DEVELOPING STORMWATER SOURCE CONTROL POLICY: EXPOSED METAL ROOFING IN AUCKLAND

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ABSTRACT

Environmental monitoring has identified that zinc is accumulating in estuaries and at rapid rates in parts of the Waitemata Harbour. Treatment of stormwater has been shown to have limited to moderate effectiveness at removing some metals, and in particular dissolved contaminants. Source control is an option that may reduce contaminant loads significantly. The Auckland Regional Council initiated a technical investigation into the quality of stormwater from roofs in the Auckland region in 2002. The primary need for the study was to better understand the type and concentrations of stormwater contaminants from roof runoff and address the statement from developers and consent applicants: "The roof water is clean-we don't need to treat it!" The study confirmed that new pre-painted roof materials and residential areas do not contribute significantly to non-point source contaminant loads of zinc.

However, higher levels of contaminants were found to be associated with stormwater from industrial areas, galvanized roofing and, to a lesser extent, unpainted zinc-aluminum coated steel roofing. The level of contaminants from galvanized roofing varied with the degree of weathering, with poorly maintained and unpainted material giving zinc concentrations of up to about 3000 mg/m^3. Typical concentrations of zinc in urban stormwater in Auckland are about 220 mg/m^3.

Further work was also initiated by the ARC to understand the total catchment contaminant budgets and identify the extent of the problem that a given source control mechanism would address. The ARC considered that reducing the use of galvanized iron and exposed metal roofing products and maintenance of older galvanised iron roofs would be effective stormwater quality source controls and reduce requirements for stormwater treatment.

This paper presents an overview of the background to source control development in Auckland, policy mechanisms available to implement source controls in New Zealand and the ARC source control policy on exposed metal roofing products. Key components of the policy development are presented.

Given the potential for source control to adversely affect the sales of products, the technical basis for requiring source control must be sound. The roof runoff study identified the range of contaminants from a variety of roofing products. This was further reviewed and independent testing undertaken by New Zealand Metal Roof Manufacturers' Incorporated.

The policy developed did not simply address "rules" for source control, but identified the need for education, investigation and integrated catchment management planning inputs.

Consultation is a key component of the policy development process. Industry organizations may perceive there is a significant commercial risk and be averse to the implementation of source controls. In Auckland, the ARC and New Zealand Metal Roof Manufacturers' Incorporated have worked through a range of issues relating to the development of source controls for exposed metal roofing.

KEYWORDS

Source control, zinc, galvanised roofing.

1 INTRODUCTION

In the late 1980s and early 1990s, the Auckland Regional Council (ARC) initiated a stormwater quality programme. This was largely in response to American studies such as the National Urban Runoff Programme (NURP) (USEPA 1983) and the Upper Waitemata Harbour Study (NIWA, 1994). Information from the NURP had identified a range of contaminants in stormwater. Similar work to characterise stormwater in Auckland was undertaken (ARC, 1992a, 1994) and found similar levels of contaminants in run-off in Auckland. The Upper Waitemata Harbour Study identified potential effects of those contaminants in the harbour. A stormwater quality programme was initiated and a stormwater treatment design manual prepared (ARC, 1992b). Effects were also summarized in ARC (1995). The key treatment mechanism utilised was settlement of particulate contaminants with a stated aim to remove 75% of total suspended solids from storm water runoff on a long term average basis.

To some extent it was recognised that simple treatment of silt (and the attached particulate contaminants) was not good enough to avoid ecological effects, but there was insufficient information to more specifically identify or remove contaminants. Treatment of silt (or total suspended solids) was seen as beneficial as it prolonged overall estuarine health by delaying the build-up of contaminants to higher effects levels. Preventing contaminants from entering stormwater or “Source control” was identified as a better way of eliminating contaminants, but there was limited information to justify the implementation of such controls.

Over the past three to four years a range of studies have been undertaken and information synthesized in Auckland that has allowed better identification of adverse effects, contaminant origins and treatment/ management methods. These studies have largely been initiated because, in 2001, Territorial Authorities (TAs) around the Auckland region applied to the ARC to renew consents for storm water discharges from their networks. The applications cover approximately 80% of the urbanised catchments in Auckland and were required because the existing use authorisations on which they previously relied had expired under Section 386 of the RMA. New consents were required for the first time in over 30 years and the effects of discharges from drainage networks needed to be better understood. The ARC and TAs started work on the Regional Discharges Project (RDP) to provide a technical and policy framework for processing the consent applications.

