WATER

Issue 169. May 2011

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The New Zealand Water & Wastes Association Wairoa Aotearoa

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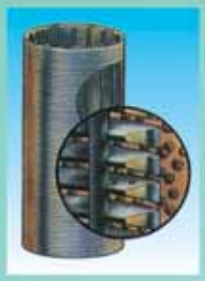

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ISSN 1177–1313

The next issue of *WATER* will be published in July 2011.

On the Cover

Water New Zealand News

Features and Articles

Cover photo: istock.com

The official journal of *Water New Zealand* – New Zealand's only water environment periodical. Established in 1958, *Water New Zealand* is a non-profit organisation.

Depth of Technical Expertise within *Water New Zealand*

Clive Rundle

> "Almost without exception they are the best body of expertise available in New Zealand in their areas of activity. The *Water New Zealand* Board is very keen to support the SIGs, recognising the important contributions they can make to the advancement of knowledge and best practice and the wider benefit this brings to our membership."

One of the strengths of *Water New Zealand* is the great depth of technical expertise within our membership. The opportunity is there for us to gain greater leverage from our collective skills and experience by collaborating to address common problems and pursue good ideas that promise benefits for us all.

It is not hard to see that many of you face similar challenges every day, but in isolation lack the resources to resolve them. Can we do more to harness our collective skills and resources for the wider benefit of *Water New Zealand* members?

We already have structures in place to advance our body of knowledge. The Water Services Managers Group has a fund at its disposal which it can allocate to worthwhile projects. Current projects include:

- Review and update of the current water treatment chemical guidelines
- Participating in WSAA's Advanced Metering Project
- Contributing to numerous Standards New Zealand working groups including addressing fire sprinklers, fire hydrants, land development & subdivision engineering, backflow and construction specifications

This Group is also keen to progress a review of the current biosolids guidelines and to establish an oversight group to help steer the review of water treatment chemicals.

For those who participate in this Group, I encourage you to build on this momentum by actively seeking ideas from your staff (and suppliers) to identify opportunities to advance our collective knowledge.

Similarly, our Special Interest Groups (SIGs) provide a forum for members with similar technical expertise to come together. Almost without exception they are the best body of expertise available in New Zealand in their areas of activity. The *Water New Zealand* Board is very keen to support the SIGs, recognising the important contributions they can make to the advancement of knowledge and best practice and the wider benefit this brings to our membership.

Each year we seek work plans from the SIGs identifying funding they need for worthwhile projects so these can be included in the Annual Business Plan. My impression is that the organisation's willingness and capacity to make such funding available is not well understood and we are looking at ways to improve this.

I suggest to you that our potential from technical collaboration remains largely untapped. Let us capitalise on the enthusiasm and skills in our technical groups and the resources at the disposal of *Water New Zealand* and our larger corporate members to broaden the benefits to us all. ■

Clive Rundle
President, Water New Zealand

new members

Water New Zealand welcomes the following new members:

MARCUS CAMERON
KERRY CONNORS
STEVE APELDOORN
LOUIS DU PREEZ
RICHARD IRWIN
GARETH PATCHETT
JOHN SAXTON
PETER MCKEAN
ALISTER HOOD
ADAM SEARANCKE
PETER REID
TROY FIELD
PAUL FRIEDRICH
NICK WELLS
REYNANTE VARGAS
KARL TIMMINS
ANDREW MERCER
SHAYNE CUNIS
LAURA DAVIES
BRUCE NESBITT
STEPHEN BAILLIE
NEIL JORGENSEN

Membership

Join *Water New Zealand*
For a membership application form please contact:
Jan Lang
P: + 64 4 472 8925
E: jan.lang@waternz.org.nz

Member Details

Please advise us if you have changed contact details recently. An accurate database depends on the supply of timely and accurate information.

Please contact Jan Lang
P: + 64 4 472 8925
E: jan.lang@waternz.org.nz
To update details online visit the *Water New Zealand* website
www.waternz.org.nz

Communications

Murray Gibb

"The initial audit indicated that we had some way to go to achieve our organisational purpose of being the pre-eminent organisation in New Zealand for promoting and enabling sustainable management and development of the water environment. We were consistently ranked second or third in response to questions round influence in the water space."

Effective communication has always been vital to success, be it in the commercial, not for profit, regulatory or political arenas. With the passage of time the tools and methods for transfer of information and ideas have changed. Possession of specific information can carry with it power, and it is interesting to reflect on the rebalancing of power as methods of communication have changed over time.

In medieval time literacy was by and large confined to the clergy and political oligarchs. The individuals within the associated entities had far more influence than the masses, and the church and state prevailed.

With the Enlightenment and the period leading up to the Industrial Revolution came the printing press, cheaper paper, periodicals, a small but growing middle class, and more widespread literacy. This facilitated more commerce, which in turn created more wealth, and allowed more people to become literate. Printed material became more important for communication.

Compulsory education, the telegraph and telephony arrived in the 19th century. Not surprisingly these social and technical initiatives led to an extraordinary level of rebalancing of power between church, state and the masses.

Radio, television, cell phones, facsimile machines and the internet followed in the last century. Not forecast until as recently as the early 1980s, the world wide web has revolutionised the way we do business today and further adjusted the balance of power – witness the growing influence of well connected and informed bloggers.

Two years ago *Water New Zealand*'s Board ratified a communications strategy. It had several elements:

- An audit of key influencers to gauge the level of awareness and influence of the organisation
- An ongoing programme of media engagement
- The use of fora and speaking engagements to promote our organisational objectives
- Rebranding the organisation as *Water New Zealand*

How is it working? The initial audit indicated that we had some way to go to achieve our organisational purpose of being the *pre-eminent organisation in New Zealand for promoting and enabling sustainable management and development of the water environment*. We were consistently ranked second or third in response to questions around influence in the water space.

For benchmarking purposes this exercise was recently repeated, albeit on a more limited scale. The questions used in the previous audit were put to respondents again. While not top of mind in response to all questions our ranking has improved. There is still work to do.

Pleasingly there is a high level of recognition of the new name. The rebranding exercise has worked.

A revised strategy has been endorsed by the Board. It has been built on the existing plan. Members will notice some changes. There will be more activity in the news media. The website will be divided into public and/or members' zones. Our electronic publications will be refreshed.

Finally a word on member engagement.

There are two strands to this. Firstly, from the survey conducted last year there was a fairly clear message from members that they wanted more opportunities for networking. Accordingly this year we are stepping up the frequency of regional meetings.

Secondly, we place weight on member involvement in the development of our formal policy positions. Late last year the Board reviewed and reaffirmed its process for development and formal adoption of policies.

Once developed, and depending upon the degree of generic interest and sensitivity, a draft policy statement may go through a greater or lesser degree of consultation. At the minimum members are notified in *Pipeline* and draft policies are posted on the website for six weeks.

The internet provides a cost effective and efficient way for communication with all members. If members don't agree with draft policy, but don't respond, we are in no position to take their views into account.

As much as possible we try to develop policies that fairly reflect the views of members. The Board is diligent in this regard. Communication is after all intended to be a two way process. ■

Murray Gibb
Chief Executive, Water New Zealand

NEXT ISSUE OF *WATER*

The next issue of *WATER* will be in mailboxes mid-July.

The topics for the July issue will be **URBAN METERING, MODELLING, GOVERNANCE AND TRAINING & RECRUITMENT.**

If you wish to contribute an article or photos please contact the editor, Simone Olsen, on +64 4 473 8047 or email simone@avenues.co.nz

To advertise in the next issue of *WATER* contact Noeline Strange, P: +64 9 528 8009, M: +64 27 207 6511 E: n.strange@xtra.co.nz

Water New Zealand's Annual Conference & Expo 2011

Conference Themes and Format

The 2011 Conference will have a core theme of ***'Advancing Water Reform'***.

The Conference will have three primary streams plus full Modelling and Operations streams. Also included are IWA Science and Small Water and Natural Systems one day streams.

The Format for the 2011 Conference differs from previous years. The sessions will be held on Wednesday 9 November and Thursday 10 November, followed by the Awards Dinner on Thursday evening.

The *Water New Zealand* AGM will be held at 9am on Friday 11 November followed by an Open Forum. Friday morning will also be an opportunity for Exhibitors to hold appointments with delegates. The Conference will close at midday on the Friday.

Registrations

Registrations will open via www.waternz.org.nz on Friday 22 July. An email and mailout flyer will be sent to *Water New Zealand* members prior to opening.

Poster Presentations – Submit Summaries Now

Poster presentations are always a popular component of the Conference. Poster summaries are due Wednesday 7 September. Please visit www.waternz.org.nz for more information and to submit your poster summary online.

Awards 2011

- CH2M Beca Young Water Professional of the Year Award
- Watercare Services Limited Trainee of the Year Award
- Orica Chemnet Operations Award
- Ronald Hicks Memorial Award
- Hynds Paper of the Year: Gold, Silver, Bronze
- AWT Poster Awards: Best Poster & 2 x Highly Commended
- Water New Zealand Board: Certificate of Service
- Technical Committee Certificates
- Exhibition Awards: Best Expo Stand and 2 x Highly Commended

Exhibition Sites

We have a record number of sites this year. The Annual Conference Exhibition continues to be the largest trade exhibition for the sector.

Key Dates for Your Diary

22 July	**Registrations open**
21 September	**Earlybird registrations close**

Key Diary Dates for Presenters

20 July	**Authors advised of selection**
7 September	**Poster summaries due**
19 October	**Powerpoint presentations due**

The Stormwater Conference Report will be included in the July issue of *WATER*.

Premier Sponsors

Water New Zealand wish to thank the family of Premier Sponsors who have recommitted their support to the *Water New Zealand* Annual Conference & Expo 2011.

Awards Once Again Honour Outstanding Contributions

Nominations for this year's Green Ribbon Awards are in with the winners to be announced on 9 June 2011. The Awards honour the outstanding contributions New Zealanders make in caring for the environment.

"It takes initiative and dedication to tackle environmental issues and I welcome the opportunity at the 21st Green Ribbon Awards to honour the people and organisations that are committed to protecting and improving New Zealand's environment," Environment Minister Hon Dr Nick Smith said.

"The Green Ribbon Awards are categorised into six areas of environmental endeavour and six different types of groups to recognise the different ways people contribute to the environment. There is also a supreme winner to recognise the best overall nomination."

The six categories of endeavour are:

- Protecting our coasts and oceans
- Caring for our water
- Reducing our greenhouse gas emissions
- Minimising our waste
- Protecting our biodiversity
- Improving our air quality

The six categories of groups are:

- Small businesses making a difference
- Environment in the media
- Community action for the environment: volunteers and not-for-profit organisations
- Community action for the environment: Young people
- Environmentally responsible large organisations
- Central and local government stepping up

Nominations are open to all individuals, businesses, community organisations, media and public sector organisations that demonstrate visible results from their commitment to the environment. ■

Water New Zealand Staff News

Amy Aldrich joined Water New Zealand in April as Special Interest Group Coordinator having worked previously at Darroch. Amy will use her strong administration background to provide support to the Backflow, Stormwater and Modelling SIGs. Amy replaces Hannah Dawson in this role.

Oxfam Water Challenge 2011

Oxfam New Zealand

Thank you to everyone who took part in and supported the Oxfam Water Challenges recently held in Auckland, Wellington and the Bay of Plenty. You can still support the teams at www.oxfam.org.nz

The relay style race celebrates World Water Day and has doubled in size again this year. Fifty teams of four enjoyed the challenge, which involved carrying 20L of water around a relay course. Why 20 litres? Because it is common for women and children in developing countries to carry up to 20L of precious water long distances each day, for their family's basic needs.

We had three exciting events!

Auckland, Narrow Neck Beach Takapuna

Auckland was a great success with our largest attendance ever. Teams enjoyed warm weather, a fun race and great hospitality.

Wellington, Oriental Bay

The inaugural Wellington event started at Oriental Bay and included some new challenges involving skipping and cargo nets! Teams dressed up for a fun day and enjoyed a lively after-event function.

Bay of Plenty, Mount Maunganui

The Bay of Plenty sun came out on Sunday afternoon as teams raced at the foot of Mount Maunganui. Spot prizes, new challenges and delicious food ensured that the event was enjoyed by all. Congratulations to the winners and all who participated on the day.

See the winning teams, hear what happened and look for yourself in a photo at www.oxfam.org.nz ■

It was with sadness that we had to cancel the Christchurch event, and we wish everyone in Canterbury a speedy recovery from the devastating earthquake. All being well, the inaugural Canterbury Oxfam Water Challenge will be held in March 2012.

Thank you

A big thank you to our wonderful sponsors – Beca, Opus and Conneq – for all your support. Also, the University of Auckland Business School Short Courses for donating over $36,000 of prizes. These were very gratefully received by the winning teams of the fundraising prize at each event.

Thank you also to Beca for managing the event logistics, providing so many Beca volunteers and donating the lovely glass trophies for the winning teams on the day. We are also very grateful to our prize donors, caterers, suppliers, councils, supporters and participants!

We are thrilled to announce that over $70,000 was raised towards Oxfam Water for Survival projects, which provide life-saving clean water, hygiene education and sanitation to people in the Pacific and South East Asia. Your contribution has helped people in developing countries, towards their first steps out of poverty.

Images taken during each of the Oxfam Water Challenges held recently in Auckland, Wellington and the Bay of Plenty to celebrate World Water Day

Focus on Industry Training Benefits United Water

Water Industry Training

Upskilling staff through industry training adds value to organisations in the water industry as well as to trainees' career prospects, according to United Water General Manager New Zealand, Ian Cathcart.

"Training keeps staff challenged, rewarded and evolving on their career pathway," he says. "We have contractual obligations with our district council clients to train our staff – you've got to make sure everyone is up to speed on compliance under health and safety legislation."

United Water currently has 38 staff members completing qualifications through Water Industry Training. The organisation provides water and wastewater services in seven regions in New Zealand, from Papakura in the North Island, through to Queenstown in the south. Finding skills gaps and eliminating them through training is all part of its strategy for new staff members.

"We do a training assessment when staff first come in and assess them to find out what they need to do the job," Ian says.

Water Industry Training manager, Ashley Chisholm, says that the way United Water has integrated staff training into their business sets a standard for the water industry.

"United Water sees the benefit of investing in its staff through training and helping them to obtain recognition for their skills and competencies through industry recognised National Certificates and Diplomas," he says.

"Training is a tool that assists United Water to maintain a high standard of work, helps with succession planning and maintains staff morale and motivation," Ashley continues. "Organisations like United Water can use training as a value-add when quoting for new work – they can show that a commitment to training and skills development is part of their corporate culture."

United Water's advocacy of industry training resonates with employees. Jeremy Harris, leak detection technician for United Water in Queenstown, says that seizing the opportunity to upskill himself was easy.

"I started in the water industry in the UK," he explains. "My work experience in the UK wasn't recognised over here, so it was great when United Water was happy to help me get qualifications that are recognised.

"It's really good training, too," he says of the National Certificate in Water Reticulation (Service Person) (Level 3) he completed. "It's a great course to complement what we do out in the field. You get an understanding of a network, what can go wrong with it and how to fix it."

Jeremy adds that United Water has encouraged him to train. "They're more than happy to have you do the training you request if it's beneficial to them – and it is beneficial because they're building up a great foundation of trained employees."

Wastewater plant operator for United Water in Taumarunui, Deon Graham, also perceives the benefits training adds to his career. He is currently in the final stages of completing his National Qualification in Wastewater Treatment, Level 4, through Water Industry Training.

"I learned the processes around treating waste and the processes of pump stations – things that I need to know to do my job," Deon

says. "United Water has been really good at sending us away on courses to learn things we wanted to know for our field – it benefits us and it encourages you to stick around if you're getting training."

For Deon, it's not just the daily running of the plant that qualifications assist with. "There are opportunities for advancement if you want to move up – you've got to have qualifications these days, it's a must. The Council looks at the qualifications you have when you're running the plant so it's really important to get them. I'd definitely recommend training to others in my situation – there are plenty of opportunities within United Water."

Nigel Hesford, Water Industry Training Adviser, agrees. "United Water is proactive around training its staff. They're always willing to put people through the training courses and it's benefiting the company by having trained staff around.

Ian Cathcart also believes upskilling his employees increases their confidence and self esteem.

"From a risk perspective it reduces both our risk and the client's risk by having trained individuals who are able to carry out their tasks competently and meet their obligations to public health," he says.

"Even in the recession, we haven't dropped our focus on training – I have great people working for me and I want to make sure they enjoy where they work and that they're fully empowered every day they come to work," Ian says. ■

For more information about Water Industry Training's qualifications or to enrol, please contact your local training adviser on 0800 WATERIT (0800 928 374) today or visit www.waterit.ac.nz

Ian Cathcart – United Water

Jeremy Harris – United Water

Deon Graham – United Water

"Training keeps staff challenged, rewarded and evolving on their career pathway," he says. "We have contractual obligations with our district council clients to train our staff – you've got to make sure everyone is up to speed on compliance under health and safety legislation."

The Management of Freshwater Resources in New Zealand is at a Crisis Point

Russel Norman – MP and Green Party Co-Leader and Spokesperson on Water Issues

Close to half of our monitored rivers are unsafe for swimming, almost one-third of our lakes are eutrophic or worse, and two-thirds of our native freshwater fish are threatened or at risk.

The first-level causes of this crisis are pollution flows into freshwater bodies from agriculture, horticulture, and sewerage, combined with an increased uptake of water for irrigation, industry, and urban use. But standing behind each and every one of these first-level causes is a failed governance system.

The Resource Management Act is too weak to deal with the cumulative effects of growing and multiplying sources of pollution and water takes. This is, in part, because it lacks a precautionary principle – something that would allow regional councils to err on the side of environmental caution when they are considering the effects of resource consent applications.

Although there was a large clean-up of point-source discharges in the 1990s, our rivers are still declining. Every report on water quality in New Zealand has pointed to the role of land use intensification, particularly pastoral farming, in driving this decline.

Between 1989 and 2007, cow numbers in New Zealand increased from 2.3 million to over 4 million while 458,000 hectares of land were converted to dairying. At the same time, data from the National Rivers Water Quality Network shows that nitrogen increased 1.4% per annum in rivers across the country. Trends for phosphorous were mostly upwards too.

These figures demonstrate that our failure to manage freshwater in this country is in some respects a result of our failure to understand the New Zealand economy. In a finite world, the relative price of primary commodities inevitably increases. This means that those that have an advantage in finite resources have a global economic advantage. Our advantage in relatively untouched natural environments has fuelled tourism while our advantage in freshwater has fuelled our dairy industry. By causing water quality problems, the growth in dairying now threatens the long term profitability of both industries by undermining our New Zealand brand.

