



the *American* Surveyor

MARCH/APRIL 2022

New Technology

Mapping Ireland

Ordnance Survey tales

Meridian Stones

Nantucket mystery

Scanning Ships

Combining passions

DANIEL
BOONE
Explorer
Surveyor
1734-1820

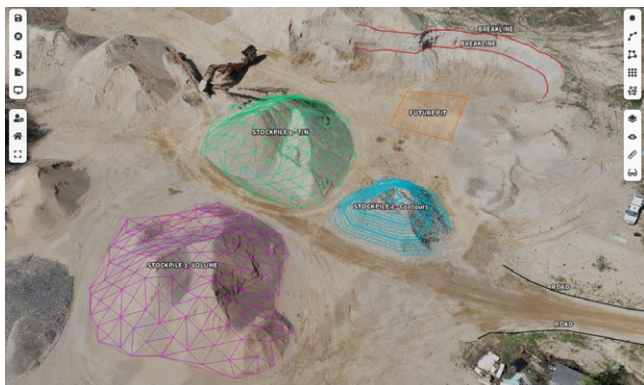
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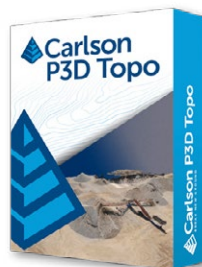
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The Value of History

As surveyors we know all about history and how that history affects a parcel of property. Without this knowledge we could not do our work. Many of us older surveyors like history for more romantic reasons because we have seen a lot of it in our years. The genesis of this month's cover feature revolves around a well-known historical character, Daniel Boone. Like John Brown, the cover subject of our July/August issue last year, who knew Daniel Boone was a surveyor?

For many years, Bruce Carlson, founder and CEO of Carlson Software, has had a vision for his hometown of Maysville, Kentucky. In addition to basing his business there, he has developed not only his office space in a beautiful old building, he has also built a park next door and populated it with several works of art. We wrote about this in our May 2017 issue: <https://bit.ly/3IJMV8a>. You can see the base for the Daniel Boone statue in the PDF.

Daniel Boone was a practicing surveyor during his residence in Maysville. According to Bruce, "In one of the books I read on Daniel Boone, it stated that he was a very good surveyor and knew how to measure accurately." In discussing why he decided to have a statue created, Bruce added, "The country needs some heroes right now." Hats off to Bruce for all he done for our profession all these years, and for providing an economic boost to his hometown.

In the world of commerce, we all know the value of a good website. But in addition to putting people together with products, a website can be a repository of knowledge. I'm proud of the fact that all the articles from my 26+ years as a magazine editor are available in online archives. Two of the articles in this issue are a direct result of material contained in the extensive archive on our website.

The first came as a result of research a resident of Nantucket, Nikoline Bohr, was making into two odd-looking stones in her town. She was concerned because the stones were not being protected, and one had even been hit by a car. In her research she came across an article written by Dr. Vladimir Strel'nitski in our May 2006 issue <https://bit.ly/3HPIkA5>. Likewise a resident of Nantucket, Dr. Strel'nitski was a friend of our unparalleled historian Silvio Bedini. Nikoline approached me and asked if I'd like another article about these two particular stones. You can see the result on page 16.

The second article comes from Ireland. Ian Sherry began his surveying career with the Ordnance Survey in Ireland back in the 1970s. Electronics descended on our profession during this time, but not before he had the opportunity to do it the "old way." His recollections are fascinating, and at times hilarious, and can be found on page 30.

I'd like to call special attention to this issue's GLO Record of the Week. Because it's so close to where I live I don't know why I haven't featured it before, but in a circular fashion, it brings up another subject: the 2022 Surveyors Rendezvous. This year it will be held in Harper's Ferry, WV, a stone's throw from the C&O Canal. Those of you who know your history are aware that Harper's Ferry is where John Brown made his last stand. And who knows, maybe Daniel Boone passed this way during his many explorations.

There's plenty more in this issue, including a feature about ship scanning and installments from Gary Kent (with help from Jessica Hess), Wendy Lathrop and Dave Lindell. And once again, if you like the print version of the magazine, I hope you'll consider supporting us. You can subscribe on our website. ■

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GLO RECORD OF THE WEEK

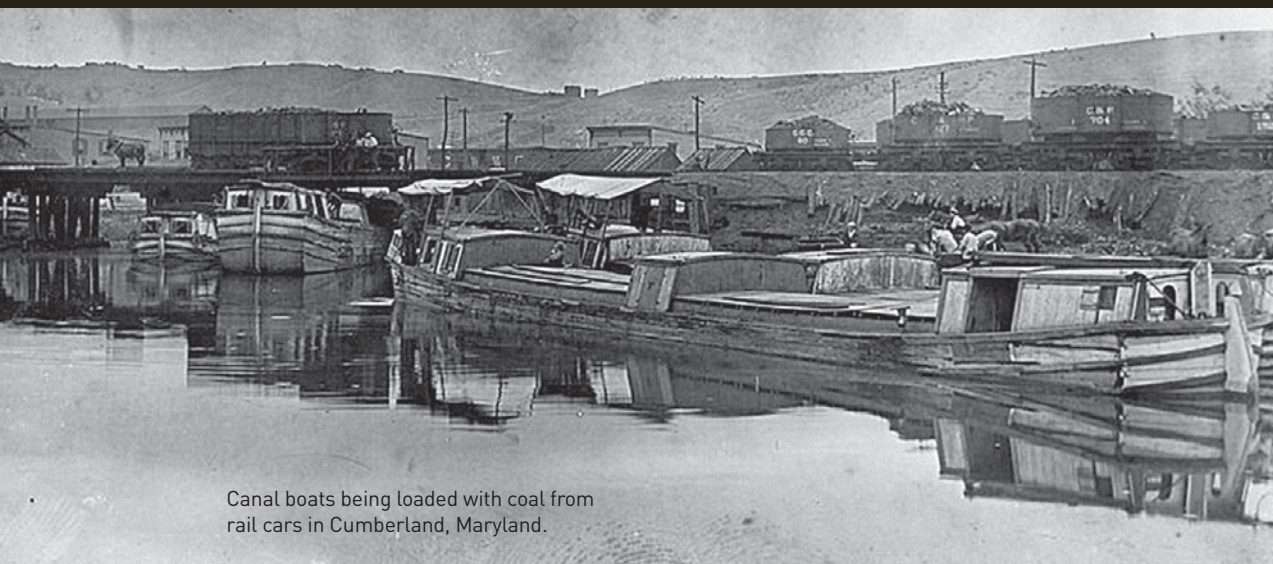
Chesapeake and Ohio

This week's record is of the Chesapeake and Ohio National Historical Park. This specific survey was accepted on Jan. 22, 2003, and depicts a segment of the C&O Canal just south of Cumberland, Maryland.

In November of 1823, the first Chesapeake and Ohio Canal Convention was held in Washington, D.C., to garner support for the proposed project. Delegates from Pennsylvania, Virginia, Maryland, and D.C. were all in attendance. By December of 1823, President James Monroe, in his annual address, urged Congress to appropriate the funds for a survey of the proposed route.

On Feb. 14, 1825, the United States Board of Engineers made its preliminary survey report. The city of Cumberland, Maryland, had been following the progress of the surveyors closely in anticipation. When the estimated cost of the C&O Canal according to the Board of Engineers was returned, it was seen as far too high. In response, the president ordered a new survey to be completed by James Geddes and Nathan Roberts. They concluded that a canal could be constructed from tidewater of the Potomac in Georgetown, to Cumberland for around \$4.5 million. Soon after, on May 24, 1828, Congress passed an act subscribing \$1 million to the company's stocks, and more investors followed.

» BUREAU OF LAND MANAGEMENT/
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Canal boats being loaded with coal from rail cars in Cumberland, Maryland.

Today's record was surveyed from July 16, 2002, to September 19, 2002. The reason for this particular survey was the structure located on the left side of the plat, a private building which had been constructed on National Park Service land. The survey crew was successful in locating many of the original stone survey markers which were set during the canal's construction in the 19th century.

Unlike most of the surveys that the General Land Office maintains, this is one of the relatively few

records which shows a Cadastral survey done in a metes-and-bounds state. In addition to conducting surveys in Public Land Survey System states, the Bureau of Land Management's Cadastral Surveyors also help identify boundaries of government lands in the Eastern States.

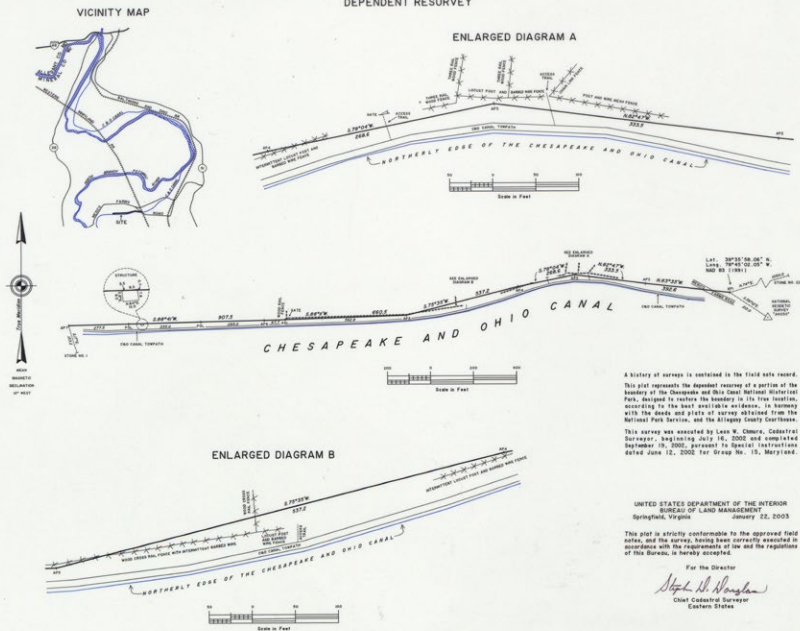
Despite numerous setbacks during construction, the portion of the canal from Cumberland to Lock 72 was filled with water on June 23, 1850. Lock 72 sits not far south of the area surveyed on this week's

Canal Historical Park



Swimmers take a dive in the canal, some time between 1909 and 1919.

