

# 2016 Waterways Postgraduate Student Conference

Tuesday November 15, 2016  
Lincoln University,  
Christchurch, New Zealand

## Abstract Booklet



The Organising Committee would like to acknowledge our generous sponsors:

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*The Waterways Centre for Freshwater Management is a teaching and research centre, jointly supported by the University of Canterbury and Lincoln University. Established in 2009, it aims to improve the knowledge-driven management of freshwater resources by offering a full complement of nationally accredited tertiary courses and actively supporting postgraduate research programmes.*

## Conference Programme

Time	Presentation	
8:30	Registration	
9:00	Introduction – <b>Jenny Webster-Brown</b> , Director, Waterways Centre for Freshwater Management	
9:05	Welcome – <b>Professor Ian Wright</b> , Deputy Vice-Chancellor (Research and Innovation), University of Canterbury	
9:15	Nitrate fluxes and nutrient rehabilitation strategies in agricultural waterways	Brandon Goeller PhD Candidate, University of Canterbury
9:30	Spatial variation and bioavailability of mercury and other toxic trace elements in the Puhipuhi mine catchment, Northland	Marlese Fairgray PhD Candidate, University of Canterbury
9:45	Glacial suspended sediment: character, composition and adsorptive behaviour in the Waitaki Catchment, New Zealand	Phil Clunies-Ross PhD Candidate, University of Canterbury
10:00	Failure indicators for conventional on-site wastewater treatment systems	Preston Prince Masters Candidate, University of Canterbury
10:15	An assessment of Kamativi tin mine's water supply	Property Munsaka Masters Candidate, University of Canterbury
10:30	The SODIS method in South Tarawa, Kiribati	George Barbour Masters Candidate, University of Canterbury
<b>10.45</b>	<b>Morning Tea</b>	
11.15	Identifying changes in the Mayfield-Hinds aquifers, following irrigation conversion	Will Dench Masters Candidate, University of Canterbury
11.30	Groundwater monitoring in Southland - quantifying NO3 lag effects for land use policy decisions	James Thornton Masters Candidate, University of Canterbury
11.45	Fluid practices: understanding adaptations to everyday water use	Julie Clarke PhD Candidate, Lincoln University

12.00	Standardising environmental management and the implications for Māori conceptions of water	Kenya Calder Masters Candidate, Lincoln University
12:15	Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt province Zambia	Mando Chitondo Masters Candidate, University of Canterbury
12:30	Pollution of urban waterways in Nairobi City: case study of Mathare 4B	Kevin Kienja Masters Candidate, University of Canterbury
<b>12.45</b>	<b>Lunch; Poster Session from 1:00 pm</b>	
1.30	Options for treatment of ammonia in landfill Leachate	Doctor Segweni Masters Candidate, University of Canterbury
1:45	Phosphorus release from waste activated sludge under different pH, temperature and anaerobic conditions	Shiv Prasad Pokhrel PhD Candidate, University of Canterbury
2:00	Optimising the use of coral beach sands for the treatment of onsite wastewater in Kiribati	Bronwyn Humphries Masters Candidate, University of Canterbury
2:15	The impact of trace elements in road dust on waterways	Christopher Sampson Masters Candidate, University of Canterbury
2.30	Morphological and physiological acclimations of <i>S. pectinata</i> to low light conditions	Qian Hu PhD Candidate, University of Canterbury
2:45	Testing and developing tools for weed macrophyte control in Canterbury agricultural waterways	Katie Collins PhD Candidate, University of Canterbury
3:00	The effects of fine inorganic bed sediment on fish community composition in New Zealand	Nicky Glenjarman Masters Candidate, University of Canterbury
<b>3:15</b>	<b>Afternoon Tea</b>	
3:45	The interactive effects of flow and nitrate on <i>Phormidium</i> accrual	Tara McAllister PhD Candidate, University of Canterbury

4:00	Factors driving algal blooms in Ugandan crater lakes. A case study of six crater lakes in Western Uganda	Emmanuel Busobozi Masters Candidate, University of Canterbury
4:15	The role of nutrients and light in the growth of phytoplankton in Te Waihora/Lake Ellesmere	Emma MacKenzie Masters Candidate, University of Canterbury
4:30	New Zealand's whitebait fishery: a mixed bag of species and sizes	Mark Yungnickel Masters Candidate, University of Canterbury
4:45	Applying ecosystem-based management to riparian management: addressing critical habitat objectives for īnanga in statutory plans	Shane Orchard PhD Candidate, University of Canterbury
5:00	Large brown mudfish populations are keystones of landscape-scale resilience to global warming in Westland swamp-forests	Richard White PhD Candidate, University of Canterbury
5:15	<b>Drinks and Nibbles; Prize Presentation</b>	

Presenters and student committee members can be identified by colored name tags. Presenters are keen to hear your questions and feedback, so please feel free to approach them throughout the day. Also, please let a committee member know if you need any assistance.

## Posters next page

Poster presenters can be identified by coloured name tags. There is a scheduled poster session in the foyer from **1:00 to 1:30 pm** where all poster presenters will be available at their poster for questions and discussion. However, please feel free to approach poster presenters throughout the rest of the day.



## Posters

Poster Title	Presenter
Groundwater resources management: a sustainable policy approach for the Purapurani Aquifer, Bolivia	Estefania Arteaga Valdivia Masters Candidate, University of Canterbury
Evaluation of the community involvement of the Nam Theun 2 hydropower project in Lao People's Democratic Republic	Phonesavath Khamvilay Masters Candidate, University of Canterbury
Water policy and governance in Guyana, "The land of many waters"	Onika Baptiste Masters Candidate, University of Canterbury,
Determining the main drivers of future hydrological alterations in the Mekong floodplains	Thanh Duc Dang PhD Candidate, University of Canterbury
Sustainable livelihoods framework and water-related climate change adaptation interventions in Vietnam	Huong do Thi PhD Candidate, University of Canterbury
Photolysis of emerging contaminants in surface water	Lara Marayag Masters Candidate, University of Canterbury
Designing an integrated water quality monitoring programme for Te Waihora/Lake Ellesmere	Val McMillan Masters Candidate, Lincoln University
First flush TSS and heavy metals from urban car parks under a low intensity rainfall climate	Salina Poudyal, PhD Candidate, University of Canterbury
Evaluation of community preferences for decentralised water management systems: a case study in Akaroa, Banks Peninsula	Han Sun Masters Candidate, Lincoln University
Emerging contaminants in Canterbury groundwater	Rebecca van der Krogt Masters Candidate University of Canterbury
Dynamics of nitrogen compounds in Haytons urban drainage stream, Christchurch	Fabio Cabral Silveira Masters Candidate University of Canterbury
The analysis of pasture water requirement due to grazing roster	Meida Meidaliyantisya Masters Candidate, Lincoln University

## Introduction

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Hello everyone

Welcome to the Waterways Postgraduate Student Conference.



I would like to warmly welcome everyone to the 2016 Waterways Postgraduate Student Conference. We look forward to this great day every year. It is an opportunity to showcase highlights of freshwater related research being undertaken by postgraduate students at our two Canterbury universities. Through oral presentations and posters, our students will be presenting their research on freshwater systems, on policies that affect, or could affect, water use and management, and on potential solutions to freshwater problems.

It is a day when those who have supported the Waterways Centre get to see the tangible results of their support, and it is our chance to say thank you.

It also provides an opportunity for students to talk to community, industry, economic, regulatory, consultancy and research stakeholders in the freshwater resources of Canterbury and New Zealand.

This day is entirely organised by a very dedicated committee of capable Waterways Centre Masters and Doctoral research students. We greatly appreciate their efforts and they deserve all of the compliments that I am sure will come their way. I hope you will end the day feeling some confidence that the future of NZ's water resources is in good hands!

Enjoy your day!

A handwritten signature in black ink, reading "Jenny Webster-Brown".

