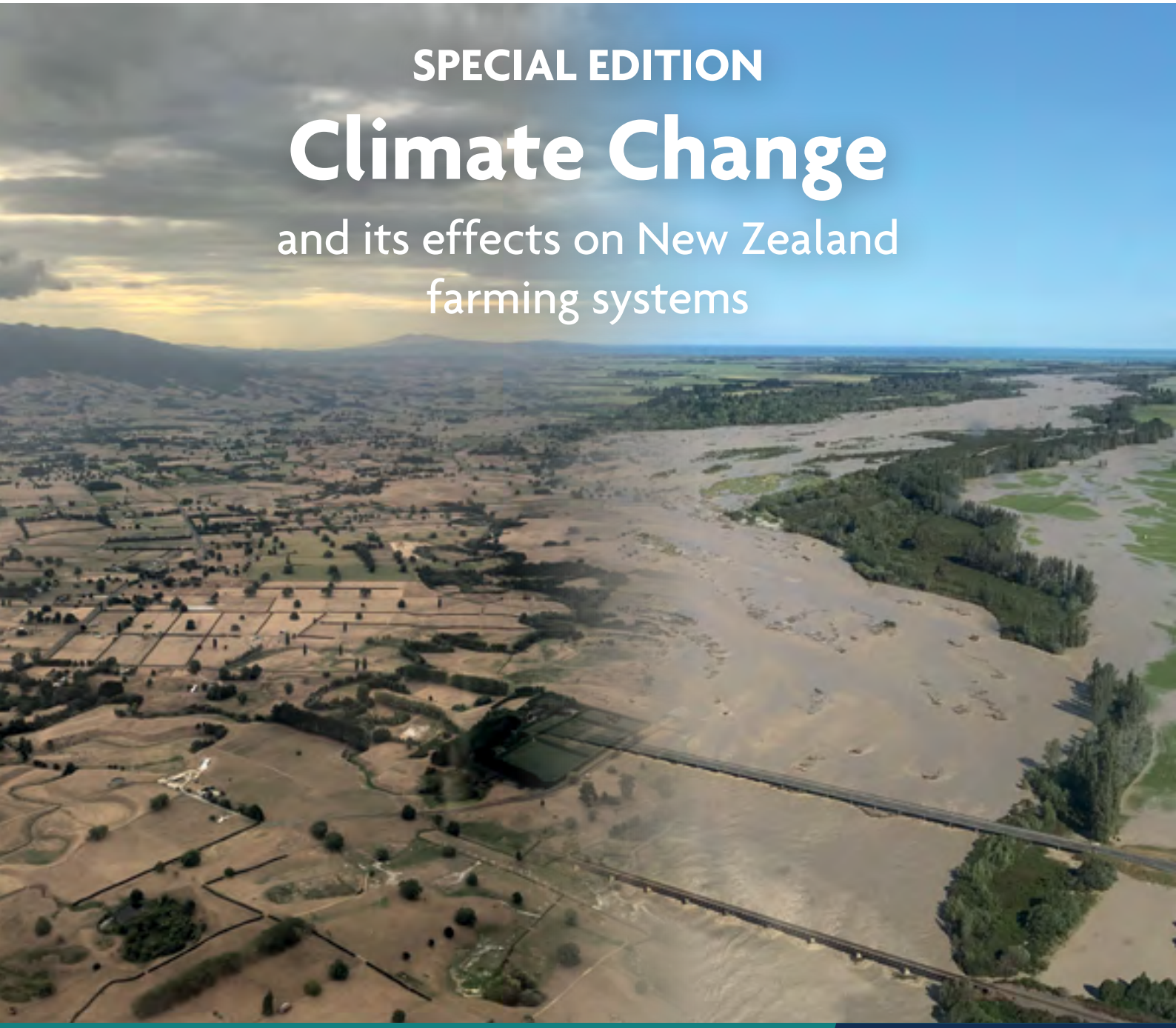
IrrigationNZ news

AUTUMN 2020



SPECIAL EDITION

Climate Change

and its effects on New Zealand farming systems

IRRIGATION NEW ZEALAND

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Design: Rosie Fenton

Printing: Caxton Press

Distribution: New Zealand Post

Cover Photos: Courtesy of Sarah Fraser, NIWA; and Environment Canterbury

IrrigationNZ News is published by Irrigation New Zealand Inc four times a year in March, June, September and December. The circulation includes all IrrigationNZ members. The opinions expressed in IrrigationNZ News do not necessarily reflect the views of Irrigation New Zealand Inc. The information contained in this publication is general in nature with every effort being made to ensure its complete accuracy. No responsibility can be accepted for any errors or copyright breach that may occur beyond the control of the editor or IrrigationNZ. Permission must be sought from the Editor prior to reproduction of any material contained in this publication.

ISSN 2230-5181

IRRIGATION NEW ZEALAND

www.irrigationnz.co.nz

So much learned, and more to come

Welcome to the first issue of IrrigationNZ News for 2020 – and my second as communications manager here. I have now been in my role for just over three months and have already learned much more about irrigation than I'd ever thought I would know – and I still have much more to come!

It's been great to be exposed to some of the high-level advocacy work that is happening around water policy, allocation, and infrastructure.

The irrigation industry is an exciting one to be part of, with so much forward-thinking involved. There is so much innovative technology used in day-to-day use of water, not only for irrigation management and production but, ultimately for the environment. Adapting to the environment and learning to work with it is something that is a part of all of our lives and all sectors of society, not just the primary sector. This issue of IrrigationNZ News has a strong focus on climate change and I hope you can learn something from it.

I started my career as a journalist in Dunedin with a focus on rural reporting, a no-brainer given my passion for the primary sector.

This is where I found my love for telling people's stories. I have already had great opportunities to meet some incredibly knowledgeable people while I've been at IrrigationNZ.

These people have been kind enough to share their stories and knowledge with me. This sparked my idea for the 'Champions Series', which I am excited to introduce in 2020.

It is a series that highlights the people who are doing good work in the primary industry and beyond, to those people who have a general interest in the greater good for water and the environment. I believe anyone and everyone has an interesting story to tell whether it be at the grassroots level or the highest industry and governance level, every person's story has its special element of individuality. It's often those with the best stories who slip through the cracks and don't get told. Please get in touch with me if you or someone you know is showcasing good practice big or small. And don't be scared of an interview – it's just a general yarn!

Something that is keeping everyone here at IrrigationNZ busy is gearing up for our 2020 'Water For Life' Conference which is being held in April in Christchurch at the Airforce Museum of New Zealand in Wigram.

Everyone has an emotional attachment to water whether it be through farming, fishing in your favourite river, or learning to water ski on your local lake, and so much more. Everyone cares about water in one way or another. Come along to our conference to share your views and thoughts on what the future strategy for freshwater in New Zealand should be – every story counts.

Ella Stokes
Editor, IrrigationNZ News

Get in touch to tell your story. Don't worry – no microphones, just a friendly yarn!

IrrigationNZ: out & about

AT THE SHOW

The New Zealand A&P show season is underway bringing together the heart of urban and rural communities. IrrigationNZ will be at the Wanaka A&P show from 13–14 March. If you're there, be sure to pop in and see us. We love going to events and getting the chance to catch up with a range of people.

CHAMPIONS – THE PEOPLE WHO WORK BEHIND THE SCENES

In 2020. IrrigationNZ is launching an exciting new series called the 'Champions Series'.
This series aims to celebrate people who are passionate about New Zealand, it's land and natural resources. Whether it's to do with water management, environmental improvements, showcasing innovation, work in the community and more, we want to celebrate them and their commitment for what they do.

POSTCARD FROM THE USA

IrrigationNZ CEO Elizabeth Soal and board chairwomen Keri Johnston were in America in late January. Read more about why and what they learnt on page 22.

IRRIGATION NEW ZEALAND CONFERENCE & EXPO ON 7–9 APRIL 2020

Our conference is getting closer. Find out more about the upcoming IrrigationNZ Conference and Expo in Christchurch on the feature pages within this issue, starting from page 27.

A hot dry start to 2020

Happy new year to all of our members.

We farm 970 hectares west of Hastings. Primarily an irrigated dairy farm with integrated support block partially irrigated and a calf rearing operation. The past twelve months (January 2019 to December 2019) have been the driest we have experienced in the 19 years we have lived in Hawke's Bay, with half as much rainfall as 2018. With the community opting out of committing to large community water storage projects, it has been left to individual enterprises to develop their own irrigation storage infrastructure. Some have completed their storage projects and others are in the pipeline. As I write, the Ngaruroro River, our main source of irrigation water, is fast approaching the low flow irrigation ban level, with no rain on the horizon and 30+degrees days and strong Nor'westers.

RESOURCE MANAGEMENT DECISION MAKING

TANK Collaborative Process

I was a dairy farmer representative on the Hawke's Bay Regional Council (HBRC) TANK (Tutaekuri, Ahuriri, Ngaruroro, Karamu catchments) not to be confused with the Tukituki Catchment which is further south and involved the rejected Ruataniwha Dam project. HBRC adopted a collaborative Catchment Plan Change process which took six years from October 2012 to December 2018. The group was made up of 30 community representatives from Iwi groups, environmental groups and industry organisations. At the conclusion TANK made recommendations to Council which have since been under consideration at the Regional Planning Committee which is made up of 50/50 Māori/HBRC Council elected representatives. Just before Christmas HBRC announced they were delaying notification of the Plan Change for further consultation with Māori groups. The result of seven and a half years of deliberation is no plan change.

Water Conservation Order

In 2014 some TANK groups were not happy with the direction and speed of travel of the TANK process and lodged an application for a Water Conservation Order (WCO) on the Ngaruroro River and Clive River. The Minister appointed a tribunal to hear submissions on the application. This move destroyed much of the goodwill built up within the TANK group to that point, created division and uncertainty amongst TANK members, and diverted resources away from TANK – delaying the process further. This process is still on-going with various groups appealing the Tribunal decision.

A Discussion Document for National Direction for our Essential Freshwater

This government has tried to short-circuit these long drawn-out processes throughout the country by releasing the "Action for Healthy Waterways" discussion document – one of several. IrrigationNZ, other organisations and individuals have been kept busy submitting within tight schedules on each of these. If our three yearly election cycle delivers a new government this year, priorities will change, and we may repeat the process again.

As a society we need a better a system to identify, prioritise and deliver more focused, well considered decisions relevant to the local community in acceptable timeframes. These issues will keep challenging us to find solutions, we need a more fit-for-purpose framework or we will be swamped. The Resource Management Act was supposed to streamline this process but councils throughout the country have gone about the process in widely different ways resulting in varied outcomes. There needs to be a more coordinated approach, learning from what has worked and what hasn't throughout the country.

Ivan Knauf
Deputy Chair
IrrigationNZ Board

Reliable water and food production go hand in hand

Access to reliable water is becoming increasingly difficult. Whether it is from tighter rules or climate change impacts, we are seeing the challenges of managing water supply on our food production systems in Aotearoa.

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New to the IrrigationNZ Board

Late last year IrrigationNZ welcomed two new members to the board – Randal Hanrahan and Jared Ross, who replaced previous members Nicky Hyslop and Rab McDowell. Learn more about Randal and Jared here.

What is your current occupation?

R: I own and run an arable farm in Mid Canterbury just north of Ashburton. I have just over 300 hectares under irrigation and along with arable crops I also do beef finishing. My farm is part of the Ashburton Lyndhurst (ALL) irrigation scheme.

J: My wife Susan and I own and operate a mixed grazing/finishing property near Kurow in the Waitaki Valley. We have primarily been dairy oriented in our business endeavour to date. Our current land holding is within the Kurow Duntroon Irrigation Company command area and we are open minded about the future as we develop the property under irrigation.

Randal Hanrahan.

Jared Ross.

What previous experience do you have with irrigation/water use, are you on any other boards or involved in governance etc?

R: On my property I was involved in the development of dry land to irrigated land. Along with running the farm I operate an agricultural contracting business. I sit on the board of ALL and am a board of trustee member at Ashburton Borough School. I am also a member of the Rangitata Diversion Race Management Ltd's audited self-management committee which was an important part of establishing and implementing Farm Environment Plans.

J: I have been farming in the irrigated Waitaki since completing my tertiary studies in 2004. I'm experienced operating both various spray and border dyke systems, utilising monitoring and scheduling technology. I am currently a director for the Kurow Duntroon Irrigation Company and a community member for the South Coastal Canterbury Lower Waitaki Zone Committee. I am the Vice President for North Otago Federated Farmers and a member of the Central South Island Beef and Lamb Farmer Council.

Why did you decide to become involved with IrrigationNZ?

R: I have always had a strong interest in irrigation and agriculture itself as well as being involved in governance roles. I felt it was important from the schemes' perspective to have a representative from not only the scheme I am part of, but schemes across the board. I have learnt a lot during my time of being part of my scheme and it's a great scheme to be a part of and I want to bring that knowledge to my role.

J: I have an interest in the political realm and was encouraged to become involved following a near miss with local government elections recently. I am eager to progress my governance experience and have been well supported by those whom I am associated, and I thank those of you whom have shown confidence in me ahead of time. I welcome contact from members.

How have you seen your area change over time due to irrigation?

R: Not only has its enhanced land use but irrigation efficiencies have hugely improved. The water delivery system is much more effective and many farms that were previously border dyke are now operating under more efficient irrigation systems. All the technology means allocation and on-farm water use is much easier to manage than it was in the past.

J: The rolling downlands of North Otago have been transformed in my time in the area with irrigation. The previous generation speak of endless drought challenges with sand-dune like dry periods and dust storms frequent. I have learned that those that have farmed locally without irrigation and since adapted to an irrigated production system would not return to a dryland state. They value soil health and retention and have been able to improve farming viability whilst providing options for succession. Stock water has also been catered to a higher capacity within irrigation scheme development, which has further aided higher value land use propositions.

Why is water use/irrigation important to you?

R: Without irrigation we wouldn't be able to grow what we do in New Zealand, and so efficiently. Not only is the day-to-day running of my personal irrigation important to me so that I'm doing the best for both the farm and environmentally, but it is also important to me at a higher level which again is why I have got involved in this role. As well as the environmental compliance, everyone in the ALL scheme is running at an A grade on their environmental audits, this is just an example of the good work that is being done and I want to promote that. The technology available now is amazing, such as VRI (variable rate irrigation), soil monitoring and fertigation just to name a few. I see more and more technology becoming part of everyday farming.

J: My grandparents began irrigated dairy production post-war in Central Otago, in a somewhat pioneering era. The intensive dairy production system I am familiar with is simply not economically viable in North Otago without irrigation. The transformation of fertile

but drought-prone land was as much about community development and resilience in the 1950s, as it is today.

What do you think are some of the biggest challenges for water users/irrigating farmers and growers in New Zealand?

R: Challenges… well storage is a big thing, having access to reliable water is so important. Investing in water storage so it can be used when it is needed. Also, the environmental aspect. The environment itself is changing and is something we must adapt to, but also the environmental compliance, keeping farms performing well at the same time as doing the best for the environment. We have to make sure people have the right attitude about environmental practices, it's happening and it's not something you can bury your head in the sand about.

J: Primary industry succession. Pathways to equity creation are not what they once were. Quality people have been in demand for the entirety of my time farming and I don't believe this situation has improved. Technology can achieve more of our daily requirements and this will without doubt continue to advance however we have an aged farming population and succession is becoming increasingly complicated and unpalatable.

Uncertainty. Our current political climate evolves at such pace it may be deemed irrational. The potential cost of compliance and legislative objectives pending in some instances currently will render modest business untenable and ask significant capital contributions to reach compliance of others. We need to respond constructively to the loud and fast-paced local and global pressures on food production systems, particularly involving livestock and the subsequent, evidence based environmental and climate impacts. Much political ambition coupled with perception-based direction is understandably fuelling uncertainty. I know the current compliance process to be quite undesirable for the older farming demographic, with departing the industry seen by some as a relief. Whilst the modern consenting and compliance space is normal to my generation, it is fair to describe this as, at times, a tedious and duplicative data gathering exercise which could be much improved to deliver meaningful outcomes. We fund this process from rates, taxes, levies and memberships, and I am, like you, very sure we can do this better.

What do you hope to achieve/learn in your role with IrrigationNZ?

R: Going forward I want to be involved in the advocacy, advocating for farmers and getting them involved. Encouraging them to uptake technology and get involved with decision making beyond their farm gate.

J: I believe it is paramount that IrrigationNZ continues to ensure credible relevance in the policy and advocacy space as its priority. This is undoubtedly the core theme of my discussions with members so far. Further, I want to understand the comprisal of current core commercial activity and how this meets the demand of the membership. I know the membership value proposition to be in question by some and this needs to be addressed in a qualitative and timely manner.

I am motivated to contribute to the funding strategy review and furthering the development of the information base and initiatives to assist advocacy. We need to be working closely aligned with other industry bodies going forward. I look forward to furthering pan-sector communication.

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The start of a decade, time for climate action

View from here with James Shaw, Minister for Climate Change.

The 2020s is a decade we have been talking about for a long time.

This time in ten years we will know if we have done enough to reduce our emissions to a level necessary to keep us within the 1.5 degrees of warming every country in the world – with one notable exception – has committed to.

Water is one of the primary means through which we are likely to feel the effects of climate change. Put simply: climate change is water change – and it poses a serious risk to us all.

Droughts, floods, more extreme weather events and, in coastal areas, rising seas are all likely consequences of climate change.

There are tens of millions of people around the world who are on the frontline of these climate impacts, their already precarious water resources under even greater threat.

Here in New Zealand, climate change has already been linked to severe droughts and flooding in some of our communities, devastating the lives and livelihoods of so many of our friends, colleagues and loved ones.

These are not isolated incidents. The worrying truth is, without a concerted effort from all of us, these impacts could become a much more common feature of life in New Zealand.

It's predicted that extreme rainfall events will increase, leading to more intense flooding throughout the country. With more flooding we can expect to see rivers bursting and flash flooding if, and when, urban drainage systems become overwhelmed.

