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REGIONAL COUNCIL
Te Pane Matua Taiao

# Stormwater toxicants:

## Summary of Greater Wellington’s Expert Panel Workshop, 2 May 2011


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# Contents

# 1. Introduction and background

On 2 May 2011 Greater Wellington Regional Council (Greater Wellington) hosted an "expert panel" workshop to discuss stormwater toxicants, particularly in relation to setting limits on these in urban streams and coastal environments.

Six consultants were contracted to provide their expertise for the day. A brief project proposal (Internal Reference #893509-V3, attached as Appendix 1) was distributed to each prior to the workshop. This brief provided:

- Background to Greater Wellington's monitoring and investigations to date of the effects of toxicant-related stormwater contaminants on fresh and coastal waters in the Wellington region;
- Background on the proposed approach to reviewing Greater Wellington's existing regional plans in relation to stormwater issues; and
- A list of 21 questions to be discussed at the workshop.

## 1.1 Workshop purpose

The purpose of the workshop was to discuss – and where possible reach a consensus – on various technical issues relating to establishing toxicant limits for coastal and fresh waters in the Wellington region, utilising the consultants' qualifications and "on the ground" experience in this field. This work is being undertaken to inform the review of Greater Wellington's regional coastal and freshwater plans.

## 1.2 Workshop attendees

The following consultants were involved in the workshop:

- Dr Bruce Williamson (Principal, Diffuse Sources Ltd)
- Dr Chris Hickey (Principal Scientist – Ecotoxicology and Environmental Chemistry, NIWA)
- Dr Olivier Ausseil (Principal Water Quality Scientist, Aquanet Consulting Ltd)
- Paul Barter (Senior Marine Biologist, Cawthron)
- Paul Kennedy (Principal Environmental Scientist, Golder Associates (NZ) Limited)
- Dr Shane Kelly (Director, Coast and Catchment Ltd)

Each of these consultants has considerable experience in relation to toxicants and/or stormwater management issues and has worked in the Wellington region on related matters.

Two further external people were invited to attend the workshop:

- Graham Sevicke-Jones (Science Manager, Hawke's Bay Regional Council and convenor of the SWIM Special Interest Group)
- Amanda Hunt (Senior Analyst – Science Team, Ministry for the Environment)

Greater Wellington staff involved in the workshop included:

- Juliet Milne (Team Leader, Environmental Science) – co-chair

- Rachel Pawson (Senior Policy Adviser) – co-chair
- Summer Warr (Senior Environmental Scientist, Freshwater Quality and Ecology)
- Dr Megan Oliver (Environmental Scientist, Coastal Water Quality and Ecology)
- Murray McLea (Senior Policy Advisor)
- Caroline Ammunsden (Policy Advisor)

Miranda Robinson (Team Leader, Policy Development), Jonathan Street (Manager, Environmental Policy) and Ted Taylor (Manager, Environmental Monitoring & Investigations) also provided background input to the workshop.

# 2. Workshop summary

This section provides a summary of the responses made to each of the 21 questions discussed at the workshop. An asterisk (*) in the text indicates post-workshop comments were made by one or more consultants – refer to Appendix 2 for these comments. A full transcription of the workshop discussion is available as a separate document (Greater Wellington reference WGN_DOCS #913304_V2).

Note that a short powerpoint presentation was delivered at the workshop to "set the scene" as to current stormwater management issues in the region and provide some context for the discussion.

A key recurring theme throughout the responses to many of the questions was the need for regional councils to clearly define their management purposes and objectives. There was also considerable reference to the ANZECC (2000) water quality (and sediment quality) guidelines and the current review being undertaken (by the Australian and New Zealand governments[1]) of these.

## 2.1 PART A: General – water management purposes

### Qstn 1: What water management purposes need toxicant limits?

*General*

There was general agreement on the management purposes identified by Greater Wellington. However, it was noted that this was not a "complete" list and the ANZECC guidelines identified some other obvious purposes such as horticultural use, stock water and industrial use. There were two key questions for Greater Wellington:

- What aspects of the environment will the regional plan manage and/or protect?
- Will the regional plan control amenity effects caused by toxicants (e.g., foul smelling sulphide-rich sediments) as well as toxic effects?

*Water supply*

The National Environmental Standard for Sources of Human Drinking Water (NES) requires consideration of toxicant concentrations in public water supplies. This would

[1] The Australian and New Zealand Environment and Conservation Council (ANZECC) has ceased to exist and new joint governmental committees are overseeing this review (Hickey, pers comm. 2011).

be situation-specific – assess water supply catchments where there is potential for significant sources of toxicants. There were two key questions for Greater Wellington:

- Will the regional plan protect both reticulated public water supply and individual non-reticulated water supply?
- What responsibility do TA's have in respect of water supply (apart from those identified through the Ministry of Health (MoH) drinking water management system)?

*Shellfish*

The discussion focused on the human health effects associated with the consumption of shellfish. The regional plan is likely to include contact recreation limits that protect human health so it would be logical to have shellfish limits for the protection of human health. There were three key questions for Greater Wellington:

- Will the regional plan set specific toxicant limits to protect shellfish survival/reproduction or will these be addressed through the broader management purpose of aquatic ecosystem health?[2]
- In addition to microbiological limits, will the regional plan set toxicant limits for shellfish to protect human health (over and above those set through the ANZFA food quality limits that include fish and shellfish)?
- What is the role of the public health agencies, including MoH and ANZFA *vs* Greater Wellington in the protection of human health in respect of shellfish consumption?

Mercury was noted as a potential toxicant of concern – widespread in many receiving environments.*

*Mahinga kai*

Greater Wellington's regional plan will need to recognise mahinga kai and the fact that some people may consume a disproportionate amount of shellfish, fish or other foodstuffs (including water cress), that in some situations may contain contaminants concentrations potentially above human health limits. It is noted that human health limits are based on an assumed dietary intake (e.g. X kg/year) and these limits may not adequately reflect the risk to people eating significantly larger amounts of shellfish and fish.*

*Māori cultural values*

There was general agreement that the majority of cultural values associated with fresh and coastal waters would be covered by other management purposes such as aquatic ecosystem health, contact recreation and shellfish gathering. A study in the Waikato has investigated mauri and found no specific mauri toxicant limits greater or more stringent than those that might be included in aquatic ecosystem health[3]; however, significant concerns were raised over the effects of landfill and sewage discharges.

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2 Bruce Williamson noted that he didn't think this could be done in terms of shellfish concentrations.

3 NIWA. 2010. *Waikato River Independent Scoping Study.* A report prepared for Guardians Establishment Committee and Ministry for the Environment. NIWA Client Report HAM2010-032.

Dioxins, chlorinated organics and arsenic (in watercress) were also raised as a potential concern to Māori. The mauri of coastal and fresh waters can also be affected by other non-toxicant issues such as taste, odour, colour and clarity.*

Amanda Hunt stated that it is always preferable to consult with Maori directly over protection of tangata whenua values.

*Trout fishery*

Trout fisheries do have specific requirements (enshrined in the RMA) – for example, protection of spawning areas – that are over and above the generic aquatic ecosystem health limits.

The Horizons One Plan has two fishery categories: native fish and trout. These categories are both split into two sub-groups, fisheries and spawning. These categories included general toxicant limits expressed in the Horizons Proposed One Plan as the ANZECC guidelines protection levels – for example 95% protection level for most waters, but 99% in upland areas, trout spawning areas and "outstanding" trout fisheries.

Ammonia limits need to be considered for trout – but trout fisheries should be identified in the regional plan rather than apply the limit everywhere. Paul Kennedy was not sure the special protection was warranted, noting that while the USEPA approach included separate criteria for communities where salmonids were absent or present (typically half the concentration), the ANZECC approach – which uses no observed effect concentrations (NOEC) – does not separate salmonids from other fish in providing trigger values. Oliver Ausseil confirmed that the Horizons Proposed One Plan does include specific ammonia limits for the protection of trout.*

### Qstn 2: Do you agree with our receiving environment types? If not, how should they be categorised?

*(Examples presented by Greater Wellington were rivers and streams, lakes and wetlands, embayments, estuaries and harbours and the open coast)*

Yes.

There was general agreement that all the receiving environment types should have toxicant limits even though in some cases – such as the open coast – the limits may not be triggered (i.e., exceeded).

### Qstn 3: Is there a scientific rationale that justifies a lower/higher level of protection for urban streams which differ in health? We note that the ANZECC guidelines allows for this differentiation with respect to toxicant concentrations (i.e., 3 levels of species protection).

Yes. It would be unrealistic for all urban streams to have the same level of protection.

Universal application of the ANZECC guidelines "default" $95^{th}$ percentile protection level is not an appropriate management tool. The regional plan would have to specify where/how a lower level of protection applies so that the $95^{th}$ percentile protection level

is not automatically applied. The ANZECC guidelines allow for this approach but regional councils do not generally apply them in this way.

The regional plan will have to balance the existing degraded state of some urban streams with targets for improvement in the future. Even if a stream does not currently meet the $80^{th}$ or $95^{th}$ percentile type situation, it does not mean that it can not in the future.

The regional plan should state what purposes it will be managing urban streams for rather than applying a blanket percentile stream protection level.

A concern was raised that including numerical guidelines in the regional plan would become de facto standards or "no go" limits – but the consensus was that guidelines don't have to be put in as standards.

## 2.2 PART B: Types of contaminants

### Qstn 4: What are appropriate toxicant contaminants to set limits for in relation to protection of aquatic ecosystems? (e.g., Zn, Cu and PAHs)

There was general agreement that the regional plan should not limit the list of contaminants – have a "core list" covering the more common ones (e.g., copper, lead, zinc, ammonia, TPH, PAHs – plus non-toxic parameters such as TSS, temperature and pH) but also have a link to the ANZECC guidelines to cover off everything else (a "catch all").* Amanda Hunt noted that the revised guidelines will be on-line (internet-based) with rolling revisions.

There were a couple of qualifying statements, such as being aware of how the ANZECC review pans out, being careful of "the list syndrome" where inclusion of every possible contaminant could imply the need to monitor them[4], and the need to 'flag' site-specific considerations relating to certain activities.

### Qstn 5: What emerging toxicants should we be looking at, if any?

Emerging contaminants – sediment organics in particular – are a "watching brief". There is no real way of managing them but councils need to establish a process for identifying them and managing their effects. Graham Sevicke-Jones said a document was coming out later this year that is expected to address this.

Chris Hickey noted that addressing emerging contaminants may require site-specific consideration of catchment and wastewater monitoring[5].

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[4] Paul Kennedy noted this was already happening in relation to the Horizons Proposed One Plan where there is a tendency for Horizons staff to ask for all the parameters in Schedule D as they have limits (standards) and as such should be checked.