CHESAPEAKE AND OHIO CANAL NATIONAL HISTORICAL PARK, ALLEGANY COUNTY, MARYLAND.
DEPENDENT RESURVEY



the B&O Railroad actually beating the canal to Cumberland in 1842.

The Baltimore and Ohio Railroad (B&O), as well as the Western Maryland Railroad, can both be seen here in the 2002 survey. They both paralleled the canal, as the Potomac River often cut the shortest route through the mountains.

The B&O Railroad actually broke ground on the same day as the C&O Canal—July 4, 1828. Competition between the two was high during construction, with each company levying injunctions against the other to stall construction and obtain right-of-way. By the 1870s, the canal was bringing economic prosperity to Cumberland and the surrounding areas. It was moving vast amounts of cargo, and industries grew around the area to support the growing business. Other than coal, its largest business, boats transported other bulk goods such as lumber, wheat, flour, iron, and limestone.

The railroads were eventually too much for the canal to compete with directly, and a devastating flood in 1889 led to the canal being purchased by its largest rival, the B&O Railroad.

The canal would continue on until 1924, when another major flood left it too damaged to continue.

In 1971, the Chesapeake and Ohio Canal National Historic Park was created. The National Park Service has maintained the original towpath as a popular bike trail. Today, bikers can ride 184.5 miles from Cumberland to D.C. You can also rent one of several historical houses along the canal! ■

Record from 2003. More segments of the canal would be filled in the coming months, but from June to the canal's opening in October this stretch of the canal was left filled with water. It was reported by the *Cumberland Civilian* on July 26th that people were chartering canal boats to take advantage of the new attraction.

The canal was fully completed on Oct. 10, 1850, and the city of Cumberland held a celebration to send the first five canal boats off towards Washington D.C.

While originally planned to go all the way to Pittsburgh, Pennsylvania, the canal would never go further west than Cumberland. The numerous setbacks during its construction resulted in



A surveyor wearing a black long-sleeved shirt with a 'VELCON' logo, a cap, and safety glasses is operating a Topcon total station. The instrument is mounted on a tripod and has a yellow sensor unit at the top. The background is a grassy field with a fence line.

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Carlson Photo Capture and xML2

Accurate Image-Based Trench Mapping

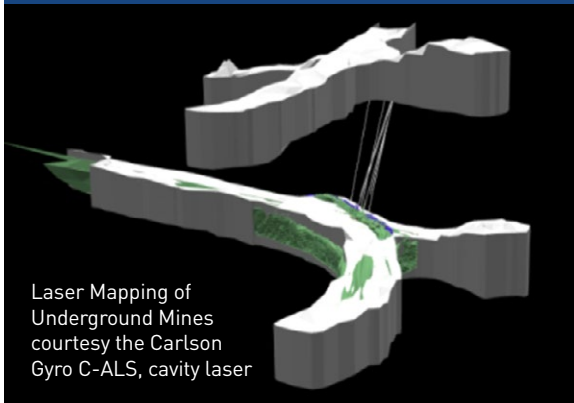
Buried pipes, cables, lines of sewage, gas, water, fiber optic, electricity are the basic infrastructure of a city environment. They are registered with their location and identification in utility maps. Utility maps provide us with the following functions:

- interrelation among geospatial objects in order to ensure correct land ownership
- safe and fast excavation in any place
- utility network management

In recent years, utility objects have been surveyed and mapped by conventional surveying equipment. This has changed because of the advances in mobile technologies as well as photogrammetric solutions.

Carlson has developed products that convert an ordinary mobile phone into a 3D geospatial information system for utility mapping. Also, drone-denied environments present an opportunity for a surveying pole and close-range photogrammetry solutions.

—Birol Gucluer, Carlson product consultant



Laser Mapping of Underground Mines courtesy the Carlson Gyro C-ALS, cavity laser

Carlson Software has greatly expanded its product line over its 38-year history, and recently has introduced two new products that represent technology breakthroughs: Carlson PhotoCapture and the Carlson Mini Locator 2 (xML2).

The Recent Evolution of Survey Technologies

Measurement technology for surveying and mapping rest today on 3 pillars: GNSS and the real-time kinematic (RTK) engine, image-based (pixel-based) mapping and laser-based measurement. Many of us can recall measurement by steel tape back in the 1970s, in association with horizontal and vertical angles from theodolites. This method of measurement existed since the time of Daniel Boone and George Washington and lasted for hundreds of years.

Then along came lasers in the late 1970s giving us total stations. Then GPS arrived initially from Trimble, and through the genius of the late Javad Ashjaee, the survey world obtained the RTK engine for instantaneous positioning. Then in the last 15

» MARC CHEVES, PS

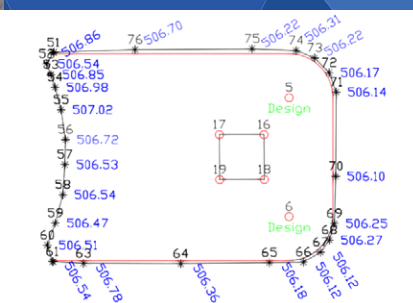
years, image-based mapping from drones made its debut. Carlson Software offers all three of these fundamental technologies in the form of laser-based products provided at present primarily for mining applications, image mapping through PhotoCapture, GNSS through the highly popular Carlson BRx7 and now Carlson introduces combined image/GNSS technology in the form of the xML2 trench mapping solution.

Carlson Photo Capture (CPC) and the xML2 "Mini Locator"

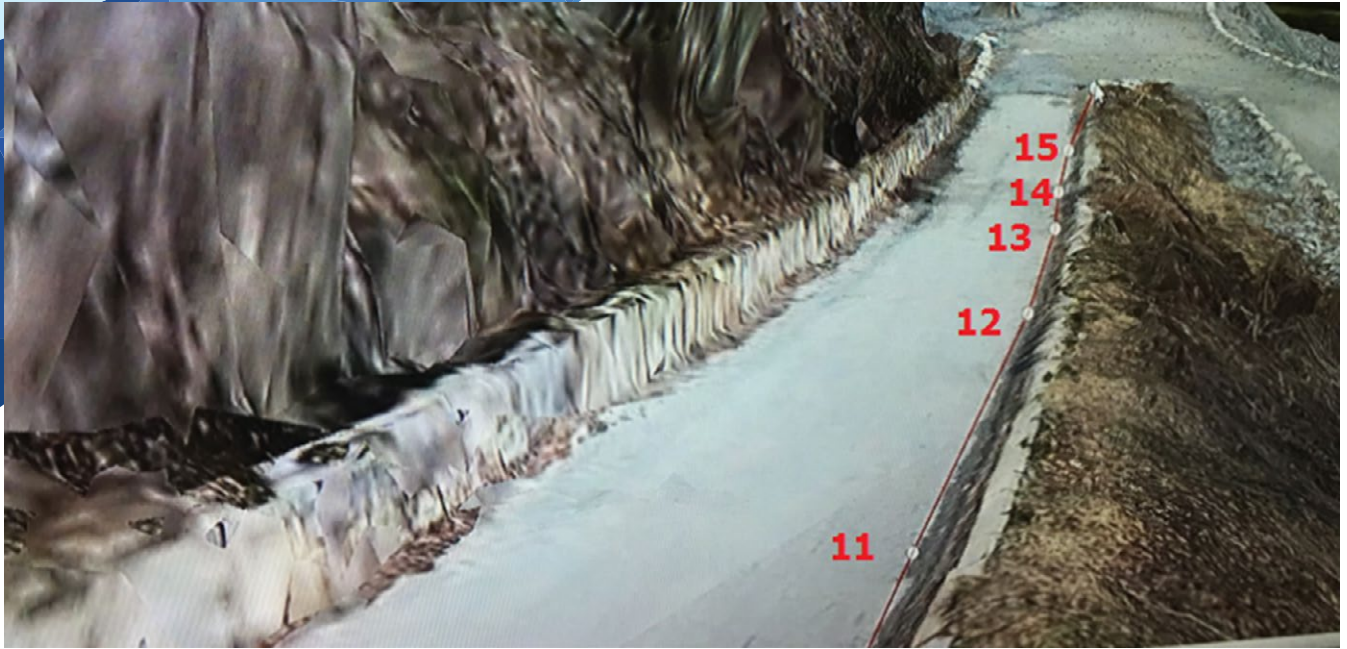
In order to understand the technology used in the xML2 Mini Locator solution, it is important to begin with CPC and image processing. Although the 4 main competitors (Pix4D, Drone Deploy, Datumate and Agisoft) were first on the scene, Carlson PhotoCapture offers a unique and seamless integration of this rare pixel analysis technology with the highly popular Carlson SurvPC, Carlson Survey and Carlson Point Cloud product offerings. SurvPC is used



Pedestal for Daniel Boone, mapped in 3D by PhotoCapture. Pick on map using Polyline option at right, then draw to CAD. Note "Bare Earth" feature, where tree branches are flattened to ground level.



Example 1: Design in Red, As-built CPC-drafted Line of Daniel Boone Statue Island in black, in CAD



Example 2: Draw EOP (road edges) in 3D within PhotoCapture

for ground control, then Carlson Survey and PhotoCapture combine for powerful field-to-finish symbol and linework mapping and finally, the Carlson Point Cloud module takes over for feature extraction ranging from paint stripe mapping, 3D tree/pole detection, 3D curb and gutter mapping and building perimeter identification. These in turn lead to precise, high-quality contouring of as-built sites.