Summers are also set to become longer, hotter and drier. Lower river levels will heat up the water more rapidly and increase water quality problems like algae growth.

Then there is the possibility of an increase in the frequency and intensity of droughts, as well as changing and unpredictable rainfall patterns, which could increase demand for irrigation, putting pressure on our groundwater reserves.

Of course, more droughts also means further restrictions on irrigation and total bans in extreme cases, which could have knock-on effects for food production.

To mitigate the worst effects of climate change we must, as a minimum, improve the way we farm, design our communities, and run our economy. But past greenhouse gas emissions have already locked in some future climate change, so resilience is also going to be key.

James Shaw at the School Strike for Climate Change in Wellington, 2019.

For rural communities this means having accurate information, reliable services and technology to anticipate how and when conditions will change. We are already seeing innovative solutions emerge that will enable people to better manage natural resources.

Hawke's Bay Regional Council recently started a 3D aquifer mapping project to gain an accurate picture of the state of the region's freshwater supply. Through cutting edge technology the region will be better placed to understand, manage and predict their water security. We need more and more of these kinds of innovations.

Our Government has taken more climate action in the last two years than the past 30 years combined. The Zero Carbon Act was passed into law unopposed last year, meaning that whatever happens in the world of politics, every future government will now be committed to taking action to solve climate change.

But to meet the necessary limits we have set on our emissions, every part of the economy must play its part. We already see some great progress being made in the agriculture sector. Improved water use efficiency practices, farm environmental plans and technological solutions are creating positive change. Right now, we are working with farm leaders to develop practical ways to measure and price emissions so they can do even more.

We are also developing a National Climate Change Risk Assessment to provide a national overview of the threats New Zealand faces from climate change.

The assessment is focused on the physical impacts of climate change, such as those on water security, and it will help us to identify where there are gaps in our knowledge. We will then use what we learn to develop a National Adaptation Plan that identifies the areas that need our attention the most.

The type of planet our kids and grandkids inherit from us will depend on the decisions we take today, on the difference we all choose to make. We have made a great start, but it is just a start. We need to go further and faster to ensure we leave behind a planet that is better for what we did.

Towards collective management of a common resource

View from There by Josselin Rouillard, Research Fellow, French Geological Survey.

In France, irrigated agriculture covers about 2 million hectares and uses about 4 billion cubic metres of water every year. Irrigation for agriculture was traditionally restricted to Mediterranean regions and used through collective irrigation systems for vegetable and fruit crops and pastures. Irrigation was adopted more widely in other regions in the 1970s and 1980s, especially in the cereal growing plains of central and western France. Irrigation then took mostly the form of individual schemes, where each farmer would extract water from shallow aquifers using a private borehole.

Although rainfed agriculture is possible everywhere in France, access to water made it possible to increase yields and diversify production, especially of corn, and act as a safeguard against the risk of drought for high-value crops, such as seed production. Today, agriculture accounts for 50 percent of net water use in France, and up to 80 percent during the dry season, coinciding with seasonal river low flows and competing with other uses for water.

RESTRICTIONS DRIVING EFFICIENT WATER USE

Growing water use and a drier climate have resulted in increased water scarcity in many French regions. With increased scarcity, French authorities started in the 1980s to define minimum flow targets for rivers and minimum groundwater levels for aquifers. Water use is restricted if these minimum thresholds are breached. These restrictions are used to ensure that sufficient water flows reach downstream ecosystems and water users.

The progressive tightening of restrictions on water use in the 1990s have posed significant challenges to irrigated agriculture. Farmers have invested in more efficient irrigation techniques. For example, water productivity has increased by 30% on cereal crops in 20 years, thanks to reductions in water loss conveyance, improved irrigation piloting, genetic selections, and better rotational choices.

Farmers have also worked on increasing their security of supply, by investing in reservoirs to store winter flows for use during the summer period, when most restrictions on direct pumping in rivers and shallow groundwater apply. Much ongoing work focuses on the better-coordinated use of surface water and groundwater. Despite these investments and initiatives, conflicts have become increasingly frequent.

ALLOCATIONS TO SHARE A LIMITED RESOURCE

The use of restrictions on water use based on minimum river flow thresholds had an unexpected impact. As water levels fall and approach thresholds, farmers increase irrigation to build up soil moisture reserves. They install bigger pumps to irrigate all their land in a shorter time, thereby hastening the onset of a water shortfall and increasing the frequency of such crises. Farmers irrigating in the late season are more affected than those irrigating early in the season.

To align water demand with available resources, French authorities started to experiment, in the mid 1990s, with "volumetric management" in catchments and aquifers faced with a deficit of water. This involved capping the total volume that can be extracted and dividing it between water users in the form of individual allocations (quotas). This approach was generalised across France in the 2000s. The advantage of this new approach is that it reduces uncertainty for water users because each user has a clear allocated volume for the whole irrigation season. Restrictions on water use are theoretically phased out if the cap is properly set.

WATER AS A COMMON, NON-TRADABLE RESOURCE

A number of studies undertaken to define sustainable extraction limits concluded that extractions should be reduced by 10 to 20 percent in most catchments and by over 50 percent in some cases. However, reductions are to be achieved with no financial compensation. Various discussions in the 1990s explored the potential to create a system of tradable water use quotas. At that time, experiments were being conducted on "water

Traditional Mediterranean irrigation canal near Montpellier, France. *(Photo: AFEID)*

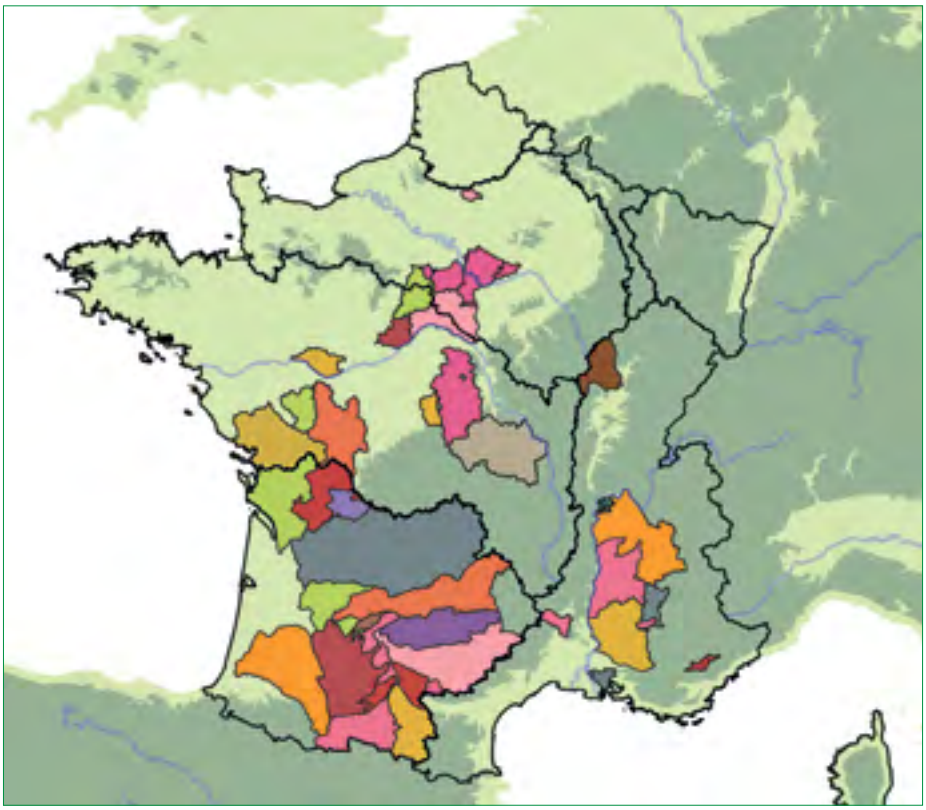
banks" in the western U.S., and Australia was moving towards a formal water market. This proposal was never implemented in France, the State considering that water trading went against "our concept of water, which goes beyond that of a purely economic good". The Water Law in 1992 defined water as the "common good" of the nation. Hence, the State can revoke water use quotas (or caps) without financial compensation, and quotas cannot be traded.

A COLLECTIVE APPROACH TO REALLOCATING WATER

Instead of opting for water trading, France established an allocation system where users, under the supervision of the State, negotiate collectively over who gets water, how much, and when. The rationale for devolving the responsibility of allocating water to users is that users are best placed when it comes to adjusting water allocations taking into account local technical and economic circumstances.

Given the large number of farmers, the State gave the responsibility of managing the bulk allocation designated for irrigated agriculture to an intermediary institution in the form of an agricultural water user association. Its role is to allocate water and monitor water use between irrigators. Policing and compliance remain in the control of State authorities.

When allocating water, the agricultural water user association has to make decisions on who can legitimately benefit from access to the water resource, and the criteria used to determine the share of the volume that each beneficiary can claim. Difficult choices must be made: should allocation rules give priority to historical users, or should it be given to those who make the most beneficial use? Should allocation rules encourage efficient water use? Should it compensate for natural inequalities (e.g. in soil depth)? Overall, Agricultural Water User Associations (AWUAs) have adopted a large diversity of rules to share the water, reflecting local preferences on how to balance local economic priorities and equity considerations.



Map of France, showing the main river basins (thick black line) and the areas covered by the agricultural water user associations in charge of allocating water to farmers (unified colors).

FUTURE PROSPECTS

Collective management of water allocations has increased the transparency of who benefits from water use and it has reinforced the notion that water is common property. In agriculture, farmers are equipped to share water more equitably. Some agricultural water user associations are starting to allocate water to support crop productions and value food chains that bring jobs locally and maximise the benefits for the regional economy. The collective allocation system is thus becoming one of the tools that local farming communities can use to strengthen local resilience and transition towards a sustainable future.

Impact of climate change on irrigation and agricultural systems in NZ

Contributions by Christian Zammit, Programme Leader Hydrological Observations and Predictions – NIWA Christchurch; Petra Pearce, Manager – Climate, Atmosphere and Hazards – NIWA Auckland; Daniel Collins, Hydrologist –NIWA Christchurch.

Christian Zammit.

Petra Pearce.

Daniel Collins.

Climate change is already affecting New Zealand with downstream effects on our natural environment, the economy, and communities. In the coming decades, climate change is highly likely to increasingly pose challenges to New Zealanders' way of life.

NIWA has interpreted global climate model projections for the New Zealand context, resulting in high-resolution projections that can be interpreted at the regional, local, or catchment scale. The information that underpins these projections comes from the Intergovernmental Panel on Climate Change (IPCC) suite of climate models. Several future scenarios, or Representative Concentration Pathways, are modelled, where differing atmospheric greenhouse gas concentrations lead to different climate futures. Higher greenhouse gas concentrations generally lead to more drastic climate changes (i.e. more warming, larger changes to rainfall) than lower greenhouse gas concentrations (Ministry for the Environment 2018).

In general, New Zealand can expect ongoing warming throughout the 21st century, as well as changes to extreme temperatures. Extreme warm temperatures and heatwaves are likely to be more common in the future, and extreme cold temperatures and frosts are likely to decrease. In addition, rainfall patterns may change across the country, with the west and south of New Zealand becoming wetter and the north and east of the North Island becoming drier. Some areas may not experience much change in total annual rainfall, but the seasonality when rainfall occurs may change, i.e. summers may become drier and winters may become wetter (Figure 1). The intensity of extreme rainfall is likely to increase in a warmer climate. Winds are also likely to increase across central New Zealand, particularly in winter.

These coming changes are likely to have significant impacts on the country's water cycle. This in turn will impact the availability of water for irrigation and crop demand for irrigation, and as such affect New Zealand's agricultural systems and irrigated land.

Increasing temperatures will impact pasture grass and crop growth, as plant phenological development may occur at a faster rate. The pasture growth season may extend into the cooler part of the year as the climate warms, and higher concentrations of carbon dioxide in the atmosphere

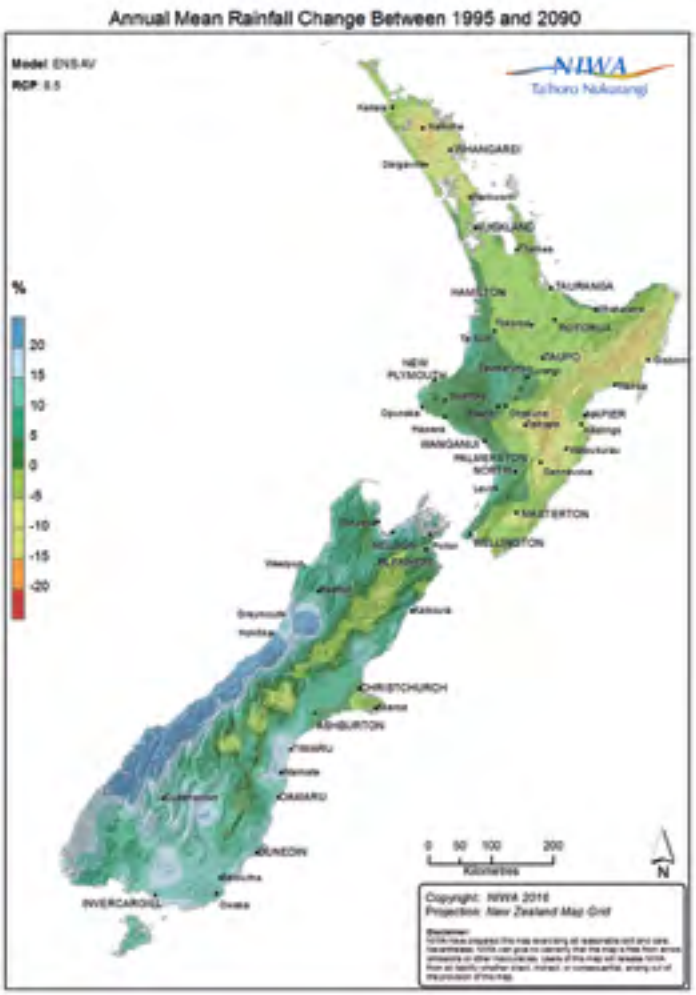


Figure 1. Annual mean rainfall change (in %) between 1995 and 2090, under the highest IPCC Representative Concentration Pathway (RCP8.5).

means that pasture may grow more vigorously when it is not constrained by temperature or water availability. For the cropping industry, different stages of plant growth (e.g. bud burst, flowering, and fruit development) may happen at different times, which may affect the harvested crop. For example, the hottest summer on record for New Zealand in 2017/18 saw wine grapes in multiple New Zealand regions ripen faster than usual (Salinger et al., 2019).

Extreme heat affects the rate of evapotranspiration, or the uptake of water by plants. Therefore, increases to extreme heat may affect water availability and increase the amount of water needed for irrigation, as under hot conditions plants use more water than usual. Extreme heat may also result in current varieties of crops and pasture becoming unsustainable if they are not suited to growing in hot conditions.

Reductions in cold conditions may have positive impacts for diversification of new crop and grass varieties that are not able to currently be grown in cooler parts of New Zealand. However, future warmer temperatures may increase the risk from pests (plants and animals) and diseases. Currently, many pests are limited by New Zealand's relatively cool conditions, so that they cannot survive

low winter temperatures, and therefore their spread is limited (Kean et al., 2015). Under a warmer climate, these pests may not be limited by cold conditions and therefore cause a larger problem for farmers and growers in New Zealand.

Increases in extreme rainfall event magnitudes may impact agriculture and horticulture in several different ways. Slips on hill country land may become more prevalent during these events, and soil erosion may also be exacerbated by increasing drought conditions followed by heavy rainfall events (Basher et al., 2012). This has impacts on the quality of soil, the area of land available for production, and other impacts such as sedimentation of waterways (which can impact flooding and water quality). Slips may also impact transport infrastructure (e.g. roads, farm tracks) which may in turn affect connectivity of farms and orchards to markets.

NIWA in collaboration with Aqualinc refined the national scale analysis of climate change impacts on water availability (Collins and Zammit 2016), by considering the effects of climate change alone on irrigation demand, and by considering when effects may become discernible from or significantly different to current climate variability (Collins et al 2019). This was carried out by using climate change projections to drive the national hydrological model, TopNet (Clark et al 2008), and an irrigation water demand model, IrriCalc (Allen et al. 1998). The assessment focussed on areas that are currently under irrigation and for simplicity assumed that land use stays fixed. In addition to facilitate inter-regional comparison, the assessment was carried out using national scale minimum flow estimation based on the proposed National Environmental Standard (NES) for Environmental Flows and Water Levels (Ministry for the Environment 2008). Given unavoidable uncertainties and model limitations, the key results of the national scale analysis, presented hereafter, can be used to inform qualitative, sub-regional conclusions at this stage.

As a result of climate change, mean river flows during the irrigation season are projected to increase across many but not all irrigated areas in the South Island with Southland and parts of Central Otago showing the first substantial signs by mid-century (2039–2049). Irrigation water demand is projected to increase across most of New Zealand, with effects emerging by mid-century in the North Island and later (2080–2099) in the South Island.

From a water management aspect, irrigation restrictions are expected to occur earlier in the year, mostly for the North Island, but only after the middle of the century and largely only for the extreme warming scenario. At the same time, irrigation restrictions are expected to stop earlier during the water year, although the shifts are neither as widespread nor as large as with the change on the onsets of irrigation restrictions. This shift in the onset and offset of the irrigation restrictions results in a minimal change in the duration of the irrigations restrictions, but the frequency of irrigation restrictions tends to increase over the course of the century with the North Island and northern South Island irrigated areas hardest hit.

