CENTRAL PLAINS
WATER

Central Plains Water Limited

Annual Ground and Surface Water Monitoring Report

2019/2020

Central Plains Water Limited

	Name	Position	Signature	Date
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Ground and Surface Water Expert Review Panel Members for the 2019-20 Period

John Sunckell (Chairman), John Bright, Peter Callander, Ned Norton, Carl Hanson

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1. Purpose

The purpose of this report is to present all monitoring data collected by Central Plains Water Limited (CPWL) between 1 July 2019 and 30 June 2020, and to provide an interpretation of background conditions, and impacts arising from consented activities. This report is prepared to comply with condition 25(a) of Schedule 2: Administrative Conditions of Resource Consent CRC165680. The condition requires that:

> *The consent holder shall prepare a report describing the results of the environmental monitoring outlined in the Ground and Surface Water Plan, for the period from 1 July to the following 30 June for each year.*

CPWL are required to measure a suite of parameters for river and stream water quality; lake water quality; and groundwater quality and quantity and report the results in this Ground and Surface Water Monitoring Report for the Period 1 July to the following 30 June each year. This report is required to include all the monitoring data and an interpretation of background conditions and impacts arising from the consented activities.

CPWL have developed a Ground and Surface Water Monitoring Plan (GSWP) (as required by Condition 18 of CRC165680), which is in two parts:

- Part I: includes an outline of CPWLs monitoring programme; and
- Part II: specifies (amongst other matters) trigger levels for monitored parameters.

The results from the monitoring programme are included in this report and are compared to applicable trigger levels.

2. Executive Summary

Alpine sourced CPWL irrigation water has been supplied to the Stage 1 area for five seasons, to the Sheffield Scheme area for three seasons and to the Stage 2 area for just under two full seasons.

Due to water having been supplied to Stage 1 shareholders for five seasons this is the first report to officially consider monitoring results against trigger levels and trigger response protocols contained in the Ground and Surface Water Monitoring Plan, a plan required by water use consent CRC165680 issued by Environment Canterbury.

Irrigation water was available from 1 September 2019 through to 29 April 2020. This is the first season that all three sections of the Scheme were able to operate for the entire season.

The effects of this irrigation water on surface water and groundwater flows, levels and quality are being monitored at multiple locations within, and downstream of, the CPWL supply area.

A range of environmental trigger values are, or will be in future, used by CPWL to draw attention to changes in the state of water flows, levels and quality in the Selwyn Waihora catchment that *may* be attributed to the operation of the CPWL scheme.

There were two trigger level exceedances from the lowland groundwater level monitoring bores in 2019-20. This is similar to the single exceedance from 2018-19 and well down on the 16 exceedances from 2017-18. We will have to wait for further years of alpine water use and the associated reduction in groundwater abstraction, in order to be able to determine if groundwater levels are rising and flows in the lowland streams are recovering due to the influence of the Scheme.

In many instances where stream and lake water quality triggers were exceeded, the results were found to be consistent with concentrations or trends from previous years (prior to the CPWL Scheme operating).

One surface water quality site that has been consistently monitored since 1992-93 (Selwyn River at Coe's Ford, see Figure 17) showed new maximum annual median, and maximum annual 95th Percentile, Nitrate-N concentrations, however, both concentrations have been increasing since the 1990's.

Fifteen percent less rain was recorded at Hororata during 2019-20 compared to 2018-19 and 34% less compared to 2017-18 (which is the second highest on record). 2019-20 rainfall was 10% less than the mean since 1981-82.

Past landuse and recently intensified irrigated landuse are the likely potential contributors to the new maximum Nitrate-N concentrations measured at some of the sites. However, it is too early to be conclusive about the relative contributions of pre-existing landuse and the CPWL scheme. The time-lagged effects of past landuse, recent improvements in practice both in and outside the scheme, and climate variability all complicate assessment of the relative causes of elevated Nitrate-N and increasing trends. Time will tell whether the new elevated concentrations will be sustained.

New maximum annual mean Nitrate-N concentrations were reached in 25% of Stage 1, and 40% of Stage 2, bores during 2019-20. Any trends cannot yet be confirmed statistically significant at the present. Further monitoring and time will tell whether the newly elevated concentrations are sustained and will allow examination of the extent to which CPWL is contributing to this trend.

Nitrate-N levels measured in the Sheffield monitoring bores were found to be within ranges previously encountered before the Scheme commenced operating. *E. coli* was not detected in the Sheffield monitoring bores during 2019-20.

E. coli was detected on three and nine occasions during routine monitoring of Stage 1 and 2 bores respectively during 2019-20. This was similar to the three and ten occasions for Stage 1 and 2 respectively during 2018-19.

In general, the monitoring results obtained during the last two years of full scheme operation, and prior three years of partial scheme operation, confirm that nitrate levels in groundwater and surface water are continuing to increase as they were before the scheme commenced. However, the results are not sufficient to enable any definitive statements explaining the impact of the Scheme on water quality. This is because the CPWL monitoring results are being compared against existing elevated, or increasing contaminant level trends, caused by historic land uses and practices whose effects are time-lagged.

Additional years of water quality monitoring will be necessary, together with on-going assessment of CPWL facilitated, and other, land use change patterns in the catchment, to determine whether any significant change to existing elevated Nitrate-N concentrations or increasing trends, can be attributable to CPWL, previous land use changes and/or to improving practices through time.

Until the main cause(s) responsible for trigger exceedances and increasing trends of Nitrate-N concentrations identified in this report can be accurately attributed, CPWL will assess its operations against its Sustainability Protocol, ensure all Farm Environment Plans are audited, including compliance with nitrogen application limits, and use/application of Good Management Practice/Matrix of Good Management.

CPWL did not receive any complaints during 2019-20 concerning adverse environmental effects of the Scheme on groundwater or surface water, including more specifically, impacts on land drainage, or on-site wastewater systems.

3. Background

The CPWL Irrigation Scheme (the Scheme) is located in the Selwyn Waihora Zone, within the Selwyn District (Figure 2).

The Scheme has been developed in a staged manner. Once the full uptake of water is completed the Scheme will provide water to up to 47,600ha situated between the Rakaia and Waimakariri Rivers, the Foothills and State Highway 1.

The 22,500ha Stage 1 section of the Scheme was constructed during early 2014 – mid 2015, with first irrigation water supplied on 1 September 2015. The 4200ha Sheffield Scheme first supplied irrigation water on 25 November 2017. Water was first supplied to the 18,200ha Stage 2 section of the Scheme on 2 October 2018 (see Figures 1 and 3).

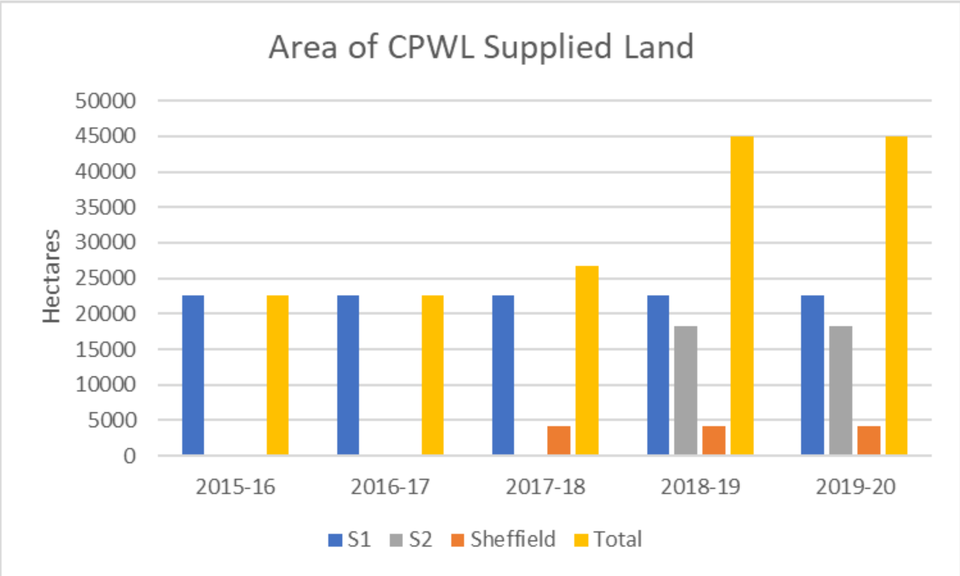


Figure 1. CPWL Scheme Area of Land Under Irrigation

The limit/target for nitrogen losses in Selwyn Waihora is 5,044.4 tonnes/year by 2037 (Table 11(i) of the Canterbury Land and Water Regional Plan (CLWRP)). A total of 358 tonnes/year (7% of the total) has been allocated to CPWL to allow for the conversion of dryland into irrigated land. This allocation is in addition to the assessed dryland nitrogen baseline of 621 tonnes (giving a total of 979 tonnes, as specified in Table 11(j) of the CLWRP).

The regulatory environment planning framework has changed since CPWL's original Take and Use Water permit was granted in 2010.

The Selwyn Waihora Zone Implementation Plan (ZIP, and ZIP Addendum) was developed by the Selwyn Waihora Zone Committee as a result of a two-year collaborative process, which commenced in December 2011. The ZIP identified a number of priority outcomes sought for the Zone, which is considered, by Canterbury Regional Council, to be over-allocated in terms of consented groundwater takes and nitrogen contamination in groundwater.

Variation 1 to the Land and Water Plan was therefore developed based on the recommendations in the Selwyn Waihora ZIP.

The original Central Plains Water Trust (CPWT) consent decision recognised the trade-off between benefits associated with increased baseflows in the lowland streams resulting from operation of the Scheme with the potential negative effects on land drainage and wastewater infrastructure in the lowland Central Plains area due to groundwater mounding.

While Variation 1 to the Land and Water Regional Plan (LWRP) has provided explicit recognition of the positive benefits associated with increased baseflows in lowland streams, it does not provide equivalent guidance in terms of thresholds for adverse effects on land drainage and wastewater infrastructure. It remained the task of CPWL to operate in accordance with the consent conditions to ensure appropriate management of environmental effects resulting from operation of the Scheme.

For a detailed summary of the background to CPWL and the Schemes' water use, and nitrogen discharge consents please refer to Appendix 6.2: Central Plains Water Limited Annual Compliance Report 2015/2016 Irrigation Season; Section 4.

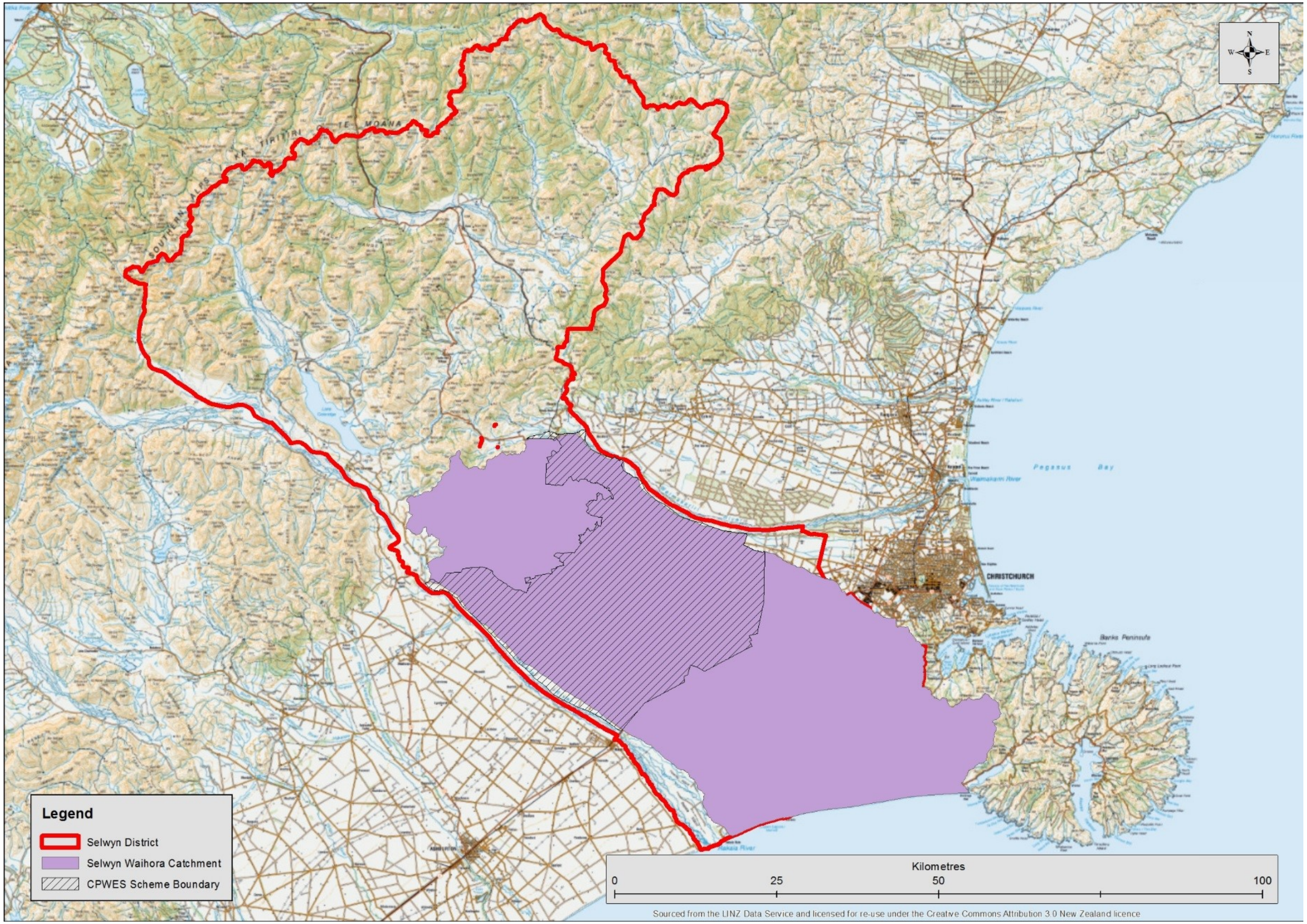


Figure 2. CPWL Scheme with the Selwyn Waihora Catchment

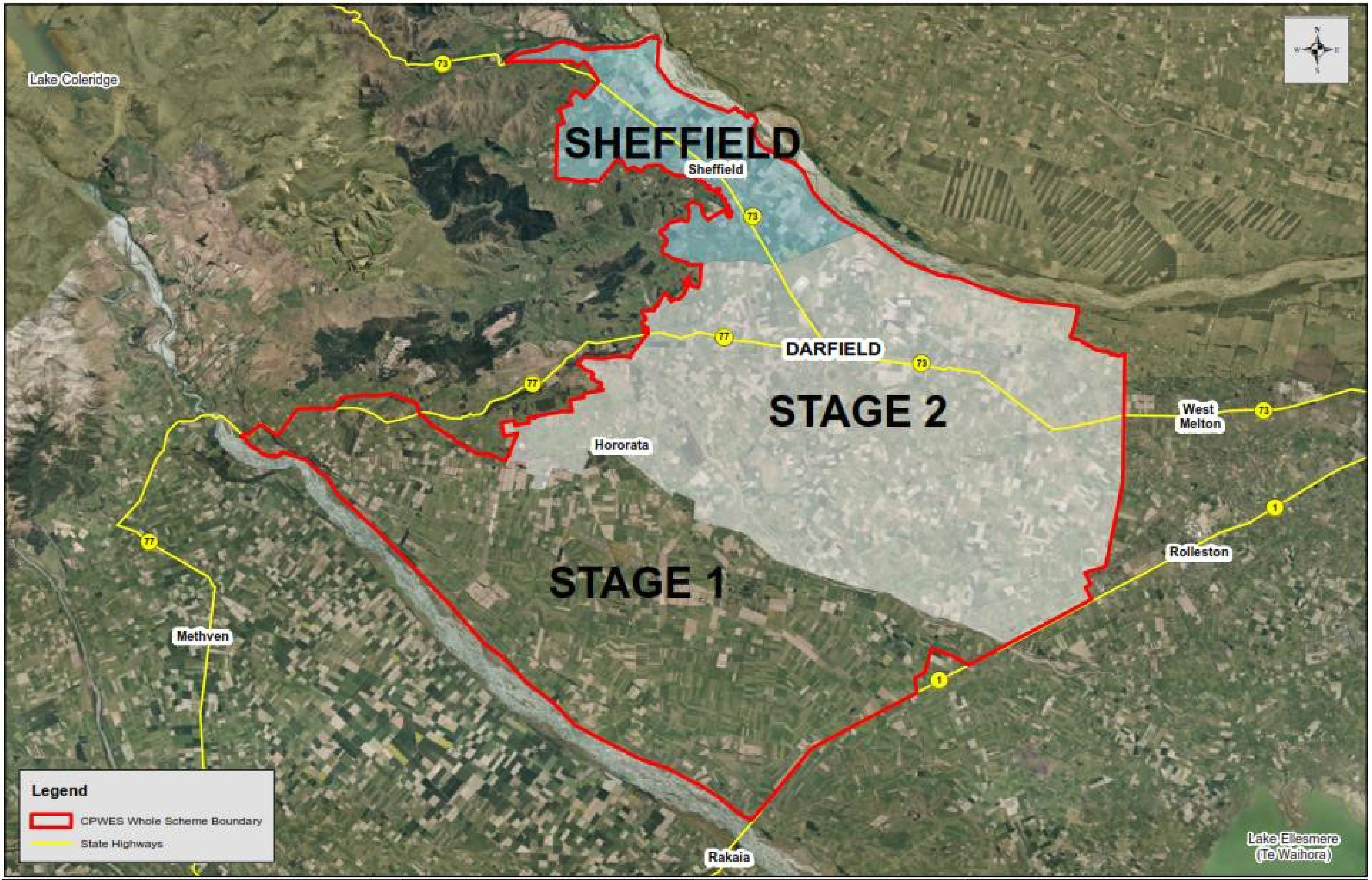


Figure 3. Scheme Overview

Water Use

During the 2019-20 irrigation season, 94,465,919m^3 of water was delivered to Stage 1, 63,412,776m^3 to Stage 2 and 14,119,367m^3 to Sheffield, farms. This can be compared to approximately 96,113,830m^3, 56,511,000m^3 and 19,619,634m^3 of rainfall that fell on Stage 1, Stage 2 and Sheffield CPWL irrigated land respectively over the irrigations season and 173,423,770m^3, 104,741,000m^3 and 35,400,846m^3 of rainfall over the 12 months July 2019 to June 2020.

Figure 4 details seasonal water use by the various stages of the Scheme since water was first supplied by CPWL (to Stage 1) for the 2015-16 season.

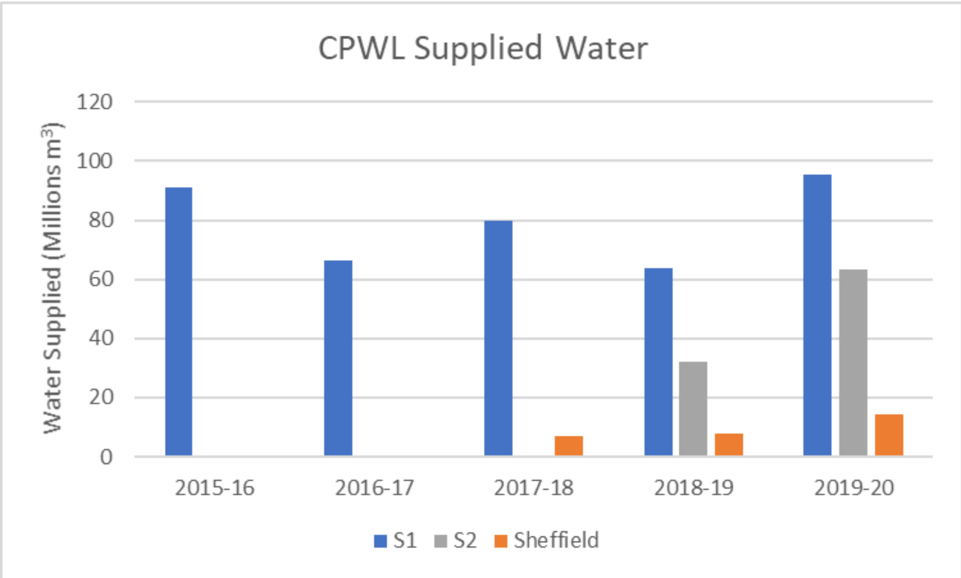


Figure 4. CPWL supplied water 2015-16 to 2019-20.

For 2019-20 groundwater abstraction by CPW shareholders was 17,482,677m^3 for Stage 1, 24,417,369m^3 for Stage 2 and 1,485,378m^3 for Sheffield. Figure 5 shows the large reduction in groundwater abstracted by; shareholders in Stage 1 from 2014-15 compared to 2015-16, and by shareholders in Stage 2 from 2017-18 compared to 2018-19, following the supply of CPWL water to the respective Stages of the Scheme.

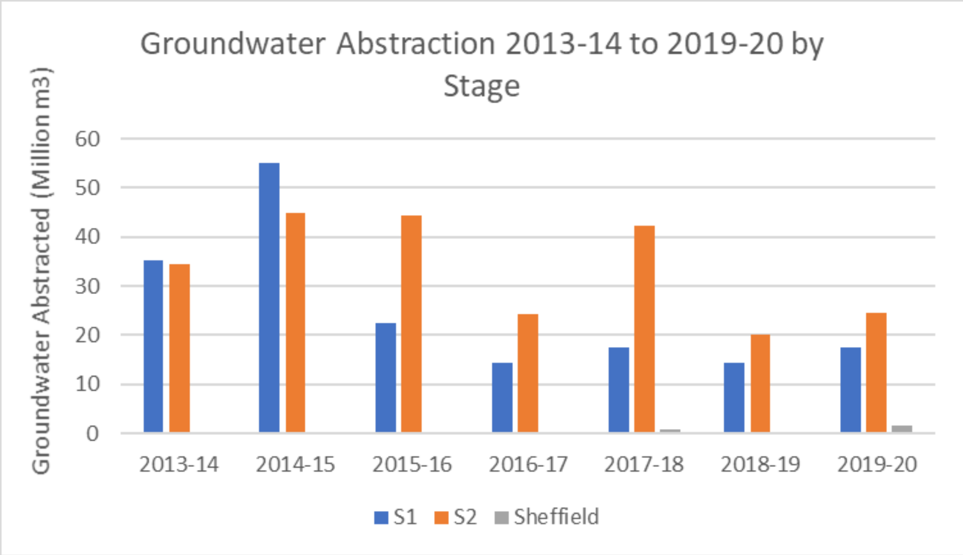


Figure 5. CPWL Shareholder Groundwater Abstraction 2013-14 to 2019-20.

Figures 6 to 8 show the sources of water to shareholder properties in the various Scheme stages during the irrigation seasons that CPWL has supplied water. To date the irrigated land areas have largely remained constant so differences in volumes of water used reflect differences in seasonal application rates.

More groundwater, and CPWL supplied water was used by shareholders in all stages of the Scheme during the 2019-20 season compared to 2018-19. Fifteen percent less rain fell during the 1 July 2019 to 30 June 2020 period compared to 1 July 2018 to 30 June 2019 period (Source NIWA's Hororata Weather Station Number 4072). Thirty nine percent less rain fell during the 2019-20 irrigation season compared to the 2018-19 season.

Appendix 6.2: CPWL Annual Compliance Report 2019/2020 Irrigation Season (Section 6(b) for further details on the use of CPWL Scheme water for irrigation.

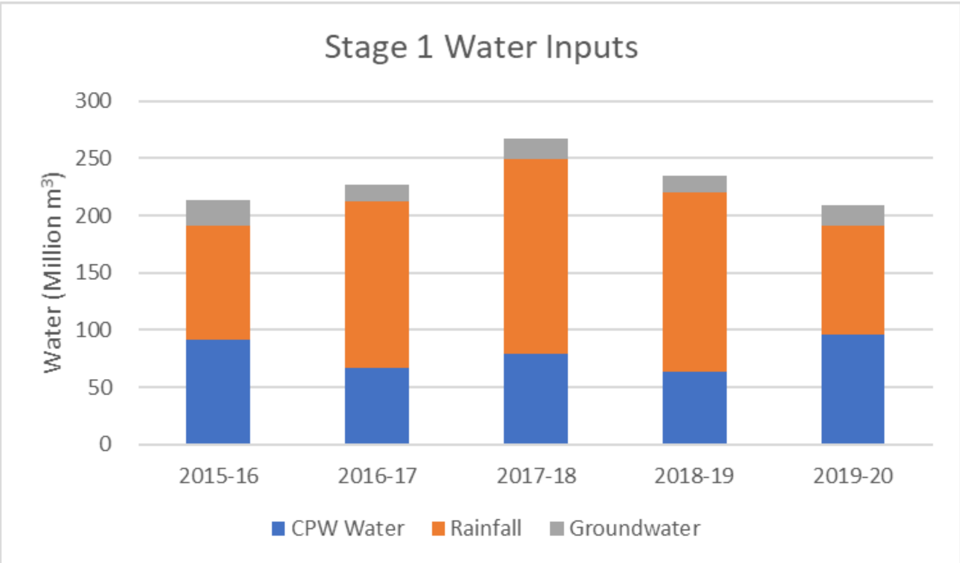


Figure 6. Stage 1 Water Inputs for the 2019-20 Irrigation Season

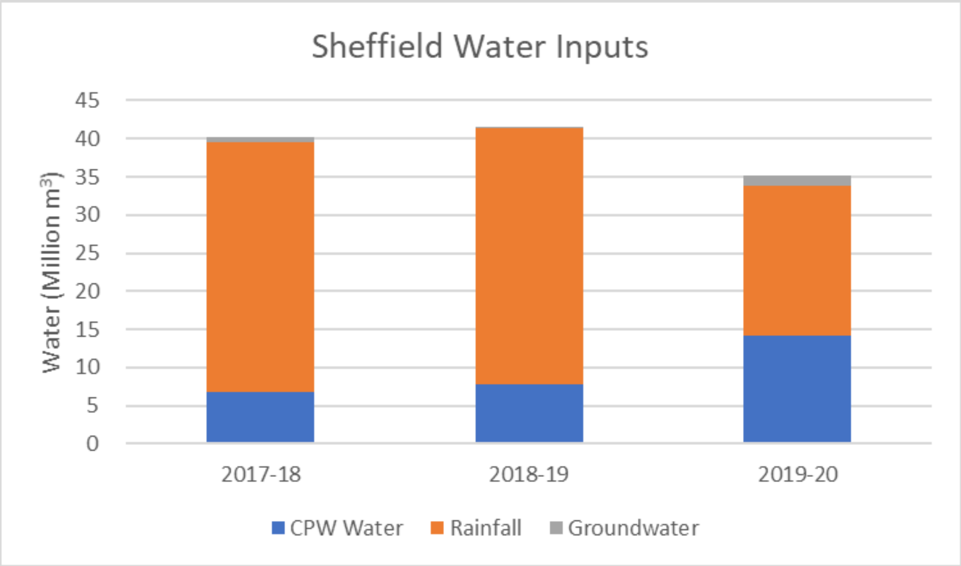


Figure 7. Sheffield Water Inputs for the 2019-20 Irrigation Season

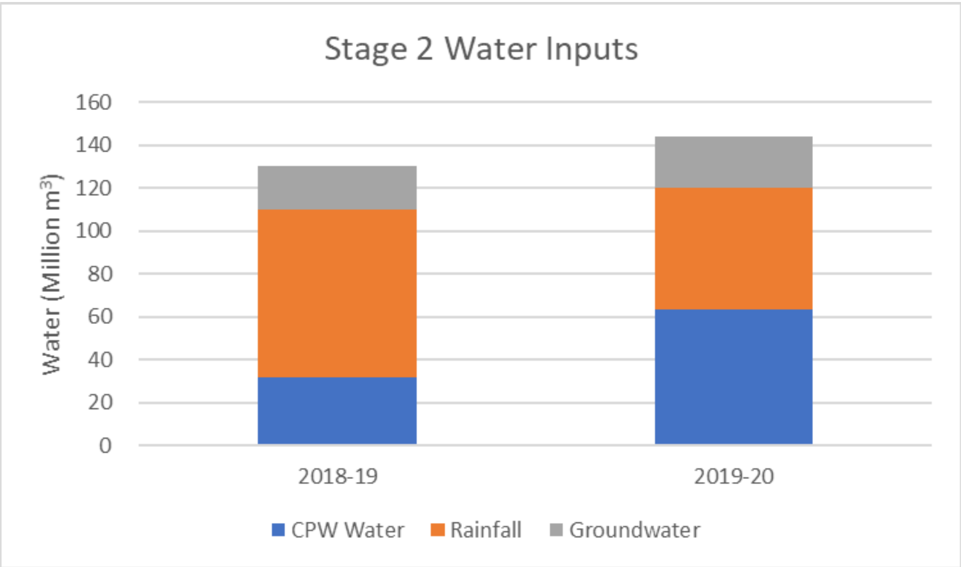


Figure 8. Stage 2 Water Inputs for the 2019-20 Irrigation Season

3.1. Scope of Water Monitoring Programme

River and Stream Water Quality

CPWL is required to monitor on a monthly basis surface water quality at 29 river and stream sites (see Figure 9). Full details of CPWL's surface water monitoring programme is contained in Part 1 of CPWL's Ground and Surface Water Monitoring Plan (available at https://www.cpwl.co.nz/companydocuments).

CRC165680 authorises CPWL to rely on data collected on Te Waihora/Lake Ellesmere, lowland streams, other rivers/streams or drains and the stockwater network by the Canterbury Regional Council or any other entity in lieu of establishing new monitoring sites. Instances where CPWL rely on data from ECan will be noted in this report.

Parameters to be analysed are: *Escherichia coli* (*E. coli)*, Turbidity, Nitrate + Nitrate-Nitrogen, Total Nitrogen, Total Ammoniacal Nitrogen, Dissolved Reactive Phosphorus, Total Phosphorus, Electrical Conductivity, Dissolved Oxygen, pH and temperature. CPWL has water quality triggers in place for Nitrate-Nitrogen (Annual Medians and Annual 95th Percentiles).

The Surface Water Monitoring programme began at the same time as the commencement of Stage 1 of the Scheme in September 2015.

Lake Water Quality

This report contains water quality data from ECan's monitoring of Te Waihora from July 2019 to June 2020. Water samples are analysed for a wide range of parameters but only those required by the Ground and Surface Water Plan (as per those listed under 'River and Stream Water Quality' above and Trophic Level Index (TLI_3) and Chlorophyll *a*) are included in this report. Figure 9 shows the five locations sampled by ECan. CPWL has water quality triggers in place for Trophic Level Index (TLI_3), Total Phosphorus, Total Nitrogen and Chlorophyll *a*.

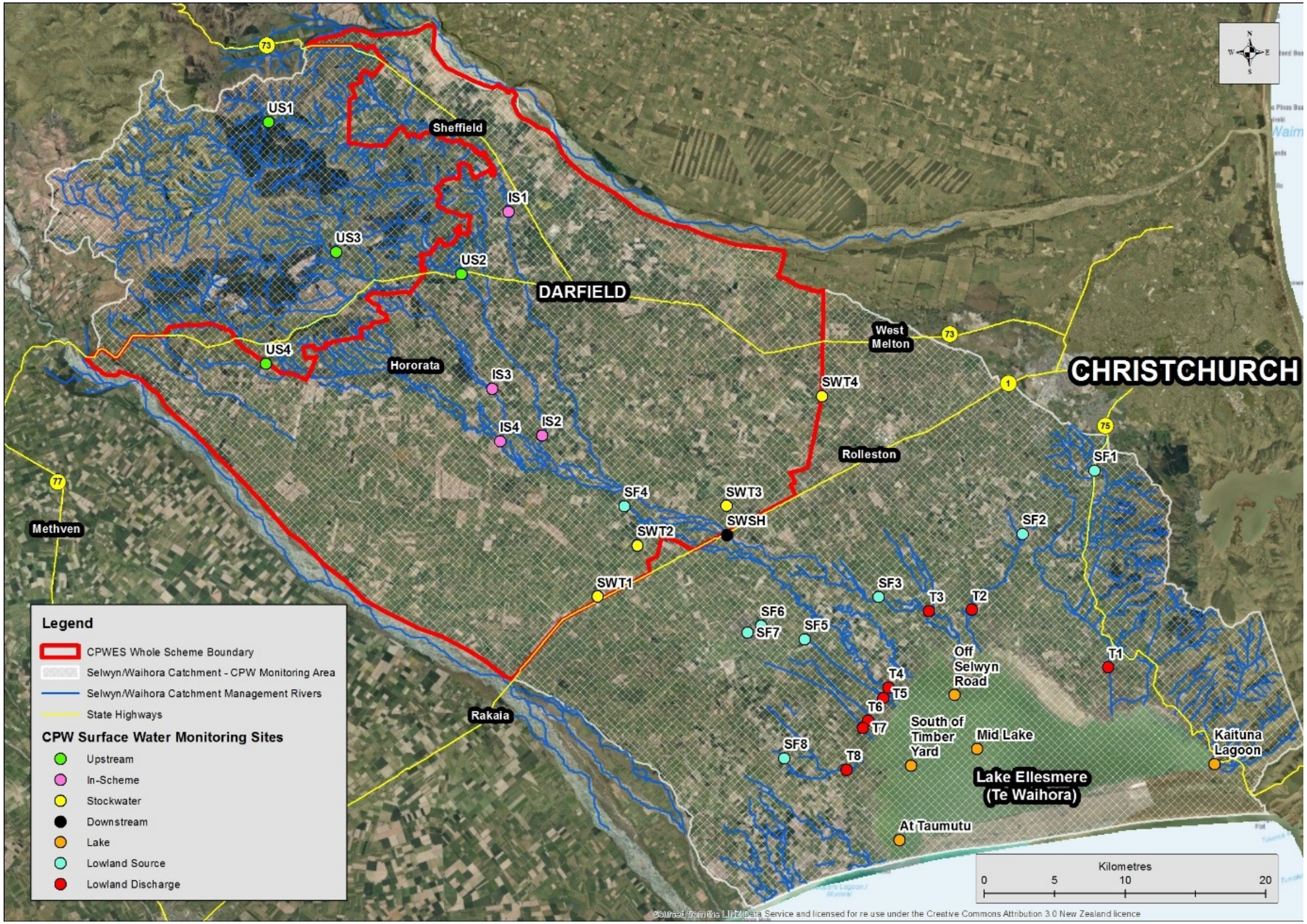


Figure 9. Surface Water Monitoring Sites

Ground Water Quality and Levels

Twenty monitoring bores have been installed by CPWL throughout the Scheme area (refer to Figure 10). Eight bores are located within Stage 1, ten in Stage 2 with two in the Sheffield area.

CRC165680 required two years of ground water monitoring data to be collected prior to the use of water. By 1 September 2015, CPWL had completed seven rounds of quarterly monitoring of our Stage 1 dedicated long-screen bores (Refer to Figure 11 for a comparison of a water supply bore to a dedicated long-screen monitoring bore). Long-screen monitoring bores are screened across the water table and this enables samples to be taken from close to the groundwater's static water level (SWL). This contrasts with typical Canterbury water supply bores that can have relatively short (~2m long) screens located close to the bottom of the bore. Water samples taken from typical Canterbury water supply bores may be abstracted from some distance below the SWL. This difference is important because some groundwater contaminants, in particular Nitrate-N, are typically most concentrated at the SWL and become decreasingly concentrated with depth, rather like cream in a bottle of milk. This means that samples taken from near to the SWL are more likely to accurately reflect Nitrate-N concentrations affected by land surface recharge in the immediate vicinity than samples collected from a bore screened 20m below the SWL. This difference is illustrated in Figure 11.

In order to have two years of monitoring data before the commencement of Stage 1 irrigation, the Stage 1 dedicated monitoring bores were located adjacent to existing water supply bores that had been monitored for at least two years prior to CPWL's first irrigation season. The water supply and long-screen bores were monitored concurrently for two years to establish a relationship between the two forms of monitoring that may be useful when comparing future results to the historic record.

The dedicated long-screen monitoring bores were installed in the Stage 2 area of the Scheme in the first half of 2015. These bores had been monitored for three and a half years prior to the commencement of Stage 2 irrigation in 2018.

Full details of the Groundwater Monitoring Programme are contained in Part 1 of CPWL's Ground and Surface Water Monitoring Plan (available at https://www.cpwl.co.nz/companydocuments).

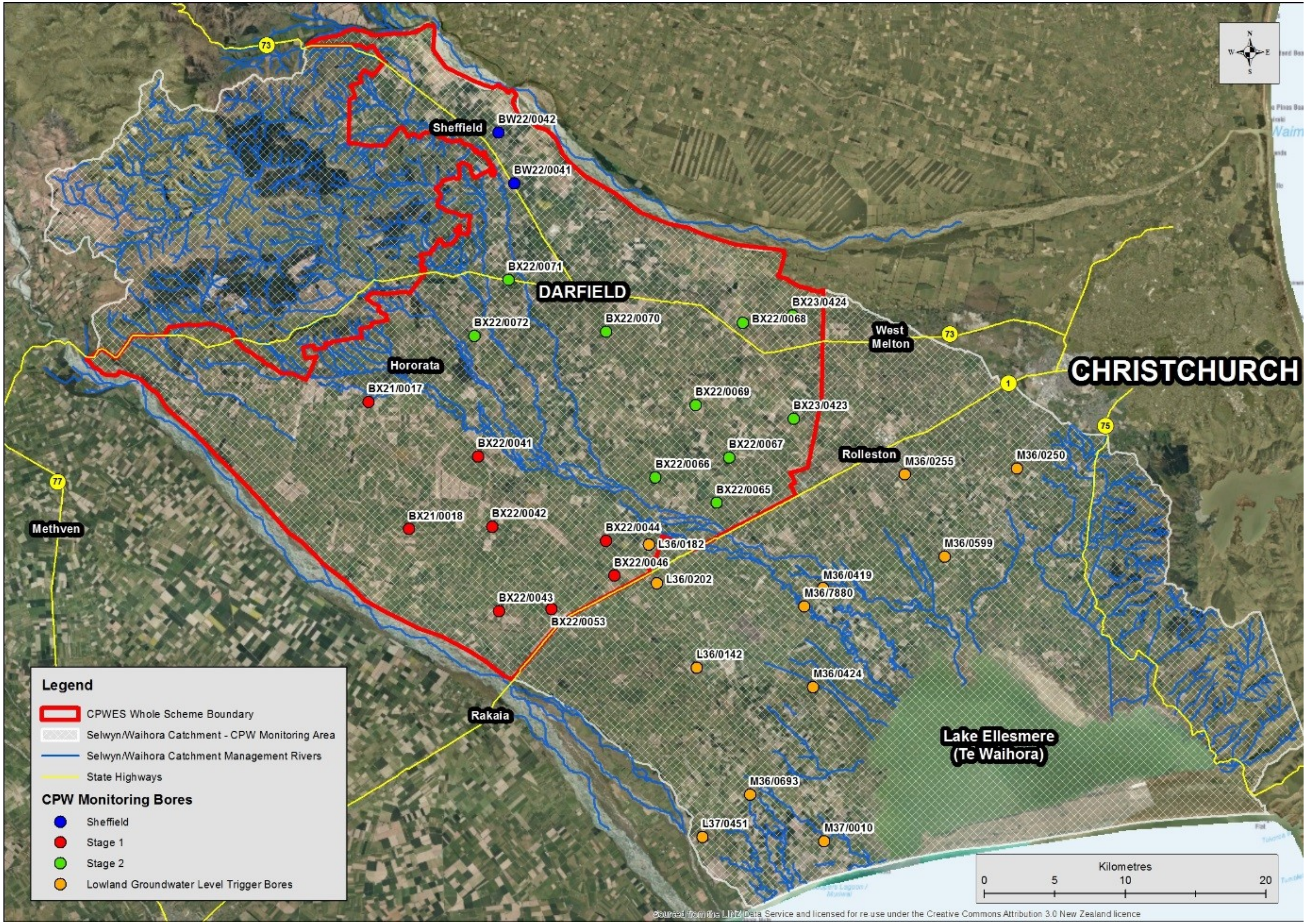


Figure 10. CPWL Groundwater Quality and Lowland Water Level Monitoring Sites

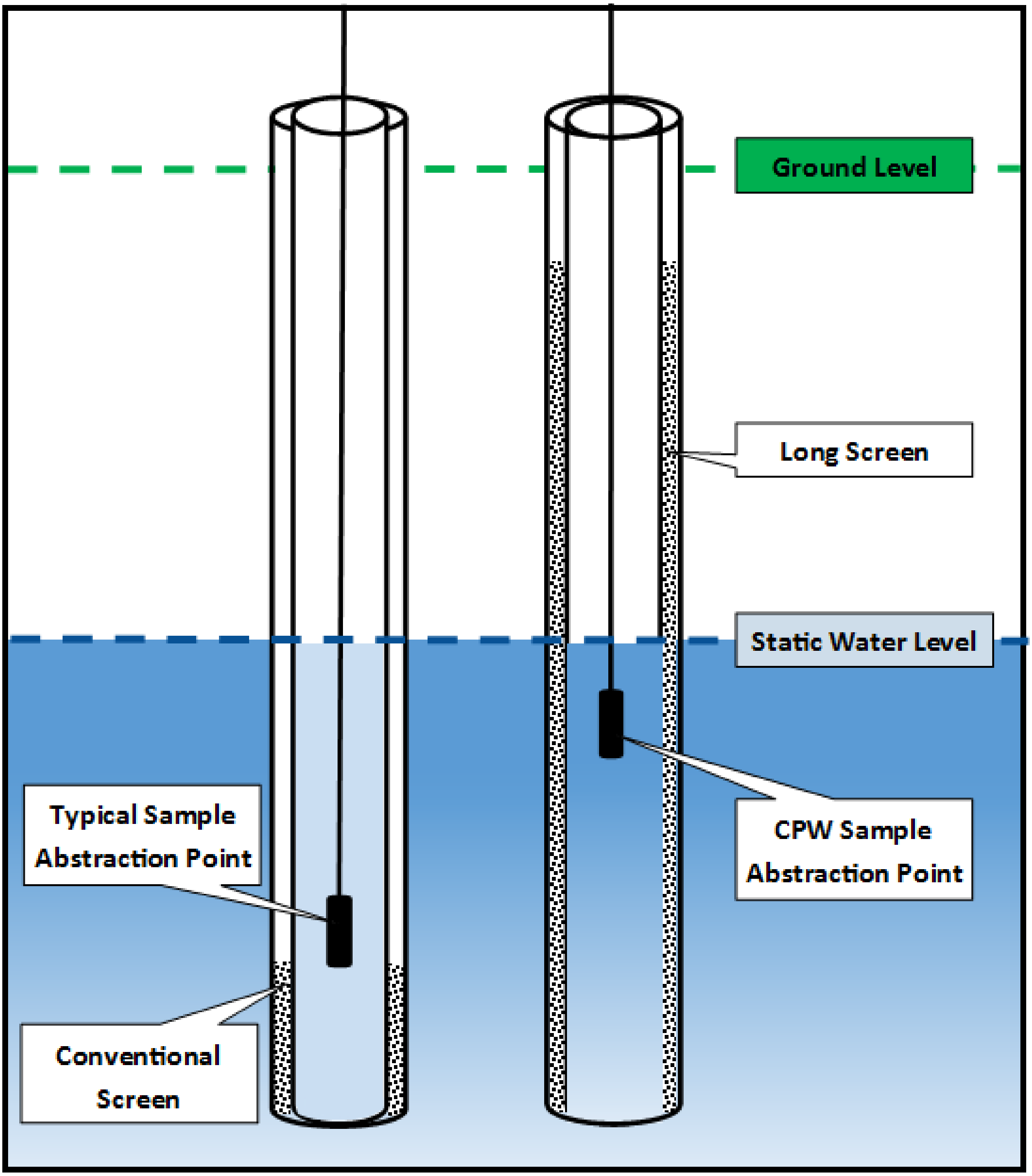


Figure 11. Comparison of a typical Canterbury Water Supply Bore to a dedicated CPWL long-screen Monitoring Bore

Groundwater Level Trigger Levels

CPWL does not carry out any specific groundwater monitoring in the Lowland Central Plains area but instead utilises data collected by Environment Canterbury (ECan). ECan operate an extensive groundwater level monitoring network in the Lowland Central Plains. GSWERP has established groundwater level trigger limits for a series of 12 bores within the ECan network (orange circles in Figure 10). The trigger limits will be used to provide advance warning of potential groundwater mounding. In order to provide sufficient warning of possible groundwater mounding the trigger limits are relatively conservative in that they have been set at a level which has been reached in the past. This may result in occasions where the triggers are reached following for example, high intensity rainfall events that lead to elevated groundwater levels, or for other reasons that are outside of CPWL's control. For example, the large, complex low-pressure system that brought heavy rain to and gales to Canterbury during 20-22 July 2017 led to trigger levels being exceeded from 5 out of 12 monitoring bores. No trigger levels were exceeded during the 2015-16 and 2016-17 monitoring periods.

Groundwater Quality Trigger Levels

With the exception of Nitrate-N and *E. coli* in groundwater, CPWL's trigger levels are assessed against monthly or annual data.

Trigger levels for Nitrate-N in groundwater are based on five-year annual averages. This means a comparison of monitoring results to the groundwater Nitrate-N trigger from five years' of CPWL activities cannot be made until September 2020 for Stage 1, 2022 for Sheffield and 2023 for Stage 2. It will still be useful however, to evaluate the results obtained prior to 2020-23 to see if any developing trends can be identified.

Until a sufficient amount of data has been collected to report against five-year annual averages, CPWL will highlight in the results section instances where new maximum Nitrate-N concentrations are detected and where annual average Nitrate-N values exceed 7.65mg/L[1] for the Stage 1 and Sheffield areas.

