Issue 60 • November 2015

Coastal News

Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

CONTENTS

www.coastalsociety.org.nz

ISSN 1172-6938

Leaf litter is transported by flooding and ebbing tides to nearby adjacent shores. Photo: Rebecca Gladstone-Gallagher.

Turning over a new leaf: Ecological subsidies of leaf litter in New Zealand's coastal ecosystems

By Rebecca Gladstone-Gallagher, PhD Candidate, University of Waikato

Accumulations of washed up, decaying leaf litter from mangrove forests, seagrass beds, and seaweed stands are a common occurrence on New Zealand's intertidal shores. Marine plants produce large amounts of leaf litter, which is transported by flooding and ebbing tides to nearby adjacent shores, where it washes up, accumulates and decays.

My PhD research explores the importance and the ecological role of this decaying plant litter in New Zealand's coastal ecosystems, in what is known as the "ecological subsidy concept". The ecological subsidy concept refers to the production of resources that are exported across ecosystem boundaries to support the food chain of recipient ecosystems. Ecosystems are often connected by this transfer of resources, and as a result, the ecological function and food chain of one ecosystem can often rely on another spatially distinct ecosystem.

In New Zealand, changes to the land use surrounding our coasts are modifying the distribution and abundance of marine plants in our estuaries, such as the decline in seagrass beds and the expansion of mangrove forests. These changes are likely to alter the supply of leaf litter from these vegetated habitats to other connected habitats, and the resulting impact on the recipient ecosystem is unclear. My research aims to quantify the ecological effects of the different types of marine leaf litter on receiving shores.

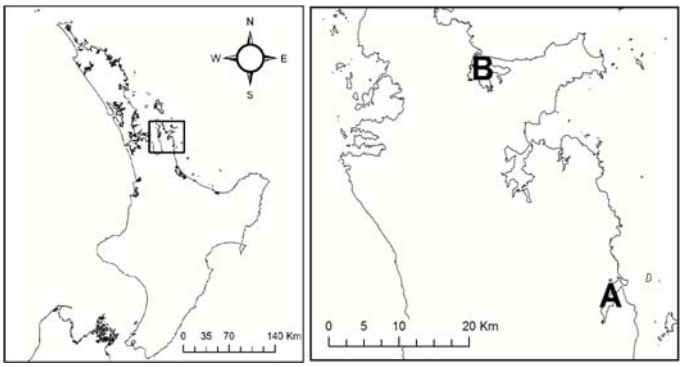
Field experiments

Over the past two years, I have spent time in two Coromandel estuaries (Figure 1), conducting field experiments to gain a greater understanding of how marine plant leaf litter contributes to coastal ecosystems and food chains. My first field study was carried out in the Tairua Estuary, where I considered the "outwelling hypothesis" developed by Odum (1968)[1], which hypothesises that coastal ecosystems, such as estuaries, supply a significant amount of primary production to adjacent offshore waters.

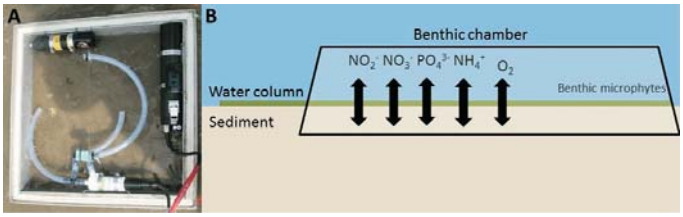
The intent of my research is to quantify this outwelling and export of marine plant leaf litter. To achieve this, I have been sampling seasonally at the mouth of Pepe Inlet (in the Tairua Estuary) and have measured the amount of leaf litter that is transported in and out of the sub-estuary on ebbing and flooding tides. The results of this study will quantify the amount of leaf litter that coastal marine plants offer to adjacent connected ecosystems.

The second study of my PhD was a field experiment conducted in the Whangapoua Estuary, to explore how leaf litter contributes to the marine food chain as it decays and breaks down in the sediment. In a field experiment, myself and a team of volunteers added dried leaf litter (from mangroves, seagrass, and kelp) into the sediments. We then placed benthic chambers over the sediments on an incoming tide to encapsulate a known volume of water above the sediment surface, and water samples were taken from the chamber during a four-hour period (Figure 2 illustrates the benthic chamber).

[1] Odum, E. P. (1968). A research challenge: evaluating the productivity of coastal and estuarine water. In *Proceedings of the Second Sea Grant Conference*, University of Rhode Island: 63-64.



◀ *Figure 1. Location of the two study sites: A. Tairua Estuary and B. Whangapoua Estuary (in the Coromandel Peninsula).*



▼ *Figure 2. A: Photo of one of the benthic chambers that were deployed to measure primary production of the sediments. Photo: Daniel Pratt. The chambers contain pumps to recirculate the water within the chamber and an oxygen sensor. B: Benthic chambers are placed on the sediment surface at high tide to capture a known volume of water, and then this water is incubated for four hours. During the four-hour incubations water samples are taken from within the chamber, and then nutrients and dissolved oxygen (a measure of primary production) are measured from the water samples.*

The benthic chambers allow us to sample and measure the movement of dissolved oxygen and soluble nutrients to and from the sediment into the overlying water column during the incubation period. These oxygen and nutrient fluxes are often used as proxies for sediment ecosystem function, because they quantify the primary production (important for the food chain) and nutrient cycling processes that occur within the sediments.

Primary production of the sediments is a measure of the growth rate of the small microscopic plants that grow on the sediment surface, and is measured by the amount of oxygen that they produce during photosynthesis. My preliminary findings indicate that the role of leaf litter in modifying ecosystem processes, such as primary production (measured by oxygen fluxes across the sediment-water interface) in the sediments, is dependent on the litter source, and this has implications because of the modification to marine plant habitats in our estuaries.

For the final study, I returned to the Tairua Estuary to determine whether the common mud crab (*Austrohelice crassa*), which lives in and bioturbates the sediment, increases the breakdown and decay of washed up leaf litter.

In March 2015, we established crab cages on intertidal sand and mud flats to which we added crabs and seagrass leaf litter. This study has revealed some interesting initial findings so far. It shows that the presence of crabs can increase the decay of seagrass leaf litter, which has the potential to make the detritus more palatable and available to other organisms in the food chain, and seagrass decay was greatest in sandy sediments indicating that the role of decaying leaf litter may be dependent on where it washes up (Figure 3).

We also measured sediment primary production in the crab cages, again using benthic chamber incubations. Results have revealed that both washed up seagrass leaf litter and the presence of crabs reduce the primary production, and these effects are additive (that is when crabs and seagrass are combined primary production is reduced) (Figure 4).

