October 2021 #106

SURVEYING + SPATIAL

Magazine

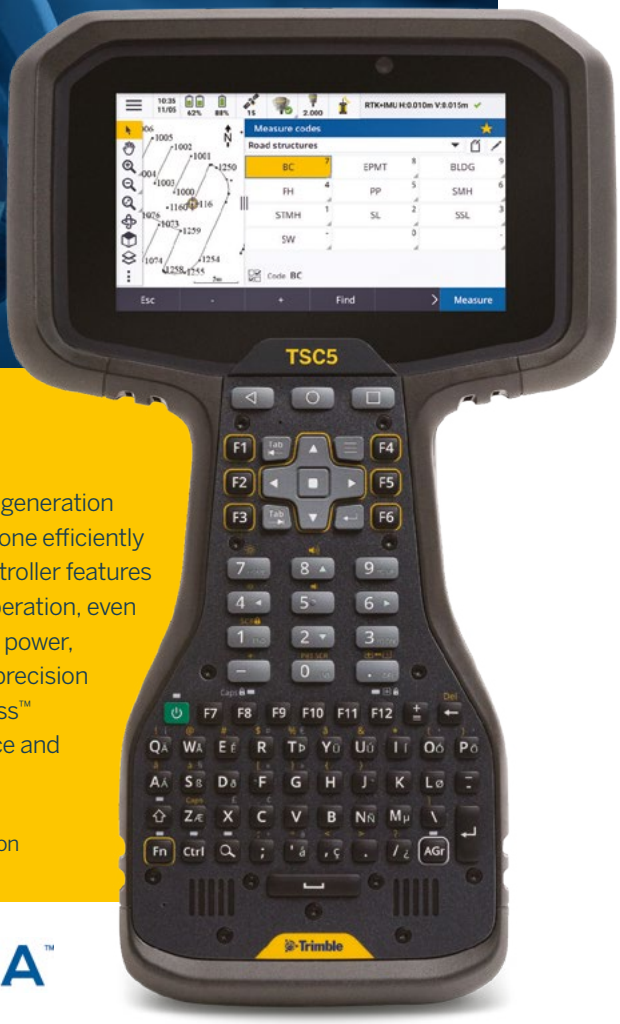
Focus on Technology

THE FUTURE OF AUTONOMOUS SURVEYING

ANALYSIS FROM THE TECHNOLOGY SECTOR

SAR TECHNOLOGY IN NEW ZEALAND

TSC5 CONTROLLER



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Focusing on Technology

New developments and innovations in the technology sector have made rapid progress over the past couple of decades, with many new technologies changing the way professionals and businesses operate and provide information for clients.

This edition we are taking a look at some of the new and diverse ways that technology is shaping the survey and spatial industries and the impact that these evolving applications are having across many diverse sectors and industries both in New Zealand and overseas.

Geospatial technology is one area where the advancements are having far-reaching effects on our communities, businesses and organisations in gathering data specific to a location. The range, and use, of geospatial data is immense with many applications in everyday use, including mapping and information services, agriculture, civil construction, ecology, defence, engineering, scientific research, marketing, logistics and transportation.

These new applications have become game-changers for many industries, solving problems, making information easier to access, creating new products and services, generating greater efficiencies and providing professionals with a new set of tools to assist with their work.

Geospatial technologies have advanced the performance of smart machinery and new applications incorporating GPS technology have allowed greater precision and the ability to carry out tasks with greater safety control.

In sectors such as the construction industry, autonomous machine control systems for earthmoving machinery have become increasingly widespread and the applications are important tools for companies wanting not only to ensure job accuracy and productivity but operator protection in line with increasingly common Zero Harm company policies.

Integrated technology solutions are paving the way for companies in the sector with project sites becoming progressively more digitised to include site assessment and monitoring tools with drones, apps and mobile devices for onsite evaluation and monitoring job progress.

As the technology advancements rapidly evolve and new platforms become more commonplace, contractors of the future will be adopting the latest tools to stay ahead in the digital age.

In our 'Focus on technology' theme this edition, reality capture and construction specialist Haydn Bradfield takes a look at how automated technology and adaptable solutions

have helped overcome some of the challenges in the survey sector by creating customisable innovations that are emerging as significant developments for the future.

With technology advancements occurring at a rapid pace in the survey and spatial sectors, we asked three consultants what opportunities, challenges, innovations, and trends lie ahead for the industry in our technology sector perspective article.

Steve Critchlow, of Critchlow Geospatial, presents new high-resolution synthetic aperture radar (SAR) satellite technology and its many applications for New Zealand's government and private sectors to detect and respond to change in New Zealand's natural and built environments.

And in our case study this edition, Tom Goodwin of Ferntech examines how a new clip-on LiDAR payload is making aerial surveying more accessible for one forestry consultant and data management company. •

Survey and Spatial New Zealand
TĀTAI WHENUA

SURVEYING+SPATIAL
ISSUE 106 OCTOBER 2021

A publication of Survey and Spatial New Zealand, Tātai Whenua.
ISSN 2382-1604
www.surveyspatialnz.org

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Distributed free to members of S+SNZ. Published in March, June, September and December by S+SNZ.

DESIGN & PRINT MANAGEMENT
KPMDesign – *www.kpmdesign.co.nz*
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OCTOBER 2021

FOCUSSING ON TECHNOLOGY: SURVEY AND SPATIAL SECTOR PERSPECTIVES

Technology advancements in the survey and spatial sectors are accelerating rapidly with new applications having a significant impact on industries around the world.

With demand increasing in many different sectors, *Surveying + Spatial* asked three high-profile technology firms what major themes, trends and current challenges are emerging in the technology sector now and into the future.

How can technology contribute to our sustainable future?

Bruce Robinson, Survey Manager, Global Survey

Survey and spatial technology can help our industry create workflows that match New Zealand's sustainability goals. The objective is to do things in a smarter way so that everyone can benefit now and for generations into the future.

Part of this process is to look beyond what we believe our clients' needs are, and to understand what our clients' requirements are and be able to deliver a solution that enables everyone's goals to be met. Technology is making it easier for us to achieve these solutions and those who adopt early will reap the benefits in the long term.

Hardware automation and autonomy are only part of the technology puzzle; the movement and re-use of data is where true benefits can be found and delivered. For example, by moving your data rather than your people with your data, it is possible to speed up processes and contribute towards sustainable development.

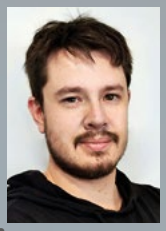
If a survey crew is equipped to operate with the right technology, do they really need to come into the office, or can they go straight to site? If a crew have the tools at their hands (hardware and software), with current onboard computing power and edge computing, it is possible to do on-site processing of the data and produce reports and deliverables before leaving a site.

Current reality capture technology enables data to be used for more than just design purposes. It can be used for client/public engagement, virtual site visits, facilities management and much more.

While GNSS drives external positioning, visual positioning systems (an emerging technology) enable precise indoor positioning to occur; this further drives the need for correct as-built information to be captured and the requirement for the integration of both horizontal and vertical BIM. An accurate as-built is critical for ongoing maintenance and for safety of life.

The right technology and a company's effective digital strategy that is aligned with New Zealand's commitment to the United Nations Sustainable Developments Goal's plan (*https://sdgs.un.org/goals*) can certainly help with client retention, growth and strength of the industry.

Trends and Developments



Daniel Morton, Support and Technical Manager, Ferntech

Over recent years, Ferntech has seen a steady and consistent uptake in drone technology being utilised across the surveying industry. Local teams are relying on drones for greater accuracy and efficiency across a wide range of projects and sites.

The trend promises to continue as organisations focus on collecting quality data and removing inefficiencies from their workflows to increase productivity.

With the rise in the number of drones in the sky, commercial UAV manufacturers have stepped up with new products that are affordable and seamlessly integrate with commercial drones already on the market.

The major trends we see:

LiDAR – LiDAR is becoming more affordable to surveyors across the board, driven by developments in solid-state LiDAR and competition between manufacturers. This quarter, drone giant DJI released a high-quality, integrated LiDAR system at a price point never seen before in the industry.

Oblique Photogrammetry – Though the concept has been around for many years, integrated payloads with multiple camera orientations are improving the quality of data and increasing captured areas, without the expense of flight time.

Software – We have observed that software developers are focusing on improving data processing time and implementing new algorithms to reduce the amount of hardware investment required. A number of organisations have moved to processing data in-house due to the ever-increasing costs for data processing providers. The biggest consideration of moving data processing in-house is the investment cost of processing hardware and software licensing.

And finally, we are keeping an eye on the Ministry of Transport's Enabling Drone Integration review, and eagerly awaiting the final reports. With strong government support for commercial drone use, we believe it will open up pathways for more advanced flights such as BVLOS (Beyond Visual Line of Sight) and autonomous missions. In any case, the future of drones is bright!

Industry Observations and Challenges

Dylan Revell, Regional Sales Manager, 12d NZ Ltd

The survey and spatial industries in New Zealand are seeing major movement with regards to digital asset standards and asset management as the New Zealand Code of Practice for 3 Waters Assets and the Asset Management Data Standard (AMDS) from Waka Kotahi (NZ Transport) come on-stream this year.

The introduction of these prescribed standards for asset capture and attribution brings the New Zealand spatial industry forward to join the rest of the world with regards to digital data workflows and BIM collaboration.

The challenge for the spatial industry is providing asset as-built information to comply with these attribute/information rich standards, without requiring additional man hours spent fulfilling the requirements of the authorities for metadata attribution. Luckily, the tools and technology available to spatial professionals can do much of the hard lifting for this work.

Gone are the days when a printed plan with the lid level and invert level of constructed asset were all that was required for surveyors and engineers to deliver to the certification authorities.

We are also seeing major projects in New Zealand delivered where the projects had a clear and unambiguous intention of BIM and digital collaboration from all the project parties in a true 'field to finish' format.

The workflows and learnings from these projects will filter down eventually to all aspects of project delivery, from both major and minor projects as has been the case overseas. Once project principals are aware of what can be produced and delivered by the spatial industry, they will not want to go back to the information-poor plans of the past.

One of the last major hurdles to true digital collaboration in the New Zealand industry is the reluctance of all parties to provide digital data as the liability and risk processes have historically, and still do somewhat, rely on a non-digital delivery.

One major contractor I was talking to recently decried the effort of getting a digital 3D model from the designer as they didn't have the processes in place to sign off and approve this method of delivery – even though the technology in the construction equipment was capable and far more efficient using the 3D model than the operator following a plan.

We are confident these hurdles will be overcome as it has been accomplished elsewhere in the world.

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Please take a look. We'd love your feedback.

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THE AUTONOMOUS SURVEYOR

By Haydn Bradfield, Reality Capture and Construction Specialist – Global Survey

Working in the survey and spatial industry presents many challenges; some involve dangerous environments, confined spaces and sites where health and safety requirements prohibit people from entering.

All experienced professionals will have encountered challenging situations that required some sort of innovation to get the job done, and opportunities are lost due to not having the time or the budget to develop a solution.

Why robotics and reality capture?

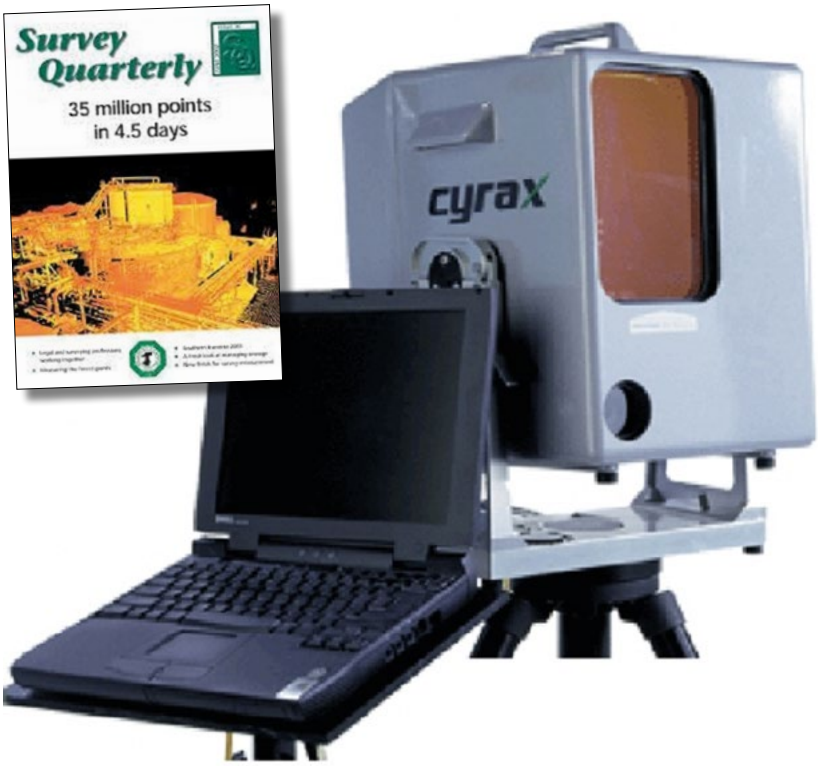
To start understanding the 'why' and the future, we must first understand reality capture and how far we have come.