It is worth noting that there is a recognised lag effect in the transport of nitrogen in the groundwater system. Therefore elevated and/or increasing Nitrate-N readings may continue to be measured in deep groundwater, lowland streams and Te Waihora for a period of time, from pre-scheme land use, irrespective of improving farm practices that would be expected to result in lower discharges of nutrients into the environment. Consequently, in deep groundwater, lowland streams and Te Waihora it may take many years to detect changes in Nitrate-N concentrations resulting from changed land use under CPWL, if this occurs.

Prior to the commencement of CPWL irrigation, 42% of the water samples taken from Stage 1 long-screen bores had Nitrate-N concentrations greater than 7.65mg/L, for Sheffield bores the figure was 30%, and for Stage 2 the figure was at 61%.

The *E. coli* trigger level is a median (over the length of record, post commencement of CPWL irrigation) of a detectable concentration of the bacteria.

Groundwater samples are analysed for pH, Electrical Conductivity, Dissolved Oxygen, Temperature, Alkalinity, Bromide, Chloride, Dissolved Reactive Phosphorus, Nitrate-Nitrogen, Total Nitrogen, Sulphate and *E. coli.* The static groundwater level is also measured at the time of sampling. CPWL has water quality triggers in place for Nitrate Nitrogen and *E. coli*.

Appendix 6.1 contains all trigger limits and trigger response processes from Part II of the Ground and Surface Water Plan.

[1] 7.65mg/L is the trigger level for Nitrate-N based on a five-year annual average concentration.

3.2. 2019/2020 Seasonal Climatic Influence

Rainfall

During the period 1 July 2019 to 30 June 2020, 762mm of rainfall was recorded at NIWA's weather station 4702 located approximately 4km west of Hororata. This was the 14th lowest 12-month total (1 July to 30 June) since records began in the 1981-82 period (n=39) (refer to Figure 12), which is 10% less than the long-term mean of 849mm.

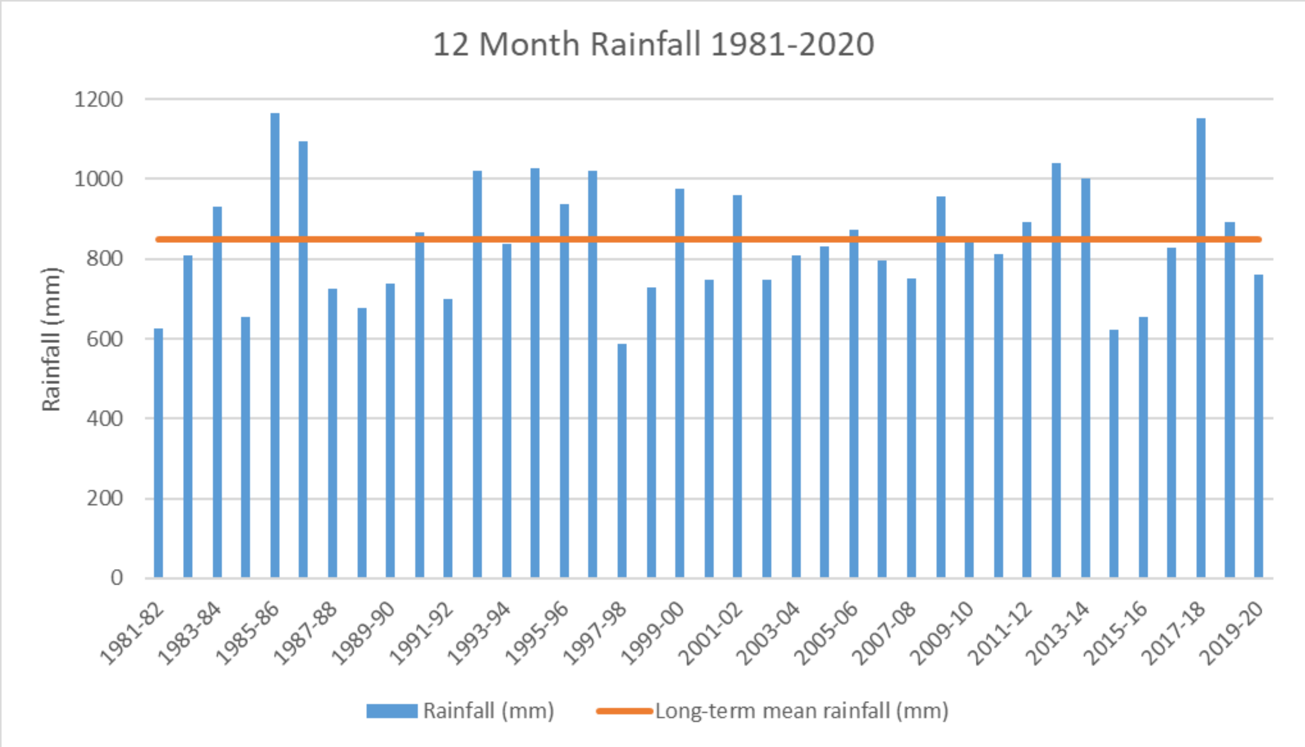


Figure 12. Rainfall record at NIWA's Weather Station 4702, Hororata
Source NIWA Clifo Database.

Rainfall and Soil Moisture Deficit data generated from NIWA's weather station (4702) for the July 2016 to June 2020 period is shown in Figure 13 below. The soil at weather station 4072 site could be classified as being severely dry for 57 days, with 42 days rated as extremely dry, during the 1 July 2019 to 30 June 2020 period. Table 1 illustrates the soil moisture classification data from 2015-16 to 2019-20.

Table 1 Soil Moisture Classification at weather station 4072 from 2015-16 to 2019-20

	NIWA Soil Moisture Classification	
Year	Severely Dry (Days)	Extremely Dry (Days)
2015-16	76	8
2016-17	25	17
2017-18	28	0
2018-19	16	0
2019-20	57	42

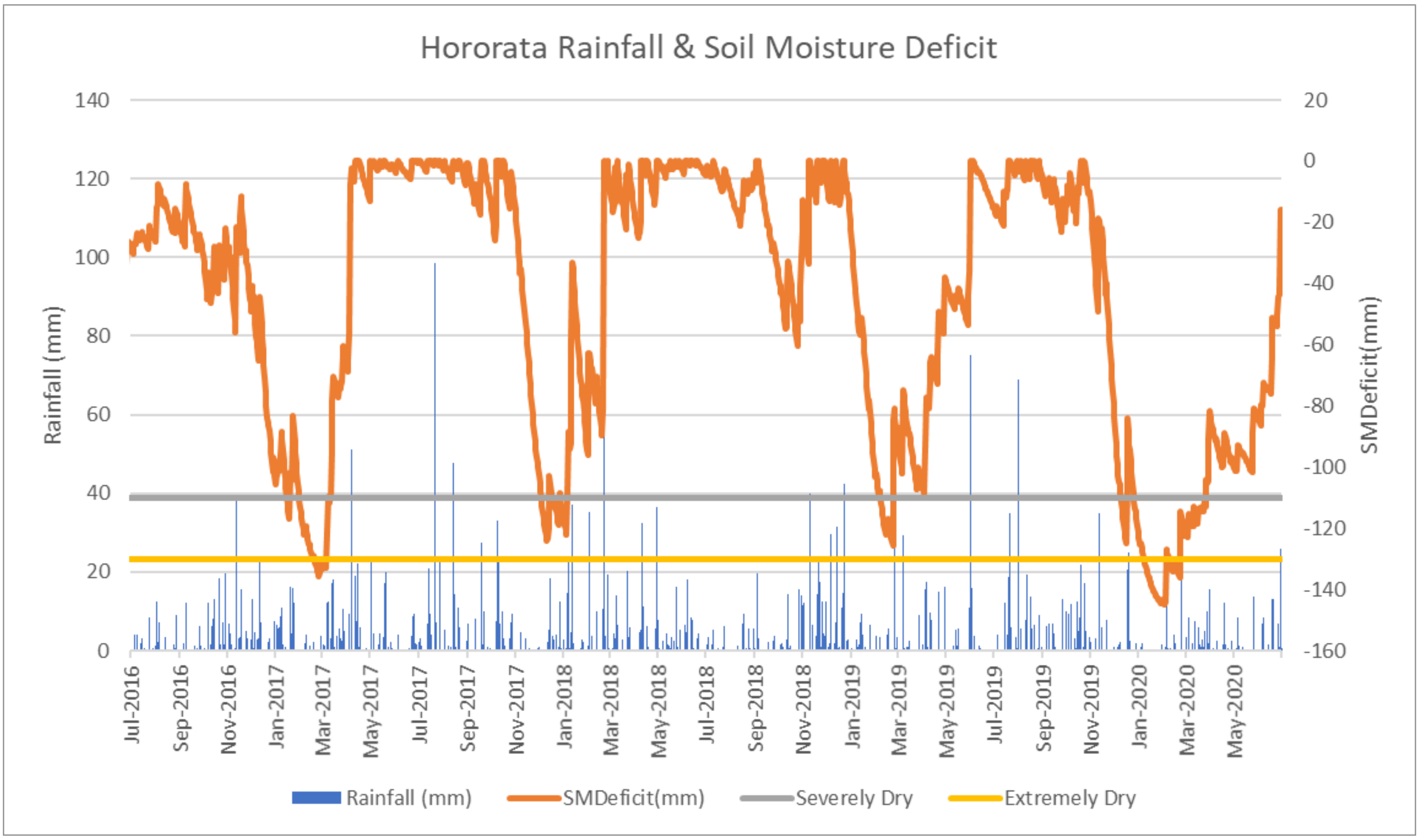


Figure 13. Rainfall and Soil Moisture Deficit Measured at NIWA's Monitoring Station in Hororata (unirrigated pasture).
Source NIWA Clifo Database.

4. Results & Interpretation

All monitoring data is listed, as required by CRC165680, appears in Appendices 6.3-6.6.

4.1. River and Stream Water Quality

CPWL has annual median, and annual 95th percentile, trigger limits for Nitrate-N. CPWL has surface water samples analysed for Nitrate + Nitrite-N. Like ECan and the majority of Regional Councils in New Zealand, CPWL monitors oxidised nitrogen as Nitrite-Nitrate-Nitrogen. Nitrite is not directly measured because of its transient nature and the very low concentrations that are present in Canterbury Rivers. When discussing surface (including lake) water quality monitoring results in this report, Nitrate-Nitrogen + Nitrite-Nitrogen will be referred to as Nitrate-N.

CPWL River and Stream quality trigger levels are shown in Table 2 and the monitoring results are shown in Table 3 (NB: values depicted in red indicate trigger level exceedances). The number of samples collected, as reported in Table 2, is a reflection of flows in those waterways; samples can only be collected if the waterway is flowing. For example, the Selwyn River at SH1 was only found to be flowing on only six out of 12 occasions throughout monitoring period.

A maximum of 308 samples were able to be collected by CPWL and ECan during the 2019-20 monitoring period from the 25 sites displayed in Table 2 if all rivers and streams are flowing. During 2019-20 the total number of samples collected was 251. This compares to 279 out of a maximum of 308 for 2018-19 and 285 out of a maximum of 306 during 2017-18.

Table 2. Surface Water Quality Triggers for Nitrate-N in mg/L

River Type	CPWL Surface Water Monitoring	
	Annual Median	Annual 95th Percentile
Hill-fed Lower	1.8	2.6
Spring-fed Plains	5.2	7.4

Table 3. Surface Water Quality Nitrate-N Annual Medians and 95th Percentiles. Results in red indicate trigger exceedances.

		2015-2016			2016-17			2017-2018			2018-2019			2019-2020			2019-20
Site	Site ID	Nitrate Annual Median (mg/L)	Nitrate Annual 95th percentile (mg/L)	No. of samples	Nitrate Annual Median (mg/L)	Nitrate Annual 95th percentile (mg/L)	No. of samples	Nitrate Annual Median (mg/L)	Nitrate Annual 95th percentile (mg/L)	No. of samples	Nitrate Annual Median (mg/L)	Nitrate Annual 95th percentile (mg/L)	No. of samples	Nitrate Annual Median (mg/L)	Nitrate Annual 95th percentile (mg/L)	No. of samples	Month of Peak Nitrate-N Conc-entration
Hill-Fed Lower Sites																	
Hawkins River In-scheme	IS1	**1.9**	2.1	2	1.8	2.4	9	**2.69**	**3.11**	12	**2.30**	**2.83**	12	**2.44**	**2.66**	8	Aug-19
Waianiwaniwa River In-scheme	IS2	n/a	n/a	0	**4.4**	**4.4**	1	1.80	**3.05**	6	0.75	0.91	2	**2.26**	2.29	2	Jul-19
Selwyn River In-scheme	IS3	0.5	0.5	1	0.7	0.7	3	0.66	0.85	9	0.75	1.09	4	1.02	1.40	5	Sep-19
Hororata River In-scheme	IS4	1.1	1.4	6	1	1.5	12	**2.05**	**3.21**	12	1.79	2.15	12	**1.81**	**2.66**	12	Aug-19
Selwyn River @ SH1	SWSH	**2.8**	**2.8**	1	1.1	1.1	1	1.53	2.16	9	1.13	2.10	6	**2.10**	2.47	6	Sep-19
Hawkins River Upstream	US1	0.1	0.3	10	0.5	1.1	12	0.54	1.22	12	0.46	0.61	12	0.44	1.21	12	Jul-19
Waianiwaniwa River Upstream	US2	0.5	1	3	0.5	1.3	9	**1.87**	**2.78**	9	0.74	1.20	8	1.14	**2.83**	6	Jul-19
Selwyn River Upstream	US3	0.2	0.4	14	0.2	0.3	12	0.41	0.65	12	0.48	0.63	12	0.44	0.66	11	Aug-19
Hororata River Upstream	US4	0.2	0.7	10	0.7	1.4	12	1.09	1.34	12	0.79	1.18	12	0.64	1.07	12	Jul-19
Spring-Fed Plains Sites																	
Halswell River Source	SF1	3.7	4.4	10	3.3	3.8	12	3.14	3.48	12	3.55	3.77	12	3.29	3.64	12	Aug-19
LII Stream Source	SF2	4.9	5.2	10	4.2	4.6	12	4.09	4.18	12	4.13	4.45	12	4.39	4.72	12	Aug-19
Selwyn River Spring Source	SF3	**7.8**	**8.4**	10	**7.5**	**8.5**	11	4.94	6.30	12	**5.73**	**7.45**	12	**7.52**	**8.50**	12	Mar-20
Irwell River Source	SF4	2.2	2.8	2	1.8	3.4	4	1.95	3.31	12	1.72	2.42	10	2.14	3.01	7	Jul-19
Hanmer Road Drain Source	SF5	3.8	3.9	2	**7.8**	**7.8**	1	4.23	**7.96**	12	3.08	4.44	12	3.90	4.80	8	Sep-19
Boggy Creek Source	SF6	**6.4**	**8.5**	10	**8.3**	**12.2**	5	**8.10**	**12.89**	12	5.04	7.17	12	5.16	6.59	12	Aug-19
Doyleston Drain Source	SF7	n/a	n/a	0	n/a	n/a	0	**8.10**	**14.49**	12	**5.25**	**8.79**	12	**8.30**	**9.38**	6	Aug-19
Harts Creek Source	SF8	**9.2**	**9.3**	2	**8.7**	**8.8**	6	**8.40**	**9.41**	12	**9.19**	**10.25**	12	**9.69**	**10.51**	10	Dec-19
Halswell River Downstream	T1	2.9	3.2	10	2.5	3	12	2.34	2.66	12	2.51	2.82	12	2.43	2.64	12	Jun-20
LII Stream Downstream	T2	3.4	3.9	10	2.9	3.3	12	3.10	3.55	12	3.80	4.00	12	3.35	3.60	12	Jul/Dec-19
Selwyn River Downstream	T3	**6.5**	6.8	14	**6.1**	**7.5**	12	5.05	6.65	12	**6.15**	**7.50**	12	**7.25**	**7.69**	12	Jun-20
Irwell River Downstream	T4	0.03	2	5	<0.01	4.8	4	1.93	4.87	12	0.93	1.92	12	1.68	2.56	9	Aug-19
Hanmer Road Drain Downstream	T5	1.1	2.1	4	<0.01	3.6	9	3.40	6.85	12	2.04	3.67	12	3.34	4.08	9	Sep-19
Boggy Creek Downstream	T6	4.5	6.4	14[A]	3.8	**8.5**	16[A]	**8.18**	**10.74**	15[A]	4.50	5.81	16[A]	4.90	5.61	16	Dec-19
Doyleston Drain Downstream	T7	0.2	1.3	14[A]	0.4	3.2	16[A]	**5.72**	**10.55**	15[A]	4.63	6.67	16[A]	0.74	5.94	16	Sep-19
Harts Creek Downstream	T8	**6.7**	7.3	14	**7**	7.3	12	**7.55**	**7.89**	12	**8.05**	**8.35**	12	**7.80**	**8.25**	12	Nov-19

[A] Includes ECan monitoring data. NB: Nitrate-N results supplied to 1 decimal place in 2014-15 and 2015-16 and 2 decimal places from 2017-18.

Both the annual median, and annual 95th percentile, trigger limits were exceeded at seven monitoring sites [2018-19 six sites, 2017-18 eighteen sites], one site only exceeded the 95th percentile trigger [2018-19 no sites, 2017-18 two sites] and two sites only exceeded the annual median trigger level [2018-19 no sites, 2017-18 no sites]. Figure 14 spatially depicts which sites experienced trigger level exceedances during 2019-20.

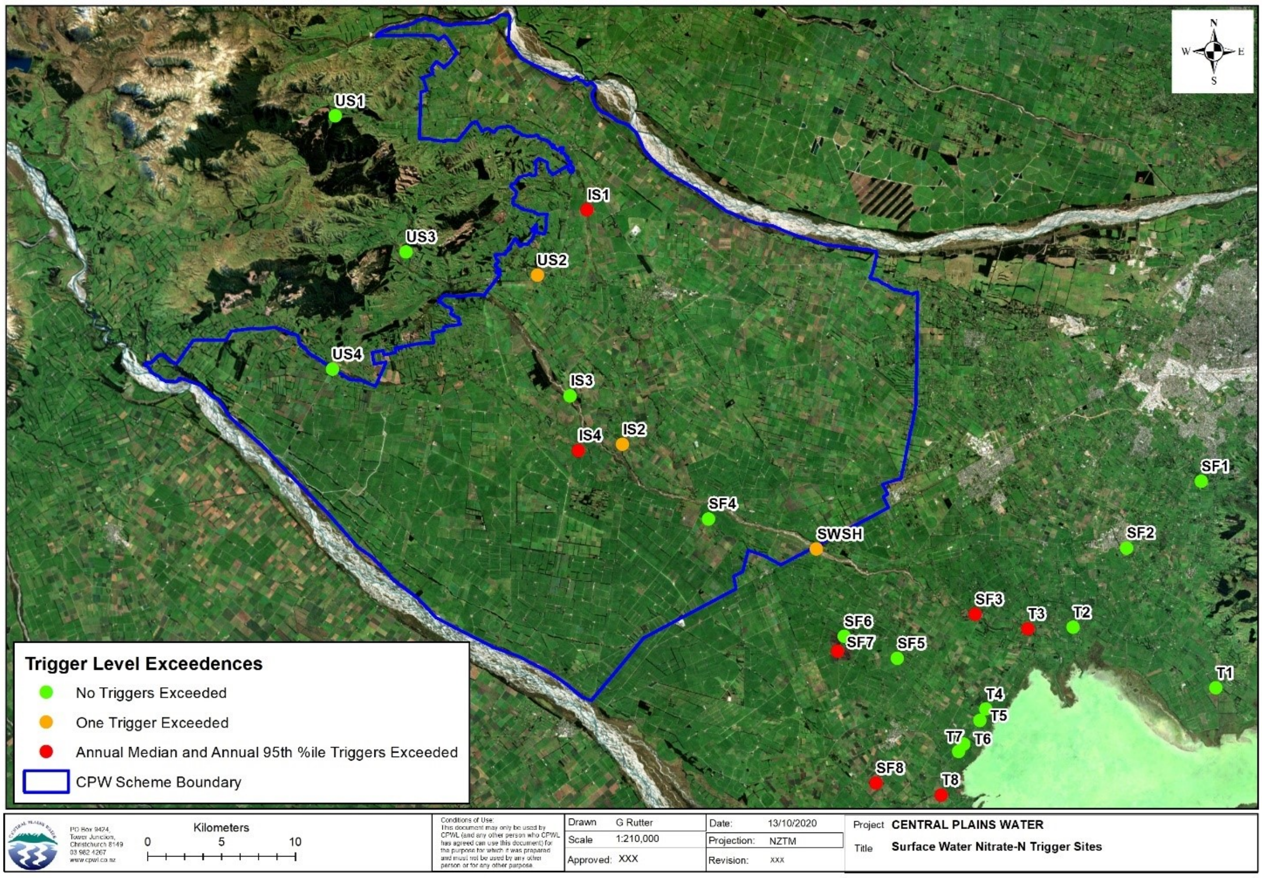


Figure 14. Surface Water Nitrate-N Trigger Level Exceedances

The trigger exceedances were from six waterways, Hawkins River, Waianiwaniwa River, Hororata River, Selwyn River, Doyleston Drain and Harts Creek. These six waterways have all had trigger exceedances during at least once of the previous monitoring periods.

No monitoring sites have shown a trigger level exceedance for the first time for the 2019-20 monitoring period.

Results presented in Part II of CPWL Ground and Surface Water Monitoring Plan also highlighted elevated nitrate readings, prior to commencement of CPWL irrigation, from sites in the Hawkins River, Selwyn River, Doyleston Drain and Harts Creek that would have exceeded CPWL's trigger limits when based on 2014 and/or 2010-15 data.

HILL-FED LOWER SITES - Annual Median Nitrate-N Trigger = 1.8mg/L, 95th%ile Trigger = 2.6mg/L

Five Hill-Fed Lower sites exceeded a trigger level for 2019-20 compared to one in 2018-19.

The Hawkins River at the Deans Road location, monitored by ECan (within the CPWL Scheme but upstream of monitoring site IS1) had a similar annual median (2.40mg/L vs 2.43mg/L) and a higher annual 95th percentile (3.02mg/L vs 2.65mg/L) Nitrate-N concentration compared to CPWL's Hawkins River instream site (IS1) (located 3.5km downstream) during 2019-20 (refer to Figure 15).

Annual Median and 95th Percentile Nitrate concentrations measured at the ECan, and CPWL In-scheme, locations in the Hawkins River were similar in the 2019-20 and 2018-19 periods.

A review of historic ECan data for the Deans Road site shows that although the Annual Median and Annual 95th Percentile, for 2019-20, exceeded their respective trigger levels, the results fit within those recorded prior to operation of the Sheffield Scheme.

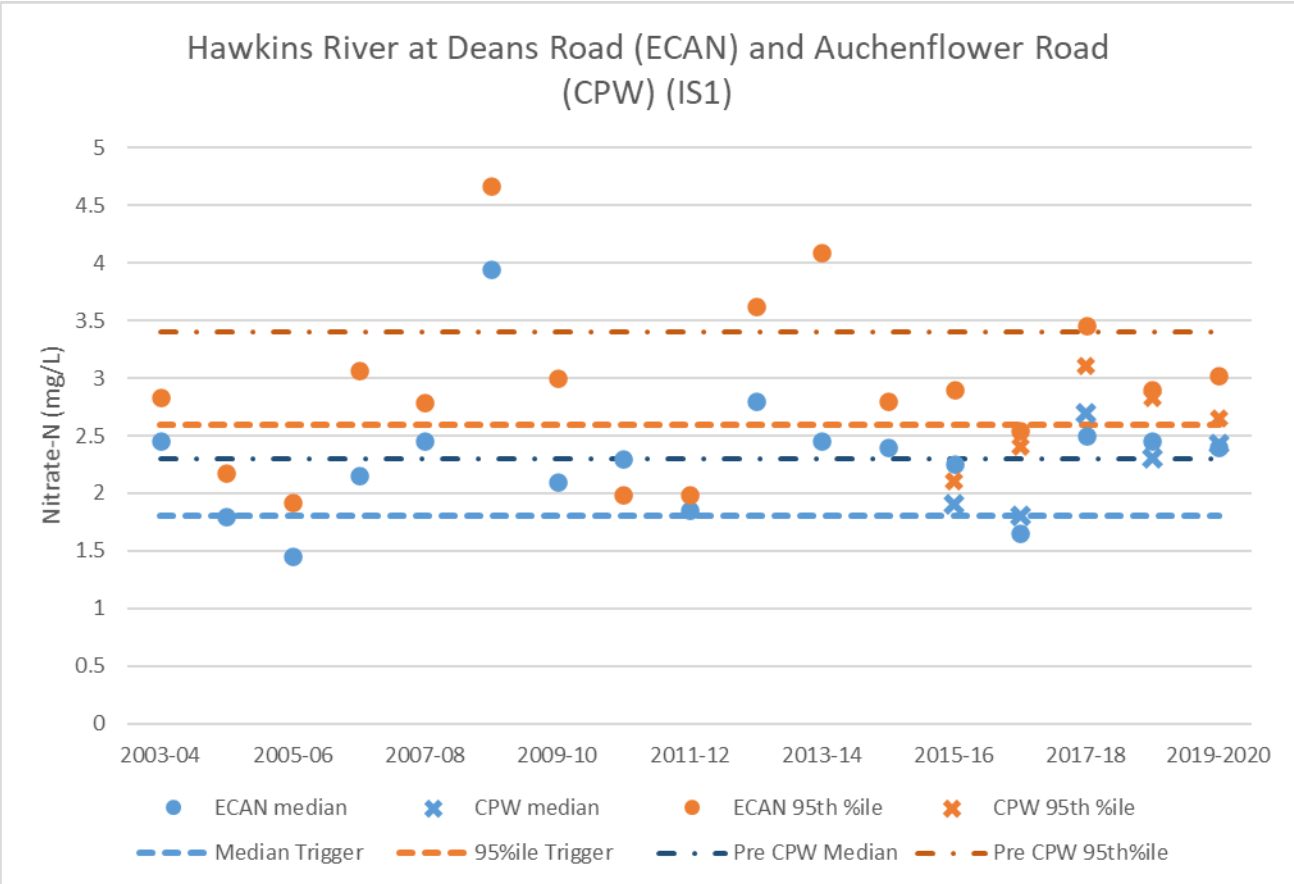


Figure 15. Hawkins River at Deans and Auchenflower (IS1) roads – Nitrate-N concentrations 2003-04 to 2018-19

Trigger level exceedances recorded in 2019-2020 at the other Hill-Fed Lower sites were within ranges recorded in previous years with one exception. The Annual 95th Percentile Nitrate-N concentration recorded at the 'upstream' site in the Waianiwaniwa River was 2.83 mg L^{-1}. This was marginally greater than the 2017-18 level of 2.78mg L^{-1}. There is no pre-CPWL monitoring data for the other Hill-Fed Lower sites with which to make further comparisons.

Although it does not exceed the applicable trigger levels, results from the In-scheme site (IS3) on the Selwyn River appear to be showing an upward trend (Refer to Figure 16). NB: To date CPWL has been able to sample site IS3 on an average of 4.4 times per year due to the site often being dry. This is not frequent enough to produce robust annual medians and annual 95th percentiles for viable statistical analysis to confirm at present whether a non-seasonal increase in Nitrate-N is occurring. The 2019-20 Annual median and annual 95th percentile Nitrate-N concentrations at IS3 are the highest measured so far.

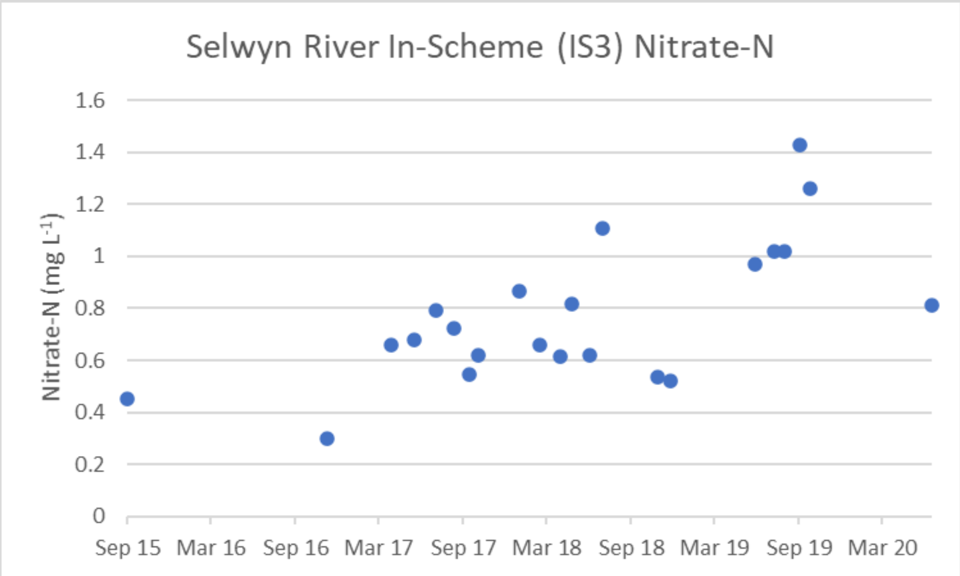


Figure 16. Selwyn River In-scheme (IS3) Nitrate-N concentrations 2015-16 to 2019-20

SPRING-FED PLAINS SITES - Annual Median Trigger = 5.2mg/L, 95th%ile Trigger = 7.4mg/L

Both annual median and annual 95th percentile Nitrate-N triggers were exceeded for the Selwyn River sites SF3 ('Spring Source' at Chamberlains Ford) and T3 ('Discharge' site at Coes Ford), Harts Creek at SF8 ('Spring Source' and T8 ('Discharge') and at the Doyleston Drain SF7 ('Spring Source ').

Annual Median and Annual 95th percentile Nitrate-N concentrations for site SF3 in 2019-20 were less than, or similar respectively, to those measured previously (Refer to Figure 17). Albeit they have been rising following the higher rainfall, 2017-18 period where concentrations showed a noticeable decrease on the previous two years.

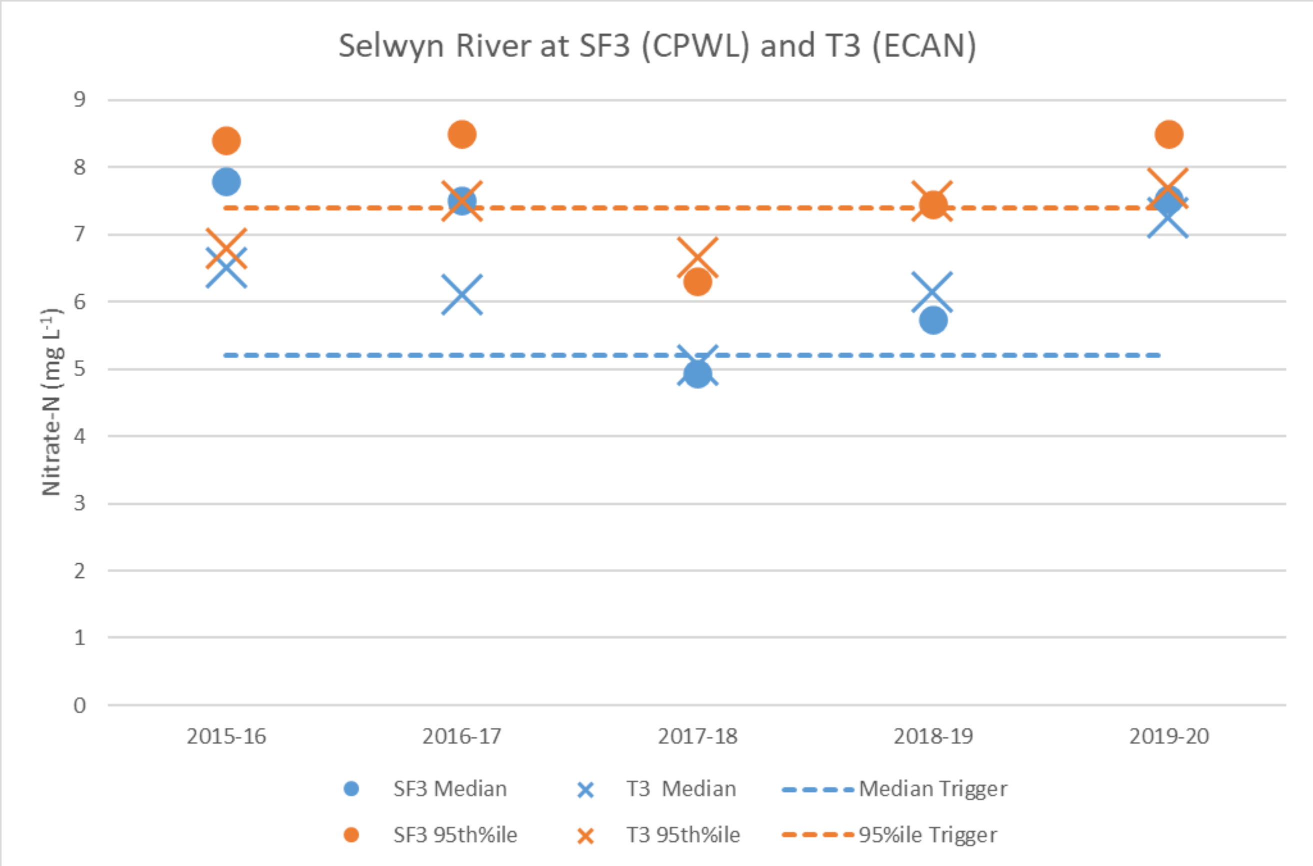


Figure 17. Selwyn River Spring Source (SF3) and Downstream (T3) location – Annual Nitrate-N concentrations 2015-16 to 2018-19

At 7.25 mg L^{-1} and 7.69mg L^{-1} the Annual Median and Annual 95th Percentile Nitrate-N concentrations at T3 were the highest recorded to date. Figure 18 shows both the Annual Median and 95th Percentile concentrations have been generally steadily increasing since 1992-93. Therefore, the trigger level exceedance may be due to the (increasing) baseline water quality i.e. the lag effect from historic farming practices, and it is not yet possible to conclude what contribution the CPWL related activities make Further monitoring will allow closer examination of this trend in future.

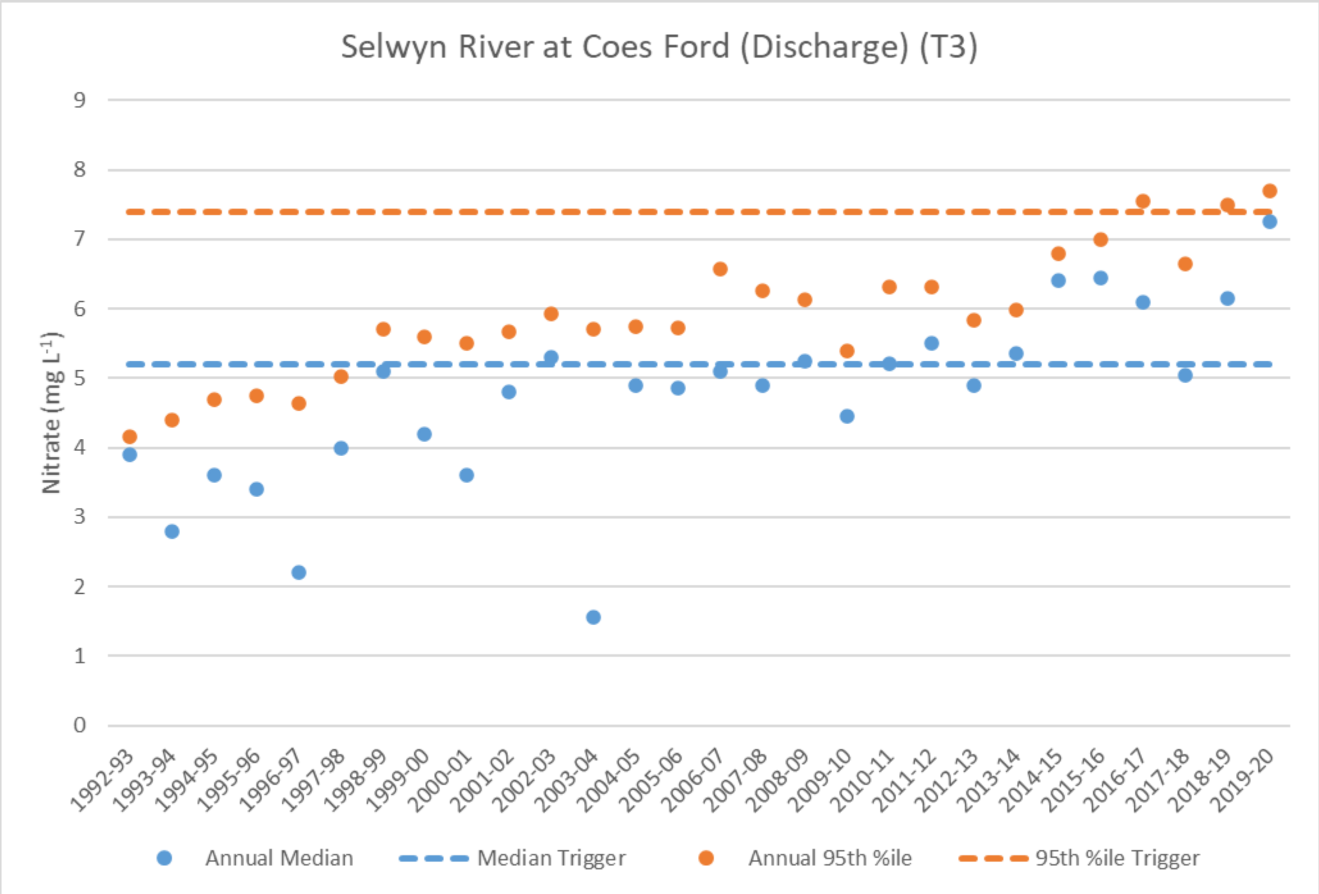


Figure 18. Selwyn River Downstream (T3) location – Annual Nitrate-N concentrations 1992-93 to 2019-20

The Doyleston Drain Spring Source site (SF7) was found to be flowing during six monitoring rounds in the 2019-20 period.

From the commencement of the surface water monitoring programme in September 2015, through to the 27 June 2017 monitoring round, SF7 was never observed to be flowing. Following a significant heavy rain event during 20-22 July 2017, SF7 was found to be flowing on 25 July 2017. It has continued to be flowing at each monitoring round since, up until the December 2019 round, from which point it has not been observed to be flowing.

At 8.30mg L^{-1} and 9.38mg L^{-1}, both the annual median and annual 95th percentile trigger levels were exceeded at SF7 during 2019-20. This is an increase on 2018-19 concentrations but a decrease from 2017-18 concentrations. Figure 19 shows the monthly Nitrate-N concentrations and flows recorded at SF7 to date. There is only three years of monitoring data for site SF7, so more information is needed to confirm whether any trend in Nitrate-N concentration is developing. The Nitrate-N concentration does appear to be related to flow rate.

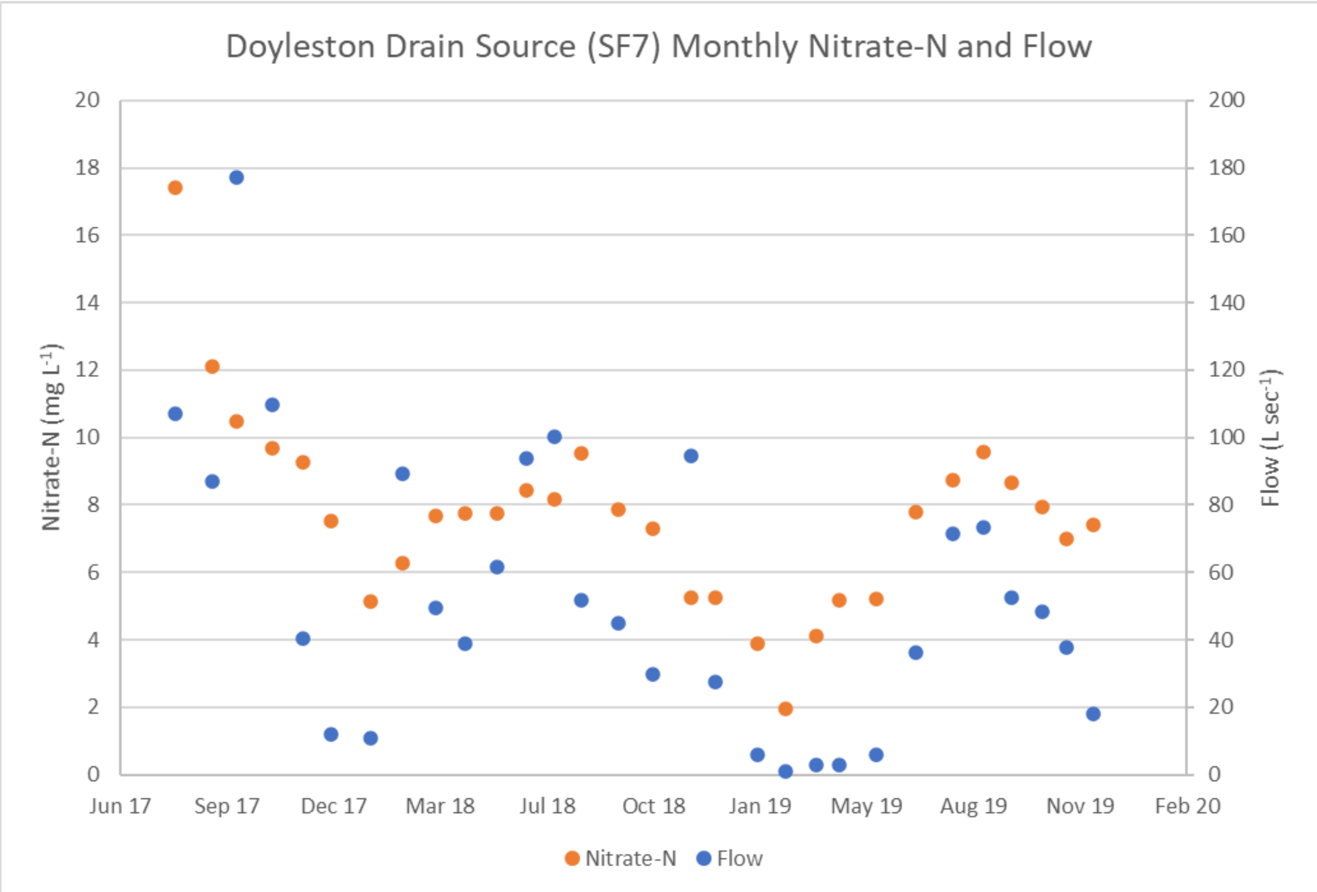


Figure 19. Doyleston Source location –Spot Nitrate-N concentrations and flow July 2017 to December 2019

Throughout 2019-20, Nitrate-N concentrations continued to be found at higher concentrations at site SF7 compared to the downstream site T7 (refer to Figure 20). This is potentially due to the uptake of nutrients by periphyton and aquatic plants and/or the dilution of groundwater inflows that have been denitrified as they seep upwards through low permeability confining sediments.

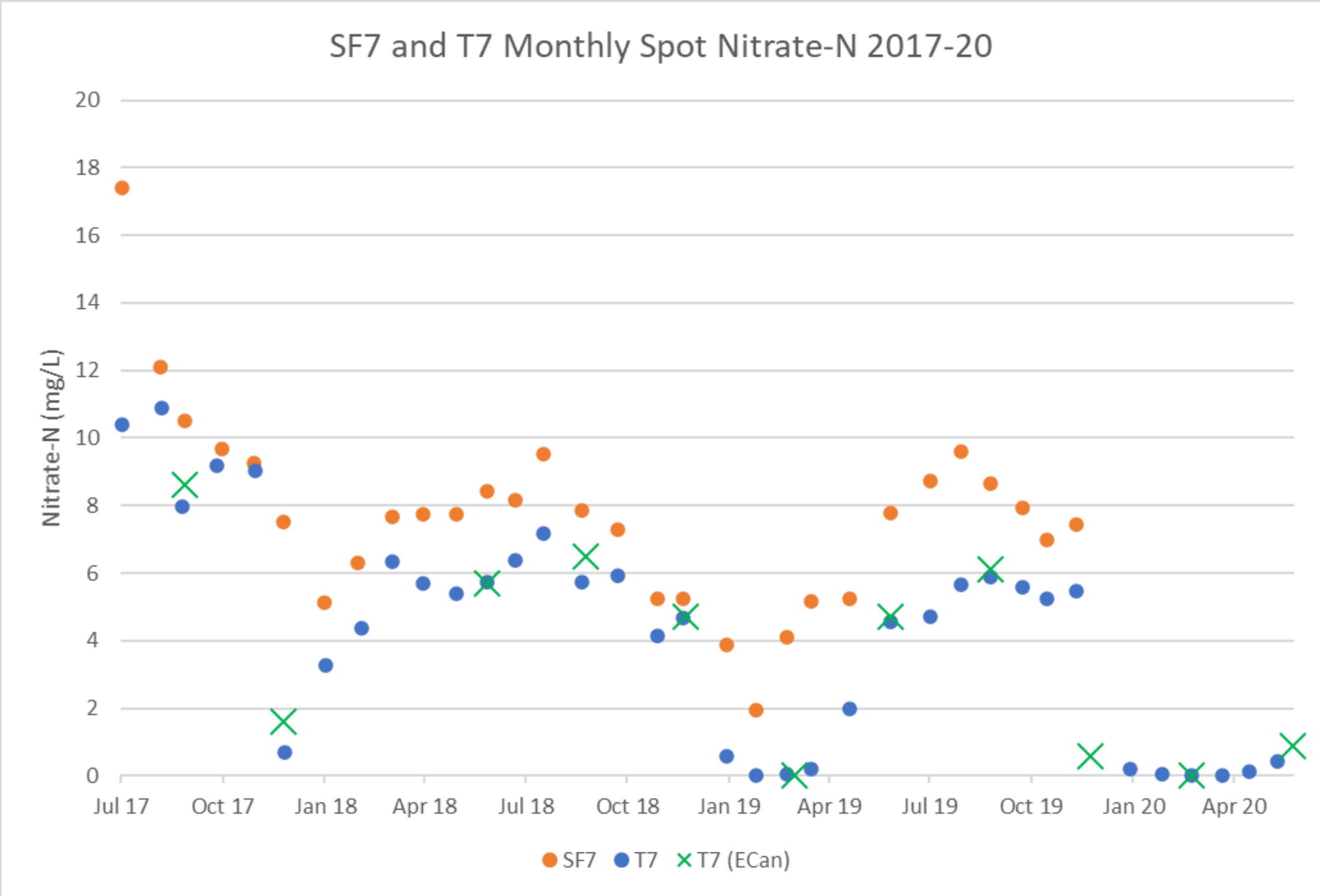


Figure 20. Doyleston Drain Source and Discharge locations – Discrete Monthly Nitrate-N concentrations 2017-18.