2 THE NEED FOR SOURCE CONTROL

2.1 RECEIVING ENVIRONMENT - RECORDED LEVELS OF CONTAMINANTS

One of the first projects initiated by the RDP project team was to better quantify the effects of stormwater contaminants in Auckland. ARC had a Long Term Baseline (LTB) / State of the environment monitoring programme to measure environmental effects at a regional scale. This was supplemented in 2001 by an RDP receiving environment monitoring programme which measured sediment quality contaminant levels and the health of biological communities. The results of this monitoring are reported in ARC reports on Long Term Baseline monitoring (ARC, 2004b) and RDP Monitoring (ARC, 2003). Monitoring of both programmes is ongoing at a two year frequency.

Monitoring results identified that zinc, copper and lead were all present in Auckland’s estuaries. Levels of the contaminants varied across the region and were classified against sediment quality concentrations (Environmental Response Criteria green, amber and red) to determine whether adverse effects were present and whether further investigations were required into methods to reduce/ stop contaminant accumulation. In addition, analyses of the LTB data indicated varying rates of contaminant concentration increase, depending upon land-use and settling zone characteristics. Relatively rapid rates of increase were identified for a number of sites along the southern edge of the middle Waitemata Harbour (ARC, 2004b). The contaminant of most concern from both monitoring programmes was identified as zinc, with levels of copper of secondary concern.

Figure 1 shows the monitoring sites and the sediment quality monitoring results for 2001.

Figure 1: Long Term Baseline sediment quality zinc (after ARC, 2001)

