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MEMORANDUM

TO Sonia Baker | Greater Wellington Regional Council (GWRC)
FROM Alex James | EOS Ecology

Review of ecological components of GWRC's flood protection operations and maintenance activities in the Otaki River and tributaries consent application

EOS Job No: GRE01-14074

Dear Sonia,

Please find below my review of the ecological components of GWRC's "Resource Consent Application WGN140054: Flood Protection Operations and Maintenance Activities in the Otaki River, Waimanu, Rangiuru & Ngatoko Streams, Katihiku & Pahiko Drains". This has involved the review of the actual consent application document prepared by Tonkin & Taylor Ltd, August 2013 (updated October 2014) (referred to herewith as Tonkin & Taylor, 2013 or the application report) and the report "Effects of flood protection activities on aquatic and riparian ecology in the Otaki River" prepared by David Cameron of MWH, September 2014 (herewith referred to as Cameron, 2014 or the ecological AEE report). I have not covered the proposed mitigation/avoidance/remedies included in these reports, as it is understood these elements will be covered in the Code of Practice, which will be reviewed in a separate memo.

1 DESCRIPTION OF THE EXISTING ENVIRONMENT AND ASSESSMENT OF ECOLOGICAL EFFECTS

"Your opinion on the appropriateness of the updated ecological effects assessment in the Otaki River application report"

"A review of the updated ecology effects assessment in Cameron (2014) for the Otaki River and the validity of the conclusions reached"

1.1 GENERAL COMMENTS

The Otaki River application report (Tonkin & Taylor, 2013) included some information on riparian vegetation that was lacking from the supporting ecological AEE report (Cameron, 2014). This is of concern as in my experience the ecological AEE should give comprehensive coverage of ecological matters with the actual consent application document then providing a summary of that information, rather than the consent application having to supply additional ecological information because it was not provided in the ecological AEE report.

The area covered by the consent application has been subjected to various flood protection activities for over 100 years. Hence it is already modified by these activities (e.g., rip rap bank treatment and willow plantings). To determine if this "impact" section of the river shows any signs of such impact, it is important to compare ecological information between this section and the upstream "reference" part of the catchment. Apart from fish, little information from the "reference" part of the catchment has been presented. Conversely, there is very limited fish information from the "impact" part of the catchment.

In the application report, there is a lack of a simple map showing the area covered by the consent application. While the detailed aerial photographs are useful, a single page overview map is beneficial to quickly show the extent of the waterways where flood protection activities occur. Figure 1-1 from the ecological AEE report does this well and should be included in the application report.

Both reports need to have the references checked and corrected for omissions and inconsistencies.

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In general, I agree with the determination of effects for most of the proposed activities based my own general knowledge of gravel bed rivers, however many aspects of aquatic and riparian ecology specific to the application area are not adequately covered. However, I consider the description of the existing environment to be significantly lacking, and is missing some important information that in my view is required to adequately determine effects beyond that of a generic New Zealand gravel bed river. Such specific information is especially important in this instance as an adaptive management regime driven by a "living" Code of Practice document is the proposed means of avoiding/remediating/mitigating the impacts of the flood protection activities for the next 35 years.

1.2 DESCRIPTION OF THE EXISTING ENVIRONMENT

A comprehensive description of the existing ecological condition of the area covered by the consent application and the catchment in general is crucial to undertaking a rigorous assessment of ecological effects. The description included in the ecological AEE report and consent application report largely relies on GWRC state of the environment (SoE) data for periphyton and macroinvertebrates, the New Zealand Freshwater Fish Database (NZFFD), and a report by McArthur *et al.* (2013) for birds. In my view there are gaps in the coverage of these ecological components while other relevant ecological components are missing entirely. There is also limited coverage of the area of catchment outside that covered by the consent, which is needed to allow comparison with the reach already impacted by flood protection activities, thus giving an indication of whether the past flood protection works have had a measureable effect on river and riparian ecology.

