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MAY/JUNE 2022

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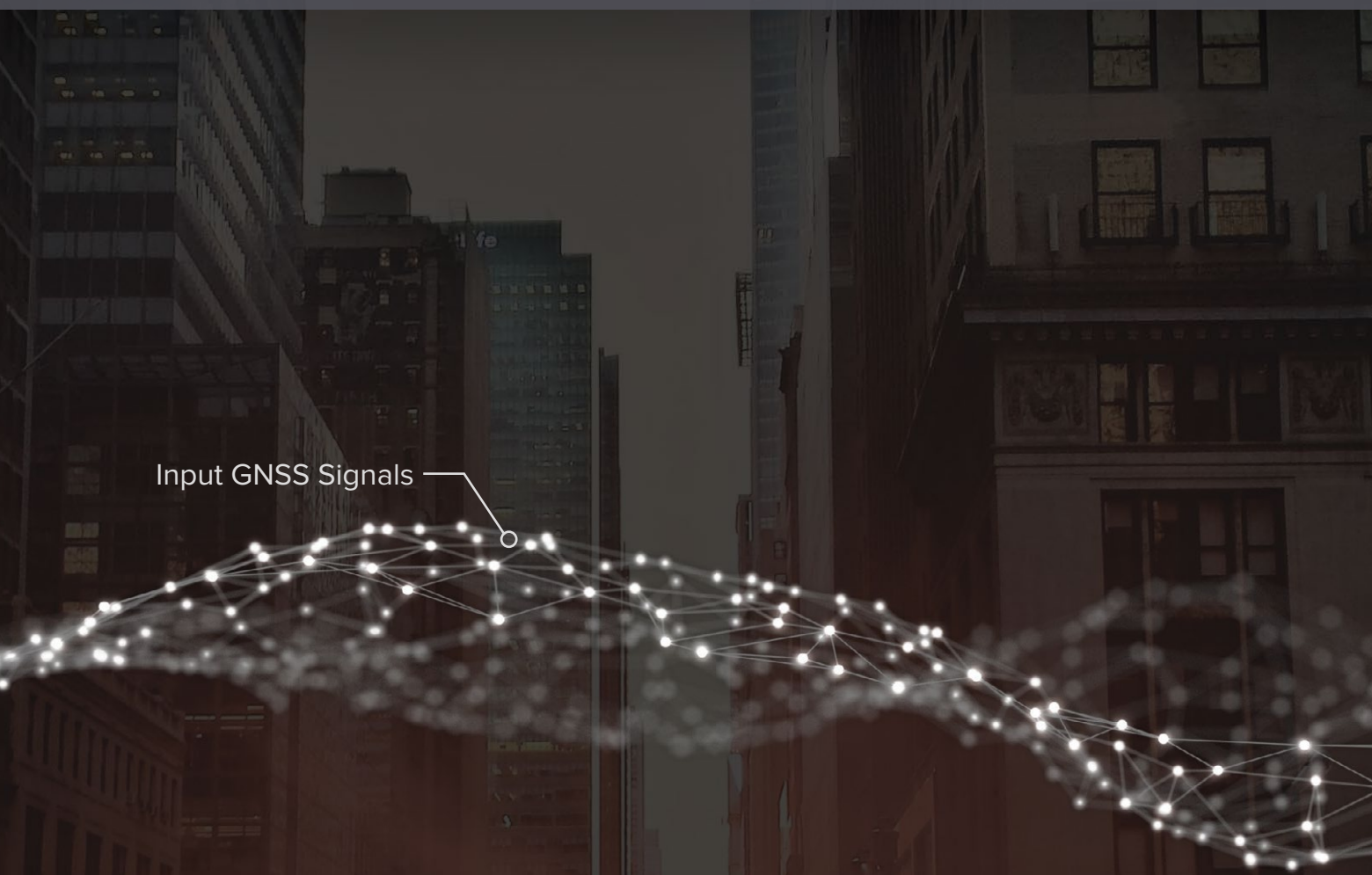

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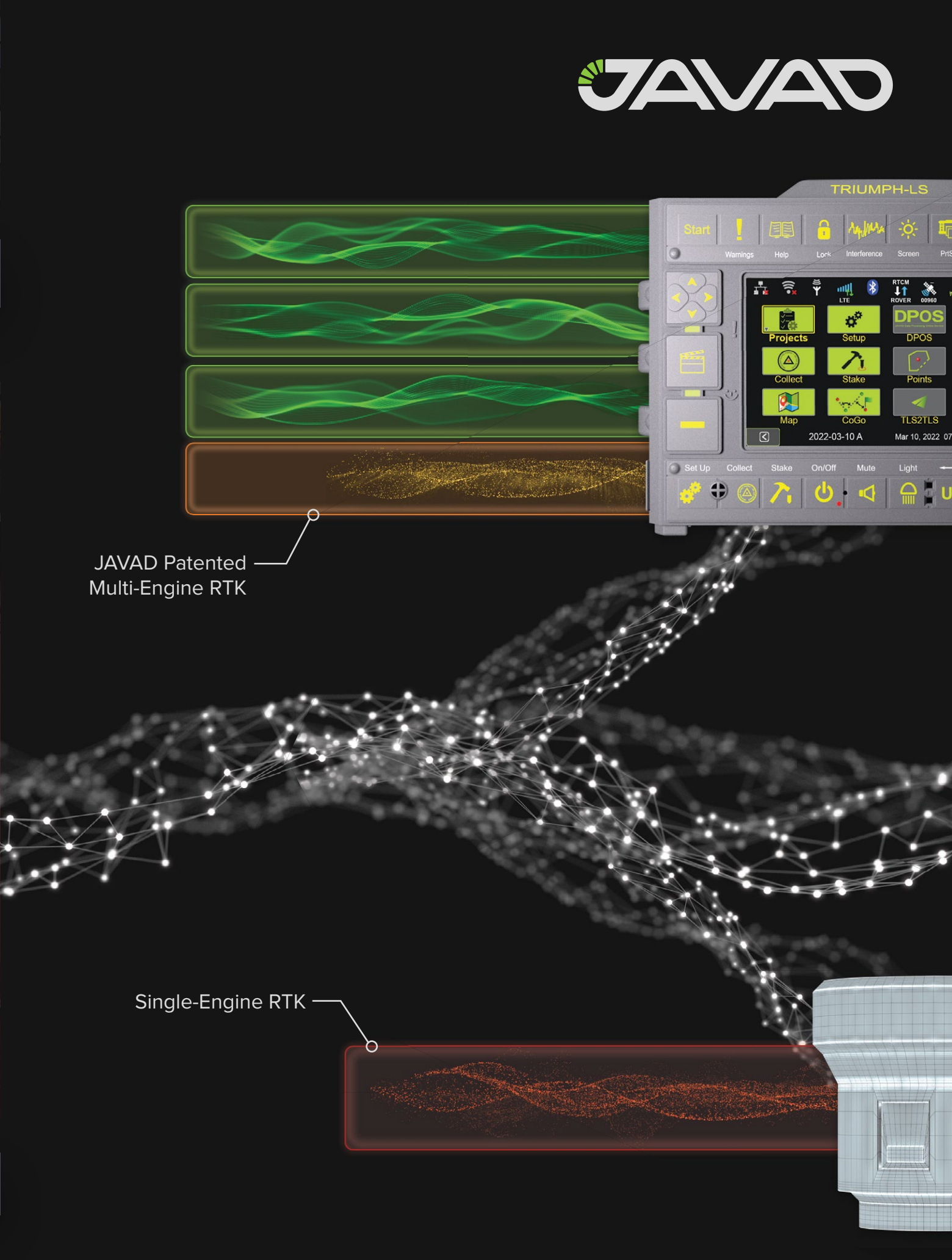
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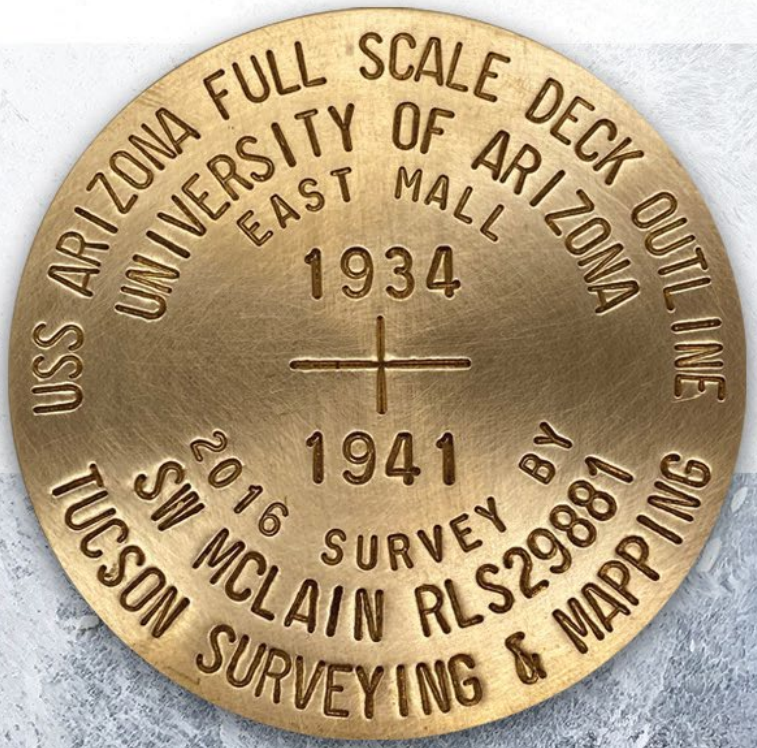

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editorial

Those Who Served

Chad and Linda Erickson are back, this time with an article that was the side-result of research they did into Linda's father who was a decorated Marine at Iwo Jima. I have a personal connection because my father was a Boatswain's Mate Seabee in the South Pacific. Like most soldiers of that war, neither Corporal Spletter nor my dad spoke much about their experiences, so we find ourselves doing research to find out as much as possible about their valiant service. One of my regrets is that I didn't ask my dad more questions. I don't even know which islands my dad was on, but he did mention being on one where runways were being built. I suspect some of our readers might have similar regrets.

I often wonder why the Silent Generation was so silent. Chad thinks one of the main reasons they did not want to talk about the war is that they knew that they would break down and sob. That and guilt that they lived, and their buddies did not. Much is written today about PTSD, and surely these guys had it, but unlike today when the ailment is applied to a whole host of problems, these guys and those who have experienced combat in more recent wars, confronted a life or death, kill or be killed situation. Now, we have veterans who are homeless and have trouble getting on with their lives the way our fathers did. I wonder why that is?

According to Chad, "In a companion photo we can see the plumb bob swaying under the tripod, as though the tripod had just been lifted, carried and set down. Our take is that the Seabee is a little more well-fed than the two Marines. The Marines are almost gaunt, indicating that they are front line troops to whom supplies seldom reach. Though there are no shoulder patches, the ages indicate that these are probably NCOs, visiting the new cemetery." Behind them are some of the 7,000 crosses from the battle, with Mt. Suribachi in the background. With an additional 19,000 wounded, Iwo Jima was one of the costliest battles of the war. ■

the American Surveyor

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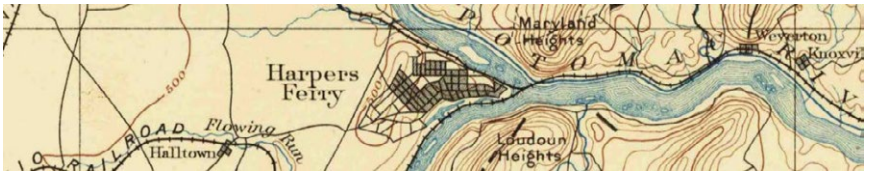
May/June 2022 / Vol. 20 No. 3

The American Surveyor (ISSN 1548-2669) is published bi-monthly by Cheves Media LLC. Editorial mailing address: 7820-B Wormans Mill Road, #236 • Frederick, MD 21701. Tel: (301) 620-0784.

Subscription prices per year, six issues: U.S. $25; Canada $50; International $75 (Airmail). Visit the website to pay online. Back issues (subject to sufficient stock) $5 plus S&H.

New subscription inquiries and all other address changes should be sent to *The American Surveyor,* P.O. Box 4162, Frederick, MD 21705-4162. Subscribe online @ www.amerisurv.com



"CONFLUENCE IN HARPERS FERRY"

SURVEYORS RENDEZVOUS '22

Clarion Inn Harpers Ferry-Charles Town, Harpers Ferry, West Virginia
September 21-23, 2022

Harpers Ferry, West Virginia is a confluence of time and history. Not only do the Shenandoah and Potomac River come together here, but a few of the SHS Rendezvous have connections here as well.

