BEFORE AN INDEPENDENT HEARINGS
PANEL OF THE WAIKATO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of an application by Watercare Services Limited for regional resource consents required for the Pukekohe Wastewater Treatment Plant at Parker Lane, Buckland

STATEMENT OF EVIDENCE OF DAVID JAMES CAMERON
ON BEHALF OF WATERCARE SERVICES LIMITED

1. INTRODUCTION

1.1 My full name is David James Cameron.

1.2 I hold a degree of Bachelor of Science (Hons) in Zoology from Victoria University of Wellington. I am a member of the New Zealand Freshwater Sciences Society and the Environment Institute of Australia and New Zealand.

1.3 I am a Senior Environmental Scientist at Stantec New Zealand Limited (Stantec, formerly MWH New Zealand Limited), based in Wellington. I have been employed with MWH for the last 23 years. My principal role at MWH is to advise on the effects of infrastructure projects on natural water quality and aquatic ecology. I have provided technical advice to local authorities in the Waikato Region for the Hamilton, Otorohanga, Te Awamutu and Cambridge municipal wastewater discharge consent projects. I have also provided advice to a number of local authorities for other municipal wastewater discharge consent projects including Ruakaka, Hastings, Tauranga, Hutt Valley, Wellington, Palmerston North, Feilding and Shannon.

1.4 I have read and I am familiar with the Environment Court's Code of Conduct for Expert Witnesses December 2014. For the purpose of this hearing, I agree to be bound by that Code of Conduct and have familiarised myself with the requirements as set out in the Code.

1.5 This evidence is provided in support of the regional resource consent application sought by Watercare Services Limited (**Watercare**) for the Pukekohe Wastewater Treatment Plant (**WWTP**).

2. MY INVOLVEMENT IN THE PROJECT

2.1 My involvement with the application has been as peer reviewer of the Aquatic Ecology Survey report prepared by MWH in February 2015 (Support Document 2 to the Assessment of Environmental Effects (**AEE**)). I have also attended a site visit on 28 July 2017.

3. SCOPE OF EVIDENCE

3.1 My evidence will address the following matters:

(a) The methodology used for assessing aquatic ecological effects of the existing discharge;

(b) The results of the aquatic ecological assessment;

(c) The existing weir on the Parker Lane Stream and its effects on fish passage;

(d) The effects of existing and proposed discharges to Parker Lane Stream;

(e) Matters raised by submitters;

(f) Officer's report (on the issue of riparian planting); and

(g) Consent conditions (also on the issue of riparian planting).

4. SUMMARY OF EVIDENCE

4.1 The aquatic ecology assessment of Parker Lane Stream involved two surveys undertaken in May 2014 (winter) and January 2015 (summer), in wet and dry conditions, respectively. Two monitoring sites were established in the Stream upstream of the WWTP discharge and three sites were located downstream. During each monitoring round the following parameters were assessed:

(a) Physical habitat of the stream and riparian zone;

(b) Fish species and diversity:

(c) Macroinvertebrate community composition;

(d) Aquatic plant cover (periphyton and macrophytes);

4.2 All sites were assessed as having moderate to low habitat quality, due largely to the straight engineered channel downstream of site 4, the soft sediment substrate, and scarce riparian vegetation. Site 3 (upstream of the discharge) had the lowest habitat quality due to lack of riparian shade and a very high density of macrophytes, while conditions improved in a downstream direction from site 3 to site 1.

4.3 At total of six native fish species and three exotic species were recorded. There was no significant difference in fish species presence or abundance between sites upstream and downstream of the WWTP discharge. However, there was evidence of higher species diversity at sites closest to the Waikato River

4.4 Macroinvertebrate taxa were dominated by those tolerant of poor water and habitat quality. The biotic index scores were low at all sites, falling in the 'poor' quality class. There was no significant difference in macroinvertebrate community metric scores between upstream and downstream sites, except for macroinvertebrate abundance which showed a decrease between upstream and downstream.

4.5 Macrophyte surveys showed that bottom rooted aquatic plants covered between 7.4 % and 100% of the water surface within each survey reach. Macrophtye cover was the highest at site 3 (upstream of the WWTP discharge) which had the lowest water flow and very little riparian vegetation.

4.6 Periphyton cover was low in winter. During summer there was extensive free floating algae (phytoplankton) at the three sites downstream of the discharge, which turned the water green. Periphyton cover ranged from < 5% at site 1 to 100% at site 3.

4.7 Overall the aquatic ecology monitoring results showed no clear difference between sites upstream and downstream of the WWTP discharge, and did not identify any adverse effects that could be specifically attributed to the discharge. It is likely that the existing discharge has had some adverse effects in Parker Lane Stream which are masked by poor background quality and the complexities of the site. However, these adverse effects are probably negligible.

4.8 The proposed stage 2 discharge is predicted to result in a substantial improvement in water quality of Parker Lane Stream (as described by Mr Hall in his evidence). Nevertheless, I would not necessarily expect to see much change in the macroinvertebrate or fish communities of the stream, unless in-stream conditions also improve further upstream in the catchment.

5. AQUATIC ECOLOGY SURVEY

5.1 Over 2014 and 2015 Stantec completed a survey of the Parker Lane Stream to assess the effects of the existing WWTP discharge on aquatic ecology. Specifically, the study aimed to determine if the existing discharge from the Pukekohe WWTP was having an impact on fish, macroinvertebrates, macrophytes, periphyton, or physical habitat within Parker Lane Stream.