NB: Samples for paired SF7 and T7 sites were taken on the same day for all monitoring rounds from 26-03-2018.

Annual Median and 95th Percentile Nitrate-N concentrations both exceeded trigger levels at the Harts Creek Source (SF8) and Discharge (T8) sites during 2019-2020 (refer to Figure 21) with the 2019-20 Annual median and annual 95th percentile Nitrate-N concentrations at SF8 being the highest measured so far.

Spot Nitrate-N concentrations at the downstream Harts Creek Discharge (T8) site have been found to be consistently lower than those from the Source site, SF8 (Refer to Figure 22). On one occasion where the Nitrate-N concentration at T8 was found to be greater than at SF8, the flow at SF8 was the lowest that water quality sampling has been carried out at to date (0.1L sec^{-1}). NB: SF8 Nitrate-N concentrations were however, found to be greater than the corresponding T8 concentration, on ten occasions when the flow at SF8 was between 1 and 7 L sec^{-1}.

A review of Annual Median and Annual 95th Percentile Nitrate-N data from site T8 as far back as the 1994-95 period (refer to Figure 23) shows that the 2019-20 Annual Median Nitrate-N concentration [7.80mg L^{-1}] was the second highest measured to date after the 2018-19 result [8.05mg L^{-1}]. The third highest result 7.55mg L^{-1} was from 2017-18. At 8.25 mg L^{-1}, the 2019-20 Annual 95th Percentile Nitrate-N concentration was the third highest recorded to date. Only the 2013-14 [8.4 mg L^{-1}] and 2018-19 [8.35mg L^{-1}] values were greater.

Both annual median and annual 95th percentile Nitrate-N concentrations at T8 have been increasing since the mid 2000's (refer to Figure 23) and the Mann Kendall trend test confirms the trends are statistically significant (P = .00000008 and P = 0.000002).

The trigger level exceedances at T8 may be due to the (increasing) baseline water quality and it is not yet possible to conclude what contribution the CPWL related activities make. Further monitoring will allow closer examination of this trend in future.

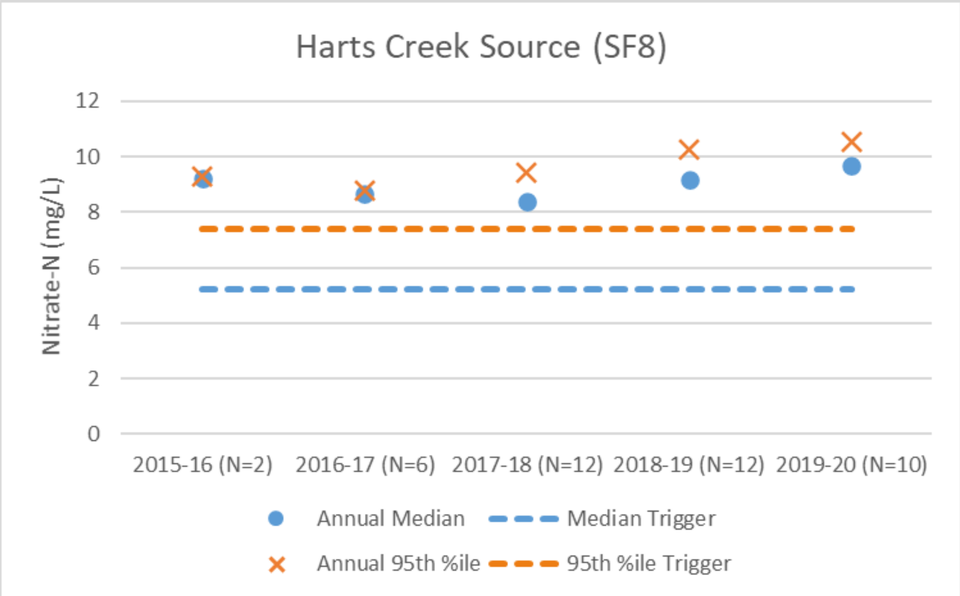


Figure 21. Harts Creek Source location – Nitrate-N concentrations 2015-16 to 2019-20

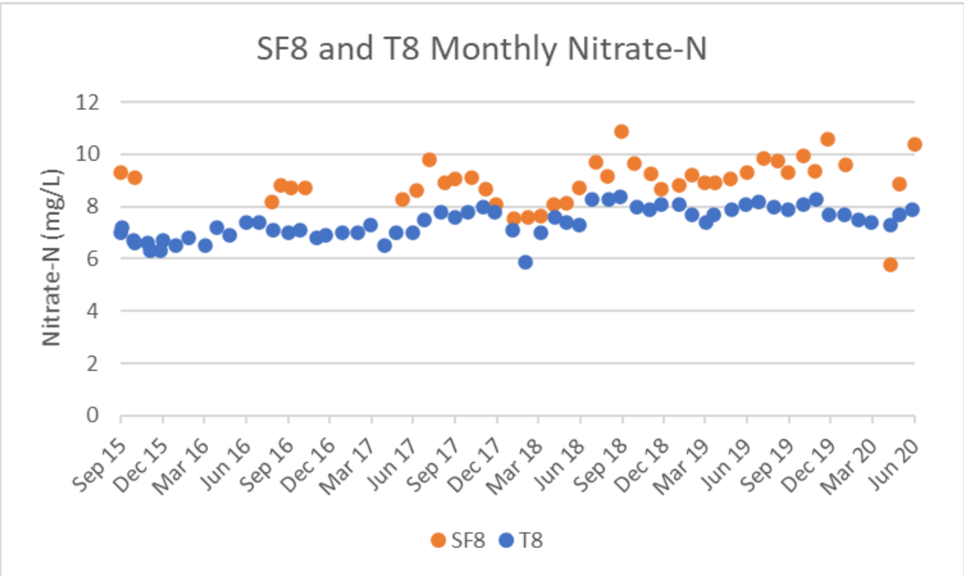


Figure 22. Harts Creek Source and Discharge locations – Discrete Monthly Nitrate-N concentrations from September 2015.
NB: Data gaps for site SF8 represent times when the Creek was dry.

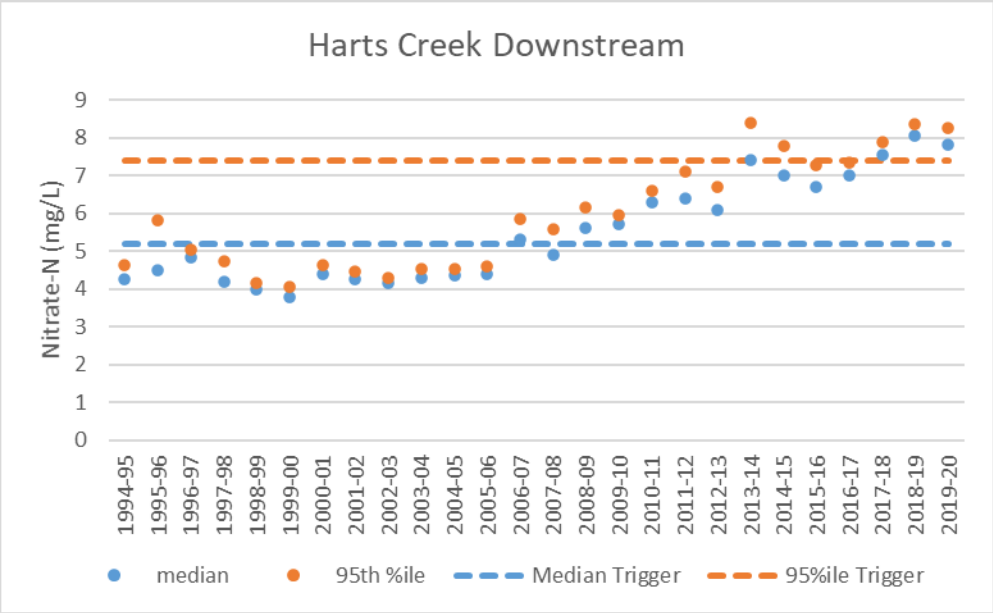


Figure 23. Harts Creek Discharge (T8) location – Nitrate-N concentrations 1994-95 to 2019-20

4.2. Lake Water Quality

The trigger levels for Lake Water Quality are listed in Table 4. The trigger levels have been taken from the water quality limits contained in Table (l) of the Land and Water Regional Plan.

Table 4. Lake Water Quality Triggers

Monitoring Location	**Chlorophyll *a* (µg/L)(b)**	**Total Phosphorus (mg/L)(b)**	**Total Nitrogen (mg/L)(b)**	**TLI(a)**
Mid-Lake	74	0.1	3.4	6.6
Lake Margins	no trigger	no trigger	no trigger	6

(a) TLI (Trophic Level Index) assumed to be calculated as TLI3 (using TP, TN and chl a)

(b) As a maximum annual average determined from 12 (monthly) rounds of monitoring results.

During the 1 July 2019 to 30 June 2020 period, 12 rounds of data were obtained by Environment Canterbury for Kaituna and 11 rounds for the remaining sites (April 2020 missed due to Covid-19 restrictions).

The total phosphorus trigger limit is an annual average of no more than 0.1mgL^{-1}. The 12-month average for total phosphorus at the Mid Lake monitoring site was 0.19mgL^{-1}.

The Chlorophyll *a* trigger limit is an annual average of no more than 74µg/L. The 12-month average for Chlorophyll *a* at the Mid Lake monitoring site was 107µgL^{-1}. (see Table 5, NB: data in red indicates an exceedance of the applicable trigger limit).

Table 5. Lake Water Quality Monitoring Results 2019-2020

Te Waihora Site	Chlorophyll *a* (µg/L)	Total Phosphorus[A] (mg L^{-1})	Total Nitrogen[A] (mg L^{-1})	TLI_3
Mid Lake (2019-20)	**107**	**0.19**	2.44	**6.95**
Lake Margin Sites				
• Kaituna Lagoon (2019-20)[B]	63	0.20	1.80	6.65
• Off Selwyn River Mouth (2019-20)	110	0.20	2.61	**7.00**
• South of Timber Yard (2019-20)	113	0.18	2.48	**6.96**
• Taumutu (2019-20)	116	0.17	2.41	**6.93**

A Annual Mean

B Kaituna Lagoon is included for comparison only; it is not a trigger level site.

ECan has generally monitored the Mid Lake location on at least a monthly basis since July 1993. From July 1993 the mean annual (July to June) Total Phosphorus level has been 0.24mg L^{-1} (Figure 24).

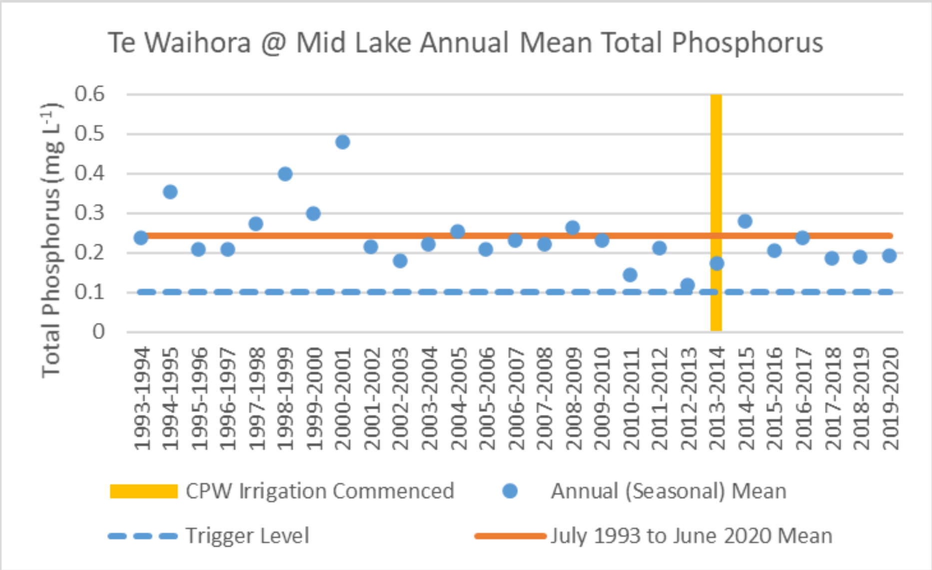


Figure 24. Total Phosphorus at Mid Lake in Te Waihora from 1993 - 2020

Figure 24 suggests that although the result for Total Phosphorus at 'Mid Lake' for 2019-2020 exceeded the trigger level, the level is not inconsistent with previous years' (pre CPWL scheme operation) results that ranged between 0.12mg/L and 0.48mg/L between 1993-94 and 2014-15. CPWL therefore suggests the exceedance of the phosphorus trigger at Mid Lake is consistent with elevated baseline levels and it is not possible to attribute any change resulting from CPWL related activities. Further monitoring will allow ongoing examination of any trends in future.

The mean annual (July to June) Chlorophyll *a* level since 1993-94 has been 86µg L^{-1} (Figure 25).

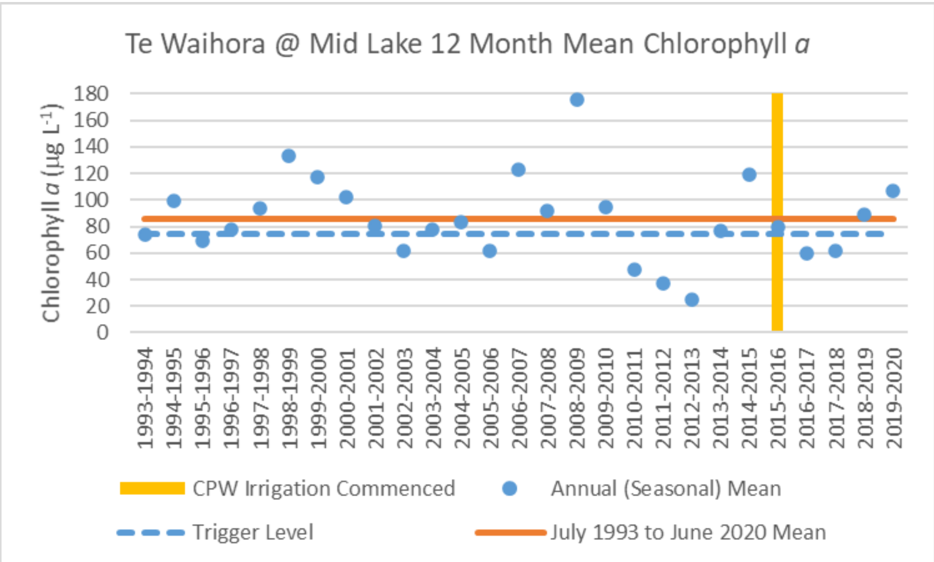


Figure 25. Chlorophyll *a* at Mid Lake in Te Waihora from 1993 - 2020

Figure 25 suggests that although the result for Chlorophyll *a* at 'Mid Lake' for 2019-2020 exceeded the trigger level, the level is not inconsistent with previous years' (pre CPWL scheme operation) results that ranged between 25µg L^{-1} and 176µg L^{-1} between 1993-94 and 2014-15. CPWL therefore suggests the exceedance of the Chlorophyll *a* trigger at Mid Lake is consistent with elevated baseline levels and it is not possible to attribute any change resulting from CPWL related activities. Further monitoring will allow ongoing examination of any trends in future.

The Trophic Level Index (TLI_3) is an indicator of lake water quality specifically developed for New Zealand lakes. The TLI_3 is derived from a number of water quality measures including total nitrogen, total phosphorus and chlorophyll *a* (found in Phytoplankton). Triggers were exceeded at all lake water monitoring sites (see Table 5).

A review of monitoring data from the Mid Lake monitoring site from 1997-98 (Monthly monitoring of Total Nitrogen (needed for TLI_3 calculation) started in October 1996)) (see Figure 26), illustrates that it is not possible to attribute any change resulting from CPWL related activities on Mid Lake TLI_3 trigger level exceedances.

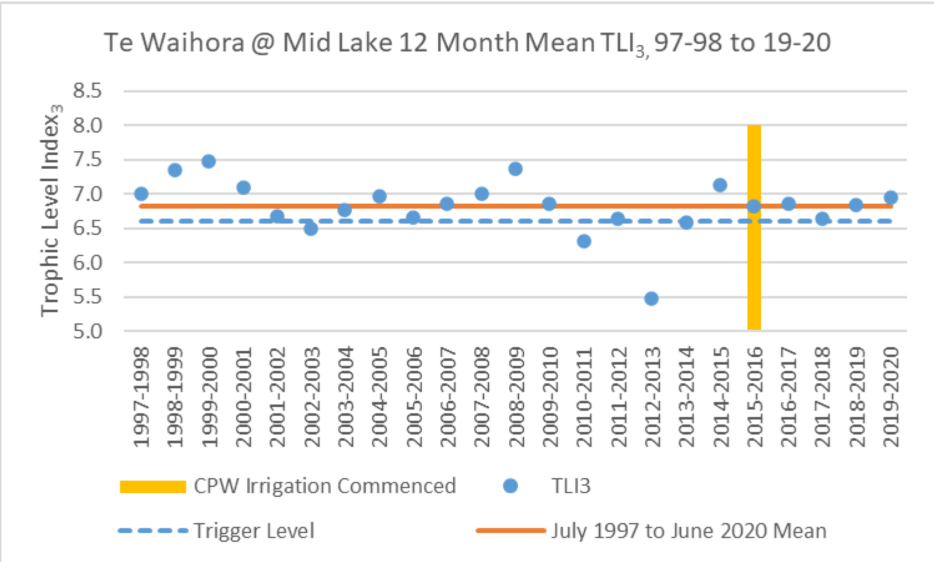


Figure 26. Trophic Level Index$_3$ at Mid Lake in Te Waihora from 1997 – 2020

A review of monitoring data from the three Lake Margin sites from 1997-98 (refer to Figure 27), that have trigger levels, also suggests that it is not possible to attribute any change resulting from CPWL related activities on Lake Margin TLI_3 trigger level exceedances.

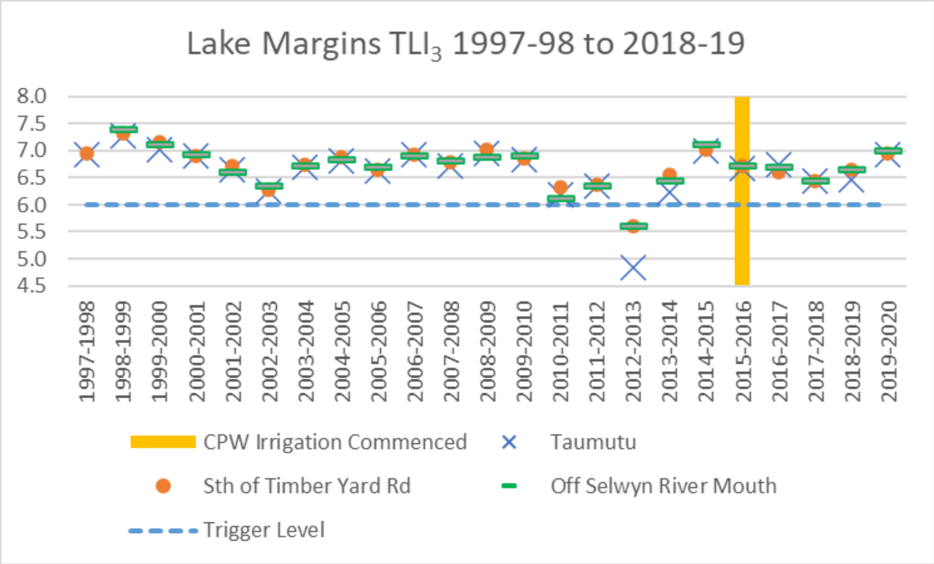


Figure 27. Trophic Level Index$_3$ at Lake Margins in Te Waihora from 1997 – 2020

Since 1997-98, the Total Nitrogen 12-month mean for the Mid Lake site has only exceeded the 3.4mg L^{-1} trigger limit on two occasions, 1999-2000 and 2000-2001 (refer to Figure 28).

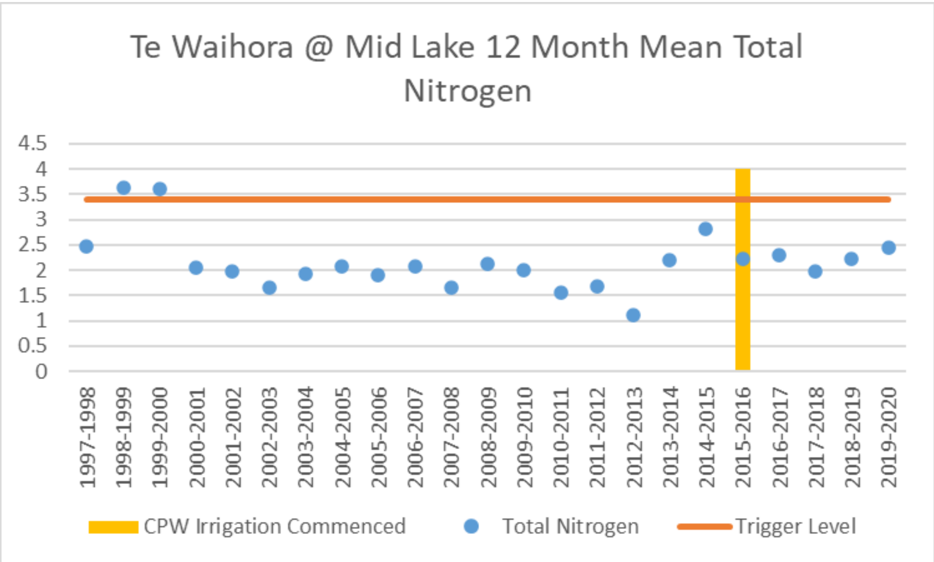


Figure 28. Total Nitrogen at Mid Lake in Te Waihora from 1997 – 2019

The discharge of phosphate laden sediment to surface waters is not a significant issue for CPWL farms when compared to farms in the lowland areas surrounding Lake Ellesmere/Te Waihora. The discharge of Nitrogen is a more significant issue for (but not exclusive to), CPWL Scheme farms. It is noted that whilst the lake Trophic Level Index was exceeded, the trigger level for total Nitrogen concentration was not (see Table 5).

4.3. Groundwater Quality

CPWL have trigger levels in place for *E. coli* and Nitrate-N (Table 6). Since water has now been supplied to the Stage 1 area for 5 seasons, an assessment against the Nitrate-N trigger level can now be made for the Stage 1 bores the intercept shallow (<50m below ground level) groundwater. Assessment against the Nitrate-N trigger cannot be made until December 2022 for the Sheffield Scheme and December 2024 for Stage 2.

Table 6. Groundwater Quality Trigger Levels

Contaminant	Measurement	Trigger
Nitrate-Nitrogen	5-year annual average concentration[a]	7.65 mg/L
E.coli	Median concentration[b]	<1 organism/100 millilitres

(a) In shallow groundwater <50 metres below groundwater level

(b) Measured over the length of record

There are however several CPWL monitoring bores across both Stage 1 and Stage 2 where Nitrate-N concentrations have been found to be consistently greater than 7.65mg/L (refer to Tables 7 and 10 and Figures 9, 33 and 44).

4.3.1. Stage 1

E. coli

During routine monitoring within the operational Stage 1 area of the Scheme during 2019-20, *E. coli* was detected from three bores occasions on a single occasion each (9.4% of samples [2018-19 – 9.4% of samples]). This however did not result in the trigger level being exceeded.

Occasional occurrences of *E. coli* in groundwater bores are not uncommon particularly during wet weather sampling. ECan's annual regional groundwater surveys from 2009 to 2019 detected *E. coli* in 3.7% to 14% of bores [Spring 2019 = 6%, Spring 2018 = 11%]. There is also the possibility that positive *E. coli* readings may result from the sample collection and handling procedures.

Rainfall data for up to a week preceding positive detections of *E. coli* are shown in Table 7. References made regarding rainfall associated with Stage 1 monitoring refers to ECan's Ridgen Road Monitoring site.

Table 7. Rainfall[A] associated with bore water samples that had positive detections of *E. coli*

Bore	Sample Date	Site Condition	E. coli (MPN/100ml)	Rainfall (mm)			
				Sample Day	Previous 24hrs	Previous 48hrs	Previous week
BX21/0018	5/09/2019	No Stock or manure	3	0.5	12	12	12
BX22/0043	9/09/2019	No Stock or manure	1	0*	0	0	13
BX22/0044	11/09/2019	No Stock or manure	1	0	0	0	13

[A] Rainfall from ECan's Ridgen's Road monitoring site.
* Few spots of rain during sampling

When groundwater *E. coli* trigger levels are exceeded, CPWL works through a response flowchart as per Figure 51 of this report. Instances where *E. coli* concentrations are found at a similar or lower level, to those recorded prior to commencement of CPWL irrigation, are considered to reflect baseline groundwater quality, and as such no further action is generally taken at the time. Likewise, retesting is not generally undertaken when an *E. coli* concentration of < 10MPN/100ml is detected as when retesting has occurred under this circumstance, 60% of the time *E. coli* is not detected.

Table 7 shows that 12-13mm of rain fell in the seven days preceding the positive *E. coli* detections made in September 2019.

There was a strong air discharge from Bore BX21/0018 during monitoring, with pumped water initially being quite turbid. No other factors were readily apparent from BX21/0018, BX22/0043 and BX22/0044 that may explain the *E. coli* detection. There are no potable water bores within several hundred meters of BX21/0018 and BX22/0043. Potable water for the dwelling located adjacent to BX22/0044 is sourced from a 62 metre deep bore. BX22/0044 had static water levels of between 5-7mbgl at the times of monitoring for 2019-20.

Nitrate-Nitrogen

Five year Annual Means >7.65mg/L

The five-year annual mean trigger level (7.65mg L^{-1}) was exceeded for three of the eight Stage 1 monitoring bores (Refer to Table 8).

Table 8. Stage 1 Nitrate-N trigger level exceedance bores

Bore	Nitrate-N (mg L^{-1})
BX21_0017	12.2
BX22_0053	9.1
BX22_0046	15.5

BX21/0017 is located south of Hororata township, and BX22_0053 and BX22_0046 are located at the eastern extent of Stage 1 (refer to Figure 10).

This is the first report that can assess monitoring results against the 5-year annual mean Nitrate-N trigger level, so a more detailed analysis is useful to identify any potential effects of CPWL supplied irrigation.

The annual (12-month) data that contributed to the five-year annual mean is displayed in Figure 29

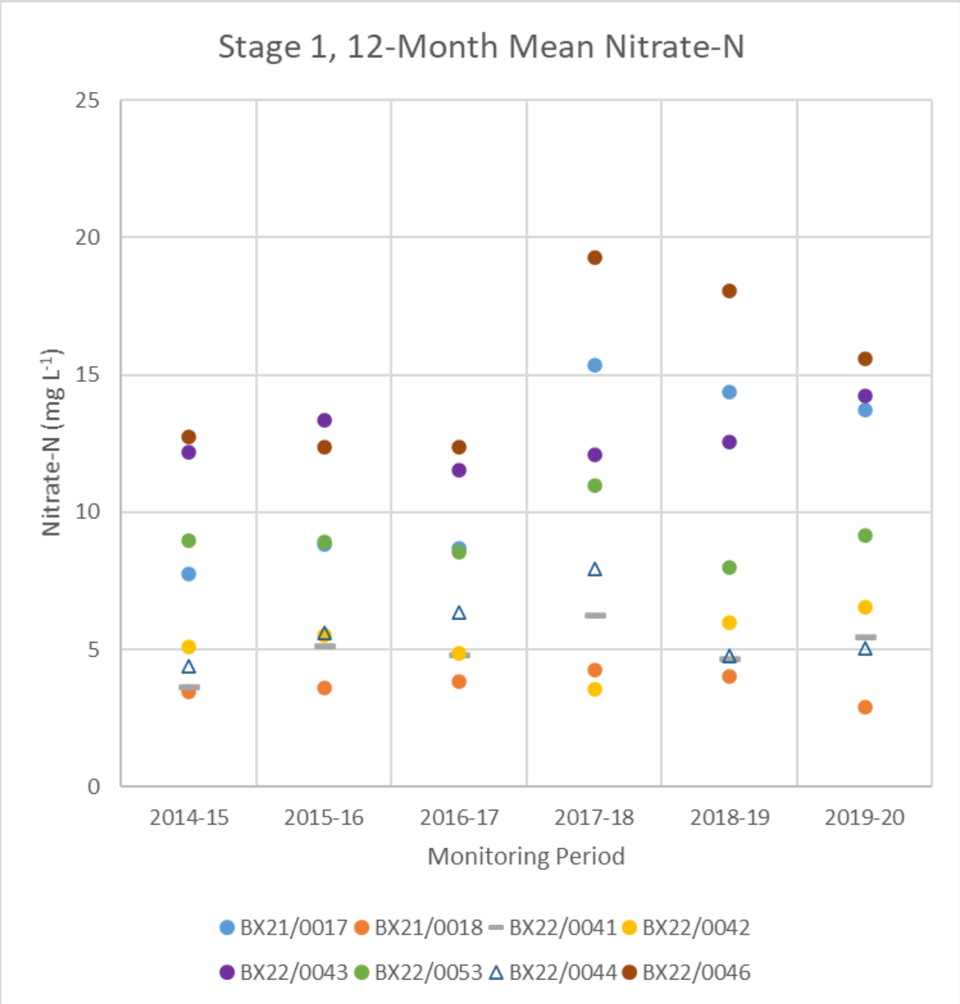


Figure 29. Stage 1 - 12-month Mean Nitrate-N
* Data from 2014-15 was collected prior to commencement of CPW Irrigation and is included here for comparative purposes.

Four Stage 1 bores had a mean Nitrate-N concentration for the 2019-20 monitoring period greater than 7.65mg/L, namely BX21/0017, BX22/0043, BX22/0053 and BX22/0046 (see blue shaded columns in Table 9, and Figure 29). Note that the trigger levels only apply to groundwater less than 50 m below ground level (Table 6). To date the static water levels encountered during water sampling at BX22/0043 have been greater than 54m below ground level, so despite having a five-year annual average of 12.8mg L^{-1} this does not constituent a trigger level exceedance. These four bores have also had mean Nitrate-N concentrations greater than 7.65mg/L for the four previous 12-month monitoring periods and for the 2014-15 period which is prior to the commencement of CPWL supplied irrigation.

However, none of the trends were statistically significant. CPWL concludes that exceedance of the trigger level for Stage 1 bores is generally consistent with what is expected based on the combined effects of historic pre-CPW land use, namely time lagged effects still coming from that pre-CPW land use, and the consented new activities under CPW that will also be contributing to water quality. For the 2019-20 season, Stage 1 shareholders were 24% below their total nitrogen discharge allowance.

Bores BX22/0042 and BX22/0043 showed the highest annual mean Nitrate-N concentrations to date in 2019-2020. All other Stage 1 bores showed the highest annual mean Nitrate-N concentrations measured so far was during the 2017-18 period.

ECan's Ridgens Road Rain Gauge has data available for 1 July to 30 June periods since 2006-07. During the 2019-20 period 575.5mm of rainfall was recorded compared to 603mm for the 2018-19 period.

The 1 July to 30 June mean from 2006-7 to 2019-20 is 647mm. During the 2017-18 period, which included a significant rainfall event in July, 925mm of rainfall was recorded.

Table 9. Stage 1 Bores Nitrate-N Results (mg/L) March 2014 to June 2019

Date	BX21/0017	BX21/0018	BX22/0041	BX22/0042	BX22/0043	BX22/0053	BX22/0044	BX22/0046
Jun 2020	11.8	3.34	4.93	8.04	15.7	11.0	4.15	14.6
Mar 2020	12.6	2.63	6.11	7.45	15.2	10.2	4.30	15.1
Dec 2019	13.0	3.00	5.14	2.17	15.4	8.86	4.78	16.2
Sep 2019	17.4	2.65	5.73	8.52	10.7	6.63	6.93	16.5
Jun 2019	19.0	3.65	5.4	8.67	13.7	6.15	5.07	18.5
Mar 2019	13.6	3.55	5.36	1.12	14.6	11.2	4.51	18.3
Dec 2018	12.3	3.99	3.77	7.88	10.3	6.60	4.61	16.8
Sep 2018	12.6	4.87	4.19	6.21	11.6	7.94	4.90	18.6
Jun 2018	13.0	4.98	5.02	4.76	11.2	9.35	5.46	16.8
Mar 2018	16.7	4.04	6.97	2.42	11.2	10.7	7.19	18.9
Dec 2017	14.4	4.22	6.31	2.86	14.9	10.5	6.46	19.2
Sep 2017	17.3	3.79	6.77	4.18	11.0	13.3	12.6	22.2
Jun 2017	14.0	3.2	4.8	3.8	10.4	8.3	7.2	13.9
Mar 2017	8.8	5.4	5.5	5.2	9.4	9.7	6.3	11.8
Dec 2016	5.2	3.5	4.9	5.5	12.7	8.3	6.7	11.9
Sep 2016	6.8	3.3	4.0	5.0	13.7	7.8	5.2	11.9
Jun 2016	9.2	3.6	4.5	5.4	13.0	9.0	5.9	12.2
Mar 2016	8.5	4.4	6.7	5.7	13.0	9.8	5.0	12.3
Dec 2015	9.1	3.5	5.3	6.1	13.1	8.5	5.6	12.4
Sep 2015	8.5	2.9	4.1	4.9	14.3	8.3	6.0	12.5
Jun 2015	5.9	3.2	2.7	5.2	14.6	10.5	4.5	12.6
Mar 2015	7.1	4.0	3.1	3.5	10.9	11.0	4.6	12.8
Dec 2014	7.9	3.6	4.9	6.2	13.0	8.0	3.9	12.4
Sep 2014	10.2	3.1	3.9	5.5	10.2	6.3	4.5	13.2
Jun 2014	11.2	4.3	4.6	5.7	9.9	-	7.4	14.4
Mar 2014	7.8	-	4.3	5.3	13.6	-	4.1	12.9
2019-20 Mean	13.7	2.9	5.5	6.5	14.3	9.2	5.0	15.6
2018-19 Mean	14.4	4.0	4.7	6.0	12.6	8.0	4.8	18.1
2017-18 Mean	15.4	4.3	6.3	3.6	12.1	11.0	7.9	19.3
2016-17 Mean	8.7	3.9	4.8	4.9	11.6	8.5	6.4	12.4
2015-16 Mean	8.8	3.6	5.2	5.5	13.4	8.9	5.6	12.4
2014-15 Mean	7.8	3.5	3.7	5.1	12.2	9.0	4.4	12.8
5yr Annual Mean	12.2	3.7	5.3	5.3	12.8	9.1	5.9	15.5
All Data Mean	11.3	3.7	5.0	5.3	12.6	9.1	5.7	15.0
Screened Interval (mbgl)	1.1 - 11.1	55.1 - 105.1	10.1 - 40.1	29.4 - 69.4	20.1 - 70.1	20.3 - 50.3	1.0 - 9.0	1.0 - 30.0
Water level range (mbgl)	6.4 - 9.9	75.3 - 93.7	18.6 - 23.8	40.1 - 49.5	50.7 - 65.2	32.9 - 46.4	4.3 - 7.6	7.1 - 14.4

Figure 30 shows the land use, and Figure 31 the irrigation type, of CPWL shareholder farmland located up-gradient of the monitoring bores that had mean annual Nitrate-N concentrations of greater than 7.65mg.

Figure 30. Shareholder Land Use Up-Gradient of the Stage 1 Elevated Nitrate-N Bores

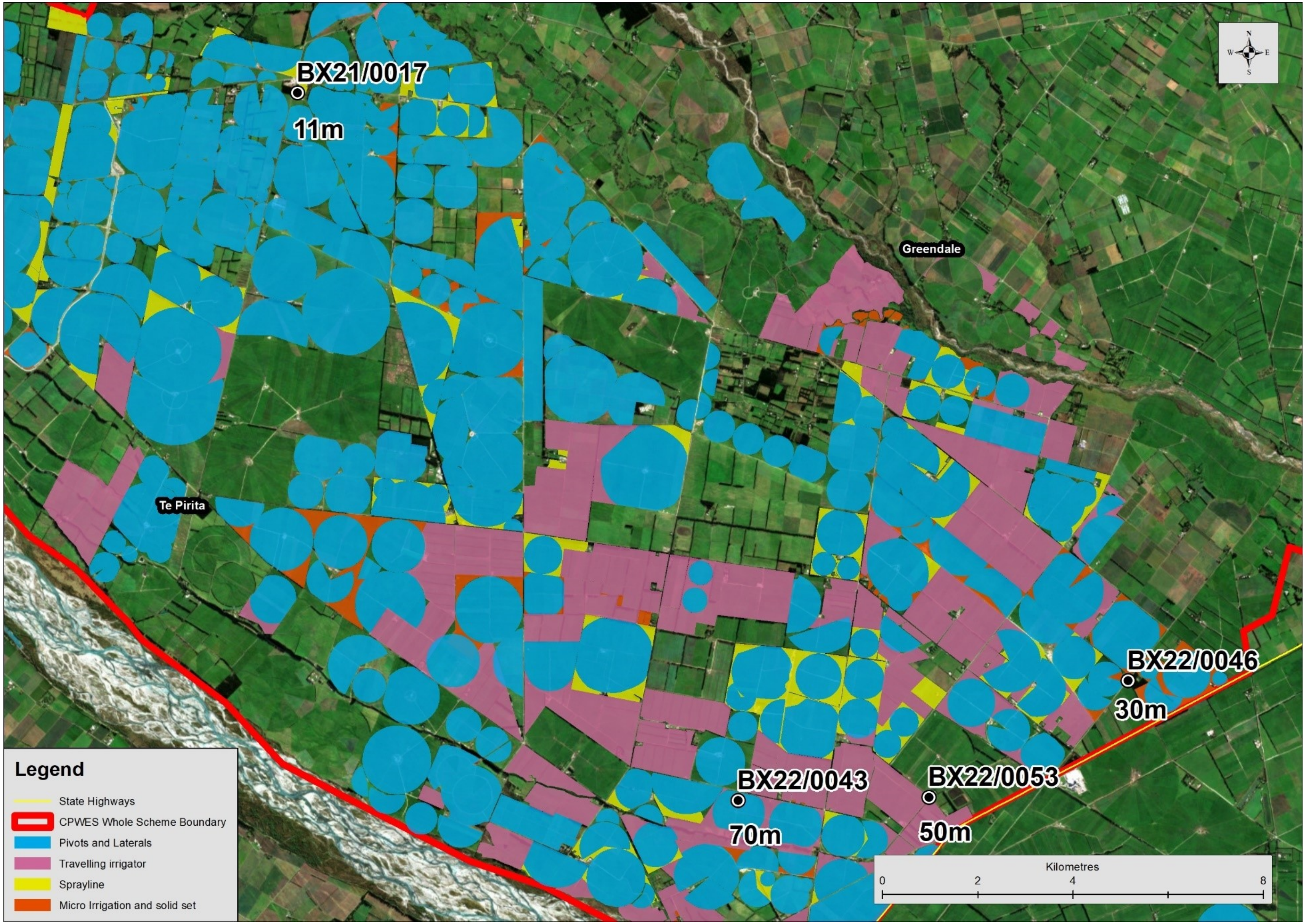


Figure 31. CPWL Shareholder Irrigation Types for Farms Up-Gradient of Stage 1 Elevated Nitrate-N Bores

Although BX22/0042 showed its greatest Mean annual Nitrate-N concentration to date in 2019-2020, its highest discrete value came during the 2018-19 period.

There is no apparent correlation between depth to water vs concentration of Nitrate-N for bore BX22/0042

While Nitrate-N concentrations from L36/2122 (82m deep, screened from 80-82m), located approximately 10m from BX22/0042 (69.4m deep, screened from 29.4-69.4m), do not show the same degree of variability as those from BX22/0042, they did appear to have been increasing from the mid 2000's until 2018 (see Figure 32).

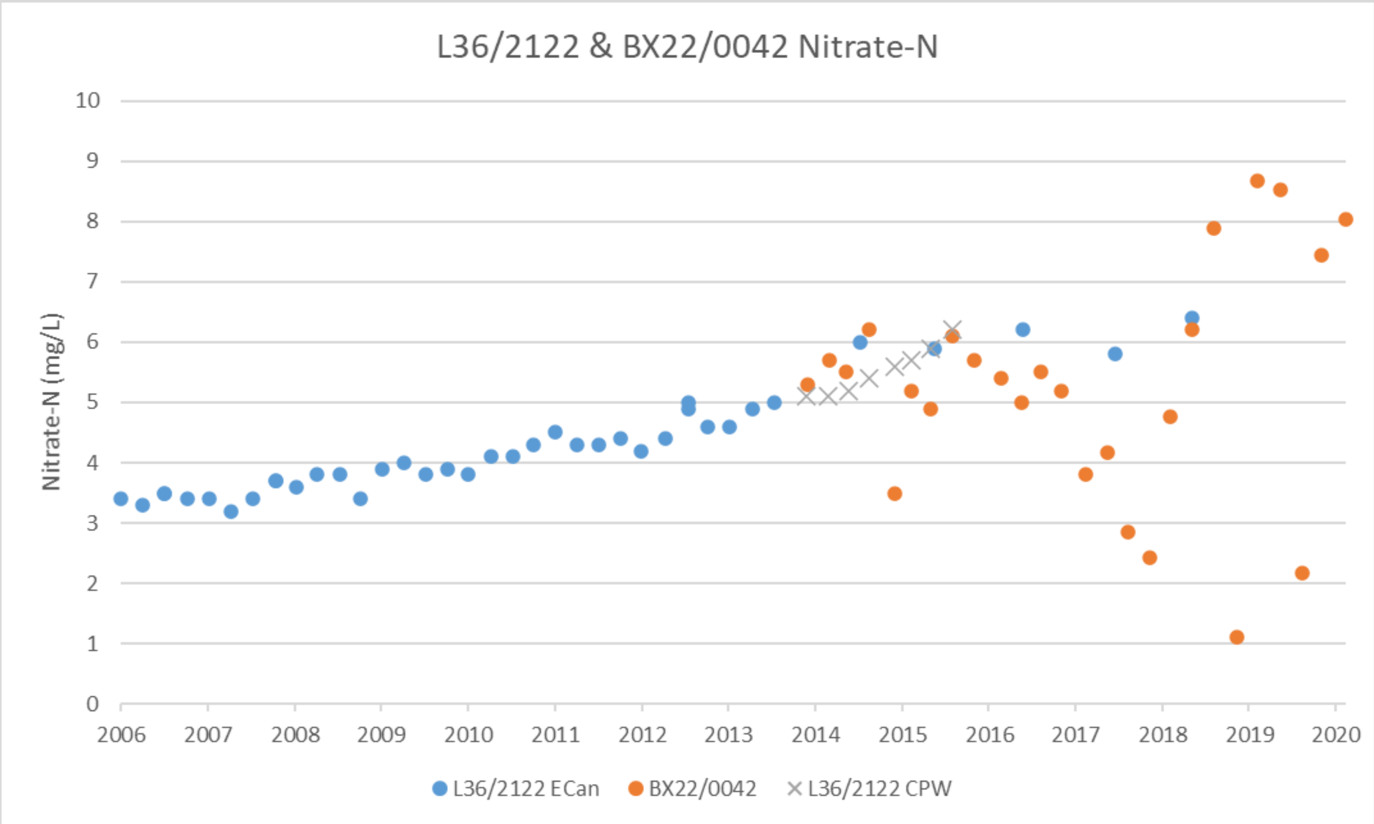


Figure 32. L36/2122 and BX22/0042 Nitrate-N Concentrations.

L36/2122 was consistently sampled by ECAN four times per year between August 2006 and June 2015. The Mann Kendall trend test confirmed an upward trend in 12-month mean Nitrate-N concentration from L36/2122 during this period that is statistically significant (P = .00026). The upward trend determined for 12-month mean Nitrate-N from BX22/0042 was however not statistically significant (P = .452). Figure 33 displays the 12-month mean Nitrate-N data from L36/2122 and BX22/0042 used in the Mann Kendall analysis.