16 March 1803, Meriwether Lewis secured armaments and oversaw the construction of a frame for a 40 feet iron Canoe for the Corps of Discovery mission. This endeavor was in search of a water route to the Pacific Coast as well as a scientific expedition which yielded an abundance of new species but no direct water route to the Pacific as hoped. In July 2004, SHS held its Rendezvous in St. Joseph, MS on the Surveying of Lewis and Clark.

16 October 1859, John Brown attempts an insurrection at the National Armory in Harpers Ferry to arm slaves. This mission failed, and John Brown and his followers were hanged for treason and murder. In October 2016, SHS held its Rendezvous in Lake George, New York. An excursion to Lake Placid brought us to the downhill Olympic practice venue which is just over ½ mile from John Brown's final resting place. In September 2017, SHS held its Rendezvous in Boxborough, Massachusetts studying Henry David Thoreau. This, an area in which John Brown visited several times and impressed Mr. Thoreau as history states. In both instances we may have shared footsteps with John Brown.

PROGRAM

- Welcome Reception
- Annual Membership Meeting
- Presentations on state boundary controversies and John Brown as a Surveyor
- Hospitality Room
- Spouse/Guest Program
- Swap Meet
- Evening at the Movies
- Plenty of free time to explore area attractions

SPEAKERS/ PRESENTATIONS

- Catherine Mägi Oliver, Esquire, Co-Author of Confluence: Harpers Ferry as Destiny, *John Brown- Surveyor*
- Gary Thompson, PLS NC, North Carolina Geodetic Survey Chief, *NC/SC Boundary Line Resurvey*
- David Ingram, PS, Author, Presenter, Instrument Re-furbishing, Boundary of Virginia, Maryland and West Virginia (Deakins Line and River Boundaries) *& Andrew Ellicott's survey of the PA Notch*
- Don Teter, PS, Assist. Professor at Fairmont State University, Author, Presenter, Past President of WVSPS, Boundary of Virginia, Maryland and West Virginia (Deakins Line and River Boundaries) & *New Mexico and Colorado Border*
- Marshall Robinson, PS, President and CEO of Allegheny Surveys, Inc., Presenter, Past President of WVSPS, *Legal aspects in creating West Virginia in trying times*
- Rich Leu, PS Retired, Chairman SHS, Iowa and Missouri - Honey War
- Jerry Taylor, Esquire, PS, Professor at ETSU (retired), *Supreme Court as Original Jurisdiction*
- John Brock, *Collectable Ephemera Related to Surveying*
- Nikoline Bohr, *Meridian Stones on Nantucket Island*

Our 2022 Rendezvous hopes to relate to us a bit of John Brown in one of his many professions, that as a surveyor. John Brown surveyed in several states and utilized it as a tactic to gather intelligence while in Kansas. We also seek to relate the legal aspects in which West Virginia (WV) gained statehood, a long-fought boundary dispute between WV and Maryland, rivers as state boundaries and why or how some other states ended up in the peculiar shape(s) they now possess.

Something new to our 2022 Rendezvous will be a Thursday Night at the Movies. Dave Ingram has found an early film which features Surveying as a backdrop, "No Sad Song For Me", staring Margaret Sullivan, Wendall Corey, Viveca Linfors, and a quite young Natalie Wood.

For more information or to register for Rendezvous 2022, visit www.surveyorshistoricalsociety.com.

Shedding Light on a DARK PROJECT

Surveying and scanning ease challenge of building New Zealand's first underground railway

» MARY JO WAGNER

Inside the new City Rail Link Tunnel in Auckland, New Zealand.

What often gets lost in the gloss of large construction projects are the small, precise elements that lead to the high-profile finish—the nitty gritty points and nuts and bolts that surveyors meticulously measured, set out and measured again to ensure buildings are straight, floors are level, tunnels are the right shape and railway lines are correctly aligned.

But surveyors are used to succeeding in the shadows—sometimes literally.

Nearly 40 meters below Auckland, the survey teams with Link Alliance have been guiding the successful build of New Zealand's first underground rail network for the past two years.

The largest transport infrastructure project ever to be undertaken in New Zealand, the $4.4 billion NZD ($3.2 billion USD) City Rail Link (CRL) will build a 3.45-kilometer twin-tunnel underground rail link below the city center. The twin tunnels will vary in depth so two different construction methods are required: cut and cover where

A Trimble R10 GNSS receiver acquires static observations above the Aotea station work site.

the tunnels are dug from the surface, and mined tunnels using either excavators or a 7-m by 7-m tunnel boring machine (TBM). Crews will also redevelop two existing stations (Mount Eden and Britomart) and construct two new underground stations (Aotea and Karangahape). When complete, the CRL will carry up to 54,000 people an hour, moving the equivalent capacity of three Auckland Harbour Bridges or 16 extra traffic lanes into and through the city at peak times.

"As surveyors, we're like the hunters and gatherers; we collect a lot of data and provide it to many teams," says Sam Williams, surveyor manager with Link Alliance, a group of New Zealand and international companies building the CRL. "And it needs to be good data because the success of this entire project rides on the exactness of our survey points and measurements. We have to be right all the time."

To Williams and his survey crew's credit, their survey marks have been right 100 percent of the time since they first arrived on site in September 2019.

"With the accuracy, automation and user-friendliness of our gear, and the skills of our team, we've been able to work smoothly and quickly to keep everyone on track without sacrificing tight control, process or precision," says Williams.

Under control

The first critical element they needed to get right was the primary survey control network, which was no easy feat given the project extends through three suburbs and principal construction would run through the heart of Auckland's built-up central business district (CBD). Unlike with previous projects where tunnel survey teams have set up their own control networks, Williams wanted to establish a high-quality primary control network that could also be used for the entire project.

> "As surveyors, we're like the hunters and gatherers; we collect a lot of data and provide it to many teams. We have to be right all the time."

Setting up on the summit of Mount Eden 4 km south of the CBD, Williams used Trimble R10 GNSS receivers to verify the Land Information New Zealand (LINZ) continuously operating reference station (CORS) at the port of Auckland and established that as his base station. He then carried out static GNSS observations on three

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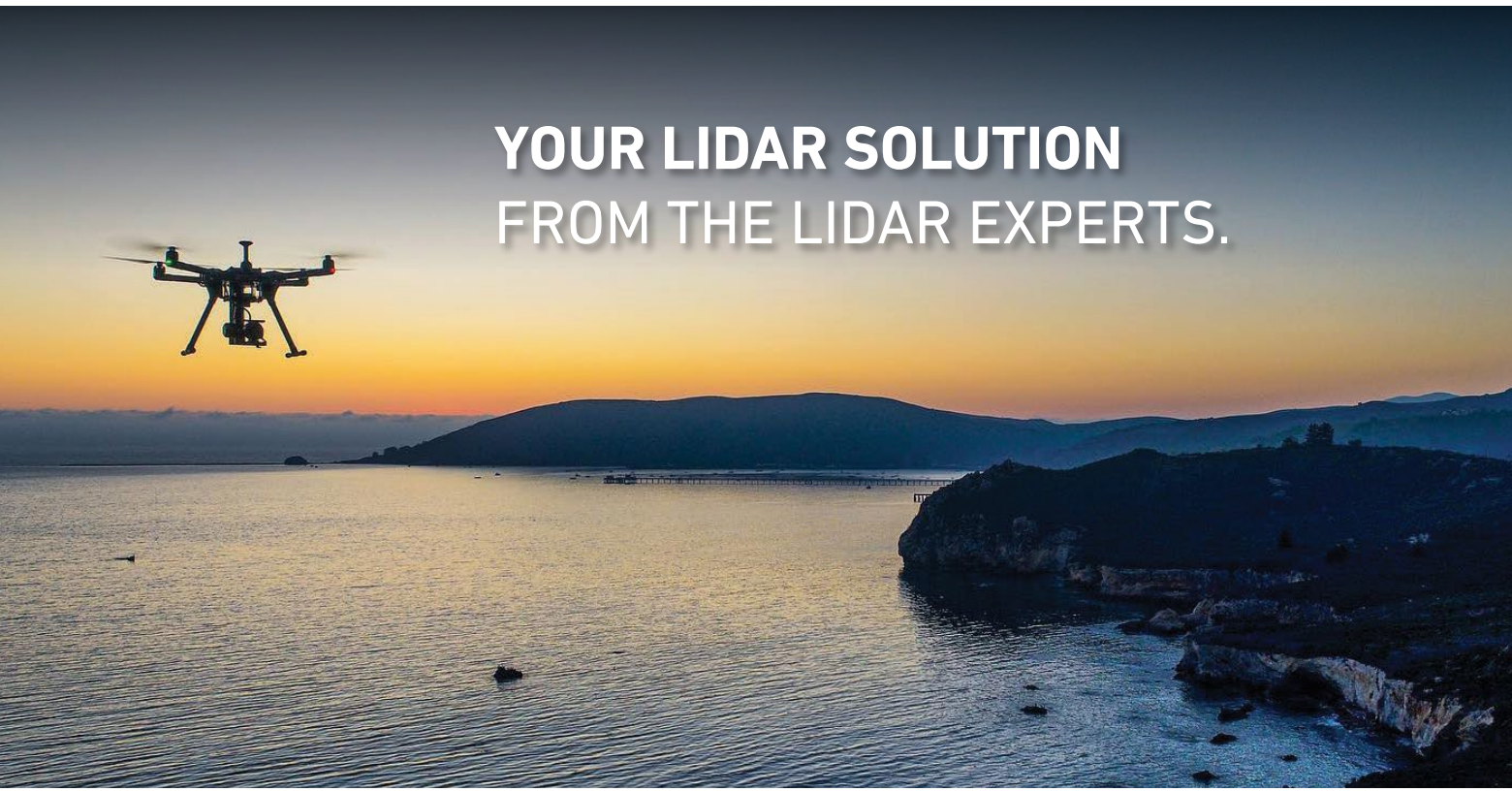

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Trimble

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Establishing above ground survey control with a robust traverse network in preparation for the start of tunnel construction.

existing LINZ datums and verified those accuracies. Satisfied with that foundation, he performed a series of four-to-six-hour observations with R10 receivers to extend the GNSS campaign to marks more relevant to the project. They established two new marks at each of the three project stations visible from the summit of Mt Eden—two of which were at heights of 10 stories and six stories. After the GNSS survey, Williams performed terrestrial observations with the Trimble S9 total station on the same intervisible marks to further improve the horizontal accuracy. He then input those measurements into Trimble Business Center (TBC) network adjustment software to more accurately compute each station's coordinates, ultimately creating a primary network baseline precise to 1-2 mm.

For vertical control Williams performed a 10-km level run with the Trimble DiNi 03 level, measuring from the base of Mt Eden, down through each station and back again with an impressive misclosure of 4mm.

"The S9, DiNi and TBC network adjustment were game changers for this," says Williams. "The long-range fine lock allowed us to measure and establish a 3-km baseline, in a built-up city environment, with a single prism at 1-2 mm accuracy. Pairing that with our vertical control results gave us the confidence that when we took that network down to street level and created secondary construction control for the guys on site, our tunnels and our stations were going to tie in perfectly."

Survey team setting out initial foundation work for tunnel construction.

In the tunnels, the teams have been setting out targets at set intervals—every 80 m inside the TBM tunnels and 50 m inside the mined tunnels—and then build a secondary network off those to fill the gaps between and provide control on both sides of the tunnel.

With those primary and secondary control networks, Williams has maintained site control at the surface and in the tunnels at 3 mm or less.

