Flow

rivers GROUP

A joint technical interest group of IPENZ & Water NZ

Rivers Group Newsletter

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GROUNDWATER ABSTRACTION EFFECTS

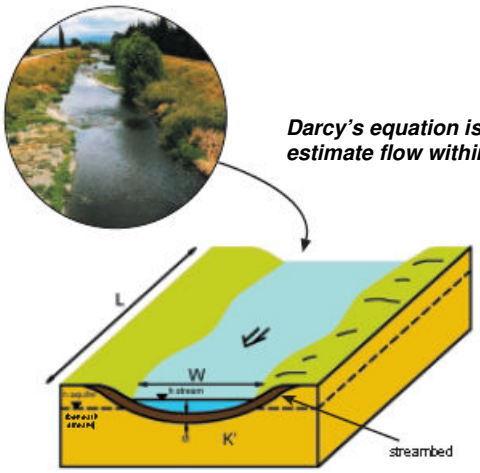
Peter Callander, Director, Pattle Delamore Partners Ltd

Understanding and managing the effects of water abstraction on river flows is a key component of water management. However, the abstraction of groundwater can also influence surface water flow and needs to be understood and, where appropriate, incorporated into the management of surface waterways.

In almost all surface water settings, there is movement of water between the underlying and adjacent groundwater and the surface water body. This occurs in streams, lakes, wetlands, estuaries and at the sea coast. Because of this interaction, there are some situations in which wells pumping from permeable aquifers can reduce the flow or volume of water in the surface waterway. This groundwater abstraction effect can either cause an increased loss of seepage out of the surface waterway, or a reduced inflow of seepage into the surface waterway. In either case, the effect of the groundwater abstraction is to reduce the rate of flow and/or the volume in the surface waterway.

With the increasing demand on water resources, it is important to understand and assess the depletion effect caused by pumping from groundwater.

The interactions of water movement between groundwater and surface water are difficult to observe and measure. This creates uncertainty regarding the magnitude of any surface water-groundwater interaction, the implications of the effect and an appropriate form of management.

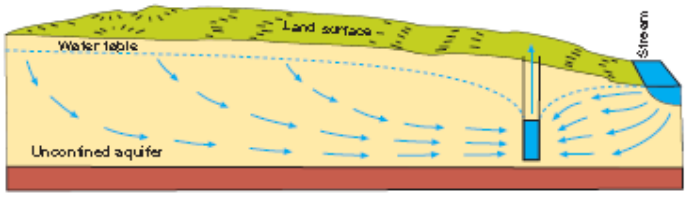


Darcy's equation is used to estimate flow within aquifers

A simplified quantification of the interaction between surface water and groundwater can be achieved by applying Darcy's equation which makes use of parameters related to surface and ground water pressures and the nature of the stream bed strata.

However, abstractions from groundwater will cause a variable alteration to the hydraulic gradient adjacent to the surface waterway which requires a more detailed analysis than the Darcy equation.

It is not unrealistic that after a prolonged period of groundwater pumping, as may occur during summer months, that the loss of surface water can range from less than 1% to more than 99% of the bore pumping rate given the range of potential hydraulic conductivities in the strata. Given this range of potential effects, an accurate quantification is required. This is best achieved by detailed analysis of carefully controlled groundwater pumping tests with observation bores and may also include surface water measurements, but only if an observable change is likely to be achieved within the scale of the pumping test.



