SURVEYING + SPATIAL

June 2016
Issue 86

EnviroDevelopment – Environmentally sustainable urban development

Preserving History – 3D scan of the Triumphal Arch

The GIS behind Battle for our Birds

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REGULAR FEATURES

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Keeping it Green

Diane Moriarty

I like to think of myself as a bit of an 'urban greenie' and before making many decisions in life I first consider the environmental impacts. Our family only owns one car, where possible I make a conscious choice to buy locally made/grown products, waste is kept to an absolute minimum and what waste is created is recycled where possible. We are low level consumers and hence low waste producers. These are values I have instilled in my children and hopefully as they grow they will embrace this way of living.

I attended the FIG working week in May and one presentation which struck a chord with me was that of Mr Gregory Scott of the United Nations. He spoke of the 2030 Agenda for Sustainable Development and how we, as geospatial professionals, can help through using location data to measure and monitor sustainable development. Although this came from a high level in terms of climate change, world population rise and disaster prevention, it serves as a reminder of how the decisions that we make at a country, regional or individual level can impact on the functioning of the planet. So think before you act and make it your June resolution to start keeping it green.

I broach this topic as this edition comprises two articles about projects with a common theme of sustainability and environmental protection.

On page 6 the Land Development and Urban Design Professional Stream (LDUD) table a proposal for EnviroDevelopment certification for land development projects in New Zealand. This certification process is currently in use in Australia. It is a scientifically based assessment scheme that independently reviews developments and awards certification for meeting environmental outcomes. The scheme was founded in 2006 and is achieving amazing results and producing high quality developments across Australia. As a country that loves to promote our 'clean green' image, it is time as a profession to start living up to this image and take on the challenge that is EnviroDevelopments. I urge all land development professionals to get involved in establishing this scheme by contacting the LDUD stream committee and indicating your support and commitment to this project.

The second article comes from the Department of Conservation and their 'Battle for our Birds' campaign. This is a GIS project that was set up to aid in the fight to save NZ's native fauna from a seed-fuelled plague of rodents and stoats. The project demonstrates how using GIS as a tool to plan, implement, monitor and assess the operation greatly improved its success ensuring the continued survival of vulnerable native birds and bats as they bred over summer. This project could be viewed as a disaster prevention/recovery project and a fine example of using location based data to achieve positive environmental outcomes.

Happy reading.

LINZ positions for the future

Mark G. Dyer

I'm constantly reminded that the one thing we have to embrace in the geospatial business is change. Yes, it may be a cliché, but if there was any doubt, that should have been dispelled by the breadth of subjects at the FIG Working Week in early May. I was delighted to attend, not just because of the opportunity to catch up with what's new, particularly with regard to disaster recovery, but also because of the many friendships that are built and reinforced by everyone who attends.

Naturally, there was some curiosity at FIG about one of the major changes that's going to take place at LINZ - the Advanced Survey and Title Services (ASaTS) that will replace, and possibly revolutionise, Landonline when it's operational in five years' time.

It almost goes without saying that when Landonline was rolled out 15 years ago, the face of land transfer and ownership transactions was changed forever. For the first time, the paper records were dispensed with and the electronic recording of property ownership and transactions set the standard for the rest of the world. Now it's taken for granted by lawyers, surveyors, real estate agents and property owners themselves that this is the way to manage property information. It didn't end there and in 2009 we introduced electronic lodgement of all survey plans.

Arguably, we could trundle along with Landonline, but the fact is that it is based on 1990s technology that's difficult to update and demands extensive testing when changes are made. ASaTs offers all sorts of potential, such as the ability to maintain a 3D digital cadastre and it will be better at managing Maori and Crown land and other government systems that record land information.

It also will help in the move towards the integrated property services vision that we aspire to. Today, property information is held in a variety of central and local government agencies, but joining them up so the data can be used more effectively is no easy task. Connecting it together will not only simplify access, but it will also contribute to other benefits from improving access to official data and the opportunities for new businesses and services build on "open data".

To bring home ASaTS, LINZ is looking at a different approach from Landonline, one called 'as a service.' We'd use the system to process surveys and titles and we would still be custodian of the data, but the system itself would be owned by a private provider. This approach can deliver the benefits we're looking for at a lower cost than building a system ourselves and make the system more agile into the future.

ASaTs, and what it will link into, will require us to rethink yet again how we use geospatial information. But that's what it's all about – change is our business.

Nāku noa, nā Mark

[For further reading on the new ASaTs system please refer to page 35]

Cadastral

The recent coastal water seminar, presented by Stacey Spooner of LINZ and Emeritus Professor John Hannah has been well received around the country. The research presented on sea level rise is compelling and challenges surveyors to consider how they will define tidal boundaries into the future.

Earlier in the year a Cross-lease titles seminar was held in Christchurch attended by a mixture of local surveyors and lawyers. Rigorous debate highlighted the fact that there were many differing opinions as to the legalities of rebuilding houses held in cross-lease titles. While the discussion centred on the effects of earthquake damage to cross-lease properties and titles, it is felt by the stream that this subject is important across the country and efforts are being made to bring a similar seminar series to other centres.

Further on Christchurch cadastral issues, a great deal of effort has been put in by the 'Best Practice guidelines' working group. The group received a good amount of feedback on the draft guidelines document and work is progressing well towards a further revision. The review of the Cadastral Survey Act 2002 being undertaken by the working group is also progressing well and an opportunity for member consultation and comment will be made available shortly.

Members are encouraged to consider an entry for the 2nd annual Cadastral Survey of the year award. The judges are looking for complex and challenging datasets where the surveyor has used innovative solutions and while applying a high level of survey best practice.

Anyone wishing to make contact may do so to the chairman Matt Ryder at *mattr@cheal.co.nz*

Engineering Surveying

The Engineering Stream had an open teleconference in March, where all those registered as stream members were invited to attend. Amongst the items of discussion was developing ideas for the growth of the stream, how value can be returned to its members, and how to attract new members from outside the NZIS. Ideas are forming and we will meet again in the coming months to elaborate.

Construction remains strong around the country, especially in the major cities. There are shortages in all technical aspects of construction and surveying is one of them. We encourage the Auckland branch's initiative to start more actively promoting the surveying profession in our schools as a career. Hopefully this can provide a long term solution to the current skilled staff shortages that many of us are facing.

Health and Safety

We wish to remind those working on construction sites to be familiar with the new Health and Safety legislation that came into effect in April, and to know your health and safety responsibilities. Surveyors have mentioned that WorkSafe has been noticeably more active in the initial month. The NZIS has run some continuing professional development (CPD) training about the new legislation and you can contact Vanessa Delegat at National Office for information about the training. Health and safety is a major component of our daily work lives and we need to ensure that members and their co-workers go home without harm every day.

Michael Cutfield, Engineering Surveying Stream Chair

Hydrography

Port Upgrades

A number of ports around the country are currently undergoing upgrading works. The port of Napier has released a draft proposal for public consultation to add a new berth within its existing boundary; this would also involve the construction of a new wharf and an extension of the shipping channel. At the Port of Otago the multi-year project to deepen the shipping channel to Port Chalmers continues according to plan. In Auckland maintenance dredging has begun on the Rangitoto channel and around the Ports of Auckland wharves. Dredging in the Port of Tauranga continues and should be completed by mid year.

Port of Tauranga

These upgrades provide a steady work load for hydrographic surveyors. Dredging is an expensive operation requiring resource consents, budgeting, environmental monitoring and survey. Hydrographic surveyors are engaged in the pre, intermediate and post dredge surveys. The extra depth can be measured in increased tonnages and reduced shipping costs for exporters and importers alike. Ports receive their revenue from the levies and berthage fees and in New Zealand, local authorities are gen-

erally large shareholders in the port companies and share in this revenue stream for the benefit of their ratepayers. As the capacity to accommodate larger vessels increases our ports become more attractive to shipping companies. North and South Island ports are all pursuing increased channel and berth drafts.

Land Information New Zealand

LINZ is currently seeking tenders for the 16/17 financial year Civil Hydrographic Survey Programme; with a focus on projects in the approaches to Auckland and the Marlborough Sounds. LINZ has planned this survey using preliminary results from its NZ Hydrography Risk Assessment. The risk assessment is a new process where vessel tracking data as well as hazard data and other information is used to prioritise survey work to the areas where it is needed most. First trialled in the South-West Pacific, LINZ has extended this to all of New Zealand and will be publishing the results in June 2016.

LINZ has also begun to release bathymetric data, and is making details of the data it holds as well as information on ordering available on the LINZ Data Service (*https://data.linz.govt.nz/*). This release includes the library of scanned, geo-referenced survey sheets. Future releases will include the index of digital bathymetric data held on LINZ's Bathymetric Data Base.

Land Development and Urban Design

Most of our members are experiencing very high workloads with particularly strong growth in the provincial areas as well as the cities. The main topic of the moment is the inflated housing market in Auckland and this is certainly starting to filter down into the provincial areas with the house prices in the Waikato Region also reaching all time highs. It would also appear that this is driven to some extent by a significant portion of the Auckland population looking to more affordable housing options in the provinces. Certainly house prices in Hamilton and Tauranga, for example are still far more affordable than Auckland by comparison.

Managing growth in an orderly fashion is certainly one area Local Authorities have their work cut out and it is imperative that sound structure plans are developed with an emphasis on modern urban design guidelines to provide optimum housing solutions and ultimately vibrant new communities. Thorough consultation with community groups along with land development and urban design consultants is a prerequisite to obtaining successful solutions for new developments. The survey profession is at the forefront of this growth and in an excellent position to help lead the way in how our cities and towns evolve.

Phil Cogswell,
Land Development and Urban Design Stream Chair

Positioning and Measurement

The Positioning and Measurement stream would like to thank the speakers and coordinators of the Reference Frames workshop, which took place in Christchurch, immediately prior to the FIG working week. This was truly an international event as the workshop was joint organised by FIG, IAG, ICG, NZIS and UN-GGIM-AP and attracted more than 50 participants from 19 countries (5 continents).

The focus of the workshop was reference frame issues relevant to New Zealand, Australasia and the Pacific. The initial sessions provided background (revision) of the key concepts related to 3D and vertical reference frames (datums). Followed by sessions on deformation, global geodesy initiatives, geodetic infrastructure and software. There was some great discussion and networking opportunities from across the geodetic community.

Rachelle Winefield,
Positioning and Measurement Stream Chair

Spatial

In the last few months the focus of the Spatial Stream has been on preparing for the recent FIG Working Week in Christchurch. The FIG Working Week included the Women in Spatial breakfast and the Spatial Stream met to form a working party to discuss the value proposition for spatial professionals as part of our drive to recruit more members to the Spatial Stream. These events together with a large number of spatial related sessions at the conference ensured the spatial sector was well represented.

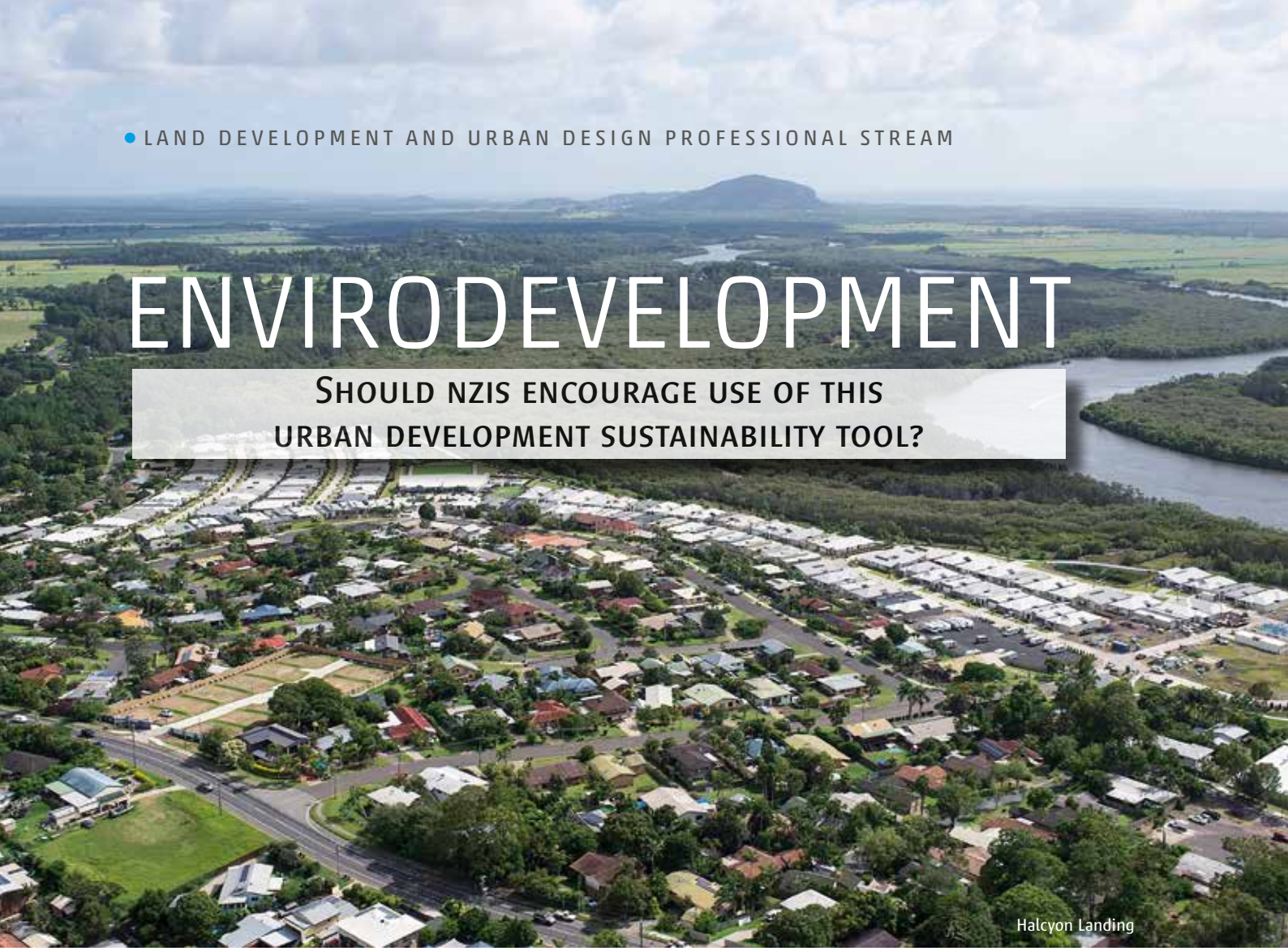
The launch of the University of Canterbury Geospatial Research Institute Toi Hangarau took place in the last week of April, with the objective of accelerating work in spatial infrastructure as well as boosting New Zealand's research capability. Land Information Minister Louise Upston opened the Institute, which will deliver economic, social and environmental benefits for New Zealand.

The Women in Spatial blog was announced recently, this contains information on the Women in Spatial events and can be found on *https://womeninspatial.wordpress.com/*. Women in Spatial also held a field trip to Matiu Somes Island on the 21st May. Keep an eye on the blog for details of future trips.

Greg Byrom, Spatial Stream Council Representative

ENVIRODEVELOPMENT

SHOULD NZIS ENCOURAGE USE OF THIS URBAN DEVELOPMENT SUSTAINABILITY TOOL?


Halcyon Landing

Brett Gawn, Urban Development leader, Calibre Consulting NZ

Introduction

The Land Development and Urban Design Stream (LDUD) of NZIS has as one of its primary objectives to ensure that our members are integral and valued professionals throughout the urban development process.

For this to happen our developer clients and the other professionals we collaborate with in this field must want us to be part of their teams from the beginning. One way to achieve this is to demonstrate that we can help balance good urban design and environmental sustainability with economic and financially successful development.

It is important to surveyors that we are able to help design urban development projects that are sympathetic to the environment and community and can demonstrate that.

These projects will:

- create better places to live
- have better community acceptance
- have easier consent processes
- sell better.

There is value to developers in being able to demonstrate their projects' environmental credentials. I believe there is also value for New Zealand surveyors to support a tool for independent certification of a project's environmental credentials.

In New Zealand we have the Greenstar and Homestar systems promoted by the NZ Green Building Council. Both of these systems are buildings focused – commercial and residential respectively. There isn't a current sustainability rating system in New Zealand that also includes the land development component of urban development.