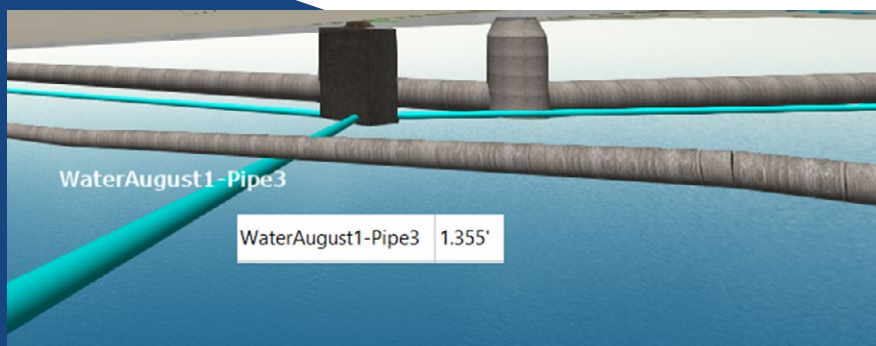
Mapping of Trenches with xML2 and CPC

Trenches are complex. There are issues of pipe clearance (as below).

Regulations have to be strictly followed. The time is right for accurate trench measurement, at low cost, using high technology. The time is right also for “technology fusion” to accomplish this task. With xML2, an Android phone or Android tablet, costing as little as \$100, can be used with Carlson Layout to snap photos as you walk the trench. No drone is involved. As each photo

“I use PhotoCapture on almost every job. The accuracy is unreal and time saved on topo work is amazing.”

—Mike Ruggles, PLS, KY.



Sanitary Sewer Lines in blue underneath Water Lines and alongside Storm Sewer Lines



Regulations even govern pipe deflection angles between pipe segments, and allowable fittings



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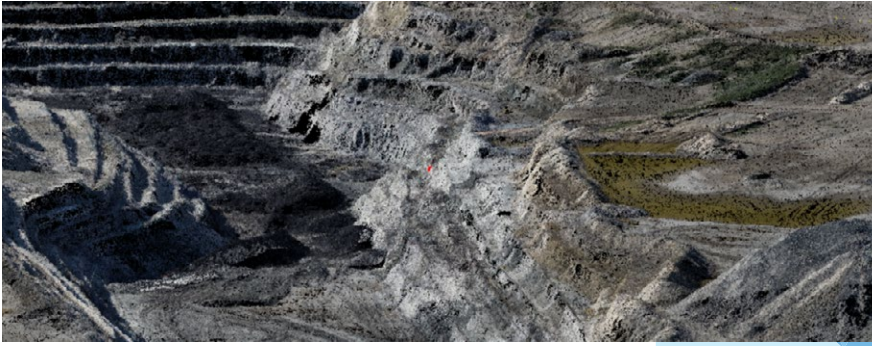


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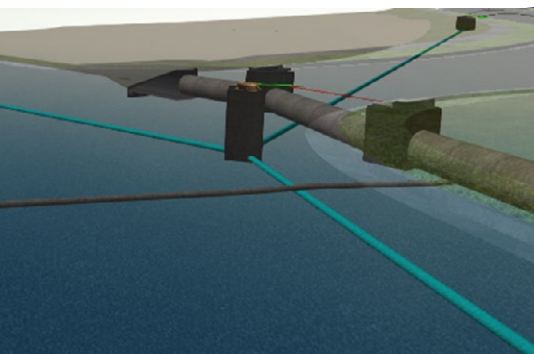
Example 3: Mine Applications—stockpile volumes, pit volumes

is taken, a GNSS (GPS) satellite reading is taken at the same time, georeferencing the photo. The Carlson RTK engine in Layout is computing the position instantaneously from the GNSS receiver in the xML2 unit. Heights and tilts are computed, and relative accuracy is 4 to 5 cm on the entire ditch in terms of excavation depths and alignments. With 2 or more ground control points taken by photo, with known position, absolute accuracy can reach centimeter level. Trench alignments and widths in this way can be archived for all-time, confirming satisfaction of regulations and proper bedding and alignment.

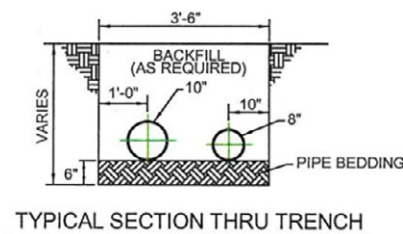
The xML2 collects the GNSS signal by the helix antenna and communicates to the Android phone running Layout by Bluetooth. Photos are taken from the Android phone by the press of a handheld button. The georeferenced images are then fed into PhotoCapture, and processed into final maps and 3D images that can be delivered to CAD and GIS solution platforms.



The Carlson xML2 system consists of any Android phone with photo capability mounted as shown, along with the top-mounted xML with built-in GNSS. Carlson Layout on Android provides the RTK engine. No cables or wires are involved.

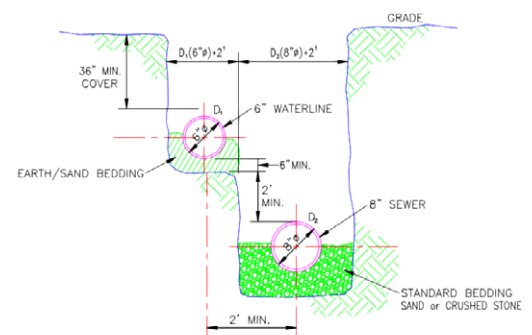


There are further issues of Pipe separation, H and V offsets, within the trench.



Dual Pipes Side by Side on Same Bedding

Complex Trenches with Sewer Line at H and V Offsets from Water Line





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“Carlson Software is doing the trenching to bury multiple overhead lines along a community path in Maysville, KY. I’ve been proofing out the xML2 system on these trenches.”

The trench below illustrates a fully georeferenced 3D map of multiple utilities placed in a trench, archived for all time. Note the presence and recording of 6 different utility pipes and conduits of two distinct types, separated by concrete block, meeting regulations in this case. The mapping can be stored in CAD form as plan and profile and also archived in 3D form. Trench mapping can be conducted at all stages of construction: initial trench excavation as above, then after bedding is placed, then with pipes in place as below, and finally with full backfill applied to the trench.

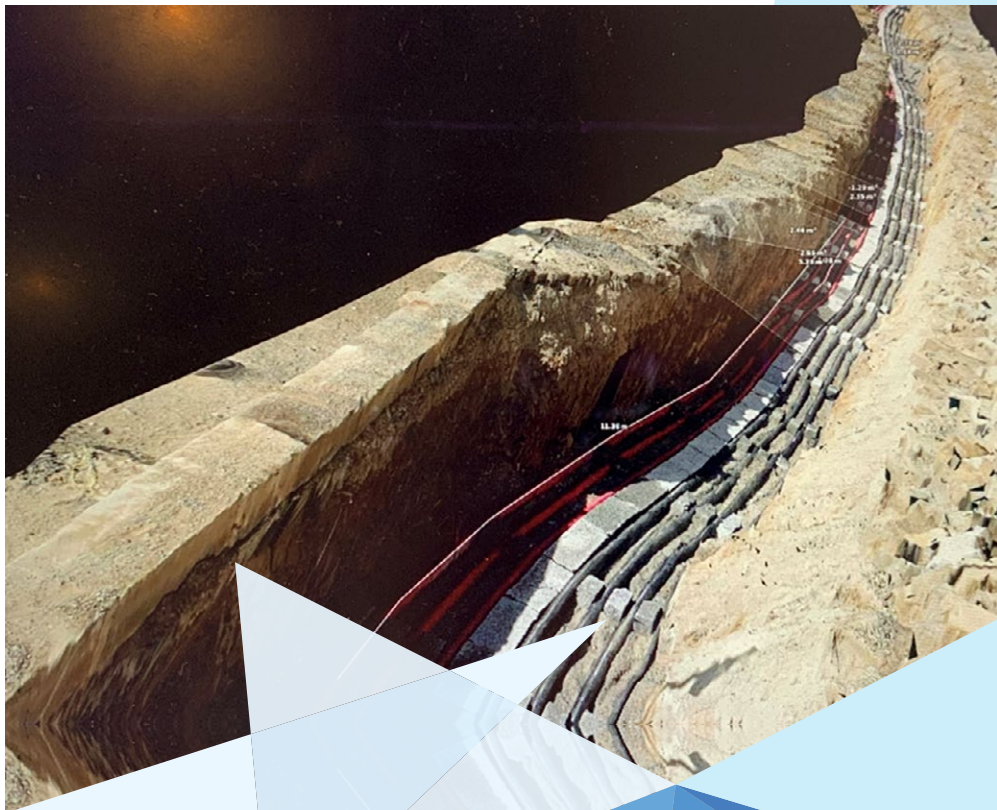
All across the globe, utilities are going underground, and the mapping and recording of pipe and utility locations is becoming critical to record keeping, GIS mapping and pre-construction site analysis. With xML2, and the processing of PhotoCapture, trench mapping becomes highly automated, and the process of mapping becomes as easy as walking alongside the trench, snapping photos, using the extremely effective xML2 system.

It took the convergence of multiple new technologies, including GNSS-based measurement and image-based processing, with links to CAD and GIS, to make this possible at low cost. Happy trench mapping! ■

Marc Cheves is editor of the magazine.



Left: Erik Wesley, Carlson Software, the Four Corners Regional Director



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Nikoline Bohr examines the northern Meridian Stone on Nantucket Islands historic Main Street.

