Wetland Health State of the Environment monitoring programme

Annual data report, 2018/19

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Contents

1. Introduction

This report summarises the results of the Wetland Health State of the Environment (SoE) monitoring programme for the period 1 July 2018 to 30 June 2019 inclusive. The Wetland Health monitoring programme has been designed to survey 150 wetlands across the Wellington Region over a 5 year timeframe. The region has been divided into five whaitua (super-catchment areas) by Greater Wellington Regional Council (GWRC) for the purposes of freshwater planning. Thirty wetlands are surveyed annually, with a whaitua-based approach being taken in the sampling programme. The order in which wetlands are being sampled in each whaitua is as follows:

- Year 1 - Ruamahanga,
- Year 2 – Kapiti Coast,
- Year 3 - Te Awarua-o-Porirua and Te Whanganui-a-Tara,
- Year 4 - Eastern Wairarapa
- Year 5 - Ruamahanga and Kapiti remaining wetlands.

In addition to this sampling, three wetlands a year are surveyed in the relevant whaitua for the presence and abundance of fish and indicator wetland bird species. This report details the results of wetland health monitoring undertaken at 30 sites in Year 3 of the programme in 2018/2019.

2. Overview of the Wetland Health SoE monitoring programme

Wetlands are recognised by GWRC as a key ecosystem type that has undergone major decline. Only 2.3% of the original wetland extent is estimated to remain in the Wellington region (Ausseil et al. 2003). The National Policy Statement on freshwater management details that ‘The overall quality of fresh water within a region is maintained or improved while … protecting the significant values of wetlands.” GWRC’s proposed Natural Resources Plan (pNRP) contains policies, rules and methods intended to achieve this protection and improvement of wetland health.

GWRC also has a Key Native Ecosystem (KNE) programme which aims to improve ecological outcomes at selected high value ecological sites in the region. The KNE programme includes 30 wetlands across the Wellington region.

The aim of the Wetland Health SoE monitoring programme is to monitor the state and trend of wetlands in the region to determine the effectiveness of GWRC policies and interventions through the KNE programme. We do this by surveying 30 wetlands per year, with a return time of five years, so that 150 wetlands in total will be monitored on an ongoing basis.

2.1 Monitoring objectives

The work described here aims to monitor:

1. the state and trend of wetland health in the Wellington region,

2. the effectiveness of the proposed Natural Resources Plan (pNRP) policies, rules and methods, and

3. the outcomes of management at selected wetland sites.

2.2 Monitoring network

2.2.1 Wetland health programme

The monitoring network is based on sampling the 211 wetlands that have been scheduled in the proposed Natural Resources Plan (14 of which have been designated ‘Outstanding” and 197 as “Significant). All 14 “Outstanding” wetlands and the 74 wetlands managed under GWRC’s KNE programme were included in the sample, along with a randomised selection of the remaining wetlands. Proportional representation of wetlands between whaitua was maintained during the randomisation process. The distribution of the 30 selected wetlands surveyed in 2018/2019 in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua are shown in Figure 2.1.

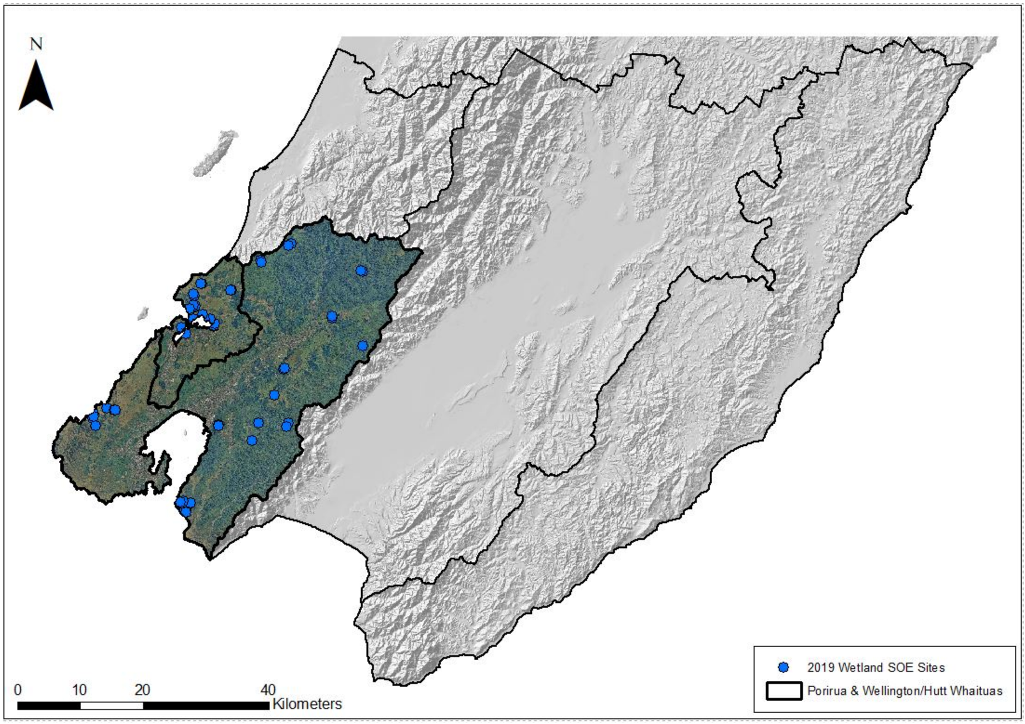

Figure 2.1: Wetlands surveyed in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua in 2018/2019

2.2.2 Fish and wetland bird sampling

Five of the 30 wetlands were selected for bird and fish surveys in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua based on their significance and vulnerability to change. Fish and bird survey sites were selected within the wetlands based on habitat and accessibility. The number of sites fished varied between one and four sites per wetland.

2.3 Monitoring variables

2.3.1 Wetland Health programme

Wetland monitoring followed Clarkson et al 2003, with adaptations from Clarkson et al. 2013. The following indices/attributes were surveyed:

- Wetland Condition Index
- Wetland Pressure Index
- Vegetation composition
- Soil condition
- Plant nutrient status

The Wetland Condition Index is a compositie index that uses indicators of the following components of wetland health:

- Hydrologic integrity
- Physiochemical parameters
- Ecosystem intactness
- Browsing/predation/harvesting
- Dominance of native plants

Assessments were made at both the wetland scale and at a more detailed plot level. A Wetland Pressure Index was also scored at the landscape scale for each wetland.