[5] A recent review provides some guidance in this area:

Tremblay LA, Stewart M, Peake BM, Gadd JB and Northcott GL 2011. *Review of the risks of emerging organic contaminants and potential impacts to Hawke's Bay*. Cawthron Report No. 1973 prepared for Hawke's Bay Regional Council.

## 2.3 PART C: Setting of contaminant limits

### Qstn 6: Should contaminant limits be set in the sediment, or in the water column, or both?

Both sediment and water column limits are needed (rivers/streams and estuaries/coast) since both have a role to play in environmental quality and ecosystem wellbeing. Additional points:

- Limits may not ever be exceeded in some environments (e.g., open coast) but it's still appropriate to have limits for these environments.
- The bigger the freshwater flow into an estuary the more critical it is to have water column limits.
- It needs to be clear in the regional plan what each (sediment *vs* water column) limit relates to.
- Sediment integrates impacts from multiple activities in the upstream catchment so it's better to consider sediment quality targets that trigger further investigations; hard limits can be applied more easily to the water column where the source is often easier to identify (i.e., treatment of limits for sediment and the water column are potentially different).

### Qstn 7: Should we consider both acute and chronic limits?

*Water column*

The ANZECC guidelines don't currently cover acute (short-term) exposure. There may be a need to consider acute limits within mixing zones for discharges (such limits would be standards in the case of parameters like pH and temperature) – may not need a table but a reference in the regional plan that allows site-specific deviation from the guidelines for short-term exposure.

From a consenting perspective, Olivier Ausseil noted that chronic limits have been included as an annual median (or some median based on a defined compliance cycle) while acute toxicity is addressed via an absolute (maximum) or 95$^{th}$ percentile limit.* In contrast, the Horizons Proposed One Plan set numerical limits that applied only as general targets and permitted activity standards.

Chris Hickey advised that the revised ANZECC guidelines are considering providing short-term exposure guidance and trigger values for the key toxicants of concern such as copper, zinc and ammonia.

*Sediment*

The ANZECC sediment quality guidelines are not derived in the same manner as acute and chronic water quality guideline values – they are management tools based on the probability of adverse effects; there are low and high effect thresholds (previously called Interim Sediment Quality Guideline (ISQG) trigger values. Chris Hickey noted that ANZECC (2000) ISQG-High trigger values correspond to a 50% probability of an adverse effect in sediments with that concentration of contaminant.

### Qstn 8: If sediment limits are used, should they be addressed through contaminant loads and/or contaminant concentrations? Are they appropriate in urban streams (which are usually already highly degraded and receive multiple stormwater discharge inputs)?

The contaminant load approach is very common in the US (set a total maximum daily load, TMDL) and is the approach Auckland Council is using in Integrated Catchment Management Plans (ICMPs). There may not be a problem now, but there could be in say 15 years time. It's important for Greater Wellington to know its management objectives – e.g., is the current level of sediment contamination in Porirua Harbour acceptable? *(Greater Wellington's response is don't want it to get any worse – maintain at or below ANZECC-Low trigger values).* It was agreed that while there wasn't the same knowledge about Wellington and Porirua harbours compared with Auckland's harbours, generally there was still a lot of knowledge and much could be gleaned from Auckland and applied in the Wellington region.

Urban streams need careful consideration (integrated assessment for instream and downstream receiving waters) because there are multiple environmental habitat factors and instream stressors (impervious surfaces, lack of riparian vegetation, etc.) at play as well as the presence of toxicants. A possible management approach is to seek water quality improvements but the costs involved may be high and should be balanced against resulting ecological outcomes (i.e., you need to be realistic).

### Qstn 9: Which guidelines should we consider using – ANZECC? USEPA? etc.

This comes back to what you are managing/protecting ecosystem for. The USEPA water quality guidelines have been developed slightly differently from ANZECC[6] to provide a different level of protection. The ANZECC guidelines are the principal guidelines in use now even if they're not perfect – they allow for flexibility of approach with different effect thresholds and it is legitimate within the overall decision-making framework to deviate from ANZECC if a particular trigger level doesn't provide the desired protection. Overall though, ANZECC is the base to work from – there's no need to try and develop sediment quality guidelines like ARC did now that the ANZECC guidelines are being critically reviewed and updated for key contaminants of concern to the regulatory community (i.e., the questionable numbers and mistakes are being addressed).*

The updated ANZECC sediment quality trigger values should be available soon, possibly later this year; they can therefore be considered in Greater Wellington's new plan (Chris Hickey noted these revised values will not be new derivations from incorporation of new testing data, but rather a revisiting of the international guidelines with corrections of errors). It was agreed that the sediment trigger values should be considered as management tools and not used in the same manner as water quality limits – they are a mix of a range of toxicity data from all over the place and should just be

[6] Additional explanation from Chris Hickey: the ANZECC water quality guidelines have a different statistical derivation method and generally include more species than the US EPA guidelines (the latter only use species resident in North America). In contrast with the water quality guidelines, the ANZECC sediment quality guidelines are a compilation of various internationally used "low" and "high" threshold values – ARC adopted a hybrid version of the international guidelines for their planning documents.

used as a 'flag' for further work (consider a reference site or, for already contaminated receiving environments like a harbour, a gradient site approach away from the contaminant sources). Chris Hickey noted that site-specific sediment quality guidelines have been derived for Auckland intertidal species sensitivity to provide alternative copper, lead and zinc thresholds appropriate for the Auckland intertidal environment, based on some recent work led by Judi Hewitt at NIWA[7].

## 2.4 PART D: Mixing zones

*Note: The questions in this section were discussed together and this is reflected in the transcript. It was also noted that guidance on mixing zones was updated in an ARC-commissioned report prepared by Cooke et al. (2007).*[8]

### Qstn 10: Should mixing zones be set in the water column or the sediment, or both?

The RMA provides for mixing zones but that doesn't make these zones a 'free for all' regarding the effects of discharges.

It often isn't easy to define mixing zones in estuary/harbour systems receiving discharges from multiple outfalls with 'overlapping' impacts (e.g., there are gradients of contamination but are these mixing zones?) – however, they provide a basis for establishing compliance assessment and calculating end-of-pipe conditions.

### Qstn 11: What allowances do we make for mixing zones and known areas of existing/historic contamination (e.g., depth of sediment and distances from outfalls)?

When considering toxicant limits (for Wellington Harbour), be practical in operating port areas and around wharfs where there are significant mass loads of copper from anti-fouling use; these environments also tend to have degraded habitat and are subject to physical disturbance. Allowing for some sediment quality degradation in the inner harbour doesn't have to compromise other values like contact recreation though (manage through the water column). This degradation could be likened to applying the ANZECC 80$^{th}$ percentile (as opposed to 95$^{th}$ or 99$^{th}$) protection level for toxicants in fresh waters. If sediment quality targets aren't being met currently, you can still use them in the regional plan as an overall management objective; this is the approach taken with water quality targets in Horizon's Proposed One Plan.

Accept that contamination is present in harbour sediments and seek to ensure that it does not get worse (i.e., the principle of 'maintain or enhance'). Although inner port areas in harbours may be of poorer quality, there should be concern – and action – if contamination was to exceed guidelines over more extensive areas.

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[7] Hewitt JE, Anderson M, Hickey CW, Kelly S and Thrush SF 2009. Enhancing the ecological significance of sediment contamination guidelines through integration with community analysis. *Environmental Science and Technology 43*: 2118–2123.

[8] Cooke J, Milne P and Rutherford K. 2007. *A review of definitions of "mixing zones" and "reasonable mixing" in receiving waters.* A report prepared for Auckland Regional Council by Beca Infrastructure Ltd.

Inputs of clean sediment have the potential to reduce contaminant concentrations. However, the effects of adding sediment could outweigh those of the contaminants. Consideration should be given to the absolute and relative loads of sediment and contaminants.

### Qstn 12: What mixing zones are appropriate for large/medium/small stormwater discharges? (e.g., Fitzroy Bay and Moa Point sewage discharges allow a mixing zone of 100 metres)

It is important to consider the scale of the mixing zone in relation to the nature of the receiving environment (both physical and biological, and overall sensitivity); often mixing zones are designed to fit a confined receiving environment (e.g., Evans Bay in Wellington Harbour) rather than the discharge outfall(s) being designed to provide mixing appropriate for the receiving environment.

Mixing zones often correspond to an allowable dilution of point sources – so they should translate back to an "end of pipe" measurement plus dilution (reasonable mixing).

### Qstn 13: How should mixing zones in urban streams be treated particularly when there are multiple and overlapping discharge points?

Ideally, the quality of each discharge would be to the level appropriate to meet the uses specified for the waterbody as a whole. Realistically though, the problems are historical (stormwater discharge networks are not able to be designed again from scratch) and so the USEPA came up with the Total Maximum Discharge Load (TMDL) approach – set the management goal on what the final load at the bottom of the stream should be. In the lower reaches of many streams draining intensive urban areas, the instream habitat is probably significantly modified and ecological values compromised. Values are probably higher further upstream and so management objectives need to be clear and realistic for today (avoid blanket protection values) and the duration of regional plans and shorter term resource consents. In highly impervious cases (e.g., Ngauranga Stream in Wellington City), the management focus may be on contaminants released into the downstream receiving environment (Wellington Harbour).

Wellington's urban streams may have compromised water quality but their proximity to the coast and steep gradients support many valued native fish species – so fish passage may require significant consideration in addition to consideration of toxicant inputs. Overall, from a management perspective, you need to be realistic about water quality – mixing zones may not be all that relevant for small urban streams due to variable flow (low *vs* storm and which to manage for) and multiple inputs.

Classifying streams based on imperviousness created difficulties in Auckland because the catchments were then developed for urban use; there needs to be a connection between any classification and the value you put on the stream and what the future options are for that site. Engineers need more guidance around mitigating development-generated impacts on streams such as reducing water temperatures and collecting some of the fine sediment prior to entry to the stream.

## 2.5 PART E: Setting limits in the regional plan and their implications

Qstn 14: In your experience where should a limit(s) be set: at the end of the pipe, within urban streams and/or in the coastal environment?

There was general consensus that limits should be set in the receiving environment rather than at the end of the pipe. The regional plan has to be effects based and it is difficult to make a link between the effect in the receiving environment and the discharge at the end of the pipe.

One option presented was that the regional plan would have receiving environment limits but at the resource consent level or the catchment management tool level "end of pipe" limits could be applied (these could be back-calculated to the receiving environment limits). It was agreed that this would work better for industrial discharges rather than stormwater discharges due to the highly variable nature of stormwater.

In terms of the coastal marine environment – the ultimate receiving environment – there are two types of effects: (i) the build up of contaminants over time which is a load situation (best addressed through catchment management) and (ii), the level of dissolved toxicants in the water which is a concentration situation (best addressed through limits).

Qstn 15: Do you have any views on what form these limits should take?