At the 2015 NZIS conference in Wellington the LDUD, supported by Calibre Consulting and the Urban Design Institute of Australia (UDIA) sponsored Andrew McPhail to present the EnviroDevelopment paper as a thought piece for the profession. The LDUD's and UDIA's purpose in doing that was to see whether NZIS might promote this tool in New Zealand as a way for surveyors to take the lead in this area for land development projects. This article is based on Andrew's paper to the conference and information provided by and with the express permission of EnviroDevelopment. Much of this documentation is available on their website at *http://www.envirodevelopment.com/*.

What is Enviro Development?

To quote the UDIA "The EnviroDevelopment concept has been created to increase the uptake of sustainability throughout all aspects of the development process and across all development types including residential, retail, commercial and industrial as well as mixed-use developments. Its purpose is to mainstream more sustainable development, beyond display projects. It is designed to harness the enthusiasm of industry, government and the community and to inspire higher achievement than would be achieved through regulation, whilst maintaining opportunities for flexibility and innovation".

EnviroDevelopment is a scientifically based sustainability assessment scheme for urban development projects that certifies high levels of environmental performance and has independent verification. Its technical standards are set by an expert panel that reviews and updates those standards based on the latest research and new technologies. Certification indicates that a project exceeds current regulatory standards – in other words is better than the current industry norm.

EnviroDevelopment has been established by the UDIA which is recognised as the primary body representing the property development industry in Australia. UDIA's members include developers, planners, engineers, architects, surveyors, state and local government authorities, product suppliers etc.

EnviroDevelopment's goals are to:

- **educate and inform** developers, community members, local authorities
- encourage and **reward** developers
- overcome the problem of "greenwash" by providing **integrity and clarity** in marketing
- hasten **implementation** of sustainable development
- provide **Industry leadership**.

To achieve those goals it provides for:

- independent certification of sustainability credentials
- coverage of the environmental areas of energy, water, ecosystems, materials, waste and community
- input from the first phase of development to operation and maintenance
- transparency and integrity to withstand scrutiny
- uptake of research, knowledge and tools
- flexibility to encourage innovation
- certification in time to be useful for developers
- the progressive raising of standards.

The types of projects that can obtain EnviroDevelopments certification are:

- residential subdivisions
- masterplanned communities
- seniors living (retirement facilities)
- industrial
- mixed use including retail
- multi unit and medium density
- education.

The EnviroDevelopment elements

There are six elements of EnviroDevelopment. These are **ecosystems, waste, energy, materials, water** and **community**. They each have their own "leaf" symbol shown here.

The **Ecosystems** certification targets projects that protect and enhance native ecosystems and ecological function, and rehabilitate degraded sites.

Waste certification requires waste management procedures and practices to reduce the amount of waste to landfill and facilitate recycling.

Energy certification can be obtained for projects that implement measures that optimise energy reduction across the project beyond current regulatory requirements.

Materials certification requires the use of environmentally responsible materials and construction methods that lower environmental impacts of material usage.

Water certification shows that the project implements measures that reduce potable water use across the project beyond current regulatory measures, and

Community certification demonstrates that the project encourages healthy and active lifestyles, community spirit, local facilities, alternative transport modes and accessible and flexible design that welcomes a diversity of people and adapts to their changing needs.

The standards for each element have been drafted by an Australian Technical Standards Taskforce consisting of developers, local government, state government, environmental consultants and other professionals. There has been input from a range of other relevant experts, such as academics involved in calculating water savings and private sector organisations researching the environmental merit of particular materials.

A developer may apply to have a development certified as meeting the EnviroDevelopment standards for all or some of the six key elements. There is a minimum number of elements (currently four in Australia) that need to be met before a development can be given recognition as an EnviroDevelopment project. A certified development may only display the icons in the 'leaves' relevant to its certification.

How does a project get certification?

Application for certification can be submitted as soon as evidence is available offering certainty of achievement of the EnviroDevelopment standards. The timing of the application is likely to be prior to or concurrently with lodging the resource consent application as certification should provide the consenting authority with assurance that environmental sustainability issues have been addressed.

Applications will be considered by the EnviroDevelopment Board of Management, with advice and input from appropriately qualified experts as necessary. Processing takes 6-8 weeks and is valid for 12 months.

EnviroDevelopment Renewal and Compliance

Certification can be renewed provided the basis of certification remains valid. The developer is required to provide information to verify this and explain any changes. Certified projects may be subject to random site checks and certification may be revoked if conditions are not being met.

The following diagram shows the process.

Examples of EnviroDevelopment projects

Fitzgibbon Chase

Twelve kilometres north of Brisbane's central business district, **Fitzgibbon Chase** is a 1700 small lot development on 295 hectares. It has obtained certification in all six of EnviroDevelopment's elements.

Stand out factors of this development are:

- on-site recycling plant during construction
- 40% of civil materials to be from recycled or reuse sources
- selective building partners to reduce waste generation
- planned 40% reduction of water use (roofwater and stormwater harvesting and reuse systems)
- 50% of houses overlook public space.

Halcyon Landing

Another fine example of an EnviroDevelopment project is Halcyon Landing project in Bli Bli, Queensland. It is an over 50's community of 170 homes on 22 hectares of land that was previously cane fields. Certified in all six elements, it has 9.2ha mangrove wetlands and 3.4ha open space (55% of site) and revegetation/rehabilitation of a buffer to the Maroochy River.

Other aspects include balanced earthworks, flood immunity to the development, recycling of construction waste and management and treat contaminated soil and demolished building materials. The site home builder had a four tier waste management system to minimise, reuse, recycle, and dump as last option. The ongoing site management includes a recycling program for grass cutting and food scraps composting. Favourable solar orientation, 1.5kw solar PV panels on each roof, and passive design for ventilation ensured the homes achieved a high level of energy efficiency.

It has an integrated water strategy designed to reduce potable water consumption, and a landscape master plan based on native revegetation that does not require watering after establishment.

Many community facilities including significant areas of open space and a "signature" walking trail through the wetlands, all in a safe, vibrant, attractive and well maintained master planned site, were provided upfront by the developer. Community consultation throughout the development process ensured that the existing community and new residents were informed and listened to.

Ongoing engagement with residents still occurs, and has resulted in a vegetable garden and orchard being added subsequent to the initial development work.

Here are two examples of feedback to UDIA from users of EnviroDevelopment that illustrate some of the reasons developers choose to get their projects certified.

Michael Hurley, ARIA Property Group says:

"The decision to work toward EnviroDevelopment accreditation was an easy one. Being able to associate with an industry body such as the Urban Development Institute of Australia, and be recognised for sustainable development at the same time, it's beneficial to the development community, our buyers, and everyone involved."

And Chris Carley from Halcyon says:

"We wanted to make a statement and have our customer clearly see the advantages to them. The EnviroDevelopment accreditation allows Halcyon to very clearly communicate its sustainability credentials in a meaningful way to all of our customers and even our neighbours. As a long term owner it was the most appropriate tool to recognise and demonstrate the unique aspects of a retirement living community and gave us the platform to demonstrate our achievements in this area. It's worked."

(Continued bottom p10)

Welcome function at the Christchurch Transitional Cathedral

78TH FIG WORKING WEEK

72 Different countries share experiences

Jan Lawrence, NZIS

FIG Working Week 2016 opened on 2 May in Christchurch with 475 international, 160 local and 118 young professional delegates and over 40 exhibitors enjoying a beautiful and uniquely New Zealand 'Powhiri' from the local Ngai Tahu tribe. A descendant of Ngai Tahu himself, Sir Tipene O'Regan – an academic and Chair of the Ngai Tahu Trust Board – followed with a cultural perspective on the sense of place we gain by owning our own heritage and place names and the surveyor's role in helping create this. This was followed by Margareta Wahlstrom, who set the scene with her knowledge of disaster relief requirements and an overview of the Sendai framework and disaster risk reduction and prevention. It was a great start to the week – just a small taste of things to come.

Hadyn Smith, NZIS CEO says "With 72 different nations represented and some of the leading young professionals in attendance, it was amazing to see the power of such an occasion. It was certainly well beyond anything I have experienced at a conference! I was interested to see the focus of such issues as Building Information Modelling (BIM), technology and land development was so similar globally to the New Zealand focus – which shows borders are no longer an obstruction to knowledge sharing."

Christchurch Transitional Cathedral, an easy walk from the city centre, provided the dramatic venue for the Welcome Ceremony. It was packed with hundreds of delegates representing over 70 different countries enjoying New Zealand wines and food.

As well as over 80 technical sessions, the week had something for everyone: an Historical Symposium, young surveyors' conference, Small Island Developing States (SIDS) workshop, professional women's breakfast, social events, technical tours, a gala and Kiwi/Foundation dinner and to end the week, a typical NZ rugby match – BNZ Crusaders vs Reds!

Seventy international and over thirty local young professionals got together for the *3rd Young Surveyors Network Conference* held prior to the Working Week. Following the theme of Rescue, Regenerate and Rebound, New Zealand, Japanese and Fijian delegates amongst others, were able to give context. "It was very topical given the disasters each of these countries has faced in recent years" says Melissa O'Brien, Chair of NZIS Young Professionals group.

(Continued from p9)

Why should NZIS consider supporting Enviro Development in New Zealand?

In New Zealand we have seen the emergence of large master-planned projects that contain significant medium density housing areas within them. For this type of development to work well, the urban amenity and public spaces need to be well designed and built ahead of the new residents moving in. There is also much public discussion over the requirement for more affordable housing but at the same time how that medium and high density housing development can fit sustainably into the existing urban fabric and without upsetting existing communities.

While we have the Urban Design Protocol, urban design guidelines and the Homestar rating system, none of these provide a single overall tool that is suited to both the housing and land development component of urban development. I believe there is a need for a comprehensive system that designers and developers can assess their proposals against to give Councils communities and others the confidence that what we are doing meets the high standards we set for ourselves

Many of you who are involved in urban development projects will know that many of the features that would

First plenary session underway

A highlight of the two days was the session on *MapAction* says Melissa. "They are a humanitarian mapping charity that works through skilled volunteers. They deploy people to disaster areas immediately following a disaster to help save lives and minimise suffering by making the response to humanitarian emergencies as targeted, efficient and effective as possible. As a rapid response team, they assist aid agencies with the distribution of aid and identifying areas of greatest need. Examples of the type of work they do includes locating where infrastructure has failed such as a destroyed bridge or the power is down. The group collaborates very closely with aid agencies mapping the locations of where aid has been distributed."

Melissa says that MapAction is keen to establish a presence in the Pacific and see New Zealand as an ideal location for a group. The young professionals organised a 5km fun run to help raise awareness of the great work that MapAction undertake. See more about MapAction and what they accomplish at: *http://www.mapaction.org/*

Enjoying great food, interesting discussions and sharing information in the Exhibition Hall at Horncastle Arena were over 30 sponsors, exhibitors and conference partners including Platinum Partners ESRI/Eagle Technology and Trimble, Diamond Partner LINZ and Silver Partners Leica and Bentley.

The full list of key partners who made the event possible and worthwhile can found on the webpage *http://www.fig.net/fig2016/sponsors.htm*.

Third FIG Young Surveyors Conference delegates

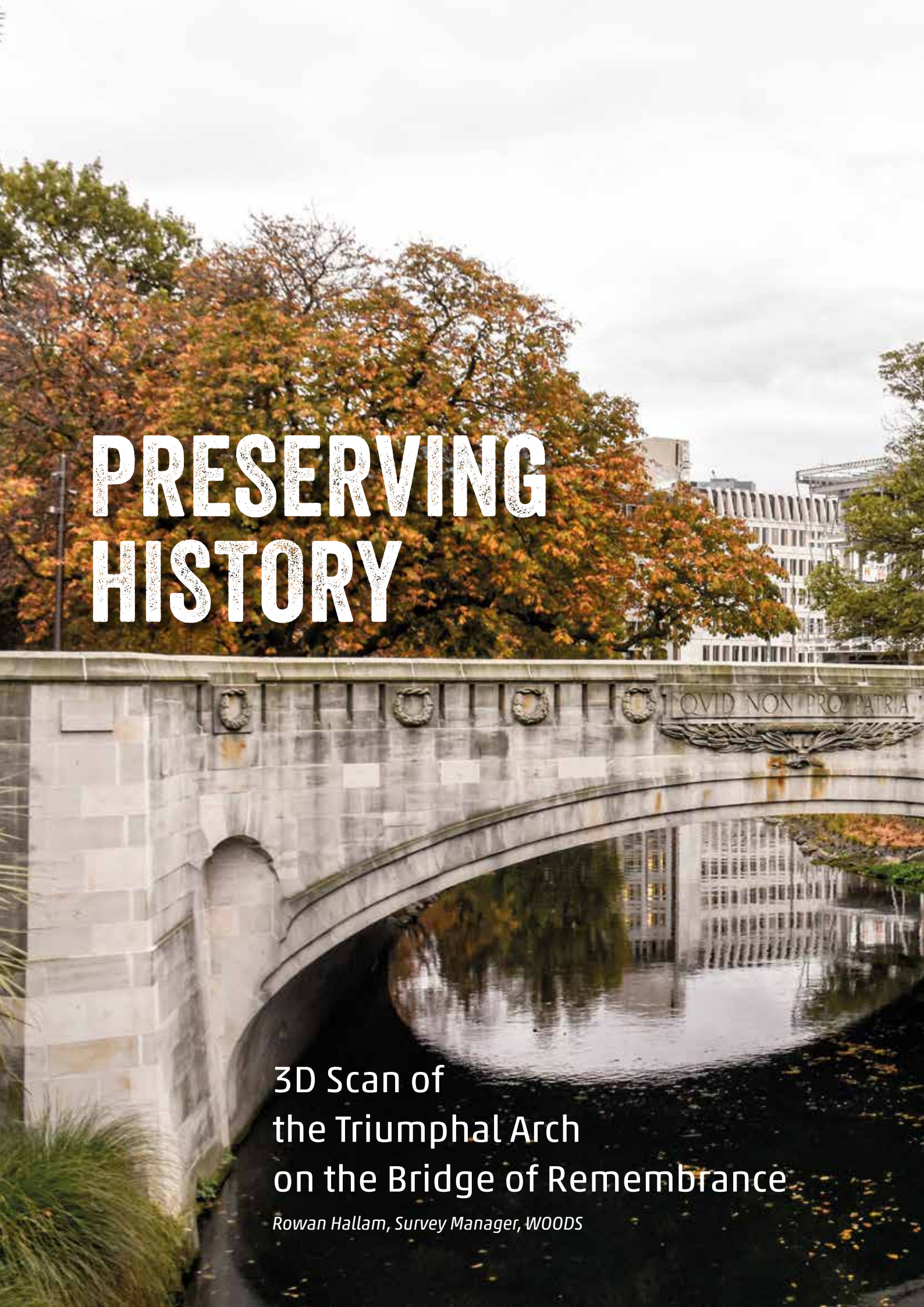
enable EnviroDevelopment certification are already incorporated in the way we design as a matter of course and responsible developers already see that these things are important.

Wouldn't it be good if surveyors and NZIS could lead the charge in getting a system that recognises what we already do up and running in New Zealand?

The Land Development and Urban Design Stream committee will be discussing this possibility through the rest of 2016 with the support of the EnviroDevelopment Board. The LDUD Stream committee looks forward to debate and discussion on this from members to help determine how to proceed with this initiative.

This article has been prepared by Brett Gawn on behalf of the LDUD Stream Committee of NZIS. Other committee members are Phil Cogswell (Chair), Phil Rhodes, Paul Turner, Richard Bromley and Scot Plunkett.