The vegetation composition was sampled in 5m x 5m plots randomly located off a sampling grid in all plant communities covering > 20% of the terrestrial area of the wetland. Field measurements of water table depth, water conductivity and pH (if water was present) and von Post (if peat was present) were recorded at each plot. Two soil core samples (100mm diameter x 70mm depth) were collected from the plot boundary and analysed in the laboratory for water content, bulk density, pH, conductivity, total C%, total N% and total P. Note that soil samples were not collected from all plots, as in some instances the water table depth was too high at the time of sampling. Leaf samples of the two dominant canopy species present were also collected and analysed for %N and %P.

2.3.2 Fish and wetland bird surveys

Sampling of birds and fish was conducted in spring. Gee-minnow traps (3mm mesh) and finemesh fyke nets with exclusion chambers were set overnight and retrieved at first light to minimise hypoxia risk. Up to five fyke nets and 10 Gee-minnow traps were deployed at each site where accessibility allowed. Species, numbers and size classes were recorded for fish. All fish were released alive at their capture location.

Wetland birds were surveyed from the margins of each wetland using play-back calls for spotless and marsh crake. Surveys were conducted between 3pm and midnight, and in the morning starting 1 hour after midnight. Listening for bittern calls took place between 3am and 1 hour after sunrise. Recording devices were also left at each wetland for 4-6 weeks and were pre-set to record bird call for 4 hours at dusk and 2 hours before dawn. Species, number and location were recorded for wetland birds.

3. Results

3.1 Wetland types

Wetlands are classified by the dominant wetland class, but it should be noted that different wetland classes can occur within a wetland, (e.g. an ephemeral wetland on the side of a swamp). There was a wide range of wetland types monitored this year; 1 bog, 2 fens, 14 swamp, 2 marsh, 8 saltmarsh and 3 seepage wetland types. One of the fen wetlands also contained an area of bog, while one swamp dominated wetland had saltmarsh present. Each wetland had between one and four plots established, depending on the number of vegetation communities present. A total of 48 plots were established across the 30 wetlands surveyed. Nine vegetation community types were identified as present: forest, shrubland, flaxland, reedland, rushland, sedgeland, grassland, herbfield and turf. Some wetlands are dominated by one vegetation type, while others contain two or more types.

3.2 Wetland Condition Index (WCI)

A range of condition scores were recorded for the 30 wetlands surveyed in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua in 2018/2019, with the highest WCI score being 20.75 and the lowest 13.5 (see Figure 3.1).

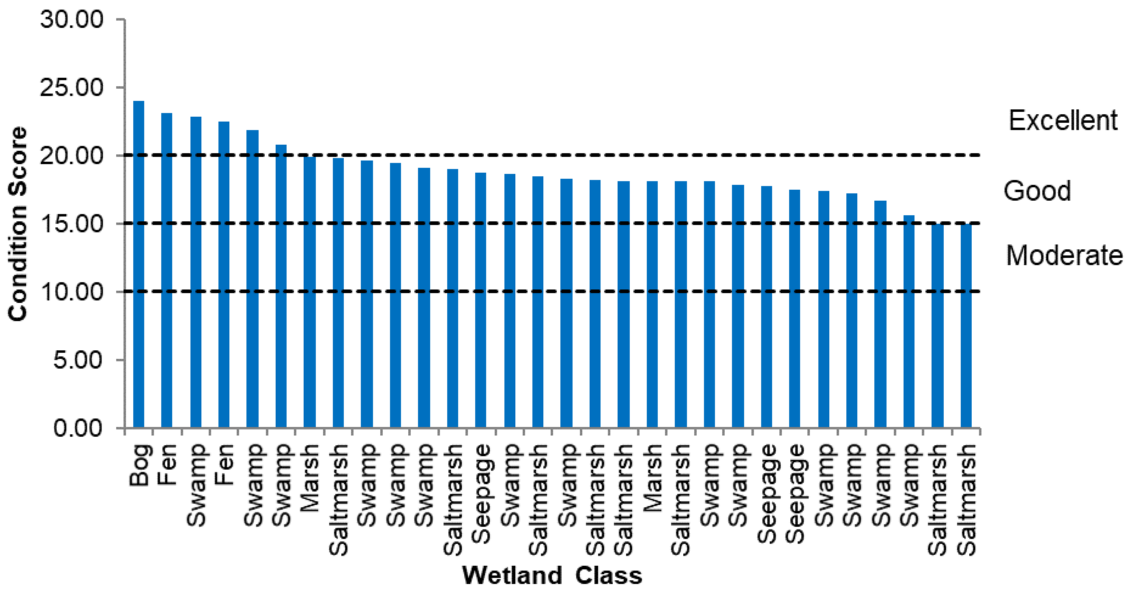

Figure 3.1: Ranked Wetland Condition Scores for wetlands surveyed in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua

Using the scoring system of Clarkson et al. 2015:

- 6 sites were classified as being in excellent condition,
- 22 sites were in good condition, and
- 2 sites were in moderate condition.

3.3 Wetland Condition Index components

The scoring for wetland condition is comprised of the following indicators: Hydrological Integrity, Physiochemical, Ecosystem Intactness, Browsing/predation and Dominance of Native Plants. The Hydrological Integrity indicator (Figure 3.2) showed the best scores in Te Awarua-o-Porirua and Te Whanganui-a-Tara compared to the results from the Kapiti Coast and Ruamahanga whaitua gathered in previous years (Crisp et al 2017, 2018). Urbanisation and land use practices influenced some of the physiochemical scores this year, especially for the Porirua wetlands that were located near infrastructure. Ecosystem Intactness, Browsing/predation and Dominance of Native Plants indicators are influenced by site-based management. The wetlands this year had higher scores for all of those parameters than in previous years, which is a reflection of the large number of wetlands in GWRC's parks and forests or on Public Conservation Land managed by the Department of Conservation (DOC). High numbers of good and excellent wetland scores were recorded for the Dominance of Native Plants indicator.

3.4 Wetland Pressure Scores

The Wetland Pressure Index scores ranged between 6 and 21 (out of 35). In general, the Wetland Condition Index scores were a reflection of the Wetland Pressure Index scores; with wetland condition being inversely related to pressure scores (ie the higher the pressure the lower the condition, see Figure 3.3). By comparison, the higher level of human impact on wetlands surveyed in 2017/2018 across the Kapiti Coast whaitua resulted in a clumping of scores at the higher end of the pressures scale. In the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua however, the scores were well spread across the pressure range. A higher pressure score due to grazing was recorded at the one of the wetlands which was rated as being in moderate condition.