*e.g., Should they be concentrations or loads? Should they be target reductions? Should they be a set limit? Should it be % change relative to upstream or a reference site? Should they be included in objectives, policies, rules and/or other methods?*

Limits can have a dual purpose in the regional plan; they can be used at both the policy and the rule level.

At the policy level they can be expressed as long-term objectives for the receiving environment (i.e., streams, rivers and harbours).

At the rule level they can be permitted activity standards or triggers for a shift in activity status. ECan and Horizons use the numbers as triggers to shift from one activity status to another. The limits are most useful as a trigger for further investigation or mitigation rather than a "no-go" limit or absolute standard.

The regional plan should acknowledge the difference between acute toxicant concentrations in the water column and mass toxicant loads depositing in the receiving environments. These issues have to be dealt with separately; catchment loads are best managed through ICMPs and ANZECC values should be used as triggers, not standards – if exceeded, it requires some action (e.g., further investigation).

In terms of "target reduction" approaches, it was agreed that Greater Wellington needs to decide if an issue (e.g., harbour contamination) is significant enough that it warrants action (e.g., zinc in Auckland harbour sediments) – then weigh up the costs and benefits.*

The decision of whether to apply “end of pipe” limits comes back to your management purposes and whether or not the ecological health of the receiving environment is being affected. Stormwater quality varies between outfalls/discharge sources but we can say generally which ones – e.g., industrial and commercial (as opposed to residential) – produce the greatest toxicant loads. From a consenting point of view, in particular cases – such as sensitive locations – it would be sensible to put limits on selected stormwater outfalls/discharges to encourage the TAs to look into catchment sources and controls. It was noted that monitoring could also be based on selected outfall types (e.g., industrial, commercial and residential).

While there was general agreement that discharge limits on specific problem stormwater outfalls would be appropriate, Shane Kelly said he would be reluctant to impose end of pipe limits and an associated discharge quality monitoring programme on urban stormwater networks without a clear understanding of the reasons for it – he felt the diffuse nature of urban stormwater contaminants and multiple discharge points made monitoring problematic, and there was already sufficient information available now on the quality of stormwater discharges and sources of stormwater contaminants. He felt that efforts could be better directed at implementing contaminant controls. However, discharge limits and monitoring may be appropriate for point source discharges, such as runoff from industrial sites.

Other topics discussed included ICMPs (summarised in later questions), the need for some absolute standards (e.g., for physical parameters like temperature) alongside the use of limits/targets, and stormwater from industrial sites.

*Stormwater discharges from industrial sites*

The management of industrial sites should be a high priority (i.e., potentially generate the highest toxicant load). The regional plan review should consider delegating control of stormwater discharges from industrial sites in urban areas to the TAs rather than including industrial stormwater discharges in the regional plan. The main benefit of TAs controlling these discharges is that they then control the source of the main contaminants entering their stormwater networks. One-on-one attention is required to effect change in the management of industrial sites; one-off regional council site visits are not enough – a dedicated TA officer is almost needed.

### Qstn 16: What, if any, knowledge and experience (good/bad) do you have of using limits as thresholds to trigger resource consent activity status?

*e.g., if the limit is breached, a discharge requires non-complying activity resource consent rather than a discretionary activity consent).*

Yes, limits can be used as permitted activity conditions and as triggers between different consenting statuses – such as controlled activity to discretionary activity status.

The regional plan should consider differentiating between discharges from existing urban areas and those from new greenfield developments.

TA network discharges should be controlled activities subject to conditions relating to toxicant limits and/or types of receiving environment (i.e., sensitive *vs* non-sensitive).

Non-compliance with these conditions should trigger an activity status change to discretionary, so that industrial sites and problem catchments can be adequately managed.

### Qstn 17: Can we – and do we need to – develop provisions that allocate specific contaminant loads within catchments in the region? What science would be required to develop these provisions?

*Note: This was largely discussed in relation to question 8 re the US approach (total maximum daily load) and ICMPs although post-workshop comments were made by Paul Kennedy and Bruce Williamson as outlined below.*

Paul Kennedy: contaminant load approaches are typically developed in response to specific environmental issues that have been identified (e.g., nutrients in the Manawatu River, urban metal accumulation in Auckland harbours, sedimentation in estuaries). As such, a blanket approach is unlikely to be justifiable and would involve extensive work.

Bruce Williamson: a good catchment model is needed (these models are being developed in Auckland by NIWA, based on Mike Timperley's Contaminant Load Models) but a receiving water model is also needed and that can be tricky with complex, mixed energy, receiving environments. The original USC model is such a tool, but only handled very simple receiving environments.

### Qstn 18: How do you manage the 'right to pollute' problem where the water quality is better than the limit we recommend for inclusion in the plan?

*e.g., Do we opt for a combination of limits, including one that restricts the increase in a contaminant concentration/load relative to the upstream/ background value?*

The RMA says the standards in a regional plan should not allow for the degradation of water quality unless it is consistent with the principles of the RMA. The RMA does not require there to be no adverse effect – therefore, this allows for the degradation of water to a certain standard provided that any adverse effects are no more than minor (i.e., some "allocation" for contaminants is allowable).*

The management purposes and associated targets and trigger values dictate the level of protection a waterbody should receive. These will be critical to the development of the regional plan. What the community wants is also important – they may want water quality to be maintained, even though some degradation will not have an effect.

### Qstn 19: How do you manage situations where the water quality doesn't meet a limit we recommend for inclusion in the plan? (e.g., Do we opt for a target % or amount reduction or a "no further degradation" policy for the life (10 years) of the plan?)

Greater Wellington's regional plan should seek to synchronise the expiry of all water abstraction and discharge consents to water and land in each sub-catchment or catchment. The benefits of synchronisation are that it allows toxicant "allocation" issues to be considered on a whole of catchment basis and also sets a platform for

implementing management objectives around either no further degradation or improvements compared to upstream values. There is also the ability for TAs to combine resources and undertake integrated catchment planning on a catchment scale rather than being restricted to local body boundaries (which often traverse catchments).

A question for consideration in Greater Wellington's regional plan is will the water quality in some areas ever meet the limit? If not there are three options: (i) lower the level of protection, (ii) accept the limits will never be met and so remove them altogether, or (iii) keep the limit and require off-site mitigation (i.e., enhancement elsewhere).* The RMA allows for this latter option.

The Auckland Council's stream ecological valuation (SEV) methodology allows for off-site mitigation in respect of habitat loss; this method probably could be modified to address water/sediment quality in urban streams as well as estuaries and harbours.

Graham Sevicke-Jones noted that Hawke's Bay was embarking on a regional water strategy with the TAs – outside of the statutory process – that takes a longer-term view (at least 80 years) of water management (both quantity and quality). This type of strategy was more effective in dealing with long-term objectives than 10-year regional plans.

## 2.6 PART F: Improving water quality – and monitoring and reporting effectiveness/ progress

Qstn 20: Is there a practical and achievable method of reducing toxicants in stormwater discharges? Devices? Management plans? Retrofitting low impact urban design? Treatment? ICMPs

The answers are difficult and there is no silver bullet – a combination of different approaches is required including treatment devices (focussed on priority areas), restrictions on Greenfield* subdivisions, phasing out of certain contaminant generating materials (e.g., zinc roofs), first flush treatment devices, reduction of imperviousness and targeting of hot spots. Greater Wellington's regional plan should be prescriptive in respect of an appropriate stormwater management approach or suite of tools.

Chris Hickey noted that, in principal, much can be done with Greenfield sites but this requires much more consideration of building materials and contaminant sources and clear inclusion of treatment systems in new urban development. In existing urban development this is much more complex and can only be based on examining mitigation options that are targeted to identified concerns (i.e., meeting discharge load requirements).

*Devices*

The Auckland Council approach works where treatment devices are properly assessed to prove they capture the targeted contamination – the high costs associated with devices mean that developers and TAs want to know the devices they invest in are going to work. There is an enormous amount of literature in the United States and elsewhere,

including stormwater manuals and databases. Greater Wellington's regional plan should not re-invent this resource.

Industry should be targeted for attention. These are high risk areas and perhaps could be addressed better through TA stormwater bylaws. It was also noted that zinc – a common stormwater toxicant – is present in significant amounts in the dissolved fraction and so is harder to manage compared to contaminants that are predominantly associated with particulate material. In such cases there are advantages in managing and or treating at source. Chris Hickey noted that the implementation of targeted road sweeping programmes with appropriate equipment could be used to reduce the loads of contaminants from road run-off.

*Integrated Catchment Management Plans (ICMPs)*

Points to note about the content and development of ICMPs:

- ICMPs should be based on catchment boundaries rather than local body boundaries.
- The ICMP process has to start with the establishment of a clear set of agreed environmental and community objectives. The ICMP should be directed towards achieving those objectives.
- The ICMP should focus on both water quality/ecology and quantity. The development process should involve a team of people with multiple skills – such as ecologists, engineers and planners. Greater Wellington needs to work closely with the TAs through the whole process – especially during the development of the initial ICMPs – and own the review process (to ensure it reflects regional requirements), rather than relying on external consultants.
- ICMPs do not have to be complicated documents with a lot of sophisticated information. Knowledge can be gathered through simple tasks such as walking streams in the catchment and describing their characteristics.
- Greater Wellington should be prescriptive and provide guidance on the expected content and development of ICMPs.
- Greater Wellington should provide a list of any base information it held that would be useful to the TAs in the development of ICMPs – alternatively developing and collating regional information that is required to be included or utilised in local ICMPs would assist in the preparation of ICMP and make their preparation more cost effective.

It was noted that a lot of lessons had been learnt from ICMP development in Auckland (and now elsewhere in New Zealand); there may be benefit in capturing that in some guidance document – perhaps a consideration for Envirolink funding?

*Financial incentives*

In the United States, financial incentives – such as rates or building restriction relief – are used to encourage a higher level environmental performance including on-site treatment of stormwater. Other countries also charge per unit of pollution (e.g., BOD) to incentivise better management practices.

Qstn 21: What additional monitoring requirements (or further investigations) might be necessary if we introduce toxicant limits?

Compliance monitoring on individual consents should be undertaken by the consent holder – there needs to be a balance between frequency (to assess trends) and cost. Greater Wellington should be responsible for the broader scale monitoring, typically the state of environment monitoring.

In harbour/estuary receiving environments, the monitoring programme should assess contaminant gradients away from specific problem outfalls and specific points near problem activities. There needs to be a link between the gradients from the outfalls to the distant reference sites to provide a complete picture of the receiving environment.

There was discussion about whether consideration should be given to some shellfish monitoring since shellfish gathering is generally something the community values (and therefore the regional plan will be managing for); even though the risks of shellfish consumption may be largely from microbiological contaminants, it might be useful to demonstrate to the community whether or not the toxicant (and bioaccumulation) risk does or doesn't exist (i.e., public reassurance at shellfish harvesting sites). There was support for this although Shane Kelly commented that if shellfish monitoring was to be undertaken, then the purpose of the monitoring and interpretation of the monitoring data would have to be carefully considered.*

Mercury remains a toxicant that continues to crop up in various receiving environments across New Zealand – it may be more of an historical issue now since, in the last 30 years better controls are in place on its use.*

Monitoring information can be used to inform and motivate the general public to request environmental improvements. The accessibility of the data is critical. Greater Wellington should consider innovative ways to present monitoring data.

