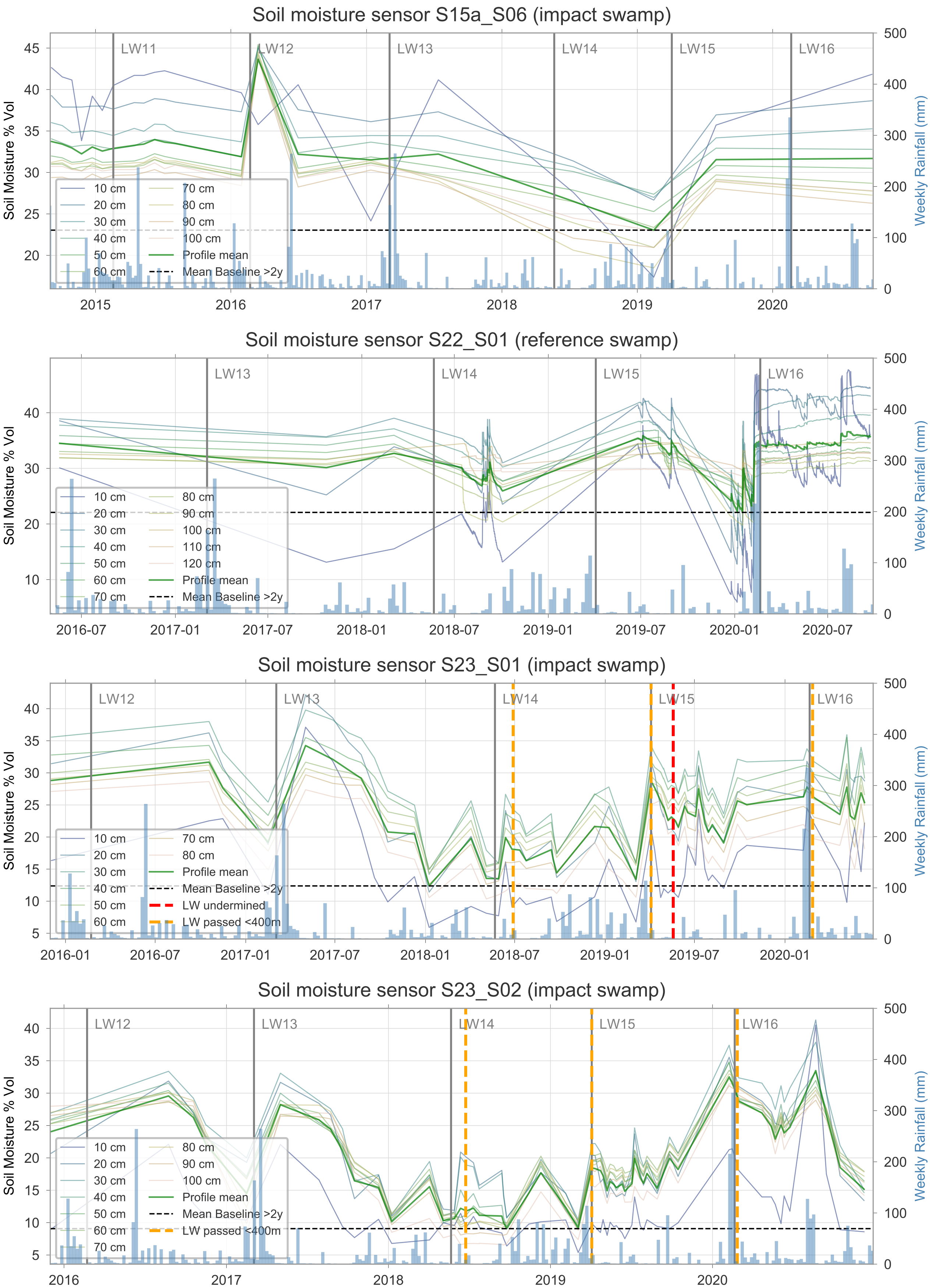


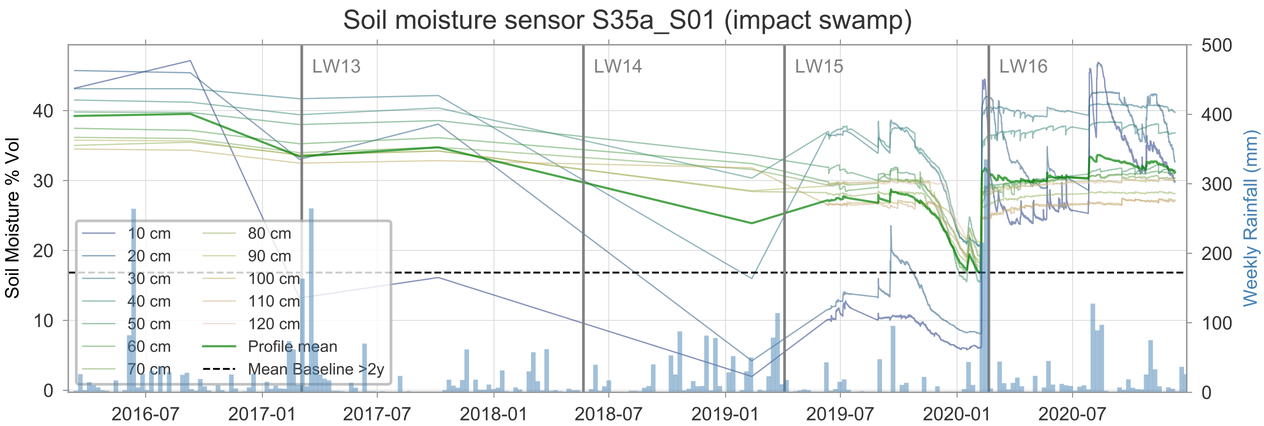
Soil moisture sensor S15a_S03 (impact swamp)

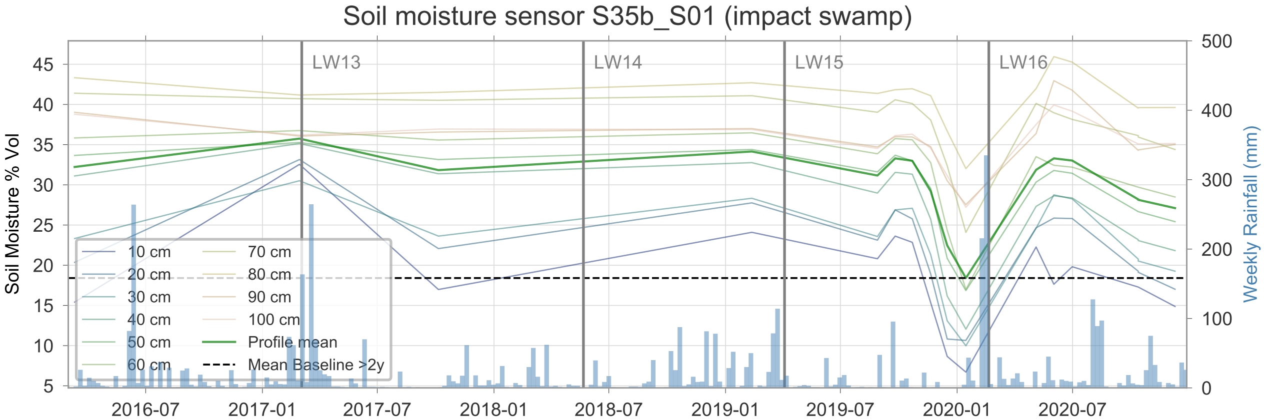


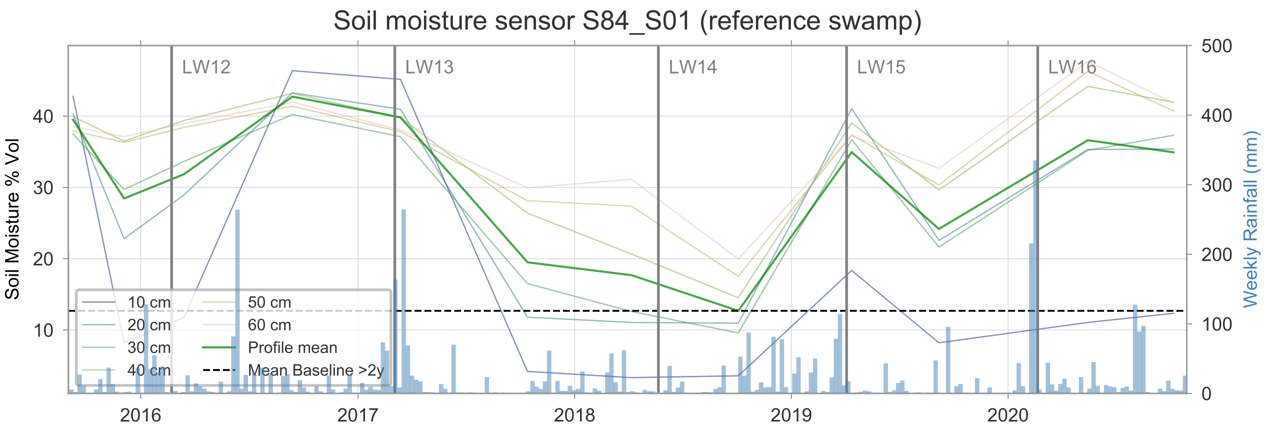
Soil moisture sensor S15a_S04 (Sedge Inflow) (impact swamp)