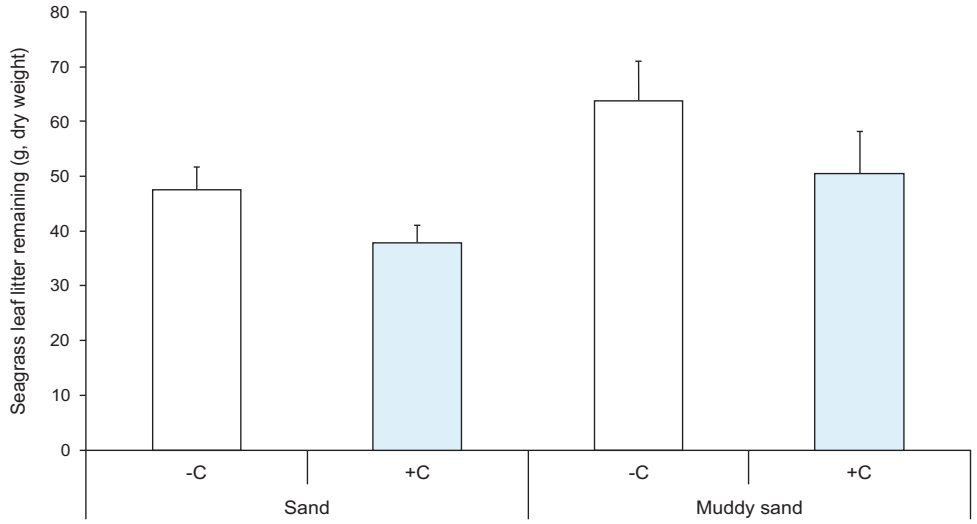


Figure 3. Amount of seagrass leaf litter (g, dry weight) remaining in the cages after 10 days (a measure of the decay rate) is decreased by the presence of crabs (+C, shaded bars) compared to cages with no crabs (-C, white bars). Seagrass decay was greatest at the sand site. Error bars illustrate standard error.

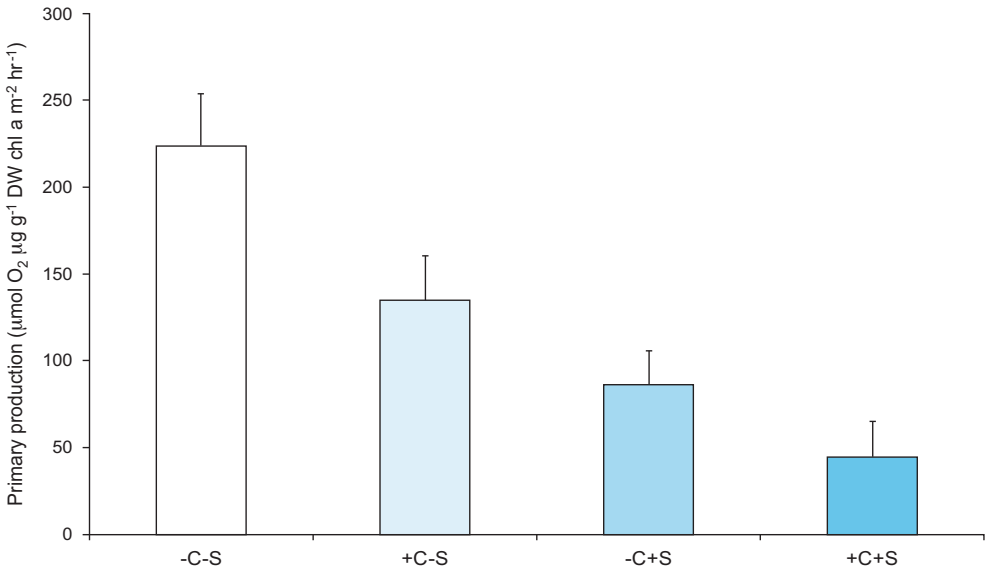


Figure 4. The primary production of the sediments (measured by the dissolved oxygen flux across the sediment water interface in transparent benthic incubation chambers) is influenced by both the presence of crabs and the presence of seagrass leaf litter in an additive manner. The presence of seagrass leaf litter is indicated by +S, and no seagrass litter, -S; the presence of crabs is indicated by +C, and absence of crabs, -C. Error bars illustrate standard error.

Summary and the wider picture

So far, my PhD research has found that washed up leaf litter subsidies influence ecosystem functions, such as sediment primary production, but these effects depend on the leaf litter source, sediment type (such as mud or sand flat), and the presence of bioturbating animals (such as crabs). These functions underpin the many ecosystem services (such as food gathering and carbon sequestration) we derive from coastal habitats.

To effectively manage and conserve New Zealand's coastal ecosystems, including marine plant habitats, we must have some knowledge of the ecosystem services that these marine habitats provide to wider coastal and offshore ecosystems. My research is contributing to this knowledge by addressing how marine plant habitats are connected with other adjacent coastal ecosystems in the ecological subsidy concept, and how connected ecosystems could be affected if we lose ecologically valuable ecosystems, such as seagrass beds, from our estuaries.

Water sampling and the deployment of nets at the mouth of Pepe Inlet, Tairua Estuary, to measure the import and export of leaf litter. Photo: Dean Sandwell.

Acknowledgements

Last year, I was delighted to be awarded the New Zealand Coastal Society PhD Scholarship, which has contributed to funding the nutrient analysis for my research, and I would like to thank NZCS for the generous contribution. In addition, I would like to acknowledge and thank my supervisors, Associate Professor Conrad Pilditch, Dr Carolyn Lundquist, Dr Andrew Lohrer, and Associate Professor Ian Hogg. I also appreciate the time and efforts of the numerous volunteers that have helped me during my field work!

Crab cages set up in the Tairua Estuary to manipulate the presence and absence of crabs and seagrass leaf litter for the final field experiment. Photo: Warrick Powrie.

Australasian Coasts & Ports 2015

In September, over 300 coastal engineers, planners and scientists from around the world met in Auckland for the Australasian Coasts & Ports 2015 conference.

During the conference, presenters from Australia, New Zealand, Japan, Pacific Island nations and the United States shared their knowledge and experiences on issues ranging from planning for coastal storm inundation and sea-level rise, to modelling coastal erosion hazards, to adapting to climate change in the design and construction of ports, bridges and roads.

Conference Chair Richard Reinen-Hamill says the presentations at this year's conference reflected the growing need to plan and address the consequences of climate change in innovative ways.

"As events like the 2011 Tōhoku Earthquake and Tsunami have taught us, we can't get away with doing things the same way we've always done them. One of the benefits of this interdisciplinary and international conference is it offers coastal engineers, scientists and planners the opportunity to find out how other professionals are dealing with the effects of climate change and to share lessons learned."