The challenge for the management of this surface water depletion effect is that it is a variable effect depending on the duration of the groundwater pumping and the location of the abstraction point, both laterally in terms of the position of the bore relative to a surface waterway, and in terms of the depth of the bore intake and the nature of the strata between the groundwater intake and the surface waterway. Therefore, management of the effect must also be linked to an accurate quantification of the effect. ≈

FLOOD FORECASTING SYSTEM – CONSERVATISM AND FEEDBACK

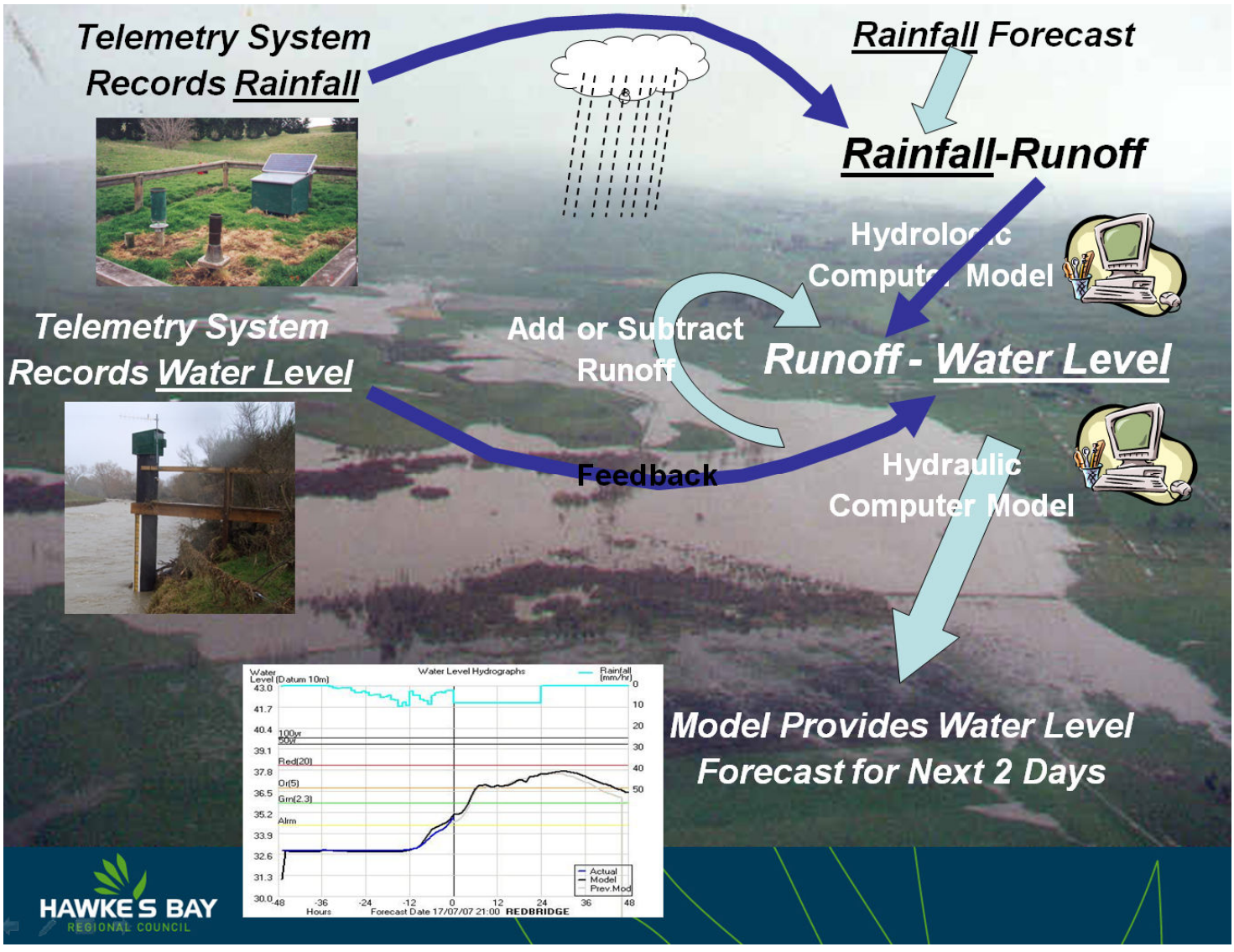
Craig Goodier, Hawke's Bay Regional Council

A Flood Forecasting system was implemented at Hawke's Bay Regional Council (HBRC) in late 2007. Since then, there have been several minor events that have enabled the system to be used (and tested) to predict flood extents. For each rainfall event the system has been a valuable tool to help make decisions. Luckily (but unfortunate from my point of view!), there haven't been any major events which would have caused widespread flooding, and thus provide a good test for the system!