As a small producer at the edge of the world, we need an export brand to sell our products overseas. That brand is clean green New Zealand, 100% Pure. The brand is already worth $18 billion to New Zealand, and can be worth much more in the future. The smart way to protect our economic advantage is to protect that brand, not undermine it with poor water quality. However, successive governments have tried to have their cake and eat it too, 'balancing' GDP growth and environmental degradation: This year a bit more dairy intensification balanced by a few more polluted rivers and the same again next year.

This idea of balance, or environmental destruction traded for GDP growth, is an economic and environmental dead end.

We need to recognise that our environment is our economy: no water, no milk; no environment, no economy.

We cannot grow our dairy industry indefinitely. There are limits on access to water and how much pollution our rivers and lakes can handle. Although some claim we can grow the industry and reduce its environmental impact at the same time, it is a dubious proposition given that scientists have pointed to the role of intensification in driving environmental decline.

"These figures demonstrate that our failure to manage freshwater in this country is in some respects a result of our failure to understand the New Zealand economy. In a finite world, the relative price of primary commodities inevitably increases. This means that those that have an advantage in finite resources have a global economic advantage. Our advantage in relatively untouched natural environments has fuelled tourism while our advantage in freshwater has fuelled our dairy industry. By causing water quality problems, the growth in dairying now threatens the long term profitability of both industries by undermining our New Zealand brand."

Even Dairy NZ admits, "The primary means for increasing dairy production, is either by intensification or conversion of other land uses, both increase the environmental footprint for dairy farming. This is a fundamental dilemma for the industry."

Voluntary measures to clean up our waterways aren't working. The Dairying Clean Streams Snapshot of Progress 2009/10 showed that levels of significant non-compliance by the dairy industry have increased over the last three years to 16%. This is unacceptable and shows that the industry is incapable of regulating itself. Recently, the CEO of Environment Bay of Plenty said that regulation is the way forward. In dealing with pollution, voluntary measures are not enough.

Even if all farmers abided by their consents, we would still have a pollution problem. You need a consent for the dairy shed effluent,

Russel Norman paddling on the Wairoa River near Clevedon as part of his Dirty (and Threatened) Rivers Rafting Tour

but that is only 10% of the nitrogen flowing through a dairy farm. The other 90% leaches through the field and there is no consent required for that. So until councils control what happens in the field as well as in the shed, by requiring a consent for intensive agriculture, they have no control over the vast majority of the pollution.

For example, the Waituna Lagoon in Southland – one of the first wetlands of international significance recognised under the RAMSAR Convention, an intergovernmental treaty for the conservation and wise use of wetlands – is threatened by high levels of nitrogen and phosphorous, largely attributed to intensive dairy farming. This pollution threatens to flip the lagoon from its current condition of clear water with diverse fish and plant life, to an unhealthy eco-system dominated by algae.

The Chair of Environment Southland, Ali Timms, said in March, "Even if there is 100% compliance with every condition on every consented activity and 100% adoption of best management practices by everyone in the Waituna catchment, the science is telling us that these [measures] on their own will not be enough to prevent the lagoon from flipping."

This environmental disaster in waiting demonstrates the need for regulation with teeth, such as the National Policy Statement on Freshwater Management (NPS) as recommended by the Board of Inquiry. The NPS uses Section 55 of the RMA to immediately introduce provisions into regional plans, making agricultural intensification and new water takes a discretionary activity, requiring a resource consent in catchments where there is contamination and over-allocation.

Unfortunately, Environment Minister Nick Smith has instructed officials from the Ministry of Agriculture and Forestry and the Ministry for the Environment to work on a revised National Policy Statement, due to having been advised by officials and stakeholders that the version recommended by the board of inquiry is ultra vires – that is, that it goes beyond what a National Policy Statement can do under the Resource Management Act.

It is doubtful that the NPS is ultra vires given that Judge Sheppard, who chaired the Board of Inquiry, has extensive judicial experience as Principal Planning Judge and Principal Environment Judge, and hasn't had a single verdict overturned in 20 years. Nick Smith has refused to release the source or content of the advice, so the public does not even know which part of the NPS the Government considers to be ultra vires. For the sake of our environment and our economy, let us hope this lack of transparency isn't hiding an agenda to weaken the NPS. We desperately need an NPS quickly, and one with teeth.

We also need the proposed National Environmental Standard on Ecological Flows and Water Levels (NES) to ensure that there is enough water left for our fish and birds. The Green Party acknowledge the necessity of renewable energy, but we must not dam our last

"We can also protect our environment and economy by providing an economic framework that rewards those who play nicely with nature."

wild rivers or destroy the habitat of our threatened native freshwater species. The proposed NES would be a great step towards ensuring that our energy needs are not met at the expense of our freshwater ecosystems.

A study conducted on behalf of the energy companies shows that if the NES default limits were applied in a blunt method across all rivers, it would be expected to cut average hydro generation by around 17%. This shows that already, 17% of our electricity generation is unsustainable. We cannot continue to grant consents for hydro projects that reduce flows to damaging levels. The most recent assessment of the state of New Zealand native freshwater fish found that two-thirds of all species are threatened or at risk, and that habitat loss is one of the key drivers. We must protect our freshwater habitats, and implementing the NES default limits would be a start.

We can also protect our environment and economy by providing an economic framework that rewards those who play nicely with nature. We need to reward smart farmers and innovative businesses. By putting a resource rental or price on commercial water-takes, we can make it financially worthwhile to protect our rivers. The price will drive efficiency, and the revenue generated can be used to create a fund for remediation or to replace other taxes.

Water is a tremendous economic advantage for New Zealand, but it is much more important than that.

Our rivers and streams and lakes are some of the last of the wild places left on the plains and lowlands. After virtually all the lowland forests have been felled and burned, and their stumps dynamited and destroyed, there is precious little that is wild left down on the plains. And it is the plains where most of us live, while the conservation estate is mostly in the high country. The rivers are the last remaining wild places and as such are specially deserving of protection.

If our rivers are drained, if they become polluted and dead, they are no longer wild places. When the whitebait are all gone, when there are no trout to chase, when the river smells foul, where does a person go to escape the urban noise and the rural monoculture? And where do our river ecosystems survive when sediment fills the gaps between the rocks in the river bed, the gaps in which our threatened freshwater fish live? And what happens to the wrybill when the high flows are taken away and the braids slowly disappear?

Rivers are about much more than money; they are about who we are.

We are losing something fundamental to who we are as a people when we no longer have access to the last of the wild places. When rivers are too polluted for people to use they are no longer wild and they are no longer held in common – they are privatised drains.

My dream is that one day our rivers will be once more full of birds and fish, and safe for our kids to swim in. But I also hope that we won't just focus on restoring our rivers but that the fencing and wide riparian margins will be the start of returning corridors of native forest to our lowlands, to give to our children that which has been taken from us – the pleasure of wandering through an extensive mixed podocarp broadleaf lowland forest full of birds and insects. ■

Fit for Purpose, Fit for Future – Margaret Devlin

Simone Olsen – Editor, WATER

An ethos of continuous improvement and a focus on customers is the tenet that has run through Margaret Devlin's career – long before she entered the water industry.

With a background in retail, it was the chance sighting in 1990 of a situations vacant ad for the role of Customer Services Manager at a water company in the UK and her then successful application that led to Margaret making the shift from retail to the water sector.

Margaret is a co-opted member of the Board of *Water New Zealand* and Chairman of infrastructure investment company EPIC.

"Irrespective of speciality or location, the characteristic that members of the water sector share, in my opinion, is the genuine dedication and pride they have in the work they do. It's a cliché but in my experience it's absolutely true, people understand they contribute to an essential service, which gives them a sense of satisfaction and rightly so," Margaret says.

It is fair to say that this characteristic has been a contributing factor to Margaret remaining in the sector. When Margaret took on the aforementioned role, the water sector in the UK was just beginning a new regime of private management. A new regulatory environment was being introduced. She remained with the company for 15 years, moving up the ranks to Managing Director, and during that time merged four separate water companies into one entity.

While Margaret gained a lot of experience in dealing with change, she is reluctant to call herself an expert on the topic.

"I prefer to talk about a focus on continuous improvement rather than change, it's important to look at how we could do things better, always examining the ways we operate and ask ourselves if it's working."

Margaret is quick to make the point that she isn't advocating change for change sake, that the maxim 'if it ain't broke, don't fix it' remains true but the questions must be asked – "is it broken?", "is this still the best way?"

"Sometimes after reviewing it the way we've always done, it remains the best way, sometimes it's not, and importantly 'because we've always done it this way' is not a good enough reason on its own to carry on."

"With new technology emerging constantly it's important we don't lose sight of what works for the sake of appearing as though we're keeping up with technology if it doesn't offer the same service or result as the 'old' way. The crucial element is the questions we ask, the review of things and the drive to improve."

From her background in retail and her approach to the water sector, at the heart of which is the fact that it is a public need, Margaret has maintained her focus on the customer.

"Continuous improvement and customer focus go hand in hand." Margaret describes it as ensuring the sector is fit for purpose and fit for the future. In a sector that has traditionally been engineering focussed, her customer service background has been essential in helping shape organisations to be more customer focussed.

In Margaret's experience, coming from a different area of expertise hasn't been an issue, in fact it has been an asset.

"I didn't apologise for a lack of technical expertise and was always upfront about where my expertise lay. The technical experts have, appropriately, a different role and my role was about applying my expertise where it was best utilised."

"The advantage of this was my ability to be a generalist, looking at all facets of the organisation and applying what I know of business, customers and striving for efficiency."

"I left the technical experts to do their job and I focussed on what I could contribute to improving the way our business worked. The mutual respect for these two specialities meant this wasn't an issue."

Margaret's advice is that creating a culture and environment of continual improvement in the business will result in people thinking of ideas and suggesting them.

"It's also important to remember that people at the top of the organisation are not exclusive owners of all the good ideas. In fact it's the people that deal directly with specific areas that can suggest improvements – their perspective enables them to see what works and what could work better."

Having spent considerable time in the water sector in both the UK and New Zealand it would be tempting to make comparisons but Margaret cautions that there is a danger in comparing apples with oranges and says it's about what is appropriate in your organisation, your sector and your country.

"One size does not fit all and we're kidding ourselves if we think it does."

This advice is particularly true when talking about regulation, according to Margaret.

"We often hear debate about regulation which seems to be polarising. People talk about good regulation versus bad regulation – I prefer to use the term 'appropriate regulation'."

"Let's be honest, any regulation, no matter how right it is, will likely encounter speed bumps and teething problems when implemented – this doesn't make it bad. New regulation should be reviewed and tweaked to ensure a good result and to take care of any unintended consequences."

"We often hear debate about regulation which seems to be polarising. People talk about good regulation versus bad regulation – I prefer to use the term 'appropriate regulation'."

"I often use the analogy of a Christmas tree when I talk to people about regulation. Do we add decorations each year, do we strip it back, or throw them all out, do we swap decorations, or do we stand back, take a look all around the tree and then decide what should be replaced and the best option to replace it?"

"We need to ask ourselves – what does it look like now, what could it look like and what do we need to do to make it look like that?"

"The questions need to be asked regularly so that as the situation changes around us we continue to evaluate what is or isn't working and make the appropriate improvements."

Regulation, and the public's view of it, has been a challenge in Margaret's work, but she is quick to point out that having a clear message with clear direction and leadership makes the communication of these ideas much more effective. Having clarity of purpose and vision is more important than the message itself.

The other challenge Margaret notes is the view the pubic have of water.

"Let's face it, people don't much care until it affects them directly in an adverse way. I'm sure many Cantabrians care very much about water and wastewater infrastructure following weeks and months without the usual services."

"However, without this experience it's easy for people to take for granted what continues to work well for them and what remains out of sight for most."

"It's difficult to build a business plan around something people don't care much about. The general view is that water is free, rain is free – it falls straight from the sky – and rain is plentiful so what's the issue and why should we pay?"

It's a simple message – that to have that water that falls freely from the sky stored, treated, in the right place at the right time, consistently and reliably to an appropriate quality – costs. It's a message that Margaret says needs to be told and told often.

"I believe we have an obligation to communicate and inform the general public. It's similar to the kind of discussion that has taken place around food miles, prompting people to think about where the food has come from before it lands on their plate. Similarly again to the energy conservation discussion – urging people to turn the lights off when they're not using a room – prompts people to think further than simply the moment they come into contact with these utilities."

Despite these challenges Margaret says this is an interesting juncture for the water sector – in its broadest sense.

"I don't believe that anyone in the debate is disputing the end goal of a sustainable world class water infrastructure which provides for all who need it and delivers on economic performance. Where we may differ is the roadmap to get there. But it's not all doom and gloom and there is much we all agree on."

"We all want long term results from our long term infrastructure. We need to build a sustainable resource out of that which is plentiful. We have the opportunity to grow our economy by answering these questions, we must simply ensure that the infrastructure, the policies, the entities and management are fit for purpose and fit for the future." ■

Background – Margaret Devlin

Margaret moved to New Zealand with her family in 2006. Although she hadn't lived here before she was well acquainted with New Zealand, having married here and with plenty of family living here, she had visited often.

Since being in New Zealand Margaret has had the following roles at various and sometimes over-lapping times:

- Chairman Director, EPIC Ltd
- Deputy Chairman Director, WEL Networks Limited. Chairman of Audit Committee
- Non-Executive Director, Metrowater. Chairman of Risk, Health and Safety Committee
- Non-Executive Director City Care
- Co-opted Director, *Water New Zealand*
- Chairman CF Reese Ltd
- Chairman of Scott Sheet Metal Manufacturing
- Director Moto International Holdings
- Director EPIC Bermuda
- Trustee Waikato Youth Empowerment Trust
- Accredited Member of the Institute of Directors in New Zealand Inc and Chairman of the Waikato Branch
- National Council Representative Institute of Directors in New Zealand Inc.
- Member of IoD Accreditation Board
- Director Midland Health Group

Margaret entered the water sector in 1990 following a career in retail. Since entering the sector in the UK she held the following roles:

- Managing Director South East Water Ltd
- Chairman Water UK
- Non-Executive Director Valuation Office
- Non-Executive Director Pipeway Ltd
- Non-Executive Director Water UK Information and Learning
- President Institute of Water Officers

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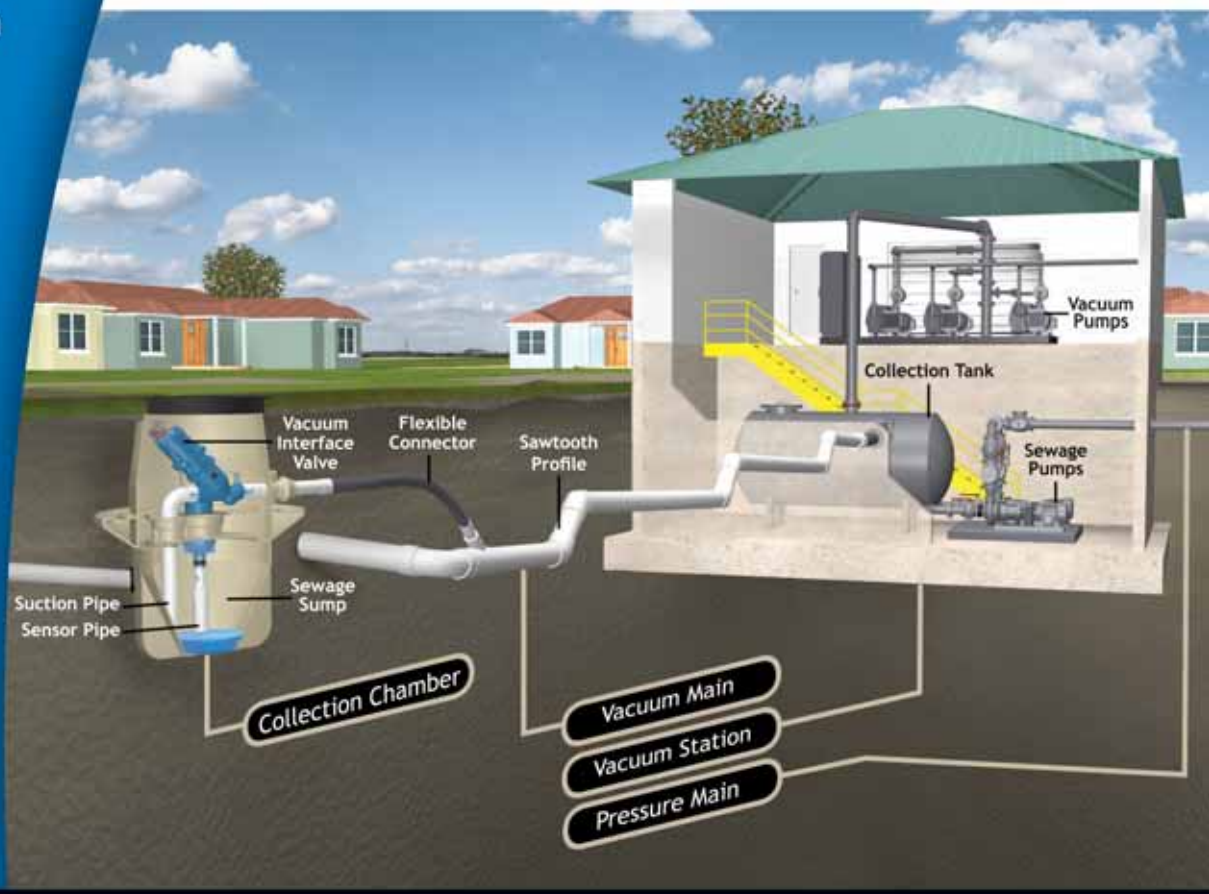

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Legal Round Up for April

By Helen Atkins – Partner & Vicki Morrison – Senior Associate, Atkins Holm Joseph Majurey

Introduction

This article provides comment on a number of current policy and legal matters which may be of interest to the water sector. This article commences with an overview of the final report of the Land and Water Forum and notes the initial government response to that report. This article then moves on to discuss the proposed changes to the Environmental Protection Authority, including its expanded scope and new standalone structure. A brief outline is then provided of some new legislative developments in Canterbury in the wake of the earthquake of 22 February. This article concludes by providing comment on a recent Court of Appeal case regarding prosecutions.

Land and Water Forum

We provided an overview of the first report of the Land and Water Forum in the February edition of *WATER*. In early April this year, the Government released the final report of the Land and Water Forum, which provides the framework for advancing water reform. This report outlines the engagement process that the Forum undertook after the release of its first report, summarises the responses the Forum received, identifies a number of areas of concern, and sets out the Forum's views on the sequencing and implementation of the Forum's recommendations.

