MARLBOROUGH DISTRICT COUNCIL

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Water Quality Monitoring Summary for the Taylor River Improvement Project 2022

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Executive Summary

State of the Environment monitoring and detailed water quality investigations have shown that water quality in the Taylor River and its tributary Doctors Creek were degraded. The Taylor River Improvement Project was initiated with the aim of improving the ecological health of waterways within the Taylor River catchment. The project was largely funded by the Ministry for the Environment and included monthly monitoring of water quality at key sites within the catchment.

Eighteen stream and river sites were monitored as part of the project, with monitoring consisting of monthly grab samples that were analysed for a number of parameters. This report summarises the monitoring results for the three years 2020-2022. Results from two State of the Environment monitoring sites are also included.

The monitoring showed that water quality was generally poorest in the Doctors Creek sub catchment. Over the three-year monitoring period, most sites showed little year-to-year change, however, at a number of sites Dissolved Reactive Phosphorus concentrations increased. At some sites improvements were observed with decreases in E. coli concentrations and Turbidity.

One tributary of Doctors Creek, the Fairhall School Creek, showed some of the greatest changes over the three years of monitoring. While Ammoniacal Nitrogen and E. coli concentrations in this stream decreased, levels in Dissolved Reactive Phosphorus and Turbidity increased.

Despite the changes observed within the catchment, water quality at the two State of the Environment monitoring sites remained comparatively unchanged with the exception of a reduction in Turbidity in Doctors Creek.

The results clearly show that further improvement actions are required, particularly within the Doctors Creed sub catchment. To assess the effectiveness of further actions, it is recommended to repeat sampling of the sites in three- or five-year intervals using monthly sampling over a period of 12 months.

It is also recommended to follow up with an assessment of the current monitoring results in relation to the improvement actions carried out within the catchment. This will contribute to ensuring that future actions have the desired outcome of improving river health in the Taylor catchment.

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Abbreviations

DRP	Dissolved Reactive Phosphorus
NPS-FM	National Policy Statement for Freshwater Management
MEP	Marlborough Environment Plan
MfE	Ministry for the Environment
SoE	State of the Environment

1. Introduction

State of the Environment monitoring has shown that the lower Taylor River and its tributary Doctors Creek are degraded. A catchment study in 2013/2014 took a closer look at water quality throughout the catchment and identified the Doctors Creek tributary as the main contributor to poor stream health. The catchment study found several causes for degraded water quality. These included livestock access to water ways, bank erosion and maintenance works within tributary streams and the main river.

Marlborough District Council is committed to improving the ecological health of degraded water ways in the region and successfully applied for funding from the Ministry for the Environment for the "Taylor Improvement Project". One part of the funding agreement included the requirement for monthly monitoring of water quality at key sites throughout the Taylor River catchment. This monitoring began in late 2019 and ended in December 2022. This report is a summary of the results from this monitoring.

2. Monitoring

Water quality monitoring for the Taylor Improvement Project was carried out at 18 sites. Two additional sites are monitored as part of the State of the Environment (SoE) programme but are included in this report as they contribute valuable contextual information. The two SoE sites provide information for water quality management on a regional scale and are ultimately the performance indicators for the assessment of the success of the Taylor River Improvement Project.

The location of the 20 monitoring sites is shown in Figure 1. Table 1 lists the names and coordinates of the sites. Sites are generally located at major stream confluences and at intervals along longer reaches of rivers and streams.

Monitoring consisted of monthly grab samples independent of weather and flow conditions. The samples were analysed by Hill Laboratories Ltd for the following parameters:

- Nitrate Nitrogen and Nitrite Nitrogen concentration;
- Total Ammoniacal Nitrogen concentration;
- Dissolved Reactive Phosphorus concentration;
- E. coli concentration;
- Turbidity; and
- pH