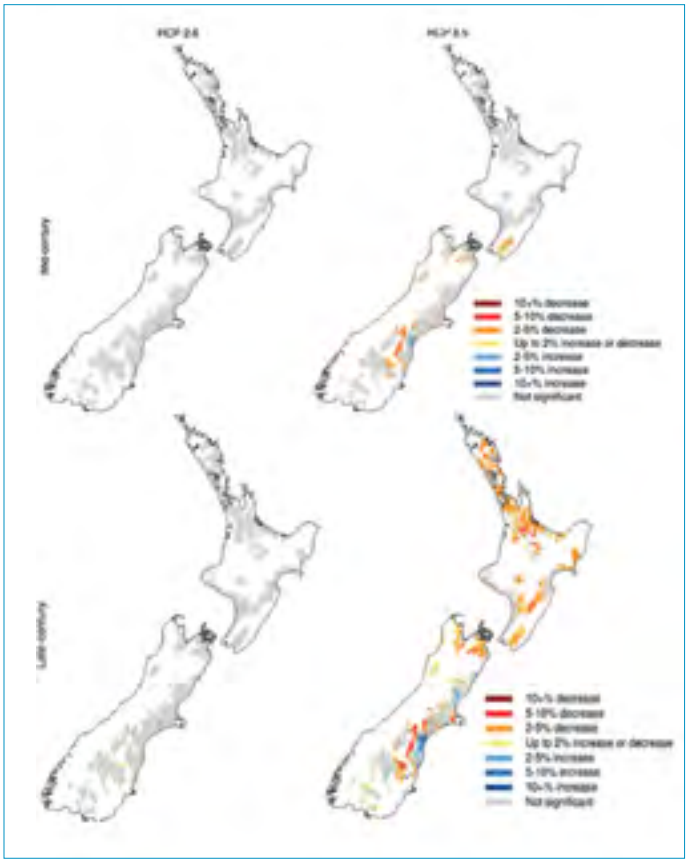


Figure 2. Mid- and late-century changes in river reliability of supply (Collins et al. 2019).

Reliability of river water supply (the average fraction of time during each irrigation season that the river flow is too low and thus irrigation is restricted) tends to decline during the century but largely only by late-century and for the extreme climate change scenario (Figure 2).

The decline in supply reliability and increase in irrigation demand point towards increasingly challenging conditions for irrigators, despite increases in average flows. These results have several important implications for multi-risk management (e.g. the increased risk of wildfire which may threaten agricultural and horticultural land) and adaptation of irrigated systems and water resource management. Adaptation strategies may include changing water allocation policies, increasing water storage, changing crops, and improving water use and economic efficiency. Given long planning horizons for both irrigated systems and water policies, such strategies may have to consider transitions to drought-resilient futures before it becomes necessary.

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Climate change: A farmer's perspective

With knowledge about climate change and the environment farming for the future is a passion for one Canterbury farmer.

Craige Mackenzie is a cropping and dairy farmer in Methven.

He and wife Roz own Greenvale Pastures, an intensive irrigated cropping farm which grows several specialty seed crops along with wheat and ryegrass, as well as Three Springs Dairies an irrigated dairy farm which milks 940 cows.

Mr Mackenzie was the recipient of the New Zealand Nuffield Farming Scholarship in 2008 where he had the opportunity to travel globally and learn for six months. This sparked his interest in precision agriculture and in 2010 along with Roz and their daughter Jemma, started their own business, Agri-Optics. Through tools and processes they investigate the best way to spatially apply water, nutrients and more to land. Mr and Mrs Mackenzie also have a son Scott who completed a Law and Philosophy Degree and now lives in Australia.

"Being able to spatially apply water, fertiliser, nutrients and more based on what is happening below the ground is so important. There is so much variation from paddock to paddock, even within the paddock… we saw this as the best way forward."

Alongside his own businesses, Mr Mackenzie shared his knowledge through other avenues. He volunteered as a board member for the Global Farmer Network, was a representative to the International Society for Precision Agriculture and was heavily involved in several industry research initiatives involving the dairy and cropping sectors. He had also been the recipient of the 2013 National Balance Farm Environmental Award and in 2016 was recognised as International Precision Ag Farmer of the year. Mr Mackenzie had also patented the Smart N fertiliser application system which, with the use of sensors, can apply nitrogen in between dairy urine patches and not on them.

Mr Mackenzie was incredibly knowledgeable about the best environmental farming practices. IrrigationNZ caught up with Mr Mackenzie to discuss a farmer's perspective on climate change.

Craige stands in a paddock of hybrid carrot seed crop at his arable cropping farm in Methven.

When did you first become interested in farming?

I have been farming for most of my life, I enjoy farming, you're always adapting and learning and discovering how to best work with the environment. Over the years as technology has become more advanced, I have become more and more interested in it and made it part of our everyday farming operations.

How do you sum up what climate change is in one sentence?

Climate change, in my opinion, is increased extreme events. Much greater extremes, extreme dry periods, extreme wet periods. When looking at data about how much the climate is altering there is no doubt that it is happening. The best way to address it is by looking at how do we manage those extreme events for our farms with the technology available to allow us to mitigate as much as we can.

What made you become interested in climate change?

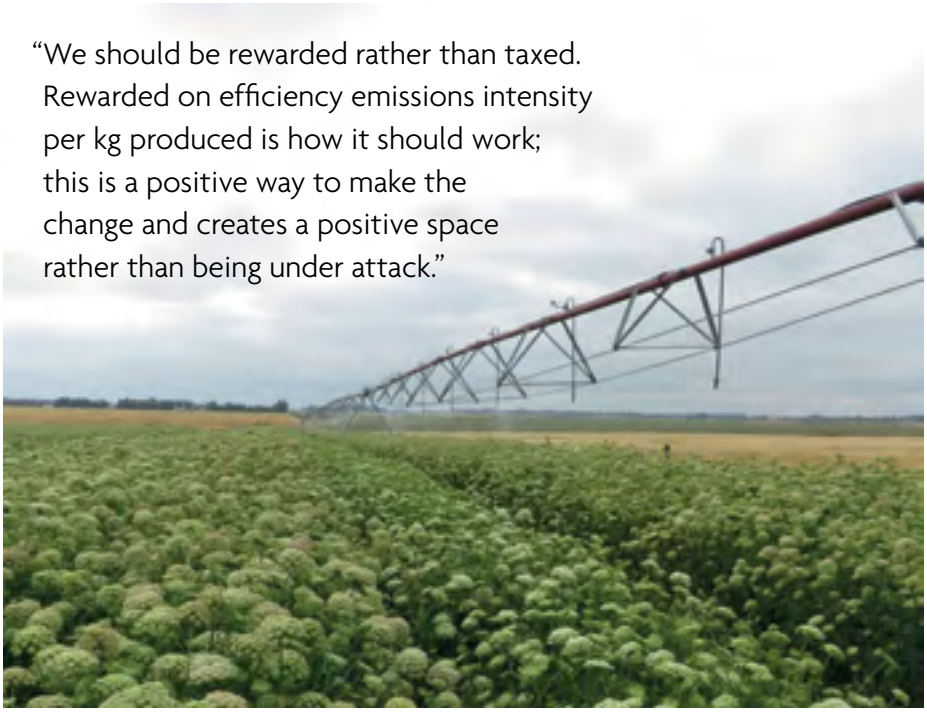
As our own farming operations started to become more developed, I started to step back and look at it from the outside in, standing back and working on the business rather than inside the farm helped me to look at it differently. Once you start looking at your business you start looking at other things.

When I received the New Zealand Nuffield Farming Scholarship, I got the opportunity to go overseas and travel for six months to study 'understanding the carbon footprint in farming systems'. This really opened my eyes to what issues were happening not only in New Zealand but also in other countries. While on my travels I did a lot of work around precision agriculture in Colorado and I saw this as the way forward which ultimately prompted me to start my own business. Spatial efficiency can really affect your inputs, and by cutting your inputs you are ultimately cutting your emission outputs therefore mitigating while maintaining or increasing production. This travel also helped me gain a lot of knowledge from a range of people, people who I have created friendships with from around the world.

What is New Zealand's position in climate change globally and how does New Zealand compare to the rest of the world?

We're a drop in the ocean really. We're not going to change the world's climate. However, a low carbon footprint can promote our premier products; we want to be able to show that we can add value to a product. Compared to the rest of the world we're leading in agriculture and horticulture climate change reduction impacts already. We have the lowest emissions intensity per kilogram produced already and have made massive gains without majorly increasing our inputs, such as increased lambing percentages, etc, we are already very efficient farmers.

Craige checking his VRI system. VRI is a crucial part of his cropping operation as it allows him to apply water where necessary across the paddock due to the spatial differences. Just one of the technologies he utilises on his farms.



"We should be rewarded rather than taxed. Rewarded on efficiency emissions intensity per kg produced is how it should work; this is a positive way to make the change and creates a positive space rather than being under attack."

What is your position when it comes to Government policies on climate change in New Zealand?

Water is the biggest issue that faces the world and water and climate change policies go hand in hand. We don't want, and can't afford it as an industry, to have a gross tax. We don't want to end up in a position where we can't reach targets.

We should be rewarded rather than taxed. Rewarded on efficiency emissions intensity per kg produced is how it should work; this is a positive way to make the change and creates a positive space rather than being under attack.

As mentioned earlier, as a country we're not going to stop climate change. Climate change is a community problem both local and global, but we can do our best to mitigate as best as possible while still farming the land. Planting trees is not a long-term solution because what happens when the trees all have to get cut down, or they create leaching, etc so this is not an overall viable solution. We just need the most appropriate use of our land.

What is important for farmers and growers going forward and into the future?

It is a lot easier to find reasons why you won't change than why you will change. Climate change is recognised New Zealand wide and in other sectors of society, but needs to have everybody buying into it and everybody making some changes.

The best place to start is with the easiest mitigation options while keeping production sustainable and maintaining profitability, the more profitable you are the more options you have for mitigation. Buying into new technology and changing your business for the better is great but being efficient is about using what you've got the best you can. Pick all the easy things and that's a place to start. Get alongside the Government and be informed about what is going on so we can shape the policy space. The top three mitigation techniques are to:

1. Use good farming techniques – refine the application of fertiliser and water, better use of precision agriculture techniques and appreciation of the spatial difference of land could make a big difference.
2. Growing the most appropriate crop for the area you live in – if something is suited to the area it is going to need fewer inputs, therefore, a better overall outcome.
3. Technology – although it may seem like a big cost to invest in technology, having the right equipment can make a farming business much more successful and most of the time you will get the return on your investment.

How would you maximise inputs while maintaining standards, we are only limited by our imaginations? We must remain proud to be farmers because if we don't have farmers to farm the land, what are we going to do with it?

A new role for irrigation infrastructure in a changing climate

By Dr Brett Painter, Project Leader of Assessments for the Canterbury Water Management Strategy.

Managing Canterbury's water resources for fish, families and farming has been a challenge since agriculture first expanded across the plains – and a changing climate is increasing this challenge.

We are fortunate in Canterbury that our extensive irrigation infrastructure can be used not only for delivering irrigation, but also environmental benefit. Managed Aquifer Recharge, or MAR, is one way we can use Canterbury's irrigation infrastructure to make it easier to improve both water quantity and quality without impacting on irrigation delivery.

Analysis of long-term Canterbury plains climate records (rainfall and evapotranspiration) shows that over the last century, the climate has been slowly drying, with Pacific climate cycles also influencing drought regularity and intensity. One such cycle, the Interdecadal Pacific Oscillation, is currently entering its El Niño-dominant phase. This tends to produce more regular droughts in Canterbury – in fact the last cycle provoked the droughts of the 1980s and 1990s. These events accelerated irrigation development and were a factor in the development of the Canterbury Water Management Strategy (CWMS), a collaborative process to enable sustainable futures for all water uses and users.

The CWMS suggested trialling of environmental infrastructure connected to irrigation scheme infrastructure. The potential rewards of this approach are obvious – water infrastructure is expensive, and we all pay for it one way or another. The challenges, as always, are in the detail.

A significant network of water infrastructure has existed on the Canterbury plains since the late 1800s. This has enabled reliable supply of stockwater as well as some firefighting, domestic and irrigation uses; in particular when westerly systems provided rain in the alpine river catchments but not on the plains. The races also provided additional habitat opportunities for fish during dry periods and artificially supported the groundwater systems, as they were unlined and lost most of their flow to groundwater (over 90 percent in many cases). However, this water wasn't necessarily clean (in particular from bacterial contamination) and wasn't targeted to support groundwater systems where and when it was most required. Recent initiatives to shut down stockwater races (along with lower recharge from improved irrigation efficiency) have reduced the beneficial impacts of "unmanaged" recharge but provided the opportunity for a more efficient and targeted use of this water.

> "We are fortunate in Canterbury that our extensive irrigation infrastructure can be used not only for delivering irrigation, but also environmental benefit. Managed Aquifer Recharge, or MAR, is one way we can use Canterbury's irrigation infrastructure to make it easier to improve both water quantity and quality without impacting on irrigation delivery."

MAR focusses on making aquifer recharge more "managed". It involves letting clean water penetrate into the ground (usually through a soakage basin) in a manner that targets specific water quantity, quality and/or habitat objectives. Where the temperature and/or chemistry of the recharged water is different from the receiving groundwater, it is important to filter the recharge water through soil. We are also trialling two variations of this concept:

- **Near River Recharge (NRR):** In this system, soakage basins feed the same groundwater system recharged by the losing reach of a hill-fed river.
- **Targeted Stream Augmentation (TSA):** This involves drilling a well into the groundwater system that normally provides spring flows, which will continue to feed the waterway when natural spring flow ceases.

MAR supply can be retrofitted to match available supply capacity in an irrigation scheme by the siting and sizing of MAR sites throughout a catchment. It can operate with low supply reliability during the irrigation season because groundwater travels slower than surface water. Rivers and pipes transport water downstream in hours or days, but groundwater particles will likely take years or decades to travel the same distance. MAR supply for water quality objectives is therefore managed for this slow response time. MAR supply for water quantity objectives (such as lowland waterways) relies on the groundwater pressure response (like a boat bow wave), which travels through a catchment in days to months. For example, using MAR at upper catchment sites in winter is important for groundwater-fed lower catchment waterways in the summer. TSA sites that are independent from irrigation infrastructure can fill the gaps, providing immediate top-up supply to key waterways where required.

Hekeao Hinds MAR Pilot Site.

South Hinds Near River Recharge project, with supply from Rangitata Diversion Race.

In the Ashburton District, MAR is being trialled through the Hekeao Hinds MAR project. This project was initiated by the Ashburton CWMS Zone Committee, which proposed reduced nutrient leaching, improved water supply management and a MAR trial as key components of Plan Change 2 to Canterbury's Land and Water Regional Plan. The MAR project has water quality and quantity objectives, with the current priority to protect drinking water supplies from high nitrate concentrations.

The Hekeao Hinds MAR project began operations at their MAR Pilot Site in mid-2016. By mid-2019 11 new small test sites were also operating, as well as an NRR site beside the South Hinds River. Further MAR sites are currently under development so that a catchment scale MAR scheme can be tested and costed by mid-2022. The Rangitata Diversion Race and MHV Water irrigation scheme are critical to the potential for MAR in this catchment. All MAR water is taken from the Rangitata River via transfer of unused stockwater consents and delivered via scheme infrastructure to MAR sites. Irrigation supply is always prioritised during the irrigation season, but irrigation ponds enable some supply buffering. They also allow water to settle, which reduces suspended sediment concentrations that can clog up MAR sites.

In the Selwyn District, a pilot TSA trial was conducted in 2015. This followed the 2014–15 drought, where a significant population of the Canterbury mudfish, one of New Zealand's most threatened fish species, was wiped out when a lower tributary of the Selwyn River dried up. Following three dry winters, the Selwyn River then ran dry at the Coes Ford recreational reserve in March 2017. These significant adverse effects accelerated efforts to construct a large scale NRR project by the upper Selwyn River.

Construction of the Selwyn NRR project was completed in late 2019, and commissioning is planned for autumn 2020. Project infrastructure connects directly to the Central Plains Water (CPW) irrigation scheme with water sourced from unrequired stockwater and scheme water. This project would not have been able to proceed without a willing partner in CPW, as the cost of independent supply infrastructure would not have been justifiable.

As with the Hinds MAR project, the Selwyn NRR project will operate as the lowest priority scheme user, with a focus on recharging groundwater during dry winter periods, when there is no demand for irrigation. This project will support flows to nearby mudfish habitat. It will also improve flows in the lower catchment many months later.

In short, like the MAR scheme in the Ashburton region, the Selwyn project will make use of the irrigation infrastructure in times of low demand to top up underground aquifers. It's a win-win that will allow for a more efficient use of the water that we take from our alpine rivers, boosting underground water levels, lowering nitrate concentrations, and preserving habitats for Canterbury's valued fish species.

The Canterbury mudfish (Kōwaro) – one of New Zealand's most endangered freshwater fish species.

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TOGETHER WE WILL ENDURE

Farming is the backbone of a proud nation carved out by our early pioneers' strength, determination and hard work. Resilience and an inherent belief in a better way forward still drive's our farmers desire and need for perpetual innovation.

These same qualities are the foundation of Zimmatic. We are proud to lead the way in irrigation technology and to be part of the enduring legacy our farmers leave for future generations.

Flexible decision-making for water storage under climate change

By Anita Wreford, Associate Professor Lincoln University.

Water availability, supply and distribution are already presenting challenges across diverse water users in New Zealand. Climate change, as well as population and economic changes, will exacerbate these pressures. What do we know about what a changing climate will mean for water availability? On one hand, we have a range of projections of future climates that allow us to model future water availability across different regions in New Zealand. Broadly, we know that we can expect changes to the distribution of rainfall across New Zealand over the course of the century and beyond, relative to the 1986–2005 time period. The Ministry for the Environment provides projections of climate change, which are freely available (Ministry for the Environment 2018), and contain information by region under different scenarios of future climate change.

But on the other hand, these projections contain high levels of uncertainty. The uncertainty stems from three main sources: uncertainty in how the world will reduce emissions of greenhouse gases and therefore how much warming and associated changes in variables such as rainfall is likely; then there is uncertainty arising from limitations in our understanding of climate processes and their representation in climate models; and finally there are uncertainties around the natural climate variability. While some of these uncertainties may reduce over time, for example as the level of success of the global effort to reduce emissions becomes more apparent, others are irreducible.