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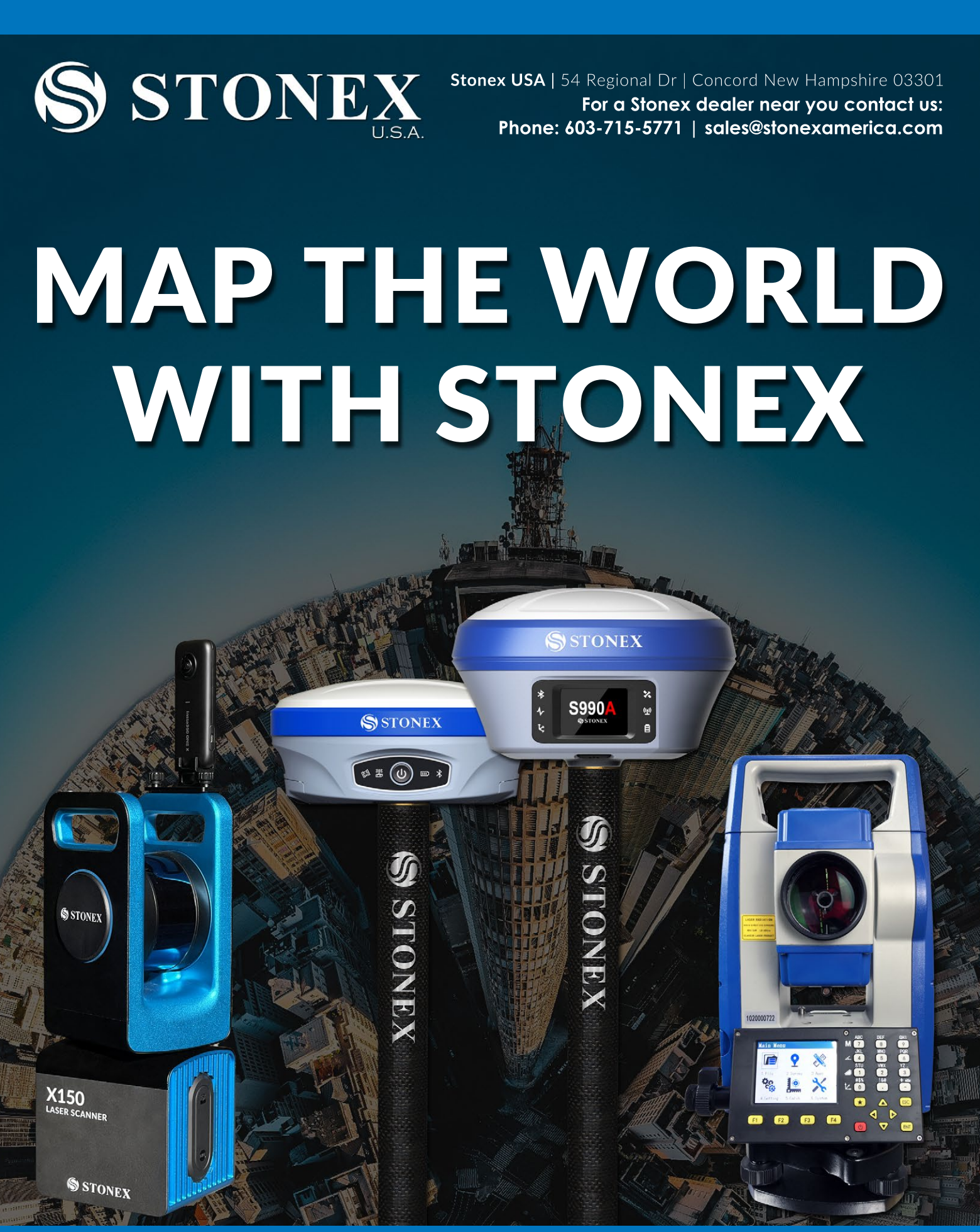

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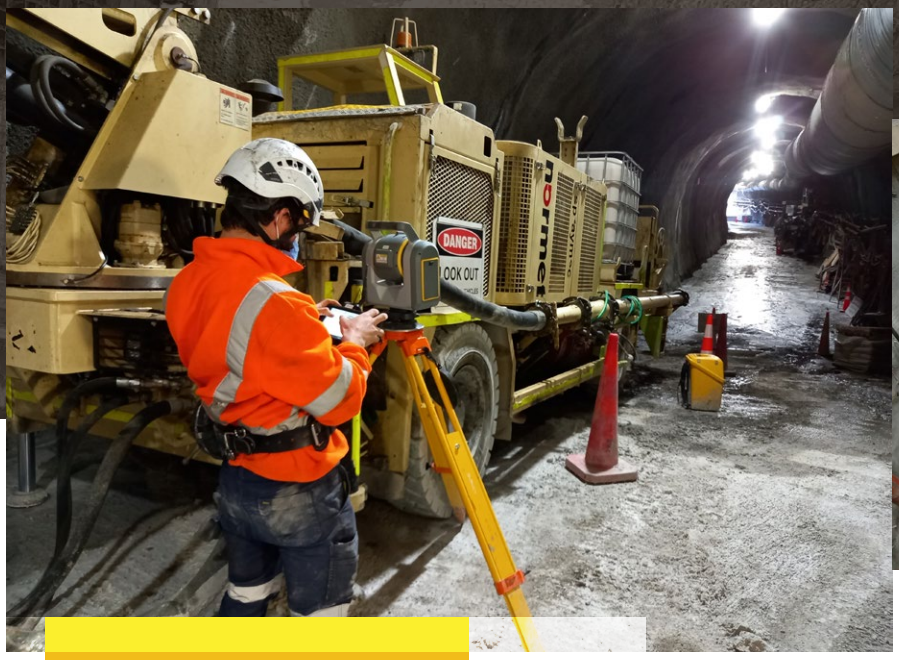
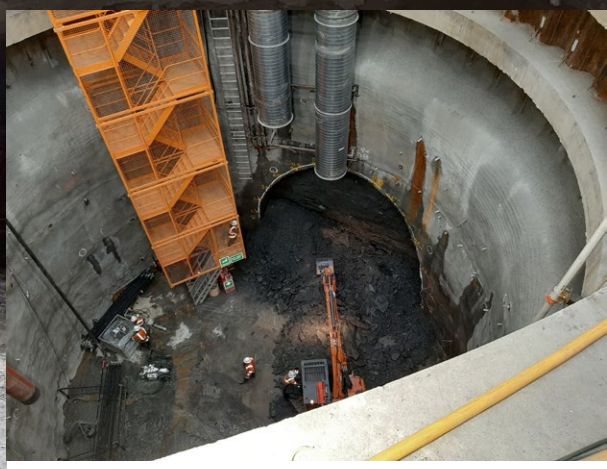




Left: Using Trimble SX12 scanning total station instrument to measure as-built shotcrete thickness to verify the construction is meeting project tolerances.

Right: Looking down into the Karangahape tunnel entrance shaft from ground level.

Tracking the tunnels

Whether setting out, confirming earthworks, guiding machines, marking bolt locations or capturing as-builts, life in the tunnels has been ruled by cramped quarters and "Hurry up."

"Nothing advances without our survey support or confirmation, but mine tunnelling is very production focused so the tunnellers want you in and out as fast as you can," says Darrell Wymer, Link Alliance's tunnel survey manager. "Once an excavation or shotcreteing is deemed complete, we need to scan the cut and check that against the design model stored on our Trimble TSC7 controller to identify any underbreaks or overbreaks. From that scan we need to produce a point cloud to support the geologist's geological mapping and create reports that show conformance to design for the construction, engineering and client teams—all in less than an hour. So, we're under significant pressure to perform our work accurately without causing great delay to the tunnellers."

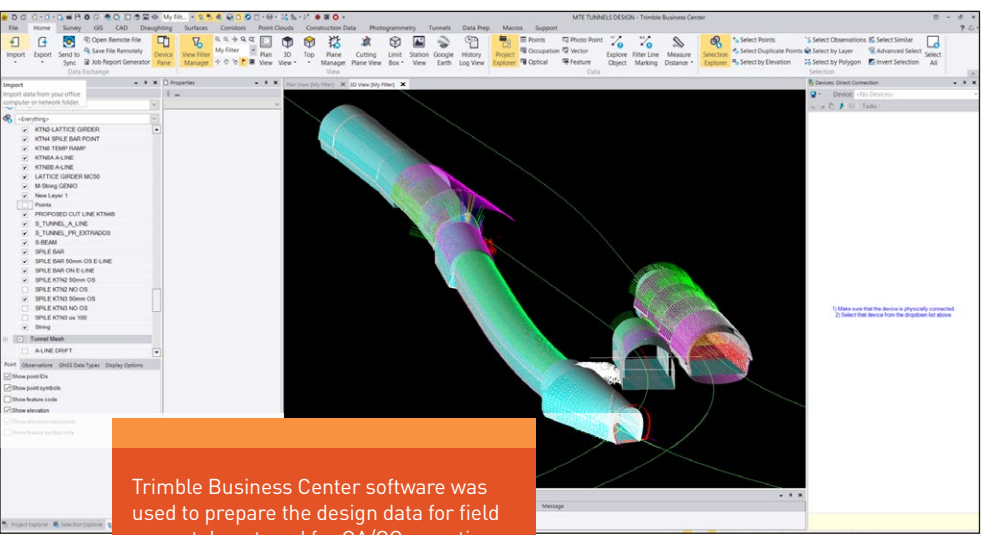
They began to relieve some of that pressure in February 2021 when they acquired the Trimble SX12, a total station and scanner combination that can scan a full dome at 100 m with a point density of 0.1 m in 11 minutes, offers a 1.6-second total station measuring time in prism mode, and can pinpoint a 3-mm diameter spot at 50 m with its green, eye-safe laser pointer.

"With tunnels you need both total station and scanning functionality," says Williams. "With the SX12, we have both in one unit and that alone saves us hours in the field because we can do our set outs, volume calculations and as-builts from one set up. And because the scans are automatically georeferenced, it saves us significant time in the office as well."

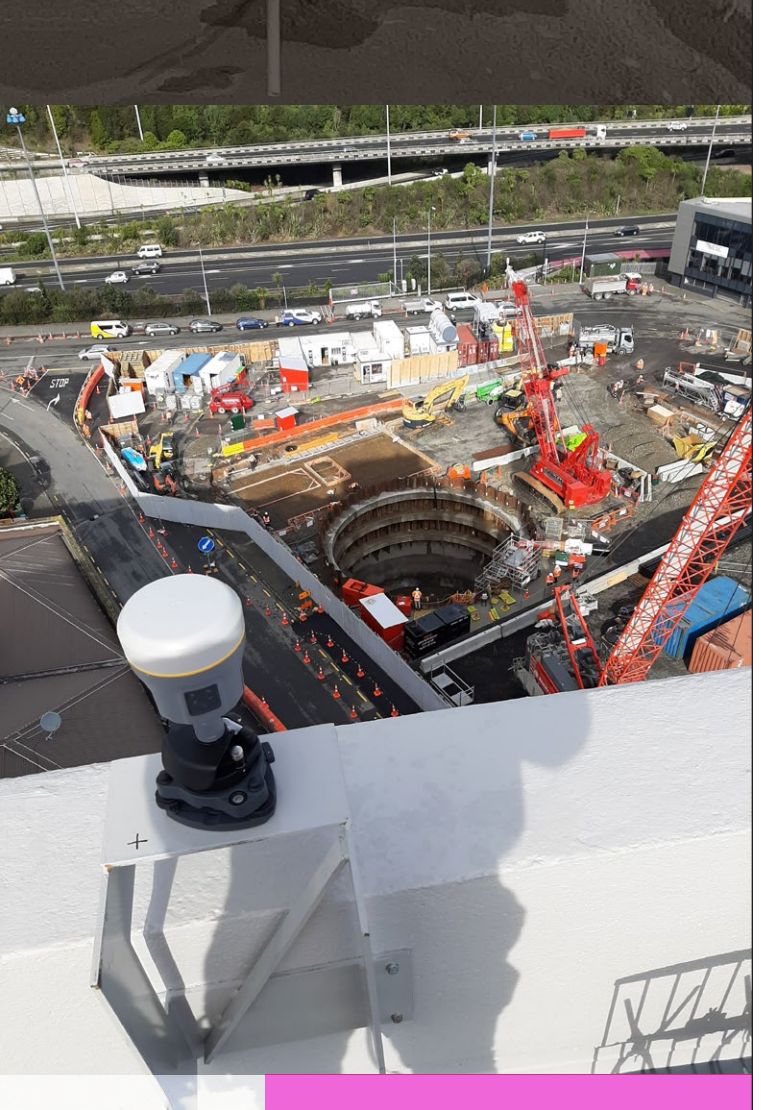
The ability to perform multiple functions from the same set up has boosted their efficiency, precision and speed, particularly at Mt Eden and Karangahape, two of their busiest work sites.

For the Karangahape station tunnels, teams sunk a 25-m-diameter shaft 25-m deep and then tunneled 20 m east and west to provide launch points for excavating the station's 278-m-long rail tunnels that include 203-m-long platforms. As the two excavators and road header advance, survey teams use the SX12 to guide the excavation, set out rock bolts, and confirm shotcrete layers.

"With the SX12, we can monitor the earthworks in real time and confirm excavation and shotcrete accuracy on the fly," says Williams. "Once teams get to a certain advance point we set up and guide



Trimble Business Center software was used to prepare the design data for field crew stakeout, and for QA/QC reporting during the construction process.



A Trimble R10 GNSS receiver acquires static observations above the Karangahape station work site.

the last pieces using the instrument's quick scanning and calculating functions in the TSC7's Trimble Access software. When that's done, we scan the finished excavation, compare it to the design model on our controller, and then scan the first layer of shotcrete. Then with Access software, we can use the previous excavation scan to produce a heat map that'll indicate areas that don't have proper thickness and they can top it up with shotcrete. It removes any need for post-processing in the office and keeps us moving."

At Mt Eden, speed and agility have been particularly critical. As the first launch point for the 130-m-long TBM, teams first needed to create a 50-m-long tunnel to set the TBM on the right course for its 860-m-long journey to Karangahape station. In parallel, they began building three tunnels—each

The survey team was instrumental to building the initial 50-m-long tunnel portal for the TBM and then ensuring it stayed on the right path during boring.