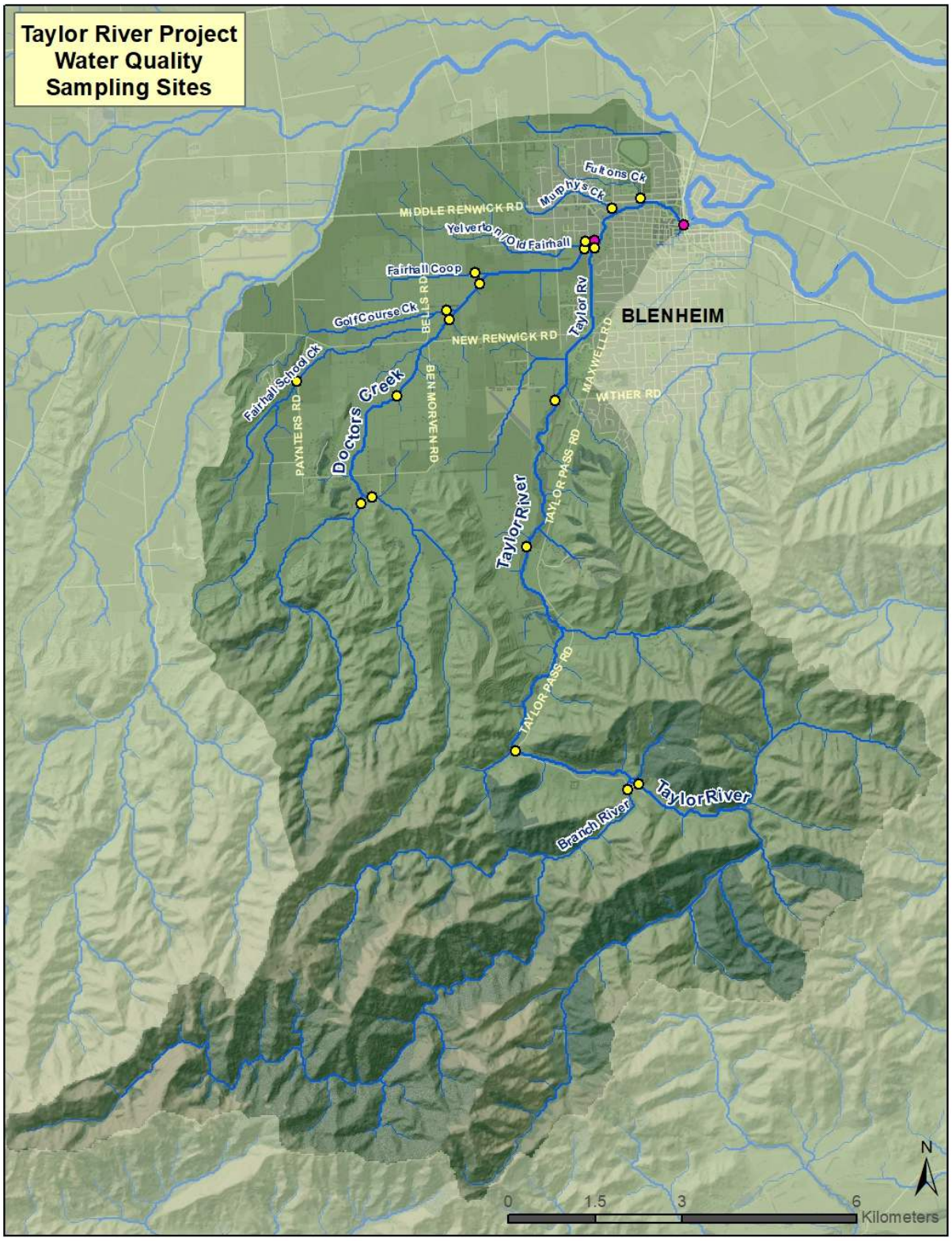

Figure 1: Monitoring Sites for the Taylor River Improvement Project. Yellow dots are project sites, while State of the Environment (SoE) monitoring sites are shown as pink dots.

SITE NAME (HILLTOP DATABASE)	MAP/GRAPH NAME	EASTING	NORTHING	COMMENT
TAYLOR RIVER UPSTREAM BRANCH RIVER	T1	1679304	5394324	
TAYLOR RIVER AT TAYLOR PASS ROAD BRIDGE	T2	1677178	5394894	
TAYLOR RIVER AT MEADOWBANK	T3	1677376	5398428	
TAYLOR RIVER AT WITHER ROAD FORD	T4	1677864	5400930	
TAYLOR RIVER UPSTREAM DOCTORS CREEK	T5	1678525	5403430	
TAYLOR RIVER AT RAIL BRIDGE	T6	1680148	5403948	SoE Site
DOCTORS CREEK STUDY - SITE 01	D1	1674525	5399169	
DOCTORS CREEK STUDY - SITE 05	D2	1675145	5401008	
DOCTORS CREEK UPSTREAM GOLF COURSE CREEK	D3	1676048	5402332	
DOCTORS CREEK UPSTREAM FAIRHALL COOP	D4	1676557	5402942	
DOCTORS CREEK AT UPSTREAM OLD FAIRHALL S	D5	1678385	5403533	
DOCTORS CREEK UPSTREAM TAYLOR	D6	1678553	5403672	SoE Site
BRANCH RIVER AT TAYLOR PASS ROAD	s1	1679104	5394243	
DOCTORS CREEK STUDY - SITE 02	s2	1674710	5399282	
FAIRHALL SCHOOL CREEK AT PAYNTERS RD	s3	1673426	5401274	
GOLF COURSE CREEK AT UPSTREAM DOCTORS CR	s4	1675995	5402493	
FAIRHALL COOP DRAIN UPSTREAM DOCTORS CK	s5	1676485	5403126	
YELVERTON STREAM UPSTREAM DOCTORS CREEK	s6	1678341	5403665	
MURPHYS CREEK AT MINI RAILWAY BRIDGE	s7	1679330	5404418	
FULTONS CREEK UPSTREAM TAYLOR RIVER	s8	1678840	5404246	

Table 1: Water Quality Monitoring sites of the Taylor River Improvement Project. The table shows site names in the Hilltop databased, their Short Names used in Graphs as well as their coordinates.

3. Monitoring results

Although monitoring was carried out every month, the sampling of some sites was restricted to times when surface flow was present. During the summer months, waterways within the mid-section of the Taylor catchment regularly dry out. This includes reaches of the Taylor River itself and the upper reaches of Doctors Creek.

The northern part of the catchment lies within a spring belt that provides groundwater inflow which ensures that the lower reaches of Doctors Creek and the Taylor River flow all year round. During dry summers, Doctors Creek and Murphys Creek contribute a substantial proportion of the flow to the lower Taylor River.

The emerging groundwater is part of the large Wairau River aquifer and therefore originates from an area west of the Taylor River catchment. The results for some water quality parameters in the lower reaches of the Taylor River and Doctors Creek are therefore greatly influenced by landuse effects outside of the catchment. This particularly applies to Nitrate Nitrogen concentrations. Other parameters, such as Turbidity and E. coli concentrations, however, have sources strictly from within the catchment as groundwater monitoring is showing these to be very low in the groundwater itself.

The following sections present the results for the parameters monitored for the three years 2020-2022. Each section contains a graph showing individual monitoring results as well as annual median concentrations. Where applicable, median band limits from the NPS-FM are shown as background colour within the graphs to provide context for measurement values. However, it is important to note that NPS-FM state assessments are not solely based on median concentrations and require other statistics to be calculated. Additionally, most parameters require state band assessment using data over a period of five years.

3.1. E. coli concentrations

E. coli are an indicator for faecal contamination such as animal droppings and human sewage. In the Taylor catchment, the main sources of faecal contamination are livestock (beef cattle and sheep) and wildfowl (predominantly mallard ducks). An area within the Doctors Creek catchment that was identified in the original (2013/2014) study as being heavily impacted by cattle access, was fenced off several years before monitoring for the Taylor Improvement Project began. However, livestock access to critical sources areas and very small side streams remains.