Professor Jenny Webster-Brown  
Director - Waterways Centre for Freshwater Management

## **Deputy Vice-Chancellor (Research and Innovation), UC**

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Professor Ian Wright



Professor Ian Wright is the Deputy Vice-Chancellor (Research and Innovation) at the University of Canterbury since August 2016. Ian has a significant personal research career, coupled with extensive experience in research and technological leadership and management, having previously worked at the National Institute of Water and Atmospheric Research in Wellington. At NIWA he was the Centre Leader for Coasts and Oceans, and then spent eight years at the National Oceanography Centre / University of Southampton in the UK. His time in the UK included four years as Director of Science and Technology at the National Oceanography Centre, and a member of the Natural Environment Research Council Science Board.

Ian is a Director of the Canterbury Medical Research Foundation and New Zealand Brain Research Institute, and sits on a number of National Science Challenges governance groups.

## Oral Presentation Abstracts

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### Nitrate fluxes and nutrient rehabilitation strategies in agricultural waterways.

**Brandon Goeller**, [brandon.goeller@pg.canterbury.ac.nz](mailto:brandon.goeller@pg.canterbury.ac.nz)



A vast network of surface- and subsurface drains supports agricultural production on the Canterbury Plains, South Island, New Zealand, but those drains act as 'leaky plumbing' because they often transport leached nutrients downstream, circumventing riparian protection networks. A multi-scale spatial approach within the Canterbury Waterway Rehabilitation Experiment (CAREX) was used to quantify the export of nitrate-nitrogen in small agricultural headwaters <2 m wide to identify leaky plumbing and trial stream rehabilitation tools.

Water quality parameters, including nitrate-N concentrations, were continuously measured and supplemented with grab samples to characterize nitrate-N fluxes. The flux of nitrate-N ranged from <1 to >50 kg/day at the bottom of study reaches with <0.01 to >5 kg/day from tile drain 'hotspots'. To complement existing stock exclusion and riparian planting measures, edge-of-field denitrifying bioreactors and in-stream additions of labile carbon were trialled to reduce downstream export of nitrate-N.

Early results show that bioreactors could reduce downstream nitrate-N export during all seasons without impeding the drainage function of agricultural waterways; however, in-stream solutions are needed to address the large downstream flux of nitrate-N that is not removed by edge-of-field and riparian nutrient tools. This emphasizes the need for a toolbox-based stream rehabilitation approach which addresses the scale and source of nutrient problems in agricultural waterways. Practical, cost-effective stream rehabilitation tools are recommended to address downstream nutrient export while catchment-scale nutrient plans are developed to address losses from land.

#### **Research/career interest:**

Stream ecosystem ecology & rehabilitation, biological monitoring, environmental policy

## **Spatial variation and bioavailability of mercury and other toxic trace elements in the Puhipuhi mine catchment, Northland.**

**Marlese Fairgray**, [marlese.fairgray@pg.canterbury.ac.nz](mailto:marlese.fairgray@pg.canterbury.ac.nz)



Elevated levels of mercury and other toxic trace elements have been found in the catchment of the historic Puhipuhi mine site. Mercury is a contaminant of significant concern as it has no known ecological benefits and bioaccumulates in the food chain. Previous studies on the levels of mercury in the area have reported elevated levels downstream of the mine site but have not identified the potential impacts on ecology, nor how this can be remediated or

where efforts to remediate should be focussed.

This research has undertaken high resolution water and sediment sampling at the top of the catchment and around the mine site. It was found that some elements, such as Hg, Ni and Pb, are highest at the mine site while others, such as Cu, As, Sb and Se, are low at the mine site itself but are elevated in streams adjacent to the mine-affected Waikiore Stream. Sequential extractions of toxic trace elements in the sediment have also been carried out in order to identify the form, and therefore potential bioavailability of, sediment-bound trace elements.

A preliminary assessment of the flesh composition from two eels (one downstream from the mine area, and one from upstream) in order to assess trace element bioaccumulation and therefore human health risk was carried out. It was found that while the eels had similar levels of mercury, flesh from the downstream eel (from the Hikurangi Swamp) contained higher levels of selenium.

### **Research/career interest:**

- Acid mine drainage
- Site remediation
- Geochemistry
- Modelling

## Glacial Suspended Sediment: character, composition and adsorptive behaviour in the Waitaki catchment, New Zealand.

**P. J. Clunies-Ross**, [phil.clunies-ross@pg.canterbury.ac.nz](mailto:phil.clunies-ross@pg.canterbury.ac.nz)



The dissolved concentrations of many toxic trace metals, nutrients and organic contaminants are strongly influenced by sorption-desorption processes on the surfaces of suspended particulate material (SPM). Because such pollutants are typically more bioavailable to aquatic biota in their dissolved form, the adsorption of trace contaminants and nutrients onto SPM is an important process regulating their transport, bioavailability and toxicity.

Glaciers produce huge volumes of fine sediment through the crushing of rock in alpine environments.

Much of this sediment is extremely fine grained and suspends in meltwaters for extended periods, dominating SPM in downstream rivers and streams. The freshly eroded surfaces of these sediments are both primed for chemical adsorption and susceptible to chemical weathering. These particles may therefore play an important role in regulating water quality as glacier-fed catchments are subject to increasing levels of pollution as well as changes to runoff and sediment load resulting from glacial retreat.

The aim of this research is to determine the character, composition and behaviour of glacial sediment-dominated SPM in the Waitaki catchment, a large alpine catchment in New Zealand fed by a number of the country's most prominent glaciers. Five large hydroelectric lakes increase the residence time of the water to approximately 2 years, optimizing opportunities for SPM characteristics to weather and change. Comparisons have been made between the upper glacier-fed catchment (Aoraki/Mt Cook) and the lower, agricultural Waitaki catchment SPM. Observed changes in mineralogical and morphological character with time include an increase in the proportion of clay minerals, aggregates and diatoms, to feldspar and quartz minerals. The capacity of upper and lower catchment SPM to adsorb copper, cadmium and phosphate has been assessed through adsorption experiments.

### Research/career interest:

I am currently in the final year of my PhD and will be pursuing a career in water resources management in 2017. I am especially interested in characterising the behaviour of environmental contaminants and communicating science to stimulate positive environmental outcomes.

## Failure indicators for conventional on-site wastewater treatment systems.

**Preston Prince**, [preston.prince@pg.canterbury.ac.nz](mailto:preston.prince@pg.canterbury.ac.nz)



Conventional on-site wastewater treatment systems (OWTS) are systems used for the treatment of domestic wastewater. These systems are comprised of a septic tank which provides primary and secondary treatment in which solids are settled and broken down by biological processes, and a soil absorption trench/field that provides advance treatment by which the discharge effluent is treated mainly through filtration and adsorption. These systems are used primarily in regions where there is no reticulated wastewater disposal. However, a significant increase in population and poor

design/management of these facilities has led to a large number of failing systems throughout the world.

Owing to the constituents present in wastewaters and the discharged effluent, failure of these systems is a public and environmental concern as they have the potential to contaminate both surface and groundwater resources, primarily through the release of pathogenic micro-organisms and nutrients. This research identifies modes of failure for these systems and establishes indicators which can signal irregularities in the performance of a system before complete failure occurs.

Design, technical, management and compliance are presented as the four categories of failure modes and these are further divided into several sub-categories. The ratio of occupancy size to septic tank volume and the frequency of use contributed significantly to system failure during the primary stages of treatment, while poor siting, user incompetence and soil properties within the drainage area largely contributed to failure during the advance treatment stage. Implementing simple procedures such as checking the sludge and scum levels in a tank every 3-5 years can provide awareness of system performance and aid in preventing complete failure.

### **Research/career interest:**

Best management practices for on-site wastewater treatment systems

## An assessment of Kamativi tin mine's water supply.

**Property Munsaka**, [property.munsaka@pg.canterbury.ac.nz](mailto:property.munsaka@pg.canterbury.ac.nz)



Kamativi is a tin mining town in North Western Zimbabwe with an estimated population of 7000. Mining operations ran for about 58 years before 1994 when low tin prices at the time forced indefinite suspension of business. The Hwange District Council has since taken over administration of the town, including running the water supply system which utilises surface abstraction from a local dam.

Since the mine was the main source of economic income in the area, its closure led to deterioration of infrastructure in Kamativi and water problems have dogged the town ever since. There have been several reports about poor water quality and availability without actual data on the extent of the problem.