In recognition of our host city, we have featured some of the papers that discussed different aspects of coastal science, planning and engineering projects within Auckland.

Note: In our upcoming special publication we will include insights from a number of the presentations that addressed sea-level rise and adapting to climate change.

The Onehunga Foreshore Restoration Project

By Richard Reinen-Hamill and Manea Sweeney, Tonkin + Taylor, Auckland; Mike Howatt, Fulton Hogan Ltd, Christchurch; and Greg Hannah, Auckland Council, Auckland

The Onehunga Foreshore was separated from the harbour in 1975 as part of Auckland's motorway development programme that was initiated in the 1950s. The proposed amenity enhancements were not carried out at the time due to budget constraints. As discussed in the following article, through ongoing community advocacy, Auckland Council and the New Zealand Transport Agency revisited the issue with a vision to:

- restore the coastline of Onehunga Bay and the recreational and amenity values which once existed there;
- reconnect the community to the foreshore;
- provide improved pedestrian and cycle connections;
- enhance visual amenity and natural character; and
- provide facilities for public enjoyment of the coast.

The preferred design concept was developed through a competition process via consortia comprised of contractors and consultants to provide both creative and affordable solutions. The winning consortium, including Fulton Hogan Ltd, Tonkin + Taylor, Isthmus Group and URS, was commissioned to gain consent and complete the design and construction for 6.8 hectares of new park land; three sand beaches, six gravel shell beaches, a pedestrian and cycle bridge, a boat ramp as well as a biodiversity offset for marine birds to address the loss of intertidal area.

The design objectives for the project were to:

- restore the natural character of the bay and to enhance the integrity and function of its landscapes, coastal processes, habitats and intrinsic biodiversity values;
- restore and enhance the public access to the coastal edge and coastal waters and to provide a wide range of new recreational opportunities for the whole community;
- acknowledge the cultural connections and heritage values of the indigenous people (tangata whenua);
- restore the connectivity of the site to the Onehunga community and enhance the important public access corridors and connections;
- maintain the function of the existing Onehunga Lagoon; and
- complete all aspects of the works for $28 million including design, consents and construction.

Design process

The core design and contractor team developed and progressed the design through the competition, tendering and consenting stages to create a design that has met all the client and stakeholder requirements to provide significant enhancement of access and use with no significant adverse effects on coastal processes.

Through the tender process, the design was adjusted and modified with interaction between the engineers, landscape architects and the contractors to optimise the value of the offering to Auckland Council.

Post award of the design, consent, and build, verification of the beach orientation and stability was completed using a number of different methods. The first approach was done using a wave transformation within UNIBEST, a shoreline evolution model developed by Delft Hydraulics of the Netherlands using the results of a nearshore wave climate derived from SWAN wave model output. Waves in this area are depth and fetch limited and are dominated by locally generated wind waves. Wave heights typically ranged from 0.1 metre to 0.6 metre, but with extreme wave heights of up to 1.0 metre.

A second verification method to test the beach orientation and stability was done using spiral beach theory. This was particularly necessary for those beaches that have headland controls that are not adequately taken into account by the equilibrium

beach method used by UNIBEST that assumes an infinite uniform beach.

The results of this assessment confirmed the results of the UNIBEST equilibrium beach modelling that the main central beaches are closely aligned to the incident wave energy, but that the northwestern area adjacent to Seacliffe Road and the proposed eastern park headland are out of alignment to the incident wave energy and may become increasingly less aligned with increases in sea level, or as a result of storms at high water levels.

Design studies were carried out for each of the main coastal elements, including the reclamation level and bund, the sand and gravel beaches, as well as rock armour sizing from the groynes and headlands. Design was carried out using standard empirical formula and relationships. Design innovation was achieved with a strong focus on understanding the natural character and coastal processes operating at the site to create 1.4 kilometres of soft edge to replace 700 metres of rock revetment and to create a landform that included varying topography to reflect the surrounding landscape.

For more information:
RReinen-Hamill@tonkintaylor.co.nz

A collaborative approach

By Mark Foster, Tonkin + Taylor, Auckland and Sean Burke, Isthmus Group Ltd, Auckland

The coastal edge is a complex environment, where many different environments collide. For coastal practitioners the same is true for the environment in which we work. The best outcomes are achieved where practitioners of all backgrounds and skill sets work together, alongside the community. The Onehunga Foreshore Restoration Project is an example of a multidisciplinary approach achieving outcomes above and beyond those that could be achieved in a siloed approach.

The Onehunga Foreshore Restoration Project has restored a more natural edge to the foreshore by creating 6.8 hectares of new park land; three sand beaches, six gravel shell beaches, 11 headlands, a pedestrian and cycle bridge, and a boat ramp.

The genesis of the project was in the Onehunga community, whose foreshore became the site of a new motorway in 1974. The community advocated for the project for more than 30 years, in response to promises made at the time. As such, this was no ordinary coastal reclamation project. Firstly, it was very much the community that drove for the project to be initiated. Secondly, the project was not about building a functional piece of infrastructure, such as a road or a port, with easily calculated economic benefits. The project was about restoring the foreshore and the community's connection to it. And providing a recreational asset to be enjoyed by this and future generations.

Mana Whenua, the community, Auckland Council, Fulton Hogan, Tonkin + Taylor, Isthmus Group and AECOM worked together to deliver the design and construction of the new park. The focus of this diverse team was on providing a built environment that reflected the natural, cultural and human environment in which it sat. The boundaries of engineering, science, architecture, recreation and culture overlapped. This complexity was embraced and resulted in innovative and unexpected outcomes.

There were many lessons learned on this project, particularly how to run a successful collaborative process. If a collaborative approach is preferred, or required as was the case with this project, then funders and practitioners should ensure that:

- additional time is allowed for the beneficial consultative, and iterative design process;
- appropriate forums are set up for collaboration (such as workshops);
- funding is sufficient for the design process and construction of the resultant designs;
- all viewpoints are considered; and
- decisions are made to ensure the process is not drawn out any longer than is needed.

Get your project set up for decision-making

Decision-making is essential if a project is to move forward. A collaborative approach involves balancing multiple viewpoints, as well as financial and programme constraints. Clarity on who makes decisions, how they are made, and strong leadership in this regard can add tremendous value to a project. As a microcosm of the wider project, the headlands were an area of the project where, for the most part, such clarity existed and worked well.

Auckland Council, and other stakeholders outside of the design and construct consortium, did not take a large interest in the headlands. This may be due to their unfamiliarity with design of such elements.