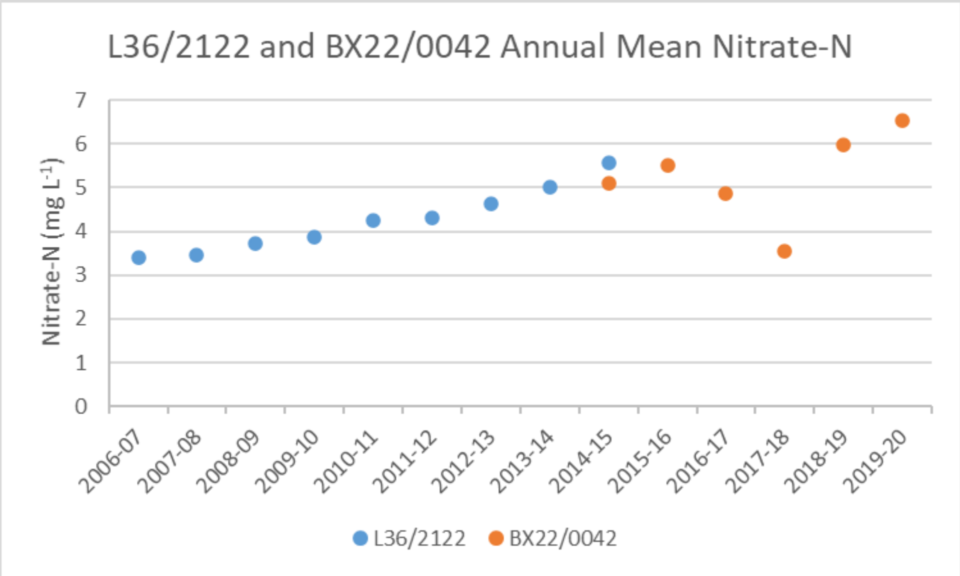


Figure 33. 12-month Mean L36/2122 and BX22/0042 Nitrate-N Concentrations.

Bores with new maximum Nitrate-N concentrations measured within the last 12 months

Discrete monthly Nitrate-N concentrations reached a new maxima during the 2019-2020 monitoring period for BX22/0043 with the highest concentration [15.7mg L^{-1}] being recorded in June 2020 (Refer to Figure 34). Nitrate-N concentrations from December 2019 [15.4mg L^{-1}] and March 2020 [15.2mg L^{-1}] are the second and third highest recorded to date from BX22/0043.

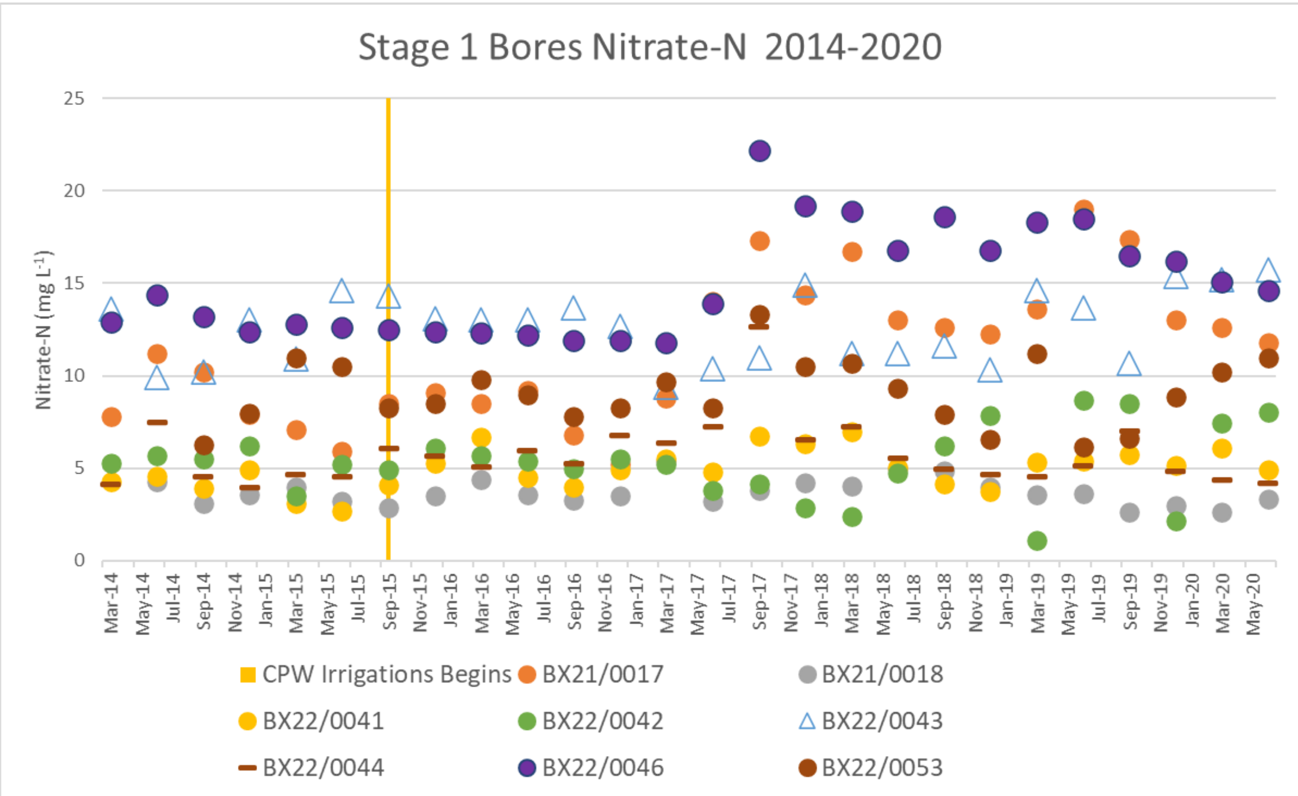


Figure 34. Stage 1 Groundwater Nitrate-N; March 2014 to June 2020

There was pooled water observed in a low spot in a paddock within 20m of BX22/0043 at the time of sampling on 10 June 2020. 12mm of rain was recorded at the Ridgens Road rain gauge over the 4-6 June 2020 period. The bore is located under the path of a centre pivot irrigator that was observed operating downgradient of (but heading towards) the bore at the time of sampling on 10-03-2020. 11.5mm of rain was recorded on 10-03-2020 with a further 2mm each on 3 and 4-03-2020. There was no rain recorded on the day or, or seven days prior to, sampling on 11-12-2019 and it appeared that pasture in paddocks adjacent to the bore had been recently cut and left to dry possibly to be turned into hay.

A comparison of static water level vs Nitrate-N at BX22/0043 (Refer to Figures 35 and 36) shows no strong correlation. The farm was sold in May 2017 and was converted from a Dairy support to a Dairy Farm.

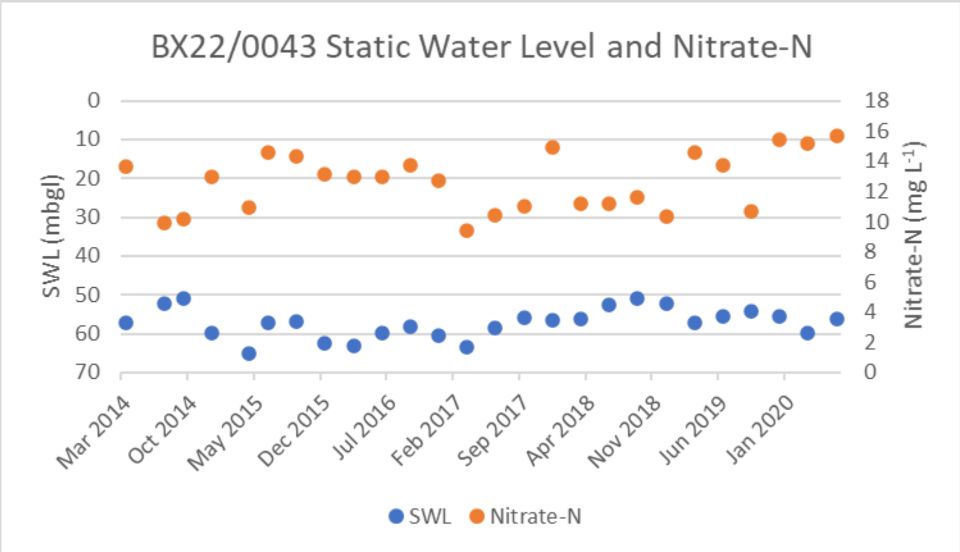


Figure 35. BX22/0043 Nitrate-N and Static Water Level

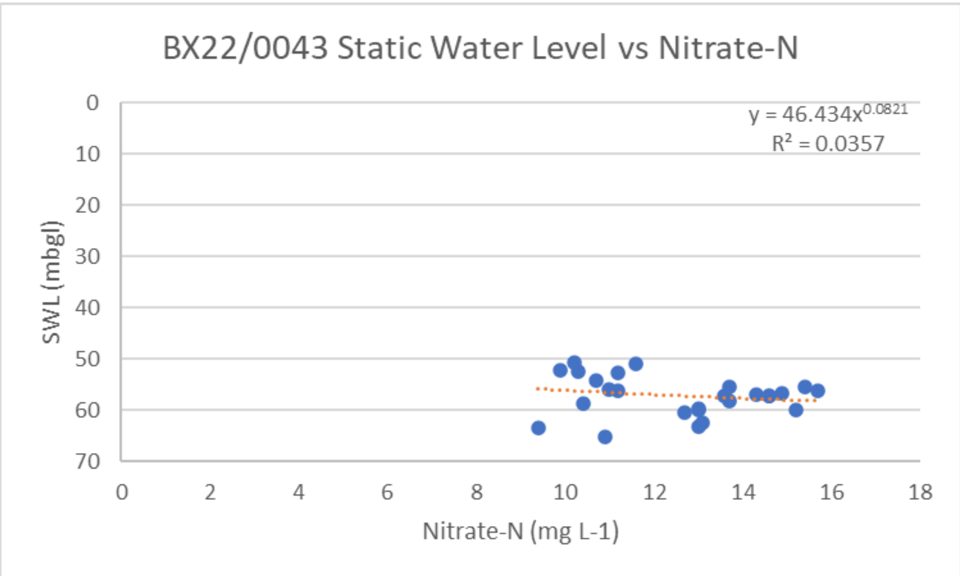


Figure 36. BX22/0043 Nitrate-N vs Static Water Level

Table 3 from the CPWL's Baseline Water Quality assessment (Part 1 of the Ground and Surface Water Plan) contains a summary of ECAN monitoring data (to June 2013), which showed Nitrate-N levels have been recorded as high as 36.9mg/L.

It is noted that discrete Nitrate-N concentrations measured from bores BX21/0017 and BX22/0042 were lower in 2019-20, compared to 2018-19 which at that time, showed their highest discrete concentration to date.

For comparison, three out of 10 Stage 2 monitoring bores showed new maximum discrete Nitrate-N concentrations during the 2019-20 monitoring period.

4.3.2. Sheffield

E. coli

E. coli was not found above the detection limit in the Sheffield Scheme Monitoring bores, BW22/0041 and BW22/0042 during the monitoring period. This was also the case during the 2018-19 monitoring period.

Nitrate-Nitrogen

Nitrate-N levels measured in the two Sheffield monitoring bores between September 2019 and June 2020 were within the ranges previously measured (before such time as the Sheffield Scheme was operating) (refer to Figure 37). Annual Median Nitrate-N concentrations were 5.5mg L^{-1} for BW22/0041 and 7.5mg L^{-1} for BW22/0042.

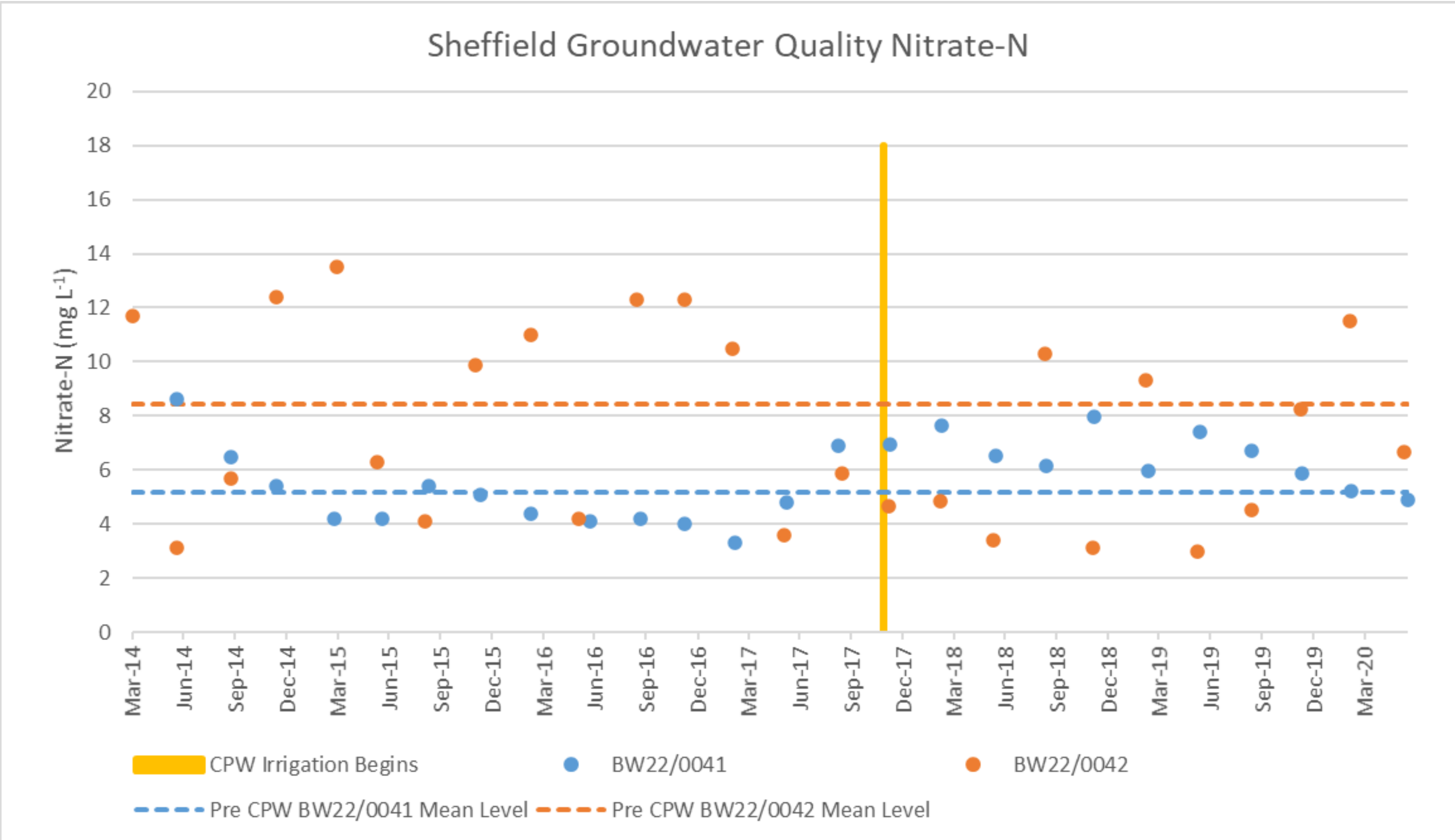


Figure 37. Nitrate-N Concentrations in CPWLs Sheffield Monitoring Bores

4.3.3. Stage 2

E. coli

CPWL commenced supplying irrigation water to the Stage 2 area during October 2018. This has meant assessment against *E. coli* trigger levels (a median of <1 organism per 100ml over the length of record) can now be made. However, as the 'length of record', post commencement of CPWL supplied irrigation only stands at less than two years' worth of monitoring results (n=7), any exceedance of trigger level should be considered with caution.

BX22/0065 returned positive *E. coli* detections in December 2019 and March 2020. This bore has tested positive for *E. coli* on four out of seven occasions during routine monitoring post commencement of CPWL irrigation supply and has therefore exceeded the trigger level.

BX22/0067 returned positive *E. coli* detections in December 2019, and March and June 2020. This bore has tested positive for *E. coli* on five out of seven occasions during routine monitoring post commencement of CPWL irrigation supply, and so has therefore exceeded the trigger level.

Both BX22/0065 and BX22/0067 had a history of *E. coli* detections before receiving CPWL water (refer to Table 10).

Table 10. Bores BX22/0067 and BX22/0065 *E. coli* Results (MPN/100ml) Prior to CPWL Irrigation

Sample Date	BX22/0067 E. coli (MPN/100ml)	Sample Date	BX22/0065 E. coli (MPN/100ml)
12/09/2018	<1	6/09/2018	<1
14/06/2018	16	5/06/2018	<1
-	-	14/3/2018	1
13/03/2018	<1	2/03/2018	4
12/12/2017	2	-	-
5/12/2017	29	7/12/2017	12
12/09/2017	<1	12/09/2017	<1
13/06/2017	0	6/06/2017	0
8/03/2017	78	1/03/2017	0
10/01/2017	34	10/01/2017	0
13/12/2016	>201	6/12/2016	3
14/09/2016	0	7/09/2016	0
22/06/2016	2	2/06/2016	0
10/03/2016	5	02/03/2016	0
10/12/2015	>201	10/12/2015	12
8/09/2015	0	7/09/2015	0
18/06/2015	0	16/06/2015	0

Prior to the start of CPWL irrigation, BX22/0065 tested positive for *E. coli* on 4 out of 14 occasions, while BX22/0067 tested positive for *E. coli* on 7 out of 14 occasions. For BX22/0067, this means the trigger level was exceeded for the period before Stage 2 Irrigation commenced.

The detection of *E. coli* continues to occur at a higher frequency in bores from Stage 2 bore compared to Stage 1. For the 2019-20 monitoring period, *E. coli* was detected in 22.5% of routine Stage 2 samples compared to 9.4% for Stage 1 [2018-19 - 25% for Stage 2 compared to 9.4% for Stage 1].

Rainfall data for up to a week preceding positive detections of *E. coli* are shown in Table 11. References made regarding rainfall associated with Stage 2 monitoring refers to ECan's Ridgen Road Monitoring site.

Table 11. Rainfall[A] associated with bore water samples that had positive detections of *E. coli*.

Bore	Sample Date	Site Condition	E. coli (MPN/100ml)	Rainfall (mm)			
				Sample Day	Previous 24hrs	Previous 48hrs	Previous week
BX22/0070	5/09/2019	No stock, old dung	62	0.5	12	12	12
	9/09/2019	Recent cattle and dung	<1	0	0	0	13
BX22/0065	9/12/2019	No stock or dung, irrigation 200m upgradient	21	0	0	0	0.5
	12/12/2019		1	0	0	0	0
BX22/0067	12/12/2019	Stock and dung 10m upgradient of bore	>200	0	0	0	0
	16/12/2019	Stock and dung around bore	>200	0	0	0	0
BX22/0065	3/03/2020	No stock or dung, loud running water audible from bore, irrigation operating <50m upgradient, leak in irrigation pipe ~200m upgradient	89	2	0	0	2.5
	12/03/2020	No sound of running water	>200	0	2.5	11.5	14
BX22/0067	6/03/2020	No stock, no dung, irrigator operating >400m away, effluent spreader has passed within 20m of bore	170	0	0	2	6.5
	12/03/2020	No stock, no dung	15	0	2.5	11.5	14
BX23/0423	9/03/2020	Sheep in paddock, no dung near bore	2	0	0	0	4
BX22/0068	11/06/2020	No stock, old dung	3	0	0	0	12
BX22/0067	11/06/2020	No stock, no dung	1	0	0	0	12
BX23/0424	11/06/2020	No stock, old dung	16	0	0	0	12
	16/06/2020	No stock, old dung	1	0	0	0	0

[A] Rainfall from ECan's Ridgens Road Monitoring Site.

During 2019-20 the presence of rainfall does not appear to be a consistent factor in positive *E. coli* detections from Stage 2 bores. On eight out of nine occasions where *E. coli* was detected during routine monitoring there was a maximum of 2mm of rainfall recorded at the Ridgens Road Monitoring site on either the day of, or two days prior to, groundwater sampling taking place. Between 0 and 12mm rain was recorded in the week prior to all nine positive detections of *E. coli*.

Other than bores BX22/0065 and BX22/0067, no other Stage 2 bore had more than a single positive detection from routine monitoring during 2019-2020.

There was no rainfall recorded on the day of, or during the week before, an *E. coli* concentration of greater than 200MPN/100ml was detected from a routine sample taken on 12/12/2019, and from a retest sample taken on 16/12/2019 from BX22/0067.

Table 11 details some on-site conditions that may have contributed to the positive *E. coli* detections for BX22/0067 in March 2020.

There does not appear to be a relationship between *E. coli* concentration and either Nitrate-N concentration or Static Water level at BX22/0067 (refer to figures 38 and 39). NB: concentrations of *E. coli* at >200MPN/100ml have been plotted at 200MPN/100ml.

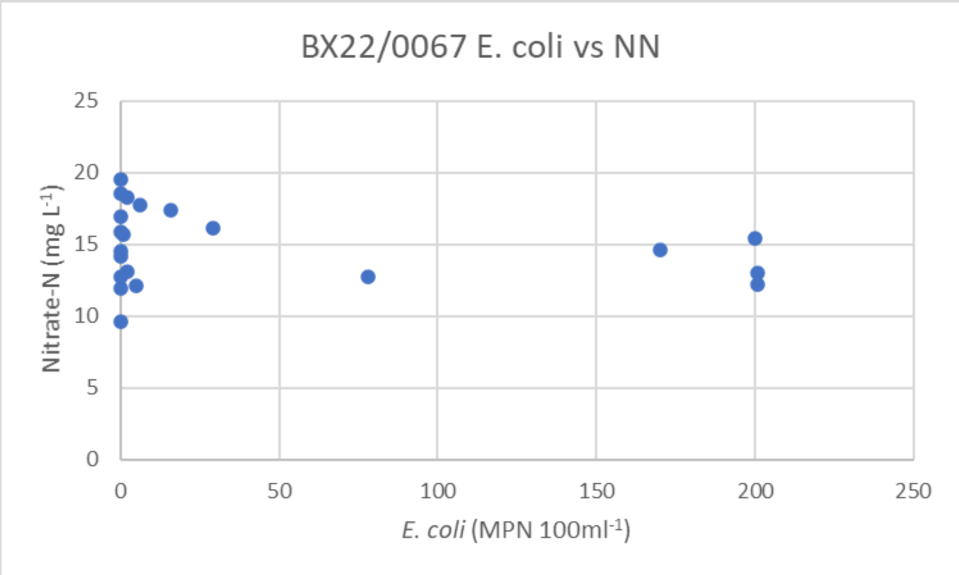


Figure 38. BX22/0067 *E. coli* vs Nitrate-N

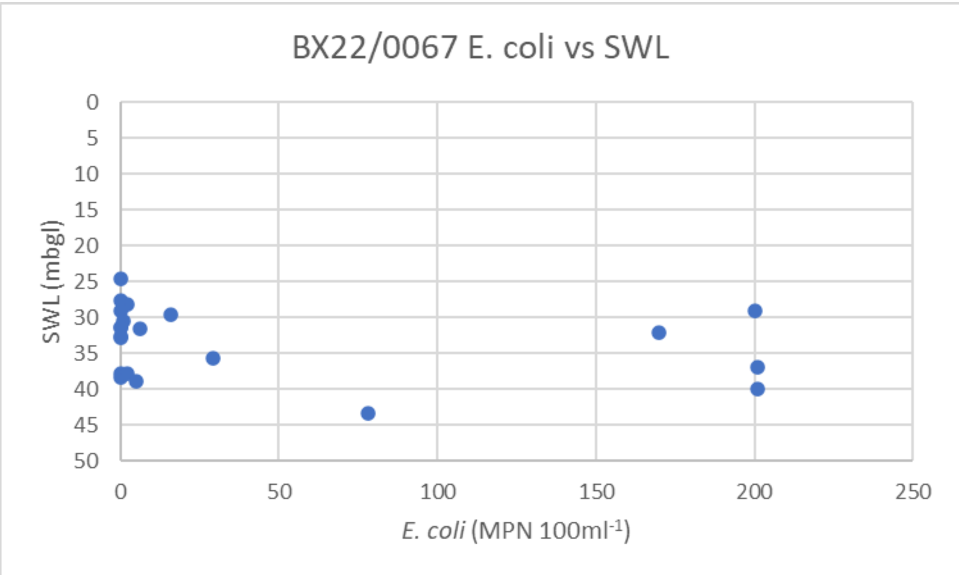


Figure 39. BX22/0067 *E. coli* vs Static Water Level (SWL)

There was no rainfall recorded on the day of, and only 0.5mm recorded during the week before, an *E. coli* concentration of 21MPN/100ml was detected from a routine sample taken on 9/12/2019 from BX22/0065. BX22/0065 was retested on 16/12/2019 and the concentration of *E. coli* was 1MPN/100ml. There was no rain on the day of, or week before, the retest.

E. coli was detected from BX22/0065 on 3/3/2020 at a concentration of 89MPN/100ml. Two millimetres of rainfall was recorded on the day of sampling and a further 2.5mm during the week before sampling took place. BX22/0065 was retested on 12/3/2020 and *E. coli* was detected at >200MPN/100ml. Fourteen millimetres of rainfall was recorded during the two days prior to the retest. Table 11 details some on-site conditions that may have contributed to the positive *E. coli* detections for BX22/0065 in March 2020.

There does not appear to be a relationship between *E. coli* concentration and either Nitrate-N concentration or Static Water level at BX22/0065 (refer to figures 40 and 41).

Dwellings are located within 100m of BX22/0065 and BX22/0067. However, their drinking water sources are located more than 1km and 250m away, at depths 30m and eight metres greater than the respective monitoring bores. Therefore, the positive *E. coli* detections in the monitoring bores are not considered to provide an indication of the quality of the drinking water for these dwellings.

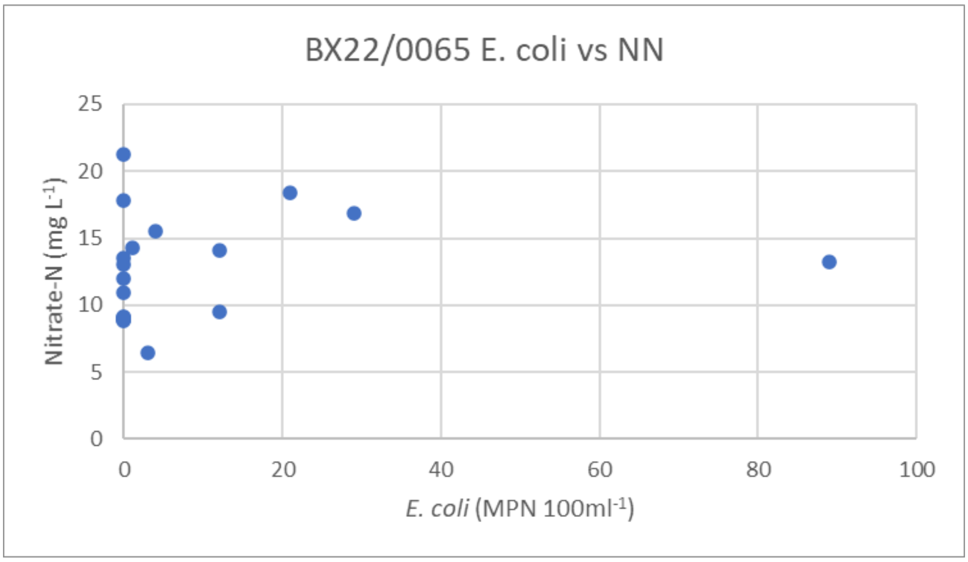


Figure 40. BX22/0065 *E. coli* vs Nitrate-N

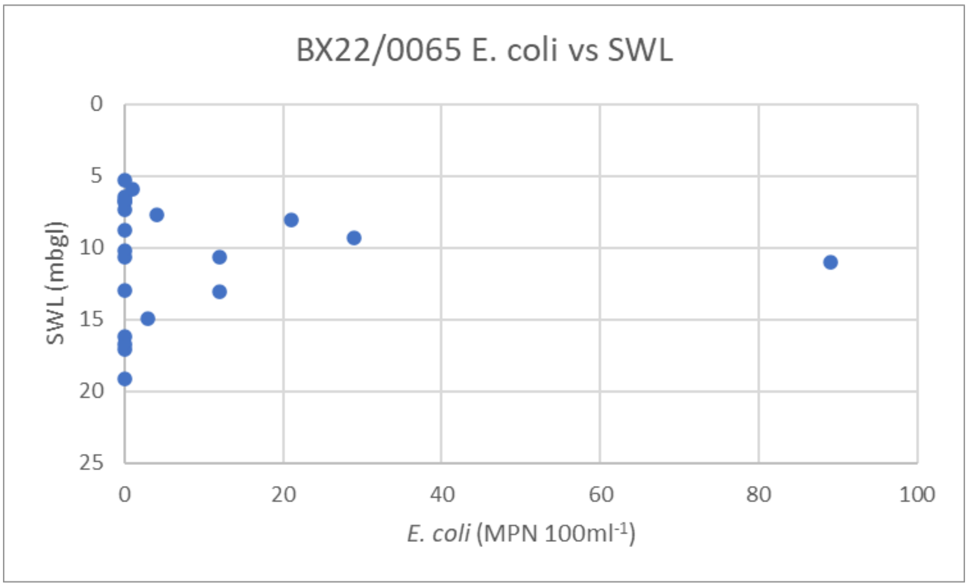
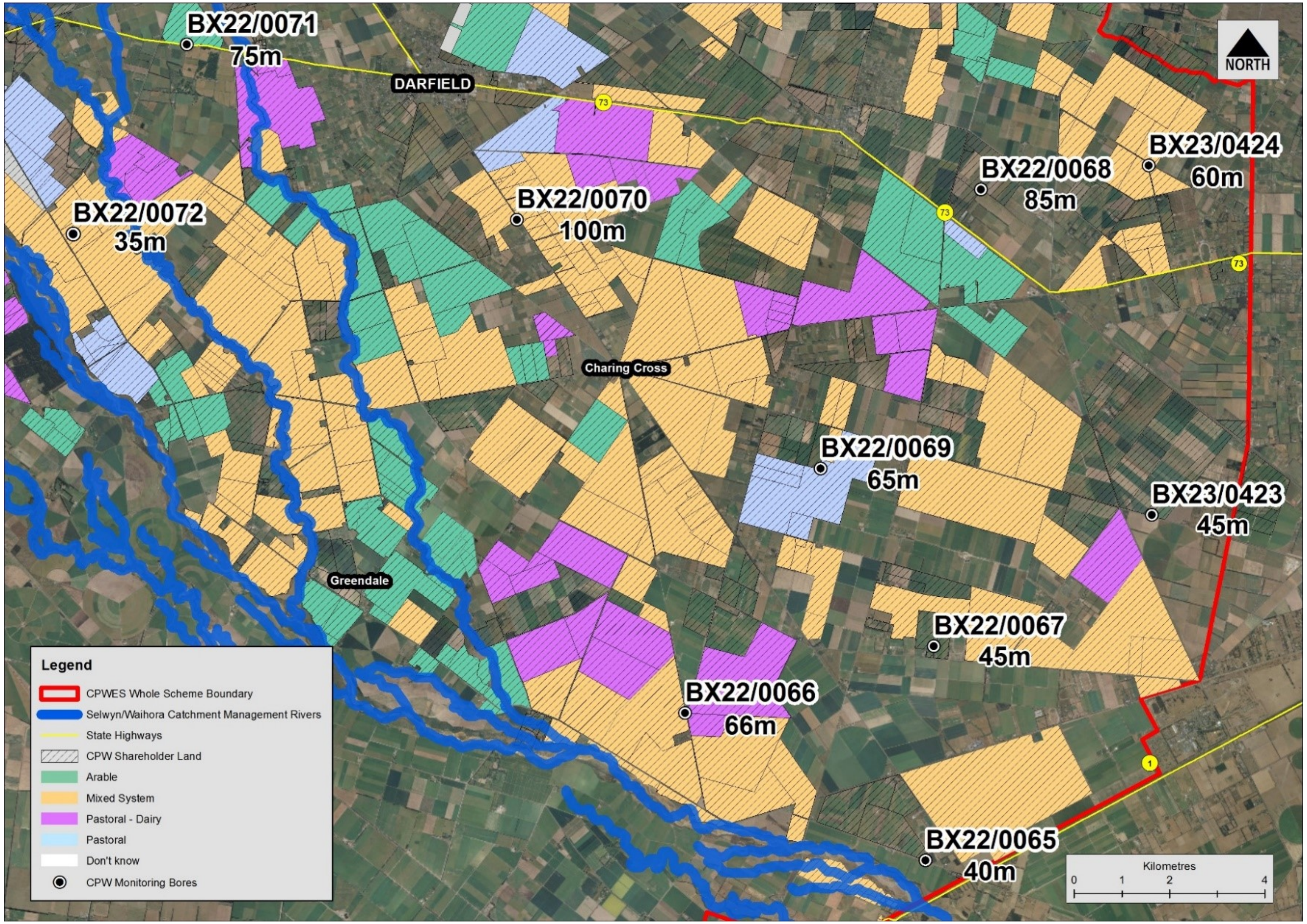


Figure 41. BX22/0065 *E. coli* vs Static Water Level (SWL)

Figures 42 and 43 display the land use and irrigation type used by farms up-gradient of the groundwater that gave samples positive for *E. coli* in 2019-20.



Data current at 2017-2018

Figure 42. Land use of Stage 2 farms located up-gradient of *E. coli* positive, and/or elevated Nitrate-N, bores.

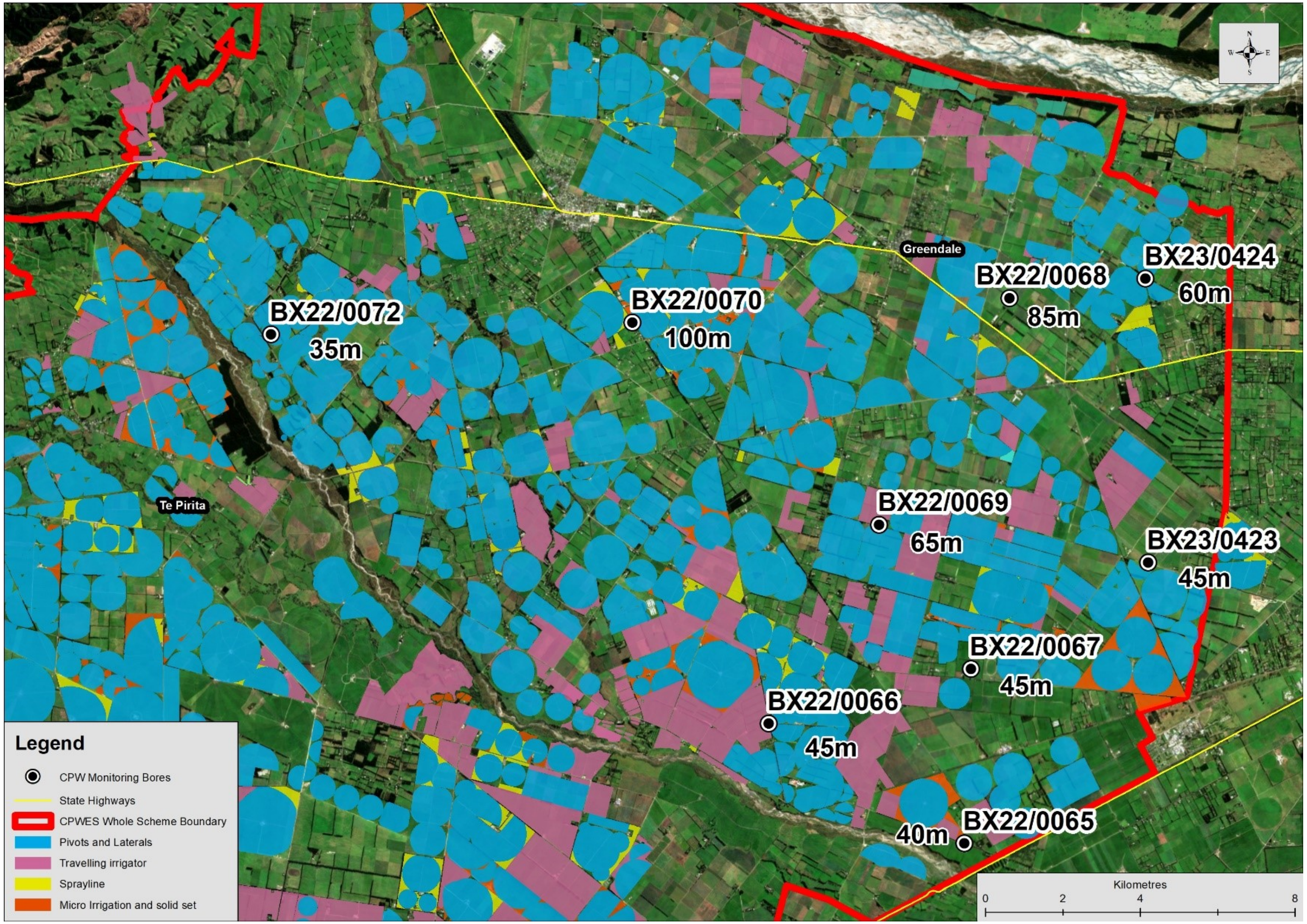


Figure 43. Irrigation status of Stage 2 farms located up-gradient of *E. coli* positive, and/or elevated Nitrate-N, bores.

Nitrate-Nitrogen

Nine of the ten Stage 2 bores had a 12-month mean Nitrate-N concentration of greater than 7.65mg/L (Refer to Table 12). With the exception of BX22/0071, whose 12-month mean Nitrate-N concentration has never exceeded 7.65mg L^{-1}, all bores have recorded a 12-month mean Nitrate-N concentration of greater than 7.65mg L^{-1} on at least one occasion prior to the commencement of CPWL irrigation.

Table 12 Stage 2 Bores Nitrate-N Results (mg/L) June 2015 to June 2020

Date	BX22/0072	BX22/0071	BX22/0070	BX22/0066	BX22/0069	BX22/0065	BX22/0067	BX22/0068	BX23/0424	BX23/0423
Jun 2020	6.12	3.36	7.65	11.2	11.4	13.0	15.7	4.81	12.4	8.97
Mar 2020	8.49	3.85	8.79	12	10.9	13.2	14.6	13	15.9	18.3
Dec 2019	13.9	3.25	8.47	9.68	13.2	18.4	15.4	14.5	14.6	13.3
Sep 2019	17.3	3.89	8.1	8.5	16.5	8.99	19.5	21.5	12.5	14.2
Jun 2019	9.3	4.96	8.30	7.92	10.3	8.87	18.3	4.26	14.9	11.1
Mar 2019	12.8	2.75	8.54	4.99	10.4	16.9	17.7	7.12	12.5	9.39
Dec 2018	13.7	2.91	8.52	4.75	10.2	14.3	15.9	9.30	11.5	19.3
Sep 2018	11.8	2.89	8.89	4.72	10.8	8.94	14.2	7.13	12.3	10.7
Jun 2018	14.6	3.40	9.47	5.21	9.76	13.5	17.4	15.7	10.7	18.2
Mar 2018	15.00	3.51	10.1	5.87	13.5	15.5	16.9	17.7	16	17.9
Dec 2017	16.6	3.34	9.48	3.88	11.7	14.1	16.1	15.7	13.1	17.5
Sep 2017	15.2	3.59	14.6	6.54	15.7	21.3	18.5	24.8	13	18.1
Jun 2017	11.3	3	7.6	3	well dry	17.8	11.9	2.8	7.5	11.2
Mar 2017	6.4	2.9	well dry	4.1	well dry	8.9	12.7	2.5	7.6	well dry
Dec 2016	7.5	3	7.7	3.9	9.7	6.4	12.2	3.3	7.8	4.4
Sep 2016	7.2	3	7.5	7.2	9.4	9.1	9.6	2.8	7.9	4.9
Jun 2016	4.6	3.6	7.6	13.1	9.6	9.1	13.1	2.9	7.9	10.3
Mar 2016	5.8	3.2	7.7	8.9	9.8	8.9	12.1	3.3	8.1	5.5
Dec 2015	7.4	2.8	7.6	6.2	10.2	9.5	13	3.5	9	9.1
Sep 2015	9.0	3.1	7.5	4.9	9.9	10.9	14.5	11.9	11	10.7
Jun 2015	4.9	3.2	7.5	10.1	9.9	12.0	12.7	2.7	11.4	13.9
2019-20 Mean	11.5	3.6	8.3	10.3	13.0	13.4	16.3	13.5	13.9	13.7
2018-19 Mean	11.9	3.4	8.6	5.6	10.4	12.3	16.5	7.0	12.8	12.6
2017-18 Mean	15.4	3.5	10.9	5.4	12.7	16.1	17.2	18.5	13.2	17.9
2016-17 Mean	8.1	3.0	7.6	4.6	9.6	10.6	11.6	2.9	7.7	6.8
2015-16 Mean	6.7	3.2	7.6	8.3	9.9	9.6	13.2	5.4	9.0	8.9
All Data Mean	10.4	3.3	8.6	7.0	11.2	12.4	14.9	9.1	11.3	12.3
Screened Interval (mbgl)	10.0 - 35.2	35.0 - 79.0	60.7 - 100.7	15.5 - 45.5	30.6 - 65.6	10.3 - 40.3	15.3 - 45.3	39.6 - 84.6	15.3 - 60.3	20.0 - 47.4
Water Level Range (mbgl)	6.7 - 21.5	46.7 - 71.0	77.3 - 99.3	15.8 - 36.4	47.7 - 63.6	5.3 - 19.1	24.6 - 43.4	58.7 - 70.2	37.3 - 53.5	24.5 - 41.8

NB: If static water levels are found to be outside of a bore's screened interval, water is sampled from a point level with the top of the screen rather than 1m below the water level. This was sometimes required for BX22/0065 and BX22/0072 during 2019-20.

The Mann Kendall trend test on five 12-month periods (2015-16 to 2019-20) showed an upward trend for Nitrate-N concentration for all ten bores but the trends were not statistically significant. Figure 44 displays the 12-month mean Nitrate-N data used in the Mann Kendall analysis.

BX22/0066, BX22/0069, BX22/0071 and BX23/0424 showed their highest 12-month mean Nitrate-N concentration measured to date in 2019-2020.

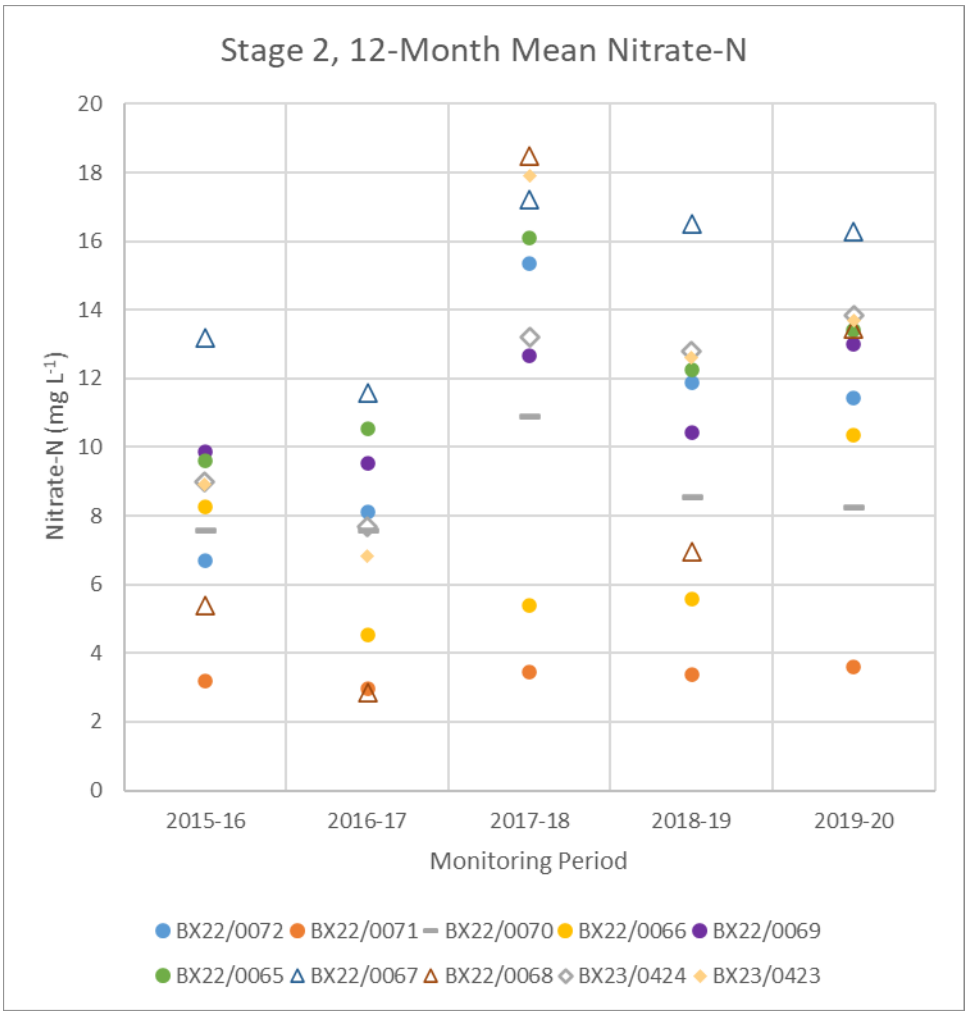


Figure 44. Stage 2 Groundwater Nitrate 12-Month Mean September 2015 to June 2020

<u>Bores with new maximum Nitrate-N concentrations measured within the last 12 months</u>

Discrete Nitrate-N concentrations from Bores BX22/0067, BX22/0069 and BX22/0072, reached new maxima during the 2019-20 monitoring period, with all three bores exhibiting the greatest concentration in September 2019, (refer to Figure 45). There is no apparent relationship between the elevated Nitrate-N readings and amount of rainfall that fallen on either the day of, and 6 days prior to, or the day of and 29 days prior to sampling taking place.

