Memo

Disclaimer: This document refers to Proposed Plan Change 5 to the Land and Water Regional Plan (Nutrient Management and Waitaki). All aspects of this Plan Change are currently under appeal. The final form of Plan Change 5 will not be known until all appeals are resolved.

Date	18 August 2017
To	Daniel Clark, Craig Davison
cc	
From	Shirley Hayward, Marta Scott

Subject: Water quality issues and options for groundwater and surface waterways of the Timaru freshwater management unit (FMU)

1 Introduction

This memo is intended to provide the OTOP zone committee with a summary of the key issues for surface and groundwater quality in the Timaru FMU, and key decisions areas for these issues.

The Timaru FMU differs from the other OTOP FMUs in that it includes an extensive urban area alongside rural areas that are a mix of intensive irrigated land use (e.g, Levels Plains) and less intensive and lifestyle rural land uses on the surrounding downlands.

The urban area of Timaru has a number of small waterways. Many activities in urban areas such stormwater run-off from extensive areas of impervious surfaces, modification of waterway channels, urban and industrial generated contaminants, all can affect the habitat, flow and quality of urban waterways. Under the Land and Water Regional Plan (LWRP), District councils need to have lodged discharge consents for existing reticulated stormwater systems by June 2018. As part of this process they need to develop a stormwater management plan. Policy 4.16 requires (amongst other things) stormwater management plans to address how the discharge will meet the water quality outcomes and standards and limits for that waterbody set out in Table 1a, and Schedules 5 and 8 (whichever applies). Where the discharge is from an existing reticulated network, a commitment must also be made to improve the quality of the discharge by no later than 2025, but as soon as practicable to meet Table 1a and Schedules 5 and 8.

The OTOP healthy catchments project provides the zone committee the opportunity to consider the suitability of the outcomes and water quality standards and limits for the OTOP zone. This will help provide clear direction and expectations for the management of stormwater and other activities to meet water quality outcomes and limits in the Timaru FMU.

Below is a brief summary of the most relevant existing criteria in relation to waterways in the Timaru FMU.

Water quality classes – the LWRP includes a classification of rivers and lakes for the purposes of referencing to water quality outcomes, limits and standards. In the Timaru FMU, most streams are either classified as hill-fed lower or hill-fed lower-urban (Figure 1). There are a few streams on the northern boundary of Levels Plains that are classified as Spring-fed lower. Some watercourses such as Seadown Drain are currently not classified. The only lake in the zone is Waitarakao/Washdyke Lagoon which is classified in the LWRP as a coastal lake.

Water quality outcomes (Tables 1a and 1b) – many of the water quality outcomes listed in Tables 1a and 1b have now been superseded by the NPS-FM 2017 national objectives framework, and relevant attributes are discussed below. However, it is worth noting in Table 1a the difference in outcomes for indicators of streams health, specifically the Quantitative Macroinvertebrate Community Index (QMCI), between hill-fed lower rivers (QMCI target of 6) and hill-fed lower urban rivers (QMCI outcome of 3.5). The higher the QMCI value, the greater diversity and abundance of sensitive species. The markedly lower QMCI value for hill-fed lower urban streams reflects both the general poor health of many of our urban streams, and the immense difficulty of achieving higher QMCI values.

Water quality standards – Schedule 5 – The LWRP includes Schedule 5 that defines receiving water quality standards for permitted activity discharges and for discretionary activities such as reticulated stormwater discharges, along with defining zones of non-compliance (mixing zones). The most relevant aspect in the Schedule 5 for Timaru's FMUs is the level of protection criteria for aquatic toxicants.

The criteria for toxicants in Schedule 5 are based on the ANZECC 2000 water quality guidelines and provide different trigger values for different levels of protection (percentage of species expected to be protected). These trigger values relate to three ecosystem conditions as follows:

- 99% level of protection – applies to high conservation/ecological value streams. It effectively relates to unmodified or other highly-valued ecosystems.
- 95% level of protection – applies to slightly to moderately disturbed systems
- 90 – 80% level of protection – applies to highly disturbed systems, where these are measurably degraded ecosystems of lower ecological value.

Schedule 5 sets the 95% level of protection for toxicants for hill-fed lower, spring-fed plains and coastal lakes, and 90% level of protection for hill-fed lower urban. These are discussed further below in relation to each of the main surface waterways.

Key decision areas:

Recommending freshwater limits for surface and groundwater in relation to nitrate concentrations

Recommending other freshwater limits for surface waterways (particularly urban waterways)

2 Groundwater of the Levels Plains area

Groundwater across the Levels Plains area is used extensively for irrigation and drinking water supplies. Approximately 84 wells (69 of those are less than 20 m deep) on Environment Canterbury's database within the area are identified as potential domestic drinking water supplies. Groundwater in the Levels Plains areas flows in a general south eastward direction towards the coast and towards Washdyke (Figure 1). Most of the Levels Plains groundwater that emerges to the surface ultimately drains to Waitarakao/Washdyke Lagoon catchment.