With fewer stakeholders, a simple and clear governance structure and clear decision-making process eventuated. The multiple specialists in the design and construction team provided their input to the design and construction methodology. The design was worked through collectively and then the design manager and construction manager would balance requirements and make decisions together. Where a conflict arose, the construction manager held the ultimate decision-making responsibility, as the lead contractor for the project (so long as technical requirements were met).

The defined lines of responsibility and hierarchy contrasted with some other areas of the project. The areas of the project where these were lacking suffered from delays, uncertainty and dissatisfaction through lack of decision-making or lack of acceptance of decisions that were made.

Specific recommendations we would make to assist with decision-making include:

- Setting a clear hierarchy for decision-making. This includes agreeing who should be involved in decision-making at each level of the project, and who ultimately takes responsibility for decisions where a consensus is not reached.

- Agreeing the value criteria against which the issues can be assessed in making decisions. This can facilitate quicker, clearer decision-making as a project progresses and allows for simple documentation of decisions.
- Having a regular forum for decision-making following the agreed process.

For more information: MFoster@tonkintaylor.co.nz

Valuing the coast for Auckland

By Paul Klinac, Sarah Sinclair, Julie Pickering and Kath Coombes, Auckland Council, Auckland

Auckland is characterised by 3100 kilometres of coastline, the bulk of which is owned and managed by Auckland Council directly. Historically, much of the way New Zealand has managed its coastline has been reactive. Increasing erosion rates, however, coupled with predicted climate change effects, and a finite pool of ratepayer monies indicate that for Auckland a more proactive approach is necessary.

The potential impacts of coastal hazards, climate change and effects of sea-level rise and coastal erosion need to be carefully considered in any operational planning for Auckland's coastal parks, and infrastructure related to stormwater and transport. In effect, these impacts will determine the future location or potential relocation of infrastructure such as buildings and structures, car parking areas, coastal walkways and cycleways, or utilities in vulnerable areas.

A strategic approach to identifying management options for high-risk areas is intended to enable more informed decision-making, reducing the urgency related to storm-event responses and improving the rationale applied to prioritisation of coastal structure renewals or replacement.

The Coastal Asset Data Review Project (CADRP) seeks an improved understanding of the quantum of coastal assets under Auckland Council control and is intended to provide a revised baseline for operational planning based on potential future development risk. This region-wide initiative is intended to support the development of Coastal Compartment Management Plans (CCMPs) which assist with the preparation of development guidelines, asset management, and hazard resilience for prioritised areas of Auckland's coastline. The application of this approach is intended to reflect national and international best practice and refinement to the criteria applied to CCMPs prior to the amalgamation of Auckland Council in 2010.

For more information:
Paul.Klinac@aucklandcouncil.govt.nz

Planning for coastal-storm inundation and sea-level rise

By Scott Stephens and Rob Bell, NIWA

High storm tides and large waves combine to cause property flooding and damage, the impact of which is expected to worsen with future sea-level rise. This study used joint-probability methods to model the likelihood of high coastal-storm inundation events, which were mapped into potential coastal-hazard areas in the Auckland region as part of the Proposed Auckland Unitary Plan process.

The coastal-storm inundation maps are proposed to be included in regional and district plans to control development as part of a risk-reduction strategy, and have been debated within a Hearing under the Resource Management Act 1991 (RMA) and Local Government (Auckland Transitional Provisions) Act 2010.

The joint-probability methods stood up well to Hearing scrutiny in providing a robust and flexible framework to calculate coastal-storm inundation elevations. The static inundation mapping method provided maps that efficiently defined the coastal-storm inundation risk at a regional scale, but were less accurate at individual property scale.

Following the initial Hearing, the panel issued interim guidance recommending that the plan provisions should deal with a 1 per cent annual exceedance probability coastal-storm inundation event plus 1-metre sea-level rise by 2115 for coastal areas. The panel acknowledged uncertainties in the current mapping and welcomed suggestions on how the maps could be improved.

Top: Aerial photograph of Mission Bay. Centre: Mission Bay with present-day 1 per cent annual exceedance probability storm-tide plus wave set-up elevation superimposed (purple shading); Bottom: Mission Bay with present-day 1 per cent annual exceedance probability storm-tide plus wave set-up elevation superimposed (purple shading), plus 1-metre sea-level rise (light shading), and plus 2-metre sea-level rise (orange shading). Credit: NIWA.

The panel was not convinced of the need for a 2-metre sea-level rise to be identified as a statutory requirement for greenfields development in the plan or maps . The panel indicated a preference for stronger and new subdivision-scale policies in coastal-hazard areas, including at the regional policy level, rather than management at the scale of building controls, for example, on minimum floor levels.

Planning timeframes

The Hearings process identified a tension between the different way in which planning timeframes and risk have been addressed under the RMA and the Building Act 2004 (Building Act). The discussion below centres on the probability of occurrence, which can be specified in terms of annual exceedance probability, but the likelihood of an inundation event increases as the planning or design timeframe increases.

There are two key variables which come into play when looking at either a 50-year or 100-year timeframe:

1. the likelihood of an event occurring (independently of sea-level rise), which directly relates to risk (together with the consequences); and
2. the effects of climate change over this period, and a resulting increase in sea-level rise (which compounds risk).

The RMA and the Building Act deal with timeframes in different ways. The RMA does not directly specify a particular planning timeframe to be considered for hazard risk, but under the RMA district and city plans covering the coastal environment need to give effect to the New Zealand Coastal Policy Statement 2010 (NZCPS). The latter provides a directive of at least 100 years. As a result, case law points to a 100-year timeframe being considered appropriate for coastal hazards such as coastal erosion. A 50-year timeframe is usually considered for building works when applying the Building Act based on the minimum intended life of a building under the Act.

Further, the Building Regulation (1992) and the mandatory Building Code associated with the Building Act contains clause E.1.3.2 that states that surface water, resulting from an event having 2 per cent probability of occurring annually, shall not enter buildings. This clause is applied in the form of a minimum floor level for habitable buildings, and it is a minimum standard some councils have adopted a 1 per cent annual exceedance probability floor-level standard for surface waters. Applying a 2 per cent annual exceedance probability to a 50-year building design life means that the likelihood of such an event exceeding this level is quite high at 63 per cent.

The 1 per cent annual exceedance probability and 100-year planning timeframe were adopted for coastal-storm inundation maps within the Proposed Auckland Unitary Plan, with a 1-metre sea-level rise component added on top of this. The 1 per cent annual exceedance probability event has a 63 per cent chance of occurrence over 100 years and is thus considered likely to occur, whereas over a 100-year period a 2 per cent annual exceedance probability event has an 86 per cent likelihood of occurrence and so is almost certain.