Research was completed to find out the physico-chemical and biological characteristics of Kamativi's water supply and how it compares to Zimbabwe drinking water standards. The research also sought to measure the impact, if any, of mining and other anthropogenic activities on the quality of water in Kamativi with the aim of suggesting means of improving or resolving Kamativi's water quality issues. This was done through quality analysis of samples from different water sources in Kamativi during both the dry and wet seasons of 2016.

### **Research/career interest:**

Integrated Water Resources Management, Terrestrial and Aquatic Ecotoxicology, Environmentally Sustainable Technologies, Environmental Law and Policy, Human-Environment Geography and Occupational Health.



## The SODIS method in South Tarawa, Kiribati.

**George Barbour**, [george.barbour@pg.canterbury.ac.nz](mailto:george.barbour@pg.canterbury.ac.nz)



Solar disinfection of drinking water or the SODIS method has been used around the world to disinfect drinking water since the late 1980's but has only recently been applied in the Pacific. The method involves filling a plastic bottle with water and putting it in the sun all day after which it is safe to consume. The disinfection process occurs indirectly from the ultraviolet light forming reactive oxygen species (ROS) in the raw water. It is these ROS that damage the DNA of the pathogens.

Kiribati is an island nation in the Pacific Ocean with a population of 106,000 people spread over 33 islands with approximately half living on South Tarawa. With typical island heights of 0-3m AMSL the shallow ground water that is used for drinking water is easily contaminated.

Being equatorial, however, it is ideally placed to receive a high degree of sunshine year round that would allow use of the SODIS method.

The aim of this research is to assess the effect of key variables on the time required to obtain safe drinking water using the SODIS method. The variables investigated include water conductivity, pH, age of bottles used and possible water additives. Experiments will be conducted under controlled conditions in the environmental engineering laboratory at UC to simulate the conditions found in Kiribati.

### **Research/career interest:**

Humanitarian problem solving.

## Identifying changes in the Mayfield-Hinds aquifers, following irrigation conversion.

**William Dench**, [william.dench@pg.canterbury.ac.nz](mailto:william.dench@pg.canterbury.ac.nz)



The Hinds Rangitata Plain (HRP) is located on the Canterbury Plains and bound by the Rangitata and Hinds Rivers, Southern Alps foothills and the Pacific Ocean. Irrigated agriculture on the HRP started in 1947 with the completion of the Mayfield Hinds Irrigation Scheme (MHIS). The Rangitata River supplies freshwater to the MHIS from the Rangitata Diversion Race (RDR). The MHIS operates today as a farmer owned co-operative, delivering water to more than 33,000 hectares of highly productive land.

Irrigation practices on the HRP have changed in the past decade from primarily border dyke irrigation to spray irrigation. Border dyke irrigation, a type of flood irrigation method, provides greater quantities than the soil can hold and results in large amounts of irrigation water recharging the underlying groundwater. Spray irrigation applies water at a uniform rate and results in a reduced loss of irrigation water to groundwater, compared to border-dyke irrigation. The reduced groundwater recharge associated with conversion to spray-type irrigation is thought to have considerable impacts on HRP groundwater resources. These impacts include declining groundwater levels, drying of shallow wells and a reduction of baseline flow in coastal spring-fed waterways.

Continuous declines in groundwater quantity and quality over the past decade in the HRP pose a serious risk to drinking water sources and waterways ecology. The aim of the current project is to improve understanding of the change in groundwater hydrology in the HRP following conversion from border dyke to spray irrigation.

### **Research/career interest:**

Hydrogeology, groundwater monitoring and modelling

## Groundwater monitoring in Southland - quantifying NO<sub>3</sub> lag effects for land use policy decisions.

**James Thornton**, [j.m.thornton@live.com](mailto:j.m.thornton@live.com)



Highly elevated nitrate concentrations in groundwater under the Waimea Plains, Southland, have long been suspected of affecting surface water nitrate concentrations in the Waimea Stream. Nitrate concentration in the Waimea Stream are highly elevated ( $> 3.0 \text{ mg/L NO}_3\text{-N}$ ) over winter across all reaches monitored, while in the lower Waimea nitrate concentrations remain elevated above  $2.0 \text{ mg/L NO}_3\text{-N}$  during summer as well. This has been accompanied by observations of significant levels of macrophyte and periphyton growth.

The aim of this study is to establish the flow paths by which nitrates are entering the Waimea Stream. By analysing groundwater chemistry, along with in-stream chemistry during low base flows, and winter high flows, the chemistry of two basic hydrological end-members, groundwater and overland flow (run-off) is established.

It was found that an elevated Na:Cl ratio, relative to that of marine aerosols, acted as a good tracer of groundwater inputs to in-stream flow, while Ca,  $\text{SO}_4$  and Al acted as good tracers of overland flow. From this evidence it is clear that overland flow, or runoff, is the main pathway by which nitrate enters the upper Waimea Stream, while the lower Waimea Stream is subject to both significant overland and groundwater inputs of nitrate. Analysis of the stable isotopes of carbon, hydrogen and oxygen indicated connectivity between groundwater and surface is at its greatest in the middle reaches of the Waimea Stream. This connectivity coincides with the large increases in in-stream nitrate previously identified.

## Fluid practices: understanding adaptations to everyday water use.

**Julie Clarke**, [julie.clarke@lincoln.ac.nz](mailto:julie.clarke@lincoln.ac.nz)



I am using Social Practice Theory to examine everyday domestic water use. Social Practice Theory does not treat nature and society as separate, but views our routine practices, or habits, as the configuration of a variety of different elements. These elements are: material, such as technologies, natural resources and infrastructure; competences, such as skills and know-how; and meanings or social norms and emotions. Our performance of social practices connects these elements together, and consistent repetition creates stability – in other words, habits.

I focus on how people adapt to disruptions in their water-use, where there has been a change in the materiality, competences or meanings of their practices. These adaptations can illuminate some of the taken-for-granted elements of practice, and reveal how change or continuity in our water use occurs. Interviews have been conducted with four groups: earthquake-affected residents from Christchurch, who went without water or sewage infrastructure for a period of months; immigrants who have encountered a difference in water provision and infrastructure after moving to Christchurch; people living off-grid and unconnected to municipal utilities; and visitors to Antarctic bases who are actively encouraged to conserve water due to the energy-intensive nature of its provision.

The ways we adapt to disruptions in everyday water use can help identify what drives our water use, and usefully inform policy aimed at building adaptive capacity to such things as water scarcity.

## Standardising environmental management and the implications for Māori conceptions of water.

**Kenya Calder**, [kenya.calder@lincolnuni.ac.nz](mailto:kenya.calder@lincolnuni.ac.nz)



The 2014 National Policy Statement for Freshwater Management (NPSFM) requires regional councils to implement freshwater accounting systems, and set limits for freshwater quality and quantity in order to meet value-based objectives. Hence, the NPSFM establishes a resource management framework which is heavily reliant on standardised and numerical representations of complex and dynamic freshwater systems. The NPSFM also enshrines Māori concepts to represent the values associated with freshwater, and requires that tangata whenua values and interests be “included and reflected” in resource management and planning.

Ostensibly, Māori hold culturally distinct ways of knowing water and conceptions of the relationship between people, land and water. Using a conceptual framework concerned with the implications of standardising complex systems, divergent knowledges, and knowledge integration, my research will examine the apparent disconnect between the standardising tools deployed under the NPSFM, and Māori conceptions of the environment which this policy statement attempts to capture. I will do so through interviews with policymakers and scientists involved with the development of the NPSFM.

Ultimately, my research asks: How do the standardising methods of water resource management embedded within the NPSFM accommodate Māori ways of knowing water? Understanding the relationship between the policy methods (limit setting and accounting regimes) and objectives (protecting values associated with water) is critical in evaluating both the potential implications of the policy framework for tangata whenua, and the intended outcomes of the policy.

## Exploring appropriate approaches to returning water quality data to communities in Ndola, Copperbelt province Zambia.

**Mando Chitondo**, mando.chitondo@pg.canterbury.ac.nz



Many scientific projects carried out in developing countries take data and fail to return any summary of results to the community. Even when reports are written, they are rarely communicated effectively. Residents from communities facing water issues are most at risk, however they are often deprived of effective participation as they are used only as a source of data and no further involvement regarding access to research results occurs.

water issues being faced, formulation of accounts and solutions to the water challenges.