In terms of the engagement process, the Forum held 18 meetings around the country and received a variety of different responses from the approximately 1,200 participants. In discussing these responses the Forum states, (at page 2 of the report) that "there was a strong sense [from the participants] that the recommendations sketched out the middle ground", and that while most participants recognised the need for change, there was no consensus on what that change should be. Key areas of concern to participants were how standards, limits and targets for water quantity and quality were set, and how they might be achieved. Participants were also keen to know when the detail of the changes might be available, as well as how they could be involved going forward.

The report notes that as a result of these engagement meetings, the Forum considers there is widespread support for the "general direction of the report and the implementation of its recommendations" and the key focus should now be on giving effect to the recommendations in a timely and effective manner.

> "Following the earthquake that hit Canterbury on 22 February this year, the Government has introduced nine Orders in Council under the Canterbury Earthquake Response and Recovery Act 2010. The intention of these Orders is to help reduce red tape so that the Canterbury recovery efforts are not hindered and Canterbury can get back up on its feet again quickly."

In terms of implementation, the key points the Forum highlighted in the report were that:

- The recommendations were an integrated package and any sequencing of implementation needed to respect that package
- A national policy statement on freshwater was important but would not be sufficient on its own. Other regulatory measures, such as national environmental standards, and other non-regulatory measures, such as the adoption of best practice procedures by regulators and users, would also be required
- Work in other areas, such as the development of a national strategic approach to water management, water allocation procedures, and water services management, needed to commence in concert with the policy statement workstream, as such information would be necessary to give effect to the policy statement
- Clarity was needed from the government on the timeframe and sequencing of the water reform package
- While implementation of the legislative measures would take time, there was no reason why local government, industry, stakeholders and iwi could not start related work streams and programmes now
- Reform on this scale required involvement from all sectors and it was hoped that a collaborative approach would continue to be taken

The report concludes with some comments on the role of the Forum going forward. The Forum considers that given the knowledge, trust, and goodwill that has been built up between members (and the work completed so far), the Forum should be retained to assist in implementation of the reform package. The Forum could add value in a number of areas, including through work on water limits and targets, water allocation, and water services management (amongst others).

The Government has not yet released a formal response to this latest report. However, Environment Minister Hon Nick Smith indicated in a recent ministerial statement that it was encouraging that there was an "emerging consensus on the key elements of the reform that is required", and that the government's immediate priority, (now that the report has been completed), is to finalise the decisions on the National Policy Statement for freshwater by the end of the year. No timeframes have yet been provided for the other work streams set out in the Forum's report [at the time of writing].

Environmental Protection Authority

The Environmental Protection Authority (EPA) was established in 2009, (as a statutory authority within the Ministry for the Environment), to assist in streamlining the decision making process for nationally

significant proposals under the Resource Management Act 1991 (RMA).

The types of proposals that the EPA considers generally relate to major infrastructure or public work projects, such as the current Waterview Connection application in Auckland, and the proposed new men's prison at Wiri. However, the EPA is also able to consider plan provisions where these relate to a nationally significant project – the application by the New Zealand Transport Agency for policy amendments to the Greater Wellington Regional Freshwater Plan to allow its Transmission Gully roading project to proceed, is one such example.

Since well before the time of its inception, the role and function of the (then proposed) EPA has been a hot topic of discussion. In particular, there has been much debate over whether the EPA's role should be limited to the RMA or whether it should be extended to cover regulatory responsibilities under other Acts – such as the Hazardous Substances and New Organisms Act 1996 (HSNO) or emerging areas such as environmental regulation within New Zealand's exclusive economic zone.

In November last year the Government's view on the appropriate role and functions of the EPA was clarified (somewhat) by the introduction of the EPA Bill. This Bill proposes establishing a new standalone EPA (separate from the Ministry for the Environment) which, along with its RMA functions, takes over the role and functions of the Environmental Risk Management Authority (ERMA) under HSNO, as well as some of the functions and duties of the Ministry of Economic Development. The Bill also indicates that a Maori Advisory Committee will be established to advise the EPA and that this Committee will be modelled on the current ERMA Maori Advisory Committee, Nga Kaihautu Tikanga Taiao.

The Bill was referred to the Local Government and Environment Committee late last year and the public submission period closed in January this year. The Committee received 38 submissions covering a variety of issues including substantive matters such as appropriate functions along with more technical drafting suggestions. After considering these submissions, the Committee determined that the Bill should be passed with some amendments including minor drafting clarifications, as well as some more substantive amendments such as to its role. For example, the Committee recommends that the EPA be given a decision making role in relation to the Imports and Exports (Restrictions) Act 1988 and the permitting and enforcement functions under the Ozone Layer Protection Act 1996.

It remains to be seen what Parliament's response to the Committee's report will be. At a recent seminar in Auckland on working with the EPA, it was indicated that a clearer picture should emerge in early May, including whether the amendments will come into effect in July (as intended) or at some subsequent date.

Canterbury Earthquake

Following the earthquake that hit Canterbury on 22 February this year, the Government has introduced nine Orders in Council under the Canterbury Earthquake Response and Recovery Act 2010. The intention of these Orders is to help reduce red tape so that the Canterbury recovery efforts are not hindered and Canterbury can get back up on its feet again quickly.

The Orders relate to a range of matters including the following (which are of relevance to the local government sector):

- Land information memorandum (LIM) – this Order allows Councils to issue incomplete LIM reports where information is not available and extends the time Councils have to respond to a LIM request

- Weight of vehicles – this Order seeks to ensure that authorised vehicles carrying additional weight are not penalised where the vehicles are assisting in the recovery efforts
- Councils' administrative, record keeping and enforcement obligations under the RMA – this Order reactivates provisions which applied after the September 2010 earthquake and also allows for the Kate Valley Landfill to operate outside the conditions of its consent, where required, to help respond to the aftershocks
- Permitted activities – this Order provides for a range of temporary activities, such as housing depots and storage facilities, to be permitted activities provided the activities comply with all of the relevant standards
- Resource consents for land remediation and council infrastructure and flood protection works in Canterbury – this Order streamlines the consultation process for these consents, removes the requirement for notification and also removes any appeal rights, except on the part of the Applicant

Most of the orders stay in effect until around 31 March 2012 (with the exception of the weight of vehicles order which expires on 31 October 2011).

The Government has also announced the creation of a new authority, the Canterbury Earthquake Recovery Authority (CERA), which is intended to provide leadership and a single point of contact for the coordination of recovery efforts. The CERA will have wide powers to relax, suspend or extend laws and regulations where this is considered necessary to further the recovery efforts. A Bill setting out the role and functions of CERA (the Canterbury Earthquake Recovery Bill) is expected to pass into law on 14 April 2011. Earthquake recovery Minister Gerry Brownlee was quick to reassure the public that CERA's powers were "reserve powers" and that there would be checks and balances to ensure that these powers were used 'judiciously'. These checks and balances include (but are not limited to):

- Having a four person independent review panel which is chaired by a retired High Court judge to assess any legislative or regulatory changes
- The provision of appeal rights to the High Court
- Making CERA subject to the Official Information Act

John Ombler has been appointed as the acting Chief Executive of CERA and it is understood that a recruitment process is currently underway to appoint a permanent chief executive. What the final shape of CERA will look like and more importantly what impact it has, has yet to be seen. It is a development that we will certainly watch with interest and report on in future articles.

Prosecutions under the RMA

A recent Court of Appeal case, Down v R[1], is of interest as it clarifies the law in relation to prosecutions under the RMA – including those applying to unlawful water takes and discharges.

The central issue in this case was whether leave was required from the Court before a prosecution could be brought in relation to an "infringement offence", (which include offences under s.338(1)(a) of the RMA). The Appellants argued that leave was required under section 21 of the Summary Proceedings Act 1957 (SPA) and as such leave had not been sought, the subsequent convictions were a nullity. The Respondent maintained that leave was not required (as the RMA and SPA prosecution regimes are separate processes) and therefore the convictions stood.

In its decision the Court acknowledged that if the Appellant was correct that leave was required, the consequences of such a finding would be far reaching. Any prosecution where leave was not sought would potentially be affected, and any subsequent convictions unlawful. Counsel for the Waikato Regional Council (one of the Respondents) noted that there had been 400 such prosecutions within the last five years alone.

Interestingly, while the outcome of the appeal in the Court of Appeal was the same as the High Court, in that leave was not required and the convictions were found to be lawful, the reasoning for that outcome differed quite significantly. In the High Court, Justice Wild sought to reconcile the two regimes by interpreting the section 21 SPA requirement for leave as only applying where an infringement notice had first been issued in relation to the offence. In other words, only where such a notice had been issued was leave required. Where an infringement notice had not been issued, leave was not required.

The Court of Appeal disagreed that the two Acts could be reconciled in this way. Instead, the Court of Appeal found that the SPA and RMA infringement notice regimes, while similar, were separate regimes, and as a consequence leave was not required:

> [59] ...In our judgement, s 343C does not provide "for the use of the [s 21] infringement notice procedure. It provides its own procedure for issuing infringement notices, self contained within the terms of s 343C and the prescribed form. It is analogous to the s 21 procedure. But it stands alone, independently of that provision. The s 21 procedure must refer to and be limited to infringement notices issued in accordance with the form prescribed by regulations made under the SPA, not under the RMA.
>
> [60] It follows that infringement offences under the RMA are to be prosecuted by laying an information in the usual way... Leave was not required.

The Court further held that even if such leave was required (which it denied), the proceedings in that particular case would be saved by s 204 of the SPA. This section states that proceedings are not to be questioned due to a defect, irregularity, omission or want of form unless there has been a miscarriage of justice. In this case, the Court found that the failure to obtain leave was a procedural irregularity and that there was no miscarriage of justice. The Appellants were not disputing that the offences occurred, just the correct procedure for prosecuting the offences.

It remains to be seen whether leave will be sought to appeal this decision. However, given the Court's acknowledgement of the far reaching consequences of the issue, and the fact that the reasoning (if not the ultimate outcome) differed significantly from that given by the High Court, it is likely that if leave was sought to appeal, it would be granted. So for now, it is a case of watch this space. ■

Footnotes

[1] [2011] NZCA 119

Helen Atkins is a partner at Atkins Holm Joseph Majurey specialising in resource management, environmental and local government law. Helen provides advice to both the public and private sectors and has been involved in a number of large development projects as well as advising on some of the most significant law changes in this area.

Vicki Morrison is a senior associate at Atkins Holm Joseph Majurey specialising in resource management and local government law. Vicki has worked in both the public and private sectors, and has given advice on large land development projects as well as iwi consultation issues.

Impacts of Climate Change on Rural Water Schemes

Emily Rudkin, Project Manager – MWH New Zealand Ltd

New Zealand's agricultural sector will face a changing climate in the future including warmer temperatures, increased droughts and more intensive and frequent rainfall. This will affect both the growing conditions and the performance of long term operations of rural irrigation and water supply schemes. To help aid understanding of the physical impact climate change could create MWH has recently completed a significant research study for the Ministry of Agriculture and Forestry (MAF), the first comprehensive research into the rural water infrastructure area.

MWH's research focussed on a series of case studies from across the country to illustrate the relevant effects of climate change, issues and solutions for various water infrastructure schemes. The schemes were selected to cover a range of geographic climatic variations, catchment hydrology and infrastructure assets. They were located from Northland to Southland and comprised old and new schemes, with both pipe and canal distribution, with various storage sizes from small to large, irrigating between 2,000 to 18,000 hectares. The rural stock water supply schemes comprised different scheme types, from constant flow to on-demand schemes and operating via pumped and gravity feed, serving between 200 to 20,000 hectares. All were assessed against meteorological and hydrological changes and consequential changes to water quality and ecology using existing climate change projections available from the Ministry for the Environment's document Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand – 2nd Edition (2008).

"A key focus of the research was the likely impacts on rural water infrastructure assets. Climate change will impact on all New Zealand rural water infrastructure schemes to a greater or lesser extent, affecting capital, operating and maintenance costs."

This assessment showed that a fairly uniform warming across New Zealand is expected, with an average temperature increase of about 0.9°C by 2040 and 2°C by 2090. Average annual rainfalls are projected to increase in most areas, other than in the far north of the North Island and the east coast of the country. There will be some seasonal changes, with reduced summer rainfall in the upper catchments of the Southern Alps and reduced spring rainfall in Northland. The frequency of extreme rainfall events and droughts is projected to increase across the entire country. Temperature increases will lead to warmer water temperatures, which could lead to increased risk of new invasive organisms and increased aquatic plant productivity in source streams. These climatic changes will impact on rural water scheme infrastructure by increasing sediment loads on storage facilities, increasing the frequency and severity of floods and droughts, having significant consequential effects on water quality and ecology and altering the reliability of supply.

These effects are summarised below:

Climate Change Effect	Effect
Increase in rainfall	Higher rainfall and average river and stream flows will provide benefits for instream ecology and at times reduce pressure on the water resource.
Decrease in rainfall	Lower stream flows and potentially more rigorous residual flow requirements for source streams. Increased pressure on water resources.
Changing rainfall patterns	Seasonal variations may lead to increased pressure on water resources at times. Less water (or more water) available for storage at different times of the year.
Less snow fall and shorter snow melt season	Lower flows in spring and summer may lead to increased pressure on water resources at times.
Increased risk of drought	Increased frequency and durations of very low river and stream flows may at times increase pressure on water resources and stream ecology. Minimum/environmental flow could be reached more often and abstraction for schemes reduced or halted for periods of time.
Increase in average temperature; Increase in very hot days	Increased temperatures in source rivers and streams with potentially adverse effects on stream ecology. Increased temperatures in storages contributing to higher risk of nuisance algae blooms. Increased risk of weeds, pest fish or other unwanted organisms. May contribute to increased variability on DO and pH regimes. Potentially higher maintenance costs for scheme infrastructure due to clogging of screens and increased corrosion. May also increase the risk of invasion by other unwanted organisms (but possibly reduced risk associated with didymo). Increase in peak demand for stock watering.
Increased frequency and intensity of heavy rain events	Increased sediment and nutrient inputs to storages contributing to higher risk of nuisance algae blooms or weeds. Increased sediment yields and erosion in scheme catchments. Potentially increased maintenance costs for scheme infrastructure. An increase in the frequency of large floods may lead to re-evaluation of design parameters for storage lakes. Potential effects on pipeline stability.
Increased summer water deficit for un-irrigated land	Increased water demand for land currently in schemes.
Increased windiness	Coupled with an increase in temperature this could lead to an increase in erosion of topsoil.
Sea level rise	Bores near the coast will have an increased risk of saltwater intrusion.
Decrease in groundwater levels	Increase in pumping head.

A key focus of the research was the likely impacts on rural water infrastructure assets. Climate change will impact on all New Zealand rural water infrastructure schemes to a greater or lesser extent, affecting capital, operating and maintenance costs. Significant one-off capital cost will typically be limited to flood change impacts to storage reservoir spillways. Weed growth due to the increase in water temperature will require upgrades and additional operation and maintenance costs. Schemes with screened intakes will likely require increases in capacity and cleaning mechanisms. Support infrastructure including roads and culverts could be disrupted by flooding limiting access to the schemes.

Mechanical items such as pumps, gates and valves, are likely to be affected through increased sediment-induced wear and tear and increased operational use, and the reduction in lifespan and increased operation and maintenance costs. The impacts on pipe infrastructure is anticipated as only moderate, and on canal based schemes the significant issues were identified to be increased operation costs with sediment and weed accumulation removal.

The most significant water related impacts of climate change will arise from the on-farm consequences of altered levels of service and potential disruptions to supplies.

To minimise the financial costs associated with a changing climate, there are a number of remediation and adaptation measures that the industry and farmers could adopt. Adaptation strategies include increasing storage within schemes, installing remediation measures to reduce flood damages and identifying secondary flow paths, increasing volumes of water taken, and undertaking various river works to protect scheme assets.

"The projections indicate an increase in catchment runoff and inflows into the storage dam over winter and spring."

Possible response options are summarised below:

Climate Change	Impact	Response
Increase in droughts	Reduced yields from existing storages Increased peak water demand Reduced pipe lifespan due to cracking of pipes from drought shrink	Reduced production or requirement for increased storage Increase in pipe repairs
Increase in flood risk	Increased flood damages to key infrastructure intakes, pipeline crossings, etc	Remediation measures to reduce flood damages Increase in repairs Increase in dam spillway capacities Increased emergency planning and compliance costs
Increase in rainfall	Increased peak runoff	Increased culvert sizes Identification of secondary flow paths
Changes in wind speed and direction	Less stability in natural vegetation, more wind throw	Contingency planning and changes to emergency management procedures
Increase in air temperatures	Changes in air temperature Changes in frost patterns	Possible change in land use Increase or decrease in frost protection mechanisms
Increase in stream temperatures	Increase in weed growth Increased clogging of rural water infrastructure screen intakes Increased corrosion Smothering of river beds reducing infiltration gallery intake performance	Redesign intakes Increased maintenance
Changing rainfall patterns	Increased river flows Decreased river flows Aggradation of stream beds Degradation of stream beds Demand pattern changes Seasonal variations may lead to increased pressure on water resources	Additional water take maintenance Additional river training Additional dredging River works to maintain intakes Altered take regime
Sea level rise	Impacts on hydraulic performance of drainage systems and drainage pumps	More pumps More maintenance Less production Remediation measures
Groundwater yields	Lowering or raising of groundwater levels Potential salt water intrusion	Change or adaptation of pumping systems Need for alternative sources of water or shift of bore location
Weed and algae growth	Fish screen blockage Canal cleaning Irrigator blockage Damage and clogging of service lines and spray heads	New technology for alternative screening Additional screen cleaning and intake maintenance Operation and maintenance
Consent limit abstraction reliability	Increased flow Decreased flow Altered sedimentation patterns	Additional take Decreased take Maintenance changes
Intake ability to abstract water	Intake blockage Intake damage Altered river morphology Fish screen utilisation	Increase in maintenance or automation of screen cleaning Increase in repairs or alternative intake technologies Additional river training Additional maintenance

The likely impacts can be further demonstrated via the case studies used in the study, one of which is on the Manuherikia Irrigation Scheme in Central Otago.