How then can we plan for the future to ensure we are prepared for the range of changes that may occur? The uncertainties can present challenges to our planning but there are several ways we can make changes in our thinking and the tools we use.

First of all we can consider a range of plausible climate futures, rather than just one. And we can apply different types of methods to help us make decisions, beyond the familiar ones such as Cost Benefit Analysis (CBA). An approach that focuses on flexibility to handle future uncertainty, but other useful approaches consider diversification and 'robustness' – changes that work well across a range of futures, rather than optimising for one future that may not eventuate.

Questions about future water availability inevitably turn to water storage as an adaptation to manage water variability, enabling greater security of supply and a reliable source of water at critical times for crop growth. But it is an expensive option – water storage facilities are a significant investment, and it can be difficult to justify the immediate costs when the benefits may not be seen for several years. Furthermore, because of the uncertainty identified previously there is considerable scope for over- or under-investment: either providing too much storage that turns out to be unnecessary if water availability increases in future, or too small and limiting future production.

In a research project, funded by the Deep South National Science Challenge, we attempt to tackle this problem of uncertainty by applying a method called Real Options Analysis (ROA), to water storage investment decisions in New Zealand. ROA is really an extension of CBA, but the difference is that it allows – and estimates an economic value for – flexible strategies that can be adjusted over time depending on how the future climate plays out. By placing an explicit value on flexibility and learning over time, ROA makes investments as efficient as possible and adaptable to a range of climate futures, avoiding costly over- or under-investment.

In this research project, we use a range of climate scenarios (four different scenarios of future climate, using six different models, to provide 24 potential futures) to simulate expected changes in water availability over the course of the century. Hydrologists from NIWA built a simple reservoir model to estimate the size of reservoir/s required to meet crop and pasture needs to maintain production in a given location under these 24 different water availability scenarios for the future. The size of reservoir is chosen for the current time period based on the net present value of the reservoir between now and 2040, for the range of scenarios, including an allowance in the design for an extension in 2040 if necessary. The net present value (NPV) calculations are based on the costs and benefits of the production with and without water storage. In a second stage of analysis, the NPV out to 2090 is estimated based on the size of reservoir chosen in 2040 and the water availability between then and 2090. As a result, the most cost-effective investment based on current information is made now, and at the future time point this will be reviewed, and the storage capacity will either be expanded or not, depending on the information and observations available at that time. This approach identifies the most cost-effective solution as it analyses many potential futures and specifies which strategy to pursue in any of those contingent situations.

In this particular project we apply ROA to a site in Canterbury as an example, using a hypothetical reservoir but actual local climate and hydrological data. This is the first application of ROA for hydrological data in New Zealand, and paves the way for future applications in other locations. Although the analysis is relatively complex, the principles of flexibility and revisiting decisions as we learn more about how the climate is likely to change, can be applied to other decisions and contexts without the formal analysis. The research will be of direct relevance to local authorities, farmers, investors and any decision-makers considering large, irreversible investment that may be affected by a changing climate.

Reference: Ministry for the Environment 2018. *Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition*. Wellington: Ministry for the Environment.

IrrigationNZ in America: Water is the blood of the earth

In January 2020, IrrigationNZ CEO Elizabeth Soal and board chairwomen Keri Johnston attended the Irrigation Leader Tour and annual Irrigation Leadership Conference. Ms Soal's attendance as an international speaker was sponsored by Water Strategies LLC, a private lobbying consultancy based in Washington, DC. Ms Johnston self-funded her attendance on the tour herself. Ms Soal said the trip was incredibly insightful into water infrastructure and government policy as well as a great opportunity to meet a vast range of people and speak on behalf of irrigation and water use in New Zealand.

"Of course, the issues faced in America with water storage, use, allocation and irrigation are different to what we face her in New Zealand but they're also the same," Ms Soal said.

She recalled her trip...

THE HOOVER DAM

The first stop on the tour was to visit the Hoover Dam, situated on the Colorado River, on the border between Nevada and Arizona. It was built during the 1930s and created Lake Mead, the largest water reservoir in the US, with a storage of 80,176,200 megalitres (one megalitre equals 1,000 cubic metres).

Lake Mead reached its lowest point in 2012, at 328.2 metres. 320 metres is the lowest intake point, but by this stage, the lake water is very warm. On the day we visited, it was at 333.5 metres, and the "high tide" line (known locally as the bath ring) is visible, from when the lake reached a high level in the 1980s.

The Dam discharges between 12 and 24 million cubic metres of water per day, at an average of 337 cubic metres per second. The priority purposes of the Dam are to provide water for (in descending order of priority): flood control, navigation, irrigation, water storage, power generation.

A true feat of engineering at the time, there was so much concrete used in the construction of the dam that it would have taken around one hundred years to cure. A refrigeration plant and cooling lines were installed within the dam to accelerate the process. Its elevation is 376 metres, and the dam is 221 metres high. It is 201 metres wide at its base.

Elizabeth and Keri stand in front of a turbine at the Hoover Dam.

American Indian (Navajo and Pueblo) designs are incorporated within the artistic motifs throughout the dam's interior. The dam also incorporates many art deco design features, reflective of the time that the dam was built.

There are over 200 employees at the

The "bath ring", as it is known to locals shows when Lake Mead reached its highest point in the 1980s, it hasn't been at this height since.

Vegetables grow alongside the canal in Yuma, Arizona.

Dam, which is a major power generation site, and two further hydro dams, the Davis and Parker dams, are also controlled from the Hoover Dam. The control centre at the Dam is operated 24 hours a day, seven days a week. The Dam consists of two separate power stations, one in Nevada and one in Arizona. Until 1988 these were operated completely independently of each other, with separate staff, operations and so on. From 1988, the US Bureau of reclamation took over and now the two are operated together.

The penstocks are around nine metres in diameter, these are held together with pins, that were inserted frozen and then expanded as they thawed to make a perfect fit. The wicket gates act like a venetian blond around the turbine to regulate flow in – there is a "set" in each turbine structure, at a value of $24 million per set.

Invasive quagga mussels are a major problem in both Lake Mead and the Colorado River. They attach themselves to the inside of the penstocks and pipes and are extremely difficult to prevent and move.

The Hoover Dam represents the largest built infrastructure on the Colorado River, which is now a highly modified watershed, as water is used for municipal supplies, hydro-generation, irrigation, and flows are managed to prevent flooding. The amount of water now reaching the Sea of Cortez in Mexico is a fraction of what it once was, and is the subject of international treaties, signed in the early twentieth century.

YUMA WATER USERS' ASSOCIATION

We then travelled by van from Nevada, through parts of California, to Yuma in Arizona. Here, we visited the Yuma Water Users' Association (YWUA). The command area of the Association borders Mexico and Southern California. Yuma was once the only southern crossing point of the Colorado River, it was therefore an important access point to California during the 1849 gold rush. The area was subject to enormous floods, a long levee now prevents the fertile growing area from being flooded.

Yuma is a major food growing area – including citrus (particularly lemons), dates, broccoli, cauliflower, lettuce, celery and other fruits and vegetables. Many of these crops are highly profitable. For instance, Romaine lettuces can earn a grower US$4,800 per hectare. The sector is highly reliant on immigrant labour from Mexico, with most of the crops being harvested by hand. Around 2,000 come across into the Yuma area from Mexico every day to work on the farms. During the height of the winter harvest, a truck and trailer carrying fresh produce leaves the Yuma district every 90 seconds, feeding the US and Canadian markets.

Under a 1944 Treaty between the US and Mexico (mentioned above), 1,850,222 mega-litres per year are required to be released to Mexico from the Lower Colorado river. The

An irrigation canal in Yuma. The right-hand side is the border with Mexico.

majority of this is discharged through the Morelos Dam. A large screen is required to remove rubbish from the canal before it goes through a hydro station and then into Mexico.

YWUA is one of the only irrigation areas in the States that is a private company. Most other irrigation districts are public corporations, set up as a subdivision of the State government. They often have the power to collect rates and distribute water for agricultural and municipal uses and may also generate hydroelectricity. The Districts are governed by Boards of Directors, which will include public officials and their meetings will often be public affairs, with members of the public able to participate by presenting submissions and issues, just as they do at local government council meetings in New Zealand.

The YWUA has the "senior" diversion for Arizona out of the Lower Colorado River, which means their water comes to the from Lake Mead (controlled by the Hoover Dam), and they have the priority take.

Irrigation in the Yuma area occurs mainly in winter, as the summer months are too hot for growing (often over 40 degrees Celsius). On-farm irrigation systems include drip, furrow, and sprinklers. Water use has reduced significantly in recent years as systems have become more efficient.

As the district becomes more efficient with its water use, there is less water going into the Salton Sea. The Sea is a large inland lake which is highly saline, and its salinity is increasing each year. Irrigation Districts are selling their efficiency gains to municipal users in nearby California.

Fish screen. The YWUA uses grass carp to control moss and weed growth in the canals. The carp come from California and require a permit. The conditions of the permit are that no fish can leave the canals, therefore the district employs screens at their discharge points to ensure the carp do not enter natural waterbodies.

Very high groundwater levels (in some places less than two metres below ground level) with elevated salt levels mean that groundwater must be pumped to keep the water away from crops.

The YWUA employs 17 "ditch riders" to maintain the water supply and manage the canal and offtake systems.

Within the area of the Association is one of the world's largest desalination plants – the Yuma Desalting Plant. It was constructed under authority of the Colorado River Basin Salinity Control Act of 1974 to treat saline agricultural return flows from the Wellton-Mohawk Irrigation and Drainage District. The treated water is intended to be part of the allocation provided to Mexico, which would reduce the amount needed to be discharged through the Hoover Dam from Lake Mead. However, the plant has only been fully operational on two occasions since it was built in 1992 and requires significant funding to maintain and upgrade its reverse osmosis technology. This has been due to surplus and then normal water supply conditions on the Colorado River.

IRRIGATION LEADER 8TH ANNUAL OPERATIONS AND MANAGEMENT TRAINING WORKSHOP

Phoenix, Arizona, 29–30 January 2020

A range of topics were covered at the workshop and conference, including effective public communications and messaging, irrigation districts managing supply and demand under increasing urbanisation, women in water, skills for successful managers, working with boards, using HR analytics, how to fire a employee the right way, risk reduction strategies, canal-friendly hydro-power, irrigation safety and asset management, the latest in technology developments including fish screens, and irrigation delivery management.

Two of the most interesting presentations highlighted the differences in approach to irrigation between the US and New Zealand governments. Firstly, Cheryl Kester from the Kester Group presented on the Drought Resiliency Project Grant Programme, run by the US Bureau of Reclamation. The Programme provides grant funding to irrigation districts to develop projects that: mitigate and reduce risks to infrastructure, reduce conflict, and reduce overall impacts caused by droughts.

Two types of grants are available – US$300,000 over two years or US$750,000 over three years. Both streams require 1:1 funding contribution, but this can include in-kind funding.

Elizabeth speaks to the audience about public perception challenges in New Zealand.

An example is the A&B Irrigation District in Idaho, which has received a $250,000 grant for seven deep managed aquifer recharge injection sites for the purposes of drought mitigation.

Next to speak was Tia Cavender, from Dig Deep Research, who provided the audience with a raft of information on various public finance options available for irrigation schemes. The US government provides publicly subsidised loans that are non-competitive and have extremely low interest rates of 0–2.5%. There will often be loan forgiveness provisions within the conditions, meaning repayments can be tailored to best suit the projects' needs.

I presented on public perception challenges in New Zealand. Keri was a panellist for the women in water session, and we presented jointly on the past and future of irrigation in New Zealand.

IRRIGATION DISTRICTS IN PHOENIX, ARIZONA

Roosevelt Irrigation District

The Roosevelt Irrigation District just outside of Phoenix delivers untreated water under gravity to 180 farmers and a growing number of "backyard" irrigators, as urbanisation in their command area has increased by up to 400 per cent in the last 15 years. The area of farms over 5 acres in size has decreased from 35,000 acres to only 4,000 acres during that time period.

The District has needed to employ an urban liaison specialist to assist their urban clients manage their water effectively.

The District has around 49 employees and an annual budget of US$7.2 million. Like the Yuma Water Users, Roosevelt District has employed grass carp to control weed within the scheme's canals. Prior to this, the scheme used the chemical magnesite, which was both dangerous and expensive.

Salt River Project

The final day of the tour took us to the Salt River Project (SRP) in Phoenix, where we visited the Arizona Falls hydro plant. The SRP was one of the first five federal reclamation projects in the United States. The Government built the Roosevelt Dam to provide water to the Project, with the farmers who received the water putting up their properties as collateral security.

Today, the Project consists of seven canals, covering 131 miles, as well as 1,100 miles of lateral pipes and ditches. Like the Roosevelt District, the SRP has seen increasing urbanisation within its command area, commencing in the 1960s.

Arizona Falls had long been an important recreation spot for the local community, and the first power plant was constructed in the 1800s. When the plant was rebuilt in 2003, the Project formed a collaboration with the Arcadia municipality authority, as well as the Phoenix Arts Commission to create a functional hydro station that also incorporated artistic and educational elements and provided recreational and aesthetic benefits to the community.

The site includes education boards for the public to learn about the history of the project, the history of the site, and the way water is managed in the area. The artistic elements include a recreation of the "natural" Arizona Falls site, poetry within the walking areas, and imprints within the concrete of indigenous reeds growing in the area.

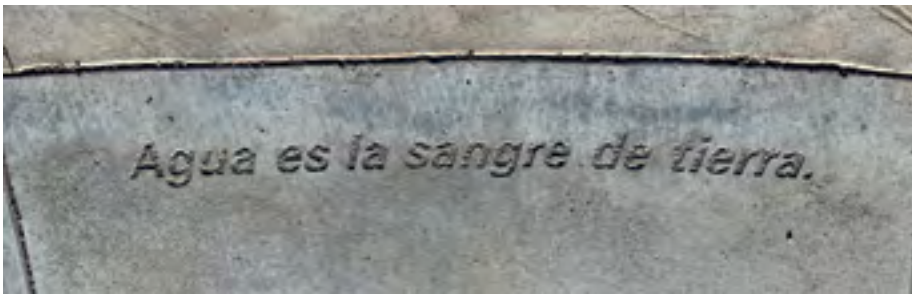
Today, the SRP maintains the generation assets, whilst the landscaping, lighting and public facilities are maintained by the City. The physical land on which the station sits is owned by the Bureau of Reclamation.

The large pathways on either side of the canal provide for cyclists, walkers, and runners to engage directly with irrigation infrastructure within the city. Up to 80 miles of canals are being utilised within Phoenix for this purpose, and they will eventually all be connected as one trail circuit.

Within the city of Scottsdale, in the wider Phoenix area, the SRP has also collaborated with the City to create an incredible public space and live public arts experience where the Arizona Canal passes through Old Scottsdale Town.

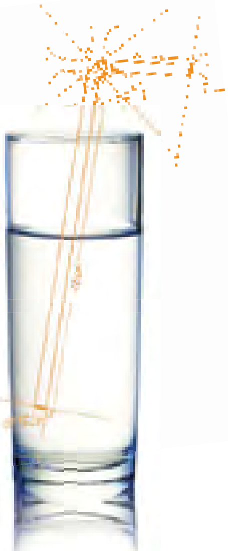
The Canal Convergence event, which began as a way of getting the public interested in the cleaning of the canal, has grown into a major tourism event, with the 2019 event attracting 300,000 attendees. International artists create spectacular, large water-based artworks, which integrate the water with lighting and are displayed on the canal, which is crossed by three bridges in the compact area of downtown.

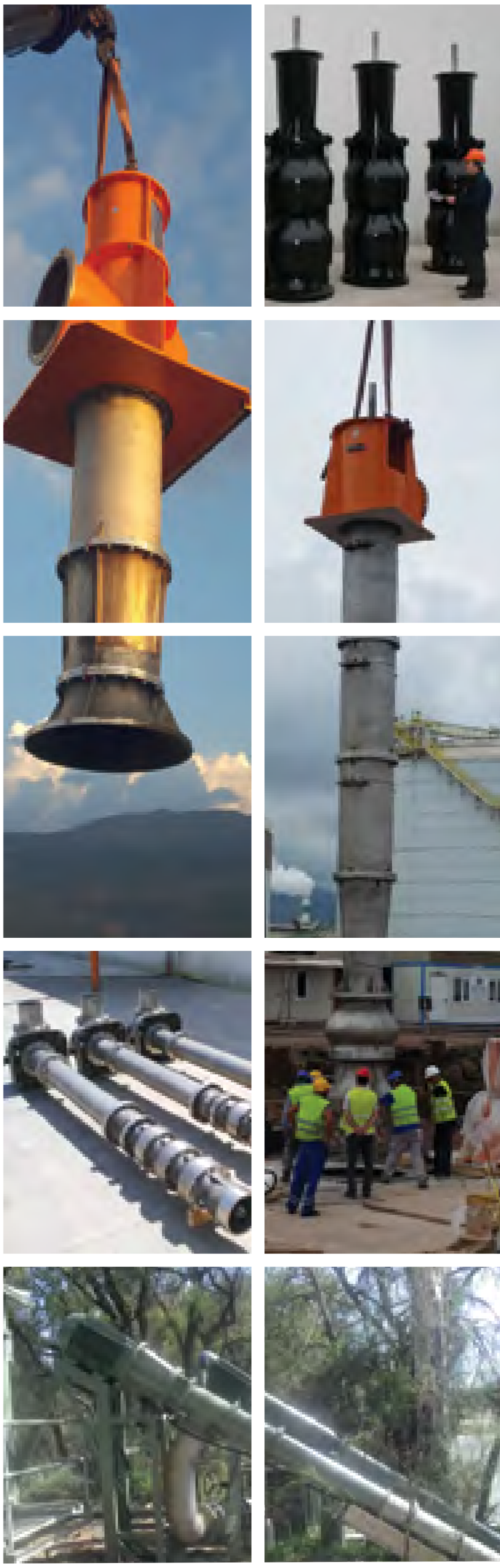
Arizona Falls hydro plant.



