April 2018

MRQ

Monitoring Research Quarterly

Monitoring Research Quarterly, MRQ is the newsletter of Auckland Council's Research and Evaluation Unit, RIMU. The newsletter reports on RIMU's current work including information about recent publications, research, facts and trends about Auckland. RIMU publications are available on council's research information website, Knowledge Auckland www.knowledgeauckland.org.nz

Contents

Monitoring our big blue backyard: Auckland Council's marine monitoring programme

The marine environment is a big part of Auckland's identity. Auckland is home to spectacular twin coasts lined with beaches and estuaries, three large harbours and the islands of the Hauraki Gulf.

Auckland Council's marine monitoring programme covers the water column, foreshore and seabed, and incorporates regional variation in habitat types, gradients of exposure, and land use and environmental issues. Our data set is one of the most comprehensive long-term marine data sets in New Zealand. We focus on detecting the effects of stressors generated by activities that the council has a statutory role in planning and regulating, particularly land-based activities generating sediments and contaminants. Our long-term data sets also provide an important resource for investigating, tracking and understanding the effects of climate change on our marine environment and the potential consequences for people living in a coastal city.

Collecting water quality samples near the Auckland CBD. Photo: Pete Dal Ferro.

Marine water quality

Auckland Council has monitored marine water quality in the Auckland region every month since 1987. The monitoring network has grown to 32 sites, including the Manukau, Kaipara, and Waitematā harbours, Mahurangi and Tāmaki estuaries, and sites along the east coast.

For the most part, water quality in the Auckland region has improved since monitoring began, but over half the sites receive a water quality score of fair or poor (See, *Marine water quality annual report 2016*, TR2017/033). In addition, there are some concerning trends emerging at sites around the region. For example, total nitrogen concentration has been increasing at many sites in the last five years (up to a 36 per cent annual increase), particularly at sites in the Waitematā Harbour where we are also seeing a significant increasing trend in soluble phosphorus concentrations (up to a nine per cent annual increase).

In the Manukau and Waitematā harbours, we are also seeing a significant increase in water temperature, up to two per cent per year. Increasing nutrients in the water column can increase the frequency of algal blooms, while increasing temperature can change the growth and feeding rates of marine species, particularly those that are already living at the edge of their thermal tolerance.

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Although there were no significant trends in the amount of total suspended sediment in the water column over the last five years, many sites exceeded threshold levels, including half of the sites in the Manukau Harbour. Average turbidity – another indicator of water clarity – is also above the threshold at many sites. Understanding what is driving these recent declines in water quality is important so that appropriate decisions can be made on how to reverse them.

Marine ecology

The marine ecology programme monitors changes in the numbers and types of plants and animals found in coastal ecosystems to detect changes in ecosystem health. Monitored species are a significant component of our regional biodiversity and provide an important food source for birds, fish, and people. They also provide additional ecosystem services, including clean water, carbon sequestration and primary productivity.

We started monitoring intertidal mud and sandflats in the Manukau Harbour in 1987 and have expanded our efforts to cover the Kaipara, Waitematā and Mahurangi harbours as well as eight smaller east coast estuaries. Cores of sediment are collected at each site and all animals found are identified, measured and counted.

The Benthic Health Indicator is a reporting tool for classifying sites based on the number of animals present and their responses to heavy metal concentrations and the level of mud.