The first scanner in New Zealand takes us back 20 years to 2001 when Global Survey's Survey Manager Bruce Robinson imported the Cyrax 2500. This first-generation laser scanner was an exciting innovation back then and considered cutting edge. The Cyrax 2500 had the capability of

measuring 1000 points per second and an accuracy of +-6mm.

This scanner was limited by several factors, it could only scan a 40 x 40 degree window and weighed a whopping 29kg, excluding the tripods, cables, computer and in some cases, a petrol generator. It is easy to look back now and wonder how it was even manageable.

But Bruce did manage to scan with it, and the data captured left his 256-megabyte Pentium 2 Toughbook with little space left on its 10-gigabyte hard disk. He went on to write an article on how he was able to capture 35 million points in 4½ days . . . revolutionary!

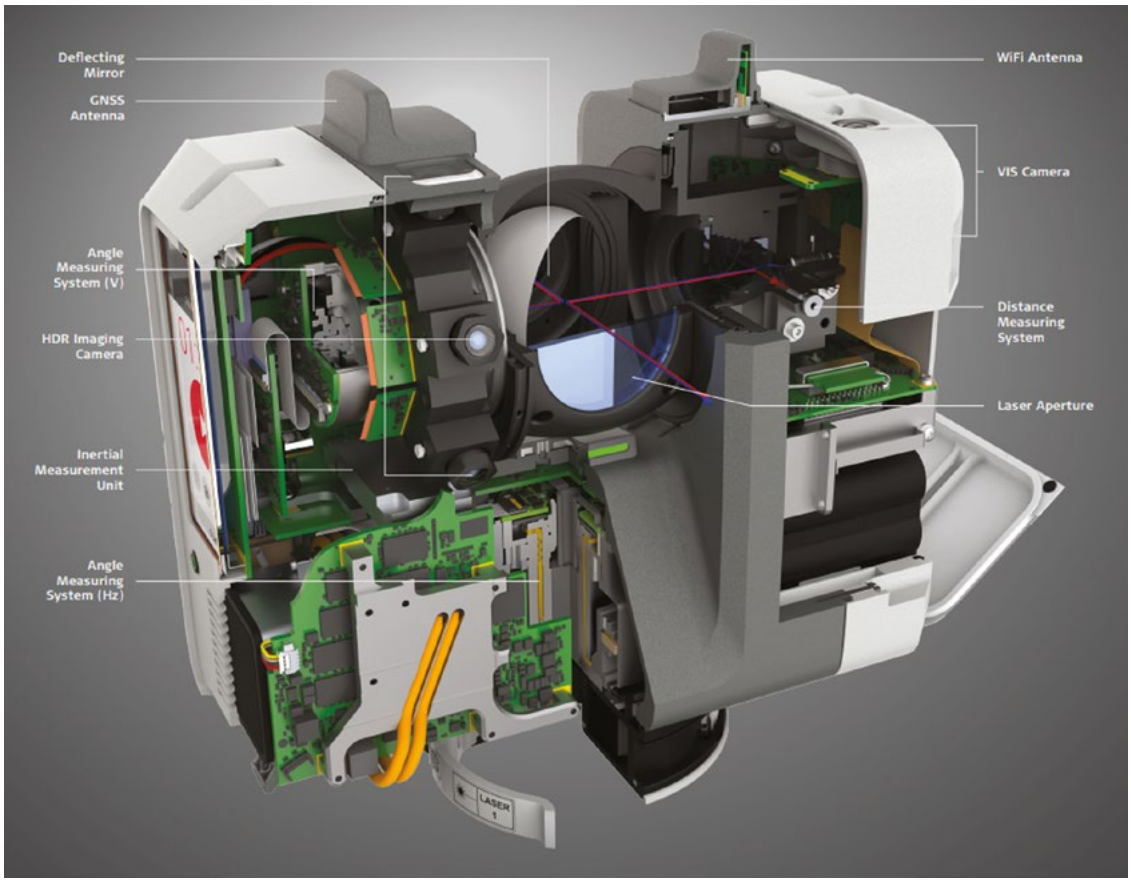


The evolution of scanning

In the past few years, we have seen a steep and steady growth of laser scanning adoption. To put it into context, collecting 35 million points can now be done in under 18 seconds.

We are at a point in time where we have the technology to capture 2 million points a second and with the development of innovations such as Visual Inertial System (VIS) in the Leica RTC360, registration happens almost autonomously, in the field, within seconds of completing each scan.

Further hardware and software developments have seen LiDAR technology become more accessible and



easier to use. The range of industries that are adopting laser scanning to improve their operations is staggering. It is not limited to surveying or building construction any more, but has expanded into design, heritage conservation, marine and asset management as well as creative fields such as movie-making and virtual reality applications.

So we have gone from having a survey tool in the hands of a few highly skilled people, in companies with large budgets, working on massive projects, to a much more accessible and affordable solution that is being used across a broad range of industries.

As laser scanning has branched into new industries, some that involve more creativity than engineering and surveying, we get some interesting views about the technology. With new industries comes new challenges where creative thinking and new ideas are required. We get more "Can we scan that?" or "Should we be scanning that?" moments which then turn into opportunities that in turn drive the development of the technology.

The point I am making is scanning isn't a fad, it isn't going away. In fact, the opposite is true, it's only getting more exciting and more useable as we go forward. The next step is efficiency, there is a gap to be filled in post-processing and the autonomy of data extraction and creating useable digital assets from point cloud data. But there are also efficiencies to be gained in the field, which leads us to the discussion around robotics.

What's our current best approach?

Automation delivers efficiencies when capturing data in disaster, hazardous, repetitive or repeatable environments.

But what is our current best approach and what can we develop for when the next fire rips through a building or when the next earthquake puts a city sideways? How do we access those confined and dangerous spaces, with little risk, when we need to capture as much data as possible?

When we look at repeatability, for automated progress documentation and monitoring, we need assurances that the comparable data sets are common to each other, which starts from repeatable data capture processes.

Practical solutions used in New Zealand

Initiative and innovation are alive and well in the construction industry in New Zealand. Here I'll share some case studies of previous challenges that were overcome with autonomous scanning solutions.

Case study 1 – Heavy payload vehicle (Tim Jervis, Global Survey)

A few years ago, Global Survey built this vehicle for a customer looking to enter some dangerous caves. These caves were in a coastal environment with a sand and rocky floor with known evidence of rockfalls and collapses, which were obviously a concern for entry.

Solution

A robotic vehicle was bought from the US; it was the right size and had a rugged design with tyres suitable for stable transportation across sand. The comms were replaced with a long-range wifi assembly and a 360 camera was installed on the wifi network. A combination of its 100kg payload capability, as well as the Scan and GO self-levelling airbag, meant a survey-grade scanner could capture levelled data at any inclination.

It took roughly a month to build, which was mostly spent waiting for parts. It was incredibly durable and could really tank through nasty conditions, truly a capable load bearing vehicle with a quality levelling system.

Challenges

Changing out the communications system as the imported solution from the US operated on illegal frequencies.

Having moved to a long-range wifi solution, the latency in video transmission had the potential to make controlling the vehicle difficult.

A low ground clearance had the potential for snagging on rocks or getting stuck.

The unit weighed over 100kg which presented a logistics challenge if it needed to be recovered from inside the caves.

Lessons learnt

Some key concepts would be maintained but the assembly and components would all be bought individually.

A higher ground clearance would be better suited.

Although weight can be shed, there is huge benefit in maintaining the rugged capability and the tank steering system.

Case study 2 – Confined spaces (Marcus Hall, licensed cadastral surveyor, Beca)

Marcus has a passion for technology, particularly for innovations where he looks at ways of making jobs safer, easier and more efficient.

In 2019 one of Beca's highway inspectors was undertaking a confined space inspection of an approximately 40 metres long and 2m diameter reinforced concrete culvert and noticed some significant cracking in the obvert. The challenge was simple: how to accurately measure the inside of the culvert without sending a surveyor inside?

Marcus used his ingenuity and solved this challenge with a robotic solution and a LiDAR scanner. He custom built a robotic vehicle, modelling and 3D printing all 34 components himself, which took 10 hours each and used 1.2km of filament. The robot featured a scissor lift for elevated scanning with the compact Leica BLK360 scanner and a FPV radio camera on a controllable gimbal. Impressively, Marcus did this on his own in under a month and spent as little as $1500.

Beca were finalists in the Innovation category for the 2021 NZ Safeguard Awards for this project.

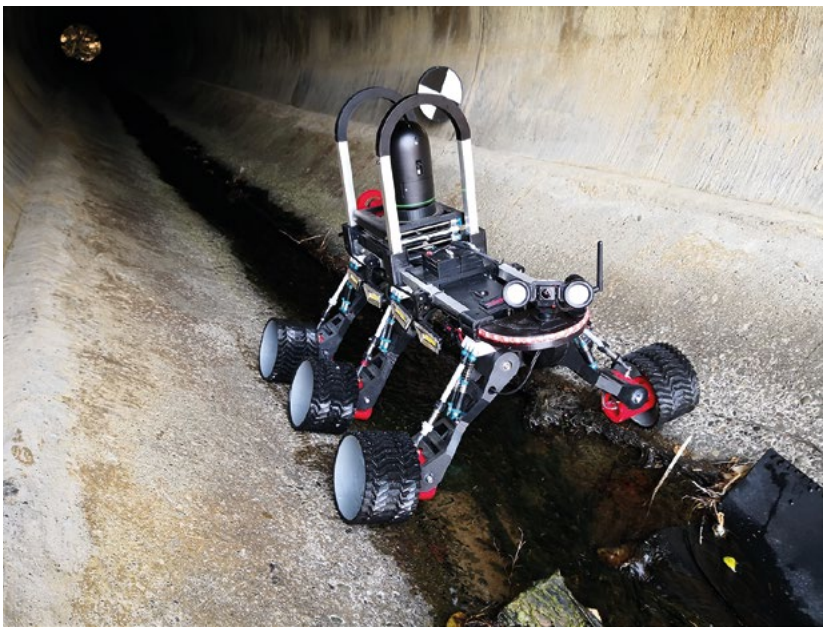
Following the successful deployment into the culvert in 2019, another project opportunity followed in the form of a 100-year-old cathedral with an underfloor area where entry to the confined space and the added risk of asbestos made prohibitive.

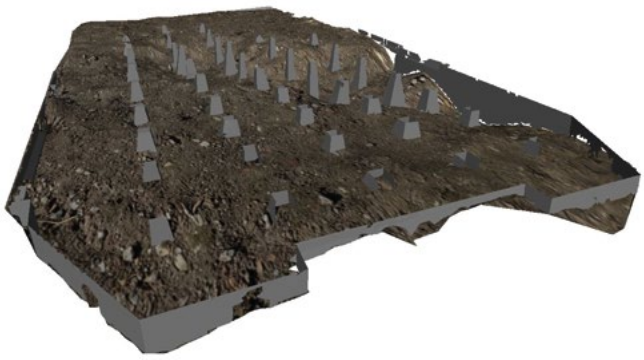
Marcus made some minor modifications to the original solution and was able to measure all the concrete footings; the inspection also revealed a previously recorded redoubt established in 1864 by two companies of the 4th Regiment Waikato militia which had accommodated 128 men.

Conventional scanning of the 100-year-old cathedral was completed on both the exterior and interior of the building. The successful rover captured scans showing the underfloor footing model that has clear evidence of the previously recorded redoubt.

Case study 3 – Disaster recovery (Haydn Bradfield, Fletcher Construction)

This rover was built for the purpose of scanning a multi-level facility that was subjected to a huge fire and





was severely damaged, including the ceilings and structural beams. The objective was simple: to create a rover with a live video feed and the ability carry a scanner to be used in the fire-damaged areas which were unsafe to access.

Solution

We stripped an off-the-shelf remote controlled vehicle for its chassis and drive assembly; the original body and mountings were removed and replaced with new mountings. The body and fixtures were modelled in a modular fashion in Autodesk Fusion360. All parts had a 20x20mm grid spaced checkerboard pattern for easy customisation and modulisation.