Manuherikia Irrigation Scheme

The Manuherikia Irrigation Scheme is located just north of Alexandra and east of Clyde in Central Otago. It is a storage and gravity scheme supplying irrigation water to land with varying uses including arable farming, horticulture, viticulture and lifestyle properties. The scheme supplies water to about 285 properties, with an irrigated area of about 2,250 hectares. It was opened in 1922, being the first scheme in Central Otago that was not founded on the remains of mining enterprise, with the main race being constructed specifically for irrigation purposes. The scheme consists of a main race which draws water from the Manuherikia River and utilises storage from the Falls Dam located on the upper reaches of the river. The supply is supplemented by the Borough race system which is supplied by a local stream (Chatto Creek).

The mean annual rainfall over the Manuherikia catchment area is projected to increase across all seasons, with up to 20% over the winter months by 2090. Similarly, there will be an increase in the frequency of extreme rainfall events. However annual snow falls at high elevations of the catchment (1600 to 1800 m) are expected to decrease considerably, by 20% in 2040 and 40% in 2090. This will result in a marked change in seasonal river flow in spring and early summer when snowmelt traditionally boosts flows.

Temperatures are projected to increase in line with the national average by 0.9°C above current levels by 2040 and 2.0°C by 2090, coupled with the number of very hot days (over 25°C) increasing and number of frosts decreasing. The number of drought days is not projected to increase markedly. The temperature of the river water

Location of Manuherikia Irrigation Scheme in Central Otago

Main race of Manuherikia Irrigation Scheme

is projected to increase with rising air temperatures, and water in the Manuherikia main race, which is mostly unshaded, is expected to be susceptible to summer heating.

There are a range of potential climatic effects on the Manuherikia Scheme. The rate of supply of water is constrained by the existing capacity of the race network, and increasing daily supply rates would require a major upgrade of the irrigation reticulation system. The projections indicate an increase in catchment runoff and inflows into the storage dam over winter and spring. Depending on the operational use of the dam storage, and the flexibility of supply from the storage reservoir, this increase in over season inflows could provide additional seasonal supply to match increased seasonal demand.

The system operators expect that regional pressure will drive the scheme to use water more efficiently and may potentially result in a change of infrastructure to piping. Land use change to dairy or other intensive uses in the upstream catchments may increase nutrient loadings and potentially weed growth. Weed growth is a primary concern and an increase in weed clearing requirements is already being experienced. Increased sedimentation will require more canal cleaning.

Flooding is an area of concern due to the difficulty in accessing the tunnel intake and the risk of damage to the gorge races and piped sections from high waters. Automation of the intake gates, which is programmed into the Scheme's forward works programme, will decrease the risk of damage. The annual operation and maintenance costs for the scheme are anticipated to increase by about 40% as a result of climate change.

"To minimise the financial costs associated with a changing climate, there are a number of remediation and adaptation measures that the industry and farmers could adopt. Adaptation strategies include increasing storage within schemes, installing remediation measures to reduce flood damages and identifying secondary flow paths, increasing volumes of water taken, and undertaking various river works to protect scheme assets."

Being aware of the impacts of a changing climate on a scheme, means action can be taken to minimise costs. The report identifies ways to respond, including the adoption of alternative infrastructure technology and the conversion to pipe schemes. In some cases the appropriate response will simply be incorporated as part of the ongoing annual maintenance or asset management programme. MAF Analyst Trecia Smith says the aim of the research is to help provide rural water users with the information they need and more importantly, practical ways to manage the impacts, with the ultimate aim of factoring climate change preparedness into business as usual.

The report is available for downloading on the MAF website. ■

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Lessons from Austria

Dylan Stuijt – Water Supply Manager, Hastings District Council

Ever since a young lad, I've been a fan of European cars. That 'look at me everyone, I've got a Ferrari!' just isn't my style. For me, it's always been the understated class, attention to detail and build quality that's appealed. It's no wonder, that when Hawle produced their 'A' Valve I was immediately impressed and intrigued. How do they get that wedge into the one piece valve body? This question would continue to plague me from the day the Hygrade representative shrugged his shoulders, admitting even he didn't know.

A month or so had gone by when our local Hygrade representative rang and asked "How would you like to go to the factory to see how they make the 'A' Valve?"

"Of course I would", I replied, thinking it was a hypothetical question.

"No really!" he said, "we're inviting a number of water managers from around the country."

Wow – this guy's serious! How on earth am I going to get this past our CEO, even a gifted $10 bottle of wine draws attention, let alone a supplier-funded trip to Austria! Fortunately my division manager is an experienced engineer, who's been around long enough to understand the Hynds/Hygrade ethos around training. Having educated engineers is ultimately good for the industry, and of course, business.

This was to be the second year that clients from the water industry would be invited to Austria through a joint Hynds/Hygrade and Hawle initiative. The itinerary would see us visit the Hawle Valve Factory and Agru Polyethylene Factory in Vöcklabruck, Vienna Water and the Salzburg Water Museum.

We prepared to depart Auckland on 4 September, the very day Christchurch would be rattled by a magnitude 7.1 earthquake. Initially the fate of our Christchurch counterparts was unknown, but to our relief they were fine, if not somewhat shaken. Fortunately they were able to join us a few days later in Vienna.

We arrived in Vienna to be greeted by Manfred Hiden, Hawle's southern hemisphere sales manager. Manfred would be our host for the rest of the trip. The scenery and architecture were immediately breathtaking, but it's not long before you notice how tidy everything is, and how efficiently everything seems to run. Buses, trains and trams were ferrying multitudes of Viennese around with seemingly more cycling along the many dedicated pathways which cover the city.

The following morning I opened my hotel window and started surveying the amazing architecture around me. My eyes were immediately drawn to a monstrous structure hidden behind the buildings. It looked like a giant water reservoir, but seemed too large to actually be one – typical, only an engineer would notice this kind of thing amongst the fabulous Renaissance architecture. Every time I caught a glimpse of this structure it intrigued me. It actually wasn't until I got back home and started checking out on Google Earth where I'd been, that I stumbled across what the structure was. It turns out that it was one of 8 anti-aircraft flak towers constructed during World War II. Three of these towers were built in Vienna alone. Wikipedia informed me these Flakturm Towers were largely accredited for saving Vienna from the heavy bombing raids of the Allied forces, and subsequently saved the city's amazing architecture. For a country that has such an interesting war history, it's clear it's not something they like to advertise.

You can't come to a city like this and not look around; fortunately that's exactly what we got to do on the first full day, but funnily

Centre – Schoenbrun Palace, Vienna; Top Right – Maria Theresien Platz, Vienna; Bottom right – Wasserwerk Der Stadt Wien, water reservoir, Vienna

enough it wasn't long before most of us started looking at sumps, manhole lids, valve boxes, hydrants – that kind of thing. However the city's history and architecture quickly drew us back in. I was amazed at how well the city functioned – bikes, buses and trams whizzed past (on the wrong side of the road!). The number of times I caught myself looking the wrong way as I was about to step out! Underground car parks dotted the city, resulting in a calm, uncongested feel. The city was also remarkably safe. We entered the subway, some four stories below ground, mid week and near midnight, and there were numerous commuters, including young women freely walking around on their own. And when a train says it's turning up at 12:03am it turns up at 12:03am!

Not long after arriving in Vienna I noticed an absence of the tell tale chlorine smell in the water. I looked around the hotel room for signs advising not to drink the water, but there weren't any. I just figured these guys were really good at getting their dose levels right. Surely such a large international city would chlorinate their water supply? Given we were about to visit Vienna Water the following morning, my question would soon be answered.

We were introduced to Walter Kling, Deputy Managing Director of Vienna Water, and Director of the 2008 World Water Congress. I asked him about the lack of chlorine, and was greeted with a cheeky grin, "we wouldn't put that stuff in our water!" It turns out you can drink water straight out of the tap just about anywhere in Austria without the need for chlorine. After two days, it's pretty obvious Austrians like to do things properly. We were given an impressive presentation on the history of Vienna water, prepared by professional film producers, Brains & Pictures. Impressive cinematography aside, what the Austrians have done with their water supply is genuinely inspiring. The lengths they've gone to to secure and protect their water quality is nothing short of amazing and is something we could learn from.

In 2003 following a European Commission presentation on behalf of its member states at GATS (General Agreement on Trade in

"Our afternoon was rounded out by a tour of a 200+ year old water tower, which was just a much a piece of art as it was a water reservoir."

Services) it was obvious Vienna, in addition to the rest of Austria, weren't going to bow to commercial forces, or 'Liberalisation' as they put it. Following an initiative by the Mayor of Vienna in 2004, 18 cities (Vienna, Berlin, London, Paris, Rome, Athens, Amsterdam, Luxembourg, Sofia, Bratislava, Barcelona, Munich, Leipzig, Frankfurt, Stuttgart, Brno, Madrid and Brussels) adopted a resolution on maintaining services of general interest in Europe, rejecting the Liberalisation movement. Many years on, Walter remains a firm believer that they did the right thing, and from what I've witnessed, I couldn't agree more. The ability for a water company to own and manage an entire water catchment, while maintaining cost effective services, shows an amazing level of dedication and fortitude for its customers, which would be hard to replicate in a privatised market.

We'd be doing ourselves a favour if we allowed the Walter Kling's of this world the opportunity to share their experiences, rather than succumb to the media savvy juggernauts of the international water giants. However, it's ironic that we watched a video worthy of an Oscar Award at Vienna Water. Our afternoon was rounded out by a tour of a 200+ year old water tower, which was just a much a piece of art as it was a water reservoir.

The following day, we hit the Autobahn and headed west – destination Vöcklabruck, home of the Hawle Valve Factory and Agru Polyethylene Factory. On the Autobahn I could have sworn the speed sign said 120km/hr, so why was everyone flying past us when we were only doing a cool 140 in a minibus. I guess old habits die hard. Traffic was smooth. Swales, flood detention ponds, and even windmills (the modern kind, think the Manawatu Gorge) dotted the highway. Green is a very strong theme in this country. I'm amazed how similar Austria is to New Zealand, not only in landscape (except for the more than 1000 year old buildings), but also in mindset, but polished with millennia of growth, conflict, turmoil, enlightenment and how could I ignore Mozart, to reflect upon.

I questioned Manfred on the state of the apparently poor traffic management and site safety practices I saw around the roads and city construction sites. This seemed to be a rare opportunity for New Zealand to rise above the Austrians. The response was a surprising "self responsibility! If you walked in there, you'd be an idiot,

"Winter gets pretty cold in Austria, and the life for any kind of infrastructure is pretty hard, and as a result I'm told, quality really matters. Just looking at the workmanship on the above ground hydrants is certainly testament to this."

as it's pretty obvious it's a construction site." (Some paraphrasing on my part, but you get the message). The duty of self responsibility was another strong feature to come out of my tour. I'm not sure if my counterparts had the same feeling, but it felt like a breath of fresh air, like the whole PC brigade hadn't made it there, or they simply got booted out at the door!

Winter gets pretty cold in Austria, and the life for any kind of infrastructure is pretty hard, and as a result I'm told, quality really matters. Just looking at the workmanship on the above ground hydrants is certainly testament to this. Austrians also claim to be at the technology forefront and not just in the automotive or IT industries. A surprising concept I discovered was that property owners even had their hot water supplied, just like your gas or other services. A special hybrid alloy and polyethylene pipe was in the process of being tested for this purpose. A visit to the Agru factory in Vöcklabruck would shed light on some other technological advances in polyethylene. Of particular interest was the PE100-RC pipe they're starting to produce in large volumes. We were assured by the head of design, that the "slow crack growth rate" of this product was so low, that you could lay the pipe without any specialised bedding. He went as far as to show an example which appeared to be in the Swiss Alps where the pipe was laid directly onto bare rocks! There were also some very interesting concrete lining products.

A relatively new product they were promoting was in the Agrusafe range called 'Sure Grip' or 'Ultragrip'. This was a polyethylene sheet lining product that could be set into fresh concrete, or retrofitted to line old reservoirs, pipes, manholes, oval pipes, and protect against aggressive environments or to simply extend the life of a product. Temperature fluctuations were a slight limiting factor, but they also had a solution for that. Just about everyone in our tour group wanted a sample of the 'Sure Grip' product as immediate applications came to mind. Our next stop in Vöcklabruck would be the Hawle Valve Factory where a lunch of crumbed schnitzel and potato salad was waiting. A Hydrant beer tap was a major talking point. As I went to take a photo, an Austrian staff member quickly jumped up and stopped me. What was this? He then refilled the two beer classes that were sitting below the hydrant to ensure they each had a perfect head. "You can't take a photo of Austrian beer without a perfect head on it," he said with a huge grin.

During the tour of the Hawle Fabrication Plant, it was strictly cameras off. Throughout the tour staff were eager to show us how important QA testing was and how every step had a quality check in place. I was particularly impressed by how Hawle managed to cold press the stainless steel threads of the valve spindles, rather than just cut them out using conventional methods. Soon we approached the room where they vulcanised the rubber onto the wedge of the Hawle 'A' Valve. At last I'd see how they get the wedge into the one piece body. But alas, unfortunately, even these guys didn't know this bit, the actual putting together process took place in another secret location. At least I got to take out my frustration on some vulcanised rubber with a pair of pinchers, and yes the rubber did stick like the proverbial to the steel. The tour was capped off by an impressive display room of self restrained fittings for just about every known pipe material type, and a particularly large valve that we could play within the pressure testing facility.

The final leg of the tour took us to the beautiful city of Salzburg to visit the Water Museum. This city has a remarkable water history dating back to medieval and even roman times. It was explained that during medieval times, a convent engineer (for want of a better name) was executed for not getting the hydraulic head correctly worked out to make a fountain to work for the King. Certainly brings a new perspective to KPI management. To see pipes made of wood, with iron jointing systems was something else. Much of the technology hasn't really changed over the years, and many of the tried and trusted technologies are still being used today. Austria really opened my eyes in terms of dedication to quality, but also to the depth of understanding they have around water management.

I will fondly remember my time there, and hope to return again one day. Many thanks to Hynds/Hygrade and Hawle for presenting the opportunity, and a special thanks to Manfred Hiden who looked after us so well. ■

Above (left to right) – PE Pipe at Agru Factory; Leigh John & Peter Bahrs inspect an 800mm 1936 Sluice Valve with 150mm By-pass situated outside Vienna Water offices; Gareth Philips, Greg Manzano, Dylan Stuijt, Walter Kling and Manfred Hiden outside the entrance to a 200+ year old water reservoir, Vienna; Greg Manzano operating a 600mm Hawle Valve; Schoenbrun Palace, Vienna; Facing page (bottom) – Dubai airport under construction; Hawle's range of self restrained fittings on display and under mains pressure

The Water Footprint of New Zealand's Goods & Services

Indika Herath; Markus Deurer & Brent Clothier – Production Footprints Team, Plant & Food Research; David Horne & Ranvir Singh – Institute of Natural Resources, Massey University

Recently, the Chief Scientist of the UK, Professor Sir John Beddington, suggested that by 2030 the world faces a 'perfect storm of food shortages, scarce water and insufficient energy resources' (Beddington, 2009). The imperative is therefore to lighten our water, carbon and energy footprints. Water, carbon, food and energy are inextricably linked.

A recent paper in the *Harvard Business Review* referred to 'sustainability' as an emerging business megatrend (Lubin and Esty, 2010). In their article entitled 'The Sustainability Imperative', the authors reckoned that for businesses there is a clear correlation between environmental performance and financial returns. We would add that, in the future, this will also apply to countries. They suggest that there is a "value tied to the successful execution of a sustainability strategy – what [they] call an eco-premium." They concluded that 'winners' will be those who have the capacity to demonstrate sustainability through metrics such as product footprints.

The large supermarket chains, through their control of shelf-access for products and through their 'choice editing' on behalf of their consumers, will play a critical role in how eco-labelling and product footprinting will be used. Whereas, carbon footprinting is already on the public's radar, there is an emerging trend around water footprinting. Growing concerns about the water footprint of primary products (Chapagain & Orr 2008), have led to moves to develop water footprinting labels on products, especially food (Segal and MacMillan, 2009).

International protocols for quantifying the water footprint of products and services are being developed (Hoekstra et al., 2011), and water footprints are already being reported for a range of goods, including beer (SAB-Miller and WWF-UK, 2009). Here in New Zealand, Ministry of Agriculture & Forestry (MAF) have initiated studies into the water footprint of kiwifruit and red meat. Standards New Zealand is working with the International Standards Organisation (ISO) to develop requirements and guidelines for an ISO protocol to quantify the water footprint of goods and services. Brent Clothier serves as *Water New Zealand's* nominee on Standards NZ's working group on water footprinting.

Furthermore, supermarkets are developing their own protocols for assessing the footprints associated with the provision of goods and services. Water use is likely to be an important component of these procedures. In July 2009, the American-based supermarket chain Wal-mart announced plans to develop a worldwide sustainable-product index. Wal-mart is providing its global suppliers with a survey of 15 questions on: energy & climate, natural resources, material efficiency, people & community. Two relate to water use. Reporting the sustainability of water use along the supply chain of primary products is likely to become a necessary condition to ensure shelf access for food products in supermarket chains.

There is currently no international consensus on the procedures that should be used to determine the water footprint of goods and services. Our article here on the water footprint of hydropower highlights the different ways that this might be carried out. It is our view that any protocol must correctly acknowledge the local hydrological settings.

For New Zealand, the water footprint of our plant and food products is inevitably linked, through processing and refrigeration, to the water footprint of our hydroelectricity.

Hydropower is the major portion of the electricity we use. While hydroelectricity appears very attractive compared to other energy sources because of its low CO_2 emissions and renewable nature, it has been rated to have a large water footprint. But no systematic study has been carried out to substantiate this claim. At the same time, many of New Zealand's export products have secured shelf access and a price premium based on their 'clean green' image. Consequently, the water footprint of hydropower services in the production of New Zealand goods may have an important influence on the marketing New Zealand's export products. This work is being carried out by Indika Herath as part of her PhD research on the water footprint of wine and potatoes. The processing and packaging of these primary products consumes electricity.

Our objective here is to quantify the water footprint of a unit of New Zealand

hydroelectricity, as delivered by the national grid, and to compare this with reported values.

Methods

All major hydroelectric power plants in New Zealand were considered and these account for more than 95% of hydropower generated in the country (EDF, 2010). The hydropower stations in the North Island are clustered together in the central part of the island, while the plants in the South Island are more widely scattered.

We used and compared three different concepts to quantify the water footprint.