At Arizona Falls – translates to "water is the blood of the earth".

The canal shores have been landscaped and integrated with the traditional architecture to create a space that people are attracted to and want to spend time in – all thanks to irrigation infrastructure. Artists are now lining up to participate in the annual Canal Convergence event, and companies are clamouring to sponsor the event, which has put Scottsdale (in the middle of winter) firmly on the tourism map.





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WATER FOR LIFE
7–9 April 2020, Christchurch

Join the Conversation at the Air Force Museum of NZ

The Water for Life Conference 2020 offers a whole lot more than just its talks, with the opportunity to network with your peers, take part in tours and more. Over the next few pages, we will take you through everything on offer for this year and prove just why you need to be a part of the conversation.

Pre-Conference Tours

TOUR 1 – DIVERSIFICATION IN CANTERBURY

Over the last five years, there have been some exciting changes to Canterbury's land use. From the introduction of hemp and quinoa, to expanded production of lilies and blackcurrant. Join us as we travel through Canterbury, stopping for presentations in Ashburton from some of the key growers and manufacturers of these crops.

TOUR 2 – PADDOCK TO BOTTLE

How does your beer get to the bottle? Join us on a discovery tour to Gladfield Malt in Dunsandel and then onto the Wigram Brewing Company, to tour the brewery and even taste the end product. There will also be a lunch stop at Melton Estate winery. You can find further information and the full tour itinerary on our website.

PRICES START FROM $85.

Awards Dinner

After a day filled with thought-provoking speakers, new technologies and debate, what better way to keep the conversation going than by joining your peers at our Conference dinner? Dine amongst the planes in the magnificent Aircraft Hall on Wednesday evening, a dramatic venue seeped in aviation history, with humour coming from our MC Te Radar, and Mark Inglis, the first double amputee to climb Mt. Everest. The evening will also host a number of awards, including the Ballance Innovation Awards. Tickets are available for $155, which includes dinner and drinks.

Spaces are limited

Head to ***waterforlife.kiwi*** to purchase your dinner or tour ticket.

IRRIGATION NZ
CONFERENCE
AND EXPO

Conference Introduction

See the Latest Irrigation Technology

Water keeps us alive, and that's why decisions around what happens with it are so important, and we know that you think so too. Get involved with our 2020 Conference and join the 'Water for Life' conversation. The Conference will feature an expo with over 45 exhibitors showcasing the latest in irrigation technologies and services. It will also bring together thought-provoking speakers from a range of backgrounds all with an interest in water use and management – beyond just irrigation. There will be nine workshop presentations on technologies, policies and water use for the future of irrigation, as well as the gala dinner and pre-Conference tours. There's something for everyone.

The Conference is held every two years, and is always popular. The 2018 conference was held in Central Otago with over 400 attendees. "Freshwater is consistently identified as an issue of concern for most New Zealanders. One of our key goals as an organisation is to be a thought leader in freshwater management and governance, through the sharing of ideas and promoting new and innovative technology solutions to some of our biggest challenges," IrrigationNZ Chief Executive Elizabeth Soal said.

"It's a great opportunity not only for farmers and growers to come together to talk about the future of water in New Zealand, but also for those from other backgrounds." Local and international speakers will present their views on a range of topics at the Conference. One of these speakers is Monty Teeter. Monty has been in the irrigation industry in the United States since 1972 and has a vast range of experience and a wealth of knowledge across various aspects of irrigation and water use. He has most recently focused on mobile drip irrigation and how this can be incorporated into existing systems. He is going to share his vision for making the most out of every drop of water.

The Conference attracts a wide range of people. It is a great way to create conversations so people become more informed about water and its use in New Zealand and globally. In recent years extreme natural events have become more common from severe drought in Northland, the Christchurch earthquakes, and more recently high rainfall and extensive flooding in Canterbury and Southland. Our neighbours in Australia have experienced some of the worst environmental circumstances their communities have ever seen. These extreme events highlight the need for effective water storage to allow reliability of supply and enable community resilience during these events. We can achieve this, but we need to strategically plan for it as a country. Not just for the sake of irrigation but for the wellbeing of everyone.

The Future of Water Allocation in New Zealand

Water users are facing a challenging environment in 2020. It is unknown what the outcome of the new National Policy Statement for Freshwater Management (NPSFM) and the National Environment Standards (NES) proposals, which were announced last September, will be or who will be the next Government. This has created a grey area around environmental compliance and water allocation, leading to uncertainty and difficulty for farmers and growers to plan for the future. A range of panellists will discuss the key challenges and opportunities ahead for the industry. The discussion will work towards creating plans and setting a direction for the industry and its people. Panellists will also discuss the future of water infrastructure, with moderator, journalist, mum, and farmer's wife, Donna-Marie Lever. The audience will be invited to participate in the conversation. Come along and have a say on the future of water in New Zealand.

Diversification

Irrigation plays an important role in Canterbury. We have chosen it as the location for IrrigationNZ's 2020 Conference as the region demonstrates a range of uses of and the advantages of irrigation. Good practice in irrigation with environmental effects front of mind is a daily practice for farmers throughout the country. Canterbury is an example of where irrigation is not only used for productivity success but environmental benefits as well. "Canterbury has some fantastic examples of diverse land uses – from sheep and beef and dairy, to viticulture and cropping, and new and innovative food and crop species include hemp and quinoa. We'll be showcasing some of this innovation in our pre-conference tours" Ms Soal said.

The Conference will be held at the Air Force Museum of NZ, in Christchurch.

Social Functions

Welcome Function

The Welcome Function will be held on Tuesday evening in the Exhibition Hall from 5.30pm to 7.30pm. If you do go on one of the Pre-Conference Tours during the day, the bus will return you to the Air Force Museum of NZ in time for the Welcome Function. A great way to start your time at the Conference by having a drink with friends and colleagues, new and old.

Delegate Breakfast

The Delegate Breakfast is being held on Thursday 9 April, from 8am to 8.45am. Wake up with this networking breakfast and start the final day of Conference on the right foot. If you intend to come along to the Delegate Breakfast, please advise at the time of registration for catering purposes.

Expo Information

A major feature of the Conference is our Expo, open to all on both days, it offers a high traffic area where all delegate catering will be served. The Expo has been designed specifically to showcase industry products and services, and offers you the chance to explore, question and learn about the latest in irrigation technology. Keep an eye on our website for the latest list of exhibitors you can expect to see. Alternatively, if you would like to showcase your organisation at the event, please do contact the event management team for availability. You can view the latest floorplan at waterforlife.kiwi/exhibitor-info

Accommodation

The Conference has secured block bookings in many hotels in the Christchurch CBD for the duration of the Conference. A list of partner hotels and discount codes are available on our website at **waterforlife.kiwi/conference** – check back regularly for updates.

Registration Info

REGISTRATIONS ARE OPEN UNTIL 27 MARCH

You can register by heading to **waterforlife.kiwi**
Please see options and everything included with your registration below.

Full Registration

MEMBER: $699

NON-MEMBER: $870

Includes:

- Welcome Function
- Conference satchel and handbook
- Attendance at the two day conference programme including technical and practical breakout sessions
- Access to the Trade Expo
- Conference Catering: morning/afternoon tea and lunch
- Delegate Breakfast

Day Registration

MEMBER & NON-MEMBER $470

Includes:

- Conference handbook
- Attendance at sessions on the specified day
- Access to the Trade Expo on the specified day
- Conference Catering on the specified day

If you would like further information regarding registration, social events or accommodation, please contact Jane@beckandcaul.co.nz. If you have a query regarding the Conference Expo, please contact Jules@beckandcaul.co.nz.

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Conference Programme

We are bringing our Conference and expo back to Christchurch in the heart of Canterbury. The Air Force Museum of New Zealand is a fantastic location and site, allowing our plenary, breakout sessions, dinner, and expo to be held on one site, in a fascinating setting. Our pre-Conference tours will also take place in Canterbury, see our full programme below.

Tuesday 7 April

7.30am	**PRE-CONFERENCE & PRE-TOUR REGISTRATION**
	PRE-CONFERENCE TOURS The pre-Conference Tours are back for 2020 and will be held on Tuesday 7 April. There will be two tours to choose from: **Tour 1: Diversification in Canterbury** Over the last 5 years, there has been some exciting changes to Canterbury's land use. From the introduction of hemp and quinoa, to expanded production of lilies and blackcurrants. Join us as we travel through Canterbury, stopping for lunch and presentations in Ashburton from some of the key growers and manufacturers of these crops. **Tour 2: Paddock to Bottle** How does your beer get to the bottle?! Join us on a discovery tour to Gladfield Malt in Dunsandel, and then onto the Wigram Brewing Company, to tour and taste the end product. The tours will start from the conference venue, the Air Force Museum of New Zealand, (times TBC) and return by 5.15pm, for the Welcome Function in the venue Exhibition Hall.
3.30pm – 5.30pm	**CONFERENCE EXHIBITION OPEN**
5.30pm – 7.30pm	**WELCOME FUNCTION** Held in the exhibition hall.

Wednesday 8 April

7.30am	**REGISTRATION DESK OPEN**
7.30am – 5.00pm	**CONFERENCE EXHIBITION OPEN**
7.30am – 8.30am	**WELCOME COFFEE**
8.30am – 9.00am	**CONFERENCE WELCOME & OPENING** Powhiri Keri Johnston, IrrigationNZ Chair John Penno, Chair of the Freshwater Leaders Group

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(Wednesday 8 April continued…)

9.00am – 10.00am	**THE NEW ZEALAND FARMING STORY SO FAR** ***Giving value to water: the journey from a free to a treasured resource:*** Keith Woodford ***Living with elevated nitrate in our water; why and what's to be done?*** Dr Jenny Webster-Brown.
10.00am – 10.30am	**MORNING TEA** Irricon resource solutions
10.30am – 12.00pm	**THE FUTURE – RESILIENCE AND DIVERSIFICATION** ***Opening:*** Todd Muller, MP for Bay of Plenty and National Party Spokesperson for Agriculture ***A new business model enabling sustainable land use transformation:*** Susan Goodfellow, Leftfield Innovation ***Waimea Community Dam, a public-private partnership to secure our region's future:*** Mike Scott, CEO, Waimea Water ***Sustainable crop production in CEA (Controlled Environment Agriculture) – a grower's story and future tech reality:*** Kylie Horomia, Autogrow
12.00pm – 1.00pm	**LUNCH**
1.00pm – 2.30pm	**PANEL DISCUSSION** FMG **WHISKEY AND WATER – the future of water infrastructure** ***Moderator:*** Donna-Marie Leaver ***Panelists:*** Susan Kilsby, Agri-Economist, ANZ Sarah Perriam, Agri-Food Broadcaster, Perriam Media Elizabeth Soal, CEO, IrrigationNZ Carl McGuiness, The Nature Conservancy Gary Kelliher, Otago Regional Council Traci Houpapa, Chair, Federation of Māori Authorities
2.30pm – 3.00pm	**AFTERNOON TEA** WSP
3.00pm – 4.30pm	**KEYNOTE** **MAKING EVERY DROP OF WATER COUNT** ***Opening:*** Mark Patterson, MP and New Zealand First Spokesperson for Agriculture and Primary Industries ***Monty Teeter, Teeter Irrigation:*** Developer & CEO of Dragon-Line Mobile Drip Irrigation (Ulysses, Kansas)
7.00pm	**CONFERENCE DINNER** Venue Aircraft Hall

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IRRIGATION NZ
CONFERENCE AND EXPO

Thursday 9 April

7.30am	**REGISTRATION DESK OPEN**
7.30am – 2.00pm	**CONFERENCE EXHIBITION OPEN**
8.00am – 8.45am	**DELEGATE NETWORKING BREAKFAST IN EXHIBITION HALL**
9.00am – 10.00am	**KEYNOTE** **TRANSFORMING LANDSCAPES USING DIGITAL TECHNOLOGIES AND VISUALISATION.** ***Opening*** Hon Damien O'Connor, Minister of Agriculture ***Dr Seth Laurenson, Ag Research.***
10.00am – 10.30am	**MORNING TEA**
10.30am – 12.00pm	**FUTURE FOCUSED PRESENTATIONS** **How technology will support better farming outcomes** ***Invisible technologies, where is Agri in the world going?*** Stu Bradbury, Business strategy advisor, technologist, and thinker outside of squares. ***Reducing Nutrient Loss Through Irrigation Efficiency:*** Greg Sneath, Fertiliser Association of New Zealand ***Irrigation Monitoring – helping farmers find their sustainable future:*** Jim Hargreaves, SCADA Farm **POLICY: the future of water allocation in Aotearoa** ***Legal Implications:*** David Goodman and Sarah Eveleigh Anderson Lloyd. ***Policy Debates and Social Media – Don't be a Drip:*** Chelsea Millar, Grass Roots Media ***Effects of irrigation on Canterbury soil water storage capacity*** Sam Carrick, Landcare Research **Water use and the future of farming** ***The Future of Farming and Growing:*** Angela Hogg, FMG. ***The relative impact of soil variability on the value of VRI strategies:*** Joanna Short, Plant and Food ***Mt Cook Alpine Salmon:*** Brian Blanchard, Director of Aquaculture ZIMMATIC BY LINDSAY
12.00pm – 1.00pm	**LUNCH**
1.00pm – 1.30pm	**CEO WRAP UP** Elizabeth Soal
1.30pm – 1.45pm	**CONFERENCE CLOSING** Keri Johnston, IrrigationNZ Chair

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Key Speaker Bios

Monty Teeter, Dragon-Line Irrigation

Exploring how we can make every drop count

Monty has been a distributor, designer and installer of centre pivots for over 40 years, and has experience in SDI (Sub-Surface Drip Irrigation) for over 20 years. This experience of selling more than 3,500 pivots and thousands of acres of SDI has allowed Monty to become proficient in understanding the technologies and benefits of both irrigation applications. In addition, he started developing Dragon-Line nine years ago, the Orange Mobile Drip Irrigation. He will be sharing his vision with us about "How to make very drop of water count!" and the benefits of Mobile Drip Irrigation.

Seth Laurenson, AgResearch

The future of water needs better designed landscapes

A senior scientist and Science Impact Leader for Soil and Water at AgResearch, Seth has a background in soil and water dynamics. At AgResearch, Seth's work has focused on the physical health of soils under pastoral grazing systems and how farmers can mitigate against contaminant losses from critical source areas and vulnerable landscapes. More recently Seth's research has focused on how environmental dynamics operate at a landscape level. Seth is interested to understand how productive landscapes can be designed to better incorporate a wider range of well-beings beyond production alone. For instance, how can landscapes remain productive and also provide biodiversity or aesthetic value to communities as well as deliver desirable water quality.

Donna-Marie Lever

Keeping the panel on track with the future of water infrastructure

Award-winning journalist Donna-Marie Lever has been in broadcast journalism for more than 20 years – more recently, 12 years as the Police and Crime Reporter for 1News. She's conquered news, current affairs, radio, dodged bullets in East Timor, been on tour with the World Cup All Whites, trained at the BBC and CNN and reported from international conflict and disaster zones like the Boxing Day tsunami. The born and bred Aucklander now takes corporate media training masterclasses, crisis communications, is a dinner speaker and a freelance journalist for North & South Magazine, The Guardian, TVNZ and CNN, and is now based in the heart of rural mid-Canterbury.

Panel Guests

Susan Kilsby
ANZ
Agri-Economist

Sarah Perriam
Perriam Media
Agri-Food
Broadcaster

Carl McGuiness
The Nature
Conservancy

Gary Kelliher
Otago Regional
Council

Traci Houpapa
Federation of
Māori Authorities
Chair

Elizabeth Soal
IrrigationNZ
CEO

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Innovation Award Finalists

IrrigationNZ: Innovation Award

IrrigationNZ, in association with Ballance Agri-Nutrients, appreciates the brainpower that goes into creating inventive irrigation tools and techniques, and we want it to be recognised. A $2,500 cash prize will be awarded for 'the best innovation, discovery or achievement that makes a positive contribution, impact or benefit to irrigation in New Zealand'. The winner will be announced at the conference dinner on Wednesday night. With many worthy entrants, three finalists were selected. Read more about the strides they are making in irrigation here.

Aqualinc: N-Wise Irrigation

A pilot desktop study led by Dr John Bright of Aqualinc has found that changing irrigation scheduling rules can significantly reduce nutrient losses. Dr Bright has decades of experience when it comes to irrigation management and was approached by the Fertiliser Association of New Zealand to carry out this study. "The study is prompted by the obvious environmental aspect that needs to be considered in day to day farming, particularly the need to reduce N losses." The study was carried out on 12 Canterbury dairy farms. The current practice was to irrigate when soil moisture drops below 50% available to the plant and to apply enough water to refill to a target level of 90% of the full point, often higher. The study systematically examined the effects on production, drainage and Nitrogen loss to water of varying the irrigation trigger and target levels. "We were particularly interested in the effects of reducing the soil moisture trigger level to significantly lower levels than current practice during spring and autumn, and of not refilling the soil profile as much as is usual practice." The aim is to increase the soil's capacity to utilise rainfall to reduce the risk of drainage and N leaching. Dr Bright said it was about being "smarter about things in spring and autumn... essentially it's as simple as varying irrigation triggers and targets month by month as set out in a table of values."

Qtech: Water-Insight

Five years in the making, Water-Insight (a brand of Qtech) can now offer a complete Irrigation Management System known as IMS. Launched in 2019, IMS is a state-of-the-art solution that integrates both monitoring and control into one platform. Unique and intelligent sprinkler controllers are placed at each fixed post or pod and can be managed remotely using the new cloud-based interface. A mesh radio network means that these devices can operate over large land areas and on terrain that would typically defeat traditional irrigation methods. IMS includes real-time maps and a communication service that sends out alerts to problems, ensuring the farmer can respond quickly to any issues, streamline operations and reduce service costs. Sensors can also be integrated into IMS to provide farmers with more informed decision-making capability. Moving forward Water-Insight aimed to create tighter decision support which would allow for greater autonomous capability, develop additional sensor types and provide more advanced workflow/operational support.