The current state groundwater report identified elevated nitrate concentrations in the shallow groundwater of the Levels Plains area (Zarour et al. 2016). Three out of seven shallow wells monitored routinely over the past 5 years have had nitrate concentrations exceed the Drinking Water Standards for New Zealand (DWSNZ) maximum acceptable value (MAV) of 11.3 mg/L (Figure 2). Deeper wells have lower nitrate concentrations but we are seeing increasing trends in some wells (e.g. K39/0006) which may be due to lagged land use effects. While recharge of shallow groundwater in this area is dominated by land surface recharge, there is recharge from the river which dominates the area just south of the Opihi River resulting in lower nitrate concentrations (blue and green dots) (Figure 2). Other areas within the purple outline in Figure 2 are dominated by land surface recharge and hence have higher nitrate concentrations.

A 'targeted' well downgradient from the Ravensdown fertiliser storage, at times shows very high nitrate concentrations (note different scale for that well K38/0172 compared to other graphs). Historically, the operations of the fertiliser plant resulted in a significant plume of contaminated groundwater downgradient of the factory (Smith 1992). Currently the site only stores, mixes and transports fertiliser and has consents to store stormwater from the site into a storage pond, from which it is irrigated onto adjacent land. Ongoing monitoring by the consent holder indicates that elevated nitrates (and other related contaminants) continue to occur downgradient of their site. Their consent requires them to supply alternative potable water supplies to any downgradient domestic supplies affected by the activity.

Figure 3 shows the modelled nitrate leaching concentrations for the high concentration area. Table 1 provides the average modelled nitrate leaching concentrations and reductions that would be required to reduce the modelled concentrations to various targets.

Table 2 compares the modelled average concentration with the average concentration measured in shallow wells in the high concentration areas over the past 5 years. Differences between modelled and measured average concentrations are likely because of modelling uncertainties and additional dilution from river recharge and leakage from water races/ponds.

Based on the measured average nitrate concentrations, an 11% reduction in nitrogen losses across the area would be needed to achieve an average groundwater nitrate concentration equal to half the MAV, which would provide a moderate level of protection for shallow drinking water supplies. From the agricultural losses, this may be achieved through implementation of good management practices (GMPs) through Plan Change 5.

Table 1 Modelled nitrate leaching concentration below root zone in the high concentration area and reductions required for the leachate to meet MAV, ½ MAV, National bottom line set to protect ecosystem health and ¾ MAV.

Province	Concentration (mg/L)	Meet MAV of below	Meet ½ MAV or below	National bottom line	Meet ¾ MAV or below
Levels Plain	9.5	0%	-41%	-28%	-11%

Table 2 Modelled nitrate concentrations of recharge below root zone in the high concentration area, average measured nitrate concentrations in <20 m deep wells in the last 5 years and required reductions to meet ½ MAV in groundwater.

Province	Modelled recharge concentration (mg/L)	Measured groundwater concentrations (mg/L)	Meet ½ MAV (5.6 mg/L) in measured groundwater
Levels Plain	9.5	6.3	-11%

3 Waitarakao/Washdyke lagoon and tributaries

Waitarakao/Washdyke Lagoon is a brackish lagoon located on the northern boundary of Timaru. It has long been recognised as a significant coastal wetland habitat for a wide range of endemic, native, and migrant bird species and is an important link along a network of coastal wetlands in Canterbury for migratory birds. The importance of the lagoon for regional biodiversity was recognised as far back as 1907, when the lagoon was officially gazetted as a Wildlife Sanctuary Reserve. The lagoon and surrounding land is owned and managed by the Department of Conservation (DOC).

Waitarakao/Washdyke Lagoon also has a long history of cultural significance to local rūnanga as an important site for traditional food gathering. Today a Mataitai reserve covers the area of the greater lagoon and Seadown Drain and restricts commercial fishing. Areas of particular importance include not only the lagoon itself, but the coastal area opposite the lagoon outlet.

The two main freshwater inputs to the lagoon are Seadown Drain and Washdyke Creek. The catchment area of the lagoon includes a key industrial zone of Washdyke with regionally significant industry and infrastructure. Extensive areas of hard surfaces and roading network have required the increasing development of a network of open and closed drains. At some point in the early development of the industrial Washdyke area, an open ring drain was constructed that collects drainage and stormwater water run-off from the urban and industrial areas and diverts that water around the lagoon and discharges directly to the sea. Furthermore, Washdyke Creek has a weir as it crosses the Ring Drain that diverts low flows into the Ring Drain, while high flows in the creek overtop the weir and discharge along its historical bed into the lagoon.

Seadown Drain starts around Beach Road (Seadown) and runs parallel to the coast until it discharges into Waitarakao/Washdyke Lagoon. The 8.5 km long Seadown Drain is fed by numerous lateral drains that intercepts emergent groundwater from the Levels Plains area and surface run-off from rainfall. The No. 1 Drain is a tributary of Seadown Drain that also receives emerging groundwater and stormwater run-off from parts of Washdyke industrial area.

Very little was known about the water quality of the lagoon and its tributaries prior a study in 2009 to 2011, which showed elevated nutrients and faecal indicator bacteria (Escherichia coli (E. coli)) in the lagoon and some tributaries (Hayward et al. 2016). A further study has been initiated for the catchment that investigates the water quality and quantity of the main inflows to the lagoon and Ring Drain. This study began in November 2016 and water quality measures include nutrients, E. coli and metals as indicators of urban/industrial contaminants. A summary of the results to date from this study are provided below to assist the zone committee to understand the current water quality issues and consider options for addressing those issues.

