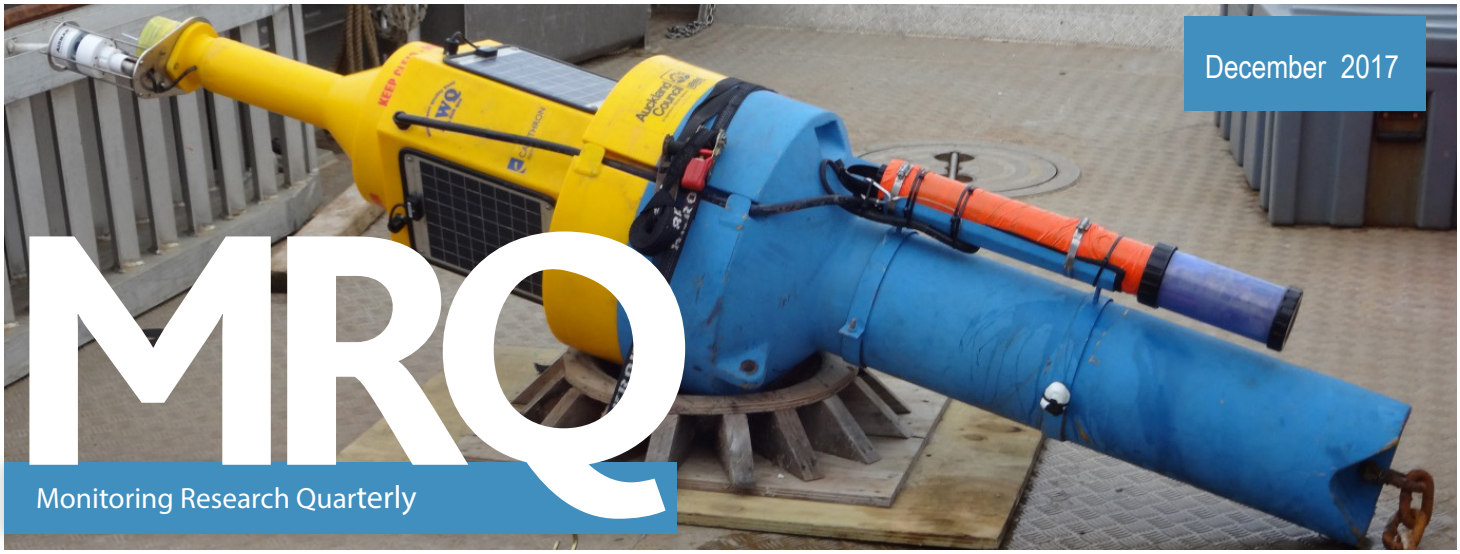

December 2017

MRQ

Monitoring Research Quarterly

Monitoring Research Quarterly, MRQ is the newsletter of Auckland Council's Research and Evaluation Unit, RIMU. The newsletter contains reports of RIMU's current work including information about recent publications, research, facts and trends about Auckland. This is a double edition, September to December 2017. RIMU publications are available on the Auckland Council and Knowledge Auckland websites.

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Auckland's creative businesses

The Auckland Council technical report, *Industry snapshot for Auckland: creative sector 2017* is part of a series of snapshots of important Auckland industries and sectors. As well as providing data and analysis to inform council's involvement in economic development, this snapshot informs arts and culture strategy and policy making.

Creative industries generate and exploit intellectual property originating in individual creativity, skill and talent. They range from music and the arts to screen and digital content, publishing and design services. The sector provides a platform for knowledge and technology intensive activities, and has important links to ICT, professional services, manufacturing and construction. It also adds to the local quality of life and attracts tourists, innovative skilled migrants and knowledge workers.

Auckland's creative sector includes 10,000 businesses with 30,900 employees generating $2.8 billion a year of GDP. That's 3.3 per cent of Auckland's total GDP and 3.7 per cent of its employment. Creative sector firms are small on average: 3.1 employees each as compared to 4.5 for Auckland's other sectors.

GDP and productivity growth

GDP per worker is 11 per cent lower than Auckland's other sectors, but improving faster (1.6% a year average 2000-2016, versus 0.8% for other sectors). GDP grew faster for the sector (3.8%) than for the total Auckland economy (3.0%), but employment grew at the same rate (2.2% versus 2.3%).