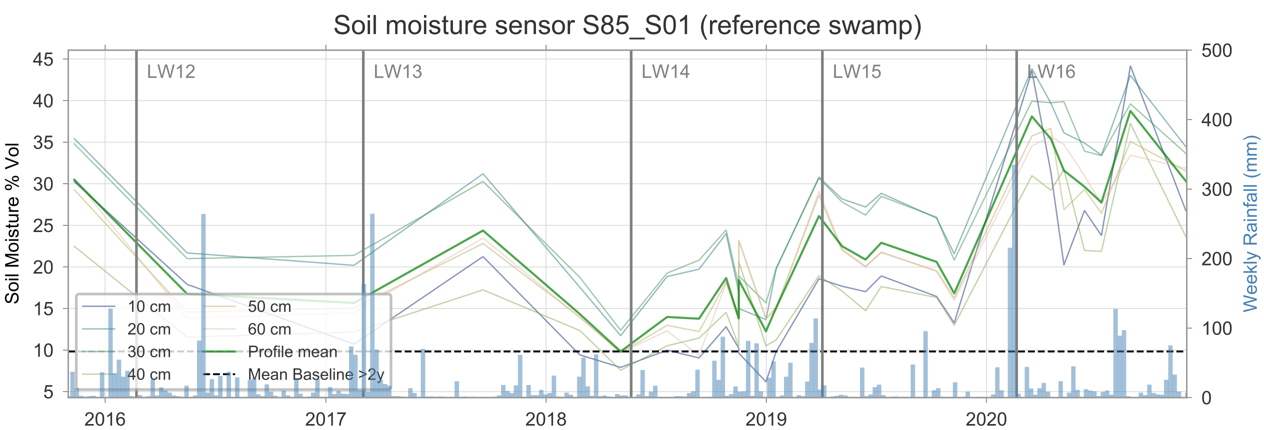


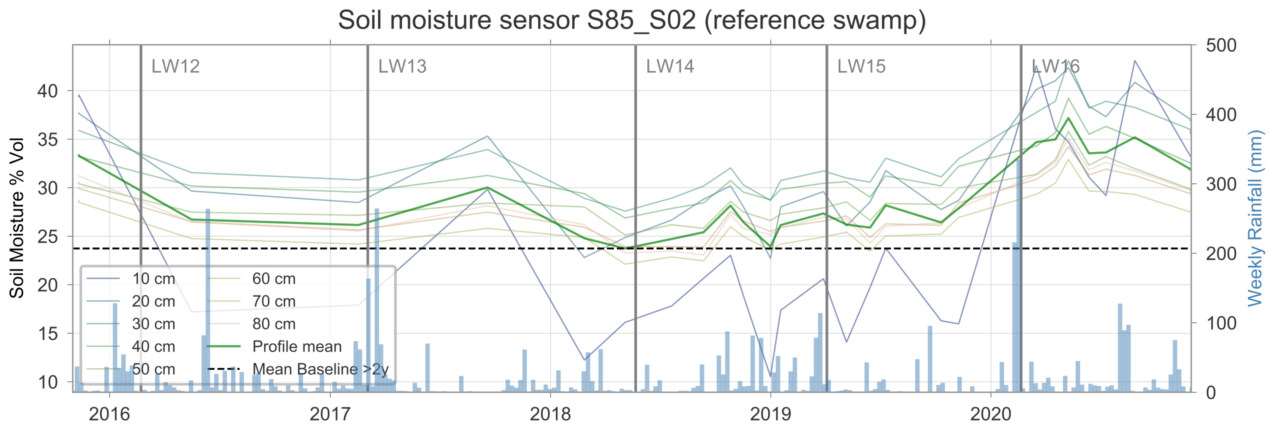

Soil moisture sensor S15a_S06 (impact swamp)
LW11
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2015
2016
2017
2018
2019
2020
Soil moisture sensor S22_S01 (reference swamp)
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
Soil moisture sensor S23_S01 (impact swamp)
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline >2y
LW undermined
LW passed <400m
2016-01
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
Soil moisture sensor S23_S02 (impact swamp)
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
LW passed <400m
2016
2017
2018
2019
2020

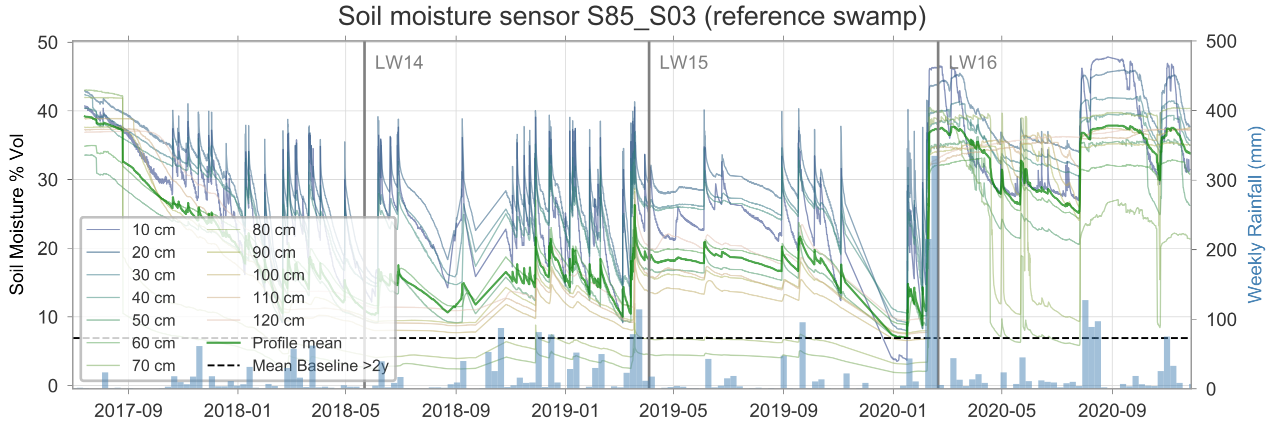

Soil moisture sensor S35a_S01 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07

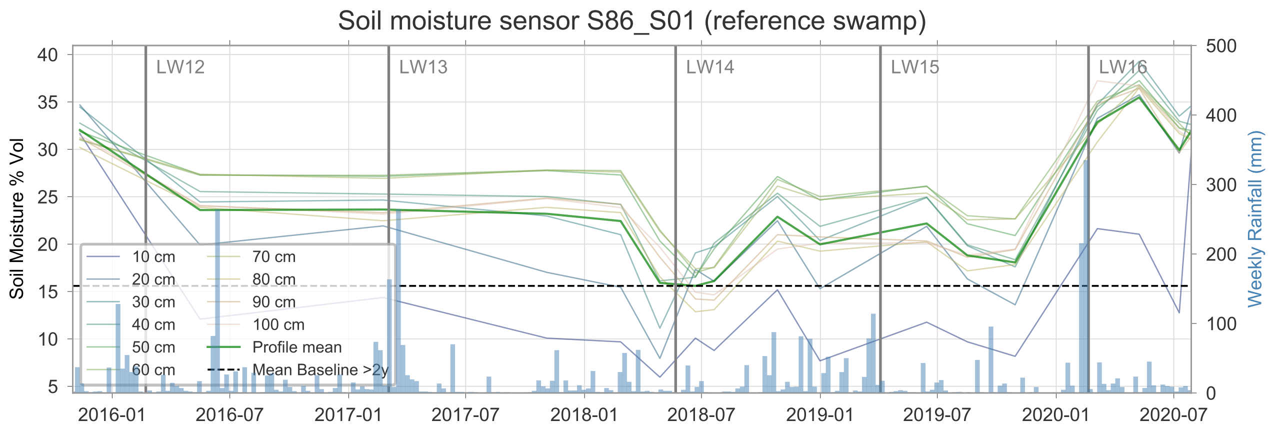

Soil moisture sensor S35b_S01 (impact swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07

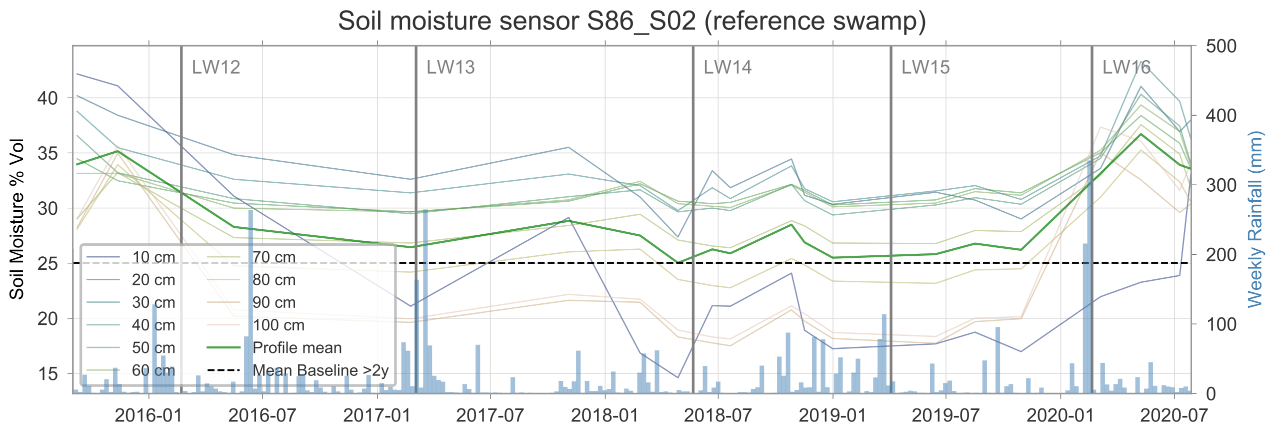

Soil moisture sensor S84_S01 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
Profile mean
Mean Baseline >2y
2016
2017
2018
2019
2020

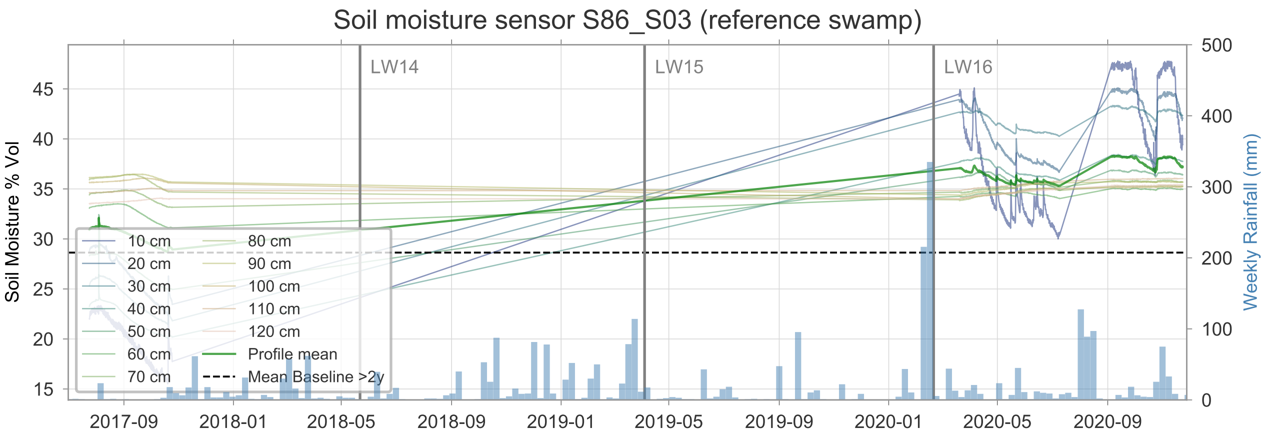

Soil moisture sensor S85_S01 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW12
LW13
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
Profile mean
Mean Baseline >2y
2016
2017
2018
2019
2020

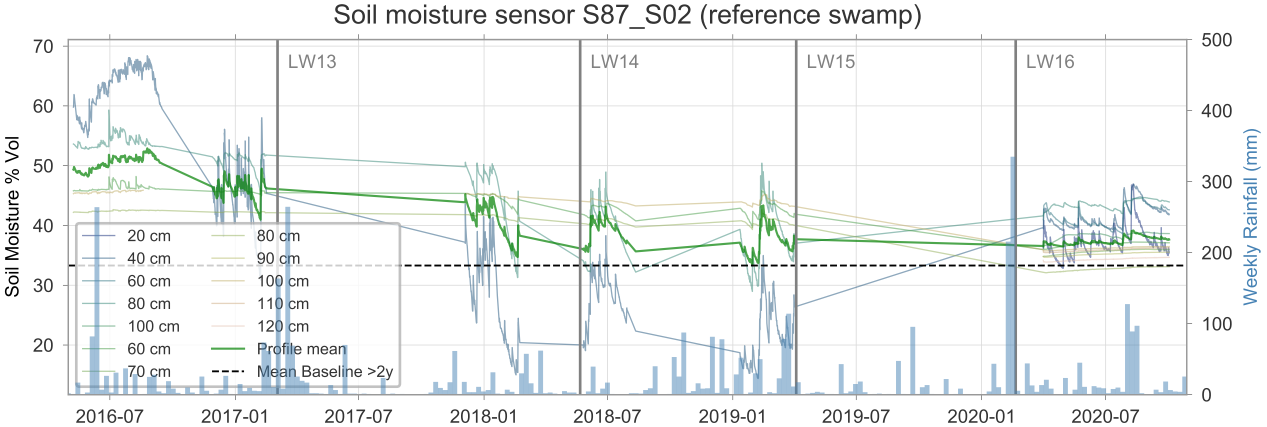

Soil moisture sensor S85_S02 (reference swamp)
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
Profile mean
Mean Baseline >2y
2016
2017
2018
2019
2020


Soil moisture sensor S85_S03 (reference swamp)
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2017-09
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09