3.1 Faecal indicator bacteria (E. coli)

Concentrations of E. coil in Waitarakao/Washdyke Lagoon are extremely high compared to many other waterways in Canterbury and compared to E .coli concentrations of inflowing streams (Figure 4). E. coli concentrations in Washdyke Creek are elevated but not a high as the lagoon, while lower concentrations are found in Seadown Drain and the No. 1 Drain. Given that the E. coli concentrations of the inflowing streams and drains are generally lower than those found in the lagoon, it is likely that the high concentrations are primarily caused by the high numbers of birds that occur the lagoon and its surrounds (including Washdyke Creek). Observations of extensive bird faecal material are noted around the lagoon and Washdyke Creek. However, during rainfall events, it is apparent that additional inputs of E. coli occur via stormwater discharges. Furthermore, observations stock access to lateral drains that feed into Seadown Drain may be contributing additional faecal matter in the Seadown Drain.

The NPS-FM 2017 does not have a national bottom line for E. coli, rather it has an E. coli attribute table for human health for recreation, which has five attribute state categories (A to E). Attribute states A, B and C are considered suitable for primary contact recreation. While the current dataset available for the Waitarakao/Washdyke catchment is too small to allow calculation of the four metrics that make up the attribute states, the data available indicates that only sites on the No 1 Drain and Seadown Drain **may** meet attribute state C. Sites on the Washdyke Ck, Ring Drain and the Lagoon are likely to fall into category E (worst category). The NPS-FM 2017 directs councils to develop regional targets for improving the quality of 'specified'[1] river and lakes. It is accepted that a small proportion of rivers or lakes may not be able to achieve attribute states C or better.

Options:

1. Investigate significance of faecal contamination from sources other than birdlife
2. Recommend faecal indicator bacteria inputs to the lagoon and its tributaries from sources other than birdlife are identified and reduced over time
3. Target Waitarakoa / Washdyke Lagoon for improvement, acknowledging that is unlikely to achieve attribute C or better in the short term, but target E.Coli inputs to improve quality.
4. Specify that drains are also subject to the stock exclusion requirements of the LWRPNutrients

Nutrient concentrations in Waitarakao/Washdyke Lagoon are high and both Total Phosphorus (TP) and Total Nitrogen (TN) concentrations do not meet the NPS-FM 2017 national bottom lines. In contrast and despite the high nutrient concentrations, phytoplankton biomass (as measured by chlorophyll a) is not high and falls within the attribute state A (midpoint site) or just above A (lagoon outlet site). The reasons for low phytoplankton biomass despite high nutrient is not clear, but may include low water clarity, high wind disturbance and low water residence time because the lagoon outlet (via the Ring Drain) is permanently open to the sea.

[1] Specified rivers and lakes is defined in the NPS-FM 2017 as rivers that are fourth order or above, and lakes with a perimeter of 1.5 km or more. This includes Washdyke Creek upstream to Rosewill Valley Rd and Waitarakao/Washdyke Lagoon.

The two main tributary inputs to the lagoon, Washdyke Creek and Seadown Drain, have contrasting relative contributions to nutrient loadings. The highest concentrations of phosphorus come from the Washdyke Creek catchment. At the SH1 site, dissolved reactive phosphorus (DRP) and TP are 3 fold higher than the site downstream of the railway line, and nearly 10 fold higher than concentrations in Seadown Drain and No. Drain. Washdyke Creek drains the northern extent of the basalt geological formation that underlies Timaru. Loess soils overly this basalt base rock. Volcanic rocks such as those that underlay Timaru and Banks Peninsula are known natural sources of phosphorus enrichment of the waterways that drain these areas. All of the streams that drain the Timaru area tend to have elevated phosphorus concentrations compared to those that drain greywacke dominated catchments (Hayward et al 2016). Therefore, Washdyke Creek contributes a disproportionately high phosphorus load into Waitarakao/Washdyke Lagoon and the Ring Drain. While much of this is naturally derived, activities that increase soil erosion and sediment inputs to the stream can exacerbate this situation.

In contract to high phosphorus concentrations, Washdyke Creek above SH1 has low nitrogen concentrations (median nitrate nitrogen =0.3 mg/L, median TN=1.3mg/L). There is little in the way of significant groundwater inputs to the creek above SH1. However 900 metres downstream at the site below the railway line, nitrate and TN concentrations increase 10-fold and 4-fold respectively (median nitrate nitrogen =4.3 mg/L, median TN=5.3mg/L). There is clearly a significant gain in nitrogen inputs between these two sites, likely from nitrate rich groundwater inputs. Similarly, Seadown Drain which receives groundwater inputs from the Levels Plains also contributes to the elevated nitrogen content of the lagoon (median nitrate nitrogen 3.3 mg/L, median TN=3.7mg/L).

The Ring Drain above its confluence with Washdyke Creek has very high nitrogen concentrations and does not meet the national bottom line for nitrate toxicity. Through dilution of Washdyke Creek and lagoon outlet to the drain, nitrate concentrations in the Ring Drain at its discharge to the sea are considerably lower.

Options:

- Set National Bottom Line limits for Nitrates and Phosphorous to be met over in Waitarakao / Washdyke Lagoon, acknowledging that these will take time to achieve.
- Maintain current concentrations in the Washdyke Creek Catchment where National Bottom Lines are currently being met.