This is a major concern because access to research findings encourages examination of

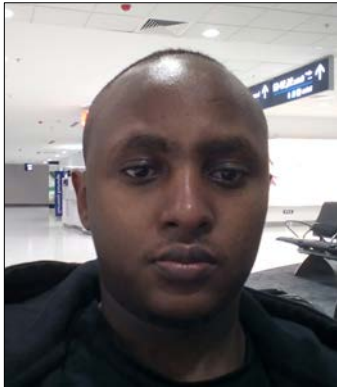
This project seeks to understand participants experience of a water quality study carried out in 2013 and to explore the effectiveness of approaches for returning water quality results to affected communities in Ndola. The results from the water quality project in 2013 were presented back to community members via a brochure, video and presentation, so as to establish the participant's preference for results communication. By exploring the experiences of individuals from communities facing water issues, I aim to explore what they know about the quality of their water, how they know what they know and what method is appropriate to communicate water quality results to them.

### **Research/career interest:**

Approaches that enable thorough participation of local communities in research projects, planning and management of water resources.

## Pollution of urban waterways in Nairobi City: case study of Mathare 4B.

**Kevin Kienja**, [kevin.kienja@pg.canterbury.ac.nz](mailto:kevin.kienja@pg.canterbury.ac.nz)



This study examines pollution of urban waterways in Nairobi city with a specific focus on informal settlements; the causes, effects, as well as possible pollution management options. The study recognizes that there are many other diverse pollution sources within the cities including but not limited to; industries, markets/businesses, and human settlements.

Previous studies conducted on assessment of human pathogens associated with the Nairobi and Athi Rivers determined that the river water is not potable and poses health risks to downstream communities which rely on this water for

domestic and agricultural use.

The informal settlements and city's sewage treatment plant were found to be the major contributors of microbial pollution of Nairobi and Athi Rivers.

Preliminary study findings confirm microbial pollution of Nairobi and Athi Rivers at selected sampling points along the informal settlement case study area as well as after discharge from the city's sewage treatment plant. The last sampling point 50km downstream is a major recreational site called Fourteen Falls. The samples collected also indicated high counts of faecal coliform and E coli which is a major health risk for people visiting this site. The water had a bad odour at the site and also appeared greenish brown with traces of solid wastes as well as carcasses of dead animals.

Interviews conducted with residents of the informal settlement revealed that people perceived the urban waterways as the easiest and most convenient way of discharging human and solid wastes due to lack of sewer connections and poor solid waste management by the city authorities.

### **Research/career interest:**

Industrial and microbial pollution of urban waterways.

## Options for treatment of ammonia in landfill leachate.

**Doctor Segweni**, [doctor.segweni@pg.canterbury.ac.nz](mailto:doctor.segweni@pg.canterbury.ac.nz)



Treatment of landfill leachate is often needed to remove ammonia-nitrogen (free ammonia and dissolved organic nitrogen) because its high concentrations are known to negatively impact on waterways and wastewater treatment processes. The main objective of this study was to examine ways to reduce ammonia in landfill leachate. One method studied was coagulation-flocculation. Jar test experiments were used to explore the best coagulant, effective dosage, pH control, mixing regimes and the use of polyelectrolytes.

Two conventional coagulants, ferric chloride and aluminium sulphate (alum) were examined. In addition, three commercial cationic polyelectrolytes of the amide family were co-examined. Better results were obtained with ferric chloride than alum. Among the variables explored, the coagulant dosage and pH were very significant. The result was about 10% ammonia-nitrogen removal at optimum dosage of 3000 mg/L and at pH 7. The mixing regimes and polyelectrolytes addition were not very significant in removing ammonia-nitrogen. Coagulation-flocculation seems not to be useful as a treatment method for removing ammonia-nitrogen from landfill leachate.

Sorption was also studied. Zeolite soil, which is known to have an affinity for ammonium ions, and four other local silty and calcareous soils (type A, type B, and WSD and silt dam soils) were examined using batch tests. The results show 23% of ammonia-nitrogen removal with zeolite soil and less than 5% with four other local soils. Sorption also seems not very effective in removing ammonia-nitrogen from landfill leachate, however, further in-depth analysis needs to be conducted. Biological nitrification is being examined using a sequencing batch reactor with best COD removals from coagulation-flocculation method.

### **Research/career interest:**

Water and wastewater.



## Phosphorus release from waste activated sludge under different pH, temperature and anaerobic conditions.

**Shiv Prasad Pokhrel**, Shiv.pokhrel@pg.canterbury.ac.nz



Wastewater plants generate large amounts of waste activated sludge (WAS) with 1-2% phosphorus (P) by dry mass (Cordell et al. 2011). Optimisation of P release from WAS could make recycling of P cost-effective. Batch P release experiments were performed on WAS from Christchurch City in anaerobic conditions in 1 Litre bottles at 10, 20, 35°C and a pH of 4, 6, 8 and without change (control). Aqueous ortho and total phosphorus (Dissolved Reactive and Total Dissolved Phosphorus) were measured spectrophotometrically (APHA, 2005).

Solid P extraction yielded organic, mineral and sorbed fractions (Inorganic (IP), Orgic (OP), Non Apatite Inorganic (NAIP) and Apatite Phosphorus (AP)) (Gonzalez Medeiros et al., 2005).

Two batches (1 and 2) were run for 8 and 23 days. Both show a similar trend with rapid release of P within the first 7 days. The maximum concentration of TDP was 74.4 mg P/L and 83.2 mg/L in liquid phase under lower pH≤6 and 35°C. Similarly, initial total P in solids was 18.1 and 16.8 reduced to 9.5 and 8.3 mg P/Kg after post treatments for batch 1 and 2. Analytical P fractions indicated that IP (NAIP+AP) was dominant and always more than 60% of TP. More than 70% of IP fraction was released under pH≤6 and 35°C. The results indicate great variation in P forms and release, and show that nutrient removal systems show high potential for beneficial P recovery.

### Research/career interest:

Water Quality, Wastewater Treatment, Resource Recovery and Anaerobic Digesters.

## Optimising the use of coral beach sands for the treatment of onsite wastewater in Kiribati.

**Bronwyn Humphries**, [Bronwyn.humphries@pg.canterbury.ac.nz](mailto:Bronwyn.humphries@pg.canterbury.ac.nz)



Management of human waste disposal remains a major health and groundwater contamination issue on atolls in Kiribati. Approximately 60% of the population practice open defecation with pit latrines and basic septic tanks representing alternative sanitation methods. Very little research has been conducted to evaluate the fate and transport of microbial pathogens through coral sand that forms the substrate of atolls.

Laboratory based, controlled elution experiments have been undertaken using worked coral beach sand, to examine its drainage and effective microbial removal properties. Solutes containing bacterial and viral indicators, together with viral pathogens, were drained under gravity through the unsaturated sand-packed columns, serving as physical models of an effluent drainage field. Elution tests were performed on unconditioned (clean) sand and conditioned sand to mimic an aged effluent drainage field.

The experiments confirm that filtration likely plays a major role in the ability of coral beach sands to attenuate microorganisms found in wastewater. All organisms examined showed removal efficiencies over 4-log removal values (i.e. 99.99 % reduction). The results appear to demonstrate the effectiveness of coral beach sand for attenuation and removal of microbial pathogens. Further research and field trials are however needed to validate these results. This readily available low cost media could improve waste treatment in Kiribati and offer enhanced protection of the groundwater resources.

### **Research/career interest:**

How land use affects groundwater quality in NZ/Pacific Islands

## The impact of trace metals in road dust on urban waterways.

**Christopher Sampson**, [christopher.sampson@pg.canterbury.ac.nz](mailto:christopher.sampson@pg.canterbury.ac.nz)



Trace elements, such as copper and zinc, present a significant problem in New Zealand waterways, as small concentrations can have severe detrimental effects on entire ecosystems. These effects can range from forcing restriction on certain uses of water to a significant reduction in biodiversity. Minimising any discharge of these elements into freshwater resources is therefore crucial in maintaining their health.