E. coli concentrations were variable across all sites but were generally lowest in the mid sections of the Taylor River (T3–T5) (Figure 2). Occasional high values at these sites were associated with rainfall.

In Doctors Creek (D1-D6) and all its tributaries (s2-s6) E. coli levels were generally elevated, including during periods of dry weather. Median concentrations were mostly within the upper A-C band or the D band. E. coli concentrations in the two most upstream sites (s2, D1) were increasing, particularly in the eastern tributary s2. However, at many other sites median concentrations were highest in the first year of monitoring and have decreased since. The greatest change was observed in Fairhall School Creek (s3). While some of the changes between years are due to inherent variability caused by weather conditions or movement of wildfowl, some of the larger changes are likely a result of improvement actions.

Median E. coli concentrations in the Blenheim springs, Murphys Creek (s7) and Fultons Creek (s8) were consistently within the A-C band, but levels in Murphys Creek were mostly lower compared to Fultons Creek and appear to be decreasing significantly.

Overall, despite some significant changes within the catchment, the E. coli concentrations at the two SoE monitoring sites (D6 and T6), remained relatively unchanged over the three-year monitoring period.

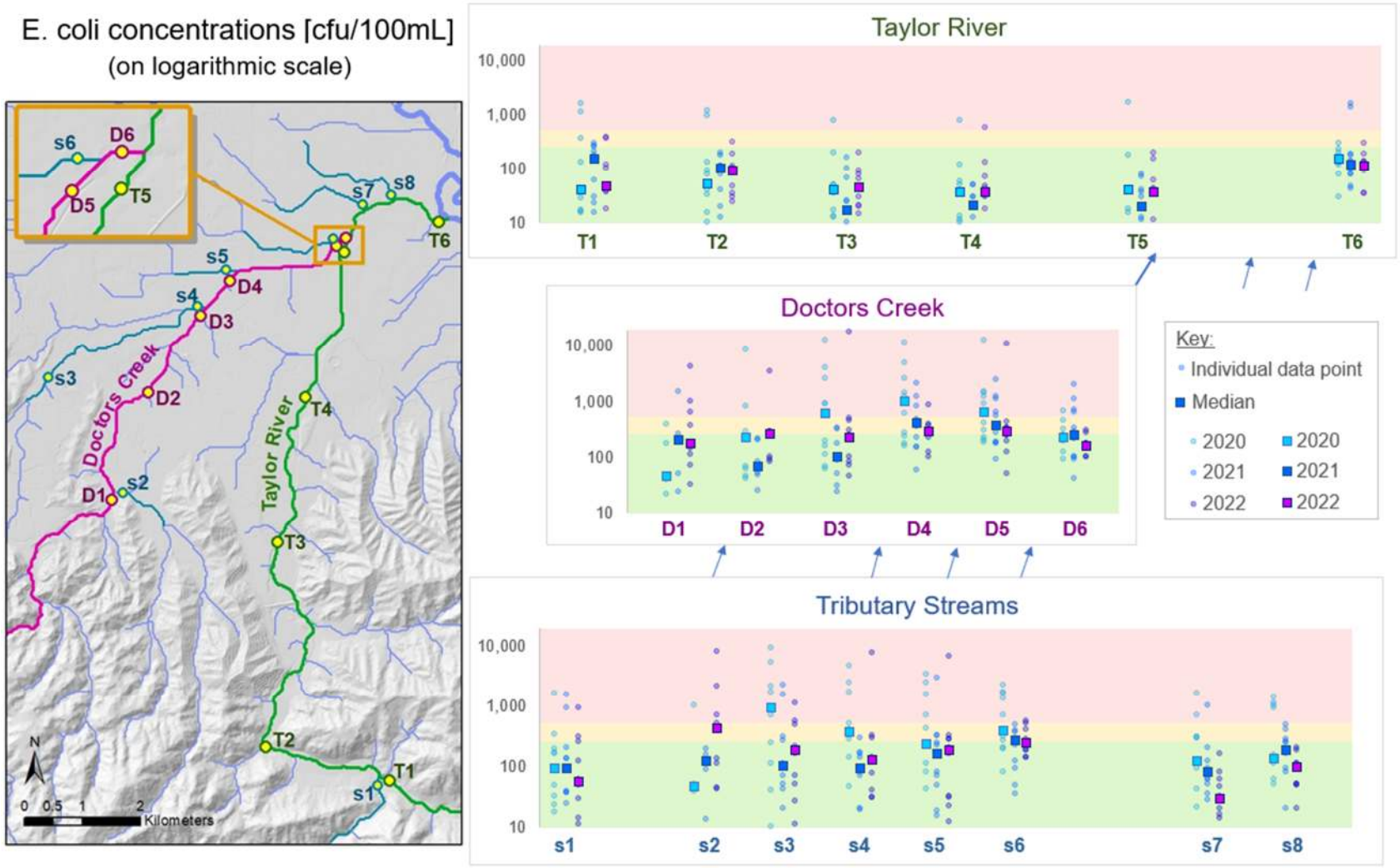

Figure 2: Log E. coli concentrations in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours of the graphs are based on the median band limits of the National Policy Statement for Freshwater Management (NPS-FM) (green = A-C band, yellow = D band, red = E band).

3.2. Ammoniacal Nitrogen concentrations

Ammoniacal Nitrogen is the reduced form of dissolved nitrogen, which means it occurs at low dissolved oxygen levels and is the initial form of nitrogen released during the break down of organic material. In the presence of oxygen, Ammoniacal Nitrogen is quickly converted to Nitrate Nitrogen.

Ammoniacal Nitrogen is therefore an indicator for larger amounts of fresh organic material (such as animal droppings) or a lack of oxygen within the water column. Flowing streams within the Taylor River catchment generally contain sufficient oxygen and Nitrate is the main form of dissolved nitrogen. Generally, samples were only taken from flowing water, but it was not always clear during site visits if flow was continuous, particularly in small overgrown stream sections. When stream sections start to dry up, disconnected pools can form, and the breakdown of animal or plant material (including algae and leaf litter) can temporarily lead to low oxygen concentrations.