Methodology

5.2 The aquatic ecology assessment involved two surveys undertaken over 14 to 15 May 2014 (winter) and 29 to 30 January 2015 (summer). The winter survey represented very wet conditions and the summer survey was undertaken in dry low flow conditions.

5.3 During winter, a total of four site locations were selected for monitoring. This included two sites upstream (control) and two sites downstream (impact) of the discharge point into Parker Lane Stream. During the summer monitoring round, an additional downstream site (site 5) was added at the request of Waikato Regional Council. This was to account for the return flow that discharges into Parker Lane Stream from the adjacent Fish and Game wetland (Piggott Wetland) between sites 1 and 2.

5.4 Monitoring site locations are summarised in Table 1 and shown on Figure 1 below.

Table 1: Aquatic ecology monitoring site location description

Site	Location (NZTM 2000)	May 2014	Jan 2015	Description
1	1768477 E 5873902 S	✓	✓	880m downstream of WWTP discharge, near confluence with the Waikato River
5	1769162 E 5874346 S	×	✓	200m downstream of WWTP discharge location and downstream of Fish & Game channel discharge
2	1768082 E 5873098 S	✓	✓	130m downstream of WWTP discharge, between the discharge and Fish & Game channel
3	1768424 E 5873794 S	✓	✓	100m upstream of WWTP discharge
4	1768540 E 5873977 S	✓	✓	990m upstream of WWTP discharge location at upstream extent of Watercare property.

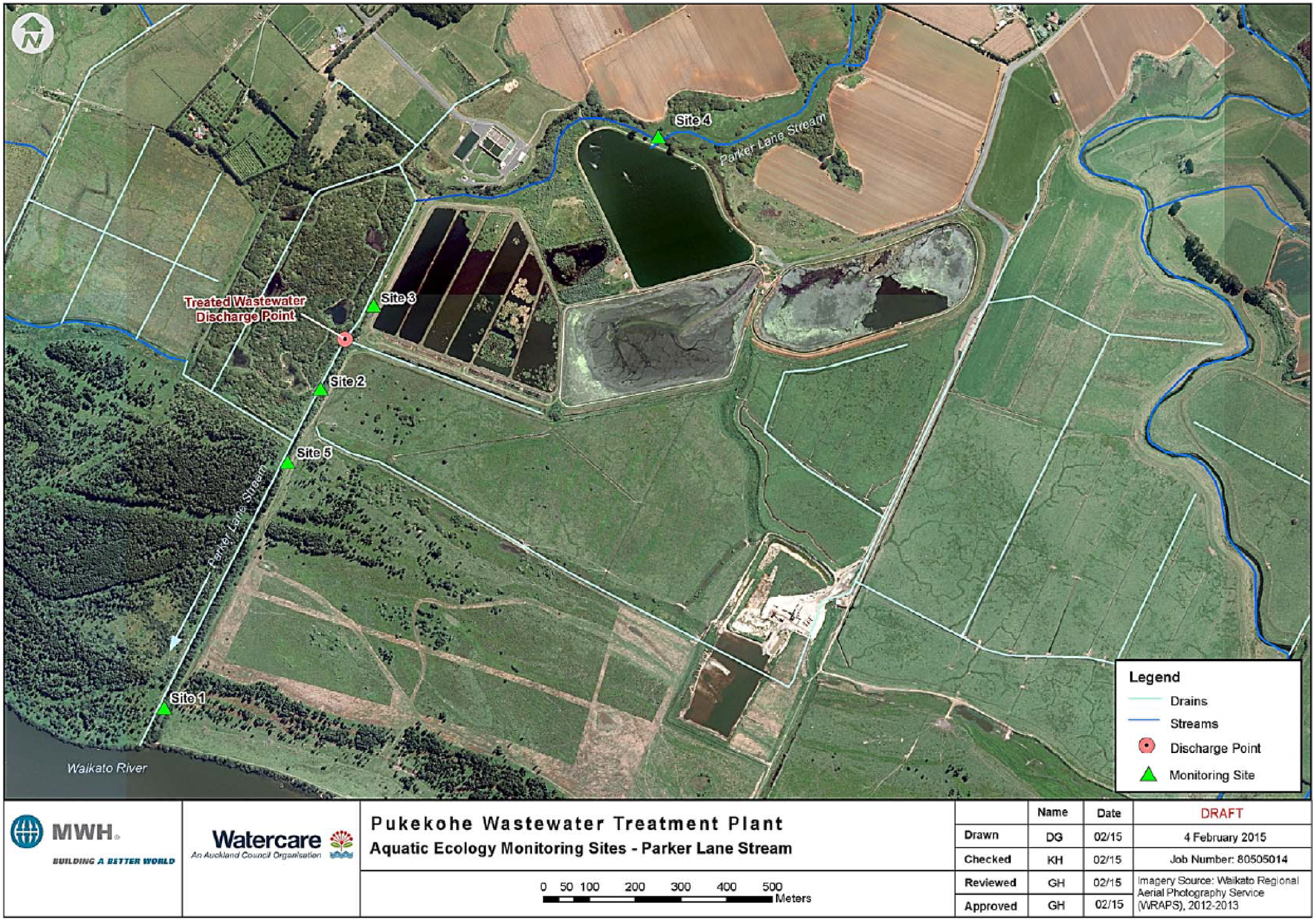


Figure 1: Aquatic ecology monitoring site location map

5.5 During each monitoring round the following parameters were assessed:

a) Physical habitat of the stream and riparian zone;

b) Fish species diversity and abundance;

c) Macroinvertebrate community composition;

d) Macrophyte cover (emergent, submerged or floating aquatic plants); and

e) Periphyton cover (algae).

