Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

Coastal News

Newsletter of the New Zealand Coastal Society: a Technical Group of Engineering New Zealand

Issue 68 • March 2019

Super-sized dredging

In August 2018, Lyttelton harbour was the site of the country's biggest ever dredging project using one of the world's largest dredging vessels. In this issue we take a look at the project, including some of the major challenges that were faced and the successes that have resulted (see page 3).

The dredge Fairway *in operation at the eastern end of the new Lyttelton Channel (Photo: Lyttelton Port Company Ltd).*

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Word from the Chair

Tom Shand

Kia ora koutou

Welcome to 2019. Firstly I'd like to congratulate Sam and the team for putting on an excellent NZCS conference in Tairwhiti Gisborne late last year. These conferences continue to grow and have certainly become the pre-eminent forum for discussions of coastal science, engineering and management in New Zealand. It's very pleasing to see multiple generations of practitioners debating and exchanging ideas and philosophies. This year's conference will be heading to the deep south, to Invercargill, in November – another first for the society. Stay tuned for further details.

This issue of *Coastal News* includes several of the conference presentations as short articles, including John Duder's discussion of Cook's circumnavigation and charting of Aotearoa, Michael Tyler on storm surges in Tauranga Harbour, Tom Simons-Smith on foredune notching at St Kilda Beach, and a trio of short articles on advances in remote sensing. Having worked with each of these authors I am very impressed by how these new technologies are contributing to coastal monitoring and improving our understanding of coastal processes.

This issue also includes a full length article by Lucy Brake on the Lyttelton Port channel deepening project, a truly impressive feat of engineering and collaborative environmental monitoring, an article by Kay Vopel on ecosystem functions in the Firth of Thames, and Eastland Port's new log yard stormwater treatment system – with results good enough for whiskey apparently (we await our samples).

Our AGM saw the departure of two NZCS committee members, Hannah Berger and

Sarah McRae, and election of two new members – Craig Davis and Sam Morgan. We thank Hannah and Sarah for their efforts these last years and look forward to new energy and ideas from Craig and Sam. We also have a host of new regional coordinators, all with fresh ideas and enthusiasm and I'm really looking forward to seeing what exciting events are held in 2019.

This is my last Chair's message. Paul Klinac will be taking over as NZSC Chair in 2019 and Mark Ivamy stepping in as Deputy. I have really enjoyed working with Hugh, Paul and the committee over the last few years. They are a great bunch of people who work very hard promoting the Society's mission, vision and values. I wish them all the best navigating the society towards 2020 and beyond.

Mā te wā
Tom

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 300 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.

Membership applications should be sent to NZCS Administrator Renée Coutts (nzcoastalsociety@gmail.com).

Lyttelton Port channel dredging – a collaborative journey

Lucy Brake, Contributing Writer

After years of planning, expert investigations and consultation, a highly technical and collaborative dredging project, New Zealand's largest, has been successfully delivered in Lyttelton. We take a look at this journey and some of the major challenges and successes that have resulted.

Dredging has always played a part in the successful operation of Lyttelton Port. The year 1880 saw the first dredge vessel visit Lyttelton and since then dredging has been done on varying levels almost every year for over a century. However, in August last year Lyttelton harbour was the site for New Zealand's biggest ever dredging project using one of the world's largest dredging vessels, and ultimately, delivery of New Zealand's largest-ever environmental monitoring programme for a dredging project.

The Lyttelton Port Company Limited (LPC), which is owned by Christchurch City Council, is focused on delivering a bold 30-year vision, where the re-development of the Port facility will see $1 billion spent including a much-needed wider and deeper channel created to support larger container ships. "The upgraded Port facility and channel deepening are essential to ensure Lyttelton Port remains viable in a highly competitive global market," highlights LPC Chief Executive Peter Davie.

After 12 weeks of intensive dredging, which commenced in August 2018, by the 230 m long *Fairway*, the first stage of the project has been completed. This stage lengthened the existing channel by 2.5 km, deepened it by up to 4 m, and widened it by an extra 20 m. This now enables the port to attract ships carrying up to 8,000 containers. To put it in perspective, the volume excavated in this stage alone is four times greater than all of the excavation (including the tunnel) for the recently completed Waterview Connection in Auckland. "Dredging the channel is future-proofing our port", Peter previously commented to journalists back in 2016 when the project first starting gaining national attention. "We need to have the right facilities and capacities to continue to attract major international shipping lines," Peter said at the time.

A focus on resource consents

LPC invested over $4 million in gaining the required Resource Management Act consents, with a particular emphasis on expert assessments and environmental monitoring in regards to the environmental impacts. The construction of the wider, longer and deeper channel required the dredger to operate all day and night, seven days a week, for three months. The dredger sucked up 6.5 million m^3 of sediment and then disposed of this in a 12.5 km^2 'disposal zone' about 5 km from Godley Head.

"The environmental monitoring programme is the most extensive ever undertaken on a dredge project in New Zealand," outlines Jared Pettersson, Project Director at Enviser/LPC. Jared has been involved in the dredging project since around mid-2015, initially as the Project Director of the consents, then as Project Environmental Adviser during the delivery phase. "To protect the important ecological and cultural values, tight environmental conditions were set and LPC implemented the most robust environmental monitoring programme ever undertaken for a New Zealand dredging project," says Jared.

From the perspective of tangata whenua the monitoring was always going to be a critical component. The majority of their concerns related to the potential impact on mahinga kai, fishing grounds, mussel farms and Hector's dolphins. LPC worked closely with Te Rūnanga o Ngāi Tahu, Te Hapū o Ngāti Wheke (Rapaki), Te Rūnanga o Koukourārata and Ngāi Tahu Fisheries to resolve the issues raised through their appeal against the granted resource consents in 2017. Ngāi Tahu's negotiations during mediation in 2018 led to tighter environmental controls, funding for projects to restore and enhance the cultural and environmental health of Whakaraupō/Lyttelton Harbour, and a reduced consent timeframe from 35 years to 25 years.

The Surfbreak Protection Society also appealed against the granted resource consents in 2017 due to concerns about the unknown impacts on surf breaks in the area. They withdrew the appeal once a robust monitoring programme, including a dedicated web-based camera system to record any changes to the Taylors Mistake surf break, was set up. This was an important step for the Society as it provided valuable input into an agreed adaptive management programme.

Extensive monitoring approach

The monitoring of the project consists of three parts, pre-dredging baseline

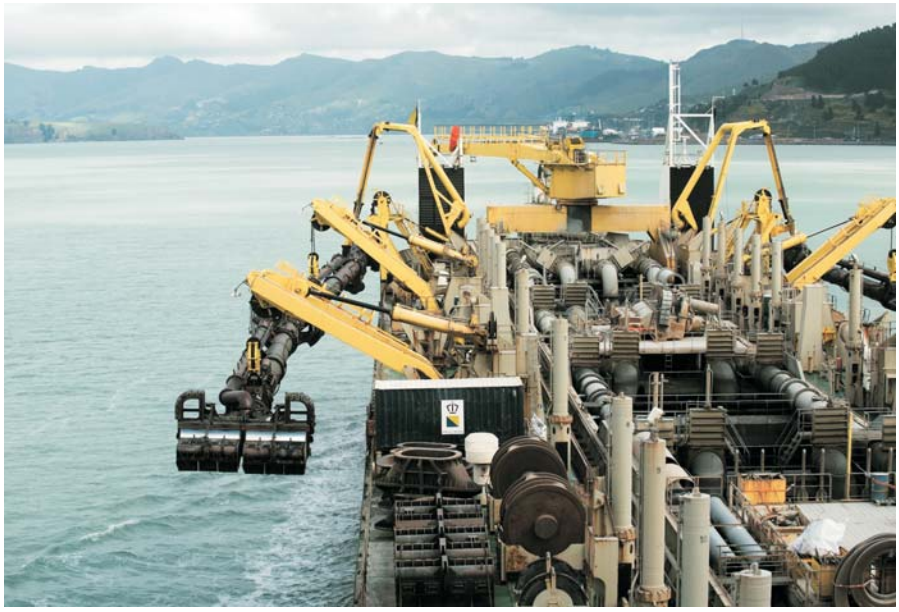
The dredge Fairway *in Lyttelton Port (Photo: Lyttelton Port Company Ltd).*

View from the bridge of the Fairway *as a bulk carrier vessel passes it exiting Lyttelton Harbour (Photo: Lyttelton Port Company Ltd).*

measurements, monitoring during dredging operations, and post-dredging baseline measurements. Vision Environment were tasked with monitoring and maintaining the array of surface and benthic equipment that was deployed in late 2016, as well as carrying out monthly water sampling and depth profiling to 'ground truth' the instrument outputs.

There are 14 monitoring buoys, which were installed in September 2016. These buoys measure a range of factors, including turbidity, temperature, salinity, currents, water clarity and dissolved oxygen. There are 15 beach shore monitoring stations that are checked before and after the dredging. In addition, peer reviews are being completed by an independent group of scientists.