The precautionary risk-reduction directives of the NZCPS suggest it is appropriate to plan for low-probability, high-magnitude events, and thus 1 per cent annual exceedance probability is more appropriate. Given the short data records we have in New Zealand, it is difficult to accurately assess the magnitude of coastal-storm inundation events at probabilities lower than 1 per cent annual exceedance probability.

A related observation during a workshop with Auckland Council engineers was that although the Building Act (or Building Code) does not consider climate change and sea-level rise, there was a perceived need that good practice would be to include a 50-year sea-level rise allowance in minimum floor level requirements when implementing building development controls under the Building Act, unless otherwise required under district or regional plans under the RMA.

Thus, there seems to be ongoing discussion around the concepts of risk, between planning lifetimes and probability of extreme events, and the cross-cutting roles of both RMA planning processes and the Building Act in considering hazards such as flooding and sea-level rise, and managing the risk of adverse effects or material damage to the land or structure.

The Hearing panel's interim guidance suggests the adoption of the 100-year planning timeframe (NZCPS) as appropriate for managing coastal hazards.

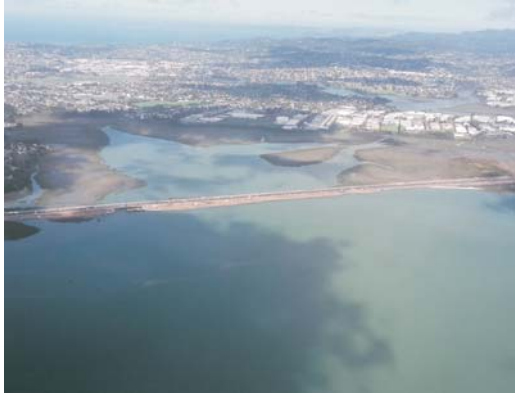
For more information: Scott.Stephens@niwa.co.nz or Rob.Bell@niwa.co.nz

Monitoring the environmental effects of a major roading project on an adjacent marine reserve

By Jacqueline Bell and Graham Don, Bioresearches Group Ltd, Auckland

As part of the wider Western Ring Route project (see page 9), the New Zealand Transport Agency's State Highway 16 Causeway Upgrade Project in Auckland involves raising and widening 4.8 kilometres of nationally significant coastal roading infrastructure to increase vehicle capacity and to mitigate coastal flooding, particularly as sea levels continue to rise.

The causeway runs adjacent to the Motu Manawa Pollen Island Marine Reserve. Extensive monitoring



Causeway project. Photo: Bioresearches Group Ltd.

of the impacts of the upgrade project on the marine environment is a resource consent requirement. Baseline monitoring was carried out in 2012 before construction began.

In 2014, following the commencement of construction activity, Bioresearches Group Ltd was commissioned to carry out routine monitoring to identify and quantify any effects of the project on the marine environment. Benthic biota, sediment quality and grain size are being monitored at a number of sites surrounding the project. To date, monitoring has not detected any significant changes over time. It has, however, provided us with a better understanding of the local marine environment.

Our results indicate that at the exposed sandy sites north of the causeway, species abundance is in general low and diversity is relatively high, likely due to the increased level of predation and competition, and the good sediment quality at these sites. Conversely, the muddy mangrove sites located along the urban fringes are dominated by a few highly abundant, very hardy species.

These sites have background contaminant levels, not associated with the construction activity. They are highly exposed to urban stormwater runoff, which is the main contributing factor reducing the quality of these habitats.

Based on our monitoring results to date and discussions with the Causeway Alliance and Auckland Council, it was decided that this project would be well suited to an adaptive management regime. This has enabled us to focus on the ecologically important areas adjacent to ongoing construction activity and less on the sites already affected by the neighbouring urban environment. An adaptive management approach to this project has reduced costs whilst continuing to manage risk by retaining statistical power for detecting ongoing changes.

Causeway fieldwork. Photo: Bioresearches Group Ltd.

For more information:
Jacqueline.Bell@bioresearches.co.nz

Conference dinner photos

All photo credits: IPENZ.

Information on the Australasian Coasts & Ports conference, including the final programme and an image gallery, is available at www.coastsandports2015.com.

Waterview Connection Project

By Chandra Littlewood, *Coastal News* writer

The Waterview Connection Project is one of the most significant infrastructure developments to take place in New Zealand. It is described as the missing link to complete the Western Ring Route – a motorway alternative easing pressure on State Highway 1 through the centre of Auckland and the Auckland Harbour Bridge.

Once complete, the project will connect the Southwestern and Northwestern motorways (State Highways 20 and 16) providing a direct motorway link between Auckland's CBD and the Auckland International Airport.

At a cost of $1.4 billion, the Waterview Connection Project is New Zealand's largest and most ambitious roading project. The project employs 800 to 1000 people.

There are two key features to the project:

- Waterview tunnels: Twin tunnels that are 2.4 kilometres in length that will each carry three lanes of traffic.
- Great North Road Interchange: Four ramps that total 1.7 kilometres in length to connect the Southwestern and Northwestern motorways immediately north of the tunnels to complete the Western Ring Route.

Preliminary work began in January 2012 at the southern (Owairaka) end and construction began in June 2012. The tunnels and interchange are due to open in early 2017.

The Waterview Connection Project is the missing link that completes the Western Ring Route in Auckland. Photo: Well-Connected Alliance.

First part of Alice's breakthrough. Photo: Well-Connected Alliance.

The Waterview Connection project is being delivered by the Well-Connected Alliance, which includes the New Zealand Transport Agency, Fletcher Construction, McConnell Dowell, Parsons Brinckerhoff, Beca Infrastructure, Tonkin + Taylor and Japanese construction company Obayashi Corporation. Sub-alliance partners are Auckland-based Wilson Tunnelling and Spanish tunnel controls specialists SICE.

Tunnel construction included use of a 2400-tonne giant tunnel boring machine (TBM) named Alice. The TBM was specifically designed for Auckland's geology by German company Herrenknecht. She is one of the largest TBMs in the world, and the largest ever built for use in Australasia.

Alice began her underground journey in November 2013 at the southern end, to build the southbound tunnel. She reached the northern end of this tunnel on 29 September 2014 and just last month (19 October 2015) Alice successfully completed excavation of the second motorway tunnel. Alice excavated enough dirt to fill 320 Olympic-sized swimming pools and installed more than 24,000 concrete segments to line both tunnels. Over the coming months, Alice will be taken apart and returned to the German company that designed and built her.

A busy programme to complete both tunnels is now underway. Sixteen cross passages linking the two tunnels are being constructed; equipment to safely operate the tunnels together with lighting and signage are being fitted; walls and the ceiling are being painted; and back-filling continues before the motorway asphalt is laid.

