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September 2019
Issue 99

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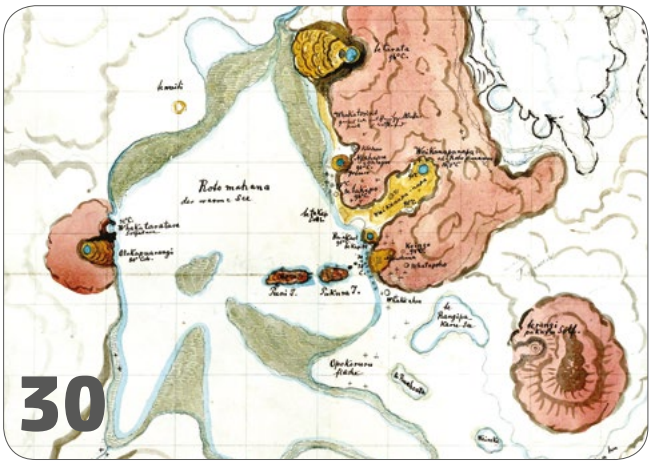

SURVEYING + SPATIAL

SEPTEMBER 2019 ISSUE 99

COVER IMAGE

The wreck of the *Mikhail Lermontov* as she lays in 30m of water in Port Gore, Marlborough. The 175m-length former Russian cruise liner sank on February 16 1986 after striking rocks off Cape Jackson.

The image of the wreck was created by Discovery Marine Ltd using multibeam echosounder bathymetry, seafloor backscatter and water column backscatter techniques.

ARTICLES

REGULAR FEATURES

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EDITOR
Rachel Harris
surveyingspatial@gmail.com

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The Chief Executive
Survey and Spatial New Zealand
PO Box 5304
Lambton Quay
Wellington 6140
New Zealand
Phone: 04 471 1774
Fax: 04 471 1907
Web address: *www.surveyspatialnz.org*
Email: *admin@surveyspatialnz.org*

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KPMDesign – *www.kpmdesign.co.nz*
info@kpm.co.nz

TO ADVERTISE
Email: *admin@surveyspatialnz.org*
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Development and environments

Rachel Harris

New Zealand is fortunate to contain some of the most exceptional landscapes in the world, with some equally unique flora and fauna.

Mick Strack's report this edition on the Environmental Defence Society's annual conference raised some interesting points around the Resource Management Act and the value and protection of landscapes in New Zealand, particularly the Mackenzie Basin.

I lived in the Mackenzie Basin for several years until moving away five years ago and watched on as commercial and residential developments rapidly took shape in the district.

At times, many of these developments were controversial and divided communities in the district, and indeed the RMA has been contentious at times, but the Mackenzie Basin is unequivocally being impacted both visually and ecologically.

Forest & Bird states the Mackenzie environment supports a habitat for the endangered kakī (black stilt) and numerous other wading birds, as well as native skinks and geckos that feed on selected plants in the area and is home to up to 81 threatened or at-risk plant species.

As New Zealand's unique landscapes continue to be diversified for residential, commercial and industrial purposes, it is important for all of us to take part in the conversation of balancing future growth and protecting our unique environments.

This edition features a wide variety of subject matter from across the surveying and spatial industries, from technological developments to legal perspectives and project updates.

The engineering stream reports on the latest stages of development on Auckland's City Link rail project, New Zealand's largest transport infrastructure project.

GIS specialist Nathan Heazlewood looks back on 20 years since the inception of New Zealand's national topographic database, and the lessons learnt from developing this innovative database.

From the hydrographic stream, University of Otago Hydrographic Surveying lecturer Emily Tidey and university students report on the Australasian Hydrographic Society's annual New Zealand region seminar held at the School of Surveying in Dunedin in July. The day's events included a visit to Port Otago's $8 million backhoe dredge, Takutai, and Port Chalmers as well as presentations ranging from Captain Cook's New Zealand hydrographic charts to acoustic imaging research on a Stewart Island shipwreck, the Marine Maid.

And following on from last year's extensive study of Hochstetter's 1859 survey of the Pink and White Terraces, Rex Bunn reports on new research findings from the Hochstetter material.

Cadastral survey system – Where are we heading?

Anselm Haanen
Surveyor-General/Kairūri Matua

Over the next five years or so, Land Information New Zealand (LINZ) will be leading some significant changes to the cadastral survey system. These include the Review of the Rules for Cadastral Survey and changes to Landonline. While these are significant in themselves, they are part of a set of integrated changes that are intended to significantly improve the cadastral survey system.

Some of the issues with the current regime are relatively recent, such as those resulting from the 2010 Rules. Some relate to the early design of Landonline, while others have been around for even longer. In a broader sense these issues include:

- The need to better reuse data already in the cadastre when undertaking a survey.
- Inefficiency in dataset and plan preparation, with duplication of some information.
- High levels of validation effort, including by LINZ.
- High error rates in cadastral survey datasets (CSDs over the long term, with requisition rates of more than 40 per cent.
- Processes for CSDs with height boundaries not in digital form.
- Increased demand for a spatially accurate parcel fabric.

A third key contributor to addressing these issues is survey software – acknowledging the important role that it plays in the digital processing of a CSD.

The following are intended to give surveyors a sense of the upcoming changes and how they contribute to improvements in the broader system.

Rules review

The Surveyor-General started a review of the Rules for Cadastral Survey in July 2017 by looking at feedback on the 2010 Rules and consulting through an Issues and Opportunities paper. We then prepared a series of proposals and tested these with a reference group of licensed cadastral surveyors before consulting more widely.

We've amended and refined the proposals and in June started drafting the actual rules in conjunction with Parliamentary Counsel Office. Later this year we will once again use the reference group to test the draft rules before consulting with the wider profession.

The new rules will in many cases be simpler, and will be presented in a new layout and style that should make them easier to interpret – feedback indicates this is the biggest issue for the profession.

Early in the process we explored the feasibility of dispensing with the requirement for a Diagram of Survey, but I have decided to defer further consideration until we have suitable, tried and tested visualisation tools.

Here are some of the key changes that you can expect to see:

- Removal of the term 'defined by adoption' and simplification of when 'defined by survey' applies so it is more intuitive and aligns with surveyor practice. The class A 0.4ha rule will be removed.
- Simplification of the requirements for reference marks – merging the requirements for permanent reference marks (PRMs) and witness marks, but aiming to ensure that sufficient PRMs remain in the long term to support the re-establishment of boundaries.
- The requirement to connect to the survey network will be extended – surveys of primary parcels will have to be connected to a mark of 6th order or better (LINZ's PositioNZ service can be used to calculate the vectors to LINZ base stations). Similar connections will also apply vertically, with NZVD2016 to be used as much as possible.
- Simplified requirements for non-primary parcels, with consolidation in a specific part of the rules. Underlying primary parcel boundaries won't have to be accurately located on rural surveys that define only non-primary parcels ('easement only' surveys). However, in these cases they will have to be connected to the survey network, and some will still require PRMs.
- A new section specifically for boundaries in the water, such as marine reserves and customary marine titles. These boundaries will be required to be connected to the survey network, without PRMs.
- Simplification of the requirements for reinstatement surveys, with only two options rather than the current three. The emphasis will be on enabling the use of digital data, with simplified reporting requirements. A 'full' survey will still be required where there is conflict.

While the rules are likely to be ready early in 2020, they will not come into force until the necessary changes have been made to Landonline, survey software and LINZ business processes.

Rebuilding Landonline

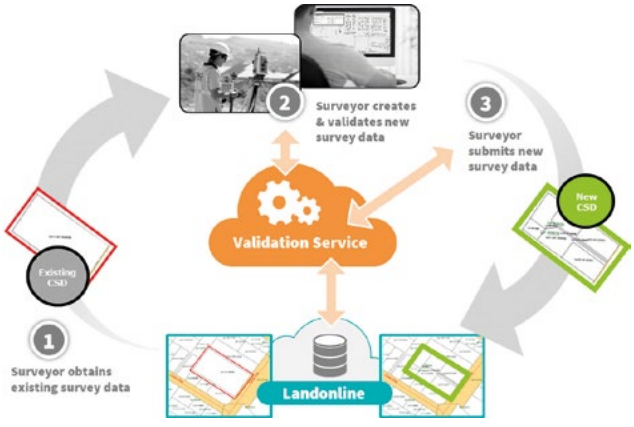
In reviewing the rules it became very obvious that many of the issues being experienced by surveyors are actually to do with Landonline. It also became clear that Landonline and the rules are often not well aligned.

In October 2018 LINZ obtained approval to embark on a five-year programme to progressively rebuild and enhance Landonline. Further information can be obtained under *Rebuilding Landonline* on the LINZ website. The initial phase will focus on updating the underlying technology and on providing better search capabilities. This platform will then be used to develop a range of further services and products. For the cadastral changes I have picked out five key focus areas:

Improving visualisation. CSDs are already substantially submitted in digital form, but we need better tools for visualising that data in a form suited to specific uses, and rely less on 'paper' plans.

Avoiding duplication and rework. Most datasets are prepared in survey software, but require completion within Landonline. Better integration between survey software and Landonline will improve data flows, especially following requisition, and increase compliance.

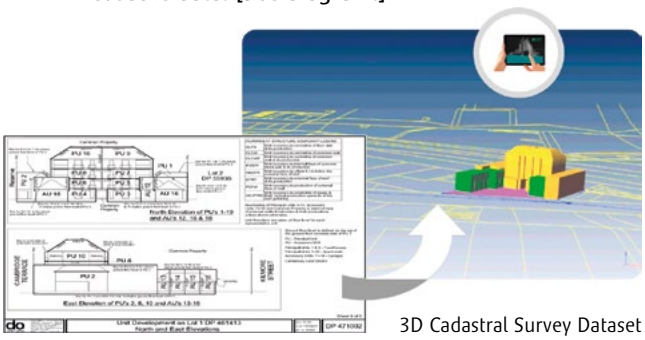
Improving CSD quality. The current testing of CSDs through Landonline business rules delivers equivocal results and comes late in the cycle. We are looking at developing a new web-based validation service that will provide APIs[1] for use by both survey software and LINZ / Landonline. The service would provide an extensible library of granular business rules and will enable intelligent feedback of data elements that fail. [See diagram.]



Online Validation Service

Improving the easement process. The current process results in a high number of errors and is often poorly coordinated between surveyors and conveyancers. We are looking at re-engineering the processes for creating and re-creating easements and integrating this with the conveyancer e-dealing process.

3D Cadastre. While the majority of CSDs are represented in digital format, those defined in the third dimension are not. We need to enable the lodgement of unit title, cross-lease and stratum CSDs in digital format, to streamline the production and validation process and maintain a 3D cadastre that delivers reusable data. [See diagram.]



3D Cadastral Survey Dataset

Integration with survey software

Landonline functionality was designed to capture CSDs because survey software did not have this functionality at the time. Survey software has now enabled the vast majority of CSDs to be captured and exported to Landonline. We want to work with survey software vendors to improve the capture, validation, and lodgement of CSDs. The use of APIs to access data and validate CSDs is a critical component of this goal.

The LandXML format is also something that we want to review, to enable a more efficient and accurate import and export of cadastral survey information. LINZ plans to work with vendors and surveyors to make sure that the solutions work for all.

A cadastre for the future

Changes to the rules, changes to Landonline, and better integration with survey software will each provide significant benefits. However the broadest and most enduring benefits will arise from developing a fully integrated solution where these contributions are fully aligned. These are big changes that will take time to develop and implement. We all need to ensure the integrity of the cadastre is maintained throughout the process.

With close collaboration we will be able to improve efficiency, reduce rework, improve the quality of cadastral surveys, and deliver a more complete and accurate cadastre.

NOTES

1 Application Programming Interface

Priorities

A key priority for the Board and National Office over the past few months has been to develop a business plan that responds to the priorities identified by the Council earlier in the year. At the front of our minds is the need to better communicate both to the membership and to external parties what Survey and Spatial NZ is about: why we exist, what we offer and how our members contribute to society.

This is especially important given our name change. Some of the activities you will see over the next few months include testing our current vision, values and mission with existing and potential members; understanding our members and partners better to ensure we continue to deliver services of value at all stages of an individual's career and delivering on our earlier promises to clarify membership and certification pathways.

The Council has been working on improving the examinations process with the examinations panel and Cadastral Surveyors Licensing Board. We require experienced planning and engineering practitioners to join the team and assist with candidate interviews. If this sounds like you, please contact Russell Benge or Julia Glass.

A working group has been set up to share lessons learnt by our members during and after the Canterbury earthquakes. This will benefit other regions in the event of a natural disaster by ensuring we are prepared (logistically) to offer help and that we are better connected both across S+SNZ and with external organisations. I would like to thank Todd Airey and Bruce Robinson for being passionate and committed to progressing this work.

On a completely different note, I recently watched a really great TED talk that I thought was worth sharing. While it is pitched at women, I think it would be good viewing for most of our members. If you're a business owner wondering how to lift the performance of your senior staff to the next level, you will get something out of it.

If you're someone at the mid-level who is frustrated by slow career progression, it will give you some pointers on areas you could be focusing on other than your technical expertise and people skills. And if you're just starting out, it's also useful to know what to consider once you have mastered the basics. Happy viewing!

www.ted.com/talks/susan_colantuono_the_career_advice_you_probably_didn_t_get?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare

Cadastral Professional Stream

The stream is collaborating with the Institute of Cadastral Surveying to produce a good survey practice guidance document. The guidance material will aim to identify the principles of topics but not be a how-to guide. It is likely we will be calling for assistance from members who would like to be involved with this project – watch your inbox for details.

We are also organising a webinar – *A practical guide to Unit Title Subdivisions for Cadastral Surveyors*. This is being held on November 8. See the Survey and Spatial website for further details.

Our members are continuing to work with LINZ on both the STEP and rules review projects. We understand a draft set of rules is in the process of being composed and LINZ is hoping to consult with surveyors once it has been completed. The STEP project is progressing well with the working group meeting every three months in Wellington. From what we have seen to date, there are some great ideas being implemented into the wider Landonline system.

Matt Ryder, Cadastral Stream Chair

Hydrography Professional Stream

Some members of the HPS recently attended the New Zealand Region of the Australasian Hydrographic Society Seminar in Dunedin. The seminar was aligned closely with World Hydrographic Day (WHD) and featured presentations from the Government, industry, defence and academia. Ten students (from Otago, Canterbury and Lincoln) were generously supported to attend, present or write up the activities of the day. Their write-up is published in this issue of *S+SNZ*.

The HPS was recently represented at the Port & Harbour Marine Safety Code Forum, held in Auckland. Maritime NZ and LINZ reported back on the review of the Hydrographic Guidelines that supports the code. The rewrite of the guidelines is ongoing, taking in to account comments from a number of port companies and harbourmasters. The main change is the audience for the guideline. The previous version was a technical document aimed at the surveyor, whereas the new version is being aimed at the decision makers within the port environment. The intention is to encourage the use of multibeam systems and qualified/certified hydrographic surveyors in this type of work. A draft of the new guidelines will be sent out to HPS members for comment later this year. As hydrography professionals who work this space it is very important we participate – please watch for the email!

LINZ survey activities have seen the final survey deliverables from DML for the Eastern Bay of Plenty survey and fieldwork in Fiordland completed by iXblue – deliverables expected by November. LINZ and Marlborough District Council are planning another partnership with surveys in the Pelorus Sound area this year; and LINZ continues with the MFAT Pacific Regional Navigation Initiative programme with survey work in Samoa. LINZ is also working on a stock take of marine geospatial information across government agencies and organisations. This work includes working with Stats NZ.

The NZ Coastal Society (NZCS) Conference will be held in Invercargill on 12-15 November this year. NZCS is a technical group of Engineering New Zealand. More info can be found at: *www.coastalsociety.org.nz/conferences/nzcs-2*.

We hope to see some S+SNZ members there.

HPS Team

Land Development & Urban Design Stream

The Land Development and Urban Design Stream is currently looking to gain more of an understanding of the areas of interest of its members. The intention is to identify focus areas for possible workshops and webinar opportunities.

The committee is pulling together a questionnaire that will be circulated to stream members. Please complete

AHS event attendees. Mithun Muraleedharan.

AHS-NZR 2019 seminar pic – Commander Tim Garvan presenting. Maurice Perwick.

this questionnaire as it is really valuable to hear from you. Feedback is vital to the direction of the stream's work plan.

Julia Glass, LDUD Stream Chair

P&M Professional Stream/ Engineering Professional Stream

The stream working group is currently actively working on the following:

- A workshop in conjunction with the engineering stream, to be held in Christchurch on Friday, October 4. This should be seen as a great opportunity to come together and learn some new skills and network with others in this space. The programme has been designed to offer tangible practical benefits to those who attend. Previous events have been held in Auckland and it was decided to share the success of an event that can easily be seen as a fly-in fly-out event with other centres. For more details register online at: *www.surveyspatialnz.org/news_and_events/tickets_and_events/eng_pos_workshop_2019*.
- A Resilience Initiative – this initiative is in its early stages of development. The overarching goal is to be able to provide, equip and train a volunteer group of surveyors who are prepared to offer their services in times of national emergency. The need for such a group has been seen during both the recent Christchurch and Kaikōura earthquakes.
- Certification – in conjunction with the engineering stream the goal is to be able to provide a certification path for those who choose not to follow the cadastral or hydrographical survey path.