The basic flood forecasting system incorporates rainfall and water levels that have occurred in the recent past, along with predicted rainfall, to forecast water level values at many locations in the network for an advance period of 48 hours. Feedback from most recently observed water levels is used to automatically correct any model inaccuracies, and assist in predicting the future water levels. A schematic of the system is shown in the figure below.

The system uses Mike11-NAM and Mike11-HD computer models to produce the predicted discharges and water levels. Control of the models and connection with the telemetry system is done using a Visual Basic program written for the system. The output from these models is transferred to the Council's website for anyone to view.

One of the difficulties that we experience in the forecasting is the level of conservatism we apply to the flood level forecasts. Rainfall predictions usually come in the form of "200 mm in the next 24 hours", and HBRC also receive 4 site specific hourly predictions from Met Service. With these rainfall predictions, the forecasting model is run several times, with a variety of input scenarios, such as double the predicted rain, or the predicted rain over half of the catchment. The output is then examined and a decision is made as to which forecast appears most realistic, or sometimes just the most conservative. This can be a tough decision, since we don't want to over-predict too often, and we also don't want to under-predict if we can avoid it. During emergency events we update the model run every hour with new information gained from the telemetry system. With each update, we get a better understanding of how the event is unfolding, and (hopefully!) our forecasts are getting more accurate. ≈



INTERNATIONAL PERSPECTIVES

An interview with Geoff Wilson, a NZ trained river and water resource engineer working abroad. Geoff responds to several questions regarding international work. *Geoff Wilson graduated in Civil Engineering from Canterbury University in 1989 and continued his education at IHE, Delft, The Netherlands. He has spent 13 of the last 16 years living and working overseas and has worked in more than 20 countries, mainly in Asia and the Middle East. He is currently Business Manager of Floods and Water Resources (Asia/Pacific/India/Middle East) for HR Wallingford. Geoff can be contacted on g.wilson@hrwallingford.co.uk*

You have worked in many countries as a river/water resource engineer, what do you find interesting about this?
I love to travel and the biggest constraints to travel are usually time and money. As a river engineer you can work while travelling. But what I find most interesting are the projects and the people. The people I meet come from diverse cultures and customs. It becomes evident that your way is not necessarily the right way, and this teaches you humility and tolerance.