CHRIS BERKENKAMP

Exploring the Mystery of NANTUCKET'S MERIDIAN STONES

In 1840 the astronomer and surveyor William Mitchell erected two white marble obelisks on perpendicular sidewalks in the Town of Nantucket, Massachusetts. These two stones are set in an astronomic north-to-south alignment and are commonly known as the Meridian Stones. The two historical stones have seen better days. Both stones have on multiple occasions been struck by carelessly driven vehicles. The southern stone was knocked to the ground numerous times during the early 1900s (*The Inquirer and Mirror* 1921; *The Inquirer and Mirror* 1964). To protect it from further damage two large concrete-filled iron bumpers have been erected on either side of it. The Northern stone has been struck several times during recent years and as a result, several marble chunks were gouged off of its surface. At this point, there are no established barriers positioned to protect the northern stone from yet another destructive vehicle impact.

Last February I began a research project focused on understanding just what Nantucket's Meridian stones are. It quickly became clear to me that these stones were once far more influential than they are currently believed to have been. Time has taken its toll on the stones and on the historical records of the stones. Over the course of nearly 200 years, most fact-based knowledge of their original purpose has been lost. The current perception is that the Meridian Stones were placed with the intent of being used by land surveyors as compass stones (Strelnitski 2009). Other suggested but until now unsubstantiated theories include that William Mitchell erected the Meridian Stones to aid him in rating chronometers, that ship captains would visit the Meridian Stones in order to correct their compasses and safely navigate the oceans, and that the Meridian Stones had no functional use other than being a monument to surveying and astronomy (Strelnitski et al. 2006; Orr 1995). Based on my

» NIKOLINE BOHR



Figure 1: Google Maps view of the meridian stones placement in relation to the Pacific Bank.

GOOGLE MAPS

Left: The sun rises over the northern Meridian Stone.

NIKOLINE BOHR

Below: The Meridian Stones dedication plaque mounted on the Pacific National Bank.

NIKOLINE BOHR



research it seems each of the suggested uses, at best, provides a partial understanding of what the Meridian Stones are and how William Mitchell intended for them to be used. I suggest the Meridian Stones join the terrestrial with the astronomic, mark the Town of Nantucket's first primary astronomic baseline, guided Mitchell in establishing Nantucket Mean Time, facilitated the determination of Nantucket Islands' true geographic position, and mapped the way for safer nautical navigation.

To better understand how William Mitchell used the Meridian Stones we must realize the significance of their exact location. The northern meridian stone is positioned beside the Pacific National Bank. The southern meridian stone is positioned a few hundred feet away and is in a clear line of sight from both the northern stone and from the bank's rooftop. Thus, if one draws a straight line passing through the center of the tip of the two Meridian Stones, the line will pass directly through the Pacific National Bank (**Figure 1**). In 1840 the Pacific National Bank was the location of William Mitchell's nautical rooftop observatory (H. Mitchell 1889).

The line indicated by the two Meridian Stones is a longitudinal line spanning from astronomic north to south as observed from the bank's rooftop. This line passes through the Pacific National Bank and through the heart of William Mitchell's rooftop observatory. Such a line is called a meridian line. It reaches from astronomic north to south and often passes through the position of an observer. In the mid-1800s, astronomy was still in its early stages, observatories were of

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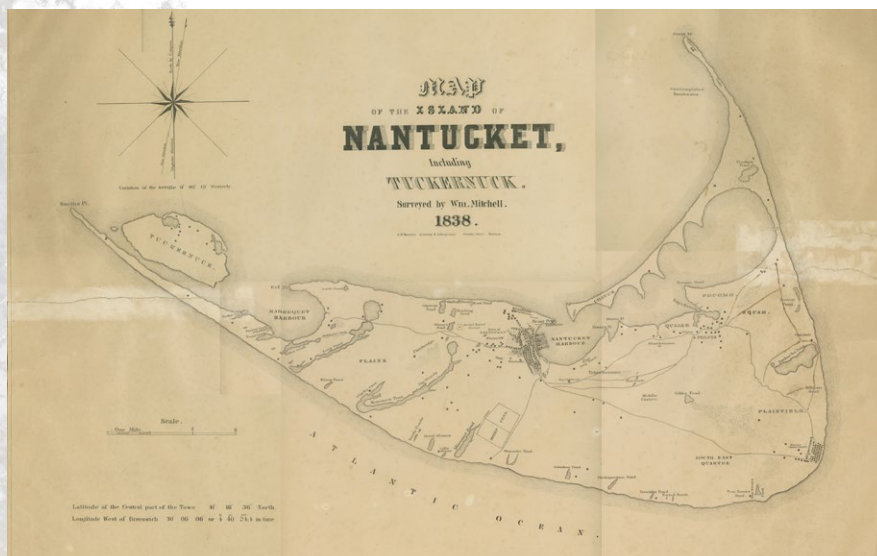
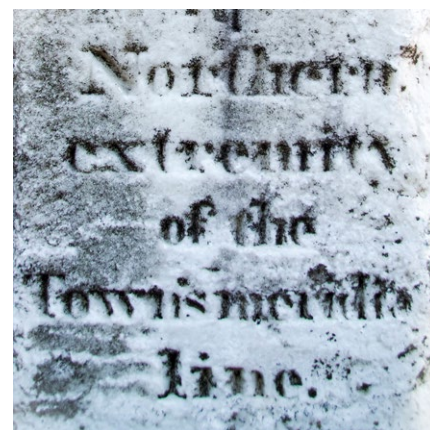


Figure 2: Map of the Island of Nantucket, Including Tuckernuck, William Mitchell, 1838, in the Map & Chart Collection, Nantucket Historical Association.



The northern Meridian Stone reads, Northern extremity of the Town's meridian line.

NIKOLINE BOHR

experimental makeshift construction, and time and place were not yet unified global measures. The early astronomers spent much time dedicated to measuring the globe. Timekeeping and cartography were a primary focus. Astronomers such as Mitchell would align their telescope to the meridian of their observatory in order to accurately and precisely observe the transit of planets and stars as they crossed over the meridian line. It is from these observations one can accurately calculate local mean time, determine relative local latitude and longitude, and chart the sky, the land, and the ocean. It should furthermore be noted that during the mid-1800s large international observatories, including the Greenwich Observatory and the Cambridge Observatory of Harvard University, not only established meridian lines but also erected meridian sight marks on their meridian lines (Pond 1833; Lovering and Bond 1846). These sight marks were used by the astronomer to align the micrometer hairs of a telescope's sight with a mark on the respective meridian sight mark thus ensuring the telescope would always be perfectly in line with the meridian line. It seems likely Mitchell similarly aligned the sight of his telescopes to the vertical markings on the southern meridian stones, thereby suggesting the Meridian Stones are meridian sight marks. In essence, the Meridian Stones are the grounding markers of Mitchell's astronomical observations. But let's look a little closer at how this applies to the current and past perception of how William Mitchell used the Meridian Stones.

Calculations in William Mitchell's astronomical journal indicate he calculated the position of the Meridian Stones in 1836 from



Map of the Town of Nantucket in the State of Massachusetts, William Coffin 1834, in the Map & Chart Collection, Nantucket Historical Association.



X150
LASER SCANNER



SLAM XH120
HANDHELD 3D SCANNER





William Mitchell and youngest daughter, Kate Mitchell, posed for artist Herminia B. Dassel about 1857, depicting the time when William and Maria Mitchell viewed a solar eclipse from their home on Nantucket in 1831
COURTESY OF THE NANTUCKET MARIA MITCHELL ASSOCIATION



Stones directly assisted Mitchell in rating chronometers to the highest standard.

Assuming the Meridian Stones are compass stones, it seems plausible ship captains would have visited the stones to check the local magnetic field variation. By doing so a captain would be able to more accurately read local nautical maps depicting Nantucket's near-lying treacherous shoals. During the mid-1800s the shoals off of Nantucket's coast were a deathtrap for many a large seafaring vessel. The geographic location of the shoals was poorly documented and to further complicate the task of safely navigating in and out of Nantucket Harbor, Nantucket's known geographic position was also of questionable accuracy. Mitchell recognized the dangers of Nantucket's shoals and brought this to the attention of the Coast Survey. His suggestion to map Nantucket's near-lying shoals was taken seriously by the Coast Survey who responded immediately. One of the first tasks at hand would be to determine the exact geographic location of Nantucket Island. This task was appointed to William Mitchell (Bache, U.S. Congress. House, et al.

the rooftop of the Pacific National Bank (W. Mitchell 1845). Their latitude and longitude appear to be the same as the latitude and longitude of the Town of Nantucket as presented on the first accurate map of Nantucket town, as surveyed by William Mitchell, and printed in 1838 (**Figure 2**). Thus, it appears the Meridian Stones represent a surveyor's baseline. Compass Stones are one of several types of land surveyors' baselines. They are set in local astronomic north-to-south alignment and are intended to aid surveyors in accounting for the influence of the earth's magnetic field variations on their compass needles. Mitchell knew accounting for magnetic field variations was essential when one wished to

make consistent and repeatable land measurements. If Mitchell erected the Meridian Stones for this purpose, it seems likely there may once have been a third stone placed between the northern and the southern stone.