## 2.7 Other comments

Improvements in receiving environments can take decades to be noticeable – longer than the life of regional plans and most consent terms. It would be worthwhile to develop short-term action-based indictors which monitor progress towards achieving the overall longer-term management objectives; reporting on these through simple report cards and easily understandable indicators etc. will help the community see that progress *is* being made.

Groundwater recharges/discharges back into streams and lakes. Will Greater Wellington's regional plan see groundwater as having an ecological value and impose toxicant limits?

# 3. Next steps

The information from this workshop will be used by Greater Wellington's Environmental Policy Department over the next 12-18 months to assist with the formulation of new regional plan objectives, policies and rules in relation to managing the effects of stormwater discharges on the fresh and coastal receiving waters.

# Appendix 1: Background memo provided to consultants

| | |
|---|---|
| TO | Bruce Williamson (Diffuse Sources Ltd), Chris Hickey (NIWA), Olivier Ausseil (Aquanet Consulting Ltd), Paul Barter (Cawthron), Paul Kennedy (Golder Associates), Shane Kelly (Coast & Catchment Ltd) |
| COPIES TO | Murray McLea, Summer Warr, Miranda Robinson, Megan Oliver, Caroline Ammundsen, Jonathan Streat, Ted Taylor |
| FROM | Rachel Pawson and Juliet Milne |
| FILE | ENV/31/03/02 |
| DATE | 8 April 2011 |

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## Developing coastal and fresh water quality limits (toxicants) for the Wellington region

### 1. Background – stormwater investigations and reporting

Greater Wellington has been investigating stormwater contaminants in aquatic receiving environments in the Wellington region since 2002. The need for these investigations arose out of a 2001 NIWA report that identified a number of knowledge gaps with respect to the effects of stormwater contaminants in the Wellington region. A series of investigations to address these gaps in information have since been commissioned (or supported) by Greater Wellington.

Work is currently under way to summarise the findings of the various stormwater-related investigations and relevant SoE monitoring data in a single report for use by Environmental Policy and other staff. Although this report is not likely to be finished until late 2011, we know from the information to be summarised that that there is probably a need to regulate stormwater discharges through the resource consent process (at least at a TA network level in catchments discharging to Porirua and Wellington harbours). With such regulation comes the need to consider limits or standards to safeguard the recreational, ecological and other values we place on our receiving waters.

Refer to the Appendix for tables summarising concentrations of selected toxicants present in surface sediments at sub-tidal monitoring locations in Porirua and Wellington harbours, and information gained from investigations of contaminants in urban streams and stormwater quality.

### 2. Background – regional plan review

Greater Wellington has an operative Regional Coastal Plan (2000) and a Regional Freshwater Plan (1999) with specific policies that manage the water quality of all surface water bodies and coastal water for the following identified purposes:

- contact recreation (identified areas of coastal water and identified water bodies)
- shellfish gathering (identified areas of coastal water)
- aquatic ecosystems (all fresh water bodies)
- natural state (identified fresh water bodies)
- trout fishery and fish spawning (identified water bodies)
- water supply (identified water bodies).

Both narrative and prescriptive receiving water quality guidelines associated with each water quality purpose are identified in appendices in each plan that are linked to each relevant policy (although the guidelines are very limited reflecting the date of the plans). Some water bodies that are known to be degraded are identified, separately, as needing enhancement, so that water quality guidelines for aquatic ecosystems, contact recreation or fishery and fish spawning purposes are met.

State of the environment reporting has established that guidelines for receiving water quality are sometimes not met. Key reasons for not meeting receiving water quality guidelines are stormwater discharges, which are a **permitted activity**, and non-point source discharges, which are not controlled.

Other matters that diminish the effectiveness of our existing receiving water quality provisions include:

- receiving water quality guidelines are applied through policies not rules or standards (i.e., only regard is given to them and they are not binding or enforceable)
- few of the prescriptive guidelines are applied in practice – most guidelines are narrative (although prescriptive receiving water quality limits are sometimes applied to a particular resource consent application on a case by case basis).

We are currently reviewing our all our regional plans. While our current approach to managing water quality is not entirely effective, we think that by addressing the above matters, an effective approach can be developed.

Accordingly, we have reviewed our Regional Policy Statement (will become operative once final appeals have been resolved) and it directs the following approach to be taken in our regional plan (review):

- policies and rules shall require water bodies and coastal water quality to be managed for the purpose of aquatic ecosystem health and any other identified purpose (cultural purposes, contact recreation, trout fishery etc.)
- policies and rules shall minimise ecotoxic and other contaminants in stormwater that discharges into water or onto land that may enter water from new subdivision and development.

## 3. Background – regional plan review

Various terminology in use in relation to concepts like standards or limits. What we will use in the regional plan has yet to be finalised but for the purposes of this workshop, the following definitions will apply:

- **Water management purpose** means the overall objective/goal that a water body is to be managed for.

- **Toxicant limit** means the concentration (or may potentially be a load or percentage change above a background level) of a toxic contaminant in a water body that is capable of causing ill health, injury or death to any living organism.

Potential management purposes and receiving environment types

Broadly speaking, receiving surface water environments within the Wellington region can be categorised as:

- Harbours (Wellington Harbour Porirua Harbour)
- Estuaries (e.g. Lake Onoke, Waikanae River)
- Open coast
- Lakes and wetlands
- Rivers and streams

Of these, the environments considered to be "at risk" from toxicants are harbours, estuaries and urban streams. We are not sure if we should/need to include toxicant limits for all rivers and the open coast.

Potentially the following water management purposes could be used on the coast:

- Aquatic ecosystems
- Contact recreation
- Shellfish gathering
- Cultural purposes.

The management purposes for freshwater could be:

- Aquatic ecosystems
- Contact recreation
- Water supply
- Trout fisheries
- Cultural purposes.

### 3.1 Purpose of the meeting

The purpose of the workshop is to discuss technical issues relating to establishing toxicant limits for coastal and fresh waters in the Wellington region, utilising your qualifications and "on the ground" experience in this field. This work is being undertaken to inform the review of our regional coastal and freshwater plans. A series of questions regarding toxicant limits are included in the attached memo. The aim is to gain a consensus view, if possible. The intention is to record what is said at the workshop so that we can later produce a "report" that documents the key discussion points and conclusions. There will be a chance for you to review the report and request any alterations and/or deletions to ensure the report states your position correctly. We do not want the recording of the event to inhibit free and frank discussion.

### 3.2 Attendees

In addition to the six consultants listed as recipients of this memo, the following people will also attend the workshop:

- Juliet Milne, Summer Warr and Megan Oliver (GW Environmental Science)
- Rachel Pawson, Murray McLea, Caroline Ammunsden and Miranda Robinson (GW Environmental Policy)
- Amanda Hunt (Ministry for the Environment)

It is possible that a staff member from Hawke's Bay Regional Council may also attend the workshop.

### 3.3 Questions

The following questions have been developed to focus on the technical scientific issues facing Greater Wellington in the plan review process. The questions have been grouped into a number of broad categories. Consensus will be sought where possible.

#### PART A: General – water management purposes

1. What water management purposes need toxicant limits?

   *Discussion here on contact recreation limits and shell fish limits*

2. Do you agree with our receiving environment types? If not, how should they be categorised?

   *Will present a slide here on receiving environments and management purposes*

3. Is there a scientific rationale that justifies a lower/higher level of protection for urban streams which differ in health? We note that the ANZECC guidelines allows for this differentiation with respect to toxicant concentrations (i.e., 3 levels of species protection).

   *Discussion here on whether a lower level of protection is justifiable for significantly degraded urban streams*

#### PART B: Types of contaminants

4. What are appropriate toxicant contaminants to set limits for in relation to protection of aquatic ecosystems? (e.g., Zn, Cu and PAHs)

5. What emerging toxicants should we be looking at, if any?

## PART C: Setting of contaminant limits

6. Should contaminants be set in the sediment, or in the water column, or both?

7. Should we consider both acute and chronic limits?

8. If sediment limits are used, should they be addressed through contaminant loads and/or contaminant concentrations? Are they appropriate in urban streams?

9. Which guidelines should we consider using – ANZECC? USEPA? Etc.

## PART D: Mixing zones

10. Should mixing zones be set in the water column or the sediment, or both?

11. What allowances do we make for mixing zones and known areas of existing/historic contamination (e.g., depth of sediment and distances from outfalls)?

12. What mixing zones are appropriate for large/medium/small stormwater discharges? (e.g., Fitzroy Bay and Moa Point sewage discharges allows a mixing zone of 100 metres)

13. How should mixing zones in urban streams be treated particularly when there are multiple and overlapping discharge points?

## PART E: Setting limits in the regional plan and their implications

14. In your experience where should a limit(s) be set: at the end of the pipe, within urban streams and/or in the coastal environment?

15. Do you have any views on what form these limits should take?

    - Should they be concentrations or loads?
    - Should they be target reductions?
    - Should they be a set limit?
    - Should it be % change relative to upstream or a reference site?
    - Should they be included in objectives, policies, rules and/or other methods?

16. What, if any, knowledge and experience (good/bad) do you have of using limits as thresholds to trigger resource consent activity status? (e.g., if the limit is breached, a discharge requires a non-complying activity resource consent rather than a discretionary activity consent).

17. Can we – and do we need to – develop provisions that allocate specific contaminant loads within catchments in the region? What science would be required to develop these provisions?

18. How do you manage the 'right to pollute' problem where the water quality is better than the limit we recommend for inclusion in the plan? (e.g., Do we opt for a

combination of limits, including one that restricts the increase in a contaminant concentration/load relative to the upstream/background value?)

19. How do you manage situations where the water quality doesn't meet a limit we recommend for inclusion in the plan? (e.g., Do we opt for a target % or amount reduction or a "no further degradation" policy for the life (10 years) of the plan?)

PART F: Improving water quality – and monitoring and reporting effectiveness/ progress

20. Is there a practical and achievable method of reducing toxicants in stormwater discharges? Devices? Management plans? Retrofitting low impact urban design? Treatment? ICMPs?

21. What additional monitoring requirements (or further investigations) might be necessary if we introduce toxicant limits?