Because the description of the existing environment in the application report is largely drawn from the ecological AEE report, both documents are covered here. These gaps and other identified issues are outlined below:

- » Estuary – A comprehensive description of the Otaki River estuary is crucial to this application as it includes activities in the estuary extending into the coastal marine area (CMA) (i.e., river mouth realignment, removal of flood debris). The application report and the ecological AEE report have short sections on the Otaki Estuary that provide more questions than answers:
 - It is stated some salt marsh habitat remains, and as of 1992 some native salt meadow species were present. Are these species still there? Where is the salt marsh habitat located in relation to proposed flood protection activities? Is it potentially under threat from these activities?
 - Which resident and migratory shorebird species make use of the estuary and when? Are these areas within that affected in some way by the activities?
 - There is no information on estuary invertebrates.
 - In the ecological AEE report (Section 3.1.7 Recreational fisheries) it is stated the Otaki River mouth and estuary provide spawning and rearing habitat for species including kahawai, snapper, dogfish, red cod, gurnard, and yellow eyed mullet. Why is this not included in the estuary section and what is the reference?
 - It is stated in Section 3.1.1 of the ecological AEE report that due to the coarse nature of the bed, low habitat diversity, strong salinity fluctuations and water currents, the productivity and biodiversity within the estuary is expected to be low. Low values relative to what – other estuaries or river mouths? This statement needs to be supported with data to show this, and with published references that can attest to the author's assumptions on values. Estuaries are typically regarded at being particularly productive and abundant in life. While they do not have as much diversity as purely fresh or salt water systems (and shouldn't be compared to them), they can have a high abundance of animals that can tolerate (and indeed thrive) in such conditions. Section 3.1.7 (recreational fisheries) of the ecological AEE report also states that the mouth and estuary provide rearing and spawning habitat for a large range of fish, thus the comment by the author that the estuary is of low productivity and biodiversity value is certainly contradictory with this earlier statement.
- » Aquatic plants – The ecological AEE report states that no records of aquatic macrophytes for the Otaki River have been located while the application report states only that no threatened aquatic plant species have been identified in the application area.
 - While I understand that macrophytes are unlikely to be present in most of the Otaki River main stem, the proposed activities in some of the tributary streams and drainage channels involve mechanical "weed" clearance so I assume there are macrophytes in these waterways. While it is likely most of these are exotic species, it is still important to describe the macrophyte communities of the area covered by the consent application and determine their importance as habitat for fish and invertebrates. There may be places where native species or exotic species considered noxious are present. This detail is needed to inform the proposed adaptive management regime. While the draft Code of Practice (COP) includes the retention of around 10% of aquatic vegetation to act as a refuge/recolonisation source and where practicable, leaving selected ecological refuge areas, these actions could be better targeted if there was knowledge of the macrophyte species present.

For example, perhaps significant patches of native species would be left in preference to exotic species, while special effort would need to be made with noxious species to prevent their spread.

- » Macroinvertebrates – The macroinvertebrate data presented were from GWRC SoE sites (2009–2011). There is little information provided in the ecology AEE report regarding macroinvertebrates, and there is key information missing that I would expect to be standard for any AEE report. This is detailed further below.
 - While the presented data provides a broad catchment-scale appreciation of some invertebrate metrics, it does not provide the required detail. For an application that involves invasive instream activities such as bed recontouring and gravel extraction, more detail on the invertebrate community is required. What are the most common species/taxa in the sections to undergo gravel extraction/bed recontouring? How does the community composition (density/abundance of main species, diversity, evenness etc.) compare to that found outside of the area (i.e., are the communities within the project area distinct or similar to that found outside of the affected area)? Are there any threatened or at risk invertebrates present according to the listing of Grainger *et al.* (2014)? Which EPT taxa are present in the river?
 - Are freshwater crayfish/koura present in the tributaries? Are freshwater mussels/kakahi potentially present?
 - In the ecological AEE report, it is stated in the text that the lower river site near the mouth is rated “good” however Table 3-3 indicates all sites are rated “excellent” according to the QMCI.
 - All the macroinvertebrate data is from shallow habitats. Is there any data available on the invertebrates of deeper, non-wadeable habitats?
 - Table 11 (application report) and Table 3-3 (ecological AEE report) present means, thus some kind of measure of variability would be useful (e.g., ranges, standard errors).
 - There is no coverage of the invertebrate fauna that lives in the gravel substrate both in the wetted bed and laterally in gravel bars and beaches (hyporheic invertebrates = hyporheos). Wherever bed/beach recontouring or gravel extraction occurs, there will be negative effects on the hyporheos. While such effects are largely unavoidable, it is still important to characterise this fauna and acknowledge as much. Sampling of this fauna may have been undertaken as part of some past research project or survey.
 - There is no information for any of the tributaries. While I understand they are likely to have never been surveyed for macroinvertebrates, the Freshwater Ecosystems of New Zealand (FENZ; Leathwick *et al.*, 2010) is a freely available resource that provides probabilities of encountering various freshwater invertebrates in waterways throughout New Zealand. Given that surveys were not undertaken to fill these information gaps, FENZ should have been used to at least give a prediction of the likely main invertebrate taxa in these waterways.
 - The ecological AEE report and application report both present GWRC SoE monitoring invertebrate data for the period 2009–2011. I know there is data from these sites for several years earlier than this. Why hasn't the full period for which there is data available been presented? This would be particularly interesting in determining any trends (or lack thereof).
- » Fish – I have a number of concerns regarding the use of information in this section and the conclusions reached. The data used included a summary of NZFFD records, data from the Hutt River, and the results of a 2001 Boffa Miskell survey.
 - The table of NZFFD records (application report: Table 13; ecological AEE report: Table 3-5) gives no indication of where each species has been found in relation to the area covered by the consent application. To make effective use of this information, the records should be split into those from in the application area and those outside. A map of site locations would also be useful in the application report. Distribution maps of five fish species in the Otaki River catchment are provided in the ecology AEE report (Figures 3-1 to 3-5). These would be more useful if they showed the area of the catchment included in the consent application and this data was used to help determine those species likely to be most impacted by in river works.
 - Tables 3-7 and 3-8 (ecological AEE report) show the results of fish surveys undertaken in the Hutt River by Perrie (2013). While these are useful at indicating the deeper water fauna of the Hutt River and could perhaps give an indication of the effects of gravel extraction in other gravel bed rivers similar to the Hutt River, they are not directly applicable to the Otaki River in describing the existing environment.
 - The tables of fish data also only present presence/absence rather than any abundance (relative abundance, rank abundance etc.), which means that it is impossible to know what species are more abundant and what the general community composition is.
 - Apart from a 2001 Boffa Miskell study, there is very limited information on the fish fauna of the lower Otaki River. This report apparently noted a relatively low abundance of freshwater fish compared to the Waikanae