3.1.1 Urban contaminants

The current study of water quality and flows of Waitarakao/Washdyke catchment included four metals as indicators of urban stormwater contaminants (arsenic, zinc, copper and lead). The current data indicates that under dry weather conditions, sites comply with toxicant trigger values for 95% level of species protection complies for all metals except zinc in the lagoon and tributaries. Under rainfall conditions, higher metal concentrations occurred, with some exceedences of the 95% level of protection. If the targets of 95% level of species protection or higher were set for this catchment, this would require improvements to the quality of many stormwater discharges especially for contaminants such as zinc and copper.

4 Other streams of Timaru FMU

Saltwater Creek (including Otipua Creek) is classified in the LWRP as a hill-fed lower urban stream: Key characteristics include:

- Used recreationally by rowing club
- Includes both urban and rural catchment areas
- Highly modified habitat
- Small lagoon, with infrequent direct sea connection
- Amenity values linked with walkways
- Supports diverse native and coarse sports fishery

Taitarakihi Stream is classified in the LWRP as a hill-fed lower urban stream. Key characteristics include:

- Includes both urban and rural catchment areas

- Modified habitat
- Small lagoon, regular sea connection across gravel bar (recent planting enhancement work completed around the lagoon)
- Supports native fishery including inanga
- Low flows in summer, waters can stagnate and deoxegenate.

Water quality is monitored at one site of each of these streams for general water quality indicators but does not include urban stormwater indicators such as metals.

Nutrient concentrations in both streams show elevated phosphorus concentrations, which is in part because of the naturally P-rich geology of the catchments. Nitrogen concentrations are higher than desirable for constraining aquatic plant growth in both streams, but are well below nitrate toxicity risk thresholds (both in the A attribute state for nitrate toxicity).

Concentrations of E. coli do not meet the swimmability criteria of the NPS-FM 2017 (attribute states of C or better).

5 Key decision areas

5.1 Recommending freshwater limits for surface and groundwater in relation to nitrate concentrations

Option 1 - Average groundwater nitrate concentrations in the Levels Plains area are set at ½ MAV in the Levels Plains area?

- Note this would provide protection for drinking water supplies but would not ensure Waitarakao/Washdyke Lagoon met the national bottom line for TN. An 11% reduction of nitrates is likely needed to achieve this, and the shift to Good Management Practice under Plan Change 5 alone may be sufficient to meet this target.

Option 2 Average groundwater nitrates in the Levels Plains area is set at a lower level in order to assist reducing TN in Waitarakao/Washdyke Lagoon.

- Note: nitrate levels in groundwater may need to be set at below 1mg/L to achieve the national bottom line in the lagoon for TN if no other interventions were used to reduce TN in the lagoon

Option 3 Average groundwater nitrate concentrations in the Levels Plains area are set at less than ½ MAV in the Levels Plains area, and other interventions are developed to achieve national bottom lines or better in Waitarakao/Washdyke Lagoon.

- Note: Other interventions could include strategically place constructed wetlands to reduce nitrates (and potentially other contaminants)

5.2 Recommending other freshwater limits for surface waterways (particularly urban waterways)

Urban toxicants and levels of protection

Option 1 Water quality classifications and current levels of protection set in the LWRP are retained (90%) over a specified timeframe

Option 2 All waterways in the Timaru FMU aim to achieve toxicity trigger values that provide for 95% level of species protection, over a specified timeframe

Faecal indicator bacteria and swimmability

Option 1 All waterways in Timaru are improved over time to achieve Attribute state C or better for E coli

Option 1 E. coli concentrations in Saltwater Creek, Washdyke Creek and Seadown Drain improve over time to meet Attribute state C (or better).

6 References

Hayward, S., Clarke, G., Dynes, K., Barnden, A., Arthur, J., Barbour, S., 2016. *Orari, Temuka, Opihi and Pareora Zone: state and trends in water quality and aquatic ecology.* Environemnt Canterbury Report No. R16/63

Zarour, H., Aitchison-Earl, P., Scott, M., Peaver, L., DeSilva, N., 2016. *Current state of the groundwater resource in the Orari-Temuka-Opihi-Pareora (OTOP) Zone*. Environment Canterbury Report No. R16/41.