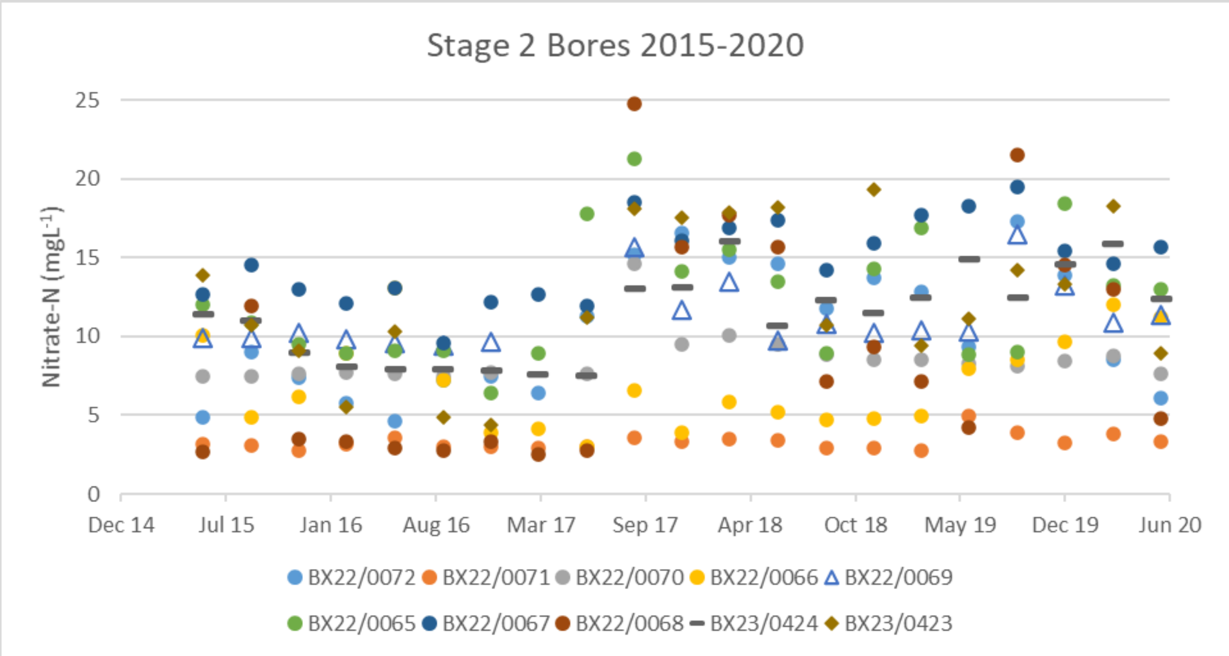


Figure 45. Stage 2 Groundwater Nitrate; June 2015 to June 2020

Overall, the same number of Stage 1 bores and two more Stage 2 bores had a mean annual Nitrate-N concentration of greater than 7.65mg/L in 2019-20 compared to 2018-19. Figure 46 displays which of CPWL's 20 monitoring bores had a 2019-20 mean Nitrate-N concentration of more than 7.65 mg L^{-1}. NB: Trigger levels for Nitrate-N in groundwater are based on a five-year annual average so cannot be assessed against the Sheffield scheme until the December 2022, and for Stage 2 until the December 2024, groundwater monitoring rounds are completed.

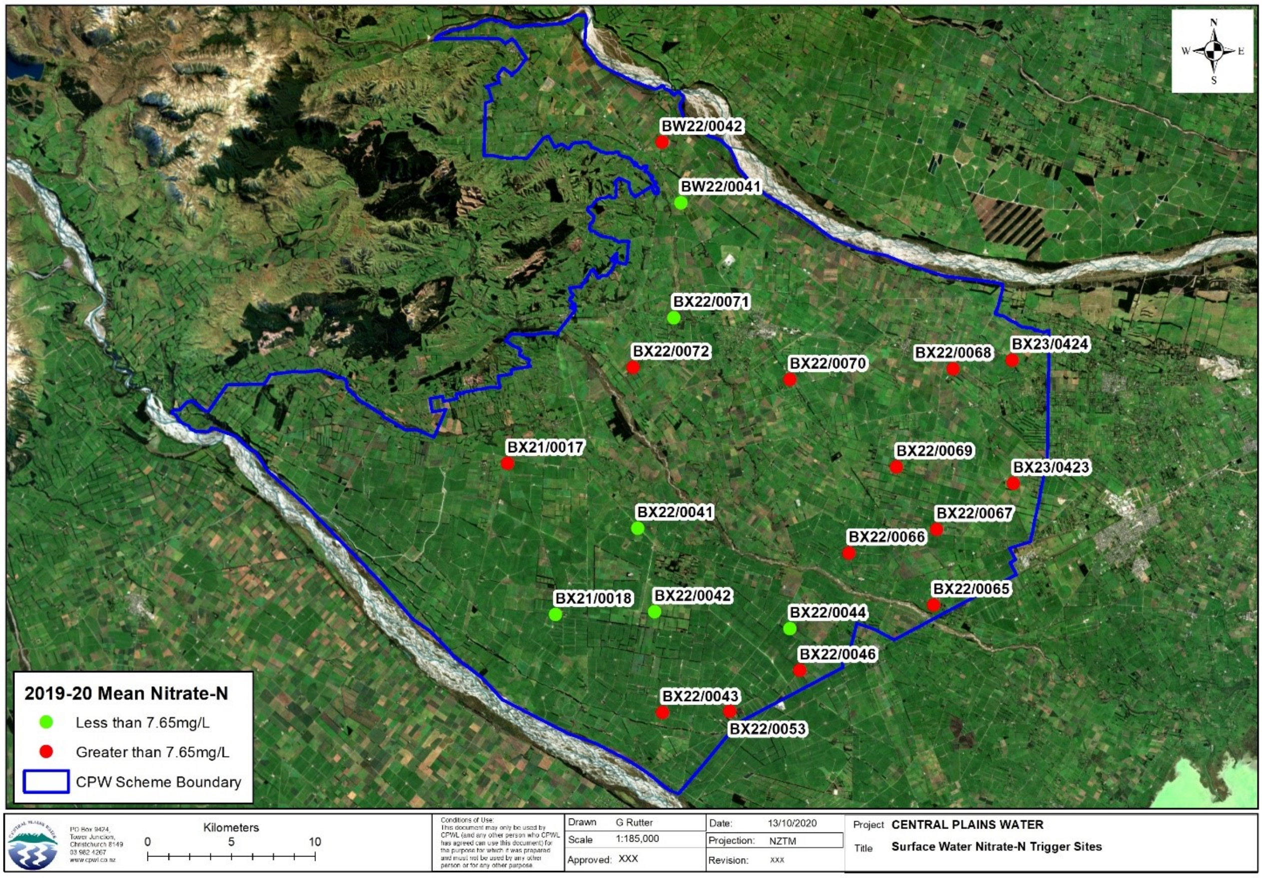


Figure 46. Groundwater monitoring bores 2019-20 Mean Nitrate-N

4.4 Lowland Groundwater Level Monitoring

The Lowland groundwater level triggers are set at the 95th percentile of the (at least 40 year) historical record.

Between July 2019 and June 2020 groundwater trigger levels were exceeded in two monitoring bores, M36/0424 and M36/7880, during the July 2019 monitoring round (refer to Figures 47 and 48). The exceedances were by very small margins, one centimetre for M36/0424 and three centimetres for M36/7880. Figure 49 shows the relationship between the static groundwater level at M36/0424 and the spring fed source of the Doyleston Drain (surface water monitoring site SF7) and Figure 50 shows the relationship between the static groundwater level at M36/7880 and the spring fed source of the Irwell River (surface water monitoring site SF4).

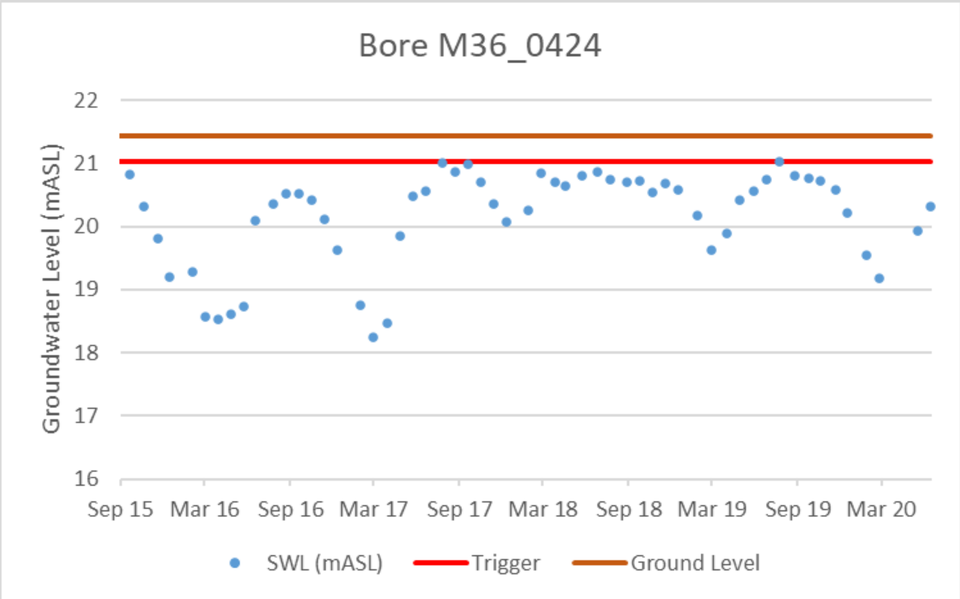


Figure 47. Lowland Monitoring Bore M36/0424 Trigger Level Exceedance

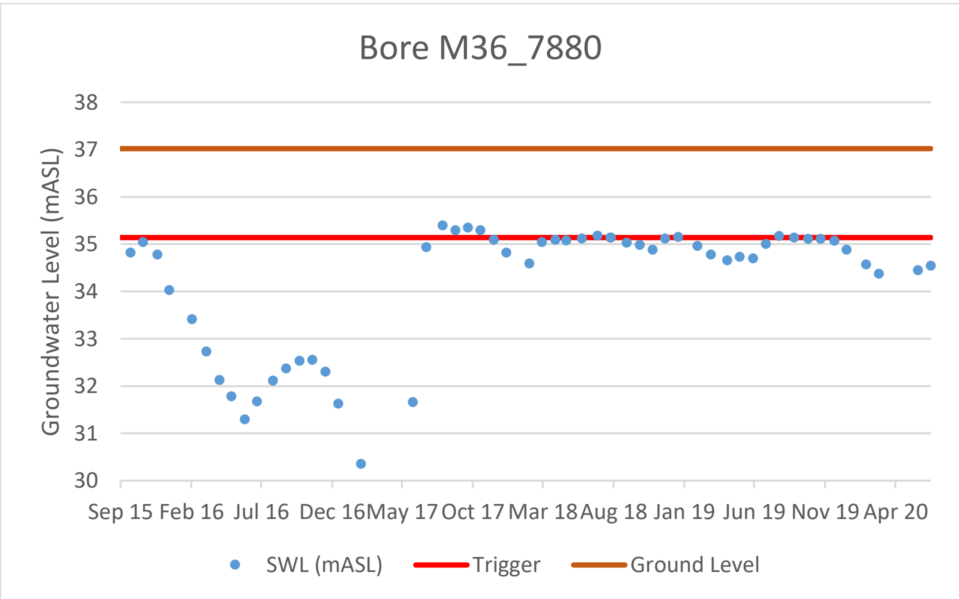


Figure 48. Lowland Monitoring Bore M36/7880 Trigger Level Exceedance

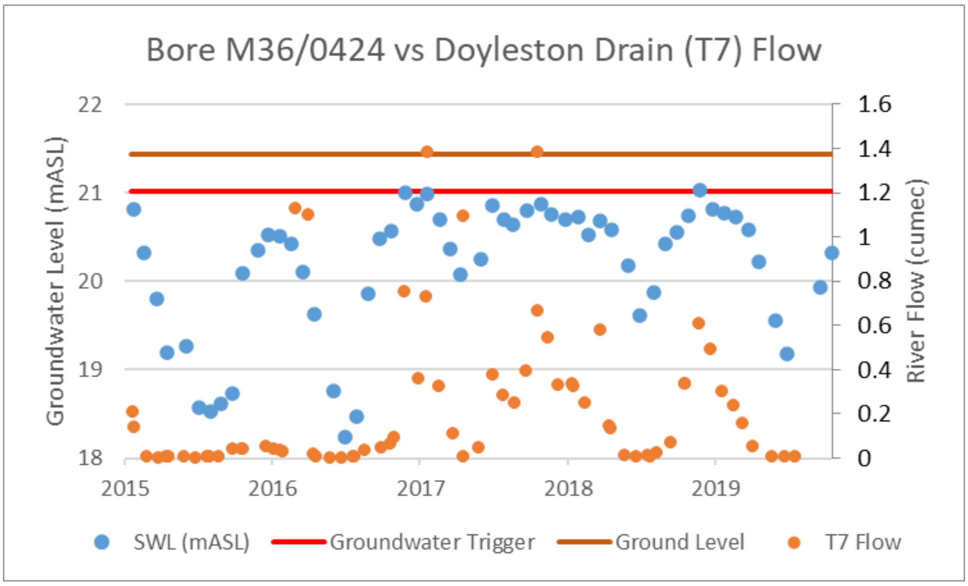


Figure 49. Lowland Monitoring Bore M36/0424 SWL vs Doyleston Drain Flow at Site SF7

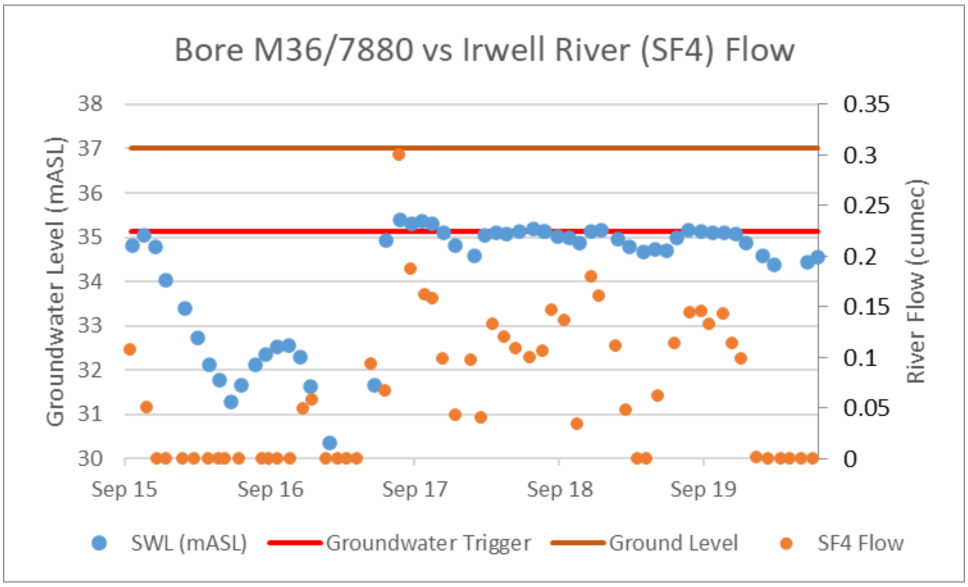


Figure 50. Lowland Monitoring Bore M36/7880 SWL vs Irwell River Flow at Site SF4

There was a single trigger level exceedance during 2018-19 and 16 trigger level exceedances from five bores during 2017-18. No trigger levels were exceeded during the 2015-16 and 2016-17 monitoring periods.

CPWL did not receive any complaints concerning regarding elevated groundwater levels, or impacts on land drainage or on-site wastewater systems, in the Lowland Plains Area.

5. Conclusion

Central Plains Water has now supplied irrigation water to the Stage one area for five seasons, to the Sheffield Scheme area for three seasons, and the Stage two area for two seasons.

Although some surface water and lake water quality trigger levels were exceeded, the levels were often found to be consistent with results from previous years (prior to the CPWL Scheme operating).

Nitrate-N Trigger levels were exceeded at ten surface water sites during 2019-20. This is an increase from six sites during the 2018-19 period but less than the eleven from 2017-18.

The 2019-20 Annual median and Annual 95th percentile Nitrate-N levels from the Selwyn River 'In-scheme', and the Harts Creek 'Spring source', sites exceeded trigger levels and were at the highest levels measured since monitoring began in 2015-16.

Annual median and annual 95th percentile Nitrate-N levels from the Selwyn River 'downstream' (Coe's Ford) site reached new maximums in 2019-20 but appears to be from a continuation of an increasing trend that has been occurring since the early 1990's.

The respective trigger level was reached on a single occasion from two lowland groundwater level monitoring bore during 2019-20. This is similar to the previous year where there was a single trigger level exceedance from one bore.

No complaints were received during 2018-19 concerning any adverse environmental effects of the Scheme on groundwater or surface water, including more specifically, impacts on land drainage, or on-site wastewater systems.

During routine monitoring *E. coli* was detected from three Stage 1 monitoring bore on a single occasion during 2019-20. *E. coli* was detected in a significantly lower number of Stage 1 bore water samples compared to Stage 2 bore samples.

For the second year running *E. coli* was not detected in either of two Sheffield monitoring bores during the monitoring period.

Nitrate-N levels measured in the Sheffield monitoring bores were found to be within ranges previously encountered before the Scheme commenced operating.

New maximum annual mean Nitrate-N concentrations were measured in two of eight Stage 1, and four of ten Stage 2, monitoring bores during 2019-20. In the absence of long-term records from dedicated long-screen monitoring bores, it is not certain whether these new measured maximum Nitrate-N concentrations represent new absolute maximum concentrations present in the environment.

The 5-year annual mean trigger for Nitrate-N was exceeded for three Stage 1 bores. Annual Nitrate-N concentrations in all three bores, have been decreasing since their peaks in 2017-18 but were still found to be at a concentration that is greater than the trigger level prior to CPWL irrigation commencing.

At the conclusion of the 2019-20 period, no statistically significant upward or downward trends in Nitrate-N concentrations can be confirmed from any groundwater bore or surface water site monitored as part of the CPWL monitoring programme.

In general the monitoring results from two years of full Scheme operation (Stage 1 has received CPWL water for five years, Sheffield three years and Stage 2 two years) are insufficient to confidently detect and attribute any effects of the Scheme on water quality, particularly when compared against some existing elevated and increasing contaminant trends caused by historic land uses and practices whose effects are time-lagged.

Some years of further water quality monitoring will be necessary, together with on-going assessment of CPWL and other land use change patterns in the catchment, to determine any significant change to existing elevated Nitrate-N concentrations and increasing trends, and whether any cause is attributable to CPWL, to previous land use changes and/or to improving practices through time. Until the main cause(s) responsible for trigger exceedances and increasing trends of Nitrate-N concentrations identified in this report can be accurately attributed, CPWL will assess its operations against its Sustainability Protocol, ensure all Farm Environment Plans are audited, including compliance with nitrogen application limits, and use/application of Good Management Practice/Matrix of Good Management.

Notwithstanding the inability to currently attribute the effect of the CPWL Scheme on water quality, the trigger exceedances and increasing trends identified in the report are a concern to keep watching. CPWL must continue to comply with the conditions of its resource consents to minimise its contribution to water quality deterioration.

6. Appendices

6.1. Ground and Surface Water Plan Part II – Trigger Limits and Trigger Response Processes

Table 13. Surface water quality triggers (Nitrate-N (mg/L)) for the CPWL monitoring programme

River Type	pLWRP Variation 1		CPWL surface water monitoring	
	Annual Median	Annual 95th percentile	Annual Median	Annual 95th percentile
Spring-fed plains	6.9	9.8	5.2	7.4
Hill-fed lower	2.4	3.5	1.8	2.6

Table 14. Water quality triggers for CPWL lake water quality monitoring

Monitoring Location	TLI[(a)]	Total Phosphorus (mg/L)[(b)]	Total Nitrogen (mg/L)[(b)]	Chlorophyll A (µg/L)[(b)]
Mid-Lake	6.6	0.1	3.4	74
Lake Margins	6	n/a	n/a	n/a

(a) TLI assumed to be calculated as TLI3 (using TP, TN and chl a)

(b) As a maximum annual average

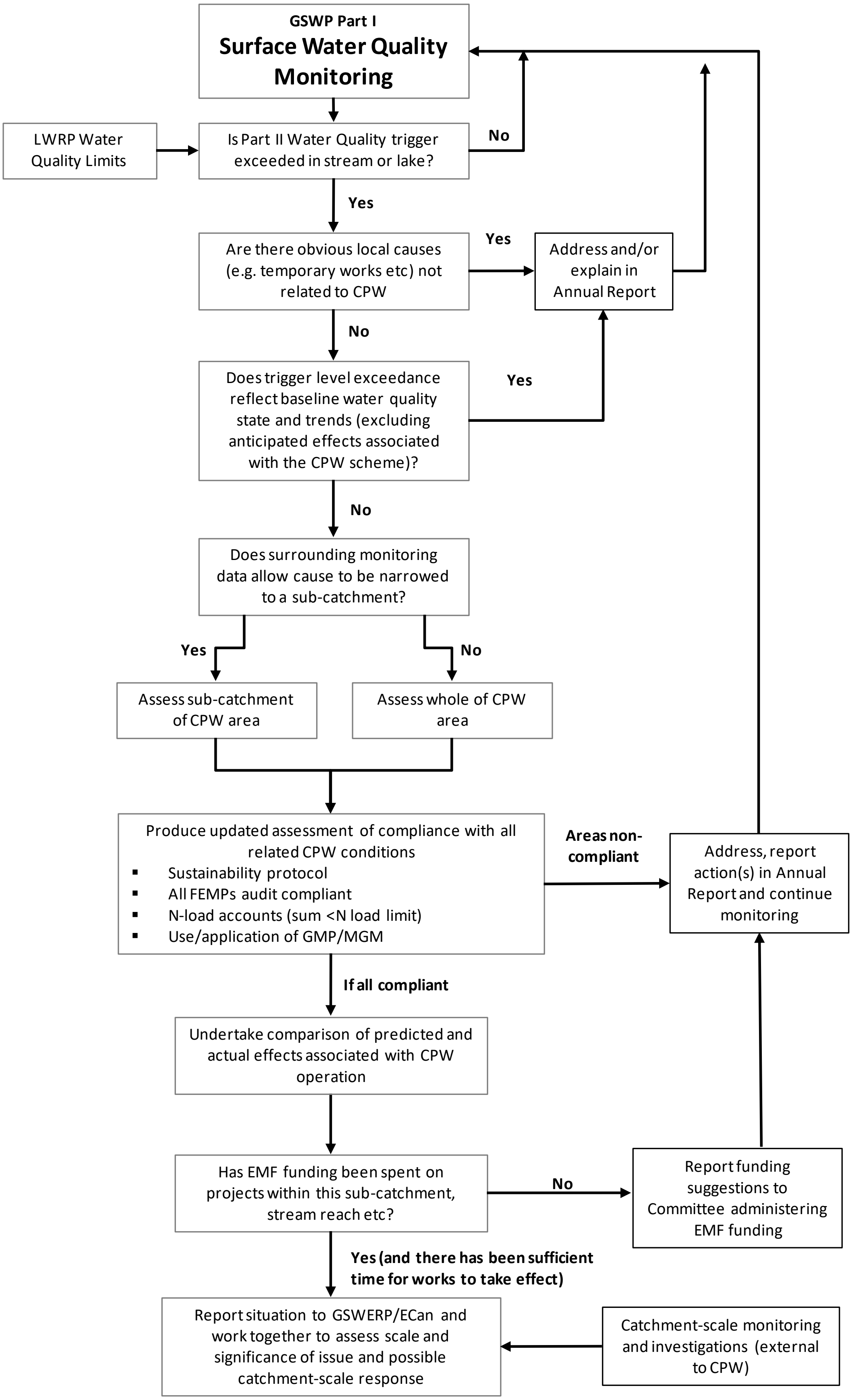


Figure 51. CPWL response to surface water quality trigger level exceedance

The CPWL response initiated following an exceedance of lake water quality triggers is consistent with that established for surface water quality monitoring.

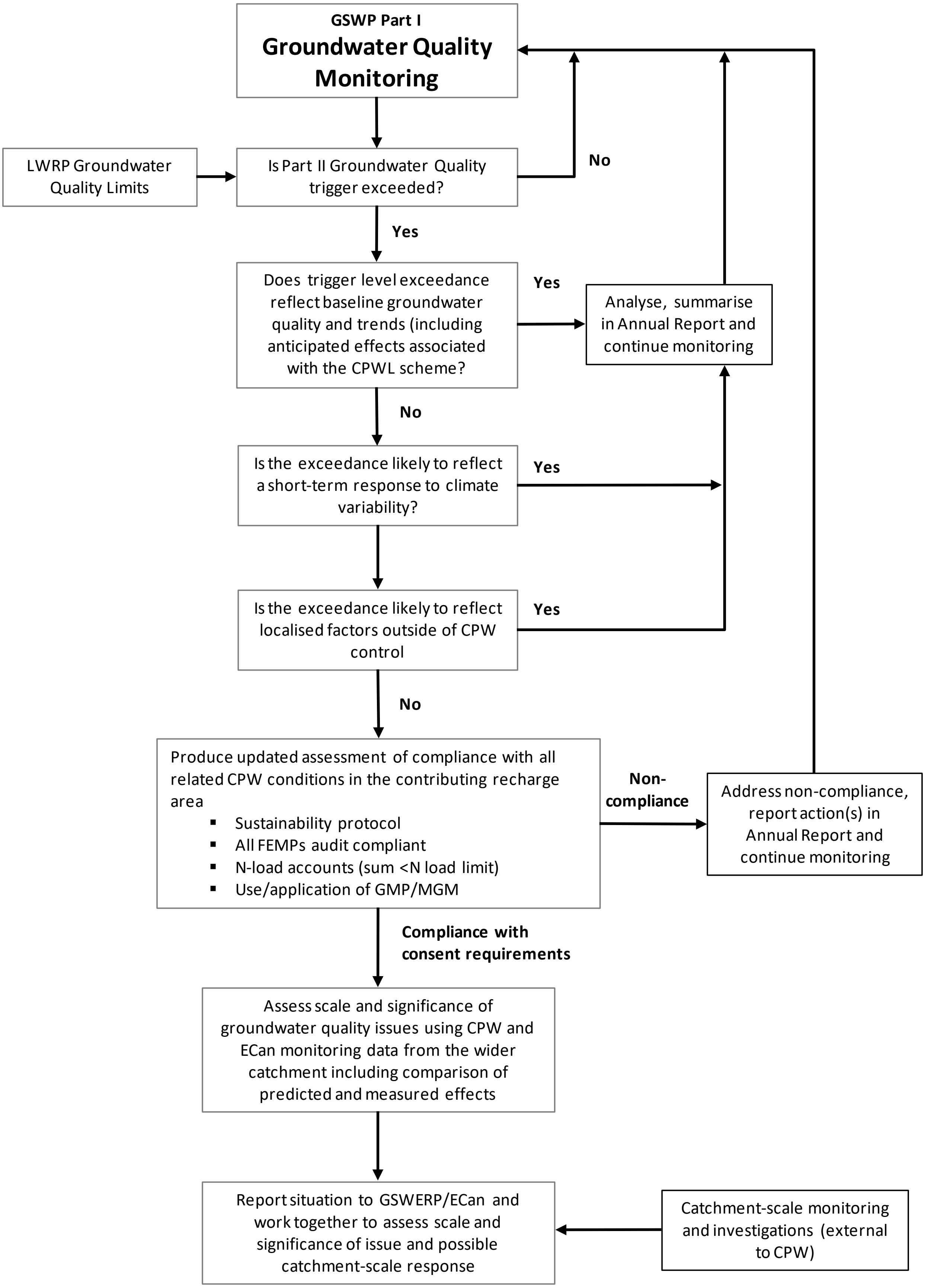


Figure 52. CPWL response to groundwater quality trigger level exceedance

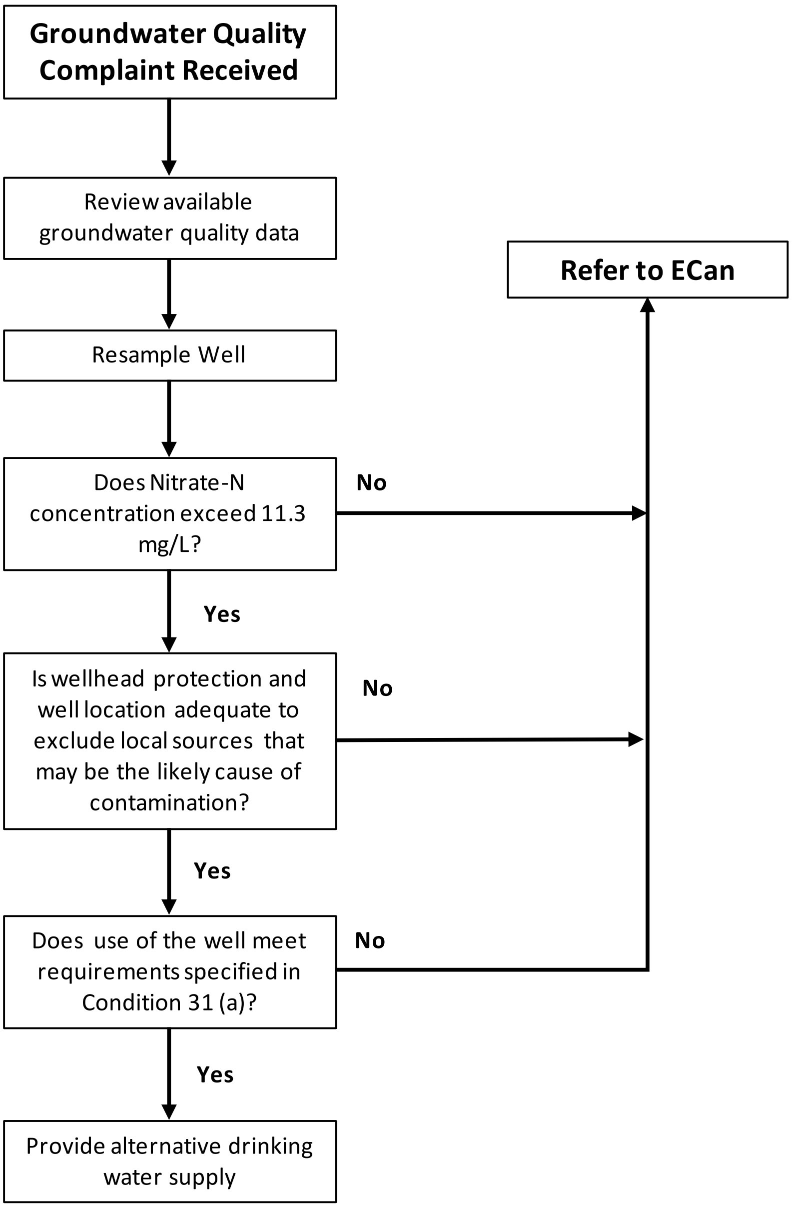


Figure 53. CPWL response to groundwater quality complaints

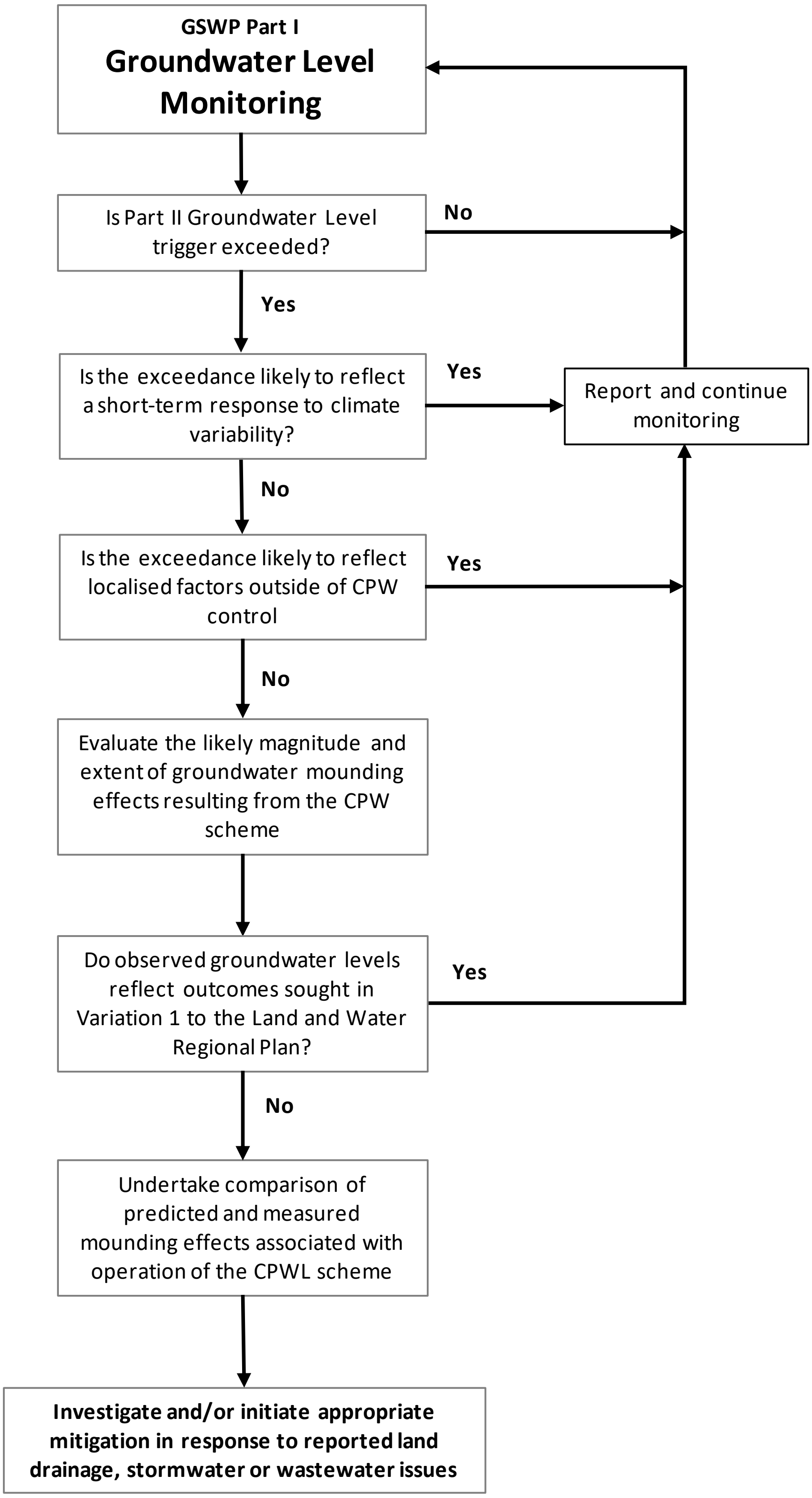


Figure 54. CPWL response to groundwater level trigger exceedance

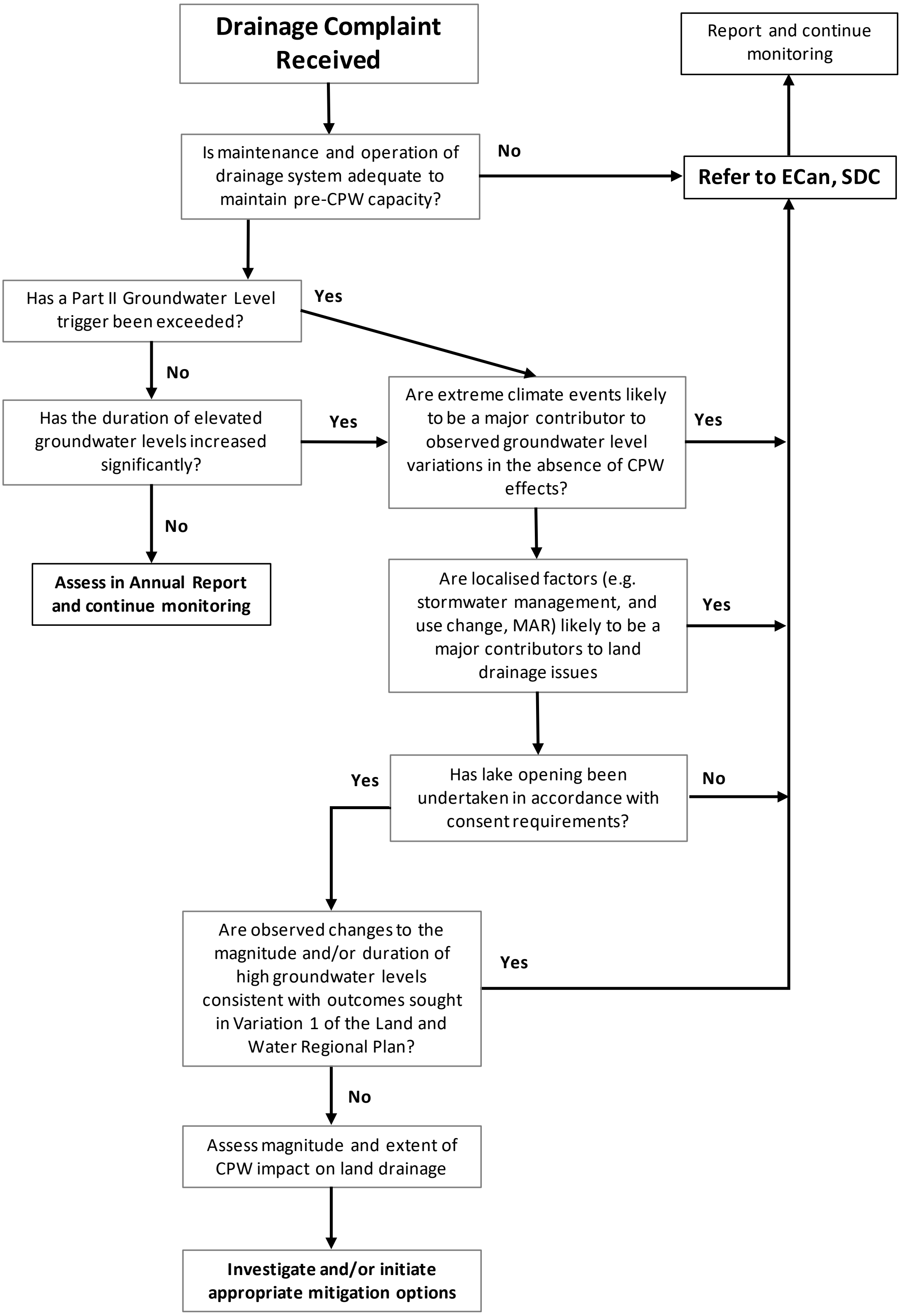


Figure 55. CPWL land drainage complaint response procedure

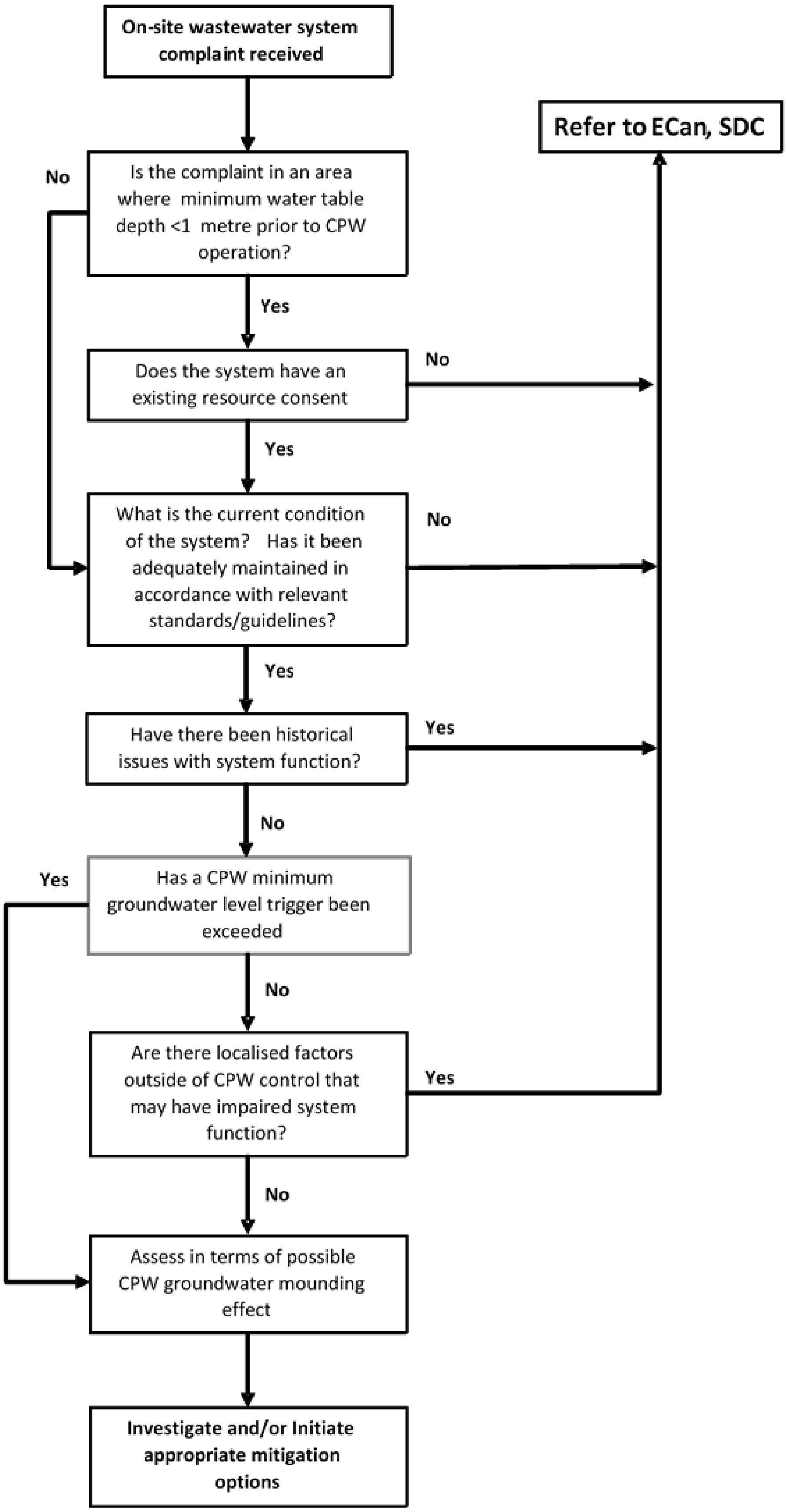


Figure 56. CPWL on-site wastewater complaint response procedure

6.2. Central Plains Water Ltd Annual Compliance Report 2019/2020 Irrigation Season

6.3. River and Stream Monitoring Data (ECan data shown blue)

US1	24/07/2019	20/08/2019	18/09/2019	11/10/2019	6/11/2019	2/12/2019	14/01/2020	10/02/2020	13/03/2020	7/04/2020	4/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	1.480	0.987	0.461	0.535	0.484	0.381	0.198	0.076	0.078	0.790	0.253	0.426
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Total Nitrogen (mg/L)	1.72	1.19	0.58	0.67	0.59	0.48	0.31	0.22	0.22	0.93	0.41	0.52
E. coli (MPN/100ml)	21	16	<4	160	290	170	350	100	240	130	54	68
Dissolved Reactive Phosphorus (mg/L)	0.009	0.005	0.005	0.009	0.007	0.007	0.007	0.006	0.006	0.005	0.007	0.008
Total Phosphorus (mg/L)	0.016	0.009	0.009	0.009	0.011	0.010	0.010	0.011	0.009	0.014	0.013	0.009
Electrical Conductivity (µS/cm)	74	81	76	86	91	97	106	111	110	100	105	102
Dissolved Oxygen (% Sat.)	100.1	100.2	95.1	97.3	100.7	98.4	95.5	92.6	93.1	99.8	99.5	95.8
pH	7.39	7.66	7.55	7.62	7.78	7.73	7.65	7.49	7.56	7.59	7.84	7.53
Temperature (DegC)	6.6	5.0	4.1	8.4	11.3	12.5	11.6	11.8	11.0	12.0	9.3	3.3
Turbidity (NTU)	2.16	0.71	0.72	0.77	0.88	0.83	0.63	0.32	0.26	0.71	0.52	0.53
Flow (cumec)	0.951	0.374	0.286	0.180	0.090	0.065	0.039	0.023	0.030	0.108	0.055	0.071

US2	23/07/2019	15/08/2019	16/09/2019	10/10/2019	5/11/2019	2/12/2019	16/01/2020	17/02/2020	13/03/2020	7/04/2020	4/05/2020	30/06/2020
Nitrate + Nitrite-N (mg/L)	2.860	1.730	0.373	0.554	0.365	dry	dry	dry	dry	dry	dry	2.730
Total Ammoniacal-N (mg/L)	0.080	0.010	<0.01	<0.01	0.010	dry	dry	dry	dry	dry	dry	0.040
Total Nitrogen (mg/L)	2.90	2.00	0.73	0.93	0.61	dry	dry	dry	dry	dry	dry	3.19
E. coli (MPN/100ml)	330	64	200	170	58	dry	dry	dry	dry	dry	dry	1200
Dissolved Reactive Phosphorus (mg/L)	0.015	0.010	0.006	0.005	0.012	dry	dry	dry	dry	dry	dry	0.016
Total Phosphorus (mg/L)	0.085	0.045	0.039	0.035	0.028	dry	dry	dry	dry	dry	dry	0.071
Electrical Conductivity (µS/cm)	127	150	172	145	158	dry	dry	dry	dry	dry	dry	162
Dissolved Oxygen (% Sat.)	97.3	95.8	98.6	100.9	68.5	dry	dry	dry	dry	dry	dry	96.7
pH	7.16	7.14	7.48	7.48	6.72	dry	dry	dry	dry	dry	dry	7.29
Temperature (DegC)	8.4	5.1	9.0	11.8	15.1	dry	dry	dry	dry	dry	dry	7.1
Turbidity (NTU)	26.50	7.40	5.75	3.86	1.43	dry	dry	dry	dry	dry	dry	17.90
Flow (cumec)	1.733	0.428	0.194	0.154	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.032