In the Taylor River upstream of Doctors Creek (T1-T5), Ammoniacal Nitrogen concentrations were very low with only occasional higher values observed during rainfall events (Figure 3). The same was true for the two Blenheim springs, Murphys Creek (s7) and Fultons Creek (s8) as well as the sites furthest upstream within the Doctors Creek sub catchment (s2, D1, D2).

The highest Ammoniacal Nitrogen concentrations were observed in Doctors Creek and some of its tributary streams. Although median concentrations were generally within the A-band, annual 95th percentiles were above the A-band limit of 0.05 g/m^3 for several sites (limit not shown in graphs). Ammonia concentrations within the A-Band are a Marlborough Environment Plan (MEP) objective for all waterways in Marlborough.

Apart from a significant reduction in Ammoniacal Nitrogen concentrations in Fairhall School Creek (s3), there were no discernible changes at any of the other monitoring sites over the three years. The small reduction in Yelverton Stream (s6) is within the variability of the measure and therefore unlikely to be a true improvement.

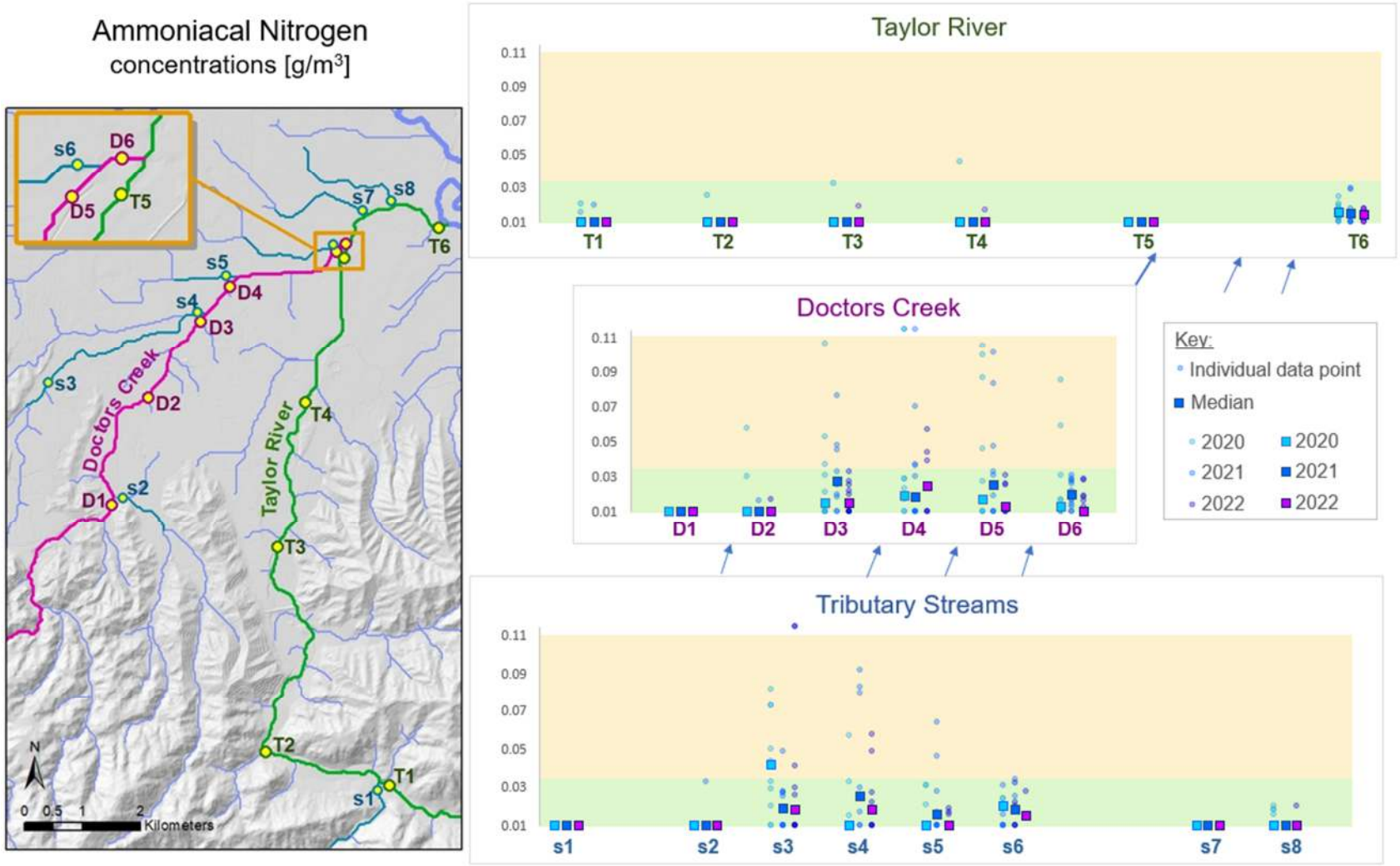

Figure 3: Total Ammoniacal Nitrogen concentrations in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours of the graphs are based on the median band limits of the NPS-FM (green = A band, yellow = B band). Note that monitoring results were not adjusted as required by the NPS-FM as Water Temperatures were not measured during sampling.

3.3. Nitrate Nitrogen concentrations

Nitrate Nitrogen is the predominant form of dissolved nitrogen in waterways withing the Taylor River catchment. The main pathway for nitrogen into the Taylor River and Doctors Creek is via groundwater inflow, particularly in the northern part of the catchments. Although some localised nitrogen leaching is occurring, the majority of nitrogen originates from sources outside the Taylor River catchment.

Small quantities of older groundwater are emerging in the mid-reaches of Doctors Creek, but this groundwater is generally low in nitrogen.