Employment concentrations

Half of the country's creative sector employment (50%) is concentrated in Auckland, as compared to "only" a third of the economy as a whole. Within Auckland the sector is highly concentrated around the CBD and fringes, with over half of its employment (53%) in just one local board (Waitematā).

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Auckland's creative businesses – continued

Sub-sectors – employment shares

Auckland's largest creative sub-sector is design services (architecture, advertising and graphic design), which provides 41 per cent of the creative sector's employment. Next is screen production (22%), split into TV (9%) and film and video (13%). Publishing (12%), previously the second-largest, is the only sub-sector with fewer jobs now than in 2000. The other creative sub-sectors are radio (4%), digital media (5%), performing arts (7%) visual arts (7%) and music (2%).

Sub-sectors – employment growth

The fastest employment growth from 2000 to 2016 was in digital media (9% a year); the largest absolute growth was for design (+5200 jobs – over half the sector's total growth), but at a more modest 3.3 per cent a year. TV also had healthy growth (3.6%), driven by Sky TV, as did radio and music. Publishing declined by 1500 jobs (-2.1% each year).

Sub-sectors – productivity growth

Productivity (GDP per worker) improved by around 4 per cent a year for publishing, TV, film and video and radio, but saw little or no measured change for design, digital media, visual arts and music – and declined for performing arts (-1.7% a year).

Design and digital media appear particularly promising as enablers for Auckland's future.

Industry snapshot for Auckland: creative sector 2017, Auckland Council technical report, TR2017/023 and other industry snapshots are available on Knowledge Auckland.

For more information please contact Ross Wilson, ross.wilson@aucklandcouncil.govt.nz

Climate projections for the Auckland region

Auckland Council, Council-Controlled Organisations, and Auckland's three District Health Boards commissioned the National Institute of Water and Atmospheric Research (NIWA) to model climate projections for the Auckland region. The research looks at climate changes over three time horizons, 2040, 2090, and 2110 – across a range of climate variables. The main anticipated changes are:

- increased temperatures
- increased drought
- increased extreme rainfall events
- sea-level rise and coastal inundation
- increased ocean temperatures and ocean acidification.

It is important to consider what these projections mean for all aspects of the city – our communities, our infrastructure, our health, and our environment. Council will develop a risks and vulnerabilities assessment to explore what the projections mean for Auckland. The NIWA findings will also be used to help inform planning and investment decisions.

The council's sustainability office is sharing the projections across the Auckland Council family and our external partners so that we work together to develop integrated solutions to address the climate change related challenges and identify opportunities for Auckland.

The NIWA climate projections report and video, launched on 6 December, are available on Knowledge Auckland. Please contact Sarah Anderson or Alexandra Clement-Jones for more information.

sarah.j.anderson@aucklandcouncil.govt.nz
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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

- *Arrested (re)development? A study of cross lease and unit titles in Auckland,* TR2017/025
- *An assessment of potential impacts of growth scenarios on Auckland's natural environment,* TR2017/022
- *Auckland ambient air quality trends for $PM_{2.5}$ and PM_{10} for the decade 2006-2015*, TR2017/029
- *Auckland region climate change projections and impacts*, TR2017/030
- *Auckland region climate change projections and impacts. Summary*, TR2017/031
- *Auckland's greenhouse gas inventory to 2015,* TR2017/026
- *Creative sector 2017 industry snapshot for Auckland*, TR2017/023
- *LakeSPI assessment of 33 Auckland Lakes: 2017 update,* TR2017/028
- *Muriwai Beach to Te Henga (Bethells) 2016 grey-faced petrel and little penguin survey*, TR2017/027
- *The relationship between pedestrian connectivity and economic productivity in Auckland's city centre. Second edition. Network scenario analysis*, TR2017/007-2
- *Remapping the extent of Auckland's wetlands: methods and summary*, TR2017/024

Discussion papers

- *Affordability of housing in Auckland – who will teach our children? A discussion paper*
- *Exploitative landlord-tenant relationships in Auckland*
- *Marae and emergency accommodation: a response to Auckland's housing and rental shortage*

Research reports expected soon

Air quality related reports

- *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*

Other reports

- *Probability of occurrence of acid sulphate soils in the Auckland region*
- *Airbnb and the Auckland housing market*
- *Central Waitematā Harbour ecology monitoring 2000-2017*
- *Upper Waitematā Harbour ecology monitoring 2000-2017*

• Knowledge Auckland, RIMU's research information website, has been updated with a new design, improved search capability and an information subscription service. Go to www.knowledgeauckland.org.nz to see the changes and explore our online research resources.