1. WF-1: Consumptive Water Use

We first follow the definition of the water footprint given by the Water Footprint Network (Hoekstra et al., 2011). This consumption-based water footprint (WF-1) (m^3/GJ) can be calculated as the evaporative water loss from the surface of the reservoir divided by the energy produced,

$$WF\text{-}1 = E_0 / P.$$

Here, E_0 is the annual open-water evaporative loss from the reservoir (m^3/yr) and P is the annual energy production of the power plant (GJ/yr). This approach was used by Gerbens-Leenes et al. (2009) to estimate the global water footprint of hydropower.

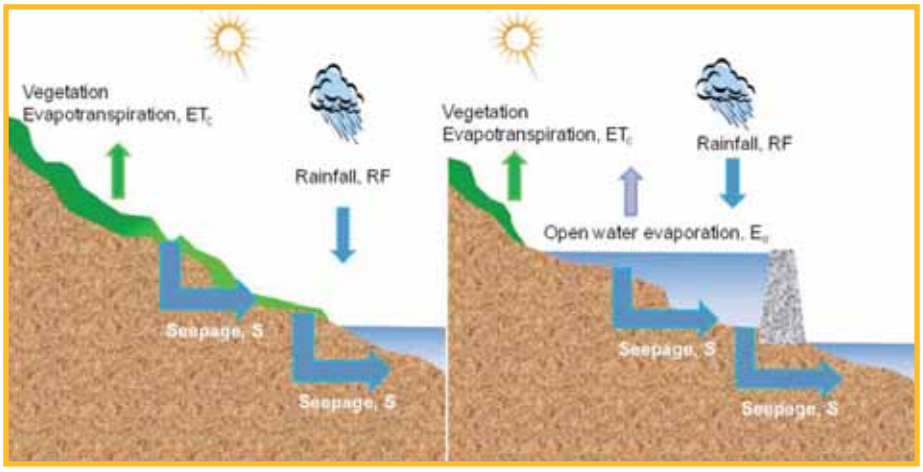

Figure 1 – Schematic diagram showing different hydrological components and land-scape features before (left) and after (right) the construction of a hydroelectric dam. Flow through the turbines is ignored

2. WF-2: Net Consumptive Use

The second approach also considers consumptive water use, but it compares the consequences of the land use change created by the dam through the replacement of vegetation by a free-water surface (Figure 1). Thus, evapotranspiration from the vegetation is replaced by open-water evaporation from the reservoir. Taking this into account, the WF-2 (m^3/GJ) considers the net evaporative water loss from the area of the reservoir,

$$WF\text{-}2 = (E_0 - ET_c)/P.$$

"We found large variation in the water footprint of hydropower generated across the different locations in New Zealand, which illustrates the inappropriateness of using global average values."

Here, ET_c is the amount of water that would have been lost by evapotranspiration (m^3/yr) from the antecedent vegetation prior to construction of the dam.

3. WF-3: Net Water Balance

Lastly, we moved beyond just a consumptive-use definition of the water footprint. In WF-3, we analysed the net water balance by taking into account the water leaving from and entering to reservoir. Water through-flow for hydropower generation was not taken into consideration as this is returned to the river, and considered as simply a through flow.

The WF-3 (m^3/GJ) for hydroelectricity is the net loss of water from the reservoir per unit energy produced in the hydroelectric plant estimated as,

$$WF\text{-}3 = (E_0 - RF)/P.$$

Here, *RF* is the annual volume of rainfall falling on the reservoir (m^3/yr).

Water loss through seepage generally remains within the basin, and is highly likely to become available downstream, or it may recharge underlying ground water resources (Gleick, 1994). Seepage is therefore not a true loss from the reservoirs.

Data and Assumptions

The areas of the water storage reservoirs associated with hydropower plants were determined using a Geographic Information Systems (GIS) analysis. It was assumed that pasture was the vegetation before the dam was constructed.

We sourced weather data from the nearest official NIWA meteorological station to the reservoirs. Four NIWA stations were selected: Rotorua Aero Aws (Automatic Weather Station) for the North Island dams; and Tara Hills, Clyde Ews (Electronic Weather Station), and Manapouri Aero Aws, respectively for the South Island reservoirs. Daily open-water evaporation and evapotranspiration rates were considered for the ten-year period from 2000 to 2009.

Results and Discussion

The weighted-average values of the water footprint for New Zealand's electricity using the three different methods ranged between 1.55 and 6.05 m^3/GJ (Table 1). Irrespective of the method, the water footprint of New Zealand's hydropower is low compared with the value of 22 m^3/GJ estimated by Gerbens-Leenes et al. (2009), and also the value of 68 m^3/ MWh (18.9 m^3/GJ) reported for United States of America (UNCCC, 2009). However, Fthenakis and Kim (2010) reported a value of 4.72 m^3/GJ for the United States of America using a calculation of the average water consumption in hydropower generation. This is close to our WF-1 value of 6.05 m^3/GJ for New Zealand.

Table 1 – The average water footprint of hydroelectricity generated in New Zealand, calculated using three different methods

Method	Water Footprint (m^3/GJ)
Consumptive water use WF-1 = E_0/P	6.05
Net consumptive water use WF-2 = $(E_0 - ET_c)/P$	2.72
Net water balance WF-3 = $(E_0 - RF)/P$	1.55

Conclusions

Three methods have been used to quantify the water footprint of New Zealand's hydropower. The water footprint of New Zealand's hydroelectricity was estimated to be lower, irrespective of the method we used, than the commonly cited international value of 22 m^3/GJ. Depending on the calculation method, the national water footprint ranged from 1.55 m^3/GJ (WF-3) to 6.05 m^3/GJ (WF-1).

The WF-1 and WF-2 are based on consumptive water use during power production. WF-2 considers the consequences of dam construction. This approach has recently been used in water footprinting assessment of beer (SABMiller and WWF-UK, 2009). Their net approach was mooted to account for the water loss from the cultivated crop compared to the antecedent natural vegetation. This approach, however, raises the question as to what is 'natural'? Furthermore, it says nothing about the contemporary hydrological functioning of the catchment. Both WF-1 and WF-2 simply ignore the supply side of the catchment's water balance. Therefore, these values provide only a partial guide to understanding the footprint from the hydrologic functioning of a dam.

The WF-3 approach moves beyond consumptive water-use and considers the water balance of the reservoir system by including rainfall as an input, which is the key driver for replenishing the catchment's water resources. The WF-3 method yields negative footprint values for some hydropower schemes. This just means the evaporative output of water is smaller than the rainfall input of water into the riparian system. The hydrological framework we present here in WF-3 can be used to assess the water footprint of any other power generation system, or product or service elsewhere in the world. It provides meaningful information that helps to understand the differences in the impacts of the water footprint in locations which are diverse in terms of water resource availability. This study also highlights the effect of local climatic differences and the structural specifics of a hydroelectricity scheme on the WF of hydropower. We found large variation in the water footprint of hydropower generated across the different locations in New Zealand, which illustrates the inappropriateness of using global

average values. Local values, calculated using a hydrologically rational method, must be adopted. We recommend WF-3 for it can be linked to hydrological impacts.

Our WF-1/WF-2 versus WF-3 comparison here has an analogue in the carbon footprint debate. Originally, the carbon-footprint discussion focussed simply on an erroneous metric of the carbon considered to have been consumed in the travel component associated with exporting a primary product to market – simply, food miles. However this unscientific measure has now been superseded by quantification using full life-cycle assessments which can rationally assess all carbon flows as the product moves from cradle-to-grave (BSI, 2008).

The three-fold analyses we have discussed here for the service of hydroelectricity can also be used to determine the water footprints of goods and services. The Water Footprint Network (Hoekstra et al., 2011) advocate a consumptive approach based on WF-1. However, we consider that a water-balance approach based on WF-3 is hydrologically rational. Such a footprint takes into account the local water balance by including the inputs by rainfall, as well as the losses by evaporation and transpiration.

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Improving Resource Consent Conditions

Mike Freeman – Director, Freeman Environmental Ltd

Introduction

The management of New Zealand's water, stormwater and wastewater infrastructure is critical to our wellbeing. Many millions of dollars have been invested in the policy and planning framework for this infrastructure under the Resource Management Act and the Local Government Act but comparatively limited attention has been paid to its implementation via the development and implementation of resource consent conditions.

When a resource consent is granted, the consent conditions are essentially the only active resource management mechanism. Do these provide the community, the consent holder and the consent authority with certainty about environmental outcomes? Are they absolutely clear about the consent holder's obligations? Do they give the consent holder an appropriate level of certainty? Are they enforceable should the need arise? Are they the most efficient and effective methods to achieve the desired objectives?

The current practice of formulating resource consent conditions is patchy across New Zealand. There are many examples of excellence. However, there are a significant number of published examples of poor practice and the lack of application of some potentially useful resource consent condition mechanisms. There is scope to learn from current best practice and improve.

The purpose of this brief overview article is to raise awareness in the water, stormwater and wastewater sector about resource consent condition issues and how they can be resolved to improve outcomes for all parties with an interest in the resource consent process. The focus of this article is on publicly notified discharge permits and water permits but the issues generally apply to other, non-notified resource consents and to other sectors involved in the resource consent process. There may be some other resource consent issues that are not addressed here that may be more particularly relevant to land use consents, for example, issues relating to financial contribution conditions.

"The current practice of formulating resource consent conditions is patchy across New Zealand."

Consent Conditions – What are the Current Issues?

Obtaining resource consents for major infrastructure developments usually requires a significant investment of human and financial resources. For contentious, notified resource consent applications, millions of dollars can be spent on consultation, investigations, environmental modelling, policy analysis, reporting, attendance at hearings and legal representation. Experts frequently spend weeks preparing and presenting reports and evidence on complex technical and policy issues. However, the same level of investment and expertise is not always applied to the process of formulating resource consent conditions.

There are some important implications of water and wastewater infrastructure resource consent conditions not meeting best practice. They include:

- Uncertainty about compliance requirements
- Poorly targeted compliance and reporting requirements
- Disagreements about what is required to obtain a resource consent secondary approval from a council officer
- Unnecessary repetition of the resource consent process as a consequence of inappropriately short-term resource consents
- Poorly targeted conditions that address an indirect potential consequence of an activity
- Unnecessary expenditure on unnecessary or poorly targeted monitoring and reporting
- Compromised ability of the consent authority to take enforcement action in the event of significant non-compliance because of either poor condition wording or because of a condition that inadvertently limits enforcement options

Critical Issues

This article summarises and develops the Quality Planning guidance on resource consent conditions[1]. The most common critical issues are summarised in the following table:

Issue	Explanation	Alternative
The use of secondary approvals, e.g., "… plan shall be submitted for approval by …", "… to the satisfaction of the Manager…", "… unless as otherwise agreed in writing by the Manager…", etc.	Conditions that provide explicitly or implicitly for a subsequent approval will generally be invalid and unenforceable[2]. A resource consent should provide the authority to do something that is complete in itself.	Significant issues should be resolved prior to a decision being made. Secondary approvals can be replaced by reference to a specific technical plan or design/ performance standard that can be independently certified[3]. However, if such a condition is volunteered by the consent holder and accepted by the consent authority, under the 'Augier principle[4]' it is enforceable.
Reliance on unenforceable and/or vague guidelines, 'standards' or "best practicable measures".	A resource consent must be absolutely certain about what must be done to achieve compliance and should as far as practicable be self-contained. Standards referenced from a conditions should not provide for a secondary approval.	Care should be taken to ensure that any specific guidelines or standards are certain and enforceable. Standards should be incorporated directly or by reference in the conditions. Reference to a whole document is often inappropriate because it may contain irrelevant or uncertain provisions. A "standard" requires clear mandatory wording, e.g., "shall" or "must". "Best practicable measures" conditions should only be used to address relatively insignificant effects, and should provide a list of specific example measures that must be undertaken.
Reliance on a future management plan to resolve a significant issue.	This would generally offend the principle of transparency and the public's right to have input to the resolution of significant issues during a public consent process. A decision maker needs to be satisfied that all significant issues are resolved or readily able to be resolved and not abdicate their responsibility by transferring a significant matter to a plan or person who does not have authority to make a resource consent decision.	Management plans are most appropriately used as mechanisms to provide an assurance that systems and procedures are in place to ensure that other conditions can and will be complied with[5]. Where some matters are left to management plans, the objectives and contents of the intended management plan need to be incorporated into the consent conditions and must be sufficiently clear and certain to be enforceable.
Reliance on references to technical plans that are not adequately defined e.g., no unique reference number or date.	Lack of specificity can lead to uncertainty and debates about what specific plan must be complied with.	Plan and design specification references need to be quite specific for example, about exactly what version must be complied with, and if necessary, what specific parts.
Reliance on shortened consent duration as the principal mechanism to address a significant adverse effect.	Consent duration is "a blunt instrument"[6] to address adverse effects. There are two basic circumstances where a shortened consent duration is appropriate: where the sensitivity of the receiving environment is likely to increase over time or where adverse effects are only acceptable for a short period. A replacement application must be given additional consideration i.e., regard must be given to that investment[7].	There are usually better 'sharper' tools that can provide greater environmental certainty. Alternatives to shortened duration consents include combinations of conditions for: feedback control, targeted monitoring programmes, mitigation measures, requirements to undertake treatment investigations, and condition review clauses.
Monitoring requirements not directly linked to a specific information need arising from the exercise of the resource consent.	Monitoring must be reasonably related to the effects of the activity – it is not an opportunity for wider research. Its scale and extent must also be reasonable i.e. commensurate with the scale of potential effects.	Monitoring requirements need to be clearly justifiable e.g., to check the extent of a specific adverse effect relative to a specific environmental outcome/standard or to gather specific information related to a specific adverse effect.
Inadequate technical specifications about how environmental effects information must be collected, analysed and/ or reported.	Occasionally too many technical specifications are inadequately defined and potentially at the discretion of a consent holder. This could result in inappropriate methods being chosen e.g., out-dated or with inappropriate detection levels. In addition, there could be legal debate about monitoring requirements.	Important technical issues such as the methodology for sampling, preservation and reporting need to be specified by reference to a published methodology or at least to "…methods generally accepted by the scientific community…". For example, it would normally be essential to specify that laboratories undertaking analyses need to be IANZ accredited or provide some equivalent assurance. It would also usually be appropriate to specify chemical analysis detection levels.
Reliance on terms such as "suitably qualified" for individuals undertaking critical certification.	This terminology is fundamentally uncertain and has the potential to result in debate about what is "suitable". The greater the potential adverse effects the greater the need for an assurance that a qualified person has undertaken the certification that will provide assurance that those potential adverse effects will not occur.	For any significant issue it is preferable to specify a professional qualification e.g., CPEng, CEnvP, MNZILA, RPSurv, etc., or a tertiary qualification plus a specific level of experience. These conditions need to be complemented by a requirement to provide evidence of the relevant qualification.
Over-reliance on general (adverse effects) review conditions.	A review condition should not be relied on as the primary mechanism to address unanticipated adverse effects. An adverse effects review should generally be limited to unforeseen adverse effects.	It is preferable to have targeted reviews and/or other mechanisms to deal with anticipated effects by way of feedback control. However, a review clause is usually essential.

"There are some infrequently used innovative resource consent condition mechanisms, that in many situations have the potential to provide the community, the consent holder and the consent authority with greater certainty and significantly improve the efficiency and effectiveness of the resource consent process. The following are brief summaries of some key resource consent condition mechanisms."

Specific Resource Consent Condition Mechanisms

There are some infrequently used innovative resource consent condition mechanisms, that in many situations have the potential to provide the community, consent holder and consent authority with greater certainty and significantly improve the efficiency and effectiveness of the resource consent process. The following are brief summaries of some key resource consent condition mechanisms.

Feedback Control and Trigger Response

In its simplest form, feedback control has been used as a resource management tool in New Zealand since the 1970s, for example, limiting the abstraction of water if and/or when a river flow or groundwater level drops to a predetermined threshold.

A more advanced feedback control system can involve a variable response requirement based on the state of a specific resource, for example, modelled groundwater recharge, groundwater levels or river flows. These have been referred to as a form of 'adaptive management'. However, it is probably more accurate to consider the approach as 'variable or conditional feedback control', i.e., allowing for a change in resource use or allocation depending on resource availability. This concept has historically been applied to some point source discharges to rivers where the allowable discharge increases or reduces as the river flow increases or reduces (this requires a specific environmental quality standard to be maintained at all times). Another example is the use of a water permit where the amount of water that can be abstracted varies in response to water flows or levels.

The concept has also been applied to the annual allocation of groundwater when the total available resource (above an environmental 'bottom line') can vary significantly from one year to the next. This would require robust environmental monitoring and modelling and resource consent conditions that specify individual 'entitlements' for a given period depending on the estimate of the total resource available before the start of, for example, an irrigation season. The method used to estimate resource availability would have to be detailed in advance in a resource consent condition. A trigger standard would be specified in a resource consent condition and ongoing monitoring undertaken to determine whether the trigger would apply. Clearly water permit holders want a high level of certainty about water availability before operational decisions are made.

Such mechanisms can provide certainty about environmental outcomes and provide annual certainty for water permit holders about their annual allocation.

Previous page – Tahuna marine outfall, Dunedin, photo courtesy of McConnell Dowell; Above – Project Pure, Wanaka wastewater treatment plant, photo courtesy of Queenstown Lakes District Council; Below – Hobson tunnel, Auckland, photo courtesy of McConnell Dowell

For some situations, particularly those that involve essential services such as discharges from sewage treatment plants a "trigger response" mechanism may be more appropriate than an "absolute standard" condition. For example, instead of a condition that requires the concentration or mass loading of a contaminant to be less than a specified quantity, a condition can specify what the response must be if an environmental or other threshold is exceeded. This can serve to highlight the need for the consent holder to control systems to ensure compliance with the predetermined threshold within an established timeframe. A focus on a trigger response can also recognise that it is generally not practicable for example, to stop a sewage discharge, but it is clearly prudent to have a mechanism that reinforces the fundamental requirement to achieve the specific environmental outcome that the resource consent decision is designed to achieve.

It is important to appreciate that reliance on a trigger response condition instead of an absolute standard may limit the enforcement options to actions required to achieve the required environmental outcome. However, in situations involving essential services the ultimate enforcement response would be a requirement to control the activity to ensure that the required environmental outcome is achieved.

Certification and Assurance

The use of certification mechanisms has the potential to replace the current level of reliance on generally invalid secondary approvals. The key requirement is to have clear and certain technical specifications for an independent and qualified expert[8] to assess compliance against. Basic guidance on certification conditions are outlined in the Quality Planning guidance on resource consent conditions[9]. It is important to have a clear understanding that certification involves an expert assessing whether or not well-defined technical standards or other clearly stated requirements have been achieved, i.e., the expert is a 'certifier' not an 'arbitrator'.