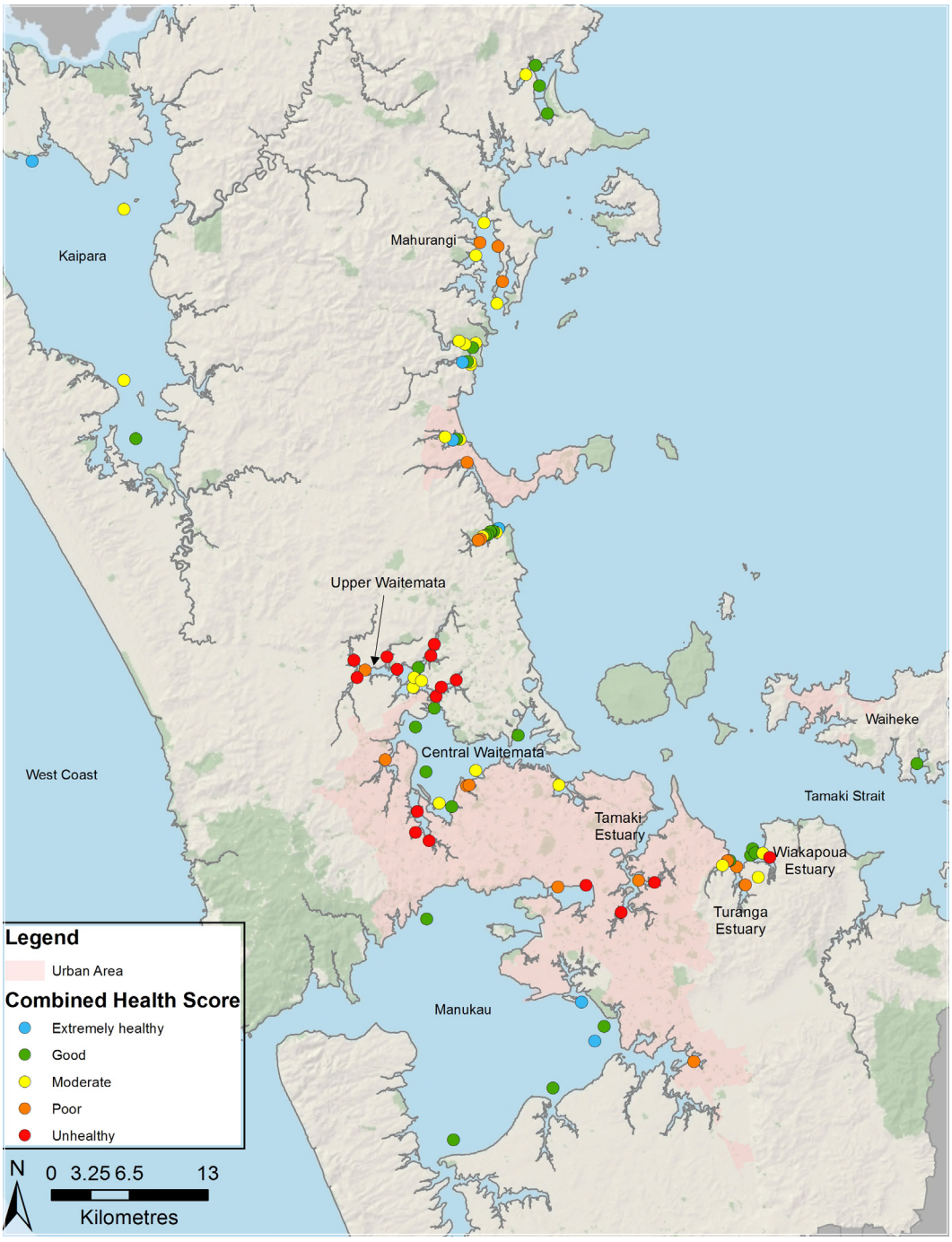
The Traits Based Indicator counts the numbers of species essential functions (for example, burrowing crabs turning over sediment and burying contaminants or filter-feeding shellfish cleaning the water).

This tells us not only how healthy the ecosystem is and how well it is functioning, but also how resilient the system is to change and impact. These measures are added together to score sites from one to five, with one being healthy and five being unhealthy with low resilience. – See the map of marine health scores.

The regional pattern of health scores across Auckland clearly shows the historical impact of urbanisation. Most sites near the older urban centres are unhealthy (scores of four to five), particularly in Waitematā Harbour and Tāmaki Estuary.

The intertidal sand flats of the greater Manukau and Kaipara harbours are relatively healthy due to frequent tidal flushing. However, the tidal creeks and arms are muddy due to sediment washed off the land. Some areas such as Māngere and Pāhurehure inlets were rated unhealthy due to additional contamination from current and historical discharges. While some sites were scored as very healthy or healthy, all harbour and estuary locations contained sites that were scored as only moderately healthy and most had sites scored as unhealthy. This includes sites further away from urban Auckland, showing the influence of rural land use in generating sediment.

An analysis of changes through 2016 showed that patterns of ecological health have remained relatively consistent. For those sites showing changes, the majority were declines, most often in relation to increasing mud.