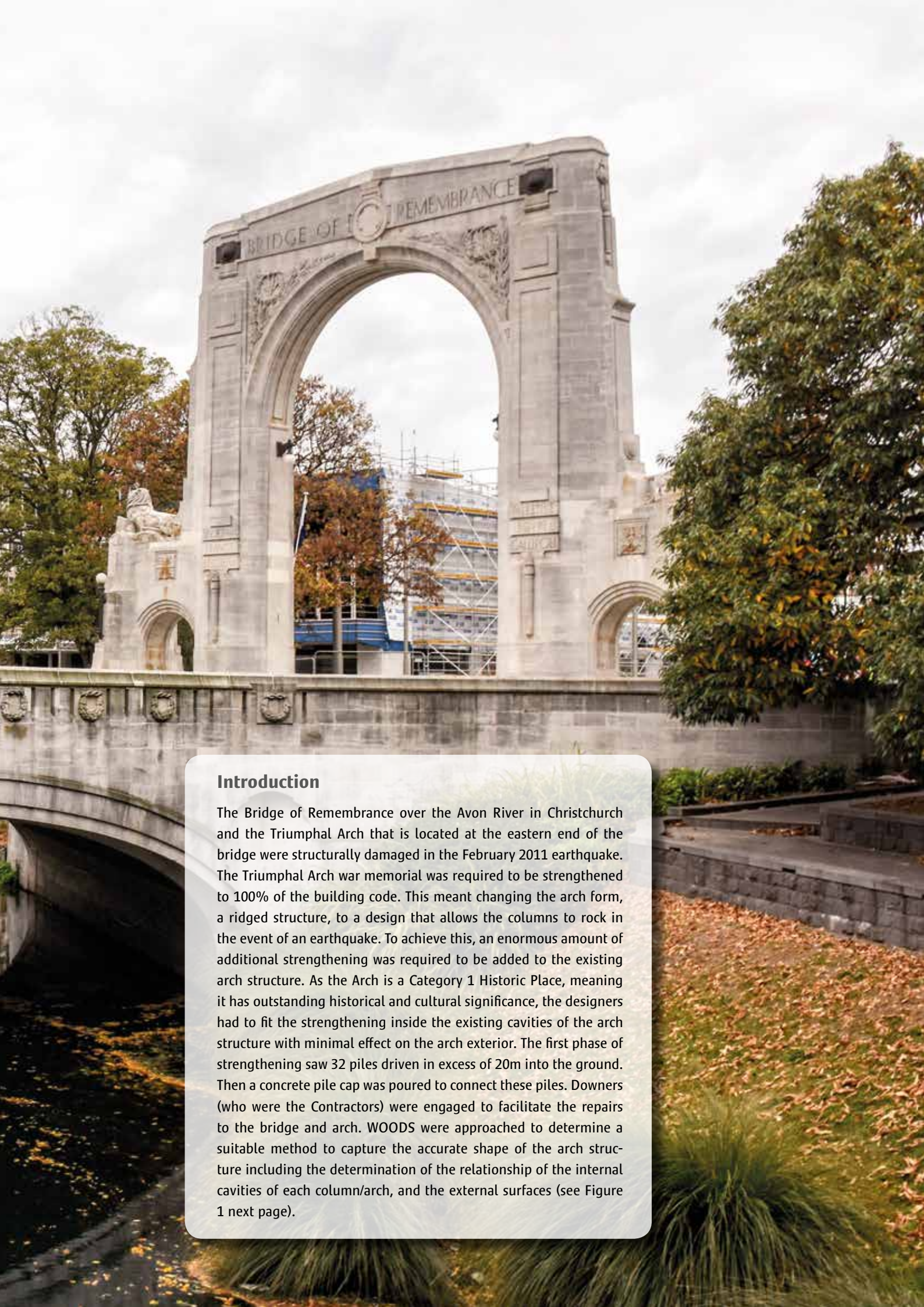
Brett Gawn is the urban development market sector leader (New Zealand) for Calibre Consulting. As well as his membership of the LDUD Stream Committee, he is a member of the National Committee of the Urban Design Forum and is the current Chair of the Cadastral Licensing Board of New Zealand. He has 40 years extensive experience in all aspects of land development in a number of areas throughout NZ and overseas.



PRESERVING HISTORY

3D Scan of the Triumphal Arch on the Bridge of Remembrance

Rowan Hallam, Survey Manager, WOODS



Introduction

The Bridge of Remembrance over the Avon River in Christchurch and the Triumphal Arch that is located at the eastern end of the bridge were structurally damaged in the February 2011 earthquake. The Triumphal Arch war memorial was required to be strengthened to 100% of the building code. This meant changing the arch form, a ridged structure, to a design that allows the columns to rock in the event of an earthquake. To achieve this, an enormous amount of additional strengthening was required to be added to the existing arch structure. As the Arch is a Category 1 Historic Place, meaning it has outstanding historical and cultural significance, the designers had to fit the strengthening inside the existing cavities of the arch structure with minimal effect on the arch exterior. The first phase of strengthening saw 32 piles driven in excess of 20m into the ground. Then a concrete pile cap was poured to connect these piles. Downers (who were the Contractors) were engaged to facilitate the repairs to the bridge and arch. WOODS were approached to determine a suitable method to capture the accurate shape of the arch structure including the determination of the relationship of the internal cavities of each column/arch, and the external surfaces (see Figure 1 next page).

Fig 1: Sectional view of triumphal arch cavities

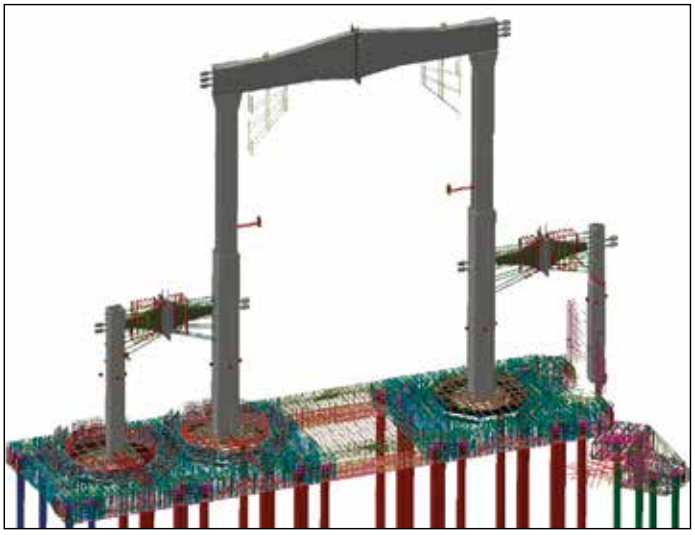


Fig 2: Structural design for arch strengthening

Scope of work

The scope of work called for the accurate capture of the Triumphal Arch for the purpose of three dimensional structural design. This included determining, and presenting the spatial relationship between the external arch surfaces and the multiple internal cavities within the Arch. With a complex structural design that required the internal components to interconnect between cavities inside the arch, along with limited access and space around heavy steel beams, there was concern components wouldn't fit or align correctly during the construction phase.

Part of the remedial works was to provide steel strengthening within the existing voids of the 14m high major (see Figure 3) and 7m high minor columns and, at each arch, install sliding joints at the crowns and horizontal post tensioning across the full spans.

3D modelling of the Arch was commissioned to allow the designer to complete the internal structural steel design and other design elements (see Figure 2). An accurate point cloud would allow the designer to proceed with confidence, identify design clashes, confirm the ability to build, and demonstrate the available space to manoeuvre the structural steel into place. This had the potential to accelerate the construction programme and prevent rework caused by potential clashes with the existing structure.

Our initial plan consisted of capturing all elements of the arch by scanning over 1-2 consecutive days. This need was highlighted to ensure targets could be placed to register the scans from the top and bottom of the arch voids. Unfortunately changes the construction programme resulted in three separate visits being required over four months. This created many difficulties in achieving accurate point cloud registrations between separate days.

Inverted Scanner

We were aware of our scanner's capabilities to operate upside down with its compensator turned off. This was going to be the first time using our scanner in this way. With an approximate width of the cavities

Fig 3: Image down the taller cavities

we engaged an engineer to design and build a bracket that could support itself and the scanner by bracing itself between the cavity walls. The bracket had variable width abilities to enable it to be used sitting across the top of the voids also (see Figures 4 & 5). We had hoped once access was gained to the cavity the scanner could be mounted part way up or down the void to improve coverage.

Three site visits were required in the completion of this survey due to scaffolding availability, and the time taken to obtain the necessary approvals to remove a brick.

Visit 1 – Exterior and outer arch cavities

Visit 2 – Upper arch cavities

Visit 3 – Inside base of each cavity.

Point Cloud Registration

The registration of these three days' work took on a very manual process using hierarchal evidence to build combined scans. Subgroups were established of primary accurate scans that could be registered together with the greatest confidence, usually from common targeted control. These sub-groups were then registered with the scans left over using patches, cloud to cloud techniques sampling different percentage of point clouds, and using identifiable features as control elements. Accuracy of registrations was verified by checking alignment of distinctive features in scans. Multiple slices through the structure were interrogated to ensure accurate registration alignments.

This proved to be very difficult for the tallest vertical cavities scanned from the top and bottom due to a lack of horizontal features that could help in the z direction. Features in the cavities became control elements to assist in completing the successful registrations. Examples of these features took the form of cavity surface changes, crumbled concrete areas, areas of excess concrete on wall surfaces and protruding steel work. This was a very manual process and required significant time and patience. Once again multiple slices through these cavities were interrogated to ensure accurate registration of the point clouds.

Fig 4: Inverted scanner with engineered bracket

Fig 5: Top of the main arch

Summary

The two end users of this data were Downers design engineers and Southern Cross Engineering. Downers received a CAD file with a fully registered and accurate point cloud. Their designers were totally satisfied with the final outputs. Southern Cross engineering used different software including Autodesk Inventor. WOODS liaised with their team to deliver a point cloud compatible format suitable for their purpose. Additional models were developed and supplied by WOODS including a Geomagic mesh model obj file and a Revit Model (by an external consultant).

This project won the NZIS Gold Award of Excellence in 2015. Ed

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ARE BEACHES ROADS?

Mick Strack, National School of Surveying

This commentary is a response to a note in the AA Directions magazine about a correspondent's concern that beaches are legal roads. It is also prompted by ongoing concern that vehicle use of beaches (e.g. bus traffic along Ninety Mile Beach – the tourist website asserts "This beach is officially a highway." (*http://www.newzealand.com/int/feature/ninety-mile-beach/*)) is culturally and ecologically destructive of the marine habitat, disruptive of coastal and dune processes and disturbs the peaceful enjoyment of the coastal marine area.

The law about roads has developed out of the English common law and custom from time immemorial. Public access has always been an important consideration when looking at land and property. For the most part, in Britain, access-ways were carved out of private property, rather than being consciously defined and set-out by any authority. They depended on a grant of a right of passage or right of way. They provided for required use, and became established as walkways, bridle paths or carriageways depending on that use. The ways in which rights to use such routes were extended to motor vehicles is somewhat obscure and is not clearly dealt with by the common law.

In New Zealand, much early legislation focused on the establishment of public roads, so the law moved on from the common law. The primary focus of early land administration was on surveying the land for settlement. In fact, Queen Victoria's instructions asked that land for all public purposes (roads, recreation, quays, schools, churches, etc.) should be set aside first, before the allocation of the remainder of the land to settlers.

In order to provide access to the land parcels, the legal requirement was that roads must be explicitly and legally defined, created (by processes including grant, proclamation and vesting), and dedicated in the possession of local or central government as public. The survey requirement included that a road should be explicitly defined by survey and illustrated on survey plans and record sheets. The priority of roads is therefore clear: "a road provides a right of access superior to any other right" (Hayes 2008;2).

Access to the sea, lakes and rivers has also been an important component of our land law, but such access only exists when it has been explicitly set aside, surveyed and dedicated for access. Many early marginal reserves were actually established as legal roads – a practice that emphasised the importance of access to water margins. Many rivers and lakes also became public, but again this did not provide for an automatic right to access by motor vehicle, although vehicle access along riverbeds was often allowed for in the interests of providing access to otherwise difficult to access lands. Beaches have also been used to gain vehicle access to remote land, but have they become roads?

Beaches were regularly assumed to be public land and possessed by the Crown. This assumption, with regard to the foreshore part of the beach, was refuted by the Court of Appeal in the *Ngati Apa* (Foreshore and Seabed) case – the Crown could not assume ownership of the foreshore unless Maori customary title had been explicitly extinguished. As for the coastal margins (the strip of land upland from MHWS), there may have been some unformed legal roads (road reserves) established there, and many of the originally laid out marginal reserves were illustrated as roads: "Will you therefore be good enough to ensure, that in all cases where reservations are made along River Banks, Sea Coast, Lakes, etc, that they are called roads, that the official plans showing them be coloured Burnt Sienna and that every such road be shown on the marginal plans of grants or certificates of title as roads" (Circular No130 from General Survey Office, Wellington. Jan 15th 1890). As roads, those reserved lands provide for a full public right to pass and repass. Because of coastal retreat and erosion, some of these roads may appear on GIS map overlays as part of the beach. This does not mean that the beach is also a road. Under recent legislation (Marine and Coastal Areas (Takutai Moana) Act 2011), if that unformed road becomes part of the foreshore (i.e. MHWS line encroaches into that road reserve), then that part of the road becomes

foreshore (and therefore part of the common marine and coastal area), subject to the general right of the public for access, navigation and fishing, but not subject to access rights as they prevail over a legal road.

Other land that remains Crown Land may be considered by some to be open for public access. However the Crown has the capacity to designate and control the use of all other land for specific purposes – for scenic, nature, or recreation reserve, for national park, for pastoral lease, for school or hospital use. So Crown, or public land does not provide an automatic right of access, and especially not for motor vehicles.

In a 1981 case *(Brader v Ministry of Transport* [1981] 1 NZLR 73 at 78, 84), the New Zealand Court of Appeal rejected a claim that the law gave individuals an absolute right to use motor vehicles, stating that the 'liberty to drive' is not a natural right and that the provisions in the legislation imposed restrictions and obligations, rather than granting rights.

The Local Government Act 1974 and the Government Roading Powers Act 1989 provide other definitions of what a road is. Neither provides any detail about the extent of the public rights in a road, but both are focused on the legal establishment of the road, for example: "(a) Crown land over which a road is laid out and marked on the record maps." The latter Act gives a further hint at the rights attaching to a road: "(b) land over which right of way has in any manner been granted or dedicated to the public by any person entitled to make such grant or dedication." The 'right of way' description reflects the old common law definition, and prompts reference to legislation defining a Right of Way. The Property Law Act 2007 (Schedule 5) defines a right of way: "right to go, pass, and re-pass is exercisable at all times, by day and by night, and is exercisable with or without vehicles, machinery, and equipment of any kind." The Land Transfer Regulations 2002 (Schedule 4 s6) describes "the right to go over and along the easement facility with or without any kind of (a) vehicle, machinery, or implement; or (b) domestic animal or (if the servient land is rural land) farm animal." It is clear from this that a road must necessarily provide for similar vehicle use to travel from place to place.

By the Land Transport Act 1998, beaches may be deemed to be roads for the sole purpose of regulating vehicles (registration and warrants of fitness) and enforcing driving rules (licencing, speed limits), but this provision does not make them legal roads or highways. The interpretation section states that for the purposes of this Act, a road includes: "(c) a beach; and (d) a place to which the public have access, whether as of right or not." This expansive definition makes it clear that this legislation, in no way, defines what is a legal road.

The Marine and Coastal (Takutai Moana) Act 2011 established the foreshore part of any beach as included in the common coastal marine area, not being subject to any ownership, and being available for free public access, navigation and fishing. Access is not defined in the Act, and the specifics of the rights of access are not detailed, but in the context of other legislation and usage, public access is likely to refer to recreational access by foot, not vehicle access for travelling from one place to another.

The New Zealand Coastal Policy Statement 2010 generally provides for the management of the coastal environment, and mostly focuses on the protection of the coastal environment, character, features and landscapes from the adverse effects of inappropriate subdivision, use and development. The Policy (18(a)) specifically provides for use of public coastal land, but that use must be "compatible with the natural character, natural features and landscapes, and amenity values of the coastal environment." The Policy (18(c)) also specifically refers to "maintaining and enhancing walking access linkages between public open space areas in the coastal environment." Policy 20 refers to vehicle access in the context of controlling and limiting vehicle use, while Policy 19 (Walking Access) emphasises the importance of promoting walking access opportunities. Clearly the meaning of access is heavily weighted towards walking access (promoted) rather than vehicle access (controlled). Policy 20 also details the types of damage, disturbance and danger arising from vehicle use on beaches, and while it may allow for some necessary vehicle use, that should only be permitted if there is no likelihood of that damage, disturbance or danger occurring. Except for some necessary uses across the coastal margin for boat launching and access to the sea, ecological, social and cultural sustainability will be enhanced if motorised vehicles are kept off beaches,

Beaches are mostly part of the common marine area not subject to any ownership claims. Beaches are not highways and they do not provide any right of access for vehicles. Vehicles and drivers on beaches are subject to statutory regulation to the same extent as if on roads. There is a strong desire to ensure beaches are open for public access, but the general expectation is that this is about non-motorised access. Some restricted vehicle use on beaches can be tolerated where some properties and communities do not have road frontage, or where access to the sea is required. Vehicle use on beaches causes considerable adverse effects on dune systems, bird nesting sites, shellfish beds and passive recreational enjoyment of beaches. Local authorities have the power to control vehicle access to beaches, and given the adverse effects, it would seem they should more actively close beaches to vehicle use.