### 3.4 Meeting agenda/timetable

- 9:30 am: Arrival and introductions / tea & coffee
- 9:45 am: Overview from Greater Wellington science and policy staff
- 10:00 am: Part A and Part B questions
- 10:45 am: Part C and Part D questions
- 12:00-12:45 pm: Lunch (provided)
- 12:45 pm: Part E questions
- 2:30-2:40 pm: Afternoon tea
- 2:40-4:20 pm: Part E and Part F questions
- 4:20 pm: Wrap up and where to next with finalising the day's discussion in writing
- 4:30 pm: Close

## APPENDIX TO MEMO

### Porirua and Wellington harbours

- Three rounds of monitoring at five locations in Porirua Harbour (Figure 1) show concentrations of total copper, lead and zinc are above ‘early warning’ sediment quality guidelines in the subtidal sediments of the Onepoto Arm of Porirua Harbour (Table 1). Concentrations of the other metals analysed are currently below guideline levels in the Onepoto Arm, as are the concentrations of all metals in the subtidal sediments of the Pauatahanui Arm. DDT concentrations are above sediment quality guidelines in both arms of the harbour (in the 2005 survey, concentrations ranged from 3.4 mg/kg to 6.2 mg/kg.
- Based on a baseline survey in late 2006, (Figure 2) concentrations of lead, mercury, and to a lesser extent copper and zinc, are present above sediment quality guidelines in the subtidal sediments of various parts of Wellington Harbour, especially those adjacent to Wellington City (Table 2). Tributyltin is only present above sediment quality guidelines at the entrance to the Lambton Basin and off Ngauranga, but its less toxic breakdown product dibutyltin is widespread. Fluorene, phenanthrene, benzo[a]anthracene, and total high molecular weight PAHs are above sediment quality guidelines in southern Evans Bay, and Total HMW PAH in northern Evans Bay and at the entrance to the Lambton Basin (Table 3). Total DDT is present above sediment quality guidelines over much of the harbour (Table 4). Concentrations of other heavy metals, organochlorine pesticides and PAHs are currently below guideline levels in the subtidal sediments of the harbour.
- Although the concentrations of several contaminants are above sediment quality guidelines in parts of Porirua and Wellington harbours, the benthic ecology data from (collected at sites adjacent to the sediment chemistry sites) suggest there is not yet any clear evidence of significant adverse effects – some of the environmental variables measured are influencing lower-order benthic community structure, but, at this stage any effects of contamination cannot be separated from the effects of differences in sediment texture and organic carbon content.
- There are localised pockets of more significant stormwater-derived contamination in intertidal sediments of Porirua Harbour, most notably at the southern-most end of the Onepoto Arm adjacent to Porirua City’s CBD. Here, zinc concentrations exceed ANZECC sediment quality guidelines (ISQG-low) at all 10 sites sampled between the Semple Street stormwater outfall and the Porirua Stream channel. Copper, lead and Total HMW PAH concentrations are also present above guideline values at some sites in this area, and Total DDT is present above guidelines at all sites.

### Estuaries

- Concentrations of total metals and some organic contaminants have been tested in surface sediments from 1-2 representative intertidal locations in several estuaries monitored in accordance with the National Estuary Monitoring Protocol (e.g., Waikanae, Hutt and Whareama estuaries). No sediment contaminant concentrations exceed guidelines values at the sites monitored although localised “hotspots” are likely/known (e.g., Hutt Estuary, Porirua – see above) and in early 2010 nickel was found to present at concentrations approaching ANZECC ISQG-low in surface sediments from one location in Lake Onoke (south Wairarapa).

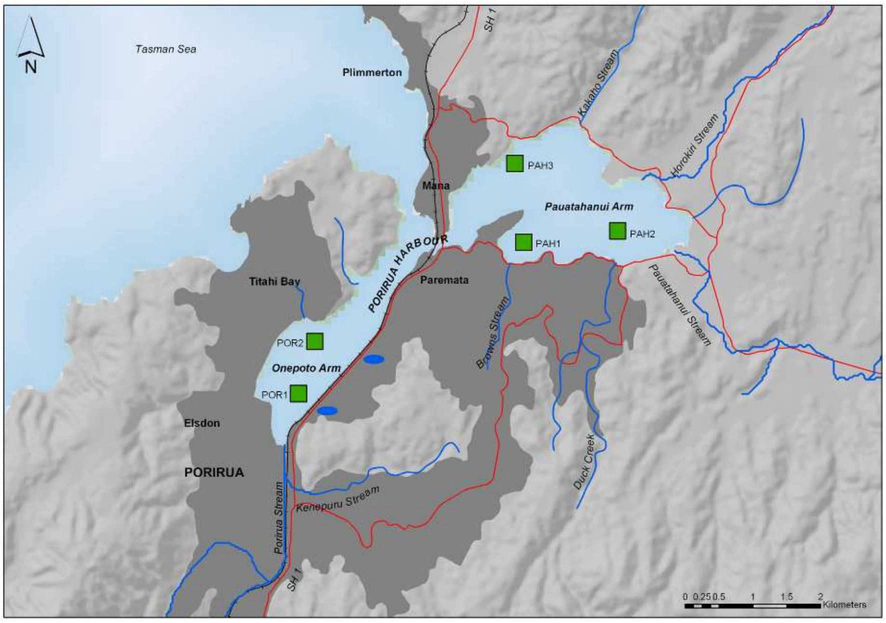


**Figure 1: Porirua Harbour subtidal monitoring locations.**

**Table 1: Mean particle size, percentage of particles <63 µm, and summary of concentrations and variability (c.v. %, n = 5) of TOC and metals in sediments of five sites sampled in Porirua Harbour in November 2008. Sediment quality guidelines for comparison are ANZECC (2000) and ARC Environmental Response Criteria (ARC ERC; ARC 2004). Values in amber exceed the ARC ERC amber threshold and values in red exceed the ARC ERC red and/or ANZECC ISQG-Low thresholds.**

| Analyte | Fraction | ANZECC | | ARC ERC | | PAH1 | | PAH2 | | PAH3 | | POR1 | | POR2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | analysed | ISQG-Low | ISQG-High | amber | red | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. |
| Mean particle size (µm) | <500 µm | - | - | - | - | 77.17 | 4.9 | 66.09 | 4.7 | 99.88 | 2.7 | 47.49 | 6.9 | 33.07 | 14.2 |
| % particles <63 µm | <500 µm | - | - | - | - | 39.19 | 5.8 | 43.27 | 8.0 | 20.41 | 6.0 | 73.83 | 3.5 | 89.89 | 4.8 |
| Total Organic Carbon (%) | <63 µm | - | - | - | - | 1.44 | 2.4 | 1.54 | 1.7 | 1.09 | 4.6 | 1.47 | 4.5 | 1.70 | 1.2 |
| Total Organic Carbon (%) | <500 µm | - | - | - | - | 1.66 | 3.2 | 1.59 | 5.1 | 0.97 | 3.4 | 2.22 | 2.5 | 1.95 | 1.3 |
| Metals (mg/kg, 2 M HCl): | | | | | | | | | | | | | | | |
| Copper | <63 µm | - | - | - | - | 8.7 | 3.4 | 7.9 | 2.3 | 7.2 | 3.3 | 14.0 | 0 | 13.2 | 3.4 |
| Lead | <63 µm | - | - | - | - | 21.0 | 0 | 17.6 | 3.1 | 16.8 | 2.7 | 32.2 | 1.4 | 34.4 | 1.6 |
| Zinc | <63 µm | - | - | - | - | 67.4 | 2.5 | 57.0 | 1.2 | 54.2 | 2.7 | 145.8 | 1.7 | 127.4 | 1.6 |
| Total Metals (mg/kg): | | | | | | | | | | | | | | | |
| Silver | <500 µm | 1 | 3.7 | - | - | 0.09 | - | 0.07 | - | 0.06 | - | 0.18 | - | 0.13 | - |
| Arsenic | <500 µm | 20 | 70 | - | - | 11 | - | 7.5 | - | 9.0 | - | 12 | - | 13 | - |
| Cadmium | <500 µm | 1.5 | 10 | - | - | 0.04 | - | 0.06 | - | 0.04 | - | 0.17 | - | 0.04 | - |
| Chromium | <500 µm | 80 | 370 | - | - | 21.9 | - | 15.7 | - | 17.1 | - | 21.6 | - | 23.9 | - |
| Copper | <500 µm | 65 | 270 | 19 | 34 | 14.6 | - | 10.5 | - | 9.5 | - | 23.4 | - | 20.6 | - |
| Mercury | <500 µm | 0.15 | 1 | - | - | 0.09 | - | 0.08 | - | 0.07 | - | 0.12 | - | 0.14 | - |
| Nickel | <500 µm | 21 | 52 | - | - | 15 | - | 11 | - | 12 | - | 14 | - | 16 | - |
| Lead | <500 µm | 50 | 220 | 30 | 50 | 22.7 | - | 17.3 | - | 16.2 | - | 40.2 | - | 37.2 | - |
| Zinc | <500 µm | 200 | 410 | 124 | 150 | 88.6 | - | 70.1 | - | 69.7 | - | 200 | - | 150 | - |

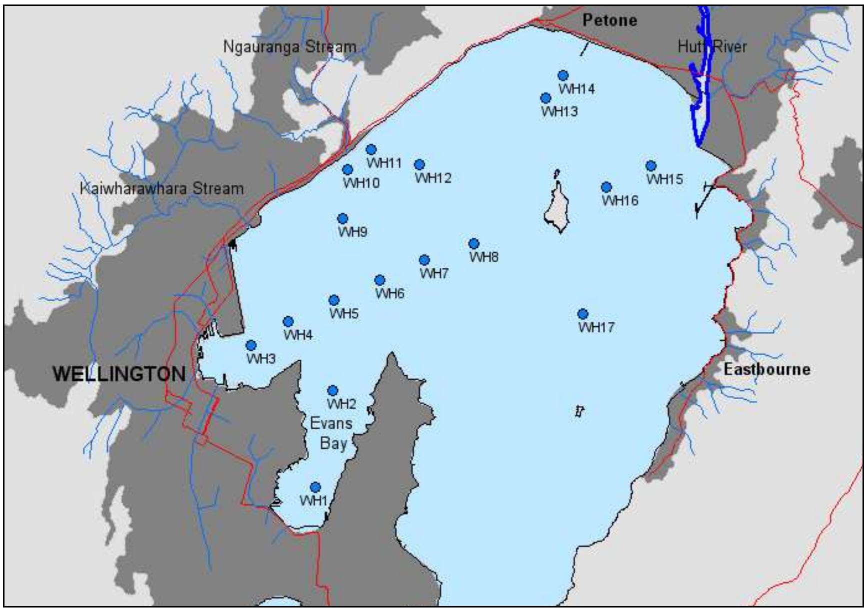


**Figure 2: Map of Wellington Harbour showing the 17 subtidal locations sampled in 2006 for the Wellington Harbour marine sediment quality investigation.**