US3	15/07/2019	13/08/2019	18/09/2019	15/10/2019	21/11/2019	10/12/2019	21/01/2020	20/02/2020	16/03/2020	no April sample	21/05/2020	26/06/2020
Nitrate + Nitrite-N (mg/L)	0.500	0.790	0.530	0.450	0.440	0.380	0.310	0.270	0.310	-	0.370	0.500
Total Ammoniacal-N (mg/L)	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	-	0.010	0.010
Total Nitrogen (mg/L)	0.54	0.95	0.63	0.54	0.46	0.44	0.39	0.35	0.33	-	0.44	0.62
E. coli (MPN/100ml)	56	31	4	75	36	69	17	72	38	-	28	133
Dissolved Reactive Phosphorus (mg/L)	0.002	0.003	0.001	0.001	0.004	0.003	0.003	0.002	0.002	-	0.002	0.004
Total Phosphorus (mg/L)	0.004	0.008	0.004	0.007	0.005	0.007	0.009	0.004	0.004	-	0.004	0.011
Electrical Conductivity (mS/cm)	97	91	95	95	97	99	977	99	97	-	97	87
Dissolved Oxygen (% Sat.)	102.3	99.4	104.0	100.5	100.3	100.8	110.4	100.6	100.8	-	102.2	99.7
pH	7.56	7.10	7.51	7.03	6.91	7.35	7.59	7.46	7.31	-	7.46	7.25
Temperature (DegC)	6.4	5.6	9.6	9.3	14.2	13.2	16.1	14.3	13.7	-	9.4	7.3
Turbidity (NTU)	1.40	2.80	0.80	1.00	0.40	0.30	0.30	0.30	0.20	-	0.20	4.00
Flow (cumec)	2.938	6.056	3.092	2.972	2.721	2.214	0.895	0.718	0.790	-	0.913	4.950

US4	24/07/2019	20/08/2019	16/09/2019	11/10/2019	8/11/2019	4/12/2019	16/01/2020	10/02/2020	13/03/2020	7/04/2020	4/05/2020	2/06/2020
Nitrate + Nitrite-N (mg/L)	1.140	1.020	0.684	0.723	0.831	0.689	0.592	0.342	0.208	0.259	0.148	0.251
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Nitrogen (mg/L)	1.55	1.23	0.83	0.90	1.06	0.95	0.75	0.51	0.44	0.43	0.31	0.38
E. coli (MPN/100ml)	110	58	16	120	76	130	140	120	150	64	25	12
Dissolved Reactive Phosphorus (mg/L)	0.015	0.011	0.009	0.014	0.013	0.017	0.015	0.012	0.008	0.006	0.007	0.006
Total Phosphorus (mg/L)	0.032	0.024	0.019	0.022	0.031	0.030	0.023	0.020	0.025	0.018	0.012	0.010
Electrical Conductivity (µS/cm)	78	83	85	90	101	104	105	105	90	89	105	97
Dissolved Oxygen (% Sat.)	96.9	96.5	96.5	97.3	92.5	93.2	93.8	103.9	95.8	97.9	98.4	nt
pH	7.12	7.33	7.44	7.40	7.34	7.34	7.28	7.59	7.30	7.32	7.46	7.52
Temperature (DegC)	7.7	5.2	9.2	10.0	13.1	13.2	12.2	14.4	12.0	13.5	11.4	5.7
Turbidity (NTU)	4.56	2.93	1.86	1.38	1.53	1.20	1.03	0.57	1.30	0.83	0.41	0.58
Flow (cumec)	1.350	0.731	0.384	0.321	0.162	0.091	0.043	0.038	0.117	0.142	0.052	0.096

IS1	24/07/2019	20/08/2019	18/09/2019	11/10/2019	6/11/2019	2/12/2019	14/01/2020	10/02/2020	13/03/2020	7/04/2020	4/05/2020	30/06/2020
Nitrate + Nitrite-N (mg/L)	2.540	2.730	2.540	2.430	2.260	2.220	2.440	dry	dry	dry	dry	2.300
Total Ammoniacal-N (mg/L)	0.020	0.010	<0.01	0.010	0.020	0.020	0.010	dry	dry	dry	dry	<0.01
Total Nitrogen (mg/L)	2.90	2.94	3.04	2.71	2.38	2.28	2.43	dry	dry	dry	dry	2.48
E. coli (MPN/100ml)	140	52	25	180	150	160	330	dry	dry	dry	dry	200
Dissolved Reactive Phosphorus (mg/L)	0.018	0.010	0.007	0.010	0.010	0.009	0.008	dry	dry	dry	dry	0.017
Total Phosphorus (mg/L)	0.035	0.016	0.009	0.012	0.011	0.011	0.009	dry	dry	dry	dry	0.029
Electrical Conductivity (µS/cm)	116	128	131	134	133	134	139	dry	dry	dry	dry	113
Dissolved Oxygen (% Sat.)	97.6	98.7	102.1	98.8	101.7	102.2	97.1	dry	dry	dry	dry	96.6
pH	7.12	7.48	7.67	7.53	7.66	7.78	7.55	dry	dry	dry	dry	7.15
Temperature (DegC)	8.1	6.6	7.8	9.7	11.5	13.1	12.7	dry	dry	dry	dry	8.2
Turbidity (NTU)	4.45	0.95	0.78	0.53	0.58	0.43	0.48	dry	dry	dry	dry	3.71
Flow (cumec)	3.941	1.586	0.666	0.447	0.275	0.069	0.005	0.000	0.000	0.000	0.000	3.227

IS2	23/07/2019	15/08/2019	16/09/2019	10/10/2019	5/11/2019	2/12/2019	16/01/2020	10/02/2020	13/03/2020	23/04/2020	6/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	2.290	2.220	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Total Ammoniacal-N (mg/L)	0.020	<0.01	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Total Nitrogen (mg/L)	2.85	2.40	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
E. coli (MPN/100ml)	230	21	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Dissolved Reactive Phosphorus (mg/L)	0.027	0.018	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Total Phosphorus (mg/L)	0.088	0.029	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Electrical Conductivity (µS/cm)	117	124	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Dissolved Oxygen (% Sat.)	95.3	83.4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
pH	6.95	6.57	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Temperature (DegC)	8.2	8.6	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Turbidity (NTU)	22.00	4.49	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Flow (cumec)	1.746	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

IS3	23/07/2019	15/08/2019	16/09/2019	9/10/2019	5/11/2019	2/12/2019	16/01/2020	10/02/2020	13/03/2020	23/04/2020	6/05/2020	30/06/2020
Nitrate + Nitrite-N (mg/L)	1.020	1.020	1.430	1.260	dry	dry	dry	dry	dry	dry	dry	0.812
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	dry	dry	dry	dry	dry	dry	dry	<0.01
Total Nitrogen (mg/L)	1.25	1.09	1.47	1.45	dry	dry	dry	dry	dry	dry	dry	0.99
E. coli (MPN/100ml)	39	<4	<4	25	dry	dry	dry	dry	dry	dry	dry	270
Dissolved Reactive Phosphorus (mg/L)	0.011	0.009	0.008	0.008	dry	dry	dry	dry	dry	dry	dry	0.009
Total Phosphorus (mg/L)	0.049	0.013	0.008	0.008	dry	dry	dry	dry	dry	dry	dry	0.027
Electrical Conductivity (µS/cm)	90	101	111	112	dry	dry	dry	dry	dry	dry	dry	95
Dissolved Oxygen (% Sat.)	99.1	97.1	94.1	90.3	dry	dry	dry	dry	dry	dry	dry	98.2
pH	7.49	7.33	7.07	7.01	dry	dry	dry	dry	dry	dry	dry	7.45
Temperature (DegC)	9.3	7.4	11.2	13.2	dry	dry	dry	dry	dry	dry	dry	7.0
Turbidity (NTU)	20.00	0.96	0.26	0.29	dry	dry	dry	dry	dry	dry	dry	9.64
Flow (cumec)	11.960	2.546	0.299	0.211	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.706

IS4	24/07/2019	20/08/2019	16/09/2019	11/10/2019	8/11/2019	4/12/2019	16/01/2020	10/02/2020	13/03/2020	7/04/2020	4/05/2020	2/06/2020
Nitrate + Nitrite-N (mg/L)	2.260	2.720	2.610	2.180	2.000	1.840	1.770	1.680	1.440	1.480	1.400	1.520
Total Ammoniacal-N (mg/L)	0.030	<0.01	<0.01	<0.01	0.030	<0.01	<0.01	0.020	0.020	<0.01	<0.01	<0.01
Total Nitrogen (mg/L)	2.45	2.92	2.66	2.39	2.06	1.96	1.86	1.74	1.57	1.59	1.55	1.63
E. coli (MPN/100ml)	81	48	25	98	190	110	360	660	310	530	320	220
Dissolved Reactive Phosphorus (mg/L)	0.019	0.011	0.006	0.010	0.005	0.006	0.008	0.010	0.009	0.007	0.008	0.007
Total Phosphorus (mg/L)	0.027	0.016	0.009	0.012	0.011	0.009	0.010	0.017	0.017	0.016	0.012	0.011
Electrical Conductivity (mS/cm)	127	142	144	141	139	139	140	136	129	129	130	130
Dissolved Oxygen (% Sat.)	95.1	95.1	102.0	96.8	82.7	92.7	89.2	92.2	95.3	97.6	95.9	nt
pH	7.19	7.41	7.52	7.40	7.38	7.27	7.33	7.33	7.45	7.53	7.50	7.66
Temperature (DegC)	10.0	8.9	11.9	11.6	13.1	12.7	12.4	13.0	12.1	14.2	11.6	9.1
Turbidity (NTU)	1.92	0.94	0.61	0.72	1.28	0.50	0.94	2.58	2.60	2.44	1.08	0.64
Flow (cumec)	4.339	3.865	2.655	2.251	1.870	1.525	0.761	0.317	0.092	0.062	0.108	0.070

SWT1	22/07/2019	22/08/2019	17/09/2019	21/10/2019	13/11/2019	5/12/2019	14/01/2020	13/02/2020	17/03/2020	14/04/2020	11/05/2020	5/06/2020
Nitrate + Nitrite-N (mg/L)	0.089	0.021	0.006	<0.005	0.012	0.008	<0.005	0.006	<0.005	0.005	0.022	0.049
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	0.020	0.010	0.020	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Nitrogen (mg/L)	0.17	0.10	0.08	0.11	0.11	0.16	0.12	0.06	<0.05	0.07	0.08	0.12
E. coli (MPN/100ml)	59	1600	98	460	1700	860	490	590	450	310	130	100
Dissolved Reactive Phosphorus (mg/L)	<0.005	<0.005	<0.005	0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus (mg/L)	0.011	0.016	0.013	0.020	0.034	0.245	0.029	0.018	0.009	0.011	0.010	0.008
Electrical Conductivity (µS/cm)	63	68	70	61	49	43	54	65	69	71	63	70
Dissolved Oxygen (% Sat.)	104.1	100.0	98.1	100.3	97.3	98.1	99.1	99.7	104.3	99.4	nt	103.1
pH	7.70	6.85	7.79	7.69	7.52	7.48	7.61	7.75	8.13	7.78	7.95	8.19
Temperature (DegC)	7.6	9.4	12.6	12.9	13.5	18.3	21.6	17.4	12.5	8.4	10.5	7.8
Turbidity (NTU)	5.84	6.83	2.90	9.10	56.40	216.00	26.60	14.10	4.33	3.39	7.94	3.84
Flow (cumec)	0.026	0.073	0.065	0.070	0.060	0.042	0.027	0.052	0.045	0.059	0.046	0.034

SWT2	22/07/2019	26/08/2019	17/09/2019	11/10/2019	8/11/2019	4/12/2019	16/01/2020	13/02/2020	17/03/2020	1/04/2020	6/05/2020	2/06/2020
Nitrate + Nitrite-N (mg/L)	dry	0.008	<0.005	<0.005	0.007	<0.005	0.006	<0.005	<0.005	dry	<0.005	<0.005
Total Ammoniacal-N (mg/L)	dry	<0.01	<0.01	0.010	<0.01	<0.01	0.010	<0.01	<0.01	dry	0.200	<0.01
Total Nitrogen (mg/L)	dry	0.17	0.22	0.20	0.44	0.28	0.41	0.22	0.27	dry	0.25	0.10
E. coli (MPN/100ml)	dry	940	2500	1400	380	410	990	200	620	dry	1200	380
Dissolved Reactive Phosphorus (mg/L)	dry	0.010	0.012	0.014	0.014	0.010	0.010	0.011	0.127	dry	0.055	0.013
Total Phosphorus (mg/L)	dry	0.029	0.035	0.042	0.125	0.066	0.094	0.035	0.178	dry	0.081	0.030
Electrical Conductivity (µS/cm)	dry	67	63	63	55	55	55	62	88	dry	85	69
Dissolved Oxygen (% Sat.)	dry	102.9	107.1	105.3	124.1	107.7	101.4	86.6	82.3	dry	87.5	nt
pH	dry	7.67	8.03	8.12	9.31	7.88	7.45	7.04	7.31	dry	7.14	7.42
Temperature (DegC)	dry	10.3	15.2	14.0	20.8	18.0	25.0	17.4	12.1	dry	6.0	8.1
Turbidity (NTU)	dry	4.96	7.24	5.93	32.40	17.60	9.76	7.80	8.99	dry	3.96	3.02
Flow (cumec)	0.000	0.002	0.005	0.012	0.005	0.007	0.005	0.005	0.005	0.000	0.005	0.005

SWT3	30/07/2019	27/08/2019	19/09/2019	17/10/2019	12/11/2019	6/12/2019	20/01/2020	13/02/2020	17/03/2020	14/04/2020	11/05/2020	5/06/2020
Nitrate + Nitrite-N (mg/L)	0.740	0.618	0.718	0.535	0.692	0.527	0.134	0.047	0.334	0.412	0.506	0.507
Total Ammoniacal-N (mg/L)	0.020	<0.01	<0.01	0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Nitrogen (mg/L)	0.91	0.74	0.83	1.08	0.89	0.64	0.34	0.18	0.51	0.53	0.66	0.87
E. coli (MPN/100ml)	8	43	<4	1700	25	410	130	230	240	54	16	1000
Dissolved Reactive Phosphorus (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Total Phosphorus (mg/L)	0.009	0.006	0.005	0.031	0.011	0.011	0.009	0.006	0.009	0.005	0.010	0.023
Electrical Conductivity (µS/cm)	89	90	96	95	76	84	84	89	97	95	88	99
Dissolved Oxygen (% Sat.)	97.0	110.6	95.3	93.6	105.7	83.6	98.8	69.8	81.0	96.1	nt	100.9
pH	7.39	8.61	7.46	7.35	8.10	7.06	7.46	7.03	7.18	7.39	8.34	7.57
Temperature (DegC)	7.8	9.1	5.8	9.3	16.2	14.3	19.5	17.1	12.8	8.1	10.8	7.8
Turbidity (NTU)	0.94	0.87	0.65	5.42	2.38	2.04	0.59	0.50	0.47	0.31	0.76	2.49
Flow (cumec)	0.008	0.017	0.008	0.014	0.010	0.015	0.018	0.010	0.020	0.012	0.011	0.011

SWT4	25/07/2019	21/08/2019	17/09/2019	14/10/2019	7/11/2019	4/12/2019	22/01/2020	20/02/2020	20/03/2020	23/04/2020	20/05/2020	23/06/2020
Nitrate + Nitrite-N (mg/L)	0.252	0.268	0.214	0.139	0.070	0.043	0.010	0.025	0.007	0.055	0.058	0.136
Total Ammoniacal-N (mg/L)	0.010	<0.01	0.010	0.010	0.010	0.080	<0.01	<0.01	<0.01	<0.01	<0.01	0.050
Total Nitrogen (mg/L)	0.34	0.35	0.30	0.23	0.15	0.20	0.13	0.09	0.07	0.11	0.10	0.16
E. coli (MPN/100ml)	68	43	250	710	2300	990	3100	2900	860	130	280	140
Dissolved Reactive Phosphorus (mg/L)	0.009	<0.005	<0.005	0.005	<0.005	0.082	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus (mg/L)	0.040	0.012	0.012	0.025	0.023	0.223	0.029	0.019	0.011	0.011	0.008	0.012
Electrical Conductivity (µS/cm)	73	79	80	68	71	41	74	68	76	67	71	74
Dissolved Oxygen (% Sat.)	99.7	99.5	96.2	97.9	98.7	94.2	95.6	94.9	96.0	100.1	nt	98.7
pH	7.56	7.76	7.62	7.53	7.57	7.33	7.53	7.47	7.60	7.73	7.86	7.61
Temperature (DegC)	7.7	7.2	9.0	10.3	16.3	16.2	18.1	17.4	14.1	11.2	8.6	7.2
Turbidity (NTU)	43.20	6.69	5.39	17.40	10.50	489.00	8.47	13.70	3.36	11.00	2.97	5.32
Flow (cumec)	0.177	0.153	0.178	0.197	0.177	0.145	0.152	0.155	0.129	0.159	0.140	0.134

SWSH	29/07/2019	16/08/2019	13/09/2019	10/10/2019	5/11/2019	2/12/2019	16/01/2020	13/02/2020	17/03/2020	14/04/2020	6/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	2.080	2.210	2.560	2.110	1.680	1.710	dry	dry	dry	dry	dry	dry
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	dry	dry	dry	dry	dry	dry
Total Nitrogen (mg/L)	2.18	2.30	2.60	2.23	1.71	1.80	dry	dry	dry	dry	dry	dry
E. coli (MPN/100ml)	49	4	<4	<4	25	39	dry	dry	dry	dry	dry	dry
Dissolved Reactive Phosphorus (mg/L)	0.010	0.007	0.005	0.007	0.007	0.005	dry	dry	dry	dry	dry	dry
Total Phosphorus (mg/L)	0.010	0.009	0.006	0.010	0.006	0.013	dry	dry	dry	dry	dry	dry
Electrical Conductivity (µS/cm)	121	126	135	135	130	128	dry	dry	dry	dry	dry	dry
Dissolved Oxygen (% Sat.)	97.7	97.6	107.6	96.6	62.1	74.1	dry	dry	dry	dry	dry	dry
pH	7.24	7.41	8.31	7.38	6.67	6.51	dry	dry	dry	dry	dry	dry
Temperature (DegC)	8.5	7.8	10.2	12.3	12.9	14.4	dry	dry	dry	dry	dry	dry
Turbidity (NTU)	0.69	0.65	0.28	0.25	0.26	0.38	dry	dry	dry	dry	dry	dry
Flow (cumec)	2.439	4.109	0.635	0.141	0.137	0.010	0.000	0.000	0.000	0.000	0.000	0.000

SF1	26/07/2019	21/08/2019	19/09/2019	14/10/2019	7/11/2019	3/12/2019	20/01/2020	17/02/2020	19/03/2020	16/04/2020	11/05/2020	5/06/2020
Nitrate + Nitrite-N (mg/L)	3.400	3.690	3.410	3.520	3.590	3.520	3.060	3.180	3.140	3.140	2.990	2.870
Total Ammoniacal-N (mg/L)	0.040	0.020	0.020	0.020	0.020	<0.01	0.020	0.030	0.020	0.010	0.050	0.060
Total Nitrogen (mg/L)	3.63	3.48	3.92	3.70	3.53	3.45	3.04	3.11	3.11	3.33	3.41	3.36
E. coli (MPN/100ml)	150	110	160	370	370	350	1000	550	360	840	1400	1800
Dissolved Reactive Phosphorus (mg/L)	0.017	0.019	0.020	0.028	0.029	0.022	0.020	0.031	0.021	0.015	0.015	0.021
Total Phosphorus (mg/L)	0.091	0.057	0.032	0.050	0.042	0.036	0.032	0.049	0.030	0.024	0.042	0.096
Electrical Conductivity (µS/cm)	240	245	233	224	222	219	214	212	208	214	217	207
Dissolved Oxygen (% Sat.)	88.3	102.0	110.2	117.5	109.2	117.8	90.9	114.6	124.2	92.4	nt	80.6
pH	7.22	7.56	7.77	8.05	7.94	8.04	7.33	8.01	8.54	7.48	7.34	7.06
Temperature (DegC)	11.0	12.6	12.7	14.0	15.6	15.7	15.6	17.8	14.2	10.5	11.2	10.1
Turbidity (NTU)	14.80	3.93	2.42	2.00	2.34	0.90	1.78	1.98	1.94	1.96	7.24	19.50
Flow (cumec)	0.718	0.771	0.747	0.802	0.802	0.696	0.507	0.431	0.396	0.444	0.448	0.683

SF2	26/07/2019	21/08/2019	19/09/2019	14/10/2019	7/11/2019	3/12/2019	23/01/2020	17/02/2020	19/03/2020	16/04/2020	11/05/2020	5/06/2020
Nitrate + Nitrite-N (mg/L)	4.410	4.820	4.160	4.290	4.380	4.550	4.390	4.640	4.430	4.280	3.980	4.070
Total Ammoniacal-N (mg/L)	<0.01	0.010	<0.01	<0.01	0.010	<0.01	<0.01	0.050	<0.01	0.010	<0.01	<0.01
Total Nitrogen (mg/L)	4.31	4.28	4.71	4.45	4.25	4.33	4.47	4.42	4.37	4.40	4.28	4.32
E. coli (MPN/100ml)	8	300	220	12	48	100	80	130	130	53	120	88
Dissolved Reactive Phosphorus (mg/L)	0.011	0.013	0.011	0.014	0.012	0.011	0.009	0.010	0.009	0.010	0.012	0.011
Total Phosphorus (mg/L)	0.012	0.011	0.011	0.016	0.014	0.011	0.010	0.009	0.011	0.013	0.014	0.015
Electrical Conductivity (µS/cm)	234	234	232	230	230	230	235	234	235	232	230	225
Dissolved Oxygen (% Sat.)	79.8	85.8	75.9	76.5	72.6	80.5	64.0	69.3	66.4	74.6	nt	78.0
pH	6.88	7.03	6.92	6.91	6.90	7.01	6.86	6.88	6.82	6.84	6.86	6.88
Temperature (DegC)	12.1	13.0	12.9	13.3	14.1	15.0	14.2	15.0	13.3	13.3	13.2	12.1
Turbidity (NTU)	0.62	0.33	0.58	0.41	0.49	0.48	0.29	0.28	0.36	0.73	0.63	2.49
Flow (cumec)	0.097	0.109	0.104	0.094	0.099	0.100	0.104	0.091	0.086	0.091	0.090	0.086

SF3	29/07/2019	27/08/2019	19/09/2019	21/10/2019	13/11/2019	5/12/2019	20/01/2020	17/02/2020	19/03/2020	23/04/2020	20/05/2020	23/06/2020
Nitrate + Nitrite-N (mg/L)	4.310	4.870	6.060	3.390	6.610	7.700	7.500	8.130	8.820	8.220	7.540	8.230
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	0.020	<0.01	<0.01	<0.01	<0.01	<0.01	0.020
Total Nitrogen (mg/L)	4.39	4.65	6.79	3.51	6.89	6.99	7.78	8.13	8.65	8.10	8.04	8.24
E. coli (MPN/100ml)	21	21	8	140	74	49	130	120	130	140	54	34
Dissolved Reactive Phosphorus (mg/L)	0.012	0.005	0.007	0.007	0.012	0.013	0.010	0.011	0.011	0.007	0.008	0.010
Total Phosphorus (mg/L)	0.013	0.012	0.006	0.014	0.011	0.014	0.012	0.011	0.011	0.010	0.010	0.012
Electrical Conductivity (µS/cm)	170	186	220	158	238	247	253	262	269	266	263	260
Dissolved Oxygen (% Sat.)	94.5	96.8	101.5	92.0	92.1	90.4	90.1	82.5	84.1	85.2	nt	92.7
pH	7.14	7.33	7.29	7.17	7.21	7.19	7.20	7.22	7.11	7.13	7.20	7.33
Temperature (DegC)	10.2	8.4	13.0	12.0	12.8	14.3	17.2	16.9	14.0	12.9	11.4	10.9
Turbidity (NTU)	0.92	0.49	0.34	1.42	0.52	1.16	0.41	0.22	0.47	0.15	0.25	0.25
Flow (cumec)	4.002	3.596	1.873	7.162	1.327	0.889	0.475	0.345	0.279	0.332	0.409	0.471

SF4	30/07/2019	26/08/2019	17/09/2019	21/10/2019	13/11/2019	5/12/2019	14/01/2020	10/02/2020	13/03/2020	7/04/2020	4/05/2020	2/06/2020
Nitrate + Nitrite-N (mg/L)	3.040	2.940	2.320	2.140	1.820	1.680	1.380	dry	dry	dry	dry	dry
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	0.040	dry	dry	dry	dry	dry
Total Nitrogen (mg/L)	3.19	2.96	2.69	2.20	1.99	1.74	1.65	dry	dry	dry	dry	dry
E. coli (MPN/100ml)	260	25	12	640	270	270	310	dry	dry	dry	dry	dry
Dissolved Reactive Phosphorus (mg/L)	0.012	0.009	0.007	0.006	0.009	0.005	0.010	dry	dry	dry	dry	dry
Total Phosphorus (mg/L)	0.025	0.010	0.009	0.011	0.011	0.010	0.022	dry	dry	dry	dry	dry
Electrical Conductivity (µS/cm)	142	140	135	134	132	130	135	dry	dry	dry	dry	dry
Dissolved Oxygen (% Sat.)	87.0	96.7	106.5	97.8	88.1	95.2	108.1	dry	dry	dry	dry	dry
pH	6.66	6.97	6.98	6.88	6.81	6.86	6.98	dry	dry	dry	dry	dry
Temperature (DegC)	10.9	11.0	11.6	11.3	12.2	15.4	24.4	dry	dry	dry	dry	dry
Turbidity (NTU)	0.39	0.34	0.72	0.42	0.24	0.41	8.08	dry	dry	dry	dry	dry
Flow (cumec)	0.144	0.146	0.132	0.143	0.114	0.099	0.001	0.000	0.000	0.000	0.000	0.000

SF5	22/07/2019	16/08/2019	13/09/2019	10/10/2019	5/11/2019	2/12/2019	16/01/2020	10/02/2020	13/03/2020	7/04/2020	6/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	3.200	4.080	4.970	4.470	4.030	3.760	2.810	1.620	dry	dry	dry	dry
Total Ammoniacal-N (mg/L)	0.020	<0.01	<0.01	<0.01	0.010	0.010	0.010	0.010	dry	dry	dry	dry
Total Nitrogen (mg/L)	3.96	4.15	4.73	4.78	4.28	3.91	3.03	2.13	dry	dry	dry	dry
E. coli (MPN/100ml)	380	80	150	1100	4800	940	490	1600	dry	dry	dry	dry
Dissolved Reactive Phosphorus (mg/L)	0.190	0.016	0.011	0.015	0.133	0.045	0.045	0.025	dry	dry	dry	dry
Total Phosphorus (mg/L)	0.275	0.032	0.032	0.039	0.175	0.067	0.071	0.065	dry	dry	dry	dry
Electrical Conductivity (µS/cm)	268	266	243	238	227	221	201	210	dry	dry	dry	dry
Dissolved Oxygen (% Sat.)	92.9	109.1	108.4	105.6	110.7	109.6	133.9	115.9	dry	dry	dry	dry
pH	7.02	7.30	7.57	7.48	7.73	8.04	9.08	8.56	dry	dry	dry	dry
Temperature (DegC)	10.1	9.1	10.8	13.0	14.7	16.0	20.5	14.4	dry	dry	dry	dry
Turbidity (NTU)	22.40	3.21	2.07	4.23	8.80	2.86	4.39	4.33	dry	dry	dry	dry
Flow (cumec)	0.867	0.525	0.415	0.350	0.316	0.186	0.050	0.010	0.000	0.000	0.000	0.000

SF6	25/07/2019	22/08/2019	18/09/2019	17/10/2019	12/11/2019	6/12/2019	22/01/2020	20/02/2020	18/03/2020	14/04/2020	8/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	5.850	7.070	6.190	5.740	5.110	5.530	4.830	4.600	4.910	4.850	4.700	5.200
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	0.040	<0.01	<0.01	<0.01	<0.01	0.040
Total Nitrogen (mg/L)	6.05	7.07	6.89	6.28	5.65	5.67	4.86	4.74	4.77	5.01	5.06	5.12
E. coli (MPN/100ml)	25	100	160	650	780	370	250	100	390	110	190	250
Dissolved Reactive Phosphorus (mg/L)	0.018	0.005	0.006	<0.005	0.014	0.006	0.047	0.005	0.005	0.007	0.007	0.008
Total Phosphorus (mg/L)	0.019	0.014	0.007	0.017	0.026	0.017	0.007	0.012	0.011	0.011	0.015	0.015
Electrical Conductivity (µS/cm)	247	259	251	242	239	237	231	233	229	233	231	231
Dissolved Oxygen (% Sat.)	87.0	86.5	92.8	89.9	83.0	70.4	62.7	66.0	78.4	79.5	nt	85.3
pH	6.68	6.82	6.77	6.71	6.74	6.69	6.66	6.69	6.67	6.62	6.68	6.72
Temperature (DegC)	11.5	9.5	11.5	11.7	13.4	13.3	15.3	15.3	14.0	13.1	13.4	12.2
Turbidity (NTU)	1.05	0.86	0.84	0.50	0.63	0.40	0.34	0.22	2.50	0.39	0.68	0.68
Flow (cumec)	0.223	0.206	0.177	0.168	0.272	0.098	0.068	0.063	0.054	0.073	0.057	0.030

SF7	25/07/2019	22/08/2019	18/09/2019	17/10/2019	8/11/2019	4/12/2019	22/01/2020	20/02/2020	17/03/2020	14/04/2020	8/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	8.730	9.590	8.650	7.940	7.000	7.430	dry	dry	dry	dry	dry	dry
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	0.020	0.010	dry	dry	dry	dry	dry	dry
Total Nitrogen (mg/L)	9.18	9.68	10.30	8.96	8.24	7.60	dry	dry	dry	dry	dry	dry
E. coli (MPN/100ml)	200	770	580	770	3900	2600	dry	dry	dry	dry	dry	dry
Dissolved Reactive Phosphorus (mg/L)	0.017	0.005	<0.005	<0.005	0.013	0.014	dry	dry	dry	dry	dry	dry
Total Phosphorus (mg/L)	0.027	0.015	0.013	0.023	0.047	0.037	dry	dry	dry	dry	dry	dry
Electrical Conductivity (µS/cm)	297	304	290	282	272	267	dry	dry	dry	dry	dry	dry
Dissolved Oxygen (% Sat.)	90.4	103.2	122.6	95.1	106.5	93.2	dry	dry	dry	dry	dry	dry
pH	6.63	6.88	6.86	6.78	8.70	6.78	dry	dry	dry	dry	dry	dry
Temperature (DegC)	11.2	9.6	14.2	11.1	20.6	18.3	dry	dry	dry	dry	dry	dry
Turbidity (NTU)	3.10	1.71	0.83	2.31	3.24	3.55	dry	dry	dry	dry	dry	dry
Flow (cumec)	0.071	0.073	0.053	0.048	0.038	0.018	0.000	0.000	0.000	0.000	0.000	0.000

SF8	29/07/2019	27/08/2019	20/09/2019	22/10/2019	18/11/2019	16/12/2019	23/01/2020	20/02/2020	17/03/2020	29/04/2020	20/05/2020	23/06/2020
Nitrate + Nitrite-N (mg/L)	9.870	9.760	9.300	9.940	9.360	10.600	9.610	dry	dry	5.780	8.870	10.400
Total Ammoniacal-N (mg/L)	<0.01	<0.01	0.020	<0.01	<0.01	<0.01	0.010	dry	dry	0.010	<0.01	<0.01
Total Nitrogen (mg/L)	10.20	9.80	11.30	0.12	10.40	10.10	10.60	dry	dry	6.74	9.80	10.60
E. coli (MPN/100ml)	8	8	21	<4	150	340	1100	dry	dry	12	96	30
Dissolved Reactive Phosphorus (mg/L)	0.012	0.008	0.010	<0.005	0.009	0.009	0.010	dry	dry	0.025	0.013	0.008
Total Phosphorus (mg/L)	0.017	0.017	0.029	0.010	0.015	0.010	0.011	dry	dry	0.106	0.018	0.011
Electrical Conductivity (µS/cm)	329	328	327	64	325	329	335	dry	dry	347	345	354
Dissolved Oxygen (% Sat.)	84.2	82.7	73.0	99.7	65.4	67.7	58.6	dry	dry	36.2	nt	72.2
pH	6.76	6.85	6.73	7.51	6.73	6.73	6.73	dry	dry	6.74	6.84	6.81
Temperature (DegC)	12.3	12.0	11.5	12.2	11.8	13.7	15.9	dry	dry	10.7	12.1	12.0
Turbidity (NTU)	0.51	0.27	0.34	7.58	1.80	0.90	0.22	dry	dry	2.25	0.28	0.79
Flow (cumec)	0.087	0.110	0.124	0.138	0.115	0.031	0.007	0.000	0.000	0.000	0.001	0.010

T1	26/07/2019	21/08/2019	19/09/2019	14/10/2019	7/11/2019	3/12/2019	20/01/2020	17/02/2020	19/03/2020	16/04/2020	11/05/2020	5/06/2020
Nitrate + Nitrite-N (mg/L)	2.370	2.400	2.140	2.450	2.570	2.540	2.040	2.030	2.360	2.600	2.510	2.690
Total Ammoniacal-N (mg/L)	0.070	0.030	0.010	<0.01	0.040	0.030	0.020	0.010	0.020	0.020	0.010	0.020
Total Nitrogen (mg/L)	3.00	2.69	2.85	2.68	2.55	2.65	2.15	2.05	2.45	2.79	2.89	2.98
E. coli (MPN/100ml)	75	97	52	49	140	370	120	120	53	69	58	150
Dissolved Reactive Phosphorus (mg/L)	0.068	0.035	0.034	0.028	0.030	0.044	0.018	0.024	0.022	0.021	0.024	0.026
Total Phosphorus (mg/L)	0.140	0.096	0.086	0.060	0.064	0.075	0.033	0.035	0.035	0.034	0.040	0.048
Electrical Conductivity (µS/cm)	349	367	317	269	258	248	238	237	241	249	250	259
Dissolved Oxygen (% Sat.)	71.9	84.9	94.1	108.3	94.6	108.6	98.0	123.1	85.2	88.3	nt	78.4
pH	7.09	7.48	7.56	7.95	7.72	8.04	7.86	8.53	7.52	7.54	7.42	7.33
Temperature (DegC)	10.3	10.4	12.1	14.8	16.0	18.0	18.9	19.6	14.3	11.5	11.9	10.4
Turbidity (NTU)	14.00	6.88	3.48	1.68	2.16	2.81	1.11	0.62	0.76	1.20	1.22	1.47
Flow (cumec)	1.812	1.802	1.502	1.539	1.257	1.080	0.694	0.647	0.629	No data	1.061	1.384

T2	18/07/2019	19/08/2019	18/09/2019	22/10/2019	20/11/2019	17/12/2019	21/01/2020	19/02/2020	18/03/2020	29/04/2020	20/05/2020	17/06/2020
Nitrate + Nitrite-N (mg/L)	3.600	3.300	3.300	3.300	3.400	3.600	3.300	3.300	3.400	3.200	3.400	3.500
Total Ammoniacal-N (mg/L)	0.010	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030	0.032	0.027
Total Nitrogen (mg/L)	3.80	3.80	3.60	3.40	3.60	3.60	3.60	3.60	3.60	3.70	3.70	3.60
E. coli (MPN/100ml)	72	75	99	120	166	921	144	93	75	479	488	179
Dissolved Reactive Phosphorus (mg/L)	0.013	0.023	0.009	0.011	0.014	0.017	0.013	0.010	0.011	0.020	0.014	0.012
Total Phosphorus (mg/L)	0.014	0.036	0.016	0.017	0.027	0.023	0.022	0.016	0.017	0.026	0.026	0.019
Electrical Conductivity (µS/cm)	226	265	233	219	215	224	233	228	226	214	215	218
Dissolved Oxygen (% Sat.)	94.9	93.4	107.7	100.3	98.0	80.0	114.6	98.4	103.8	82.2	78.2	82.3
pH	7.33	7.21	7.58	7.07	6.93	7.19	7.53	7.26	7.46	7.23	7.24	7.34
Temperature (DegC)	10.4	10.3	12.0	12.7	13.8	14.1	17.2	16.7	13.0	13.2	11.1	12.1
Turbidity (NTU)	1.70	2.90	0.90	0.90	2.60	1.20	0.80	0.70	0.40	2.30	4.30	6.20
Flow (cumec)	2.467	3.092	2.451	2.512	No data	1.553	1.189	1.156	1.143	1.730	1.767	2.169

T3	18/07/2019	19/08/2019	18/09/2019	22/10/2019	20/11/2019	17/12/2019	21/01/2020	19/02/2020	18/03/2020	29/04/2020	20/05/2020	17/06/2020
Nitrate + Nitrite-N (mg/L)	7.500	4.200	6.400	4.500	7.300	7.200	7.300	7.300	7.200	7.100	7.600	7.800
Total Ammoniacal-N (mg/L)	0.013	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Total Nitrogen (mg/L)	7.20	4.70	6.60	4.80	6.60	6.30	7.20	7.10	7.50	7.60	6.90	7.10
E. coli (MPN/100ml)	313	86	190	144	193	2420	308	365	345	291	365	345
Dissolved Reactive Phosphorus (mg/L)	0.021	0.016	0.005	0.006	0.008	0.017	0.014	0.013	0.009	0.010	0.010	0.013
Total Phosphorus (mg/L)	0.018	0.022	0.006	0.009	0.011	0.019	0.014	0.014	0.014	0.011	0.010	0.013
Electrical Conductivity (µS/cm)	264	189	240	186	248	249	263	265	264	262	254	259
Dissolved Oxygen (% Sat.)	98.4	97.5	106.9	98.1	92.0	86.4	95.3	94.2	97.7	97.3	93.7	95.1
pH	7.39	7.26	7.43	7.07	7.04	7.38	7.44	7.48	7.41	7.43	7.45	7.49
Temperature (DegC)	8.7	8.2	11.1	12.6	14.2	15.1	18.9	19.3	14.2	12.3	9.8	10.1
Turbidity (NTU)	1.50	1.70	0.30	1.10	0.30	0.30	0.30	0.00	0.40	0.20	0.30	0.40
Flow (cumec)	1.761	9.287	2.613	7.081	1.817	1.148	0.583	0.375	0.344	0.473	0.563	0.710

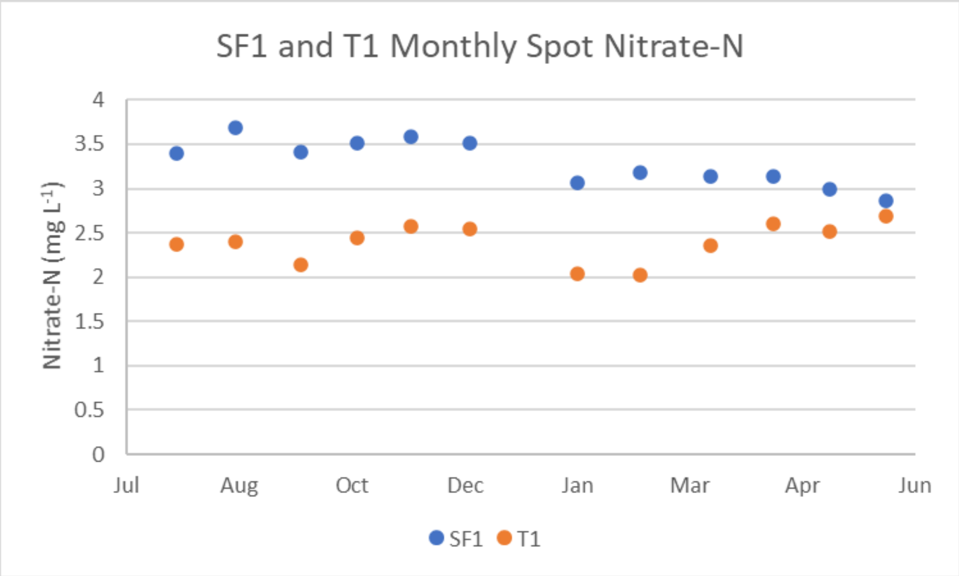
T4	30/07/2019	26/08/2019	17/09/2019	21/10/2019	13/11/2019	5/12/2019	14/01/2020	10/02/2020	13/03/2020	7/04/2020	6/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	2.370	2.640	2.130	1.680	1.620	1.360	0.403	dry	dry	dry	<0.005	<0.005
Total Ammoniacal-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	dry	dry	dry	0.600	0.180
Total Nitrogen (mg/L)	2.66	2.57	2.51	1.93	1.89	1.48	0.66	dry	dry	dry	1.35	0.69
E. coli (MPN/100ml)	160	220	430	410	390	260	410	dry	dry	dry	160	16
Dissolved Reactive Phosphorus (mg/L)	0.014	0.007	0.006	0.005	0.014	0.012	0.015	dry	dry	dry	0.203	0.017
Total Phosphorus (mg/L)	0.028	0.016	0.013	0.026	0.027	0.029	0.033	dry	dry	dry	1.120	0.272
Electrical Conductivity (µS/cm)	216	205	206	196	193	185	193	dry	dry	dry	510	387
Dissolved Oxygen (% Sat.)	93.2	96.4	95.2	93.2	93.5	94.8	93.8	dry	dry	dry	10.3	13.8
pH	7.37	7.71	7.59	7.51	7.51	7.63	7.69	dry	dry	dry	6.84	6.64
Temperature (DegC)	10.1	9.9	10.9	12.8	12.6	15.0	16.4	dry	dry	dry	9.1	11.3
Turbidity (NTU)	1.47	1.62	1.31	2.45	2.72	3.47	2.64	dry	dry	dry	20.80	13.20
Flow (cumec)	1.537	1.619	1.500	1.345	1.246	0.609	0.099	0.000	0.000	0.000	0.005	0.003

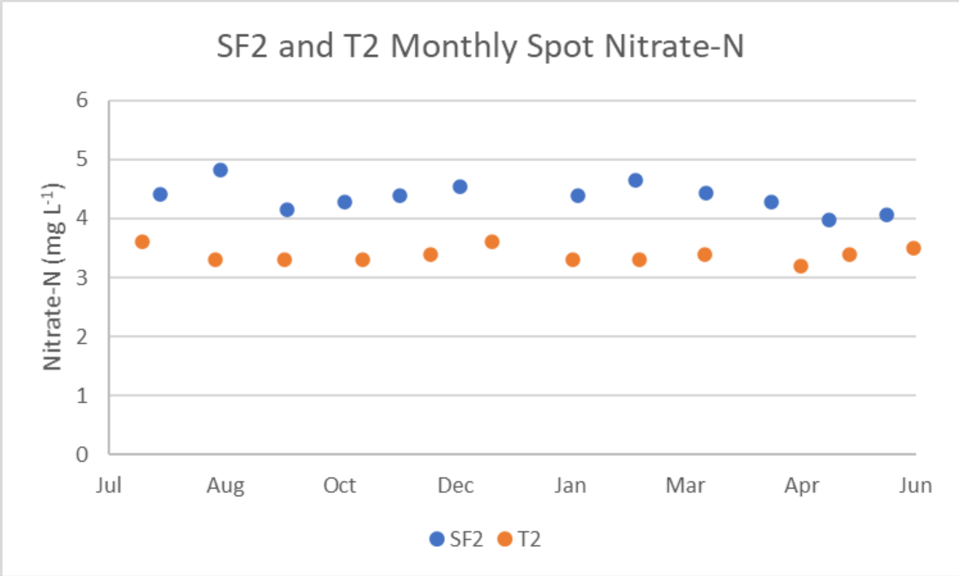
T5	22/07/2019	16/08/2019	13/09/2019	10/10/2019	5/11/2019	2/12/2019	16/01/2020	10/02/2020	13/03/2020	7/04/2020	6/05/2020	3/06/2020
Nitrate + Nitrite-N (mg/L)	2.450	3.340	4.180	3.860	3.350	3.020	0.170	dry	dry	dry	<0.005	<0.005
Total Ammoniacal-N (mg/L)	0.020	<0.01	<0.01	<0.01	<0.01	0.020	0.010	dry	dry	dry	<0.01	0.010
Total Nitrogen (mg/L)	3.44	3.49	4.11	4.09	3.57	3.24	0.51	dry	dry	dry	0.48	0.26
E. coli (MPN/100ml)	570	110	98	550	1200	1000	270	dry	dry	dry	350	4
Dissolved Reactive Phosphorus (mg/L)	0.182	0.017	0.011	0.018	0.037	0.037	0.018	dry	dry	dry	0.020	0.020
Total Phosphorus (mg/L)	0.304	0.025	0.027	0.048	0.062	0.056	0.031	dry	dry	dry	0.043	0.025
Electrical Conductivity (µS/cm)	325	316	284	275	260	252	311	dry	dry	dry	614	590
Dissolved Oxygen (% Sat.)	96.1	101.7	105.3	104.3	103.3	102.4	92.8	dry	dry	dry	70.6	87.1
pH	7.25	7.62	8.20	7.96	8.04	8.25	7.88	dry	dry	dry	7.58	7.71
Temperature (DegC)	10.2	9.1	10.7	13.7	15.5	16.7	14.2	dry	dry	dry	7.3	9.7
Turbidity (NTU)	24.90	2.50	1.50	3.75	4.09	1.94	1.00	dry	dry	dry	1.16	0.18
Flow (cumec)	1.141	0.598	0.437	0.375	0.329	0.180	0.007	0.000	0.000	0.000	0.000	0.005