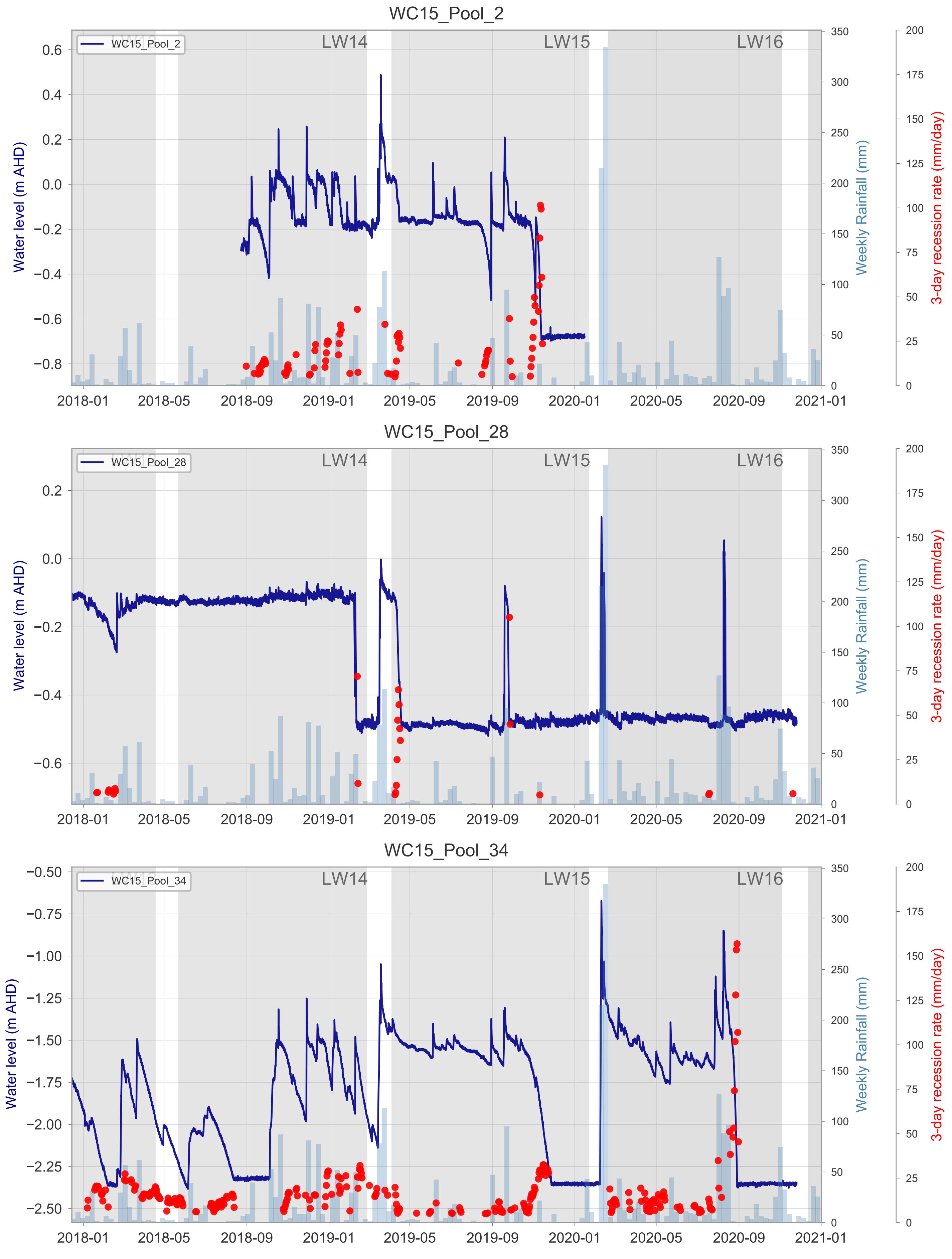

Soil moisture sensor S86_S01 (reference swamp)
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2016-01
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07

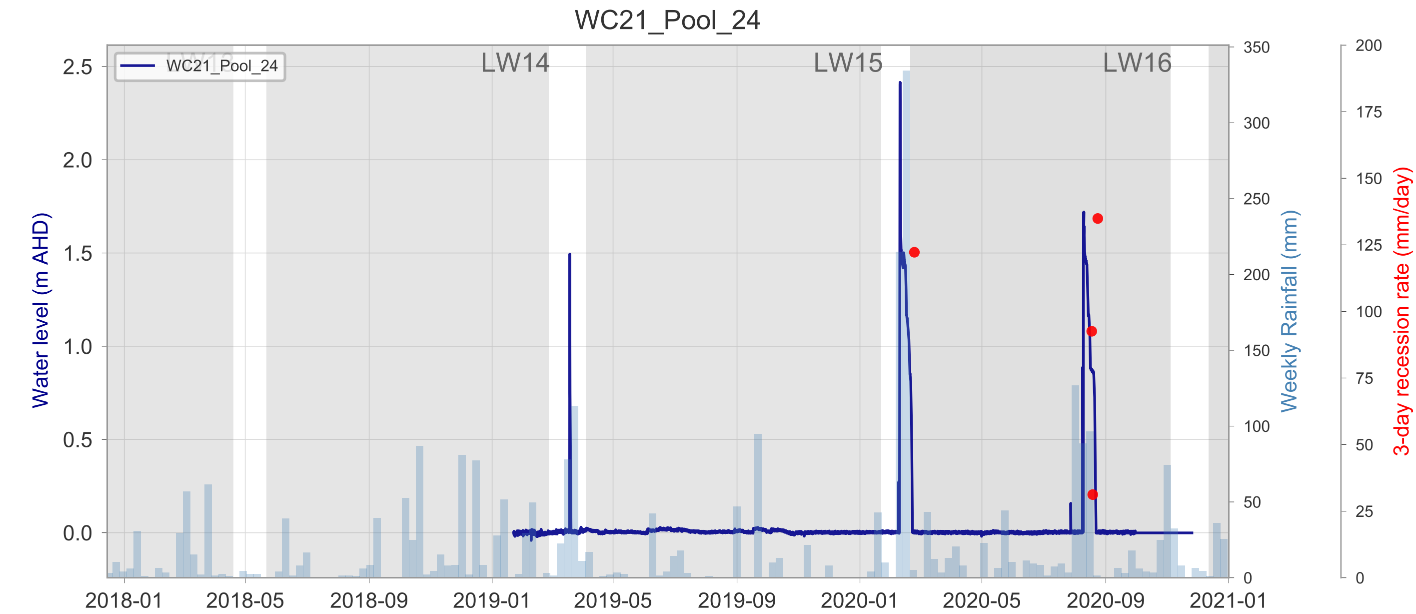

Soil moisture sensor S86_S02 (reference swamp)
LW12
LW13
LW14
LW15
LW16
Soil Moisture % Vol
Weekly Rainfall (mm)
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
Profile mean
Mean Baseline >2y
2016-01
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07

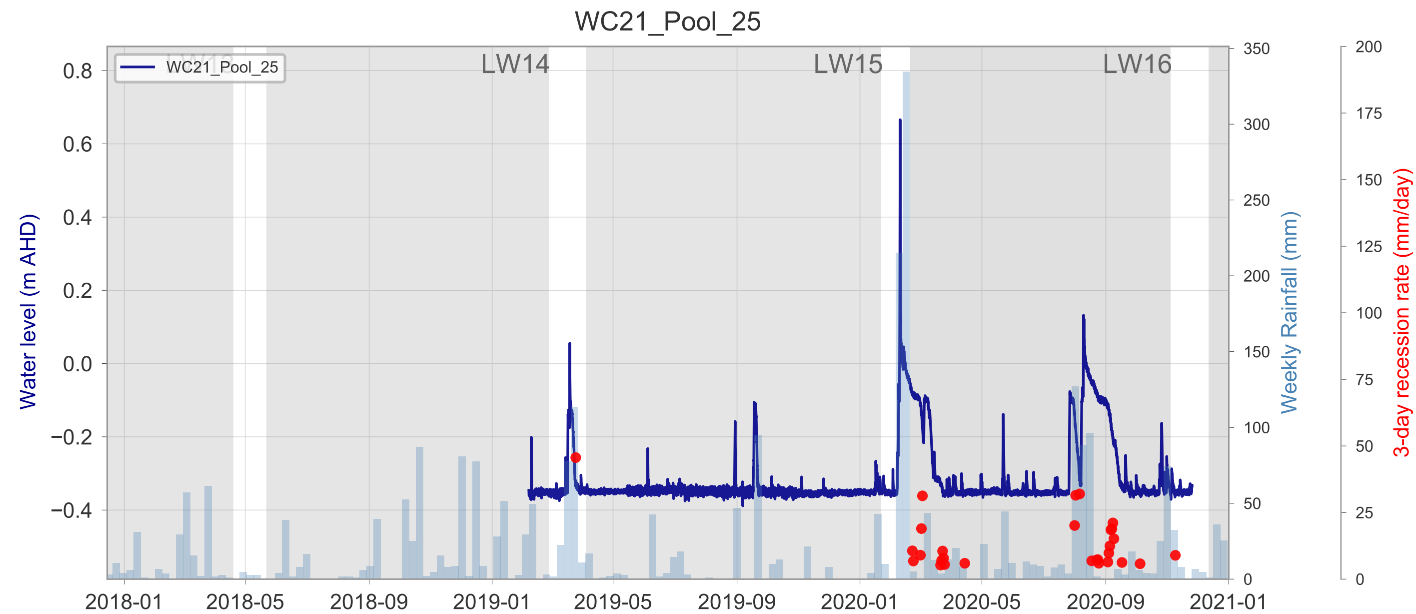

Soil moisture sensor S86_S03 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW14
LW15
LW16
10 cm
20 cm
30 cm
40 cm
50 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2017-09
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09

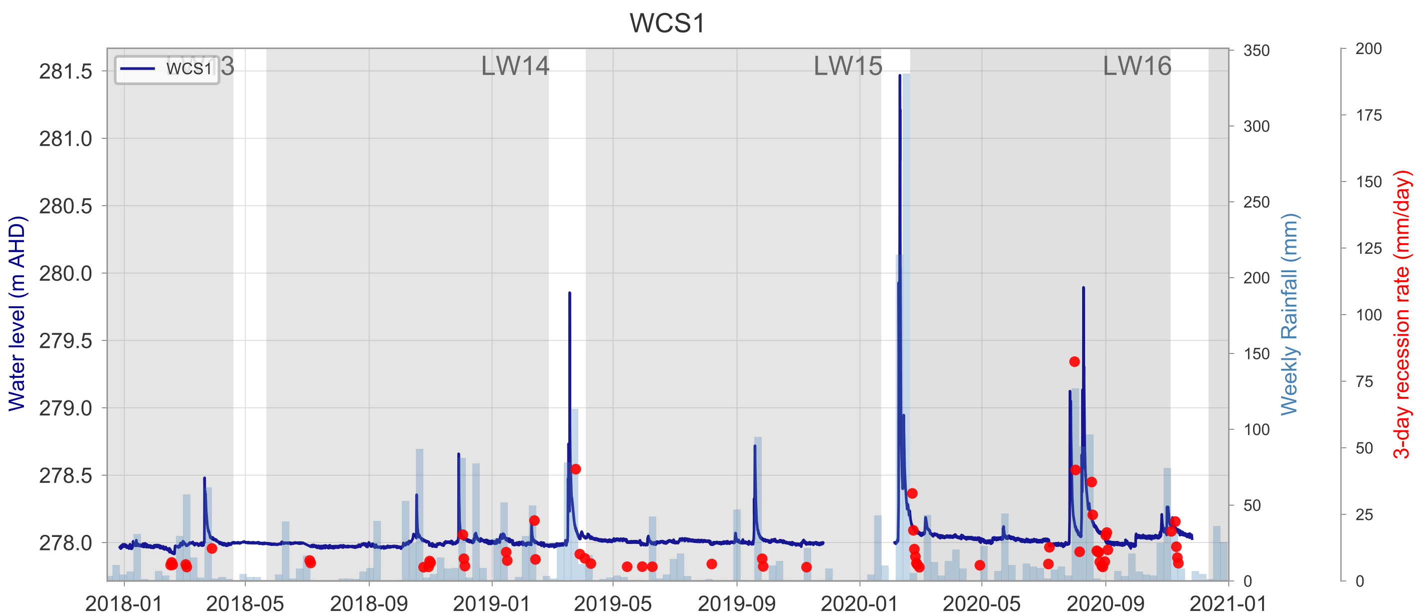

Soil moisture sensor S87_S02 (reference swamp)
Soil Moisture % Vol
Weekly Rainfall (mm)
LW13
LW14
LW15
LW16
20 cm
40 cm
60 cm
80 cm
100 cm
60 cm
70 cm
80 cm
90 cm
100 cm
110 cm
120 cm
Profile mean
Mean Baseline >2y
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07