Bruce Robinson, P&M Stream Chair

Spatial Professional Stream

The Spatial Professional Stream held the Spatial Value Workshop in Wellington on 30 August in Wellington. This was facilitated by Jordan Alexander – one of our S+SNZ Board members. Results from the workshops will be summarised and will be used to guide our future direction and value for spatial members.

We are looking forward to further progressing our value to existing members, and our appeal to new members, within our vision of supporting a thriving, dynamic, and connected spatial professional community in New Zealand.

Entries for the New Zealand Spatial Excellence Awards (NZSEA) have now closed and judging is under way. The finalists will be announced on 5 September at a breakfast event so please register to come along and find out who will be in the running for the awards – the support of our spatial community for these awards is invaluable.

There are a number of spatial conferences coming up in the next few months, including the NZ Geospatial Research Conference (NZGRC) in Queenstown on 18 September (*www.geospatial.ac.nz/nzgrc-2019/*), the International Adventures in GeoComputation conference (*www.otago.ac.nz/geocomputation/index.html*) from 19-21 September in Queenstown, and the FOSS4G conference in Wellington on 12-15 November (*2019.foss4g-oceania.org/*).

The Spatial Professional Stream has also just set up a dedicated LinkedIn group so please do find us and join – S+SNZ Spatial Professional Stream. We will be using it as a channel for interesting industry articles and stream updates.

We are also looking for stream committee members, so please get in contact if you are interested in being part of the committee: *spatial@surveyspatialnz.org*.

Dr Kat Salm, Spatial Professional Stream Chair

TO ALL OUR MEMBERS AND ASSOCIATES:

S+SNZ would like to acknowledge the careers and contributions of all members past and present upon their passing and would like to actively encourage all branches to prepare obituaries for publication in *Surveying + Spatial* as the occasion arises.

If you would like to publish an obituary for the next edition, please email the editor, Rachel Harris at: *surveyingspatial@gmail.com*

GSI
INSURANCE BROKERS

Our story with S+SNZ so far...

GSI Insurance Brokers have partnered with S+SNZ for the last 6 years and service over 70 land surveying and multidisciplinary firms. We were the first diamond sponsor and this has enabled S+SNZ to better support its members and the land surveying profession in general.

We work with S+SNZ on insurance related topics or legislative changes that might impact the profession.

Some of our key achievements over the last few years:

- Lowering costs and excesses to land surveyors.
- Introducing an alternative insurance choice.
- Delivering covers not previously available in New Zealand.
- Continuous development of innovative solutions.

We recognise relationships are important:

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Simplifying The Complex

Surveying students demonstrate the School's interactive sandtable. Source: Harrison Long.

Hydrographic information driving marine knowledge

Annual Seminar of the NZ Region of the Australasian Hydrographic Society

Robbie Columbus[1], Ben Grant[1], Jocelyn Henderson[2], Harrison Long[1], Mithun Muraleedharan[1], Jessie Scurr[1] and Emily Tidey[1]

1. Te Kura Kairūri/School of Surveying, Te Whare Wānanga o Otāgo/University of Otago.

2. Faculty of Environment, Society and Design, Lincoln University.

Around 50 people attended the recent Australasian Hydrographic Society (AHS) Annual Seminar at the School of Surveying in Dunedin. After a morning tour we heard presentations from government, academic, industry and defence sectors. Four high school and 13 university students attended, with 10 students receiving sponsorship for presentations or the write-up of this report.

Field trip: Port Otago backhoe dredge Takutai and Port Chalmers

Gary Chisholm, of Trimble, gave us a quick introduction to the Port Otago backhoe dredge, Takutai, the $8 million platform recently acquired for maintaining Otago Harbour.

Takutai was retrofitted with a modern operator interface, giving the operator an accurate bucket position. Gary spoke about the dredging work done in the channel and gave us a peek into the real-time live operation of the dredger using Teamviewer remote access.

We followed this with a trip to the wharf where Takutai was working. Three 13-metre long spuds support the

Seminar attendees at Flagstaff Lookout. Source: Mithun Muraleedharan.

platform and allow it to 'crab' along the seafloor. It can dredge up to 19.8m depth, while RTK and sensors on the excavator boom give the operator centimetre-level precision.

The second part of the field trip took us to Port Chalmers. At Flagstaff lookout Alan Sutherland of PrimePort pointed out the cruise ship and container cargo areas of the port, as well as the two islands which require tricky ship manoeuvres to navigate between.

Rebecca McGrouther from Port Otago gave us an insight into the history of Port Chalmers. She spoke about the tsunami gate, multipurpose berths, container shipping, logging areas and ship management into Port Chalmers.

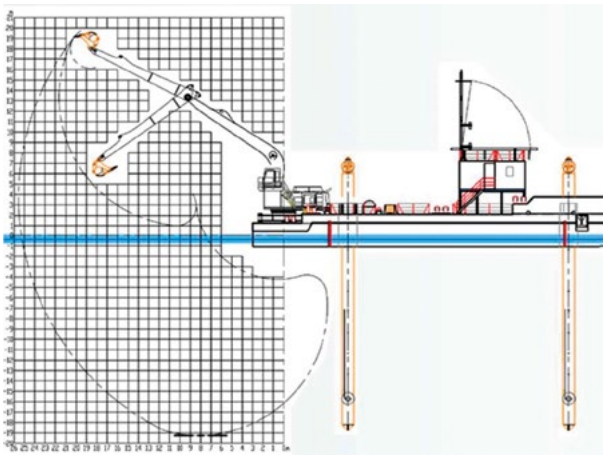
Backhoe dredge Takutai. Source: Port Otago.

Port Otago address: Rebecca McGrouther – Port Otago

Rebecca explained the 25-year vision for the port. This involves dredging to 10.5m In the Upper Harbour Channel to allow deeper draft logging, oil and gas vessels up to Dunedin on the Victoria Channel which is the 'trickiest pilotage in New Zealand'. This channel will be widened and deepened, and the turning circle extended.

This development is not yet at resource consent stage – currently they are assessing the possible detrimental effects of the dredging, including looking at flush rates and contamination, impacts on benthic communities, shelf bank loss, suspended sediment and contaminants and nutrients.

Meanwhile, Lower Harbour dredging started in March 2015 and by February 2016 the depth was at 13.5m. Several interesting objects were found during this, including railway lines and a pre-1900s artillery shell. While this part of harbour doesn't need to be deeper than 14m, it



Takutai. Source: Gary Chisholm presentation.

Port Chalmers from Lady Thorn Rhododendron Dell. Source: Mithun Muraleedharan.

does need to be wider for cruise ships (120 cruise ships visit Dunedin every season).

Tuia 250 – Captain Cook the hydrographer: Kara Jurgens, Jean-Louis Morrison (fourth-year BSurv finalists) and Emily Tidey – Otago University

In 2019 Aotearoa commemorates Tuia 250; 250 years since the first meetings between Māori and Europeans. This coincided with the donation of three charts dated around 1795 to the School of Surveying by Ron Tyson (of NZ Ocean Technology).

This generous gift inspired an investigation into hydrography in New Zealand. Reports in Cook's log book covered many of the same things that we record today, like weather and depth. The main discrepancy, compared with today, seemed to be the lashings doled out for misbehaviour!

The charts covered Cook Strait, Fiordland and Mercury Bay, so the researchers focused on these areas to assess how charts have changed over time and are now developing web maps showing this.

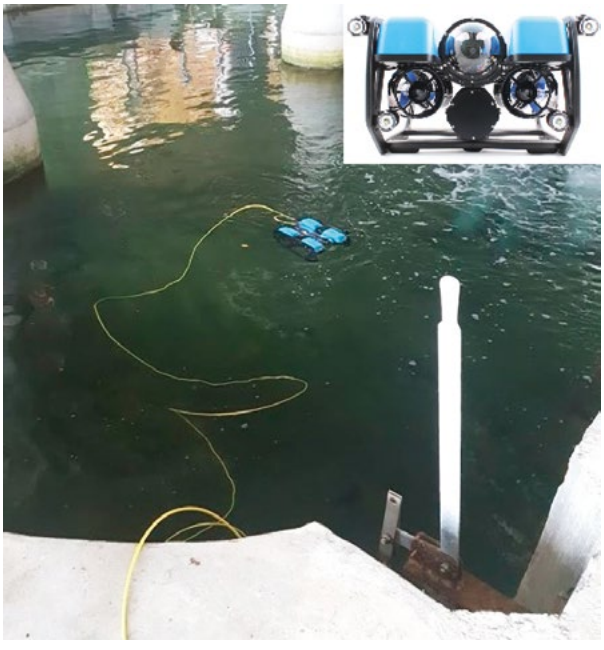
They also considered what motivates hydrographers today through a questionnaire, finding out that 29 per cent have worked with data that was collected on Cook's voyages, and one participant was disappointed that, in modern hydrography, 'we don't accurately chart sea monsters any more'.

Blue ROV: Michael Ellison (fourth-year BSurv finalist) – Otago University

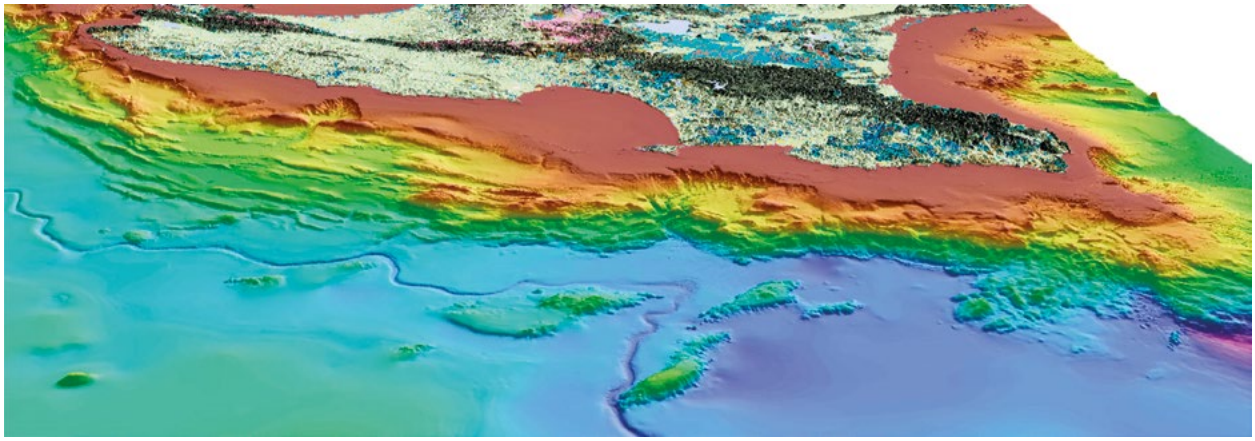
The School of Surveying recently received a BlueROV2 remotely operated vehicle (ROV) thanks to the generous donation of Alexander Waugh (of Fugro BTW). Michael spent the summer learning how to operate the ROV, exploring its use for different applications and creating an operation manual for future users.

The ROV has a front-facing camera and temperature and pressure sensors, but no underwater positioning capabilities. Michael's initial testing began in still water at the university's physics lab and Portobello aquarium.

The next step was to trial the ROV in open waters of the Dunedin Harbour at greater depths. Michael identified that the live-feed capabilities of the ROV will most definitely aid future research by many departments at the university.



BlueROV2 testing at Portobello Aquarium.
Source: Michael Ellison presentation.



Hikurangi Bathymetry. Source:Sam Davidson

Marine datasets used to study volcanoes in the Hikurangi subduction margin: Sam Davidson (PhD student) – Canterbury University

Sam presented on his research of morphology and structure associated with rough subduction in the northern Hikurangi subduction zone. The objectives of his work included investigating the current along-margin morphology and subsurface fault structure of the deformation front and accretionary wedge, and how seamounts influence the margin as they are subducted.

Critical to his research was NIWA-sourced multi-beam data with 10m to 50m spatial resolution in depths greater than 3 kilometres. This data allows him to develop an understanding of the processes involved in this area.

Sam indicated that the resolution of this data was fundamental to his study, but that he was amused that the audience of hydrographers working mostly in shallow water may have a different opinion on what constitutes 'high-resolution' data!

Sam suggested that he was fortunate to be so close to such a world-class example of a plate subduction zone.

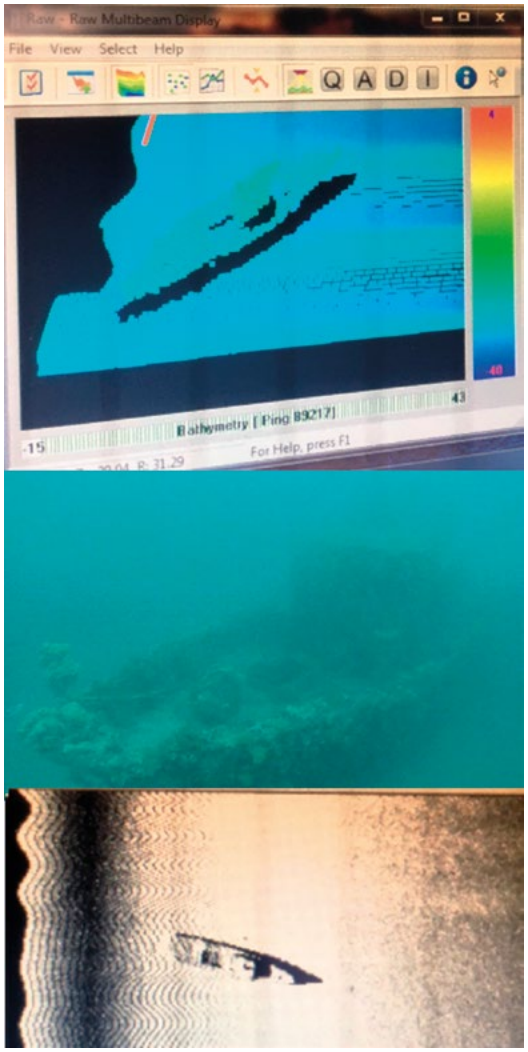
Multibeam survey of Port Pegasus: Jean-Louis Morrison (fourth-year BSurv finalist) – Otago University

Jean-Louis outlined the SURV470 Professional Project he is undertaking this semester. He joined a field excursion of the University's Marine Science department on the RV Polaris II to investigate the Holocene environment of Port Pegasus in Stewart Island. Data collection involved an R2 Sonic 2026 multibeam echo sounder.

Jean-Louis discussed interference problems they had had between the multibeam echo sounder and the boomer and seismic instruments used. The trip also provided an opportunity to use the school's new ROV to provide ground truthing imagery to the data collected by the multibeam.

Stewart Island shipwrecks: Kara Jurgens (fourth-year BSurv finalist) – University of Otago

The Marine Maid wreck is a 20m cargo vessel that sank in 35m water after striking the Barclay Rocks in 2000. Using the university's R2 Sonic 2026 multibeam echosounder over varied frequencies and with different settings,



Marine Maid. Source: Kara Jurgen presentation.

Kara is investigating acoustic imaging of the shipwreck for her SURV470 Professional Project.

The BlueROV was deployed for a visual confirmation of the wreck and the seafloor features surrounding it. While it was challenging manoeuvring the ROV with no underwater positioning, it did produce some exciting images of the wreck.

Overview of the new HMNZS Manawanui: Commander Tim Garvan – Royal NZ Navy

Tim showed us the Ministry of Defence's recently acquired hydrographic and dive support vessel. The former 84.7m offshore support vessel MV Edda Fonn is undergoing extensive upgrades and will be renamed HMNZS Manawanui.

The new vessel enables both hydrographic and diving tasks to be undertaken. Operations such as the survey of coastlines and harbours after natural disasters, recovery and salvage after maritime accidents, location and removal of unexploded ordinance, as well as providing border protection and supporting the New Zealand Government and regional south west Pacific partners are envisaged.

Various upgrades to the vessel include an IHC Hytech 3-person wet bell system, 100-tonne heave compensated salvage crane and a Cougar Seaeye ROV. Overall the cost of the new Manawanui is $103 million.