The monitoring results show a clear gradual increase in Nitrate Nitrogen concentrations in a northern direction (Figure *4*). In the upper and mid reaches of the Taylor River, Nitrate Nitrogen concentration are very low and occasional higher values are generally associated with rainfall, which creates surface-runoff carrying contaminants from surrounding pasture into the streams. The same is true for the two most upstream sites of Doctors Creek (D1, D2). Of note is the comparatively smaller variability in the upper tributary of the Taylor River, the Branch River (s1), indicating that inputs of nitrogen are minor even during rainfall.

In the lower reaches of Doctors Creek and the Taylor River, Nitrate Nitrogen concentrations approach the limits of the NPS-FM A-band, but do not exceed it. Median Nitrate Nitrogen concentrations in the Blenheim Springs, Murphys Creek (s7) and Fultons Creek (s8), however, did reach levels within the B-band in 2022.

Many of the sites in the lower reaches showed a slight increase in Nitrate Nitrogen over the years, but the changes are within the natural variability of the parameter and likely not indicative of long-term changes. Fultons Creek (s8), is the only tributary stream with a potentially significant increase in Nitrate Nitrogen concentrations that is likely caused by changes within its catchment.

Some of the tributary streams of Doctors Creek (eg; s3 and s4) show significantly more variability in Nitrate Nitrogen concentrations than can be explained by fluctuations in groundwater concentrations and rainfall events. This points to sporadic direct inputs of nitrogen during dry weather conditions, for example from animal droppings.

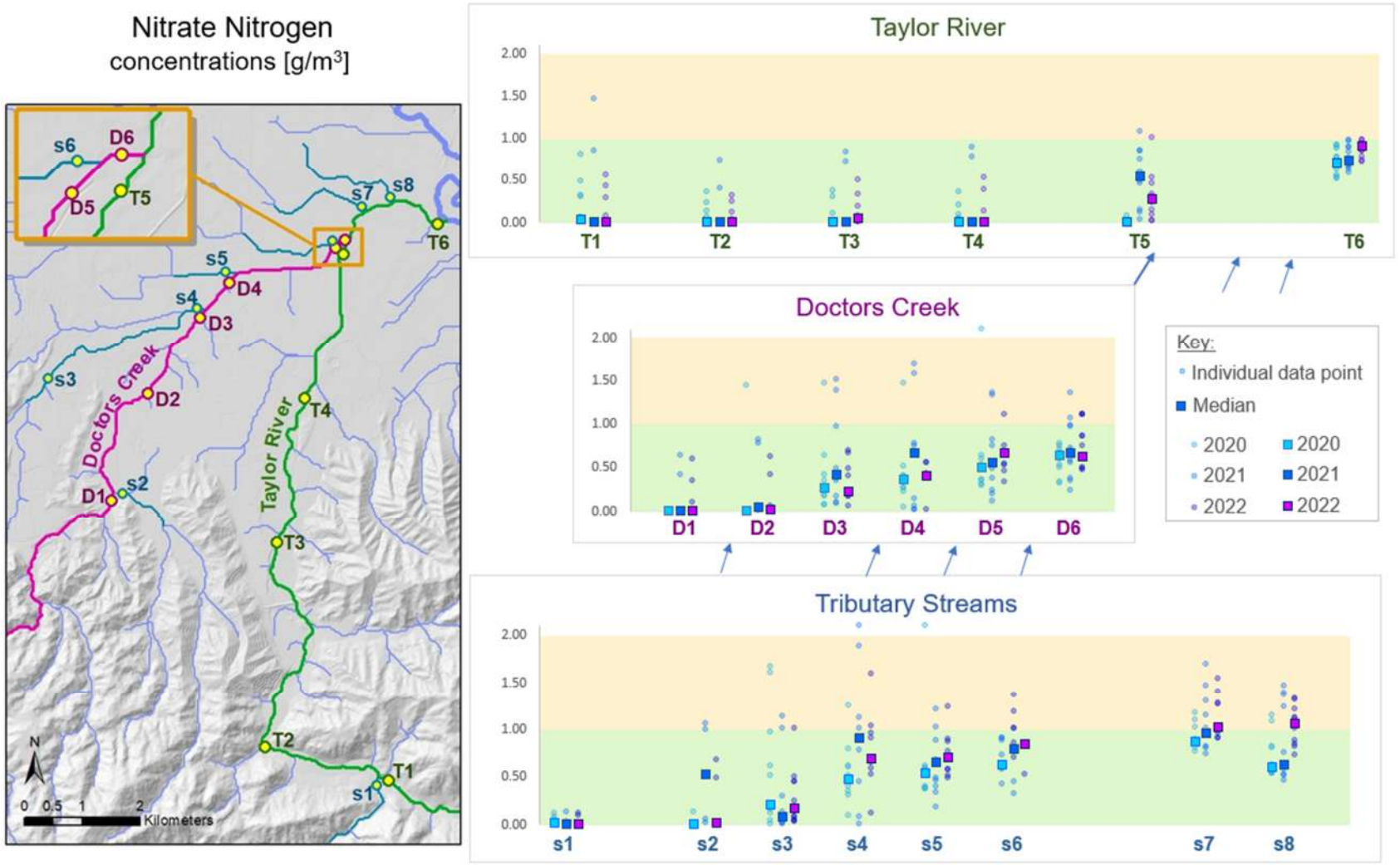

Figure 4: Nitrate Nitrogen concentrations in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours of the graphs are based on the median band limits of the NPS-FM (green = A band, yellow = B band).

3.4. **Turbidity**

Turbidity is an indicator for the amount of fine sediment within stream water. NPS-FM limits apply to Water Clarity, which is a surrogate for suspended sediment, similar to Turbidity. Recent collection of Water Clarity data allowed for a relationship to be established between Water Clarity and Turbidity. The NPS-FM bands shown in the graphs below are based on that relationship. The NPS-FM limits create comparatively narrow B and C bands.