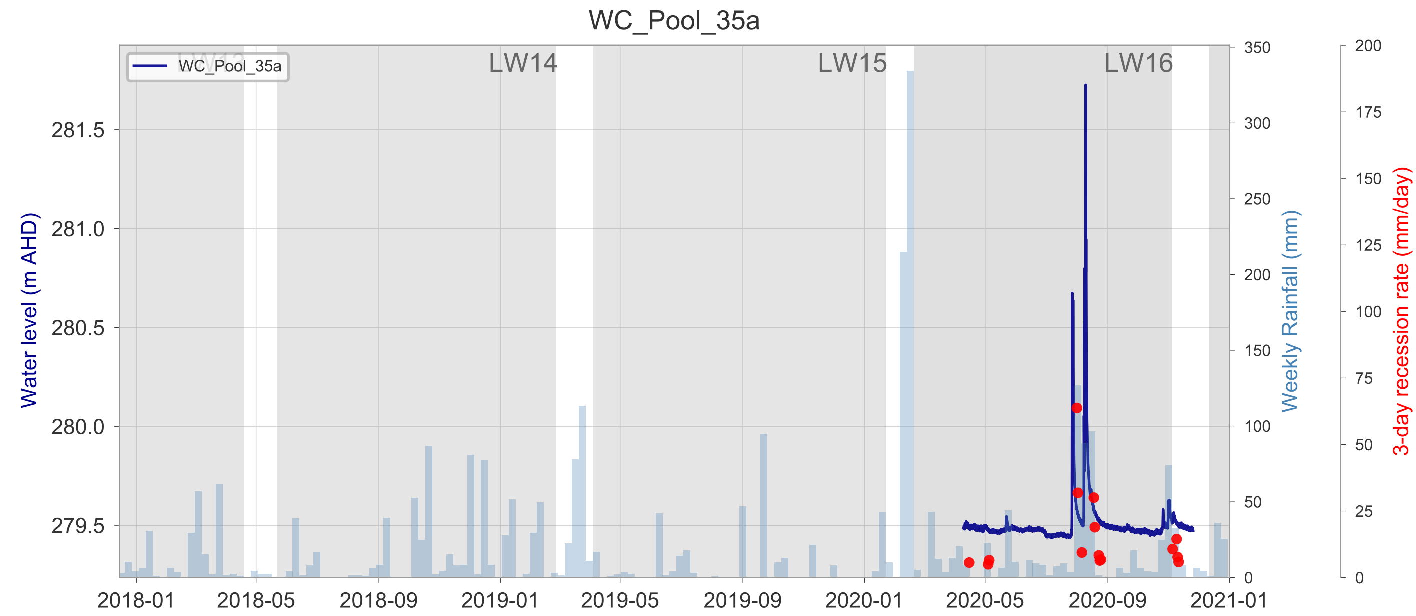
Appendix F: Stream pool level hydrographs

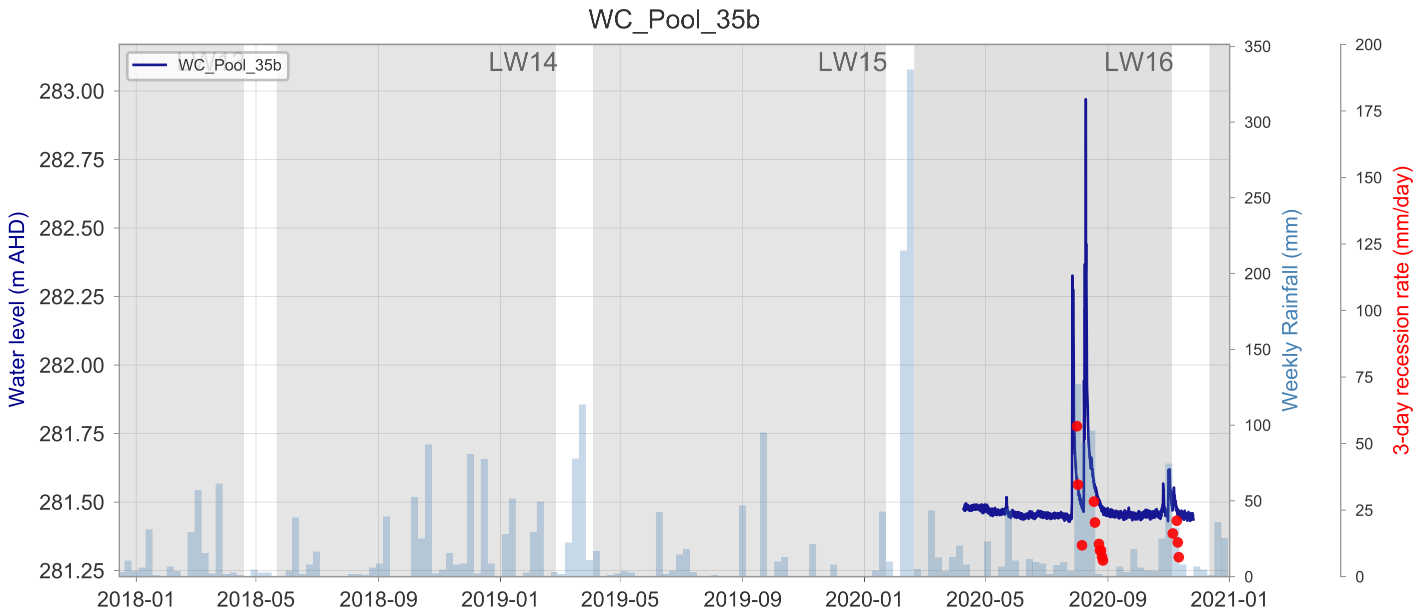

WC15_Pool_2
WC15_Pool_2
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
WC15_Pool_28
WC15_Pool_28
WC15_Pool_34
WC15_Pool_34
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

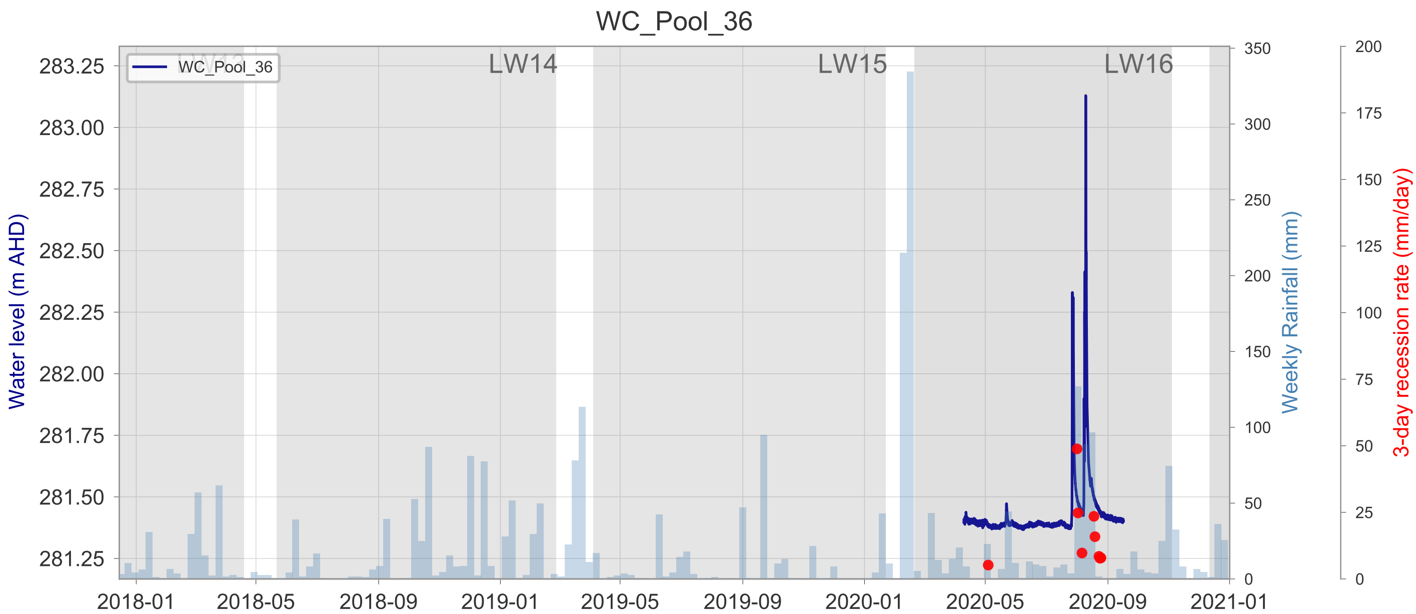

WC21_Pool_24
WC21_Pool_24
LW14
LW15
LW16
Water level (m AHD)
2.5
2.0
1.5
1.0
0.5
0.0
Weekly Rainfall (mm)
350
300
250
200
150
100
50
0
3-day recession rate (mm/day)
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