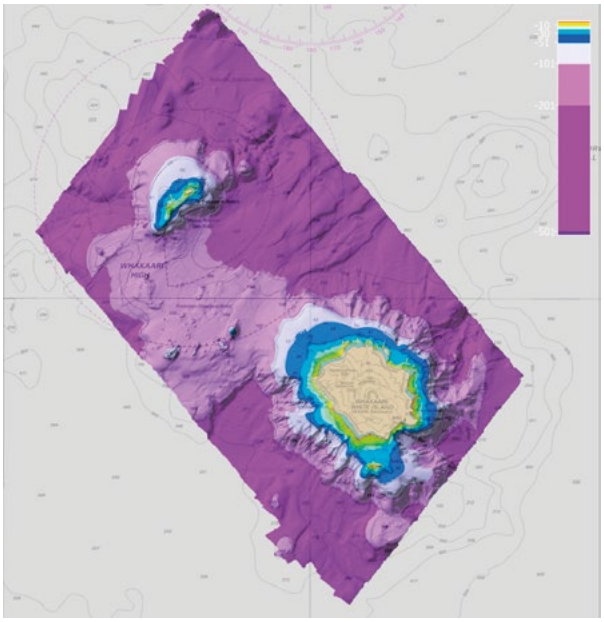
Military operation and operational testing and training are expected to be complete in late 2019 and 2020, respectively. The vessel is expected to be fully operational from mid-2021.

Satellite-derived bathymetry and Cat B training: David Crossman – IIC Technologies

Dave discussed how IIC Technologies uses satellite-derived bathymetry (SDB) to collect data for analysing and monitoring changes in shorelines, habitats and other uses including prioritisation of charting effort and identification of shoal dangers. SDB has many advantages over other traditional acoustic and LiDAR surveys including its low cost, potential for large area coverage and office-based approach for data collection.

It was acknowledged that there are key limitations including depth penetration of between 12m and 15m and up to 30m in exceptional conditions and target detection sizes, which mean it will not replace but complement acoustic and LiDAR methods.

Crossman also addressed the IIC Academy's IHO recognised S5 Cat B coastal hydrography training course. The course is designed for entry-level hydrographic surveyors and consists of 11 weeks' theory through distance learning, five weeks' practical training and a final assessment.

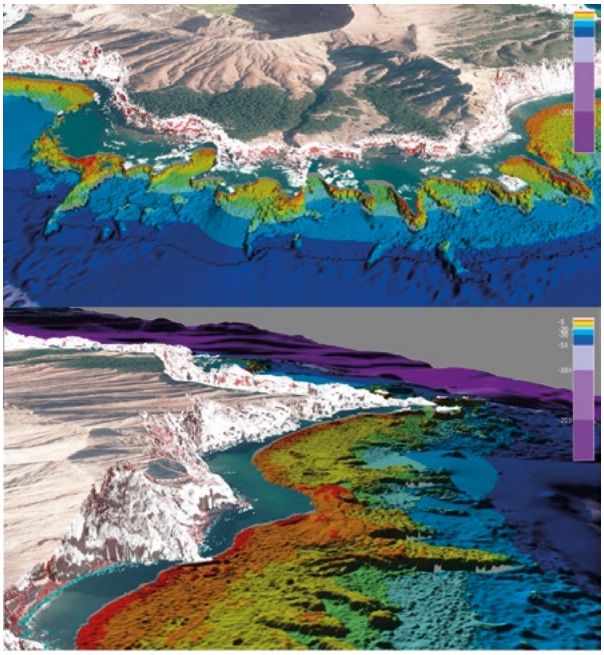


DML survey data around White Island.
Source: Jimmy Van der Pauw presentation.

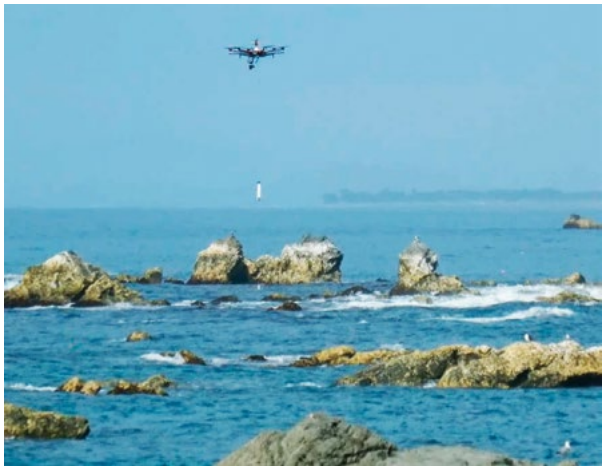
Eastern Bay of Plenty nautical charting survey: Jimmy Van der Pauw – DML

Jimmy discussed the results of the survey of three different areas off the east coast of the North Island – White Island/Whakaari, East Cape and Whale Island/Moutohora. These areas are busy shipping routes and tourist areas, and charting here will increase safety.

Two boats were used in the surveying work – the Ocean Eagle for work around the East Cape and White Island, and the Taniwha was used inshore and closer to the coast.



Laser scanned shoreline shown with underwater lava flows and complex intertidal reef structures around White Island.
Source: Jimmy Van der Pauw presentation.



Drone and 'blink' working off Kaikoura.
Source: Maurice Perwick presentation

The surveying work was carried out over 72 days over a five-month period, taking advantage of good weather windows. The data then took more than 2500 hours to process.

Around the East Cape, the surveyors found geologic reef features and faulting which were previously uncharted and hazardous for smaller vessels. Around White Island, which is popular with fishing vessels, they found complex intertidal reef systems, submerged 50m-tall cliffs and canyons, and volcanic sediment flows. They also found an uncharted pinnacle outside the 50m contour.

Around Whale Island, they imaged the scuttled Boston Seafire and found volcanic vents – both of which were imaged impressively using watercolumn data.

Multisensor surveying for safety of navigation in the Kingdom of Tonga: Andrew Price – iXblue

Andrew discussed iXblue's recent work with complementary technologies in the southwest Pacific. Some of the existing nautical charts were from the late 1800s using leadlines and sextants, fathom based and had unknown datums. Three sensory methods were used: satellite-derived bathymetry (SDB), airborne LiDAR bathymetry (ALB) and multibeam echo sounding (MBES). SDB provided a reconnaissance to a 2m resolution. Amazingly, some features of the existing charts were up to 350m away from the SDB results. The next stage of the project used ALB for coastline and water depths up to 3 metres.

The ALB survey produced a 25cm resolution point cloud, with 18 nominal depth measurements taken for every 2x2m area. Lastly, a MBES survey filled in places where the ALB could not get the bottom, whilst also providing overlap as an independent check on the ALB.

iXblue's autonomous unmanned surface vessel (AUSV) was used in the MBES data collection and proved to be a far more cost-effective technique than the large mothership. The MBES survey found unsurveyed large coral reef features at depths of approximately 5m, an important discovery for the safety of maritime users.

Dipping helicopter: Maurice Perwick – Eliot Sinclair

Maurice presented a video showing how a DJI drone was used after the 2016 Kaikōura earthquake to gather seabed depths in areas vessels couldn't safely go. A leadline was attached to a drone and a device known as Blink showed when the leadline touched the seabed; at this time the height and position of the drone were recorded using an onboard GPS. This was an accurate but slow process, however, the camera feature of the drone allowed the ability to be able to spot any shoals and record more points in these areas.

JLAS Overview: Glen Rowe – LINZ

Glen talked about the Joining Land and Sea (JLAS) project that will help merge together land elevation data and marine depth data. He stated that this would support seamless mapping across the intertidal zone that will aid coastal studies and inundation modelling. Furthermore, he outlined how this would help with expanding the marine geospatial system to assist with our understanding of, and preserving, the health of marine and coast ecosystems.

After the seminar, an informal dinner was held at Emerson's Brewery – a great end to a busy day. Many thanks to those who supported student participation and displays on the day: Discovery Marine Ltd (DML), IIC Technologies, Seismic Asia Pacific Pty Ltd, Sitech System NZ Ltd, and the School of Surveying, University of Otago.

Presentations are available on the AHS website: www.ahs.asn.au/NewZealand_Region.html.

LINZ graphic showing benefits of integrated marine geospatial data.
Source: Glenn Rowe presentation.

5 differences between a good recruiter — and a cowboy...

Here are 5 tell-tale signs to help you discern a kick-ass recruiter from a drop-kick...

1. Good recruiters will meet you face to face
Clever recruiters have deep insights of the companies they represent so they'll meet you In real life to get an understanding of your personality. This will help them decide whether you'll be a good cultural fit for a business or not, which contributes massively to how much you'll enjoy working at your new company.

2. Good recruiters have in-depth knowledge of the industry
The best recruiters usually work with a specific industry and have in-depth knowledge of that industry. Amateur recruiters "dabble" in multiple industries. Good recruiters have built exceptional relationships with the decision-makers in their chosen industry and have access to those jobs that don't even get advertised — often the best roles...

3. Good recruiters keep you updated
If you find yourself desperately emailing your recruiter, pleading for progress, move on. A good recruiter will happily (but metaphorically) hold your hand through the process — they won't leave you feeling needy, like a bad recruiter will.

4. Good recruiters respect your career goals
If you're ever involved in a conversation where the recruiter's trying to persuade you to accept a role that you're not really interested in and it makes you feel undervalued, despite you being clear about what you want? Hang up as soon as you can.

5. Good recruiters focus on long-term relationships, bad recruiters on one-night stands
Bad recruiters dump your CV into the recruitment pipeline and only contact you if there's good news. Maybe they hate to be the bearers of bad news, or maybe they're just emotionless pimps. Either way, it's no good for a candidate or a business. A good recruiter walks the extra mile to ensure their clients and candidates achieve what they want.

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LINZ VIRTUAL FIELD TRIP

Photos: CORE Education

Earlier this year more than 10,000 schoolchildren from 347 classes nationwide joined a three-day virtual field trip to Wellington, the Marlborough Sounds (Meretoto/Ship Cove), and Nelson, commissioned by Land Information New Zealand (LINZ).

The virtual field trip entitled Matariki and Navigation – Kupe, Cook and Today took place from 11-13 June. It revolved around the Tuia 250 First Encounters commemoration and was supported by a range of subject matter experts and organisations.

Day one in Wellington involved Space Place at the Carter Observatory, Te Wharewaka o Pōneke, and LINZ. Participants learnt about the Matariki star cluster, early Polynesian navigation and the earliest navigator Kupe with an on-the-water waka experience, as well as learning the art of Story Mapping.

Day two in the Marlborough Sounds, Meretoto/Ship Cove saw LINZ and Māori Eco-Cruises join forces to show students how navigation and charting methods used by James Cook compare with hi-tech methods used to crate 3D maps of Charlotte Sound/Tōtaranui seabed. Students also learnt about Kupe's adventures in the Marlborough Sounds

Day three in Nelson was brought to students by the Nelson/Marlborough Institute of Technology, Nelson Provincial Museum and LINZ. Students were shown the ins and outs of modern maritime navigation training, heard about the first Māori and European (Abel Tasman) encounter in Mohua/Golden Bay, and learnt about the navigation and charting methods used by Abel Tasman.

At each location 12 three to five-minute video interviews were created with the subject matter experts. These were edited and uploaded each evening ready for teachers and students the next day. At the beginning of each day, children read the LEARNZ Teacher diary, viewed the videos and joined a live web conference where one or two classes were able to ask the experts questions, while other classes around the country listened in and asked their own questions online.

Each year LINZ commissions one geospatial 'virtual' field trip as part of its mandate to help grow the geospatial industry, and since they began in 2012, they've been growing in popularity.

By focusing on the practical use of geospatial information, the field trips help raise awareness among school teachers and students about the value of the spatial sciences and the varied geospatial careers available in New Zealand.

LINZ commissions CORE Education to run virtual field trips for schools under its established LEARNZ Programme. Experienced LEARNZ teachers develop online curriculum material related to the virtual field trip theme that is freely available for teachers and students to use at a time that suits them.

Teachers reported very positive feedback from students about the virtual field trip:

"They LOVED it! They did so much learning and can confidently talk about their knowledge of Matariki and navigation."

"The LEARNZ trip was great for opening up experiences to children who have not been to Wellington or Marlborough – many have not travelled beyond the city as we have a large number of families from various cultures and socio-economic levels."

"Great to learn from experts in such different ways."

"This field trip was incredibly empowering for our Māori and Pasifika learners!"

"Ease of access to the LEARNZ website and the field trip allowed students to access the trip at home too and share with their whānau thereby furthering their knowledge and understanding of new concepts."

"This field trip allowed my students to engage with Matariki in a new and interesting way. They were able to investigate lots of different ideas, how to use a sextant, traditional navigation, te wheke and Kupe and how the Marlborough Sounds was created. It provided such a range of interests that the students could follow. My students were given complete responsibility for sharing their new knowledge, we ended up with two raps, a play, a pop-up book and a speech. It was awesome."

Brad Cooper showing students how to plot a coastline from a running survey similar to how Captain James Cook would have done.

Shelley Hersey (LEARNZ field teacher) and Brad Cooper (LINZ senior hydrographic surveyor) answering student questions during a live morning audio conference with class bird and animal ambassadors listening intently.

The videos can be seen at *www.learnz.org.nz/location192/videos*. All LINZ VFTs and their curriculum material can be viewed and used at any time on *www.learnz.org.nz* so if you know any teachers or schools that may be interested let them know!

LINZ input for this year's virtual field trip was led by Geoff O'Malley, principal advisor geospatial capability building, with support from senior hydrographic surveyor Brad Cooper, the LINZ Whānau Group, and LINZ geospatial capability and outreach advocate Duane Wilkins.

A Nelson Marlborough Institute of Technology tutor taking students on a ship voyage in Meretoto/Ship Cove using the institute's maritime navigation simulator.

GSI

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Simplifying The Complex

Making the most of our HIDDEN DEPTHS

Land Information New Zealand (LINZ) through the New Zealand Hydrographic Authority (NZHA) is responsible for delivering hydrographic services to meet New Zealand's obligations under the International Convention for Safety of Life at Sea (SOLAS). This includes the collection of hydrographic information through a prioritised survey programme (HYPLAN) to update charts to meet the needs of modern shipping.

LINZ is also responsible for producing and maintaining nautical charts for a number of Pacific Island countries – the Cook Islands, Niue, Samoa, Tokelau and Tonga. In 2015, in partnership with New Zealand's Ministry of Foreign Affairs and Trade, LINZ embarked on the Pacific Regional Navigation Initiative (PRNI) to improve maritime safety in the Pacific.

From stars to satellites – how technology is improving safe navigation in the Pacific

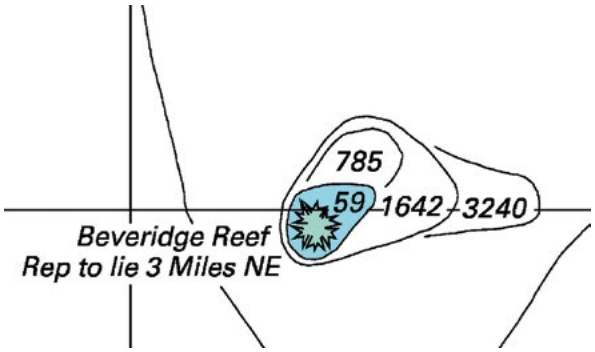
Safely navigating the pristine environment of the Pacific has come a long way since early navigators used a star compass or sextant to travel the oceans. There are still nautical charts used today that show data collected in the late 1800s when sextant and lead line were the latest technology.

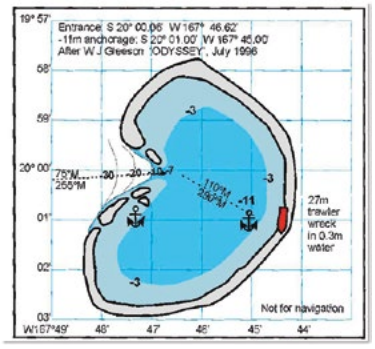
Today, we are able to measure the depth of the oceans from space using satellites; from planes using lasers; and from boats with nobody on board.

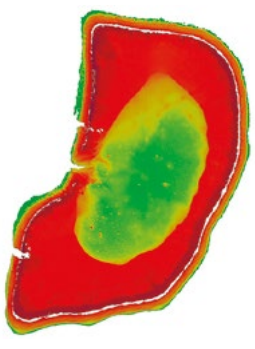
In late 2018 a combination of satellites, planes and boats was used to survey and map the seafloor in the Ha'apai island group in the Kingdom of Tonga, revealing never-before-seen features and helping to improve safe navigation in the region. LINZ contracted survey research companies iXblue, Geomatics Data Solutions (GDS) and EOMAP to undertake the work in Tonga and Niue.

Using state-of-the-art technology, images were taken from satellites orbiting high above the Earth and used to determine the water depth in the shallow waters around the many islands of Tonga and Beveridge Reef in Niue. This satellite-derived bathymetry (SDB) technique collected images of the whole of Tonga. When the data was processed, the depth of water around the islands was calculated every 2 metres to depths of 15 metres. The result is one of the largest areas in the world covered by SDB technology to such a high resolution.