The Trimble S9 was used to establish survey control points for the TBM (tunnel boring machine) guidance system to ensure the tunnel was built in the correct direction, accurately.

at different directions and heights—and constructing twin rail lines that will tie-in to an existing line. The functionality of the SX12 has enabled one, two-person crew to handle the aggressive workload.

"The ability to seamlessly switch between surveying and scanning has cut the time we need to be at the face checking and collecting data by 60 percent," says Wymer. "We can collect a polygon scan of a tunnel face in about 2-3 minutes, and that's including photos. That speed allows us to be so much more responsive."

The confidence in knowing they've captured all the points they need at each set up has also been a boon.

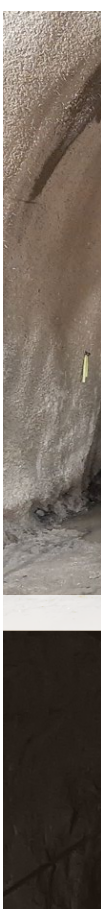
"Usually, we're about 10-15 m away from whatever we're surveying," says Williams "With traditional terrestrial total stations, we produce reports every 500 mm in chainage and every 300 mm of profile around the tunnel. Measuring each of those points manually takes a long time. With scanning, you pick up every surface in its entirety at 95 percent accuracy and you capture it all in minutes."

All by design

Equal to the versatility and efficiency of their instruments has been their software functionality, particularly the TBC tunnel module where all the tunnel design and as-builting happens. Wymer has been using the specialized software to create three design profiles: one for excavation, one for the shotcrete lining and one for the final concrete lining—a process he needs to repeat for each tunnel section. All of those models are exported to the controllers for field crews to support the excavators and roadheader guidance systems and to guide, monitor and verify all the construction work like installing the reinforcement layers.

And sometimes, because of the dynamic nature of the tunnels and the geologic composition of rocks, Wymer's had to be ready to respond to urgent requests for design model changes.

"There have been times when they've hit bad rock and the geologists have called for a design change," says Wymer. "That means we have to generate a new design by the time the next cut is complete. On a good day we may have six hours to make changes to the profile and adjust bolt positions but if the call has been made overnight, we'll often only have an hour to turn it around. With the scan detail and the automation and bulk data import features in TBC, we can meet these tight timelines so crews can keep working at speed."



Working in dark isolation can make it difficult to see the light at the end of the tunnel but crews received their first validation that the CRL is on track on Oct. 16th when the TBM broke through at the Karangahape station site—right on target. It was a significant milestone and nod to Williams and his survey crews, giving them the confidence that their process, precision and tight control will serve the team well in their drive to complete the project by 2024.

"I've never been on a project of this scale, for this length of time and not had some sort of survey incident," says Williams. "That's a great testament to our team and our technology."

It's also a testament to survey crews who sweat the small stuff to achieve a big reward. ■

Mary Jo Wagner is a Vancouver-based freelance writer with 25 years experience in covering geospatial technology. She can be reached by phone at: +1 604 221 4583; or e-mail: mj_wagner@shaw.ca

The survey team using Trimble Access field software with the S7 robotic total station to guide and position rockbolt drilling machines.

LET'S F

PHOTOGRAMMETRY

In November 2019 my company, Plisga & Day Land Surveyors in Bangor, Maine, was suddenly faced with three big projects that were open sites with urgent deadlines.

These were what I call "ground pound" projects—road surveys, topo surveys, site surveys—places where you have to get a lot of data and you have to do it accurately and fairly quickly. But winter was approaching, and in Maine that means snow. Often lots of it with huge snow banks that hide the edges of roads, driveways, and lots more.

In the past for larger projects—20 acres or more—we would have hired a consultant to do our photogrammetry flights and map projects for us. They'd go out there fairly quickly, but we wouldn't get the results for several months or so. We needed it all done sooner.

Earlier in the fall of 2019, I had been to a Carlson Software seminar hosted by Maine Technical Source and learned more about Carlson Point Cloud and how it worked with Carlson Survey. And near the end they mentioned their new photogrammetry software Carlson PhotoCapture.

Since that seminar, 3D mapping, laser scanners, drones, and point clouds had been on my mind. So, when the pressure of projects getting done before snowfall bore down on us, I had—I'll call it my "eureka" moment—and said, "Let's fly it with a drone!"

These project requests definitely lent themselves to photogrammetry techniques in that they were large and mostly open to the sky (meaning not a lot of trees). They included a road/sewer project further north in Maine that needed six road sections mapped—close to a total of four miles of road, a nursing home on 10 acres, and a 50-acre initial mapping for the Bangor School Department that included two schools, five athletic fields, tennis courts, a track, and assorted parking. But all three would be harder if not impossible to do once the

» JONATHAN STEWART, PLS

LY IT!

SAVES THE DAY

Plisga & Day Drone Team:
Keith Blanchard (left), Remote Pilot in Command; and Jon Stewart, Visual Observer.

Carlson PhotoCapture Survey Canvas with spot elevations picked on athletic fields.

Digitized elevation breaklines for a lumber mill site.

snow arrived. Plus, in these times, our work slate was full and how do you expand your services if you can't find qualified people. So, we decided to go with technology.

I had never really dabbled in photogrammetry other than setting targets for other people to do the mapping, but I was in touch with a fellow graduate of the University of Maine Surveying Engineering program, Langley Willauer, who had an early model DJI Phantom 4 drone with a 12-megapixel camera. He was very interested and willing to assist me in getting the work done. Now we had a drone and, more importantly, a registered UAV pilot to fly the sites.

Having 15 licenses of Carlson Survey and recalling that PhotoCapture demonstration earlier that fall, it was natural to turn to Carlson for our photogrammetry software. We started with just a trial version of PhotoCapture after talking with Carlson people, including Steve Cummings, Carlson's PhotoCapture Product Manager, who said, "Yeah, that's what this product is made to do." So, we crossed our fingers and went with it.

Speed and Richer Data

We knew that for a flight to work, meaning for this methodology to translate into good mapping, we needed to do some work to include real world points to control the model. In our case, this meant setting out ground targets or targeting on existing features such as paint strips. In surveyor mode, this part is very easy. Just paint 5 to 20 4- by 18-inch X-shaped crosses on the ground and locate them with survey GPS or whatever is used to get geo-referenced control.

In the span of two weeks, we targeted and then flew all three sites. Each flight took less than a half-hour. Additional field work included capturing the ground control points and many check points. As a surveyor, "measure twice" is more than a saying.

However, with hundreds of photos in hand, we had to extract the mapping data that our client requested. We uploaded the overlapping photos with the ground control to the PhotoCapture cloud. Carlson's photogrammetric wizardry of turning photos into a 3D tangible model occurred in the cloud where the aero-triangulation and bundle adjustments processed massive amounts of common pixels to create a 3D representation of our flights.

Of course, once we got the photos we had to learn how to process the data using PhotoCapture Survey Canvas. That's when I had my training with Steve Cummings of Carlson. Survey Canvas extracts the data you need. For example, I used Survey Canvas to quickly create 3D objects such as points, polyline, or grid meshes that were exported to a CAD environment for final drafting. The software is relatively straight forward so it didn't take long to be up and running. Carlson does the hard part, the

Carlson Software for Photogrammetry

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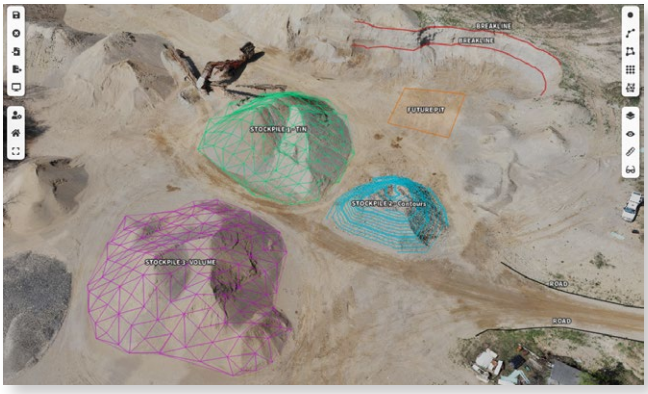

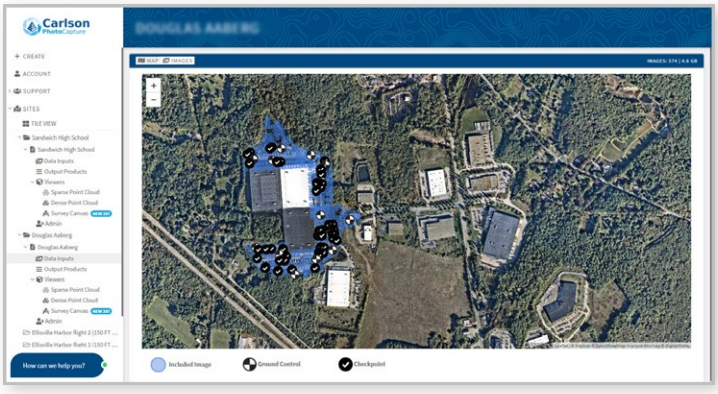

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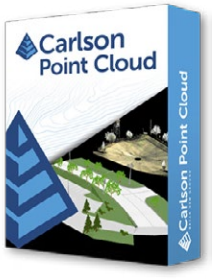

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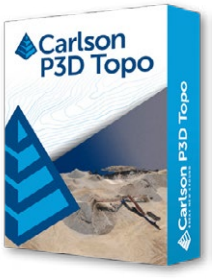

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Carlson
BREAK NEW GROUND

math—we just had to keep doing what we were doing, measure and work and make sure things lined up, and try to make the real world squeeze onto a flat computer screen.

The processed results and deliverables such as the orthophoto, DEM, and LAS file were available in several hours. In summary, the model is built from the photos in a matter of hours. Once we had the 3D model it was time to extract the specific data needed such as breaklines, sewer manholes, utility poles, edges of pavement and other "TOPO" features.

Added bonus

It all worked. We had our needed CAD data from the 3D model. And, sure enough, about a week after we flew them, we got a foot of snow.

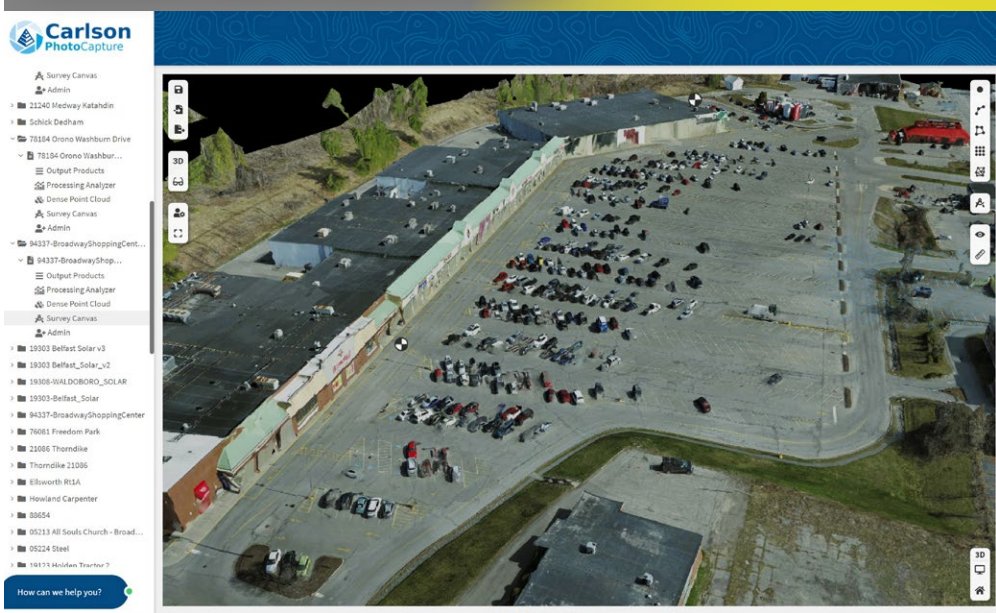
How well did we measure? We got really good results out of the process. Our typical Ground Sample Distance (GSD) was around 0.02 feet. For what we were trying to accomplish, it was more than good enough at the time. We delivered each of the three projects on time with the added bonus of having an up-to-date background image for the clients.

One other benefit was realized a little later. Soon after we delivered the street project for sewer work, the engineer called and needed seven manholes. By then there was two feet of snow on the ground, and I grimaced at the thought of digging those out to locate them. I soon smiled, however, as I thought they might already be in one of the PhotoCapture models. Sure enough, I logged in and using Survey Canvas clicked on six of the "missing" manholes and got the x, y, z location for the engineer. There was still one outside our mapped area that had to be dug out, but better an hour of work than a full day.