Modelled components were then 3D printed and LED strip lighting and the first-person view (FPV) camera system were installed. The unit could facilitate different equipment from laser scanners, 360 cameras and normal cameras.

This allowed us to perform the following reality capture operations remotely including:

- Matterport
- Holobuilder
- 360 videos and photography
- Leica BLK360 laser scanning

This unit was built in five days with a total cost of under $2500.

Challenges

- Heavy radio interference with all the steel structural elements
- Limited range on the iPad and scanner's wifi connection, which was around 30m

Learnings

- Having the stability wheels provided excellent side stability but heavier payloads still proved challenges for the front and back tip angles.
- Adding more weight and tracked wheels put more stress on the steering servo.
- Huge efficiency benefits in

keeping the designs modular and customisable as it helps when changing equipment and bolting on additions as required.

What have we learnt?

These case studies demonstrate real examples of where there has been a practical need to create customisable, cost-effective solutions, capable of capturing accurate 3D point data and 360 imagery, while minimising health and safety risks.

Up till now, the development of rover solutions have some common elements:

- Where there is a need, there can usually be found a solution. Necessity has been the mother of innovation.
- Time and resources are sometimes limited; in some cases this dictates how the solution evolves.
- Most systems and collection of sensors operate in complete isolation of each other.
- The use of additive manufacturing such as 3D printing and use of a modular design proved to be the optimal approach.
- The solutions solved capturing data, but post-processing stays the same.

How autonomous is our future?

We are now moving from a systems integration exercise to fully fledged, integrated systems.

The latest releases from Leica Geosystems; the BLK 2FLY and BLK ARC (September 2021) are starting to show what is possible . . . and probable for our future.

It is important to understand what autonomous can really mean.

There are two parts to autonomy. The first part is the movement of the data capture tool driven by the sensors, be it on Spot the robotic dog from Boston Dynamics (BLK ARC) or in the air with a drone (BLK 2FLY). The sensors on the device ensure the device captures the necessary data (with correct detail and density) and also avoids obstacles, while at the same time ensuring safety and completeness of capture.

When we look at moving toward the automated missions, we see how valuable the VIS positioning benefits the robotics' awareness of position; the terrestrial robot will assume a tripod stance, trigger scans and then proceed to the next scan location along a programmed route – essentially capturing both mobile and static scan data in one mission.

Software solutions will be intelligent enough to fully decide where that next scan position should be, based on user requirements and live data capture feedback from scans, imagery or thermal measurements.

The second part is the autonomy of data flow. The sensors' missions can be created and established remotely and sent to the sensors. Once the mission is finished, the sensors can report on success and failure of the mission.

The captured data can then automatically start on its own autonomous mission through software such as HxDR to produce deliverables with no intervention. This video shows what is already possible: *https://www.youtube.com/watch?v=x-aNHyeHvZPQ*.

In the end, our results and deliverables will be as endless as our imaginations, or our client's needs. The journey has more than began.

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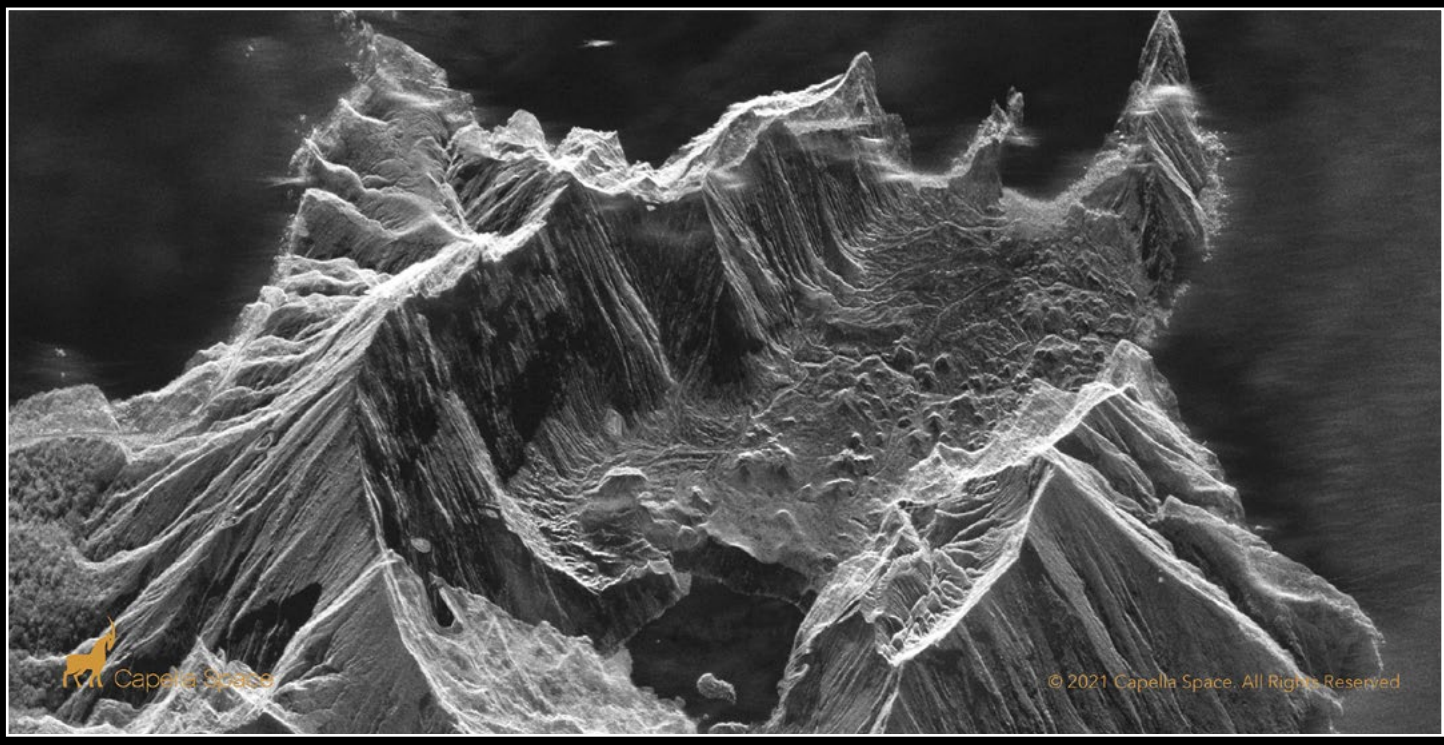
Whakaari/White Island, New Zealand, 24 June 2021,10pm NZT. Copyright: Capella Space.



Obstacles of darkness, smoke and cloud cover overcome with on-demand, high resolution SAR imagery for New Zealand

Steve Critchlow, Group Managing Director, Critchlow Geospatial Limited

Satellite imagery services have properly come of age recently, largely due to the democratising impact of cloud computing and AI. This has meant that optical satellite imagery is now readily accessible and directly useful for everyone without the requirement for highly specialised resource ground stations, and huge onsite processing power and storage.

Critchlow Geospatial is at the forefront of bringing newly accessible optical satellite imagery to the New Zealand market, where it has multiple applications across a broad range of industries that power our economy including environmental monitoring and reporting for emergency response, insurance assessment and agriculture purposes.

But time and technology wait for no one and the advancement of technology innovation in satellite services is rapid and continual. Which is why Critchlow Geospatial has become a one-stop shop for satellite imagery for New Zealand and has recently partnered with a satellite company, Capella Space, that's looking to change how we see our world.

Capella Space is the first US company to launch and operate commercial high-resolution Synthetic Aperture Radar (SAR) satellites. Critchlow Geospatial's partnership with Capella means that, for the first time, on-demand, 0.5m resolution SAR data and analytics are now available to New Zealand's government and private sector.

Why Capella and SAR are making waves globally

As the name would suggest, synthetic aperture radar is not the same as optical imagery. SAR is all about radar and wavelength and there is a lot of clever thinking that has

gone into the concept of the 'synthetic aperture' aspect to enable it to effectively operate from space without the need for an enormous impractical antenna that would normally be required to generate useful spatial resolution. Effectively, the synthetic aperture aggregates data from several shorter antennae to simulate a much larger antenna.

SAR offers this unique data product because it's a transmitted radar signal that actually reflects off surfaces such as structures and ground vegetation (rather than relying on reflected sunlight), to bring near real-time visibility in smoke or cloud covered areas, both day and night.

Indeed, what Capella's SAR technology really solves is the piece of the Earth observation puzzle that's missing from optical satellite imagery –it provides the images that you normally can't see in the darkness of night, or where there is smoke or cloud cover. Look at the clarity of the SAR image of Whakaari/White Island, New Zealand, taken at 10pm.

Capella's SAR satellite technology offers many advantages that optical and multi-spectral earth observation sensors cannot provide, including:

- It is surprisingly affordable and easy to use through an intuitive self-serve online tasking and download platform
- 24/7 all-weather monitoring
- Precise high-resolution imagery (resolution as small as 50cm or up to 1.2m)
- Penetration of darkness, cloud and smoke
- Satellite tasking and high-cadence revisit timeframes e.g. several visits per day

To detect and respond to change and disruption to New Zealand's natural and built environments, New Zealand government and private sector can now add Capella Space's SAR imagery data to their capabilities.

With resolution as small as 50cm or up to 1.2m, all-weather, night-time and smoke penetration capabilities offer new insights for analytical models and forecasts that will improve how New Zealand manages risk, responds to events, and leverages the technology for growth opportunities.

Not only is SAR incredible technology, but it also enables a richer understanding of our country in entirely new and powerful ways.

Capella's self-service offering is also surprisingly affordable and easy to use. It will be of particular use to many New Zealand sectors, such as maritime and land search and rescue; oil spill response; earthquake, flood and landslide monitoring; and traffic volume assessments, to name a few.

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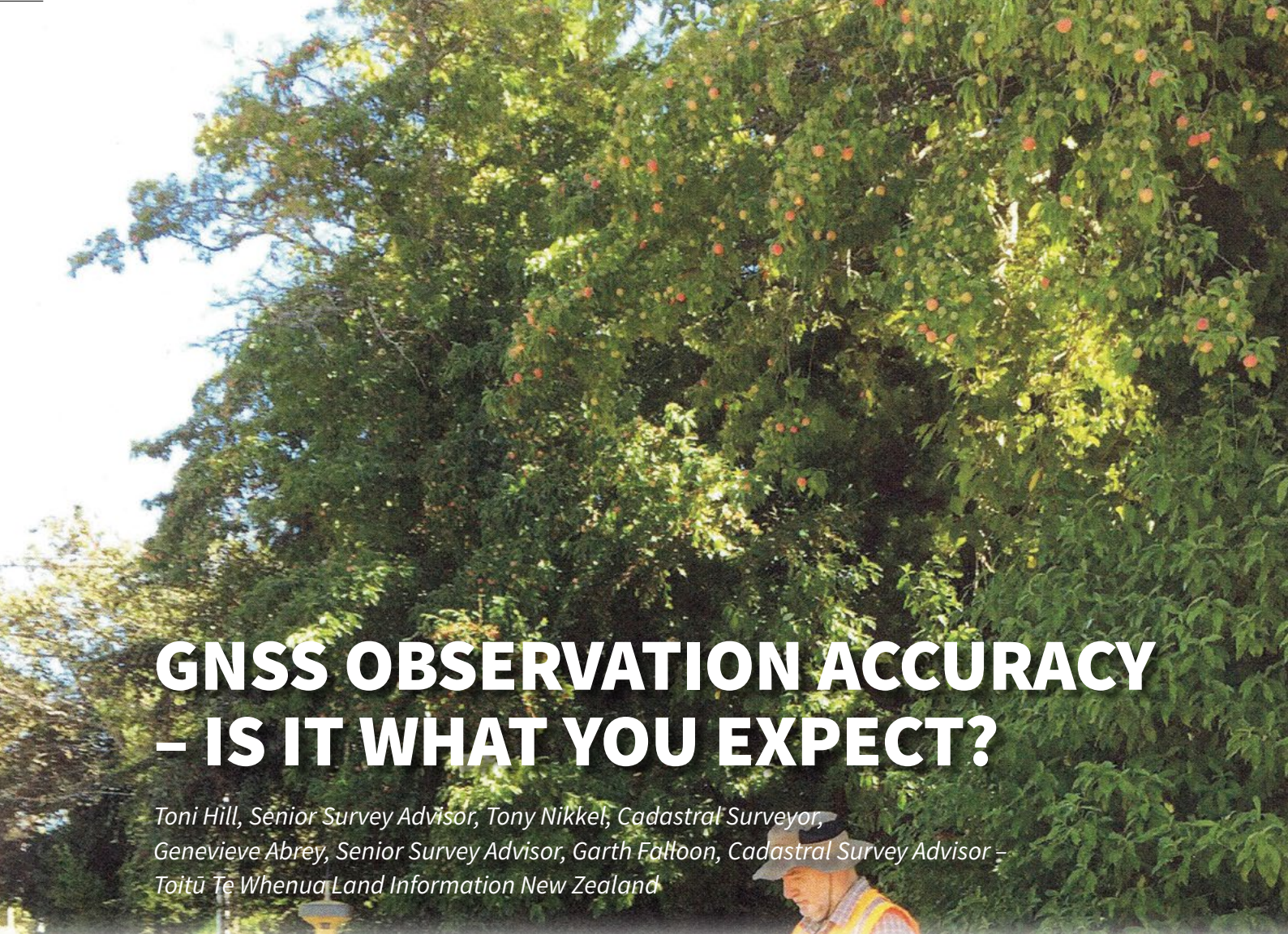

GNSS OBSERVATION ACCURACY – IS IT WHAT YOU EXPECT?