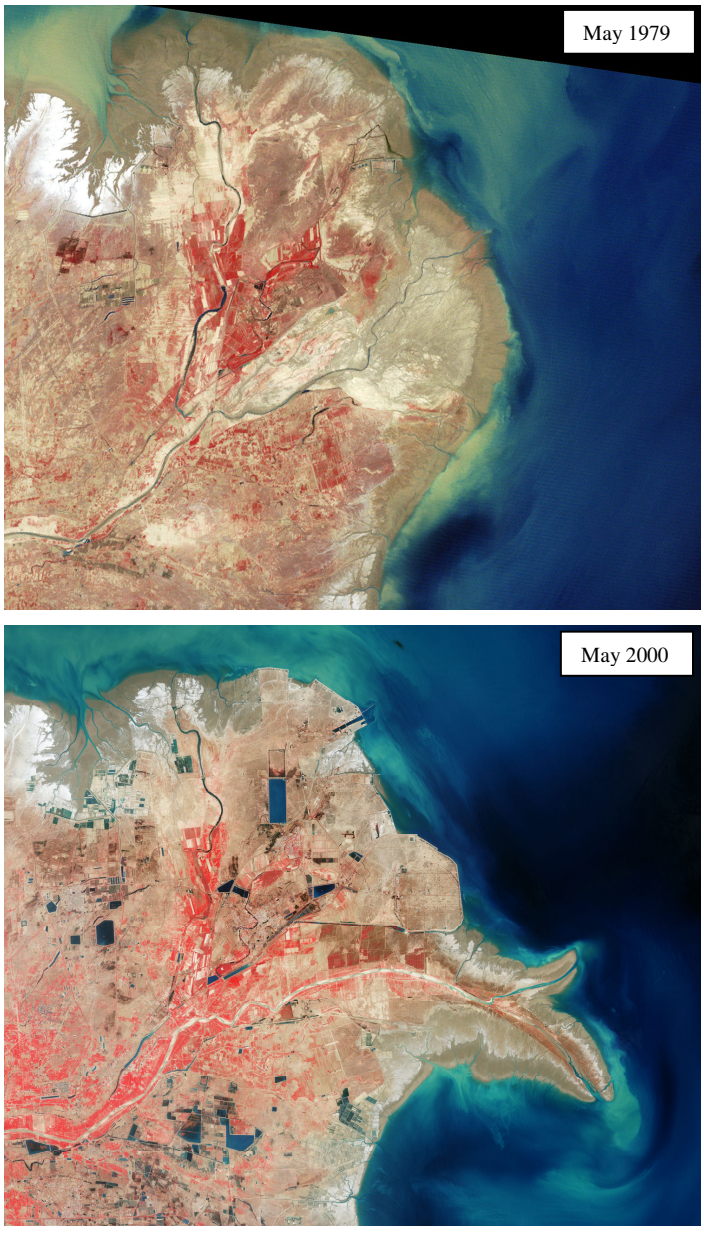
What kind of projects do you work on?
New Zealand rivers are facing the same issues that many countries of the world's rivers: shortage of supply, competing demand, degrading water-quality, development on the floodplain. Now we add to that an uncertain future climate. But what is different from New Zealand is the scale of the projects and the multi-disciplinary nature – you just don't get this kind of work in NZ.

What is the most interesting place that you have visited?
Every country has some interesting sites, but the most impressive places I have seen are Venice, Italy and the Old Walled City in Sana'a, Yemen. Venice is full of tourists but The Yemen is almost completely devoid of tourists.

What is your opinion on climate change?
I am not a climate change expert and I don't have time to undertake my own research, so I must listen to the experts. There are experts on both sides saying conflicting things so it becomes a little confusing even to those in the industry. I feel the implications are potentially so important that we need to err on the side of caution. If climate change continues the main problems will come from the changes in hydrology that it will cause – mainly more extreme droughts and floods. Water can no longer be seen as a free and unlimited resource. We must manage our use of water in a way that meshes with the natural cycle and within the local context.

In your opinion, what are the international challenges facing rivers and water resources?
1. Number one is food and water security in terms of quantity and quality.
2. Potential conflict. Some of the major rivers and water resources cross international boundaries and this is a recipe for conflict if there are no equitable treaties. Examples are India/Bangladesh and Israel/Jordon/Palestine. There need to be internationally brokered deals for sharing such water resources in an equitable and socially-just manner.
3. Uncertainty in future water resources under climate change, population growth and development pressures.
4. Catastrophic flooding - the Yellow River in China is stopbanked along most of it length but being the world's siltiest river it has become perched and continues to rise. The risk is a major upstream flood will occur that the upstream dams cannot contain, and the floodplain embankments will breach with dreadful consequences.
5. A more sensible and equitable water allocation based on the value of the water. Only that way will water be sensibly protected, allocated and conserved, whether in the home or for a multi-purpose reservoir.

Will you come back to New Zealand?
The thing about living overseas is that you realise that we do really have a slice of heaven back home. I think it's something you take for granted when you live there. I will return to New Zealand someday, but until then there are still many interesting places to visit and people to work with.



China's Yellow River, or Huang He, is the world's muddiest. Stretching some 5,475 kilometres from eastern Tibet to Bo Hai, the river travels through soft plateaus of silt, picking up a massive sediment load on its journey. The river derives its yellow colour from fine particles of mica, quartz, and feldspar.