3.5 Soil analysis

The aim of the soil analysis was to detect human-derived inputs and impacts of nutrients. Total carbon, total nitrogen and total phosphorus were all measured in soil cores at each plot, but understanding how this data will be used to assess wetland health is still in development. This is challenging as nitrogen levels are influenced by natural inputs from plants and the reduction of nitrogen in the wetland environment. Nitrogen levels therefore do not necessarily reflect the human-derived nutrient inputs to a wetland because denitrification is a feature of wetlands and nitrogen is bound to carbon in the wetland organic material. Similarly, total phosphorus can reflect the composition of the wetland substrate itself, rather than nutrient inputs. Some analyses of total carbon and bulk density levels are of interest however, as these can indicate impacts such as trampling, grazing or land disturbance such as earth moving.

Interim national limits for some soil variables have been developed for swamps, bogs and fens, but not for marsh, saltmarsh, ephemeral or shallow water wetland types at this stage (Clarkson et al. 2015). It should be noted that interim national limits have been set for wetlands that have a WCI score of greater than 15. Eight of the sites reported here scored less than 15. Nevertheless, all plots are included in the comparison with the national limits (even for wetlands with a WCI equal or less than 15).

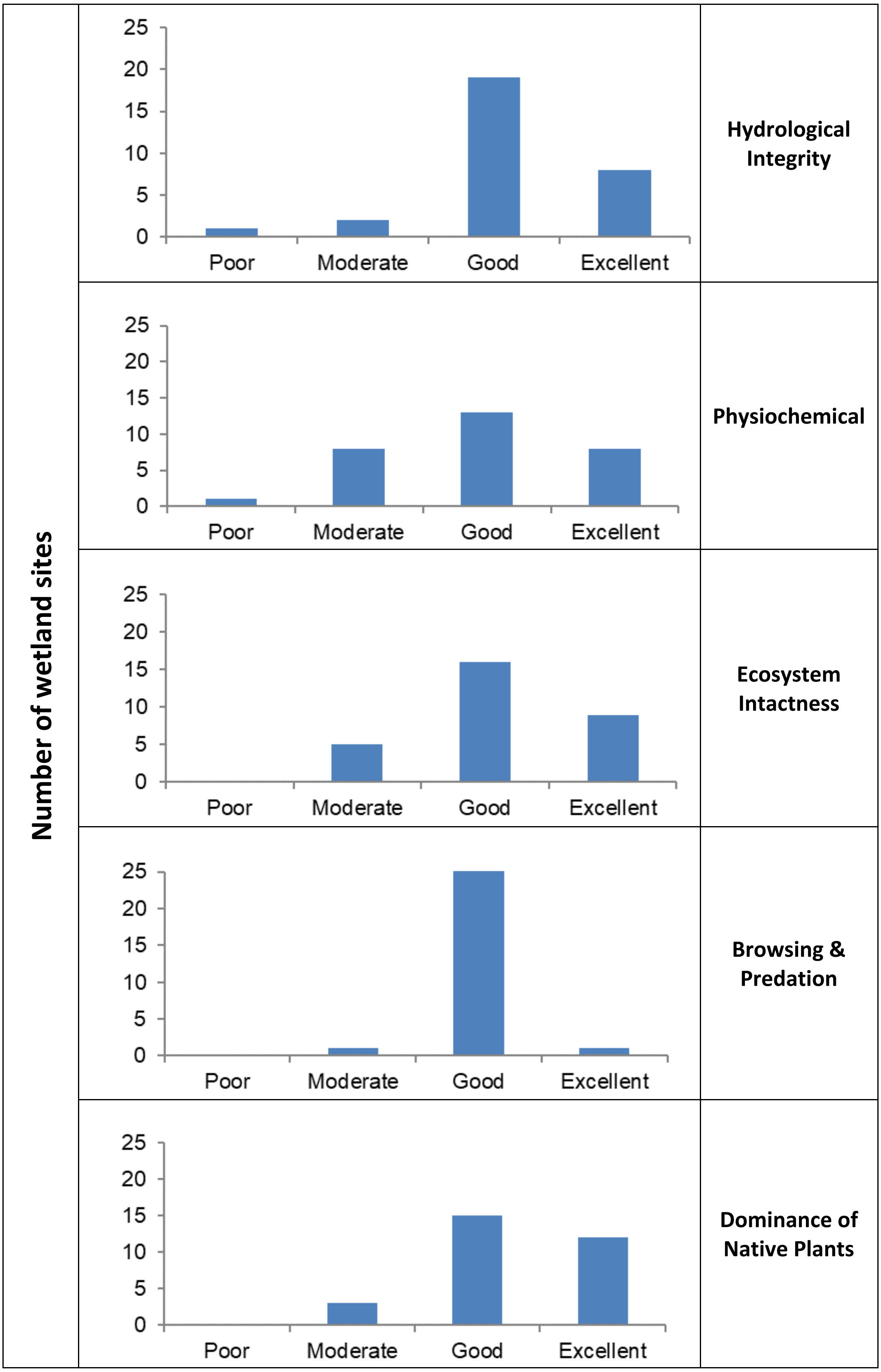

Figure 3.2: Wetland condition component scores

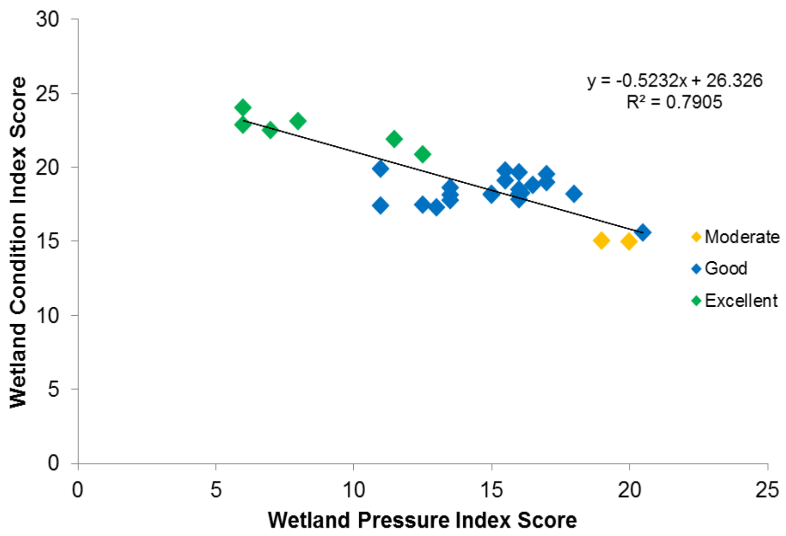

Figure 3.3: Relationship between the Wetland Condition Index scores and the Wetland Pressure Index scores for the wetlands surveyed

The very high organic carbon result at one site (Figure 3.4) was recorded in an old swamp forest comprised of a mānuka-kahikatea-swamp maire vegetation community and is likely to reflect the high peat accumulation at the site. Six wetlands had very low organic carbon levels. Some of those sites had been historically impacted by earth-moving equipment, e.g. from digging drains, while sampling difficulties are likely to have affected the results at other sites. These sampling difficulties were caused by the sites being too wet to collect a soil sample, meaning that samples could only be collected from the edges of the wetland on the sides of drains or tracks. Two of the low carbon sites had been grazed by stock for many years.