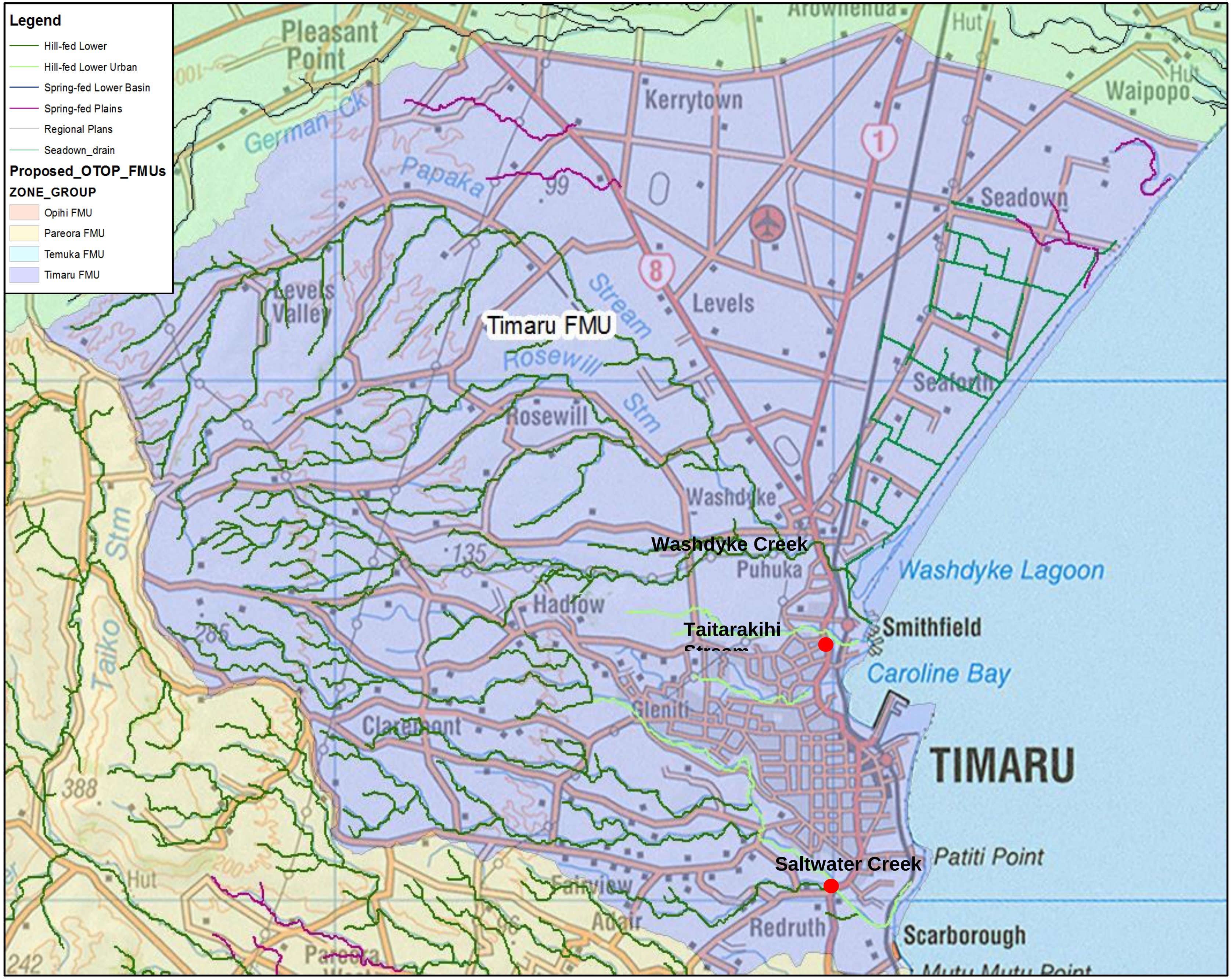

Legend
Hill-fed Lower
Hill-fed Lower Urban
Spring-fed Lower Basin
Spring-fed Plains
Regional Plans
Seadown_drain
Proposed_OTOP_FMUs
ZONE_GROUP
Opihi FMU
Pareora FMU
Temuka FMU
Timaru FMU
Timaru FMU
Washdyke Creek
Taitarakihi
Saltwater Creek
Pleasant Point
Kerrytown
Waipopo
Seadown
Levels
Levels Valley
Seaforth
Rosewill
Washdyke
Washdyke Lagoon
Puhuka
Hadlow
Smithfield
Caroline Bay
Gleniti
Claremont
TIMARU
Patiti Point
Fairview
Adair
Redruth
Scarborough