Besides colouring the river yellow, the sediments have reshaped the coast, as shown in the above images taken 21 years apart. A steady supply of sediment expanded the Yellow River delta until it pushed into Bo Hai like a giant hook. Sediment coloured the coastal waters bright blue. This delta-building process has added several hundred square kilometres of land to China's coast. In these false-colour images, red indicates vegetation, blue indicates water, and beige indicates bare ground. (Images sourced from NASA's Earth Observatory) ≈

SALMON FISHERY UPDATE

Ross Millichamp, Fish and Game

Salmon runs are notoriously fickle, with returns varying significantly on an annual basis. Experts believe that changes in marine productivity are the principal cause although in recent years the loss of quality freshwater habitat may also be an issue. The 2009-10 season has been something of a mixed bag. It started well with good returns of big, fat salmon from the Rakaia and Rangitata Rivers in November. Anglers reported that the fish were in the best condition they could remember, being short, fat and full of energy.

However, the early run was relatively short-lived and fishing has been more difficult since. The Rakaia and Rangitata rivers have remained the most consistent, with reasonable catches at the rivermouth and upriver. The typical story has been of good, but very short duration runs separated by periods of poor fishing. I fished with my father for two days in January on the lower Rakaia River and we did not see a single salmon. I went home and left him to it, only to hear that he had caught three salmon in the following two days.

Salmon runs have started to pick up in recent weeks with some quite good fishing at the Rakaia and Rangitata rivermouths. Catches during the annual Rakaia River Fishing Competition, which is held over three days in late February, were four times greater than catches at the same event in 2009.

The smaller salmon rivers such as the Hurunui, Opihi and Orari have also fished quite well at times. These rivers tend to get very low during the summer and much of the fishing takes place in the surf alongside the rivermouth. Although the absolute number of salmon caught in these places is often modest, there are generally far less people fishing than at the bigger rivers and individual catches can be quite good.

The sorry story of the current season has been the Waimakariri River, which has yet to provide any consistent salmon fishing. This follows a poor season in 2008-09 and so the patience of Waimakariri anglers has been tested. However, this river has a notoriously late run and there is every chance of an improvement over the next month. In fact the month of March is often under-rated by anglers who are fed up with fishing rivers which are low and warm during mid-summer. Flows and water temperatures tend to become more favourable in autumn and the fishery comes back to life. ≈

Waimakariri River, Canterbury

Simon Arthur, Rakaia Mouth, February 2010

WHAT PLACE FOR PHYSICAL MODELS?

Tom Parsons (GHD Limited) asks Stephen Coleman (University of Auckland) about physical models

I was fortunate early in my career to undertake a physical model study of a reach of the Water of Leith in Dunedin. The decision to build a physical model was driven by the complexity of the channel geometry, the erodible nature of the bed, and the extensive proposed works. What struck me was the interaction you get with a physical model. To actually see the flow behaviour was enlightening, entrancing and occasionally mystifying.

The question that I ask a few years later having seen advances in computer technology is: what place do physical models have in modern engineering? I asked questions around this topic of Dr. Stephen Coleman of The University of Auckland, an experienced physical modeler and Rivers Group Chairman.

What are the typical applications of physical models?

In terms of rivers-related works, physical models are typically applied to analyses of river flows and channel developments, and the design of hydraulic structures such as fish passes, spillways, drop structures, pump intakes, etc. These models are used to make predictions regarding the progression of erodible-boundaries, and water quality and flow patterns and magnitudes.

When should a physical model be considered? Aren't local history or computer models enough?

Numerical modelling has been greatly empowered by the significant advancement of computational capacity in recent times. However, this capacity still remains grossly inadequate to enable timely and cost-effective detailed modeling of 3D flows. In addition, the equations underlying computational models of sediment transport are at best broad-brush, and few models simulate erodible-boundary development. Physical models are therefore the best technique for hydraulic structure design and the analysis of erodible-boundaries. Local history is not sufficient to predict how new measures may influence future flow and boundary development.