James Frazerhurst, who joined the Vision Environment team in early 2017 as a Senior Environmental Officer, played a key role in the environmental modelling of the dredging. He has been working on the measurement and modelling of the coastal and marine environment since 2001 and has been involved in Real Time (RT) data collection since 2012. James has recently moved on to a new role, but he has some valuable thoughts on the Lyttelton dredging project. "We have an excellent integration of autonomous water quality measurement instruments and current profilers, with data loggers and modems connecting the data to the 3G cellular network," he observes. "We are working alongside leading international organisations that have significant expertise in this area." The data is passed through a proprietary algorithm, which filters for errors and fouling issues before presenting via a web-based interface. "Exceedance and persistence analysis were presented during the dredging operation in order to comply with consents and manage dredging impacts," James notes. Additionally, he says there are benthic sites that have more traditional monthly deployments/ maintenance with water quality, PAR and deposition measurements. Data is also recovered from an array of passive acoustic sensors for marine mammal monitoring.



One of the six-metre wide drag heads on the Fairway *(Photo: Lyttelton Port Company Ltd).*

> "To protect ecological and cultural values, tight environmental conditions were set and LPC implemented the most robust environmental monitoring programme ever undertaken for a New Zealand dredging project"
>
> *Jared Pettersson, Project Director, Enviser/LPC*

"The use of such a large number of surface instruments, telemetered, and used to monitor and direct such a large and important project represents the conjunction of technologies for the digitizing of environmental parameters, and the processing and presenting of data in RT to minimise adverse effects and meet the concerns of multiple stakeholders," comments James. From his perspective the size, scope and immediacy of the Lyttelton dredging operations made it unique, and he believes it is very likely that this level of sophistication represents the future of monitoring.

Challenging conditions

LPC, with the stakeholders, developed a rigorous environmental management system. "This system required collection of continuous real-time water quality monitoring data and comparison, (also in RT), with a range of multi-factor environmental levels," observes Jared. "This necessitated a complex network of marine instruments generating a huge volume of

The Fairway*'s hopper being filled during dredging operations (Photo: Lyttelton Port Company Ltd).*

data, but also needed a simple interface to allow the project team to easily evaluate the results."

With such a comprehensive monitoring programme underway it is not surprising that the team faced a range of challenges. Jared is of the opinion that developing a reliable system which could generate the data, process it and present it in a way that was useful to the dredge contractors, stakeholders, project team and the public was one of the most challenging aspects of the system. "Particularly given the very high potential costs of shutting down the dredge if the system failed, or gave incorrect results," he comments.

The inevitability of fouling and operational errors arises with so many instruments in the water at once. "Getting out on the water to exchange instruments as well as meeting the schedules of monthly sampling, benthic exchanges and acoustic instrument exchanges, meant that we averaged around 4-8 days in the field per month," remarks James. "Lyttelton Harbour and the northern Banks Peninsular would seem to be a sheltered part of New Zealand, but the combination of katabatic winds, Southerly fronts and Canterbury's famous Northwester, made the deciphering of weather windows to allow for operations on the array, a never-ending puzzle."

Access to local knowledge is always vital in these types of monitoring programmes. Vision Environment were extremely fortunate to have had an excellent local partner in Chris Jarman and his vessel ATAZ. "Chris knew the local conditions extremely well, with his history of decades of Inshore Commercial Fishing and between us, we would constantly be checking and interpreting various forecasts and applying seasonal variations," reveals James.

Teamwork and relationships key to success

Building and maintaining strong relationships with both the stakeholders and the teams of specialists involved has been a critical part to ensuring the project continues to progress forward and deliver positive outcomes, recognising that sometimes this takes balance. "Collaboration with our stakeholders, experts and contractor has been one of the key aspects of the project's success – both in the consenting and delivery stages," outlines Jared.

From Jared's perspective the development of the monitoring system was 'incredibly challenging', but ultimately it functioned extremely well and is now providing valuable information about this coastal environment. He notes that not only did it offer important data to ensure environmental compliance, it also enabled the dredge contractor to quickly learn how their operations impacted turbidity. "As a result, the contractor tuned their methods to achieve a high degree of dredge productivity whilst generating low levels of turbidity," Jared says. There was also a comprehensive geotechnical investigation programme in place. This provided the team with a ground model that was "accurate and avoided complications associated with unanticipated ground conditions."

"Whilst the delivery of the project was successful and had many, many groups and people working on it, who all contributed to its success in many different ways, I found that once the dredging was taking place it was very satisfying tracking a plume of turbid water through the array in real time," professes James. He notes that this may seem insignificant, but it represented a tremendous effort of the people involved and represents what he believes to be the future of monitoring in order to minimise impacts. "Whilst the complex turbidity management system presented some risks, in the end it was pivotal to the project's success," observes Jared.

The client/contractor relationship was also important and early on a highly collaborative team approach was established with a high degree of face-to-face communications, rather than just communicating through the contract. The combination of these factors, including the collaborative effort by the team and the extensive monitoring programme, resulted in a successful project with "no variations, completed to programme and to budget," points out Jared. He is hoping to present a paper with Irena Doets, Environmental Engineer, Boskalis Australia Pty Ltd at the 2019 Australasian Coasts and Ports Conference later this year, which offers some unique insights into the main strategies for successful project delivery in such a complex social and environmental context.

Ultimately, the key to realising such a large and visible project has been developing an early team-based approach and a robust, extensive monitoring programme. Through this work on the consent applications gained some valuable new information and knowledge about coastal processes in the Lyttelton harbour which will support well-informed decision-making in the future.

To learn more about the monitoring programme, including some of the latest information and progress updates, check out:
https://lpcharbourwatch.co.nz/blog/

Circumnavigating Aotearoa: James Cook's charting of New Zealand

John N Duder FEngNZ, CPEng, NZCS Life Member

This article is based on a presentation made by John Duder at the 2018 NZCS Conference in Gisborne.

Māori had their own knowledge and images of all three main islands. Abel Tasman and his navigator François Visscher identified most of the western coastline, from Hokitika to Cape Maria Van Diemen and the Three Kings Islands. However it was Lieutenant James Cook and his crew in HM Bark *Endeavour* who put New Zealand on the world map.

From October 1769, over the next six months, Cook defined the three land masses and returned to England with a full New Zealand chart and coastal sections and profiles drawn with remarkable precision. Appointed largely for his skill and experience as a surveyor, he and his officers created these charts while navigating a square-rigged collier along unknown and treacherous coasts. Some of those charts were still in use in the 20th century.

My presentation followed *Endeavour* around all three islands, focussing on Cook's techniques of survey and cartography, while acknowledging the perils encountered, the high level of seamanship demanded, and their considerable good fortune. Fundamental to day and night operation, not to mention survival, was the relentless management of 91 men aboard an 18th century sailing vessel, often sailing in foul weather along a lee shore.

There were eight landings: Turanganui-a-Kiwa (near Gisborne), Anaura Bay, Tolaga Bay, Mercury Bay (Whitianga), Firth of Thames, Bay of Islands, Queen Charlotte Sound and lastly, Admiralty Bay, always looking for fresh water, firewood and green stuff (puha or sowthistle) to ward off scurvy. Inevitably, there were encounters with interested and wary locals, often in waka alongside the ship in their considerable numbers.

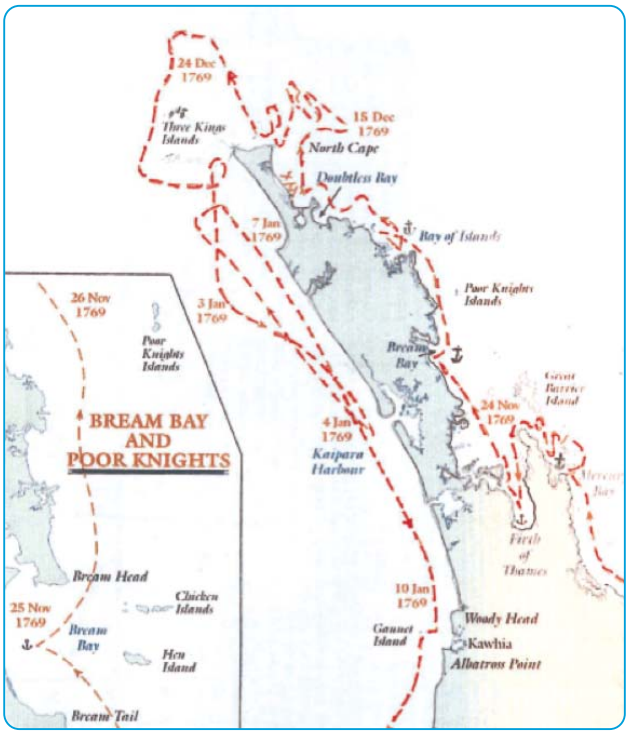
After the initial misunderstandings and killings in Poverty Bay, it was the Tahitian priest and navigator Tupaia who greatly facilitated interactions and trading with Māori at Whitianga, the Waihou River near Thames, Motuarohia in the Bay of Islands, and Ship Cove in Queen Charlotte Sound. Landings in the fjords were not made on Cook's first voyage, to Joseph Banks' intense annoyance and frustration.