Marlborough District Council – eWater

Water is Marlborough's most significant resource. The district relies on adequate supplies of freshwater for a range of sectors. Most water resources in Marlborough are at, or nearing, a state of full allocation. A review of Marlborough's Resource Management plans identified the inability to allocate water beyond these limits would create a significant constraint to future growth. To facilitate this, the council outlined an approach to the Ministry for the Environment using the proposed water framework; this resulted in a partnership project that the parties believed "had potential wide reaching implications for water management in New Zealand", after a constructive design period eWater was developed.

Data is used within the system to understand and manage the pressures and demands on Marlborough's water. Users can access the system data and check water records at a glance, by logging in they can see how much has been used to date and how much is left this month, or this year based on their individual consented allocation. This system can determine your irrigation status, whether you are irrigating or when you can irrigate. The site also shows any restrictions on your permit including when you can take water, flow reductions and cut-offs. eWater was designed with users in mind and as a result will work on any mobile device or desktop allowing users instant access to information from the field or home, enabling informed and smarter decision making of our precious water resources.

Purchase your tickets now to the Awards Dinner to see which project is awarded the Ballance Innovation Award at Water for Life.

Ballance agri-nutrients

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Principal Partners

Anderson Lloyd

Anderson Lloyd is a leading New Zealand law firm focused on achieving the best possible outcomes for our clients, with a history of supporting the sectors and industries that make New Zealand successful.

We are the leading legal provider to infrastructure development in New Zealand and widely recognised for our Irrigation practice. Our lawyers are recognised for their expertise and the value they deliver.

Located in Auckland, Christchurch, Dunedin and Queenstown, we have more than 145 partners and staff across our offices.

WHAT MAKES ANDERSON LLOYD SUCCESSFUL?

OUR CLIENTS – We take time to understand our clients and form long-term partnerships with them.

EXCELLENCE – We strive for excellence in everything we do to achieve the best results for our clients. We provide the highest standards of service.

COMMERCIAL OUTCOMES – We understand the needs of our clients' businesses and provide strategic and commercially focused solutions. We are straightforward and pragmatic.

ACTING RESPONSIBLY – Our sustainability programmes promote environmentally sound practices, encourage diversity, and form partnerships that benefit the communities in which we live.

www.al.nz

WaterForce

Water is the most precious resource on earth. At WaterForce we help farmers, growers, businesses, communities, sports clubs and green-thumbed gardeners gain maximum benefit from every single drop. With our technical expertise, vast industry knowledge and leading product range, we can help breathe life into your land and provide clean, safe drinking water to every single tap.

Good business is all about resources: time, money, passion and expertise. In New Zealand, more often than not, it's also about water.

By using our industry knowledge and technical expertise to provide the best water system design and technology, installation and after-sales support. Our extensive product range comes with the most experienced and up-to-the minute advice and knowledge. And we won't just sell you an irrigation system then disappear. Our complete end-to-end service means we're always on hand to provide you with ongoing maintenance, monitoring and support.

WaterForce is 100% owned and operated by New Zealanders and we employ over 200 staff nationwide at 14 strategically-placed branches. We are proud to be leaders in the New Zealand irrigation industry and are always looking for ways to innovate and use the best technology, systems and designs available. Everything we do stands the test of time. Because when it comes to water – and the skills to use it wisely – we can't afford to waste a single drop.

www.waterforce.co.nz

ANZ

For many agribusinesses, irrigation unlocks the potential to maximising productivity and profitability. With reliable alpine water, new scheme developments, new technology and a focus on enhancing environmental outcomes, improved irrigation "on farm" and beyond becomes a reality.

ANZ work closely with farmers and the private sector to support the development of irrigation through scheme enhancement and growth that will ultimately enable individual farmers and New Zealand to benefit from the demand for this country's produce.

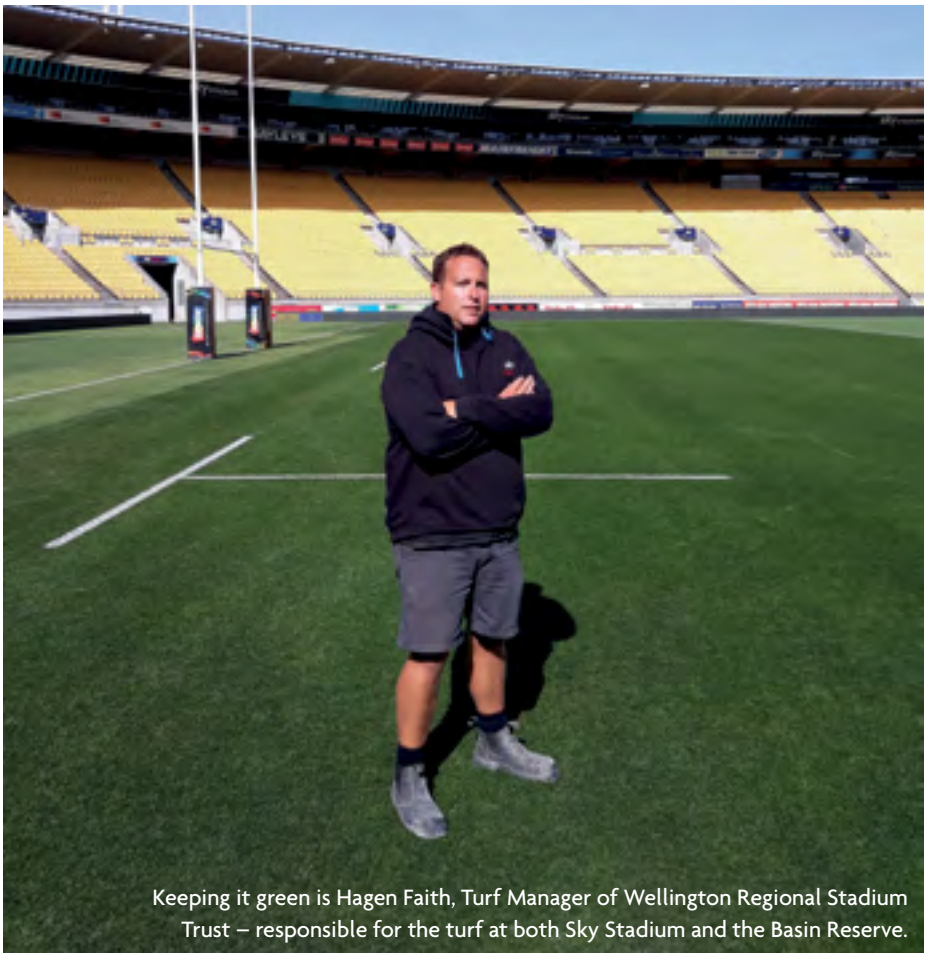
They are a part of a global team who not only connect customers around the world but provide insights to destination markets, giving access to global trends and vital networks. They understand the challenges and complexities of running a responsible and sustainable agribusiness. Helping New Zealand farmers, businesses and communities to thrive is a priority for ANZ.

ANZ has been a Principal Sponsor of the New Zealand Irrigation Conference since 2012 and are proud to support IrrigationNZ and the sector that is a pillar for New Zealand's primary industry and a mainstay for our economy. To find out more about how we can help you contact your nearest ANZ Rural Relationship Manager.

P: 0800 212 269
anz.co.nz/rural

CHAMPIONS SERIES:

Irrigation on the pitch, not just the paddock



Keeping it green is Hagen Faith, Turf Manager of Wellington Regional Stadium Trust – responsible for the turf at both Sky Stadium and the Basin Reserve.

When the word irrigation comes to mind the words grass, crops and paddocks often follow, although it is much more than that.

Irrigation is a crucial aspect to one of New Zealand's biggest sports stadiums.

Hagen Faith is the Turf Manager of Wellington Regional Stadium Trust.

Mr Faith is responsible for turf surfaces at Sky Stadium, formerly known as Westpac Stadium or 'The Cake Tin' to some, as well as the Basin Reserve.

Some may not appreciate the responsibility that comes with looking after surfaces that host international sports games and concerts, which can be viewed by over 30,000 people – and that's just those in the stands.

In the early days, Mr Faith worked on a dairy farm before starting his racecourse maintenance apprenticeship at Otaki Racecourse.

He then crossed his apprenticeship to Sports Turf Management in 2008 when he began working for the Trust (Wellington Regional Stadium Trust). Mr Faith has found his passion in turf management and became manager in 2015. He said his job involved managing staff and everything to do with grounds upkeep from regular mowing, fertilising, pest management and irrigating, to continually prepping for events.

Both Sky Stadium and the Basin Reserve were operated by a Rainbird network system.

"The system means I can operate the irrigation for both grounds from anywhere,

Irrigation to keep the Sky Stadium field in perfect condition.

"Grass plays an important part in a match, the cricket wicket moisture percentage can affect how it can play ... the moisture profile is different for rugby and soccer as in soccer there needs to be a faster ball roll ... we know the numbers and have a target for each event."

which is really effective … as long as everything is working right."

Mr Faith said Sky Stadium covered 1.5 hectares and had 65 pop up sprinklers.

Approximately 5ml of water coverage was applied to the field on each application and 750kgs of Nitrate each year.

"It has a sand-based profile so there's no time to muck around if it's getting dry."

He said when they irrigated was of course weather dependent but, during the summer it was usually every second day based on evapotranspiration levels.

Not only did the fields have to look good but they also had to perform well, especially when the stadium hosted an excess of 55 high profile events a year.

"Grass plays an important part in a match, the cricket wicket moisture percentage can affect how it can play … the moisture profile is different for rugby and soccer as in soccer there needs to be a faster ball roll … we know the numbers and have a target for each event," said Mr Faith.

"If we didn't have irrigation the fields certainly wouldn't be up to scratch."

Mr Faith said he found his job very rewarding but, like all jobs it came with challenges.

"One of the biggest challenges is keeping the grass good between events, sometimes there's not much time to look back and reflect … last year we had the Eminem concert which was the biggest event we've ever had, and then a week later we had our first super rugby match. Having the grass performing after having so many people on it at the concert was important."

He said in a lot of ways his job was similar to working in the farming and growing industry.

"You're always on the go, thinking about how the grass is growing … utilising good watering techniques and fertiliser management … fertilising is crucial coming into a rugby event following a concert."

CHAMPIONS SERIES:

Robyn Wells – working for the future of water in the Wairarapa

Robyn Wells grew up in Masterton and has almost come full circle after being appointed chief executive of Wairarapa Water Ltd (WWL), the region's community water storage project.

Ms Wells was appointed in the role late last year, previously she was the chief executive of North Otago Irrigation Company.

However, her responsibilities haven't always been for water and she has had an extensive career in executive and management roles that reach beyond New Zealand.

After growing up in the Wairarapa, Ms Wells studied at Massey University where she gained a Bachelor of Science before heading overseas in the 1980s to Australia where she completed a Master of Science in Applied Microbiology. Ms Wells had her first child Jeremy in Dallas, Texas 1992. While pregnant with her second child Elizabeth, Robyn completed a Master of Business Administration at the College of William and Mary in Virginia which enabled her to bring her science background and management skills together. She became the youngest and first female general manager of an ethanol plant in the country in a role which she took up in 1998.

She then moved to Australia in 2001 where she worked in the cane sugar industry as the manager of the largest ethanol distillery in Australia based in North Queensland. She undertook the role of project manager as half the distillery's capacity was converted to renewable fuel production, and was responsible for importation of molasses and exporting ethanol.

In 2007 she was then recruited back to the USA for what she said was a "huge growing opportunity" in her career. Here she was Executive Vice President for an Australian – initiated company (cooperative / investment bank ownership) that purchased ethanol plants to produce ½ billion litres of fuel per year. She assisted in guiding the finishing of the construction of one plant and set up the operational structure and systems of business for both.

Ms Wells decided to return home to New Zealand in 2009 to be closer to her family.

"I came home and sort of thought 'what am I going to do now?' and that's when the role for North Otago Irrigation Company (NOIC) came up."

"I hadn't previously had any involvement with irrigation schemes but in some ways they and the ethanol plants were similar … they're both large infrastructure projects, typically farmer-owned, are in rural communities and create social development in communities."

"Both have an environmental oversight."

Ms Wells became chief executive of NOIC in 2010. During her time there she moved the organisation from a primarily out-sourced to an internally managed business, integrated environmental management into all aspects of the company, restructured debt and oversaw the construction of stage two which she said was one of the biggest challenges of her career.

> "The times have changed and there is a maturing approach for water storage that includes whole communities in a collective approach … it's not about intensification it's about fulfilling a reliability gap for all end-users in the face of increasing climate change."

"The delivery of the NOIC project was delayed by a year due to construction setbacks and unintended failures."

"It taught me the importance of keeping all the groups together through the difficult time and being open and transparent … it is what it is, there's no point in trying to hide things."

Ms Wells was the CE of NOIC for almost nine years and in that time, she helped to double the size of the scheme.

"It was incredibly challenging, but we had a great team and we're lucky to have a good outcome."

"Running an irrigation scheme is more complex than running an ethanol plant in the USA."

Ms Wells finished her role at NOIC in May 2019 when she decided it was time to move on.

"I was looking for something different I enjoy a challenge."

Currently based in Dunedin, Ms Wells travels to the North Island for her new role as CE for Wairarapa Water Ltd which she took on late last year. However, she knows Masterton well.

"I grew up here and we swam in the river all the time … this role really resonated with me, I wanted to come back and help make a difference."

She took on the role of CE at WWL in September last year, although the role is part time she is also kept busy by her other responsibilities which includes being a board member of IrrigationNZ, filling in as Acting Director of Strategy and Policy at Waitaki Irrigators Collective (for which she was a board member from 2011–2019) and provided some consulting advice through McKeague Consultancy who are also based in Dunedin.

Being CE at WWL involves the development of the Wakamoekau Community Water Storage Scheme (WCWSS) which, when completed, would provide water to multiple users across the Wairarapa, including food and fibre production, environmental, industrial and urban.

Ms Wells has a big vision for Wairarapa Water and realises the importance of water storage and looking after water in New Zealand.

"The times have changed and there is a maturing approach for water storage that includes whole communities in a collective approach … it's not about intensification it's about fulfilling a reliability gap for all end-users in the face of increasing climate change."

She said everything she had learned from her previous role would help her at WWL.

"A, B, C it's not like that at all … building all the required blocks incrementally is so important, as is to have everyone involved and ensure two-way communication."

Ms Wells was looking forward to continuing her interest in biking in the Wairarapa however a switch from mountain to road biking is on the cards. A competitive swimmer in her early years she is also heading back to the Masterton pool where she spent so many summer days growing up.

Community-wide water storage – Wairarapa Water

The Wairarapa Water project has come one step closer to reaching its goal of having water stored by 2026, by gaining further Government funding. Wairarapa's Water Resilience Strategy and Wakamoekau Community Water Storage Scheme (WCWSS) gained $7 million of Provincial Growth Fund (PGF) support in January.

Wairarapa Water Limited (WWL) is leading the development of a community-wide water storage project based out of the upper Ruamahanga catchment. WWL took over the project from Greater Wellington Regional Council in 2018 following the Council's work on water storage opportunities in the valley.

WWL has since concentrated on the Wakamoekau site north-west of Masterton.

The PGF funding consisted of $7m towards the Wakamoekau Storage Scheme and $110,000 towards the Water Resilience Strategy. This follows an earlier funding announcement in May 2019 of $800,000 towards the storage project which allowed for initial community engagement, consent planning, and further fundraising.

Due to this funding, the project can now progress with the work that is required to complete feasibility studies, lodge a resource consent application and prepare for construction start.

The storage project, when ultimately constructed, will help reach the goal of providing a resilience of freshwater supply to Wairarapa.

WWL chairman Tim Lusk said he was excited the projects had received additional funding from the PGF.

"The announcement puts WWL in a strong financial position to finalise the community water storage project development phases to meet the high expectations of our Wairarapa communities and businesses."

"This very considerable funding by the PGF means we can now engage comprehensively with landowners, Iwi, councils, businesses and the wider community, knowing we have the means to conclude together what it must look and operate like before we move into construction, which, all going well, will be in 2023.

"The target must be stored water available in 2026."

The current estimate for construction is $100 million.

The Wakamoekau Community Water Storage Scheme (WCWSS) is being led by WWL in collaboration with local government and input from the Wairarapa Economic Development Group.

Physically, the project involves the construction of a reservoir, (in the hills northwest of Masterton), with a capacity of nearly 19 million cubic metres of stored water. Water will be collected from the Waingawa River and Wakamoekau Stream during periods of high flow. Stored water is likely to be distributed through a mix of underground pipes and river transport.

WWL Chief Executive Robyn Wells said the storage project was essential for the future of the region's water dependability.

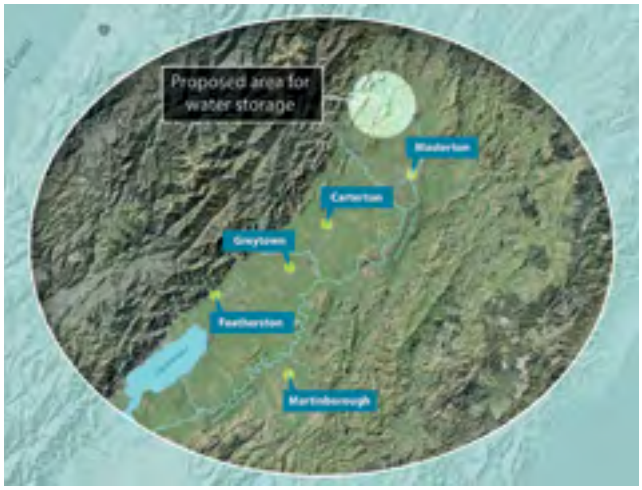
"In the future, there will be increased demand for water due to climate change … a project like this can provide reliability to the whole community for future-proofing the water supply of the region."