THE GIS BEHIND *BATTLE FOR OUR BIRDS*

South Island robin (Herb Christophers)

Geraldine Moore, Geospatial Information Analyst, Department of Conservation

The Department of Conservation's (DOC's) Battle for our Birds — and largest ever aerial pest control programme — was launched in 2014 in response to the biggest seeding ('mast') seen in South Island beech forests for 15 years. Its aim: the protection of native birds, bats and giant land snails deemed at-risk from a seed-fuelled plague of rodents and stoats.

Via 27 separate aerial 1080 operations, >600,000 ha of forest was treated. Operations involved up to 80 staff, contractors and comprehensive GIS support. Generally, rat populations crashed dramatically, and stoat plagues were averted, helping ensure the continued survival of vulnerable native birds and bats as they bred over summer.

Contributions of GIS and careful record keeping

Decision making

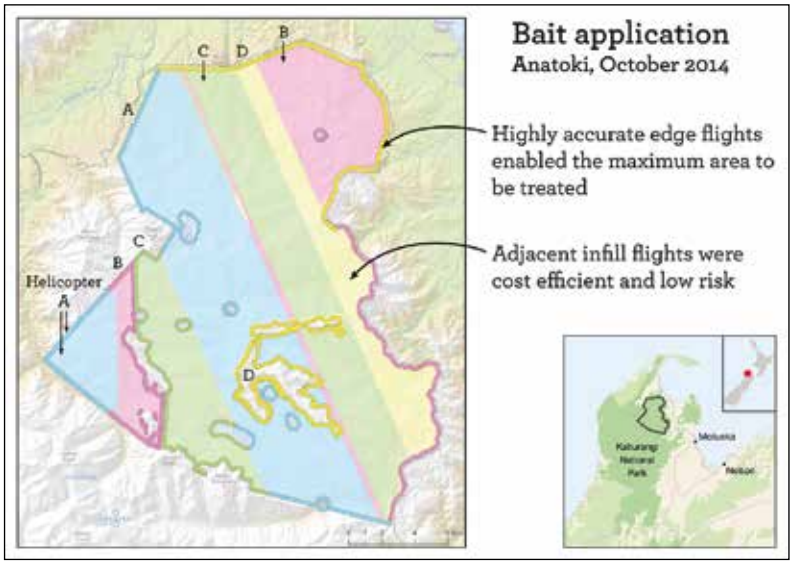
Coordinating DOC's largest ever aerial pest control programme would have been impossible without GIS. GIS aided decision making from the outset as scientists predicted the mast, monitored predator trends, and the extensive campaign was planned and implemented. Maps were vital to consultation, boundary decisions, resource consent decisions and tendering processes. GIS informed operational decisions at local levels e.g. logistics. During treatment, GIS guided decision making second-by-second as pilots sowed pre-feed or toxic bait, and hour-by-hour as progress was monitored. Analysis of pre-feed operations informed toxin operations.

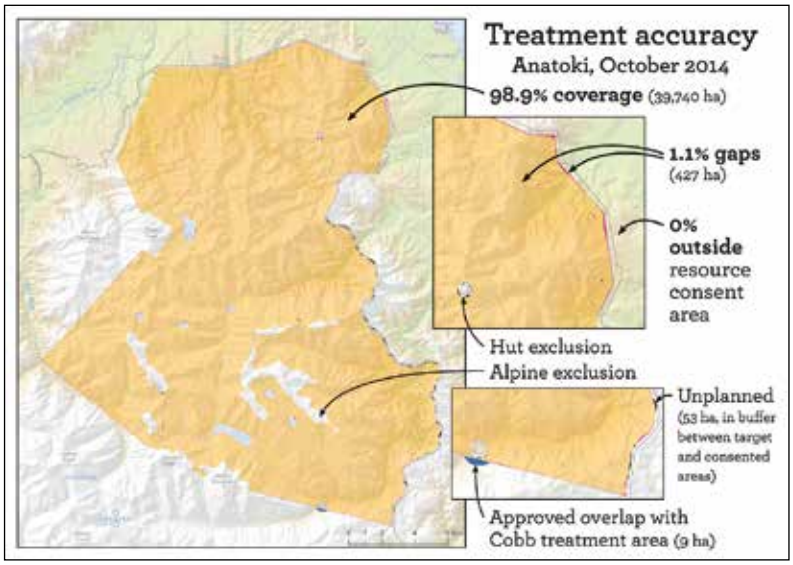
Cost savings and efficiency

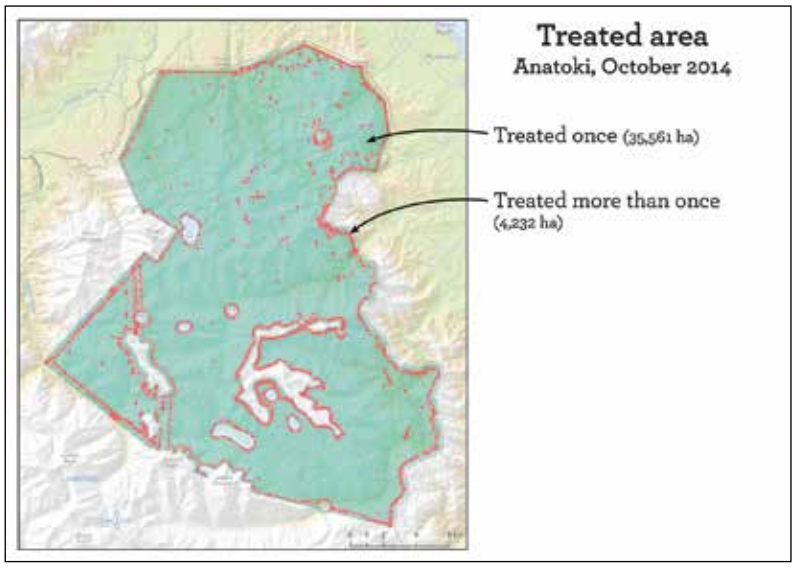
GIS was pivotal in:

- Ensuring 1080 was placed accurately, targeting pest habitats whilst avoiding waterbodies, huts, private land etc., and minimising overlaps.
- Reducing the potential for controversy by demonstrating 1080 was being used with the utmost care.
- Ensuring the maximum benefit from limited funding ($10+ million).

Aerial 1080 operation (Herb Christophers)







Maps (Geraldine Moore)

- Constant monitoring of treatment enabling issue resolution and continuous improvement.

Geospatial technologies have contributed to a ≥10-fold reduction in bait application rates (1970s–2010s), reducing costs and risks to non-target species. DOC is researching further optimisation.

Communication

GIS was a common language of Battle for our Birds. Maps and geospatial analyses were critical to communicating the sizeable looming problem, gaining managerial buy-in, planning at numerous scales, consulting, obtaining consents, contracting companies, organising logistics, and ultimately sowing toxic bait accurately. Maps were also valuable in taking a complex ecological story and potentially controversial – though well grounded – response to the public. Sought after by the media, maps helped win hearts and minds and assisted in bringing the public on the journey with us. Other key audiences included hunting, fishing, environmental and special interest groups, landholders, operational staff, and government ministers.

Careful geographic information record keeping

Careful geographic information record keeping enabled:

- Mast prediction
- Monitoring of predator trends and assessment of risk
- Robust operational planning
- Interagency cooperation, synergies
- Numerous parties to use the same boundaries
- Support roles to be passed between GIS staff
- Analysis and reporting of progress and success at numerous scales and times. (>99.9% of bait fell within consented areas)
- Novel questions to be researched
- Lessons to be captured and applied.

Additional detailed scientific analysis is underway to advance understanding of the

complex ecological systems and further refine pest control.

Operations GIS methods

Taking a closer look at the operations side of the pest control programme, GIS support was a key component.

Pre-operation

Before treatment, analysts helped create maps for consultation, tenure analysis, resource consent applications, tendering processes and public notification.

Treatment areas were carefully digitised to target pest habitats and be flyable whilst avoiding waterbodies, huts, private land etc. They were set inside resource and Medical Officer of Health consent boundaries, minimising risk of overflying. Some large treatment areas were divided into several adjoining operations. Some operations comprised blocks of differing treatment regimes such as bait application rates and/or the use of deer repellent.

GIS analysts provided boundary files and void areas for the helicopter companies in formats compatible with their GPS units.

Where necessary, boundaries were adjusted just prior to an operation to exclude areas of recent snowfall.

During treatment

During pre-feed and toxin operations, at strategic intervals, with the use of the helicopter GPS files, GIS staff mapped bait spread, monitored progress and advised of any issues. Maps included areas sown within and outside the treatment area, gap analysis, and overlaps (areas treated more than once). These were invaluable to managers and a helpful reference for pilots.

Post-operation

Flight lines were buffered to better represent treatment achieved along boundaries and within blocks. (Buffering creates polygons of a specified radius enclosing features. For example, flight lines become swaths.) Post-operation maps included:

- Bait sown – buffered flight lines, multiple bait regimes distinguished, areas calculated.
- Treated total – dissolved buffered flight lines, multiple bait regimes distinguished, consent boundaries shown, areas calculated. (*Dissolve* means to "flatten" the data, i.e. merge it all together. Dissolving eliminates overlaps allowing gross areas to be calculated.)

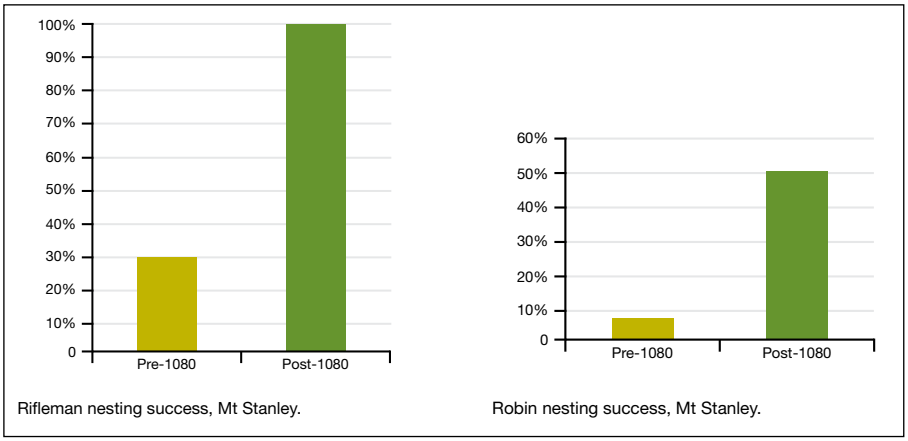


Figure 1

- Gaps and coverage — dissolved buffered flight lines clipped to the treatment area, gaps, areas treated outside the treatment area, areas and percentage coverage calculated.
- Flight lines and direction.
- Application type by machine – buffered flight lines per helicopter with application type (trickle, broadcast or parallel to the boundary) distinguished.
- Overlaps — areas treated more than once, hectares calculated.
- Secondary points by machine — where helicopters were flying but not sowing bait.

Contractor payment was based on performance against stipulated targets. The analysis as described above enabled this performance to be measured.

Throughout

Efficiency and consistent outputs for the numerous clients were important. GIS staff used a centralised folder structure and protocols and followed a comprehensive guid-

Stoat with chick (David Hallett)

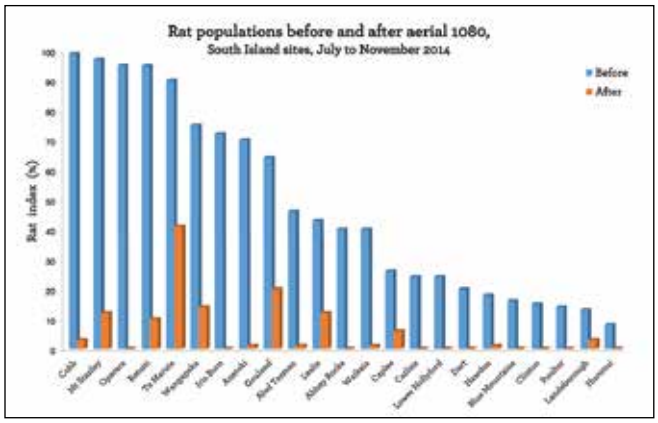


Figure 2

ance document. Models and scripts assisted with geoprocessing of raw data from the most commonly used type of helicopter GPS, and with analysing overlaps.

Battle for our Birds formed a significant peak of work for DOC's dispersed Geospatial Services team. With most staff members involved and additional business as usual priorities, communications and task assignment technologies were also invaluable e.g. Skype, GoTo Meeting, e-mail and assyst.

Results and environmental benefits

Battle for our Birds was very successful. Rat numbers crashed dramatically, rats being undetectable or at very low levels at most treated sites (Figure 2), and stoat plagues were averted. This helped protect vulnerable native birds and bats across large areas of South Island beech forest.

At Mt Stanley, Marlborough Sounds, 4,000 ha was treated. 24 robins were monitored during the operation. None died. Where 1080 was used, nesting success was 50% compared to just 7% before the operation and outside the treatment area (Figure 1). Thirty riflemen also experienced 100% post-operation nesting success compared to 29% previously (Figure 1) i.e. three times as many chicks were produced after treatment! The nesting success of mohua in the Dart Valley, Mt Aspiring National Park, was 57% during the last mast rat and stoat plague. With 1080 treatment, success increased to 89%. In Kahurangi National Park, rock wrens in the treated area achieved more than 80% nesting success compared to just over 20% outside. Monitoring of these and other species is continuing so the full effects can be gauged.

While a small number of sites had lower than expected rat knockdown, scientists are scrutinising relationships between rat survival and bait sowing and this will provide insights to improve the way aerial 1080 is used against predator plagues in future.

DOC scientist Graeme Elliott recognises that compared with possums, rat populations can recover relatively quickly after an aerial 1080 operation. "Rats can come back, but not to the levels before the 1080 operations, and in high altitude forests their populations most often don't recover until the next beech mast. Even in forests where rats recover quickly, a 1080 operation stops rat numbers rising to levels that are catastrophic to forest birds. By the time rat numbers increase again, most forest birds will already have successfully fledged their young. That's a win. The alternative is population decline."

Beech masts and corresponding increases in rat and stoat populations — and their devastating effects on native fauna — are cyclical. Graeme concludes: "Doing nothing during these big mast-driven rat plagues is not an option, as without pest control we would lose our smallest and most vulnerable populations like mohua and long-tailed bat" (Figure 3).

2016

2016 is looking to be another mast year with hikes in rodent and stoat populations. The scale of the threat will not be known until late autumn when the seeds have fallen and rodent numbers can be accurately tracked. However DOC staff are already preparing for the additional pest control that may be needed and GIS is again providing a strong foundation for assessment, planning, prioritising and operation preparations.

For further information please refer to the Battle for our Birds web page *http://www.doc.govt.nz/our-work/battle-for-our-birds/*.

This project won the Environment and Sustainability Award at the 2015 NZ Spatial Excellence Awards. Ed

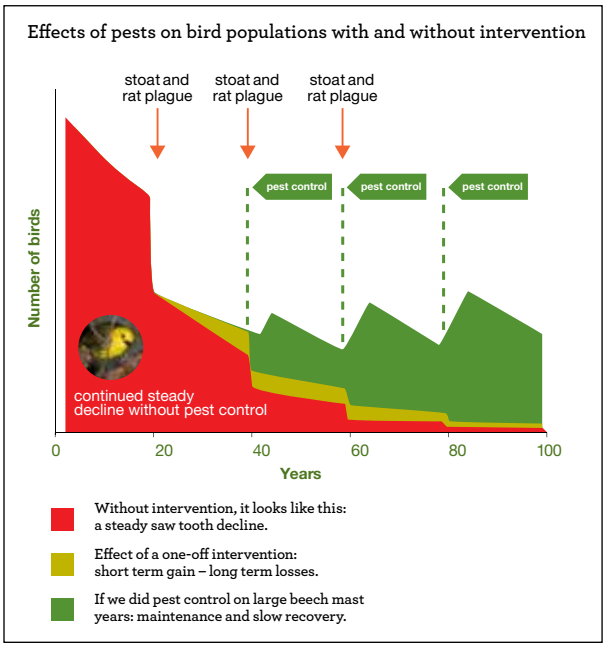


Figure 3

Understanding 3D Laser Scanning and Revit Technology

Malcolm Archbold, Survey Director, asBUILT

In recent years 3D laser scanning technology has revolutionised how surveyors collect high resolution and survey accurate spatial information. A typical 3D laser scanner will collect tens of thousands of points per second and with often over 100 setups per day this can result in gigabytes of data being collected in one day. Users register (combine the scan station setups) into one point cloud then georeference this in terms of the local coordinate system and mean sea level height datum.