Map: Auckland marine ecology combined health scores 2016

Contaminants in marine sediments

The concentrations of chemical contaminants in marine sediments have been monitored at estuary, harbour, and open coastal sites around the region since 1998. Contaminants measured include heavy metals, including urban-derived metals such as copper, lead, and zinc, and persistent organic contaminants such as organochlorine pesticides (for example, DDTs), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). These contaminants can be toxic to marine life, so it is important to know what the levels are and how they are trending over time. Contaminant concentrations can be compared with sediment quality guidelines to check the marine sediment quality across the region and assess the impact of stormwater and other discharges. Monitoring is carried out at two- to five-yearly intervals depending on the contamination level at a site.

Approximately 134 sites have been sampled at least once, providing a spatial picture of contaminant levels across the region and their potential effects. In rural areas, recently urbanised areas, and open coastal zones where contaminants do not tend to accumulate, contaminant concentrations are usually below sensitive sediment quality guideline levels, indicating that monitored contaminants are unlikely to have adverse effects on benthic aquatic life. However, in the muddy inner reaches of estuaries in mature urban catchments, chemical contaminant concentrations sometimes exceed sensitive sediment quality guideline thresholds, and for a small number of sites higher level guidelines (which indicate adverse effects are more likely to occur) are exceeded.

The latest assessment of contaminant levels based on concentrations of copper, lead, zinc, and PAHs, indicated that approximately 77 per cent of monitored sites fall below the sensitive guideline threshold, 13 per cent were above the sensitive guideline but below the high level guideline, and a further 10 per cent were above the high level guidelines.

The areas where guidelines were exceeded were mainly in the older industrial and urbanised areas of the Tāmaki Estuary and Central Waitematā Harbour. Contaminant sources affecting these sites may include runoff or leaching from historical industrial sites and landfills, as well as stormwater runoff from current urban land use. Most of the high level guideline exceedances were for zinc, a metal with many urban sources (for example, vehicles, building materials, industrial processes, waste materials).

Overall, the sediment quality monitoring results indicate that there has been little appreciable change in metal concentrations over the past 10-12 years. The lack of evidence for increasing trends in contaminant levels is encouraging given the intense development in Auckland over the monitoring period. However, whether the historical trends measured in the sediment contaminant monitoring programme to date will continue is unknown and will depend on continued contaminant reduction measures being implemented.

Changing sediment texture, in particular sites becoming muddier over time due to fine sediment accumulation, or less muddy due to erosion of fine material, is also a factor affecting trends in metal concentrations at some sites. More work is required to fully assess the importance of texture in influencing trends in metals.

Also, a monitoring programme for emerging contaminants (such as flame retardants and pharmaceuticals) is currently being developed.

For more information about the marine monitoring programme, please contact senior marine scientists, Dr Melissa Foley and Dr Megan Carbines.

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Consumption-based carbon emissions

RIMU maintains and updates Auckland's greenhouse gas (GHG) inventory to identify sources and trends of carbon emissions and to evaluate progress with actions from council's Low Carbon Auckland. It is a sector-based inventory focusing primarily on emissions from energy use within the city boundary as well as from the treatment of waste.

Recently, the C40 Cities Climate Leadership Group in partnership with the University of Leeds, the University of New South Wales and Arup consultants conducted an assessment of the consumption-based GHG emissions for its member cities (including Auckland) to better understand the impact of the consumption of goods and services in cities on climate change. The consumption-based carbon emissions inventory for Auckland includes estimates of GHG emissions from consumed goods such as food and drink or construction materials in the city. This offers complementary insight into identifying opportunities for mitigation actions, as compared to the current sector-based inventory for the update of Low Carbon Auckland.

For more information, please contact Dr Shanju Xie Air Quality Scientist
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A more gender-responsive transport system for Auckland

On average, women in Auckland spend an additional 13 minutes per week on their day to day travel compared to men, despite covering 21km less in distance. This is because women in Auckland walk and use public transport more and drive less (Figure 1). They also perform more care-related trips, leading to more complicated travel patterns caused by trip-chaining (for example, picking up children and shopping on the way home from work.) (Ministry of Transport, 2018).