Figure 1 Timaru FMU water quality classifications and long-term monitoring sites

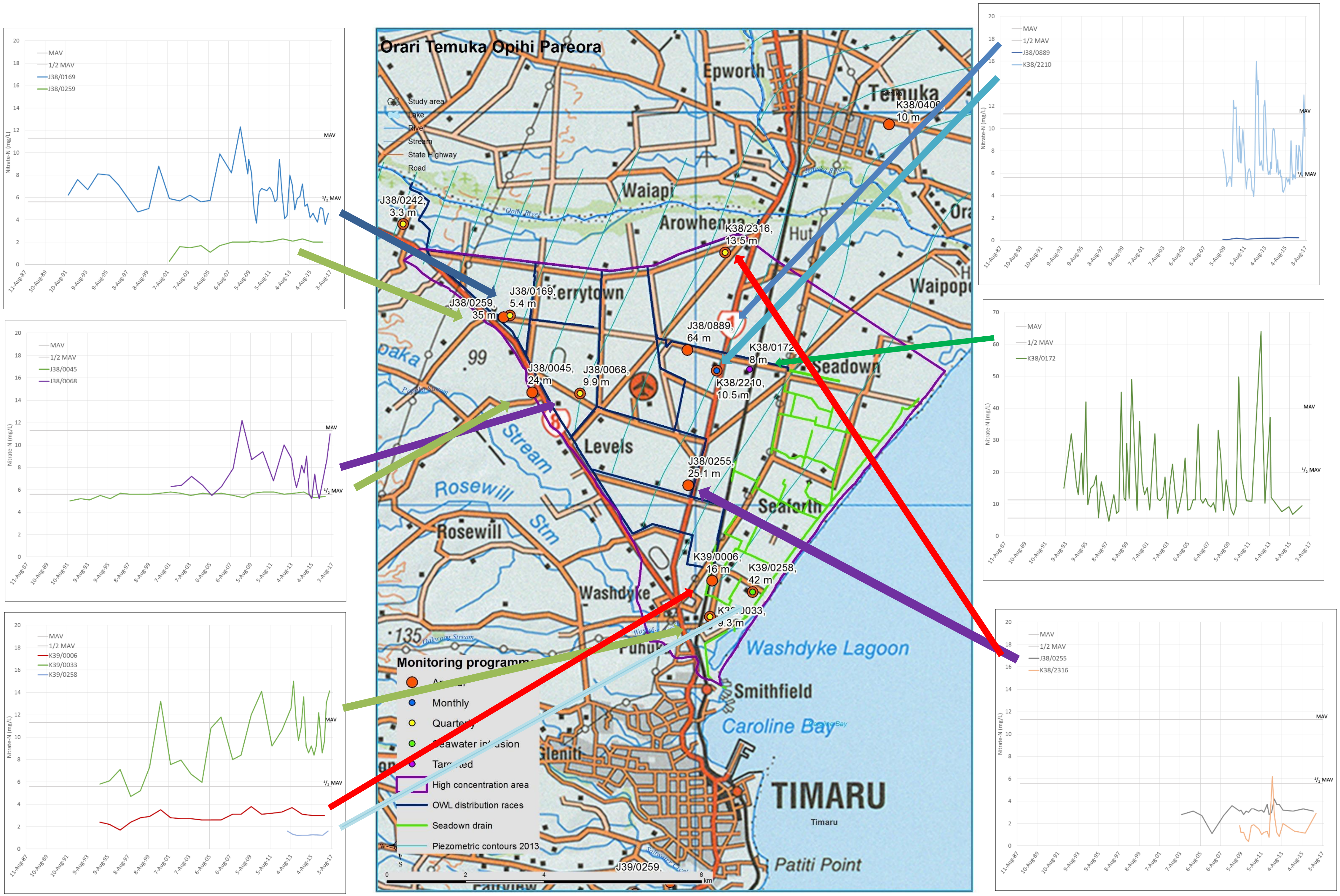
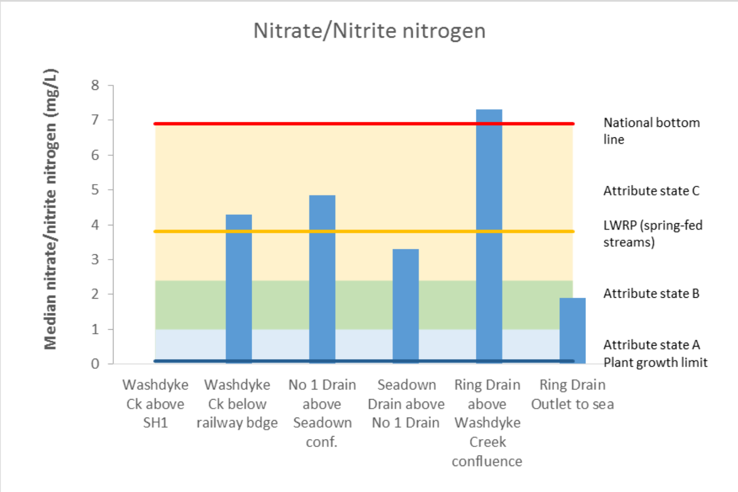
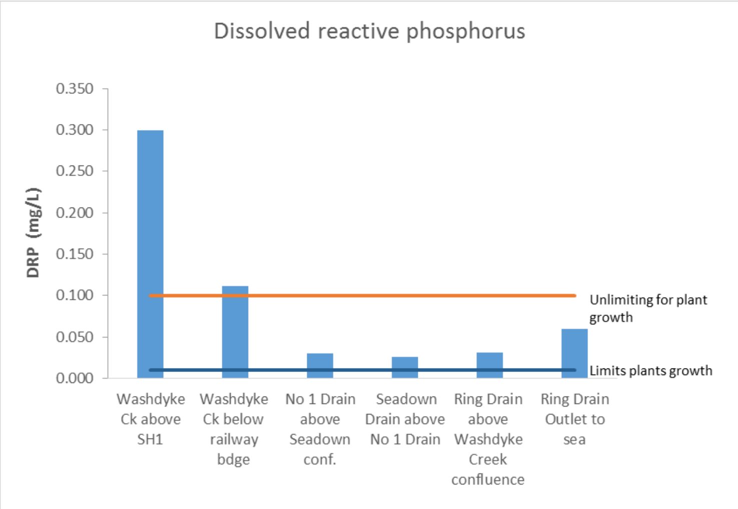
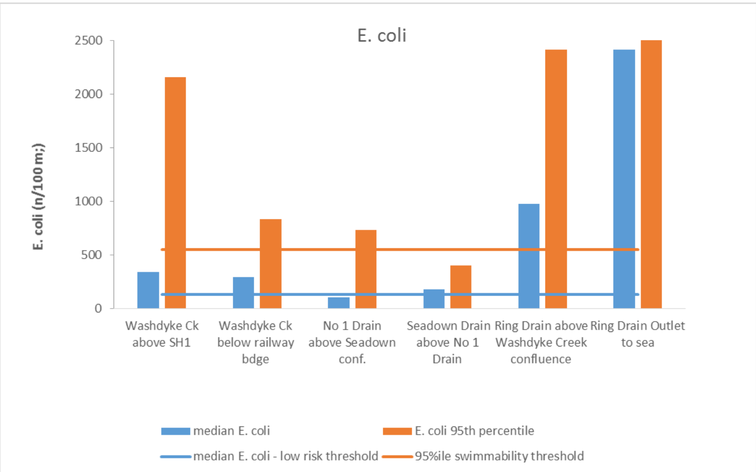