This research focuses on road dust, resuspended particulate matter found on roads and gutters that is largely generated by motor vehicles through abrasion processes. Road dust contains these trace elements from various car parts, particularly brake pads and tyres, and present a potential pathway for pollution through storm water drains.

In this study 30 sites of varying traffic densities around Christchurch were regularly sampled for trace elements present in road dust, and these concentrations were compared to other factors such as rainfall and age. In addition, the concentration of platinum group elements has been measured, as the mandatory requirement of every motor vehicle to have a catalytic converter could present a pathway through road dust for platinum and palladium to discharge into waterways. To understand how these trace elements could impact our waterways, several leaching studies using stream water, rain water and hydrochloric acid were performed to attempt to predict the environmental fate of these trace elements.

### Research/career interest:

- Analytical/ Technician role
- Environmental Chemistry

## Morphological and physiological acclimations of *S. pectinata* to low light conditions.

**Qian Hu**, qian.hu@pg.canterbury.ac.nz



*Stukenia pectinata* (Sago Pondweed), a submerged aquatic plant, is indigenous to Lake Ellesmere and densely colonized the marginal area of the Lake prior to the “Wahine Storm” in 1968. A major challenge for re-establishing the plant population is identifying a zone where there is sufficient light in the turbid lake water but where wave action does not prevent establishment.

To address this challenge, a series of experiments were carried out to determine the plant’s ability to acclimate to low irradiance. *S. pectinata* was cultured in greenhouse conditions in the summer of 2015 under three irradiance regimes, such that solar noon irradiance on a sunny day yielded 650  $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$ , 350  $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$  and 150  $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$ .

Acclimation to low light resulted in plants with low above- and below-ground biomass, elongated stems, which reached the water surface before other treatments, had fewer secondary shoots, and least lateral rhizome spread and few tubers. Individual low-light leaves had shorter lifespan and a lower dry weight to fresh weight ratios than high-light plants. Leaves of plants acclimated to low irradiance had higher chlorophyll-a and -b concentrations and lower saturating PAR compared to high-light leaves. No difference was detected in maximum photosynthetic rates, dark respiration rate or leaf anatomy. In brief, *S. pectinata* prioritises stem elongation to escape the light limiting conditions, while enhancing leaf photosynthetic rates at low light.

### Research/career interest:

Limnology

## Testing and developing tools for weed macrophyte control in Canterbury agricultural waterways.

**Katie Collins**, [katie.collins@pg.canterbury.ac.nz](mailto:katie.collins@pg.canterbury.ac.nz)



Aquatic macrophytes provide important functions in stream ecosystems, however, excessive macrophyte growth in agricultural landscapes can have negative impacts including accumulating sediment and causing flooding. When agricultural waterways become choked during summer, management typically involves mechanical clearance using a bank-side digger. This practice can over steepen banks, damage in-stream habitat and hinder aquatic ecosystem function.

As part of the Canterbury Waterway Rehabilitation Experiment (CAREX), we tested macrophyte control methods at a small-scale, testing: hand weeding, herbicide spray, weed mat, channel shading, flower and seed removal, sediment removal and physical disturbance. Hand weeding, weed mat and herbicide spray provided effective reductions in macrophyte growth.

Macrophyte growth was severely limited under full shade across the channel (with 70% light reduction), however growth was enhanced in partially shaded channels. To identify the optimum level of shading required to control excessive plant growth, we tested shading across a gradient using 25 five-metre shade tunnels. Additionally, to test the practicality of hand weeding and weed mat at a real-world scale, we have expanded these treatments to larger-scale, ongoing, field trials. Overall, our results reveal ecologically sound solutions to global weed macrophyte problems are likely to involve combinations of tools, but will ultimately need to include optimal levels of shade.

### **Research/career interest:**

Aquatic macrophytes, land-use effects on streams, stream rehabilitation and agricultural waterways.

## The effects of fine inorganic bed sediment on fish community composition in New Zealand.

**Nicky Glenjarman**, [nglenjarman@gmail.com](mailto:nglenjarman@gmail.com)



Intensive and long term land-use changes have led to increased inputs and retention times for fine inorganic sediment in streams and rivers.

In New Zealand, fine inorganic sediment (<2mm) covering more than 20% of the bed has been linked to negative changes in invertebrate communities. This is reflected in a decline in EPT (i.e., Ephemeroptera Plecoptera and Trichopteraera) taxa with communities becoming dominated by pollution tolerant (e.g., Potamopyrgus sp. snails) and burrowing species (e.g., Chironomids).

We have conducted an extensive survey of 50 waterways covering the South Island of New Zealand, to establish if bed sediment effects freshwater fish diversity and community structure. Our data indicates sediment significantly effects fish diversity.

### **Research/career interest:**

Restoration, conservation, emerging nations and triple bottom lines.

## The interactive effects of flow and nitrate on *Phormidium* accrual.

**Tara McAllister**, tara.mcallister0@gmail.com



Toxic benthic cyanobacterial proliferations, particularly of the genus *Phormidium*, are an escalating problem worldwide in freshwater environments and associated animal toxicosis events are being reported with increasing frequency. *Phormidium* proliferations are problematic in New Zealand rivers, where there has been a marked increase in the distribution, intensity and frequency of proliferations in recent decades. Ingestion of *Phormidium* mats has resulted in over 100 dog deaths in New Zealand in the last decade.

Previous observational studies have indicated a range of environmental factors as potentially important in determining patterns of *Phormidium* occurrence, but manipulative experimental approaches are required to disentangle and identify the causal mechanisms underlying these patterns. *Phormidium* is common in streams draining agricultural catchments, and elucidating the effects of nitrate concentration and flow velocity on bloom development, are an important consideration for both fluvial science and management. We conducted a streamside channel experiment that evaluated the responses of *Phormidium*-dominated mats in terms of biomass, patch expansion, cellular nutrient concentrations and taxonomic composition to three different nitrate levels, crossed with two flow levels, resulting in a total of six treatments each replicated three times.

Preliminary analysis highlighted no significant differences in exponential growth rates between treatments. There was, however, greater *Phormidium* biovolume under fast flow treatments compared to slow flow treatments. The study highlights the complex and interactive relationships between flow and nitrate and benthic *Phormidium* accrual cycles.

### Research/career interest:

- Freshwater ecology, toxic algae
- Mātauranga Māori

## Factors driving algal blooms in Ugandan crater lakes: a case study of six crater lakes in Western Uganda.

**Emmanuel Busobozi**, [emmanuel.busobozi@pg.canterbury.ac.nz](mailto:emmanuel.busobozi@pg.canterbury.ac.nz)



The presence of algal blooms in a waterbody is an outstanding indicator of ecosystem disturbance. Algal growth is mainly enhanced by the influx of nutrient pollutants such as nitrogen and phosphorus into freshwater. These two nutrients underpin the entire primary production in a lake and eutrophication. As a response to eutrophication, algal biomass also forms an active source of organic matter to support the freshwater food-web. However, the excessive growth of algal blooms leads to discoloration of water, foul smells and

tastes, oxygen depletion, toxicity and alteration of food webs.

Western Uganda is a host to over 80 crater lakes formed through volcanic activities. These lakes are a livelihood source to a larger community through provision of domestic water and cheap fish protein to the immediate and distant communities. Despite these values, some crater lakes have shown signs of steady water quality decline due to eutrophication and toxic algae development. These water quality changes are linked to both natural and anthropogenic nutrient pollution. Studies on some of these lakes show a general association between the water quality decline and some of the environmental factors. However, no comparative and quantitative water quality assessments among these lakes has been done.

The aim of this study is to qualitatively determine the specific drivers for algal blooms among six crater lakes. The resulting information will help to develop remediation strategies towards water quality decline and help prevent further deterioration that requires costly interventions. Furthermore, this study evaluates whether the techniques of lake monitoring developed in New Zealand such as trophic level indicators can be applied on Ugandan crater lake systems.