NZCS Mission Statement

The New Zealand Coastal Society was inaugurated in 1992 "to promote and advance sustainable management of the coastal environment". The society provides a forum for those with a genuine interest in the coastal zone to communicate amongst themselves and with the public. The society currently has over 400 members, including representatives from a wide range of coastal science, engineering and planning disciplines, employed in the engineering industry; local, regional and central government; research centres; and universities.

Applications for membership should be sent to NZCS Administrator Renee Coutts (email: nzcoastalsociety@gmail.com).

Coastal News

Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

GWRC adopts climate change strategy

By Chandra Littlewood

In October, the Greater Wellington Regional Council (GWRC) adopted a climate change strategy focused on strengthening the long-term resilience and sustainability of the Wellington region through action and awareness.

As noted in the strategy, "Hemmed in to the south, east, and west by the sea, the Wellington region is particularly vulnerable to even a small rise in sea level, and coastal hazards such as erosion and storm surge."

The Climate Change Strategy is intended to act as a guide for climate resilience activities across the region, and to provide clear strategic direction on GWRC's intentions and priorities in this respect.

"Many of the actions are currently underway, and we are looking forward to working with stakeholders from the community to progress a number of others," GWRC Chair Chris Laidlaw said at the launch of the strategy.

"Those actions range from reducing the emissions associated with GWRC's own operations, through to supporting energy efficiency, negotiating with public transport operators to achieve lower emission transport options, and ensuring we have up-to-date information about both the region's greenhouse gas emissions and the anticipated impacts of climate change."

One aim of the strategy is to help strengthen information sharing and integration with regard to climate change planning and actions across GWRC departments, between councils, with central government and with the community.

GWRC has been working with Wellington City Council, and both councils are keen to promote a region-wide collaborative approach that promises to be more effective than individual councils working in isolation.

Strengthening resilience and sustainability

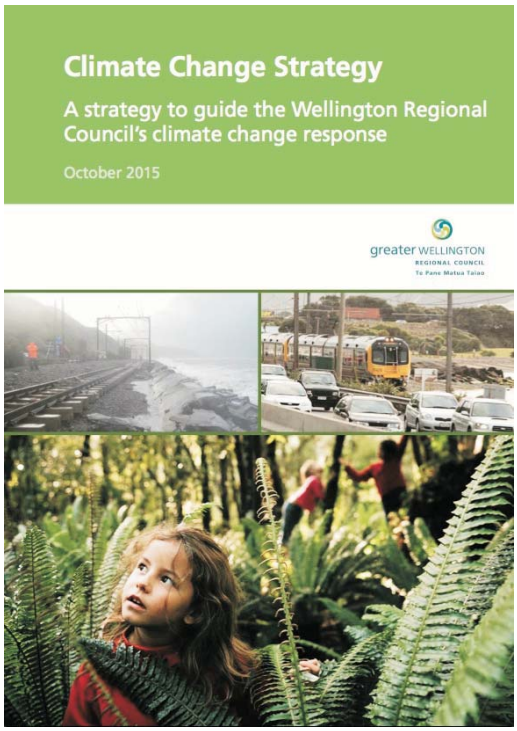
The vision of the strategy is to strengthen the long-term resilience and sustainability of the Wellington region through climate change action and awareness.

This vision acknowledges the key role that GWRC can play in contributing to the region's sustainability and resilience to climate change.

Many other stakeholders also have a crucial role to play. GWRC is committed to working with the community, businesses, other councils and central government in pursuing the objectives of this strategy.

Implementing the strategy

The strategy is accompanied by an implementation plan that sets out actions GWRC will take to achieve measurable outcomes. While the strategy and implementation plan take a long-term view, the implementation plan contains actions to be completed in the near-term, which will be reviewed and updated on a three-yearly basis.



The strategy is a non-statutory document that is designed to complement key statutory documents, such as the draft Natural Resources Plan, Regional Policy Statement, and Regional Land Transport Plan, and non-statutory documents such as floodplain management plans, the proposed Regional Natural Hazards Strategy and GWRC's Corporate Sustainability Action Plan.

The strategy and implementation plan are available at www.gw.govt.nz/climatechange/.

Strategy objectives

The strategy contains three overarching objectives as outlined below.

Mitigation: GWRC will act to reduce greenhouse gas emissions across all its areas of influence, including its own operations, helping to create the conditions for a smart, innovative, low-carbon regional economy.

Adaptation: Risks from climate change-related impacts are managed, and resilience is increased, through consistent adaptation planning and actions based on best scientific information.

Engagement and awareness: Community awareness of climate change mitigation and adaptation solutions increases and individuals and organisations know what they can do to contribute to the long-term resilience of the region.

Policies have been developed to support each of the overarching areas and actions have been identified that will help achieve the policy goals.

Word from the Chair

The value of working across disciplines

By Rick Liefting

Welcome to the November issue of *Coastal News* – our last newsletter for 2015.

First, a huge thanks to the organising committee for the recent Australasian Coasts & Ports conference – it was the most well attended Coasts & Ports conference ever hosted in New Zealand. Thanks also to the sponsors, presenters and all the participants.

For me, the conference further solidified my feeling that we can only address issues, such as the consequences of climate change, by working across disciplines. There were moments when I looked around the room and felt really proud that we were able to bring together so many high-calibre scientists, engineers, planners and policy people all working together to address some of the most challenging issues our country faces. For those of you who were unable to attend, we have provided a sampling of some of the excellent papers that were presented in this issue of *Coastal News*.

NZCS committee update

At our annual general meeting we elected our first student management committee representative – Hannah Berger. Hannah is working towards her Masters of Science in Geography at the University of Canterbury and received one of our scholarships this year.

We also elected two new management committee members:

- Paul Klinac, Team Manager – Coastal Management Services, Auckland Council; and
- Tom Shand, Senior Coastal Engineer, Tonkin + Taylor.

All three new committee members are a welcome addition and are already bringing some great ideas on how to better connect with current and potential members – stay tuned.

At the same time we welcomed three new committee members, we said goodbye to Amy Robinson who stepped down from the committee. Amy recently accepted a new role at Waikato Regional Council and will not be able to devote as much time to the society. She will be sorely missed – she has been a dedicated, hard-working committee member who was always willing to take on a new challenge. The good news is that Amy will still be an active NZCS member, so hopefully you will be able to catch up with her at NZCS events and conferences.

Special publication update

While this is our last newsletter for 2015, you will be hearing from us soon with our second special publication that we are busy finalising. The special publication will provide insights on engaging with communities, an update on both central government's work in this area, and an article based on some of the papers presented at the Coasts & Ports conference on the methods used for assessing coastal erosion hazards.

Bring on summer!