5.6 Physical habitat quality was assessed at each site using the Environment Waikato Qualitative Habitat Assessment methodology for soft-bottomed streams (Collier & Kelly, 2005). This provides an assessment of riparian and in-stream condition and produces an overall score for the stream ranging from a theoretical low of 9 (an extremely modified stream) to a maximum score of 180 (a pristine, high quality stream). In addition, site photographs were taken and a description of each monitoring location was provided.

5.7 Fish communities were surveyed by way of trapping. During the winter survey, one fyke net and five box traps were set at each of the four sampling locations. During summer, two fyke nets and four gee-minnow traps were used, in keeping with the New Zealand Freshwater Fish Sampling protocols (Joy, David, & Lake, 2013) modified for a shorter (50m) reach. In all occasions, un-baited nets were deployed overnight. Trapping was selected as the preferred sampling method due to the depth of water, knowledge that the stream is subject to tidal influence, and health and safety requirements.

5.8 Aquatic macroinvertebrates were sampled in accordance with the New Zealand Protocols for Sampling Macroinvertebrates in Wadeable Streams (Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001). Two replicate samples were collected from each monitoring site following Protocol C2: Soft-bottomed, semi-quantitative with a fixed sampling effort of approximately 3 m^2 per sample. Macroinvertebrate samples were preserved in the field using ethanol and analysed in the laboratory following Protocol P2: 200 fixed count with scan for rare taxa. Results were presented as standard indices and statistical analysis was undertaken to determine whether there was any significance difference in macroinvertebrate indices between upstream and downstream sites.

5.9 Macrophyte and periphyton was assessed using the Regional Guidelines for Ecological Assessments of Freshwater Environments: Aquatic Plant Cover in Wadeable Streams (Collier, Kelly, & Champion, P, 2007), modified for a 50m reach. This allows assessment of macrophyte and periphyton abundance. It is

noted that these guidelines were updated in June 2014 (Collier, Hammer, & Champion, 2014), between the time of the winter and summer surveys.

Physical Habitat

5.10 The physical habitat of Parker Lane Stream varies across the five monitoring sites.

5.11 Site 4 is located near the upstream boundary of the Watercare property. In this location Parker Lane Stream maintains a more natural meander pattern, and is partially shaded by exotic crack willow trees (*Salix fragilis*) and pampas (*Cortaderia sp.*) with dense cover of macrophytes in unshaded sections, mainly reed sweet grass (*Glyceria maxima*). The remaining four sites are located on an engineered straight drainage channel which flows to the Waikato River. Site 3 has no riparian shade and was covered in macrophytes, with site 1, 2, and 5 mainly open but partially shaded by exotic willows, pampas and alder trees (*Alnus glutinosa*). There is a partial barrier to fish passage upstream of site 3 where a wooden weir diverts water flows through to the adjacent Piggott Wetland. This reduces the volume of water flowing through site 2 and 3. Downstream near sites 1 and 5, there is mature native kahikatea (*Dacrycarpus dacrydioides*) forest on the floodplain of the true right bank, although the immediate stream banks have been cleared.

5.12 In winter, the wetted width of Parker Lane Stream ranged from 3.5 to 9.0 metres wide (site 4 and 2) by 1.0 to 1.8 metres deep (site 4 and 2). In summer, the stream was 3.0 to 8.0 metres wide (site 4 and 5) by 0.2 to 0.5 metres deep (site 1 and 2). All sites apart from site 4 were subject to tidal influence. At site 3, there is evidence that the WWTP discharge can be carried upstream on the incoming tide, in which case the only true upstream control site is site 4.

5.13 Qualitative Physical Habitat Assessment results are presented in Table 1. All sites had moderate to low scores for physical habitat. In winter, scores ranged from 77.5 (Site 3) to 94.5 (Site 2) out of 180, with scores in summer ranging from 63.5 (Site 3) to 87.0 (Site 1). All sites scored lower in summer, mainly due to extremely high levels of periphyton. At site 4, periphyton was in the form of long filamentous green algae, while at all other sites the algae was mainly suspended in the water column (phytoplankton), sourced from the WWTP discharge. Phytoplankton carried in WWTP discharge was colouring the water in the discharge drain and Parker Lane Stream (at sites 2, 5 and 1) green.

5.14 Note that the Qualitative Physical Habitat Assessment results below include averaged scores for riparian vegetation, vegetation protection and bank stability and total out of 180 as opposed to the raw scores (out of 240) presented in the MWH report (MWH, 2015).

Table 2: Qualitative physical habitat assessment scores

Parameter	1		5	2		3		4	
	May	Jan	Jan	May	Jan	May	Jan	May	Jan
Riparian vegetation zone width	10.5	12	12	12	10.5	9.5	4	10	5
Vegetative protection	10	12	11	8	7	5.5	8	6.5	5.5
Bank stability	13	13	14.5	11.5	8	13.5	13.5	19	16
Channel sinuosity	3	4	3	3	3	3	1	4	8
Channel alteration	13	11	13	13	11	13	11	15	13
Sediment deposition	3	8	3	3	4	4	3	3	3
Pool variability	11	8	6	13	8	8	3	8	11
Abundance and diversity of habitat	11	9	7	13	8	3	6	8	13
Periphyton	18	10	13	18	13	18	14	18	2
TOTAL:	**92.5**	**87**	**82.5**	**94.5**	**72.5**	**77.5**	**63.5**	**91.5**	**76.5**

downstream flow

Fish Community

5.15 Fish monitoring was carried out during winter high flow and summer low flow conditions. It is noted that the winter sampling did not comply with the recommended two week stand-down period after heavy rain (Joy, David, & Lake, 2013) due to restrictions in sampling times, so results may not be representative of fish distribution at base flows, and should be given less weight than the summer results.