His equipment was the best available at the time. His survey platform was the unstable deck of a slow, wooden bark, with timber spars, hemp rigging and flax sails; but seaworthy and well suited for long voyages and coastal exploring/surveying.

Given the effort and challenges *Endeavour* and her crew faced, the resulting chart of Aotearoa New Zealand is a masterpiece. The latitudes measured from the equator are accurate, obtained from sunshots at noon and use of tables related to the time of year.

Longitude was a different matter. While John Harrison had invented a series of accurate chronometers, culminating in the breakthrough timepiece of H4 in 1759, to give mariners the time at Greenwich (or Paris!), Cook did not have a copy of H4 made by Kendall until the second voyage. Until then longitude had to be tediously calculated

The accuracy of James Cook's Chart of New Zealand is confirmed by comparison with the outline on a modern day map. With no chronometer to measure longitude and only a sextant to determine latitude, Cook's placing of the two main islands in the vastness of the Pacific Ocean was an extraordinary achievement. The Cook Chart shown here is one engraved by J Bayly and used in Cook's account of his voyage edited by John Hawkesworth, published in 1774.



from a series of lunar observations and other stars: as elegantly explained by Dava Sobel in *Longitude*, a Penguin book, in essence the calculations of a spherical triangle formed by the observer, the sun and the moon. The actual position of New Zealand superimposed on the copy of Cook's chart shows the error in longitude.

Every headland and island encountered along the coast was repeatedly located by compass bearings and sextant angles, with distances from the ship's speed measured in 'knots' by running out the knotted logline against a minute-glass. The other key navigational elements were the lead line to give depth and bottom samples, and constant 24 hour lookouts from the mastheads.

It was not at all plain sailing. Some idea of the challenges and the achievement in exploring and charting an unknown coastline can be gained from the accompanying sail tracks, taken by courtesy from John Robson's masterly *Captain Cook's World Maps*.

After arriving at Turanganui-a-Kiwa (Poverty Bay) and rounding East Cape, Cook skirts the Bay of Plenty, presumably with an offshore wind and comes to his second anchorage in Mercury Bay to observe the transit of Mercury. He then tacks laboriously through Colville Channel, explores the Firth of Thames and stays a while in the Bay of Islands. Working northwards he struggles over two weeks to round North Cape and gets blown some 90 nautical miles offshore well north and west of the Three Kings Islands.

He now realises he is in Tasman territory, recognising the Three Kings and Cape Maria Van Diemen from Visscher's chart of 1642. Close hauled down the western coast, he doubles back from the Kaipara to check Mt Camel (Houhora Harbour), which had been sighted from the east coast. The crews' views are not recorded!

After Cape Egmont, and some welcome relief in Queen Charlotte Sound, he identifies and traverses Cook Strait, narrowly avoiding being tide-swept onto the craggy Brothers Islands, and reaches Cape Turnagain to establish to his own and the crew's satisfaction that Te Ika a Maui is a separate island.

Turning south, Cook circumnavigates Te Wai Pounamu between February and March 1770. Once again he is beset by headwinds and driven some 100 miles south-eastward from Otago, largely dispelling the vision of a great southern continent Terra Australis Incognita held so fervently by geographer Alexander Dalrymple, Joseph Banks, et al.

Bypassing the fjords despite Bank's protests (Dusky Sound was surveyed during the second voyage), *Endeavour* is headed at Cape Foulwind necessitating a tack to the south-west.

After a final respite at D'Urville Island, Cook determines with his officers that the ship is not fit for either the high latitudes to reach Cape Horn, nor south of Van Diemen's Land and around the Cape of Good Hope. So they sail west to make landfall, and do the first survey of on the east coast of Australia, they narrowly survived shipwreck off Queensland and limp into Batavia (Djarkarta) for refit of the vessel but tragically the loss of many crew from malaria and dysentery. Thence across the Indian Ocean, around the Cape and home to Tilbury. But the question of the great southern continent had not been fully answered, so it was not long before Cook was off again with *Resolution* and *Adventure* for an even longer voyage. What a seaman!

Back issues

Back issues of *Coastal News* (from 1996 onwards) are available to download from the Society's website at www.coastalsociety.org.nz (under the 'Publications' tab). Also available for download are author and article indexes for issues 1 to 65 (these will be updated each year), a Contributor's Guide to writing articles for *Coastal News*, and copies of the three NZCS Special publications published in 2014, 2016 and 2018.

Coastal remote sensing

Development of new remote sensing technologies are becoming a valuable tool for coastal monitoring, as outlined in the three summaries below of presentations made at the NZCS 2018 Conference.

Examining the potential for coastal monitoring using UAV ('drone')

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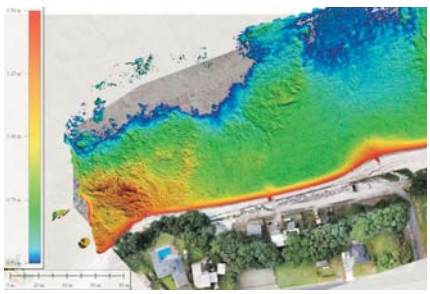
Coastal monitoring of beaches has traditionally involved surveys using a theodolite and staff to measure beach profiles. These can be repeated to show change over time, but may not characterise changes in the wider area. In contrast, UAV (Unmanned Aerial Vehicle) surveys quickly yield digital terrain (3D) models and high resolution aerial imagery as standard outputs. These models provide whole-beach information rather than discrete beach profiles. Aerial images also make this topographic information easier to interpret.

Digital terrain models may be combined or subtracted to measure profile change quickly and effectively. This information is valuable for our clients such as Auckland Council from an asset management perspective where beach sand has a high amenity value, and replacement with beach nourishment very expensive.

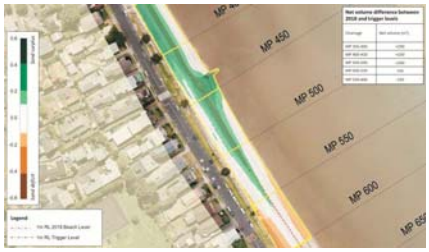
When monitoring cliffs rather than beaches, difficulties arise when comparing the cliff crest position if it is obscured by vegetation in historic aerial photos. UAV surveys can overcome this problem using innovative point classification techniques and oblique photography.

Rendered 3D models are useful in community and other non-technical consultation, or where language difficulties exist to communicate complex management issues. The increasing availability of Augmented Reality (AR) and online tools allow for this information to be easily shared.



An example of the kind of detail [obtainable] in a drone survey of the intertidal zone at Clarks Beach, Auckland.

This image shows the change in levels between consecutive surveys of the intertidal zone at Eastern Beach (Red = beach lowering, Blue = beach rise).



This image compares the current beach level with threshold levels documented in the beach scraping resource consent. Brown colouring highlights areas where sand levels are lower than consented threshold levels, and green areas show where beach scraping sand can be sourced (higher than threshold levels).

The more comprehensive nature of UAV survey information has the potential to inform the management of a wide variety of future coastal issues, even those which are not apparent at the time of survey. In anticipation of changing needs, historic information in whatever form should be incorporated. As with all forms of data, quality assurance surrounding the collection, processing and interpretation is essential.

The development of New Zealand coastal planning legislation such as the New Zealand Coastal Policy statement encourages greater consideration of 'soft' engineering approaches that, for example, enhance natural defences rather than hard structures. More recently updated guidance from the Ministry for the Environment encourages an adaptive management approach. Both these approaches benefit from high quality information collected by UAV, that in turn provide us with valuable insight into coastal processes and therefore improving the quality of our work.

Techniques for mapping coastal, river and lake environments

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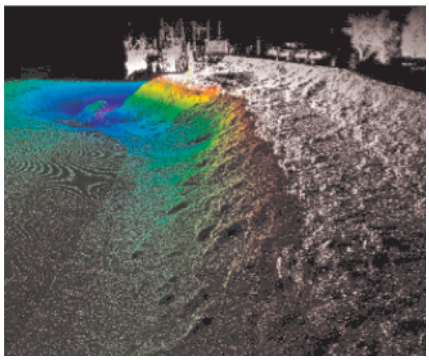
Discovery Marine Limited (DML) has spent the last 20 plus years developing techniques for mapping coastal, river and lake environments. Field capture processes have improved from traditional single point observations to using new sensors capable of remotely capturing high-resolution point clouds, seamlessly combining data from both above and below the waterline.