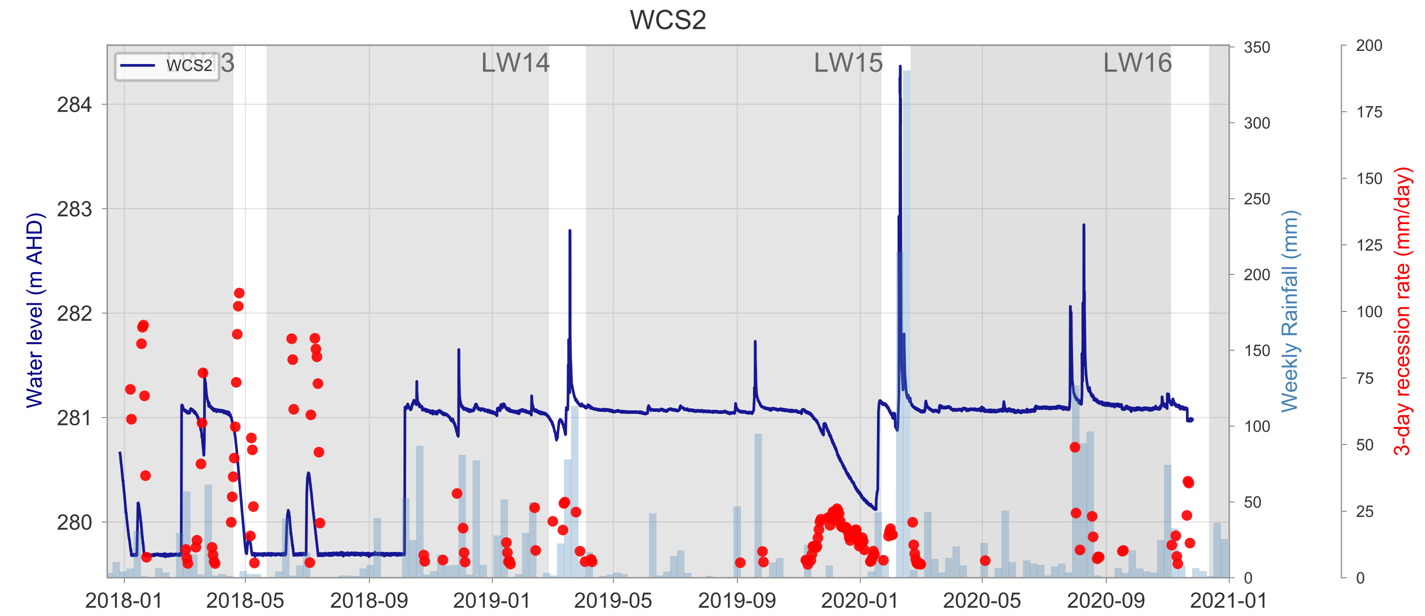

WC21_Pool_25
WC21_Pool_25
LW14
LW15
LW16
Water level (m AHD)
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
Weekly Rainfall (mm)
350
300
250
200
150
100
50
0
3-day recession rate (mm/day)
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

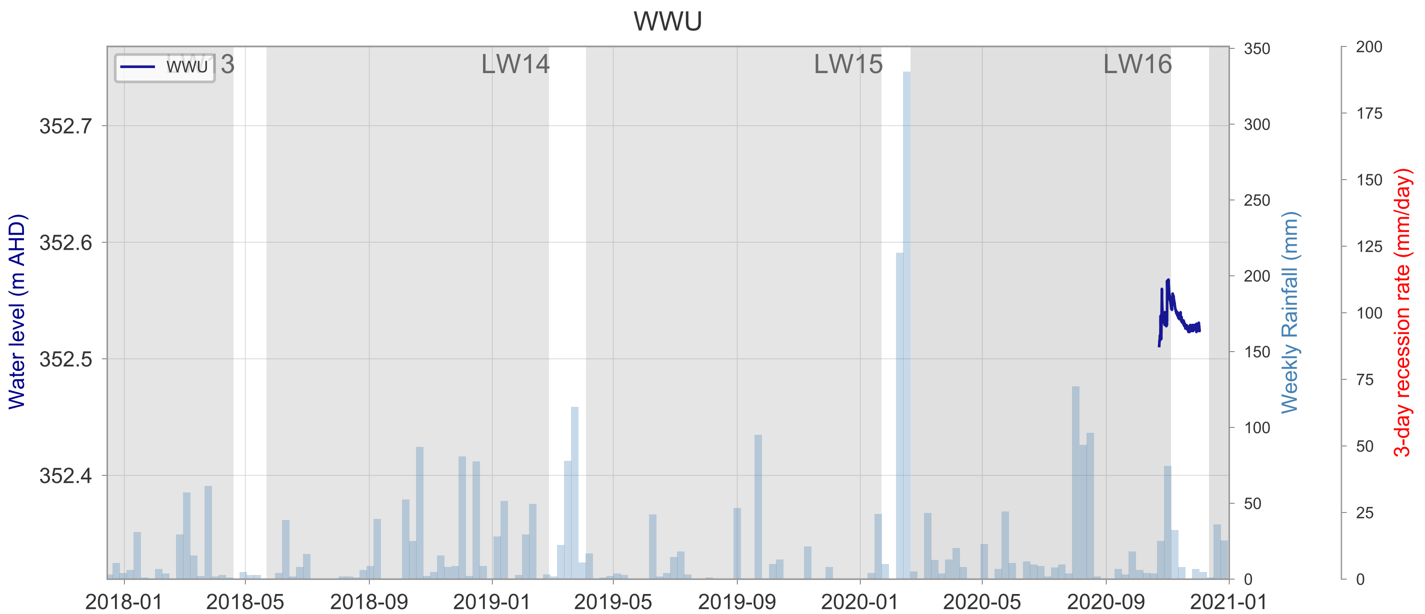

WCS1
WCS1
LW14
LW15
LW16
Water level (m AHD)
281.5
281.0
280.5
280.0
279.5
279.0
278.5
278.0
Weekly Rainfall (mm)
350
300
250
200
150
100
50
0
3-day recession rate (mm/day)
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

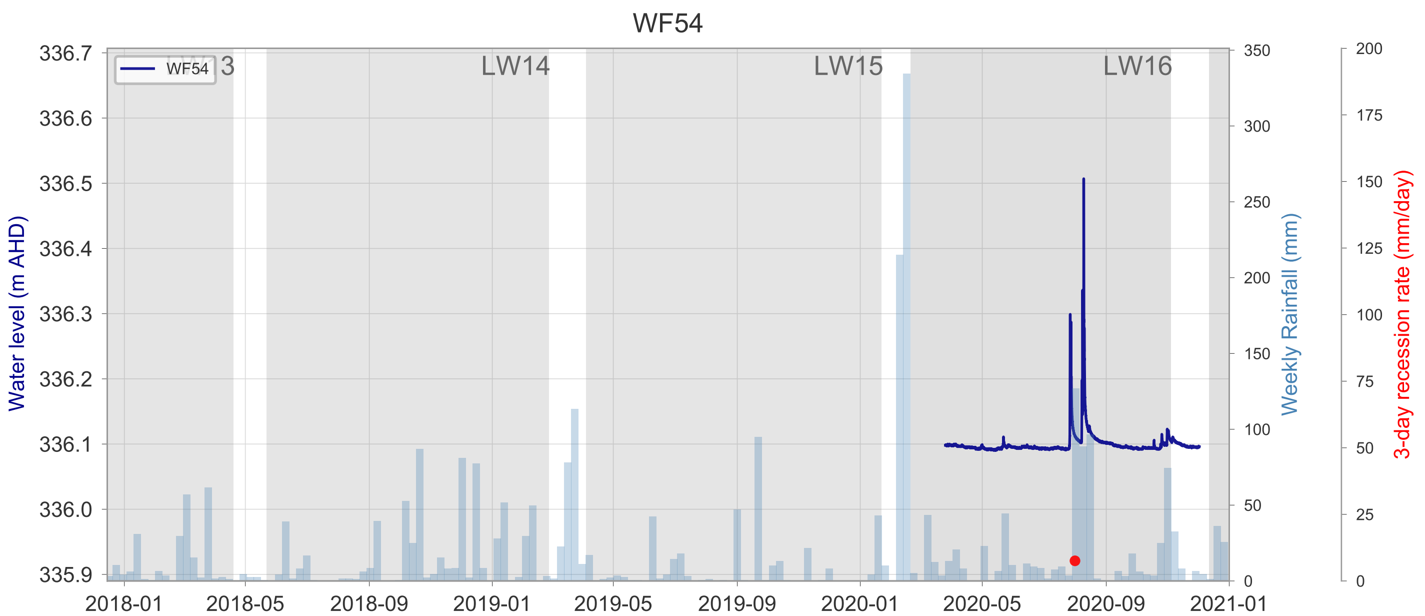

WC_Pool_35a
WC_Pool_35a
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
281.5
281.0
280.5
280.0
279.5
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01


WC_Pool_35b
WC_Pool_35b
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
283.00
282.75
282.50
282.25
282.00
281.75
281.50
281.25

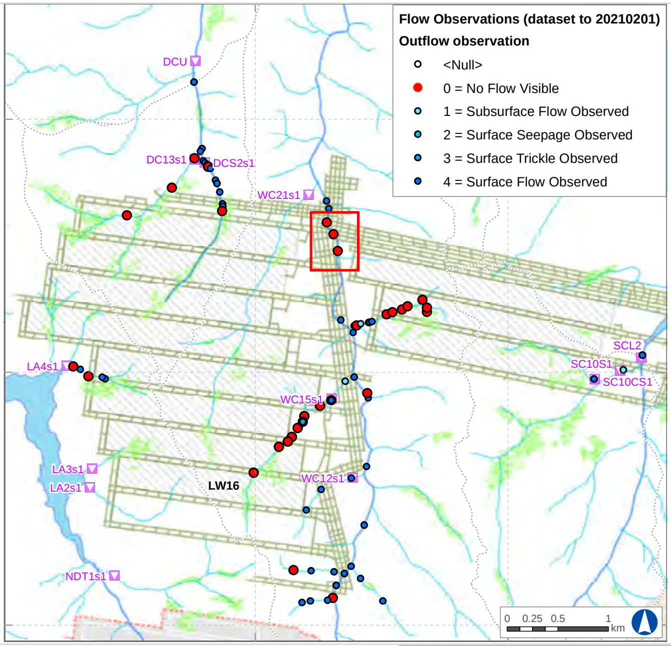

WC_Pool_36
WC_Pool_36
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
283.25
283.00
282.75
282.50
282.25
282.00
281.75
281.50
281.25


WCS2
WCS2
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
284
283
282
281
280
350
300
250
200
150
100
50
0
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

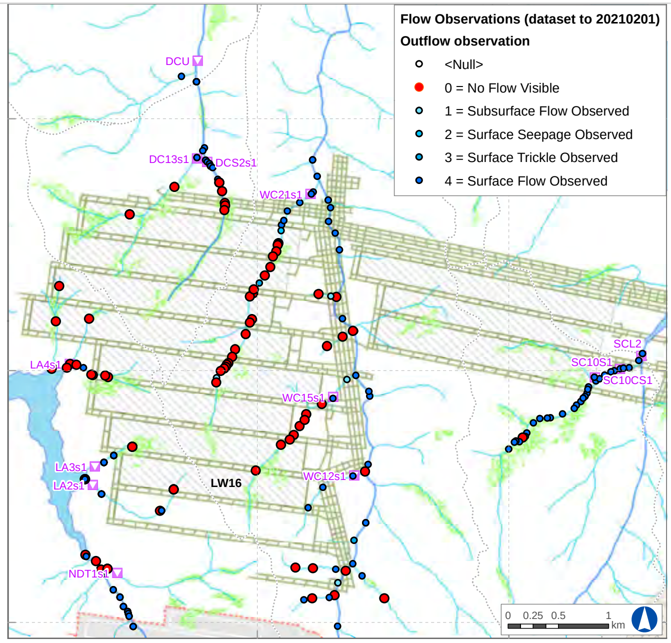

WWU
WWU
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
352.7
352.6
352.5
352.4
350
300
250
200
150
100
50
0
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01


WF54
WF54
LW14
LW15
LW16
Water level (m AHD)
Weekly Rainfall (mm)
3-day recession rate (mm/day)
336.7
336.6
336.5
336.4
336.3
336.2
336.1
336.0
335.9
350
300
250
200
150
100
50
0
200
175
150
125
100
75
50
25
0
2018-01
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01