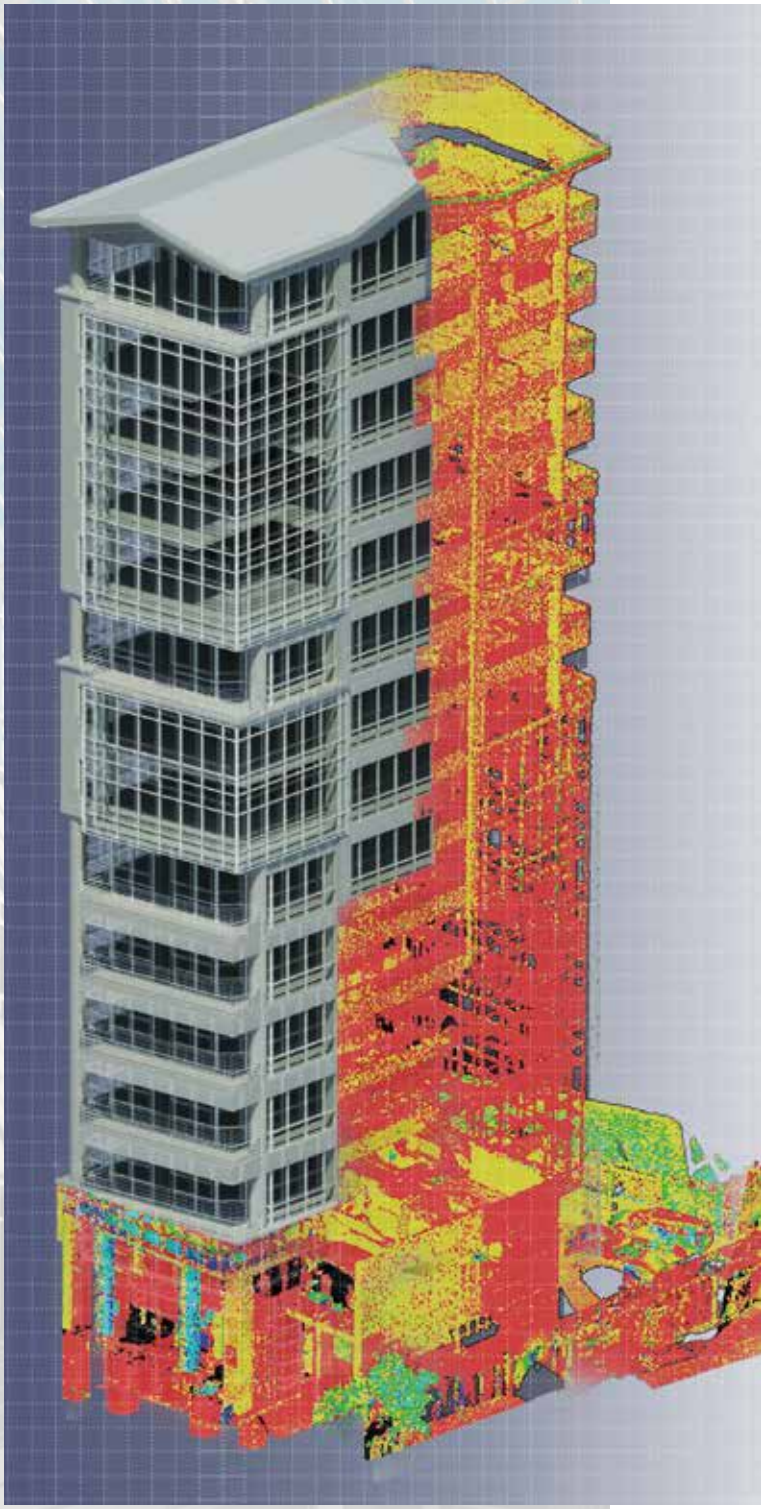
Typical output files can either be the laser scanner manufacturer's proprietary format, e.g. Leica .imp format, Faro .fls. or a generic ASCII point format (.pts, .ptx – one line per point) or a third party format e.g Autodesk Recap (.rcp/.rcs).

The engineering design and building construction sectors are seeing enormous benefits and opportunities in using 3D point clouds. Architects, building design engineers, and contractors are using 3D laser scanning to capture the 'as built' environment for use in design, construction and fabrication processes.

It wasn't too long ago that designers were saying "We received the 3D point cloud file, however, we had too many issues with it and it was all too hard. Either it is in the wrong format, the files are too large or once we imported it into our software it is in the wrong place and at the wrong scale".

In the past few years software manufacturers have made significant investments in the software tools and the 'data to design' software workflow processes to a point where the integration of geo-referenced 3D point cloud data is now a quite straight forward process if surveyors, designers and contractors understand the workflow processes.

Autodesk Revit software is BIM (building information modelling) authoring software for architects, structural engineers, MEP engineers, designers and contractors. It allows users to design a building and structure and its components in 3D and access building information from the model's database. Surveyors have the ability to capture 3D point clouds to provide survey accurate data for the model creation process. The BIM process of creating, modifying and updating the 3D building model from the initial survey stage through the design and constructions phases to the facilities management stage is now becoming common practice on many large scale NZ building construction projects. These include the University of Auckland, University of Canterbury and Skycity as well as small projects such as retail fit-outs, warehouse layout changes or building/boundary relationship surveys.



3D point cloud data can be used to create survey-accurate 3D asbuilt building models

From the surveyor's perspective an understanding of the data collection and integration of survey data in Revit model setup phase will create opportunities for both conventional and 3D laser scanning survey services. The 3D point cloud captures the as built environment which can be significantly different from the original design drawings and other post construction modifications.

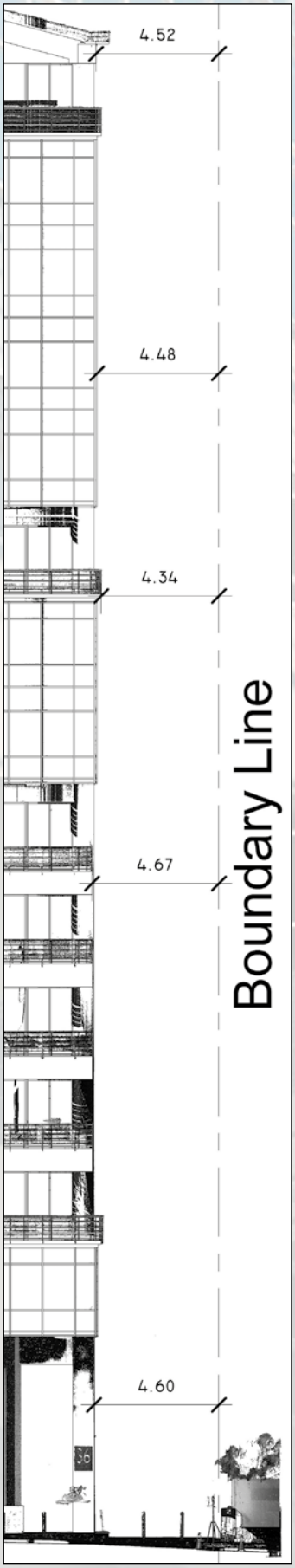
Often the intention of importing the 3D point cloud in to the 3D modelling software is to use the point cloud as the basis and guide to create the 3D model. This is often referred to as the "Scan to BIM" process. As a general rule of thumb a building scanned in one day can be modelled to the Level 1 specification (basic wall, floor, ceiling, doors, window elements) in 2-3 days.

When being asked to supply scan data to modellers the following points should be considered:

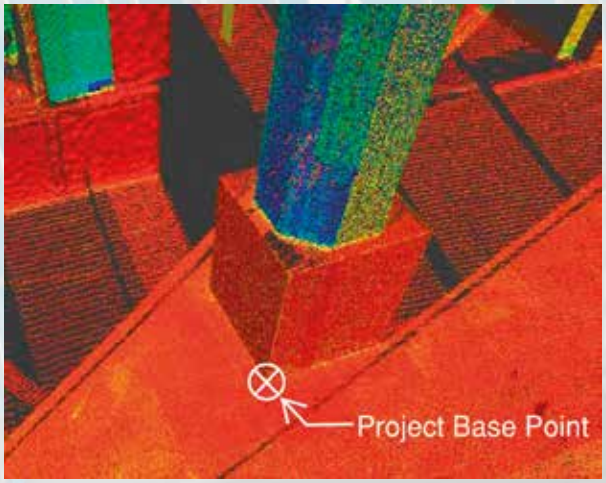
- What is the designer's 3D modelling/design software? This dictates the file formats and even if the software can use 3D point cloud data as some software packages cannot (yet) use 3D point cloud data.
- The engineer/designer may only request 2D AutoCAD drawings however at a later stage they, or other parties in the design process, may want 3D model files. With 3D point cloud data it is often easier to create a 3D model in Revit then 'extract out' 2D sections and export AutoCAD drawings than create 2D drawings only.
- Have they previously used 3D point cloud data? If not then education and assistance on the capture methods, point cloud registration and geo-referencing may be helpful. Surveyors and civil engineers often work in the 'metre world' while building engineers and contractors tend to work in the 'millimetre world' based on site grids and datums. Time taken to explain the local survey coordinate systems and the relationship with site grids used in 3D modelling is often very beneficial.
- Understand the purpose and use of the 3D point cloud. This will not only determine the extent and detail of the data to be captured but also the amount of clean up required, e.g. moving people/vehicles and unwanted areas.
- What is the final point cloud decimation spacing? This is the process of removing duplicate and overlapping points and the 'thinning' of the raw point cloud based on a point spacing distance, e.g. 10mm. The advantage of this is that it can significantly reduce data file sizes which in turn improves viewing and render times.
- Consider taking an introductory Revit, or other 3D modelling software course to get a basic understanding of the software.

In recent years hardware and software manufacturers have invested significantly in the development of software tools to import, manage, analyse and convert georeferenced 3D point cloud data in to 3D modelling design software packages.

Autodesk has developed Recap (Reality Capture) software that imports 3D point cloud data and converts it to a format that can be used in the number of Autodesk products including Revit. Recap will import 3D point cloud data that has been exported from the laser scanning process software following the registration, geo-referencing and decimation processes. Recap is a free point cloud viewer that allows users to view analyse and convert point cloud data and create the files for importing/linking 3D point cloud data in to Revit. It produces two files types (.rcp and .rcs). The .rcp file is the "reality capture project" file that contains scan station information while the .rcs file is the 'reality capture scan' file containing



Combining 3D point cloud data, model and boundary information



An example of the Project Base Point

the point cloud data. Recap can import 3D point cloud data that has been georeferenced in a NZ survey 'metre' coordinate system.

One of the limitations of Revit is the ability to directly use conventional survey coordinates in terms of a remote origin such as a meridional circuit. Only data within 20km of its local project origin can be directly imported into Revit. Therefore survey coordinates 800,000mN and 400,000mE of the origin can create issues. However there are techniques and processes within Revit to allow the use of 'real world' coordinates to accommodate this issue.

Revit operates with a system of shared coordinates. Shared coordinates are used for remembering the mutual positions of multiple interlinked files such as Revit (.rvt), Recap (.rcp/.rcs) and AutoCAD (.dwg) files. These coordinates systems are defined through two reference points, the survey point and the project base point. Every Revit project has a survey and project base point.

The project base point defines the local site reference point for the project. All modelled elements in the project are referenced in terms of the project base point. In survey terms this could be a local point on site that is a common origin for referencing the 3D model. As building projects are often rectangular in shape 'project north' is often associated with one side of the building which is positioned vertically 'up' the page or model layout.

The survey point represents a known point in the physical world such as a geodetic survey mark or even the meridional circuit origin. As the side of the building is not often orientated in the direction of true north, the survey point and survey north are used to describe the relationship between true north and project north. Knowledge of the relationship between the project point and survey point is required to understand the principle of importing/linking 3D point cloud (survey) data and other AutoCAD data to the Revit model.

When undertaking 3D laser scanning on site a well defined physical object should be selected that will represent the project base point. This should be an object that will be free from any construction disturbance, able to be modelled in Revit and can be used at the start of the project or at later stages as an identifiable reference point. Examples are corners of buildings, retaining walls or structures. The position of this object should be surveyed and scanned at high resolution during the scanning process. This point will be the project reference feature for the project and any future scanning of the site.

In addition to importing/linking the 3D point cloud data other survey data such as title boundaries and topographical survey information are often required in the 3D model. A typical application might be to determine how far an existing building is from a boundary by modelling 3D scan data and LINZ boundary/title information.

The following is a brief overview of the information surveyors can provide Revit designers to help facilitate the importing of 3D point cloud data and other survey data such as AutoCAD drawings that have been referenced to a geodetic survey coordinate system in to the Revit model.

- Survey information: Collect and geo-reference the 3D scanned point cloud data and topographical survey data in terms of the local geodetic survey control and mean sea level heights (if applicable).
- Revit project base point: Select a physical point that is visible in the point cloud and able to be surveyed. In Revit update the project base point with the surveyed coordinates and height.
- 3D point cloud data: Identify the project base point and set the point cloud origin to this point in the point cloud e.g. Revit software.
- Revit survey base point: Provide the coordinates and height of the geodetic survey mark used in the survey. In Revit update the survey base point coordinates using these values.

The final process is to import the 3D point cloud using the 'Origin to Origin' option for the 3D point cloud and the 'Shared Coordinates' option for AutoCAD drawings. Using the above process should allow the designers to use survey data in the Revit design environment for 3D modelling and analysis.

With the development of 3D modelling software tools surveyors now have opportunities to capture survey accurate as built data and provide this to designers in the architectural, building engineering and construction sectors. As the measurement specialist the surveyor provides expertise, guidance and spatial accuracy assurances required to enable other disciplines to design, build and construct with confidence.

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Delivering Project Efficiency through Digital Collaboration

Keri Niven, Global Geospatial Leader, Aurecon

Concepts of place and space are central to almost every aspect of our daily lives. We are all aware that everything exists somewhere and that fundamentally the way we behave, operate and interact as humans has a relationship with location.

Google arguably started the revolution where location was turned into information by "socialising" spatial through their Earth and Map technologies – unlocking the power of location information and taking it from a back room complexity to simple mapping tools that are accessible to all. Since then our world has been successively disrupted by "location apps", and by technologies built on this (such as Uber, Tinder and Strava) making the relationship between location information and collaboration even more deeply ingrained in both our and business and personal lives.

In business, we have seen that these concepts have taken longer to filter through into our professional world. Integrating spatial concepts within firms, and convincing people that spatial information can be used to great effect for communication, collaboration and digital story telling has in some cases disrupted the ways that organisations operate. What once were siloed business units – perhaps performing CAD drafting, engineering design and planning services, now need to be able to work together digitally to produce comprehensive and cohesive outputs that are being demanded in an increasingly digital world.

In a global consultancy like Aurecon, where a considerable part of our business involves the design and delivery of large infrastructure projects, we have realised that spatial information can provide the "glue" that binds together the multiple complex and often disparate disciplines that are required to deliver our projects. Geospatial technologies are natively designed to give context – at the location, city, region, country and global scales – to detailed and complex information.

We are using digital tools to tell a digital project story, and geospatial technology is at the heart of this story, enabling project teams and other stakeholders to visualise the project, to interact with information, and to collaborate together more effectively.

Spatial technologies are disrupting our project delivery

The technology and methods we use to make our projects happen, and to interact with our stakeholders, clients and the public is rapidly evolving. Within the geospatial discipline the impacts of disruptive technologies such as big data, geo-tagging and drone surveys (to name a few) are

also changing our requirements for data sharing and collaboration. Our workforce is encouraged to be more "connected" spatially through work share and collaboration. Both within Aurecon's global offices, and with our many joint venture partners we need to develop common platforms in order to communicate and share information. Add to this that our clients and stakeholders are becoming increasingly technology-savvy and we are now being asked to track information in real time, and to develop new mechanisms for collaborating on and visualising options, outcomes and delivery.

Within this new information-demanding environment, it is critical that we consider the bigger worldview in which we participate. We are finding that we may be engaged for a particular purpose, but seeing the bigger picture enables us to design with real value and the full lifecycle of the project, and its outcomes in mind.