• We hosted three RIMU Insights presentations:

- Vicki White and Anne-Marie Mujica on *Warm, dry, health housing? Insights from the 2015/16 BRANZ house condition survey*

- Dr April Bennett on *Te Mura o te Ahi – The heat of the battle: how science and the social converge in the struggle for the environment*

- Dr Michelle Thompson-Fawcett on *Sharing some of our mātauranga and kōrero through urban design*

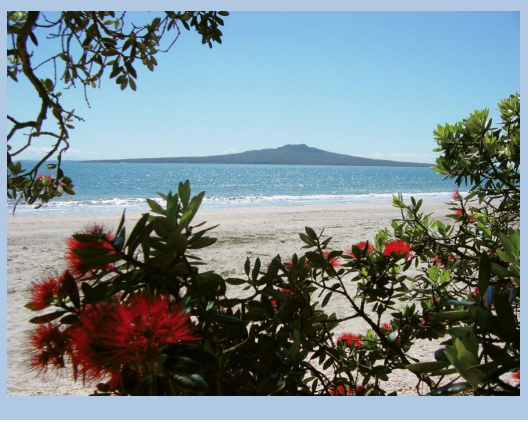
• The Social Science Team is working with Auckland Libraries on the evaluation of the summer reading programme *Dare to Explore, Kia Maia Te Whai.* This year the evaluation will focus on the experience of Māori whanau, in particular those who will be engaging with the full Te reo Māori programme. The evaluation will be led by Māori librarians, with training and support provided by RIMU researchers and evaluators.

• RIMU scientists are working with Resource Consents and BECA on the integration of monitoring data and long-term baseline monitoring for the Puhoi to Warkworth motorway project. This provides the opportunity to establish a comprehensive continuous monitoring programme throughout the motorway development project, using data from the consent holder.

• Environment scientists attended a workshop about managing sand dunes, working with biodiversity experts from other councils including Wellington, Waikato, Taranaki, Bay of Plenty and Hawkes Bay. The group intends to create a standardised duneland condition index and methods for monitoring duneland biodiversity and associated threats. The monitoring method developed is expected to be trialled this summer.

• Dr Todd Landers is working with science colleagues from the Department of Conservation, the Auckland Museum, the Northern NZ Trust, the University of Auckland, and Unitec on a seabird research and monitoring programme.

• SafeSwim evaluation: RIMU is undertaking the evaluation of signage and beach visitor behaviour after the launch of the SafeSwim service in November.



Invertebrates – the inconspicuous majority

Terrestrial biodiversity monitoring

Auckland Council monitors a variety of plants and animals as part of our regional Terrestrial Biodiversity Monitoring Programme so as to fulfil our RMA obligations, ensure we are meeting the objectives of our plans and policies, and improve the effectiveness of our management activities. This programme's animal focus has been on pest animals and indigenous biodiversity, the latter mostly via bird surveys because birds are easy to survey and they are useful indicators, being high on the food chain, and they have high public interest.

Invertebrates account for the majority of the world's animal species (potentially as much as 85%), and so are an important component of biodiversity and potential useful bioindicators. These animals however, are rarely monitored due to the relatively high cost of sampling and the specialist entomological skills required to identify the collected specimens.

The Research and Evaluation Unit is currently trialling terrestrial invertebrate monitoring in two regional parks: Shakespear and Tawharanui. The major aims of this research are:

a) to help evaluate the restoration management programmes at these sites ('outcome monitoring')

b) to investigate whether certain invertebrates may be useful environmental indicators (as with birds), or which could be targeted in future monitoring.