Increased work and efficiency

As winter turned into spring of 2020, we started getting requests for more mapping data sets. My colleague, Keith Blanchard, was pursuing his FAA UAS Part 107 pilot license so I challenged him that if he got his license I would be forced to get him a drone to do all this work. He did so we purchased a DJI Phantom 4 with RTK and a 20-megapixel camera. Now we could take our own pictures with our own in-house pilot Keith Blanchard.

Carlson PhotoCapture perspective view of partially completed solar farm. The black and white targets are the ground control points.



A view of a small shopping mall parking lot assessment with ground control points visible.

It's just a more efficient way to work instead of ground pounding. And the flights had the added strength of a GPS base station sending corrections to the drone. This brought our average positional errors down to below a tenth of a foot. Now we were surveying!

Looking back, I have to say, "Wow!" We're offering a service that's much more robust than we did before. It may be overquoted, but we're finding that a picture is definitely worth 1000 words (and usually more than a 1000 dollars). Especially with real time precision added to the drone and a better camera, with which Keith notes we're getting quality measurements.

Engineers and designers just love seeing the ortho photo and all the background in the TOPO we give them. They can see if landscaping is in the way or if there is a sign or a mailbox across the street. They can see so much more in the photo it allows them to make some decisions that maybe they wouldn't have known about and adjust their design accordingly.

We're using the drone and photogrammetry for a lot of solar projects now. There

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In Carlson PhotoCapture, an apartment as-built. Notice black and white targets for ground control.

might be an existing 100-acre farm, which all of a sudden isn't being used for agriculture and the land owner is being talked to by a solar company, saying, "Hey, let's take 20 acres of your field and put solar panels in there."

It used to take three or four days to do the survey, but the drone with PhotoCapture is a great way to map what's there on the ground without there being a lot of ground time. So other than control points, utility location, and some boundary checks, we get some surprisingly good results of where the ground is in the field.

Typically, these are mowed fields or cleared areas without much tall vegetation and no significant tree canopy. However, an added benefit is that, because it's photogrammetry, we can model the tree canopy. Then the engineers can see how much shading there is from the trees and determine what's going to be most efficient for the solar arrays. **Please note:** *The photos are limited to what the camera sees, and they don't "see" the ground like other technologies such as LiDAR. Fortunately, the entire state of Maine has been flown over the last 10* years *with LiDAR and this data can be used to check or even fill in those trouble areas of vegetation.*

We've done landfills, where we capture information at a certain time and then go back in and show them what's been added or how a site might have settled. We have also used this process to see what volume of material has been removed in the case of gravel pits.

Plus, the flights and remote processing is more affordable for our clients. Instead of taking two to three days to survey a 10-acre gravel pit, we can do it in a couple of hours. It's a huge time savings for us on some of these large open sites.

Our largest project was more than 300 acres—that took two flights to do that one. For our purposes, the only limiting factor is how much data we are pushing up into the cloud with PhotoCapture. Once we start getting above 10 gigabytes, it really takes time. The cloud absorbs it, then two, three hours, or overnight, we get data. It just magically appears on the PhotoCapture website and we're able to download our quality report, DEM, LAS file, and orthophoto and start working in Survey Canvas.

Safety First

One of the biggest benefits of using the drone and photogrammetry is the safety factor, especially when doing busy roads. Instead of having to set up traffic signs and cones and shut off a lane of traffic, you don't have to have workers out in the roadway

Plisga & Day's Jon Stewart (left) holding a Phantom 4 RTK drone with Keith Blanchard, Remote Pilot in Command. Both are drone proponents and, on occasion, drone evangelists.

A site flown to map tree heights around a lakefront cottage.

dodging cars and trucks. While you can't fly over the road, you can fly adjacent to it.

Keith and I manage our own projects but also work with our 11 other surveyors at Plisga & Day and our sister company known as Good Deeds and when anything is near a busy road I say, "Let's fly it!"

Our most unique project was measuring a rocky shore line on the coast of Maine with 50-foot cliffs. It was a tidal area on the ocean and there were 12-foot tides. We decided that we couldn't do it with traditional survey equipment. Keith and I agreed that unless we would have people repelling off the rocks, there was no way to measure it. We opted for the interesting combination of a laser scanner at low tide and a drone flight to confirm the results we were getting from the laser scanner. Turns out we used the drone data a little bit more than the laser scanner data because it was just easier to get into the nooks and crannies from the air—to be able to get a bird's eye view.

Expanded work

We've pushed ourselves out to the mapping world a lot more. Last year we did about 30 projects from two-acre sites to 300 acres using the drone and photogrammetry. This year we've already flown five sites and lined up about five more.

There are still some things you have to measure and model on the ground. The drone and photogrammetry are just another tool in a surveyor's arsenal. It allows us to very quickly turn around a 5-, 10-, 20-acre site that might take a week with traditional survey. On site plans with lots of detail, you get it all and can easily turn the picture into points, lines, or contours.

I'd say it's our clients who are getting the big benefit. They're getting real data for what they are trying to accomplish, even more information than they initially asked for.

We're still learning all that we can do with the drone and the software, but it's a 3D world now—the world is not flat and now you don't have to model it that way. Keith and I have definitely become drone evangelists in Maine. ■

Jon Stewart is longtime resident of Bangor, Maine, and has been a Maine Professional Land Surveyor since 2001. He is actively involved in the Maine Society of Land Surveyors, and more locally as the Operations Manager and President of Plisga & Day with 14 other Professional Land Surveyors. All field operations credit goes to Jon's business partner Keith Blanchard, PLS, who maintains and pilots the drone.

THE RISE OF PHOTOGRAMMETRY

The advantages of photogrammetry for a land surveyor are many...But how did we get here, and how does it work?

Photogrammetry is not a new word. In fact, the term was coined by a Prussian architect in 1867, but the introduction and advancement of affordable low altitude unmanned aerial vehicles (drones) equipped with high-resolution cameras on stabilized gimbals has recently opened a bevy of new possibilities for surveyors.

Today, with a Part 107 License from the FAA, a small, affordable drone, and some simple flight-planning software, almost anyone can gather all the information needed to create a photorealistic 3D representation of a site. For a surveyor, we can add ground control points (GCPs) and, optionally, an RTK-capable drone, and obtain high accuracy, geolocated orthoimages and point clouds, and thence all the contours, TINs, and other end-products that can be derived from them.

The key to survey-grade accuracy is the introduction of the aforementioned GCPs. Often created via an RTK GNSS receiver, these points are marked with a target that will be visible to the drone's camera. The required number of GCPs will vary with the size and complexity of the site but can be reduced to only one or two if an RTK-equipped drone is used.

Before flying, a flight-planning software is used to select an area to be covered and determine the flight path, photo overlap, camera angle, drone height, etc. The pilot can then essentially hit the "Go" button and the drone will follow its commands before returning itself to its point of takeoff.

The resulting images and GCP information are then loaded into the photogrammetry software, such as Carlson's PhotoCapture, where the processor-heavy but fully automated photogrammetry process occurs. A variety of output files are immediately available, most notably a dense point cloud and an orthoimage. These files can then be used, in conjunction with your favorite software, to perform "bare earth" commands, extract features, create contours and linework, and more.

In all, photogrammetry has become a versatile, time-saving option that has earned its spot next to laser measurement and GNSS technology in the modern surveyor's toolkit.

—Ben Johnson, Carlson Software

SEABEES, MARINE ENGINEERS & Their Mysteries ON IWO JIMA

» CHAD & LINDA ERICKSON

Opening bombardment on Iwo Jima and Mount Suribachi
NATIONAL ARCHIVES 342-FH-3A-42765-54717AC

> "Their surveyors traveled in halftracks, carrying .50 calibre guns in one hand and transits in the other."
>
> —One Damned Island After Another, by Clive Howard and Joe Whitley, page 238

Having found a family connection with Iwo Jima in 2016, we are in the midst of an odyssey to discover what happened to Linda's Father at the Battle of Iwo Jima, between February 19th and March 26th, 1945. We have purchased and devoured forty plus books on Iwo Jima, and the quest continues, but at this 77th anniversary we pause to address another aspect that we inadvertently uncovered, namely the Navy Seabees and Marine Engineers, and two of their construction

Linda's Father, Corporal Murry O. Spletter, Bronze Star recipient from Iwo Jima

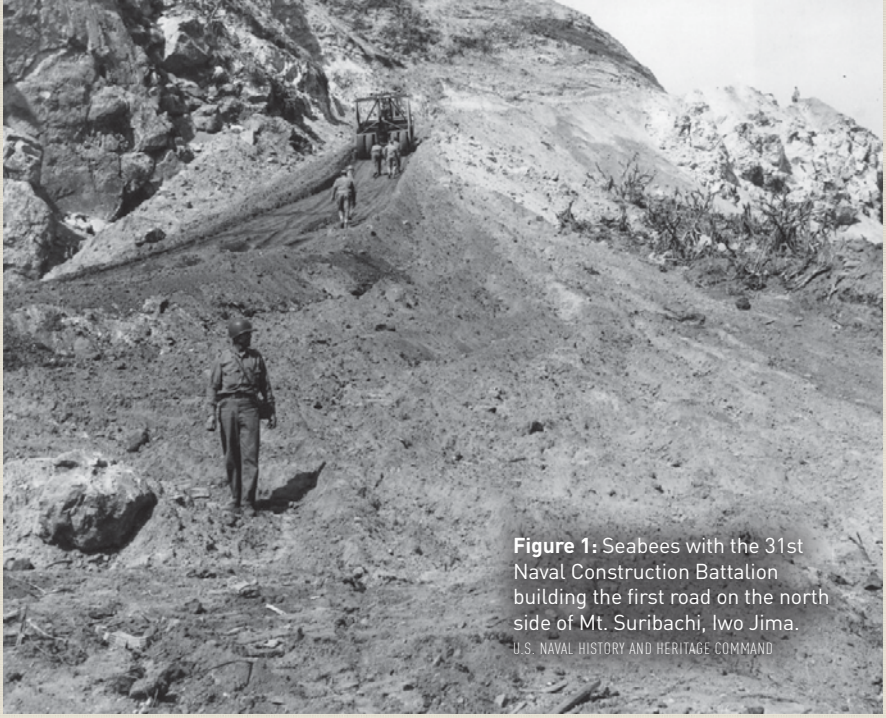

Figure 1: Seabees with the 31st Naval Construction Battalion building the first road on the north side of Mt. Suribachi, Iwo Jima.
U.S. NAVAL HISTORY AND HERITAGE COMMAND

projects. These projects were the road up Mount Suribachi and the B-29 Runways, each built under the onslaught of mortars, artillery, small arms fire and falling bombs.

Because of the endless slaughter of our Marines by the seemingly limitless Japanese artillery and mortar fire, the few journals and accounts from Murray's "D" Company 26th Marines are horrifying and shocking. For 36 days Murray's 2nd Platoon suffered extreme violence, with many bodies blown in half, and a final casualty rate of 98%. 98%!!

The impetus of the first phase of the Suribachi road was to get artillery spotters, flash ranging and echo apparatus to the top. These apparatuses greatly improved the accuracy of the U.S. naval and artillery fire, allowing the Japanese field pieces to be taken under more accurate fire nearly as soon as they fired. Slowly but surely these Japanese pieces were eliminated. Much of this success can be attributed to the building of the first road to the top of Mount Suribachi. Ironically, the secret to the Marines' ultimate success was in getting the Japanese field pieces and mortars to fire and thus reveal their hidden caves and pillboxes.

The Mystery of the Suribachi Road

Engineering wise, Google Earth Pro images indicate that the Suribachi Road is an engineering nightmare. How can this be, it was built by Navy Seabee 31? However, elevation and grade computations from Google Earth Pro show a wild variation of grades, with grades as steep as 20% and grade breaks at switchbacks as high as 32%

Figure 1 is of the nascent Suribachi road and shows a Tractor, Heavy, M1 (Cat D7) with a LeTourneau carryall scraper, doing what? It is difficult to load a scrapper going uphill and impossible to load broken rock. What are the seven following men doing? In building a quick and easy road, did NCB31 throw all their skills to the wind?

"Two drivers were shot out of the seat of an unarmored bulldozer that was called up to cut down the...bank. A third engineer volunteer managed to operate the machine by crouching in a sheltered position and manipulating the controls with a shovel and axe handle. By nightfall, the engineers had cleared the way for a tank-led attack. This was combat engineering." (A Brief history of U, S. Marine Engineers, by Ralph W. Donnelly, page 8.)

Clinton J. Trefethon, 32, (Machinist's Mate, Third of Kerby, Oregon) ...had been operating his heavy bulldozer... "Everything was fine", he says, Until I started to make a road on D+6[1], I made one swipe, then backed up in my tracks and went over the same ground again. The second time did the trick. The mine exploded beneath me, blew my helmet off, and knocked a track loose on the dozer." (Black Hell, page 188.)

"The massed artillery fires were proving their value, and their accuracy had been greatly increased now by observation posts that had been set up on newly won Mt. Suribachi." (The Fifth Marine Division in World War II by John C. Chapin, page 11.)