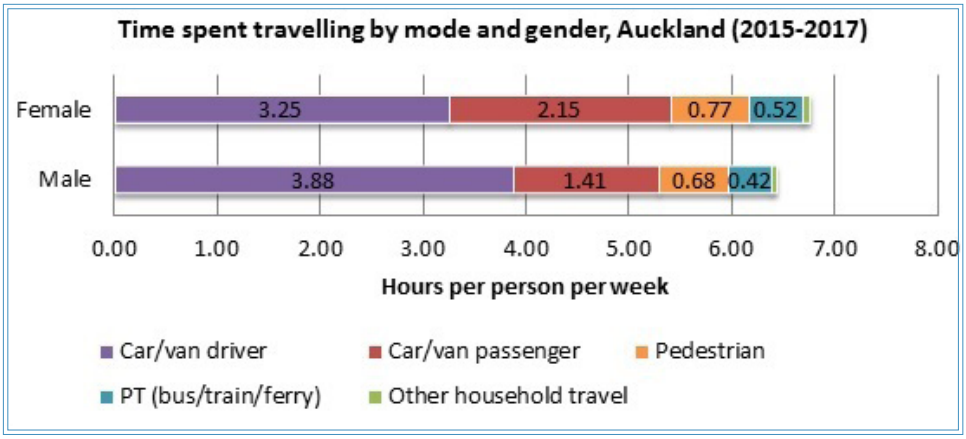

Figure 1: Time spent travelling per week by mode and gender, Auckland, 2015-2017 (Ministry of Transport, 2018)

Despite growing evidence showing that women can have significantly different travel needs and behaviour compared to men, transport planning in Auckland has traditionally not taken into account gender differences (Ng and Acker, 2018).

This has contributed to a transport system that is primarily car-based and focused on the peak period commute, where travel time and vehicle delay are the primary measures of performance. In comparison, other transport considerations such as safety, street amenity, public transport connectivity, accessibility via walking and cycling, and the comfort of journeys, have been undervalued.

This article is part of a longer strategic insights paper that council's Transport Strategy Team is working on to better understand how our transport system can better respond to the needs of women, and the flow-on benefits to other users such as children, people with disabilities and older people.

We suggest that understanding travel behaviour by gender will help us design transport policies that are fairer, more efficient and more sustainable. As an example, we examine public transport planning in Auckland in this article and propose interventions to make our public transport system more equitable.

A public transport network that works better for women as well as other users

The Household Travel Survey shows that women make more trips throughout the day (Figure 2).

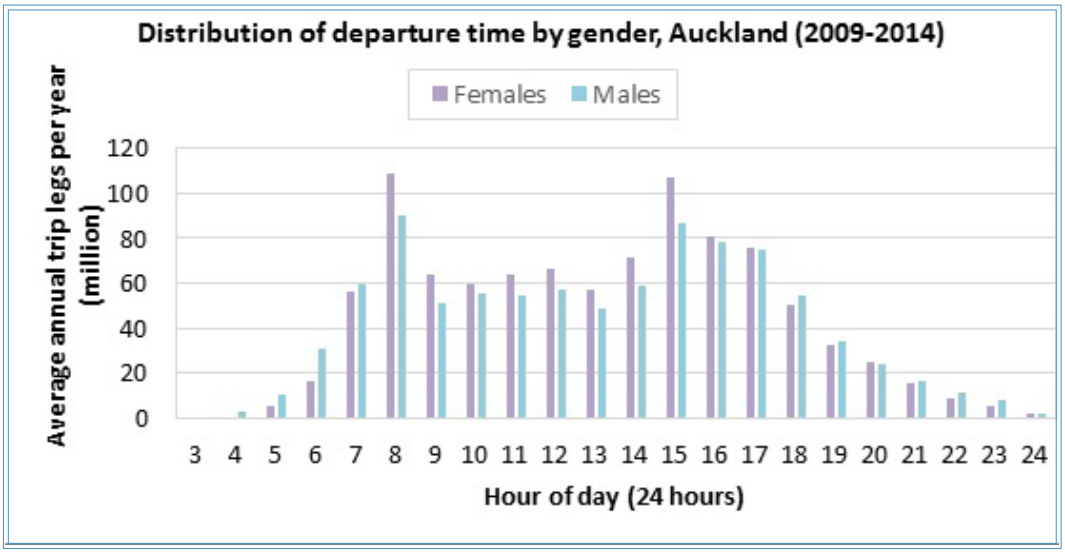

Figure 2: Distribution of departure time by gender, Auckland, 2009-2014 (Ministry of Transport)

Women's greater share of care-related responsibilities also increases their scattering of trip origins and destinations (CIVITAS, 2014).