Although local iwi Rangitane o Wairarapa, governed by the Rangitane Tu Mai Ra Trust and Ngāti Kahungunu Ki Wairarapa Tāmaki Nui ā Rua Settlement Trust had already been involved in the previous stages of the scheme development, Ms Wells said it was pivotal they remained involved in the next stage.

"Input from Iwi is critical over the next few months."

"The work programme submitted in our PGF funding application includes a properly resourced cultural impact assessment and we have asked iwi to provide guidance so that it delivers a credible outcome."

Alongside the cultural impact assessment work the terms of the PGF funding require that we work with iwi to identify specific benefits that could arise through having greater access to water."



Visual showing location of WCWSS reservoir site.

FMG delighted to continue partnership with IrrigationNZ

FMG is delighted to continue its partnership with IrrigationNZ and support it to create an environment where irrigation is part of a thriving and sustainable New Zealand.

As a mutual, FMG wants to help build strong and prosperous rural communities and recognises the important part irrigation development across New Zealand contributes to this.

"We see a lot of value in continuing our relationship with IrrigationNZ for a further three years," FMG Head of Client Strategy & Advice Services Jason Rolfe said.

"No matter how careful we are accidents still happen, so it's great to have insurance for when they do," IrrigationNZ CEO Elizabeth Soal said.

"IrrigationNZ is a not-for-profit membership organisation and we are very grateful to be in partnership with FMG."

FMG and IrrigationNZ's partnership first began in 2013 following the Canterbury windstorms when FMG signed on as IrrigationNZ's preferred risk advice partner. The extent of damage that resulted from the Canterbury windstorms highlighted a need for greater advice on what to do to help prepare for winds of this nature.

Mr Rolfe said offering advice as well as insurance is a key part of FMG's role. This was why in 2015 FMG, IrrigationNZ and Lincoln University worked together to research the storms and produced the *Irrigator Advice Guide* to help farmers and growers avoid irrigator damage.

"On-farm irrigation involves serious investment—they're high tech, expensive systems and it can take months to get them back up and running again if they're damaged," Mr Rolfe said.

Looking to the future, Mr Rolfe said FMG appreciated the significant impact irrigation will continue to have on improving the productivity of farmers and growers as well as providing jobs and contributing towards the rural economy.

"We see how the contribution from irrigation has revitalised particular rural communities across New Zealand," Mr Rolfe said.

With a predicted increase in the frequency and duration of droughts and possible changes in land use away from pastoral farming in some areas, irrigation will continue to become more and more important.

"We appreciate that there are changes on the horizon for irrigation due to concerns of the environmental impact and IrrigationNZ plays an important role in advocacy for irrigators."

Over the next few years FMG plans to support irrigation by running joint risk workshops in local areas, sponsorship of the Water for Life Conference and Expo, and releasing a new *Irrigator Advice Guide*.

Flooding in summer: The lessons from the 2019 Canterbury flooding

It seems slightly bizarre Canterbury is currently experiencing an incredibly dry period while just a few months ago some of the region was in flood. December 2019 saw higher than average rainfall (>149% of normal) for not only Canterbury but the whole South Island (NIWA).

The flooding experienced in the Rangitata, Waimakariri and Rakaia River catchments was the culmination of an extreme weather event across the West Coast and the Canterbury high country and ranges. This led to flooding on the rivers at the same time as very dry conditions occurring on the plains due to low rainfall there.

In the Rangitata catchment it caused six days of heavy rain and three high river flows that peaked at a massive 2307 cumecs (cubic metres per second).This was 35 times more flow than usual! This then caused flooding onto roads and farmland. Different flow patterns and major breakouts from the river caused most of the disruption and damage – including the closure of the two main roads and bridges, across the river, including State Highway One.

Further north the Rakaia and Waimakariri Rivers also experienced flooding but this didn't cause as much damage as the Rangitata flood. However, all three rivers flooding's caused damage to irrigation infrastructure and water supply. Four of the most affected schemes and water suppliers were the Rangitata Diversion Race (RDR), Barrhill Chertsey Irrigation, Rangitata South Irrigation Limited (RSIL) and Waimakariri Irrigation Limited.

BARRHILL CHERTSEY IRRIGATION LIMITED (BCI)

Barrhill Chertsey Irrigation Limited (BCI)is a fully piped irrigation scheme that operates across the mid Canterbury district. The scheme has around 150 irrigator shareholders operating a mix of farming systems. The scheme operates from two intake sites on the Rakaia River and utilises stored water from Lake Coleridge. The 250km pipe network irrigates around 24,000 hectares.

BCI general manager John Wright said the December 2019 flooding caused outages on both the BCI intakes, but no damage to fixed infrastructure.

"At the lower Barrhill intake significant movement in the river braids required extended river training works and around a three-day outage. At the upper Highbank intake operated by Trustpower, an in-river weir was washed out and the pumps were unable to operate for up to five days. Repairs to the Highbank site needed to wait until the river levels had receded sufficiently to safely operate equipment."

He said timing of the outages were in the period of peak demand across all farming systems so did there was a risk to crop and pasture growth however, most shareholders were understanding.

He said it certainly wasn't the largest flood the Rakaia River had experienced since the scheme inception in 2010, and not the first time damage had occurred.

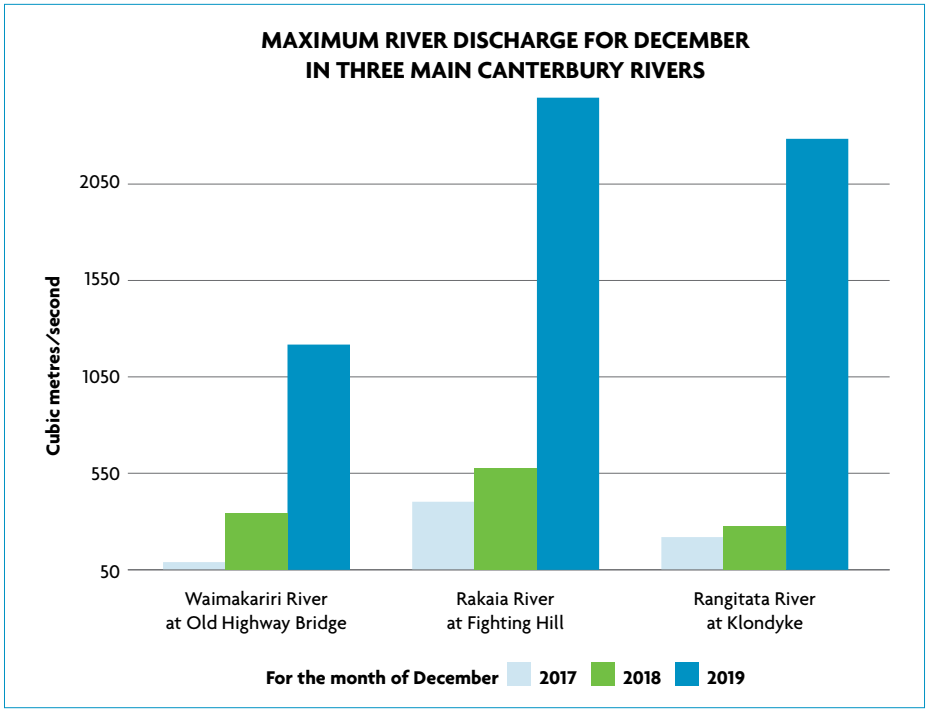
"However, this was the least convenient timing of this type of damage and the resulting outage. Similar events in the past have occurred at lower demand periods and are normally followed by a decent rainfall."

Mr Wright said outages such as those experienced in December could be mitigated through investment in significant storage infrastructure although it wasn't likely economic to do so. Well planned reinstatement plans were key, communication with share-holders should be overdone, and on-farm resilience should be encouraged.

RANGITATA SOUTH IRRIGATION LIMITED (RSIL)

Rangitata South Irrigation Limited (RSIL) operates a 13,000 hectare irrigation scheme in South Canterbury. The scheme captures high flow water from the Rangitata River, stores that water in a 16.5 million cubic metre multi-pond storage facility, and releases the water to share-holders through an 80km race networks that is around 50 percent PE lined. The scheme has around 40 shareholders who receive water to on-farm storage facilities.

Although the Rangitata's peak flow during the flood was somewhere between a 1/10 year and 1/20-year flood, the river experienced a considerable period of flood flows in the weeks approaching the peak. The bed of the Rangitata River downstream of Klondyke is significantly "steeper" than the other main rivers which results in much more braid movement and damage from a given flow. The flood waters breached the Southern riverbanks in three areas, the eastern breaches caused significant damage to road, rail, power and telecommunications infrastructure. The Western breach had the biggest impact on the scheme infrastructure. It was two kilometres above the scheme river intake and resulted in water flowing around the intake, through the



Maximum river discharge for December in three main Canterbury rivers. *(Data provided from NIWA and ECAN websites: niwa.co.nz/climate/monthly/climate-summary-for-december-2019)*

Mother nature taking over. Water from an upstream river breach crossing State Highway 72 near Arundel and entering the Rangitata South Irrigation Limited storage ponds.

Arundel village, and mostly into the scheme pond ring race adjacent to State Highway 72. The river also removed a significant area of land protecting one of the scheme ponds and risked undermining the pond bank.

RSIL interim manager John Wright said most of the damage to fixed infrastructure was limited to weir damage in the pond ring race, caused by up to 50 cumecs of water entering the race designed to cope with 20 cumecs.

"The water spilled back to the river from the lower pond spillway. The ponds and spillway performed admirably during the event although triggered "potential affected party", and Police notification under the Emergency Action Plan associated with the Dam Safety Management Plan."

"The highest risk area was the flood encroaching on one of the ponds and emergency remedial work was required. The intake had no major damage other than silting and some power and communications damage."

Mr Wright said due to the nature of the scheme there was no need to cease deliveries to shareholders. "The ponds were close to 100% full prior to the event. One of the delivery races was inundated with water and silt from the Eastern river breaches. A number of shareholders had significant on-farm flood damage."

He said repair works to fixed infrastructure would be spread over the next few months and be undertaken when water couldn't be captured from the river. River protection works would be completed when final design was complete.

The RSIL scheme was completed in 2014 and this was the biggest event since construction. Learnings from the event included:

- The need to ensure that all parties are fully aware of Dam Safety Management Plan requirements.
- Communication redundancy is critical for major water infrastructure and you cannot assume supply of power or telecommunications.
- Access to all critical sites is important in an emergency event as it is difficult to manage the event if you can't see what is happening.

Mr Wright said across both RSIL and BCI the event showed the importance of building strong relationships with emergency management parties.

RANGITATA DIVERSION RACE (RDR)

Rangitata Diversion Race (RDR) diverts water from the Rangitata and South Ashburton rivers into a 67 kilometre canal that runs from the Rangitata to the Rakaia River. The race supplies irrigation water to over 80,000 hectares and incorporates two hydropower stations owned and operated by Trustpower. The Race operates at maximum capacity 365 days per year to maintain irrigation, stock water and hydrogeneration activities. Construction of the scheme began in 1938. It is considered an essential lifeline of the Mid Canterbury economy.

The RDR has its main intake on the Rangitata River just below the gorge at Klondyke. The main features of the intake were the concrete intake positioned on the northern bank (that feeds via a radial control gate into the main canal) and a gravel weir across the river that helps to maintain the water level into the intake structure. The five inlets in the main intake wall were all oriented parallel to the bank and river flow.

This very simple but extremely clever design (circa 1935) provided a very resilient facility against the frequent high flows and floods that are a feature of the alpine fed Rangitata River. The mean annual flow in the river is around 1000 cumecs. The December peak flow was around 2300 cumecs – the highest flow since 1994 and the second largest on the Klondyke record (since 1979).

RDR chief executive officer Tony McCormick said the infrastructure sustained relatively minor damage and maintained continuous supply through and after the floods.

"Despite the high river flows, there wasn't any significant rainfall across the irrigated areas supplied by the scheme so irrigation demand

Left: The RDR intake structure at the flood peak. The walkway structure is normally 4.5m above the river level (see picture above).

remained consistently high. The main weir in the river was partially washed away, as it is intended to do to open up the 'floodway' in the river channel, and there was some minor damage to the concrete structure from impact by large rocks."

Mr McCormick said the main adverse consequence was the large amount of gravel, sand and silt that came into the system with the heavy bedload being carried by the swollen river.

He said a dragline (essentially a large crane with a scoop bucket that swings out into the race and is dragged along the bottom to fill the bucket with gravel and sand) was used to remove the deposited gravel and heavy sands from the first 500m of race. This material was dropped back onto the riverbank so it can be picked up again in a high flow.

The second facility was the sand trap – a widened section of the race located about 1.5 kilometres from the intake where the water velocity was dramatically slowed in the 'pond' area. The sand trap had a radial gate on the river side of the pond and this gate can be opened to release a flushing flow of around 70 cumecs that scours out the deposited sand and heavy silts and returns them to the river.

"After the December floods, the dragline was operated for several days and the sand trap was flushed on a 2–4 day cycle to remove the large amount of material than had come in during the flood conditions."

RDR's second intake on the South Ashburton River, which incorporated a gravel infiltration gallery fish screen, was also affected by a large influx of gravel and silt, Mr McCormick said.

There was no 'operational' facility to clean this out and the intake had to be shut down for five days to provide access to diggers and haul trucks to remove the material and clean the fish screen. Mr McCormick explained this did mean a reduction in water supply and low-level restrictions for irrigators for this five-day period.

"We did not shut off supply at all. Flushing the sand trap does result in a disruption to water flow in the race but this is only a temporary dip in supply to the schemes."

"The very fine silt does carry right through to irrigators' pumps and spray systems (on-farm storage ponds can effectively act as like settling ponds) so farmers were careful with the application of dirty water where crops or pasture could be sensitive to the silt deposits. For instance, silt can affect the plants' ability to photosynthesise."

He said the gravel removal occurred as part of normal operation. The repair of the concrete damage was carried out in early February (2020) once a suitable repair method had been identified and a contractor engaged.

There was also some repair work required at the discharge-end of the sand trap discharge chute where the river had changed course and eroded the riverbank adjacent to the chute. Heavy rock was trucked in from South Canterbury and placed with a large excavator.

"No irrigating farmer likes restrictions to water supply and the shutdown of the South Ashburton intake for five days did result in some restrictions. However, irrigators were advised several weeks ahead of the need for the work and expected timing so were not caught out by an unexpected restriction. It was anticipated that the river may have been on restriction in any case, which is typical for January when the river flows drop, however this was not the case, so the maintenance did have a small impact."

"While this was the largest flood event for the scheme in nearly 25 years, in rivers like the Rangitata (and most of the East Coast alpine rivers) large flood flows are a regular occurrence (1500 cumecs is estimated to be a one-in-five year event)."

Mr McCormick said the most noticeable impact of this weather event and the flood flows was the disruption caused downstream where the river broke its banks and cut off both highways and effectively cut the South Island in two!

"We learnt (or were reminded) that the designers and constructors did an amazing job in the 1930s!"

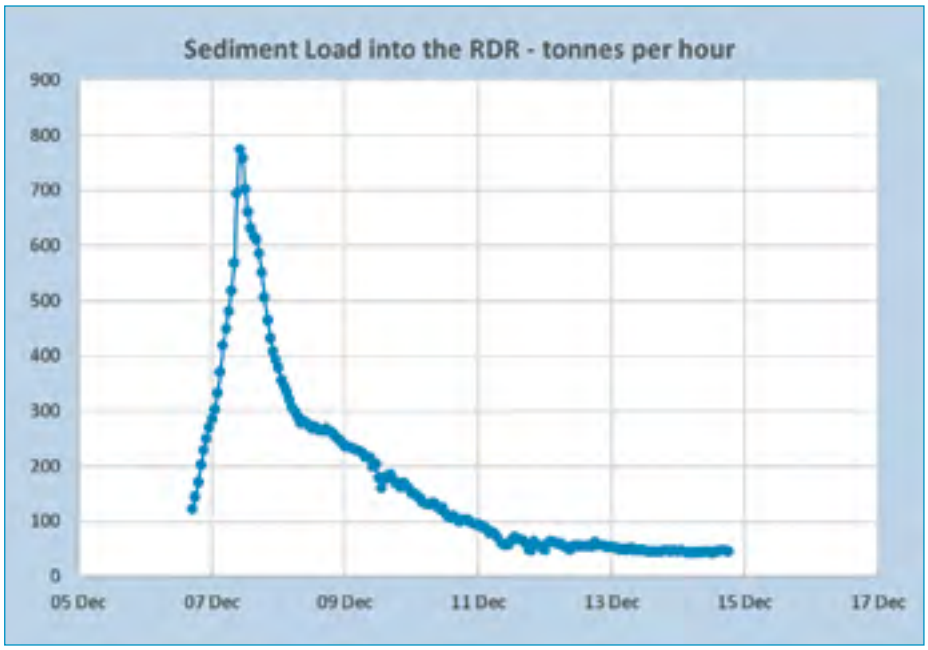
He said RDR had since revised the maintenance regime at the South Ashburton intake to improve the ability to handle high bedload inflows and had also stockpiled material to enable a quicker turnaround for the fish-screen maintenance.

"We are reviewing the operating regime of the South Ashburton intake to consider if there is a trigger point at which it is prudent to shut it off through the peak of a flood."

Mr McCormick said as part of a wider programme to gain a better understanding of sediment transport in the mainstem of the Rangitata River, they had installed a suspended sediment meter in the river at the intake.

"This new meter was actually commissioned just hours before the flood event, and we were able to obtain some very interesting results."

Previously, 'turbidity' had commonly been used as an indicator of how much material was suspended in the water, but this was only indicating how dirty the water 'looked' rather than analysing the actual sediment load that was in the water column.