5.16 A total of six native fish species and three exotic species were found across the summer and winter surveys. Species included common freshwater and estuarine fish, with exotic gambusia (*Gambusia affinis*) the most prevalent species, followed by native shortfin eels (*Anguilla australis*).

5.17 Fish species diversity was similar across winter and summer, with seven species caught or observed in each season. However, fish abundance was higher in summer, with 334 individuals caught, compared to 140 individuals

caught during winter. The increase was largely due to large numbers of exotic fish caught, primarily gambusia.

5.18 There was no significant difference in fish species presence or abundance between sites upstream and downstream of the WWTP discharge. However, there was some evidence of higher species diversity at sites closest to the Waikato River. Both climbing fish (longfin and shortfin eels) and non-climbing species (gambusia and koi carp) were observed upstream of the weir. Juvenile eels are able to climb near vertical wetted surfaces such as those observed on the concrete structures on either side of the weir. Adult koi carp are able to jump over small obstructions and may be able to overcome the weir when the water level below the weir is raised. It is also possible that all four species are able to access the stream above the weir via the Piggott wetland.

Table 2: Distribution of fish upstream and downstream of weir

Downstream of weir	***Upstream of weir***
Indigenous species:	
Longfin eel	Longfin eel
Shortfin eel	Shortfin eel
Common bully	
inanga	
Common smelt	
Yellow eyed mullet	
Exotic species:	
Gambusia	Gambusia
Goldfish	Koi carp (obs.)
Koi carp	

Macroinvertebrates Results

5.19 Macroinvertebrate sampling was conducted during winter high flows and summer low flows. It is noted that the winter sampling did not comply with the recommended two to four week stand-down period after heavy rain (Stark, et al, 2001) due to restrictions in sampling times. These results may not be representative and should be given less weight than the summer results.

5.20 Macroinvertebrate abundance was higher in summer than in winter on average (Figure 2 and Figure 3). During winter, between 4 and 13 macroinvertebrate taxa were present in each sample, increasing to between 9 and 16 taxa per sample in summer. Species abundance and diversity was highest at site 4 upstream of the WWTP.

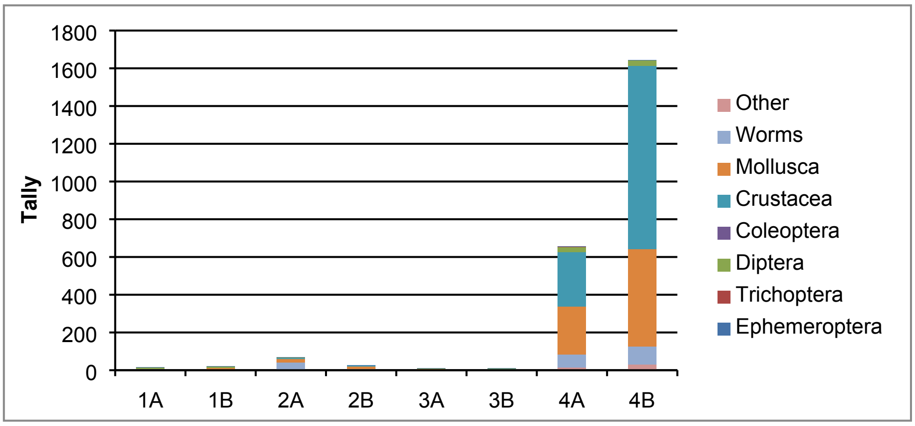


Figure 2: Macroinvertebrate abundance, May 2014 (2 replicates per site)

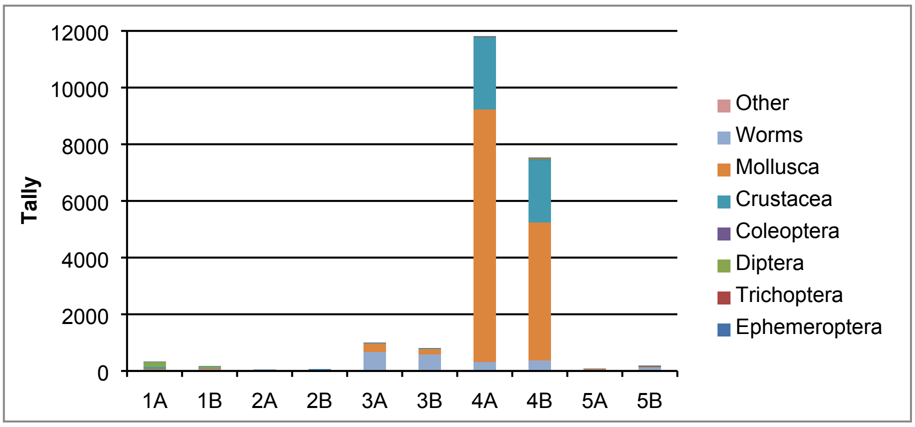


Figure 3: Macroinvertebrate abundance, Jan 2015 (2 replicates per site)

5.21 During both winter and summer monitoring, macroinvertebrate taxa were dominated by those tolerant of poor water and habitat quality. There were no sensitive EPT taxa, apart from a single mayfly (*Deleatidium* species) at site 1 in summer and pollution-tolerant caddisflies (O*xyethira albiceps*) at Site 4 in both seasons.