Organic carbon and total nitrogen are indicators of the organic reserves in the soil derived from healthy plant communities. Livestock remove plant material that contributes to the organic carbon and total nitrogen stores in the soil. So where livestock have access to graze in a wetland we might expect to find lower soil organic carbon reserves. One fen wetland had organic carbon levels below the national lower critical limit (Figure 3.5). This site was on a ridge and in gley, rather than peat soil. Peat is mostly composed of organic material and generally have high organic carbon levels. In contrast, gley soils are primarily composed of mineral material, with little organic material present.

Four wetlands had bulk density levels above the national upper limit (Figure 3.6). Three of these four wetlands had previously been impacted by earth-moving machinery. There was one fen site that had a bulk density level above the national critical limit. This site was the same wetland that had low organic carbon levels and the high bulk density score is thought to have been attributable to the soil type present (Figure 3.7).

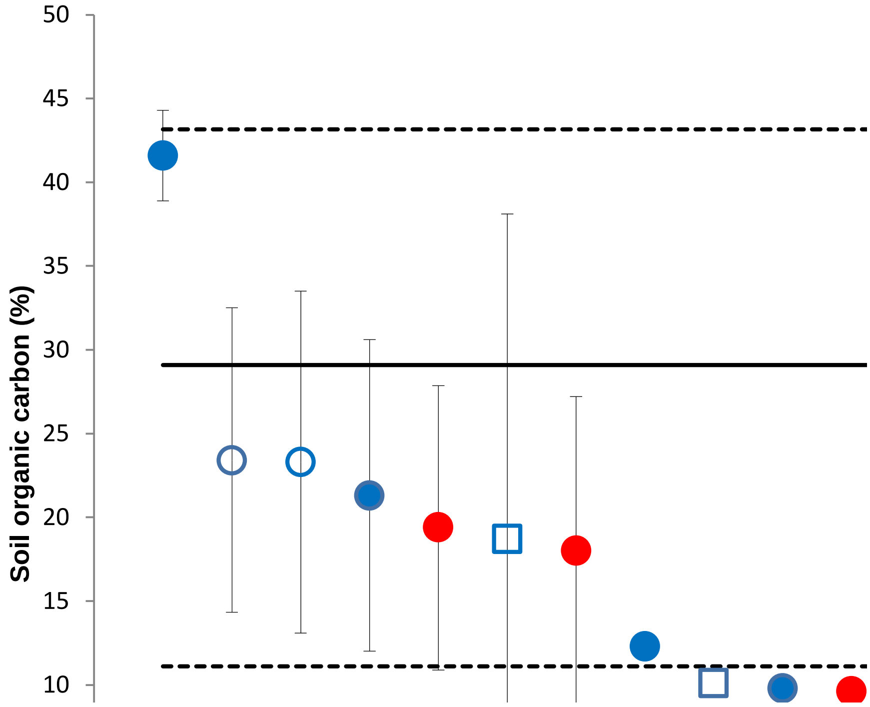

Figure 3.4: Ranked organic carbon levels within swamp sites, showing the national mean (black line) and upper and lower critical limits (dashed lines) (Clarkson et al 2015). Red indicates livestock have access to the wetland, open symbols are KNEs, circles are significant wetlands and squares are outstanding wetlands

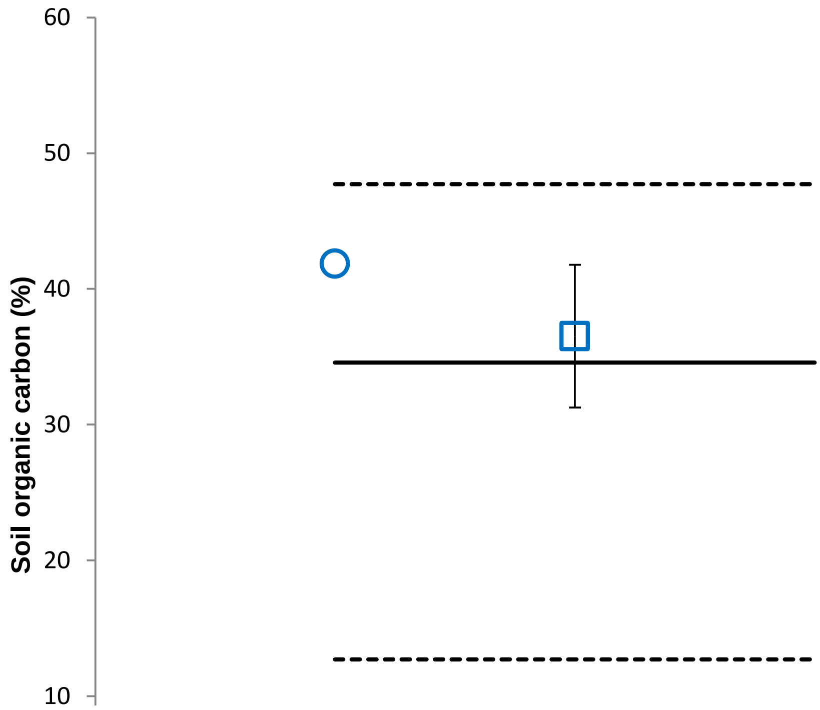

Figure 3.5: Ranked organic carbon levels within fen sites showing the national mean (black line) and upper and lower critical limits (dashed lines) (Clarkson et al 2015). Red indicates livestock have access to the wetland, open symbols are KNEs, circles are significant wetlands and squares are outstanding wetlands