Toni Hill, Senior Survey Advisor, Tony Nikkel, Cadastral Surveyor, Genevieve Abrey, Senior Survey Advisor, Garth Falloon, Cadastral Survey Advisor – Toitū Te Whenua Land Information New Zealand

GNSS technology has changed significantly in the past 20 years and is now the preferred equipment of choice among many surveyors. The advances in GNSS surveying equipment and satellite signals have been accompanied by claims that the equipment now has the ability to work in 'high multipath and signal shaded environments' allowing surveyors to work more efficiently and in more challenging environments than ever before. There is also an expectation that with the increased number of constellations and satellites, 'survey-grade accuracy with trusted reliability' can be achieved almost anywhere, every time.

It's easy to get carried away with what can be achieved but does the reality meet expectations? The question should still be asked: how reliable is the GNSS data you are collecting and what checks and balances need to be completed to have confidence that the outputs meet the required accuracy tolerances of the rules?

Toitū Te Whenua LINZ is receiving an increasing number of reports from surveyors working over GNSS surveys, finding discrepancies between the measured vectors and positions of ground marks and other documented evidence. This is further supported in LINZ field audits.

The photos included in this article represent survey marks measured to during field audits that failed to meet the accuracy requirements. The locations and environments that some of the marks were found in clearly indicate a questionable use of GNSS measurement methods to achieve the required accuracy. In other locations, the inappropriate use of GNSS technology may not be as obvious and the low accuracy achieved is surprising.

Despite manufacturer and surveyor claims, careful consideration still needs to be given to the factors that affecting GNSS accuracy, including:

- Number of available satellites
- Position or geometry of the satellites
- Weather or atmospheric conditions
- Surroundings or environmental factors (buildings, trees, terrain, power lines)
- The length of base to rover vectors
- Measurement methodology used (including the number of epochs recorded and duration of measurement time to record and reduce a measured vector).

Most surveyors are aware of the dilution of precision (DOP) or coordinate quality (CQ) values the GNSS calculates which gives an indication of the strength of the satellite configuration and the estimated precision of the data collected. Settings are generally established to only accept

observations within a certain DOP/CQ range. This can be misleading as while out in the open, the estimated precision is usually very good, but when moving closer to tall structures or trees, these values can give a false sense of security.

Weather and atmospheric conditions may need to be considered, especially when observing to marks a long way from the base. If the weather is changeable between the base station and the rover, do you have a methodology to reduce any risk this may have?

LINZ field audits have shown the biggest influence on mark accuracy from GNSS surveys is from surrounding vegetation. Just because your GNSS can record a coordinate value doesn't mean it should be relied on. Consider the risks associated with the potential errors in the observation but also the risk of that mark being recorded outside accuracy tolerances.

It is recommended that surveyors test their gear in various typical work areas and environments to understand the potential effects of different environments, surfaces and atmospheric conditions and how these could influence the satellite signals and resultant measurements. Having a suitable methodology when measuring and recording GNSS data is important. Methodology factors to consider may include the duration of observation, how and when observations are repeated, the use of independent base stations, checking on satellite configurations and number of satellites, and considering multipath effects such as the distance from tall structures/vegetation.

Also consider what constitutes an unbiased independent check, particularly when satellites are only visible/detectable in limited parts of the sky. For example, in environments that could introduce systematic errors to GNSS measurements, consider using alternate independent technology for check measurements such as a total station to ensure the results are not only precise, but accurate.

The Cadastral Surveyors Licensing Board (CSLB) this year has updated the Standards for Licensing Cadastral Surveyors which, among other things, requires an understanding of "the functions and limitations of different equipment used for cadastral surveying and the necessity for regular calibration". The ability to "apply suitable measuring methods and techniques", "eliminate material measurement errors" and "apply an appropriate quality assurance process when gathering and processing survey measurements" as well as "an ability to use survey equipment correctly to achieve the level of accuracy required for the purpose of the survey".

The risks of incorrect measurements can be long lasting. As the signing surveyor, you are taking responsibility for the accuracy of the positions of the monumented boundary marks and associated non-boundary marks relative to each other and the accuracy of the measurements between these. It doesn't matter how much later, if an error is found in your work, you could be required to undertake a correcting survey to fix any discrepancy found. Not to mention any repercussions around owner's consent and compensation.

Understand the GNSS gear you have, its capabilities and, more importantly, its limitations. If in doubt, ask questions from your suppliers and test for yourself various situations against your expectations. Where others are undertaking fieldwork under your direction, make it clear to them your expectations, and what checks and balances need to be done to ensure you can be confident in obtaining the accuracy results you are aiming for. ●



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NEW LIDAR PAYLOAD MAKES AERIAL SURVEYING MORE ACCESSIBLE

Tom Goodwin, Ferntech

Many surveyors are using UAVs in their daily operations, making drones an essential part of their toolkit. LiDAR laser scanning used to be expensive as well as difficult with the calibration setup. The new DJI Zenmuse L1 sets out to change that.

A clip-on payload that combines the power of LiDAR and high-quality photography at an affordable price, the L1 provides a glimpse into a more accessible future of aerial surveying technology.

The Zenmuse L1 delivers enhanced 3D data capture capability with a detection range of up to 450 metres, enabling the acquisition of up to two square kilometres of point cloud data in a single flight. It offers point cloud data capture with exceptional centimetre-level accuracy thanks to the high-precision IMU, vision sensor for positioning accuracy, plus GNSS data. It is the first LiDAR payload developed by drone giants DJI, who are recognised for creating accessible technology without compromising on quality.

Tom Goodwin, at Ferntech, says the new model is a welcome addition to DJI's range of surveying solutions. Ferntech's team are experienced in providing professional aerial measurement solutions to the geospatial industry, specialising in drone solutions. "There has always been an enthusiasm from local surveyors to use LiDAR in their operations but it has been unaffordable up to this point. The L1 gives more operators the opportunity to generate precise data with the incredible detail that LiDAR systems offer."

"Finally, LiDAR at any scale is within economic reach."

David Herries, of Interpine, a forestry consultant and data management company based in Rotorua, is

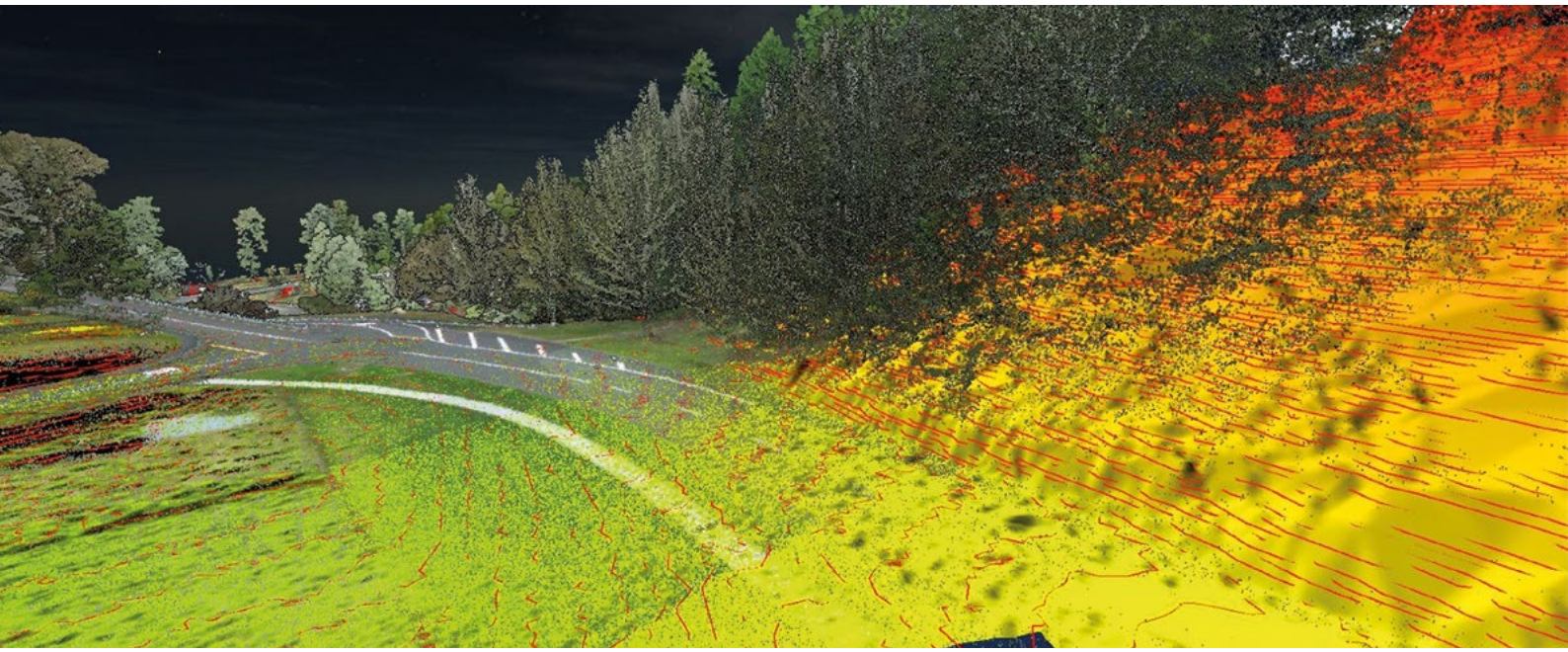
excited by the possibilities of the new integrated system. Interpine has been using LiDAR since 2008 from manned aircraft. Interpine now operates a DJI Matrice 300 RTK and the new L1 payload, which will complement its land-based LiDAR units to provide a comprehensive suite of sensors.

So far, the L1 is living up to expectations. "From the air, this unit provides high-efficiency LiDAR collection covering 100-200ha in a single 30-minute flight with 50 per cent to 20 per cent overlap respectively depending on the requirements based on its 70-degree field of view. Supporting up to three returns and detection ranges up to 450m, the L1 is able to extract terrain under the tree canopy while extracting forest resource measurement when combined with Interpine's innovative LiDAR processing solutions."

He acknowledges that the price point has certainly helped. "Finally, LiDAR at any scale is within economic reach."

Goodwin says another benefit is the full integration with the DJI Matrice 300 RTK and DJI Terra so there is no need to invest in third-party processing software. "The bonus is that it is easy to mount to a Matrice 300 RTK so our customers do not have to upgrade their whole drone system, simply attach it and fly."

For those who are new to drone technology, Ferntech offers complimentary training on the handover of its DJI Matrice 300 RTK LiDAR solution. "We know that learning new technology can be daunting, but this solution is designed to be simple. All you need is a few hours from someone to show you how to operate the system and you are sorted."



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LARGE ELECTRICITY SYSTEM UPGRADES REQUIRED TO BE CARBON NEUTRAL BY 2050

Kathryn Ward

The Climate Change Commission has recently developed an emissions budget to be carbon neutral by 2050, the first in Aotearoa's history. It has subsequently developed a list of goals that need to be met to achieve this. Several of the goals impact on where New Zealand sources its energy:

- Nearly all cars imported by 2035 must be electric vehicles
- Road transport can be almost completely decarbonised by 2050
- Phasing out coal as soon as possible
- Phasing out the use of boilers that burn fossil fuels.

Consequently, large-scale renewable generation such as wind and solar farms is required, along with a major expansion in the electricity transmission system. And the planning for both needs to start immediately.

Using the analogy of transportation

Electricity networks are a bit like roads. There is a maximum volume of power that can flow through any circuit just as there is a limit of how many cars can safely drive through a section of a road at any one time. Power does not always want to flow in the lowest loaded circuit – much like drivers trying to dodge traffic jams using side roads, power will find other transmission routes – both of these instances put strain on their infrastructure and can make a situation worse.