However, public transport planning has historically focused on catering for peak movements to and from major employment areas such as the city centre, implying that public transport services may not be readily available when required by women.

Additionally, while women walk and use public transport more than men, they also experience higher safety concerns while travelling, particularly after dark (Figure 3).

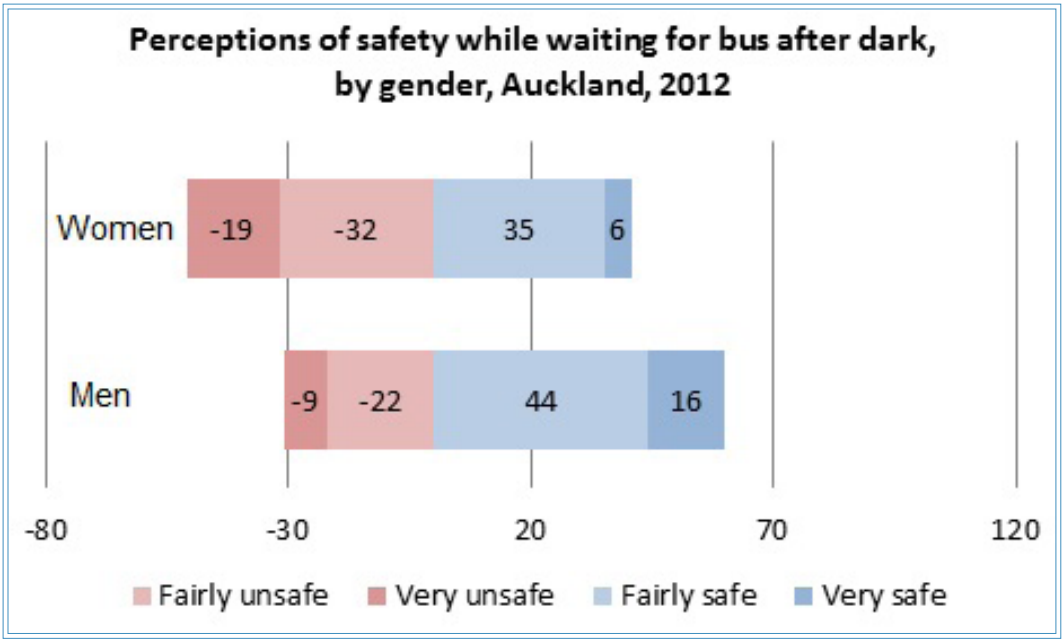

Figure 3: Perceptions of safety while waiting for bus after dark, by gender, Auckland, 2012 (Auckland Council, 2012)

Travel surveys indicate that women frequently adjust their behaviour and travel patterns to avoid public environments that make them feel unsafe (Loukaitou-Sideris, 2014). Left unaddressed, these safety concerns can lead to social exclusion, particularly for more vulnerable groups of women such as older women, transwomen, women of colour, and low-income women living in high-crime areas.

Some of the ways to increase the gender equity of our public transport network include:

• increasing the connectivity of the network to enable greater trip-chaining

• increasing the span (hours of operation) of services

• focusing on all-day service frequency, rather than peak-focused frequency

• increasing the safety of services, including making waiting areas safer and more comfortable

• collecting more gender-differentiated transport statistics to better understand the travel behaviour of women.

We note that Auckland Transport's New Public Transport Network makes significant improvements to many of these considerations. These improvements increase women's participation in society by giving them more access to opportunities including jobs, while reducing transport's harm on people and the environment.

For more information, please contact:

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Auckland Council (2012). *Public perceptions of safety from crime in the Auckland region*. Available at http://temp.aucklandcouncil.govt.nz/EN/planspoliciesprojects/CouncilProjects/Documents/publicperceptionsofsafetyfromcrimereport.pdf (Accessed, 12 March 2018)

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Ng, W and Acker, A (2018). *Understanding urban travel behaviour by gender for efficient and equitable transport policies*. International Transport Forum Discussions Paper 2018.01. Available at https://www.itf-oecd.org/understanding-urban-travel-behaviour-gender-efficient-and-equitable-transport-policies (Accessed, 12 March 2018)

Recent research activities

RIMU's scientists, researchers, technical specialists and analysts have assisted with many Auckland Council projects over recent months. A list of recent publications and research related activities follows. The reports noted here are available on the Knowledge Auckland website.