River and Waitohu Stream. However, this data along with sampling sites and methods is not presented in the ecological AEE report, making it difficult to check if this is the case. More detail is required on this study since it is effectively the only source of fish information from the application area. Having obtained a copy of the Boffa Miskell (2001) report myself, I have since confirmed this assertion of low abundance is based on limited fish trapping in the lower Otaki River using passive fyke netting and “box trapping” methods. In a large, gravel bed river like the lower Otaki, such passive methods are unlikely to adequately sample the fish community, where electrofishing of riffle and shallow runs is necessary to capture small and cryptic species such as bluegill bully and truly determine if fish are indeed in low abundance. Thus I do not trust the conclusions of Boffa Miskell (2001). Additional information could have been obtained from the Freshwater Ecosystems of New Zealand (FENZ; Leathwick *et al.*, 2010), a freely available resource that provides probabilities of encountering various freshwater fish in waterways throughout New Zealand.

- It is unclear the source of data in Table 3-6 of the ecological AEE report.
 - The presented fish information gives some idea (albeit a very poor coverage of the section of the Otaki River managed by GWRC Flood Protection) of the species present, but not about which species will be affected the most by the more invasive activities such as gravel extraction and bed recontouring. In essence the authors need to cover which of the various fish species we should be most concerned about.
 - Some information on inanga spawning locations is presented. A map of these would be most useful. It is also stated that trout migrate to headwater streams to spawn with a map in Appendix B of the ecological AEE report, but there is no information on the other species that may spawn in the reaches affected by gravel extraction and bed recontouring (e.g., torrentfish, bully species).
 - In the ecological AEE report (Section 8 Monitoring) it is implied that annual drift dive monitoring of trout abundance is undertaken at two sites in the Otaki River. Is this the case? If so, this data should be presented.
 - What is the level of customary, recreational, and commercial fishing for eels in the Otaki River and affected tributaries? This may affect their abundance and distribution.
- » Water quality – The water quality data presented were from GWRC SoE sites (2009–2011)
- It is stated the latest GWRC water and ecology trends report covers the period 2004–2011. Why wasn't the earlier data included in Table 3-1 (ecological AEE report) or Table 9 (application report)?
- » Gravel bar and beach flora and fauna – apart from riverbed nesting birds there is no information on the flora and fauna of gravel bars and beaches that may be impacted by gravel extraction and bed/beach recontouring. While the vegetation colonising such environments is more than likely composed of fast growing exotic species and these environments are periodically reset by large bed-moving floods, there is the potential that periods between large floods could see the development of plant communities that may have some native vegetation and provide habitat for native fauna. Disturbance of these plant communities through gravel extraction and bed recontouring could negatively affect any such native flora and fauna. Some basic information on what native flora and fauna are present in such environments is required to determine if there are any negative ecological effects of flood protection activities that disturb gravel beaches.
- » Riparian vegetation
- Section 3.8 of the application report gives a brief description of riparian vegetation, something that is missing from the ecological AEE report, which despite having “riparian ecology” in the title presents virtually no information on riparian vegetation. While some 85% of the flood protection reach of the Otaki River is managed willows, what is the remaining 15%? Any significant native patches, either planted or natural?
- » Birds
- A table of all bird species recorded in the 2012 survey by McArthur *et al.* (2013) is provided (application report: Table 14; ecological AEE report: Table 3-9). More information on which species are likely to be using habitat affected by the various activities (e.g., gravel extraction, beach recontouring, willow maintenance, etc.) is required. The nesting of pied stilt, banded dotterel, and black-fronted dotterel are covered, but there are likely other species that utilise riverbed and river mouth/estuary habitat. For example, which species feed and rest on gravel bars/beaches, which species may be nesting or roosting among the riparian vegetation (including willows) and when? Which of the list of species should we be most concerned about?
 - McArthur *et al.* (2013) notes, “the identity and number of all native birds on or associated with the riverbed were recorded in 1 km sections within each survey area. Although the results are not reported here, this was done to provide the opportunity to allow comparisons of bird abundance to be made between individual 1 km reaches of river, assisting us to identify reaches of river that support relatively high numbers of key species with a higher