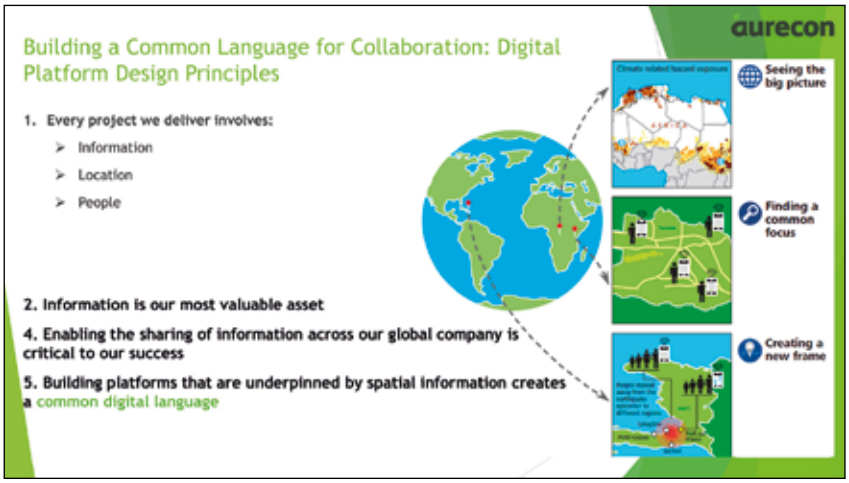

Figure 1: Building a common language for collaboration

The challenge that we as an engineering firm have faced is that when operating within an environment of such rapid and confronting technological change, and with changes to come that we cannot yet imagine, how can we develop a project delivery approach that will last the duration of major projects – some of which are in excess of ten years? How can we construct information platforms that take advantage of the modelling and visualisation technologies of today and combine this with a collaborative approach to produce more efficient, effective and transparent projects? It is no longer simply acceptable to "wait for the next release" or to do nothing until technology becomes available.

Moreover, how can our digital platforms be future proofed to account for changes in technology and how can we build platforms that are flexible enough to operate in different locations and project configurations.

Delivering Collaboration on New Zealand Infrastructure Projects

In my role as Geospatial Lead for Aurecon, it has been my task to design solutions that treat information as the most precious asset we create, and to build strategies that utilise this asset to generate real value for and from our projects. Our team has developed and implemented digital collaboration platforms that are designed to operate across the lifecycle of a project and that utilise spatial concepts to consolidate and communicate complex digital information.

Our platforms are underpinning some of Australasia's largest infrastructure projects – Melbourne Metro (Victoria, Australia), Auckland City Rail Link (New Zealand), Southern and Northern Corridors (New Zealand). These projects are all multidisciplinary and multi-agency, and all have a lifecycle of greater than five years. We have project teams in site offices, parent offices around the world and many mobile users in the field. The one thing that all these projects have in common, is that collaboration and digital information are the key currency that make the project work. If these two things are blocked, the projects will cease to function. When the project platform is unavailable, work stops.

On each of these projects, we have had to future proof our solution. In order to do this, we have constructed the information structures that underpin our platform utilising industry wide standards for collaboration, communi-

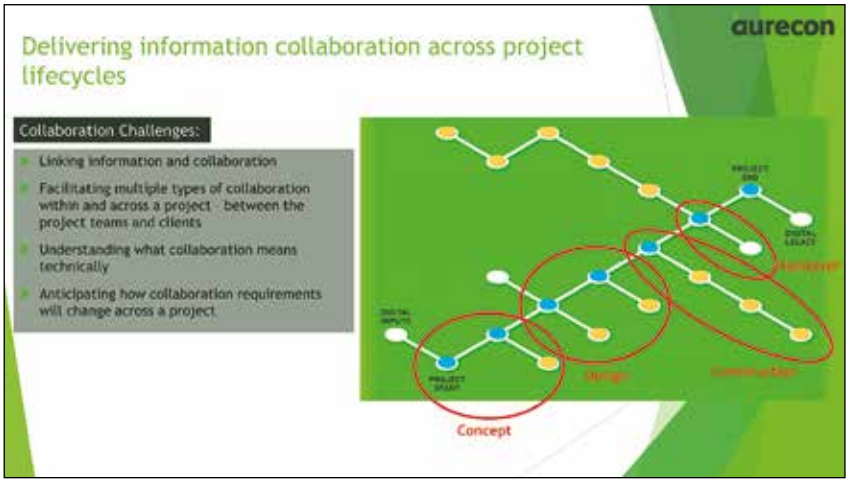

Figure 2: Information collaboration across project lifecycles

cation and asset management. These structures define the way that information is created and stored, independent of software and technology. Using this approach we are able to create flexible interfaces as the project requires and as technology permits.

Auckland City Rail Link was the first major project delivered using our digital collaboration portal. On this project we have supported hundreds of users across multiple partners located in multiple offices around Auckland and internationally for the past three years. We have created dedicated modules to support specific phases of the project and, at each phase, the consistent theme of how to create information, how to access information, and how to communicate information pervades. The success of the portal has been in its ability to create multiple access points that provide information at the appropriate level of detail, with certainty about its currency and quality.

Figure 3: Digital Collaboration on Auckland City Rail Link

Within the project team one key benefit to the programme is in the provision of a platform that enables access to - and visualisation of - information, accessibility at the right level of detail, and the active inclusion of stakeholders and the client throughout the project. What is even more valuable is the "create once, store many times" approach, where the same information that is collected to service project teams can also be abstracted to meet the needs of the public and other stakeholders with minimal reconfiguration or double handling.

Communication is key

To the public, where levels of interest in urban projects such as City Rail Link and Southern Corridor are extremely high, communication and consultation programmes were designed to openly and transparently share the same information that is created for technical project teams, but through the use of mediums that people can better understand.

Removing the engineering jargon and showing simple charts of progress, automating augmented or realistic visualisations of current state through to construction, and providing clear statements of timescales are what makes a project "real" to people who will both be affected by construction, and who will use the finished infrastructure. On City Rail Link, the statutory Notice of Requirements process was conducted to accumulate public feedback, with submissions collected on paper and inputted into the digital collaboration portal where they were mapped and analysed. Similarly on Southern Corridor, stakeholder and public consultation was conducted – this time, due to the advances in technology, using digital mechanisms both for communicating information about the project and for gathering feedback and reporting on results.

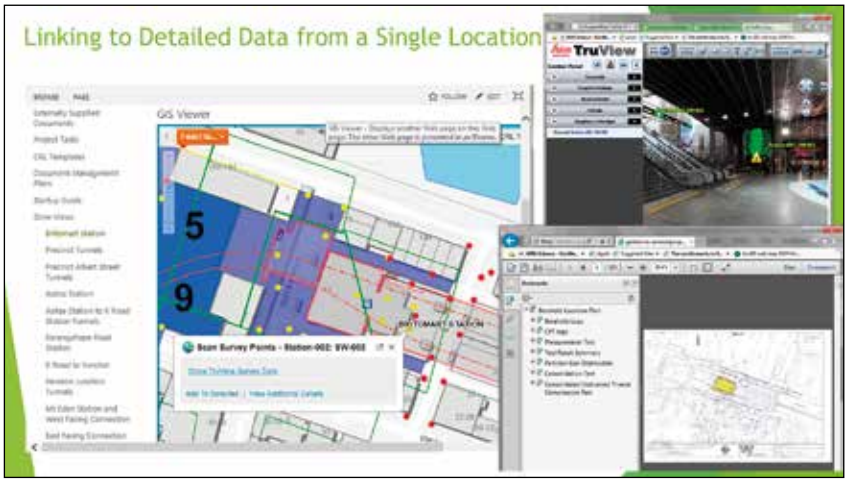

Figure 4: Spatial information (2D) on Auckland City Rail Link

What benefits does spatial information bring?

On both the Auckland City Rail link and Southern Corridor project platforms the map is pivotal, and spatial locations are tied directly to documents and textual information enabling rapid retrieval of documentation and models relevant to particular locations on the project site. From the homepage, project teams can directly locate all information relating to a single station and from there create further searches to return discipline or document type specific detail.

Integrating spatial references into core system design facilitates multi-scale views of a project, pertaining both to levels of detail and to spatial extent. Starting at the most generic level the project team might need access to a basic site plan showing current and future activities, and simple reports showing whether the project is tracking to schedule.

Designers and project teams may need more detailed information relating to their area of specialisation, and this information may come from sources elsewhere in the project and require automated update. The project platform is able to account for this without any underlying data manipulation other than searching. Increasingly, data extractions and visualisations created from this information are required to be at least in 3D.

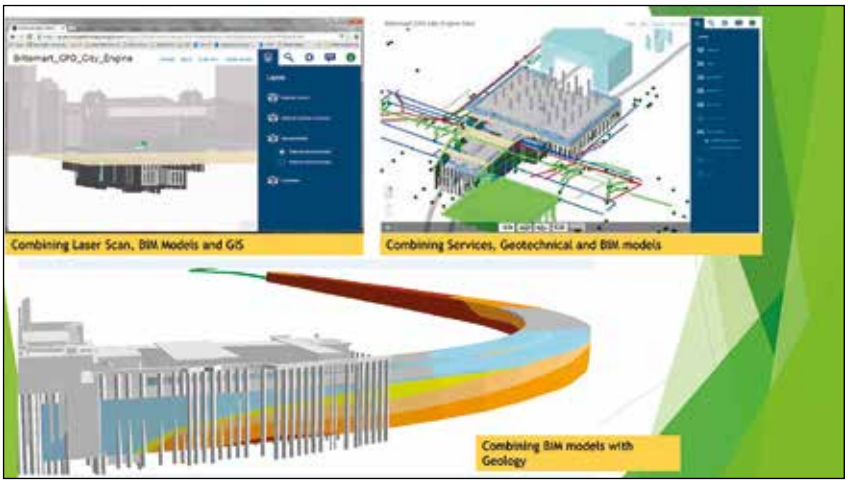

Figure 5: Integrated BIM and Geological Models using GIS on Auckland City Rail Link

Designing for Collaboration

Collaboration is often essential on projects, and indeed it is being driven internally in organisations such as Aurecon. However, collaboration means different things to different people and assuming a 'one size fits all' approach is not appropriate. For example collaboration could mean:

1. Distributed teams working together collaboratively on documents/drawings/models
2. Review and verification through a single system
3. Providing information and soliciting feedback
4. Real-time crowd sourced information
5. Social collaboration – blogs, newsfeeds, announcements etc.

The key collaborative components of the Auckland City Rail Link portal are:

- Automated document management and control
- Collaboration through multi-user editing of documents
- Model and drawing collaboration in their dedicated environments and production through a single unified portal
- The visualisation platform to engage and share information with contractors, stakeholders, the clients and other partners.

Summarising the value

Our experience on Auckland City Rail Link and Southern Corridor has reinforced the benefits of seeking new ways to innovate and embrace the power of digital information in project delivery.

The true benefit to both projects has been the creation of a single digital language, which can be used in the project to communicate over multiple phases and over many years in a consistent way. Embracing spatial concepts and integrating these into the fundamental design of project platforms facilitates a simple, effective and engaging method of communicating a project at multiple levels of complexity, by providing a common context for information.

While organisations such as Aurecon are being driven to embrace the fast pace of technological change, it is not technology that will define our success. I believe it will always be information, and the ability to communicate this to multiple stakeholders across truly collaborative environments.

In summary:

- Information is the most powerful and valuable asset created on infrastructure projects
- Unlocking information through the use of a common language and a single portal where information is stored once and used many times creates significant project efficiencies
- Creating a single platform for project delivery enables distributed teams to work together more efficiency and to deliver better value to clients
- When teams collaborate digitally they are measurably more productive
- Visual communication using maps and geospatial visualization is an effective method of engaging with stakeholders, finding a common focus and managing complexity.

Technology, Urbanisation, and Choking on It

Shamubeel Eaqub

Automation will make many occupations, even some skilled one, obsolete. Some 46% of current jobs will be obsolete within two decades in New Zealand. This progress in technological change isn't new, but the pace of change is. Change is getting faster and harder for employees, employers and institutions to keep up.

One stark application of this is in the growing divide in economic performance across our regions. The rural population has not grown at all in the last century – all of our population growth has been in some form of urban centre. The story of technological change is easily told through this regional lens. But we have been unprepared for the urbanisation, seen in unaffordable housing and congested streets in places like Auckland.

A regional perspective

The capabilities of many of our provinces is rooted in their history. Provincial economies based on relatively unskilled and labour intensive jobs are hurting the most. Often technology has replaced or vastly reduced the number of jobs. The meat processing industry, once a collection of highly skilled butchers preparing individual carcasses, now employs fewer and less skilled workers in a highly automated production chain.

Technological change can bring many benefits. Refrigerated shipping was a technological breakthrough for early New Zealand. It allowed New Zealand to become the food basket of the United Kingdom. Successive waves of technological change have further improved our quality of life and changed the way we live and work.

There are also short-term costs of technological change. Those with skills in outmoded technologies suddenly find work hard to find and wages stagnating or falling. Over the last half century, labourers' incomes have not risen as much as the cost of living. Incomes for managers and professional occupations have risen in value. Technology is affecting some skilled sectors as well. The rise of online or cloud-based accounting systems is reducing the demand for clerical workers, but increasing the demand for IT and software professionals. But bookkeepers who can't suddenly become software programmers are suddenly displaced from relatively well paid jobs. They may have to retrain or opt for a job that is unmatched to their training and skills. This is the cost of technology.

The disruption caused by technological change is real. It is also getting faster. Each new technology is being adopt-

ed at scale sooner. The rise of the smartphone is a good example. Its forebear, the landline took near 50 years to reach mass-market status. The personal computer took over 20 years; the internet over 15 years; the smartphone less than 10 years.

Yet even within the smartphone sector, the rise and fall are rapid. Blackberry was the first to popularise the smartphone. It was so successful that many called them 'Crackberries' because of their addictiveness to continuously checking emails. Yet, Blackberry is now widely seen as a company in decline. It has slumped as others like Apple and Samsung have risen. Blackberry's market capitalisation fell from over US$80 billion in 2008 to less than US$3.5 billion in May 2016.

The lifecycle of technology is getting shorter. This means the disruption from technology is becoming more frequent and there is less time to prepare. For workers and businesses in legacy industries, it is a hard environment. This has been particularly true for the manufacturing sector. In the 1986 Census just over 316,000 people worked in manufacturing, in 2013 it was just over 188,000 – the lowest since 1951. This also applies for types of work. Before the invention of computers and related technologies, clerks were a critical part of businesses and government. There were 262,000 clerks in 1986, but only 176,000 in 2013. Industries and technologies have been rendered obsolete over time. The total number of jobs have grown, but they are in different industries, occupations and, importantly for this narrative, in different places.

Sped up technological change matters for provincial New Zealand. More of their jobs are in low or medium skill occupations and many have high exposure to industries in decline. These jobs and industries are exposed to the gales of technological change. They are often shifting towards using less labour or moving to other countries where labour is cheaper.

For example, the Manawatu–Wanganui region fared badly during the 2008 recession. Between 2006 and 2013 the region lost 9 per cent or nearly 9,000 jobs. Half of the job losses were in industries and occupations that fared particularly badly in the recession, the other half was region specific. The region has a high exposure to agriculture: 12 out of every 100 jobs, compared to 7 nationally. Agriculture sector jobs have been in decline for many decades because technology allows farmers to do more will fewer staff. Agriculture shed 4 per cent of its employees at the national level, but Manawatu-Wanganui lost 10 per cent. So the region lost out twice. Once because it is more exposed to industries that are in decline. Twice because the region's large industries are doing worse than in other parts of New Zealand.

Technology and technological change present an apparent paradox: it simultaneously liberates and concentrates. For example, we can now instantly buy and listen to music from an online store from just about any place in New Zealand. This is liberating – as previous small provincial towns may have had to go to their nearest city to purchase a CD or get it delivered by mail, now music can be bought or streamed over the internet. It is wrecking many parts of the retail sector, while consumers have gained access to a much greater variety and often at a lower price.

The music industry has changed. The old model of selling albums on CDs is broken. Music is increasingly downloaded from the internet, or streamed for free or minimal charge. It has not been the end of the music industry, but a painful baptism by fire. Music is less about selling the music is physical form and more about selling the experience. Many artists are once again making more of their revenue from live concerts and product endorsements, rather than music sales on CDs and other media. It's back to the future stuff.

Technology also concentrates. As the cost of communication falls, we are swamped with more emails, more phone calls and more web pages. It is difficult to filter it all. Humans are social animals. The overwhelming tide of communication makes face to face contact even more valuable, in part because of its novelty. Rather than causing the death of cities, successive technologies like trains, cars, phones and the internet have made large and complex cities even more successful and desirable places.