Apart from the most upstream site (T1), median Turbidity in the Taylor River (T2-T6) was within the A-band of the NPS-FM, although at times near the limit (Figure *5*). The two springs in the Blenheim area, Murphys Creek (s7) and Fultons Creek (s8) had the lowest median Turbidity values of all sites monitored, and even individual measurements exceeded the median limit on only three occasions in 2020.

In the Doctors Creek catchment, however, Turbidity was generally above the A-band limit, with the highest median levels observed in some of the tributary streams (s2, s3). The exception was Yelterton Stream (s6), which has significant inflow of groundwater and therefore notably lower Turbidity. Fairhall Coop Drain (s5) is also predominantly groundwater fed, but localised sources of sediment cause this waterway to have a comparatively high Turbidity. Of the monitoring sites along Doctors Creek, Turbidity was highest at site D5, located upstream of the confluence with Yelverton Stream (s6).

At the majority of monitoring sites Turbidity did not change significantly over the three years of monitoring, however, there were exceptions. Larger increases were observed in the Branch River (s1) and Fairhall School Creek (s2), but changes in the Branch River are likely to be within the variability of the measurement. The monitoring results for the lower reaches of Doctors Creek showed a reduction in Turbidity over time, particularly at the most downstream site (D6), which is the SoE monitoring site.

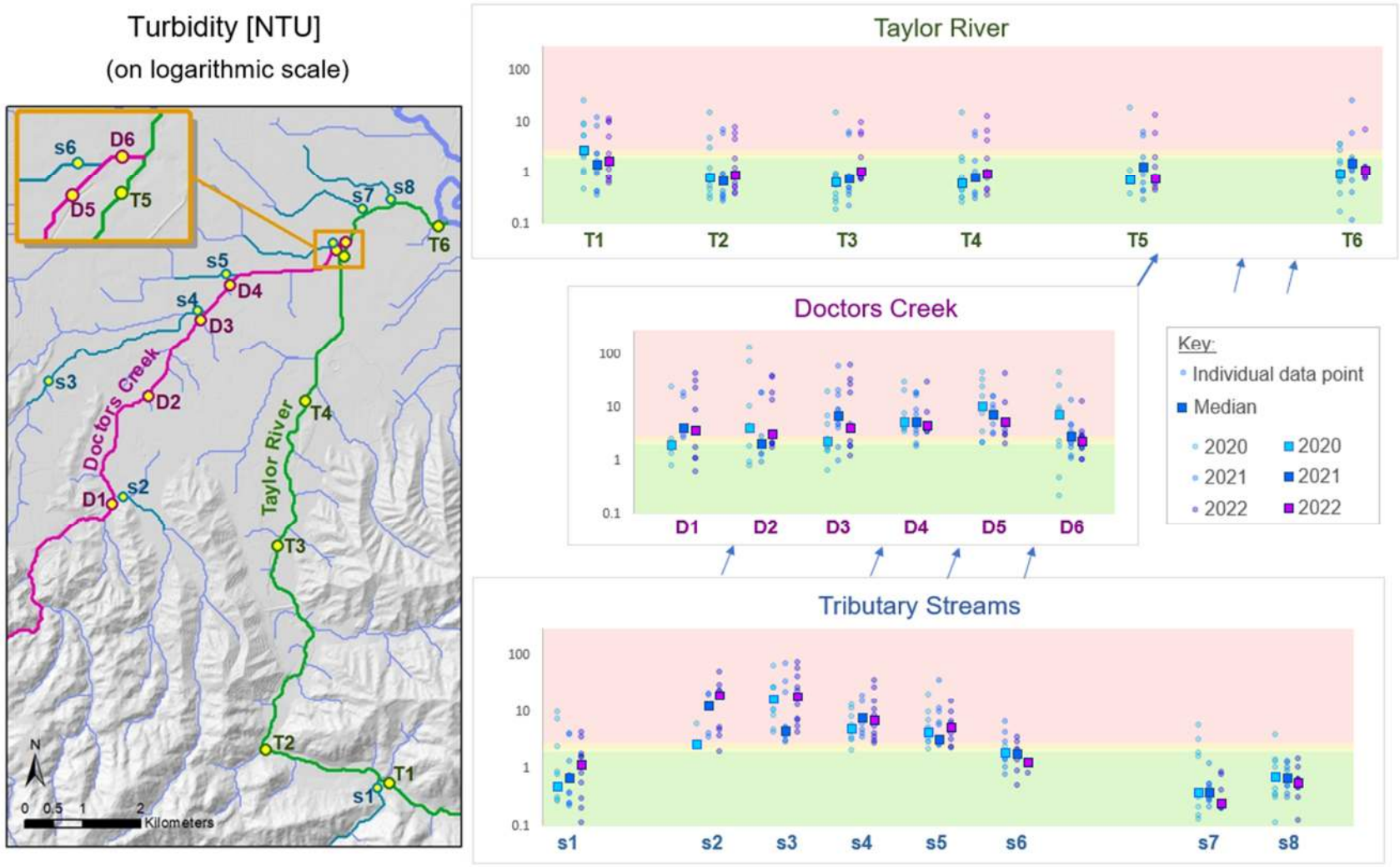

Figure 5: Log Turbidity in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours of the graphs are based on the median band limits of the NPS-FM (green = A band, yellow = B band, orange = C band, red = D band).

3.5. Dissolved Reactive Phosphorus (DRP) concentrations

Phosphorus is significantly less mobile in the environment compared to nitrogen and higher concentrations are often associated with soil or bank erosion. Turbidity and Phosphorus concentrations are therefore often linked. However, other sources such as animal droppings also contribute to the DRP concentration in waterways.

In the Taylor River (T1 – T5) as well as the Branch River (s1) and the Blenheim Springs (s7, s8), DRP concentrations were generally low (Figure *6*). Median concentrations were within the A band in the upper reaches and within the B or C band in the lower reaches of the Taylor River and in the springs.