**Research/career interest:** Limnology



## The role of nutrients and light in the growth of phytoplankton in Te Waihora/Lake Ellesmere.

**Emma MacKenzie**, [emma.mackenzie@pg.canterbury.ac.nz](mailto:emma.mackenzie@pg.canterbury.ac.nz)



Te Waihora/Lake Ellesmere is a shallow, eutrophic coastal lake in Canterbury. It is considered one of the most polluted lakes in New Zealand. Efforts are underway to improve water quality to reduce phytoplankton biomass. To inform best management practices, I undertook two sets of mesocosm experiments to explore the factors in controlling phytoplankton growth, focusing on the relative importance of light and nutrients.

Chlorophyll a responses to the additions of phosphate (+P), nitrate (+N), and both nutrients (+NP) in 40 cm laboratory mesocosms suggest nitrogen availability most often controls phytoplankton biomass, but phosphorus becomes important at times of high ambient nitrate.

A second series of experiments investigated the effects of nutrients (+NP) in mesocosms of 20, 40, and 80 cm depth, to simulate different mixing depth and hence light availability. Where no nutrients were added, concentrations were consistent in 20, 40 and 80 cm mesocosms. With nutrient addition, 80 cm mesocosm concentrations were consistent and 40 cm mesocosms increased. Growth of phytoplankton was suppressed in the deepest mesocosms. 20 cm mesocosms showed either a large increase in chlorophyll a or little change.

Irradiance appears to play a significant role in mediating the ability of phytoplankton to grow rapidly when nutrients are available, and under lake conditions is likely to be playing a significant role in moderating growth rates.

### **Research/career interest:**

Limnology, ICOLLS, water quality, eutrophication and phycology.

## New Zealand's whitebait fishery: a mixed bag of species and sizes.

Mark Yungnickel, myu25@uclive.ac.nz



It is believed that inanga (*Galaxias maculatus*) make up the vast majority of New Zealand's whitebait catch, with the remaining four species (*koaro*, *G. brevipinnis*, *banded kokopu*, *G. fasciatus*, *giant kokopu*, *G. argenteus*, and *shortjaw kokopu*, *G. postvectis*) making up a variable, but much smaller component. This belief is based on the last widespread study of the composition

of New Zealand's whitebait catch completed by McDowall in the 1960s.

Four of the five whitebait species are now ranked as 'declining or nationally vulnerable' due to bottlenecks in their life history. However, we have little current knowledge of the species composition of migratory shoals, or any temporal and spatial shifts in the make-up of the whitebait catch. We completed a nationwide study of the composition of the whitebait fishery within and outside the 2015 whitebaiting season.

Over 500 samples of whitebait were collected by whitebaiters on 96 rivers in 14 regions throughout New Zealand. Results of this study, including spatial and temporal differences in species composition and morphology, will be discussed together with whether the whitebait fishery has changed in the last 50 years.

### Research/career interest:

Freshwater, marine and terrestrial ecology, stream rehabilitation, environmental monitoring, New Zealand freshwater fish

## Applying ecosystem-based management to riparian management: addressing critical habitat objectives for inanga in statutory plans.

**Shane Orchard**, [shane.orchard@pg.canterbury.ac.nz](mailto:shane.orchard@pg.canterbury.ac.nz)



Ecosystem-based management (EbM) is an environment management paradigm with a focus on biodiversity at the level of habitats and ecosystems. It complements the so-called 'ecosystem approach' (EA) as a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. Both strategies recognise that ecosystems are an important focus for natural resource policy and the sustainability of human interactions with the environment.

In New Zealand, a mandate for EbM is reflected in policy objectives for the management of specific habitats and ecosystems. However, as a consequence of the devolved environment management system, effective implementation of higher level policies such as those found in national policy statements relies on the planning approaches adopted at regional and local levels. As a result, different approaches may be adopted in different regions despite being designed to address similar issues. This context creates opportunities for innovation and for evaluating different approaches to EbM in practice.

The management of inanga (*Galaxias maculatus*) spawning habitat provides a good example of EbM in the New Zealand context. This arises from a clear policy mandate for protection of the areas involved, and the widespread occurrence of the species across most of New Zealand's local government jurisdictions. Building on an in-depth study of waterway management in Ōtautahi Christchurch, I will present findings from a policy analysis to identify riparian management needs as interpreted against the spatial structure of inanga spawning habitat. I will discuss implications for the effectiveness of planning approaches to achieve policy objectives and extend an invitation to collaborate in a participatory process in the next step of my research programme.

### **Research/career interest:**

Coastal & waterway management, natural resource policy, spatial ecology & planning.

## Large brown mudfish populations are keystones of landscape-scale resilience to global warming in Westland swamp-forests.

**Richard White**, [richard.white@pg.canterbury.ac.nz](mailto:richard.white@pg.canterbury.ac.nz)



Typical scaling of population size with probability of persistence suggests only small populations will lack resilience to increasing environmental stochasticity associated with global warming, but this relationship may depend on the quality of habitat patches which can be affected by land use. Using empirically-derived models of a swamp-forest fish metapopulation, we show their resilience to global warming-induced drought-extremes was almost entirely dependent on land-use changes which limited persistence of large populations.

Population persistence increased indefinitely with population carrying capacity in large stable patches, but this relationship was asymptotic at low population size in small unstable patches contracted in size by forest logging. Metapopulation persistence in logged forests dropped 93 percent due to asymptotic scaling and lost persistence of large populations, compared to unaffected metapopulations.

Thus even large populations are vulnerable in stochastic environments, the loss of which has disproportionate effects at landscape scales. These results confirm longstanding theory predicting asymptotic population size-persistence thresholds will occur as environmental stochasticity rises, and highlight the keystone role of large populations in maintaining landscape-scale resilience to climate change. Consequently, achieving high carrying capacity in large stable habitats maybe the most effective tool for mitigating the impacts of extreme climate events under global warming.

### **Research/career interest:**

Freshwater fish population dynamics in highly variable environments.

## Poster Abstracts

Poster Session from 1.00pm to 1.30pm in the foyer

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### Groundwater resources management: a sustainable policy approach for the Purapurani Aquifer, Bolivia.

**Estefania Arteaga**, [estef.arteagavaldivia@pg.canterbury.ac.nz](mailto:estef.arteagavaldivia@pg.canterbury.ac.nz)



Groundwater resources in Bolivia have not been effectively regulated in relation to their exploitation and development. Currently there is no policy for sustainable use and limited information regarding the availability of the resource throughout the country. This study proposes a policy approach for the sustainable management of groundwater resources, based on the concepts of socially-sustainable development and adaptive management. The goal is to provide the government of Bolivia with a long-term strategy for managing groundwater resources

effectively taking into consideration future demand and environmental challenges.

The research uses the Purapurani aquifer in the city of La Paz as a case study for developing a management plan that could be used as a model for other aquifers in Bolivia. In addition to analysing international management policies and current policy within Bolivia, an investigation of community concerns will be undertaken.

The main tools being used in this research are Socially Sustainable Plans, a concept explored by UNESCO; Commitment Packages and Adaptive Cycles. These concepts are complementary to each other, and when used jointly the outcomes could be highly significant. The research project will be developed in three phases:

- a) Gathering and analysing information
- b) Identifying failure pathways
- c) Development of responses, structuring a management plan, a Prompt Response Mechanism and an Exit Strategy.

Modelling tools will also be reviewed as mechanisms for facilitating future policy implementation.

**Research/career interest:** Water management policies, strategies and tools, climate change, resilience and adaptation.

## Evaluation of the community involvement of the Nam Theun 2 hydropower project in Lao People's Democratic Republic.

**Phonesavath Khamvilay**, [phonesavath.khamvilay@pg.canterbury.ac.nz](mailto:phonesavath.khamvilay@pg.canterbury.ac.nz)



The Nam Then 2 (NT2) hydropower project is one of the largest hydropower development projects in Lao PDR and it is located in the central part of the country, in the Khammoune province. It has become the main factor supporting socio-economic growth. The NT2 has been considered as a role model for hydropower development in Lao PDR. However, critics found there are a number of shortcomings in relation to development of hydropower sector in Lao PDR, including the NT2 project.

There is potentially some room for improvement, especially in relation to the effectiveness of the regulatory framework and making consultation with stakeholders more comprehensive. Participation of local communities into hydropower planning is crucial in order to ensure that a development project is planned and implemented in a sustainable way.