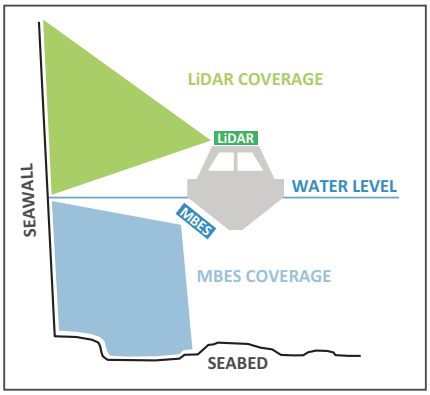
The sensors used to remote capture point cloud data sets include multibeam echosounders (MBES) for below the water and LiDAR (or laser scanner) mapping systems for above the water. DML has led the way in New Zealand in mounting both MBES and LiDAR sensors onto a vessel to simultaneously gather combined data in the order of 20,000 points per second.

The MBES system transmits a pulse of sound through the water column perpendicular to the vessel heading. The reflected sound is digitized into a swath of data points creating a 3D map of the seabed. The sonar head can be rotated to focus the direction of the swath towards a sloping seabed or vertical infrastructure such as wharves, seawalls or breakwaters.

The LiDAR system captures data perpendicular to the vessel heading. It is integrated into the same positioning and attitude system as the MBES resulting in a seamless data set.

The two sensors can be run simultaneously to capture a single data set in one pass, or when operating in tidal areas, data capture can be staged to maximize MBES coverage at high water and LiDAR at low water. Deliverables can be created to allow direct comparison with historical data sets and provide point cloud data for future interrogation, adhering to the 'capture once, use many' mantra.





(Top) Combined MBES (colour) and LiDAR (white) data set; (centre) LiDAR and MBES coverage diagram; (bottom) DML's USV 'Koura'.

Rapid advances in technology have accelerated the development of Unmanned Surface Vessels (USV) and Autonomous Surface Vessels (ASV) for bathymetric data acquisition. These platforms range in size from 0.5 m to 8 m and are providing new solutions for areas where access is problematic, manned vessels are unsuitable, or data collection efficiencies need to be increased by applying a force multiplier to an offshore fleet.

DML has developed an easy to deploy, remotely controlled USV that operates with RTK GNSS and a Single Beam Echosounder. This system can be deployed in enclosed waters where manned vessels are unsafe, expensive or time consuming to access.

For more information and imagery from DML's previous projects check out www.dmlsurveys.co.nz or contact one of DML's technical specialists.

Dipping the ocean

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Introduction

A heavy lift drone and Precision GPS is used to profile the seabed along SH1 Ohau Point, Kaikōura, to provide additional data for wave modelling in the hazardous rocky inshore zone to protect the newly constructed highway (SH1) and railway line.

Scenario

The seabed along the Kaikōura coastline was uplifted many metres and exposed a new shoreline of rugged limestone reefs, shoals and beaches following the November 2016 M7.8 earthquake. Our surveys of the Kaikōura inshore coastal zone has seen us use a number of land survey and hydrographic techniques to capture the ground and seabed shape for the wave modellers to use for their work to calculate the height and shape of the coastal defences on which the new highway has been reinstated.

However all of these techniques left out the non-navigable highly energised close inshore zone where you cannot walk, wade, swim or boat or use LiDAR.

Solution

Our answer was to 'Cross the Oceans' by flying a drone overhead and dip a lead line down to the seabed at regular intervals along preset profile lines. The technique was developed from an initial concept of tracking the drone using a total station (TS) to navigate and record its dipped 3D position – successful, but very slow and had limited range from the TS because of atmospherics and geographic location (headland). We created a sensor below the camera, which 'blinks' when the lead weight touches the seabed.

At great risk, we later mounted a high precision survey grade Trimble R8 GNSS receiver on the top of our DJI Matrice 600 drone to dip the position and level. We then processed the positions and levels of the seabed in terms of Chart Datum. Shoals, rocks and reefs can be observed using the camera and heighted using the dipping technique too.

Trimble R8 GNSS receiver on the top of the DJI Matrice 600 drone (Photo: Maurice Perwick).

Seafloor microbes drive ecosystem functions in the Firth of Thames

Kay Vopel[1], Bonnie Laverock[1], Rebecca Jarvis[1], Tarn Drylie[1], Pete Wilson[2]

The Firth of Thames (FoT) is a large mesotrophic estuary in the southern Hauraki Gulf (Fig. 1). Over time, it has received substantial quantities of sediment as a result of historic land clearance and the now predominantly agricultural use. The rivers Waihou and Piako contributed most of this sediment. Their current sediment loads, however, only account for less than half of the present-day deposition; the remaining deposition is likely due to reworking of legacy sediment by tidal and wind-driven currents and waves (Green & Zeldis, 2015; Zeldis et al., 2015).

Today, the substantial volumes of suspended and deposited sediment fuel microbial processes that drive important functions of the FoT ecosystem. These processes represent the most fundamental and valuable ecosystem services: they cycle essential nutrients that sustain food webs and they provide resilience to eutrophication (Galloway et al., 2003). For example, part of the inorganic nitrogen (the sum of nitrite, nitrate and ammonium) that fuels primary production in the seawater column and at the seafloor originates from the decomposition of organic carbon in deposited and suspended particles (Fig. 2). External sources of dissolved inorganic nitrogen are important too: westerly winds bring deep nitrogen-laden oceanic water onto the shelf, and rivers draining the FoT catchment add nitrogen to the FoT. The latter source dominates the loading of this estuary with nitrogen, but the observed increase over the past decades in dissolved inorganic nitrogen (5% per year between 1998 and 2013) cannot be explained with the upwelling of oceanic water or the stable, or even decreasing, nitrogen river load (Green & Zeldis, 2015; Zeldis et al., 2015; Vant, 2016).

There is perhaps no simple explanation for this discrepancy in the FoT nitrogen budget, but the observed trend points to changes over time in the contribution of external and internal nitrogen sources. Our new Waikato Regional Council (WRC) funded research initiative concerns one potential driver – the contribution of internal nitrogen loading to the FoT nitrogen budget. This WRC–AUT collaboration is linked to and supported by an MBIE-funded programme 'Tipping-point responses of coastal primary productivity to projected ocean acidification scenarios'. In this programme we investigate the impact of increasing atmospheric carbon dioxide on seafloor microbial processes (primary production and nutrient cycling) using experiments with natural sediment communities from the Hauraki Gulf (Laverock et al., 2018; Vopel et al., 2018). Global change phenomena, such as seawater acidification and warming, have the capacity to severely impair microbial seafloor processes, but whether they actually contribute to the observed trend of increasing nitrogen load in the FoT is unknown.

One internal microbial process of particular interest, and the main focus of our new research initiative, determines the capacity of the FoT ecosystem to recycle inorganic nitrogen into the atmosphere providing resilience to eutrophication. This process, termed denitrification, consists of a series of microbial reactions that transform nitrate to nitrogen gas (Fig. 2). Considering that 73% of the total nitrogen export from the FoT appears to be in the form of nitrogen gas (Green & Zeldis, 2015; Zeldis et al., 2015), this process seems a promising target. Denitrification requires anoxic conditions in the vicinity of a source of nitrate. The process is therefore most intense in environments in which the microbial consumption of oxygen is limited by molecular diffusion creating oxic–anoxic boundaries. Such conditions exist immediately below the surface of the FoT soft-sediment seafloor and inside larger suspended sediment particles. Because a decrease in the efficiency of denitrification would increase the retention of nitrogen in the FoT ecosystem, environmental change that causes such a decrease may also be the cause of the observed increase in FoT nitrogen load.

Mechanistically linking changes in FoT environmental conditions, denitrification efficiency, and nitrogen loading requires a solid understanding of the natural variability and likely controls on the microbial processing of nitrogen. Our new research initiatives make the first step towards such understanding. To progress on this end, our team of scuba divers collect intact sediment

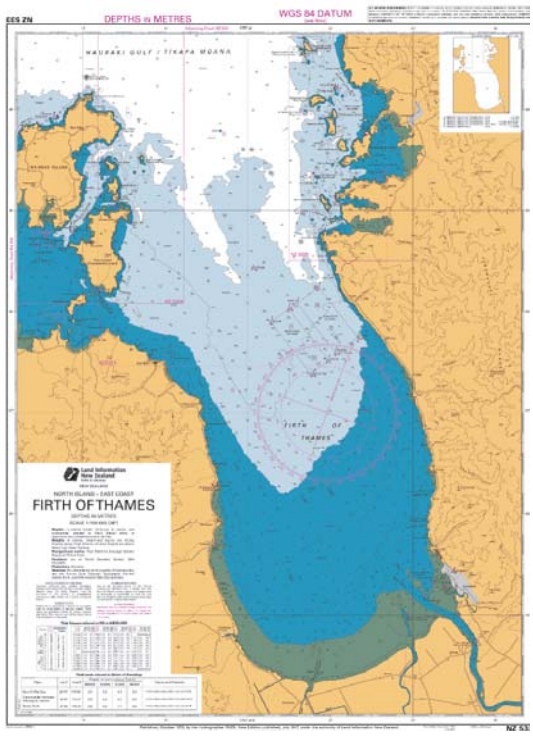

Figure 1: Nautical chart showing the Firth of Thames, a large mesotidal estuary on the east coast of the North Island of New Zealand, about 30 km long and 20 km wide, and covering an area of approximately 730 km^2. The Firth of Thames drains the catchments of four rivers: the Waihou, Piako, Kauaeranga and Waitakaruru. Seawater depth ranges from <5 m in the southern region to 40 m in the northern region. Tidal currents (spring and neap tide ranges, 3.2-3.5 m and 2.0-2.2 m) mobilise bottom sediment and disperse suspended sediment particles.