In Doctors Creek (D1 – D6), however, median DRP levels were exclusively within the D band. Concentrations were particularly high in the upper reaches. The overall highest levels were observed in Fairhall School Creek (s3), which was among the sites with the greatest variability in DRP concentrations. The lower tributaries, Fairhall Coop Drain (s5) and Yelverton Stream (s6), had comparatively lower DRP concentrations which notably reduced the DRP levels in Doctors Creek to concentrations close to the C band.

There are several sites that showed an increase in DRP concentrations over the three-year monitoring period. Most of these changes are likely within parameter variability but increases in the mid reaches of Doctors Creek (D2, D3) and at tributary sites s2 and s3 are potentially indications of actual changes. The greatest increase was observed in Fairhall School Creek (s3).

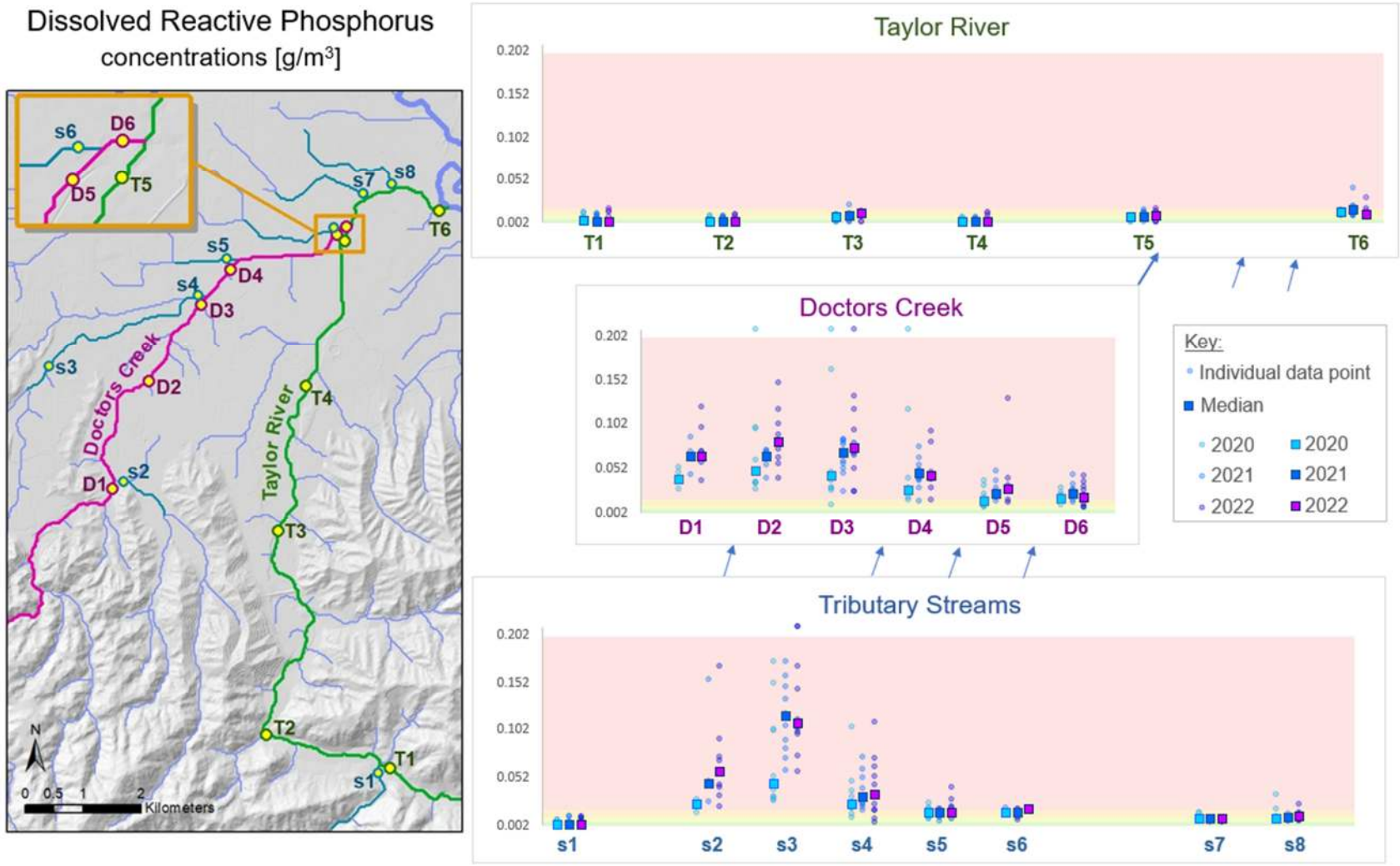

Figure 6: Dissolved Reactive Phosphorus (DRP) concentrations in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours of the graphs are based on the median band limits of the NPS-FM (green = A band, yellow = B band, orange = C band, red = D band).

3.6. **pH**

The pH of water is an indicator for its acidity or alkalinity with the of value 7.0 representing a neutral pH. Most stream organisms prefer a pH in the range of 6.5 to 8.5. The pH of stream water changes over the course of the day, particularly if algae or other aquatic plants are abundant. Aquatic organisms are adapted to deal with these changes in pH values, but sudden and extreme changes can lead to their death.

PH values in the upper catchment were overall comparatively high (Figure 7), which indicates influences of the underlying geology. The elevated baseline meant that pH values sometimes reached levels above the optimal range.

In the lower catchment, where groundwater influences are greater, pH values were closer to neutral and stayed consistently within the optimal range for aquatic organisms.

Variability in pH was greatest in the Taylor River and its tributary the Branch River (s1), with the largest range in pH values observed at the Taylor River site T4.

Over the three-year monitoring period, no significant changes in median pH values were observed at any of the monitoring sites.