degree of spatial resolution.” Thus GWRC has much higher resolution bird distribution data available than what has been presented in the ecological AEE report and application report. I suggest this would be useful information to include.

- There is no bird data for the affected tributaries of the Otaki River.
- » Herpetofauna – Not covered at all. Are there any skinks or geckos known or potentially present in the area covered by the consent application?

1.3 ASSESSMENT OF ECOLOGICAL EFFECTS

To fully assess the effects of a proposed activity on the environment, one first must have a full understanding of the existing environment. Based on Section 1.1 and 1.2 above, it is clear there are key information gaps. However, it must also be noted the Otaki River has been subjected to various flood protection activities for over 100 years and the activities proposed in the consent application are not new to the catchment (apart from wet gravel extraction). Like so many New Zealand rivers it has been severed from its floodplain by the construction of stop banks, which in turn has altered rates of gravel accumulation. Hence, in general the river fauna now present is a fauna that is tolerant to such alteration and we will never know how the diversity and abundance of species differs to the pre-impact state. It is also a fauna that is adapted to persisting in a dynamic gravel bed river where floods that redistribute bed gravels are relatively regular. We know for certain that there have been certain negative ecological impacts from flood protection works (for example the destruction of inanga spawning habitat) but there may well have been and continue to be undetected impacts, some of which could be avoided/mitigated/minimised by refining flood protection practices.

As the ecological effects in the application report are largely drawn from the ecological AEE report, the comments on these documents are combined. In general I agree with the determination of effects for most of the proposed activities and the following comments cover those areas of the AEE where my opinion differs from that of the application report and/or ecological AEE report, or where relevant information is missing:

- » Application report: Many of the proposed activities are not new to the Otaki River, thus a map showing where the main existing flood protection features (i.e., willow plantings, rip-rap rock lining, groynes, etc.) are would be most useful to gain an appreciation of the location and extent of pre-existing channel modifications.
- » Application report: Section 6.1 Positive Effects. As stated in this section there is no doubt the flood protection works over the last 100+ years have had huge economic and social benefits through the prevention of the flooding of surrounding land. This section could however be expanded to cover positive ecological effects including:
 - The potential for bed recontouring activities to actually increase river habitat variability, or at least maintain, that which is already there (which would be an improvement over how it was done in the past).
 - The construction of groynes creates structures that have the positive effect of creating deep, slow pool habitats, which are probably not dissimilar to those that naturally would have resulted from fallen trees and associated debris dams when the riparian zone had native vegetation. Likewise, debris fences, debris arrestors, and timber groynes also mimic to some extent natural debris dams, however, these are likely to be regularly cleared of debris thus diminishing any positive effect.
 - Rip-rap boulders at the water edge and below the surface provide a stable surface for the spawning of some fish species (i.e., bullies) and some aquatic insects that lay eggs on the undersides of larger rocks.
- » Application report (Section 6.3 Discharge of sediment) and Ecological AEE report (Section 5.2 Water Quality):
 - Useful information is presented on the actual measured impacts of gravel extraction and truck crossing on turbidity and TSS in the Hutt River and for riprap placement, truck crossing, and bulldozer thalweg cutting in the Waikanae River on TSS. While it appears that river works do not increase turbidity/TSS to levels any greater than recorded during floods, the important difference is that river works are generally undertaken at lower flow periods, such that any suspended sediment relatively rapidly settles out and is deposited on the riverbed in low velocity environments. While suspended sediment as a result of river works is a relatively short term disturbance, deposited fine sediment may cover the gravel bed and fill the interstitial spaces between the rocks where invertebrates and smaller fish live for an extended period of time depending on when the next significant fresh/flood occurs. Thus the effects of works on downstream deposited sediment is at least as important, or arguably more important a factor than suspended sediment and its effects need to be covered in the application report. The Hutt River gravel extraction habitat mapping report (Appendix A of the ecological AEE report) did measure deposited sediment, but only from shallow run habitats, not from pools, backwaters, or side eddies