Identifying terrestrial invertebrate indicators would help decrease monitoring costs and so maximise resourcing, while also contributing to more comprehensive terrestrial biodiversity monitoring which could be a useful tool for detecting smaller scale environmental changes (as freshwater invertebrates are in streams).

Figure 1: Invertebrate pitfall trap.

Trapping critters

Two hundred and forty 'pitfall traps' (Figure 1) were set last summer, roughly half in each park, which collect invertebrates by 'trapping' the critters as they walk over cups dug into the ground. The traps were deployed in sets of four (i.e. four traps at approximately 30 sites in each park), and were set twice over the summer for a four-week window.

Over the last eight months, University of Auckland entomology graduate students identified the huge number of collected invertebrates and placed them into their major zoological groups (phylum, class, or order levels: for example, ants, spiders, worms). We have also been analysing the most diverse group of insects, the beetles, down to very low taxonomic groups (to family, genus, or species) to use as a baseline for identifying potential indicators.

Figure 2: Wasps (Hymenoptera).

Summary of the project findings

- 37,801 individual invertebrates were collected.
- The December 2016-January 2017 collection had 40 per cent more specimens recorded (22,298) vs. the January-February collection (15,503).
- Tawharanui had approximately 13 per cent more invertebrates captured (20,173) vs. 17,628 at Shakespear.
- Both parks had similar high-level diversity of taxa (phylum/order level) with an average of 32 taxa represented.
- Tawharanui had higher numbers of individual Orthoptera (weta, grasshoppers, crickets): 903 vs. 602 at Shakespear.
- Tawharanui had slightly higher diversity of Orthoptera with six subfamilies, compared to five subfamilies for Shakespear.
- Only one individual *Hemideina thoracica* (tree weta) was caught in a trap – at Shakespear.
- Some arthropods contained other invertebrates: for example, one orthopteran had a plethora of hair-like Gordian worms, a parasitic species, erupting from its carapace, and other insects were home to Acari (mites and ticks).
- The winning pitfall trap with the highest number of individual invertebrates trapped was at Tawharanui in January containing 1154 specimens which were mostly flies and beetles.

So far, the identification work has revealed an impressive diversity of invertebrates with a variety of insects, millipedes, snails, crustaceans, spiders and many others (Figures 2 to 4, pages 4 and 5).

The next phase of the project is to conduct a detailed multivariate statistical analysis to look at how the taxonomic variation relates to the environmental variation in the parks and other invertebrate data, in hope of identifying which bugs are the best biodiversity indicators (for example, does the presence of a particular beetle correlate with the presence of a suite of other types of invertebrates?).

For more information about the invertebrates monitoring programme, please contact Dr Todd Landers, todd.landers@aucklandcouncil.govt.nz

Figure 3: Vagrant spider (*Uliodon* sp).

Figure 4: False scorpion (Pseudoscorpiones).

The Auckland laboratory: measuring the region's carbon emissions

GNS Science, Te Pū Ao, is leading a research project to determine Auckland's carbon emissions – making measurements of carbon dioxide (CO_2) and other trace gases in the air above Auckland in order to find out how much carbon dioxide the city emits.

Urban areas account for 80 per cent of global greenhouse gas emissions, and cities are leading the way in reducing emissions through efforts such as the *Auckland low carbon action plan* and the c40 cities initiative (www.c40.org) with co-benefits of cleaner air, reduced congestion, and reduced reliance on imported fossil fuels. Yet urban emissions are not well known.

Auckland's fossil fuel emissions (petrol, natural gas and coal use) are estimated by population downscaling of the New Zealand annual total emissions reported to the United Nations Framework Convention on Climate Change. They are not detailed enough to determine how government policies are influencing emission rates or whether Auckland is accomplishing its goal of reducing emissions by 40 per cent in 2040. Perhaps even more importantly, Auckland's biogenic CO_2 uptake (by vegetation) is almost entirely unknown.

The urban biosphere is very different from that of rural areas, with competing effects due to impervious surfaces (concrete, buildings), the types of plants grown (trees, lawns) and irrigation, the use of fertilizers and other management of urban and suburban landscapes. Recent research suggests that the net effect of these differences could be that the urban biosphere absorbs up to twice as much CO_2 as the surrounding rural areas. Yet there are no studies from anywhere in the world that demonstrate the size of urban biogenic CO_2 emissions, nor what proportion of urban fossil fuel emissions could be offset by this effect.