Chronometers are seafaring clocks designed to withstand the harsh conditions of a long ocean voyage while continuing to maintain a dependable and consistent time. Before modern navigational technology, a ship's captain would have depended on accurate chronometers in order to determine the latitude and longitude of a ship while at sea. It is nearly impossible to safely navigate shallow ocean waters without knowing a ship's exact geographic position. We know William Mitchell rated chronometers for ships captains long before he established his nautical rooftop observatory. A chronometer is rated by comparing the passage of time given by the chronometer to a known local mean time. This must be repeated over the course of several days, at the same exact time every day. The goal is to obtain a set value for how much time the chronometer gains or loses each day. By establishing a rooftop observatory, Mitchell was able to calculate Nantucket Mean Time far more accurately than before. With this consistent and dependable local reference time, he was capable of rating chronometers far more precisely. This is reflected in his astronomical journal where one will find Mitchell rated chronometers to Greenwich Mean Time prior to 1840 and at later dates began rating chronometers to Nantucket Mean Time (W. Mitchell 1845). Thus, the Meridian

The sun rises over historic Main Street.

NIKOLINE BOHR





The southern Meridian Stone as it currently stands on Fair Street.

NIKOLINE BOHR

1845). Thus, Mitchell continued to track the stars as they transited the meridian line of his observatory in order to determine Nantucket Islands' exact geographic position and assist the Coast Survey in accurately charting Nantucket's treacherous shoals.

With respect to the notion that the Meridian Stones were erected simply as a monument to science, this can hardly be considered accurate. However, as the stones still stand today, they are a reminder of past scientific advances and a monument to William Mitchell. It seems only right to recognize the Meridian Stones for what they truly are and to protect them from further damage in order to honor Mitchell's vision and his significant contributions to the advancement of seafaring safety.

Please visit www.meridianstones.com if you would like to protect William Mitchell's Meridian Stones and help save a significant piece of New England's history. ■

Nikoline Bohr is a scientist, a historian, a treasure hunter and an artist. She has a BS in Physics from Rensselaer Polytechnic Institute. With a scientific core and a treasure hunters taste for adventure Bohr explores our collective past with hopes of aiding a brighter future. Her current work focuses on preserving Nantucket Islands complex and fragile history for coming generations to appreciate and learn from.

This article is a just summation of my initial research on the Meridian Stones.

Forever dedicated to my beloved and wise grandmother Dorothy Hesselman.

I would like to extend a thousand thank-yous to the Maria Mitchell Association for granting me access to William Mitchell's journals and letters, and to the Nantucket Historical Association for providing a wealth of historical documents to browse.

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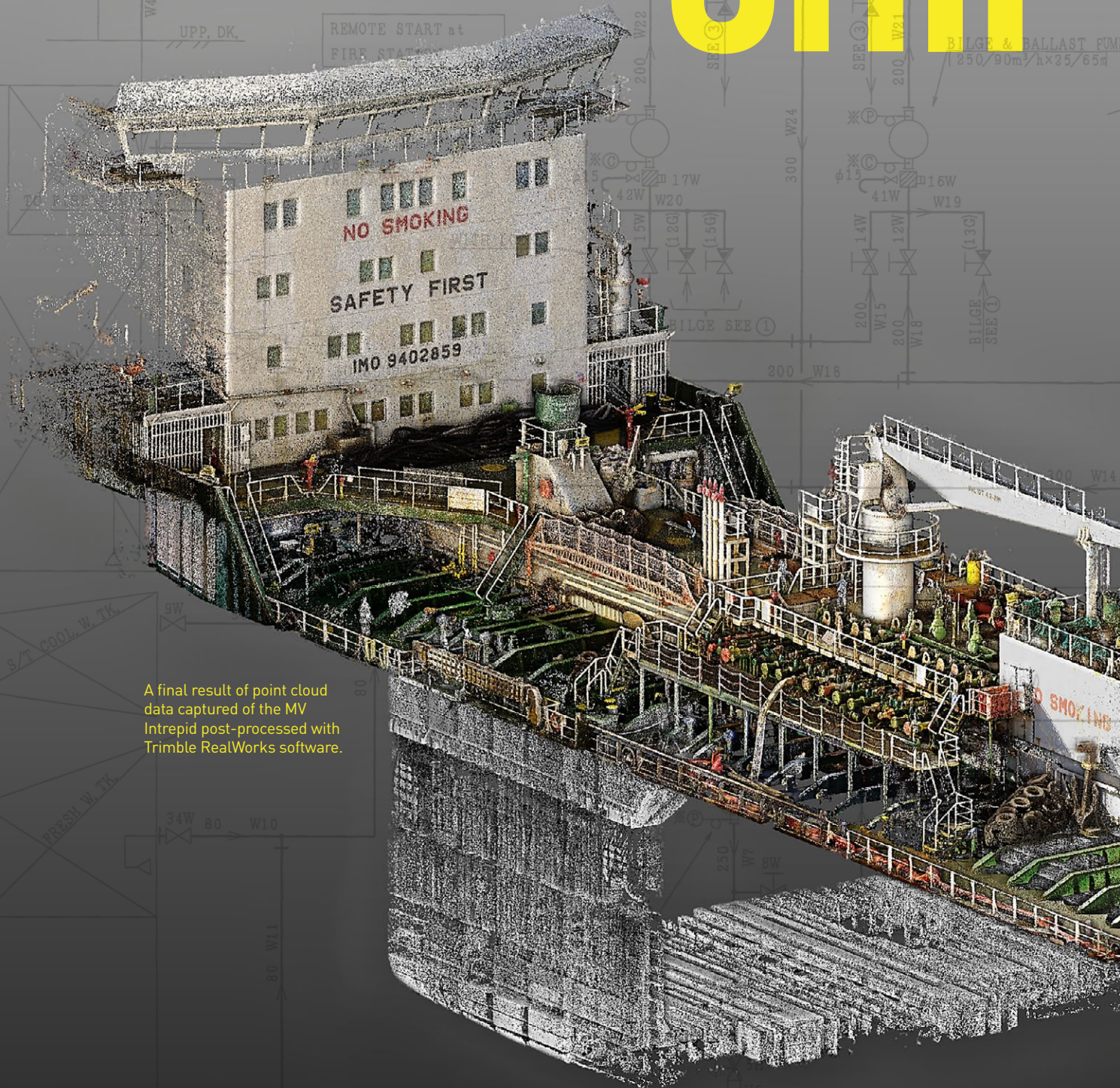
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SHIP



A final result of point cloud data captured of the MV Intrepid post-processed with Trimble RealWorks software.

SCANNING SETS SAIL

Engineering surveyor Danie Roelvert is a strong believer in one particular guiding principle: what is yours will come to you when it's ready. And after 15 years of employment with a South African survey company and months of contemplating a different career path, Roelvert felt the time was right to "fly on his own."

"I felt I'd reached a ceiling in the company and needed to pursue something different," says Roelvert.

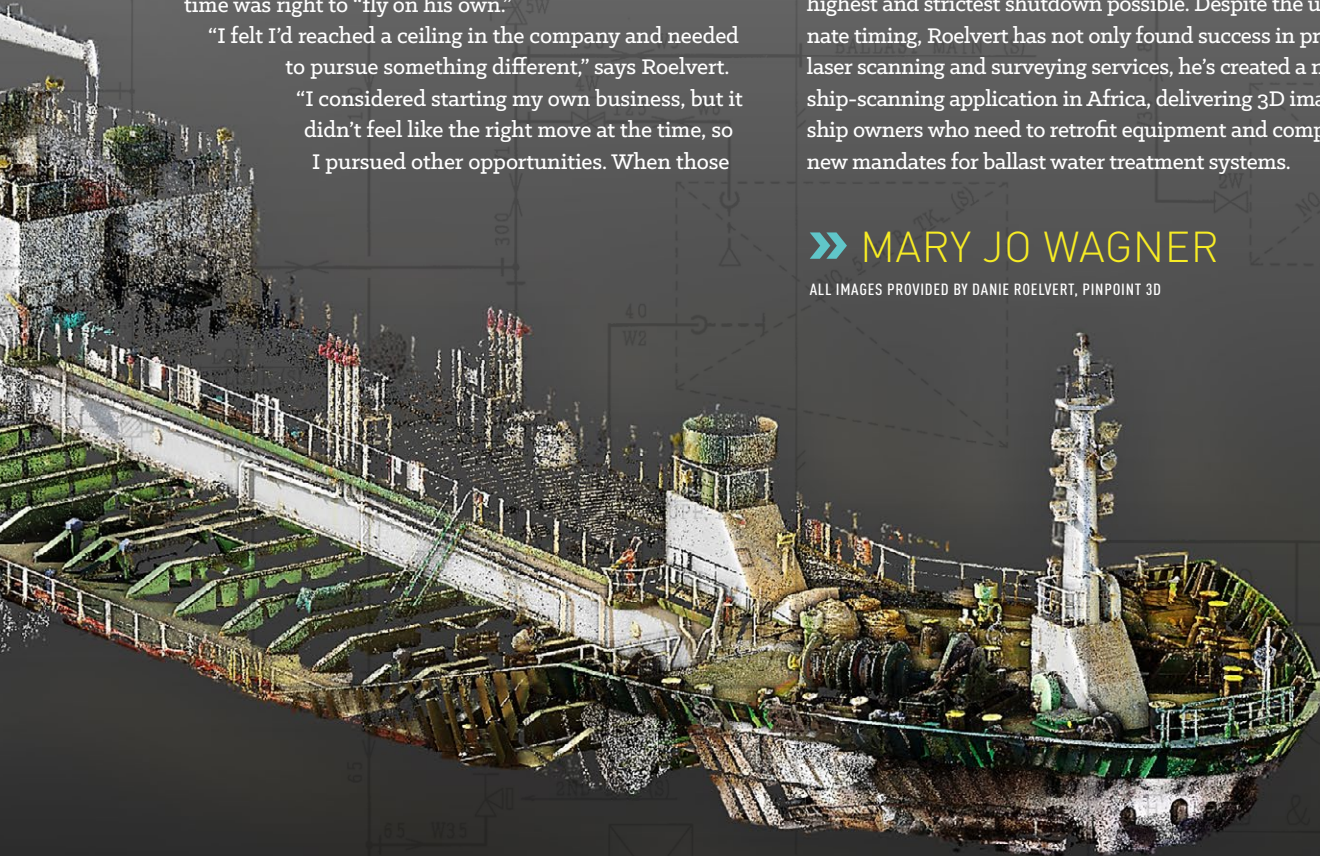
"I considered starting my own business, but it didn't feel like the right move at the time, so I pursued other opportunities. When those

either didn't work out or didn't feel right, I took that as a sign that I was supposed to take a chance on my own venture. I'm so glad I listened."