D+5 *"Intelligence observers and artillery spotters (including the flash-bang counter-battery observers) soon turned the volcano into a vital observation post."* (The Spearhead by Howard M. Conner, p. 68)

In their rush to get equipment to the top, did the Seabees, in a shell-shocked condition, lose their nerve and just slap-dash the road in?

1 Time was kept from the departure date (D Day). At Iwo Jima D Day was February 19, 1945, thus D+6 was February 25th.

Figure 2: In this image of the construction of the second road to the top of Suribachi, the cats appear to be pushing fill uphill. What? it is always MUCH more effective to build from the top, down. Here the cats are packing a darn good load, so they must be pushing downhill and the image is an optical illusion.
NATIONAL ARCHIVES A-70491A.C.

Figure 3: Photograph taken during the service of Ladelle A. Hamilton in the USAAF in the PTO in WWII.

Second Road

This Road was started on D+15 (March 6th.) A wider and more usable road was needed to move the truck-trailer mounted radar, weather and navigational equipment to the top of Mount Suribachi. For all practical purposes, by the time the radar was installed, there was little threat left from Japanese bombers and navy, and the infantry front lines had moved beyond the visible horizon to the north. The purposes of this new equipment would have been to track kamikaze attacks, traffic control our thousand plane B-29 armadas and rescue the crews of downed planes. (History of the U.S. Marine Corps Operations in WWII: Western Pacific Operations, Volume IV, page 611.)

This second Mt Suribachi road was 35 feet wide, had two lanes and was "oiled". In **Figure 2**, notice the steady grade and the regular 1.5:1 backslope of this photo, seeming to show that this was not an eyeballed job. However, where are the grade stakes in **Figure 2**?

Mystery Deepens

We know from records that the road is 5,000 feet long. The climb is about 400 feet, so a well-designed road should have a grade of less than 10%. However, Jack Cornwell in his A Seabee on Iwo Jima, They Also Served Who Drove Cranes and Cats, reports in mid-1945 that when he went up the road on a borrowed motorcycle he had to use the lowest gear, and the road was so steep that when he came down he also had to use the lowest gear. This sounds like a 20±% grade.

Mystery Begins to Be Solved

1. Mr. Cornwell probably had an underpowered cycle, see the "Mystery Solved" sidebar.
2. As in most non-continental U.S. areas, we should not depend on the terrain mode of Google Earth Pro to determine elevations or grades. For instance, Google shows the top of Mount Suribachi to be 350 feet, but all other sources give it as 550-556 feet above sea level.

Mystery Solved

According to **Figures 2 and 3**, the Suribachi road was well designed and executed, and Google is the one in error. Notice the observation tower on the left and radar equipment on the right.

D+14 "To the south even Suribachi's face began to change as the 31st Construction

Battalion built a road to the summit. Below, in a prisoner stockade, one Japanese officer wept. 'For twenty years' he said, 'we tried to make a road to the top and you did it in two weeks!'" (The Spearhead by Howard M. Conner, p. 67.)

Four B-29 Superfortress Runways

With Suribachi in the background, the Seabees and Marine Engineers prepared the runways with even greater care. At the 10,000-foot Motoyama Runway, more than 3 million yards of earth was moved. Based upon four high resolution photographs and a 14-minute movie, the Seabees and Engineers reconditioned and extended the runways as follows:

1. A Caterpillar D-7 scarified the existing surface, turning up mines, duds and large pieces of shrapnel, which were then disposed of.

Figure 4
ARCHIVES BRANCH, USMC HISTORY DIVISION

Figure 5
THAYER SOULE COLLECTION (COLL/2266) AT THE ARCHIVES BRANCH, MARINE CORPS HISTORY DIVISION

2. Another mystery. "Gunk is being trucked in and dumped in windrows the full length of the runway. It does not contain rock or coral, just lumps of gunk. What is gunk?
3. A road grader then worked the windrows, which readily broke up the large clumps of gunk.
4. A demolition squad scours the fill for duds, land mines and large pieces of shrapnel, another mystery solved.
5. The 4"± lift of sand-clay was then spread evenly. Mystery Solved! On pages 200-201 of Lt. Col. Whitman S. Bartley USMC's tome: History of Iwo Jima: Amphibious Epic: *"Quarries yielded excellent sand-clay fill that greatly facilitated the construction of roads. This material required little mechanical stabilization, and a daily motor patrol, shaping and filling were necessary and sprinkling with water sufficed to keep the roads in usable condition. This same material was also used in the rehabilitation and extension of Airfield Number 1 and made possible the early completion of (other runways)."* Is the sand-clay something like crumbly decomposed granite, which is an igneous granite with sodium instead of potassium?
6. Seawater was used to bind the fill. The sand-clay was then rolled.

PUBLIC DOMAIN

Figure 6
THAYER SOULE COLLECTION (COLL/2266) AT THE ARCHIVES BRANCH, MARINE CORPS HISTORY DIVISION

(350,000 gallons of seawater was used per day to bind fill.)

7. Such lifts were brought in until they matched the grade stakes. (One grade stake can be seen in **Figure 6**).
8. When the desired depth of sub-base was obtained the runway was then paved.

To quote Ivan Thunder from the book Black Hell, the Story of the 133rd Navy Seabees at Iwo Jima: *"The Japs got in the first lick. They ambushed the Eighth's survey party and killed C.A. Van Eps (Carpenter's mate Third, Callender IA) and wounded E.F. Young (Machinist's Mate First, Toledo OH) and F.C. McGowan (Chief Shipfitter, Jacksonville FL) ... (It was thereafter common) for a four-man surveying team to be escorted by as many as a dozen extra Seabees, just for protection against snipers. One quick-thinking power-shovel operator swung his bucket around and filled the mouth of two caves in a hurry when sniper's bullets began bouncing off his cab."* pages 74 & 89.

"...Lieutenant Sam Stanbery (Headquarters Company Commander) and a crew were out surveying... The Rodman went ahead and a man with a carbine, at the ready, guarded him. Sam and a few men were at the plane table. A Jap stood up in a small gully and looked at the Rodman. The guard swung around and was about to shoot the Jap when the Rodman said, "Don't shoot him." So, they took him prisoner...A few days before, Sam had driven over a Jap mine, and had the rear end of his Jeep blown off. It scared the hell out of him, and he was in no mood to take any Jap prisoner, but they did... The Chief Master at Arms and two MAs and the prisoner, drove all over...to show off the prisoner we had captured. I know they hailed me down on the road to show me." Black Hell, page 124.

Conclusion

On Iwo Jima the NCB133 suffered their own high casualty rate of 43%. However, many children, grandchildren and now great grandchildren owe their existence to the sacrifices made by the Seabees and Marine Engineers, without them, we would not be. *"Greater love hath no man than this, that a man lay down his life for his friends,"* John 15:13. *"...love covers over a multitude of sins"*, I Peter 4:8. ■

Chad Erickson has been licensed as a PLS in multiple states since 1985 and he and his wife **Linda** have been published in The American Surveyor 17 times.

Three servicemen on Iwo Jima on April 16, 1945, showing off their war souvenirs, two Arisaka rifles and a delivery vehicle adopted by the Japanese military and repaired by G.I.s. The delivery car might have been a little underpowered but still, it was a Harley. Is this the cycle borrowed by Jack Cromwell? In our research we found no mention of G.I. motorcycles on Iwo Jima or any other island in the Pacific.
U.S. MARINE CORPS OFFICIAL PHOTOGRAPH

MYSTERY SOLVED

IT WAS AN UNDERPOWERED CYCLE, NOT A BAD ROAD.

"When I went back to work (as a crane operator digging out Japanese caves), I hit a bonanza—a box about the size of a footlocker, full of 10-yen notes. One of those went for a buck. I borrowed a jeep, loaded it with scrip, and drove to where the pilots and mechanics had their tents. I came back with $150 cash, two bottles of champagne, and 13 eggs, plus souvenirs I could trade. I had to give the jeep back, plus a bottle of champagne for the use of it, but then the guy let me have a motorcycle with a sidecar. Off I went with a load of souvenirs. After I sold them I decided to go to Suribachi. By then the 31st Seabees had built an oiled road to the top; it was so steep I had to go in low gear. At the top I looked into the volcano and at lots of caves and the battleships and cruisers offshore. I didn't see the famous flag, whether because it had been taken down or I just wasn't looking in the right place. Coming down was as bad as going up, low gear all the way, but I returned the motorcycle in one piece. Nobody else in my unit ever got up there."

—A Seabee on Iwo Jima: They also served who drove cranes and cats.
WWII Magazine, 19th Paragraph. By Jack Cornwell

SAIPAN HARDBALL

"On Saipan, working at the runway at the North Field near the edge of the jungle, one morning some of the engineers were startled to discover two Japs sitting astride the fence bordering the field. The Japs, tattered from months of hiding in the jungle, were having a helluva time sidewalk superintending the construction job. They dropped from the fence and scampered off through the jungle when one of the men on a bulldozer reached for his rifle.

On the following day, the Japs were back, boldly hanging over the fence with the same fascination people in large cities have for excavating projects. And the engineers, quite pleased to be working for an appreciative audience, kept an eye on them but permitted them to remain.

The Nips, who must have had their own two-man reveille, showed up promptly each morning and stayed throughout most of the day—evidently enjoying the show hugely. It got to a point that the engineers felt a little lonely when their audience would suddenly disappear into the jungle.

The thought that the Japs might have deserted them to watch the Seabees was too horrible to contemplate, so they think their fans were captured or killed and were always a little bitter about it.

—One Damned Island After Another
by Clive Howard and Joe Whitley, pages 241-242.

. . . . .

"Another of the favorite sagas was of the Jap who was a rabid baseball fan. (By 1898 baseball was nationally popular in Japan). This Jap turned out for every game played by one engineering squadron and sat on a bare hill overlooking the diamond, alternately cheering the engineers and raising hell with the umpires. Whenever a decision went against the engineers, the Jap would jump up and scream something which, roughly translated, seemed to mean 'Kill the blankety-blank so-and-so.'

One day the engineers were playing the Seabees and the game was going on inning after inning with the score tied. Finally, an engineer caught a Seabee curve squarely and blasted it down the left field foul line. The umpire took one squint and then called the runner back—foul ball!

This was too much for the... Jap. He jumped to his feet, screaming curses in Japanese, and grabbed a piece of coral. Winding up like a sandlot pitcher, he beaned the umpire and then took off over the hill, followed only by the cheers of the engineer rooting section.

Later a Marine patrol—which the engineers vow was egged on by the Seabees—shot the Jap."

—One Damned Island, pages 242-243

WIKIMEDIA COMMON

CONSTRUING DESCRIPTIONS *for* RIPARIAN TRACTS

» DR. RICHARD L. ELGIN, PS, PE

Upland Conveyances, Generally

For nearly all states, on a river navigable for title, the upland's riparian boundary with the State (owning the riverbed) will be either the ordinary high water line (OHWL) or the ordinary low water line (OLWL). (This article concerns inland nontidal rivers.) On a nonnavigable stream, the upland's riparian boundary with the opposite adjoiner will be the thread of the stream. (BTW, exactly where is the "thread of the stream?") When conveying an upland tract, unless some very explicit, clear indication is expressed otherwise, the instrument will convey all the land the grantor owns…to the OHWL/OLWL or the thread.

For boundary descriptions with phrases like "to the river then along the river," "all lands north of the river," "all lands south of the south bank of the river," "to the bank then along the bank," "to and with the river," "to the river's center," "to the river thence along its bank" and like phrases, if the grantor owned to the OHWL/OLWL or thread, and barring an unusual exception, the conveyance will be to that line. The presumption is that the grantor conveyed all he or she owned. This includes all of grantor's lands gained by accretion whether mentioned in the conveyance or not and whether formed by natural or artificial means. All of grantor's lands will be conveyed, even if the acreage stated is for the uplands and does not include accreted acreage.