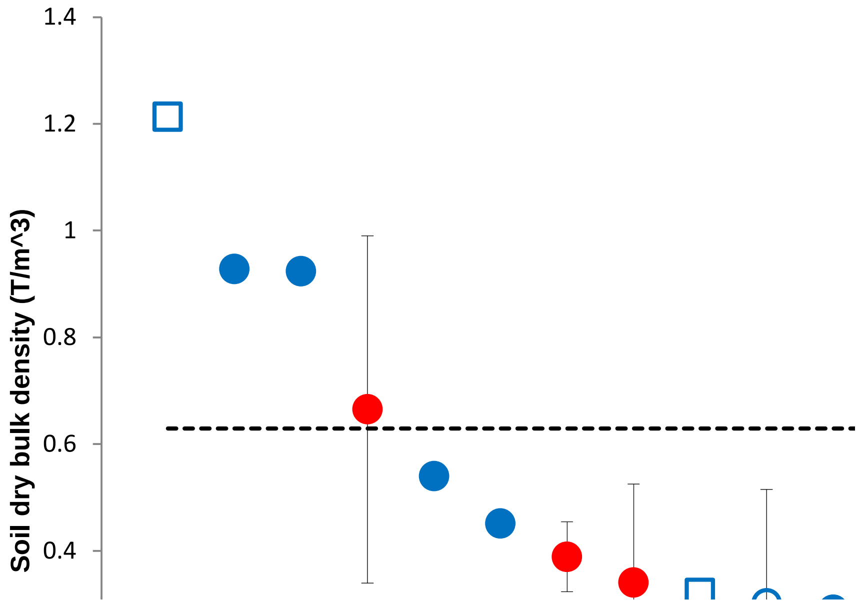

Figure 3.6: Ranked dry bulk density levels in swamp sites showing the national mean (black line) and upper and lower limits (dashed lines) (Clarkson et al 2015). Red indicates livestock have access to the wetland, open symbols are KNEs, circles are significant wetlands and squares are outstanding wetlands

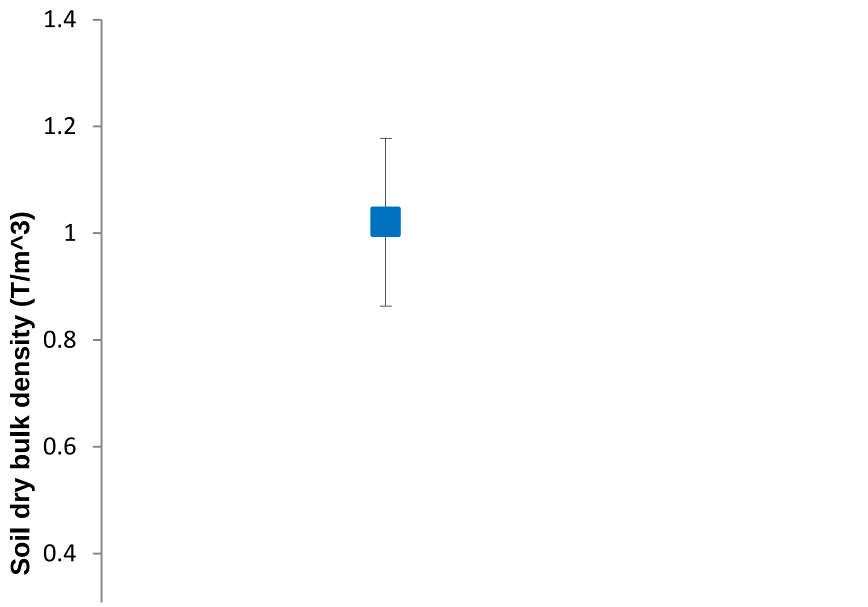

Figure 3.7: Ranked dry bulk density levels in fen sites showing the national mean (black line) and upper and lower limits (dashed lines) (Clarkson et al 2015). Red indicates livestock have access to the wetland, open symbols are KNEs, circles are significant wetlands and squares are outstanding wetlands

3.6 Native species dominance

Native species dominance within the different vegetation community types for the wetlands sampled in the Te-Awarua-o-Porirua and Te Whanganui-a-Tara is shown in Figure 3.8. Wetlands with herbfield communities present had the lowest percentage of native species and cover, while indigenous turf and forested wetlands had high native species dominance. Wetland communities with low native species dominance have often been impacted by external effects which allow for exotic species to invade and outcompete native wetland species. These impacts can include lowered water table, altered hydrology, high nutrient levels, and grazing by stock or rabbits. While the turf wetlands are also low stature, the remote location of the wetlands sampled meant that they were less impacted by human pressures.

It has been interesting to compare the percentage of native species detected in plots surveyed over the past three years in the different whaitua (Figure 3.9). Overall, the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua had higher native species present than those monitored in the Ruamahanga and Kapiti Coast whaitua. This is thought to be because the wetlands monitored in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua had the highest proportion of wetlands located on protected land (i.e. in GWRC parks and forests, or on Public Conservation Land).

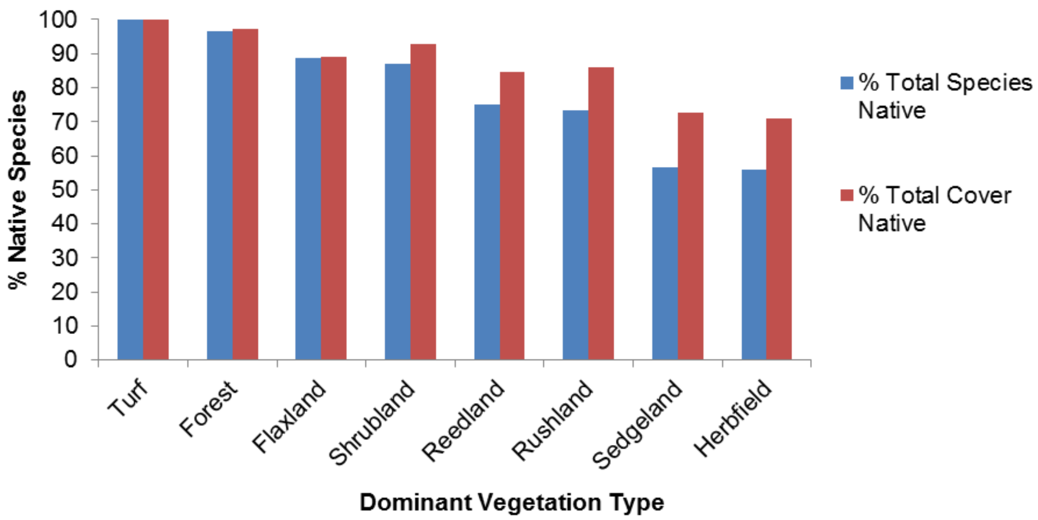

Figure 3.8: Percentage of the species and cover composed by native species in each vegetation type