On Apr. 1, 2020, Roelvert officially launched his own company PinPoint 3D. Coincidentally, that was around the time that the country issued a level 5 Covid-19 lockdown—the highest and strictest shutdown possible. Despite the unfortunate timing, Roelvert has not only found success in providing laser scanning and surveying services, he's created a niche ship-scanning application in Africa, delivering 3D imaging to ship owners who need to retrofit equipment and comply with new mandates for ballast water treatment systems.

» MARY JO WAGNER

ALL IMAGES PROVIDED BY DANIE ROELVERT, PINPOINT 3D





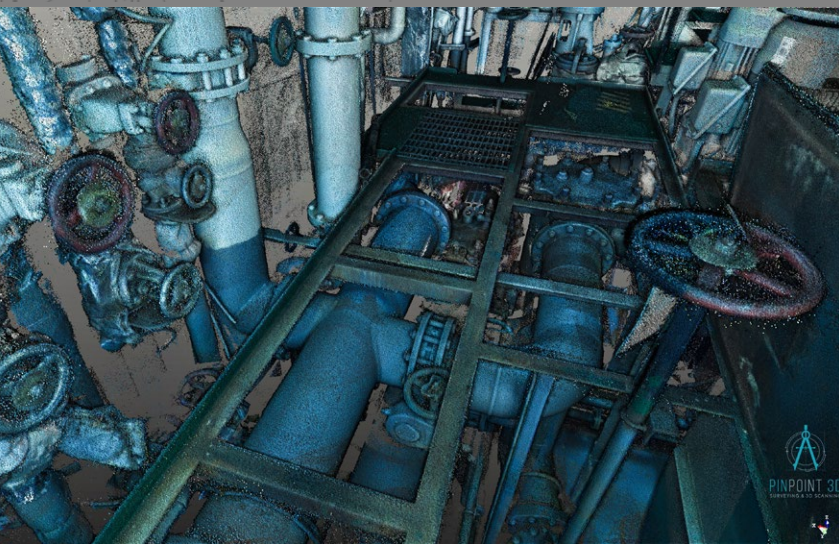
Buoying business

In September 2017, a treaty adopted by the United Nations' International Maritime Organization (IMO) to help prevent the spread of potentially harmful aquatic organisms and pathogens in ships' ballast water became a reality. Under the order, ships must manage their ballast water so that aquatic organisms and pathogens are removed or rendered harmless before the ballast water is released into a new location—marine protection that will help prevent the spread of invasive species as well as potentially harmful pathogens.

For the shipping industry, that means most ships will need to install special equipment to treat the ballast water. Although phased in over time, all individual ships that meet the treaty's vessel eligibility must be fitted with the required treatment system by September 2024. And that has buoyed Roelvert's burgeoning business with ample opportunities.



In addition to ship scanning, Roelvert has set the Trimble X7 on land to scan other facilities such as capturing as-built structural information at this Ford Motor Company warehouse in Pretoria.



A maze of engine room pipes captured by the Trimble X7 for the Melina ship-scanning project.

"Laser scanning is the perfect and only answer to this problem," says Roelvert, whose company is based in Pretoria, South Africa. "Ships are in port for a limited time so you need to work efficiently and ensure you collect everything the client needs because you don't have another opportunity to rescan once the ship sets sail. The speed, versatility and data density of laser scanning enables you to quickly set up in cramped spaces and capture the fine, detailed elements of entire engine or pump rooms in a few hours. With that virtual environment, designers can place pipes exactly where they need and ensure they'll tie together."

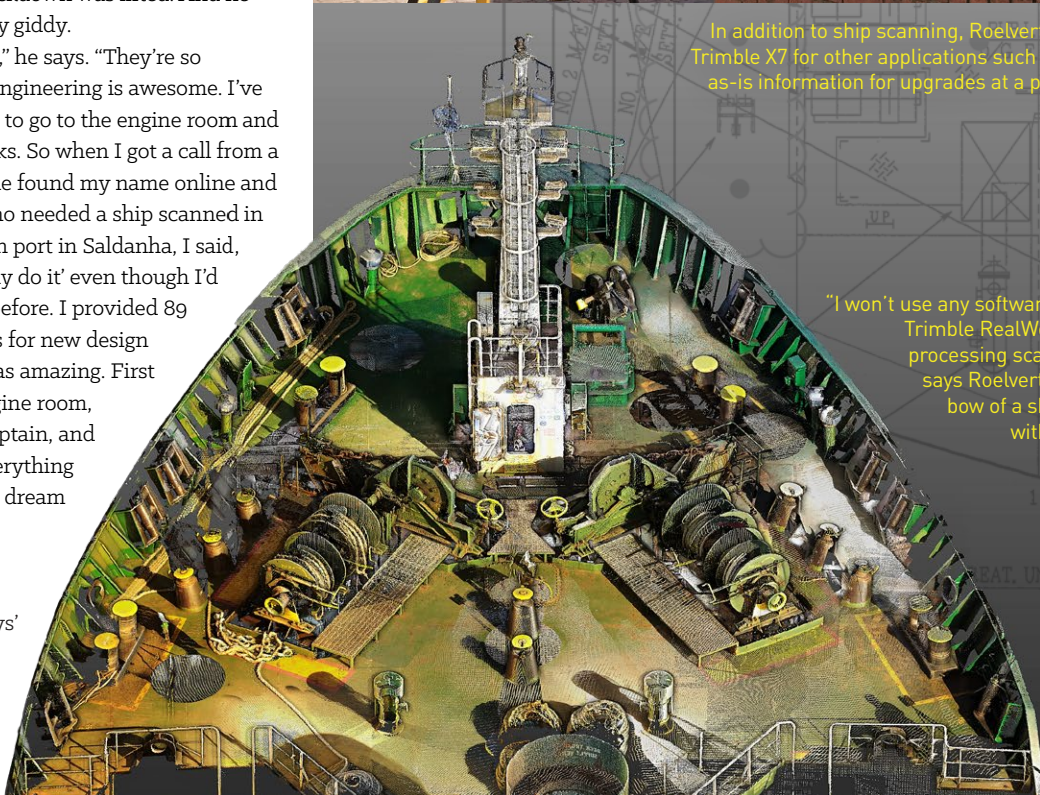
Roelvert got his first ship-scanning opportunity five months after South Africa's first lockdown was lifted. And he was undeniably giddy.

"I love ships," he says. "They're so majestic. The engineering is awesome. I've always wanted to go to the engine room and see how it works. So when I got a call from a guy who said he found my name online and had a client who needed a ship scanned in a South African port in Saldanha, I said, 'I can absolutely do it' even though I'd never done it before. I provided 89 as-found scans for new design work, and it was amazing. First time in the engine room, meeting the captain, and seeing how everything works. It was a dream come true."

Roelvert is typically only given a few days' warning from



In addition to ship scanning, Roelvert is using the Trimble X7 for other applications such as capturing as-is information for upgrades at a pump station.



"I won't use any software other than Trimble RealWorks for post processing scanning data," says Roelvert. Here is the bow of a ship rendered with RealWorks software.

operators who need vessels scanned so he needs to be ready to work at a moment's notice. Marine architects and designers provide him with drawings of the ship's layout and circle in red the specific areas or pieces of equipment they want scanned. It's Roelvert's job then to figure out how to capture that information to create one complete model of the entire area of interest.

Since that first ship-scanning assignment, Roelvert has scanned several more ships in South Africa and West Africa, including an offshore fuel tanker in Togo, which challenged his motion-sickness vulnerabilities, and a bulk carrier in the South African port of Durban, which tested his technical skills. The various assignments have given him the opportunity to utilize different scanners for different jobs, experience that has helped him determine which technology best suits his business.

"The Trimble X7 is the best all-rounder scanner," says Roelvert. "It has speed, good quality data, efficiency, and most importantly, versatility. I want to be able to put it in a backpack and fly off, and the X7 is perfect for that. Its on-site registration is incredibly valuable and saves me significant time. And its software solutions enable me to load project data such as a design file, and after scanning a particular asset, I can immediately see if that planned equipment will fit or if there are obstructions that might be a problem. That data depth is really valuable for the client."



With the Trimble X7, Roelvert scanned the Melina's engine and control room in six hours.

Confined space scanning

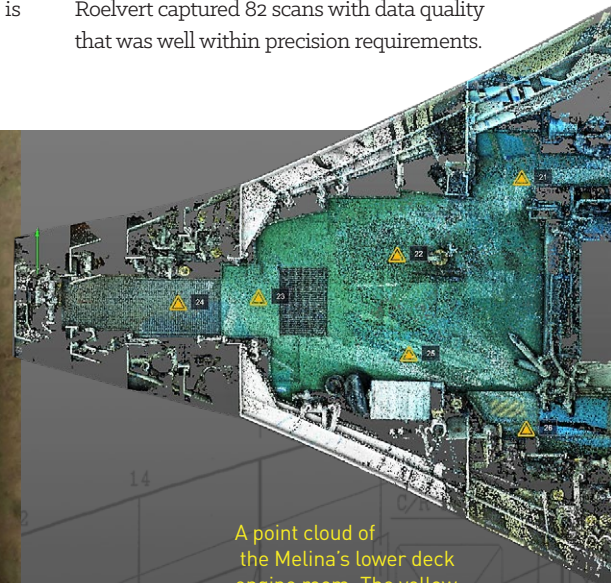
For the Durban project in April 2021, Roelvert was tasked with scanning six areas of interest (AOI) across three decks of the engine and control rooms of the Melina, a 28,000-ton bulk carrier. Of critical importance was capturing specific flange positions and connecting pipes targeted for replacement.