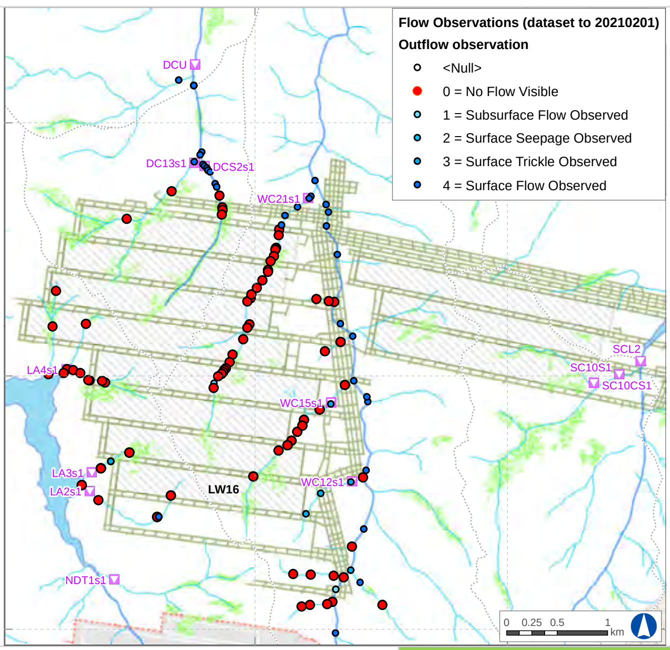
Appendix G: Watercourse flow observations



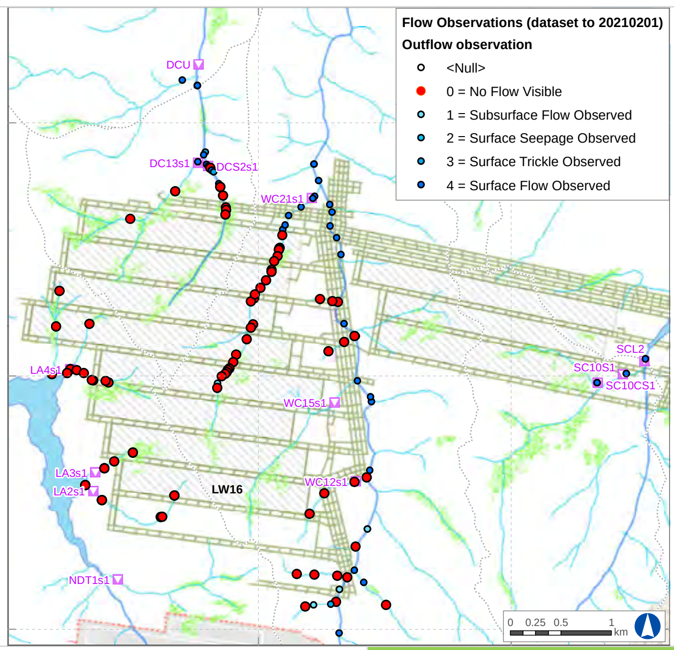
Flow observations: Feb-2020 Assessment D triggered



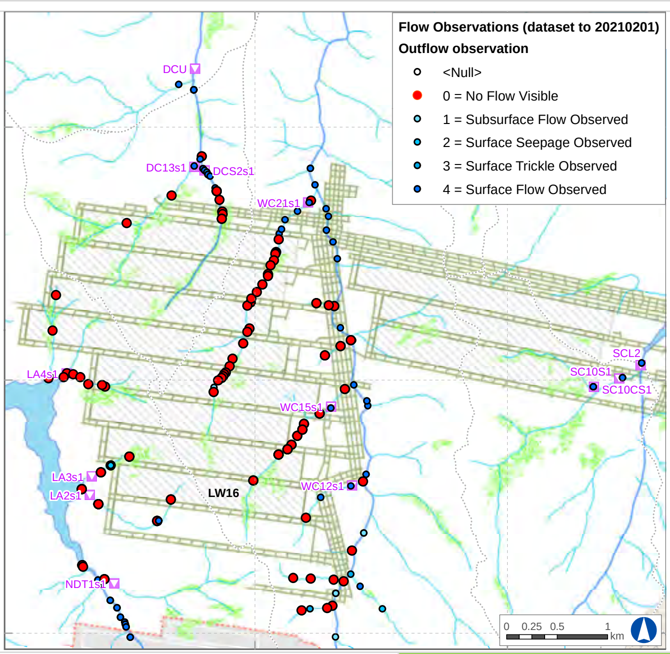
Flow observations: Mar-2020 Assessment D not triggered



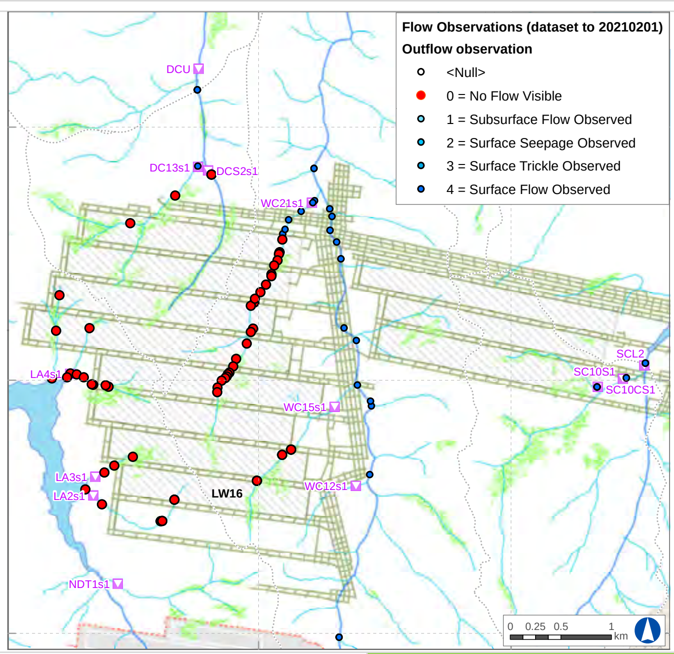
Flow observations: Apr-2020 Assessment D not triggered



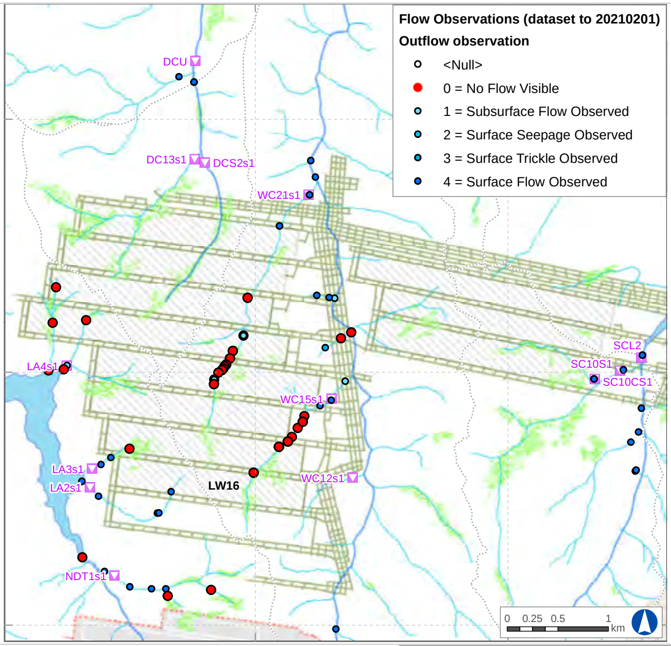
Flow observations: May-2020 Assessment D not triggered



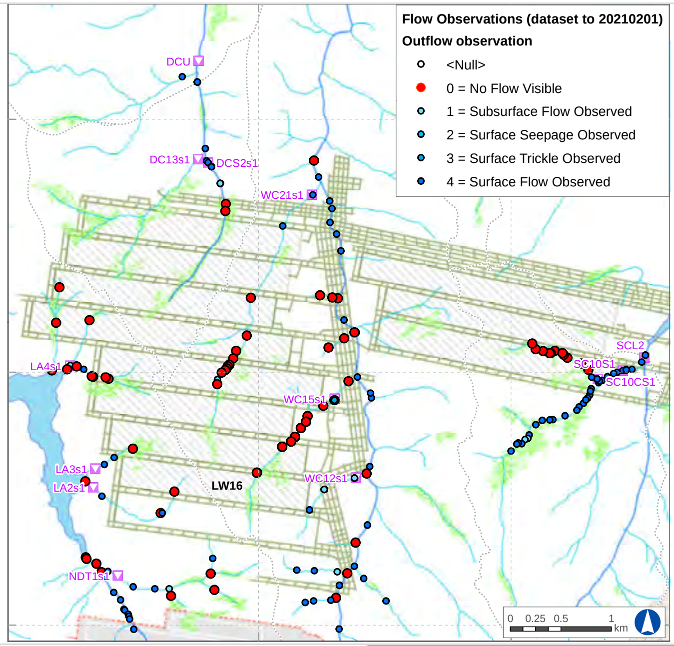
Flow observations: Jun-2020 Assessment D not triggered



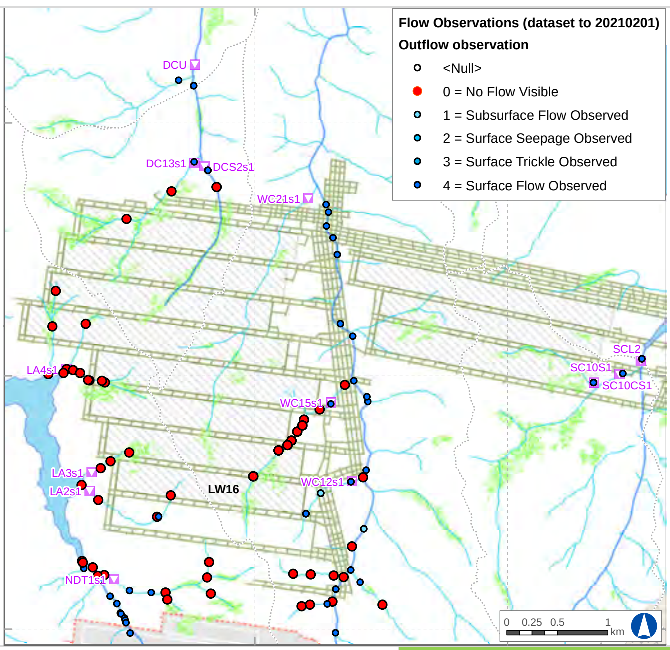
Flow observations: Jul-2020 Assessment D not triggered



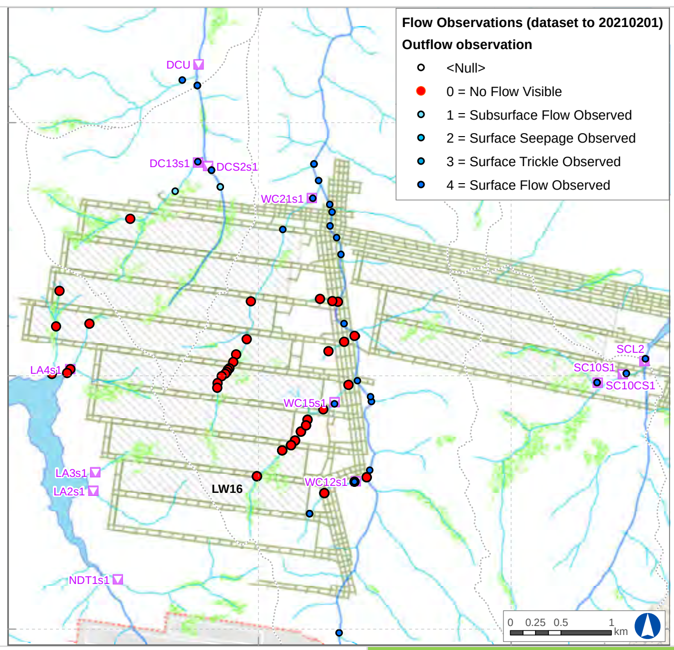
Flow observations: Aug-2020 | No Wongawilli Ck obs*