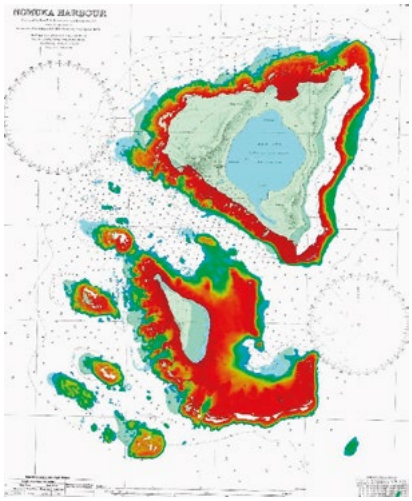
The satellite imagery also revealed for the first time the true shape and location of Beveridge Reef, a large coral reef of critical importance to Niue's marine ecosystem, located about 130 nautical miles south-east of Niue. Cur-



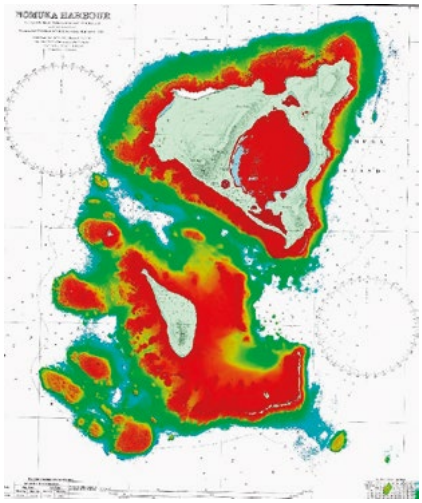




The image shows Beveridge Reef on the largest scale nautical chart. The central image is a depiction of the reef created by a recreational mariner. The image on the right shows the SDB water depths around and inside the reef.



Satellite-derived bathymetry around Nomuka



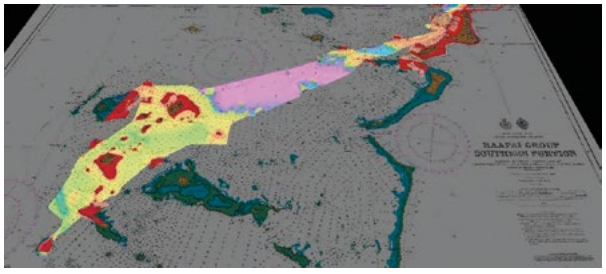
Airborne laser bathymetry around Nomuka

The image on the left shows the SDB data around Nomuka, in the Ha'apai group of islands in Tonga. You can see the difference between the new data and the existing chart. This is due to the methods and technology used in the late 1800s and early 1900s to position the islands. Using modern technology, such as GPS, the islands can now be correctly located. The SDB shows the outline of the island in the correct position. The image on the right shows the airborne laser bathymetry (ALB) coverage around Nomuka. You can see the island now aligns with the data. Using the SDB data, the chart was moved to ensure the islands aligned with the data.

rently the largest scale official chart showing Beveridge Reef is at 1:1,500,000 and states the reef is out of position.

Following the SDB for Tonga, airborne laser bathymetry (ALB) technology was used to collect bathymetric and topographic LiDAR around and over the islands. This technology collected data to a depth of 20 to 30 metres, with up to 36 data points per square metre. Geomatics Data Solutions (GDS), subcontracted by iXblue, collected topographic and bathymetric LiDAR, using a Leica Chiroptera 4X sensor fitted to a Cessna 441 aircraft. Using the SDB coverage, the planned ALB areas were reviewed, refined and amended where appropriate, taking into account features identified by the SDB. As the existing charts of the area are in fathoms and on undetermined datums, the SDB data was used to 'position' islands to align with the SDB data. This ensured the subsequent ALB planning aligned with the true position of islands and reefs.

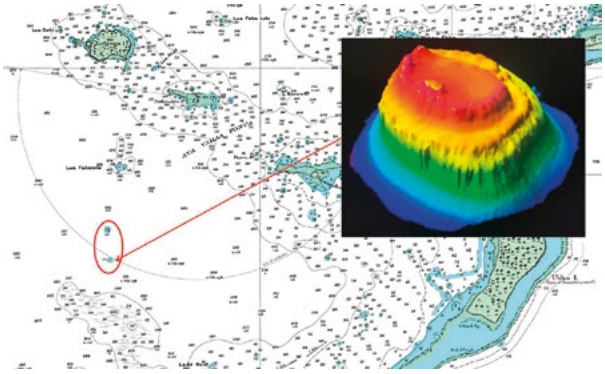
Following the ALB campaign, vessels fitted with Kongsberg EM2040C dual swath multibeam echo sounders (MBES) were used to collect bathymetric data beyond the extent of the ALB. This work was carried out by the survey boat, the MV Silent Wings and an unmanned surface vessel, named Drix, and focused on the routes taken by Tonga's domestic ferries, as shown.

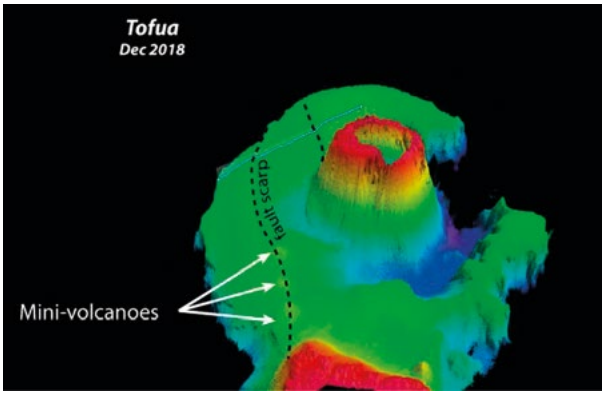


A number of previously undiscovered and out-of-place features were found during the survey in Tonga, including coral reefs and underwater volcanoes.

In one area, in water over 300 metres deep a small, isolated coral reef rises up just six metres below the sea surface. The same reef shows on Tonga's existing nautical chart at a depth of 5 metres (or 2¾ fathoms). However the reef is recorded in the existing chart more than a kilometre from where it is recorded using today's technology.[1]

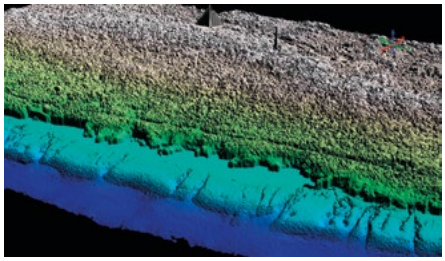
The survey work is now complete, and LINZ has taken delivery of eight hard drives totalling 35Tb of raw and processed data. Managing such large datasets has posed some IT challenges and LINZ is investigating automation of a number of routines to ease the bottlenecks.

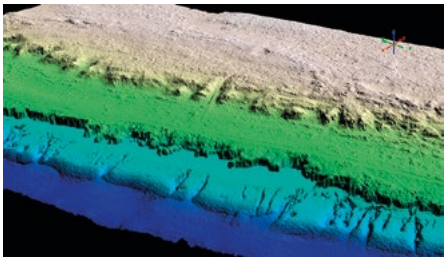




A series of mini-volcanoes identified close to the island of Tofua. Images courtesy of iXblue.

While the surveys were primarily undertaken to develop nautical charts and products to support safe shipping, the detailed underwater maps provide valuable information about Tonga and Niue's coastal and marine resources. To date, the LiDAR data has been used to support a number of projects in Niue. The Manatua submarine cable will





The image on the left shows a surface model of the LiDAR data, including vegetation cover. The image on the right shows the 'bare earth' model used to aid the planning and design of the cable route over the reef, cliff edge and road to the cable station.

land north of the nation's capital, Alofi. Using the topographic LiDAR data collected along the coast, a series of contours (bathymetric and topographic) were provided to Niue's Ministry of Infrastructure to aid the planning and design of a fibre optic cable landing.

Similarly, a series of topographic contours were produced to assist with the realignment of the road access to the wharf at Alofi and the planning for realigning the road and junction pictured in the lower of the two images to the right.

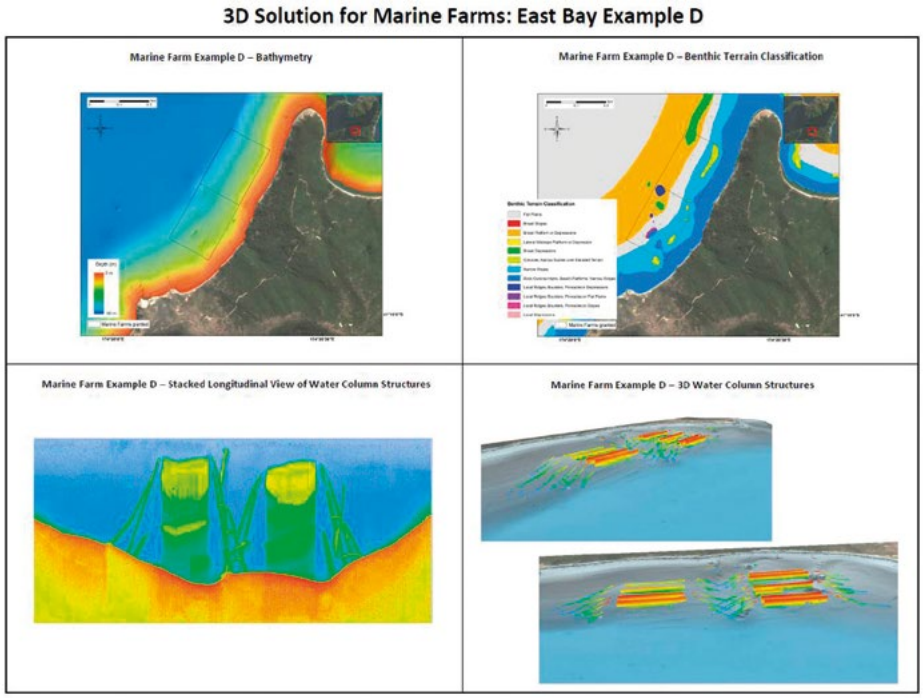
What lies beneath the waves

Back in New Zealand in 2016 LINZ completed an evidence-based hydrographic risk assessment that identified locations and levels of risk in relation to the accuracy and adequacy of nautical charting in New Zealand. Queen Charlotte Sound/Tōtaranui and Tory Channel/Kura te Au were identified as areas of heightened risk and LINZ, in partnership with Marlborough District Council (MDC), developed a programme of work to carry out hydrographic surveys for safety-of-navigation and scientific purposes, a first for both organisations.

As the territorial authority responsible for managing the marine environment of the region, MDC required information to support its monitoring, management and decision-making processes in relation to the natural environment. In particular, the characterisation and mapping of seabed habitats; benthic terrain modelling to classify habitats and ecosystems; and the identification of biogenic (or living) habitats important for biodiversity throughout the entire Queen Charlotte Sounds area.

As a result of this partnership, the data has been used by others beyond the original purpose. The local iwi, Te Ātiawa, has used the data to better understand and interpret the rohe (iwi territory) under the sea. It has also raised awareness of seabed features that were previously unknown.

In addition to bathymetric data, seafloor backscatter and water column backscatter were collected and processed. These datasets have been used by MDC in decisions regarding the locations of marine farm structures with regards to sensitive reef structure and habitats. The use of 3D animations of the data brings a different dimension to the discussions. This assists in determining if any



Datasets – bathymetry (top left) and water column backscatter (lower left) and analysis (benthic terrain classification (top right) – and 3D visualisation (lower right) presented during discussions regarding the location of marine farm structures.

biowaste from the mussels are affecting the reef habitat.

A further science research project, funded by the Ministry of Business, Innovation and Employment and led by the National Institute of Water and Atmospheric Research, has been undertaken to investigate fish habitat bottlenecks. The objective of the project is to identify where juvenile blue cod nurseries are located. The survey data has been used to map critical nursery habitats at a high resolution and determine the habitat quality. For those habitats that can't be directly mapped, the data will be used in predictive habitat models, combined with other data, to predict the probability of a nursery habitat type occurring at any given location. Developing a computer simulation model will allow end-users, resource managers, natural resource industries, and others to run 'what-if' simulations to understand the likely outcomes of different future management actions and regimes.

Making the data freely available is key to realising further benefits, whether economic or societal. The data is discoverable through the LINZ Data Service and the NZ Ocean Data Network. MDC has made the results of the survey are available on the internet: *marlborough.maps.arcgis.com/apps/MapSeries/index.html?appid=155a89b0beb74035bd1c4c71f6f36646*.

Unlocking the value of marine geospatial data

Hydrographic and marine data is collected for many purposes including environmental monitoring, resource management and exploration, scientific research and navigational safety, and it is also critical in preparing for and responding to climate change and natural disasters.

LINZ is leading a national working group with the objective of improving access and reuse of valuable marine geospatial data. The working group is made up of stakeholders from across the public and private sectors with an interest in the marine environment. The inaugural meeting was held in Wellington in February 2019.

Working group members recognise marine data has a great value beyond its original investment and want to bring to the surface collective knowledge on the state of our oceans and coastal areas. It can be difficult for parties that are not directly associated with a project to find datasets of interest or to be aware that these datasets even exist. To unlock the value of marine data, we first need to understand what data exists and how it can be accessed. Working group members are contributing to a national marine data stocktake, with support from LINZ and Statistics NZ. The stocktake will identify the breadth of marine data which has already been collected in New Zealand as a first step to improving access and reuse. The results of the national stocktake will be published on *data.govt.nz/*.

If you want to learn more about this work, or contribute by joining the national working group, please contact *hydro@linz.govt.nz*.

NOTES

1. Images courtesy of iXBlue.

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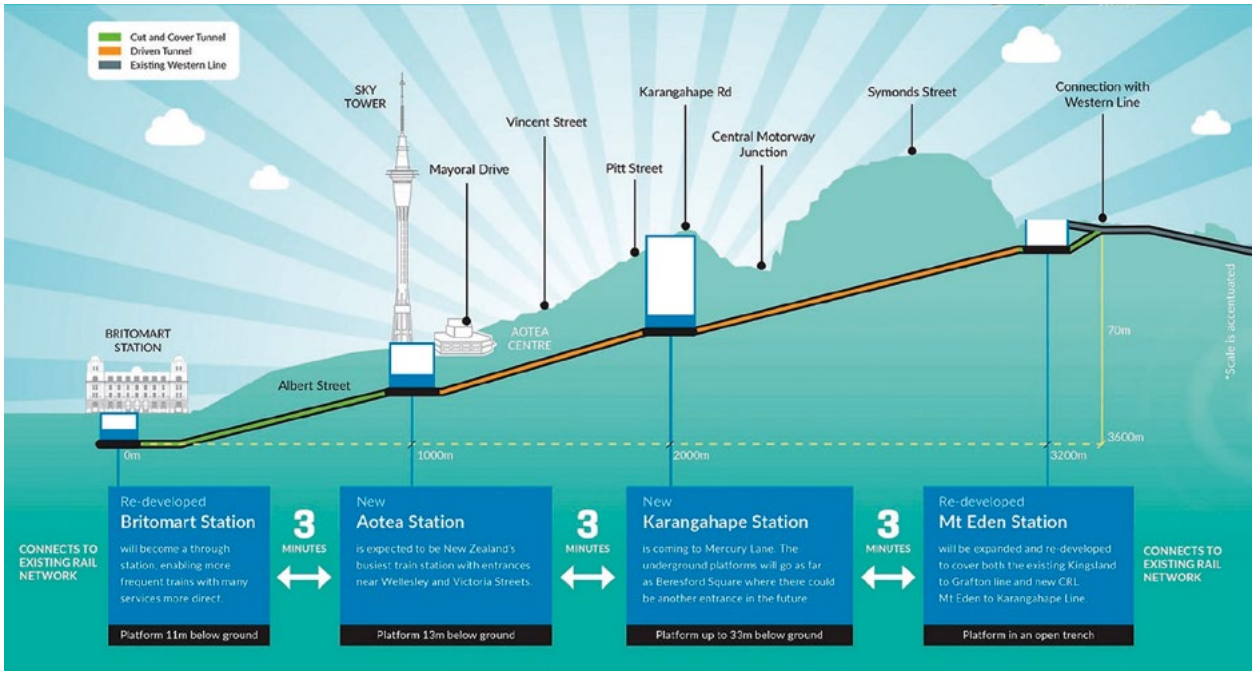
Survey and Spatial New Zealand

Last September, S+S featured an article on Auckland's City Rail Link project by Daniel Wiederkehr. In this edition, engineering surveying team Mike Cutfield and Daniel Wiederkehr take a look at the latest updates for New Zealand's largest transportation infrastructure project.



City Rail Link update

The third contract (aka C3) for Auckland's City Rail Link has now been awarded to the Link Alliance. Vinci Construction Grands Projets S.A.S., Downer NZ Ltd, Soletanche Bachy International NZ Ltd, WSP Opus (NZ) Ltd, AECOM New Zealand Ltd, Tonkin + Taylor Ltd and CRLL.

The client, CRLL, is part of the Link Alliance, and is a joint venture comprising Auckland Transport (Auckland Council) and the New Zealand Transport Agency (the New Zealand Government, which includes KiwiRail). We're building two 3.45km-long, twin rail tunnels up to 42 metres below the city centre.