**Table 2: Mean particle size, percentage of particles <63 µm, and summary of concentrations and variability (c.v., %, n = 5) of metals, dibutyltin and tributyltin in sediments 5 of 17 sites sampled in Wellington Harbour in 2006. Values in amber exceed the ARC ERC amber threshold and values in red exceed the ARC ERC red threshold and/or ANZECC ISQG-Low.**

| Analyte | Fraction | ANZECC | | ARC ERC | | WH1 | | WH2 | | WH3 | | WH4 | | WH5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | analysed | ISQG-Low | ISQG-High | amber | red | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. |
| Mean particle size (µm) | < 500 µm | | | | | 94.02 | 3.5 | 60.31 | 18.7 | 59.31 | 21.3 | 43.25 | 20.2 | 35.27 | 15.3 |
| % particles < 63 µm | < 500 µm | | | | | 25.52 | 10.3 | 57.85 | 13.0 | 58.19 | 19.7 | 72.88 | 14.2 | 85.00 | 8.2 |
| Metals (mg/kg, 2 M HCl): | | | | | | | | | | | | | | | |
| Copper | < 63 µm | | | | | 20.8 | 7.9 | 14.2 | 5.9 | 25.0 | 6.3 | 14.4 | 6.2 | 9.8 | 8.5 |
| Lead | < 63 µm | | | | | 69.0 | 7.9 | 50.5 | 6.7 | 60.4 | 4.8 | 44.5 | 4.7 | 34.3 | 5.9 |
| Zinc | < 63 µm | | | | | 121.6 | 5.3 | 101.2 | 6.4 | 116.6 | 4.9 | 93.2 | 4.8 | 75.8 | 5.1 |
| Metals (mg/kg, total digest): | | | | | | | | | | | | | | | |
| Silver | < 500 µm | 1 | 3.7 | | | 0.7 | | 0.5 | | 0.6 | | 0.4 | | <0.4 | |
| Arsenic | < 500 µm | 20 | 70 | | | 6.2 | | 5.0 | | 6.1 | | 6.1 | | 6.3 | |
| Cadmium | < 500 µm | 1.5 | 10 | | | 0.08 | | 0.05 | | 0.06 | | 0.06 | | 0.05 | |
| Chromium | < 500 µm | 80 | 370 | | | 23.7 | | 24.5 | | 25.6 | | 24.9 | | 24.4 | |
| Copper | < 500 µm | 65 | 270 | 19 | 34 | 25.7 | | 19.2 | | 31.6 | | 20.2 | | 16.9 | |
| Mercury | < 500 µm | 0.15 | 1 | | | 0.79 | | 0.62 | | 0.77 | | 0.51 | | 0.32 | |
| Nickel | < 500 µm | 21 | 52 | | | 16.6 | | 17.6 | | 18.2 | | 17.3 | | 18.4 | |
| Lead | < 500 µm | 50 | 220 | 30 | 50 | 67.1 | | 51 | | 62.5 | | 50.5 | | 37.9 | |
| Antimony | < 500 µm | | | | | <0.4 | | <0.4 | | <0.4 | | <0.4 | | <0.4 | |
| Zinc | < 500 µm | 200 | 410 | 124 | 150 | 130 | | 114 | | 132 | | 117 | | 99.1 | |
| Organotins (µg Sn/kg): | | | | | | | | | | | | | | | |
| Dibutyltin | < 500 µm | | | | | 12 | | 10 | | 22 | | 17 | | 12 | |
| Tributyltin | < 500 µm | 5 | 70 | | | < 5 | | < 3 | | 9 | | 6 | | < 3 | |

**Table 3: Summary of concentrations and variability (cv %, *n*=5) of TOC and selected PAHs in sediments of 4 of the 17 sites sampled in Wellington Harbour in late 2006. Sediment quality guidelines for comparison are ANZECC (2000) and Auckland Regional Council Environmental Response Criteria (ARC ERC; ARC 2004). Values in amber exceed the ANZECC ISQG-Low or ARC ERC amber threshold.**

| Analyte | Fraction | ANZECC | | ARC ERC | | WH1 | | WH2 | | WH3 | | WH4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | analysed | ISQG-Low | ISQG-High | amber | red | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. |
| TOC (%) | < 500 µm | | | | | 1.72 | 1.7 | 1.43 | 2.0 | 1.78 | 1.6 | 1.59 | 1.0 |
| PAHs (µg/kg): | | | | | | | | | | | | | |
| Naphthalene | < 500 µm | | | | | 132 | 4.0 | 73.0 | 9.7 | 111 | 7.5 | 66.0 | 8.3 |
| Acenaphthalene | < 500 µm | | | | | 110 | 8.1 | 26.1 | 7.4 | 41.2 | 4.1 | 20.6 | 5.7 |
| Fluorene | < 500 µm | | | | | 40.2 | 4.5 | 16.4 | 8.3 | 27.3 | 3.9 | 16.0 | 4.6 |
| Total PAH[1,2] | < 500 µm | | | | | 4,901 | 4.5 | 2,343 | 8.4 | 3,603 | 3.2 | 2,310 | 4.6 |
| Total HMW PAH[1,2] | < 500 µm | | | | | 2,757 | 5.3 | 1,254 | 9.0 | 1,990 | 3.3 | 1,210 | 5.4 |
| Naphthalene | at 1% TOC | 160 | 2,100 | | | 76.5 | 4.7 | 51.0 | 8.8 | 62.4 | 6.8 | 41.4 | 8.7 |
| Acenaphthalene | at 1% TOC | 44 | 640 | | | 64.0 | 6.9 | 18.2 | 6.6 | 23.2 | 2.9 | 13.0 | 6.5 |
| Fluorene | at 1% TOC | 19 | 540 | | | 23.3 | 3.1 | 11.5 | 7.4 | 15.4 | 2.7 | 10.1 | 5.2 |
| Total PAH | at 1% TOC | 4,000 | 45,000 | | | 2,842 | 3.4 | 1,638 | 7.5 | 2,026 | 1.9 | 1,450 | 5.0 |
| Total HMW PAH | at 1% TOC | 1,700 | 9,600 | 660 | 1,700 | 1,598 | 4.0 | 876 | 8.1 | 1,119 | 1.9 | 759 | 5.7 |

[1] Polycyclic aromatic hydrocarbons have been summarised as "Total PAH" (all the PAH compounds analysed), and as "Total High Molecular Weight PAH", which is the sum of the concentrations of chrysene, fluoranthene, pyrene, benz[a]anthracene, benzo[a]pyrene, and dibenzo[a,h]anthracene. This is the total used for the ANZECC (2000) sediment quality guidelines and ARC ERC (ARC 2004).

[2] For the purpose of calculating Total PAH and Total HMW PAH, the concentration of any individual compound reported at "less than detection limit" has been replaced by a value one half of the detection limit.

**Table 4: Summary of concentrations and variability (cv %, *n*=3-5) of TOC and selected organochlorine pesticide compounds in sediments of four sites sampled in Wellington Harbour in late 2006. Sediment quality guidelines for comparison are ANZECC (2000) and Auckland Regional Council Environmental Response Criteria (ARC ERC; ARC 2004). Values in amber exceed the ANZECC ISQG-Low or ARC ERC amber threshold and values in red exceed the ANZECC ISQG-Low and ARC ERC red threshold.**

| Analyte | Fraction | ANZECC | | ARC ERC | | WH1 | | WH2 | | WH3 | | WH4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | analysed | ISQG-Low | ISQG-High | amber | red | mean | c.v. | mean | c.v. | mean | c.v. | mean | c.v. |
| TOC (%)[1] | < 500 µm | | | | | 1.73 | 2.1 | 1.41 | 1.8 | 1.78 | 1.6 | 1.59 | 0.6 |
| Organanochlorine pesticides (µg/kg): | | | | | | | | | | | | | |
| Hexachlorobenzene | < 500 µm | | | | | < 0.1 | – | < 0.1 | – | 0.62 | 60.8 | < 0.1 | – |
| Total DDT[2,3] | < 500 µm | | | | | 5.6 | 5.4 | 2.4 | 9.5 | 11.3 | 53.9 | 3.2 | 11.1 |
| Hexachlorobenzene | at 1% TOC | | | | | < 0.1 | – | < 0.1 | – | 0.35 | 60.8 | < 0.1 | – |
| Total DDT | at 1% TOC | 1.6 | 46 | | 3.9 | 3.2 | 4.2 | 1.7 | 7.8 | 6.3 | 53.7 | 2.0 | 11.2 |

[1] The mean and cv values presented here only relate to the replicates re-analysed by NIWA (i.e., *n*=3 for sites WH1, WH2 and WH4).

[2] For the purpose of calculating Total DDT, the concentration of any individual compound reported at "less than detection limit" has been replaced by a value one half of the detection limit.

[3] DDT and related compounds have been summarised as "Total DDT", which is the sum of the concentrations of 2,4'-DDE, 2,4'-DDD, 2,4'-DDT, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT.

## Urban streams

- Streambed sediment quality surveys undertaken in urban areas across the Wellington region in 2005 and 2006 indicated that zinc and, to a lesser extent, lead were the most common metals present in streambed sediments at concentrations exceeding ANZECC (2000) Interim Sediment Quality Guidelines (ISQG). Concentrations of Total HMW PAHs and Total PAHs also exceeded guideline values at some sites, and almost all of the 29 sites sampled in 2005 and 24 sites sampled in 2006 recorded concentrations of Total DDT above guideline values. Contaminant concentrations in sediment samples from several streams exceeded ISQG–High trigger values.
- Further (limited) sediment sampling undertaken in the Onepoto catchment arm of Porirua Harbour in early 2009 identified concentrations of Total DDT, and to a lesser extent zinc, above sediment quality guidelines in Porirua, Kenepuru and 'Onepoto' streams. Sediments in the 'Onepoto' Stream also contain concentrations of several HMW PAH compounds and dieldrin above guideline values.
- Copper and zinc were the most commonly detected heavy metals in stream waters during both 'base flow' and runoff (wet weather) sampling events undertaken over 2005-2007. Dissolved concentrations of both metals were consistently above ANZECC (2000) toxicity trigger values (95% species protection) in runoff samples, with dissolved concentrations of one or both of these metals also above the toxicity trigger values in 'base flow' samples from Porirua, Kaiwharawhara, Ngauranga and Opahu streams. This suggests that dissolved copper and/or zinc concentrations in these streams frequently exceed chronic toxicity criteria for aquatic life.
- Dissolved copper and zinc concentrations also exceeded their respective USEPA (2002) Criteria Maximum Concentrations in around half of the stream water samples collected during runoff events, indicating the likelihood of acute toxicity effects on stream life. Most of the runoff events sampled were not significant from a hydrological perspective, suggesting even greater contaminant concentrations and loads are possible in higher magnitude events, particularly if rainfall is preceded by a prolonged period of fine weather.
- The bulk of the contaminant load was found to be associated with suspended sediments, so a further (and possibly greater) risk the contaminants pose to aquatic ecosystems is to the benthic biota in depositional coastal environments. In most cases the streambeds sampled contained little fine sediment (i.e., silts and clays), indicating that much of this material – and its associated contaminant load – is not retained in the streams, but is rapidly flushed through the system and into downstream receiving environments such as Porirua and Wellington harbours.
- Some urban SoE stream monitoring sites regularly show elevated concentrations of dissolved copper and zinc (Figure 3) – even at 'base flow' in some streams. These sites – which include Porirua Stream at Wall Park (Kenepuru) and the Kaiwharawhara Stream at Ngaio Gorge – consistently show an impacted invertebrate fauna; the sensitive EPT groups (Ephemeroptera, Plecoptera and Trichoptera) are often poorly represented and macroinvertebrate community index scores indicative of 'moderate pollution'. Elevated concentrations of toxicants such as copper and zinc are likely to be one of several contributing factors to the impacted invertebrate communities at these sites.
- Samples of biofilms collected from eight SoE river and stream site across the region in early 2010 had heavy metal concentrations that showed a reasonable correlation with percentage impervious land cover. The highest copper and zinc concentrations were recorded in samples from the Karori Stream at Makara Peak (100 mg/kg and 1,050 mg/kg respectively).