On behalf of the NZCS committee, I wish you a safe and relaxing summer. As coastal professionals 2016 is already shaping up to be a busy year, so make sure you take a break and get out to enjoy the coasts we all work so hard to safeguard.

NZCS Management Committee

Chairperson:	Rick Liefting	rick.liefting@waikatoregion.govt.nz
Deputy Chairperson/Regional Coordinator:	Hugh Leersnyder	hugh.leersnyder@beca.com
Treasurer:	Eric Verstappen	eric.verstappen@tasman.govt.nz
National Coordinators:	Hugh Leersnyder Scott Stephens	hugh.leersnyder@beca.com scott.stephens@niwa.co.nz
Central Government Coordinators:	Sarah McRae Michael Nielsen	smcrae@doc.govt.nz michael.nielsen@mpi.govt.nz
***Coastal News* Coordinator:**	Don Neale	dneale@doc.govt.nz
Website & Digest Coordinator:	Jose Borrero	jose@ecoast.co.nz
General Members:	Paul Klinac Tom Shand	paul.klinac@aucklandcouncil.govt.nz TShand@tonkintaylor.co.nz

Other NZCS Contacts

Administrator/Communications Coordinator:	Renee Coutts Rebekah Haughey	nzcoastalsociety@gmail.com
***Coastal News* Editor:**	Shelly Farr Biswell	shelly@biswell.net

Coastal News

Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

News from the regions

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Northland

Michael Day, Regional Coordinator

New regional plan for Northland

The Northland Regional Council (NRC) is preparing a new single regional plan to replace the three existing regional plans (Air, Water & Soil, and Coastal). Staff are currently workshopping draft provisions with councillors and it is expected that the plan will be released for informal public feedback around the middle of 2016. The intention is to formally notify the new regional plan in 2017.

A key aspect of the new plan is that it will contain a greater level of marine spatial mapping than the existing (coastal) plan. Examples include surf breaks (nationally and regionally significant), historic heritage, outstanding natural character, outstanding natural landscape and features, significant anchorages and significant marine biodiversity.

The new plan will have a greater focus on the specific uses and values to be protected, and should assist with enabling appropriate development to proceed.

Coastal monitoring

NRC has purchased two harbour monitoring buoys for continuous monitoring of water quality. These buoys can be easily deployed from a boat anywhere in our harbours or estuaries and will be equipped to monitor salinity, temperature, dissolved oxygen, pH and turbidity in the water column. The buoys are also capable of recording a wide range of other parameters, such as nutrients, total suspended solids, chlorophyll and algae. Two solar panels deliver continuous energy and modern telemetry equipment allows for the results to be seen live on a computer screen in the office.

For compliance monitoring, the new buoys mean NRC is now able to identify potential non-compliance in near real time, compared to previously where council staff needed to download collected data after retrieval. For state-of-the-environment monitoring, the buoys also allow NRC to collect more continuous data over a longer period of time and in potentially more remote locations.

NRC coastal monitoring staff member with new buoy. Photo: NRC.

The buoys will greatly increase efficiency and accuracy in sampling for continuous monitoring.

Plan Change 4 (Aquaculture) to the Regional Coastal Plan

Plan Change 4 to the Regional Coastal Plan for Northland sets out the way aquaculture will be managed in Northland. It includes policies and rules for managing existing aquaculture and directing how and where new aquaculture is located.

The Environment Court released its final decision on 29 June 2015. NRC then adopted Plan Change 4 at its 15 September 2015 meeting. The plan change is now with the Minister of Conservation for approval.

A copy of the plan change and associated aquaculture prohibited area maps can be found on the NRC's website at www.nrc.govt.nz/Your-Council/Have-your-say/Plan-Change-4-Aquaculture-Management/.

Waikato

Christin Atchinson, Regional Coordinator

Firth of Thames water quality and ecosystem health technical report

Waikato Regional Council and DairyNZ jointly commissioned NIWA to write a report on the current state of knowledge of water quality and ecosystem health of the Firth of Thames. The report presents key findings regarding sediment loading, nutrient loading, phytoplankton dynamics, dissolved oxygen dynamics and pH variability. It also identifies information gaps and priorities for future work that will enable more comprehensive assessments of water quality and ecosystem health of the Firth of Thames in the future. The report provides valuable, scientifically robust information for communities, iwi and other stakeholders.

www.waikatoregion.govt.nz/tr201523/

Firth of Thames

Sea Change – Tai Timu Tai Pari

Sea Change – Tai Timu Tai Pari recently announced the timeframe to deliver the Hauraki Gulf/Tikapa Moana Marine Spatial Plan has been extended to

2016. The announcement follows a three-month project pause during which time all parties involved in the project undertook a process review and agreed on the extension to the project's timeframes.

With the ongoing process now confirmed, the stakeholder working group (SWG) tasked with producing the Hauraki Gulf/Tikapa Moana Marine Spatial Plan reconvened in October 2015. They will be supported in their work by newly appointed independent Chair Paul Beverley.

Paul is a partner in law firm Buddle Findlay, specialising in the Resource Management Act 1991 (RMA), Māori and Treaty settlement law and negotiations, and coastal law. He was formerly the chair of the Sea Change Tai Timu Tai Pari Independent Review Panel. He has been working with the SWG in an advisory capacity since July, and was confirmed in the role of independent chair of the SWG on 10 September 2015.

The SWG's aim is for the Hauraki Gulf/Tikapa Moana to:

- be vibrant with life and healthy mauri;
- be increasingly productive; and
- support healthy and prosperous communities.

The Hauraki Gulf/Tikapa Moana Marine Spatial Plan will be delivered in 2016.

The Sea Change – Tai Timu Tai Pari Hauraki Gulf Marine Spatial Plan will not be a legally binding document, but it will guide the regulatory authorities who manage the Hauraki Gulf and its catchments. Once completed, it will be for these authorities to reflect on the recommendations from the plan when undertaking their statutory processes. The plan will also provide guidance and recommendations for voluntary action from communities, interest groups and industry.

http://seachange.org.nz

Bay of Plenty

Mark Ivamy and Sharon De Luca, Regional Coordinators

Opotiki Harbour Development receives Government support

In October, the Government announced up to $3 million to finalise geotechnical investigations and design options for a new harbour entrance in Opotiki.

The Opotiki Harbour Development Project is one of the key initiatives of the Bay of Plenty Regional Economic Action Plan designed to lift employment, incomes and investment across the region. The validation study will include geotechnical investigation and design options to create a year-round navigable harbour entrance.

www.odc.govt.nz.

Tauranga Harbour health stable

The environmental health of Te Awanui (Tauranga Harbour) and its catchment is stable and showing signs of improvement according to a report presented to Bay of Plenty Regional Council's Regional Direction and Delivery Committee at the end of September.