The C3 contract for the project's main stations and tunnels contract was changed to incorporate longer platform tunnels at Karangahape Station to cater for nine-car trains (instead of six), a second Karangahape Station entrance at Beresford Square and additional station work at Britomart, Aotea and Mt Eden stations.

These changes, along with increases in construction costs, have resulted in the project value being $1 billion more than the previous value estimated in 2017. The entire CRL project is the largest transport infrastructure project ever to be undertaken in New Zealand at a total cost of $4.4billion.

The project is split into five principal packages. The C1, C2 and DSC package has already been awarded and is expected to be complete later in 2019. The remaining four principal contracts are:

- C9 – Britomart East (<$100 million)
- C3 – Stations and Tunnels
- C7 – Systems Integration, Testing and Commissioning
- C5 – Western Line at Mt Eden Station.

The scope of works for the C9 Britomart East package has been reallocated to the C7 package.

The project also has two secondary packages, the C6 – Mt Eden Stormwater Main Relocation and the C8 – Wider Network Improvements. C6 was awarded to the March/Bessac joint venture in December 2017.

C8 has been partially reallocated to the C7 package, with the rest to be delivered by KiwiRail and Auckland Transport. It was previously expected to be put to tender.

The C7 package main works have subsequently been reallocated to the C3 Stations and Tunnels alliance contract.

The biggest myth about CRL is that it's just a inner-city 'loop'. It's not. Think of it like the Waterview tunnel, joining up motorways. By joining the rail network and adding new stations, the City Rail Link will revolutionise the way

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People-friendly streets? Let's try it and see!

Kathryn King

You've probably been on a familiar street recently and thought, "It'd be so much better here if the street was set up like *this* instead."

You're not alone; we can all think of streets that aren't great places to be, and research shows that most of New Zealand's town centres and residential streets are yielding only a fraction of the value that they should.

What's clear is that the majority of the problems centre on how we've designed around motor vehicles, for decades. But even for expert roading engineers and urban designers, it's really tricky to figure out exactly how, practically, to change a particular streetscape. Will what worked in Chicago also work in Christchurch? Will this layout work when shop deliveries are happening, or when school's out? Even where experts agree what changes to make, wholescale changes to established streets are typically difficult, with long timescales.

The circuit-breaker for our transition to better streetscapes is trying things out. It's in-situ experiments like trials, pilots and tactical urbanism, testing changes to a street, closely monitoring and making iterative improvements, before committing to a major investment. But right now, it's hard to try things out, even in low-risk street environments.

So *Innovating Streets*, a New Zealand Transport Agency programme, is making this easier. They're sorting out both

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ON THE SHOULDERS OF GIANTS

20 years of the National Topographic Database

Nathan Heazlewood

In June this year, it was 20 years since we first achieved national coverage of the New Zealand Topographic Database.

At the time to have national coverage with 1:50,000 scale topographic mapping data like that was pretty much a world first. Along with initiatives like the first iteration of Landonline, that meant New Zealand was truly world leading.

While I'm no doubt biased, nevertheless I suggest it's pretty incredible that the database survives pretty much in a similar structure to when it was first designed more than 20 years ago. I think there are some lessons to be learnt from that.

Happy birthday NZ Topo

Unfortunately, I don't think we recognise or remember the contribution of those who came before us. Even though we still use the things they produced such as basemaps, etc every day. So, this winter, I'm raising a glass of something bubbly in honour of those who produced the original NZ Topo Database 20 years ago. That data is still a cornerstone of much of the GIS data we use in New Zealand today.

Some of those pioneers are no longer with us, moe mai ra. Or they have retired. To absent friends.

So well done, Paul Lundberg, Joyce Bailey, Lorraine Crocker, Baz Parker, Rob Parkin, Robin Pickering, Geoff Howard, Dave Mole, Russell Turner, Fran McNamara and Chris Kinzett for what we achieved. That result still resonates even to this day.

Also remembering all of the cartographers who drew the original paper maps, the surveyors, photogrammetrists and aerial photography people who all contributed as well. Here's to you, NZ Topo . . . Happy birthday!

Below are some of the things that I learnt as the youngster on that team.

Lesson: Be strategic – take the time to design things to last

I remember the amount of work that Fran and other members of the team put into the database design, which took months of effort and that continued to be tweaked for years. I think one important lesson is that if you design something properly to begin with, then it can pay dividends by lasting for decades.

Amazing that even with the pace of technology change, that design has lasted relatively unchanged now for so

long. How many other pieces of technology can say that? It's a pretty big testament to those GIS pioneers in New Zealand that they had the foresight to achieve that. It wasn't a fluke. It was planned.

There was time spent looking at various emerging international standards (but they often didn't fit New Zealand). As we worked through digitising the 1:50,000 scale topographic maps we often found additional attributes that needed to be added. I guess the paper maps also provided the details for what needed to be captured so in a way there were probably many others who worked out the original cartography that indirectly contributed to that design.

The main contribution I made was to publish the NZ Topo Data Dictionary on a new-fangled thing called 'the World Wide Web' also known as 'the information superhighway'. People used to 'surf' it. Using something called Netscape Navigator (rumour has it that there were other browsers available but I think that that is an urban legend).

Lesson: To execute the design experiment with tools to work out the best solution, and keep on re-evaluating new tools

The first piece of geospatial technology that I used when doing the data capture for the NZ Topo Database was Laser-Scan VTRAK. This system used scans of printing plate colour separations to create a raster, which was then semi-automatically 'traced' to create vectors.

After my day of university study, I used to go to Heaphy House and use this system to trace contours: often until after midnight. For the most part, the job was to start a vector line tracing over a raster contour line and then watch the cursor to make sure it didn't accidentally 'jump' onto the wrong contour line. If that happened then the vector contour wouldn't join up with its point of origin and I would either have to delete and redo the whole contour or trace back manually trying to see where it had gone wrong.

I remember a particularly painful instance where I had digitised around the base of Mt Taranaki and somewhere it had gone wrong: probably about 30 minutes of wasted effort.

I also remember going home at about 1am and trying to sleep, but instead watching the echoes of glowing contours with cursors tracing around them on the inside of my eyelids. I used to dream of mapping the contours of our mountains.

Once the Laserscan process was complete we could use another system named GeoVision (or Vision) to do topology checking, create polygons and add attributes. Sometimes I would also connect it up to a digitising tablet with a puck to do some additional data capture of small areas that would take too much time to scan, etc.

It was a pretty good system for the time, but it took ages to do a lot of things that would take seconds these days. We would typically only work on one map sheet at a time (because working on anything bigger would take hours or days to load).

There was a lot of trial and error and lessons learnt when we were doing all of this, and lots of good ideas that came up along the way to improve efficiency. We were innovating new approaches all the time, because a lot of what we were doing had never been done before.

It's nice to think that even though some of that data we captured back then would have been completely superseded and replaced using more modern capture processes (particularly elevation data, etc) on the other hand, some of the data that we captured by painstaking manual processes 20 years ago is still probably still in use today.

Lesson: Stay focused on the scope

Yes, I know that in hindsight the NZ Topo Database design could have been better and even at the time 20 years ago we discussed things like improving the road network connectivity and attribution. There were also debates about alignment with the DCDB roads. There were also many arguments about the role of government v the private sector and what LINZ should and should not be capturing (these debates probably continue to this day). But we had been given our scope, which was to replicate the data on the paper maps, and by focusing on that, we didn't get distracted by lots of other 'nice to have' things that we could have done.

Lesson: Open data

Another thing that I think people have forgotten is that this dataset was one of the first major New Zealand datasets (of any type) to be released as open data. I remember when it used to cost $1 million under market-value cost-recovery models, and then when all of a sudden it was virtually free.

The only company that had actually purchased the whole dataset was Telecom NZ. Everyone else had to choose small areas and limited layers. It has been so beneficial to GIS in New Zealand since this dataset became more open.

I remember the shock in other countries at what New Zealand was doing. Many of you out there probably take this for granted now, but at the time it was a massive battle to make it happen. If that hadn't have been successful, then I wonder how much further back New Zealand open data would have been today.

Hochstetter's Survey of the Pink and White Terraces: The Final Iteration

Rex Bunn

Introduction

In the June 2018 edition of *Surveying+Spatial*, we reported on Hochstetter's 1859 survey of the Pink and White Terraces. This article reports new research findings, completing our study into the terrace locations. Hochstetter's remains the only survey of this lost *eighth wonder of the world:* providing the only primary location evidence.

Figure 1: Hochstetter's method-of-squares map 1859, showing the symbology for observation stations 21 and Puai Island. (Hochstetter Collection, Basel 3.5.10).

Firstly, we summarise the six survey methods that Hochstetter may have employed. Next we report primary evidence of his second Rotomahana observation station. Our evidence-based lakes' altimetry is updated. We reconcile the incorrect coordinates on Petermann's 1864 Rotomahana map and reintegrate it with Hochstetter's mapping. His method-of-squares map scale is calculated from his paper-stock. Our final survey iteration/replication uses all 14 surviving survey landmarks. Lastly, the third Black Terrace location is refined. The findings are consistent with the 2018 *Surveying+Spatial* article by Bunn, Davies and Stewart, i.e. the Black Terrace lies on land and the Pink and White Terraces' locations lie across the shore.

Hochstetter's methodology

Hochstetter's 1859 survey method was based on Stokes and Drury's admiralty survey. His Lake Rotomahana diary records compass bearings from two observation stations. The bearings while too few to reconstruct the survey, were reverse engineered, indicating six methods:

1. The *method-of-squares* field survey, with traversing.
2. Plane table survey with Station 21 to Puai station baseline by stepping-method and/or Pythagoras.
3. Method-of-squares using artwork, photography, observation and compass bearings.
4. Compass survey, with traverse and reciprocal bearings for local deviation and random error.
5. Marine survey with baseline by stepping-method or Pythagoras.
6. Terrestrial survey by Lamont theodolite, with surveyors Drummond Hay (1827-1881) and Julius Haast (1822-1887), cartographer Augustus Koch (1834-1901), Akutina Rangiheuea (d. 1886) and team.

Hochstetter's large team was capable of any method. Each has support with evidence favouring methods 2, 3, 4 and 5.

Puai Island station

After publishing primary evidence of Hochstetter's Station 21 in Issue 94, we evidence his second *Puai Island* station. On re-examining the 2010 first-generation photography of Hochstetter's 1859 method-of-squares (MoS) map and in Figure 1, there is an overlooked symbol on Puai Island; beneath the western end – a *circle with cross* (Nolden & Nolden, 2013). This symbol marks Station 21. The MoS map has no legend and we reviewed the symbology. There are >50 cross symbols showing geothermal features. There are circles marking other features. There are three circles with interior crosses: Station 21, Puai station and Tekapo. Tekapo was an observation spot: the landing where tourists embarked for the Pink Terrace. The *circle with cross* was an admiralty symbol for an "Observation Spot" (Hydrographic Office, 1972). This primary evidence confirms our location on western Puai. Recently, this inscription was noted on the map: *Rotomahana der 'warme See', 30 April 1859, Dr. F.H.* This confirms the MoS map was made by Hochstetter while at Rotomahana.

Altimetry update

Our 2017 *Kaiwaka altimetry* remains the only published, evidence-based study. The 1858-1886 lake altitude of c. 303m ± 1-2m is based on borehole evidence and now 15 eyewitnesses.

Resolving latitude/longitude errors by August Petermann for Station 21

The invalid Station 21 coordinates on Petermann's 1864 Lake Rotomahana map in Figure 2 puzzled investigators (Hochstetter, 1864). In 2017, we published 12 errata in Petermann's map and relegated it in favour of Hochstetter's four manuscript maps (Bunn, 2017). Petermann's creative licence affects the northern lake and includes: Lake Rotomakariri rotated 90° counterclockwise (see Figures 1, 2 and Hochstetter, 1867 p. 419), Awaporohe stream, Kaiwaka rapids and Te Karaka displaced; Makrowa relocated south below the stream junction, the lake elongated ~10% and shape-changed to a right versus equilateral triangle, Station 21 coordinates, Puai station missing, an invented island, no meridian arrow, the western bay absent and the northwest lake swivelled ~15° west.

These changes made room for the large legend box. Nevertheless, the chromolithographed map was produced at Justus Perthes, a respected cartographic publisher. Here we reintegrate it, after explaining those faulted coordinates. There is no north arrow, scale, latitude or longitude coordinate on Hochstetter's manuscript lake maps: only a legend on Petermann's version. This is negative evidence as Hochstetter left no latitude or longitude record, or record of using his theodolite (or sextant) at Lake Rotomahana. In 2016, we suggested these Station 21 coordinates were added by Petermann, Hochstetter's cartographer. Other variance between the Petermann, MoS maps and the survey data is attributed to errors in wet steam-plume surrogates (steaming fog) used by Hochstetter for sighting obscured geothermal features (Bunn, Davies and Stewart, 2018).

On the evidence, it is likely Petermann drew his map to match Hochstetter's diary bearings rather than the real outline of the lake as Hochstetter, (an artist, draughtsman and surveyor) observed it with an oblique aerial view from Kumete, canoed across it, circumnavigated it and twice sketched it. Petermann delivers a deformed map to Hochstetter, who is aware of the shortcomings in his survey package and unable to complain. Their correspondence mentions errata though not specifically at Rotomahana (Hochstetter, 1860a). Like Petermann's 1868 invention of *Petermann land* near the North Pole; his deceptive Lake Rotomahana map became the default map for generations (Tammiksaar, Sukhova and Stone, 1999). It is no longer.

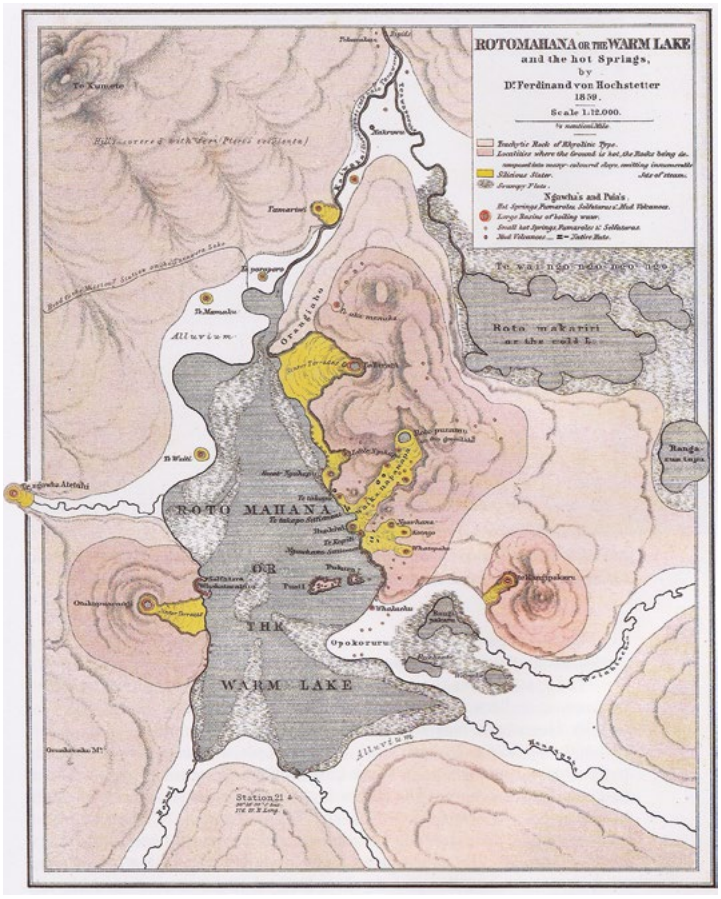

Figure 2: Ferdinand Hochstetter, published map of Lake Rotomahana, 1865. Reprinted from Ferdinand Hochstetter and August Petermann, *Geological and Topographical Atlas of New Zealand: Six Maps of the Provinces of Auckland and Nelson.* (Auckland, Delattre, 1864).

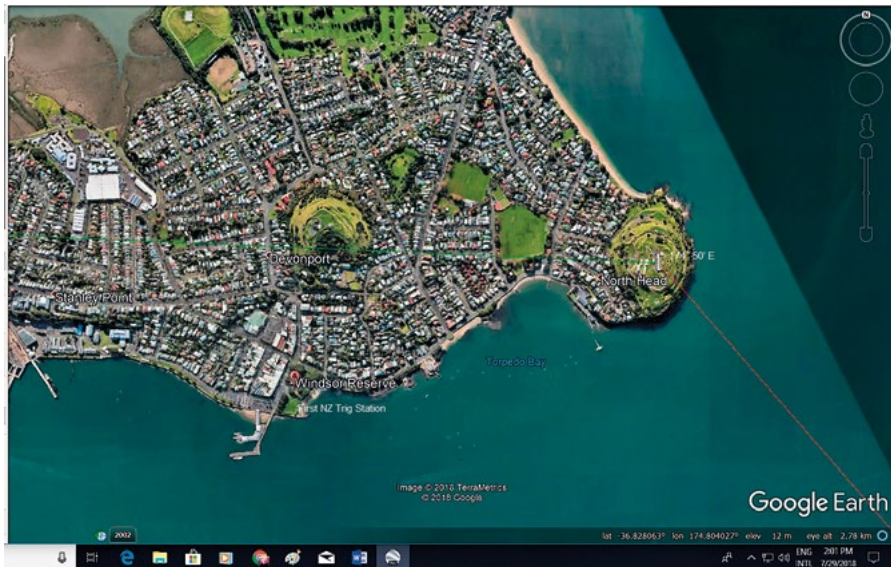

Figure 3: Plotting corrected longitude at North Head, with the first trig station nearby at Windsor Reserve. (Google Earth™/Bunn).