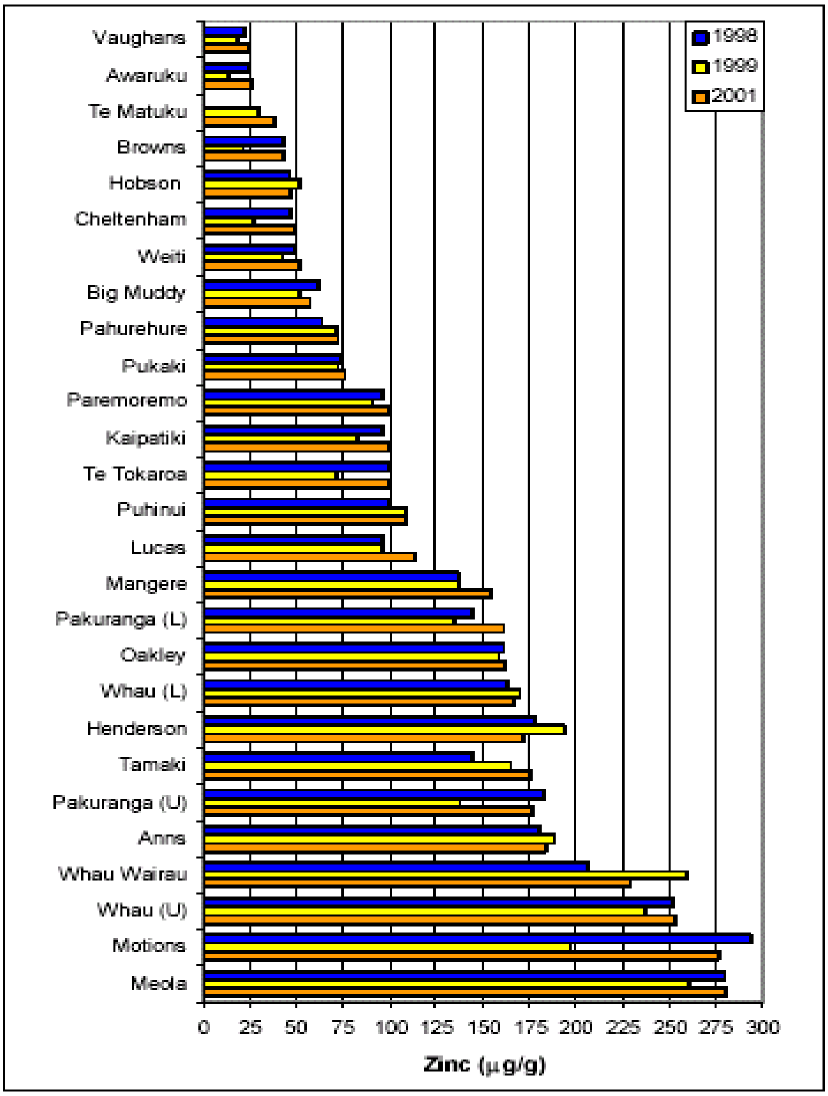


Figure 1. Total Zn from <500 µm fractions in 1998, 1999 and 2001 samples.

The other area of concern identified from monitoring is the Tamaki estuary. Manukau Harbour monitoring sites did not generally show contaminant levels as high as the Waitemata Harbour, with the exception of the Mangere Inlet as this area historically received significant levels of industrial contaminants.

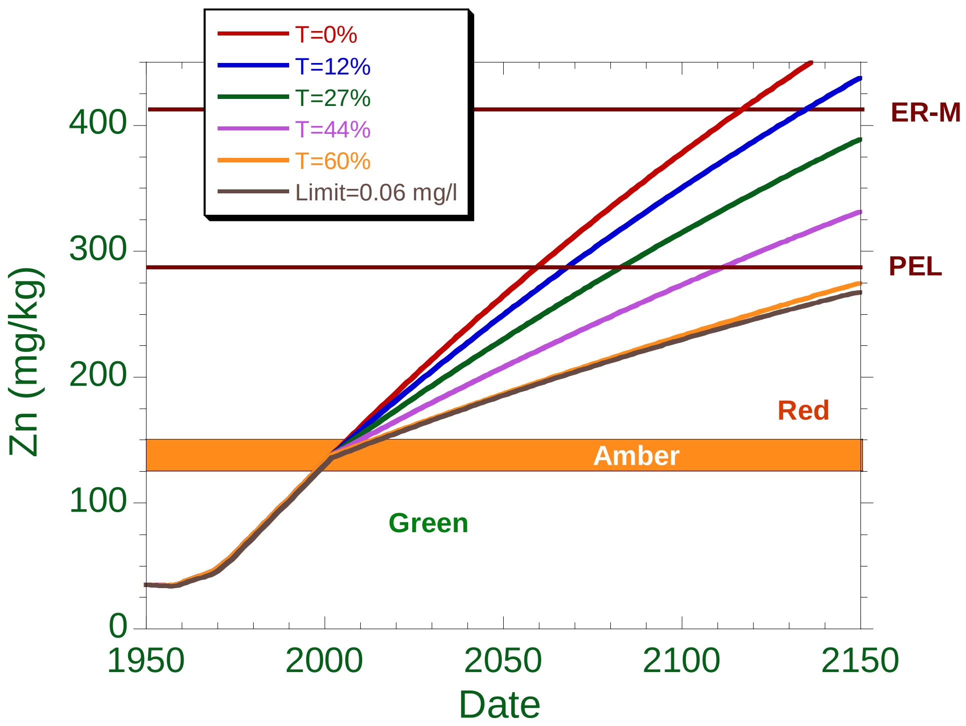
2.2 TREATMENT OF STORMWATER CONTAMINANTS

A review of contaminant association, contaminant particle sizes and treatment by sedimentation ponds in three catchments was carried out by the ARC in 2002 and 2003. The results are reported in ARC (2004c) and summarised in Seyb (2003). The work reviewed the association of contaminants against particle size and estimated the percentage of contaminants attached to various groups of suspended particle sizes present in stormwater runoff. The performance of settlement ponds was then reviewed using modelling results of pond processes and actual pond monitoring data to predict contaminant removal rates. A simple receiving environment model was then used to predict the resulting contaminant concentrations in the estuary.

Results showed that ponds designed to remove 75% TSS were removing some 43% of total zinc. In urbanised catchments where ponds of this size are often not feasible, ponds are often designed to remove about 30% to 50% of TSS and in these cases, the zinc removal rates drop to between 12% and 27%. Monitoring results of actual ponds indicated higher removal rates of up to 60% for some larger ponds and it was postulated that these were linked to removal of dissolved zinc through organic treatment processes.