The overall goal of this research is to analyse the evolution and effectiveness of the Multi-Stakeholder Process (MSP) of this project. Community participation within the framework of the project development programme is being investigated. The research examines the process of multi-stakeholder participation approaches that were applied during project development and operation. The focus on this research will be on the two resettlement sites upstream and the two communities downstream on the lower Xe Bang Fai (XBF river) zone.

The results from this study will be beneficial to many parties including, the Lao government, hydropower developers, local communities and Non-Governmental Organisations with regards to enhancing the effectiveness of designing, implementing and evaluating the MSP in future hydropower development projects in Lao People's Democratic Republic.

**Research/career interest:** Water resource and environment management

## Water policy and governance in Guyana, "The Land of Many Waters".

**Onika Baptiste**, [onika.baptiste@pg.canterbury.ac.nz](mailto:onika.baptiste@pg.canterbury.ac.nz)



Freshwater is an important natural resource for the sustainable development of a country's economy (Biswas, 1991). Guyana seeks to improve its economy by creating an environment for sustainable development, through increasing investment in renewable energy projects, and the agriculture sector. However, there is no development focus for freshwater management. The design and implementation of water policies is an important aspect for the sustainable management of this resource and for Guyana's economy.

Sustainable economies are linked to effective water management policies that identify the economic importance of freshwater resource. For example, Chile has developed policies that demonstrate the economic value of water by adopting market price for this resource through privatization (Schleyer, 1996) (Bauer, 1997). In addition to its economic value freshwater also has social and environmental value. Therefore, the need to efficiently manage this resource should be demonstrated in its inclusion in national development policies and strategies.

Efficient management of freshwater resource requires institutional structure and policy change (Koudstaal, Rijsberman, & Savenije, 1992). Identifying the appropriate policy framework and objectives is important for the design and successful implementation of water management policy in Guyana.

This research aims to analyse existing policies through the lens of the adaptive policy theory and the integrated water resource management (IWRM) theory, identifying gaps and making recommendations for an appropriate framework to inform the development of a national water policy for Guyana.

### Research/career interest:

- Water Resource Management and Policy
- Climate Change and Community Resilience

## Determining the main drivers of future hydrological alterations in the Mekong floodplains.

**Thanh Duc Dang**, [duc.dang@pg.canterbury.ac.nz](mailto:duc.dang@pg.canterbury.ac.nz)



The agricultural productivity of the Mekong floodplains contributes significantly to poverty and hunger alleviation in Vietnam and Cambodia. The productivity is maintained by its unique natural hydrological patterns and supply of rich sediment from the Mekong River. Potential hydrological alterations induced by the cumulative impacts of the development of 120 upstream hydropower dams and ongoing delta-based water infrastructure growth for agricultural expansion have thus been at the centre of public concern. Sea level rise will also likely impact flooding patterns and put more pressure on agricultural development of the two countries.

The main aim of this study is to quantify the influence of development and sea level rise on hydrology of the floodplains by hydrodynamic modelling. Results show that the development of full dams impacts the upper part of the Mekong floodplain. In the middle floodplains, localized water infrastructure was the main driver of hydrological alterations, resulting in an increase of water levels by 15% in the wettest month. Sea level rise would exasperate the flooding problem in regions around the Vietnamese coast. A sea level increase of 30 cm will flood an additional 6,000 km<sup>2</sup> of the lower floodplains.

It is concluded that if sea level rising and the development of water infrastructure are irreversible processes, it will be necessary to coordinate the development to minimize the impacts on water levels and to tackle the problem of sea level rise.

### **Research/career interest:**

Hydrological/hydrodynamic modelling, remote sensing, GIS and water infrastructure.



## Sustainable livelihoods framework and water-related climate change adaptation interventions in Vietnam.

**Huong Do**, [thi.do@pg.canterbury.ac.nz](mailto:thi.do@pg.canterbury.ac.nz)



There are currently many water-related climate change adaptation interventions in Thai Binh, a coastal province in Vietnam. However, we have little knowledge about how these interventions affect the local residents even though they should be the ultimate beneficiaries of all adaptation interventions. If we do not have this knowledge the policy makers, officials and local residents can't understand the actual benefits or drawbacks of these interventions.

This may discourage stakeholders' engagement and participation in climate change adaptation. In this paper we investigate the impacts of some water-related climate change adaptation interventions on the local residents in a particular community in Thai Binh province through the lenses of the Sustainable Livelihoods Framework (SLF).

We explore the impacts of these interventions via the local residents of Quoc Tuan community in Thai Binh province. In particular, we bring to the light the differing viewpoints of "effectiveness" amongst local participants.

### **Research/career interest:**

Climate change adaptation management, sustainable community development, water resource management

## Photolysis of emerging contaminants in surface water.

Lara Danica Marayag, Ldm45@uclive.ac.nz



Emerging contaminants are environmental pollutants that are not routinely monitored in the environment; including pharmaceuticals and personal care products. These chemicals find their way into the environment through human and animal excretion from therapeutic consumption and everyday cosmetic usage. Removal efficiency by conventional wastewater treatment for many emerging contaminants is low. Despite typically low concentrations of emerging contaminants, reported adverse effects on aquatic organisms include chronic toxicity,

endocrine disruption, genotoxicity and behavioral changes. Carbamazepine, diclofenac, 17 $\alpha$ -ethinyl estradiol (EE2), 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta[*b*]-2-benzopyran (HHCB-galaxolide) and 7-acetyl-1,1,3,4,4,6-hexamethyl-1,2,3,4-tetrahydronaphthalene (AHTN-tonalide) have low removal efficiencies in conventional wastewater treatment plants.

Degradation through advanced oxidation processes (AOP's) has recently gained a lot of attention due to its cost effective and efficient degradation of almost any organic molecule through generation of strong hydroxyl radicals, commonly known as the Fenton Reaction. A Heterogeneous Fenton-like process uses Fenton-like catalysts such as iron oxides and iron-mobilized zeolites with H<sub>2</sub>O<sub>2</sub> in generation of hydroxyl radicals. These catalysts treat organic pollutants over a wider pH range. Catalysts that are naturally present and abundant in the environment would be a significantly cheaper alternative in wastewater treatment system.

This project has two components. The first aims to compare photodegradation of carbamazepine, diclofenac, 17 $\alpha$ -ethinyl estradiol (EE2), HHCB-galaxolide and AHTN-tonalide in freshwater and seawater. The second is to compare the efficiency of iron oxide analogue and iron sands for indirect photo degradation of emerging contaminants by AOP.

### Research/career interest:

- Photolysis, Environmental Chemistry, Wastewater, Chemical and Process Engineering
- Photolysis in Antarctica
- PhD/Researcher/Academic

## Designing an integrated water quality monitoring programme for Te Waihora/Lake Ellesmere.

**Val McMillan**, [valerie.mcmillan@lincolnuni.ac.nz](mailto:valerie.mcmillan@lincolnuni.ac.nz)



Monitoring is essential to the management of almost any activity, such as running a business or managing environment change. Unless we monitor progress, and react according to the results, little improvement can be achieved. Monitoring allows for more informed decisions, and wiser management.

Te Waihora/Lake Ellesmere has a special place in the economy, culture and environment of Canterbury. As an ICOLL (intermittently opened and closed lake or lagoon), it has its own unique set of 'issues' and challenges but like all shallow coastal lakes, it is affected by the historic and current land use in the catchment it serves. The Selwyn catchment is intensively developed and there are a large number of stakeholders with an interest in the lake and its future quality.

This research aims to design an over-arching robust monitoring programme with the specific objective of identifying key water quality changes over time. The monitoring programme will build on existing discrete monitoring or survey programmes undertaken by different stakeholder groups, but will identify a new framework to address current knowledge gaps and provide for greater economic efficiencies. The programme will target water quality parameters strongly linked to the anticipated outcomes of current improvement initiatives being undertaken for Te Waihora.