There are options available to maximise the use of the existing transmission system that we can compare to roading networks. Duplexing (using two wires instead of one) in power terms can be compared with converting a single-lane road into two lanes). Installing special equipment in transmission circuits called series reactors and series capacitors provide controls to reduce or increase power flow on a circuit. Another way to force electricity to travel through under-utilised circuits in the network is to break or interrupt the circuit (like making a through road into a no exit to divert the traffic in a desired direction).

New systems require planning

A power transmission system does not have infinite capacity – each system has a physical upper limit of how much additional power can flow through it. At some point, investment in new transmission circuits is required to cater for increased capacity requirements. The catch is it can take up to a decade to acquire the necessary consents before building major new transmission lines.

The routes of any new transmission system need to be carefully planned so that the new generation systems and technologies can connect to them without the need of building long and costly transmission circuits or cable connections. Another critical aspect requiring careful planning relates to the existing transmission system so existing circuits do not become overloaded due to the power wanting to travel in an already heavily loaded circuit.

Power statistics

About 80 per cent of New Zealand's electricity capacity of about 9500 megawatts (MW) is generated from renewable sources. Electricity-type renewable energy and other renewable energy sources such as wood fuels (biomass) for heating in industrial processes and homes, and solar water heating are about 40 per cent of New Zealand's yearly energy usage. Biomass accounts for about 10 per cent

of New Zealand's yearly energy use. Transportation, which primarily uses carbon-based fuels, accounts for 40 per cent of the yearly energy use.

Assuming, the following factors:

- there is no increase to New Zealand's present energy needs from now until 2050;
- all existing non-renewable generation will be replaced with renewable generation;
- coal can be replaced by wood-based fuels for boilers; and
- electric or hydrogen ('manufactured' using electricity) fuelled vehicles will be used for all transportation

then New Zealand needs to have about 150 per cent more electricity generation. A similar increase is also required to the existing transmission grid which comprises about 12,000km of transmission lines.

Of note, if the date of the start of New Zealand's power system is taken as 1946 when the State Hydro Department was formed, it has taken the nation around 75 years to build the transmission and generation system now in service.

If the transmission and generation system needs to grow by 250 per cent by 2050, and if consenting of a new transmission line can take up to 10 years, then the start of the 'big build' is unlikely to commence before 2030, this only leaves New Zealand 20 or so years to build a hefty increase of generation and transmission assets. A rough estimate of new asset requirements is 14,000MW and 18,000km of transmission lines.

Future plans

Transpower, the national organisation which owns and operates the national grid (the high voltage (HV) network transmission system), has already started industry consultation to determine what new lines need to be built, where, and by when.

John Clarke, Transpower's general manager for grid development, has published an article outlining what work the organisation is doing on Net Zero Grid Pathways (NZGP), a major initiative to deliver on the promise of renewable electricity and electrification. The link to it is: *https://www.linkedin.com/pulse/net-zero-grid-pathways-june-2021-why-its-important-our-john-clarke/?trackingId=9ixgRDJ6RaWY9uQ9v5oFhw%3D%3D*

Competition for resources

In regards to the Government's 2050 carbon neutral goals, there doesn't appear to have been a lot of noise about:

- most First World countries are also moving towards renewable energy sources, primarily using wind and solar generation, and
- transmission grids in these countries will also need to substantially increase in size.

The result of these trends is that there will most likely be significant competition for the limited numbers of skilled resources to plan, design and build the new transmission lines and generation plant, and competition for materials and equipment. New Zealand is a small country with limited financial budgets, and a major challenge we may face is procuring critical people, materials and equipment when we are competing with larger global economies.

Planning, designing and constructing transmission and generation in a reasonably short period requires a far larger skilled workforce of power system engineers, linemen, and technicians which New Zealand does not have. Training new locally based resources and retaining them in New Zealand may not be easy once international borders reopen. Recruiting such people from overseas will not be easy if demand for such skills is also sought after by other countries.

Sourcing the equipment needed to build the new transmission and generation assets is also likely to be difficult due to competition for the same equipment by larger and more influential countries. Border restrictions due to Covid-19 have already resulted in significant disruption to existing supply chains, resulting in lengthy waiting times between order and receipt of equipment and materials sourced from overseas. It is unlikely this situation will improve much in the next few years and possibly even longer.

To achieve the New Zealand Government's worthy and ambitious goals, we cannot be complacent about the resources and equipment needed to achieve them. Focus needs to be placed on:

- increasing the numbers of skilled people to do these future projects. This may require some projects to be brought forward so there is a constant flow of work available to train more people;
- getting a larger number of our 'next generation' young people interested in working in the power systems field;
- supporting our trades training institutes and universities to be 'geared up' to train more people;
- encouraging our skilled power system people to remain in New Zealand; and
- procuring the required equipment and material early to prevent delays. ●

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

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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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Overcoming lockdown difficulties with technology in the Covid-19 era

Stephanie Harris, Partner, Paul Kim, Solicitor, Glaister Ennor

The Covid-19 pandemic has transformed the way we perceive and use technology in the legal profession. At the time of writing, we are now back in lockdown under Alert Level 4. It is however a much more settled environment compared with when New Zealand was first sent into the Alert Level 4 lockdown in March 2020.

The vast majority of lawyers are now equipped and comfortable with working away from the office and there is widespread acceptance of electronic documents and processes, as well as the adoption of video conferencing applications such as Zoom and Microsoft Teams.

Given the present circumstances, we felt it only topical to look at how the legal industry has embraced technology as a means of overcoming the difficulties first presented by these lockdowns in the deadline-sensitive area of property settlements. When New Zealand first entered into lockdown in March 2020, the industry was confronted with clients having unconditional agreements and settlements set to take place during Alert Level 4.

In the early days of lockdown, the vast majority of these transactions were unable to settle for a number of reasons, including the parties' inability to access and sign the necessary documents (such as Authority and Instruction (A&I) forms and banking documents) for settlement to take place, conduct pre-settlement inspections, deliver keys and move out in order to give vacant possession.

The standard Agreement for Sale and Purchase was silent as to what would happen in these cases. It also did not lend itself to a delay in settlement without penalty interest being owed, without the consent of both vendor and purchaser. Even the New Zealand Law Society encouraged such consent by suggesting that settlements be deferred to 10 working days after the lockdown was lifted. This was however not always possible, for example where vendors had corresponding obligations to settle on another property.

Presented with these difficulties, the legal industry and its associated stakeholders such as banks and real estate agents, turned to technology, such as:

- Electronic signing platforms (e.g. ADLS digital signing) that allow for electronic signing of documents. These platforms are readily accessible online from most electronic devices and include the necessary validation, ID verification, digital stamp and tracking processes for reliability.
- Video conferencing platforms (e.g. Zoom and Microsoft Teams) which enable the signing of documents that require the per-

son's identity to be verified and/or witnessed by another person who is authorised to take oaths and declarations. These platforms are now routinely used during lockdowns to get A&I forms signed, statutory declarations to be made and affidavits to be affirmed or sworn.

- These platforms also facilitated open homes and pre-settlement inspection of properties using audio-visual platforms. These were obviously not ideal, but ultimately necessary in the circumstances.
- Video conferencing has also been used to hold meetings, give legal advice and ensure that clients understand the advice being given, particularly for transactions involving lending and security such as personal guarantees. Advice can of course be provided over the phone but video chat allows for a virtual face-to-face meeting which is often preferable and more appropriate in some cases.

Of course, fortunately, New Zealand already had the benefit of Landonline, a project first given the green light in 1996. It was a project to turn the survey and title information held by Land Information New Zealand into a digital format so it could be viewed remotely by lawyers and surveyors. In the current times of lockdown, surveyors, lawyers, conveyancers and other professionals can securely search, lodge and update title dealings and survey data, digitally, all in real time.

Technology could not answer all of our problems, of course. Delivering vacant possession was still impossible, but again the industry responded with common sense arrangements such as short term residential tenancies for the vendors to remain in possession until the lockdown was lifted. Clauses providing for deferred settlement in the case of lockdowns are also now commonplace in Agreements for Sale and Purchase.

It is worth noting though that while technology helped minimise disruptions and pave the way forward for property settlements, it also conversely raised the bar for legal arguments such as force majeure and frustration. The performance of obligations became more difficult, but not impossible, and this meant contracting parties had to themselves have regard to the ways in which technology could again assist them. We continue to see innovative ways that clients and other stakeholders are doing so.

With the present lockdown expected to continue for at least a few more weeks, few things now 'cannot be done'; it just simply cannot be done like it used to – and we have technology to thank for that.

THE CHALLENGES BEHIND COASTAL DEVELOPMENT PLANNING

A Tug-of-War between Private Interests and the Sea

Jeremiah Er, erje7160@student.otago.ac.nz

Climate change is putting New Zealand's houses in jeopardy, particularly in flood-prone areas and along our coastline. More specifically, the mean sea level in New Zealand will rise by at least 10cm and will increase the probability that a storm tide will overtop previous high water marks. This means natural hazards that were once thought of as unpredictable and one-off are becoming more predictable and recurring.

The protection of land and infrastructure can be attempted with hard engineered structures and this is often the first response to coastal protection. However, hard engineering solutions, such as sea walls and groynes, have been proven to be vastly expensive, ineffective and unsustainable in the long term.

From a rational and logical point of view, future coastal development should stop. Coastal communities should also be relocated further inland as any expensive physical defences will inevitably fail against the sea. However, due to the financial costs involved in purchasing a coastal property, many owners expect to be able to use their property indefinitely, regardless of whether it is at risk of coastal erosion.

It is also likely the dangers associated with coastal properties are not emphasised enough when beachfront property is purchased even if the impact of coastal erosion is already evident. The value of coastal

properties appears largely unaffected by the risk of coastal erosion, and in fact, demand for coastal property has led to an increase in property prices.

Researchers have found that coastal property owners are willing to accept the risks of coastal development due to emotional reasons like wanting to be there, the amenities of an oceanfront location meeting the emotional needs of property owners, and the increasing desire to live on the coast.

Local authorities' approach towards coastal development planning

The precautionary principle is a major planning guideline in New Zealand, which can be succinctly explained using Principle 15 of the Rio Declaration on Environment and Development (1992): *Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*.

This planning principle is adopted in the New Zealand Coastal Policy Statement 2010. The NZCPS seeks to achieve the preservation of the natural character of the coastal environment and protection from inappropriate subdivision, use and development (Policy 13), and the preservation of the natural features and natural landscapes of the coastal environment from inappropriate subdivision, use and development (Policy 15). Policies 18 and 19 also state that the recreational value of the coast should also be enhanced and prioritised.

Furthermore, Policy 25 of the NZCPS directs local authorities to "avoid redevelopment, or change in land use that would increase the risk of adverse effects from coastal hazards ... and encourage managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances".

These principles and policies support the decision of many local authorities to abandon physical defensive works and implement a policy of managed retreat. Traditional hard engineering structures that are used to manage storms and tides for the protection of development in coastal zones are expensive and destroy the public utility of the coast. They are often not aesthetically pleasing and will also result in increased rates of beach loss due to the intensification of surf zone processes, passive erosion and active erosion on the beach.

Moreover, these physical structures would eventually succumb to the waves and require another huge financial investment to replace, which can easily cost millions of dollars. Sea walls also have a high rate of failure and are likely to offer property owners false expectations of protection.

Engineered solutions do not provide an adequate nor appropriate response to coastal erosion. When the full scientific certainty of climate change is factored in, managed retreat and adaptation appear to be the only reasonable long-term option. Planning policies that involve yielding to the sea are not well received by coastal property owners.

The reluctance of coastal property owners to adapt to the forces of nature is likely due to private property rights in land being deeply entrenched in the psyche of New Zealanders, which stems from case law and legislation often providing the protection of property as a basic individual right. The applicability and relevance of these rights today, particularly in the context of coastal land, were argued in the case *Falkner v Gisborne District Council 1995*.

From a rational and logical point of view, future coastal development should stop.

Case law example: *Falkner v Gisborne District Council* 1995

The foredune of Wainui Beach was known to be susceptible to coastal erosion ever since the 1920s when the beach zone was being settled. The frequent severe storm damage to the protective buffers and increasing pressures to maintain these defences to safeguard property caused the Department of Conservation (DOC) and the Gisborne District Council (GDC) to re-evaluate the feasibility of the hard engineering solutions and proposed 'managed retreat' as a more appropriate long-term solution. It involved the removal of coastal protection works and the retreat of residential occupation from the foredune.