Typical output from the work is shown in Figure 2 below. The lines show various theoretical treatment levels for different sized ponds and a best case treatment from pond monitoring results.

Figure 3: Kaipatiki Creek settling zone zinc accumulation(after Seyb, 2003)



The work concluded that while treatment by settlement removed a proportion of contaminants, it was never going to be enough to reverse estuarine contaminant accumulation rates. For significant progress to be made in managing estuarine contaminant levels, source control of contaminants was required.

As an example, the impact of removal of lead from petrol was assessed (ARC, 2004c). Reviews of stormwater runoff results showed that recent concentrations of lead in stormwater had dropped to some 5 to 10% of its concentration in the early 1990's. When this was put into the receiving environment model, lead concentrations in estuarine sediments were predicted to decrease over time due to low lead to sediment concentrations and sediment burial processes.

2.3 WHERE IS THE ZINC COMING FROM?

However, if source control is to be implemented, the specific primary sources of zinc need to be identified.

No specific information on contaminant sources was available in Auckland until about two years ago. Two studies; the ARC Roof Runoff study (ARC, 2003) and the assessment of traffic contaminant loads by NIWA (NIWA, 2002) have now allowed zinc sources to be confirmed.

2.3.1 ZINC FROM VEHICLES

NIWA set up a monitoring regime for measuring contaminant levels in road runoff from two sites in Avondale in Auckland. Previous studies had considered the effects of road runoff, but these either; combined loads with other land-uses, or; measured dust contaminant levels rather than the level of contaminants actually entrained in the runoff. The study included aerial dust monitors to allow the contaminant load from surrounding land uses to be assessed. An automatic sampler was placed in the stormwater network which carries the stormwater from the road-side cesspits. Traffic counts were taken and correlated with the contaminant levels recorded. From these, estimates of contaminant load reaching the stormwater network per vehicle per kilometre traveled were established. For zinc, the reported contaminant loading rate is approximately 0.00045 g/vehicle/km.

2.3.2 ZINC FROM ROOFS

ARC's objective for stormwater treatment in TP10 was 75% TSS removal from all impervious surfaces. This had the effect of requiring treatment for roads, carparks and all roof areas on a subdivision or development. Much debate had centered around the need for treatment of roof areas: many applicants argued that the contaminant load from roofs would be much less than trafficked areas. The Roof Runoff study was initiated to investigate whether the contaminant loads from roofs were less than trafficked areas and determine the quantity of contaminants from the roof material itself and that from aerial deposition on the roof from the surrounding land-use. The study investigated contaminants coming from different roofing materials by monitoring them in rural areas (where the land-use effects were expected to be small). Roof types investigated were:

- Long run pre-painted steel;
- Tile shaped pre-painted steel;
- Concrete tiles;
- Epoxy coated chip tiles;
- Long run painted galvanized steel of various ages/ painted condition;
- Long run zinc aluminium coated steel.

The study identified higher levels of zinc from galvanized steel and intermediate levels of zinc in the runoff from the zinc aluminium coated steel and epoxy coated chip tiles. The lowest level of contaminants came from the pre-painted steel and this product was therefore used for the next stage of the study as a material to investigate the effects of land-use.

Three artificial roof frames were constructed with the corrugated pre-painted steel and moved to urban industrial, residential and motorway locations. Industrial land-use generated the most contaminants generally and in some cases considerably higher levels when the test roof was near to industries which discharged to air the contaminants being monitored. Residential areas had lower levels of contaminants and were not significantly different to rural areas. The trafficked sites only showed contaminant levels similar to residential areas: this was unexpected and, in hindsight, it was suspected that prevailing wind conditions did not allow contaminants to accumulate at those sites. The effects of land-use were significantly less than the effect of roof material. For example, moderately weathered painted galvanized steel would still produce zinc levels about an order of magnitude higher than that from the industrial areas alone.

Overall, the study identified that, relative to each other, galvanized steel and to a lesser extent zinc-aluminium coated steel contributed higher levels of contaminants from roof run-off. Monitoring also showed that as the paint coating on the galvanized steel roofs deteriorated, significant increases in contaminants levels were recorded.

These were important results, however they did not prove the need for source control of roofs. To achieve this, it is necessary to show that the roofs make a significant component of the overall contaminant load to the receiving environment.