5.22 Macroinvertebrate community composition is shown in Figure 4 and Figure 5. At most sites, tolerant ostracod and amphipod crustaceans, snails, and worms were common. Two winged flies showed a pattern of increasing relative abundance from upstream to downstream.

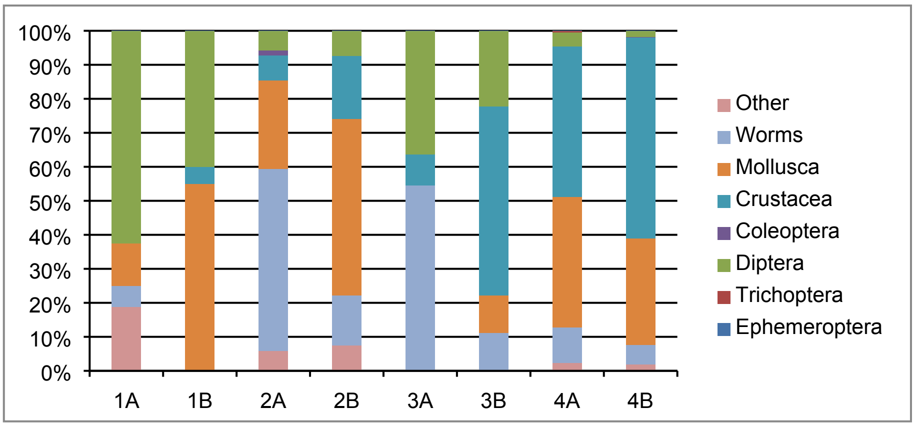


Figure 4: Macroinvertebrate community composition, May 2014

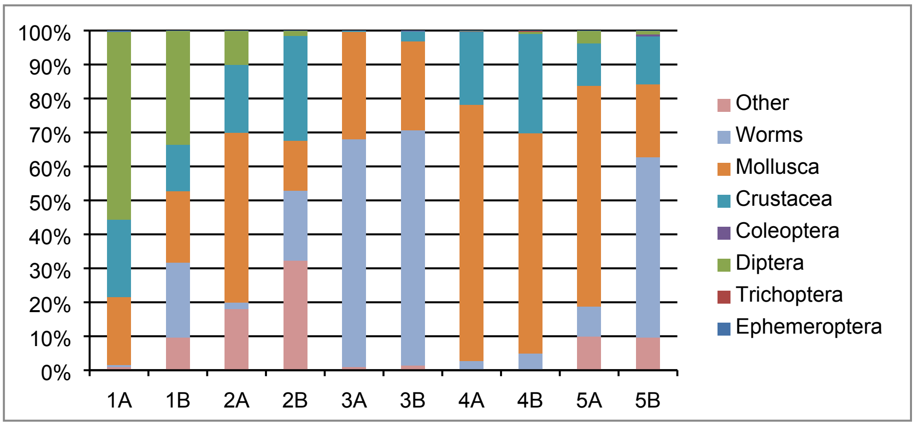


Figure 5: Macroinvertebrate community composition, January 2015

5.23 MCI_{sb} scores were low, with all samples falling within the 'poor' quality class of <80, with the exception of one replicate at site 1 in winter, which scored slightly higher with 82.8. This resulted in a higher average MCI score at Site 1 and an apparent increase in MCI_{sb} scores downstream. This pattern was not repeated during summer, whereby site 4 had higher MCI_{sb} scores than all other sites, and site 3 scored lowest overall.

5.24 $SQMCI_{sb}$ scores were all less than 4.0, with the exception of the single replicate at site 1 in winter which scored exactly 4.0. Scores less than 4.0 indicate 'poor' water and/or habitat quality. There was a pattern of increasing SQMCI from Site 3 to Site 1 in both winter and summer, reflecting the beneficial influence of tidal flows from the Waikato River.

5.25 Statistical analysis found no significant difference in macroinvertebrate community metrics (taxa diversity, EPT taxa, MCI-sb and SQMCI-sb) between upstream (sites 3 and 4) and downstream sites (sites 1, 2, 5) during winter or summer. The exception was macroinvertebrate abundance which showed a

decrease between upstream and downstream. Non-metric multidimensional scaling did not find a difference between upstream and downstream reaches but did reveal a difference between site 4 and all other sites. This may reflect the different habitat conditions at site 4 compared to all other sites which are located downstream of the weir and on a straight, artificial channel.

5.26 Overall, the macroinvertebrate results indicate poor water and/or habitat quality in both summer and winter conditions, with no significant difference detected between sites upstream and downstream of the WWTP discharge. In other words, the discharge had no measurable effect on macroinvertebrate community composition.

Macrophyte Results

5.27 Macrophyte surveys showed that aquatic plants covered between 7.4% (site 1 winter) and 100% (site 3 winter) of the water surface within each sample reach. Total cover was related to water velocities and channel shade, with site 3 having the highest percentage cover in both seasons due to low flows and no shade from riparian vegetation.