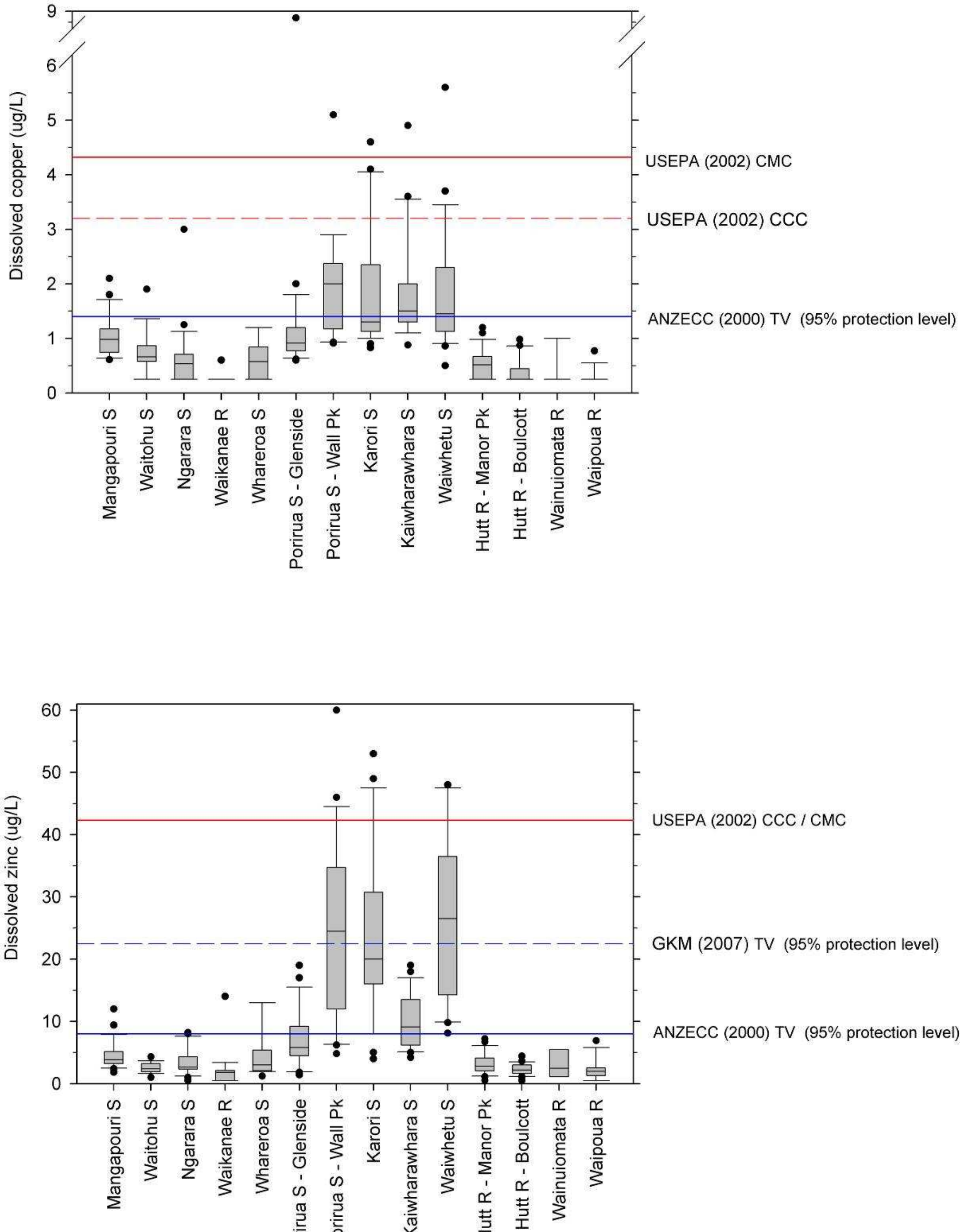


**Figure 3: Box plots of dissolved copper (top) and zinc concentrations recorded in selected river and stream SoE sites sampled monthly over January 2008 to December 2009 inclusive.**

## Stormwater quality

A range of information is available describing the nature of urban stormwater in the Wellington region. One significant source of information is the results of stormwater sampling undertaken between June 2002 and September 2004 to provide further characterisation of the nature of urban stormwater generated in the region. A total of 11 different sampling sites were used to collect stormwater from a range of different catchments in the region. The catchments ranged from newer residential (Browns Bay Stream catchment, Pauatahanui Inlet) through to catchments with well established industrial land (e.g., Parkside Rd in Gracefield Lower Hutt). Stormwater sampling was commenced within the first hour of the rainfall event and continued at hourly intervals until six samples had been collected and combined. The samples collected were examined for a range of general constituents such as nutrients and TSS, as well as a range of toxicants.

Key findings (taken from Kingett Mitchell's report for GW 2005):

- The pH, DOC, TOC and TSS concentrations were similar to that measured in stormwater in other New Zealand studies. In terms of TSS, the Wellington data is representative of other data reported in the international and New Zealand literature (i.e., about 70% of the suspended particles are <59 µm in size.
- Metals: Concentrations of arsenic, barium, chromium, nickel, strontium and tin appear low when compared to what would be expected naturally. Concentrations of cadmium, cobalt, manganese, mercury, selenium, silver and vanadium were indeterminate when compared to natural concentrations due mainly to a lack of information as to the natural concentrations of some elements in New Zealand freshwaters. In the samples collected from residential catchments, concentrations of copper and zinc were considered to be high compared to what would be expected naturally. Concentrations of dissolved antimony, chromium, cobalt and zinc were higher in the samples from commercial/industrial compared to residential catchments. The dissolved lead concentrations from the residential catchments were low compared to concentrations in many published New Zealand studies. The median concentrations from the Wellington industrial/commercial catchments were also low by comparison with other New Zealand data. Dissolved zinc concentrations in Wellington stormwater are elevated compared to natural concentrations. Concentrations were markedly elevated in two samples from industrial catchments. Concentrations of a number of elements were found to be present in suspended particulates in stormwater at elevated concentrations. Of these a number were present at concentrations higher than the ANZECC (2000) trigger values. In the samples from the residential catchments, eight of 10 particulate samples (two fractions, five samples) had concentrations of copper that were over the ISQG-Low trigger value. In the samples from industrial catchments all samples had concentrations over the ISQG-Low trigger. In the residential catchment samples, two of 12 samples were higher than the ISQG-High trigger and five of 11 samples from the industrial catchments had concentrations that were higher than the ISQG-High trigger. For lead, nine of 10 samples had concentrations over the ISQG-Low and six over the ISQG-High. In the samples from industrial catchments all samples had concentrations over the ISQG-Low and the High trigger value. 16 of 20 samples collected were over the upper trigger value. This would indicate that the particulate materials have the potential to increase the concentration of lead in receiving environment sediments. All samples examined with the exception of one sample (Browns Stream) had concentrations of zinc that were higher than the ANZECC (2000) ISQG-High trigger value. As a result of the elevated concentrations present in the suspended particulate material, deposition of the particles will have the potential to increase the concentration of zinc in sediments. In depositional environments, the elements chromium, copper, nickel, lead, and zinc are the elements most likely to result in an increase in sediment

concentration as a consequence of elevated concentrations in urban stormwater particulate material. Based upon the available data, it is evident that urban stormwater will contribute to sediment contamination through the deposition of suspended solids in stormwater.

- Organic compounds: **PAHs** were detected in eight of the 11 stormwater samples collected. The three samples that did not contain any measurable PAHs were from residential catchments. No relationship wasidentified between the landuse of the catchment and the concentration or type of PAH compounds detected. The PAHs most often detected across all sites were pyrene and chrysene. Two of the residential catchment sites had similar PAH profiles, dominated by high molecular weight PAHs. The third residential catchment site had a completely different profile, being dominated by LMW PAHs, particularly naphthalene. The highest concentrations of PAH were detected in an industrial stormwater sample, from Hutt Park Road (total PAH 2,110 μg/$m^3$). Particulate concentrations of PAHs were high with the concentration generally reflecting the concentration measured in the dissolved fraction. The profile identified appeared to reflect the emission of PAHs from motor vehicles.

  **Polychlorinated biphenyls (PCBs)** were found in the 'dissolved' fraction in seven out of 11 samples with the highest concentrations in an industrial sample (Hutt Park Road). Total PCB concentrations were 52.7 μg/$m^3$ at this site and 37 out of the 45 PCB congeners analysed were detected in this sample, more than all other samples. Stormwater from residential land-uses contained lower concentrations of PCBs (0 – 0.826 μg/$m^3$) with only three of six samples from residential land-use having PCBs above the limit of detection. Stormwater samples that did not contain detectable PCBs were from streams and creeks rather than stormwater pipes. The PCB congener profile suggests that the PCBs are from a similar source and possibly a diffuse source such as atmospheric deposition. The examination of suspended particulates filtered from stormwater showed that in the 0.7–59 μm fraction at least one PCB congener was detected in each of the samples collected. In the >59 μm fraction PCBs were detected in eight out of 11 samples. Four samples (one from an old residential catchment, one commercial and two industrial) contained over 100 μg/kg of PCBs in both the 0.7–59 μm fraction and the >59 μm fraction. Higher concentrations were generally found in the finer 0.7–59 μm fraction compared to the coarse fraction. The highest total concentrations in the particulate fractions were in the sample collected from the commercial catchment in Waring Taylor Street. The PCB profiles in the samples were very similar indicating that the PCBs in stormwater samples are potentially from the same source. Although PCBs have not been used in New Zealand since the 1980s, sources still remain in the environment (e.g., soils containing residuals of historic contamination). The median concentrations of total PCBs measured in the Wellington stormwater suspended solids is similar to the ANZECC (2000) trigger value of 23 μg/kg. The maximum concentrations are similar and typically five times the ANZECC (2000) threshold. The presence of measurable concentrations of PCBs in Wellington stormwater indicates that the stormwater provides a load of PCB to the receiving environment. The concentrations measured relative to ANZECC (2000) trigger values indicate that the suspended particulates may contribute to poor sediment quality when deposited.