Certification conditions can provide a powerful mechanism that can address potentially significant adverse effects. For example, for a highly critical certification where the consequences of an error or omission could be major, the consent authority and the community

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One took
30% less
energy to produce

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can obtain a high level of assurance if, for example, the certification is carried out jointly by a consent holder's appointee and a consent authority's nominee[10]. Two experts have the potential to provide a very comprehensive and rigorous certification process. An advantage of one of them being the consent authority's nominee (they would not be appointed by the consent authority) is that that person is likely to be perceived as particularly independent.

Appropriate certification conditions can be particularly useful for some infrastructure developments where flexibility may be needed because a final design may not be determined until fairly late in the process. Provided that the performance specifications will achieve the desired environmental outcome, are adequately defined in resource consent conditions, and the consent authority has confidence that the specifications can be complied with, the detailed design does not need to be specified in advance.

In situations where the potential adverse effects are relatively insignificant, the relevant technology or systems are well established and other conditions can provide acceptable controls, there would generally not be a need for certification conditions.

Examples of performance standards that are based on environmental effects for a stormwater discharge would be a total suspended solids reduction of 75% (used frequently in Auckland) or 25mm first flush capture and treatment (used frequently in Christchurch). An eventual design would need to be certified by one or more specifically qualified person(s) as capable of meeting the specified performance standard. Additional conditions would also be required to ensure that the certified design is installed, maintained and operated correctly. The net result would be flexibility for the consent holder while at the same time providing certainty about the level of adverse effects.

Expert Determinations

In some situations it may be appropriate to rely on expert assessment of an event. For example, if a feedback control condition requires a reduction in water take or amount of contaminant discharged in response to a breach of a specified environmental threshold e.g. a water quality standard, it is possible that an event could occur that results in a breach of that standard that is unrelated to the consented activity. If such a situation occurred it would be possible to provide for example, for two experts, one appointed by the consent holder and one nominated by the consent authority to both certify in their professional opinion on the balance of probabilities that the event was caused by events beyond the control of the consent holder. For example, if a condition provided for a trigger response controlling a discharge of treated sewage to land or water if the concentration of a specific contaminant in the receiving water exceeded a specific standard, there would need to be a provision that could take account of a breach being caused by an activity unrelated to the consented activity and beyond the control of the consent holder. If such a joint certification is provided the feedback control would not apply. In the absence of joint certification, the feedback control would apply.

Uncertainty, Adverse Effects and Resource Consent Conditions

Clearly not all situations warrant the application of all possible resource consent condition mechanisms. All the available mechanisms need to be carefully considered in the context of the potential adverse effects, the nature of the activity and level of uncertainty. This is illustrated in the following simplified diagram.

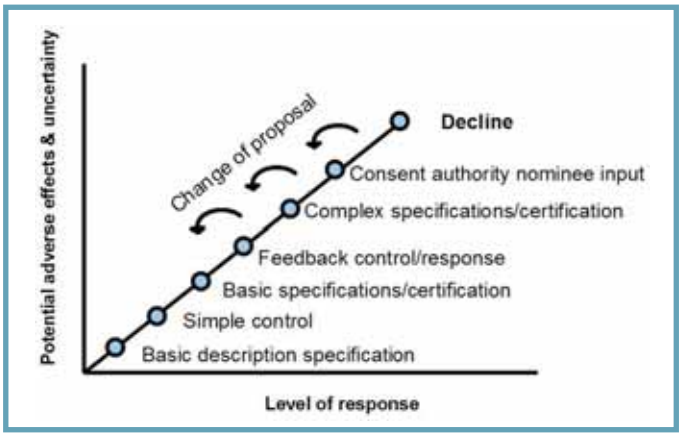


Figure 1 – A simplified relationship between the adverse effects/ uncertainty and the level of resource consent condition response

As the level of potential adverse effects and/or uncertainty increase, the level of resource consent condition response should similarly increase, up to a point where the potential adverse effects are not acceptable. In addition, a resource consent applicant sometimes reduces the scale or nature of a proposal in response to feedback about potential conditions which in turn then reduces the scale of the likely condition response, i.e., reduced potential adverse effects equals less demanding conditions.

Conclusions

The development and application of resource consent conditions in New Zealand is variable, with relatively frequent use of conditions that are invalid, unenforceable, ineffective and/or inefficient. There is scope for increased awareness of both the limitations of some types of conditions and the potential applicability of other conditions.

Greater use should also be made of available innovative resource consent condition mechanisms to improve the efficiency and effectiveness of the consent process, provide flexibility for the consent applicant/holder, and provide greater certainty that intended environmental outcomes will be achieved.

Acknowledgements

This article is based in part on the Quality Planning guidance on resource consent conditions funded by the Ministry for the Environment. Review comments by Mark Brockelsby, Environment Waikato; Marian Weaver, Otago Regional Council; Richard Hills, Ministry for the Environment, and Philip Milne, Philip Milne: Resource Management Lawyer, are gratefully acknowledged.

Footnotes

1 http://www.qualityplanning.org.nz/consents/conditions-res-con.php

2 NZ Environmental Education Charitable Trust v Manawatu-Wanganui RC, WO57/02, 8 NZED 260.

3 The courts have highlighted the distinction between an 'arbitrator' and a 'certifier'. Pine Tree Park v North Shore CC, HC 26/96.

4 The Augier Principle provides that if otherwise ultra vires conditions are volunteered by a resource consent applicant, and if that resource consent is granted with those conditions, they are enforceable.

5 Wood v West Coast Regional Council and Buller District Council, C127/99.

6 Genesis Power Limited v Manawatu-Wanganui Regional Council [2006] CIV-2004-485-1139 (HC)

7 Section 104(2A) "…the consent authority must have regard to the value of the investment of the existing consent holder."

8 The critical requirement is that the expert has the required qualifications. Some councils prefer to have a council officer undertake such certification. While this may provide some additional assurance, it also relieves the consent holder of some responsibility and transfers it to the consent authority.

9 http://www.qualityplanning.org.nz/consents/conditions-res-con.php

10 This does involve the consent authority taking on some responsibility, but may be appropriate to provide an additional level of assurance.

Left to right – Stormwater swale treatment system, photo courtesy of Stormwater Solutions Consulting Ltd; Tahuna outfall, Dunedin, photo courtesy of McConnell Dowell; Christchurch marine outfall during construction, photo courtesy of Christchurch City Council; Tahuna outfall, Dunedin, photo courtesy of McConnell Dowell; Christchurch oxidation pond, photo courtesy of Christchurch City Council

Source Control of Zinc from Roofs – in the 'Too Hard Basket'?

Nigel Mark-Brown – Environmental Context Ltd, a member of the Environment and Business Group (EBG)

As a result of rapid accumulation of zinc in parts of Auckland's Waitemata Harbour together with limitations in the effectiveness of stormwater treatment at removing dissolved zinc, the then Auckland Regional Council (ARC) initiated technical investigations to address the quality of stormwater from roofs in the Auckland region in 2002. This work, which continued over a number of years, showed that elevated concentrations of zinc were found in stormwater from industrial areas with galvanised roofing, and, to a lesser extent, with unpainted zinc-aluminium coated steel roofing. It also showed that roofs contribute most of the zinc in stormwater from commercial and industrial land uses and about half the zinc from residential uses. The ARC considered that reducing the use of galvanised iron and exposed metal roofing products and maintenance of older galvanised iron roofs would be effective stormwater quality source controls and consequently would reduce requirements for stormwater treatment.

In 2004 the ARC developed a first draft document on policy implications that identified unpainted galvanised, zinc-aluminium and copper material as requiring source control or treatment. As a result, some subsequent Integrated Catchment Management Plans (ICMPs) in Auckland suggested prohibiting the use of unpainted "Zincalume" zinc-aluminium alloy coated steel. The manufacturers of Zincalume strongly queried the justification for prohibition of Zincalume, which led to the withdrawal in 2006 by the ARC of draft policy that required source control or treatment for unpainted zinc-aluminium.

The initial draft policy was superseded by a "Management of Stormwater Contaminants at Source Issues and Options Scoping Project". It is not clear what happened to this project, but to the author's knowledge no policy recommendations or decisions arising from this project in relation to zinc in roof runoff have been promulgated by the ARC since 2006.

Roof Types Currently of Potential Concern in Auckland with Respect to Zinc

Preparation of ICMPS in Auckland over the last few years have included calculating contaminant loads from differing land uses and preparing a corresponding assessment of contaminant accumulation in the estuarine receiving environments. Land use contaminant loads are generated using a Contaminant Load Model (CLM) prepared by the former ARC. The CLM includes zinc yields for a range of roof materials. For example in the May 2006 version of the CLM, unpainted galvanised iron roofing has the highest zinc yield, which is 7.3 times higher than unpainted zinc-aluminium, and 55 times higher than Colorsteel.

The zinc yields generated by the CLM indicate that unpainted or poorly painted galvanised iron roofs have by far the highest zinc loads. Zinc-aluminium roofs have considerably less zinc load than galvanised iron, but significantly more than the commonly used Colorsteel.

"The initial draft policy was superseded by a "Management of Stormwater Contaminants at Source Issues and Options Scoping Project". It is not clear what happened to this project, but to the author's knowledge no policy recommendations or decisions arising from this project in relation to zinc in roof runoff have been promulgated by the ARC since 2006."

Aerial photo extensive area incluidng galavanised iron and zincalume roofs

There are extensive areas of unpainted or poorly painted galvanised iron roofs in the Auckland region. These are predominantly older roofs of residential houses, but include some commercial/industrial areas constructed before the introduction of Zincalume in 1994. There is very little unpainted galvanised iron used for new residential housing or commercial/industrial buildings in Auckland. Although most of the old galvanised iron roofs can be expected to be replaced within the next 25 years, they will continue to discharge zinc into stormwater over that time.

Contaminant accumulation studies carried out as part of preparation of ICMPs in Auckland show that at several locations zinc concentrations in estuarine harbour sediments have already reached undesirably high levels or is predicted to do so within the next 10 to 20 years.

Possible Need for Further Assessment of Runoff from Zinc-Aluminium Alloy Roofs

Zinc-aluminium roofs were brought to market in 1994 and are widely used in commercial applications.

Investigations associated with the Seattle-Tacoma airport in the US demonstrated significantly elevated concentrations of zinc in runoff from zinc-aluminium alloy roofs, which required treatment to protect the adjacent receiving environment[1]. These concentrations imply a zinc load from the contributing roofs much in excess of the loads nominated for zinc-aluminium roofs in the ARC's CLM model.

It is thus considered it would be prudent to revisit the extent of zinc in runoff from unpainted zinc-aluminium alloy roofs, in particular from large warehouse roofs.

Source Control as Best Practical Option

The author has carried out assessment of stormwater contaminant management options for an urban and urbanising area in Auckland in 2010. This comprised a best practical option (BPO) analysis of a range of methods that could be used to significantly reduce the discharge of zinc in stormwater runoff from a subcatchment comprising a significant area (approx 125 ha) of warehouses and factory buildings. A large number of these buildings had galvanised iron roofs constructed prior to 1994. This analysis demonstrated that source control of the older galvanised iron roofs, for example by painting, was by far the most cost effective method for removal of zinc. It was also likely to be much easier to implement than other options such as treatment of stormwater by large devices, due to the built up nature of the catchment and the relative cost-effectiveness of such devices at reducing zinc loads.

Implementation of Source Control

The author's experience is that both regulatory and non-regulatory methods are needed for implementing source control.

In theory, there is a range of regulatory methods for implementing source control. These include using mechanisms and/or regulations under the Resource Management Act and the Building Act. Other mechanisms may be available under non-statutory government-driven national initiatives, such as that which resulted in lead being taken out of petrol in New Zealand in 1996[2].

Discussions with staff of the then Manukau City Council involved in implementing the Building Act indicated that it would be difficult or impractical to use it to implement source control of zinc from roofs. The Building Act is targeted at the efficient use of materials and resources rather than managing off site effects[3]. It is thus considered that methods under the Building Act can be discounted.

Mechanisms available under the Resource Management Act 1991 (RMA) are:

- National Environmental standards promulgated by the Minister for the Environment, which could possibly control the use of certain materials for roofing based on their environmental effects
- Regional plans, which could control contaminant-generating aspects of roofing materials by:
  - » control of land-use under RMA section 9
  - » discharge of contaminants under RMA section 15
- District plans, which could control contaminant-generating aspects of roofing materials by:
  - » control of land use under RMA section 9
  - » control of subdivision RMA under section 11

Any such requirements for controlling the discharge of zinc from roofs would be determined from studies or assessment of the

effect of the discharge, and hence may vary widely over the country, depending on the receiving environment. Use of a National Environmental Standard is thus not considered likely to be appropriate. Also, as the discharge is related to the roof material rather than the actual land use, using the land use controls of the RMA are not considered appropriate. The best mechanism under RMA thus appears to be in a Regional Plan using Section 15.

Section 15 states that no person may discharge any contaminant into water unless the discharge is expressly allowed by a rule in a regional plan and in any relevant proposed regional plan, a resource consent, or regulations.

For the Auckland Region, the Proposed Auckland Regional Plan: Air Land and Water (the 'proposed plan') has a complex matrix of requirements regarding authorisations for stormwater discharges. These generally relate to areas of impervious area within individual sites. For sites with impervious areas between 1000m^2 and 5000m^2, the discharge of stormwater is a controlled activity with a range of requirements including that the ARC (now the Auckland Council) shall exercise its control over the degree and consistency and integration with any Integrated Catchment Management Plan within the same catchment. This requirement is open to interpretation, but may allow the regulatory arm of the Auckland Council to require source control if this is shown in the ICMP to be the best practical option.

Non-regulatory methods can also be used to implement source control. These comprise collaborations of various kinds and may include:

1. Consultation with owners of buildings having zinc-generating roofs to request that they replace or repaint their roofs, possibly with the encouragement of financial incentives
2. Education of the building owners, roof product specifiers and industry associations to avoid use of high zinc-generating roof materials for new or replacement roofs
3. Research into alternative roofing materials and/or source control or removal methods

The authors of ICMPs to date have not traditionally been willing or able to engage with stakeholders such as those listed above, yet this is an area where open discussion and collaboration may help clarify issues and solutions.

The method or methods eventually selected for implementation would also depend to a large extent on whether the aim is to control zinc runoff from existing roofs or from those constructed in the future.

Determining whether source control is appropriate for particular catchments or subcatchments requires contaminant load analysis and evaluation of contaminant removal options. A shortcoming of the traditional ICMP preparation process has been that they are generally desktop exercises, which by their nature often require significant assumptions to be made.

However, for older roofs on commercial/industrial buildings, it is not easy to ascertain the type of roof material without individual site inspections. As a result, assumptions are made about the extent of particular roof materials present in order to model likely contaminant runoff. Such assumptions need to be ground-truthed as part of detailed finalisation or implementation of the ICMP.

Equity and Funding Issues for Source Control of Existing Roofs

Where source control of zinc from existing roofs is identified as a preferred option (perhaps in conjunction with other mechanisms for reduction of other contaminants), significant issues arise with respect to equity and funding such source control. Key questions include:

- Are there appropriate statutory mechanisms available to the implementer of an ICMP and if so, should they be used to require individual building owners to carry out source control at their own individual cost?
- Should the network operator implementing the ICMP provide some or all of the funding to carry out source control on privately owned buildings?
- Can the network operator justify providing funding to carry out source control on privately owned buildings?

There is a need to address political implications of perception of favouring one sector of the community over the wider community, and while research[4] has been done indicating there is a return to the wider community from part-funding of improvements on rural land with public money, similar work in the urban context would be useful.

The author's opinion is that the equity and funding issues need to be addressed by way of stakeholder engagement as part of the ICMP process. This will include consultation and internal discussion within relevant parts of the network operator.

Consultation should be carried out with individual owners of builders with zinc-generating roofs. This is needed to confirm or otherwise that particular roofs are generating zinc and that source control is the best practicable option. Consultation is also needed to ascertain the age and condition of the roof and to estimate the length of its remaining life. It would also involve explaining to land owners the contamination issues and the mechanisms that were available to use in order to implement source control, and those that the network operator was intending to use. Feedback from individual building owners on available implementation mechanisms could then be obtained and the network operator would then decide on the way forward.

Source Control for New and Future Roofs

It appears to the author that some kind of regulatory mechanism may be appropriate for the use of unpainted galvanised iron for new roofs. This is probably not particularly urgent for Auckland region, given the small amount that is used, but may be an issue in other areas.

The apparent low loads of zinc being generated by unpainted zinc-aluminium roofs currently do not warrant source control or separate treatment.

As mentioned previously, given overseas experience in elevated zinc concentrations in runoff from unpainted zinc-aluminium roofs it is considered prudent to revisit the extent of zinc in runoff from unpainted zinc-aluminium alloy roofs, in particular from large warehouse roofs and the associated need for source control or separate treatment.

Summary and Conclusions

There was a flurry of investigation and discussion about source control of zinc from roofs in Auckland region from 2002 to 2006. Since then there has been little discussion in Auckland about implementing roof source control. There are a number of difficulties in roof source control implementation, but where initial analysis indicates it may be an appropriate option for contamination management, it is in the author's opinion worthwhile and necessary to investigate in detail the practicality of implementing source control options. ■

Nigel is a consulting engineer with expertise in stormwater management and environmental effects assessment. He is an accredited RMA decision maker and has sat on hearings panels for a range of consents including for discharges of contaminants.

This article is based on experience with preparation of catchment management plans in Auckland. It is hoped, however, that it addresses issues that are relevant to other parts of the country.

Footnotes

1 Warehouse Roof Runoff Contamination Corrected at Seattle-Tacoma Airport. ons magazine, pages 12–13. Downloadable from http://www.sitesolutionsmag.com/pdf/v2i2/focusonbmp.pdf.

2 http://www.un.org/esa/agenda21/natlinfo/countr/newzea/airPollution.pdf.

3 Seyb. R, Shaver.E, Fourth South Pacific Conference on Stormwater and Aquatic Resource Protection. "Developing Stormwater Source Control Policy: Exposed Metal Roofing in Auckland"

4 For example Hatfield-Dodds, Steve and CSIRO, 20033 The catchment care principle: an integrated approach to achieving equity, ecosystem integrity and sustainable development. Ecological Economics Think Tank, Auckland, November 2003.

Rainwater Tanks – Sustainable Supplementary Supplies in New Zealand?