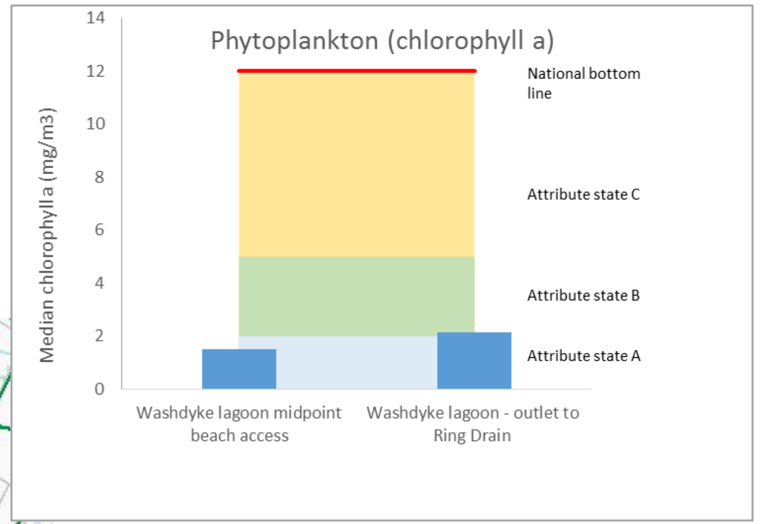
Figure 3 Nitrate trends in long-term monitoring wells in the Levels Plain area.

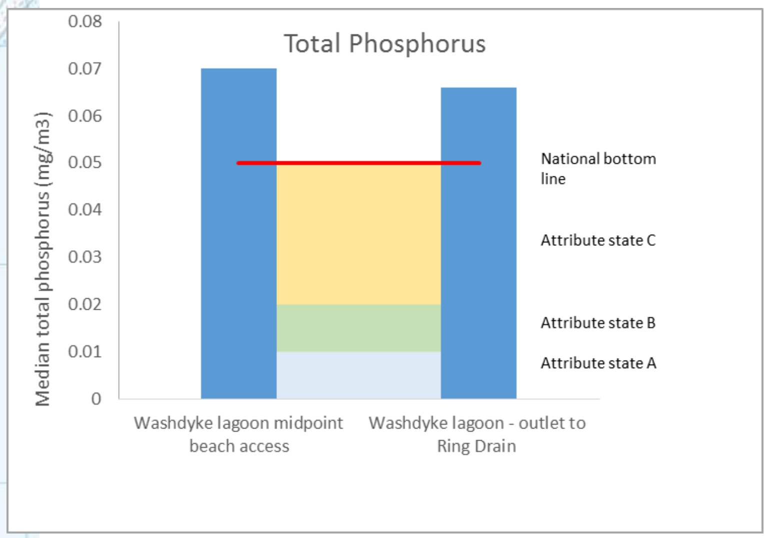
Inflows and outflows of Waitarakao/Washdyke Lagoon