"Because you're in a confined and congested space, you can easily not capture enough detail on the important elements," he says. "The scanner's in-field registration option ensures that I capture all the important pipes, flanges, and pumps, which is critical for clients because parts are prefabricated while the ship is in transit and then installed at its next port. So, if data is inaccurate, that can be costly."

Roelvert started on the lowest deck of the engine room and worked his way up, mindful of the sway of the ship and the heat of the room. He positioned the scanner to both capture the particular elements highlighted by the client and an extended boundary for proper scan overlap. For each set up, he collected a full-color scan and a set of corresponding photos in about two minutes—a few scans requiring exceptional detail took four minutes. After each scan, he reviewed the 3D image using Trimble Perspective software on his T10 tablet to confirm that he clearly recorded the important assets positions and that there was enough overlap to connect scans together. Within six hours, Roelvert captured 82 scans with data quality that was well within precision requirements.



In addition to ship scanning, Roelvert has set the Trimble X7 on land to scan other facilities such as this warehouse in Durban where he carried out floor-flatness scans after a concrete pour.

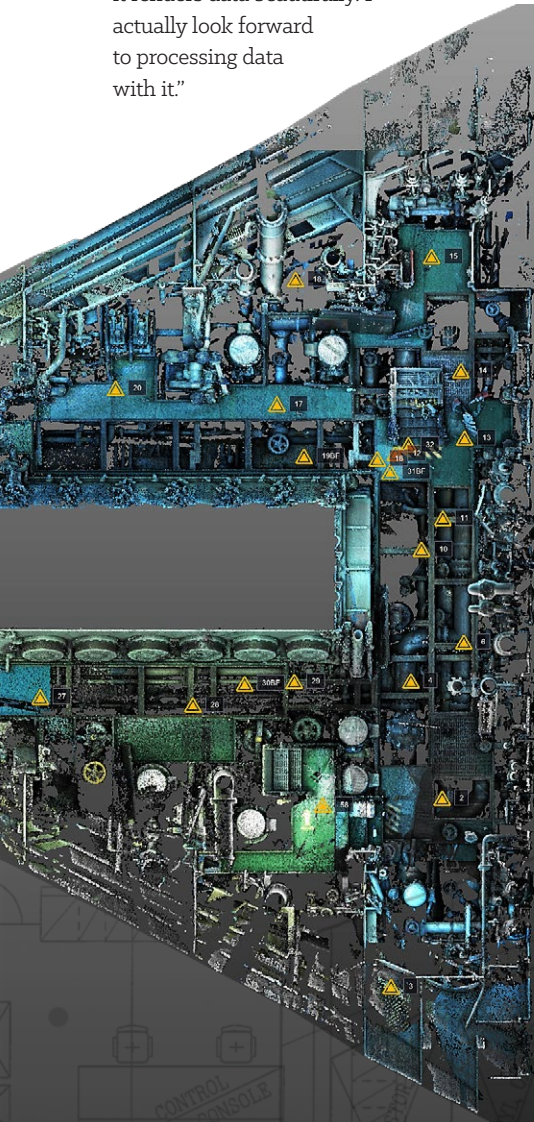


A point cloud of the Melina's lower deck engine room. The yellow triangles represent each scanning setup.

"Clients typically require density and accuracy specifications relevant to a particular scanner that has become popular for engine rooms," says Roelvert. "With that scanner, it takes about 5.5 min per set up for a color scan. With the X7 the same density and quality of data requires about 2.5 min set up. So, it saves you a lot of time and I get more data detail."

Although Roelvert says final registration and refinement can be done on a tablet on site with the X7, he prefers to post-process the data using Trimble RealWorks, a software solution specifically designed for point cloud processing and analysis. Loading his registered scans into the software, he used automated cleaning tools to eliminate any extraneous noise and then rendered the 3D dataset into a complete colorized model of the ship's engine room and control room.

"I won't use any software other than RealWorks for post processing scanning data," says Roelvert. "It's cleanup and registration tools are excellent, and it renders data beautifully. I actually look forward to processing data with it."



Roelvert uses the Trimble X7 to capture as-is information for upgrades at the Chamdor Brewery in Krugersdorp, South Africa.

Off the ships, Roelvert has taken the X7 on other projects to further experiment with the technology. Last October, for example, he used the laser scanner for an excavation project in the Johannesburg central business district. After demolishing a building and excavating 30 m down, crews inserted piling on the sides for reinforcement. Roelvert's client needed to know how much available space there was for underground parking and other elements.

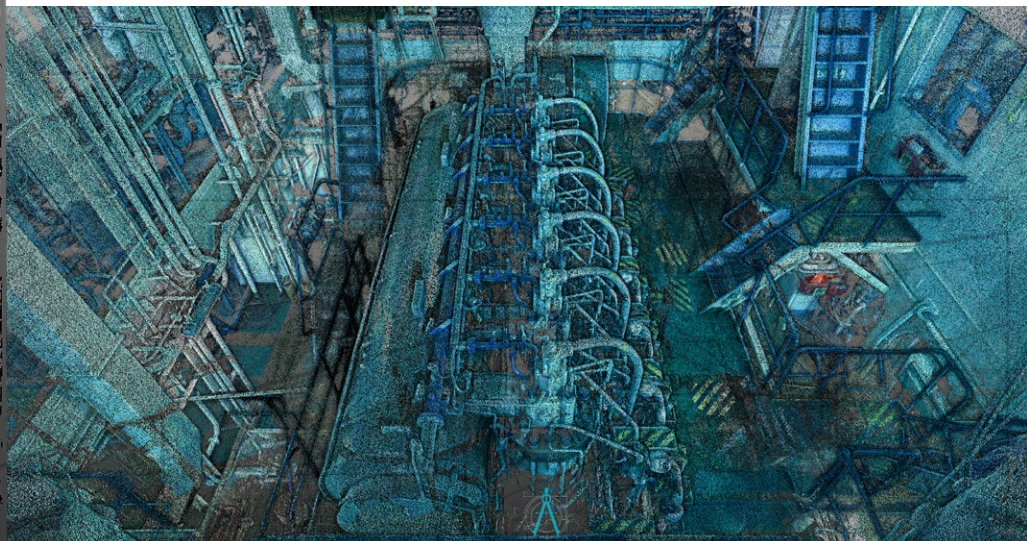
He set up at the bottom and collected full dome scans of all sides of the open space. Then he elevated a tripod about 3-meters high and set the scanner on top to capture

the surface. In one hour, he acquired 12 full color scans.

Although Roelvert welcomes all the new opportunities that continue to come his way, he feels most fortunate that he can combine his two passions — ships and laser scanning — and make a living from it.

For Roelvert, timing has indeed been everything. ■

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



Roelvert appreciated the compactness of the Trimble X7 to nimbly move around to scan the Melina's engine room.

Making Maps IN Ireland

» IAN SHERRY



Above: Me standing at the pillar on Slieve Martin above our house some time back. I observed from there more than 50 years ago. (I'm shocked)

Right: My 1:2500 Ordnance Survey field trace of Rostrevor—1978



I joined Northern Ireland's Ordnance Survey in 1966. Truly it was an organisation that hadn't changed for more than one hundred years. Hardly changed since June 1824. That was when the British Parliament approved the sum of £300,000 and charged Lt-Col Thomas Colby with the task of mapping the entire island of Ireland at a scale of six inches to one mile. His lieutenants were fellow officers Thomas Drummond and Thomas Lorcom. They had the foresight to recruit

George Petrie a member of the Royal Irish Academy (an inspired antiquarian) his protégé George Du Noyer and the celebrated John O'Donovan one of the greatest Irish Scholars of all time.

Colby understood the importance of Irish involvement but the tirade by the imperious Duke of Wellington: "The Irish map cannot be executed by Irish engineers or agents. Neither science, nor skill, nor diligence, nor discipline, nor integrity, sufficient for such work can be found in Ireland"—influenced

the training of low-grade army personnel that devastated Ireland's own mapmakers putting them out of work. And on top of that there was the matter of hostility to men dressed in military uniform—unmistakable emblems of British occupation. It was only when the British Sappers widespread drunken illiteracy had begun to get on officers' nerves that Irish 'country labourers' were employed. And in a short time were to outnumber The Sappers by four to one.

By my time only the Chief Survey Officer was British and shortly after I retired (to my delight) the post of 'Chief' is held by a former colleague and friend of mine. My career started with a month in the office learning to draw with a rule pen and a further three months in Belfast's Ormeau Park learning to 'chain.' Then to Newry to work on the 1:500 scale map. But only for a brief time because the re-triangulation of Ireland was in full swing. Colby had established a base line on the shores of Lough Foyle—7.89 miles long—that for 60 days in the Autumn of 1827 occupied 70 men.

On this 'perfect side' the entire triangulation of Ireland was built. We were doing it again. Building pillars on mountain tops



St. Bronach's Church Rostrevor.

and burying blocks in fields. This time we had a theodolite and EDM and I was given a course in both. There was fifteen or more of us in the section portaging theodolite, Tellurometer, car batteries, lights, temperature, and pressure measuring equipment to Ireland's most inaccessible points. In

looking back, I find it amazing that at the time our only means of communicating with our colleagues on the other stations was by—flashing Morse code. Unbelievably that's why we had the batteries and lights. When I see the perfusion of mobile phones now!