Technology is a central force in these shifts but we also need to be wary of easy assumptions about how it may enable provinces. For example, Philip McCann, a New Zealander and economist, has written much about regional economies. He documents the role of cities and the agglomeration or concentration benefits of a city. He goes on to make a fascinating point: ease of communication helps us communicate with those who we are already close to. Technology does not reduce the tyranny of distance.

Nevertheless, New Zealand needs to be fast in adopting technology. The conversation on technology and innovation often centres on invention. But New Zealand has long displayed the ability to adapt international technology to carve out a niche. Imported capital and technology from the UK allowed New Zealand to become the food basket in our early history. In addition to discovery of minerals, unlocking the potential of the agriculture sector marked the development of New Zealand's economy.

The lesson from our history is that technology presents opportunities. Not necessarily in inventing it, but rather to adopt and adapt it for our uses and diffuse it through our economy. In the adoption and diffusion, we are not very fast. Many of our industries are routinely using very old technology. Around half of businesses are using best

commonly available technology. But some capital intensive industries like wood and metal manufacturing are much slower.

Firms are slow in adopting technology because of costs, little management time to devote to change and skill shortages to implement new technology. These pressures, particularly management and skill shortage are more acute in the provinces than in urban centres.

We must be realistic in what we expect from technology. It will not reverse the forces hollowing out our regions. Many technologies were predicted to cause the death of cities. But the evidence has been the contrary. Technologies have alleviated the pressures of slowing or declining population growth, and have encouraged urban population growth.

The costs of urbanisation

Even though technological change is supporting and accelerating the urbanisation trend, our urban centres are choking on this growth, particularly Auckland.

The very high cost of housing and congestion on roads in Auckland are eroding the city's competitiveness. Medium skill jobs are being outsourced to places like Hamilton and overseas. Prospective businesses may decide to set up in a truly global city, rather than an aspiring global city, like Auckland.

Housing is the biggest risk to Auckland's dream to be a global city. This path is not guaranteed by any means and unless housing and transport problems can be fixed, Auckland will be yet another big city in a small country with little global relevance.

The housing crisis is of our own making. Our planning rules are out of step. The way we fund local government and infrastructure are fundamentally unsuited to a growing city.

Planning rules are slowly being changed. But the reality is we need to house more people close to work and transport. That means adding modest amounts of density across large parts of Auckland, but most specifically around the main transport corridors.

Better planning on its own won't be enough.

Local governments do not have the right funding structure to invest in long lived infrastructure. Constant demands for more rates, to fund the growth for future residents is politically destructive.

Rather other mechanisms like targeted infrastructure bonds and borrowing prudently can be better ways of letting the true beneficiaries, future generations, benefit and pay from the investment in new infrastructure.

While there are many critics and analysts who will point to interest rates, immigration, foreign buyers and capital gains as causes for Auckland's severely unaffordable housing, they are wrong.

These only add to the cycle and are not the fundamental causes.

Shamubeel Eaqub is an economist currently on a career break to be dad. He still engages through regular columns in Fairfax papers, board positions, occasional media appearances, public speaking and consulting projects. His interests are in equity and fairness, through the lenses of housing and regions. He studied at Lincoln University and is also a Chartered Financial Analyst. Follow him on Twitter: @SEaqub

Additional reading

For those interested in reading more, some suggested reading:

http://www.charteredaccountants.com.au/~/media/FutureINC/publications/091511%20FutureIncTechnological%20disruption-WEBFA2.ashx

http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

Eaqub (2014), Growing Apart, BWB *Texts*

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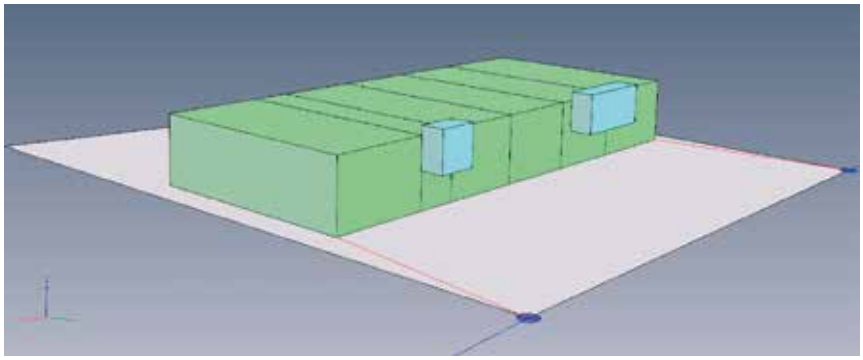
ASaTS and Opportunities for the Cadastral Survey System

Trent Gulliver, NZIS Cadastral Professional Stream Leadership and Senior Cadastral Survey Advisor, Office of the Surveyor-General, LINZ



Mock illustration of 3D units on underlying primary parcel

In April this year the Minister for Land Information, Louise Upston, announced that Cabinet had approved plans to replace an aging Landonline system through a programme of work known as Advanced Survey and Title Services (ASaTS). So what does this mean for surveyors? How can the digital cadastral survey system benefit from the opportunities that ASaTS presents? The following discussion considers these and other questions.

Introducing ASaTS

Landonline is built on technology that was considered to be leading edge in the 1990s. There have since been substantial advancements in technology, knowledge and expertise in developing land administration systems. There are also changing expectations by an increasingly diverse range of customers and consumers that include land professionals such as surveyors and conveyancers, along with experts and non-experts in spatial science, systems and information. These expectations relate to the functionality and performance of the system and the applications for which its data can be used.

A primary objective of ASaTS is to modernise New Zealand's electronic survey and title system and provide all users of the system and its data the experience of a better service. It aims to improve and extend the functionality already offered by Landonline while being a more interactive, portable and flexible system. The current system uses monolithic IT architecture which means making changes can be slow and costly to implement. ASaTS will counter this shortcoming through a modularised IT architecture solution.

LINZ is taking an 'as a service' approach to developing ASaTS. Rather than owning the system, as Landonline currently is, LINZ will select a provider that can deliver a suitable system that LINZ will pay to use. This concept, which can be likened to renting, is being used successfully by land administration jurisdictions in Australia and Canada. It is important to note that while the new system will be owned by another party, LINZ will retain control of the data and its use. LINZ and its staff will also continue to process and assure the quality of survey and title transactions.

On 26 April 2016 LINZ released an Expression of Interest document inviting prospective vendors to register their desire to work with LINZ to deliver the ASaTS solution. A vendor is expected to be in place in 2017, following which the development of and transition to ASaTS is likely to occur over a five-year period, with LINZ envisaging the new system to be completely in place by 2021. During this time LINZ will continue to maintain and manage Landonline.

Cadastral Survey System Opportunities

The ASaTS programme of work provides an excellent opportunity to consider the way in which cadastral survey data is captured, validated, presented and made available for re-use. In addition to improvements in functionality and usability over Landonline, the Office of the Surveyor-General has been exploring ideas to develop the cadastral survey system. The key areas presently under consideration, which include both adding new functionality and also removing existing functionality, are summarised below.

Developing a 3D-capable Digital Cadastre

The current digital cadastre is 2D with 3D situations handled via non-digital plan, section and elevation graphics and supporting textual information. The development of a 3D digital cadastre will enable the 3D spatial extents of property rights, restrictions and responsibilities to be captured, lodged, integrated with existing data, visualised, and available for export and use in other systems.

Recent research has concluded that the most appropriate way for New Zealand to develop a 3D digital cadastre is to build upon the existing 2D system by enabling surveys that define parcels in 3D to be incorporated. That is, the 2D digital cadastre would continue to be the default layer with 3D situations (height limited units and strata parcels) displayed as and where necessary. This approach gives rise to the term, '3D-capable digital cadastre'.

Certain Parcels as Spatial Objects

The development of a 3D-capable digital cadastre will require a new approach to permit the digital capture of unit and strata parcels. The concept of a parcel as a 'Spatial Object' is being considered as an approach to allow parcels defined by stratum and permanent structure boundaries to be integrated into the digital cadastre and subsequently maintained.

The current thinking is that a Spatial Object would be defined through a series of coordinated, connected vertices that represent the size and shape of the 3D parcel being defined – a polyhedron. There would be a need for a Spatial Object to be related to an underlying primary parcel through a defined relationship to either boundary points or survey reference marks. The representation of the Spatial Objects would be maintained in the digital cadastre through this relationship to its underlying primary parcel. Despite possible changes to the representation of a Spatial Object through adjustment processes, its original geometrical properties as submitted by the surveyor would be retained to record the boundaries as certified.

The concept of Spatial Object could also be applied to a 2D non-primary parcel, such as an easement - defining it as a polygon rather than by vectors between nodes. This possibility is, therefore, also being investigated.

Possible Removal of In-system Data Capture Functionality

The e-survey capture functionality of Landonline was originally developed from the internal capture package provided to enable LINZ staff to back-capture from plans lodged in hard copy format. As e-survey developed, enhancements were added to provide the tool being used today. It is clear that this functionality has been outpaced by that offered by third-party providers of software.

It is intended that ASaTS will provide for better interaction between the system and external software such as that used by surveyors. One particular enhancement could see Cadastral Survey Dataset validation tests published and made available as a web service that could be accessed by LINZ and external software. With better interaction between applications and a likelihood that third-party providers will continue to be better placed to provide enhanced capture tools, the ongoing need for in-system capture functionality is being questioned.

Need for CSD Plan & Title Plan

Currently CSD and Title plans are generated by surveyors or their staff from captured data. Static, TIFF-based diagrams are produced primarily from that data with varying levels of automation and user input.

The production of a Title Plan is considered to be a necessary component of a Cadastral Survey Dataset for the purpose of registration. However, should a CSD Plan still be required in the future? Or would it be sufficient for subsequent users to view the spatial depiction of the certified data and then upload or print that information if so required? These questions are currently under consideration.

Consultation on Ideas with Surveyors

The above ideas to develop the system are being headed by the Office of the Surveyor-General. Once these ideas are refined a little further, input from surveyors will be sought to understand the thoughts and perspectives of the wider profession. The channels and timing of any consultation will be announced in due course.

Final Thoughts

The introduction of Landonline in the early 2000s took the cadastral survey system on a tremendous step forward into the digital information age. However, analogue procedures were retained for handling particular situations, especially with regard to surveys that define the vertical extents of rights. ASaTS presents a window of opportunity to develop the cadastral survey system to more completely embrace the power of digital data and technologies. It would seem prudent that the surveying profession consider any ideas to develop the system against the current and foreseeable operating environments.

Further Reading

ASaTS

ASaTS information available on LINZ website, *www.linz.govt.nz*

Expression of Interest documentation available at *www.gets.govt.nz* (registration required)

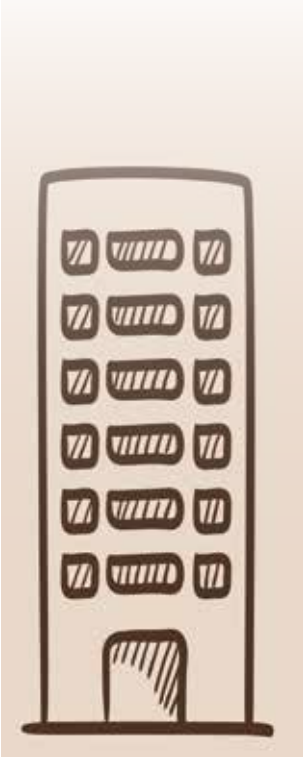
Developing the Cadastral Survey System

Gulliver, T. F. D. (2015). Developing a 3D Digital Cadastral Survey System for New Zealand. Masters thesis available at *www.ir.canterbury.ac.nz*

Land Information New Zealand. (2014). Cadastre 2034: A 10-20 Year Strategy for developing the cadastral system. Available at *www.linz.govt.nz*

Layered developments – a flawed concept?

Stephanie Harris & Tim Jones, Glaister Ennor Solicitors



The concept of layered developments was put forward as a method of allowing more complex developments for unit titles during the revision of the Unit Titles Act (the Act) prior to 2010. In fact the concept was initially discussed in our firm's boardroom with members of the Department of Building and Housing (as it was then). The concept of some form of more sophisticated development was floated. The idea was to enable owners of principal units to re-subdivide their unit into a separate body corporate of its own. In many ways a catalyst for the layered development concept was the need to separate out within a unit title development various use categories. The idea of various layers within the Unit Titles Act was a method of ensuring severance between different use categories, rather than doing a fee simple strata development and all the complexities of that form of subdivision.

Accordingly, the layered development concept found its way into the 2010 Act. The sections dealing with layered developments are Sections 19 to 21 which identify how a layered development can be created. Together with that there is the first schedule identifying how layered developments can occur from an illustrative point of view. So that where there are multiple unit title blocks that are subdivided off a head title these can be developed into a parent body corporate and various layers. This is in stark contrast to a development where there are multiple bodies corporate created and an incorporated society under the Incorporated Societies Act 1908 created as an overarching governance body to which each of the owners and each of the bodies corporate relate. Over and above the sections referred to above, there are various sections in the Act that take into consideration how matters work within a layered development where various matters are being dealt with, for example, insurance of the building refers to the arrangements for a unit title development. There are many examples of that sort of provision throughout the Act.

Looking briefly at Sections 19 to 21, it explains how layered developments can be created and what they are created into. A subsidiary development is two or more principal units, associated accessory units and common property, if appropriate. The principal unit being subdivided into a subsidiary will include all of the principal unit plus any accessory units attached to that principal unit at the head body corporate level. However, this subdivision of a principal unit to create a subsidiary unit cannot occur unless the consent of the parent body corporate in which the principal unit is part has granted consent. Moreover, it must be a special resolution of that body corporate, so that means 75% of those present at a general meeting called for that purpose or where a resolution is proposed for that purpose. Moreover, Section 20(5) confirms that the consent procedure as a special resolution is in fact a designated resolution under the designated resolution procedure.

The designated resolution procedure is new to the 2010 Act. It is a procedure that is a compromise away from unanimous resolutions under the 1972 Act. The Act identifies certain procedures where special resolutions are required as designated resolution procedures. Other than layered developments, examples are a body corporate granting an easement or complex redevelopments. A Section 212 contains a list of them, of which there are 12 which are designated resolution procedures. The designated resolution procedure is time consuming and therein lies part of the flaw with the layered development concept.

In practice, a principal unit owner will propose to subdivide that principal unit into multiple units – say, a floor of a high rise development. They will propose to the body corporate that a motion be put at an Extraordinary General Meeting (EGM) for a special resolution. If that resolution is passed by the requisite 75% majority then the principal unit owner has to then proceed with the designated resolution procedure under Sections 212 to 216. Without doing so the body corporate cannot give the requisite form of consent and without that form of consent the subdivision plan cannot be registered at LINZ.

To carry out the designated resolution procedure the principal unit owner must file a designated resolution notice with every unit owner in the building, every mortgagee of the unit owner and every caveator. Once that notice has been served on that group of people the principal unit owner must wait for 28 days before taking any further action because those notified are entitled to raise objection to the layered development resolution (in this case) within that 28 day period. They would do so by fil-

ing a notice with the High Court that they object to the subdivision of that principal unit by way of a subsidiary development. If such a notice was filed, that would bring the whole concept of the subdivision of that principal unit to a halt. A unit owner as a competitor, for example, might file an objection on the grounds that it is going to create extra pressure on the facilities in the building such as the common facilities, air conditioning, parking, lifts, toilet facilities and the like.

So the principal unit owner who wants to subdivide his unit via layer has to jump over two sets of hurdles, which are:

1. To get the special resolution passed in the first place; and
2. Secondly, to get the development past all the owners under the designated resolution procedure. This creates a significant lack of certainty for principal unit owners.

Those of us acting for developers appreciate that both uncertainty and time delays are a significant deterrent to development. Developers prefer certainty and they certainly hate delay. On the other hand, the whole concept is one that would cause any developer to seriously plan for a development that is not going to raise any objections with other owners in the building.

In terms of the timeframes for the process, for an existing principal unit owner looking to subdivide an existing principal unit, they can factor the delay and the timeframe into their processes. Where the concept problem is for those who are developing brand new apartment buildings or unit title developments who wish to do various layering of the development at the outset.

There are several new builds or conversions occurring in Auckland at the present time where the developer is looking to create a parent body corporate and various layers simultaneously. Where there is a multiple set of uses for the various units in the building it is obvious and logical that the developer would split the uses up into separate bodies corporate from the outset. However, in analysing the process and procedure (as set out above) it is clear that the process of carrying out multiple subdivisions within an apartment building as layered developments will take a considerable amount of additional time.