Petermann's notes in Hochstetter's 1864 atlas comment on spatial errors in New Zealand maps (Petermann, 1864). This offered a validation path and we checked for latitude and longitude error in his other maps. Any country-wide error should carry over into the Lake Rotomahana map, given a Perthes cartography database. In his notes, Petermann says his country mapping combined admiralty and Hochstetter cartography, viz: *While, through the surveys of the Admiralty, the outlines of New Zealand were carefully and completely settled, the knowledge of the interior was gradually developed… With the explorations and surveys of F. v. Hochstetter and J. Haast … began a new epoch in the geographical knowledge and chartography* [sic] *of New Zealand…The general map of this work (Map I.), in the completion of which Hochstetter's and Haast's observations have been used for the first time…"* (Petermann, 1864).

We examined Petermann's Auckland maps, selecting coastal landmarks against Google Earth™ (Petermann, 1864). Any spatial discrepancy might also occur at Lake Rotomahana, indicating the Station 21 coordinates were Petermann's and should propagate across his maps. Error could be applied to Station 21, correcting its coordinates. For the longitude check, in Figure 3 we selected North Head, Auckland; close to the first trig station, at 174° 50′ E (174.8333°) on Petermann's 1864 map. The central position for North Head today is 174.8122° on Google Earth™. The difference: a 0.0211° overshoot.

For latitude, in Figure 4 we took two points on the 37th parallel above Auckland Airport. The Google Earth™ latitude at this location is 36.9933°, a 0.0067° overshoot.

In Figure 5, we take the North Head longitude error and apply it to the Station 21 error. Similarly, taking the Petermann-Google Earth™ latitude difference; our hypothesis is the apparent Station 21 error should reduce.

The total Station 21 error of 4,700m-4,800m (depending on projection) reduces by ~1,400m. The major improvement is with longitude by >2,000m. This is unsurprising, given the period chronometric basis for longitude and proximity to the 180th meridian. The latitude improvement is ~800m. The improvement indicates the coordinates on the Lake Rotomahana map were inserted by Petermann. The improvement in longitude reduces the MoS Station 21 versus Petermann Station 21 variance to ~170m. Note: Petermann and Welker prepared their Lake Rotomahana map from much the same Hochstetter package as we did, i.e. an incomplete survey data set which we reverse engineered and they manipulated with artistic licence to produce their map.

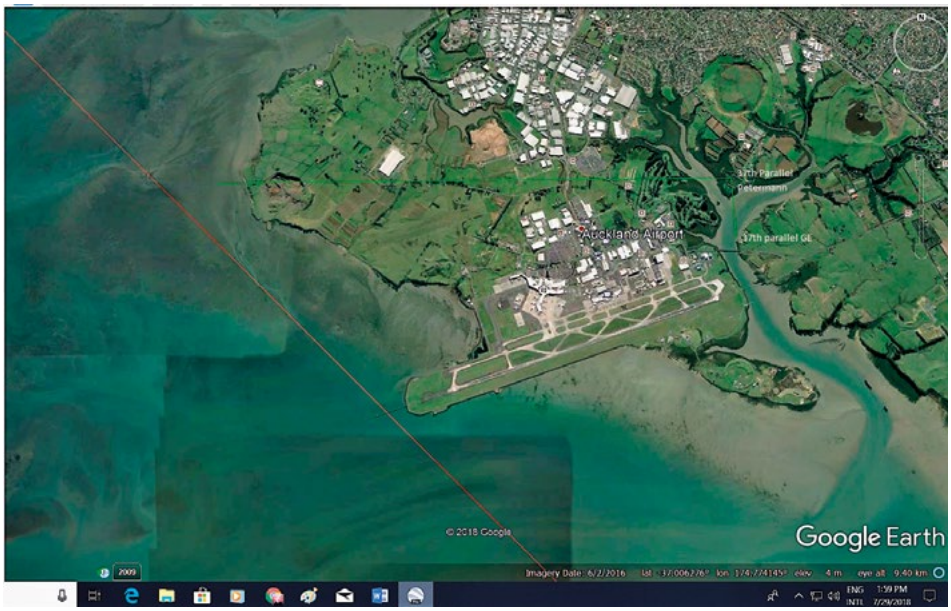

Figure 4: Plotting corrected latitude at the 37th parallel above Auckland Airport, the green line. (Google Earth™/Bunn).

Hochstetter's map scale, artwork, maps, easel and paper-stock

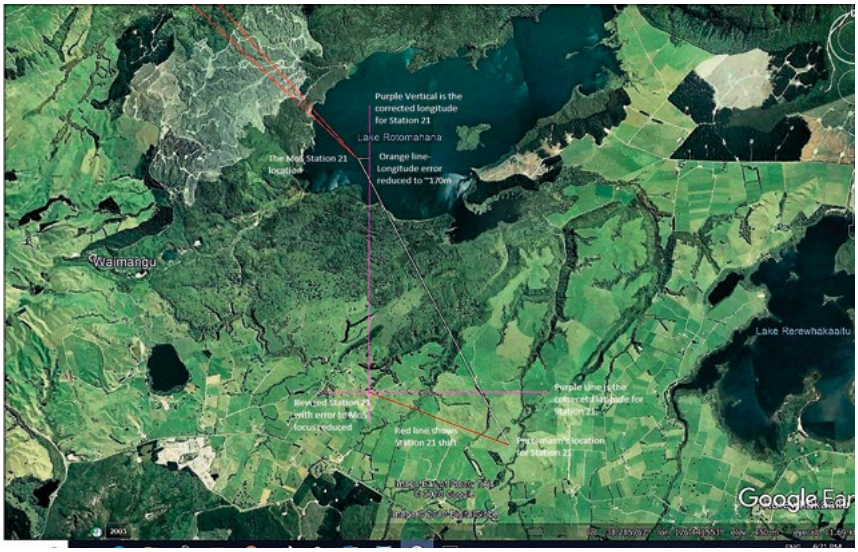

Figure 5: Plotting corrected latitude and longitude for Petermann's Station 21. (Google Earth/ Bunn).

Hochstetter's MoS map scale wasn't published and is specific to the paper-stock. Petermann's map shows a 1:12,000 scale (Hochstetter, 1862). The manuscript maps have no scale, and we deduced the MoS scale at 1:8,000. Nolden provides clarification from Hochstetter's paper-stock. While the first 29/4/1859 map is a diary sketch; the second is on 54cm by 36.9cm stock i.e. the same stock as the MoS map and at half the scale i.e. ~1:16,000. The paper size 54cm by 36.9cm is not an imperial stock size. We know Hochstetter purchased art paper in Auckland and it was Antiquarian stock, 53" by 31" (Hochstetter, 1860b). This was preferred for watercolours due to its weight, strength and resistance to cockling. Antiquarian stock cuts four pieces of 54cm by 36.9cm with overage for clamping.

Hochstetter appears to have shipped his easel. This would be metric carpentry and appears similarly sized to his watercolour maps (Ell, 1995). An artist would cut the Antiquarian sheets to fit his/her easel. We established scale by measuring his MoS baseline from Station 21 to Puai, after resecting these stations. The baseline migrated to the original map photographs on a 1cm cutting board, enabled us to scale these maps at 80m/cm. Petermann's map is available in printed and digital forms and scale may alter with printing/screen formats from, e.g. native resolution.

Integrating Hochstetter's and Petermann's maps in iteration VI

Hochstetter drew four maps of the lake and Petermann a fifth. In Figure 6, the protractor centres on Station 21 and overlays Petermann's map, both shown over Google Earth™. Puai Station locus, resected by three green rays lies at one o'clock: a white baseline joining the stations. The yellow rays are Hochstetter's surviving 11-bearing set from Station 21 (i.e. all those surviving the 1886 eruption). Note the two shorter yellow rays are his *original compass bearings* to the Pink and White Terrace locations. These two bearings are consistent with our georeferencing, but do *not* depend on it. They are the culmination of his survey and our reverse engineering. While the bearings strike the Pink and White Terrace springs on the MoS map (see Figure 7); on Petermann there is a gap shown by orange rays. This confirms Petermann's map is less consistent with Hochstetter's survey than the MoS map; supporting our decision to relegate it. The search boxes for the Black Terrace and Black Terrace Crater are in green.

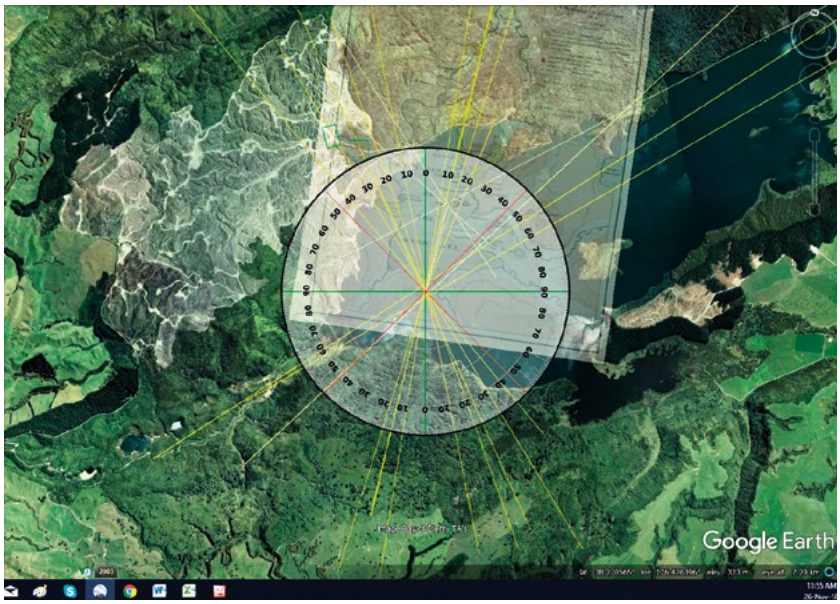

Figure 6: Petermann's map, Hochstetter's baseline, three Terrace locations and Black Terrace Crater. (Google Earth™/Bunn *Iteration VI*).

The Petermann and MoS maps' lake lengths are similar at ~1,600m, but Petermann's lake is narrowed by his *right-triangle* shaping, versus the *equilateral triangle* shapes of the manuscript maps, Keam's 1959 map and the 1858 map by S.P. Smith (1840-

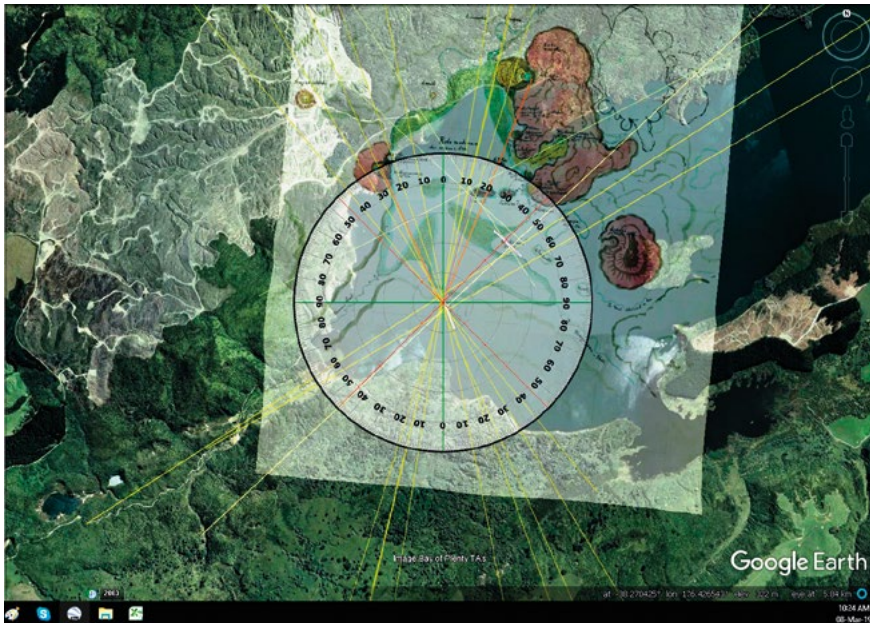

Figure 7: The 14-bearing set with method-of-squares map overlay and protractor. (Google Earth™/ Bunn).

1922; see Smith, 1858). The length is consistent with most colonial reports. There was a swamp to the southeast (as up to the 1970s in the new lake), containing three lakelets and these at times of high water merged with Rotomahana (Smith, 1858). For accurate survey dimensions, we employed nearby Lake Tikitapu as a surrogate for field validation. This lake is also 1,600m long, similarly shaped and can be circumnavigated on foot in <90 minutes. Hochstetter's marine survey methodology required a survey baseline. Given the water between, it could be thought this hindered his cartography: but such skills were taught in the nineteenth century and are today (Chung Ling, 2003). Hochstetter could accurately establish the baseline and lake length.

Other variance between the Petermann, MoS maps and the survey data is attributed to observational error, particularly from the steam-plume surrogates necessary for sighting hidden geothermal features (Bunn, Davies and Stewart, 2018). We replicated Hochstetter's field of view using Lakes' Tikitapu and Okareka and he would have difficulty localising plumes. The distances are ≤1,400m and some sites overlapped. High winds made it harder. A solution lay in his telescope and Hochstetter viewing Mt Ruapehu through his easel-mounted telescope illustrates this (Hochstetter, 1867 and Ell, 1995). At Rotomahana he would add an alidade introducing observational/parallax error; explaining the variance. Nolden and Bunn deciphered 40 Hochstetter bearings and landmarks from Stations 20, 21, 23 and Puai. Twenty-five landmarks survive and each bearing is validated, 15 landmarks were destroyed and 75 per cent of deciphered bearings and landmarks are validated.

Hochstetter's field of view

In Issue 94 we developed survey *Iteration V* using *elevation-profiling* and Hochstetter's *field of view*. This gave

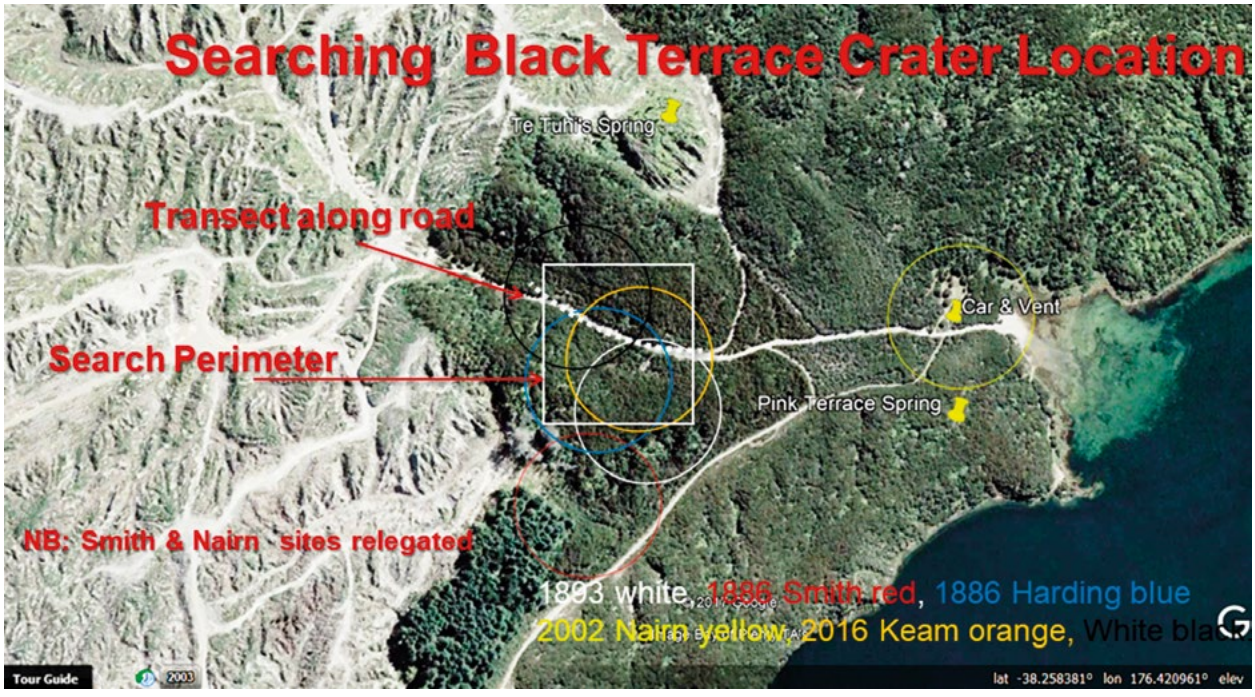

Figure 8: Black Terrace Crater locations in 2017. (Google Earth™/Bunn *Iteration VI*).

insight into landmark locations and in Figure 7 we provide 2019 *Iteration VI* bearing sets. These utilise all 14 surviving Hochstetter lake bearings (11 Station 21 and 3 Puai). The on-screen protractor minimises parallax/observational error. This improved accuracy while making no significant change to station or terrace coordinates. Note the goodness of fit with Rangipakaru overlapping Patiti Island as geoscientists expected.