where suspended fine sediment would be more likely to settle under low flow conditions.

- » Application report (Section 6.10) and Ecological AEE report (Section 5.9): Vegetative bank protection
 - I agree that for large rivers, there are no native plant species that allow an effective, reliable, and relatively inexpensive means of soft engineering for the “front line” of the river channel – land interface. It is of concern, however that some 85% of the riverbanks in the application area are now willow lined. It would be useful if the application provided evidence that all of these willows (and the required on going maintenance) are actually needed and a good use of resources. In the past were areas just planted in willows because “that is how you do flood protection” or was there a real need? Is there the potential that based on bed morphology and bank erosion potential that some reaches don’t actually require willows and could over time be “retired” and converted to appropriate native planting?
 - It is stated that the reduction in biodiversity by having a mono culture of willows is offset by the significant planting of native vegetation in the river corridor and that this contributes significantly to the increase in biodiversity values. Have any studies been undertaken to determine if such plantings are providing anything more than aesthetic benefits? (E.g., have they resulted in increased abundance of native birds, invertebrates, lizards, fungi, etc.)? It would be useful to cite such research if it has been undertaken.
 - The ecological AEE report states that based on a review of the effects of willows on stream ecosystems, they provide benefits such as provision of shade and shelter, control of water temperature, and control of sediment and nutrient levels. Additionally, the report concludes that on balance vegetative bank edge protection is expected to enhance some forms of fish habitat and the overall effect on native fish and trout populations is likely to be positive. I would suggest this is a generalisation that does not apply to the Otaki River, where based on the recent aerial photographs provided in the consent application, willows directly on the waters edge seem to occur in only a few locations with the majority of the water’s edge being gravel beaches. Thus the positive effects of willow bank edge protection are overstated in this instance. The width of the channel also results in the edge willows (or any vegetation for that matter) having little impact on shading or control of water temperature.
- » Application report (Section 6.11) and Ecological AEE report (Section 5.10): Channel maintenance
 - To adequately determine the effects of the removal of aquatic vegetation and silts from Rangiuru and Ngatoko Streams, Chrystalls Lagoon, and Katihiku and Pahiko Drains first we must have an idea of the fauna and flora of such environments. As already outlined above, this information is lacking and this is acknowledged in the application report. The ecological AEE report does recommend monitoring¹ fish in such environments however, aquatic macrophyte surveys are also required to determine if native or noxious species are present.
 - The ecological AEE report states that “Where mechanical weed removal is undertaken in perennial streams consideration given to requiring at least one observer, in addition to the digger operator, to check for trapped fish and to facilitate their capture and return to the watercourse.” What does “consideration” mean in this instance? I would suggest a dedicated person to rescue fish be a requirement rather than a consideration. Further, the COP has a sheet specific to “Mechanical clearing – Chrystalls Lagoon (Otaki River)” which states “where possible, at least one observer, in addition to the digger operator, is present to assist with finding, capturing and relocating of trapped fish”. Again, this role should be mandatory and would also include searching the removed material for freshwater crayfish/koura and freshwater mussels/kakahi, should they be known or expected to be in the areas undergoing maintenance.
 - I agree that the clearance of flood debris should be limited to only those items that present an immediate risk so that other logs/debris are left in the channel where they can provide habitat for fish and invertebrates. However, some criteria on what are left and what is removed needs to be in place to prevent the removal of material by over-zealous operators. This is a matter to be defined in the Code of Practice (see my separate review of that document).
- » Application report (Section 6.12.1) and Ecological AEE report (Section 5.10.3): Beach ripping
 - The effect of beach ripping cannot be determined in the absence of information on the flora and fauna of gravel beaches beyond birds. Are there any native flora or fauna present?
- » Application report (Section 6.12.5) and Ecological AEE report (Section 5.11.2): Bed recontouring
 - There is no mention in the construction effects of the direct mortality of fish and invertebrates that are in the former channel that is either filled in or dewatered. This needs to be resolved.