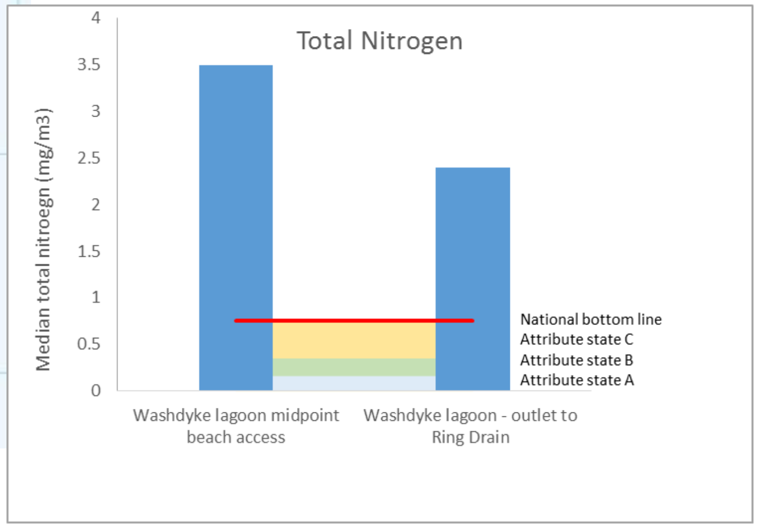












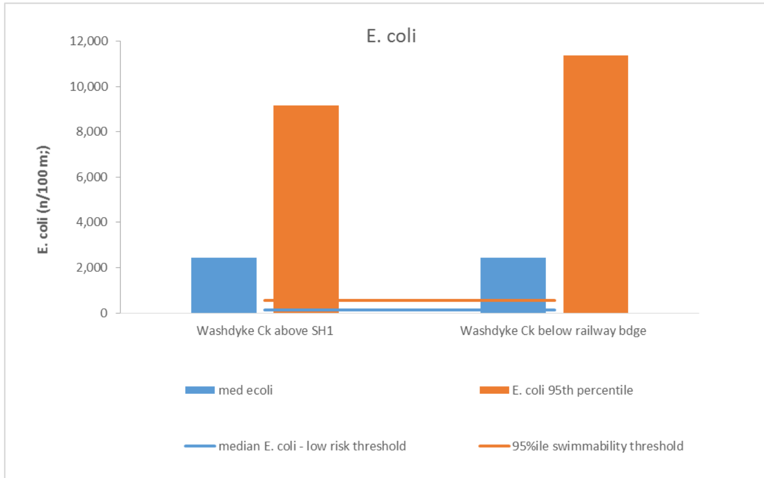
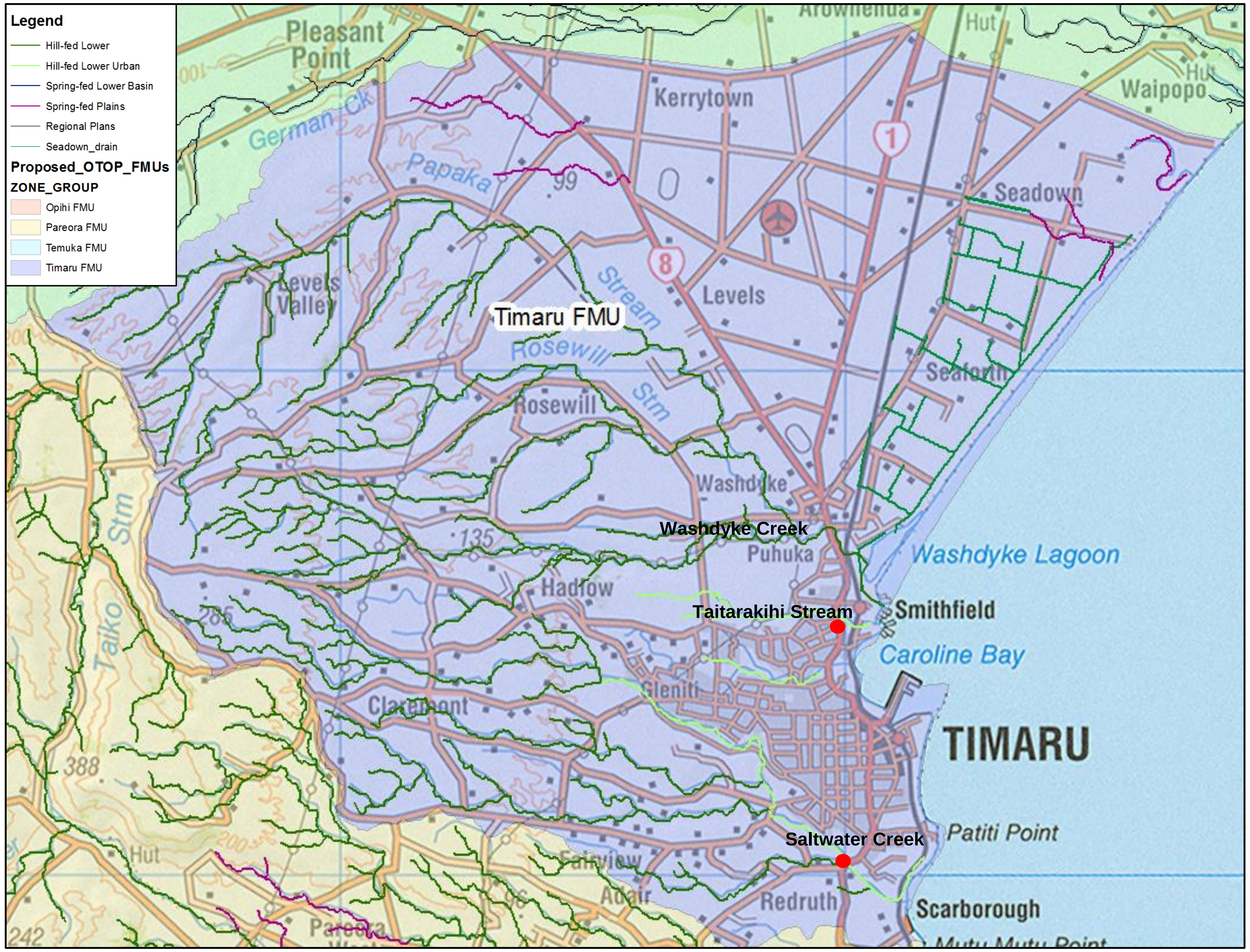


Figure 4 Summary of water quality data collected over 2016/17 in the Waitarakao/Washdyke catchment. (Note: this analysis is only based on 7 months of data and therefore need to be treated as interim results)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Pleasant Point
Kerrytown
Seadown
Waipopo
Levels
Levels Valley
Rosewill
Washdyke
Puhuka
Hadlow
Smithfield
Washdyke Lagoon
Caroline Bay
TIMARU
Patiti Point
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Redruth
Claremont
Gleniti
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