The presumption of conveying to the OHWL/OLWL or thread when the deed says "to the bank and along the bank" has been explained by the courts, saying that it is against public policy to create (or

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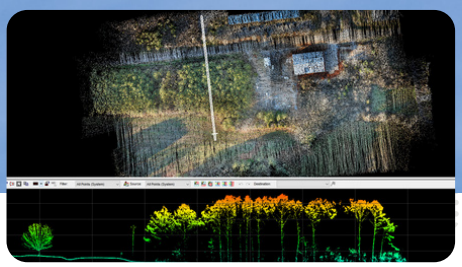

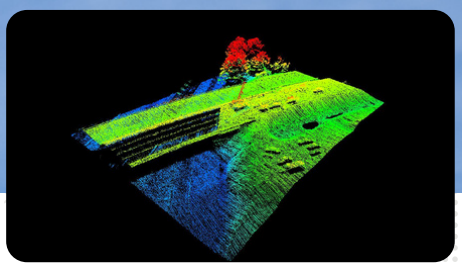

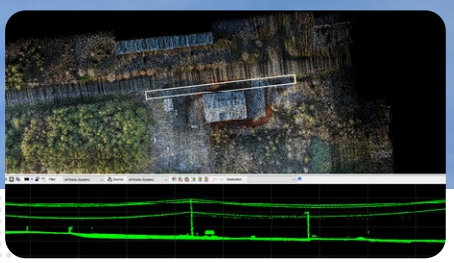

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leave) small strips (between the bank and the line) in remote grantors. This is particularly true when the strip has no use to the grantor and would benefit the grantee. Leaving a strip between the bank and the OHWL/OLWL or thread of the stream seems illogical. Such a strip, if left in a grantor, would make the grantee's lands nonriparian with no access to the water. Phrases such as "to the river," calling for a natural monument (the river), in the order of importance of conflicting title elements, trumps all other elements of the description. It extends the call to the center of the monument and as far as the grantor owns. This is also true for artificial monuments such as pins, survey markers, walls, trees and stones. And, applying that the grant is interpreted most strongly against the grantor legal principle, the questionable strip will be conveyed to the grantee.

For a nonnavigable stream, consider the hypothetical: Owner A owns a tract through which the stream flows generally north-south. Owner A conveys to B "all lands west of the river;" then A conveys to C "all lands east of the river." The boundary between B and C will be the thread of the stream, A does not retain ownership of the streambed.

For a nonnavigable stream, there could be an exception to the presumption that the thread of the stream is the boundary. Consider this hypothetical: Owner A owns a tract through which a nonnavigable stream flows generally north-south. Owner A conveys to B "all lands west of the east bank of the river," then later A conveys to C "all lands east of the east bank of the river." (This exact circumstance has been before the Arkansas Supreme Court.) In this example, the thread presumption has been overcome, Junior/Senior rights will prevail: The east "bank" will be the boundary. The bank will be the boundary, but exactly where on the bank is the boundary line?

Another variation on this hypothetical: Owner A conveys to B "all lands west of the east bank of the river," then later conveys to C "all lands east of the river." This is a Junior/Senior rights situation. You can't convey what you don't own. The boundary will be the bank (with its associated location question). Note that to properly survey C's land, the surveyor will need the adjoiner B's deed to check if the deeds "mirror," there being no gap or overlap. Here there is an overlap, easily discovered and cured.

There may be some reason to exclude a riparian strip from a conveyance of the upland (although it is hard to imagine why). If a grantor wishes to exclude a near-river riparian strip, it would be best practice to write the boundary description such that it includes the strip then excepts it. However, in doing so be aware that the grantee won't be riparian but that by future erosion the excepted strip may be washed away, making the grantee riparian. Of course, the excepted strip, retained by the grantor will gain land if the stream moves by erosion and accretion "away" from the grantee's parcel.

Some Examples, Where's the Southerly Boundary?

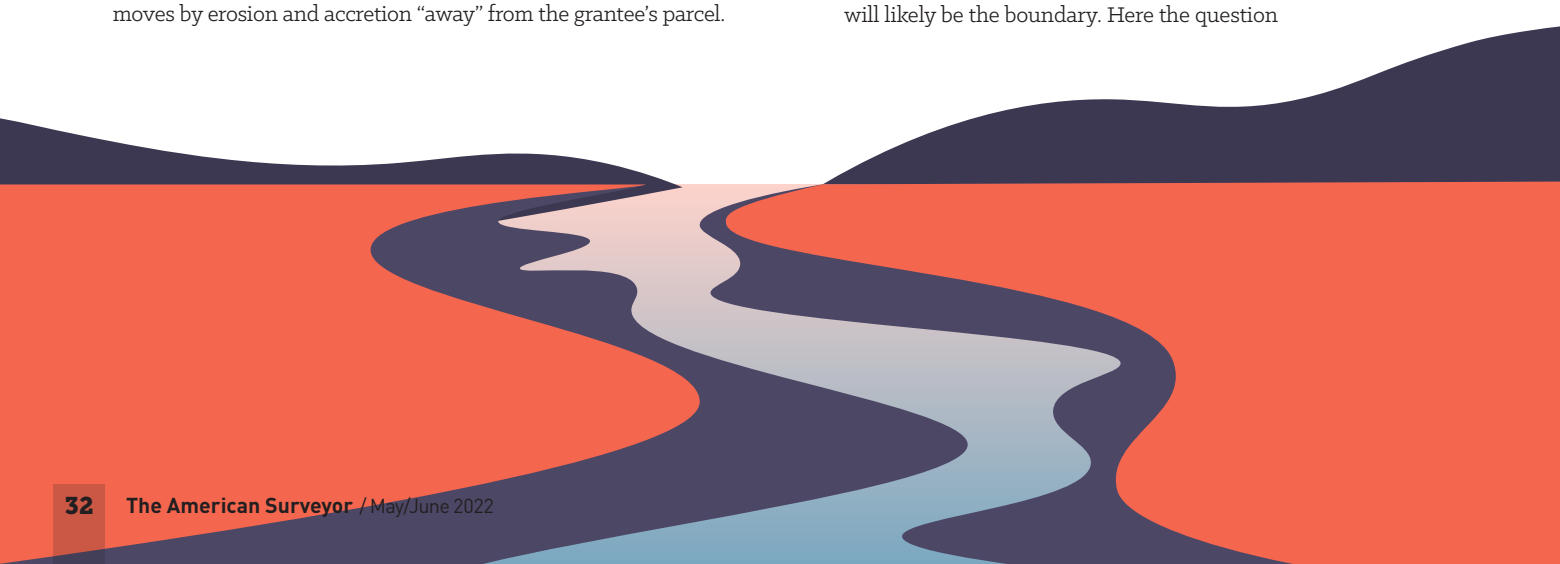
Supposing for example, there's a generally east-west stream that crosses a tract. Here are four examples of different ways lands to the north of the stream could have been described and conveyed. The question is, where is the southerly limit of the lands conveyed using these descriptions. (Let's assume the stream is nonnavigable for title.)

1. All lands north of the stream.
2. All lands north of the stream's north bank.
3. All lands north of the stream's south bank.
4. South along some line "to the stream's north bank, thence westerly along said bank" to some line, thence northerly….

Let's look at each of these descriptions

1. **All lands north of the stream.** For this description, it is highly likely the southerly title line is the thread of the stream, but not a certainty. This "likelihood" needs further title research. If Owner A originally owned the lands on both sides of the stream and then, as the common grantor conveyed "all lands south" then "all lands north" and, through mesne conveyances those descriptions have been used, then, no doubt, the boundary will be the thread of the stream. (But, where exactly, and with specificity is the "thread?" I'll leave that topic for another article.)
2. **All lands north of the stream's north bank.** One may believe the boundary is the north bank, but this may not be correct. This boundary determination will require title research. Suppose Owner A owned both sides of the stream and sold to C "all lands south of the stream" and sold to B "all lands north of the stream." Then B conveyed to D using the description at issue here, "all lands north of the stream's north bank." A strict interpretation of these conveyances would result in B retaining ownership of the lands between the stream's thread and its north bank. Owner D, being conveyed only to the bank, is not riparian. Did he or she really intend to purchase a tract adjacent to a stream that is not riparian? Did B really intend to retain half the streambed?

   Applying the court's reasoning and legal principles previously discussed, Grantor B conveyed all that he or she owned, D would own to the stream's thread. Owner D's southerly boundary will be the thread.
3. **All land north of the stream's south bank.** This description will require title research. If Owner A originally owned on both sides of the stream and that common grantor first conveyed to B all lands north of the south bank and later conveyed to C all lands south of the south bank, then the south bank will likely be the boundary. Here the question

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is a Junior/Senior rights question, not a riparian boundary question. From the conveyances, it looks like the grantor knew what he or she was doing. The question will become exactly where, with specificity and repeatability, is the boundary on the "bank" located? And note, C will not be riparian. Through the gradual processes of erosion and accretion, as the stream's bank moves, so moves the boundary.

4. **"To the stream's north bank, thence westerly along said bank…."** Again, this boundary description will require further title research. Suppose Owner A originally owned the lands on both sides of the stream and conveyed to C "all lands south" and conveyed to B "all lands north." Then Owner B conveyed to D using the atissue boundary description given above. Under this scenario and for the same reasoning as given in Example 3 above, D's south boundary would be the thread of the stream (not the bank). The courts have said the presumption is that the grantor conveys all he or she owns. If Owner B owned to the thread, then that person's grantee was conveyed to that line and not the bank.

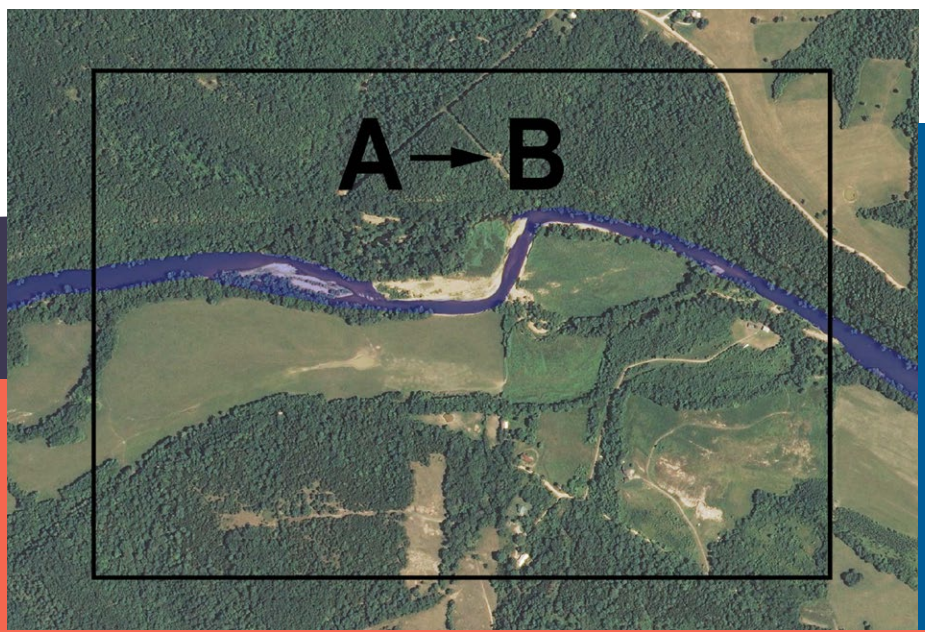
Title History Important

In construing boundary descriptions for riparian tracts, in nearly all instances research into the title history will be required. That research will be required back to when an original grantor split the lands, divided by the stream. If, in the original "split," the description made the boundary the thread of the stream, then by just about any subsequent mesne conveyance descriptions, no matter how described, the riparian boundary will remain the thread of the stream, that being the presumption. Only through some very explicit conveyance or exception will this presumption be overcome.

Caveats and a Suggestion or Two

- Riparian and littoral boundary location can be complex and can be very statespecific. Most states have no statute law pertaining to the boundary description construction issues discussed above. The applicable legal principles will be found in case law. And, as the caveat to every boundary control legal principle warns, the contrary or an exception may be shown. Complicating the location of a riparian boundary is the fact, as illustrated here, the title history (as well as the fluvial geomorphology) will be critical in determining the boundary location.
- Never use the term "bank" when describing a riparian or littoral boundary. The question will be, exactly where, with specificity and repeatability is the boundary located? Will it be the "high bank" or the "low bank" or somewhere in between? Exactly that question spent the 1920s in the Supreme Court of the United States, the "Red River Litigation" case between Oklahoma and Texas. The central issue in that litigation, the location of the south bank of the Red River is a kerfuffle that continues to this day. (In that litigation the SCOTUS invented the gradient boundary, a term/boundary location used only on the south bank of the Red River and in Texas.)
- Meander lines are just about without exception *never* the boundary line for a tract adjoining a waterbody. There are only a very few extreme exceptions to this rule, but that is the subject of a future article. Be very careful when using a meander line in a boundary description of a riparian tract. Actually, using a meander line when describing a riparian tract is probably not best practice. There are better ways to describe riparian tracts without using or describing a meander line. (I'll leave that topic for another article.) ■

Dr. Richard Elgin, PS, PE is a surveying practitioner, educator, researcher, collector and author. He codeveloped the "ASTRO" software products and coauthored the Lietz/Sokkia ephemeris. He wrote *The U.S. Public Land Survey System for Missouri* and *Riparian Boundaries for Arkansas* and *Shoulda Played the Flute* (a memoir of his year flying helicopters in Vietnam) and *Riparian Boundaries for Missouri*. He owns a large collection of early American surveying equipment, rides a Moots bicycle and drives an Alfa Romeo 1600 GT Junior. Dick's articles have appeared in "American Surveyor" for many years. Dick may be reached at: *elgin1682@gmail.com*