The third Black Terrace and Black Terrace Crater

There was a third terrace – the "Black Terrace". Hochstetter included it (*Te Ngāwhā a Te Tuhi*) on his maps. In 2017, I noted its location lay on land. Colonial records refer to "Black Terrace Crater", the final stage of the eruption being on/near the Black Terrace (Bunn, 2017b). We included both in our 2017 site investigations. On 2 November 2017, I published the first history of these sites (Bunn, 2017b). The search perimeter for Black Terrace Crater was -38.25757°, 176.41853° to -38.25756°, 176.42052° and -38.25929°, 176.41858° to -38.25925°, 176.42054°, with a transect along the road at -38.25796°, 176.41845° to -38.25859°, 176.42060°. Our location for the Black Terrace developed in *iterations V-VI*. In Figure 8, it lies along the line -38.25646°, 176.41603° to -38.25748°, 176.41621°. Locating it discloses the locations of all terraces.

Conclusions

In this final survey iteration, the 2018 findings are confirmed. This paper benefits from research into terrace photo-interpretation (Bunn, 2019). *Iteration VI* gives improved Tarawera peak bearings without significantly altering the station georeferencing. New primary evidence strengthens the reverse engineering of Puai Station and the altimetry. We explain the faulted coordinates in Petermann's 1864 map and expose his creative licence. We then reintegrate Petermann into the survey research and show the areas of agreement between the maps. Hochstetter's purchasing records let us evidence the scale of his manuscript maps, which prove the most reliable mapping of the lake and terraces. Lastly, we refine the location of the Black Terrace and Black Terrace Crater. This paper is the sixth and final iteration of Hochstetter's survey of the Pink and White Terraces, providing the only primary evidence of their locations today.

Acknowledgment – Grateful thanks to Sascha Nolden for proofreading this paper.

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Through New Eyes, Rethinking Landscape

EDS CONFERENCE AUCKLAND, AUGUST 2019

Mick Strack

The Environmental Defence Society (EDS) is a very active non-governmental organisation which is persistent in questioning Resource Management Act (RMA) processes, tools and outcomes. This includes regular litigation and policy writing in defence of the environment. One of the best explanations of the RMA has emerged from the Supreme Court's decision in the *EDS v NZ King Salmon* case from 2014.

This year's annual conference was directed to discussions on landscape. Relevant themes designed into the conference included national parks and protected areas legislation, the Mackenzie Basin landscape and ecology, and the Billion Trees policy.

There were a couple of video presentations from Europe with Dame Fiona Reynolds, author of *The Fight for Beauty*, and Anton Gazenbeek, of the International Land Conservation Network, talking about the conservation of landscapes.

While national parks in Aotearoa New Zealand are established to preserve natural landscapes, most national parks in Europe are based around areas of outstanding cultural landscapes, which seek to maintain the culture, societies and traditional land uses that have formed such landscapes.

This has been described as 'a third way' where high-value landscapes are given an additional layer of protection under IUCN Category V Protected Landscapes which seeks to maintain the values of protected, lived-in, working landscapes through a combination of regulation and incentives. They usually exist on private land, and while private land uses are regulated, traditional practices are encouraged by promoting the unique and special character of those practices and by telling stories of the land.

It is therefore interesting to compare what has occurred in Te Urewera in 2014, where the national park status was removed and the management of that land is now based on Tuhoetanga, recognition of the cultural connection with the land. It would seem that good cultural and ecological outcomes can be secured without requiring Crown ownership of the land; perhaps a model for the future.

The Mackenzie Basin is under serious threat from tourism, water demand, dairying conversions and loss of biodiversity – all within this outstanding natural landscape. The Mackenzie Basin ecology and biodiversity was described as 'hands and knees' biodiversity: it is best observed at the small scale –viewed up close.

Although the surrounding mountain and lake landscapes are bold and dramatic, the ecology is light on charismatic species (but perhaps the kakī – black stilt – is reaching that status) and it has not been highly valued in the past. As a result it has suffered from land use changes (irrigation, dairying, wilding pines and tourism pressure).

There are multiple stakeholders and interests in the area, public and private land, conservation and production land, dramatic landscapes and subtle and fragile ecology, and a wide range of fauna and flora pests. It is apparent that there is institutional and regulatory failure in the protections of landscape in the public interest, particularly in provisions and protections in district plans.

Under the Minister of Conservation and of Land Information NZ (LINZ) Eugenie Sage, there is now a big effort to coordinate and integrate decision-making in the basin. The Mackenzie District Council, Waitaki District Council, ECan, Department of Conservation, and LINZ are being

brought together for joint discussions and planning – a recognition that fragmented governance is detrimental to environmental outcomes.

It would seem that the Mackenzie is now high on the Government's and on EDS's agenda. Perhaps if a more successful governance model is successful here, then it might be replicated in other areas.

The previous Parliamentary Commissioner for the Environment Dr Jan Wright also spoke of her role in Te Manahuna Aoraki, an organisation dedicated to the eradication of pests, weeds and predators from the upper Mackenzie Basin. Many of our landscapes have been degraded or destroyed by human land-use decisions. The issue confronting restoration efforts now is eradicating the pests that inhibit regeneration and replanting efforts.

Eugenie Sage spoke to the current government's Billion Trees programme in positive terms, but the programme later came under scrutiny, particularly what trees will be planted, where they will be planted and how will they be managed. It was widely recognised that productive pine plantations are ultimately destructive on our environment and will have little long-term effect on carbon storage. The only management regime is clear felling.

Also the land-use changes required for forestry conversions are likely to be destructive of landscapes and local communities. There is certainly doubt about how the programme will proceed, and there were strong calls for a lot more indigenous planting.

The clearance of native bush from most of our land has had very serious adverse effects. Dame Anne Salmond talked about the eroding hills of the East Cape where local forest rangers and mana whenua are trying to reverse the destruction of previous forest clearances and to work on regeneration of indigenous landscapes.

In almost all the sessions there was a recognition for the Treaty partnership to be respected and strongly supported. Mātauranga Māori also reflects back on how landscapes and ecosystems are used in customary ways where humans are part of the environment, not something apart.

The conference dinner included a conversation with realist landscape artist Grahame Sydney and poet Brian Turner. They talked of their love and connection with their place, Central Otago, and bemoaned the loss of the golden tussock landscapes and the green invasion – irrigated paddocks and wilding trees.

A special breakfast session was dedicated to the underwater landscape of Queen Charlotte Sound and Tory Channel. Helen Neil, of NIWA, showed the very dramatic seabed topography that has been mapped by the hydrographic multibeam and sidescan survey undertaken by NIWA and the Marlborough District Council. This was a fascinating demonstration of a landscape that is rarely seen, but is none the less important as a habitat and ecosystem that deserves protection.

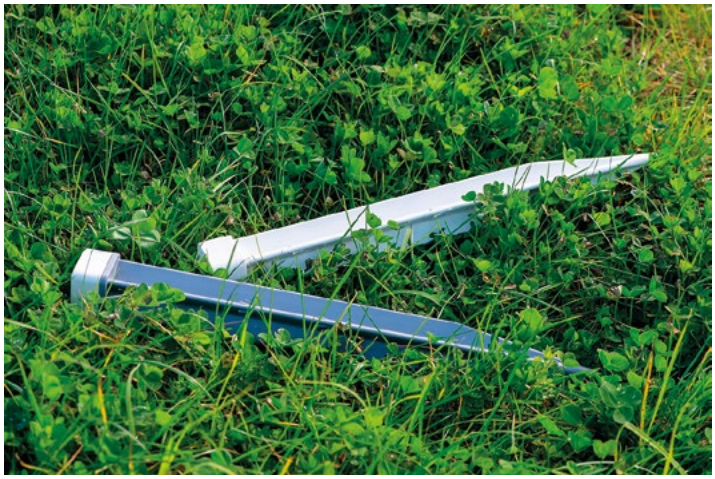
Minister for the Environment David Parker spoke of the Government's legislative plan and particularly reform of the RMA. He recognised that EDS had made very significant contributions to this discussion and provided some good direction on legislative reform. The Parliamentary Commissioner for the Environment, Simon Upton, wrapped up the conference with a review and commentary about the theme of landscape protection, commenting how the EDS conferences were his favourites.

The protection of outstanding natural features and landscapes is a matter of national importance in the RMA and in national policy statements such as the New Zealand Coastal Policy Statement. Most of our landscapes are now heavily modified by human activity, so perhaps we need to recognise and protect cultural landscapes as well, in ways similar to longer settled areas of UK and Europe.

Landscapes could be the unifying force for all government environmental policy: affecting tourism policy, tree planting and carbon sinks, land-use regulations, pest control, and protected areas legislation.

The EDS conference, *Through New Eyes, Rethinking Landscape*, shared different cultural stories about landscapes and provided an opportunity to see landscapes through new eyes.

NFC/RFID in-ground peg, a new development for land survey



By Gregar Haycock, Wellfound Ltd

Surpeg is a plastic boundary mark manufactured in New Zealand that was developed 13 years ago as a durable, visible and long-life alternative to timber and aluminium pegs.

To cover the many and varied range of ground conditions, two peg material options are produced:

- The standard peg, which is moulded in a UV-stabilised fully recyclable plastic material that also uses recycled plastic in the manufacturing process to produce a tough and durable long life in ground mark.
- The hard peg, manufactured in an extremely hard and rigid composite plastic material designed to penetrate a very hard ground surface.

The pegs have been designed with a hollow peg head for electronic chip or tag insertion and both the standard and hard pegs contain metal inserts to assist with location by metal detector.

Passive RFID inserts

When Surpeg was first developed, the objective was to provide a mark that could carry identification and data storage within the peg head.

The two-piece peg (shaft and cap) assembles to provide a hollow head to insert a passive NFC (near-field communication) or RFID (radio frequency identification) chip or tag.

Earlier RFID tags data could be read by a handheld reader and this information presented on the reader as a basic 8 to 12 numeric code that could then be related to computer-stored information to get the mark detail; the peg effectively just contained an identification number.

Latest development: Is there a fit with your process or is there a new process?

This latest iteration of the passive data peg contains an NFC tag that offers 888 bytes of available data stored in the peg head.

This information can be either read or written to a basic mobile phone. The signal from the phone activates and powers the passive unpowered tag to provide and accept information. This information can then be easily lifted and conveyed from the mobile phone field to the office onto a nominal platform or Cloud.

Compared with previous tag and chip systems, now with either reading or conveying data via a mobile phone or the latest more specialised handheld reading equipment, you are provided with much more data at a much-reduced equipment cost.

An app has also been generated to demonstrate the NFC process to show prospective users how the system works and a system can be customised to suit.

Land survey has a myriad of data gathering equipment and technology systems available. Land surveying is very well covered by dedicated brands for data stations, readers and integrated equipment systems. However, with the opportunity to now collate and store information with NFC or RFID onto an unpowered in-ground peg, there may be a feature or factor that inspires a different approach to land survey?

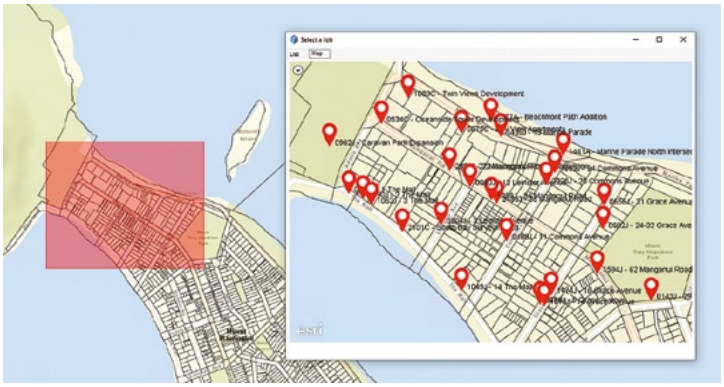
Non-land survey applications: benchmark pegs

The Surpeg cap can be manufactured with an in-moulded custom brand or logo, and with this cap and peg shaft manufactured in any colour, it clearly identifies a peg's ownership and purpose.

Customised benchmark pegs combined with NFC or RFID provide clear identification and information for in-ground marking for land assets, roading, railways, parks etc.

For more information visit: www.surpeg.com.

MAPPING THE WAY TO SUCCESS



How RPC land surveyors are saving time by searching spatially

Shane Machon

Surveyors, let's face it, the noble art of cadastral surveying is ultimately a numbers game.

Our industry is all about speed, productivity and efficiency with new technology. We've become so much more than just someone with a theodolite on one's shoulder. Our utes now carry an arsenal of technology, enough to wage war against any minor municipality.

An increasingly important, yet often neglected, weapon in this arsenal is our database. It's the brains behind everything, our mission control.

All surveyors need to be able to quickly identify what jobs have been completed nearby, what reference data is available and whether a job has already been done previously. If you can't do this, you could end up in hot water.

So we manage databases, often an Excel spreadsheet, with thousands of jobs and their addresses. But these databases have become a major overlooked time-sink. Efficiency in how we manage and search our databases can be a major competitive advantage. It can save hundreds of billable hours and thousands of dollars.

The answer is to search, not by address, but spatially. In short, spatial data should be just that, *spatial*. Let's look at a real-world example.

Our story starts: Enter RPC Land Surveyors

Here's a company which has revolutionised data management and retrieval with a new spatial search tool. We recently caught up with Blair Jackson, director at *RPC Land Surveyors* to learn more.

RPC is a New Zealand cadastral surveying firm with 20 staff across two offices in Mt Maunganui and Auckland. Founded in 1982, the company specialises in cadastral surveying and land development engineering; with services ranging from locating a boundary peg to completing a major 400-lot subdivision.

The overlooked daily time-sink – Searching for spatial data

RPC averages 400 jobs a year and has more than 7300 jobs archived across its databases gathered during its 37 years in business. Managing and accessing this data was a major challenge for RPC, explains Blair Jackson, a licensed professional cadastral surveyor with 23 years' experience.

RPC's database started as little more than a thick hard-copy book with jobs and addresses handwritten into it. This was very inefficient and time-consuming because search functionality was entirely manual.

The tedium of spreadsheets: "Hunting" for data

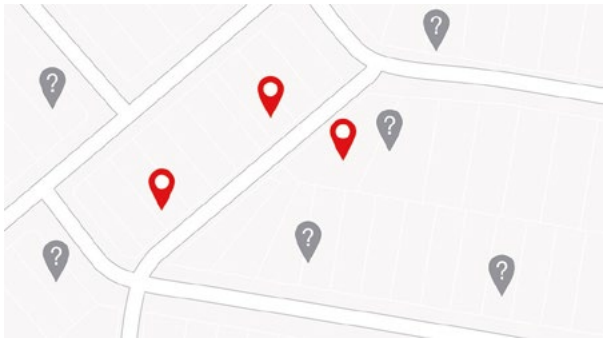
RPC eventually digitalised this database, migrating it to an Excel spreadsheet. However, the system's search functionality was still slow and limited.

Finding job information involved opening the Excel document from the network drive, and once loaded, searching a job's address. This would display basic job details and the surrounding jobs along the same road. Staff then had to hunt through Windows Explorer to find each job folder.

"The problem with Excel was that you could only search by street address. You might have 'Mt Maunganui road', a very long road, and then you'd have to try to sort by street number as well, or just go by memory.

"It was a very long, time consuming process, and even then, it didn't give you all the answers you wanted, as it couldn't search jobs on adjacent roads. And you obviously get double ups from similar addresses in different towns," Blair says.

Blair estimated that finding job information using Excel took on average 10 minutes for his office and this was being searched roughly three times per job. With up to



400 jobs a year, this very quickly added up, with an estimated 200 hours a year spent searching for job data. This is projected to have costed RPC about $25,000 a year in lost billable time.

Spreadsheets mean manual data entry

RPC's database was also reliant on manual data entry which was time consuming and inevitably resulted in human error.

"The more data entry, the more risk of street names just being a couple letters off and then they're very hard to find. If you can't find the job by its road name, you have to try to remember what the client's name was. Or worse, search the whole town and ask around the office."