Does the cost outweigh the benefit?

In my experience, physical models have always proved a very valuable investment, either in confirming the performance and validity of a conceptual design, or in quickly and cost-effectively showing limitations of a prototype situation or design and guiding revisions. A physical model may cost in the order of tens to hundreds of thousands of dollars, but these costs are typically fractions of the costs of full-scale works of millions of dollars. Physical models are also a particularly valuable tool for clients and stakeholders to see the problem and how proposed solutions work. The value of this cannot be overstated. Inviting stakeholder groups to view physical models in operation has enabled understanding of the situation and improved ownership of proposed changes.

A Physical Model Aiding the Design of a Pump Station Intake (Geometric Scale 1:7.6)

1:2 Scale Model of a Natural-channel Fish Pass Design

How reliable are they and what are the limitations?

Physical models are designed on simple but fundamental principles that ensure that (a) natural processes are accurately produced, and (b) prototype behaviour can be reliably predicted based on model results. Secondary processes can be exaggerated at the smaller model scales, but these effects are well known and can be mitigated. ≈

MID-HEATHCOTE RIVER LINEAR PARK MASTERPLAN

Text and graphics taken from Christchurch City Council website:
http://www1.ccc.govt.nz/Parks/NaturalAreas/Mid-HeathcoteRiverOpawahoMasterplan/

Fed from springs near Templetons Road and also receiving wet weather flows from as far west as Pound Road, the Heathcote River meanders around the base of the Port Hills from west to south-east. The river's route and character have been determined by historical flooding of the Waimakariri River where it once met the foot of the Port Hills.

This Mid-Heathcote River Linear Park Masterplan gives guidance for the long term management of the mid section of the Heathcote River. The Christchurch City Council applies values based management to all of the City's waterways including the Heathcote River/Opawaho, taking account of six values: landscape, ecology, recreation, heritage, culture and drainage.

The Masterplan focuses on the section of river that lies between Colombo Street and Opawa Road. As the river approaches the estuary channel it widens and saline and tidal influences start to affect the hydraulic performance of the channel.

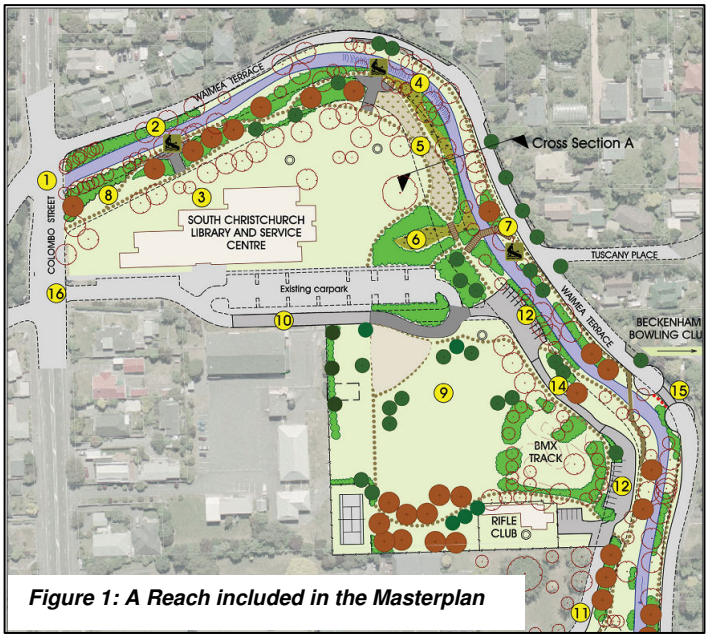


Figure 1: A Reach included in the Masterplan

The masterplan document provides background to the project from which 4 Key Goals have been developed using information gathered from neighbourhood improvement plans, ongoing consultation with iwi, individual neighbourhoods, and professionals such as ecologists (freshwater and terrestrial), ornithologists, engineers, planners and landscape architects. A series of concept plans contained in the document illustrate how the idea of a Linear River Park could be developed as a focus for community recreation, education, relaxation and as an attractive environment for walking and cycling through the river corridor.