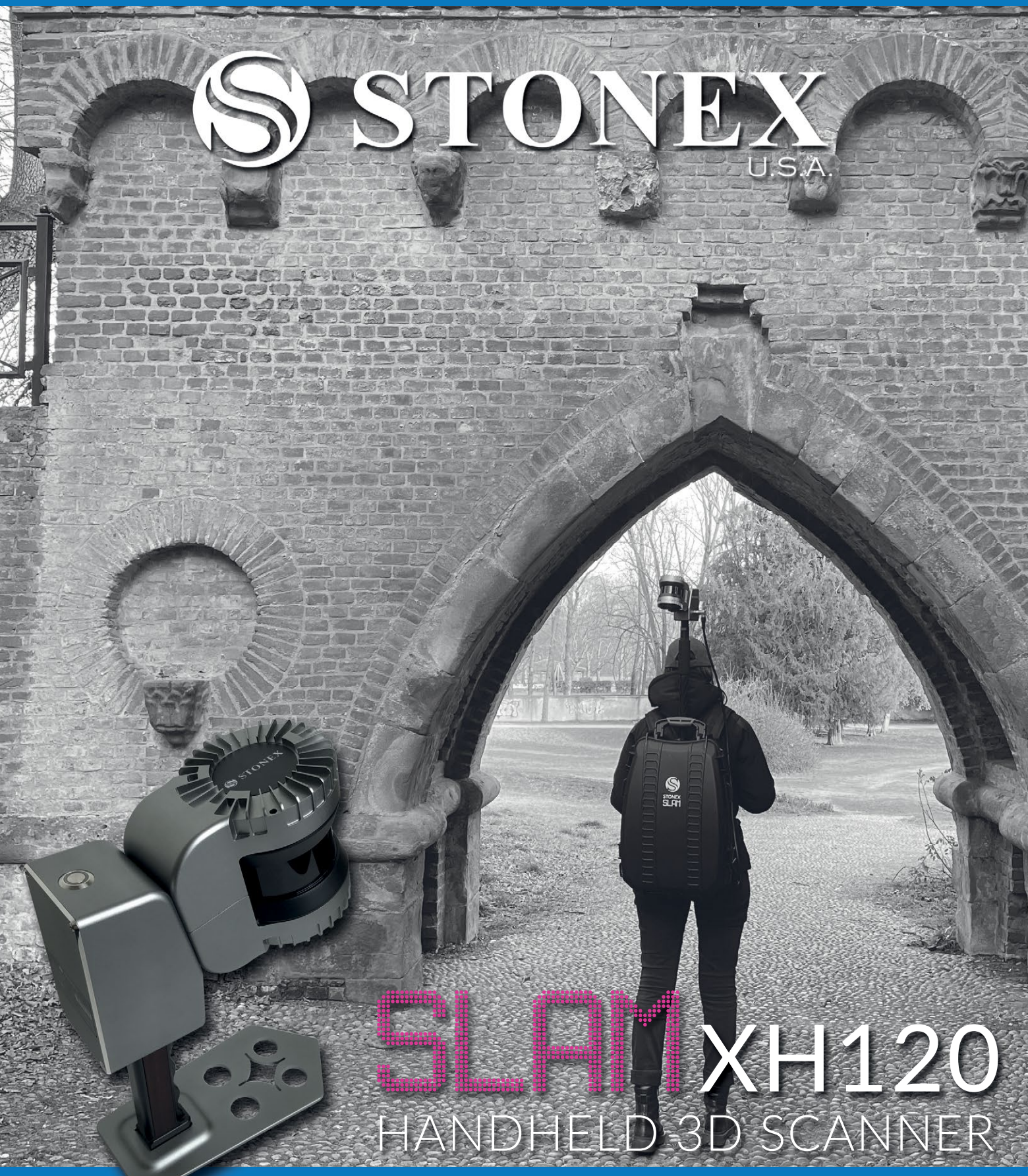
1. All lands north of the stream.

2. All lands north of the stream's north bank.

3. All lands north of the stream's south bank.

4. South "to the stream's north bank, thence westerly along said bank …."

Where's the Southerly Boundary?



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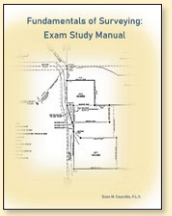

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Lathrop, *continued from page 40*

That statement means a little more work for the agent due to extra data entry. However, note that the goal is to find the most favorably priced policy for a client. In the sidebar of this article, I point you to other places to direct agents, with a few pertinent quotes to which I've bold-lettered emphasis. Elevation Certificates are by no means dead.

> "It benefits surveyors to become familiar with Risk Rating 2.0 and the Flood Insurance Manual."

There are other ways that the Elevation Certificate can be a valuable tool in rating insurance, such as confirming the foundation type (one of the factors in rating) and noting flood openings (providing eligibility for mitigation discounts). It benefits surveyors to become familiar with Risk Rating 2.0 to counter less-informed insurance agents and point them to appropriate procedures. The best weapon in this battle is the Flood Insurance Manual on FEMA's website: https://www.fema.gov/flood-insurance/work-with-nfip/manuals#flood-insurance

Remember also that Elevation Certificates provide important information for those communities participating in the Community Rating System in determining eligibility for community-wide flood insurance discounts.

To sign up for notifications of free webinars on flood insurance (most of which are only one hour long), contact floodsmart@fema.dhs.gov ■

Wendy Lathrop is licensed as a Professional Land Surveyor in NJ, PA, DE, and MD, and has been involved since 1974 in surveying projects ranging from construction to boundary to environmental land use disputes. She is a Professional Planner in NJ, and a Certified Floodplain Manager through ASFPM.

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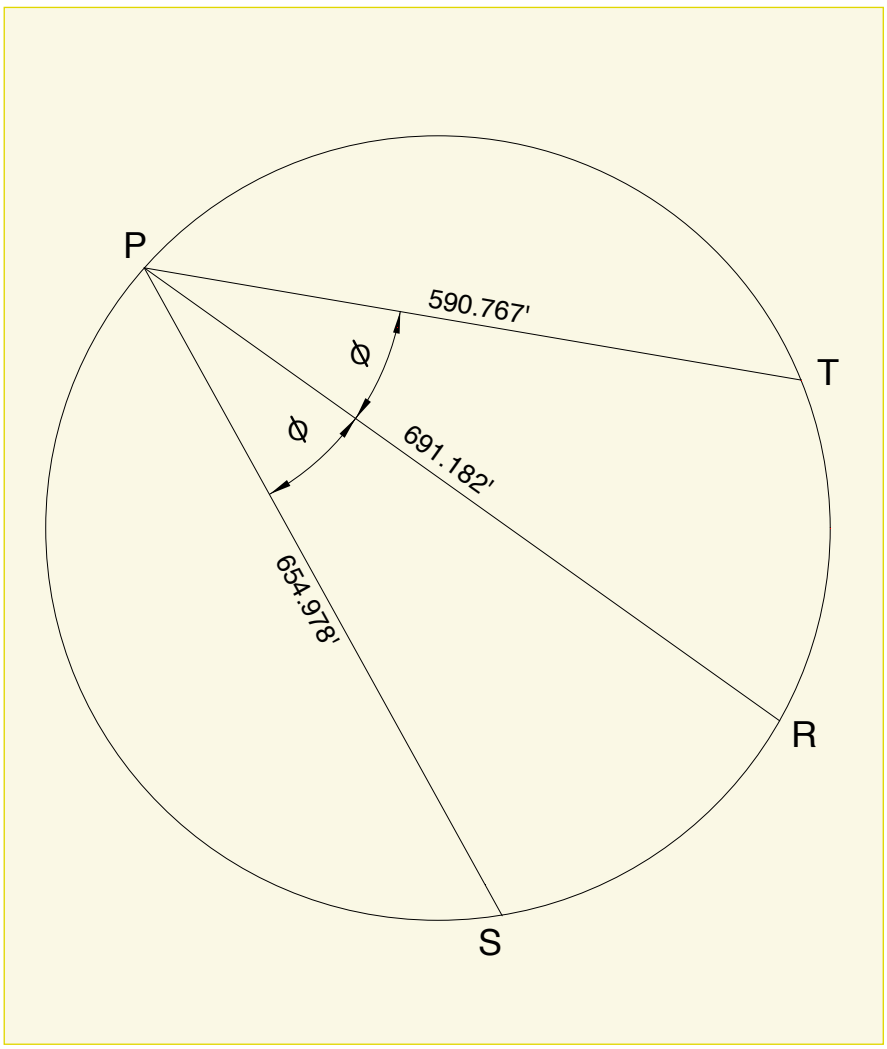
Dave Lindell, PS, retired after 36 1/2 years with the City of Los Angeles. He keeps surveying part time to stay busy and keep out of trouble. Dave can be reached at *dllindell@msn.com*.



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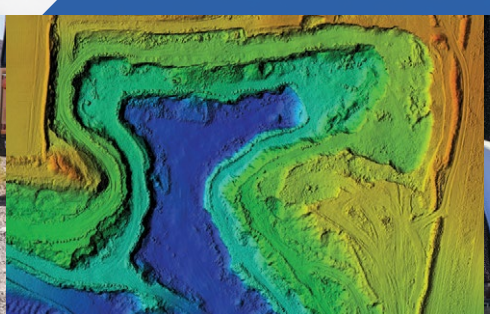

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Elevation Certificates and Risk Rating 2.0

Amid the cries that Elevation Certificates have become irrelevant, let me make this clear: Surveyors need to be educators once again.

With the full implementation of Risk Rating 2.0 on April 1, 2022, some flood insurance agents seem to be confused about the use of the Elevation Certificate. FEMA has been presenting free training sessions, but some of the messages in those sessions don't seem to be widely understood. Perhaps agents aren't attending because the training courses are not approved for agent continuing education credits in any state. Perhaps agents don't feel they need any additional training after the first round of courses FEMA began offering last summer to help transition from how flood insurance has been rated for the last 50-plus years.

I'll be shouting a bit in this column, so expect to see some **bold lettering**.

While the Elevation Certificate is no longer a mandatory requirement for rating, it is still valuable in securing the best flood insurance rating. That line bears repeating, but you can read it again on your own.

There are two ways that flood insurance can be rated. One method is what FEMA refers to as "system generated," in which the first-floor height (one factor in premium setting) is generated by FEMA's software using policy information and various datasets. The other method is to use an Elevation Certificate provided to the insurer to determine the structure's first floor height. The insurer is to **use the method most beneficial to the purchaser of the policy** (the agent must rate the policy both ways to make that determination). Elevation Certificate Sections C and E are both relevant for these purposes.

Here I'll let FEMA explain "first floor height," or FFH in the flood insurance world. FFH replaces the elevation difference between lowest floor and lowest adjacent grade as in what is now referred to as the "legacy" method of insurance rating. The explanation provided in the most current Flood Insurance Manual (issued October 2021, as Risk Rating 2.0 began phasing in) appears in Section 3, "How to Write" on page C-21: "the height of the building's first lowest floor above the adjacent grade". This means that very lowest floor may not be the "first floor" if that lowest floor is below grade. (Below grade spaces are not insured under the National Flood Insurance Program.) This information is something surveyors provide on Elevation Certificates.

The best way to underscore that Elevation Certificates are still important in flood policy ratings is to quote directly from the Flood Insurance Manual. Page 3-23 reiterates: "The First Floor Height is determined by FEMA, or the policyholder has the option to provide an EC. **IF the policyholder provides an EC, FEMA's system will compare both values and use the First Floor Height that is more favorable to the policyholder**."

For additional educational ammunition, visit the following plain language websites.

floodsmart.gov/elevation-certificates
"Elevation Certificates: Who needs them and why" (for consumers)

agents.floodsmart.gov/write-policy/elevation-certificates
"All About Elevation Certificates"
This page for insurance agents includes sections on "What is an Elevation Certificate?," "How might obtaining an Elevation Certificate benefit my client?," and "How can my client obtain an Elevation Certificate?" I've extracted pertinent quotes:

"Under Risk Rating 2.0: Equity in Action, an EC will no longer be required to purchase coverage. Instead, FEMA will use its tools and resources to determine the first-floor height of a building as one of the factors used when calculating rates. However, a property owner may choose to provide an EC and submit it to their agent to determine if it will lower their insurance costs. ECs will continue to be used for floodplain management building requirements, which can affect eligibility for Community Rating System discounts."

"Should your client choose to obtain an Elevation Certificate, each year at the time of renewal, review the rate they would get utilizing the certificate. **Insurance agents are responsible for determining the best rate and coverage for their clients,** so this is a vital step that must be done every year."

agents.floodsmart.gov/retention/costs
"Help Clients Pay Less for Flood Insurance"
Includes sections on "Providing an Elevation Certificate" and "Mitigating their Risk"

continued on page 38

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