5.28 Macrophytes were dominated by exotic emergent species including reed sweet grass, water celery (*Apium nodiflorum*), water pepper (*Persicaria hydropiper*) and alligator weed (*Alternanthera philoxeroides*). Submerged species include Canadian pondweed (*Elodea canadensis*), hornwort (*Ceratophyllum demersum*) and curly pondweed (*Potamogeton crispus*). The only site where native macrophytes were found was Site 4, where native charophytes were present.

Periphyton Results

5.29 Periphyton growth can vary according to water quality (nutrients), light availability, substrate and water velocity. As expected, periphyton growth varied between winter and summer monitoring rounds.

5.30 During winter, periphyton growth was low, reflecting high stream flows. Some short filamentous algae was observed on macrophytes at Site 4 (18% cover) and a thin film was observed on macrophytes at Site 2 (1% cover) but no periphyton was present at other sites. During summer, periphyton was observed at all 5 monitoring locations. Total periphyton cover ranged from 3% at site 1 to 100% at site 3. Sites 2, 3 and 5 had a thin film of periphyton on macrophytes while sites 1 and 4 had long filamentous algae present.

5.31 During summer, there was extensive suspended algae observed in the water column at Sites 1, 2 and 5 downstream of the WWTP discharge. There was also a small amount of free floating algae or phytoplankton observed when the stream was disturbed during sampling at Site 3. The phytoplankton was so prevalent that it turned the water green at sites 1, 2 and 5.

5.32 Periphyton monitoring results indicate nutrient enrichment from the upstream catchment as well as the WWTP being a point source discharge of free floating algae.

Conclusions

5.33 The aquatic ecology assessment found that all five monitored sites had poor in-stream and riparian habitat, due to bank and channel modification, lack of stable habitat for macroinvertebrates and fish, near absence of riparian vegetation, as well as evidence of nutrient enrichment, oxygen depletion and sedimentation from upstream land use and WWTP discharges.

5.34 Site 4 near the upstream extent of the WWTP was found to have a more natural meander and flow regime than the other sites, and is partially shaded by crack willows, but is affected by poor water quality from the upstream catchment. Site 3 had the lowest habitat values due to low flows, absence of riparian vegetation and abundance of macrophytes.

5.35 The Fish and Game weir on Parker Lane Stream between sites 4 and 3 reduces water flows to Parker Lane Stream at site 3, causing low water levels and increased macrophyte growth. The diverted flow returns to the main channel between sites 2 and 5, providing a greater base flow in the lower reach of the stream, which also benefits from tidal inflows from the Waikato River. Aquatic habitat was similar at sites 1, 2 and 5 located downstream of the WWTP discharge. Compared to site 3, sites 1, 2 and 5 had wider channels, higher flows, lower percentage cover of macrophytes and greater riparian shade from exotic vegetation. Site 1, 2 and 5 also benefited from remnant native vegetation located on the floodplain.

5.36 There was evidence of elevated free floating algae levels discharging from the WWTP to Parkers Lane Stream, particularly during summer when the stream has low flows.

5.37 Overall the aquatic ecology monitoring results showed no clear difference between sites upstream and downstream of the WWTP discharge, and did not

identify any adverse ecological effects that could be specifically attributed to the existing discharge. This may be partly due to existing degradation in the catchment and the complexities of the site. However in the absence of any clear upstream to downstream ecological differences I have concluded that the level of these effects is negligible.

5.38 With regard to the proposed stage 2 discharge, at the end of the 35 year consent when flows reach their maximum, Mr Hall has predicted that the proposed WWTP improvements will result in a substantial improvement in water quality of Parker Lane Stream downstream of the discharge, compared to the existing situation, including:

(a) Ammonia-N concentrations reducing from 7.33 to 2.14 mg/L;

(b) Total nitrogen concentrations reducing from 8.44 to 4.31 mg/L; and

(c) Total phosphorus concentrations reducing from 3.31 to 0.86.

5.39 The predicted reduction in ammonia concentrations would reduce the risk of ammonia toxicity, potentially improving the quality of habitat for invertebrates and fish. The reduction in nitrogen and phosphorus will reduce the availability nutrients in the stream, but not sufficiently to prevent the development of nuisance algae growth in the stream from time to time.

5.40 Despite these improvements, I would not necessarily expect to see much change in the macroinvertebrate or fish communities of Parker Lane Stream, unless conditions also improve further upstream in the catchment, especially in terms of reduced nitrogen inputs from agricultural land and increased shade and cover from riparian vegetation.

6. CLARIFICATIONS TO AQUATIC ECOLOGY REPORT

6.1 This section of the evidence responds to comments provided by Michael Pingram of Waikato Regional Council (Pingram, 2017), specifically those comments that relate directly to the aquatic ecological assessment. Comments that relate to water quality assessment and the AEE are addressed in the evidence of Mr Hall.

6.2 Mr Pingram highlights that the habitat assessment calculations scores for Q1 to Q3 should average out scores for both banks out of 20, not out of 40. The MWH report presented the raw scores out of 40 and did not average the scores out of 20. This has been amended in my evidence with revised scores presented in Table 2 in section 5. Although this leads to a slight change in

physical habitat scores, it is does not affect the overall results of the assessment.

6.3 The Regional Guidelines for Ecological Assessments of Freshwater Environments: Aquatic Plant Cover in Wadeable Streams (Collier, et al, 2007) were updated in June 2014 (Collier, et al, 2014), between the time of the winter and summer surveys. For consistency, the earlier guidelines were applied to the report.