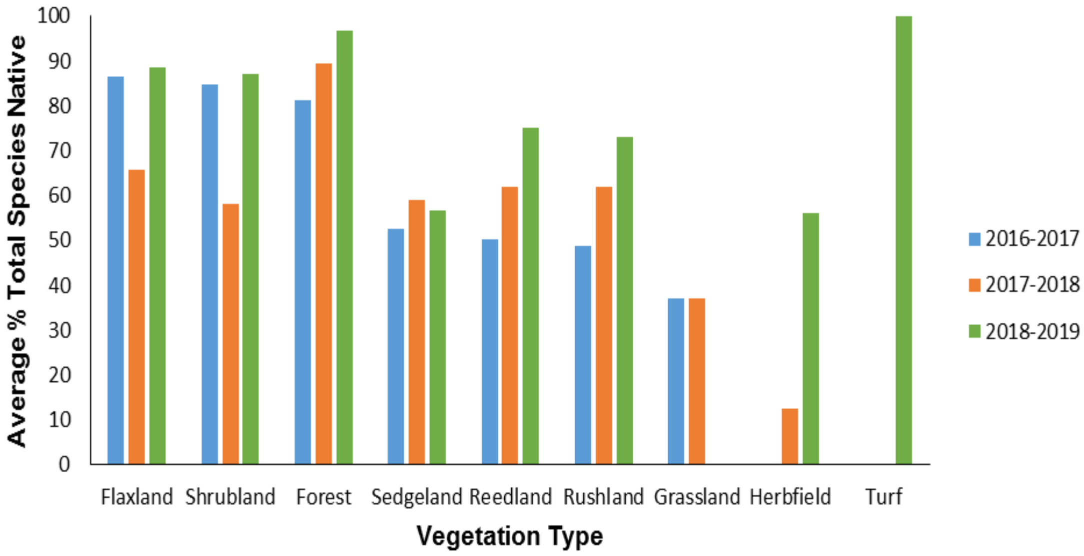

Figure 3.9: Comparison of the average indigenous species dominance recorded in plots surveyed in the Ruamahanga whaitua (2016-2017), Kapiti Coast whaitua (2017-2018) and the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua (2018-2019)

3.7 Spring faunal surveys

The findings of the spring faunal surveys for the selected wetland sites are shown in Table 3.1. This year, only one wetland had both wetland fish and bird surveys completed, as fish surveys had been completed previously at two of the sites chosen for bird surveys. A report on the wetland fishing results can be found in Morar and Kulik 2019.

Table 3.1: Wetland bird and fish species identified during spring surveys

Site	Wetland birds	Fish
Wetland 1	No spotless crake recorded	Short-fin eel, longfin eel, common bully, inanga
Wetland 2	8 spotless crake	N/A
Wetland 3	19 spotless crake	N/A
Wetland 4	N/A	Shortfin eel, longfin eel, banded kokopu, giant bully, redfin bully, triplefin, common bully, inanga, mullet
Wetland 5	N/A	Short-fin eel, longfin eel, redfin bully, dwarf galaxias

4. Discussion

A high number of the wetlands surveyed in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua (over 90%) were categorised as being in excellent or good condition by national standards. The national categories however have been set based on a small sample of wetlands from across New Zealand and may be refined as more data, particularly from wetlands in developed catchments, becomes available. This may, for example, mean that the national bottom line is ultimately set at a higher WCI. Wetlands in developed agricultural landscapes have significantly lower WCI scores than wetlands in indigenous-dominated catchments (Clarkson et al. 2013).

The overall Wetland Pressure Index scores recorded for Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua were lower than those of the Kapiti Coast or Ruamahanga whaitua. This is thought to be due to the number of sites located this year on protected land (e.g. in GWRC's parks and forests).

Livestock grazing in wetlands is expected to result in low levels of organic matter and high levels of bulk density in the soil. This is because livestock feeding on plants, reduces their contribution of vegetative material to the soil organic fraction and heavy (~400kg cattle beasts) animals compact the soil through their trampling action. The organic fraction of the soil provides nutrients and creates soil structure that retains moisture for plant growth. While compaction reduces pore spaces for gaseous exchange and water infiltration in the soil (Sorenson, 2012). A pattern of low organic matter and high bulk density was seen in grazed wetlands sampled in the Ruamahanga (Crisp et al 2018). The same pattern was not as marked in the other whaitua however, which may be because fewer of the wetlands sampled had grazing stock, but also because the tendency was for sheep to be the stock grazed (sheep have less impacts on wetlands than cattle). Wetlands in these two whaitua had other impacts such as land disturbance and the effects of urban development. There was also a higher percentage of estuarine wetlands this year (in the for Te Awarua-o-Porirua whaitua).

Eleven wetlands within Key Native Ecosystem (KNE) sites were assessed during this sampling. The KNE wetlands had a higher mean condition score (WCI = 21) than the mean for the remaining 19 wetlands (WCI = 18). These surveys have been able to point to areas that need attention to improve the WCI in these KNEs and thereby can inform management actions. Changes in the WCI over time will provide data on the outcomes of management. In terms of plan effectiveness, the need for more landscape management to improve the WCI scores has been highlighted through the results detailed in Section 3.3. Changes in wetland health do not occur rapidly. This monitoring programme has established the baseline condition of wetlands in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua and will be able to provide an assessment of changes in condition that occur over time. The spring bird and fish surveys have provided good information about the species present in the wetlands sampled and the health of those sites. The high numbers of spotless crake in one of the wetlands highlights the importance of this habitat to those species, while good fish species diversity was recorded at two wetland sites.

5. Acknowledgements

The field team who collected the data for the summer wetland surveys included Shona Myers, Owen Spearpoint and Faline Drummond. Shona Myers also produced a background report on the survey data, while Faline Drummond completed the analysis of the soils data and provided the figures for this report. Soil analysis was completed by Manaaki Whenua - Landcare Research. The spring bird monitoring was conducted by Shane Cotter and Owen Spearpoint and the fish monitoring by Shyam Morar and Dylan Kulik of the Marine and Freshwater team in GWRC's Environmental Science Department.

6. References

Ausseil A-G, Gerbeaux P, Chadderton WL, Stephens T, Brown D and Leathwick J. 2008. *Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands.* Prepared for Department of Conservation by Landcare Research, Report No. LC0708/158, Palmerston North.