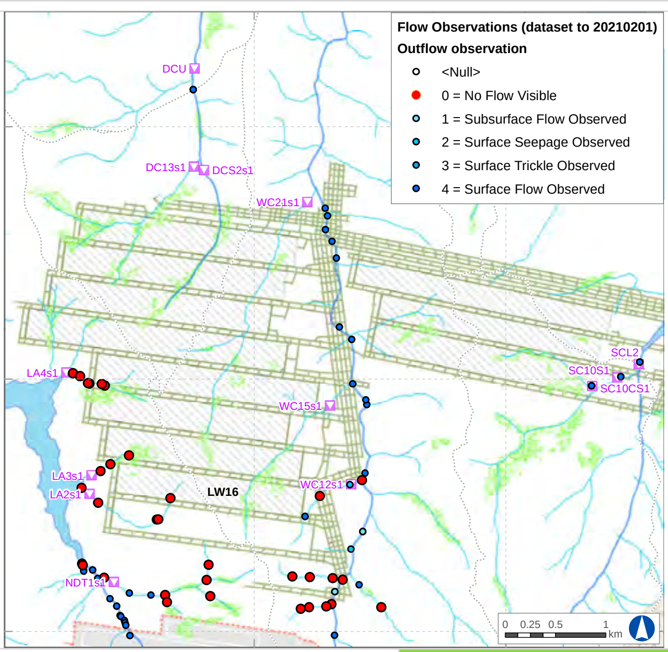
Flow observations: Sept-2020 | Assessment D not triggered



Flow observations during Oct-2020 | Assessment D not triggered



Flow observations: Nov-2020 | Assessment D not triggered



Flow observations: Dec-2020 | Assessment D not triggered

Flow Observations (dataset to 20210201)

Outflow observation

- <Null>
- 0 = No Flow Visible
- 1 = Subsurface Flow Observed
- 2 = Surface Seepage Observed
- 3 = Surface Trickle Observed
- 4 = Surface Flow Observed

* No or limited observations along Wongawilli Ck because of catchment closure due to high rainfall.

E:\DENDROBIUM\Reports\HGE012\SW Flow observations during LW16.docx
E:\DENDROBIUM\GIS\Maps\Deliverable\EoP16\SWobservations_EOP16.mxd

WATERSHED HYDROGEO

Appendix H: Rainfall-runoff modelling

H1. AWBM comparison: DCU – Donalds Castle Creek

This catchment incorporates the headwater sub-catchments DC13 and DCS2, and was mined under at the commencement of Longwall 9, and again by Longwalls 10-12, and marginally by Longwall 13. Longwalls 14-16 are beyond it (to the south). About 60% of the DCU catchment is not mined under.

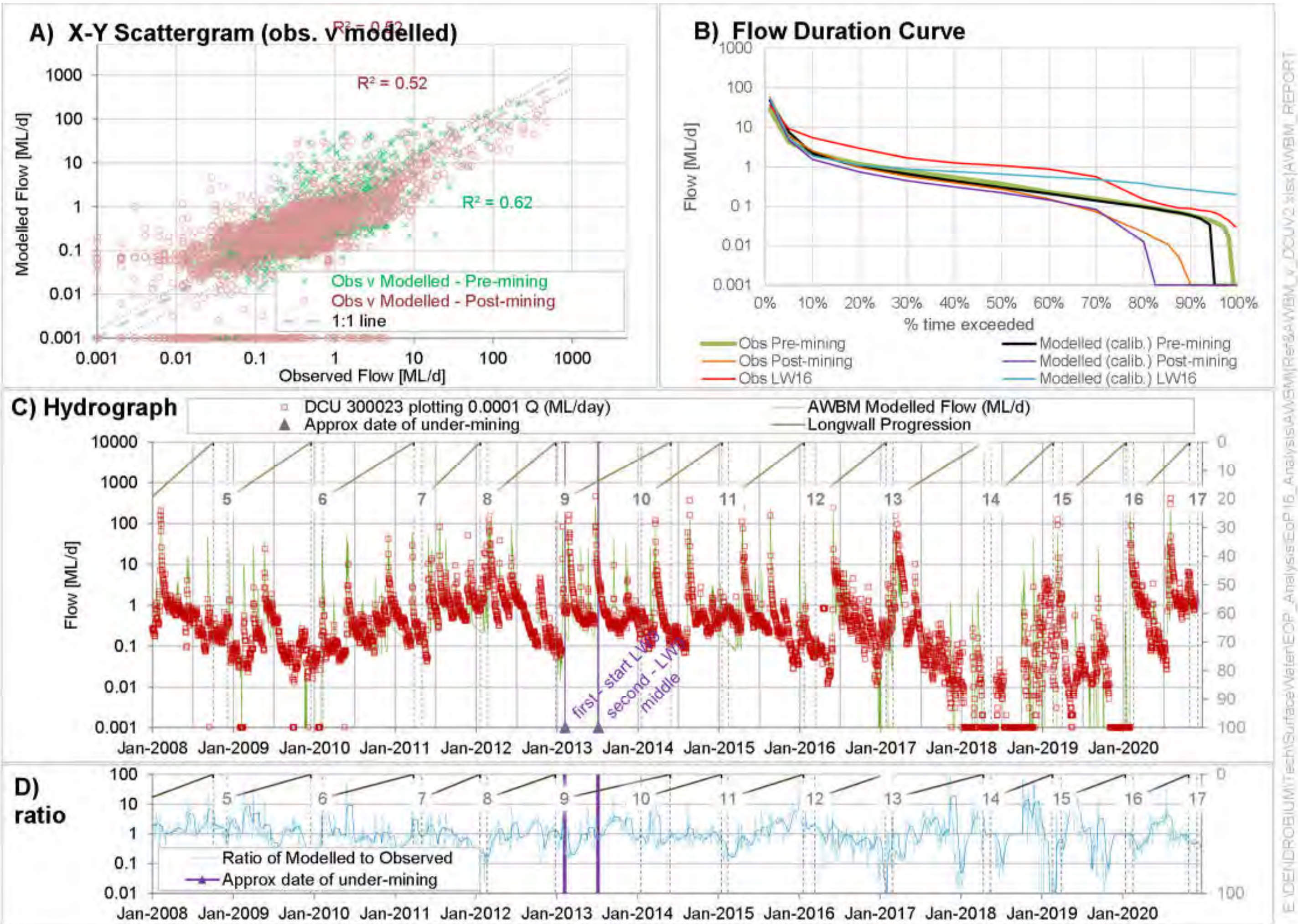


Figure H1 Comparison of observed flow against AWBM simulated flow: DCU

A	This shows that during the pre-mining period the model is a reasonable fit to observed data. This fit is only slightly weaker in the post-mining period. Simulation of the very lowest flows remains the main weakness.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period (purple vs orange). Higher flows are simulated moderately well during Longwall 16, but the observed low-flows are lower than simulated in 2020 (Longwall 16) (blue vs red).
C	The hydrograph shows a reasonable match between observed flows up until early 2013 (the start of Longwall 9), including periods of zero flow, and the match is the same after that time. The model is considered to capture the 2017-19 drought and flow in the subsequent wetter 2020 period quite well. Generally, the flow recessions are matched to a reasonable degree, but there is scope for more improvement in this catchment (it has typically been the most difficult hydrograph to match. There is no discernible systematic change in behaviour.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1 (i.e. a good match between observed and modelled). The post-mining ratio, including during Longwall 16, oscillates around 1, and is similar to the pre-mining behaviour.

Catchment discharge after Longwall 16:	For the complete post-mining period, the water balance [Q*sim* + ET*sim*] is within 6% of average P*obs* (-6%)	**Former TARP – Not triggered**
	for the Longwall 16 assessment period, the water balance [Q*sim* + ET*sim*] is within 12% of average P*obs* (-11%)	**Former TARP – Not triggered**
Assessment:	The flow duration curves suggest that there might be a mild reduction in flow at low flows during Longwall 16, but overall yield is not shown to be affected. This is in agreement with the agreed TARP assessment using Reference Sites.	

H2. AWBM comparison: WC12 – Wongawilli Creek tributary

The end of Longwall 15 skirted the north-western edge of this sub-catchment and to within 250 m of the watercourse itself. Longwall 16 mined under this sub-catchment, and within 40 m of the watercourse. No landscape impacts (cracking, iron-staining) have been reported by IMCEFT.