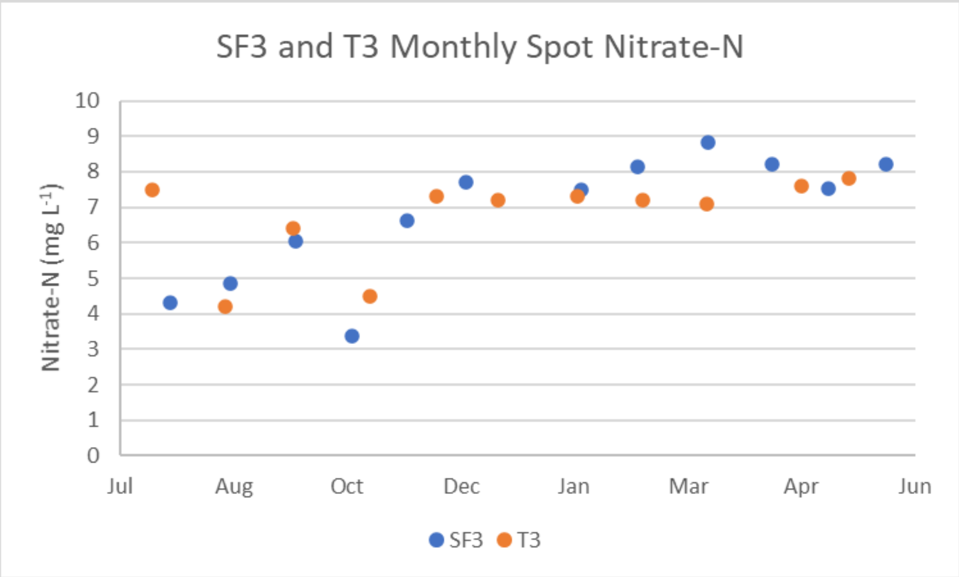
T6	25/07/2019	22/08/2019	18/09/2019	18/09/2019	17/10/2019	12/11/2019	6/12/2019	17/12/2019	22/01/2020	20/02/2020	18/03/2020	18/03/2020	14/04/2020	8/05/2020	3/06/2020	17/06/2020
Nitrate + Nitrite-N (mg/L)	4.29	4.94	5.40	5.25	5.17	5.18	5.65	5.60	4.83	4.61	4.90	4.89	4.86	4.67	4.77	4.60
Total Ammoniacal-N (mg/L)	0.020	<0.01	0.010	0.010	<0.01	0.020	0.020	0.066	0.020	<0.01	0.010	<0.01	<0.01	<0.01	0.030	0.012
Total Nitrogen (mg/L)	4.72	5.06	6.10	6.04	5.95	5.59	5.64	5.90	5.34	4.93	5.10	5.08	5.08	5.07	4.90	4.50
E. coli (MPN/100ml)	120	230	2420	890	410	5200	740	2420	4500	430	980	1300	840	480	650	579
Dissolved Reactive Phosphorus (mg/L)	0.0330	0.0110	0.0076	0.0120	0.0080	0.0280	0.0090	0.0270	0.0180	0.0150	0.0137	0.0140	0.0110	0.0120	0.0200	0.0163
Total Phosphorus (mg/L)	0.066	0.032	0.016	0.025	0.027	0.063	0.026	0.049	0.038	0.027	0.024	0.026	0.024	0.020	0.025	0.019
Electrical Conductivity (µS/cm)	380	354	299	305	291	295	276	269	273	270	264	276	271	274	278	272
Dissolved Oxygen (% Sat.)	95.8	101.9	112.3	106.9	101.6	96.5	102.5	93.1	97.6	18.5	98.1	97.8	95.9	nt	94.7	94.1
pH	7.42	7.84	7.85	8.30	7.87	7.64	7.94	7.63	7.80	7.76	7.48	7.75	7.35	7.66	7.63	7.48
Temperature (DegC)	10.2	10.1	9.2	10.9	12.2	12.5	16.4	14.7	19.1	97.5	11.8	12.5	10.7	11.3	10.3	9.0
Turbidity (NTU)	4.09	1.81	1.80	1.21	2.00	2.01	1.07	2.80	2.08	1.21	0.90	2.00	1.74	0.80	0.90	0.90
Flow (cumec)	0.598	0.477	0.345	0.331	0.282	0.530	0.125	0.157	0.077	0.085	0.074	0.081	0.107	0.124	0.135	0.136

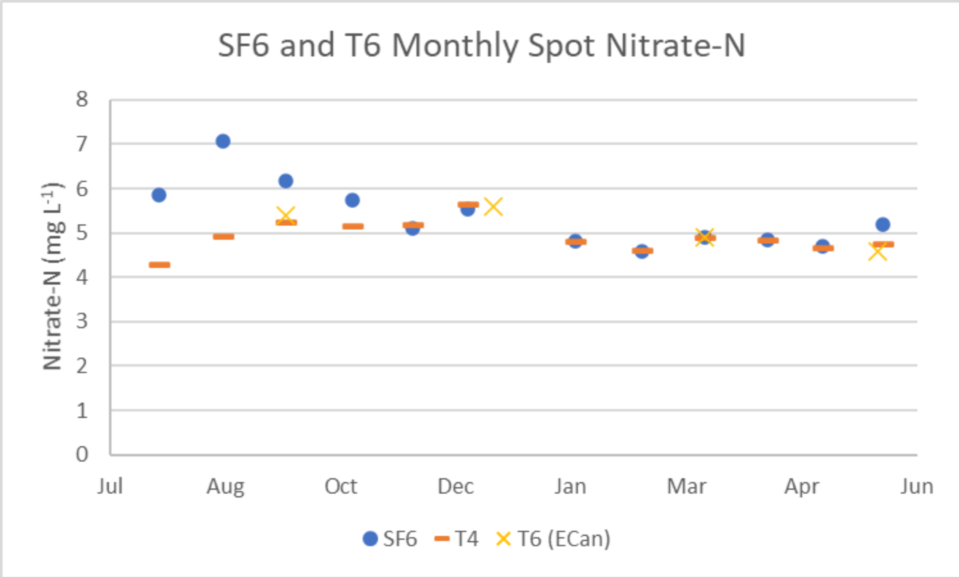
T7	25/07/2019	22/08/2019	18/09/2019	18/09/2019	17/10/2019	8/11/2019	4/12/2019	17/12/2019	22/01/2020	20/02/2020	17/03/2020	18/03/2020	14/04/2020	8/05/2020	3/06/2020	17/06/2020
Nitrate + Nitrite-N (mg/L)	4.72	5.67	6.10	5.89	5.59	5.25	5.48	0.58	0.19	0.05	<0.005	0.01	0.01	0.12	0.44	0.89
Total Ammoniacal-N (mg/L)	0.010	<0.01	0.010	<0.01	<0.01	0.010	0.030	0.113	0.070	<0.01	<0.01	0.010	<0.01	<0.01	0.030	0.025
Total Nitrogen (mg/L)	5.27	5.79	6.80	6.93	6.52	5.96	6.20	1.22	0.94	0.30	0.25	0.20	0.23	0.37	0.64	1.14
E. coli (MPN/100ml)	58	96	517	75	400	1400	990	2420	>9700	180	140	111	30	29	290	687
Dissolved Reactive Phosphorus (mg/L)	0.0260	0.0070	0.0037	0.0060	0.0070	0.0080	0.0110	0.1020	0.1830	0.0270	0.0070	0.0044	0.0110	0.0180	0.0260	0.0240
Total Phosphorus (mg/L)	0.040	0.019	0.012	0.017	0.028	0.027	0.037	0.118	0.251	0.034	0.014	0.011	0.017	0.027	0.030	0.027
Electrical Conductivity (µS/cm)	382	364	331	337	325	311	305	281	325	292	293	282	305	306	309	306
Dissolved Oxygen (% Sat.)	97.7	114.4	114.2	114.2	104.0	116.4	110.2	83.3	138.5	89.2	61.7	65.2	65.1	nt	79.9	83.6
pH	7.40	8.08	7.78	8.31	7.89	8.36	8.13	7.37	8.11	7.32	7.02	6.96	7.13	7.14	7.28	7.29
Temperature (DegC)	10.3	9.9	9.0	12.8	15.0	21.0	19.9	15.3	19.7	18.6	13.4	11.9	12.1	11.8	12.0	9.6
Turbidity (NTU)	2.40	1.08	1.30	1.68	2.35	2.43	1.30	3.00	1.24	0.50	0.47	0.30	0.17	0.27	0.54	0.60
Flow (cumec)	0.609	0.494	0.305	0.300	0.235	0.157	0.054	0.010	0.004	0.004	0.003	0.004	0.006	0.008	0.018	0.027

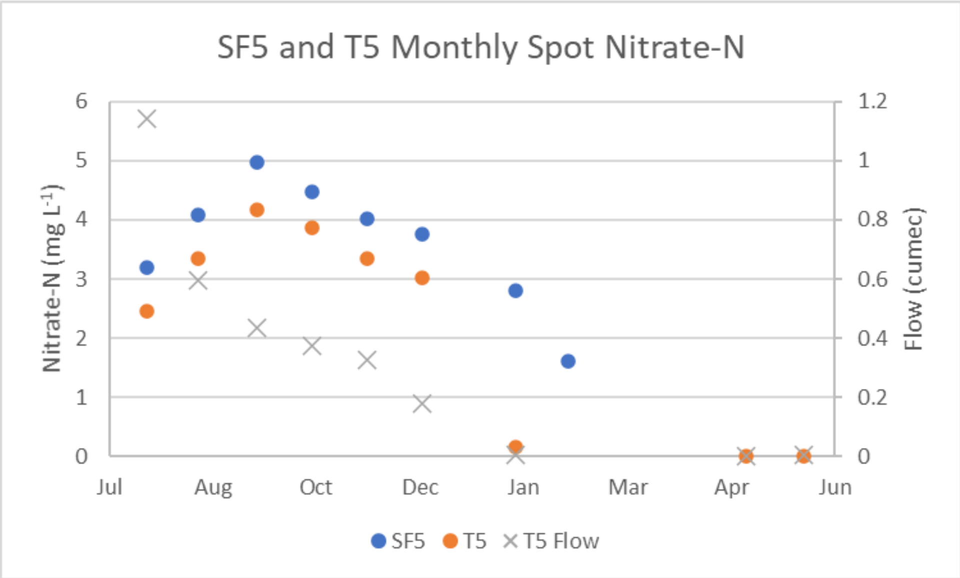
T8	18/07/2019	19/08/2019	18/09/2019	22/10/2019	20/11/2019	17/12/2019	21/01/2020	19/02/2020	18/03/2020	29/04/2020	20/05/2020	17/06/2020
Nitrate + Nitrite-N (mg/L)	8.200	8.000	7.900	8.100	8.300	7.700	7.700	7.500	7.400	7.300	7.700	7.900
Total Ammoniacal-N (mg/L)	0.010	0.010	0.010	0.010	0.010	0.015	0.010	0.010	0.010	0.010	0.010	0.010
Total Nitrogen (mg/L)	7.90	8.20	8.90	7.90	8.10	7.60	7.30	6.90	7.10	7.10	7.80	6.90
E. coli (MPN/100ml)	131	121	172	435	291	1414	579	411	387	921	236	649
Dissolved Reactive Phosphorus (mg/L)	0.009	0.009	0.004	0.005	0.006	0.013	0.008	0.009	0.008	0.009	0.009	0.010
Total Phosphorus (mg/L)	0.007	0.012	0.008	0.007	0.008	0.017	0.018	0.014	0.013	0.012	0.010	0.016
Electrical Conductivity (mS/cm)	280	302	285	277	271	260	252	248	243	285	245	254
Dissolved Oxygen (% Sat.)	89.1	90.5	91.1	93.1	88.6	88.2	86.1	85.2	85.5	84.5	84.7	86.6
pH	7.39	7.34	7.28	7.11	6.97	7.45	7.26	7.23	7.18	7.31	7.83	7.35
Temperature (DegC)	10.2	9.9	10.4	11.2	11.8	12.8	13.3	13.4	11.3	11.7	10.7	11.1
Turbidity (NTU)	3.60	2.70	1.40	1.50	1.10	2.10	2.70	2.50	1.90	1.30	1.30	2.10
Flow (cumec)	1.489	1.756	1.614	1.612	1.576	1.133	0.826	0.733	0.777	0.838	0.906	0.994


SF1 and T1 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
4
3.5
3
2.5
2
1.5
1
0.5
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
SF1
T1

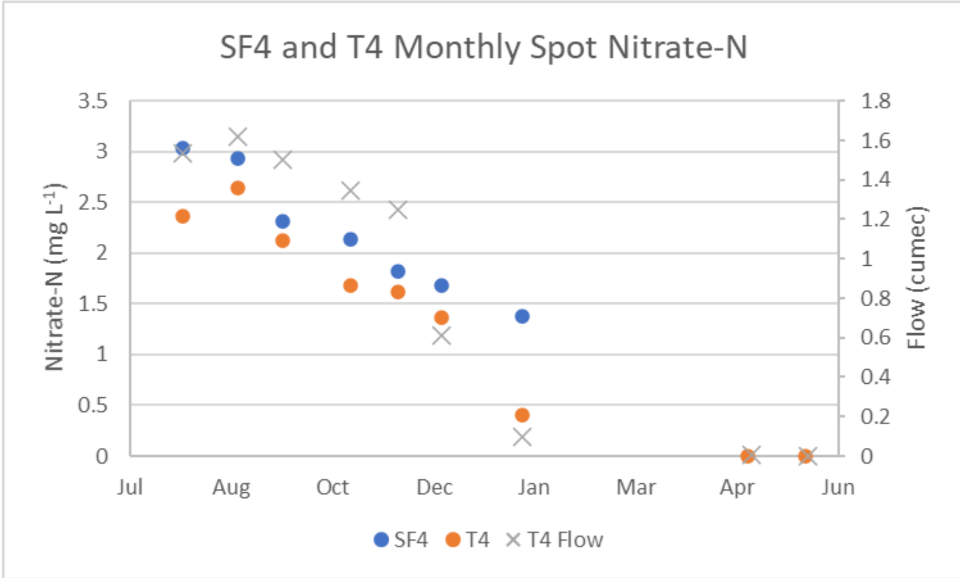

SF2 and T2 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
6
5
4
3
2
1
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
SF2
T2


SF3 and T3 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
10
9
8
7
6
5
4
3
2
1
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
SF3
T3

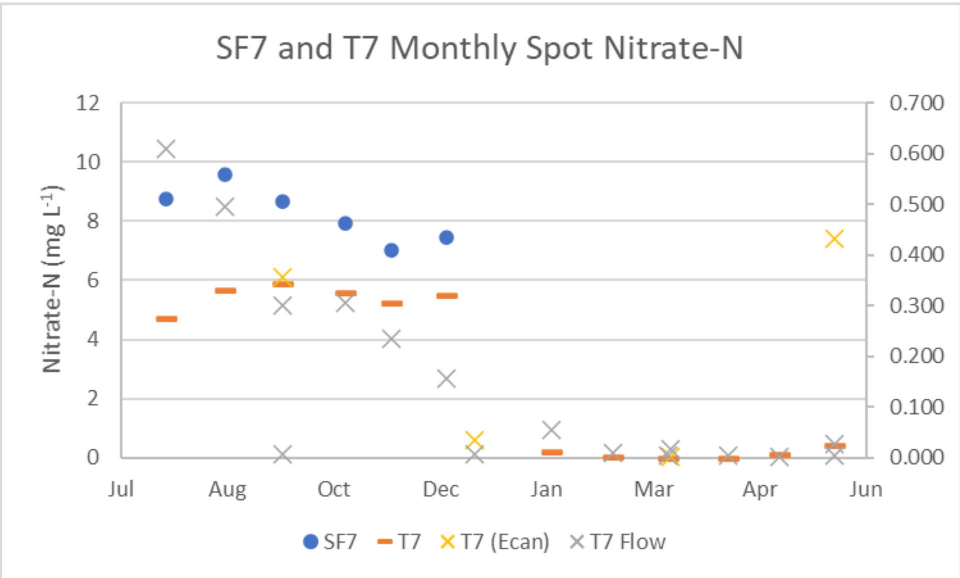

SF6 and T6 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
8
7
6
5
4
3
2
1
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
SF6
T4
T6 (ECan)

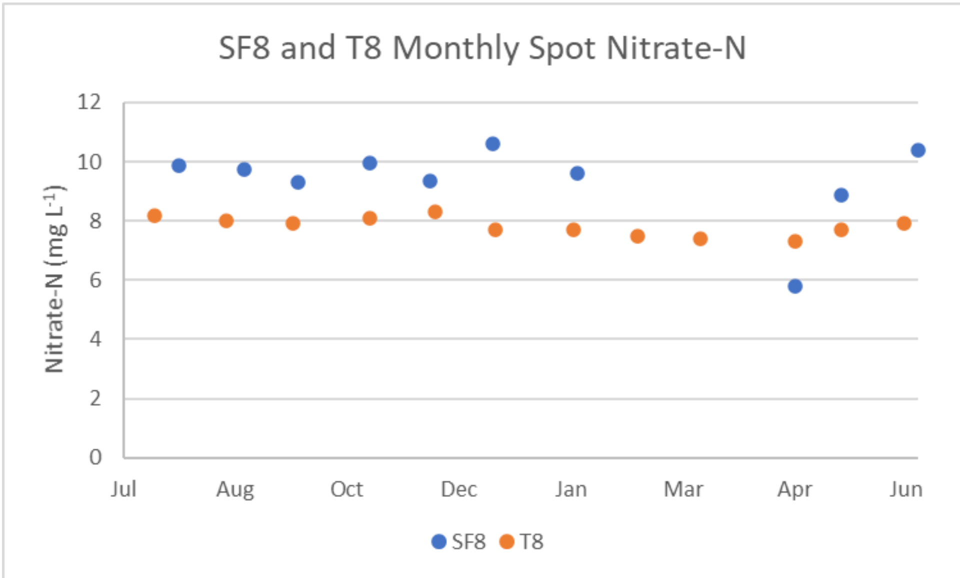


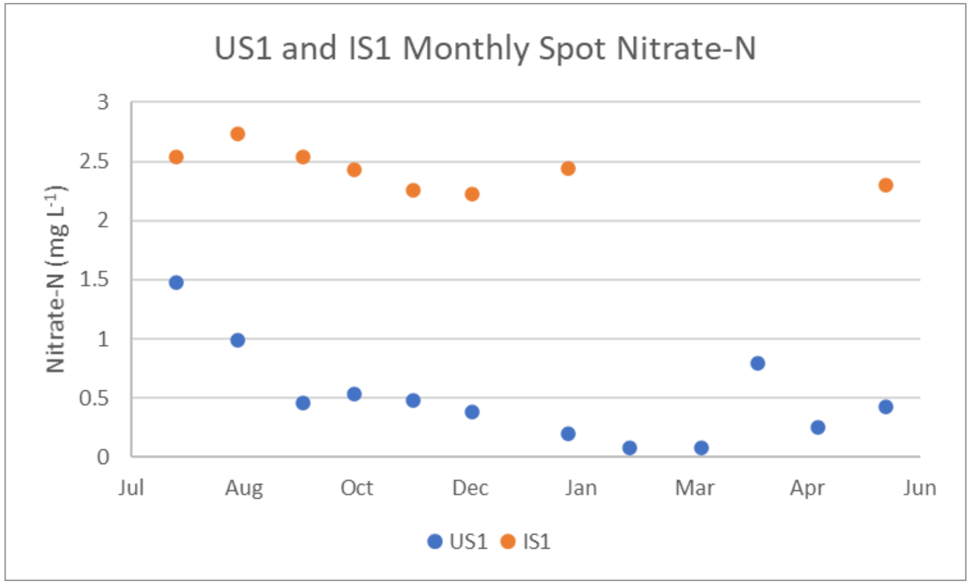
Results in the above Figure that were below the <0.005 detection limit have been displayed as 0.005 mg L-1.

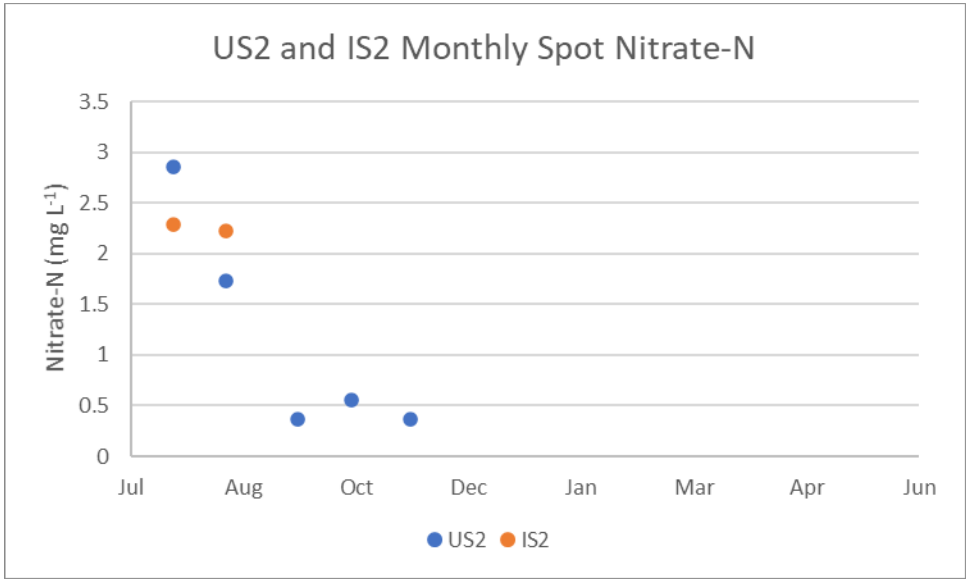


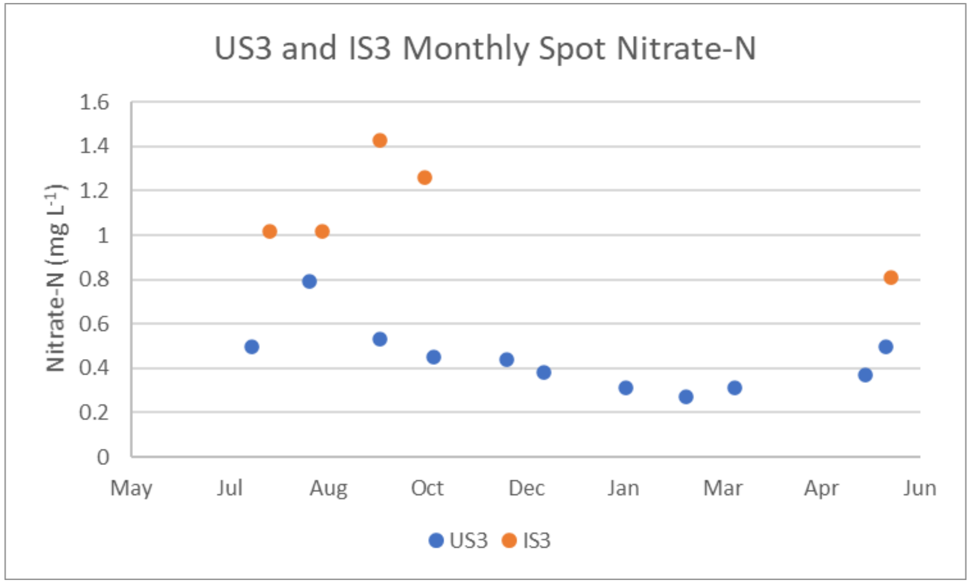
Results in the above Figure that were below the <0.005 detection limit have been displayed as 0.005 mg L-1.

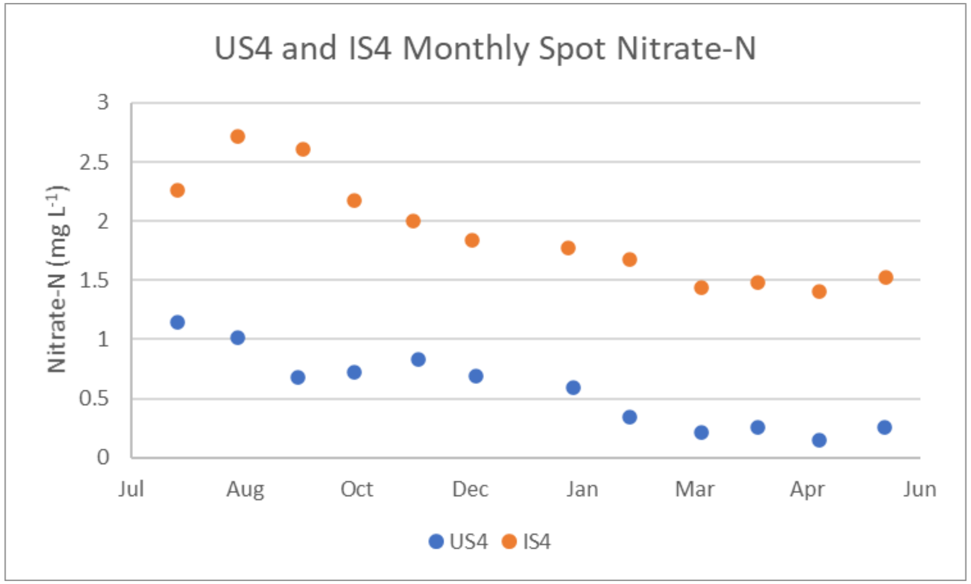


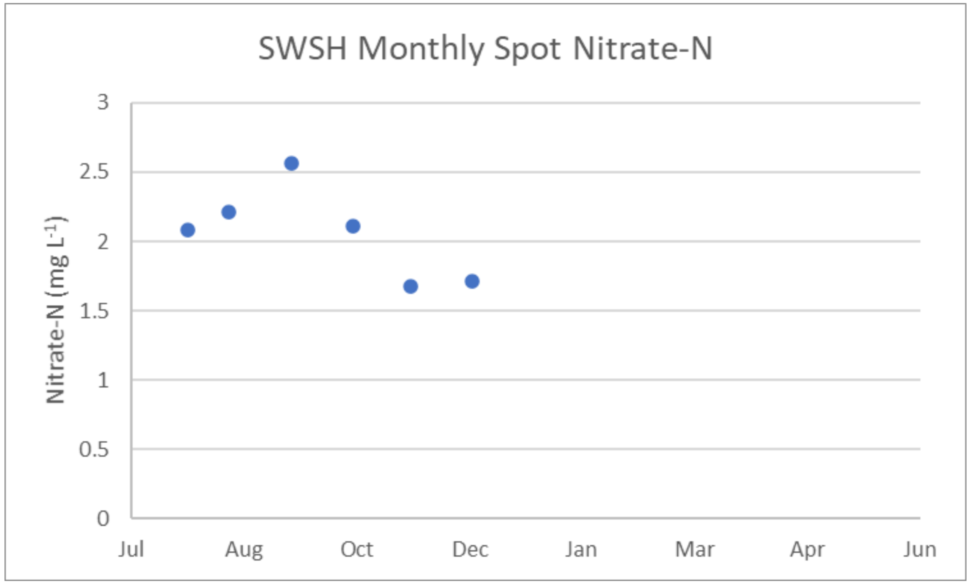


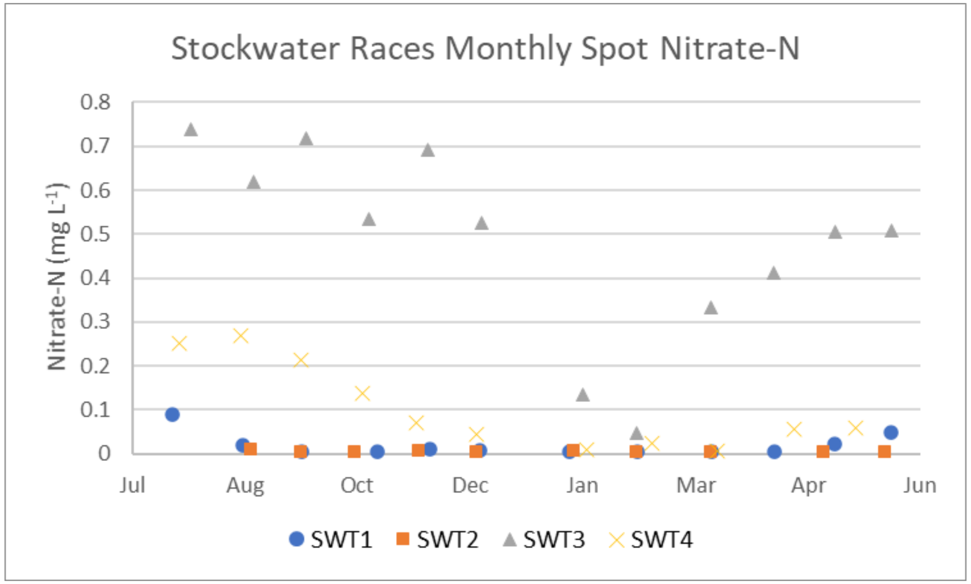

US1 and IS1 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
3
2.5
2
1.5
1
0.5
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
US1
IS1


US2 and IS2 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
3.5
3
2.5
2
1.5
1
0.5
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
US2
IS2


US3 and IS3 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
May
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
US3
IS3


US4 and IS4 Monthly Spot Nitrate-N
Nitrate-N (mg L-1)
3
2.5
2
1.5
1
0.5
0
Jul
Aug
Oct
Dec
Jan
Mar
Apr
Jun
US4
IS4





Results in the above Figure that were below the <0.005 detection limit have been displayed as 0.005 mg L^{-1}.

6.4. Lake Water Quality Monitoring Results (ECan data)

Kaituna Lagoon	22/07/2019	12/08/2019	10/09/2019	17/10/2019	25/11/2019	10/12/2019	13/01/2020	20/02/2020	12/03/2020	29/04/2020	18/05/2020	22/06/2020
Ammoniacal-N (mg/L)	<0.010	0.020	0.028	0.016	0.005	0.005	0.021	0.008	0.005	0.010	0.015	0.005
Nitrate + Nitrite-N (mg/L)	0.045	0.001	0.028	0.002	0.002	0.001	0.003	0.001	0.001	0.020	0.001	0.002
Total Nitrogen (mg/L)	1.39	1.74	1.77	1.69	2.40	1.32	1.76	2.20	2.00	1.81	2.10	1.41
Chlorophyll A (μg/L)	37	50	71	50	88	42	48	100	59	103	63	47
Dissolved Oxygen	70.2	85.7	111.5	78.5	124.6	75.3	71.2	127.6	116.8	101.1	89.9	104.8
Electrical Conductivity (mS/m)	1241.0	913.1	742.9	961.2	936.0	1239.9	1363.3	1445.7	1501.2	1420.0	1429.8	1084.5
E coli (MPN/100ml)	305	41	20	146	52	259	1309	145	408	167	63	62
Dissolved Reactive Phosphorus (mg/L)	0.0040	0.0138	0.0043	0.0027	0.0024	0.0080	0.0035	0.0033	0.0092	0.0000	0.0032	0.0086
Total Phosphorus (mg/L)	0.127	0.166	0.135	0.158	0.270	0.180	0.178	0.270	0.430	0.210	0.184	0.126
pH	7.81	7.70	8.54	8.02	8.44	8.13	7.66	8.42	8.44	8.05	8.01	8.21
Temperature (DegC)	9.4	7.8	10.1	15.1	21.9	18.5	18.2	22.6	16.9	12.0	8.9	8.2
Turbidity (NTU)	39.0	28.0	62.0	30.0	76.0	30.0	61.0	55.0	103.0	52.0	27.0	19.9

Off Selwyn River Mouth	22/07/19	12/08/19	10/09/19	17/10/19	25/11/19	10/12/19	13/01/20	20/02/20	12/03/20	18/05/20	22/06/20
Ammoniacal-N (mg/L)	0.026	0.01	0.026	0.014	0.005	0.012	0.022	0.033	0.05	0.016	0.005
Nitrate + Nitrite-N (mg/L)	0.67	0.71	0.49	0.008	0.002	0.001	0.004	0.001	0.01	0.001	0.001
Total Nitrogen (mg/L)	2.00	2.20	2.40	2.20	2.80	3.10	2.90	3.00	2.80	2.70	2.60
Chlorophyll A (μg/L)	52	62	114	110	140	150	107	140	120	97	120
Dissolved Oxygen	107.3	111.9	116.6	122.2	102.0	116.4	103.6	115.5	116.2	114.8	109.0
Electrical Conductivity (mS/m)	1031.4	935.3	1253.2	1091.6	1333.2	1167.0	1449.9	1397.2	1485.9	1365.8	1265.2
E coli (MPN/100ml)	369	31	<10	10	52	168	10	10	10	10	10
Dissolved Reactive Phosphorus (mg/L)	0.0049	0.0036	0.0035	0.0031	0.0030	0.0034	0.0021	0.0043	0.0100	0.0041	0.0063
Total Phosphorus (mg/L)	0.130	0.097	0.091	0.100	0.280	0.220	0.380	0.250	0.270	0.197	0.172
pH	8.49	8.34	8.61	9.22	8.70	8.81	8.04	8.64	8.49	8.68	8.30
Temperature (DegC)	8.7	8.2	9.0	14.9	16.4	19.3	17.9	19.9	15.3	10.0	8.0
Turbidity (NTU)	90.0	35.0	42.0	36.0	164.0	115.0	250.0	93.0	105.0	35.0	33.0

April 2020 Monitoring round not completed due to Covid-19 restrictions.

Mid Lake	22/07/2019	12/08/2019	10/09/2019	17/10/2019	25/11/2019	10/12/2019	13/01/2020	20/02/2020	12/03/2020	18/05/2020	22/06/2020
Ammoniacal-N (mg/L)	<0.01	0.019	0.026	0.021	0.01	0.005	0.023	0.027	0.005	0.016	0.005
Nitrate + Nitrite-N (mg/L)	0.69	0.041	<0.001	0.002	0.002	0.001	0.003	0.001	0.001	0.001	0.002
Total Nitrogen (mg/L)	2.40	1.79	1.92	1.99	2.50	1.99	3.50	2.90	2.70	2.70	2.50
Chlorophyll A (μg/L)	60	80	94	100	150	140	130	80	120	122	100
Dissolved Oxygen	117.6	105.3	110.2	117.4	92.9	107.8	1000.0	99.0	91.4	102.4	100.0
Electrical Conductivity (mS/m)	1389.1	1193.1	1517.8	1211.1	1480.3	1470.3	1388.1	1493.1	1475.4	1453.0	1334.9
E coli (MPN/100ml)	132	<10	<10	10	10	10	10	10	10	10	10
Dissolved Reactive Phosphorus (mg/L)	0.0080	0.0034	0.0030	0.0032	0.0030	0.0021	0.0019	0.0030	0.0043	0.0037	0.0058
Total Phosphorus (mg/L)	0.143	0.101	0.090	0.089	0.290	0.220	0.300	0.220	0.260	0.200	0.189
pH	8.56	8.35	8.61	9.16	8.70	8.59	8.48	8.46	8.39	8.47	7.99
Temperature (DegC)	8.6	7.3	8.4	16.0	16.5	18.3	17.8	20.5	13.6	10.4	7.7
Turbidity (NTU)	50.0	36.0	38.0	24.0	165.0	110.0	171.0	44.0	93.0	29.0	46.0

April 2020 Monitoring round not completed due to Covid-19 restrictions.

South of Timber Yard	22/07/19	12/08/19	10/09/19	17/10/19	25/11/19	10/12/19	13/01/20	20/02/20	12/03/20	18/05/20	22/06/20
Ammoniacal-N (mg/L)	0.021	0.019	0.027	0.025	0.005	0.005	0.023	0.025	0.005	0.014	0.005
Nitrate + Nitrite-N (mg/L)	0.0031	0.4	0.126	0.019	0.002	0.001	0.003	0.001	0.001	0.001	0.002
Total Nitrogen (mg/L)	1.85	2.00	2.30	2.00	2.70	3.00	2.80	2.80	2.60	2.70	2.50
Chlorophyll A (µg/L)	69	74	115	130	140	160	120	120	90	117	108
Dissolved Oxygen	104.1	114.0	114.3	136.1	94.7	111.7	113.2	111.6	106.1	114.2	124.1
Electrical Conductivity (mS/m)	1401.7	1081.7	1454.9	1033.3	1342.4	1415.9	1409.1	1419.7	1476.1	1339.9	1270.3
E coli (MPN/100ml)	20	<10	<10	10	10	10	10	10	10	10	10
Dissolved Reactive Phosphorus (mg/L)	0.0033	0.0037	0.0032	0.0034	0.0029	0.0021	0.0020	0.0033	0.0041	0.0040	0.0059
Total Phosphorus (mg/L)	0.087	0.103	0.119	0.107	0.320	0.260	0.260	0.200	0.220	0.178	0.172
pH	8.68	8.52	8.65	9.31	8.81	8.77	8.64	8.78	8.58	8.67	8.53
Temperature (DegC)	8.6	7.8	8.5	15.1	16.9	18.3	18.2	20.4	14.2	9.8	8.1
Turbidity (NTU)	27.0	38.0	78.0	36.0	230.0	153.0	121.0	92.0	55.0	28.0	36.0

April 2020 Monitoring round not completed due to Covid-19 restrictions.

Taumutu	22/07/19	12/08/19	10/09/19	17/10/19	25/11/19	10/12/19	13/01/20	20/02/20	12/03/20	18/05/20	22/06/20
Ammoniacal-N (mg/L)	0.021	0.02	0.027	0.016	0.005	0.005	0.022	0.024	0.006	0.017	0.005
Nitrate + Nitrite-N (mg/L)	0.017	<0.001	0.31	0.061	0.002	0.001	0.002	0.001	0.001	0.001	0.002
Total Nitrogen (mg/L)	1.57	1.71	1.98	2.20	3.20	2.10	3.20	2.80	2.60	2.70	2.50
Chlorophyll A (µg/L)	69	85	92	110	120	160	150	130	100	131	131
Dissolved Oxygen	114.2	115.8	113.3	123.8	99.8	125.4	112.5	110.1	91.8	118.4	119.0
Electrical Conductivity (mS/m)	1394.3	1186.6	1503.9	1102.6	1481.5	1425.3	1313.5	1519.5	1462.6	1370.9	1263.1
E coli (MPN/100ml)	<10	<10	<10	10	10	10	63	10	10	10	10
Dissolved Reactive Phosphorus (mg/L)	0.0039	0.0035	0.0032	0.0033	0.0025	0.0025	0.0039	0.0031	0.0045	0.0038	0.0060
Total Phosphorus (mg/L)	0.062	0.096	0.070	0.091	0.330	0.178	0.290	0.200	0.230	0.191	0.177
pH	8.69	8.77	8.76	9.23	8.72	8.87	8.71	8.72	8.52	8.92	8.49
Temperature (DegC)	8.7	7.5	8.1	15.4	17.5	20.1	17.6	20.0	13.5	10.0	7.8
Turbidity (NTU)	21.0	30.0	36.0	33.0	191.0	103.0	161.0	57.0	79.0	25.0	38.0

April 2020 Monitoring round not completed due to Covid-19 restrictions.