New reports

- *Airbnb and the Auckland housing market,* TR2018/001
- *Auckland region climate change projections and impacts*, TR2017/030-2
- *Auckland region climate change projections and impacts. Summary*, TR2017/031-2
- *Cost Benefit Analysis of natural environment investment options for the Auckland Council Long-term Plan, 2018-2028,* TR2018/005
- *Changes in indigenous ecosystems and the environment within the boundary of the Waitākere Ranges Heritage Area Act 2008: 2012-2017 report,* TR2018/002
- *Farm-scale land use capability classification for Auckland,* TR2017/016
- *Increasing voter turnout using behavioural insights,* TR2018/006
- *LakeSPI assessment of 33 Auckland Lakes: 2017 update,* TR2017/028
- *Marine water quality annual report 2016*, TR2017/033
- *Matching farm production data to land use capability for Auckland*, TR2017/020
- *Muriwai Beach to Te Henga (Bethells) 2016 grey-faced petrel and little penguin survey*, TR2017/027
- *Preliminary assessment of limits and guidelines available for classifying Auckland coastal waters,* TR2017/035
- *The relationship between pedestrian connectivity and economic productivity in Auckland's city centre. Second edition. Network scenario analysis*, TR2017/007-2
- *Renting in Auckland: tenant, landlord and property manager perspectives*, TR2017/032
- *Safeswim impact evaluation: have improvements to Safeswim changed Aucklanders' awareness and behaviour?* TR2018/004
- *State of the environment: groundwater state and trends in the Auckland region 2016,* TR2017/034
- *State of the environment monitoring: river water quality annual report 2016,* TR2018/003
- *Survey of Adult Skills: results for Auckland,* TR2018/007

Research reports expected soon

- *Auckland air emissions inventory 2016 – home heating*
- *Auckland air emissions inventory 2016 – industry*
- *Auckland air emissions inventory 2016 – transport*
- *Auckland air emissions inventory 2016 – sea transport*
- *Probability of occurrence of acid sulphate soils in the Auckland region*
- *Soil moisture monitoring in the Auckland region - programme establishment*
- *Central Waitematā Harbour ecology monitoring 2000-2017*
- *Upper Waitematā Harbour ecology monitoring 2000-2017*

• *Airbnb and the Auckland housing market* report published. The report concludes:

> *Airbnb is growing in Auckland. While its presence is more pronounced in areas with a high tourist demand, it is also slowly expanding out into the suburban areas. Our results show that the impact of Airbnb on private residential rentals in Auckland is very much limited to these areas with a high tourist demand which is made even more prominent by Auckland's housing shortage.* (Page 35)

• Auckland Regional Fono: RIMU researchers attended the Ministry for Pacific Peoples, Auckland Regional Fono in February. The fono was attended by Pacific community leaders and provided an excellent opportunity for Ministry people to reconnect with Auckland communities.

• Brian Osborne, RIMU's statistical information analyst, is working with council's Democracy Services Department and the Joint Governance Working Party on assessing options for ward boundary changes. An important task is to resolve significant under-representation in the Waitematā and Gulf Ward. The ward has had high population growth compared with other areas of Auckland since 2010 when Auckland Council was established.

• Knowledge Auckland is RIMU's research information website including the place for all council technical publications. Go to www.knowledgeauckland.org.nz to explore our online research resources.

Constructing Auckland: a decade of building trajectories

There is a keen interest in and around Auckland – some might even say an obsession – **in buildings**: what, where and when structures have been built.

To know the presence, location, and even shape of buildings is important for any number of council activities, including planning and modelling projects (such as development feasibility, structure plans, and floodplain mapping) as well as to simply understand how construction is progressing in this boom town.

Currently, buildings can be visualised for a portion of the Auckland region via the buildings footprint layer in the council's geographic information system (GIS). However, it has been a static data set, showing the state of the city in 2010. Buildings data can become out of date quickly, so a refresh of this data layer is long overdue.

In the Constructing Auckland project, we are undertaking a study of Auckland's building trajectories – not only to fill a data gap, but also to analyse the changes in Auckland's built environment over a decade. We're also exploring methodological improvements through better use of data and technology.