2.3.3 COMBINING THE CONTAMINANT LOADS

Conventional wisdom and limited information on sources of zinc in stormwater runoff suggests that the majority of zinc is associated with roofing materials and car tyres.

With specific metal loads for expected key sources (roofs and roads), it was now possible to carry out catchment contaminant mass budgets. ARC initiated such a project with the intention of checking that the key sources of metals were accounted for and there were no significant "missing" sources. If the metal inputs from roofs plus vehicle equaled the total metal loads from the catchments, it would be confirmed that any source control measures should concentrate on these sources.

This work is yet to be reported but provisional results (M. Timperley, paper to be presented at this conference) have shown that roofs contribute most of the zinc in commercial and industrial land-uses and about half the zinc in residential land-uses.

2.4 WILL SOURCE CONTROL WORK?

The catchment contaminant budgets indicate that the proportion of contaminants from roofs varies but it appears that roofs are responsible for at least half of catchment zinc loads. The roof runoff study analysis has identified the roof types which are expected to generate the most zinc. In older urbanised areas (approximately 60+ years old), painted galvanised steel roofs may make up to 70% of the total number of roofs. In areas about 30 to 40 years old, the proportion of galvanised roofs drops to about 35%, with an increasing proportion of concrete tile roofs. In new residential areas, pre-painted zinc-aluminium roofs account for most of the roofs. In industrial areas, the quantity of various roof types is unquantified, but visual inspection suggests there are significant areas of unpainted galvanised or zinc-aluminium roofs. Given the relatively high proportion of galvanised roofs in some catchments and the expected zinc loads from roofs, source control could be an effective management technique.

To further assess source control effectiveness, the ARC is investigating source control options for development around the Upper Waitemata Harbour area as part of a new Upper Waitemata Harbour Study. This study is being carried out jointly with Waitakere City Council, North Shore City Council and Rodney District Council and is modelling catchment runoff and the dispersion and accumulation of contaminants in the Upper Waitemata Harbour. A range of traditional stormwater treatment and source control options have been studied. Provisional results indicate that source control could significantly reduce future zinc loads entering the Upper Waitemata Harbour (M Timperley, pers comm).

To identify the most effective source control structures it will be necessary to confirm the proportion of contaminants from roofs, and receiving environment contaminant levels for individual catchments.

3 SOURCE CONTROL METHODS

This part of the paper investigates a range of mechanisms for implementing source control. Two scenarios are investigated; to match the different scenarios for sources of zinc from roofs in Auckland:

- Zinc from existing galvanised iron roofing;
- Zinc from new galvanised iron / zinc- aluminium roofing.

3.1 EXISTING REGULATORY SITUATION

The Proposed Auckland Regional Plan: Air, Land, Water requires storm water quality treatment to remove 75% TSS for all impervious surfaces by way of a standard and term to Rule 5.5.2 and to network discharge rule 5.5.10. Policy 5.4.4 includes the same treatment standard and requires consideration of treatment particularly for discharges to estuaries. This approach has been implemented by ARC prior to the Plan through TP10 and resource consents since the early 1990s.

Where the standards and terms of the rules in the ALW Plan are not met, stormwater discharge activities default to discretionary activity rules. This occurs for source control. For source control to be implemented as the predominant form of catchment wide stormwater quality initiative, changes to the Plan are required to avoid such approaches having to be assessed as discretionary activities (as opposed to controlled activities for more traditional TSS removal approaches).

3.2 EXISTING MARKET

In New Zealand, BHP NZ Steel is the main supplier of both zinc-aluminium roofing and galvanised steel roofing. Most of the product is supplied to other manufacturers for forming into different profiles (eg long run corrugations, “tile” sheets) and application of paint.

Galvanised steel roofing is still produced and is used mainly for rural applications. Much of the market for galvanised steel now uses zinc-aluminium roofing instead. In residential applications, the market for steel based roofing is dominated by long run pre-painted steel products.

3.3 MECHANISMS FOR IMPLEMENTING SOURCE CONTROL

A range of regulatory methods for implementing source control are available. These include methods using National initiatives, Regional Plans, District Plans and Building Act regulations. Methods are summarized below.