Knowledge gathered from the consultees was used to guide the development of this Masterplan to ensure that the river corridor can be improved to reinforce community values and neighbourhood identity.

The Masterplan recommendations include (e.g. Figure 2):

- ≈ widening riverbanks and narrowing adjacent road carriageways to provide for a healthy future of long-lived large tree planting
- ≈ reducing vehicle through traffic with more formed walkways and strengthening of existing cycle ways
- ≈ providing a balance between native and exotic planting
- ≈ creating habitat for aquatic flora and fauna
- ≈ improving accessibility and visibility to the river
- ≈ varying the riverbed and its banks to maintain flood capacity
- ≈ developing partnerships with schools, educational and recreational groups
- ≈ providing more integrated artwork along the riverbank
- ≈ working in partnership with Ngai Tahu to protect and restore the ecological health and mauri (life force) of the Heathcote River, and identify, protect and restore sites of importance, celebrating the natural and cultural heritage of the river.

The Masterplan was formally adopted by Christchurch City Council on 9 April 2009. ≈

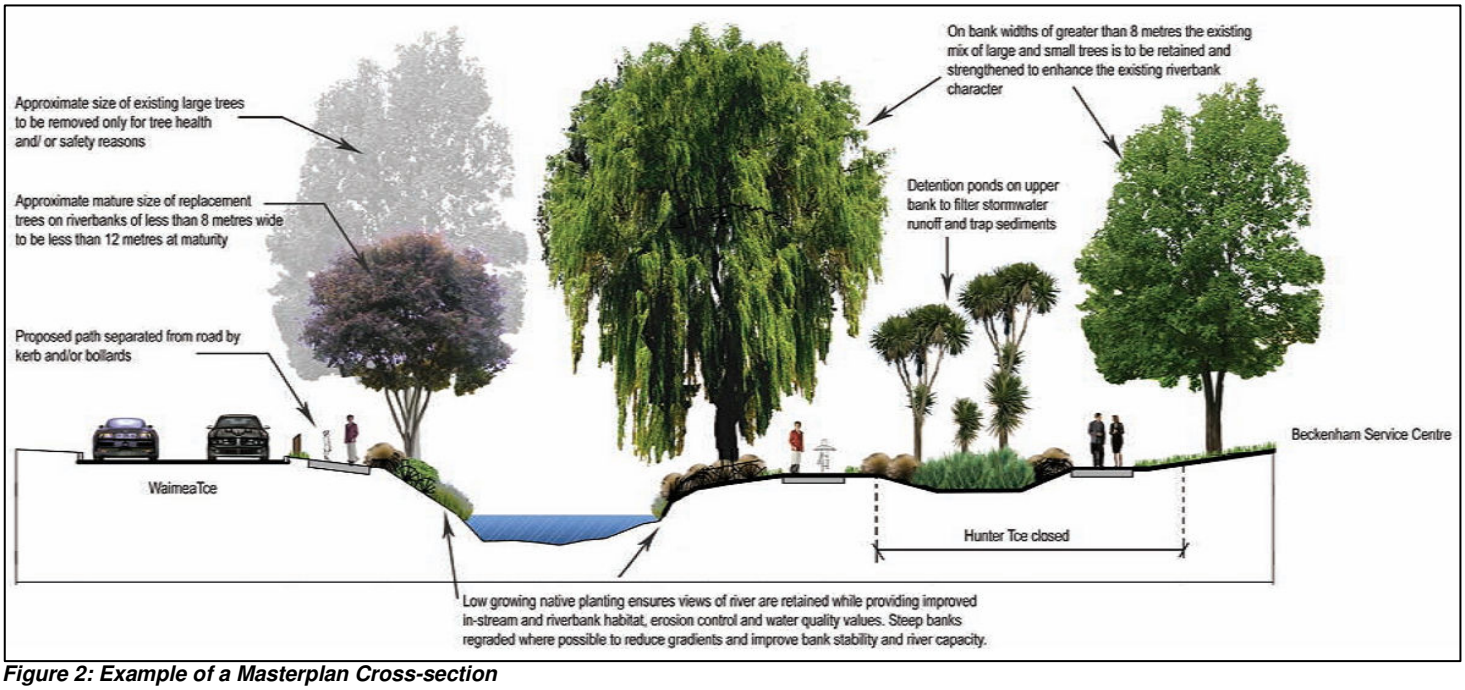


Figure 2: Example of a Masterplan Cross-section

FROM THE CHAIR

Stephen Coleman, Chairman of the Rivers Group

It is a busy time for freshwater management in New Zealand. By now, you will have been contacted regarding making input through the Rivers Group into the Land and Water Forum recommendations to government on how water should be managed in New Zealand. The Rivers Group committee has also been busy considering means of inputting into national discussions of flood-risk management, starting organization of our annual symposium and AGM, and arranging a rivers theme for the Water New Zealand Stormwater Conference 2010 in Rotorua May 13-14.

For the conference, we have managed to establish a rivers stream throughout May 13, focusing on river and stream modelling, river management, defining the river, and hydraulic structures. We will also host an afternoon tea function that day. The following morning, we have an invited keynote presentation by Gary Williams of Waterscape entitled "Healthy waterways for all: the essential challenge", which we anticipate will be of interest to a wide range of our membership. The remainder of Friday offers talks on landscape and restoration, and case studies, amongst other things.