The way that Sections 19 to 21 have been drafted provides that the developer is going to have to create the parent bodies corporate in the first instance and have that plan deposited. Then complete the designated resolution procedure and the 28 day "hold over period" under the designated resolution provisions of the Act before then lodging the subsidiary unit plans for depositing at LINZ. Therefore a developer who wants all of the titles for the subsidiary units issued simultaneously with the deposit of the parent body corporate is going to be unable to achieve that. Currently the Act has no mechanism in such situations to allow simultaneous lodgement of both parent and subsidiary layer unit plans for depositing.

From a survey point of view it is also not going to be possible to lodge the subsidiary until the parent has deposited. A concept of using FastTrack for a unit title development comprising of parent and various subsidiaries seems to be out of the question.

The legislation cries out for workarounds to enable such developments to proceed swiftly and without delay. Accordingly, it is incumbent upon both surveyors and their legal advisors to ensure that developers who want to use layered developments understand the traps and pitfalls that exist within the Act whether the layered development is of an existing principal unit or of a brand new apartment building. The message is – know the process, understand the issues and the pitfalls, so that you can better advise the developer whether or not to use the layered development process, or what to expect out of the concept at the end of the day.

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A History of the NZGD2000 Datum

Chris Crook, Dionne Hansen, and Paula Gentle, LINZ

An extract from 'Aligning the New Zealand National Datum with the International Terrestrial Reference Frame in the face of tectonic deformation' presented at FIG working week - Christchurch, New Zealand, 2-6 April 2016.

The New Zealand Geodetic Datum 2000 (NZGD2000) was developed between 1998 and 2000 to replace the previous datum New Zealand Geodetic Datum 1949. It is an innovative datum, including a deformation model that effectively provides two coordinate systems – one the geocentric coordinate system on which it is based (International Terrestrial Reference Frame (ITRF) 1996) and the other a system within which coordinates of objects fixed on the ground are substantially constant (Donnelly et al., 2015). The latter static coordinate system is what is perceived by most users as the NZGD2000 coordinate system – coordinates in this system are used in geographic information systems and in mapping to identify and locate physical features such as buildings, utilities, etc. Generally the term NZGD2000 coordinates is used to refer to coordinates in this system. It was aligned with ITRF96 at epoch 2000.0 – since then it has diverged from ITRF96 as New Zealand deforms. The deformation model defines the difference between these two coordinate systems as a function of time and location.

This style of datum, integrating a deformation model to account for tectonic movement and distortion over time, was termed a "semi-dynamic" datum at the time it was formulated (Grant et al, 1999). However this term is now deprecated in favour of the less ambiguous term "plates-fixed" datum (Donnelly et al., 2015).

The NZGD2000 datum is officially defined by the Land Information New Zealand (LINZ) standard 25000 (LINZ 2007) and its development and implementation documented in a series of papers including Grant et al (1999) and Blick (2003). Beavan and Blick (2007) highlighted the shortcomings of the deformation model that became evident from observations made after the model was developed in 1998. However it was not until 2013 that the model was first updated in response to the Canterbury earthquake sequence (Crook et al., 2016). Two further modifications were made after 2013 – firstly to account for the Cook Strait earthquakes of 2013, and secondly to expand the spatial extent of the model to include the extent of New Zealand's Exclusive Economic zone. Earlier models only covered the land extents of the New Zealand North and South Islands.

The deformation model itself includes a secular velocity model defining the ongoing tectonic deformation of New Zealand, as well as a series of "patches" representing the deformation due to earthquakes. This model is updated periodically – each version is identified by its release date (e.g. 20130801). Technically each release is equivalent to a new datum, but for most users and usages the change has little or no impact. To simplify usage of the datum the sequence of updates are identified collectively as NZGD2000. When the version of the deformation model is significant the datum can be qualified with the version identifier, for example, NZGD2000(20130801).

Although NZGD2000 is nominally defined in terms of ITRF96 it is now becoming more difficult to directly access that datum. Many of the reference stations defining ITRF96 have been affected by deformation events so that the ITRF96 defined coordinates and velocities are no longer consistent with the actual locations of the marks. Additionally products such as satellite orbit parameters are no longer calculated in terms of ITRF96. Rather than directly measuring ITRF96 coordinates, they are now derived indirectly by transforming from ITRF2008 (Pearson, 2013, Donnelly et al., 2014). The transformation from ITRF2008 to ITRF96 is now treated as definitive so that NZGD2000 coordinates can be derived from ITRF2008 coordinates by applying this transformation and the deformation model. The relationship of these coordinate systems and the deformation model is represented in Figure 1.

The NZGD2000 coordinate system is generally accessed, either directly or indirectly, by the coordinates assigned to the zero order stations which are continuously operating GNSS (Global Navigation Satellite System) receivers (CORS) forming the PositioNZ network (Gentle et al., 2016). Although these stations reflect the realisation of the datum their coordinates are not held fixed. Indeed they need to be periodically updated to maintain this alignment. While their NZGD2000 coordinates are nominally static, in practice the errors in and incompleteness of the deformation model mean that for the CORS ITRF coordinate to remain correct small updates to their NZGD2000 coordinates are required periodically.

One consequence of the using a "plates-fixed" datum in New Zealand is that although NZGD2000 coordinates serve to identify physical features well, the coordinates cannot be used to calculate the relationship between points accurately (Crook et al., 2016). Figure 2 shows the "rate of distortion" of the datum, a measure of the maximum error in an observed vector. This can be up

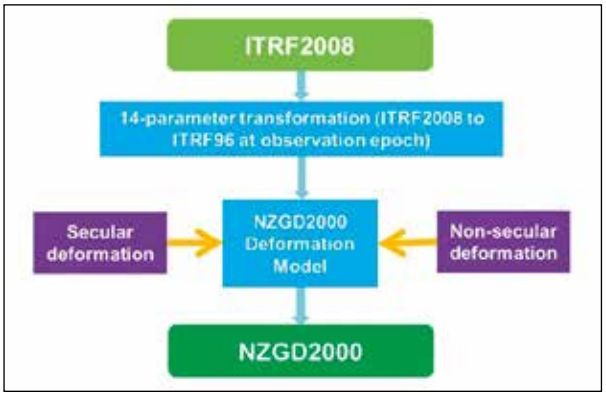

Figure 1: Transformation between ITRF2008 and NZGD2000 coordinates (from Blick and Donnelly, 2016).

to 0.8 ppm/year. So in 2015 vectors calculated from the NZGD2000 coordinates may be differ from the true vector between corresponding points by up to 12ppm (here assuming the deformation model is perfect – there may be an additional difference due to the difference between the modelled and actual deformation).

Because of this LINZ recommends that high accuracy work is done in terms of ITRF coordinates. Alternatively it can be done in NZGD2000, but then calculations must include accounting for deformation, which most survey and engineering software cannot do. For long term large scale projects it is possible that deformation will need to be considered even working in terms of ITRF, as accumulation of deformation during the project may be significant.

Most survey work in New Zealand will be either directly or indirectly tied with PositioNZ network and may be using the coordinates assigned to these stations as control. At present the only coordinates LINZ publishes for PositioNZ stations are the NZGD2000 coordinates. In addition to the errors in calculating these coordinates there are also errors inherent in the deformation model. At 1 January 2016 the maximum error in these coordinates is less than 2mm horizontally and 3mm vertically relative to the modelled time series, which is arguably the best estimate of the actual ITRF2008 coordinate at any given time.

NZGD2000 coordinates of the PositioNZ stations are periodically updated to ensure that their location in ITRF2008 is correct. However this means that their NZGD2000 coordinate may be out of terms with other stations around them. Typically other stations are located by measurements relative to the PositioNZ stations, either directly or indirectly. However these coordinates are not necessarily updated when the PositioNZ coordinates are. For example if a station is positioned relative to a PositioNZ station in 2005 and the PositioNZ station coordinate is updated in 2015, then that update will not be applied to the coordinates of the station. Generally the changes to coordinates are small, less than 2cm horizontally or vertically, and for most geodetic marks an error of this size is well within their specified coordinate accuracy.

LINZ is currently compiling a "national geodetic adjustment" that will allow the coordinates of all geodetic marks to be recomputed easily. This will make it very easy to assess the coordinates of all geodetic marks after updating the PositioNZ coordinates. The resulting readjusted coordinates can be compared with the official NZGD2000 coordinates to determine which have changed sufficiently to require updating.

In practice most users derive locations by calculating relative to other NZGD2000 coordinates without taking account of the deformation model, and this also introduces errors. For many usages this is adequate, but it may introduce errors of up to 12mm per km in 2015 and this amount of will increase each year.

In the future LINZ is working to improve the quality of the tie to ITRF by including more global reference stations, using more sophisticated atmospheric models, and using other GNSS constellations in the processing. The deformation model can be improved by including vertical deformation in its definition. Additionally with more CORS stations and using other techniques such as INSAR it may be possible to include slow slip events into the model.

REFERENCES

A full list of references is available upon request

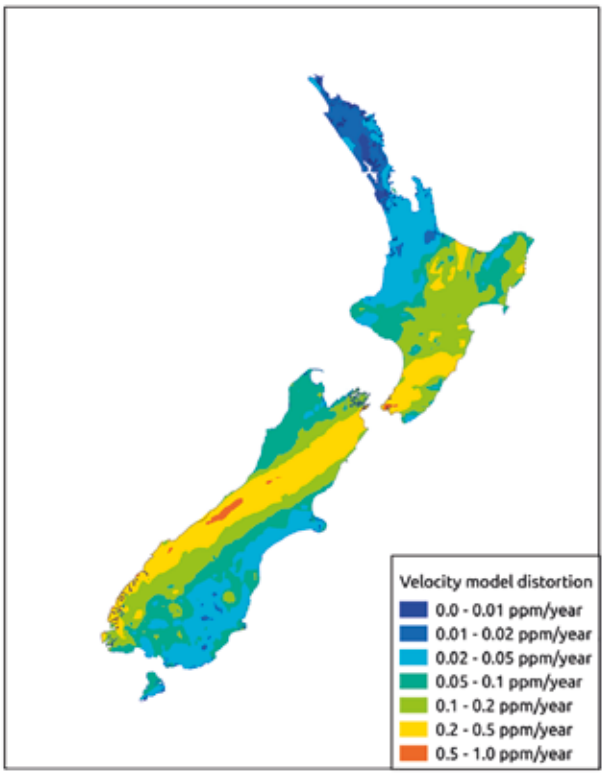

Figure 2: Rate of distortion of NZGD2000 coordinates (from Crook et al., 2016)

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ESSENTIAL INGREDIENTS

Christina Hulbe, Dean, National School of Surveying

The strong connection between research and teaching is a defining characteristic of universities. I've written before about parallels between research and professional skill development as students build from disciplinary fundamentals toward specialist expertise, always with an eye toward problem solving and problem definition. Here, I'd like to consider a few other essential ingredients, using examples from recent events around New Zealand.

Both the problem-solving approach and an emphasis on collaboration are at the heart of Toi Hangarau, the new Geospatial Research Institute (GRI) at the University of Canterbury. Launched in April, the GRI's mission is to promote and support research that engages and connects the diverse groups already working in New Zealand's geospatial sector, including universities, research institutes, industry, and government. I was happy to be able to participate in the GRI launch event and we've already had some great conversations about opportunities to work together across institutions, particularly around university-funded Research Themes here at Otago, which are themselves structured to promote interdisciplinary collaboration.

The problem-solving approach to innovation in measurement technology was clearly on display during a session on "Emerging Technologies and Careers" during the 2016 FIG Working Week in Christchurch. The drive to ask and answer challenging questions was emphasized by both hardware and software developers, as well as the Universities of Canterbury and Otago. The pace of technology innovation is fast and students graduating today must be able to adopt and adapt the new tools both wisely and well.

It's worth noting that only one of the ten presentations on technology and careers featured women among the innovators and problem solvers. We must do better than this if we want the surveying and spatial professions to mirror society—and to attract the best and the brightest. On the other hand, data—big (geospatial) data—was on display in many of the presentations.

Because it underpins (and perhaps unites) so many other attributes we care to measure and understand, geospatial data has the potential to promote new collaboration across many interests and sectors. The proprietary nature of most data is an important limitation but this is changing as the open source movement grows and as public funding agencies and institutes like Land Information New Zealand adopt and promote the open approach.

The rationale for open data is simple. First, data collected by government is a public asset. More generally, data accessibility enables innovation and the development of new tools and new knowledge. New Zealand's public sector is currently ranked 6th in the global Open Data Barometer evaluation of readiness, implementation, and impact (*http://opendatabarometer.org/*). New Zealand's ranking near the top of the list is supported by strong social, political, and economic impacts where data is accessed and used but pulled down by such measures as open practice at the regional level and the readiness of New Zealand firms to use open data.

Deep understanding of the relationship between data and innovation is another important characteristic of the research-led university environment. University researchers, surveyors, and other spatial professionals all work in data-rich environments and we are well aware of the need for sound data collection and management in our own domains. We may not all be equally able to find, adopt, and adapt exotic data (or to imagine novel uses for existing data) and our skill in this regard is probably closely related to our research interests, work experience, and exposure to sound data management principles at all stages of our professional development.

It seems clear that as more data becomes more open, both the opportunity for innovation and the need for new data skills will grow. I would argue that much of the opportunity will be lost if we don't also grow new collaborative frameworks across the many sectors that use geospatial data. New Zealand universities have a role to play here, not only as an educator but as a partner.

RUSSELL W BUCHANAN

7 December 1922–17 November 2015

On 17th November 2015 the survey profession lost one of its oldest members, Russell W Buchanan at the age of 93.

Russell was a very innovative surveyor and a pioneer in survey practices. He was the first Dunedin surveyor to purchase an Electronic Distance Measurer (EDM) and one of the first to master a computer. During one survey he even used a helicopter to lower an aluminium pole with a prism attached into the sea to get a profile of the sea bed for a proposed sewer outfall.

Russell started school St Clair Primary and was a first day pupil at Kings High School in Dunedin before starting a survey cadetship with N & E S Paterson in 1939. Because the war took senior staff from Paterson's, Russell was forced to step-up to take their place with little experience.

He joined the NZ Army Territorials at the age of 19 and went to Burnham camp. However he was quickly seconded to the Lands and Survey Department to do 1 inch to the mile military mapping in the steep Port Hills and Lewis Pass during the winter while living in a canvas tent.

When posted overseas he first went to Maadi Camp in Egypt but soon moved to Italy with the 36th Survey Battery to survey and fix target positions for the artillery. When asked of this experience Russell would say that the work was "interesting but dangerous".

Russell completed his cadetship and qualified in 1949. He worked for the Southland County Council before going into private practice in Invercargill with E R Garden and Partners (now MWH). He moved back to Dunedin in 1957 where he continued in private practice working on many tasks including photo control for the Ministry of Works at Lakes Ohau and Pukaki hydro developments. As consultant surveyor for Green Island Borough, he monitored the massive Abbotsford land slip, New Zealand's largest land slip in an urban area destroying 69 houses.

As consultant surveyor for Port Otago for 42 years he knew more about the Port Otago development than any other person. He spent time in Fiji for The World Health Organisation surveying new highways. He also worked on Queenstown subdivisions, gold mining claims on the Clutha, coal mining surveys at Shag Point and pegging Housing Corporation developments.

Russell with his wife Ngaere

Russell had a dance band in his youth playing the piano accordion, was junior swimming champion at Kings and a surf life saver with the St Clair Life Saving Club at National level. He was also a keen bee keeper and enjoyed yachting and athletics. An interest he retained as an honorary surveyor, was confirming the measurement of athletic tracks.

Russell was a generous and honest person with exceptional integrity. When a fellow sole practice surveyor had a health problem, Russell stepped in to fairly distribute his work to other surveyors to ensure clients' interests were looked after with no personal reward.

With failing eyesight Russell spent his last year at the Montecillo Veterans Home. Russell and his wife of Ngaere shared many interests, holidays in Wanaka and the Hunter Valley and cruises.

Remarkably, unbeknown to each other, they both died on the same day. Russell at Montecillo and Ngaere at the Dunedin Hospital. After 67 years of marriage if they could have planned to end life that way, Ngaere and Russell would have.

Russell is survived by his sons Graeme and Neil, his daughter Lynley, and five grandchildren. Russell was proud to have one of his grandsons (another R.W. Buchanan) become a surveyor.

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