(1) School of Science, Auckland University of Technology; (2) Waikato Regional Council.

cores during seasonal campaigns from sites throughout the FoT featuring contrasting sediment communities (Fig. 3). We then study the sediment–seawater inorganic nitrogen exchange in our marine laboratories under controlled conditions to understand the biogeochemical coupling of sediment and overlying seawater as a function of sediment granulometry, sediment community composition, organic carbon content, and temperature. The following microbial process rate measurements then shed light on the contribution of the different microbial pathways to this coupling. Our ultimate goal is a detailed understanding of the response of the FoT sediment biological community, including its complex microbial reaction network, microalgal and infaunal assemblages, to environmental change. In the future, this will allow us to assess to what extent changes in the cycling of nitrogen below the surface of the FoT soft-sediment seafloor contribute to the observed trend of increasing seawater nitrogen concentrations in the FoT.

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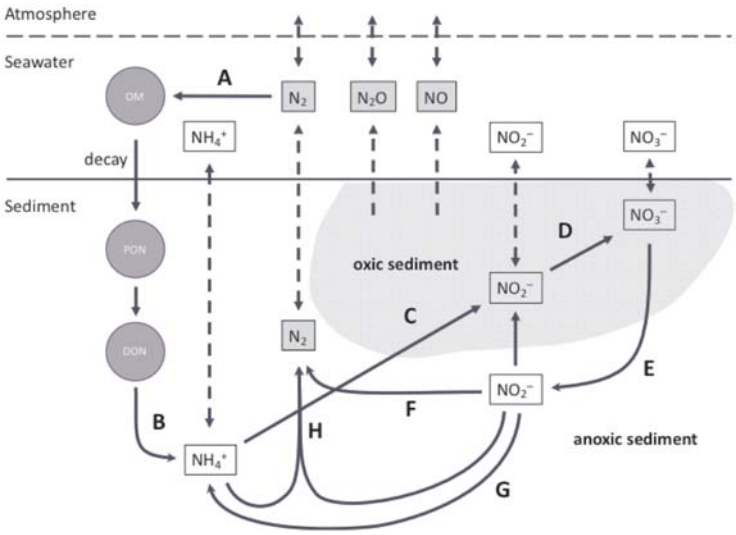

Figure 2: A simplified microbial nitrogen cycle occurring across the oxic–anoxic boundary within coastal sediment. Broken arrows indicate exchange between sediment, seawater and atmosphere. Continued arrows indicate microbial remineralisation reactions. Grey rectangles and circles indicate gaseous and organic nitrogen, respectively. PON, particulate organic nitrogen; DON, dissolved organic nitrogen. Processes: A, nitrogen fixation; B, ammonification; C, ammonia oxidation; D, nitrite oxidation; (C + D = nitrification); E, nitrate reduction; F, nitrite reduction (E + F = denitrification); G, dissimilatory reduction of nitrite to ammonium (DNRA); H, anaerobic ammonium oxidation (anammox). NO (nitric oxide) and N_2O (nitrous oxide) are intermediate products of both ammonia oxidation (C) and nitrite reduction (F). Nitrogen gas (N_2) is fixed into organic matter (OM), which settles to the sediment and is either decayed or buried. During the decay process, the microbial nitrogen cycle exchanges nutrients (NH_4^+, NO_2^- or NO_3^-) with the seawater column and converts fixed nitrogen back to N_2 (denitrification). Excess nutrients may cause eutrophication in the seawater column, which has adverse effects upon coastal ecosystems. Microbes are a key factor regulating this effect. Adapted from Laverock et al. (2011).

Figure 3: Photographs showing (A) members of the AUT/WRC project team and (B, C, D) acrylic tubes holding cores of FoT sediment. The team collects such cores at six sites featuring contrasting qualities of sediment.

Review: NZCS Annual Conference 2018

Sam Morgan, Conference Co-chair

The NZCS annual conference was held in Gisborne-Tairāwhiti from 20 to 23 November and attended by approximately 140 delegates from at least three corners of New Zealand. This year we had around 65 presentations and a good number of posters. This created a busy schedule, which we managed to squeeze in to the three days and, despite the tight timeframes, it was great to see a large number of delegates getting out and enjoying the local beaches and coast.

One of the highlights was being able to thread together stories of the different coastal aspects to Gisborne that makes it a special place to be. This was reflected in our range of keynote speakers, who covered recreational, coastal hazards, and economic components of the coast. So, for this I would like to thank Terry, Nicola and Martin for giving us a story and something to think about.

I personally enjoyed the conversation and insight given around the co-management of the Te Tapuwae o Rongokako Marine Reserve and the special relationship that Ngati Konohi now have with the reserve. The gradual buy in from the local community has now blossomed into a pride in the reserve, what it can be, and what is being achieved.

Congratulations to the NZCS award winners announced at the Conference Awards Dinner and also to the winners of the Conference Prizes:

- *Terry Healy Award:* MfE Coastal Hazards and Climate Change – Guidance for Local Government (2017)
- *Best overall oral presentation:* Tom Simons-Smith
- *Best student oral presentation:* Michael Tyler
- *Best poster:* Iñigo Zabarte
- *eCoast sustainability award joint winners:* Kelly Ratana and Caine Taiapa.

In particular I would like to mention Tom Simons-Smith's discussion (summarised on page 13). He presented on some of the work he has been trialling with the reshaping of dunes to allow for and control wind-borne sands and blowouts. The idea basically looks to increase the amount of sand in the landward portion of the foredune and potentially building volume and capacity within these features to accommodate storm-driven damage. This presented a slightly different method to dune management, which resulted in some heated debate and discussion. It is refreshing to hear people and local authorities trying new approaches, and the presentation of these ideas and associated debate is the one of the reasons we should be going to NZCS conferences.

A big part of this year's success was down to our generous sponsors – so, a big thanks should go out to: Eastland Port, NIWA, EQC, DoC, GHD, 4Sight, T+T, DML, Urban Solutions, and eCoast.

This year the conference is heading to the deep south so make sure you pack your best woollies and get ready for another ripper!

Other conference related articles in this issue

- *Best oral presentation winners* – presentation summaries (p 13)
- *Coastal remote sensing* – three presentation summaries focusing on the use of drones (p 8)
- *Circumnavigating Aotearoa* – James Cook's charting of New Zealand (p 6).

NZCS Conference – Best oral presentations

Among the awards given at the NZCS 2018 Conference were two for oral presentations – the best overall presentation and the best presentation by a student. Below are summaries of the two winning presentations.

Storm surges in Tauranga Harbour

Michael J Tyler, Waikato University
Best student oral presentation

Understanding extreme sea levels at the coast is important for managing coastal hazards and adapting to climate change. This poses challenges for coastlines around the globe due to increased pressure from sea-level rise and predictions for increased frequency of extreme events, storminess, and associated storm surge hazard. Therefore present day extreme sea levels are likely to occur more frequently in the future, reaching higher elevations. The largest storm surge on record in New Zealand was 0.88 m in Tauranga Harbour during Tropical Cyclone Giselle in 1968. This is quite large when compared to the tide range in the harbour, which can be 2 m, and significant when considering the role extreme sea levels play in coastal flooding.

The main aim of this research is to understand how storm conditions amplify the sea-level variations across Tauranga Harbour. The peaks over threshold method was applied to sea-level data at four gauges inside the harbour, and one on the open coast at Moturiki Island. Extreme storm surges were found to be influenced by the morphology of the coastline, the largest being at Omokoroa. Due to relatively short sea-level records, additional techniques using oral histories and photographic evidence were used to validate results from the extreme value analysis.

On 5 January 2018, a sub-tropical storm passing over Tauranga coincided with the highest king tide of the year, causing significant inundation of low lying areas around the harbour, particularly north facing shorelines. The combination of storm tide and wave run-up was highest around the southern entrance, which indicates significant external wave energy entered the harbour. The highest surveyed elevation of 2.11 m above Moturiki Vertical Datum 1953 was measured at Pilot Bay, Mount Maunganui. This event highlights the increased hazard

Pilot Bay, 5 January 2018, taken at 10:50 am (Photo: Michael Tyler).

from storm surges during king tide conditions.