In looking further forward, we'd like to invite ideas from the membership as to possible themes or events that they'd like to see. If, for example, recreational river users or those involved with fish management or river habitat wish to highlight events or matters of significance to be included in the symposium, then we'd really welcome this input.

In closing, we hope that you will enjoy the interesting rivers articles that we've assembled for this edition. Check our website for information updates as they arise, and be sure to let us know of potential future activities and articles that we can distribute further to the group membership.

Nau Mai Haere Mai. ≈

rivers GROUP

A joint technical interest group of IPENZ & Water NZ

See our website:

http://www.ipenz.org.nz/riversgroup/

flow is the official newsletter of the Rivers Group, is published quarterly, and is distributed to all Rivers Group members.

Limited advertising in subsequent issues may be considered.

We welcome contributions for future newsletters, and particularly appreciate any photographs of rivers that readers are willing to share. Please contact the editor, Mark Pennington, for further information: mark.pennington@pdp.co.nz.

2010 STORMWATER CONFERENCE

Stormwater 2010
NOVOTEL ROTORUA LAKESIDE
ROTORUA | 13-14 MAY

The aim of the 2010 Stormwater conference is to provide delegates with an opportunity to:

- ≈ Upskill in various areas of stormwater science and management
- ≈ Network with peers
- ≈ Hear new and cutting edge stormwater information

The 2010 conference is being run slightly differently to previous conferences in that it will have three streams, one of which will be devoted to Stormwater Modelling and another to the **Rivers Group**. Water New Zealand Stormwater SIG has teamed up with the Modelling SIG and the **Rivers Group** which is the joint technical interest group of IPENZ and Water New Zealand, and the Stormwater SIG are excited to bring you this two day conference.

In addition to a wide range of stormwater themes, this conference is able to offer Rivers Group members presentations that are closely linked to rivers and river management and include the following topics:

- ≈ River modelling
- ≈ Climate change
- ≈ Catchment management planning
- ≈ Urban Stream Ecology and Restoration
- ≈ Best practice for river management
- ≈ Geophysical, chemical, and biological processes in water flows.

In addition, having both Stormwater and Modelling Special Interest Groups present this conference provides great networking opportunities with fellow professionals involved in these related fields.

To register, please visit the conference registration website:

http://www.waternz.org.nz/stormwaterconference_registration.html ≈