Not surprisingly, the residents of the beachside properties at Wainui Beach objected to the new policy and lodged a claim to the Planning Tribunal, followed by an appeal to the High Court. The High Court identified three main issues of the case:

1. whether the Crown had a common law duty to protect land from coastal erosion;
2. whether the residents had a common law duty to protect their own property; and
3. the extent to which 1) and 2) have been repealed or modified by statute.

With regards to 1, the appellants argued that the Crown had an absolute duty to protect their property against coastal erosion. However, the court deduced that the underlying reason for the Crown's duty to protect was for the interest of the general public and it was not exclusive to those living by the sea. In the context of the case, protective works did not benefit the public and therefore, the Crown does not have an absolute duty to protect.

With regards to 2, the appellants claimed a right to protect their property, where some even referenced the sea as an enemy. However, the court said those claims were based on the common law which was fixated on private property rights and described to be "narrow" and "out-of-keeping". Holistic, present-day policies that considered sustainability and environmentalism like the RMA should carry more weight. The court also found it difficult to justify the appellants' argument even on the basis of the common law, as 'managed retreat' was a legitimate proposal that had the public's interest.

With regards to 3, the court mentioned that the implementation of the RMA signified an emphasis on social utility over private law notions. Also, there was nothing in principle to prevent the common law from being overwritten by the RMA. In fact, the Crown's power to overwrite the common law by statute has been acknowledged both academically and judicially.

The Crown's responsibility is to protect the environment and public interests over private property rights. The RMA overrides the common law right to protect private property. Therefore, any proposed protection works must be subjected to the resource consent procedure established under the RMA.

. . . the residents of the beachside properties at Wainui Beach objected to the new policy and lodged a claim to the Planning Tribunal, followed by an appeal to the High Court.

Solution 1: Effective engagement

Even though the High Court's decision in *Falkner v Gisborne District Council* 1995 has made clear that the rights and duties to protect private property have been overridden by the regulatory regime established by the RMA, the GDC eventually still relented to the insistent demands of local property owners by establishing the Wainui Beach Management Strategy to ensure the continuous protection of coastal property through the erection of defensive structures.

Evidently, the implementation of planning policies that prioritise long-term public and environmental benefits over short-term private interests has proven to be extremely challenging for local authorities, due to the political and financial influence that coastal property owners have over local authorities.

It has become clear that any planning solution will be futile without effective engagement with the community. Effective engagement strategies that lead to tangible planning outcomes involve tapping into what people love, their place attachment and identity, reminding people of their connectedness to each other and the non-human world, and engaging citizens meaningfully in joint problem-solving. It facilitates the creation of a communal goal that is larger than the sum of individual self-interest; the protection of the natural coastline is in the common interest of the wider community.

This changed perspective can help coastal property owners to come to terms and accept that people and

property will inevitably give way to the sea. It can also help coastal property owners to focus on what they can retain: deepened bonds and connection to the place and community.

Solution 2: Insurance providers

The limitations around insuring at-risk property may provide alternative requirements to retreat from the coast. Insurance is a requirement for residential mortgages and failing to maintain insurance can trigger a default. With worsening coastal hazards due to climate change, it is expected that by 2050, insurers will decline insurance coverage or stop renewing existing coverage for vulnerable coastal properties.

Coastal properties that can be insured would be likely to face policy exclusions, or very high premium prices and excesses. This could have significant impacts on potential and existing coastal property owners. By putting most of the property's risk back onto coastal property owners through decreasing the availability and affordability of insurance, it would incentivise coastal property owners to move out of harm's way.

The prices of coastal properties have been increasing in New Zealand, fuelled by the ever-increasing demand for coastal development for living and investment purposes. However, the strong preference for coastal property goes against what Mother Nature has planned for the coastal environment. As a result of climate change, sea-level rise will continue to worsen, further exposing coastal areas to hazards like flooding and erosion.

With worsening coastal hazards due to climate change, it is expected that by 2050, insurers will decline insurance coverage or stop renewing existing coverage for vulnerable coastal properties.

This has sparked increasing demands for local authorities to act. While many local authorities have recognised the futility of fighting against the sea and have demonstrated a desire to accommodate nature, coastal property owners have not. Despite the court ruling in favour of the local council and recognising the importance of environmental enhancement and public benefits over private property protections, local authorities often find themselves caving to the demands of coastal property owners and have largely been unsuccessful in implementing sustainable coastal planning solutions.

Sustainable coastal management and planning requires local authorities, scientists and policymakers to engage effectively with the coastal communities on an intentional and regular basis. The goal of effective engagement is to help coastal property owners to recognise and accept the inevitable loss of their property, put aside their self-interest, and cooperate with local authorities in the implementation of planning policies centred around sustainability.

Insurance providers can influence sustainable coastal planning solutions. By increasing the cost of insurance or refusing to insure coastal properties that are facing a high risk of coastal hazards, coastal property owners would be 'forced' to move away while potential buyers would be dissuaded from making a purchase.

In their refusal to adapt and give way to the sea, coastal property owners have unwittingly pitted themselves against the sea in a game of tug-of-war. Normally, time will tell who the victor is; but in this case, the victor is clear and apparent right from the start.

The students who were sponsored to attend the seminar. Back row, from left: Billie Jennings, Eddie Johnson, Hannah Bosinovski, Amelia Kirisome, Ella Fookes, Thornton Birchler-Stockdill, Chester Rosie. Front row, from left: Hugo Collins, Sian Mair, Frankie Robb, Tsewang Nuru Sherpa. Credit: E. Tidey

WORLD HYDROGRAPHY DAY SEMINAR

Billie Jennings, Tsewang Nuru Sherpa, Thornton Birchler-Stockdill, Hannah Bozinovski, Eddie Johnson and Emily Tidey

On July 9, 2021, the New Zealand Region of the Australian Hydrographic Society (AHS) held their annual seminar in Wellington, hosted by Land Information New Zealand (LINZ). There were speakers from all over the country, ranging from university students to the Royal NZ Navy, and to research, government and various commercial companies. Eleven students were sponsored by the AHS to attend the day and give a presentation or write up this report. Sponsored students came from Otago University, the Southern Institute of Technology and Lincoln University.

The first event of the day was a field trip to CentrePort Wellington. As we toured the port area, we were provided an overview of the operations and goals of CentrePort. Some of the unique challenges that have been tackled by the port authority in the past were outlined, as well as likely future challenges such as the pressing commitment to carbon-neutral emissions goals.

Most noteworthy among past challenges were the drastic changes following the Kaikōura earthquakes, with the damages to the port leaving it in such a reduced capacity that the cost of shipping increased by 800 per cent. Subsequent surveys under the wharf found extensive support pole damage as well as continued creep in the port.

These physical changes that continue in the port surface have created a need for continuous surveying and monitoring. Future commitment to more sustainable practices was shown with a discussion on the careful planning undertaken to reduce noise created when fixing the earthquake and settlement damage to minimise any disturbance to underwater wildlife as well as low-carbon planning by the recent introduction of a new fleet of electric container transport vehicles.

On return to LINZ, the large number of attendees (probably a record attendance for this annual seminar) settled in for the 11 presentations.

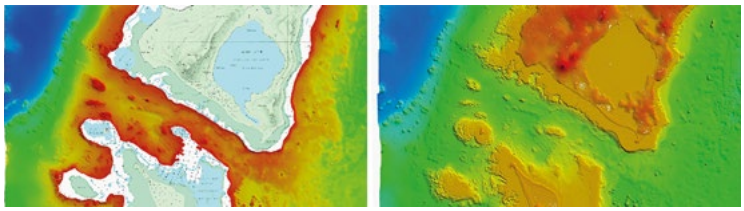
Toitū Te Whenua LINZ – Update

By Stuart Caie, Toitū Te Whenua/ Land Information New Zealand

The first presentation covered future design plans for hydrographic development in New Zealand, with project Janus a notable development, created by LINZ to update and support efficient hydrographic navigation and

transformation. Project Janus intends to aid implementation and adoption of the IHO S-100 Universal Hydrographic Data Model (from the current use of IHO S-57), which will support more metadata and a greater variety of hydrographic digital data. Project completion is intended by 2026 and extensive work is required to ensure that proper construction and implementation can be achieved.

We also heard an update on the project, Joining Land and Sea (JLAS). This project had a four-step implementation plan, with the goal of creating vertical dataset transformations and is currently at the third step. Stuart then outlined the upcoming nautical charting surveys and an interesting case study comparing satellite-derived bathymetry (SDB), airborne LiDAR bathymetry (ALB) and multibeam echosounding (MBES) around a Pacific island.

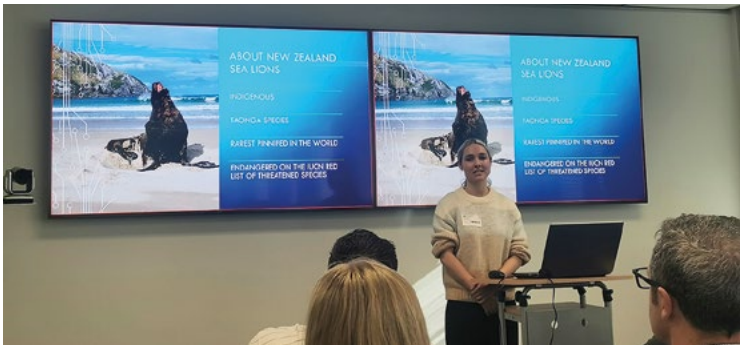


MBES bathymetry around the island, left, and the addition of ALB, right, showing the benefits of combining measurement methods. Credit: S Caie and B Cooper, Toitū te Whenua/LINZ

NZ sea lions

By Sian Mair, Southern Institute of Technology

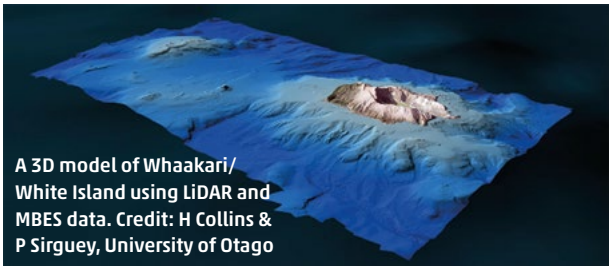
Sian gave a fantastic presentation that dived into interesting facts and information about one of New Zealand's indigenous species; the New Zealand sea lion. She is a student studying at the Southern Institute of Technology, and she has taken it upon herself to share concerns about the threatened species. Sian also spoke about positive actions such as Dunedin City Council successfully implementing the Reserves and Beaches Bylaw, banning vehicles on beaches to protect the wildlife. The introduction of cameras being mandatory on commercial vessels was also mentioned, displaying the urgent need to protect the endangered species.



Sian Mair's presentation on sea lions. Credit: T Birchler-Stockdill

Whakaari/White Island – A study in Joining Land and Sea

By Hugo Collins, University of Otago



A 3D model of Whaakari/ White Island using LiDAR and MBES data. Credit: H Collins & P Sirguey, University of Otago

Hugo presented a project that he did with LINZ and the University of Otago during the summer of 2019. This was the beginning of the Joining Land and Sea project where he studied the best way to join topographic and hydrographic data around Whakaari/White Island. The data came from two different surveys using airborne LiDAR, vessel-mounted LiDAR and MBES. All were on different vertical datums which presented an interesting challenge for combination. His presentation included some great graphics, showing the topography and bathymetry in the area before the eruption in 2019.

Hydrographic surveying from a student's POV

By Frankie Robb, Chester Rosie, Ella Fookes, Amelia Kirisome

Future hydrographers discuss their studies. Credit: S Caie

Frankie, Amelia, Ella and Chester gave a presentation on hydrographic surveying as part of the Bachelor of Surveying. They discussed their experiences in the introduction paper that they had just completed. This included practical sessions where the class surveyed parts of Otago Harbour and produced an accurate bathymetric map of the sea floor as well as coastline and navigation information.

They then discussed what they were looking forward to in the next stage of the degree, including

possible research projects. Finally, they shared what they believe their future and the future of the industry will involve, including more work on habitat mapping, seabed investigations, a move to renewable energy at sea as well as focuses on coastal and offshore environmental monitoring.

Choosing the best vessel for a hydrographic charting survey

By Rian Mayhead, Discovery Marine Ltd (DML)

Rian did an excellent presentation on choosing the best vessel for your hydrographic survey, from a young surveyor's perspective. He looked at three main points; the consideration of the type of equipment, the costs involved and the mobilisation of the survey equipment. His presentation went into detail about how environmental factors and location of the survey can greatly affect your needs.

It was interesting to hear about his recent experience in Taranaki and how this informed the comments made in his presentation.