Stepwise regression was applied to determine the variance in storm surge explained by atmospheric pressure and wind. Atmospheric pressure explains approximately 50% of the variance in storm surges. Wind from the east was found to explain an additional 3% to 15% of the variance, with the largest influence at Omokoroa. The relationship between storm surges and the Southern Oscillation Index was investigated at Moturiki, due to the potential for increased storm surge hazard during La Niña. No statistically significant relationship was identified, however the results indicate larger, more frequent surges during La Niña. Since 2012 there has been a greater frequency of storm surge events per year exceeding 0.4 m, which may be a result of the Interdecadal Pacific Oscillation that shifted around 2000, and was predicted to increase the storm surge hazard for several decades based on previous research.

Sea-level and storm surge data provided by this research also aims to be used toward the implementation of the King Tides Project in Tauranga Harbour. This is a tool primarily focused on engaging the community with sea-level related information and coastal hazards. Additional data and research will enable uncertainties around extreme sea-levels to be further validated, which will increase our ability to adapt to coastal hazards in the future.

Coastal landforms as assets, foredune notching, St Kilda Beach, Dunedin

Tom Simons-Smith, Dunedin City Council
Best overall oral presentation

Local government organisations make considerable investment in the ongoing maintenance of coastal protection assets such as sea walls, groynes and breakwaters. These investments are balanced against the services that the asset provides in mitigating the effects of damaging coastal processes. For example, a sea wall that acts as a barrier to erosion will be maintained so that the structure retains its ability to protect the coast. Natural coastal landforms such as foredunes and sand spits provide similar services, mitigating the effects of erosion and limiting coastal flooding induced by overwash and inundation. However, coastal landforms are not formally recognised as assets and as a result are rarely invested in or adequately considered in environmental assessments. Perhaps a better understanding of the value of coastal landforms could provide leverage in decision making and help coastal practioners better conserve, if not enhance, the coastal protection services of these landforms.

Historically, the value of coastal landforms has not been well identified; similarly, the ways that our actions impact the value of these landforms is not well understood. For example, when a sea wall is damaged during a coastal storm the cost can be estimated based on remedial expenditure, but when a dune is eroded and the coastal protection services of that landform lost (temporarily)

UAV view of St Kilda beach, October 2018 (Photo: Dave Borrie, University of Otago).

the cost is poorly understood as is the change in hazard exposure (risk).

The better we can understand the services that coastal landforms provide, the more effectively we can leverage decision making for the conservation of these landforms. Similarly, a building of this knowledge will enable coastal practioners to more actively encourage landform resilience to maximise the services of these landforms.

The Dunedin City Council and University of Otago have recognised the value of the St Kilda foredune in protecting inland infrastructure from the effects of storm erosion. These groups have engaged in a unique approach to coastal hazard management involving the active enhancement of landform resilience by maximising the services that the foredune provides in protecting the coast. Notching involves the deliberate and targeted excavation of a foredune to create pathways for beach-dune sand exchange. These pathways operate in a similar way to foredune blowouts – they are topographic lows in the foredune that enable enhanced onshore wind flow and sand transport. The purpose is to encourage sand to be shifted further inland, away from erosive processes that typically impact the seaward dune face, with the goal of achieving a broader dune shape, more resilient to storm erosion and more able to provide ongoing protection. The St Kilda notching project provides a standout example of a coastal landform being recognised for its value in protecting the coast. The project demonstrates a willingness to invest in a coastal landform to enable it to better serve a hazard management service. It is a unique take on asset management and a creative way to reduce coastal risk by encouraging a landform to become more resilient. In a time where our coasts are changing more quickly than ever it is important that we invest in the resilience of coastal landforms to achieve more cost efficient, adaptive management.

Disclaimer

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Contributing to *Coastal News*

We welcome contributions for forthcoming issues of *Coastal News*. Please contact the Editor, Charles Hendtlass, at cellwairmonk@gmail.com if you'd like to submit an article, contribute a news item, have content suggestions or a photo to share, or to give some feedback on the newsletter.

The submission deadline for the next issue is 31 May 2019.

A Contributor's Guide is available for download from the Society's website at www.coastalsociety.org.nz (under the 'Publications' tab). This provides information on the style and format requirements when writing for NZCS publications.

NZCS Regional Representatives

Every region has a NZCS Regional Representative who is available to help you with any queries about NZCS activities or coastal issues in your local area. If you are interested in becoming involved as a regional representative, please get in touch with Paul Klinac (paul.klinac@aucklandcouncil.govt.nz).

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Eastland Port: Upgraded stormwater treatment (with a whiskey chaser)

Hayley Redpath, Eastland Port

A bewhiskered 43-year-old father of two, Matt Schmelz can turn his hand to anything. He learns by doing, and over the past three years he's been instrumental in ensuring Eastland Port's upgraded stormwater treatment system works efficiently and is environmentally sound.

The Gisborne port's stormwater treatment system was installed in 2015 and uses lamella clarifiers – technology more commonly found in town drinking water processing – to clean its stormwater. Port staff are pretty sure they're the only ones worldwide adapting the technology for log yard stormwater treatment. And now others in the industry are taking note. Contracts project manager Mark Richards says his stormwater treatment presentation at last month's port engineers' forum, in Invercargill, led to inquiries from staff at other ports with the same issues. "I was down there explaining this technology while Matt was back in Gisborne taking clarified water home and making whiskey from the stuff!"

Eastland Port's asphalt upper log yard covers roughly the area of three rugby fields and houses up to 30,000 tonnes of wood. The logs don't stay on port long: they're weighed, graded and stacked, then shipped within nine days. But every day debris and dirt from the incoming logs creates a dusty or muddy environment, so cleaning the resultant stormwater before it flows into a neighbouring stream is a serious business.

The Kopuawhakapata Stream flows past the northern end of the port, then out under the wharfside fishing club into the turquoise waters of the city's inner harbour. This beautiful inner-city area is getting a spruce-up in time for October's Tuia Encounters 250 commemoration, when the East Coast and New Zealand acknowledge Māori and European navigation traditions.

With the port now sitting where many historical events took place, Schmelz judges himself on the ability of the port to be a good caretaker. He's the man most intimately familiar with the stormwater treatment system and, for this year and into the future, he wants to get things right.

Turning log yard run-off into cleaner water involves a number of steps. First in are the log yard sweepers – imported loaders with front-end units created originally to scoop European snow. They make extremely efficient sweepers, removing up to 3000 tonnes of wood debris at Eastland Port each month. The sweepers can't get everything, so sprinklers used to suppress dust help flush the remaining debris across the yard into a 200-metre-long, two-metre deep swale (basin) sunk into the ground to one side.

Matt Schmelz and Mark Richards from Eastland Port show the difference lamella clarifiers (at rear) are making to stormwater coming off a log yard. Both men are happy to drink the woody-tasting water on the left, and more recently Schmelz has turned some of it into whiskey (Photo: Eastland Port).

A process of natural settlement then occurs in the deep, swimming pool-sized swale. Heavy particles fall to the bottom, then the sludge is scooped or sucked out (depending on if it's dry or wet) and taken off-site to a consented clean-fill site, or it can be reused for composting. Meanwhile, the chocolate-coloured water from the swale is pumped through the two lamella clarifiers at around 24,000 litres per hour.

"The advantage of lamella clarifiers over other systems, such as settling ponds, is the large catching area created by the inclined plates inside," explains Schmelz. "It takes up a fraction of the space a pond would require."

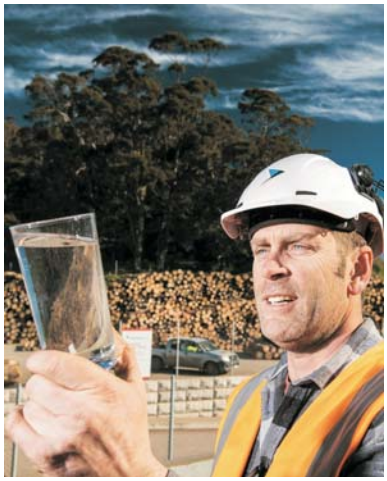
The angled plates catch floating particles from the incoming water and they accumulate at the bottom of the clarifier as sludge. Everything is left for a while before the water is decanted from the top and the sludge down below is removed to a clean-fill site. The clarified water exiting the unit at the top goes over a weir, disappears via a pipe under the road, and spills into the nearby stream and eventually into the harbour.

"Throughout this process we've done trials on things from rain gardens to sprinkler head size, from swale drain dimensions to the different weirs," Schmelz says. "Doing all of that means we're getting better at what we're doing, and the testing shows there's much cleaner water disappearing into the stream." Just recently however, not all the water has been going where it should ... some has gone into Schmelz' 25-litre water container to be taken home and made into whiskey (see sidebar).

As maintenance and project assistant, Schmelz finds the challenge of maintaining the port's water treatment system invigorating. Something about fixing and nurturing the complex process – especially when he and the engineers have had to feel their way through on their own – has been addictive.

Like a parent keeping an eye on an unpredictable adolescent, Dunedin-born Schmelz has monitored the treatment plant's response to every external change. While engineers like Mark Richards punch in the numbers, Schmelz goes a lot on gut feeling. "Every time it rains, I feel a knot of anticipation in my belly."