National environmental standards promulgated by the Minister for the Environment under the RMA which would control the use of certain materials.

Regional Plan methods to control the use of certain specified roofing materials:
- land-use permitted activities and/or consents issued under RMA section 9;
- discharge permitted activities and/or consents issued under RMA section 15.

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District Plan methods to control the use of certain specified roofing materials:
- land-use permitted activities and/or consents, issued under RMA section 9;
- Subdivision permitted activities and/or consents, issued under RMA section 11.

Building Act:
- product bans by the Chief Executive of the Department of Building and Housing under Building Act 2004, section 26;
- definition of acceptable solutions in the Building Code regulations issued under Building Act 2004, section 402;
- performance criteria in the Building Code regulations issued under Building Act section 400.

In addition, a range of non-statutory based methods are available, including:
- Natural reduction of the contaminant through the discontinued use of the products identified as generating higher levels of contaminants;
- Education of the public and product specifiers to opt for more “environmentally friendly” products;
- Integrated Catchment Management Plans recommendations. Note that these are likely to advocate a mix of regulatory and non-regulatory methods to achieve desired environmental outcomes;
- contractual arrangements between a stormwater network operator and a party connecting to the network, preventing the discharge of higher levels of contaminants (cf a Trade Waste By-law approach).

3.4 SOURCE CONTROL OF NEW ROOFING

In general each of the methods identified above could, to some extent, be used to control the type of roofing material used for new developments.

The Building Code regulations appear to have a wider scope for application as they could regulate all developments that require consents through the Building Consent process. Land-use consents could be framed in terms of permitted or consentable activities and could apply to all new developments. Discharge consents could only target roof materials through a discharge consent holder, and given that roofs are often owned by third parties connecting to a stormwater system; are unlikely to be as far-reaching or effective.

In terms of which authority or legislation appears the most suited to implementing source control it is noted that: the functions of the Regional Council include; management for the purposes of “water quality”, “maintaining ecosystems” and “maintaining indigenous biodiversity”; and that District Council functions include “maintaining indigenous bio-diversity”. The Building Act purpose includes “sustainable development”. However, when the principles of how this is to be achieved in the Act are considered, it appears the Act is targeted at the efficient use of materials and resources, rather than managing off-site environmental effects. Overall, the implementation of source control mechanisms for avoiding future adverse environmental effects from future developments and associated roofing materials would therefore seem to fit better with Regional Council regulations promulgated under the RMA. The use of the regional plan framework would ensure a consistent approach region wide whereas relying on district plan provisions could result in disparate approaches in terms of both timing and actual controls.

Initially it would appear the most direct means of requiring source control of new roofs may be through land-use consents in a Regional Plan. At this stage source control is to be implemented through discharge consents to allow implementation largely through the existing policy framework. Should these prove ineffective, these mechanisms will be investigated further to confirm the most appropriate method for wider application of source control.

3.5 SOURCE CONTROL OF EXISTING ROOFS

Existing use rights are a key factor in considering how best to implement source control of existing roofs. In particular, existing use rights with respect to land-use do not expire under section 20 of the RMA (provided there is no change to the scale and intensity of the land use activities over time) and therefore there appears to be little scope to require replacement of the roof materials on existing buildings directly by way of regional or district plan provisions and associated land-use consents. Source control of existing roofs will therefore be a long process.

As noted above, discharge consents only control discharges at the "end of the pipe": where other parties connect to those networks the consent cannot directly require them to treat storm water or manage contaminants; this can only be achieved by the network operator implementing such methods contractually as part of connection agreements. Given applications for existing stormwater networks are currently being processed by the ARC, there is an opportunity now for ARC and territorial authorities to consider the most appropriate mechanism to either treat contaminants or implement source control of contaminants for existing roofs. It is recognized that it may be difficult to implement controls and ensure compliance on parties connecting to networks.

Another factor is the length of time required for implementation. Roofs may remain in place for many years and, with maintenance, their life span may be extended significantly. Any source control policy relying upon the replacement of obsolete roofs will therefore take many years to effect change and with the lack of a direct regulatory mechanism applicable to existing roofs, voluntary source control and education will be important. The ARC policy proposes to consider this further during the development of Integrated Catchment Management Plans.