6.4 Mr Pingram notes that species of Hydroptilidae (namely *Oxyethira albiceps*) are included in the calculations for EPT taxa, but “this doesn’t have much bearing on the comparison between sites”. Although some authors do exclude Hydroptilidae from EPT calculations, this is not always the case as *Oxeythira* are within the order Trichoptera (caddisflies). On page 5 and 14 the MWH report correctly states that *Oxeythira* are not sensitive taxa.

6.5 I agree with the assessment of Mr Pingram that Parker Lane Stream “is a complex receiving environment to assess (due to the weir and wetland discharge)”. Although the aquatic ecology results did not present a clear pattern of effects from upstream to downstream, this is in part due to existing degradation in the catchment, and differences in physical habitat and flow regimes between sites.

6.6 I also agree with the statement that “at low flows the current discharge is likely contributing to stressors which are likely to have effects on aquatic ecology (e.g. algae, clarity and sediment)”. However in the absence of any clear upstream to downstream ecological differences I have concluded that the level of these effects is probably low.

7. MATTERS RAISED BY SUBMITTERS

7.1 Fish and Game New Zealand (Fish and Game) have raised a number of matters with respect to aquatic ecology in their submission. I respond to their matters with reference to their submission numbering.

7.2 Paragraph 5(g) raises concerns that increased discharge volumes will increase the frequency of flooding and therefore increased discharge of contaminants into the wetland, and that increased nutrients will exacerbate the nuisance plant growth risk. As described by Mr Hall in his evidence[1] the stream flow

[1] Section 5.21.

diverted into the wetland from the upstream catchment contains very high levels nitrate-N while the data show relatively low concentrations of dissolved reactive phosphorus (DRP). Mr Hall considers that due to a range of factors, although there are times when treated wastewater could enter the Piggott wetland, this will be highly diluted and result in a negligible adverse effect on the water quality of the wetland and that this effect would be limited in duration to flood events[2]. Occasional short term water quality perturbations of this type are not likely to have any lasting effect on the wetland ecology.

7.3 Paragraph 5(h) states that Watercare have made a commitment to maintaining the Piggott wetland and that the weir is in need of repair and upgrade to allow upstream native fish passage.

7.4 During a site visit on 28 July 2017 I observed that the weir was in good operating condition and had apparently been repaired (Figure 7)[3]. I also observed that the weir was being overtopped resulting in wetted concrete and wooden surfaces that would be passable to climbing fish species such as juvenile eels. I understand that even in very dry conditions the weir is overtopped, forming passable wetted surfaces for climbing fish (Figure 8)[4]. Installing a fish pass for climbing species would therefore provide little ecological benefit to the stream.

[2] Section 12.22.

[3] Photo taken by David Cameron

[4] Photo provided to David Cameron

Figure 7: View of weir in wet conditions (July 2017)

Figure 8: View of weir in dry conditions (March 2015)

7.5 Paragraph 5(i) of the Fish and Game submission addresses the proposed planting plan, and notes that the planting plan will “do little to off-set the adverse effects on the environment”. Riparian planting has been proposed by Watercare in order to improve the aquatic habitat of Parker Lane Stream, recognising that the existing discharge has some adverse effects on the habitat of macroinvertebrate and fish that are difficult to characterise or quantify. The

proposed planting is upstream of the Fish and Game weir, covering a total area of 1.4 hectares along a stream length of 570 lineal metres, as shown in Attachment A.

7.6 Planting is not proposed below the weir due to concerns about root penetration within the engineered treatment pond embankment. The Waikato RiverCare guidelines for riparian restoration best practice recommend that planting should not be undertaken within 10m of the toe of a stop-bank (this would be a discretionary activity under rule 4.2.18.1 of the Waikato Regional Plan should the stop banks be owned by the Regional Council, requiring resource consent). In addition, Watercare do not own land further downstream near the Waikato River.

7.7 Riparian planting can result in improvements in aquatic ecology through shading of the water column and providing inputs of wood and organic matter. The authors of the NIWA dissolved oxygen study (Hudson et al 2016) observed that extensive emergent macrophyte cover in Parker Lane Stream was likely to impair oxygen exchange and aeration, and that a combination of macrophyte respiration, and benthic and water column oxygen demand, has reduced concentrations of dissolved oxygen in the stream to low levels. Riparian planting that results in increased shading has the potential to reduce water temperature, light intensity and excessive growth of aquatic plants, thereby reducing the extent of oxygen depletion in the stream and improving the quality of habitat for macroinvertebrates and fish.

7.8 Riparian plants can also increase nutrient uptake from groundwater, provide habitat for adult phases of aquatic insects, as well as habitat for terrestrial flora and fauna.

7.9 It is recommended that planting should extend for a width of at least 5 metres on each bank, resulting in a total width of 10m but expanding out to a maximum of 40m where this is permitted by existing site activities. The planting width is constrained by the proximity of property boundaries and stop banks at many locations. A riparian width of 40m, where available, would provide a substantial benefit to Parker Lane Stream, potentially creating a self-sustaining area of vegetation with limited requirements for ongoing weed control.

7.10 Plantings should be undertaken at a density of no less than 2500 stems per hectare, and should be maintained, including replacement of losses and control of pest species (refer Standard 3.3.4.28 of the Waikato Regional Plan).

8. OFFICER'S REPORT

8.1 On page 22 of the Council Report, the Reporting Officer states that whilst it is accepted that the applicants discharge will result in a significant improvement to the existing quality of the wastewater discharge there remains an effect on the Parker Lane Stream and to a lesser degree the Waikato River particularly for the next four years and also once the upgrade has been completed. The Reporting Officer has recommended a minimum of one kilometre of riparian planting to offset the effects of the discharge on Parker Lane Stream.