"Preliminary readings from the meter indicated that the sediment load coming in to the RDR peaked at around 800 tonnes per hour with about 12,500 tonnes over the 24-hour peak period. It is estimated there was around 60,000 tonnes per hour being transported in the river."

See graph above.

WAIMAKARIRI IRRIGATION LTD (WIL)

Waimakariri Irrigation Ltd (WIL) is a run-of-river scheme with resource consent to take water from the Waimakariri River to irrigate 23,000 hectares.

The scheme delivers water to 200 share-holders and irrigated within a 44,000 hectare command area between the Waimakariri and Ashley Rivers. Within the scheme there were 108 large farm entities that are required to operate Farm Environment Plans (FEPs). The remaining 92 properties were smaller in size with 65 described as lifestyle blocks. All of WIL properties combined (including irrigation) covered 34,000 hectares of highly productive land, and this created approximately 500 jobs.

WIL chief executive officer Brent Walton said the flood itself and the subsequent closure of the intake lasted for a period much longer than had ever been previously experienced in the 20 years the scheme had been in operation.

He said the initial closure from 2–11 December 2019 was due to high river levels. During this flood event, and most flood events, gravel built up in front of the intake and this material must be removed before irrigation can resume.

Mr Walton said there was a total of nine days' loss of supply and seven days of interrupted supply through the period of 2–19 December.

"We are able to raise the intake screens (known as boats) during flooding though it is not yet known if infrastructure suffered any damage. However, this will be confirmed in the Autumn when the intake area dries off and an inspection of intake screens is completed by an engineer."

Mr Walton has been with WIL for nine years and said this was the greatest flooding event he had experienced – due to its longevity.

"Many similar-sized flood events in terms of volume but, these usually only last two or three days maximum. This event was prolonged."

"The event was frustrating for everyone, particularly the farmers who suffered significant loss of production – to the point that they have been operating in soil moisture deficit since the event."

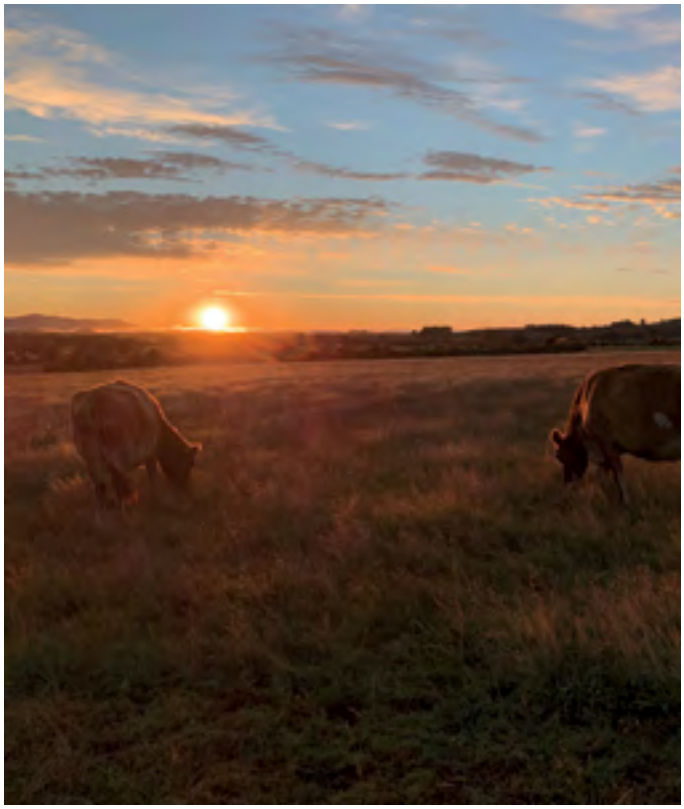
Mr Walton said the main point of learning for the future was to be more proactive with shareholder communication.

"The event demonstrated that Scheme storage would have minimised or eliminated any impact i.e., irrigation supply would not have been interrupted. Having additional heavy excavation equipment available on standby for when the river level dropped was useful. "

"Having scheme storage is a key mitigation tool, braided rivers are very difficult to control in flood events."

The dragline (crane) operating at the RDR intake canal to remove deposited gravel and sand following a high flow event. The in-river control weir is evident just upstream with the intake structure partly obscured behind the dragline boom.

Seasonal climate outlook March–May 2020



OUTLOOK SUMMARY

ENSO-neutral conditions continued during February 2020. The Southern Oscillation Index (SOI) was within the neutral range (-0.2) while sea surface temperatures (SSTs) in the central Pacific were also in the neutral range. Oceanic El Niño/Southern Oscillation (ENSO) neutral conditions will most likely persist (70% chance) over the next three months.

Warmer than average ocean waters in the Coral Sea and west-central Pacific Ocean are expected to have an influence on New Zealand's climate during March–May.

When the climate drivers described above are active, northerly quarter air flows could bring an increase in humidity, moisture, and rainfall to New Zealand; one such period could occur during March. New Zealand's air temperatures are expected to be pushed in a warmer direction by above average sea surface temperatures near the North Island and in the Tasman Sea over the upcoming three months.

March to May 2020 air pressure is forecast to be lower than normal to the northwest of New Zealand and at times near the South Island. This is expected to be associated with mixed westerly and north-easterly quarter air flow anomalies. Temperatures are mostly likely to be above average in the North Island and about equally likely to be above average or near average in the South Island.

Rainfall is expected to be near normal in all regions of New Zealand except for the north and west of the South Island where normal or above normal rainfall is about equally likely. The tropical Southwest Pacific will

be intermittently active during March and April. Four tropical cyclones (Uesi, Vicky, Wasi, Esther) occurred during February and Uesi passed near New Zealand. Significant rainfall, damaging winds, and coastal damage can occur if an ex-tropical cyclone passes near the country.

Air temperature is likely to be near normal or below normal in the north of the South Island (35–40% chance) with near normal river flows most likely (40% chance). In the west of the South Island, above normal soil moisture and river flows are most likely (45% chance).

REGIONAL PREDICTIONS FOR MARCH TO MAY 2020

Probabilities are assigned in three categories: above average, near average, and below average.

Northland, Auckland, Waikato, Bay of Plenty

- Temperatures are most likely to be above average (55% chance).
- Rainfall totals are most likely to be near normal (45% chance).
- Soil moisture levels and river flows are most likely to be below normal (50% chance).

Central North Island, Taranaki, Whanganui, Manawatu, Wellington

- Temperatures are most likely to be above average (50% chance).
- Rainfall totals are most likely to be near normal (45% chance).
- Soil moisture levels and river flows are about equally likely to be near normal (40% chance) or below normal (35% chance).

Gisborne, Hawke's Bay, Wairarapa

- Temperatures are most likely to be above average (50% chance).
- Rainfall totals are most likely to be near normal (45% chance).
- Soil moisture levels and river flows are about equally likely to be near normal (40% chance) or below normal (35% chance).

Tasman, Nelson, Marlborough, Buller

- Temperatures are about equally likely to be near average (40% chance) or above average (45% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels are about equally likely to be near normal (40% chance) or below normal (35%) while river flows are most likely to be near normal (40% chance).

West Coast, Alps and foothills, inland Otago, Southland

- Temperatures are about equally likely to be near average (40% chance) or above average (40% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels and river flows are most likely to be above normal (45% chance).

Coastal Canterbury, east Otago

- Temperatures are about equally likely to be near average (45% chance) or above average (40% chance).
- Rainfall totals are most likely to be near normal (45% chance).
- Soil moisture levels and river flows are most likely to be below normal (45% chance).

This is an extract of the Seasonal Climate Outlook published by NIWA.

Where the water will flow

PROJECTS & PLANNING IN 2020

NORTHLAND

In late January, Northland received over $12m Provincial Growth Fund support of which up to $12m would go towards the Northland Water Storage and Use Project and a further $745,000 for Kai for Kaipara Project – Kaipara District Council.

WAIKATO

There is a lot of work aimed at protecting and improving the region's water quality and quantity which is underway by iwi, landowners, organisations and communities. Waikato Regional Council also have a freshwater strategy that builds on existing initiatives such as:

- Healthy Rivers/Wai Ora: Proposed Waikato Regional Plan Change 1 – Waikato and Waipū River Catchments (hearings panel recommendations are due to be considered by the council in the next couple of months)
- Variation 5 Taupō-nui-a-Tia (known as the protecting Lake Taupō project)
- The Variation 6 water allocation project
- The Waipū Catchment Plan
- Various zone plans
- The Waikato Waipū River Restoration Strategy.

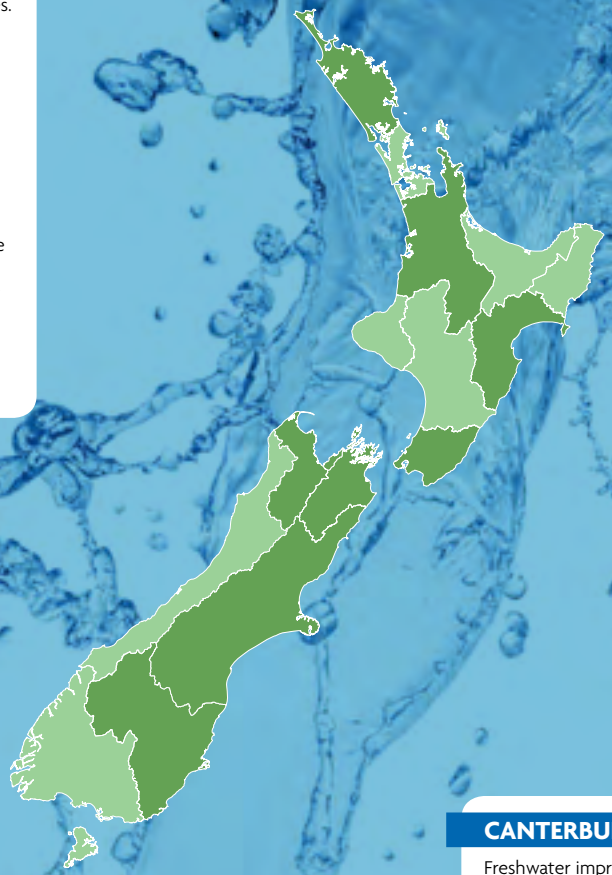
NELSON/TASMAN

Waimea Community Dam's construction began in March 2019 and is scheduled to be complete in 2021, with reservoir filling and final commissioning expected in early 2022.

HAWKE'S BAY

There's a lot going on in Hawke's Bay involving water security and water management:

- The Provincial Growth Fund is providing a $30.6m injection into water security projects across the region. This work programme includes;
- The Hawke's Bay Regional Council's 3D aquifer mapping project, which has begun using the latest airborne electromagnetic survey technology called SkyTEM.
- The Regional Water Assessment which has commenced planning and scoping.



WELLINGTON

In early January, Wairarapa Water Ltd received $7m Provincial Growth Funding towards the Wakamoekau Storage Scheme and $110,000 towards the Water Resilience Strategy. This follows an earlier funding announcement in May 2019 of $800,000 towards the storage project which allowed for initial community engagement, consent planning, and further fundraising. The project can now progress with the work that is required to complete feasibility studies, lodge a resource consent application and prepare for construction start.

MARLBOROUGH

Concept plans for the Flaxbourne Irrigation Scheme, a $16m project paid for by the water users themselves, are being finalised. The aim is for the project to be started in late 2020 subject to a resource consent application.

CANTERBURY

Freshwater improvements in Canterbury will continue through coordinated regulatory and non-regulatory approaches. The Canterbury Water Management Strategy (CWMS) has moved water management towards a collaborative, locally driven process since it was endorsed by the Canterbury Mayoral Forum in 2009. Key partners in this have been Papatipu Rūnanga, Ngai Tahu and territorial authorities together with other partners including government agencies, ECan, Canterbury District Health Boards, non-government organisations, industry and community groups. ECan has a regulatory role alongside Implementation Plans developed by CWMS Zone and Regional Committees. Significant regulatory steps include:

- Region-wide nutrient allocation zones, with high risk activities requiring a consent to farm and being held to 2009-13 baseline
- Local area (sub-regional) community derived limits set via Zone Implementation Plans
- Notified sub-region limits and outcomes in all at-risk catchments
- Use of Farming to Limits, Good Management Practice (GMP) and Farm Environmental Plans (FEP)
- Continuing development and roll out of improved Compliance Monitoring and Enforcement processes.

OTAGO

2020 is a crucial year for water planning in Otago, with a number of changes in the pipeline. Otago Regional Council (ORC) is working towards a new Land and Water Regional Plan, which will be notified in 2023. They have already started talking with communities in the Manuherekia, Arrow and Cardrona about what they value about their waterways, and will be talking with people in the Taieri and Catlins areas later this year. Other plan changes in 2020 are interim steps until this full plan review can be completed:

- The 'Water Permits' plan change (to be notified on 18 March) will set the rules for short-term water take consents to replace historic mining water permits due to expire in 2021
- The 'Omnibus' plan change (to be notified on 31 March) will provide water quality rules addressing urban and rural issues
- ORC is also writing a new Regional Policy Statement, which will update its vision and strategy for achieving resource management objectives in Otago.

PRODUCT & SERVICES DIRECTORY

Murray Tyson with his crop of sunflowers.

Sunflowers make for superb sight

A paddock of sunflowers on the Canterbury plains has proven quite the spectacle this summer.

Murray Tyson is a fourth generation farmer on his deer and arable farm in Springston.

Mr Tyson's interest in growing sunflowers came from his late father who had bred birds and fed them sunflower seeds, when the cost of seeds started to become more and more expensive, he decided to grow them himself.

He first started growing them eight years ago and has grown them every second year since – this was now his fourth paddock of the flowers.

The paddock of sunflowers made a stunning sight and Mr Tyson said there were always people stopping to take photos.

"I think if I got $10 for every car that stopped and took a photo I would make a good profit off them."

The sunflowers were conventionally drilled and didn't require any pest management however, they were highly susceptible to damage from birds and wind, Mr Tyson said.

"Like a lot of crops the birds just get at them and take a lot … the wind can damage them badly, because the flowers have such heavy tops on them in a wind they can break."

The sunflowers will be harvested in late March.

Flowers for days. Four hectares of sunflowers glowing on Murray Tyson's Springston farm.

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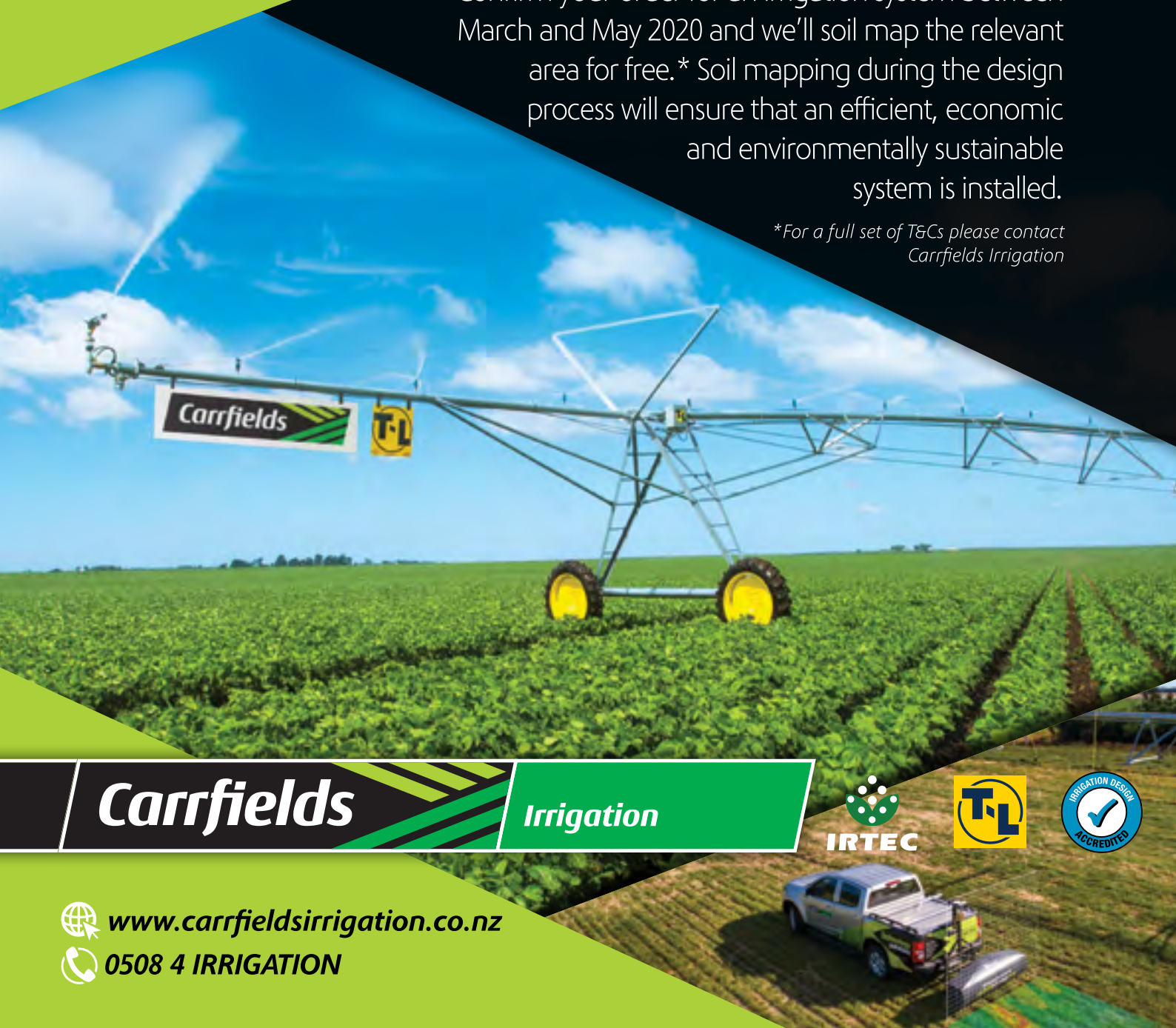

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