For the immediate mission to update the council's building layer, we used council's 2013 LiDAR data to extract building polygons in this project's first phase. A detailed quality assurance process has been undertaken and is nearly complete. Both the updated data set and analysis of building trajectories will be released soon. (In later project phases, analyses will be further updated when subsequent building footprint updates are completed.)

For further information about the Constructing Auckland project, please contact Dr Nancy Golubiewski, nancy.golubiewski@aucklandcouncil.govt.nz

The 2013 building footprint layer captures new construction since 2010 and buildings not previously captured. Here: the Millwater development between SH1 and the Whangaparaoa Peninsula (overlaid on 2010 aerial photography) showing 2013 outlines (blue – existing buildings; red – under construction).

Kaipara Harbour sediment mitigation study

Concerns about ongoing sediment loss from land into the Kaipara Harbour and into rivers and streams in the surrounding catchment led Auckland Council, Northland Regional Council and the Ministry for the Environment to commission an 18-month study to consider a range of potential solutions to reduce this loss.

Regulatory and non-regulatory initiatives to conserve soil on land have been undertaken over past decades. However, sediment accumulation rates in the harbour and levels of suspended sediment in contributing rivers and streams remain elevated, with a resulting range of adverse effects.

The study produced a catchment economic model which was used to assess the economic costs and environmental benefits of various scenarios for reducing catchment sediment loss. The model estimates that the current annual average sediment load into the harbour is about 700,000 tonnes each year, compared to 120,000 tonnes each year in pre-human times.

A baseline scenario was established for comparison with two land use change scenarios (both involved full re-afforestation of the catchment) and nine sediment mitigation scenarios. Five of the mitigation scenarios were "practice-based" (for example, fencing all streams for stock exclusion) and four "outcome-based" (for example, reducing sediment load by a certain percentage).

Results

Sediment loss is split almost equally between streambank erosion and land-based erosion, so measures that address both sources are likely to be effective. Over three-quarters of the land-based erosion comes from the 13 per cent of the catchment that is classified as "highly erodible land".

Sheep and beef farms face the largest total and per-hectare costs for nearly all scenarios investigated, largely because they occupy almost half the catchment, including the majority of "highly-erodible land".

However, costs for outcome-based scenarios are generally lower because mitigation can be targeted, for example, excluding stock and stabilising large tracts of highly erodible land could reduce sediment in the harbour by 41 per cent at a cost of $13 million a year. In all scenarios, estimates of mitigation costs are annualised and assumed to be accrued for 25 years.

The study research report acknowledges that there are uncertainties and assumptions associated with the study, but concluded that despite these uncertainties, the results of the study demonstrate the relative effectiveness and costs of the mitigation scenarios examined.

Project reports

Kaipara Harbour sediment mitigation study catchment economic modelling (the main report)

Kaipara Harbour sediment mitigation study: summary

Kaipara Harbour sediment mitigation study: harbour benthic ecology narrative

Kaipara Harbour sediment mitigation study: narrative assessment of freshwater sediment attribute predictions

All are available on Knowledge Auckland and for more information about the study, please contact Sarah Le Claire, Principal Analyst – Strategy

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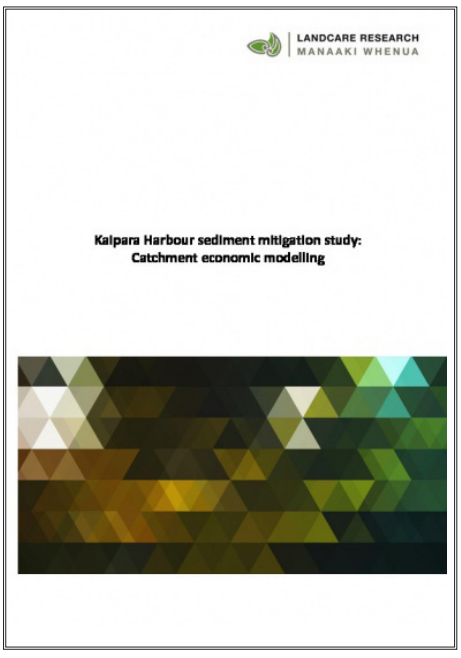

For more information about Auckland related research, data and monitoring programmes visit the Research Unit's websites:

Knowledge Auckland

www.knowledgeauckland.org.nz

Auckland Counts, census data

www.censusauckland.co.nz

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