8.2 Riparian planting as already discussed in paragraphs 7.5 to 7.10 above, would in my view provide some aquatic habitat enhancement which is required to offset the effects of the existing discharge.

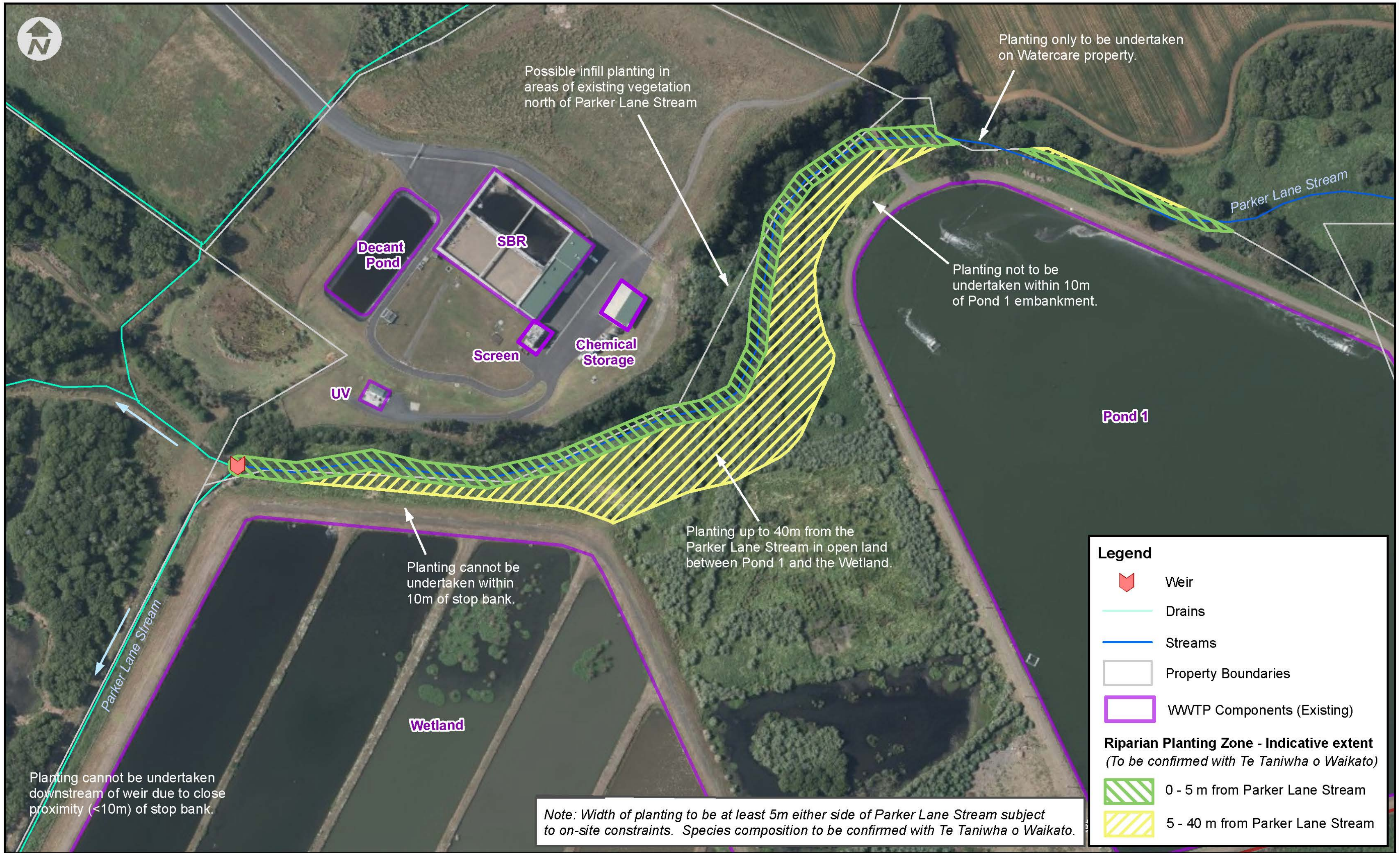
8.3 The proposed zone of riparian planting shown in **Attachment A** covers a total area of approximately 1.4 hectares along a stream length of approximately 570 lineal metres. As noted earlier, the area available for riparian planting is constrained by the proximity of property boundaries and stop banks at many locations. The proposed zone of riparian planting as shown in Attachment A is intended to make the best use of the available area.

9. CONSENT CONDITIONS

9.1 Condition 24 of the discharge to water consent sets out the minimum requirements for the riparian planting and management plan. In light of paragraphs 7.5 to 7.10 of my evidence above, I recommend that condition 24(a) be amended as follows:

> *"Describe how the objective of the Riparian Planting and Management Plan will be achieved including the requirement for a minimum of one ~~kilometre~~ hectare of riparian planting within the catchment*".

David Cameron
14 August 2017



MWH now part of Stantec

Watercare An Auckland Council Organisation

Pukekohe Wastewater Treatment Plant

Proposed Zone of Riparian Planting

	Name	Date	FINAL
Drawn	DG	Aug 17	09 August 2017
Checked	GH	Aug 17	Job Number: 80507250
Reviewed	DC	Aug 17	Imagery Source: LINZ data service
Approved	GH	Aug 17	

ATTACHMENT A Proposed Zone of Riparian Planting