Twelve hours of average East Coast rain will gently cleanse the log yard of bark and debris and the system will cope with ease. But an



"I've always been a home brewer and I figured if the water had been cleaned, I could make a brew that was quite barky," says Matt Schmelz of his home-made whiskey. "I've drunk the water out of the treatment plant and it's clean and tastes like tannin. The flavours of whiskey are imparted by its contact with wood during maturation. I couldn't think of a better water source for my next batch." *(Photo: Eastland Port)*

hour of torrential rain from a thunderstorm will flush bark out from the log stacks in a wave and create some challenges. When this happens, "in just one hour you can have a hell of a lot of water rushing along the ground towards you," says Schmelz. "We're talking over 22 millilitres an hour across the upper log yard ... that's a large swimming pool amount of water and so we get that pump shifting up to 50,000 litres of water an hour. And it's not just happening to us, the rain event will be smashing into Crawford Road and the other streets towards Wainui. When that happens everyone's stormwater systems face a challenge."

In exceptional circumstances like this, Eastland Port is consented to let its extra overflow water go untreated. It's happened once since the upper log yard was redeveloped and the small discharge still distresses Schmelz. "We monitor it, but it hurts" says the keen fisherman who cringes at the thought of discoloured water from the city entering the harbour. He's thankful the sophistication of the port's system means the risk of untreated overflow is tiny.

Richards credits Schmelz and his highly-refined picture of the weather and the water treatment system with Eastland Port's ability to keep pace with the natural elements hurled at it. "He's great to have on the ground as he understands the system's strengths and limitations," he says. "He's so keen on making sure it behaves that he even came in from his camping holiday on Christmas Eve to check it would cope with forecast rain."

Schmelz shrugs. He's had an eye on the weather for the past two decades. He's made snow on Coronet Peak. He's been a stonemason turning rough rock into structure. And he used to run the maintenance team at Gisborne Airport. "I've always had a fascination with the weather and the mix of elements and time constraints they bring. It's how my weeks have been governed for years."

But the weather is just one variable, he adds. "I care about the whole process because there are only two of us operating the system. I want to do it right and get a nice, clear end-result." Schmelz is enthusiastic about the port's next water treatment challenge. By the end of 2019 Eastland Port, New Zealand's second largest log port, will have its third log yard up and running.

The pressure is on to create a seamless water treatment system as the new yard will sit right next to the harbour's water. Lessons learned from the upper log yard stormwater treatment process will be transferred to the new system and Schmelz says he and Richards will put everything they have into making it work.

Drilling into the nuances of Eastland Port's water treatment system, tweaking components so they run better than before, is not only satisfying and fun for Schmelz, it also frames his ethos about how things should be done. "We're writing the operations manual as we go but in this day and age, like everyone else, Mark and I are worried about the effects of industry on our neighbours," he says. "It's part and parcel of working in the marine environment."

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News from the regions

Northland

Laura Shaft, Regional Representative

Proposed Regional Plan for Northland

The Proposed Regional Plan for Northland was notified in late 2017. It is a single resource management plan for the region and includes a Regional Coastal Plan. Hearings were held between August and October 2018. The Hearing Panel is currently preparing its recommendations, with the aim of presenting them to the April 2019 council meeting for approval (see: www.nrc.govt.nz/rphearings).

From a coastal management perspective, the Proposed Plan has mapped nationally and regionally significant surf breaks, regionally significant anchorages, and significant ecological (marine) areas, as well as a raft of coastal marine area 'zones' (such as mooring and coastal commercial zones).

Real time coastal water quality data

You can now view real time coastal water quality data on the Northland Regional Council's website (www.nrc.govt.nz/buoydata). Council has two coastal water quality monitoring buoys, which are deployed every quarter. Deployments last for 30 days and the buoys collect data about water temperature, salinity, dissolved oxygen, turbidity and chlorophyll every fifteen minutes. One buoy is located in the Waitangi Estuary in the Bay of Islands, and the other at the Hātea River in Whangārei Harbour. Data from the buoys provides Council with information about water quality at the two sites and helps us to understand how water quality varies over diurnal and tidal cycles and how big rain events affect water quality. The data can also help us to identify environmental issues. The webpage allows you to select which site you are interested in and to choose from six different water quality parameters for each site.

West coast dune protection

One of the newer Northland CoastCare groups is at Mitimiti, just north of the Hokianga Harbour, where locals are working to restore the dunes by protecting them from damage and planting out bare dunes with tihetihe (spinifex) and pingao. The seed is collected from healthy parts of the dune and grown into seedlings that can then be

Ana Bercich collecting spinifex seed from the dunes at Mitimiti (Photo: NRC).

planted out into areas damaged by livestock, vehicles and pest animals. Supporting this will be education, signage, fencing and pest control to protect the dunes and plants.

The main driver of the project, Ana Bercich, explains the importance of spinifex to the area: "Tihetihe grows over our dunes and gives our marae and whenua its name, Matihetihe. Ma – white, tihetihe – spinifex. In late summer the seed head turns white and detaches from the main plant. It is believed to carry toheroa spat down to the wet part of the beach, where it grows".

Bay of Plenty

Mark Ivamy, Jonathan Clarke and Kieran Miller, Regional Representatives

Kaituna River re-diversion ahead of schedule

Construction work on the Kaituna River re-diversion project is now about one-third of the way through and progressing well ahead of schedule. Dredging works are nearly complete and the mauri baseline assessment is underway. The new stopbank on the western side of Ford Road has now been built up to phase one height (2.2 m above sea level), and cutting of the new 60 m wide re-diversion channel has begun. The sheet piling and concrete foundation works to support the 12 large box culverts that will allow water flow under Ford Road have been completed. More than half of the culvert sections have now been placed into their final position. Contouring to reconstruct salt marsh habitat at Te Pā Ika (previously called Te Paika), between Papahikahawai and Ford's Cut is also underway, using material from the widening of Ford's Cut.

Kūtaicam provides key info for boaties in Eastern Bay

Cawthron Institute and Whakatōhea Mussels Ltd have been providing boaties with the key information they need to plan their summer trips in the Eastern Bay of Plenty region using 'Kūtaicam', a data-capturing buoy deployed as part of the Open Ocean Aquaculture Programme. Cawthron Institute deployed the buoy at the Whakatōhea Mussels Ltd's farm 8 km off the coast from Ōpōtiki and is now publicly sharing some of the data it captures on weather conditions – including wind direction and strength, wave heights, and water temperature. Information from the buoy is updated every 45 minutes. The data can be accessed via a page on the Cawthron Institute website (https://www.cawthron.org.nz/apps/kutaicam) and via a link on the Ōpōtiki District Council website's homepage (https://www.odc.govt.nz).

"The buoy, which we've called Kūtaicam, kūtai meaning mussels, is right in the middle of the marine farm, which is a very popular fishing site in the area so it will provide really good data for local boaties," says Cawthron Institute's Kevin Heasman, Programme Leader for the International Open Ocean Aquaculture Programme. "We hope that people will use the information to make good decisions about when to safely go boating this summer. Data can also be viewed for the previous three days so that people can analyse trends. People should also check with MetService for regular weather updates." A similar buoy called 'Tascam' has been operating in Tasman Bay near Nelson since 2011 and there is another Open Ocean Buoy deployed in Pegasus Bay near Christchurch, which will be accessible by the public soon.

Hawke's Bay

José Beyá, Regional Representative

Clifton to Tangoio Coastal Hazards Strategy

The Clifton to Tangoio 2120 Coastal Hazards Strategy began in 2014 and is now in its 4th stage. The strategy is being driven by Hawke's Bay Regional Council, Hastings District Council, Napier City Council, and groups representing Mana Whenua and Tāngata Whenua. This strategy has been actively supported by The Living Edge, a science

programme comprised of experts from Auckland, Victoria, Wellington and Massey Universities and NIWA, several of whom worked with MfE in the revised national coastal hazards and climate change guidelines. Previous stages of the Strategy have produced high-level estimates for possible solutions and recommended actions for each priority area over the short, medium and long term (more details can be found at: https://hbcoast.co.nz).

In the present stage, the Regional Council is developing more refined designs and costings for the preferred pathways. The designs involve wave and shoreline evolution modelling as well as groyne fields and nourishment volume design. Other work in this stage involves the definition of triggers (to take action) and funding models.

Clifton rock revetment

The Clifton rock revetment, part of the Coastal Hazards Strategy, is about 90% finished and is planned to be completed by March 2019. It was commissioned by Hastings District Council, designed by Beca and built by Berkett Earthmovers Ltd. This revetment protects the public access road to the Clifton Campground and Marine Club. The total project cost is $1.3 million and includes 480 m of protected coastline with 15,000 tonnes of limestone rock from a private quarry in Waimarama. Additional to the revetment this project includes roading, landscaping and a tractor ramp.

Aerial view of Clifton revetment (Photo: Hastings District Council).