Clarkson BR, Sorrell BK, Reeves PN, Champion PD, Partridge TR, and Clarkson BD. 2004. *Handbook for monitoring wetland condition. Coordinated monitoring of New Zealand wetlands.* Prepared for the Ministry for the Environment by Landcare Research, Report No. 10.7931/J2Z60KZ3, Hamilton.

Clarkson BR, Ausseil A-G and Gerbeaux P. 2013. Wetland ecosystem services. In: JR Dymond (Ed.). *Ecosystem services in New Zealand – conditions and trends*. Manaaki Whenua Press, Lincoln, pp 1.14.

Clarkson BR, Hicks A, Robertson HA, Rance BD and Ledgard G. 2013. *A monitoring approach for southlands wetlands: Stage 1.* Prepared for Environment Southland by Landcare Research, Report No. LC1722, Hamilton.

Clarkson BR, Overton JM, Ausseil A-G and Robertson HA. 2015. *Towards quantitative limits to maintain the ecological integrity of freshwater wetlands*. Prepared for Department of Conservation by Landcare Research, Report No. LC1933, Hamilton.

Crisp P, Uys R and Drummond F. 2018. *Wetland Health State of the Environment monitoring programme: Annual Data Report 2016/2017*. Greater Wellington Regional Council, Publication No. GW/ESCI-G-18/118, Wellington.

Crisp P, Uys R and Drummond F. 2018. *Wetland Health State of the Environment monitoring programme: Annual Data Report 2017/2018*. Greater Wellington Regional Council, Publication No. GW/ESCI-T-18/148, Wellington.

Morar S and Kulik D. 2019. *Wetland Health Monitoring Programme. Results of fish surveys across three wetlands in Wainuiomata, Papakowhai and Ohariu/Makara 2018.* Internal Environmental Science report. http://ourspace.gw.govt.nz/ws/watermgt/wtl/2018%20Spring%20Wetland%20Fishing%20Report.docx?Web=1

Sorensen P. 2012. *Soil Quality and stability in the Wellington Region: State and trends*. Greater Wellington Regional Council, Publication No. GW/EMI-T-12/138, Wellington.

Appendix A: Data tables

Appendix 1: Wetland protection status in the GWRC Proposed Natural Resources Plan, current state of stock exclusion, and soil mean dry bulk density and percentage organic carbon at each fen and swamp site monitored in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua over summer 2018/2019.

Site	No. plots sampled	Wetland type	GWRC protection	Stock excluded	Dry bulk density (t/m²)			% Organic Carbon		
					Mean	Min	Max	Mean	Min	Max
SOE WL80	1	Fen	Significant	Y	0.13	0.13	0.13	41.86	41.86	41.86
SOE WL81	2	Swamp	Significant	N	0.27	0.17	0.36	18.00	8.80	27.22
SOE WL82	2	Fen/Bog	Outstanding	Y	1.02	0.86	1.18	4.59	4.51	4.68
SOE WL83	1	Swamp	Significant	Y	0.93	0.93	0.93	5.12	5.12	5.12
SOE WL84	1	Marsh	Significant	Y	0.45	0.45	0.45	6.18	6.18	6.18
SOE WL85	2	Fen	Outstanding, KNE	Y	0.11	0.10	0.11	36.52	31.26	41.77
SOE WL86	1	Saltmarsh	Significant	Y	0.51	0.51	0.51	4.31	4.31	4.31
SOE WL87	1	Swamp	Significant	Y	0.92	0.92	0.92	3.79	3.79	3.79
SOE WL88	2	Swamp	Significant, KNE	Y	0.30	0.09	0.51	23.30	13.09	33.51
SOE WL89	4	Swamp	Outstanding, KNE	N	0.27	0.09	0.60	18.70	3.21	38.11
SOE WL90	1	Saltmarsh	Significant	Y	0.31	0.31	0.31	10.52	10.52	10.52
SOE WL91	1	Swamp	Outstanding, KNE	Y	0.32	0.32	0.32	10.10	10.12	10.12
SOE WL92	3	Saltmarsh	Outstanding	Y	0.28	0.19	0.36	11.33	6.50	18.79
SOE WL93	2	Swamp	Not scheduled	N	0.34	0.16	0.53	19.40	10.89	27.86
SOE WL94	2	Swamp	Significant, KNE	Y	0.16	0.12	0.20	23.40	14.33	32.51
SOE WL95	2	Saltmarsh	Significant	Y	0.62	0.45	0.78	7.35	3.77	10.94
SOE WL96	1	Saltmarsh	Significan	Y	0.27	0.27	0.27	13.15	13.15	13.15
SOE WL97	1	Saltmarsh	Significan	Y	0.52	0.52	0.52	3.13	3.13	3.13
SOE WL98	1	Swamp	Significant	Y	0.29	0.29	0.29	12.34	12.34	12.34
SOE WL99	1	Swamp	Outstanding, KNE	Y	1.21	1.21	1.21	0.70	0.68	0.68

Site	No. plots sampled	Wetland type	GWRC protection	Stock excluded	Dry bulk density (t/m²)			% Organic Carbon		
					Mean	Min	Max	Mean	Min	Max
SOE WL100	2	Swamp	Significant	Y	0.20	0.15	0.24	21.30	12.02	30.60
SOE WL101	2	Seepage	Significant	Y	0.34	0.10	0.57	25.99	11.58	40.39
SOE WL102	1	Seepage	Significant	Y	0.33	0.33	0.33	13.22	13.22	13.22
SOE WL103	2	Swamp	Significant	N	0.67	0.34	0.99	8.00	2.37	13.69
SOE WL104	1	Saltmarsh	Significant	N	4.00	4.00	4.00	0.54	0.54	0.54
SOE WL105	2	Marsh	Significant	N	0.39	0.32	0.45	9.62	9.27	9.97
SOE WL106	2	Swamp	Significant	Y	0.54	0.52	0.56	9.80	8.30	11.39
SOE WL107	2	Swamp	Significant	Y	0.16	0.15	0.17	41.60	38.88	44.29
SOE WL108	1	Seepage	Significant	Y	0.35	0.35	0.35	18.28	18.28	18.28
SOE WL109	1	Saltmarsh	Significant	Y	0.32	0.32	0.32	10.82	10.82	10.82

Appendix 2: Wetland vegetation types and the dominance of native species and native vegetation cover in the 5m x 5m plots sampled at each site monitored the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua over summer 2018/2019. Sites are numbered (e.g. SOE WL01) and plots are listed as letters (i.e. A, B, C, D and E)