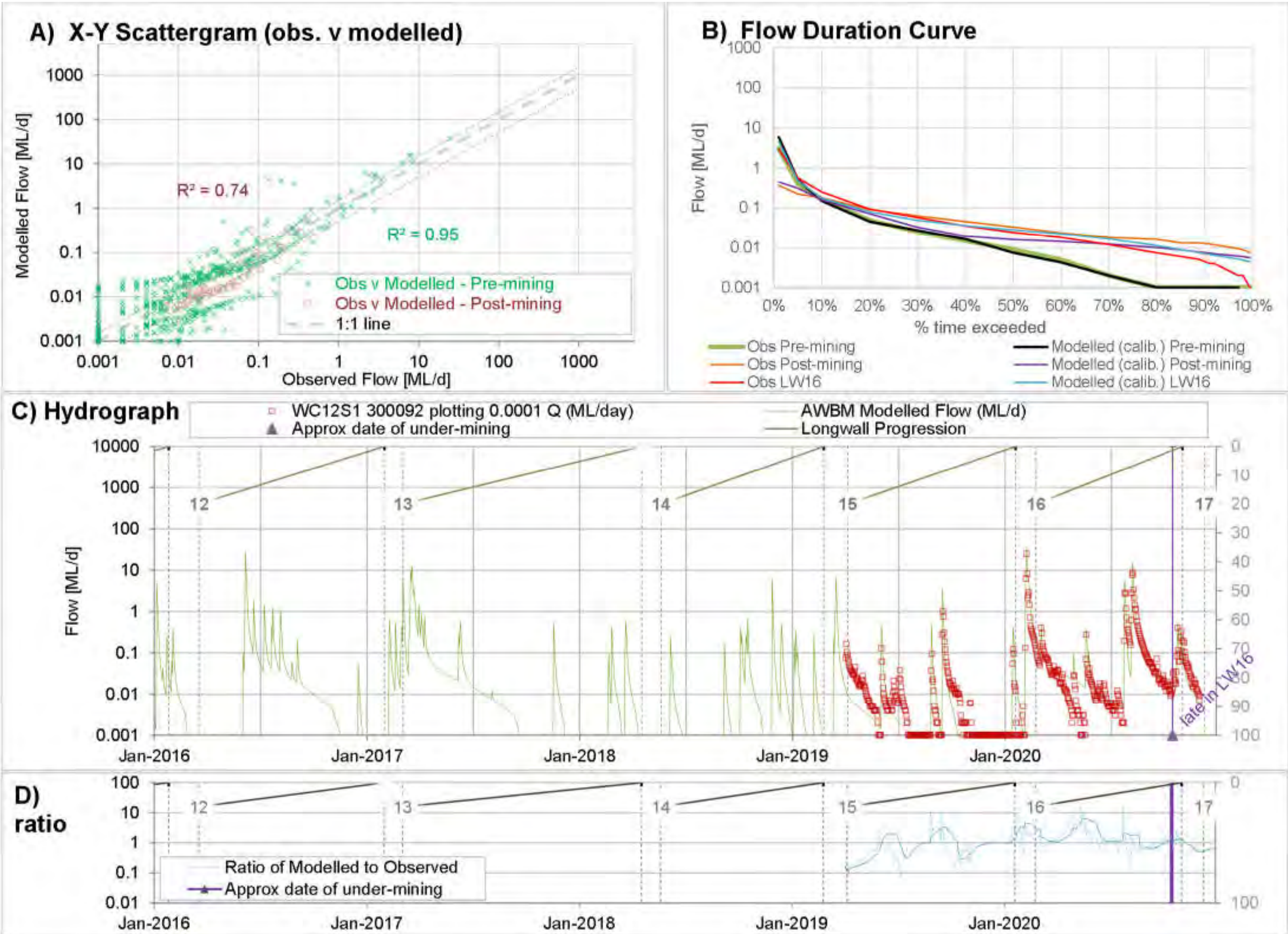


Figure H2 Comparison of observed flow against AWBM simulated flow: WC12

A	This shows that during the short (560 day) pre-mining period the model is a reasonable fit to observed data, with the fit slightly weaker in the shorter (47-day) post-mining period.
B	Confirms the moderate match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period (purple vs orange) and the Longwall 16 period (red vs blue).
C	The hydrograph shows a reasonable match between observed flows up until Oct-2020 (as Longwall 16 approaches WC12), including two periods of zero flow during the 2019 drought, and the match is the similar after that time. The model is considered to capture flow in the subsequent wetter 2020 period quite well. Generally, the flow recessions are well matched, but some are over-estimated and some under-estimated in both the pre-mining and post-mining periods. There is no discernible systematic change in behaviour.
D	The pre-mining ratio of modelled to observed flows shows the ratio oscillates at approximately 1 (i.e. a good match between observed and modelled). The post-mining ratio, late in Longwall 16, is also near to 1.

Catchment discharge after Longwall 16:	For the complete post-mining period, the.water balance [Q*sim* + ET*sim*] is within 6% of average P*obs* (-0.4%)	**Former TARP – Not triggered**
	for the Longwall 16 assessment period, the water balance [Q*sim* + ET*sim*] is within 6% of average P*obs* (-6%)	**Former TARP – Not triggered**
Assessment:	The post-mining period is very short, but this assessment suggests that mining effects on surface water flows are not present or cannot yet detected in this sub-catchment. This is similar to the finding from the agreed TARP assessment using Reference Sites.	

H3. AWBM comparison: WWL – Wongawilli Creek (lower)

Wongawilli Creek lies between Areas 3A and 3B. The watercourse is not directly mined under by longwalls, but some tributaries (e.g. WC21, WC15 etc) have been mined under by Area 3A and 3B longwalls, including by Longwall 16.

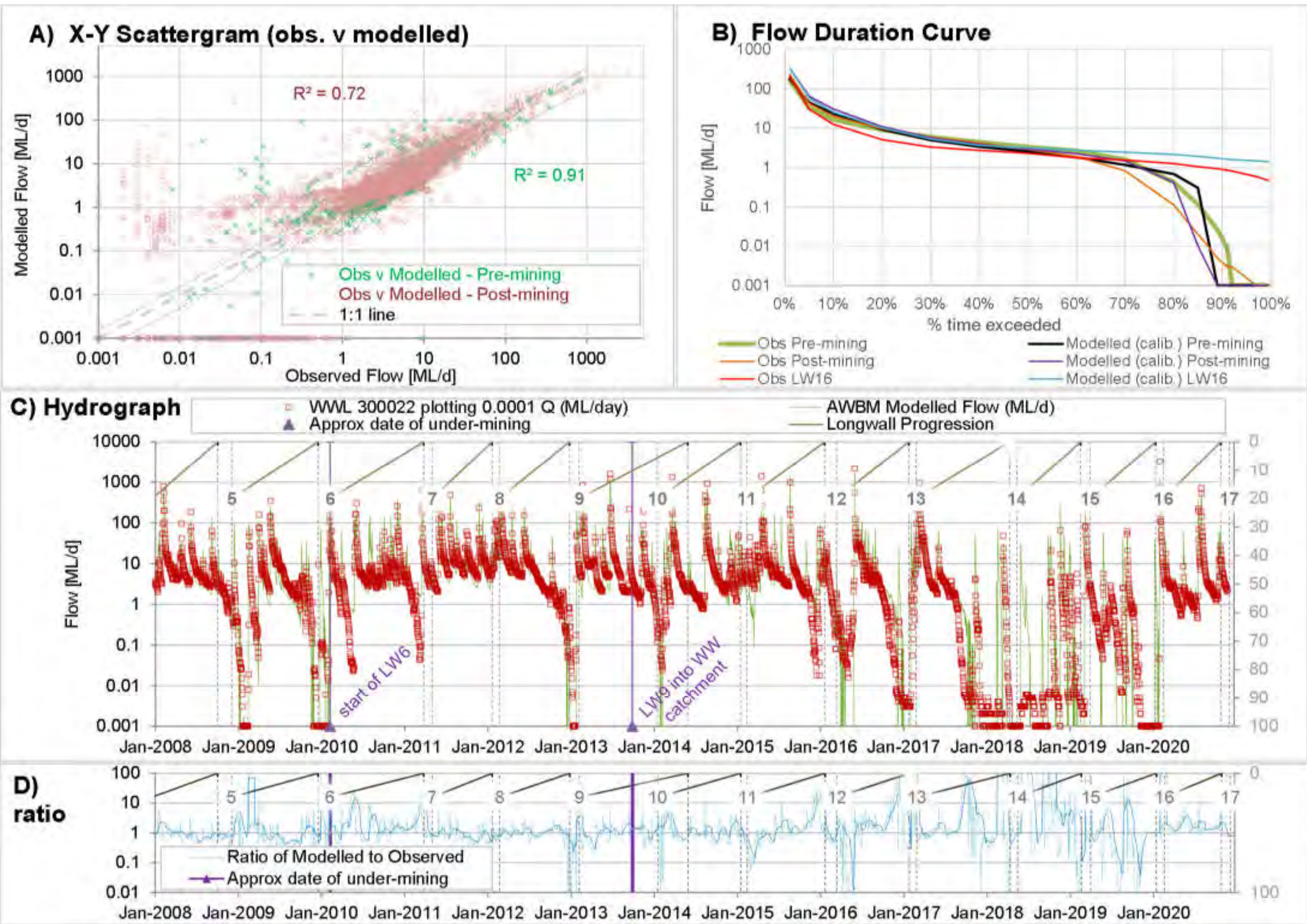


Figure H3 Comparison of observed flow against AWBM simulated flow: WWL

A	This shows that during the pre-mining period the model is a good fit to observed data. This fit is essentially is marginally weaker, but still good, in the post-mining period.
B	Confirms the reasonable match between modelled and observed flows for the pre-mining period (black vs green) and illustrates that the model still predicts the range of flows reasonably well for the subsequent post-mining period (purple vs orange). Higher flows are simulated moderately well during Longwall 16, but the observed flows are lower than simulated at the lower end of the range in 2020 (Longwall 16).
C	The hydrograph shows a reasonable match between observed flows up until Feb-2010 (the start of Longwall 6), including two periods of zero flow, and the match is the same after that time. The model is considered to capture the 2017-19 drought and flow in the subsequent wetter 2020 period quite well. Generally, the flow recessions are well matched, but some are over-estimated and some under-estimated in both the pre-mining and post-mining periods. There is no discernible systematic change in behaviour.
D	The pre-mining ratio of modelled to observed flows shows the ratio hovers at about 1 (i.e. a good match between observed and modelled). The post-mining ratio, including during Longwall 16, oscillates around 1, and is similar to the pre-mining behaviour, although during droughts (when flows were frequently close to 0), the ratio is more variable.

Catchment discharge after Longwall 16:	For the complete post-mining period, the.water balance [Q*sim* + ET*sim*] is within 6% of average P*obs* (4%)	**Former TARP – Not triggered**
	for the Longwall 16 assessment period, the water balance [Q*sim* + ET*sim*] is within 6% of average P*obs* (5%)	**Former TARP – Not triggered** (but close to L1)
Assessment:	There is a suggestion that undermining has slightly reduced sub-catchment flow / yield but enough to trigger Level 1 (6%). This is in agreement with the agreed TARP assessment using Reference Sites.	

H4. Parameters used for AWBM by modelled sub-catchment

AWBM was first developed by W. Boughton in the early 1990s (Boughton, 2004; Boughton and Chiew, 2003). The model takes average rainfall and potential evaporation across a catchment as inputs on a daily timestep. The user provides parameters to describe the relative area and soil moisture storage capacity of three stores covering the catchment (**Figure H4**).

Based on these inputs and parameters, surface runoff and baseflow are calculated and then released from the relevant storage using a linear decay (*Ksurf* or *Kbase*). These decayed flows are summed to estimate total catchment outflow on a daily basis.

Most of the parameters relate in part to the simulated connected groundwater system in the catchment. For this project, AWBM has been populated and run via a spreadsheet version of the AWBM model.

Figure H4. AWBM Rainfall-runoff model flow diagram

(modified from Boughton, 2004)

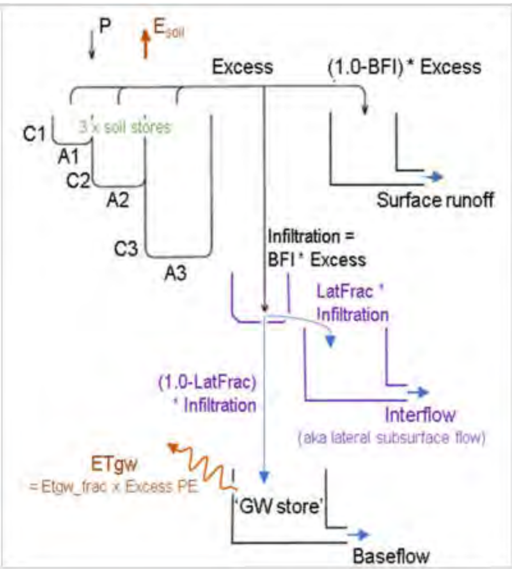


Table H1. AWBM parameters and inputs for selected Dendrobium catchment models

SITE	A1	A2	A3	Kbase	Klat	Ksurf	BFI	LatFrac	C1	C2	C3	ETgw
	area - fraction	area - fraction	area - fraction	fraction	fraction	fraction	fraction	fraction	mm	mm	mm	fraction
Donalds Castle Creek catchments												
DCU	0.08	0.20	0.72	0.99	0.7	0.30	0.60	0.7	0.04	0.25	0.40	0.006
Wongawilli Creek catchments												
WC12	0.1	0.55	0.35	0.98	0.8	0.35	0.32	0.7	0.015	0.175	0.35	0.01
WWL	0.3	0.35	0.35	0.992	0.8	0.20	0.60	0.7	0.015	0.15	0.25	0.04

SITE	DAILY RAINFALL INPUT	EVAPORATION INPUTS
Donalds Castle Creek catchments		
DCU	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid and A3B rainfall records used for Oct-2007-2020.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 0.6% of this sub-catchment.
Wongawilli Creek catchments		
WC12	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid and A3B rainfall records used for Oct-2007-2020.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 1% of this sub-catchment.
WWL	Daily SILO Data Drill “DEN-South” to Oct-2007. Average of Dendrobium Centroid, A3B and SILO “DEN-South” rainfall records used for Oct-2007-2020.	Daily SILO “DEN-South” Pan Evaporation (‘Evap’). Pan factor of 1. ET_{Gw} simulated from 1% of this sub-catchment.