Cape Kidnappers landslides

A series of at least three significant landslides occurred at Cape Kidnappers between 24 January and 7 February 2019. The first landslide produced small tsunami-like waves, which had no significant impacts, but did occur while two tourists were on the way to the Cape Kidnappers Gannet nesting area. This resulted in both of them getting swept to sea and badly injured. After the first slip, the beach access was and remains closed. Subsequently two tourists who ignored the sign had a near miss.

The total volume of the landslide estimated by Hasting District Council is over 30,000 m^3. These events are part of a natural process of erosion, which also provides sediments to the beaches located north.

Aerial view of the landslide fan on 5 February 2019 (Photo: Hastings District Council).

Port of Napier

There is a lot going on around the Port of Napier. A resource consent application for the port expansion involving a new wharf and additional dredging has recently been approved. One of the issues under discussion and relevant to the Coastal Hazards Strategy is the disposal of the suitable sandy material from the port dredging. This material has historically been disposed in the consented area about 200 m offshore from Westshore Beach as part of a renourishment programme. Napier City Council and Hawke's Bay Regional Council are the main stakeholders interested in maintaining this practice.

There has also been public consultation about the future ownership of Napier Port, currently fully owned by Hawke's Bay Regional Council. To raise the funds to enable the Port's growth, the Regional Council's preferred option is selling up to a 49% stake of the port through a sharemarket float. This will ensure majority ownership and control while funding the investment programme over the next ten years, including the construction of Wharf 6.

Whirinaki environmental issue

An environmental issue has occurred at Whirinaki where a crack was discovered in September 2018 in PanPac Forest Products' mill outfall pipeline and a brown discharge is leaking from the pipe. The Regional Council is monitoring the situation closely and is undertaking an investigation into the maintenance of the pipeline. PanPac has tried unsuccessfully two different methods to repair the leak and is now working on a third approach. The company hopes to have repairs completed by March, and is also looking at long-term replacement solutions. Signs have been put up warning people not to swim in the area, and an investigation has deemed the public health and environmental risks are sufficiently low that it doesn't warrant closing the mill down.

West Coast

Ana Serrano, Wellington Regional Representative

During the last months of 2018 we worked together with Engineering New Zealand to organise a final Regional Event for the West Coast. The event consisted of a site visit to the 'under construction' Punakaiki coastal revetment, designed after ex-tropical Cyclone Fehi left that section of State Highway 6 (SH6) running on one lane. The organisation of the event presented a challenge: the site is on SH6 between Westport and Greymouth – so close to no-one. Even though the location was not the most convenient, the event aroused great interest and we thought that the magnificent views of the West Coast beaches would make the drive worthy.

The morning of the event the weather was literally dreadful, we thought the rain and the wind would understandably put off some people from coming. Nonetheless, it turns out that the bad weather was not an obstacle for most of the attendees, and the event turned out to be a great success. We had a great turn out, and even the rain and the wind stopped for us during the site visit. Everything went well in terms of health and safety, and finally we had the opportunity to share pizza with everyone while discussing, not only how big the rocks of the revetment are, but also the challenges that the West Coast is currently facing in the coastal space.

West Coast Regional Event attendees after the site visit.

University news

University of Canterbury upate

Seb Pitman

Masters student Kate MacDonald has now finished her research into the geomorphic response of Kaikōura's mixed sand gravel coastline following the 2016 earthquake, and is preparing to present this work at Coasts and Ports later in the year. Mitchell Phillips has just completed his undergraduate thesis investigating the relative importance of hydrodynamic parameters as indicators of storm impact on coastlines along Pegasus Bay, and George Merfield has just completed a thesis on the link between synoptic weather patterns and coastal flooding in New Zealand. A warm congratulations to all three students on their excellent work!

Deirdre Hart continues to research (a) coastal and river settlement multi-hazard methodologies (in collaboration with Derek Todd, Sonia Giovinazzi, Craig Davis and others) and (b) tides around New Zealand and Korea (in collaboration with Do-Seong Byun). This year she is branching out to investigate the tides around Antarctica and is keen to connect with other researchers interested in Antarctic tidal research: deirdre.hart@canterbury.ac.nz

In collaboration with Surf Life Saving Northern Region and Plymouth University in the UK, Seb Pitman has just conducted three weeks of fieldwork looking at nearshore currents at Muriwai and Orewa. The research forms part of a workstream that aims to incorporate real-time beach risk prediction into Auckland Council's SafeSwim app. Preliminary work has identified a strong tidal modulation of rip current circulation at Muriwai, with longshore transport dominating under high water levels, intense re-circulatory flow within the surf zone at mid tide, and surf zone exits towards the outer bar at low tidal elevations. Work at Orewa identified the controls on the establishment of a significant longshore flow, which has the potential to transport bathers into strong offshore estuarine flows at certain tidal stages. Much work is left to do, and the next stage is to extend the parameter space through numerical modelling, but the team enjoyed a successful first period of fieldwork.

(Re)Introducing Dr Shari Gallop, Senior Lecturer, University of Waikato

I have just taken up the position as Senior Lecturer at the University of Waikato, Tauranga campus. I am from the Eastern Bay of Plenty (Manawahe) and previously studied at the University of Waikato before spending 10 years doing my PhD (University of Western Australia) and working in the UK (University of Southampton) and Sydney (Macquarie University). I am very happy to have returned home with my family, and am excited about the growth in marine science in New Zealand.

My research focuses on coastal morphodynamics and physical oceanography in a range of environments from surf zones, to estuaries, through to rocky and reef coasts, across multiple scales. My current projects include looking at wave propagation and the morphodynamics of estuarine shorelines. I also have a long interest in surf zone processes such as rip currents and measuring these both in the field and using video remote sensing. I am also working on looking at geological control of beach morphology such as from headlands and reefs.

Checking out the managed realignment (reintroduction of tides) to previously reclaimed farmland in Steart, UK.

Preparing instruments for deployment to look at waves and currents in the Pittwater Estuary, Sydney.

Contact: shari.gallop@waikato.ac.nz

News in brief...

Murray Ford

- The University of Auckland has farewelled Professor Paul Kench and Dr Susan Owen, who have taken up positions at Simon Fraser University in British Columbia.
- Assoc. Profs. Wayne Stephenson (University of Otago) and Mark Dickson (University of Auckland) were successful in the recent Marsden Fund round. Their project is titled *Will it stay or will it go? Determining the relationship between marine terraces formed by earthquakes and coastal erosion*. Keep an eye out for them conducting fieldwork in Kaikōura and Mahia Peninsula.
- As part of an MBIE Endeavour Fund project Dr Melissa Bowen and Assoc. Prof. Giovanni Coco will concentrate on the accumulation and distribution of microplastics in the Waitemata Harbour. They are building hydrodynamic models – mathematical models based on measuring real water flow – to figure out where the microplastic is coming from, how the water is moving microplastics around, and where they are going. For more, see: www.auckland.ac.nz/en/science/news-and-events/inscight/a-world-made-of-plastic.html

Paul Baunton: A Coastal Hazard Pioneer

The coastal community has lost one of its own and a pioneer in coastal hazard management. Through his innovation, drive and determination Paul Baunton leaves behind a legacy of work increasing the resilience of the Tauranga community for decades to come.

On Sunday 25 November, Paul Baunton, Manager of Emergency Management at Tauranga City Council, sadly passed away after a short illness.

Paul spent over 20 years at Tauranga City Council, working tirelessly to deliver the best for the Tauranga community. His commitment to evidence-based research, particularly in the area of coastal hazard management and tsunami evacuation planning, has left a long-lasting legacy.

Paul was instrumental in developing coastal hazard zones along the Tauranga City open coast in 1997 with the famous *Skinner v Tauranga* taken all the way to Environment Court then the High Court. This lead to plan changes with development controls for coastal hazard areas, including no new development in the highest risk areas. However, he not only championed coastal hazard planning but also provided guidance for appropriate development within hazard zones to assist communities be more resilient.

In more recent years, Paul was the driver of ground-breaking tsunami resilience work which changed Tauranga's approach to tsunami risk and resulted in millions of dollars' worth of new evacuation infrastructure.

In 2017 Tauranga City Council and Tonkin + Taylor Ltd won the Director's Award for Innovation for the council's tsunami risk mitigation programme. Thanks to Paul, the coastal community now has access to evacuation routes across earthquake-strengthened pedestrian bridges – a New Zealand first.

Where people can't make it out of the evacuation areas in time, the council has constructed a purpose-built tsunami high-ground structure, strengthened for seismic activity and with capacity for at least 3,000 people. This is another first for New Zealand, with similar structures planned elsewhere along the Tauranga coast.

Paul was instrumental in shifting the Tauranga tsunami conversation from sirens to evacuation. He was relentless in his commitment to ensure that the city developed a practical, effective evacuation network that people can have confidence in.

He will be greatly missed by his colleagues and by the coastal and emergency management community. He leaves behind a legacy of innovative work that will continue to serve our community for many decades to come.

We offer our thoughts and condolences to his family and especially Celia Joy Baunton who has been his support and principle cheer leader.

Matthew Harrex and Richard Reinen-Hamill