### **Research/career interest:**

Water quality in Canterbury

## First flush TSS and heavy metals from urban car parks under a low intensity rainfall climate.

**Salina Poudyal**, [salina.poudyal@pg.canterbury.ac.nz](mailto:salina.poudyal@pg.canterbury.ac.nz)



Carparks make up a large portion of impervious urban areas. Stormwater runoff from these areas is therefore considered a significant source of pollutants to receiving urban waterways, particularly of total suspended solids (TSS) and heavy metals such as zinc (Zn), copper (Cu) and lead (Pb). Pollutant concentrations can be substantially high during the initial period of the runoff hydrograph commonly known as first flush (FF).

In Christchurch, the influence of land use around urban carparks on the water quality of the first flush is poorly understood. This research focuses on quantifying FF TSS and metals from carparks within different urban land use settings.

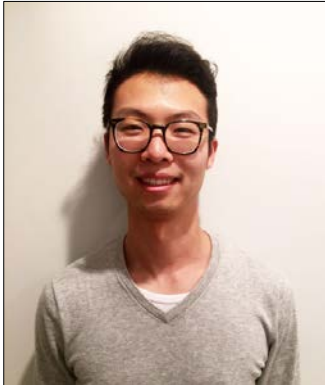
To achieve this objective, grab samplers (1 L HDPE) were deployed in a hospital carpark, a university carpark, and an industrial carpark in Christchurch. Concentrations of TSS, Zn, Cu, and Pb were quantified for each of seven rain events. TSS and total metal concentrations were higher in the FF from the industrial carpark due to its unique land use activities as compared to the other two sites studied. Furthermore, dissolved Zn and Cu were found to be above recommended guidelines for all carparks. It is concluded that characterizing the FF for individual carpark types is important for the design of effective stormwater treatment systems such as filters.

### **Research/career interest:**

Stormwater, hydrology, environmental policy and planning.

## Evaluation of community preferences for decentralised water management systems: a case study in Akaroa, Banks Peninsula.

**Han Sun**, han.sun@lincolnuni.ac.nz



Limitations on the supply of fresh water and increasing demand for council supplied water have become major issues in Akaroa, a tourist town on the Banks Peninsula. Restrictions on domestic water use in summer and new requirements for decentralised water storage and supply systems for new construction have been in place to alleviate the burden of town water supply. Rainwater harvesting systems and greywater recycling systems both represent potential options to decentralise the current water supply.

This study evaluates Akaroa homeowners' preferences for installing these systems through measuring their willingness to pay (WTP) for the systems. A choice experiment (CE) will be conducted to estimate willingness to pay, and parameters will be estimated using a suitable limited dependent variable model. The target population is homeowners in Akaroa, and respondents for the choice experiment will be randomly recruited from the electoral roll.

Estimated WTP will be compared to the actual cost of decentralised systems, to determine whether any financial incentive is required to encourage full adoption of the decentralised systems. The results will provide useful information for water-related policy making for Akaroa and the Banks Peninsula.

### **Research/career interest:**

Environmental economics (water-related) and environmental councillor.

## Emerging contaminants in Canterbury groundwater.

Rebecca van der Krogt, rhv12@uclive.ac.nz



Emerging contaminants in groundwater have had numerous negative effects towards human health and ecosystems. Most research regarding EC's has focused on surface waters and waste waters. Significant contaminants include, endocrine disrupting compounds (EDCs) in particular estrogenic hormones and steroids, antibiotics, personal care products (PCPs) and pharmaceuticals associated with wastewater.

There has been an increase in the release of EC's to the environment during the last decade due to changes in the socio-economic structure of society.

They are a potential risk to the environment due to the high quantities routinely released and their generally low biodegradability. ECs are not routinely monitored because they are often not included in environmental legislation and the environmental fate is not always well understood. Groundwater is of great importance because it is often used as a source of untreated drinking water and is also a major source for irrigation to land used for farming.

The contamination of groundwater is relatively poorly understood when compared with other freshwater resources. Within the Canterbury region dairy farming is a dominant land use. Wastewater from farming sites are a potential source of veterinary pharmaceuticals and steroid hormone contamination to groundwater. Thus far very little research has looked at emerging contaminants in Canterbury groundwater. This project will investigate what emerging contaminants are present in Canterbury groundwater, whether the source is human or animal related and the human health risks associated with these concentrations.

### Research/career interest:

Environmental chemistry, hydrogeology

## Dynamics of nitrogen compounds in Haytons urban drainage stream, Christchurch.

**Fabio Silveira**, [fabio.cabralsilveira@pg.canterbury.ac.nz](mailto:fabio.cabralsilveira@pg.canterbury.ac.nz)



Ammonia concentrations at Haytons Stream (Christchurch, New Zealand) were found to be high (up to 100 g/m<sup>3</sup>) compared to natural stream water (0.01 – 0.1 g/m<sup>3</sup>). High levels of ammonia and/or related nitrogen compounds can be toxic to aquatic organisms and can have a significant effect on the stream's ecological health and it can accumulate, leaching to the groundwater.

The aim of this project was to assess the sources, the types, and the transformation of nitrogen compounds in Haytons' through water quality monitoring at various locations, over time, during

stormflow and baseflow conditions.

Results found that nitrogen concentrations increased from the upper part to the middle part of Haytons' and decreased from the middle to the lower part. Point discharge of NH<sub>4</sub>-N and DON (dissolved organic nitrogen) occurred at the upper and middle part of the stream, which was found to be one responsible for the elevation in nitrogen concentration.

The series of retention ponds and wetland at the middle and lower part of Haytons' were found to improve water quality parameters such as neutralizing pH, decrease turbidity and nitrogen concentrations. In addition, nitrogen compounds changed its forms, from mainly inorganic nitrogen at the upper and middle part to the majority of nitrogen in its organic nitrogen at the lower part of the stream during baseflow and stormflow conditions. PON, an organic form of nitrogen greater than 0.45nm, was found to be around 40% to 60% of the nitrogen compounds that is discharged into Heathcote River.

### Research/career interest:

- Natural Processes
- Water Quality
- Stormwater Management
- Education.

## The analysis of pasture water requirement due to grazing roster

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The amount of pasture irrigation could be more efficiently applied if the roster for pasture grazing is considered. Current practice of pasture irrigation commonly considers a value of 1.0 for its crop coefficient. However, actual evapotranspiration (ETa) values, representing pasture water requirement, is expected to be influenced by the canopy density, and in turn the pasture's height. Thus, for forage crops, ETa will vary due to multiple grazing or harvesting.

The main objective of this research is to estimate actual evapotranspiration (ETa) of pasture due to the pasture height in simulated stock grazing. The water budget equation is being applied to four weighing lysimeters to determine daily ETa. The crop Coefficient (Kc) is derived as the ratio of ETa and ET for a reference crop (ETr). Each of the lysimeters used 3 shear beam load cells which are summed with a junction box as the weighing method. The pasture, consisting of ryegrass and white clover, is cut to 6 – 8 cm, simulating the animal grazing, and is allowed to grow until it reaches 25 to 30 cm high. ETr is estimated by using Penman-Monteith formula and the observed nearby daily weather data.

Based on collected and calculated information so far, Kc values versus pasture heights has shown a positive trend. This indicates that Kc is smaller for recently grazed pasture. The use of the "right" Kc values for pasture would lead to more efficient irrigation and less drainage from the root zone. This would conserve our precious water and reduce the pollution of our aquifers/waterways.

### **Research/career interest:**

Crop water requirement and management.



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The Rivers Group was formed in 2009 to provide a forum for those involved with, and with an interest in rivers, flood risk management and the operational and environmental issues of catchments and river systems. The Group incorporates a wide variety of fields, practice and interest to do with rivers, including cultural health, water quality, water quantity, flood management, energy generation and environment protection, as well as promoting a multi-disciplinary approach for river management, that reflects cultural and societal diversity in an integrated and holistic manner. Key objectives of the Rivers Group include providing a national focus for all matters relating to rivers, promoting leadership, best practice and relevant science and research, sharing of technical knowledge, facilitating cross-disciplinary discussion, promoting and sharing of technical knowledge in all aspects of catchment management, flood risk management and river engineering throughout New Zealand.

Whether you are an engineer, scientist, planner, academic, hydrologist, geomorphologist, climatologist, land manager or individual river enthusiast, membership is open to all.

Check out our website - <http://www.ipenz.org.nz/riversgroup/>

## Notes

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