3.6 COSTS

Cost will be a key factor for implementing source control. Costs may include:

- Physical cost of construction;
- Process costs for developers and site owners;
- Process costs for regulatory bodies to develop policy and implement resource consents;
- Opportunity costs where the new product cost is greater than the previous product.

Where the roofing material has reached the end of its economic life and the replacement material is only marginally more expensive, the process and implementation costs will be minimised. The best situation of all may be if the proposed replacement product is also now the most economic.

Network operators may be faced with stormwater quality treatment costs to secure stormwater discharge consents. It may therefore be appropriate for them to consider cost contributions to private source control implementation if these prove to be cheaper than catchment wide treatment methods. Conversely, if the contaminants of concern are linked to particular sources, under a general "polluter pays" principle, the generators of those contaminants should be, at least partially, responsible for managing the effects of those contaminants.

A further consideration for manufacturers is loss of profit, and the time available to make a transition to any new product. In the case of roofing, alternative products are available and the relatively long life of roofs means that any transitions will be gradual. Source control of galvanized iron or unpainted products will affect manufacturers differently; those relying on pre-painted products will be less affected or may have enhanced sales compared to those whose business relies on the product being replaced.

4 THE AUCKLAND EXPERIENCE TO DATE

4.1 PROCESS

The ARC process to implement source control has focused on ARC storm water discharge consents. This is a limited implementation of source control: it only achieves contaminant reduction on those properties that require

ARC resource consents. Thousands of other roofs exist across the region and will require other methods to be implemented to effect change. The policy recognizes this and proposes that Integrated Catchment Management Plans have a role in implementing source control in a wider context than ARC stormwater consents.

The process to implement source control for ARC consents has been to:

- consider the results of the Roof Runoff study with-in ARC;
- discuss the results of the study with TA representatives through the Stormwater Liaison Group and with New Zealand Metal Roof Manufacturers Incorporated (NZMRMI) representatives;
- formulate a draft policy and circulate this for comment to the Stormwater Liaison Group and the NZMRMI;
- review the results of the further study carried out by the NZMRMI;
- Ongoing discussions between ARC / NZMRMI and New Zealand Steel over the contaminant levels in runoff from unpainted zinc-aluminium coated products.

The key components of the draft policy are:

- Treatment of runoff or water re-use from unpainted galvanized iron, unpainted zinc-aluminium steel and copper roofing on industrial and commercial properties through ARC resource consents;
- Use of short swales and vegetative /organic filtration to treat runoff from unpainted galvanized iron, unpainted zinc-aluminium and copper roofing on residential properties;
- Use of painting, water re-use or roof replacement to reduce contaminants from existing roofs at source;
- Promoting source control of existing roofs through Integrated Catchment Management Plans, education and ARC resource consents;
- Considering the need to control mass loads of contaminants from air discharges for specific industries.

At the current time, the policy is still in draft form and has not been fully implemented. In parallel with the policy development however, there has been ongoing pressure from developers to not provide storm water quality treatment for roofs. ARC has maintained that while the policy was in draft form, treatment continues to be required for unpainted metal roofing, while accepting that the roof types with low contaminant generation do not require treatment. Often the result of this has been for the developer to elect to use roofing materials with no unpainted metal surfaces. Once the policy is finalized, changes to the Regional Plan are required to integrate the policies into the plan.

4.2 INDUSTRY INVOLVEMENT

Prior to the completion of the study, there was some early individual interpretations of the results of the study and attempts at moving away from metal based products by individual TAs. These were not completely in line with the subsequent draft policy from ARC. These ad hoc attempts at source control were quickly identified and challenged by metal roof manufacturers.

In mid to late 2003, contact was established with NZMRMI representatives and meetings were held with ARC to explain the progress of, and results from, the study. The NZMRMI discussed the study with their members and decided to carry out their own study (Tonkin & Taylor, 2004) to check the results of the ARC study. The NZMRMI study was designed in conjunction with ARC representatives/ consultants and their own consultants.

The NZMRMI study involved a similar set-up to the ARC study for measuring the contaminants generated by various roof materials by testing products in a rural area to avoid effects of land-use. Materials studied were:

- Unpainted corrugated galvanised steel;
- Unpainted corrugated zinc-aluminium (Zn-Al) alloy coated steel;
- Pre-painted corrugated Zn-Al coated steel;
- Pre-painted Zn-Al coated steel tiles;
- Post-painted Zn-Al coated steel tiles;
- Chip covered Zn-Al steel tiles.