Tauranga Harbour. Photo: Ulrich Lange (Creative Commons).

The report noted, however, that the harbour is still vulnerable to the effects of land use and run-off, which require ongoing efforts by the community, landowners and council staff if long-term harbour health is to be maintained and improved.

The report outlined work that's been completed by Bay of Plenty Regional Council staff over the last 12 months to care for land, water and wildlife in the Tauranga Harbour catchment. It highlighted catchment-wide improvements in phosphorous levels, the general good health of aquatic wildlife populations, and noted that sediment contamination levels were within safe limits. Seagrass beds in the southern harbour are showing signs of recovery, but land run-off has caused some shellfish and seagrass decline, especially in upper estuaries of the northern harbour.

The report highlighted that from July 2014 to June 2015, Bay of Plenty Regional Council staff worked with Tauranga City Council to audit 180 business and industrial sites to prevent stormwater pollution, and collect 3870 kilograms of rubbish from foreshore areas with the help of more than 1500 local school children. Throughout the year, landowners had been supported to fence and plant 62 kilometres of stream margins and to manage 900 hectares of erosion-prone land more sustainably.

The report also noted that marine pest surveillance had been completed throughout the 2014/15 year. This involved bi-annual underwater checks on 450 moorings, 800 boat hulls, 10 kilometres of marina pontoons and 1.5 kilometres of rock walls in the Tauranga Harbour.

www.boprc.govt.nz/taurangaharbour

Rena update

The five-week public hearing for the *Rena* application closed on 9 October. A decision by the independent panel of four commissioners is expected mid-December. Recovery operations at the site still continue with a focus on cargo debris.

Canterbury

Justin Cope and Gareth Taylor, Regional Coordinators

Avon-Heathcote Estuary tidal barrier research

Christchurch City Council (CCC) has rejected the idea of any further study into a tidal barrier on the Avon-Heathcote Estuary.

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Earlier in the year, the CCC commissioned a pre-feasibility study to see if a tidal barrier was technically feasible and to get a rough estimate of cost. A possible tidal barrier had been put forward as one of the options to reduce the current and future risk of flooding to low-lying parts of southeast Christchurch.

The pre-feasibility study found that:

- a tidal barrier was technically possible;
- would cost up to $350 million;
- could have the potential to significantly affect the estuary environment; and
- would still not completely negate the need for additional flood defence infrastructure such as stopbanks.

The CCC weighed up the pros and cons of the feasibility study and took feedback from their strategic partners and other key organisations, and councillors unanimously rejected any further full feasibility assessment studies.

www.ccc.govt.nz/environment/water/flooding/council-and-technical-reports/

Coastal hazard provisions

The Government has removed coastal hazard provisions from the CCC's district plan review process through an Order in Council. The fast-tracked district plan review process, enabled by earthquake recovery legislation, identified 6000 properties at risk to coastal erosion and nearly 18,000 properties potentially vulnerable to coastal storm inundation within the next 50 to 100 years.

The identification of coastal hazard and inundation zones was informed by a report commissioned by the CCC from Tonkin and Taylor (www.ccc.govt.nz/environment/land/coast/coastal-hazards/read-the-technical-report/).

The release of the proposed coastal hazard provisions prompted significant public outcry and anger, in particular over the fast-tracking process which residents considered did not provide adequate time for any significant public consultation, engagement and input. This has ultimately led to central government intervention allowing the CCC to remove the coastal hazard provisions from the fast-track district plan review process. Coastal hazard district planning issues will now be dealt with at a future time through the normal RMA planning processes.

Avon Heathcote Estuary from Clifton Hill. Photo: Mark Pilbeam Flickr (Creative Commons).

Contributing to *Coastal News*

We always welcome contributions for forthcoming issues of *Coastal News*. Please contact the Editor, Shelly Farr Biswell, at shelly@biswell.net if you'd like to submit a news in brief, article, or have content suggestions. The submission deadline for the next issue is 19 February 2016.

NZCS Regional Coordinators

Every region has a NZCS Regional Coordinator who is available to help you with any queries about NZCS activities or coastal issues in your local area.

North Island

Northland	Michael Day	michaeld@nrc.govt.nz
Auckland	Sam Morgan Paul Klinac	Sam.Morgan@aucklandcouncil.govt.nz Paul.Klinac@aucklandcouncil.govt.nz
Waikato	Christin Atchinson	christin.atchinson@waikatoregion.govt.nz
Bay of Plenty	Mark Ivamy Sharon De Luca	mark.ivamy@boprc.govt.nz sharon.deluca@boffamiskell.co.nz
Hawke's Bay	Oliver Wade	oliver@hbrc.govt.nz
Taranaki	Emily Roberts	emily.roberts@trc.govt.nz
Wellington	Iain Dawe	iain.dawe@gw.govt.nz

South Island

Upper South Island	Eric Verstappen	eric.verstappen@tasman.govt.nz
West Coast	Don Neale	dneale@doc.govt.nz
Canterbury	Justin Cope Gareth Taylor	justin.cope@ecan.govt.nz GGTaylor@globalskm.com
Otago	Suzanne Watt Jamie Torrance	suzanne.watt@orc.govt.nz jamie.torrance@orc.govt.nz
Southland	Nick Ward	nick.ward@es.govt.nz

Beach replenishment project at Torrent Bay

Photo essay by Eric Verstappen, Upper South Island Regional Coordinator

In September and October of this year, Tasman District Council and the local community completed an 11,000 cubic metre beach replenishment project at Torrent Bay in Abel Tasman National Park. Below are a series of before and after photos to illustrate the work undertaken.

Beach prior to the replenishment project.

Replenishment work in progress.

As part of the project, 3000 plants were put in along the beach face.

One week and 11,000 cubic metres of sand later! All the sand was retrieved from the ebb-tide delta-bar system using a digger and two Volvo dump trucks. Retrieval work occurred about three hours each side of low tide. The 1 September storm system shifted the sand at Torrent Bay's main beach to the delta.

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Now and then...

These photos show the estuarine area at the West Coast's Grey River/Mawheranui looking inland in 2011 and 2015. Photos courtesy of Henk Stengs, Department of Conservation. Henk leads the community restoration project on the river. As the photos illustrate, the restoration work has included reshaping the site to create diverse habitat, with an emphasis on enhancing inanga spawning sites.

So what's the best "Now and then" of coastal photos that you've taken? Send them to Don Neale (dneale@doc.govt.nz) and we will put some of the best ones in *Coastal News* (with credit to you of course!).

The New Zealand Coastal Society would like to acknowledge our corporate members for their support:

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