6.5. Groundwater Quality Monitoring Data

BW22/0041	12/09/2019	10/12/2019	6/03/2020	15/06/2020
Groundwater Level (mbgl)	6.315	6.760	7.380	7.355
Alkalinity (mg L^{-1})	28	30	32	31
Bromide(mg L^{-1})	0.03	0.03	0.03	0.03
Chloride (mg L^{-1})	7.44	7.13	6.92	6.54
Dissolved Oxygen (% Sat.)	90.2	81.6	78.5	89.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.010	0.011	0.011	0.010
Electrical Conductivity (mS/m)	17.5	16.7	16.5	16.0
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	6.73	5.85	5.22	4.87
Total Nitrogen (mg L^{-1})	6.49	5.64	4.64	4.97
pH	6.9	6.6	6.4	6.6
Sulphate (mg L^{-1})	13.4	11.6	11.4	10.8
Temperature (DegC)	12.0	6.3	11.5	11.8
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BW22/0042	12/09/2019	9/12/2019	5/03/2020	9/06/2020
Groundwater Level (mbgl)	16.150	20.015	20.570	20.340
Alkalinity (mg L^{-1})	45	48	49	45
Bromide(mg L^{-1})	0.04	0.04	0.05	0.03
Chloride (mg L^{-1})	8.01	14.70	18.60	10.60
Dissolved Oxygen (% Sat.)	70.3	69.8	76.7	70.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.009	0.009	0.005	0.006
Electrical Conductivity (mS/m)	22.2	29.3	34.0	24.8
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	4.54	8.25	11.50	6.66
Total Nitrogen (mg L^{-1})	4.52	8.09	10.70	6.73
pH	6.7	6.8	6.9	6.4
Sulphate (mg L^{-1})	26.0	32.1	34.4	23.1
Temperature (DegC)	11.9	12.1	11.6	11.4
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX21/0017	11/09/2019	10/12/2019	5/03/2020	9/06/2020
Groundwater Level (mbgl)	8.565	9.250	9.395	9.490
Alkalinity (mg L^{-1})	29	30	30	28
Bromide(mg L^{-1})	0.05	0.04	0.04	0.04
Chloride (mg L^{-1})	14.70	12.80	13.50	13.10
Dissolved Oxygen (% Sat.)	76.5	79.0	75.7	82.2
Dissolved Reactive Phosphorus (mg L^{-1})	0.013	0.017	0.015	0.013
Electrical Conductivity (mS/m)	29.0	25.4	24.6	23.7
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	17.40	13.00	12.60	11.80
Total Nitrogen (mg L^{-1})	16.90	12.60	11.20	11.60
pH	6.6	6.5	6.5	6.1
Sulphate (mg L^{-1})	14.5	15.4	14.2	13.2
Temperature (DegC)	12.0	6.1	12.0	11.9
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX21/0018	5/09/2019	10/12/2019	3/03/2020	9/06/2020
Groundwater Level (mbgl)	78.290	78.980	82.720	81.065
Alkalinity (mg L^{-1})	68	59	62	55
Bromide(mg L^{-1})	<0.02	<0.02	<0.02	<0.02
Chloride (mg L^{-1})	7.02	7.67	6.82	8.38
Dissolved Oxygen (% Sat.)	96.8	95.0	98.5	95.5
Dissolved Reactive Phosphorus (mg L^{-1})	0.015	0.016	0.012	0.012
Electrical Conductivity (mS/m)	20.5	20.0	19.8	19.7
E. coli (MPN/100ml)	3	<1	<1	<1
Nitrate-N (mg L^{-1})	2.65	3.00	2.63	3.34
Total Nitrogen (mg L^{-1})	2.62	2.98	2.62	3.47
pH	8.0	8.0	8.0	7.9
Sulphate (mg L^{-1})	9.2	9.4	9.5	9.7
Temperature (DegC)	11.4	8.0	13.1	11.3
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0041	11/09/2019	11/12/2019	5/03/2020	10/06/2020
Groundwater Level (mbgl)	19.575	20.180	20.725	21.340
Alkalinity (mg L^{-1})	55	50	51	47
Bromide(mg L^{-1})	0.04	0.03	0.04	0.05
Chloride (mg L^{-1})	10.50	10.00	10.90	10.50
Dissolved Oxygen (% Sat.)	68.3	58.6	63.0	71.1
Dissolved Reactive Phosphorus (mg L^{-1})	0.008	0.007	0.007	0.007
Electrical Conductivity (mS/m)	21.9	20.5	21.7	19.9
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	5.73	5.14	6.11	4.93
Total Nitrogen (mg L^{-1})	5.55	5.09	5.72	4.93
pH	8.0	7.5	7.3	7.0
Sulphate (mg L^{-1})	8.9	7.9	9.0	8.5
Temperature (DegC)	12.0	13.1	12.5	11.6
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0042	9/09/2019	11/12/2019	3/03/2020	10/06/2020
Groundwater Level (mbgl)	41.790	41.620	43.205	43.425
Alkalinity (mg L^{-1})	45	41	47	45
Bromide(mg L^{-1})	0.05	0.02	0.05	0.05
Chloride (mg L^{-1})	14.50	5.91	13.10	14.00
Dissolved Oxygen (% Sat.)	91.2	92.6	93.0	93.1
Dissolved Reactive Phosphorus (mg L^{-1})	0.007	0.006	<0.005	0.011
Electrical Conductivity (mS/m)	23.0	14.4	22.7	23.0
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	8.52	2.17	7.45	8.04
Total Nitrogen (mg L^{-1})	8.07	2.15	7.02	7.74
pH	7.3	8.0	7.5	7.2
Sulphate (mg L^{-1})	6.7	6.1	7.4	7.8
Temperature (DegC)	11.4	13.5	13.5	11.7
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0043	9/09/2019	11/12/2019	10/03/2020	10/06/2020
Groundwater Level (mbgl)	54.100	55.460	59.910	56.195
Alkalinity (mg L^{-1})	70	72	81	69
Bromide(mg L^{-1})	0.06	0.06	0.07	0.07
Chloride (mg L^{-1})	16.20	24.30	23.80	23.20
Dissolved Oxygen (% Sat.)	92.9	89.8	88.3	96.9
Dissolved Reactive Phosphorus (mg L^{-1})	0.007	0.008	<0.005	0.009
Electrical Conductivity (mS/m)	32.2	40.8	40.6	38.4
E. coli (MPN/100ml)	1	<1	<1	<1
Nitrate-N (mg L^{-1})	10.70	15.40	15.20	15.70
Total Nitrogen (mg L^{-1})	10.30	15.10	14.50	15.20
pH	7.8	8.1	8.1	7.8
Sulphate (mg L^{-1})	17.7	18.5	18.7	19.4
Temperature (DegC)	11.1	13.5	12.0	11.9
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0044	11/09/2019	12/12/2019	11/03/2020	15/06/2020
Groundwater Level (mbgl)	4.660	4.980	5.250	5.860
Alkalinity (mg L^{-1})	40	41	43	44
Bromide(mg L^{-1})	0.04	0.03	0.03	0.04
Chloride (mg L^{-1})	9.73	8.46	7.97	7.80
Dissolved Oxygen (% Sat.)	70.5	73.5	77.4	82.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.011	0.012	0.010	0.012
Electrical Conductivity (mS/m)	20.9	18.7	18.2	18.4
E. coli (MPN/100ml)	1	<1	<1	<1
Nitrate-N (mg L^{-1})	6.93	4.78	4.30	4.15
Total Nitrogen (mg L^{-1})	6.62	4.87	4.15	4.23
pH	6.8	6.6	6.7	6.4
Sulphate (mg L^{-1})	14.1	13.1	11.1	10.9
Temperature (DegC)	12.2	12.1	12.8	12.9
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0046	11/09/2019	11/12/2019	11/03/2020	10/06/2020
Groundwater Level (mbgl)	7.270	7.980	8.690	8.965
Alkalinity (mg L^{-1})	67	61	63	66
Bromide(mg L^{-1})	0.07	0.06	0.05	0.05
Chloride (mg L^{-1})	14.00	14.00	13.10	13.10
Dissolved Oxygen (% Sat.)	76.4	76.8	80.1	81.3
Dissolved Reactive Phosphorus (mg L^{-1})	0.011	0.008	0.008	0.008
Electrical Conductivity (mS/m)	36.2	35.3	34.6	34.6
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	16.50	16.20	15.10	14.60
Total Nitrogen (mg L^{-1})	15.50	15.30	14.60	14.20
pH	7.9	7.4	7.0	6.7
Sulphate (mg L^{-1})	18.3	19.3	20.5	20.6
Temperature (DegC)	12.3	12.9	12.2	12.4
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0053	9/09/2019	12/12/2019	11/03/2020	15/06/2020
Groundwater Level (mbgl)	35.515	37.405	40.885	39.165
Alkalinity (mg L^{-1})	54	62	56	53
Bromide(mg L^{-1})	0.04	0.05	0.05	0.06
Chloride (mg L^{-1})	11.30	12.60	13.50	15.50
Dissolved Oxygen (% Sat.)	90.8	88.4	87.2	95.1
Dissolved Reactive Phosphorus (mg L^{-1})	0.011	0.010	0.007	0.008
Electrical Conductivity (mS/m)	23.1	27.4	27.1	28.6
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	6.63	8.86	10.20	11.00
Total Nitrogen (mg L^{-1})	6.20	8.91	10.20	10.60
pH	7.7	7.8	7.7	7.5
Sulphate (mg L^{-1})	11.8	12.7	12.5	11.9
Temperature (DegC)	11.9	12.7	11.9	12.2
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0065	12/09/2019	9/12/2019	3/03/2020	11/06/2020
Groundwater Level (mbgl)	5.335	8.065	11.000	10.680
Alkalinity (mg L^{-1})	42	35	29	44
Bromide(mg L^{-1})	0.05	0.10	0.08	0.06
Chloride (mg L^{-1})	16.80	33.80	24.80	21.40
Dissolved Oxygen (% Sat.)	94.4	68.8	74.9	89.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.009	0.010	0.009	0.013
Electrical Conductivity (mS/m)	25.7	41.6	32.8	31.5
E. coli (MPN/100ml)	<1	21	89	<1
Nitrate-N (mg L^{-1})	8.99	18.40	13.20	13.00
Total Nitrogen (mg L^{-1})	8.90	17.50	12.70	12.60
pH	7.4	6.3	6.5	6.6
Sulphate (mg L^{-1})	15.4	36.6	29.1	20.4
Temperature (DegC)	12.5	12.6	14.0	12.6
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0066	10/09/2019	12/12/2019	9/03/2020	15/06/2020
Groundwater Level (mbgl)	15.840	17.370	21.505	23.885
Alkalinity (mg L^{-1})	48	49	44	41
Bromide(mg L^{-1})	0.06	0.06	0.06	0.05
Chloride (mg L^{-1})	15.50	15.50	18.30	17.20
Dissolved Oxygen (% Sat.)	76.5	67.8	69.1	71.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.011	0.008	0.009	0.009
Electrical Conductivity (mS/m)	27.1	29.3	29.7	28.9
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	8.50	9.68	12.00	11.20
Total Nitrogen (mg L^{-1})	8.18	9.61	11.10	10.70
pH	6.8	6.9	7.0	6.7
Sulphate (mg L^{-1})	21.9	24.6	24.4	20.4
Temperature (DegC)	12.0	13.6	13.1	12.1
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0067	10/09/2019	12/12/2019	6/03/2020	11/06/2020
Groundwater Level (mbgl)	24.600	29.140	32.205	30.500
Alkalinity (mg L^{-1})	44	43	39	51
Bromide(mg L^{-1})	0.10	0.10	0.10	0.10
Chloride (mg L^{-1})	31.70	25.80	29.00	27.80
Dissolved Oxygen (% Sat.)	77.8	75.0	72.9	86.7
Dissolved Reactive Phosphorus (mg L^{-1})	0.013	0.021	0.007	0.010
Electrical Conductivity (mS/m)	40.4	35.3	34.9	37.7
E. coli (MPN/100ml)	<1	>200	170	1
Nitrate-N (mg L^{-1})	19.50	15.40	14.60	15.70
Total Nitrogen (mg L^{-1})	18.40	15.40	12.70	15.30
pH	6.6	6.7	6.4	6.5
Sulphate (mg L^{-1})	24.0	19.6	22.1	21.0
Temperature (DegC)	12.1	13.0	13.1	12.3
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0068	10/09/2019	13/12/2019	9/03/2020	11/06/2020
Groundwater Level (mbgl)	58.700	60.115	62.135	60.940
Alkalinity (mg L^{-1})	25	41	44	41
Bromide(mg L^{-1})	0.10	0.07	0.06	0.04
Chloride (mg L^{-1})	52.90	17.40	16.60	11.60
Dissolved Oxygen (% Sat.)	83.0	74.9	84.0	93.9
Dissolved Reactive Phosphorus (mg L^{-1})	0.007	0.010	0.009	0.015
Electrical Conductivity (mS/m)	473.7	28.5	27.1	18.0
E. coli (MPN/100ml)	<1	<1	<1	3
Nitrate-N (mg L^{-1})	21.50	14.50	13.00	4.81
Total Nitrogen (mg L^{-1})	18.20	13.90	12.60	4.93
pH	7.2	7.6	7.8	7.7
Sulphate (mg L^{-1})	21.1	9.0	7.6	4.4
Temperature (DegC)	11.3	12.5	12.3	11.7
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0069	6/09/2019	13/12/2019	6/03/2020	8/06/2020
Groundwater Level (mbgl)	47.700	48.555	52.050	52.065
Alkalinity (mg L^{-1})	38	34	30	30
Bromide(mg L^{-1})	0.08	0.08	0.06	0.04
Chloride (mg L^{-1})	23.70	18.50	14.00	14.50
Dissolved Oxygen (% Sat.)	72.8	82.2	102.4	104.7
Dissolved Reactive Phosphorus (mg L^{-1})	0.007	0.008	0.007	0.006
Electrical Conductivity (mS/m)	32.9	26.5	22.2	21.7
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	16.50	13.20	10.90	11.40
Total Nitrogen (mg L^{-1})	13.20	12.70	9.60	11.70
pH	7.1	7.3	7.1	6.9
Sulphate (mg L^{-1})	19.5	9.9	4.8	5.0
Temperature (DegC)	11.5	12.4	12.5	11.6
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0070	5/09/2019	9/12/2019	6/03/2020	8/06/2020
Groundwater Level (mbgl)	79.665	77.260	78.910	81.290
Alkalinity (mg L^{-1})	33	34	33	32
Bromide(mg L^{-1})	0.05	0.05	0.05	0.04
Chloride (mg L^{-1})	10.50	11.10	11.40	10.60
Dissolved Oxygen (% Sat.)	93.2	98.8	83.6	89.6
Dissolved Reactive Phosphorus (mg L^{-1})	0.009	0.009	0.006	0.007
Electrical Conductivity (mS/m)	18.9	19.1	19.5	18.1
E. coli (MPN/100ml)	62	<1	<1	<1
Nitrate-N (mg L^{-1})	8.10	8.47	8.79	7.65
Total Nitrogen (mg L^{-1})	4.86	8.10	7.80	7.66
pH	7.1	7.1	7.1	6.8
Sulphate (mg L^{-1})	5.3	3.5	5.1	6.1
Temperature (DegC)	10.9	12.1	11.6	10.9
Ammonia-N (mg L^{-1})	-	-	-	<0.01

BX22/0071	5/09/2019	9/12/2019	5/03/2020	8/06/2020
Groundwater Level (mbgl)	49.380	53.950	64.345	69.030
Alkalinity (mg L^{-1})	30	30	34	28
Bromide(mg L^{-1})	0.02	0.02	0.03	<0.02
Chloride (mg L^{-1})	6.70	6.73	7.53	6.90
Dissolved Oxygen (% Sat.)	86.7	80.3	71.1	99.0
Dissolved Reactive Phosphorus (mg L^{-1})	0.009	0.009	0.006	0.008
Electrical Conductivity (mS/m)	13.9	13.3	15.1	13.1
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	3.89	3.25	3.85	3.36
Total Nitrogen (mg L^{-1})	3.95	3.27	3.51	3.56
pH	6.8	6.9	7.1	7.4
Sulphate (mg L^{-1})	7.4	7.4	8.7	7.4
Temperature (DegC)	10.7	11.3	11.1	10.4
Ammonia-N (mg L^{-1})	-	-	-	<0.01

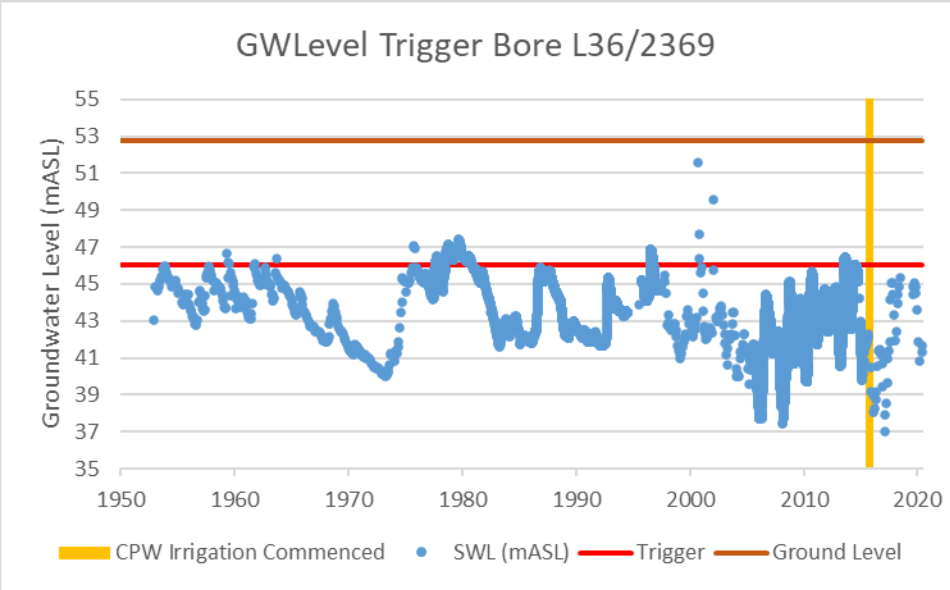
BX22/0072	12/09/2019	10/12/2019	3/03/2020	9/06/2020
Groundwater Level (mbgl)	7.765	9.645	19.005	20.110
Alkalinity (mg L^{-1})	32	36	40	40
Bromide(mg L^{-1})	0.05	0.04	0.04	0.04
Chloride (mg L^{-1})	11.80	11.70	10.40	10.20
Dissolved Oxygen (% Sat.)	84.3	76.3	72.3	67.6
Dissolved Reactive Phosphorus (mg L^{-1})	0.014	0.009	0.006	0.007
Electrical Conductivity (mS/m)	27.6	26.2	21.9	20.0
E. coli (MPN/100ml)	<1	<1	<1	<1
Nitrate-N (mg L^{-1})	17.30	13.90	8.49	6.12
Total Nitrogen (mg L^{-1})	16.40	13.30	7.78	5.95
pH	7.1	6.9	7.2	6.7
Sulphate (mg L^{-1})	9.4	11.0	10.2	10.9
Temperature (DegC)	12.6	6.5	13.2	11.7
Ammonia-N (mg L^{-1})	-	-	-	<0.01

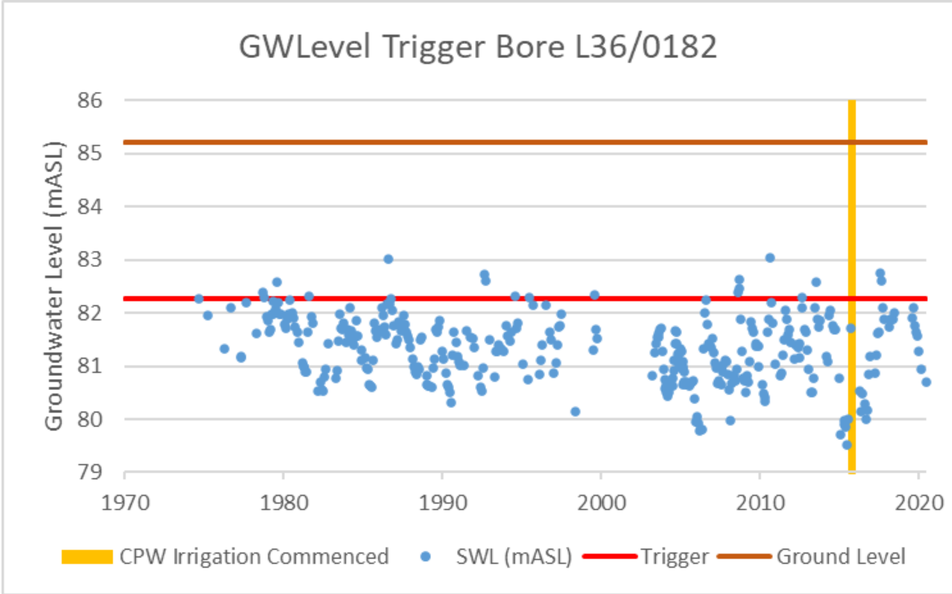
BX23/0423	6/09/2019	13/12/2019	9/03/2020	15/06/2020
Groundwater Level (mbgl)	24.535	30.135	30.740	33.175
Alkalinity (mg L^{-1})	34	36	30	35
Bromide(mg L^{-1})	0.08	0.08	0.08	0.07
Chloride (mg L^{-1})	17.60	15.80	18.90	12.30
Dissolved Oxygen (% Sat.)	99.5	92.7	85.4	100.3
Dissolved Reactive Phosphorus (mg L^{-1})	0.008	0.008	0.007	0.008
Electrical Conductivity (mS/m)	28.4	27.8	32.4	22.4
E. coli (MPN/100ml)	<1	<1	2	<1
Nitrate-N (mg L^{-1})	14.20	13.30	18.30	8.97
Total Nitrogen (mg L^{-1})	14.00	12.90	18.20	8.64
pH	7.0	7.0	7.5	6.9
Sulphate (mg L^{-1})	15.7	16.3	22.1	12.7
Temperature (DegC)	11.4	-	13.8	12.7
Ammonia-N (mg L^{-1})	-	-	-	<0.01

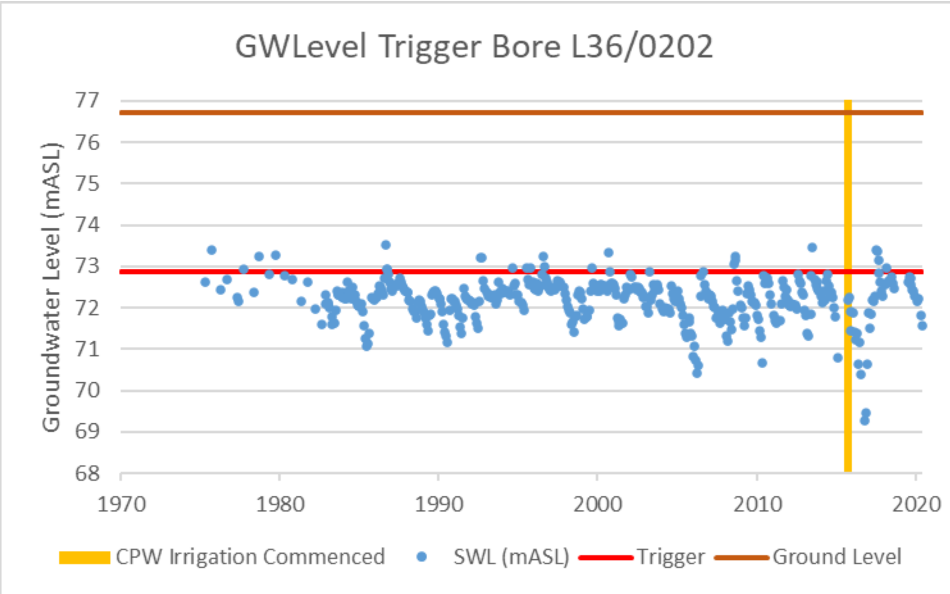
BX23/0424	10/09/2019	13/12/2019	11/03/2020	11/06/2020
Groundwater Level (mbgl)	40.560	40.220	45.820	46.390
Alkalinity (mg L^{-1})	49	47	44	35
Bromide(mg L^{-1})	0.08	0.09	0.07	0.07
Chloride (mg L^{-1})	22.70	18.90	18.80	19.10
Dissolved Oxygen (% Sat.)	66.8	64.0	76.8	80.2
Dissolved Reactive Phosphorus (mg L^{-1})	0.007	0.006	0.005	0.005
Electrical Conductivity (mS/m)	31.8	33.0	32.2	26.4
E. coli (MPN/100ml)	<1	<1	<1	16
Nitrate-N (mg L^{-1})	12.50	14.60	15.90	12.40
Total Nitrogen (mg L^{-1})	11.70	14.30	14.70	11.90
pH	7.1	7.1	7.7	7.1
Sulphate (mg L^{-1})	18.9	21.5	19.3	9.2
Temperature (DegC)	11.6	13.1	11.8	11.7
Ammonia-N (mg L^{-1})	-	-	-	<0.01

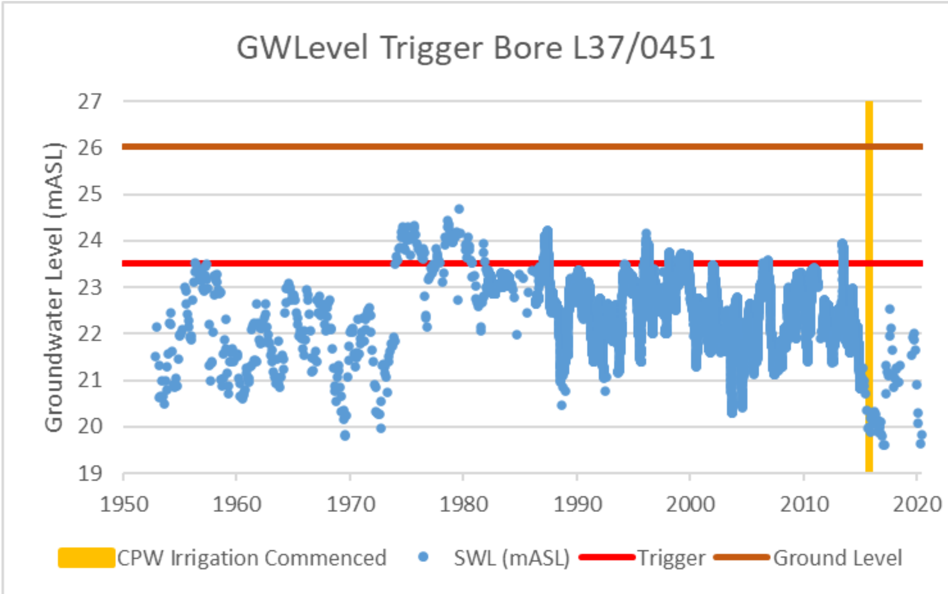
6.6. Lowland Groundwater Level Results (ECan Data)

L36/2369	Trigger	25-Jul-19	27-Aug-19	26-Sep-19		23-Oct-19	18-Nov-19	18-Dec-19	29-Jan-20	26-Feb-20	Mar-20	Apr-20	20-May-20	17-Jun-20
SWL (mASL)	>46.01	44.43	44.88	45.07		44.88	44.52	43.63	41.88	40.81	no data	no data	41.28	41.68
L36/0182	Trigger	25-Jul-19	27-Aug-19	26-Sep-19		23-Oct-19	18-Nov-19	18-Dec-19	Jan-20	26-Feb-20	Mar-20	Apr-20	May-20	17-Jun-20
SWL (mASL)	>82.26	81.91	82.11	81.76		81.64	81.57	81.27	no data	80.95	no data	no data	no data	80.69
L36/0202	Trigger	25-Jul-19	27-Aug-19	3-Sep-19	26-Sep-19	23-Oct-19	18-Nov-19	18-Dec-19	29-Jan-20	26-Feb-20	Mar-20	Apr-20	20-May-20	17-Jun-20
SWL (mASL)	>72.88	72.63	72.75	72.7	72.55	72.44	72.42	72.27	72.17	72.21	no data	no data	71.82	71.58
L37/0451	Trigger	25-Jul-19	27-Aug-19	26-Sep-19		23-Oct-19	21-Nov-19	18-Dec-19	29-Jan-20	26-Feb-20	Mar-20	Apr-20	20-May-20	17-Jun-20
SWL (mASL)	>23.5	21.54	21.93	22.02		21.87	21.65	20.91	20.3	20.08	no data	no data	19.64	19.83
M36/0250	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	21-Nov-19	17-Dec-19	28-Jan-20	25-Feb-20	Mar-20	Apr-20	May-20	18-Jun-20
SWL (mASL)	>16.1	-8.4	-8.13	-7.9		-7.76	-7.71	-8.07	-8.59	-8.95	no data	no data	no data	-9.03
M36/0183	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	21-Nov-19	17-Dec-19	28-Jan-20	25-Feb-20	Mar-20	Apr-20	19-May-20	16-Jun-20
SWL (mASL)	>23.82	21.77	22.37	22.75		22.81	22.61	22.01	21.17	20.71	no data	no data	20.81	20.94
M36/0419	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	21-Nov-19	17-Dec-19	28-Jan-20	25-Feb-20	Mar-20	Apr-20	May-20	16-Jun-20
SWL (mASL)	>33.5	33.36	33.37	33.18		33.12	32.96	32.48	32.23	32.15	no data	no data	no data	32.47
M36/0424	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	22-Nov-19	17-Dec-19	28-Jan-20	25-Feb-20	Mar-20	Apr-20	19-May-20	16-Jun-20
SWL (mASL)	>21.02	**21.03**	20.81	20.77		20.73	20.58	20.22	19.55	19.18	no data	no data	19.93	20.32
M36/0599	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	21-Nov-19	17-Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	16-Jun-20
SWL (mASL)	>13.63	13.59	13.4	13.45		13.39	13.31	13.06	no data	no data	no data	no data	no data	12.22
M36/0693	Trigger	25-Jul-19	27-Aug-19	26-Sep-19		23-Oct-19	21-Nov-19	17-Dec-19	29-Jan-20	26-Feb-20	Mar-20	Apr-20	May-20	17-Jun-20
SWL (mASL)	>21.53	19.6	19.87	20.05		20.08	19.85	19.23	18.5	18.11	no data	no data	no data	18.19
M36/7880	Trigger	24-Jul-19	26-Aug-19	25-Sep-19		22-Oct-19	21-Nov-19	17-Dec-19	28-Jan-20	25-Feb-20	Mar-20	Apr-20	19-May-20	16-Jun-20
SWL (mASL)	>35.14	**35.17**	35.14	35.11		35.11	35.07	34.88	34.57	34.37	no data	no data	34.45	34.54
M37/0010	Trigger	25-Jul-19	27-Aug-19	26-Sep-19		23-Oct-19	21-Nov-19	18-Dec-19	29-Jan-20	26-Feb-20	Mar-20	Apr-20	20-May-20	17-Jun-20
SWL (mASL)	>6.21	5.95	5.93	5.93		5.92	5.84	5.69	5.46	5.47	no data	no data	5.53	5.59


GWLevel Trigger Bore L36/2369
Groundwater Level (mASL)
55
53
51
49
47
45
43
41
39
37
35
1950
1960
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore L36/0182
Groundwater Level (mASL)
86
85
84
83
82
81
80
79
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore L36/0202
Groundwater Level (mASL)
77
76
75
74
73
72
71
70
69
68
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level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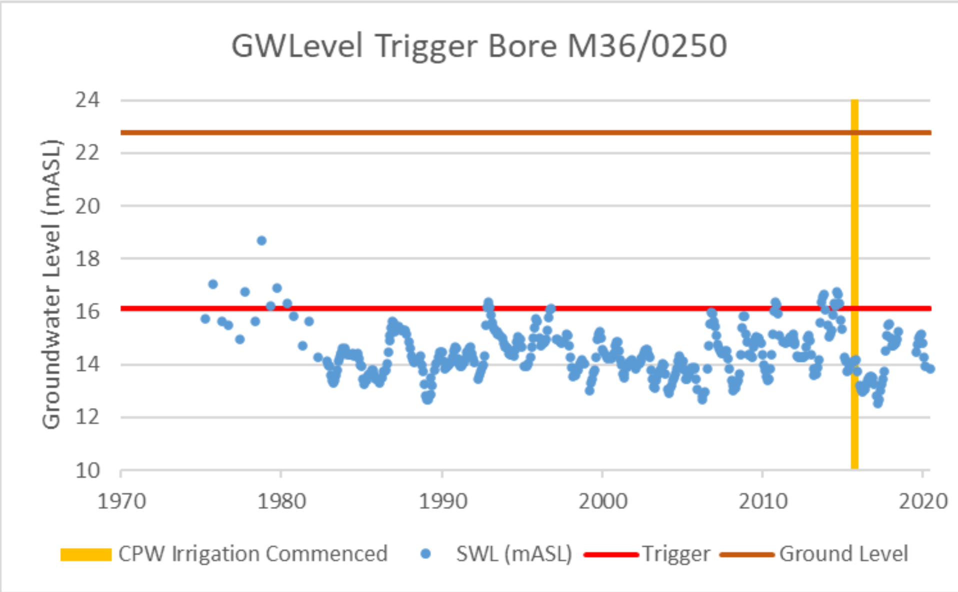
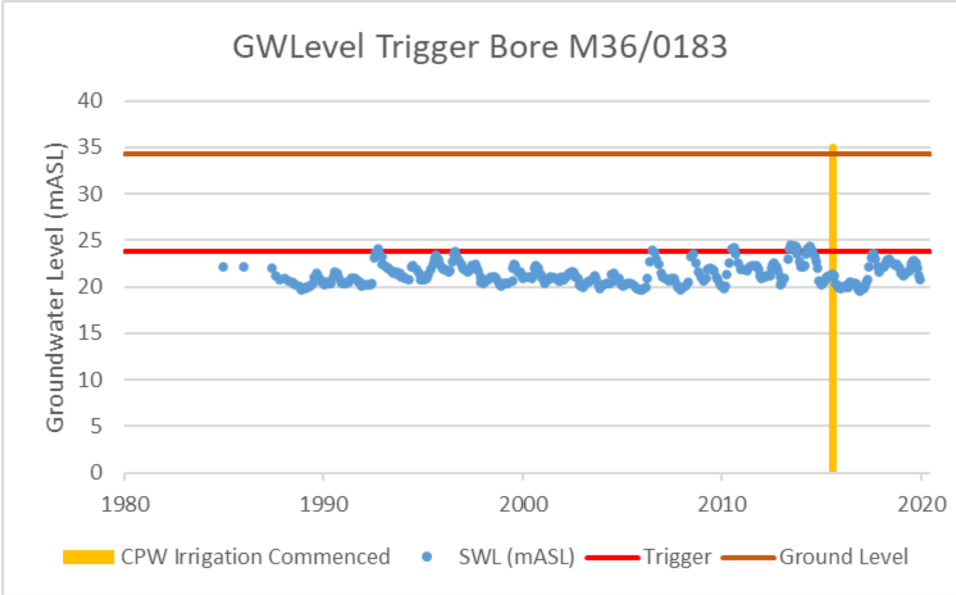
Groundwater Level (mASL)
27
26
25
24
23
22
21
20
19
1950
1960
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0250
Groundwater Level (mASL)
24
22
20
18
16
14
12
10
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level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Groundwater Level (mASL)
40
35
30
25
20
15
10
5
0
1980
1990
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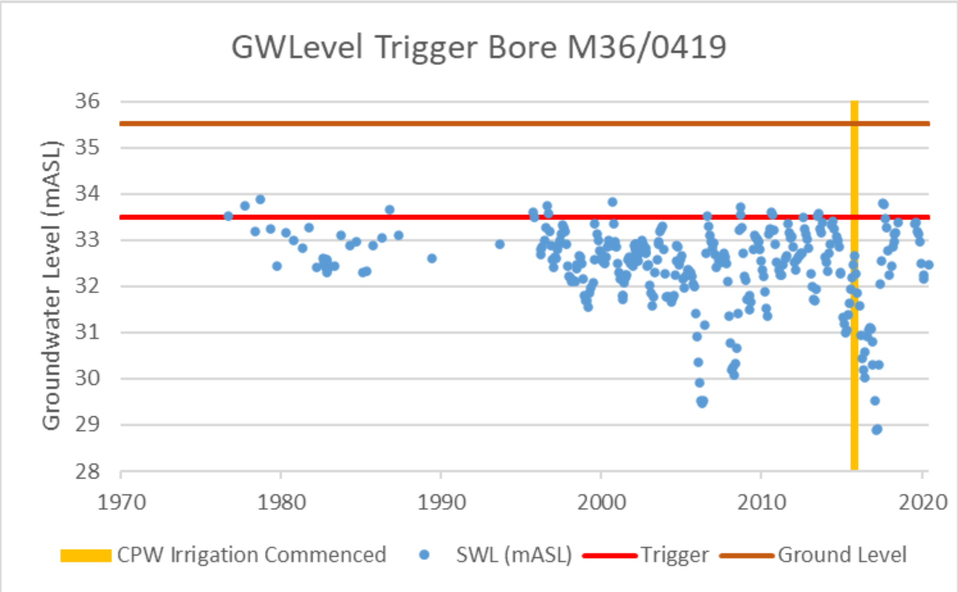
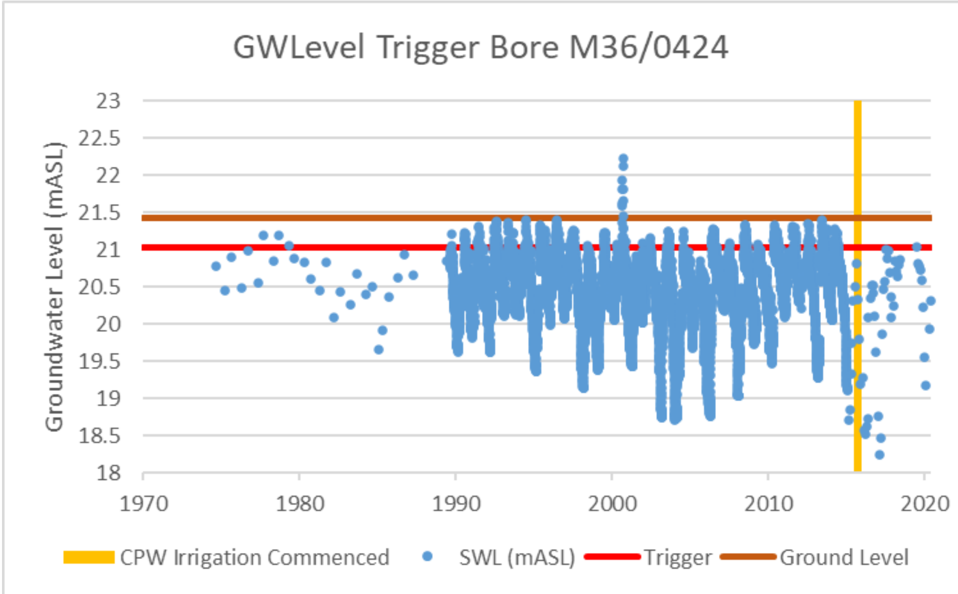
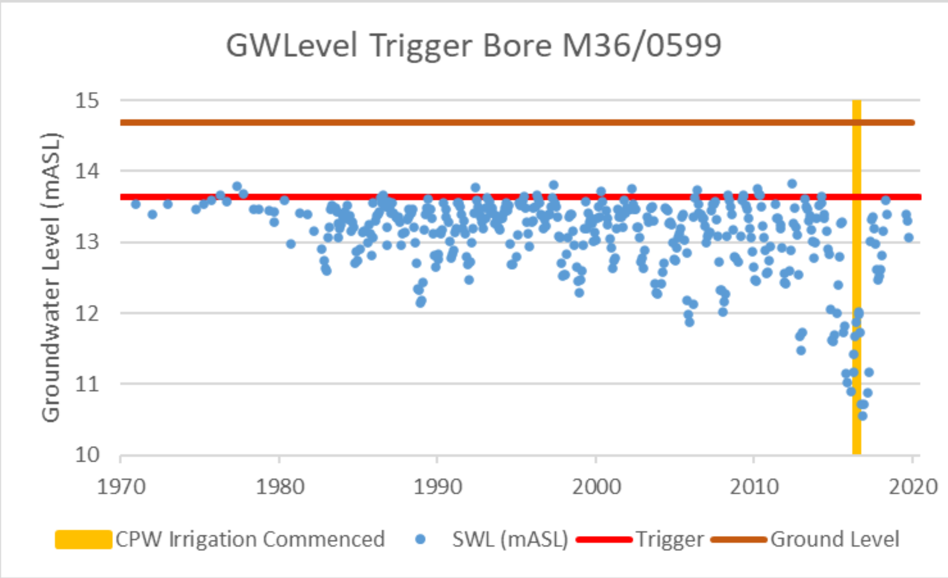
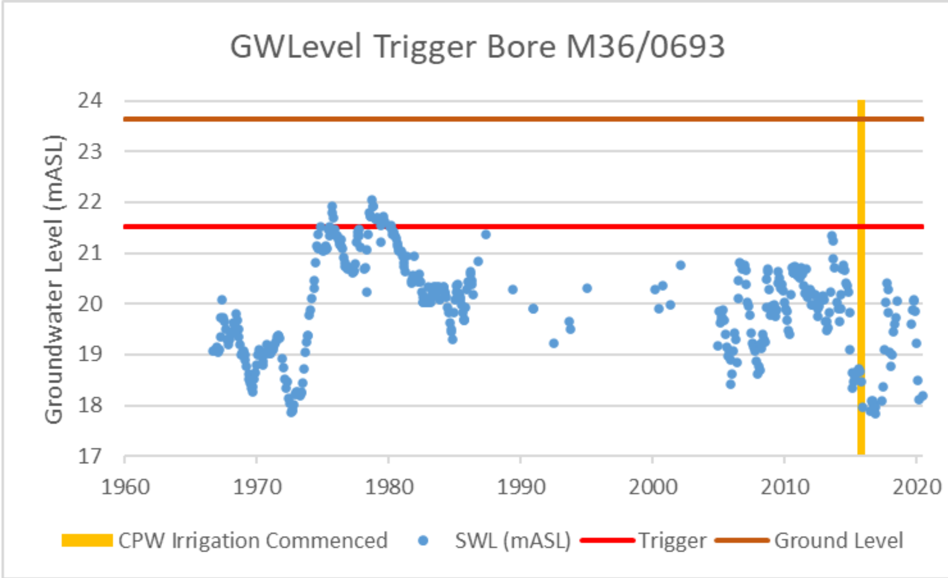
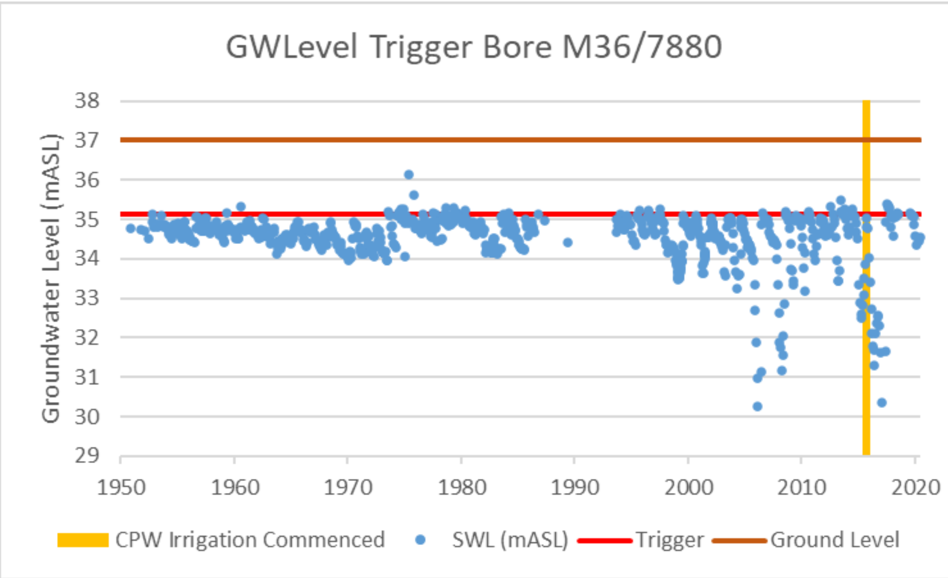
SWL (mASL)
Trigger
Ground Level

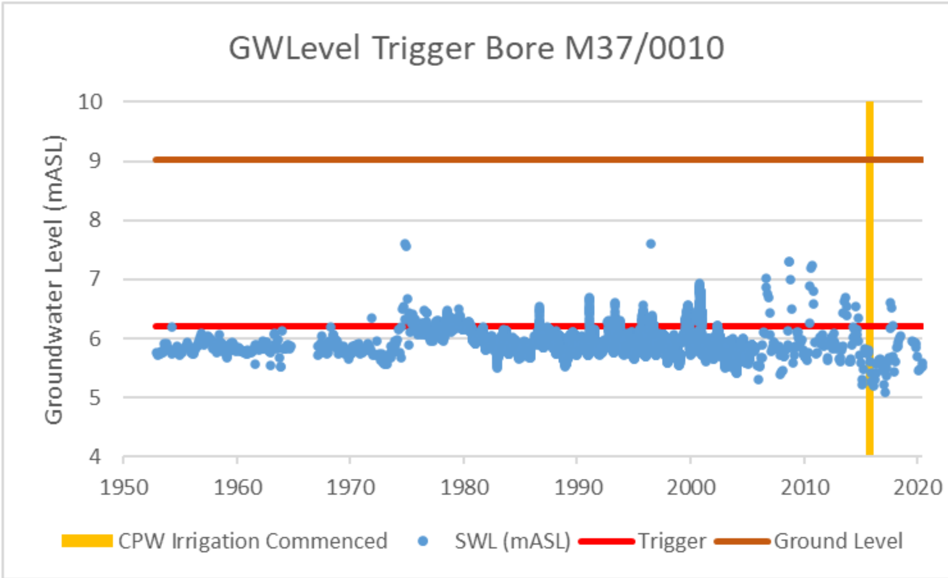

GWLevel Trigger Bore M36/0419
Groundwater Level (mASL)
36
35
34
33
32
31
30
29
28
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0424
Groundwater Level (mASL)
23
22.5
22
21.5
21
20.5
20
19.5
19
18.5
18
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0599
Groundwater Level (mASL)
15
14
13
12
11
10
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/0693
Groundwater Level (mASL)
24
23
22
21
20
19
18
17
1960
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M36/7880
Groundwater Level (mASL)
38
37
36
35
34
33
32
31
30
29
1950
1960
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level


GWLevel Trigger Bore M37/0010
Groundwater Level (mASL)
10
9
8
7
6
5
4
1950
1960
1970
1980
1990
2000
2010
2020
CPW Irrigation Commenced
SWL (mASL)
Trigger
Ground Level

6.7. Assessment of Compliance

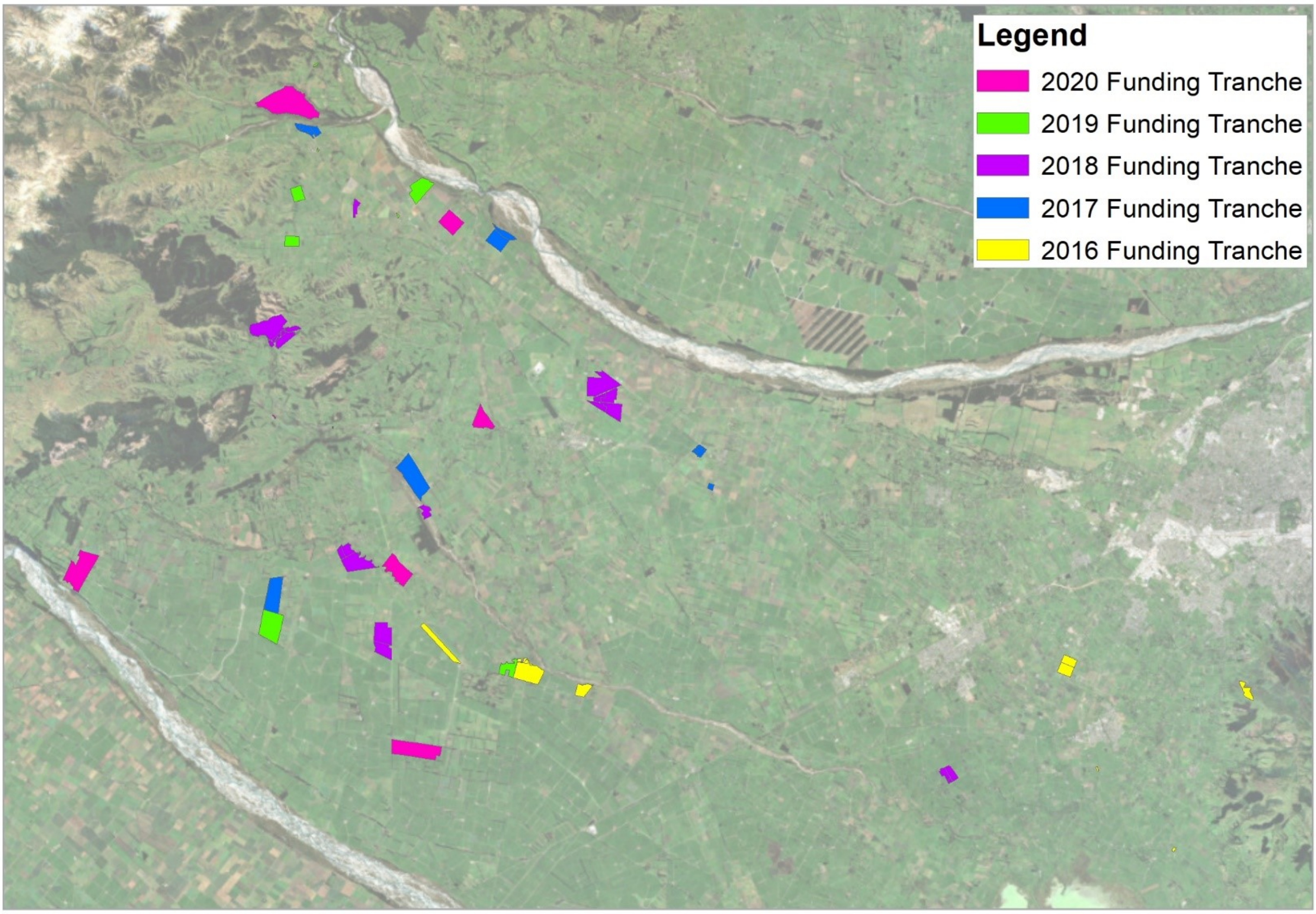
During 2019-20, 183 Farm Environment Plans were audited. 109 received an A-grade, 66 a B-grade and eight a C-grade. No plans received a D-grade during 2019-20. All properties that received a C-grade are provided a detailed list of actions that are required improve their audit grade and are assisted by CPWL with the aim of achieving a B-grade or better when next year (during the 2020-21 season).

Under the 2017 LWRP baseline CPW's allowance for the loss of Nitrogen is set at 3,644 tonnes/year. A 925 tonnes/year allocation was made for new irrigation (this includes the dryland baseline component), giving a total Nitrogen discharge allowance of 4,569 tonnes/year. CPW water users are required to reduce nitrogen losses by 24 percent (1,097 tonnes/year) of the original nitrogen loss allowance by 1 January 2022. The 2019-20 nitrogen Load for CPW water users is 3,276 tonnes/year which reflects a 28% reduction below the Schemes total nitrogen discharge allowance or a 10% reduction below the Baseline Load.

	tonnesN/yr
Baseline N Load	3,644
Allocation for New Irrigation	925
Total N Discharge Allowance	4,569
Current Load	3,276
Reduction below Total N Discharge Allowance	28%
Reduction below Baseline Load	10%

The FEP audit grades detailed above show that the majority of CPW water users are applying Good Management Practices to their farming operations which in turn means the reduction in nutrient losses required by the Matrix of Good Management are being met.

The location of projects that have received funding from the Environmental Management Fund are shown below.



Environmental Management Funded Projects Locations