Figure 1: GNS scientists, Dr Jocelyn Turnbull and Jeremy Thompson taking air samples in Aotea Square, 5 October 2017.

GNS Science is undertaking a research project to determine fossil fuel and biogenic CO_2 fluxes for Auckland led by Dr Jocelyn Turnbull and with instrumentation expertise from Jeremy Thompson. Local collaborators include council's Research and Evaluation Unit (RIMU scientists, Dr Nancy Golubiewski and Dr Shanju Xie) and University of Auckland (Dr Luitgard Schwendenmann). The project involves making "top-down" atmospheric observations of the net CO_2 and fossil fuel CO_2 emissions by collecting air samples at locations across the region. Samples will be collected every three months over a two-year period. The first survey was conducted in October (see figure 1) and the second will take place in January 2018, including sampling high above the CBD from the Sky Tower. These measurements will be analysed in conjunction with "bottom-up" process-based CO_2 inventories derived from the adaptation of international models undertaken by GNS scientist Dr Liz Keller.

The research will be a template for low-cost urban greenhouse gas emission evaluation for cities world-wide. To find out more about the project, express interest, or share ideas about how the research can help Auckland Council projects, policies, and decision-making, please contact Dr Nancy Golubiewski,

nancy.golubiewski@aucklandcouncil.govt.nz

Real time water quality monitoring in the Mahurangi Harbour

Improving our knowledge about the Auckland environment and building environmental data sets is a full-time job for the Research and Evaluation Unit's Environment Team. In November, we deployed a real time water quality monitoring buoy in the northern Mahurangi Harbour working closely with the Harbourmaster's Office and the work vessel *HM05 – JLR*. The Harbourmaster's team provided invaluable support and this project would not have happened without them.

This new monitoring site allows RIMU scientists to follow short-term fluctuations in water quality parameters and catch episodic events (such as storms) that are not captured with standard monthly water quality sampling. Understanding these short-term water quality changes across the region – particularly for suspended sediment – is becoming more important as housing and infrastructure developments increase. The data collected will provide evidence for council to monitor, understand, and improve how we manage land use activities and how we can minimise our impact on the environment.

RIMU scientists, Pete Dal Ferro and Melissa Foley were on board *HM05* to ensure the buoy was deployed in a location that was consistent with the scientific aims of the project. The target location was the northern-most point in the Mahurangi Harbour that met the buoy's instruments' depth requirements, while being as close as possible to potential sediment sources. The actual placement of the moored buoy was determined after a depth survey and working with Harbourmaster staff to find a position that does not obstruct boat traffic in the upper harbour.

Braden Cummings operates the crane while Kane Grant stabilises the buoy. Skipper Bradley Wilson holds the *HM05* in position as Pete Dal Ferro records deployment information.

What will the buoy tell us?

The underwater water quality sensor collects turbidity, salinity, dissolved oxygen, pH, dissolved organic matter, and water temperature data every ten minutes; while the above water sensor collects air temperature, wind direction, wind speed, and barometric pressure. These measurements are transmitted via the mobile network to RIMU's data archive. A particular strength of this type of continuous monitoring is the ability to collect data during storm conditions when usual collection methods are not practical or safe for field scientists.

The data helps us assess local environmental conditions and provide evidence to make better land use management decisions.

How does this fit into our work programme?

The Mahurangi Harbour is the focus of an intensified effort by RIMU to understand the effects of land use and development on environmental quality. RIMU has been monitoring marine ecology, marine water quality, plant and animal ecology, soil quality, air quality, and freshwater water quality and ecology at sites throughout the Mahurangi catchment since 1991. The new buoy data will help us better understand connectivity across the catchment.

The next phase of the project is to install a series of sediment accumulation monitoring sensors to determine short-term sediment deposition rates. The new sediment accumulation data and buoy water quality data will help us understand how our harbours are affected by sediment moving off the land and into estuaries and harbours.