The DML survey vessel Tupaia. Credit: R Mayhead, Discovery Marine Ltd

Repeat mapping reveals spatial and temporal changes on the seafloor

By Sally Watson, NIWA

Sally gave a riveting presentation on mapping the spatial and temporal changes of the seabed in three recent case studies.

The first investigated the submarine channel changes related to an individual volcanic eruption with Whakaari/White Island as an example. The second showed sediment wave changes that appear to be driven by oceanic currents in the western Cook Strait region. Finally, the presentation looked at seafloor scouring attributed to anchoring.

These three examples displayed seafloor changes and associated geomorphological changes, revealing a range of natural and anthropogenic seafloor geomorphologies.

Sally Watson on seafloor changes. Credit: T Sherpa

The presentation recognised the challenges of identifying and quantifying seafloor change and volume, and recommended considerations for measuring precise predictions such as reducing error during the acquisition phase by conducting the survey lines in the exact same dimension as the original survey line.

The case studies clearly demonstrated the complete information that can be obtained from comprehensive multibeam mapping from the land-water interface to the subtidal zone.

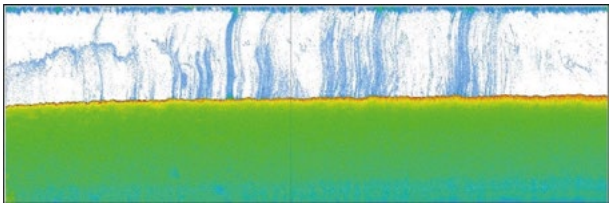
Bathymetry's 'By-Product' – Discovery Marine Ltd's exploration of water column data and its potential applications

By Eva Cloo, Discovery Marine Ltd (DML)

Eva's presentation highlighted the importance of recording water column data. The water column contains 95 per cent of the liveable volume of the ocean and is responsible for producing 50 per cent of the Earth's oxygen.

Eva spoke of the applications of water column data to GIS, research into anthropogenic environmental impacts (i.e. midwater plastic movement), monitoring fish stock, gas bubble detection and nautical charting (i.e. shipwrecks).

DML recently completed a hydrographic/bathymetric survey of the Taranaki coastline over three months, covering 345km^2 and recording 10.5 terabytes of water column data. Eva shared tips and tricks on reducing the load on manual data processing of large projects such as the Taranaki survey through compression, down sampling and processing filters.



An example of watercolumn data showing an underwater seep field. Credit: E Cloo, Discovery Marine Ltd & Land Information New Zealand

RNZN hydrography

By Cdr Tim Garvan and Lt Cdr Peter Jensen, Royal New Zealand Navy (RNZN)

The RNZN's five-year plan was introduced by Commander Garvan and he spoke about its goals of completing tasks faster and conducting safer operations.

New technology that supports these goals include Manawanui's multibeam and portable Norbit systems so future focuses of the RNZN involve the continued delivery and integration of new equipment, as well as increasing NZ's South-West Pacific engagement.

In a fun twist, Peter explained a survey in Antarctica and the struggles that came along with working in this challenging environment. The purpose was to provide initial bathymetry to support the renewal of facilities at Scott Base. Hi-tech ideas such as using an autonomous underwater vehicle, remotely operated vehicle and singlebeam echosounder were all considered, but due to time limitations, the final result was delivered with a low-tech but intensive leadline survey. Even still, there were further challenges such as deceiving ice thickness, drill limitations, and the extreme cold which required impressive intensive labour. We were interested to hear about sunlight for 24-hour periods, making us realise the option for long days down on the Ice.

Development and product testing of a new GNSS/INS receiver

By Gary Chisholm, Trimble

As a long-time key team member at Trimble, Gary spoke of his opportune work testing Trimble's new INS in the marine BX992 sensor. Despite his retirement, he was asked to do this in New Zealand after last year's relatively short lockdown had ended, at a time when his overseas colleagues were not able to undertake fieldwork.

He used a tilt-table, car, boat and see-saw at the park (for heave) to test the equipment in different environments. This system provides an affordable solution to GNSS positioning, and in addition, the INS provides precise pitch, roll and heave compensation, improved short-term dead reckoning as well as speeding up the GNSS heading solution.

In terms of application, the device would suit excavators, barges and autonomous survey boats. Gary's work at Trimble continues to push the boundaries of surveying technology and provide accurate positioning for the modern hydrographic surveyor.

IBSC training for our region

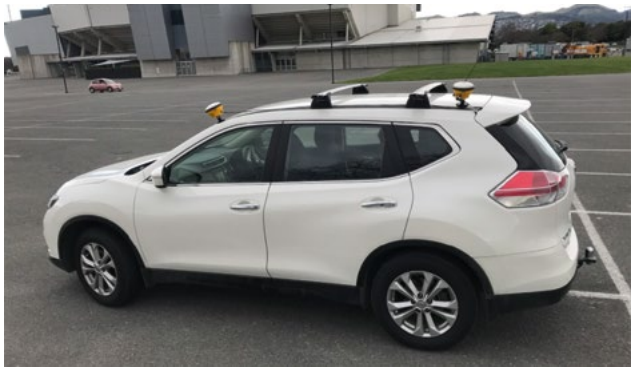
By Dave Crossman, IIC

Dave shared IIC's online course development that is recognised by the International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers (IBSC) and aims to provide opportunities for more hydrographic training in Australasia.

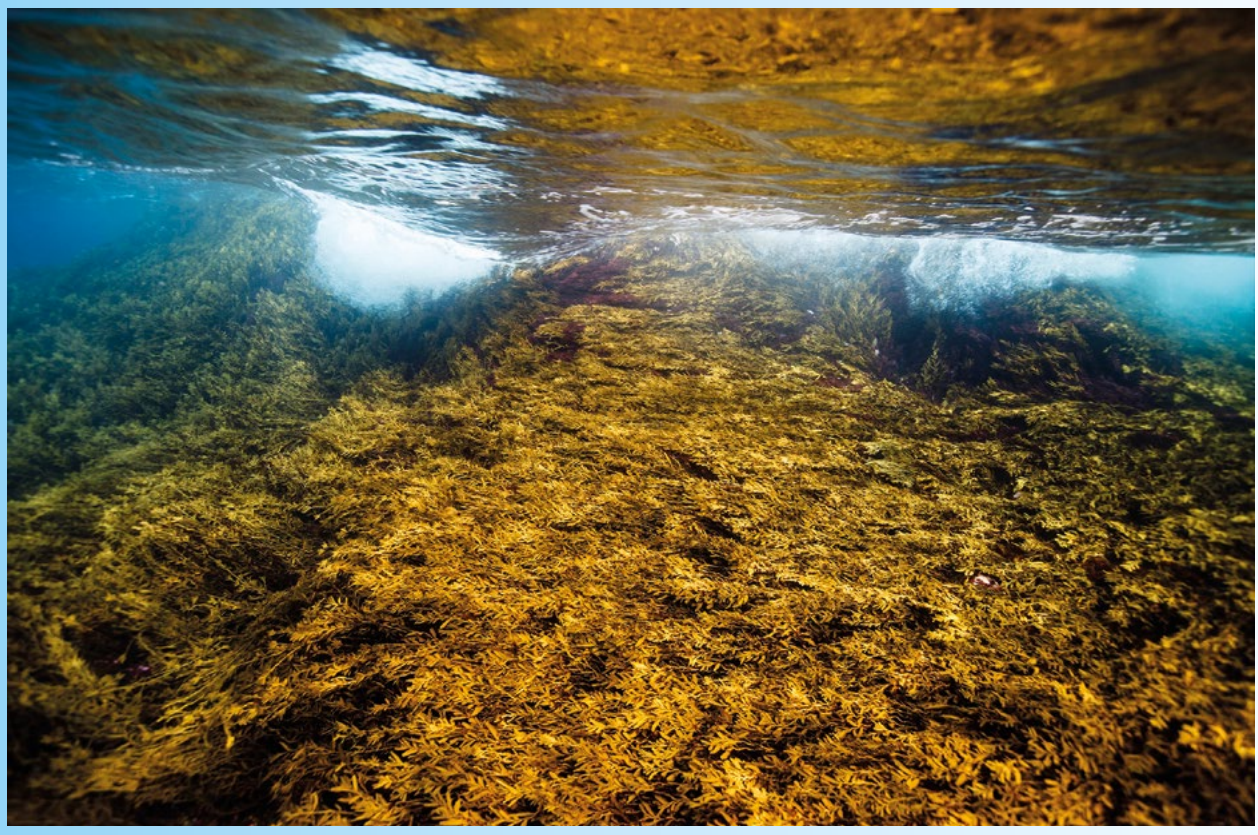
Training has been offered at times in the region, but due to costs, effort and market size, it has not been sustainable. By running an online course, IIC hopes these challenges can be overcome and hydrographers trained to fill the current void of trained professionals in the region. Dave outlined the S-5B online delivery method of 13 weeks' theory training followed by a seven-week practical and field project component. He then discussed ideas to develop a S-5A course in future.

The day concluded with the AGM of the NZR. Emily Tidey congratulated the students for taking the initiative to apply for the sponsorship opportunity to attend the day.

On behalf of all students – the presenters and those reporting here – a big thank you to the AHS, host LINZ and organiser Maurice Perwick for the opportunity to participate in this interesting event. It was a brilliant educational day out and helped us to see the scope and necessity of work in this field. We look forward to taking more hydrographic courses and to be able to work in such an exciting field.



Left: Car-based testing of the BX992. Credit: G Chisholm Right: See-saw-based heave testing of the BX992. Credit: G Chisholm



Customary Marine Title and Protected Customary Rights Orders

Mick Strack *mick.strack@otago.ac.nz*

A recent High Court decision (*Re Edwards (Te Whakatōhea No. 2*) [2021] NZHC 1025) has recognised Customary Marine Title (CMT) and Protected Customary Rights (PCR) claims from a group of whānau and hapū based around part of the Bay of Plenty coastline.

This is something of a landmark decision, and if it is supported by higher courts, it provides very useful guidance to Māori claimant groups applying for customary rights to the seabed and foreshore – the takutai moana. The case also further entrenches tikanga as a vital part of Aotearoa common law.

The lengthy decision details the developing inclusion of Māori customary law (Kupe's Law) into our English derived common law system. There is the clear acknowledgment that Māori exercised mana motuhake and tino rangatiratanga and held customary title to the whenua and the takutai moana over all of Aotearoa in 1840. The change in sovereignty effected by te Tiriti o Waitangi did not disturb Māori customary title, in fact it confirmed it. However, the *Wi Parata* decision in 1877 led to Māori custom being denied for more than a century. The Crown had then assumed ownership of the foreshore and seabed. The *Ngāti Apa* case turned that assumption on its head, but then the Foreshore and Seabed Act 2004, followed by the Marine and Coastal Areas (Takutai Moana) Act 2011 intervened.

In the case *AG v Ngāti Apa* 2003, the Court of Appeal accepted that Māori customary title to the foreshore and seabed may still exist if it has not been explicitly extinguished by the Crown, and that the Māori Land Court is where any decisions about tikanga Māori and customary title should be made. That case clarified that the Crown had not acquired title to the foreshore and seabed from Māori

in 1840, and that the existence and extent of customary property rights was not to be gauged from applying common law concepts but from applying tikanga. The Crown reacted by passing the Foreshore and Seabed Act 2004 which explicitly extinguished Māori customary title to the foreshore and seabed and declared that the foreshore and seabed was owned by the Crown, and that Māori could not go to court to challenge that. By 2011, the Crown repealed the F&S Act by passing the Marine and Coastal Areas (Takutai Moana) Act.

This Act restored the customary interests that had been extinguished, so those aspects of customary title that traditionally existed continue to exist. The Act then provided for a way to convert those inherited rights into legal rights and interests in the form of Customary Marine Title and Protected Customary Rights. However, "the specific rights actually conferred by the Act are much narrower and more limited than the customary title and rights that Māori would have enjoyed and exercised in the foreshore and seabed as at 1840".

A Customary Marine Title provides a bundle of rights allowing for some decision-making authority, some ownership rights to certain minerals and taonga, and the right to create a planning document.

A Protected Customary Right allows the claimant to exercise certain customary activities and ensures a consent authority does not grant any resource consents for activities that would have adverse effects on the claimant's activities.

There is a dual pathway by which these legal interests can be claimed: through direct engagement with the Crown, or by application to the High Court. The Crown has negotiated for similar interests for Ngāti Porou and that has been formalised in a legislative settlement (Ngā Rohe Moana o Ngā Hapū o Ngāti Porou Act 2019) which provides a different set of rights from a CMT.