Plot	Vegetation type	Native species dominance (%)	Native cover dominance (%)
SOE WL80A	Forest	96	99
SOE WL81A	Sedgeland	22	33
SOE WL81B	Sedgeland	31	37
SOE WL82A	Turf	100	100
SOE WL82B	Shrubland	100	100
SOE WL83A	Sedgeland	17	45
SOE WL84A	Shrubland	82	96
SOE WL85A	Forest	100	100
SOE WL85B	Shrubland	91	100
SOE WL86A	Saltmarsh	40	64
SOE WL87A	Sedgeland	40	52
SOE WL88A	Reedland	82	90
SOE WL88B	Forest	83	80
SOE WL89A	Reedland	67	72
SOE WL89B	Reedland	67	79
SOE WL89C	Rushland	92	97
SOE WL89D	Sedgeland	100	100
SOE WL90A	Rushland	50	96
SOE WL91A	Reedland	75	90
SOE WL91B	Reedland	87	97
SOE WL91C	Sedgeland	100	100
SOE WL92A	Rushland	100	100
SOE WL92B	Rushland	75	96
SOE WL92C	Shrubland	91	91
SOE WL93A	Reedland	43	66
SOE WL93B	Rushland	29	34
SOE WL94A	Shrubland	75	89
SOE WL94B	Forest	94	99
SOE WL95A	Shrubland	78	92
SOE WL95B	Shrubland	78	95
SOE WL96A	Rushland	100	100
SOE WL97A	Rushland	100	100

Plot	Vegetation type	Native species dominance (%)	Native cover dominance (%)
SOE WL98A	Sedgeland	67	98
SOE WL99A	Flaxland	88	97
SOE WL99B	Flaxland	83	97
SOE WL99C	Sedgeland	50	89
SOE WL99D	Flaxland	83	65
SOE WL100A	Shrubland	92	76
SOE WL100B	Reedland	80	82
SOE WL101A	Shrubland	100	100
SOE WL101B	Forest	100	100
SOE WL102A	Shrubland	81	92
SOE WL103A	Shrubland	100	100
SOE WL103B	Flaxland	100	97
SOE WL104A	Herbfield	56	71
SOE WL105A	Sedgeland	56	84
SOE WL105B	Reedland	100	100
SOE WL106A	Forest	100	100
SOE WL106B	Forest	100	100
SOE WL107A	Shrubland	78	83
SOE WL107B	Forest	100	100
SOE WL108A	Sedgeland	40	60
SOE WL109A	Sedgeland	100	100

Appendix 3: Wetland type and the condition and pressure scores by component for the 30 wetland sites monitored in the Te Awarua-o-Porirua and Te Whanganui-a-Tara whaitua over summer 2018/2019. Wetland condition indicators are scored out of 5 and averaged to give a score out of 5 for each component. The five components that make up the Wetland Condition Index are then summed to give a score out of 25 where (<10=poor, 10 ≤ 15=moderate, 15 ≤ 20 =good and >20 =excellent). The Wetland Pressure Index is calculated as the sum of seven indicators, each scored out of 5 to give a score out of 35

Site	Wetland type	Indicator component					Overall condition index	Overall pressure index
		Hydrological integrity	Physiochemical parameters	Ecosystem intactness	Browsing and predation	Dominance of native plants		
SOE WL80	Fen	4.67	5.00	4.67	3.75	5.00	23.08	8
SOE WL81	Swamp	3.50	2.50	3.33	3.25	3.00	15.58	20.5
SOE WL82	Fen	5.00	5.00	5.00	4.00	5.00	24.00	6
SOE WL83	Swamp	2.33	5.00	2.67	3.75	3.50	17.25	13
SOE WL84	Marsh	3.67	3.50	4.17	3.75	4.83	19.92	11
SOE WL85	Fen	4.67	4.67	4.67	4.00	4.50	22.50	7
SOE WL86	Saltmarsh	2.67	2.00	2.67	4.00	3.67	15.00	19
SOE WL87	Swamp	3.50	3.50	3.67	3.50	3.67	17.83	16
SOE WL88	Swamp	3.50	3.50	3.83	3.63	3.67	18.13	13.5
SOE WL89	Swamp	4.50	4.25	4.67	4.00	4.50	21.92	11.5
SOE WL90	Saltmarsh	2.00	2.25	3.00	3.88	3.83	14.96	20
SOE WL91	Swamp	4.33	4.00	4.00	4.00	4.50	20.83	12.5
SOE WL92	Saltmarsh	3.83	2.75	4.17	4.38	4.67	19.79	15.5
SOE WL93	Swamp	3.83	3.50	2.83	3.38	3.17	16.71	17
SOE WL94	Swamp	4.67	5.00	5.00	3.63	4.57	22.86	6
SOE WL95	Saltmarsh	3.83	3.00	3.83	4.00	4.33	19.00	15

Site	Wetland type	Indicator component					Overall condition index	Overall pressure index
		Hydrological integrity	Physiochemical parameters	Ecosystem intactness	Browsing and predation	Dominance of native plants		
SOE WL96	Saltmarsh	3.83	3.00	3.33	4.00	4.00	18.17	16
SOE WL97	Saltmarsh	3.67	3.00	3.67	3.88	4.00	18.21	15.5
SOE WL98	Swamp	3.83	3.00	4.50	3.75	4.00	19.08	13.5
SOE WL99	Swamp	3.67	3.25	3.73	4.00	3.97	18.62	16.1
SOE WL100	Swamp	3.57	4.00	4.00	3.88	2.83	18.28	16.5
SOE WL101	Seepage	3.33	4.25	3.00	3.88	4.33	18.79	13.5
SOE WL102	Seepage	3.17	3.75	3.33	3.88	3.67	17.79	17
SOE WL103	Swamp	3.83	3.75	3.83	3.75	4.33	19.50	15
SOE WL104	Saltmarsh	3.67	4.40	4.17	3.25	2.67	18.15	18
SOE WL105	Marsh	3.17	4.00	3.67	3.50	3.83	18.17	16
SOE WL106	Swamp	4.33	4.00	3.33	3.00	5.00	19.67	11
SOE WL107	Swamp	3.33	3.25	3.50	3.63	3.67	17.38	12.5
SOE WL108	Seepage	3.33	4.00	3.17	3.63	3.33	17.46	16
SOE WL109	Saltmarsh	4.17	3.00	3.67	4.00	3.67	18.50	17.5