¹ Note that I will be reviewing the proposed environmental monitoring plan (EMP) in a subsequent memo.

- » Application report (Section 6.13) and Ecological AEE report (Section 5.10.5): Gravel extraction
 - This section covers the general effects on, and the recovery of, fish and benthic invertebrate communities well, however given there is very limited information on the fish of the impacted section of the Otaki River, it is impossible to determine the effects at a level specific to this river. Additionally, the full effects of this activity cannot be determined in the absence of information on the flora and fauna of gravel beaches including native plants, terrestrial invertebrates, and hyporheic invertebrates.
 - As described earlier, the effects of deposited fine sediment are not well covered.
 - There is no mention of the direct mortality of fish and invertebrates that may result if gravel extraction results in a change in flow path of the river that leaves fauna stranded. This occurrence was observed by Perrie (2013).
- » Application report (Section 6.14) and Ecological AEE report (Section 5.12): Activities in the CMA
 - I do not think an adequate assessment of environmental effects can be made for activities in the river mouth/estuary given the paucity of information on the current state of estuary ecology.

2 FURTHER INFORMATION

"Identification of any further information that EOS should be provided with to complete the assessment of environmental effects for the Otaki River"

This section is divided into two parts: information that is definitely required to complete the assessment of environmental effects, as well as information that could be included in the Environmental Monitoring Plan (and thus collected/obtained later).

2.1 INFORMATION REQUIRED TO COMPLETE AEE

Information gaps and other deficiencies in the information provision are detailed in Section 1. The following is a summary of the key matters requiring resolution, but it will be important to also refer to Section 1 for additional detail:

- » More effective maps should be provided, in particular, the NZFFD records maps (and all maps for that matter) should clearly indicate the sections of rivers and tributaries covered by the consent application, the application report should include a map of ecological survey site locations, and a map showing existing flood protection features (i.e., willow plantings, native plantings, groynes, rock lining, debris fences, etc.) would be highly useful.
- » Given the consent application involves activities in the estuary and CMA, a more thorough description (that is based on actual data or cited information) of the Otaki River estuary and the potential effects of flood protection activities is required.
- » The description of the existing environment needs to provide an effective comparison of the ecology of the area covered by the consent application (the "impact" section) with the upstream catchment outside the influence of flood protection activities (the "reference" section).
- » Better coverage of the invertebrate and fish fauna of tributary waterways in the area covered by the application compared to tributaries outside of the area.
- » The description of the Otaki River benthic macroinvertebrate community needs to be expanded to better describe the typical community of the area covered by the application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring.
- » More detailed information on the fish species that we should be most concerned about such as those that are abundant and spawn in the area covered by the consent application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring. For the lower Otaki River section covered by the consent application there is very little fish information, which may make this difficult to do until the initial baseline surveys outlined in the EMP are undertaken.
- » A more complete description of riparian vegetation in the application area, specifically covering any remnant native vegetation or significant areas of native plantings.
- » More detailed information on the bird species that we should be most concerned about such as those native or endemic species that roost, feed, nest, or rest in the area covered by the consent application. The nesting of pied stilt, banded dotterel, and black-fronted dotterel are covered, but there are likely other species that utilise riverbed and river mouth/estuary habitat.
- » Coverage of herpetofauna that could be present in the consent application area.

2.2 INFORMATION TO OBTAIN LATER VIA EMP

- » A description of the macrophyte communities (e.g., species present, abundance, native species, noxious species) present in the application area.
- » A description of the flora and fauna that colonises the gravel beaches/bars of the Otaki River in the periods between bed moving flood events.
- » Fish surveys of waterways/drains subjected to mechanical clearing.

3 REFERENCES

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- Tonkin & Taylor Ltd. 2013 (updated 2014). Resource consent applications – flood protection operations and maintenance activities in the Otaki River, Waimanu, Rangiuuru, & Ngatoko Streams, Katihiku & Pahiko Drains. Report prepared for Greater Wellington Regional Council (Flood Protection). 136 p.

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