The requirements or tests to recognise the legal interests of Māori were often seen as a barrier to successful claims. The requirements for PCR are that the right has been exercised since 1840, has continued to be exercised since then and has not been extinguished. Some customary rights are protected by the Fisheries Act, Wildlife Act and Marine Mammals Protection Act. These can therefore not be used to claim a PCR.

The requirements for an accepted Customary Marine Title are that the applicant group holds the area in accordance with tikanga and it has been exclusively used and occupied since 1840 without interruption.

One of the features of Māori tikanga is that it includes the concepts of manākitanga, kaitiakitanga and mātauranga. Exclusivity was never part of tikanga and sharing and reciprocity are inherent in Māori views towards the environment. Even when Māori assert title to the foreshore and seabed, they have not demanded exclusivity. The test that requires exclusivity is therefore usually impossible to provide.

One of the other challenges dealt with by this court was that multiple adjoining hapū were involved in this claim and the boundaries between hapū were part of the arguments. The court pointed out that "hapū were defined not by land boundaries but by whakapapa and allegiance. … the land itself was not seen to be dissected by lines on plans". In other words, hapū boundaries were fuzzy, intertwined and often overlapped, and they are for the hapū to work out rather than the court.

Hapū claiming customary rights need to offer positive evidence about their continuing relationship with the marine area, but are under no obligation to prove that their interests have not been extinguished. The Crown must prove extinguishment, which can only occur with the consent of the hapū or whānau, or by clear and plain statutory extinguishment. Therefore, when the underlying assumption is that customary title exists, the hapū does not need to prove exclusivity. This seems to have cleared the barrier that the exclusivity test imposed. The result is that this court was able to acknowledge that Māori Customary Title, and in some cases Protected Customary Rights, could be recognised.

The court clarifies the nature of these rights as *sui generis* – "very different to, and much more limited than the fee simple type of property rights available under Western law", and "Holding an area of the takutai moana in accordance with tikanga is something different to being the proprietor of that area".

Such interests as are recognised do little to limit public access, navigation and fisheries – "Rights of access to the takutai moana are preserved by the Act for all New Zealanders along with the rights of fishing and navigation" but the acknowledgment of CMT and PCR will allow for hapū to be more involved in using and managing, and in decision-making for the foreshore and seabed.

There are several hundred claims for marine rights lodged at the High Court or with the Crown. It seems likely that this latest decision will provide precedent to ease the way for further successful settlements. Perhaps, finally, the legal progress made with the *Ngāti Apa* case but stymied by the Foreshore and Seabed Act will provide some satisfaction for Māori. ●

CELEBRATING PROFESSIONAL EXCELLENCE!

In August just under three hundred people gathered to celebrate professional excellence and outstanding service to the sector with their peers at a glamorous dinner held in Auckland. The hugely successful black-tie event, sponsored by GSI Partners, was part of the *Building Back Better* Survey and Spatial NZ conference being held at the Cordis Hotel in Auckland.

Rachelle Winefield of Land Information NZ, Wellington was the well-deserved winner of the premier award for the night receiving the Supreme McRae Award for Professional Excellence. Rachelle received this award for her leadership and vision that has positively impacted the sector, economy and community.

The Supreme Award was decided by the Survey and Spatial NZ judging panel and chosen from the winners of each of the six professional stream's Professional Excellence award winner. The recipients of the Stream candidates were; Lyndon Telfer, Cadastral Award for Professional Excellence, Elaine McAlister, Spatial Award for Outstanding Service, Timothy James, Land Development & Urban Design Award for Outstanding Service, Bruce Walker, Engineering Surveying

All the award winners

Award for Outstanding Service, Rachelle Winefield, Positioning and Measurement Award for Professional Excellence and Emily Tidey, Hydrography Award for Outstanding Service.

Bogle Young Professional of The Year Award

Bailey McNutt, Adam Musa and Emma Cook were the finalists for the Bogle Award – Young Professional of the Year, with the award being given to Emma for her initiative, innovation and leadership, and contributions to the professional community.

Emma Cook, Bogle Young Professional of the Year

Examination Awards

State Sector Award

The State Sector award for the highest placed candidate in the Cadastral Law Exam went to Mateusz Baranski.

Percy Dyett Award

This year's exam awards included Jason Zhou and Rachel Charlesworth – both awarded the Percy Dyett Award for excellence in the preparation of projects for the Professional Entrance Exams which is part of the process of qualifying to be a Licensed Cadastral Surveyor.

Rachel Charlesworth, Kat Salm and Jason Zhou

Technical Cadastral Stream Award

Re-introduced this year, the *Cadastral Survey of the Year Award* was awarded to Wally Sanford for SO 486878.

Kat Salm and Mateusz Baranski

Emily Tidey, Wally Sandford and Rachelle Winefield

HYDROGRAPHIC STREAM UPDATE

Eight members of the stream attended the S+SNZ 2021 Conference in Auckland and one was rewarded with the S+SNZ Stream Award for Professional Excellence. Congratulations to Emily Tidey, pictured, who had to be persuaded to stay for the night – her choices: a sleepless night with young family or a lavish dinner?

Emily Tidey with this year's S+SNZ Stream Award for Professional Excellence.

The NZ Branch of the Australasian Hydrographic Society held their AGM and Seminar on July 7, hosted by Toitū Te Whenua LINZ, in Wellington. More than 50 people attended to hear presentations on topics such as New Zealand sea lions, sea-level rise and urbanisation in Dunedin, a study into joining topographic and bathymetric data at Whakaari/White Island, mapping temporal changes to the seabed and RNZN's experiences in Antarctica.

A number of students from University of Otago and the Southern Institute of Technology attended and presented. The day started with a guided tour of Wellington's CentrePort. (See the write-up from the students in this edition.) It was great to see so many up-and-coming hydrographers passionate about the profession.

LINZ hosted an event to celebrate World Hydrography Day on June 21on the theme, One hundred years of international cooperation in hydrography. The presentations were led by CEO Gaye Searancke and National Hydrographer Adam Greenland, with a recorded message from the Minister of Land Information, Damien O'Connor. (*https://iho.int/en/whd-2021-celebrations-around-the-world-0*).

Brook Tozer from GNS presented a webinar on June 18 entitled A Global Bathymetry Map. Brook provided the background to the global bathymetry model produced by Smith & Sandwell using satellite altimetry and gravity data, and how it has improved over the years. With new space-borne sensors being launched, technology such as space lasers and higher accuracy altimeters means the accuracy and spatial resolution of global bathymetry is improving.

SCHOOL OF SURVEYING GRADUATES MULL OVER CAREER OPPORTUNITIES

Guy Frederick, Communications Adviser (Sciences), Otago University

Graduates from the School of Surveying are in hot demand this year, with job advertisements taking up a lot of wall space around the school and even overflowing into the tearoom.

The students are highly regarded and sought after in New Zealand and Australia due to both the breadth and depth of coursework and field experience during their three or four-year degree programme. Opportunities in land development, engineering, cadastral surveying and hydrography are all advertised this year, and graduates are capable of working across the increasingly diverse surveying and spatial profession.

Some graduates go on to work in what some might think of as the 'traditional' surveying areas such as cadastral surveying, where graduates must understand land law and the property system and how to establish legal boundaries. Others become engineering surveyors, involved in roading, tunnelling, drainage and other construction design, management and monitoring. Spanning these areas of specialisation, graduates understand resource management and urban design, making them vital in the current housing boom as well in longer-term planning for sustainable and liveable cities.

FUTURE LOOKING GOOD FOR KAIRŪRI COMMUNITY TRUST

The future of the KCT is looking very exciting with a very generous gift to establish the *Ian and Margaret Stirling Fund*. The gift, bestowed by the Stirling family allows the Trust to move from the building-up phase to realising tangible benefits for the young people at the start of their careers in the sector. The gift fits in nicely with the trust's objective of supporting scholarships and creating opportunities for careers in survey and spatial. The announcement, along with a brief presentation on Ian and Margaret's role in the evolution of the surveying sector in New Zealand, was made by Ian Stirling's son and S+SNZ Fellow, Andrew Stirling at a black-tie Awards event at the S+SNZ conference in August. Simon Jellie, KCT Chair says, "this is a fantastic boost for KCT and will hopefully inspire others, who have the means, to step up and do something to assist the aims of the trust".

In keeping with the Trust objectives, we congratulate Patrick Coughlan, a final year student from Otago University who was awarded the *KCT Survey and Spatial Scholarship*. This consisted of a cash award to assist with education costs and attendance at the S+SNZ Conference. The judges were impressed with Patrick's winning essay on *"The impact of diversity on the survey and spatial profession'*.

Well done Patrick!

Trustees Jayne Perrin and Melissa Harrington presenting Stirling family members with a giclee print of Peter Caley's Manaia painting

Scholarship winner, Patrick Coughlan presenting his essay to at the S+SNZ conference.

Other students work with remote measurements taken from space, planes, drones, cars or boats to capture 'reality' in four dimensions, both on the land and under the sea, and then analyse and visualise it using spatial techniques (including specialist geographic information systems or GIS). In their final year of study, all graduates develop project management and professional ethics skills to round off their studies.

Otago Uni Students. Final year students, from left, Ken Wang, Tom Scoles, Matt McMaster, Patric Truebridge, Devon Allen, Raksha Kumar

Archibald Hugh Bogle – A Short Biography by Don McKay, FNZIS

Reviewed by Ross Miller, FNZIS

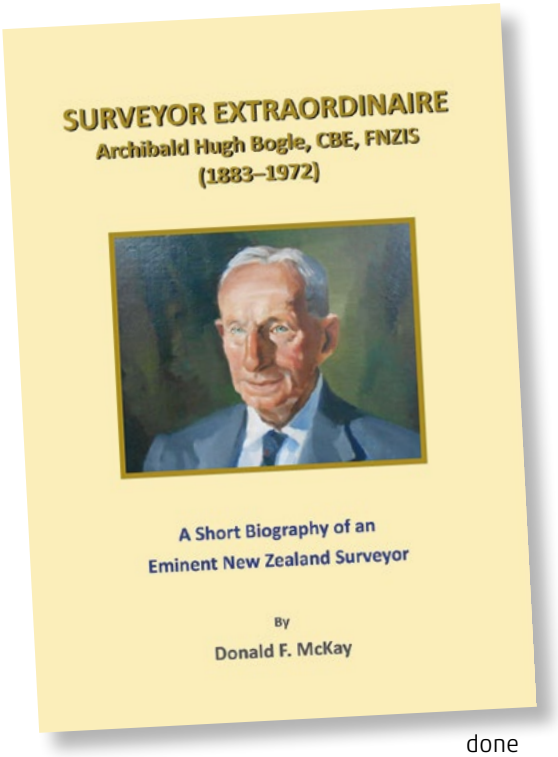
Anybody aware of the history of the NZ Institute of Surveyors would be aware of the name Archie Bogle who was a member of the institute for 68 years. Over that period he served it and the wider profession in many, many ways, all with considerable distinction.

Yet for all his great service, few members today would be aware of him. The only lasting record appears to be in the name of one of the institute's awards and a portrait, which I understand is now in storage, painted by renowned artist Peter McIntyre. Don McKay has tried to put this to right in a short biography in which he traces Archie's career and his achievements in the many positions he held.

The author describes this piece as an article rather than a book and, being only 24 A4 pages, I would agree with that. In addition, there are 18 more pages of end notes; a glossary of survey terms; a bibliography; and four appendices, which quote from a number of Archie's writings.

The author clearly has a huge admiration for this man, whom he describes as a "Surveyor Extraordinaire", and after reading the article, it is hard not to also have an equal admiration for the man who had such a large influence over our profession for such a long period of time.

The author discusses each aspect of Archie's life and career from his early life onwards. The article is well written and obviously a lot of time and effort has gone into researching it. As the author says, it is not a definitive biography – that has yet to come – but is an excellent record of Archie's service to the institute and profession over a large number of years.



I would recommend it as something that all those interested in the history of our profession and its people should read.

In virtually every survey we undertake, we have to find the work of a previous surveyor to orient ourselves, so most surveyors will have a sense of the history of what has gone on in the past. Over the years there have been a number of books written about surveyors, many published by the institute, and Don McKay is to be congratulated on producing such a good addition to them.

However, this article will cause a few problems as to what should be done with it. It is too short to be made into a book, yet it is too long to fit into any of the institute's periodical type publications, nor should it to be just tucked away into some corner of the institute's website as it would not get the exposure it, and Archie Bogle, deserves.

Fortunately, a few retired institute members have now got together to arrange the printed publication of the paper, making it available for anybody wishing to buy it to add to their library of books about and by New Zealand surveyors.

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