  **Organochlorine pesticides** were detected in all of the stormwater samples, in either the 'dissolved' or particulate fractions. More were detected in samples from sites with industrial or commercial land-use than the residential land-use sites. Dieldrin, p,p'-DDT and p,p'-DDE (a metabolite of p,p'-DDT) were detected the most frequently. This is a common pattern of detectability in New Zealand. As was found for PCBs, the data shows that although DDT has not been used in New Zealand since the 1980s, sources still remain within the environment.

# Appendix 2: Additional (post-workshop) consultant comments

## Mercury and contaminants of concern in shellfish

Paul Kennedy: Significant mercury issues in New Zealand are confined principally to geothermal environments. Although there is mercury in most urban environments it is not a widespread toxicant of concern in New Zealand coastal shellfish – the risks are associated with people who have limited dietary intakes that include fish with high mercury content.

Chris Hickey: Mercury bioaccumulation levels in some fish (e.g., old snapper) and sharks may readily lead to exceedance of dietary thresholds with regular consumption. Also:

- Total arsenic frequently exceeds consumption guidelines for marine species requiring the measurements to be adjusted for organo-arsenics prior to dietary risk assessment.
- MoH is responsible for coastal shellfish monitoring for paralytic shellfish poisoning (PSP) and for closure of fisheries. The MoH also undertakes a regular national shellfish monitoring programme for metals in commercial shellfish farms.
- Site-specific derivations of consumption limits for wild kai would have to be derived for protection of the groups of the population that eat significantly larger amounts of shellfish and fish.

Bruce Williamson:

- Most New Zealand scientists don’t see shellfish consumption as problem from a stormwater toxicants point of view – it is a major problem overseas (the USA National Coastal Condition Report highlighted mercury, DDT and PCB in terms of fish advisories on 77% of coast) but that may be due to (obviously) greater pollution, but also lower toxicant limits in flesh, dose/uptake models suggesting the need for lower concentrations in sediments, and specific groups of the population consuming fish more frequently, in larger amounts and using parts of fish that accumulate contaminants. There is mercury and DDT “pollution” in New Zealand – possibly not PCB – with mercury advisories already in place. A programme should be in place for public reassurance at harvesting sites – it’s a very common concern, and many people are limiting their gathering and consumption because of perceptions (it’s a big issue in the Waikato). Also it is important that Greater Wellington keeps a watching brief on NIWA’s Maori food basket studies.

## Māori cultural values

Additional point made by Chris Hickey:

- The cultural health index could assist here:

  Tipa, G and Teirney, L. 2003. *A Cultural Health Index for streams and waterways: Indicators for recognising and expressing Maori values*. Technical paper 75, ME number: 475. Report prepared for the Ministry for the Environment by Gail Tipa and Laurel Teirney, Wellington, New Zealand.

- Toxins produced by some marine algae and freshwater cyanobacteria may also result in adverse human health effects (and lethality to dogs and animals for cyanobacterial toxins), with closure of fisheries. Guidelines are available for cyanobacterial toxins[9].
- Consideration also needs to be given to protection of key species of value and associated habitat and migratory requirements (e.g., whitebait, tuna (eels), koura (freshwater crayfish), kakahi (freshwater mussels)). Many of these may be recognised threatened or endangered species[10], and include species for which we have no toxicological information[11]. Site-specific investigations may be required for environments where chemical contaminants are elevated and native species are of specific management concern.

### Fisheries values and ammonia toxicity

Chris Hickey: The most recent USEPA derivation of ammonia toxicity guidelines has criteria with and without freshwater mussels present[12] and the while the ANZECC approach does not separate salmonid from other fish in providing trigger values it will include the recent freshwater mussel high sensitivity data and provide multiple trigger values to reflect the presence/absence of mussels.

### Contaminants requiring limits

Chris Hickey: Guidelines for nitrogen and phosphorus are also required and determining these will require site-specific investigations[13].

### Mixing zones

Bruce Williamson: Another complication with mixing zones on the coast is tidal excursion which extends mixing zones out into estuaries. It's something that Auckland – with its large tides and shallow estuaries – hasn't explicitly tried to address yet in but the concept of the *settling zone* is a type of mixing zone.

Chris Hickey: The need to integrate multiple and overlapping discharges in environments such as estuaries/ harbours and urban streams means that mixing zones are often site-specific derivations.

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9 Ministry for the Environment and Ministry of Health. 2009. *New Zealand guidelines for managing cyanobacteria in recreational waters*. Report No. XX prepared for the Ministry for the Environment and the Ministry of Health by SA Wood, DP Hamilton, W Paul, KA Safi and W Williamson. Wellington.

10 Hitchmough R, Bull L and Cromarty P. 2007. *New Zealand threat classification system lists – 2005*. Threatened Species Occasional Publication 23. Department of Conservation, Wellington.

11 Hickey CW. 2000. Ecotoxicology: Laboratory and field approaches. In: *New Zealand stream invertebrates: Ecology and implications for management*. KC Collier and M Winterbourn, eds. New Zealand Limnological Society, Christchurch, New Zealand. Vol. pp. 313-343.

12 US EPA. 2009. *2009 update of aquatic life ambient water quality criteria for ammonia – freshwater (Draft).* No. EPA 822-R-99-014. United States Environmental Protection Agency, Office of Water, Washington D.C.

13 Biggs BJF. 2000. *New Zealand periphyton guideline: Detecting, monitoring and managing enrichment of streams.* New Zealand Ministry for the Environment, Wellington.

Wilcock B, Biggs B, Death R, Hickey C, Larned S and Quinn J. 2007. *Limiting nutrients for controlling undesirable periphyton growth.* No. ELF07202; HAM2007-006. NIWA report for Horizons Regional Council, Palmerston North.

## Application of limits and ANZECC guidelines

Bruce Williamson:

- The first step in applying the ANZECC guidelines is to decide the management objectives for a specific water body (or group of water bodies) – this is something Auckland needs to revisit when managing its estuarine receiving waters and selecting guideline values for sediment quality. The default to 95% trigger values (for water quality) not only ignores the spirit of the guidelines, it probably ignores all the other important steps managers need to go through (e.g., setting management goals) before reaching the numerical tables contained in the guidelines.
- Greater Wellington (and Auckland) should use the ANZECC guideline approach, but he was not recommending to Auckland Council that they use the new ANZECC-Low sediment quality trigger values because the latest iteration of the revisions did not demonstrate any "improvement" in the trigger values (whereas earlier revisions did). He added that both he and Chris Hickey were recommending lower trigger values because urban estuarine sediments in Auckland were clearly showing depauperate macroinvertebrate communities at relatively low levels of copper and zinc. The clearest effect is the loss of the larger species, which occur in relatively low densities in uncontaminated sediments. While this loss does not demonstrate a causative link between the benthic community health and concentration of these metals, it also cannot be ignored for developing trigger values. Field-based site specific guidelines have been derived from these observations (Hewitt et al. 2009). The current revision of the ANZECC guidelines addresses this by including these as a separate, alternative site-specific option. While Bruce still considers the general default ANZECC sediment trigger values for copper and zinc to be too high, he agreed that the draft revised ANZECC guidelines have been "improved" for many other contaminants (e.g., DDT, dieldrin).
- Unlike Auckland, which can't ignore all the information it has, it can be argued that Wellington is justified in adopting the revised ANZECC trigger values. This would make easier achieving the stated approach of not letting things worsen. However, they are still only trigger values, and it would be necessary to decide how to justify their adoption as targets or objectives. Under the ANZECC procedures, this requires further investigation. This would presumably involve demonstrating that a "reasonably diverse" benthic community is able to be supported at these concentrations, and addressing public concerns about bioaccumulation and effects on fish.
- In terms of imposing target reductions (in contamination), weighing up the costs and benefits is very important – you may not be able to stop the contamination getting any worse without major and costly catchment refits. So in such cases managing (e.g., to maintain a core set of resilient species) may be an objective/target for estuaries, rather than contamination not getting any worse. It may come down to managing streams in individual catchments to realistic limits on toxicants appropriate to the management goals for the stream, then also making sure that this does not put estuaries at risk from excessive loads or concentrations – but this needs working through with real examples.

Paul Kennedy (in response to question the comment about the RMA allowing for some degradation): To some extent this is where the concept of water quality targets and water quality criteria came from – where the ideal water quality is the target and the chronic criteria is the management limit should contaminants be discharged to a receiving environment (possibly a component of the South African water quality guidance). In addition, the identification of water quality zones can assist to some extent by ensuring non-degradation where quality is good (embodied in Horizons Proposed One Plan and Canterbury Regional Council's Natural Resource Regional Plan).

Chris Hickey (in response to comments re Horizon's application of water quality limits on resource consents): Greater Wellington has previously used percentile compliance conditions (e.g., for the Masterton District Council WWTP discharge) as recommended by the New Zealand Municipal Wastewater Monitoring Guidelines[14].

### Managing situations where water quality doesn't meet recommended limits

Bruce Williamson thought the options summarised in response to Question 19 could be expressed better:

Re option (i), if the "limit" is a trigger then the triggered investigations and actions may suggest a new guideline, or it may suggest "that the level of protection be lowered". However, this does not need to be seen as negative – if you have lost the sensitive species, than the new trigger or guideline may be set to protect what's there. If the limit is a target, then that leads to adaptive management but if the limit is an objective, then both management and the level of protection and community aspirations may need to be addressed.

Option (ii) seems to be a generalisation that is not an option anywhere. Again, if the water does not meet a limit, then that should demand a more reasoned management assessment.

### Integrated Catchment Management Plans

Chris Hickey raised climate change considerations and noted that an ICMP should also include key habitat stressors which are potentially ecotoxic. These include pH, dissolved oxygen (DO), suspended sediments and nitrate[15]. Site-specific guidelines may be required for some of these stressors for some environments (e.g., wetlands where DO is naturally depressed) and sites where native species are of special significance.

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[14] Bell RG, McBride GB, Ray DE and Hickey CW. 2002. Detailed design of monitoring program. In: *New Zealand Municipal Wastewater Monitoring Guidelines*. DE Ray (ed.) New Zealand Water and Waste Association, Wellington. Chapter 13, pp.147-162.

[15] Hickey CW and Martin ML. 2009. *A review of nitrate toxicity to freshwater aquatic species.* Technical Report No. R09/57. Environment Canterbury, Christchurch. (http://www.crc.govt.nz/publications/Reports/report-review-nitrate-toxicity-freshwater-aquatic-species-000609-web.pdf). Note: a revised interim nitrate guideline following this derivation is due for release in 2011.