- Old corrugated galvanised steel – painted;
- Old corrugated galavanised steel – unpainted;
- Old corrugated Zn-Al coated steel – painted;
- Old corrugated An-Al coated steel – unpainted.

The roofs were studied for a longer period of time than the ARC study and over 20 rainfall events were monitored. The results have verified many of the roof material type results from the original ARC study. In particular, they have confirmed the low level of contaminants generated from the pre-painted roofing products and the high level of zinc from unpainted galvanized iron roofing.

One area of disagreement is the level of contaminants generated by un-painted zinc-aluminium coated steel roofing. The NZMRMI study shows these give an average 110 to 140 ppb zinc, while the ARC study has a greater range of zinc generated and a media of about 432ppb. Ongoing debate is centered around whether run-off from unpainted zinc-aluminium coated steel should require treatment.

The key question from the industry appears to be "what level of contaminants in the run-off is acceptable"? The ARC perspective, reflects a Best Practicable Option approach, with an answer of "minimise the level of contaminants as much as possible". In resolving this question, the following points need to be considered:

- The average or median level of zinc in stormwater runoff varies. Williamson, (1993) identifies an average EMC value of 260ppb. Seyb (2003) identified an average of mean EMC's from New Zealand studies of 220 ppb.
- Given that zinc concentrations are largely dissolved at the time of runoff from the roof surface, there is potential for a roof runoff treatment procedure to be developed with the runoff contacting organic material (such as topsoil). The process may be relatively quick and devices may be smaller than standard TP10 75% TSS removal based devices.
- The use of unpainted zinc-aluminium steel is a relatively small scale activity for new residential buildings. Pre-painted steel products or concrete tiles are used in virtually all new residential developments and no regulation to implement source control is really required for these applications given the relatively small use of other products.
- Zinc aluminium roofing is used to a greater extent in industrial and commercial developments.
- Receiving environments with high or rapidly increasing zinc concentrations in estuarine sediment may require a different approach to areas which discharge to ground or to an open coastal environment.

Discussions to resolve this issue with industry representatives are ongoing.

4.3 RESULTS

The process of completing the studies, policy development and consultation has taken some time to this point and has not been completed to date.

Gathering information on the contaminants associated with roofing has been an effective basis for developing policy on source control. In particular, it has been useful to have the results of two studies in developing the policy.

Discussions with industry stakeholders have been useful. Areas of agreement have included the confirmation of contaminant loads from galvanised roofs and pre-painted steel roofs. Stakeholders have been open with information and this has assisted the policy development by focusing on technical issues.

The results of the studies for zinc-aluminium coated steel are somewhat different and discussion is ongoing as to the levels of contaminants from, and whether treatment is required for, unpainted zinc-aluminium coated steel.

Policy development to date has focused on implementation through ARC resource consents. Further work is required to implement source control of existing roofs and this will be undertaken through the development of Integrated Catchment Management Plans and network consent processes.

ARC has also recognized the potential ongoing importance of source control initiatives in the recently adopted Stormwater Action Plan. The plan includes the establishment of an ARC "Source Control" officer within the Stormwater Action Plan team. Where treatment is not expected to be an effective method of contaminant reduction, source control options may be effective and they should be considered further in the future for other contaminants of concern.

5 CONCLUSIONS

Environmental monitoring has identified zinc as a key contaminant of concern in Auckland. Traditional stormwater treatment can only remove a proportion of zinc. Recent work is indicating that roofs are a primary source of zinc and that source control could achieve significant reduction of zinc in stormwater runoff.

ARC has developed a draft policy for source control based on ARC resource consents. If wider application of source control is required, regional land use consents will be investigated further for managing source control of new roofs.

Integrated Catchment Management Plans, stormwater network consents/ connection agreements and education will be investigated for implementing source control on existing roofs.

Industry representatives agree that high zinc loads come from galvanized iron but dispute loads from unpainted zinc-aluminum steel roofing. The policy is not yet finalized.

Source control options are likely to be considered further for other contaminants in the future.

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