Iain Rabbitts – Principal and Nicky Brown – Process Engineer, Harrison Grierson Consultants Ltd

Introduction

The use of rainwater tanks as a supplementary supply to reticulation has been a topic of much discussion over the past few years. The question of sustainability has often been raised with parties advocating that rainwater tanks in the urban environment have undeniable benefits to the environment and the ratepayer. However if the sustainability of rainwater tanks is in question then each of the three aspects of sustainability must be assessed. 'Sustainability' is taken to mean the combination of Environmental, Social and Economic Sustainability.

If any of these aspects of sustainability is given the 'veto' over another, the whole concept of sustainability collapses. Therefore each aspect must be given equal weighting when assessing the sustainability of urban rainwater tanks.

Studies Performed

Over the past 5 years Harrison Grierson has performed a number of studies into rainwater tanks in the urban environment. These studies were performed for Rodney District, Pokeno Village, Wellington City, Porirua, Upper Hutt, and Lower Hutt. A model was developed for rainwater tank use in each of these cities using daily rainfall as the flow into the tank (5,000L or 10,000L) and a percentage of the daily demand as the outflow from the tank. The effective roof area was used to collect rainwater for the tank and the first 2mm of rainfall was removed for the first flush diverter.

The aim of these studies was to see whether the rain water tanks could guarantee supply over a dry summer or whether they would need topping up from the mains. In each one of the studies it was shown that unless you have a very large effective roof area with a low occupancy rate, even a 10,000L rainwater tank would not be able to guarantee supply over a dry summer. It should be noted that all the assumptions that were made in the model were in favor of rainwater tanks (for example 100% of the roof area collects water which is directed into the tank).

It has been shown by Lucas et al (2011) that this method of analysis has resulted in a maximum error of 15% in studies performed in Australia. This error comes from using total daily rainfall and demand rather than 6 minute interval rainfall and demand data. It is accepted that the models developed may have this 15% error, this may reduce the days when mains top up is required, but mains top up will still be required.

Economic Sustainability

The statement that "apart from the cost to collect and use the water, rainwater harvesting is free" is correct. These costs still need to be included in the economic evaluation as part of a sustainability assessment. The question then becomes, which of these costs is greater for the user and for the Council, installing rainwater tanks or not?

Cost of Rainwater Tank Installation

From the point of view of the ratepayer, the cost to install a 5,000L rainwater tank collection system will be somewhere in the order of $7,500, disregarding the manifold, watermeter and ongoing running costs. If the total demand per person is approximately 250L/day and 34.5% of this is used for outdoor use and toilet flushing, a 4 person household will draw 129m^3 of water from their rainwater tank in a year. If the rainwater tank can supply all of this demand (which for a dry summer it cannot, as discussed above) the maximum potential savings in the household's water bill would be a total of $194 per annum (assuming $1.50/m^3). This would give a payback period of 39 years for the rainwater tank even in the best case scenario. Thirty-nine years would be more than the useful life of the tank.

If a council decides it is in the best interest of the city to retrofit rainwater tanks, they would most likely need to subsidise the scheme. If it is assumed that the ratepayer will look for a 5 year payback period, the cost to Council will be in the order of $6,531 per household. If 25% of households will partake in the scheme in a city the size of Upper Hutt (14,253 occupied dwellings) this equates to a total cost to Council of $23 million.

Savings in Reticulated Supply

For the reticulated supply the costs and benefits to the entire supply chain should be looked at; from abstraction and treatment to distribution.

For raw water abstraction, if the supply is a groundwater/stored water source the main restriction is from a cumulative yearly total. Therefore any reduction in demand over the year relates to benefits in terms of the fines for non-compliance and the costs of increasing an existing consent or storage capacity. This means that rainwater tanks can provide a real cost benefit when groundwater/stored water sources are the main supply.

For surface water sources, such as rivers, the consent condition usually limits the instantaneous abstraction rate. During the summer months when the river flow is low and therefore restricted, the majority of rainwater tanks will be empty as there will have been little or no rain. In this scenario the demand on the reticulated supply will be the same as it would be without the rainwater tanks, meaning rainwater tanks would provide no benefit for a when surface water sources are the main supply.

For the water treatment plant (WTP), the running costs would be lower as less water will be produced over the year. However the fixed costs of running and maintaining the plant will be the same. As these cost form the majority of the costs for treated water production the savings would not be significant. Installation of Rainwater tanks does not reduce the infrastructure capacity that needs to be provided by the Council. The WTP and network are the same size regardless of whether or not rainwater tanks are installed. The provider must be able to cater for peak demand during a dry summer.

There would be some economic benefit to councils in that they may be able to provide less treated water storage as the drawdown of large reservoirs will be deferred. However a detailed model would need to be developed specific to each application to assess whether any benefits can be found here.

Environmental Sustainability

If rainwater tanks are looked at as a supplementary supply, the immediate environmental benefit appears to be lower abstraction rates from the raw water source. However, as above, during the summer months when rainfall is the lowest, the rivers will be at their lowest, the demand will be the highest and the rainwater tanks will most likely be empty (as there has been no rain to fill them). This would mean that demand would rise dramatically when there is little rainfall as all the rainwater tanks are topped up by the mains supply. This means that when the river is at its lowest, the council will need to be able to supply the same amount of water as without the rainwater tanks. The biggest risk to the environment is during low river flows. As the rainwater tanks provide no effective storage at this time, there is no reduction in abstraction and therefore no reduction of environmental impacts.

Rainwater tanks are often touted to improve stormwater attenuation in the urban environment; it is true that rainwater tanks can have some benefits in collecting stormwater. However this is only occurs when you have heavy rainfall after a long dry spell as the tank must be partially empty to collect any stormwater. Once a rainwater tank is full (which is its most desirable state) the stormwater attenuation capability of the tank is nil. This means that over the winter, the rainwater tank will have very limited stormwater attenuation capability as most of the time they will be full or nearly full.

Social Sustainability

There is no denying that in locations where a reticulated supply is not available, rainwater tanks play a vital role in water supply. However, here rainwater tanks are looked at solely as a supplementary supply to reticulation in the urban environment. In this situation the social benefits are hard to find.

Water conservation is a vital part of the future water supply strategies; however rainwater tanks, particularly without metering, provide little benefit here. Rainwater tanks help conserve water mainly over the winter months when the demand is the lowest and the sources are the most abundant.

Another aspect to rainwater tanks is their use as emergency supplies. If the tank is being installed for use as an emergency supply it must be full all the time. When the tank is full, it collects no rainwater, therefore it is not a rainwater tank at all, it is an emergency supply

"The statement that "apart from the cost to collect and use the water, rainwater harvesting is free" is correct. These costs still need to be included in the economic evaluation as part of a sustainability assessment. The question then becomes, which of these costs is greater for the user and for the Council, installing rainwater tanks or not?"

tank, filled with mains water. Emergency supply tanks can provide vital benefits in the event of a natural disaster; however this is a completely separate topic and should not be considered under the benefits of a rainwater tank.

One issue which is a big problem for retrofitting of rainwater tanks in the urban environment is size constraints. A standard 5,000L tank is 2.0m high and has a 1.8m diameter. There will be a large proportion of households in New Zealand's urban areas which will not be able to fit, or will not want to fit, a tank this size in their back yard. If the tank is installed below ground then the water will need to be pumped to a greater pressure, increasing the running and maintenance costs.

Summary

In summary, the following concerns should be carefully considered when looking at installing rainwater tanks as supplementary supplies in the urban environment:

- In the studies performed, all assumptions made were in favor of rainwater tanks
- Rainwater tanks can only guarantee supply for houses with very large roof areas and low occupancy
- If the rainwater tank cannot meet the demand during a dry summer, the reticulation network will have to supply the same amount of water as it would without the tanks and would have to draw the same amount of water from the raw water source
- Even if the rainwater tank can supply water all the time, the maximum saving from water charges would take 39 years to replay the capital cost of the rainwater collection system
- Rainwater tanks cannot be relied upon to function as emergency storage or stormwater attenuation
- There are major space restrictions which would inhibit installation of large rainwater tanks in the urban environment, potentially increasing the cost of installation

There is no denying that rainwater tanks may be able to provide benefits to the ratepayer and the council when reticulated supply is not available or a groundwater/stored water source is used for supply. However each scenario must be assessed individually from a social, economic and environmental standpoint before the question of sustainability can be answered.

Commercial Rainwater Harvesting: Integration of Stormwater Management for Marine Industry Precinct

Bronwyn Rhynd – Environmental Engineer, Stormwater Solutions Consulting Ltd

Top and Right – Hobsonville yard, Above – The landing

Waitakere Properties Limited (WPL), a subsidiary of Waitakere City Council, and Hobsonville Land Company (HLC), a wholly-owned subsidiary of Housing NZ Corporation, commissioned a review for an innovative and alternative approach to addressing their respective stormwater management objectives. The aim was to reduce the impact on the environment and to scope the cost benefit of commercial stormwater harvesting. WPL, as the developer of the 20ha Super Yacht Marine Industry Precinct, needs to manage large volumes of stormwater runoff. The site includes a large roof catchment area of 9.4ha. Onsite stormwater reuse has been considered to provide water to the estimated 1,850 employees. This would only utilise a fraction of the total water captured from the roof areas. This poses an interesting challenge in terms of stormwater disposal.

HLC is developing the adjacent Sunderland precinct which is proposed to include over 500 households units (including detached, terrace and apartment style housing). HLC is committed to installing a rainwater re-use system for non-potable re-use for toilet flushing, laundry and garden irrigation.

The catchment area made up of large impervious roof surfaces in the Marine Industry Precinct will create a considerable design challenge. In response the stormwater engineers, in consultation with local councils, developed a more sustainable solution for stormwater disposal to reduce the impacts.

Commercial harvesting of stormwater for re-use is an option that involves collection, treatment and redistribution, which can reduce demand on both the stormwater and water supply networks. Treatment of the harvested stormwater must meet industry and health quality standards, where the level of treatment depends on the end use, i.e. potable or non-potable activities.

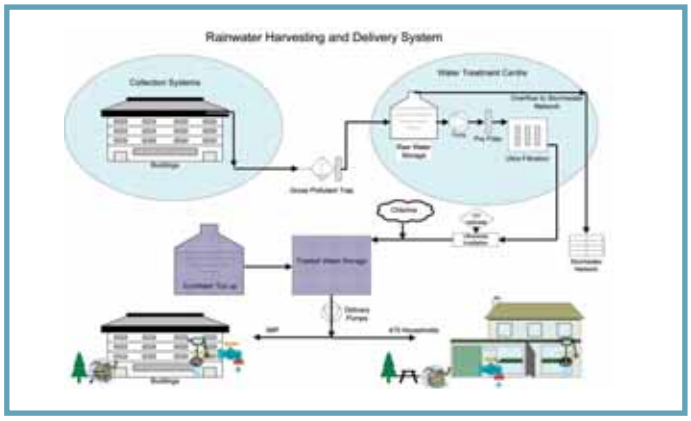
Stormwater Solutions Consulting Limited (SSCL) and MSC Consulting Group Limited were engaged by WPL and HLC to investigate the feasibility of commercial stormwater harvesting from the Yard 37 development for reuse in Yard 37 and the adjacent Sunderland precinct to mitigate the requirement for individual household stormwater reuse tanks.

Commercial stormwater harvesting aligns well with both WPL and HLCs' philosophy of practical sustainable development. HLC formulated an objective to provide 75% of the non-potable water demand via the re-use of onsite harvested stormwater. This aligns with the annual harvested volume from the Yard 37 roof area, being well in excess of the internal Yard 37 water re-use demand. The opportunity for external re-use was identified.

A water supply system has variables, such as water demand, tank storage size and treatment level, that need to be optimised in order to provide an economic outcome. The supply versus demand relationship is a challenge to manage for commercial harvesting as rainfall incidents are variable while demand is constant.

SSCL performed a cost benefit analysis to determine the optimum scenario for the stormwater harvesting needs of the WPL and HLC. The two main scenarios analysed were providing Yard 37 and the Sunderland precinct with a non-potable supply versus providing a total water supply. In both cases the need for a "top-up" from the public supply was included in the assessment. The analysis revealed that providing a total water supply to the development is the most economical option.

> "There are several interesting challenges that need to be resolved if this innovative solution is to be adopted."



Visio-Rainwater Harvesting and Collection

Implemented correctly, a commercial stormwater harvesting solution can be an effective stormwater management tool. In terms of providing a suitable water supply, it will generally have a lower overall annual cost than the conventional public water supply option, whilst concurrently decreasing infrastructure demand impacts and consequently future cost increases. An additional benefit is the mitigation of the anticipated increase in public water supply charges. Commercial stormwater harvesting also has a range of sustainability benefits that do not have a monetary value but do provide on-going benefits to the community. In the case of the Yard 37 development, stormwater re-use will link the industry with the communities surrounding the site, by creating an industry-community relationship.

This re-use philosophy has the potential to increase sustainability awareness in these developments.

There are several interesting challenges that need to be resolved if this innovative solution is to be adopted. These include timing and staging of the Yard 37 and Sunderland precinct and infrastructure, ownership, access and maintenance requirements. ■

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Sandringham Road Transport Corridor Upgrade

Zeb Worth – Environmental Engineer, Opus International Consultants

The Sandringham Road Transport Corridor Upgrade project is located in the Auckland suburb of Kingsland, adjacent to the Kingsland Rail Station and the Eden Park Stadium Complex. The upgrade was part of the Auckland Council long term transport plan for Sandringham Road to deliver an integrated transport corridor that provides transport choices for the residents and businesses within the local community. It is an integral part of the public transport and walking route for the 2011 Rugby World Cup. The core project team consisted of Auckland Transport (client), Opus International Consultants (design and MSQA consultants) and Fulton Hogan (construction contractors).

The project involved realigning and widening the existing carriageway of the main arterial road along an 800m length as well as upgrades to the local roads around the Eden Park Stadium Complex. Planning, design and consenting of the project began in 2008, with the physical works completed in December 2010. The project incorporated stormwater and utility upgrades, road safety improvements, urban design, pedestrian accessibility and public transport upgrades with a degree of integration rarely seen on projects of a similar nature.

One of the fundamental requirements of the project was to address the issue of historical surface flooding on Sandringham Road between the Kingsland Rail Station and Reimers Avenue. The flooding was primarily the result of an aging network of soakage pits that were no longer functional and unable to remove surface water from the road. The downstream piped network was unable to cope with the additional volume of run-off and significant areas of surface flooding occurred at the low point in the road during even minor rainfall events.

Initial consideration was given to installing a new large-diameter stormwater collector along the route to replace the ineffective network of soakage catchpits and convey to runoff to the catchment outlet adjacent to Reimers Ave. While this option would have solved part of the problem by reducing surface flows, the limited capacity of the downstream piped network would still have been the major constraint and the existing surface ponding issues would have remained. As upgrading the entire downstream pipe network to improve capacity was not a viable option, Opus adopted low impact stormwater design techniques to reduce the volume and rate of stormwater runoff from the site. This involved minimising the net increase in impervious area and managing stormwater runoff as close to the source as possible.

The use of swales, raingardens and permeable tree surrounds meant that the project resulted in only a 6% net increase in total impervious area while providing two dedicated bus lanes, wider footpaths and new public open spaces. Adopting this approach minimised the amount of stormwater runoff that needed to be managed and reduced the scale of the management device required. This was particularly crucial in light of the limited space available within the already highly developed urban catchment.

Soakage Raingarden

The predominant method for stormwater disposal on the project was via soakage systems in order to mimic as closely as possible the natural hydrological characteristics of the site. To replace the aging network of soakage catchpits, the stormwater engineers designed a new road drainage soakage system to capture excess runoff to alleviate the existing flooding issues and reduce overland flow. Approximately 50% of the original catchment is now diverted to groundwater, alleviating the capacity issues in the downstream pipe network. An added benefit of installing the soakage systems close to the source of runoff was that the need for traditional piped collection and conveyance systems was minimised and in some cases eliminated entirely. This significantly reduced construction costs and minimised disruption to traffic and existing services during installation.

Pre-treatment Swale with Soakage Outlet

As was evident from the historical performance of existing soakage systems within the road corridor, high sediment loadings and a

Left to right – Raingarden soakage outlet, Pre-treatment swale with soakage outlet, Soakage raingraden, another raingarden and detail

lack of maintenance can have significant adverse effects on the performance of soakage systems. To reduce the risk of premature failure and to increase the operational life of the soakage systems, the new stormwater soakage systems were provided with a high level of pre-treatment through bio-filtration systems (raingardens and swales).

The aquifer is not within a designated aquifer protection zone, However the Eden Park Trust Board indicated that it may look at the option of a water take from the aquifer in the future for use in field irrigation. The measures adopted to remove sediment and prevent clogging of the soakage systems t also help remove other significant runoff-borne pollutants thus minimising contamination of the underlying aquifer. This added benefit will help keep options for the future use of the aquifer open.

The Sandringham Road Transport Corridor Upgrade project represents a significant achievement, transforming what was once a congested arterial road prone to surface flooding into the 'Gateway to Auckland' for international visitors. It also demonstrates how using at-source stormwater management and treatment techniques can provide savings in construction costs and enhance environmental outcomes. ■

> "The predominant method for stormwater disposal on the project was via soakage systems in order to mimic as closely as possible the natural hydrological characteristics of the site."

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Extreme Weather Events and the Mining Industry

Paul Locke – Senior Climate Change; Craig Clifton – Climate Change Practice Leader, Sinclair Knight Merz and Seth Westra – Senior Research Associate, UNSW Water Research Centre, School of Civil & Environmental Engineering, University of New South Wales

Flooding is part of the natural cycle of climate variability, so the current discussion about whether the recent floods in Queensland, Australia, or the record breaking drought that preceded them, were caused by climate change, unnecessarily diverts attention away from the urgent need to adapt to climate extremes.

The best available scientific information indicates that climate change may amplify some aspects of natural climate variability, resulting in the normalisation of weather events currently considered extreme. There is a growing body of empirical evidence (especially extreme temperatures, rainfall and sea levels) suggesting that climate change is already having this effect.

To date, the mining industry's focus with respect to climate change has been on the emissions mitigation and the implications of a price on carbon. Recent events highlight the flip-side of the climate debate – climate adaptation. Mining operations may be more vulnerable to climatic extremes than previously assumed. As such, the mining industry needs to consider whether current approaches to mine and infrastructure planning and design provide an adequate basis for cost effectively managing the extreme weather events that might occur in the future. Mining industry recognition of climate change has not yet translated into widespread consideration of climate change in planning and projects.

Planning and design are generally informed by design standards that are based on historical experience. However, our understanding of climate change suggests that history will provide an increasingly unreliable guide to future experiences of climate and weather extremes. Unfortunately, since the scientific basis for extreme weather event projection under climate change is still emerging, there is no agreed alternative to the conventional approach.