For more information, send your questions to environmentaldata@aucklandcouncil.govt.nz

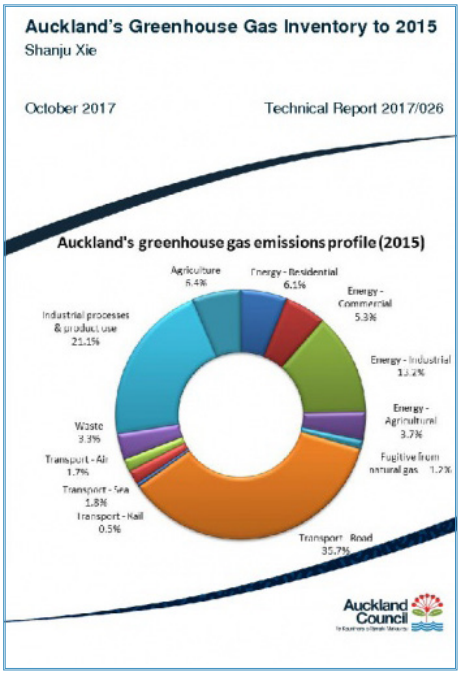
Monitoring Auckland's carbon footprint

A summary of 2015 results: *Auckland's greenhouse gas inventory to 2015*

Our climate is changing with rising temperature mainly due to increased greenhouse gas (GHG) emissions into the atmosphere from human activities. We must reduce emissions in order to limit temperature rise and harmful impacts of associated risks such as accelerated sea-level rise and more frequent extreme weather events. *The Auckland Plan* lays out an aspirational target to achieve reductions of 10 to 20 per cent by 2020, 40 per cent by 2040 and 50 per cent by 2050 (based on 1990 levels). The *Auckland low carbon action plan* sets out the pathways and actions to achieve the target. Auckland Council monitors emissions and reports the GHG inventory that identifies and quantifies the sources and sinks of GHGs in Auckland. This is essential to inform and evaluate our progress.

Measuring carbon emissions

Data on a range of activities which are responsible for producing emissions, such as the volume of fuel used by cars and electricity consumption, is collected to quantify their associated carbon emissions. Emissions are calculated by multiplying activity data by an emission factor (the amount of carbon emissions relative to a unit of activity). The Auckland's GHG inventory complies with the international standard – the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).



Emissions profile

In 2015, Auckland's GHG emissions were 10,581 ktCO_2e (kilo-tonnes of CO_2e, net emissions accounting for CO_2 removed by forests) or 11,551 ktCO_2e (gross emissions excluding CO_2 removed by forests). Transport and non-transport energy sectors dominated emissions, accounting for 69.8 per cent of gross emissions. Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) contributed 83.5 per cent, 10.3 per cent and 1.6 of gross emissions, respectively. Other GHGs contributed 4.6 per cent.

Emissions trends

Between 2009 and 2015, emissions increased by 3.5 per cent for net emissions and 7.4 per cent for gross emissions, respectively. The increase was mainly driven by transport, and industrial processes and product use sectors.

2009 is the base year for carbon emissions in the *Auckland low carbon action plan* and 2015 is the most recent year that data is available for emissions calculation.

Over this time, population increased by 10.4 per cent and GDP increased by 16.2 per cent. Subsequently, the net emission intensity decreased from 7.2 to 6.7 tCO_2e per capita, from 147 to 131 tCO_2e per million $NZ (2009/2010 price). Similarly, the gross emission intensity decreased from 7.6 to 7.4 tCO_2e per capita, from 154 to 143 tCO_2e per million $NZ (2009/2010 price). In other words, the emissions didn't increase at the rate of population and economic growth.

Meeting reduction targets

Without intervention, our GHG emissions are projected to increase. To reduce emissions and achieve reduction targets, Auckland must transform from a fossil fuel-dependent, high energy-using, high-waste society to a mobile, quality, compact city – a city typified by sustainable resource use and a prosperous eco-economy, and powered by efficient, affordable clean energy. The successful implementation of the *Low carbon action plan* is critical for the transformation.

Auckland's greenhouse gas inventory to 2015, Auckland Council technical report, TR2017/026

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

Please send requests for environmental data to environmentaldata@aucklandcouncil.govt.nz

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