Blair estimates this data entry in Excel took about three minutes per job. With 400 jobs per year, this amounted to an estimated 20 hours and $1,200 of billable time wasted populating the spreadsheet.

Rework of existing jobs

Because the Excel spreadsheet didn't show results readily or accurately, surveyors could end up resurveying a site that had already been done. It was a particular issue for new staff, who had no idea what jobs were completed previously, and could end up redoing work.

"All of us can think of a job where we're sure we've done something down that way. We hunt through the databases, but sometimes you just can't locate it or it might mysteriously pop up, but only after the job has been completed.

"If you can't find the job, you just have to start from scratch. And obviously that involves more cost and time."

Repeating work can waste anywhere from $1,500 to $15,000+ depending on the value of the job being redone. Not to mention it's frustrating for surveyors redoing work they've already done.

Inaccessible from the field

The Excel spreadsheet had to be kept on a network drive so all staff had central access to it. But this couldn't be accessed by surveyors in the field, who had to call up admin staff to search for it. This further burnt valuable time and labour.

Ultimately RPC realised that its databases couldn't efficiently nor effectively track over a thousand jobs – not to mention RPC's total archive of more than 7,300 jobs. It needed a smarter way of searching.

In the theodolite's cross-hairs: A new way to search

RPC has always been a trailblazer when it comes to technology, believing that efficiency from innovation gives it the competitive edge. Blair and his team were early adopters of 12d Synergy – a data and document management system for engineers and surveyors. When they heard about 12d Synergy's new spatial search feature, they rolled up their sleeves and gave it a go.

Spatial Search, a 'pretty novelty', who cares...?!

With 12d Synergy Version 4, users not only have a standard attribute search, but also the option of map-based search. Spatial Search lets users zoom into a region on a map and search by drawing a rectangle, dropping a pin, or a specific address. The search radius can then be defined, for example all jobs within 300m or 5km.

Jobs are shown as markers on the map, which can be clicked to quickly see an overview of the job's attributes, including job number, name and address. From the map, users can then jump directly into the folder structure of each job.

"When I first heard about Spatial Search, I thought it would be only a pretty novelty. I didn't think we'd use it much. But once you start using it, you zoom in and find six jobs nearby and you work off one of those, you realise it's actually very helpful," Blair says.

"It can save you a few hours or half a day or even more time. It's now the office's go-to search, and we use it every day."

It's simple, spatial data should be searched spatially

Spatial data is clearer once it's displayed visually on a map, rather than hidden away in rows of text: "You get the results very clearly on the map when it pops up. There's a job name and the project number and you can just click through them," Blair says.

Attributes can be applied to further refine your search, such as jobs in a 1km radius that were completed within the past two years, or were with a specific surveyor or client. You can also search for particular files as well, for instance, all files called 'dial before you dig' within 500m.

The map can also be configured to have different layers, such as adding parcel boundaries from LINZ, as well as satellite aerial imagery which both come default with 12d Synergy.

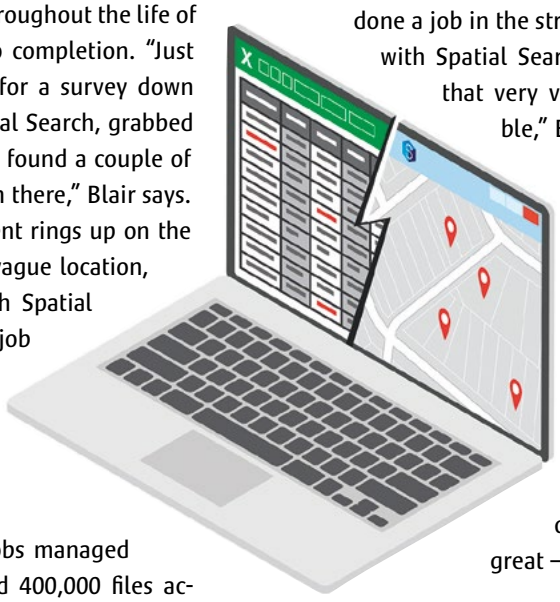
The unexpected benefits of Spatial Search for RPC

All nearby jobs are immediately searchable

At the start of every project, RPC does a Spatial Search to see what jobs are nearby. "We just quickly draw a rectangle around the job area, and then you instantly have all the jobs we've done on the map. You immediately know what we have and haven't done."

RPC uses Spatial Search throughout the life of a project, from quotation to completion. "Just today I was doing a quote for a survey down Whakatane way. I used Spatial Search, grabbed a rectangle around the area, found a couple of jobs nearby and worked from there," Blair says.

"It's also great when a client rings up on the phone and they just give a vague location, such as Marine Parade. With Spatial Search we can easily find the job in question, saving time for us and the client."



Time-savings: Excel v Spatial Search

RPC has more than 1,200 jobs managed in 12d Synergy, with around 400,000 files accounting for 300GB of data. With Spatial Search, search time for job data has been drastically reduced from about 10 minutes to under 30 seconds, a saving of up to 95 per cent.

"With Spatial Search you've got your answers within 10 to 20 seconds. It's pretty much how fast can you zoom into that map area and draw a rectangle: that's very, very quick, and that's a benefit."

The 200 hours a year of searching Excel has now been cut to about 10 hours. That's an estimated saving of up to 190 hours across RPC's 400 jobs, amounting to a projected annual saving of $23,750.

Automated data entry, minimised human error

RPC experienced further savings by no longer having to manually enter job data into both the Excel spreadsheet and its job management software, Abtrac. 12d Synergy connects with Abtrac, with the integration automatically populating new jobs in 12d Synergy with the information created in Abtrac. 12d Synergy then automatically geocodes job addresses with spatial coordinates, eliminating double data entry and human error.

In total, the new system has eliminated 100 per cent of the estimated 20 hours of tedious Excel data entry, amounting to a projected $1,200 annual saving.

"Using 12d Synergy with the Abtrac connector, we just input the job once in Abtrac and then it automatically populates across, and that's a big saving."

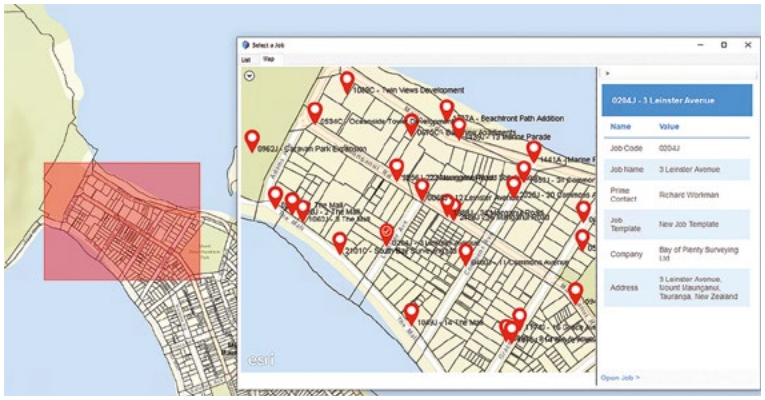
Unnecessary survey rework is avoided

When relevant data can be found, Blair estimates up to 50 per cent of a new job can be saved, freeing up staff to work on other jobs. On a typical cadastral job, this could save roughly seven hours and $1,500 or more per job.

"Before Spatial Search we could only search by street address. We might not actually realise that we've already done a job in the street that backs onto that property. But with Spatial Search your search is expanded, and all that very valuable data is immediately accessible," Blair says.

"This can cut half the job: the time spent searching, calculating the boundaries, finding marks, all takes hours. That could save us a dramatic amount of time, easily $1,500 per job.

"It also saves resources: we no longer lose the guys out in the field for a day when they didn't need to, and they can work on another project altogether. That's very great – that's brilliant."



Easier onboarding as new staff know what's been done

While existing staff may remember previous jobs, new employees may not know what work has previously been done. Spatial Search makes onboarding easier for new staff and gives everyone an instant, accurate understanding of what data is available.

"I've been with RPC for 23 years, and I seem to have a good memory of what jobs we've worked on. But the other staff may have no idea that job already exists, and they would just go and do it," Blair says.

"You'd just be wasting time and money. But with Spatial Search, everyone can easily find all the past jobs we've done, so they don't accidentally redo them."

Money is saved not repurchasing deposited plans

RPC manages more than 40,000 DP plans in 12d Synergy, with a proper naming scheme that allows fast search and access. But with Windows Explorer, RPC was having to repurchase some plans because the originals couldn't be found.

"We've had times where we had to repurchase DP plans. Somebody might've used it, but they didn't actually save it so you just have to rebuy it. You think $5 isn't that much, but once you start thinking you've bought 10,000 or 20,000 plans, it starts adding up."

Easier collaboration and job sharing

12d Synergy and Spatial Search make it easier to change hands on a project, because all data is centrally available in a common data environment, and data is easily searchable. RPC has more than six project leaders working and collaborating on jobs. If a surveyor is on sick leave or annual leave, other surveyors can easily pick up the reins on a project.

"We've got many project leaders in this office, so there's a lot of jobs you don't know about. That's one thing I find great about Spatial Search. If a client rings up and the person who's dealing with that job is away, you can still easily find everything they're working on, and where the job is up to."

Blair's verdict of Spatial Search

"When I first heard about Spatial Search, I thought it would be only a pretty novelty. I didn't think we'd use it much. But once you start using it… you realise it's actually very helpful. You're saving time, money, costs, resources, and saving staff trying to hunt for files. And it's easy to learn to use too, you don't even have to train staff. You're no longer hunting for data; you're just scrolling with your mouse and then drawing a rectangle or dropping a pin. It's now the office's go-to search, and we use it every day. We're saving a lot of time and money."

Blair rates 12d Synergy's Spatial Search feature 5/5 stars and says that he definitely recommends it to other surveyors in the industry who are struggling with managing and searching their database.

Map your own path to success with Spatial Search

If you would like to learn more about 12d Synergy and see our Spatial Search feature in action for yourself, book a personalised demo by contacting us on +64 4 528 2885 or *synergy@12d.co.nz*.

What if your park isn't a reserve?

Stephanie Harris & Vicki Toan

As our cities and towns grow, and the intensity of urban development increases, green spaces for recreation become increasingly important.

Territorial authorities are responsible for neighbourhood parks and reserves with their districts (as distinct from regional parks). These green spaces may be acquired by the relevant council using its powers as a requiring authority under the Public Works Act 1981 or they can be vested or transferred to the council by a developer as part of a subdivision. This article considers the vesting or transfer of land for a park in the context of a subdivision.

Under section 220 of the Resource Management Act 1991 (**RMA**), a council may require land to be vested in it or transferred to it for a specific purpose as a condition of a subdivision consent. Any such condition must be:

- agreed by the applicant; or
- directly connected to an adverse effect of the activity on the environment or an applicable rule in a district or regional plan or a national environmental standard (RMA, section 108AA).

Land for a green space may be vested in or transferred to the council as a "reserve" or a "park". These terms are not interchangeable. Land may be vested or transferred as a reserve under the Reserves Act 1977 (**Reserves Act**) or a park under the Local Government Act 2002 (**LGA**).

Reserves under the Reserves Act are classified according to their characteristics and intended use. Neighbourhood recreation areas are likely to be classified as a "local purpose (recreation) reserve". Reserves, including local purpose reserves, are subject to all of the protections and controls afforded to them by the Reserves Act, which include restrictions on what they can be used for and how they can be dealt with.

A park on the other hand may be referred to as a "park in lieu of reserve". A park does not have the same protections or controls as a reserve. Restrictions on use and dealings with parks are limited to section 138 of the LGA, which imposes a restriction on the disposal (by way of sale or lease exceeding six months or any other act that substantially interferes with public access).

Section 138 of the LGA provides that a council proposing to sell or otherwise dispose of a park or part of a park must consult on the proposal beforehand. For the purpose of section 138, a "park" is land acquired or used principally for community, recreational, environmental, cultural, or spiritual purposes other than a reserve under the Reserves Act.

"Consultation" has a special significance under the LGA. It refers to a formal process of consulting with residents and ratepayers before a decision is made. Consultation undertaken by a council must be carried out in accordance with the principles of consultation in section 82 and comply with the information requirements in section 82A.

The requirement to consult before sale or other disposal does not however operate to prevent the sale or disposal of all or part of a park, even where there is public opposition. This is a potential issue where essential urban green spaces are held by a council as a park in that it is possible that the green space will not be retained as a park or even in council ownership long term.

Different councils around New Zealand are likely to have different approaches when it comes to taking responsibility for green spaces on subdivision. For the developer seeking subdivision consent there is little scope for challenging a decision to, say, have land vested as a park instead of a reserve.

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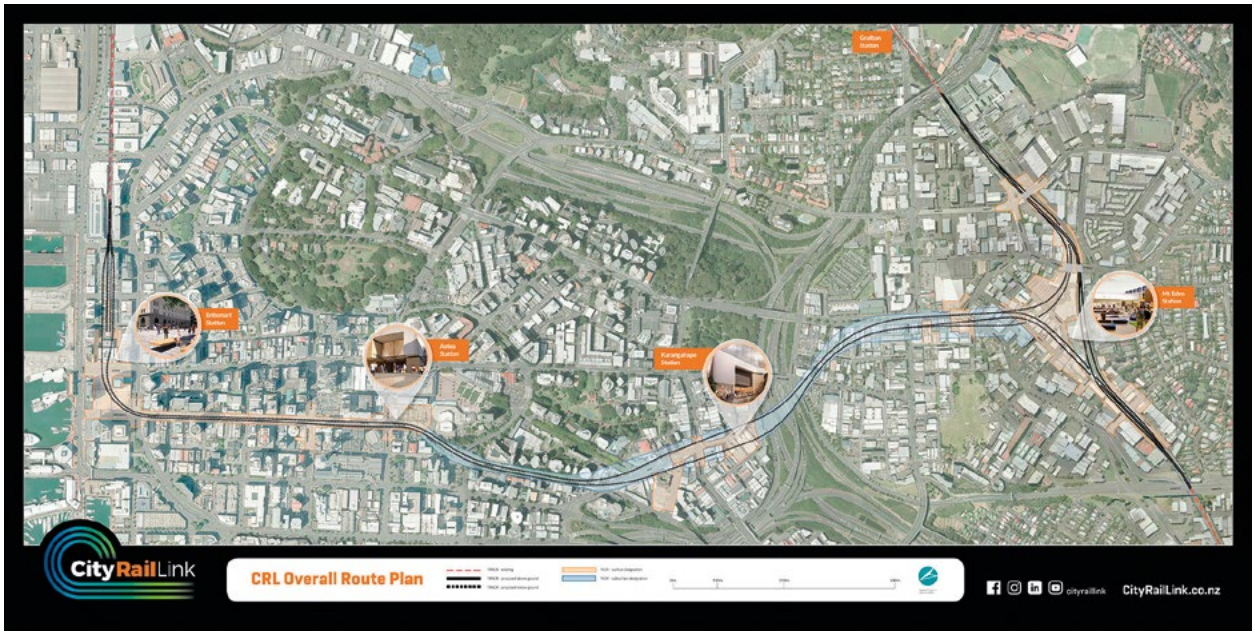

you get to your destination. It allows the rail network to almost quadruple capacity.

Completion date: the CRL is due for completion in 2024.

Alliance partner Vinci is considered one of the top two largest construction companies in the world, and with that brings many opportunities for C3 and New Zealand. The wealth of experience, resource and innovation that Vinci brings will complement our local 'No. 8 wire' approach to produce a construction systems, methodology and technology that will stand high on the global scale.

There are three main teams in the C3 Link Alliance, the design team, construction team and the engineering team. The engineering team is a developing concept for New Zealand infrastructure projects, where the primary role is to bridge the gap between design and construction, and includes many CAD operators, digital engineers and BIM managers.

At C3, the survey team is part of the construction team, but on other New Zealand projects the team is part of the engineering team. The engineering team is continuously using terms such as 'Federated Models', a 'Single Source of Truth' and 'Constructible Models', all of which have the potential to make the life of the surveyor a little bit easier with design data that is ready for the field. But this must go both ways and we are striving to provide near real-time visibility of the existing conditions of the site.

Stay tuned for future updates on CRL and C3.

(back to p24)

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systemic barriers, by reviewing legislation, and operational-level barriers – such as the diverse challenges holding back town-level projects.

Practical "how to" guidance is being developed, iteratively with ongoing input from practitioners, to make it easier for councils to make temporary physical changes to streets, improvements that are in advance of a permanent fix, and do activations with a primary aim of improving safety and the "place" value of streets.

Meanwhile, *Innovating Streets* is providing a range of practical support for projects from "play streets" to intersection redesigns and case studies that are also road-testing the *Innovating Streets* guidance and giving feedback. System-wide, there's also capability-building under way, not just for councils and consultancies but also third-sector and voluntary groups.

If you're interested in the use of experimentation to achieve more "pro-people" streetscapes, check out the interim guidance at: *www.nzta.govt.nz/innovating-streets*, and contact the *Innovating Streets* team at *innovatingstreets@nzta.govt.nz*

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