In the meantime, approaches to planning and design are required that provide a sound basis for decision making under uncertainty and enable the identification of cost effective measures to enhance resilience. Risk techniques provide a useful framework, and should draw on analyses of climate extremes and their impacts and how they might be affected by climate change.

What is Climate Risk?

Climate risk refers to the extent to which an organisation's infrastructure, operations and markets are affected by variability and long term shifts in the averages and extremes of climate. In mining operations, climate risk may be manifested in areas as diverse as:

- Threats to mine water supply security
- Damage to mines and associated transport infrastructure from flooding, cyclones and bushfires
- Threats to port operations and infrastructure from sea level rise and storm surges
- Overtopping of tailings dams, leading to failure and environmental contamination
- Delays in construction of mine infrastructure or in production and shipping of product
- Human health threats for mine staff from changes in working conditions or disease prevalence
- Climate-related social dislocation and security concerns in communities around mining operations
- Changes in surface water and groundwater interactions, with implications for acid mine drainage or movement of contaminants
- Threats to vulnerable ecosystems in areas within mining operations from direct climate impacts or via climate sensitive agents, such as fire, pests, weeds or diseases.

The effects of climate risks might include: operational delays, revenue losses, increased production costs, labour shortages, environmental damage, loss of reputation and adverse mine legacies. If properly understood and managed at the right time in the mine life cycle, these risks can be accounted for in planning, investment and operational decisions.

Assessing Climate Risk

The sources of climate risk, its importance and management responses vary with the phase of a mine's life cycle. For example, when developing a construction programme for a mine site or transport infrastructure it would be useful to know

"The effects of climate risks might include: operational delays, revenue losses, increased production costs, labour shortages, environmental damage, loss of reputation and adverse mine legacies. If properly understood and managed at the right time in the mine life cycle, these risks can be accounted for in planning, investment and operational decisions."

the projected number of rain days or the likelihood of flooding over the coming wet season. By contrast, a long-term water supply strategy could involve establishing water security from a number of supply sources over the mine's design life. Such an analysis would need to include an evaluation of the influence of natural climate modes, as well as longer term climate change projections. Finally, a mine rehabilitation strategy is concerned with the likely climate beyond the end of the mine design life, and therefore would need to consider long-term climate change projections.

The diagram below provides an overview of the techniques available for characterising climate risk at each of these time-scales.

Scale	< 10 days	1-18 months	Up to 20 years*	20-60 years*
Why is this useful?	Day to day planning	Mine construction and operation	Flood assessments. Mine water balances	Water Security Assessments. Mine rehabilitation plans
How is this assessed?	Meteorological forecasts	Forecasts using oceanic variability	Stochastic generation to simulate past climate behaviour	Downscaling from global climate model (GCM) simulations. Scenario testing and sensitivity analysis
Part of mine life	Operation	Procurement, construction, operation	Planning, feasibility, design	Planning, feasibility, design, decommis-sioning

*For long-term future impact assessments, natural climate variability and human-induced change will need to be considered jointly to ensure various climate risks are adequately characterised. It is noted, however, that most climate change assessments are for the window from 2030 to 2070 after, with implicit assumption that natural variability will be dominant from the present to 2030, or alternatively that the impact of climate change next 20 years can be adequately characterised by extrapolation between current climate conditions and 2030 forecasts.

Incorporating Climate Knowledge into Mine Management

The assessment of risks and opportunities associated with climate variability and change should be an integral part of all mining projects from the initial planning all the way through to mine decommissioning. This assessment could simply consist of asking some questions to assess risk and vulnerability as part of the design scoping discussion, or it could be a more specific and comprehensive plan tailored to specific aspects of a project.

The fundamental question is how does climate variability and change affect the mining project? This involves an assessment of:

- The project's sensitivity to climate: this refers to the degree in which change in climate will affect the project. For example, what would be the effect of a 20% increase in flooding from a nearby river or a decrease of inflows to mine water storage of 20%?
- The project's exposure to climate: this refers to the magnitude of natural variability and/or extent of projected human-induced changes in temperature, water availability, likelihood of floods and storms, and/or sea levels
- The capacity to adapt to change: the capacity – planned or unplanned – of the mine operator, local communities and/or natural environment to adapt to change in climate

Considering Climate Change at Each Step of the Project Life Cycle

An alternative framework for assessing and managing risk considers the likely climate impacts at all stages of the project life cycle (below). This will involve asking additional questions to what is normally considered, with the aim of embedding an appreciation of climate risk and opportunity in project vision, goals and delivery methods.

Overview of SKM framework for assessing and responding to climate risk in a mine life cycle

Conclusion

Climate variability and change contain risks and opportunities that will manifest at all stages of the mine lifecycle, at a range of geographic locations and over a range of planning horizons. This requires a robust understanding of how the climate currently operates and of how this might change in the future. It also requires an understanding of the design and operational flexibility to manage this risk. Although uncertainty will always be part of any assessment or risk, the tools are now available to assess and adapt to climate risk throughout the mine life cycle. ■

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Deploying Small Water Systems

Flight Sergeant Colin Edie – Environmental Health Technician, Expeditionary Support Squadron, RNZAF

The Royal New Zealand Air Force (RNZAF) often exercises or deploys to locations where normal infrastructure such as potable water and waste facilities are not readily available. This is particularly the case for 3 Squadron (helicopters) whose location of choice is usually a bare field next to an airfield, or in the middle of nowhere. This could be in New Zealand, Australia or tropical countries such as Bougainville, Timor Leste, Fiji or Samoa. Longer term tented camps whether a few weeks or few years, need to provide for a healthy, safe and preferably comfortable environment.

The Air Force 'Camp Maintainers' are our engineering people who provide camp utilities such as potable water supply, hot showers, laundry, hand washing and food hygiene facilities through to toilets and wastewater removal. To ensure a safe and dependable water supply the camp maintainers work closely with a range of people including operational planners, environmental health, medical and electrical personnel – teamwork is key to a successful outcome.

The Challenges

Deploying water treatment capabilities presents interesting challenges. These include knowing what treatment options to select, security of water supply, transportation of equipment, power requirements and having enough spares in case something goes wrong in remote locations.

"Deploying water treatment capabilities presents interesting challenges. These include knowing what treatment options to select, security of water supply, transportation of equipment, power requirements and having enough spares in case something goes wrong in remote locations."







What is the Water Used For?

Water on deployments can be divided into potable and non-potable uses. This is because it is not always practical (or necessary) to treat all the water to the level of military or New Zealand drinking water standards for potable uses. Water used for flushing toilets, washing clothes and vehicles does not need the same level of treatment as water used for drinking, cooking or personal hygiene.

Sources of Water

Usually the source of water can be determined prior to the actual deployment through desktop research, liaison with local authorities and, preferably, a site visit. The supply can range from tanker trucked potable water (e.g. from local supply, Coalition forces, UN), or local reticulation fire hydrant, river, or bore. Desalination from seawater would require reverse osmosis such as is used on the Navy ships or the Army's MFRO (micro filtration reverse osmosis).

A great deal can be learned on a quick reconnaissance, if possible, to determine adequacy of supply, conduct a sanitary survey and to take water samples. If local authorities/agencies do not have detailed current information on the bore or river then samples can be sent to an accredited laboratory for a more complete analysis including metals, hydrocarbons, pesticides, herbicides etc. In some cases this is not possible prior to the deployment. Humanitarian Aid and Disaster Response (HADR) scenarios may fall into that category.

Bottled Water

In a recent example a bore sample was imported back to New Zealand (through MAF approved procedures) prior to the actual exercise – the laboratory analysis results enabled sound decisions to be made about whether the water would be suitable and what treatment options should be deployed. Using this source through our treatment systems for drinking water saved thousands of dollars compared to using bottled water (in a tropical environment) and at the same time avoided significant plastic waste.

However, we will always have a bottled water supply on hand e.g. for the camp set-up and testing period and as a risk management protocol should the bulk supply be compromised.




Previous page – Aerial survey of catchment area, This page (left to right) – WaterTreatment Plant and accessories being loaded onto C130 Hercules Aircraft, Water testing, Handwash tubs and kitchen sink, Field showers, Tap-in modules, Treated water storgae, Plastic water bottle waste, Self-contained water treatment plant, Lighter scale treatment plant

Other deployments may permanently use bottled water if the quality of the bulk source cannot be confidently controlled.

Water Testing

Portable water testing equipment used in the camp environment (ideally in the clean, air-conditioned tent laboratory) ranges from individual test strips and kits, colorimeter, spectrophotometer, direct reading instruments, idexx sealers and incubators. These are used for accessing and monitoring the physical, microbiological and chemical attributes of the raw, treated and reticulated water.

Water Treatment Plants (WTPs)

The RNZAF portable WTPs are relatively low cost capabilities designed for treating physical and microbiological contamination (excluding seawater and heavy metals). One of the systems is self-contained with a pumping station on the right hand side incorporating pumps and pressure accumulators, with treatment options on the left. The design allows for a multi-barrier approach to pathogens such as protozoa, bacteria and viruses, including pre-treatment modules, filtration, UV disinfection and chlorination – giving up to 5 log reduction in cryptosporidium (99.999%).

Parallel or series flow can be selected through the filter housings and ultraviolet (UV) assemblies as required for specific situations. Each of the three filter housings accommodate 7 x 20" standard cartridges, and can be independently bypassed if damaged or not required. The UV assemblies include an intensity meter that will shut the flow if the lamp irradiance decreases below the fixed set point (NSF55A compliant). The in-line chlorination is adjustable and proportional to the selected flow rate.

Water can be treated up to 100LPM (6000 L/hr) through the core water treatment plant, however this depends on quality of water and what tap-in modules are selected. The plant can be used on-demand directly into a reticulation, however our preference is to store treated water in bladders. This allows a steady treatment flow, adequate chlorine contact time and a ready bulk supply of potable water. Stored water chlorine levels are monitored regularly, as chlorine dissipates quickly in the heat of the tropics.

The other core water treatment design utilised in the RNZAF is similar in intent but uses 20" Jumbo cartridge filtration. It is lighter to manhandle with the pumps being separate to the core unit.

Tap-in Modules

Pre-treatment modules can be tapped-in as required to improve the final quality of the water and prolong cartridge life. Equipment includes aerators, dosing pumps, coagulant mixers, clarifier tank, pressure vessels and different media types e.g. multi-media filtration, granulated activated carbon adsorption, pH and alkalinity dissolving media conditioning, and ion exchange treatment (for softening and limited iron and manganese removal).

The Challenge

In hot environments it is important that personnel are not only provided with enough safe water for hygiene and consumption, but if it is cool and palatable then they are more likely to drink sufficient quantities to assist in prevention of dehydration and heat illnesses. A cooler and point of use device is therefore often employed to remove the chlorine taste and odour issues and provide cool refreshing water.

There are many issues to consider regarding small portable water treatment systems, often with many unknowns, and always something new to learn – however that just adds to the challenge. ■

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A Growing Emphasis on Grit Removal System Performance

Smith & Loveless

One of the growing trends in the wastewater market is an emerging emphasis on grit removal system performance in plant headworks. The escalating application of membrane bioreactors (MBRs), specialised pumping equipment, and fine bubble diffusers in downstream plant infrastructure drives investment in protective grit removal equipment. A properly designed and operated grit removal system prevents grit buildup in unit processes, scouring and plugging in lines, and fouling of diffusers and membranes, while preserving the intended service life of the downstream equipment. In an age when funding sources are tighter and dollars are scarcer, protecting the plant infrastructure proves critical. Therefore grit removal performance and proper evaluation of performance follow accordingly. As the stakes increase, it's wise to take a closer look at the dynamics of grit removal – from a technical and business point of view – to achieve optimal outcomes.

The latest Smith & Loveless PISTA® grit removal chamber with 360° channel , flat floor and V-FORCE™ Baffle extracts an unprecedented 95% of grit as small as 100 microns. The standard for grit removal until now has been 95% removal at 250 microns, so the same removal efficiency at 100 microns (140 mesh) moves the benchmark well forward. The 360° rotation through the inlet and outlet, provides maximum travel of the wastewater for the most effective grit removal before proceeding to downstream treatment processes.

The V-FORCE™ baffle acts as a "slice weir" to control the water level in the main chamber and in the inlet channel. No additional downstream flow control device is needed to keep the velocity in the necessary range, across a wide range of minimum to peak flow conditions.

By integrating the water elevation settings with the baffle, the outlet footprint requirements decrease by as much as half the typical size. The resulting smaller footprint provides significant construction cost savings.

In summary, the benefits of the PISTA® Grit Removal System with V-FORCE™ Baffle include:

- 95% grit removal efficiency down to 140 mesh particle size
- construction cost savings due to decreased overall grit system footprint
- increased grit chamber velocity during low-flow periods
- full 360° rotation in the chamber, lengthening the grit extraction path
- elimination of the need for downstream level control devices
- an ability to handle a wide range of flows

The PISTA 360° with V-FORCE™ Baffle is just one of many Smith & Loveless design innovations that have made PISTA® the world's leading grit removal system for municipal wastewater systems and industrial facilities.

Published data from Smith & Loveless standard test procedures at numerous wastewater treatment plants consistently demonstrates that the PISTA® system maintains the highest removal efficiencies in the market.

The PISTA® system, backed by extensive Smith & Loveless R&D, has progressed in design, sizing and patented components since it was first introduced three decades ago. ■

Innoflow Technologies at Waitakaruru

Innoflow

Innoflow Technologies specialise in the design, build and operation of small to medium sized pressurised sewer systems using Orenco Systems ProSTEP® pumping packages and the AdvanTex® recirculating packed bed reactor process. These systems are ideal for local authorities looking at reticulating their small communities to an existing sewer or to a new treatment plant.

Innoflow recently installed these effluent sewer systems at Waitakaruru for Hauraki District Council and currently in the township of Piopio for Waitomo District Council. These effluent sewers, which utilise on-lot pumped interceptor tanks (STEP) or gravity interceptor tanks (STEG) and small diameter variable grade sewers, were selected because of the following benefits:

- Orenco effluent sewers (STEP/STEG) are the only form of reticulation that provides treatment of wastewater prior to discharge into a reticulated network. This offers significant cost savings downstream as primary treatment is not required or upgrades to an existing plant may be deferred
- Sludge management is greatly reduced through natural, passive anaerobic digestion in the interceptor tank, simplifying treatment plant design and minimising lifecycle costs

Below – Both pumped (STEP) and gravity-discharge (STEG) lots can be connected to the same small diameter effluent sewer system, Bottom – Orenco ProSTEP® on lot pumping package inside a 4,000 litre fibreglass tank

- The installation of the effluent sewer is simple and low impact on an existing community. Small-diameter collection lines are installed in shallow variable grade trenches or directionally drilled. Effluent sewer lines follow the contour of the land, avoiding deep trenching techniques
- A big concern for the local authority was eliminating infiltration from the effluent sewer. Using watertight tanks, polyethylene pipes and electro-fusion welds results in a lower hydraulic load and a consistent wastewater stream at the treatment plant. Wet weather flows become a thing of the past
- Depending on the effluent sewer design, Orenco effluent sewers can allow for some sites to gravity flow to the treatment plant. At Piopio township around 35% of sites will use STEG tanks and gravity fall effluent to the plant, thus minimising the number of pumped systems within the community
- Because only the liquid portion (ave. 30ppm TSS) of the wastewater flows into the effluent sewer, there is no need to design for minimum flushing velocity. This means the sewer can be operated with only one house connected to the sewer in a new development or holiday community
- Each interceptor tank has in excess of 24 hours storage above the high level alarm
- For peace of mind Innoflow offer a standard limited warranty period of 5 years, and can offer extended warranty if required. ■

Innovative Liquid Analytical Measurement Systems for Water Quality and Process Control Applications

ThermoFisher

Thermo Scientific AquaSensors products are innovative liquid analytical measurement systems for water quality and process control applications. Unique product designs reduce equipment and installation costs while improving reliability.

The DataStick™ Measurement Systems began with a revolutionary idea – simplify analytical measurements by designing digital sensors that connect directly to PLC's, HMI's and PC-based SCADA systems. The patented DataStick measurement system features pre-calibrated, plug-in sensor heads that provide 24-bit data and can be calibrated, configured or diagnosed directly from a PLC or computer system.

This evolution in analytical measurement is available in a complete line of true plug-n-play modular sensor configurations for the measurement of pH, ORP (Redox), contacting and toroidal conductivity, resistivity, dissolved oxygen, drinking water turbidity, high level turbidity, suspended solids, dissolved ozone and free chlorine.

The DataStick consumes very little power and can be used in portable applications with USB connections to laptop computers. Multiple DataSticks can be accessed directly using a standard web browser, terminal programme, AquaComm for Windows, or PLC programmes. ■

For more information please contact: Alison Young on 0800 422 469 or email: InfoWaterNZ@thermofisher.com, www.thermofisher.co.nz

Water New Zealand Conferences & Events

2011 *Water New Zealand* Backflow Group Conference
3 – 4 June 2011
Rutherford Hotel, Nelson, New Zealand

2011 *Water New Zealand* Annual Conference & Expo – *'Advancing Water Reform'*
9 – 11 November 2011
Energy Events Centre, Rotorua, New Zealand

Visit the *Water New Zealand* website for more information on upcoming 2011 *Water New Zealand Conferences*
www.waternz.org.nz/events

Other Conferences

The New Zealand Trade & Industrial Waste Forum
10 – 12 August 2011
Napier War Memorial Conference Centre,
Napier, New Zealand
For more information visit www.confer.co.nz/tiwf

IWA Diffuse Pollution Specialist Group – 15th International Conference
18 – 23 September 2011
Energy Events Centre, Rotorua, New Zealand
For more information visit www.dipcon2011.org

Pacific Water & Wastes Association Water Conference & Expo 2011
28 – 30 September 2011
Novotel Hotel, Lami Bay, Suva, Fiji
For more information visit www.pacificwaterassociation.org

84th Annual Water Environment Federation Technical Exhibition and Conference
15 – 19 October 2011
Los Angeles Convention Centre, Los Angeles,
California, USA
For more information visit www.weftec.org

6th International Specialised Conference on Sustainable Viticulture
6 – 10 November 2011
Marlborough Convention Centre, Blenheim, New Zealand
For more information visit www.wine-marlborough.co.nz

Asia Water 2012 – 7th ASIAWATER Expo & Forum
27 – 29 March, 2012
Kuala Lumpur Convention Centre, Malaysia
For more information visit www.asiawater.merebo.com

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