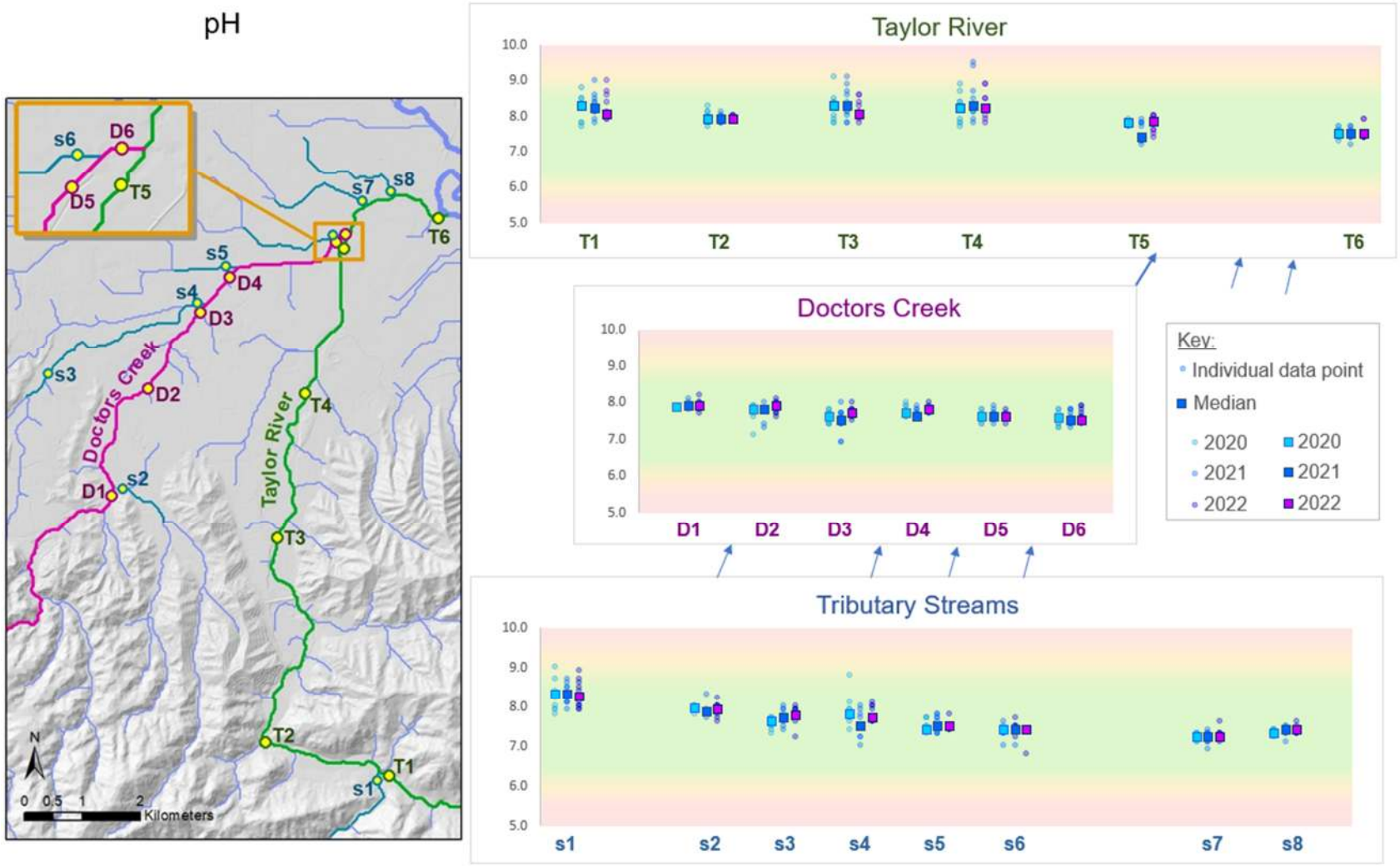

Figure 7: PH values in the Taylor River catchment in 2020, 2021 and 2022. The graphs show individual monitoring results as well as the annual median concentrations. The background colours show the optimal range for aquatic organisms in green.

Summary and Discussion

Within the Taylor River catchment, water quality remains poorest at sites in the Doctors Creek sub catchment. Measured concentrations of E. coli, Ammoniacal Nitrogen and DRP, but also Turbidity values were highest in Doctors Creek itself, but particularly in some of its tributary streams.

Nitrate Nitrogen concentrations were highest in the lower (northern) part of the catchment as a result of significant inflows of groundwater from the Wairau aquifer, but higher variability in parts of the Doctors Creek catchment points to additional localised sources.

There were some changes observed during the three-year monitoring period. These included, increased DRP concentrations at a number of sites, but also decreases in E. coli concentrations and Turbidity. The monitoring site on the Fairhall School Creek often showed some of the most significant changes. Although Ammoniacal Nitrogen and E. coli concentrations decreased at this site, DRP concentrations as well as Turbidity showed notable increases.

Despite some of the changes within the catchment, parameter concentrations at the State of the Environment monitoring sites remained mostly unchanged. An exception was a decrease of Turbidity in Doctors Creek.

Overall, the results show that further action is required to improve the health of waterways in the Taylor River catchment, but particularly in the Doctors Creek sub catchment area.

The report is a simple summary of monitoring results and assessments of the effectiveness of improvement actions is outside of its scope. However, to maximise the value of the monitoring efforts it is recommended to follow up with an assessment of the monitoring results in relation to locations and types of improvement actions taken throughout the three years of monitoring. This would allow assessment of the effectiveness of enhancement actions to date and provide direction for future management of the catchment, including prioritisation of areas for future improvements.

A large part of the improvement actions included riparian plantings, but it takes several years before these plantings are established and become effective riparian margins. Additionally, improvement actions will be ongoing beyond the life of this MfE funded project. It is therefore recommended to repeat the monitoring at a later stage, ideally at set intervals. The monitoring results to date show that water quality parameters can be very variable and frequent monitoring is the best way to capture this variability and allow assessment of changes over time. Considering the ongoing efforts to improve the health of waterways and the costs associated with water quality monitoring, a possible solution could be monthly monitoring of the project sites over a period of twelve months, every three to five years.

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