The pillar on Slieve Martin in front of our house has become the focus of many charity runs. Its purpose is long forgotten. To others it's just a slab of concrete in a scatter of rocks. But to me it's an altar that I put my hand on and remember communicating with all the other pillars, buried blocks, church spires and indeed lighthouses in every bailiwick in the land. For a couple of years, I had a wonderful time in the 'Trig Section.'

Moving from place to place; we played sport in the various parishes and drank in the local pubs. And then I was a Leveller. No nothing to do with religion or indeed finance I cut benchmarks and give them a value; a height above sea level linked to the national datum established (8 April 1837) at Poolbeg lighthouse in Dublin Port. On sights that were selected with a view to permanency, benchmarks were indeed written in stone. Cold chisels for cutting were sharpened and tempered in the local



Kilbroney River and Fairy Glen Rostrevor.



BM on step of church 1860s.

forge. At the height of the 'The Troubles in Ireland' I ran a secondary line more or less along the border between counties Armagh and Louth. It's curious how in time we become accustomed to our plight. Often, we'd just stop for a while until the shooting subsided further up the road.

It was the practice to incorporate old levelling – marks cut by The Sappers into the new work. In Crossmaglen, (spade in hand) I was searching for such a mark when a lovely man came out of the house and said, 'I've been waiting for you. You're looking for the 'crows' foot' arnt you. We had to move the stone' he said. Whereupon he took me round to the side of his house where he had public spiritly relocated it in the wall.

And away from South Armagh in The Mourne Mountains above Kilfeaghan I was levelling out on the mountain, cutting benchmarks every quarter of a mile or so on cropping rock. To each I'd give a value above sea level and draw a little sketch. Dan White was a shepherd there and I'd return each morning to find that with his own



BM I cut on bridge over Kilbroney River—1970.

hammer and chisel he too had cut marks that were more or less indistinguishable. Little did I know that with the advent of Sat Nav—in what I consider a very short time—my work would become obsolete and Dan White's benchmarks would be just as 'important' as mine.

Over the years I worked in every discipline of The Ordnance Survey. Rural Ireland is truly steeped in archaeology. Rathes, cranogs, souterrains. Newgrange!—even to a great elliptic earth work sweeping right across the country known as the 'Run of the Black Pig' And of course, myths. It's the field surveyors' job to note anything that may be of interest. So, here's a one-off. There's a field in Killowen looking directly across the Lough into Carlingford; that has a pile of stones in the corner (a possible cairn). In a bungalow at the bottom of the field the woman of the house was baking bread. She was a sonsy no-nonsense woman and through the open kitchen window I asked her did she know anything about the pile of stones. "I do," she said. "Every year on the night of the 7th of August two teams of small black men come up from under those stones and play a game of football in the field. Then they run back to the corner; and go back down." She told me this in the most matter of fact way as she continued to prepare the dough for her griddle of bread. ■



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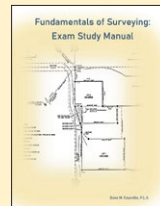
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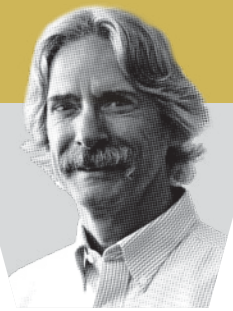
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Reconnaissance

The State of the Surveying Profession, Part III

Featuring Jessica Hess, PS

Program Coordinator of the Surveying Technology Program at Vincennes University Jessica Hess, PS shares the same concerns I expressed in Parts I and II of my latest theme of columns, and more. In order that others can gain from her insight, I respectfully cede my authorship of Part III on the State of the Surveying to Jessica...

Education and Career Development

In Parts I and II of this column, the topics of continued personal growth, the presentation of the image of the profession, and de-regulation/delicensure were discussed. The role of education and continued development should be considered in answer to some of these challenges. The question is, *"How can we harness these tools to advance the profession?"*

Education—Building the Foundation

In the rising panic of the dwindling labor market (both in surveying and otherwise), a willingness to eliminate barriers to entering or advancing within the profession are emerging—one such example being the push, from some quarters outside the profession, for delicensure. Some discussions have been bubbling in the profession about dropping college degree requirements to become licensed (in some cases, keeping technical education requirements to help ensure surveying proficiency, but eliminating the additional general education that

leads to a degree). Such considerations are short-sighted.

As an educator in surveying myself for the past 6 years, I obviously fall on the side of favoring degrees for licensed professionals— but not by reason of default or that I'm one of those stuffy people with elitist arbitrary standards.

"If we want to get the machine firing on all cylinders, we need people who have a well-rounded education; people who can merge our role as surveyors with the needs of the greater society."

On the contrary, upon entering the field of higher education and seeing how it functions and plays out behind the scenes, I've personally grappled with the necessity of college degrees and our country's ever-growing insistence that most all young people be directed toward earning one. Degrees are not necessary to meet a lot of the employment opportunities available today (though they're often listed in the job posting). Instead, formal training in specific skills would suffice. I would even partially side with those claiming that degree requirements really do stand in the way of someone who would otherwise make a great and productive worker.

I think this minimal formal skill training can greatly serve the surveying profession in keeping the machine running and bringing in new people. However, if we want to get the machine firing on all cylinders, we need people who have a well-rounded education; people who can merge our role as surveyors with the needs of the greater society.

That takes knowledge and understanding of how our communities function (i.e., social science) so that we can propose, guide, and protect land interests while creating development in beneficial and community-conscience ways. It also takes the ability to effectively interpret and communicate (i.e., English composition and speech) laws, ordinances, and the work of other surveyors as well as our own. A degree requirement helps ensure that those on the front lines representing our profession in public meetings and public repositories of record are doing so in a positive and productive light.

You can find this sentiment in [Brown's Boundary Control and Legal Principles](#).

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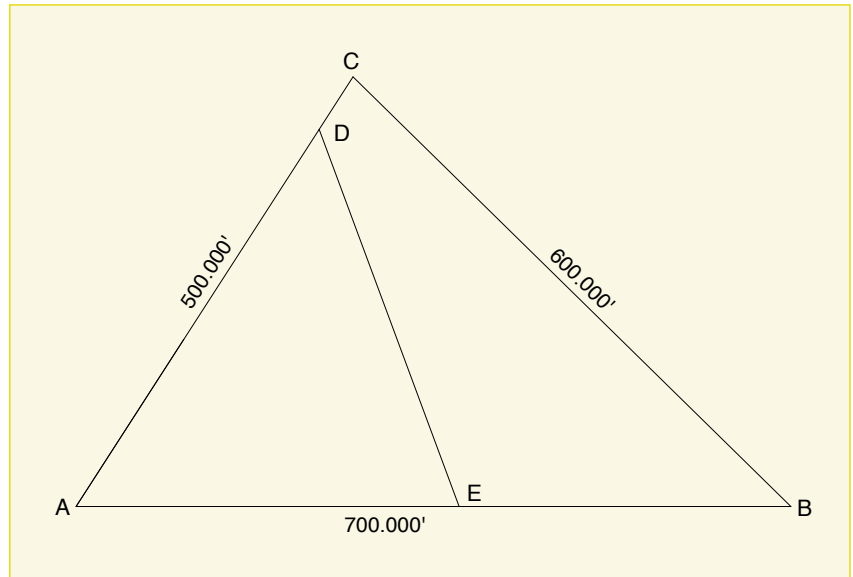
test yourself

Half and Have

F Phrita wants to divide her property so that her sons, Phrank and Phred, each get an equal area and an equal perimeter. Find a line, DE, that divides the area as well as the perimeter of the triangle ABC into two equal parts. (Not drawn correct!). ■

For the solution to this problem (and much more), please visit our website at: www.amerisurv.com. Good luck!

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 dlindell@msn.com.



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where Curtis Brown stated, *“The person most qualified to write a description is that person who has the greatest knowledge, who possesses the best vocabulary, and who has the greatest use of the English language.”*

We can all recall times when we’ve tried to follow in the footsteps of another surveyor only to become frustrated that they were so shoddily left. Devoting an equal effort to mastering language arts and social considerations will help us not perpetuate frustration onwards. Often, the leap from meeting some technical requirements of licensure to earning a degree is only a few extra courses in English, speech, and social sciences.

“We can all recall times when we’ve tried to follow in the footsteps of another surveyor only to become frustrated that they were so shoddily left.”

Career Development— Growing and Expanding

But what of continued development? Simply earning a degree and becoming licensed is not enough for contributing to the success of the profession as a whole. As professionals, we should expect to continue to expand upon the foundation built through education and early work experience. We should also encourage and support this of the rising technicians in our profession. As mentioned in a prior installment, we should expect to evolve.

To do that, a solid understanding of the basic concepts and laws of surveying is necessary. Through teaching, I’ve experienced first-hand, and witnessed of others, the need to return to topics multiple times to obtain a firm grasp. Yeah—we’ve all been through similar surveying classes and used the same books while in school. I think a good majority of us could admit that we weren’t as diligent as students as we could have been.

To teach these concepts, it often entails multiple readings and studying of selected texts to break it down as part of the process of simply introducing it to students. I can confidently assume that when they’re reading at their level, the

content is flying right over their heads (as it once did ours when we were in school). As we get into higher levels of boundary, descriptions, and technical practices, I find myself prefacing many topics with, *“This is just to provide awareness—once you are out in the workplace and have gained some experience you should return to this and re-study.”* Because that’s what it takes to develop a *working* knowledge. That’s what it takes to grow.

How many of us have returned to review the basics beyond the hours we’ve spent in required professional development? How many of us have developed a strong working knowledge so when the profes-

sion or society shifts, we can confidently pivot—knowing we’re basing our decisions and actions on a solid foundation of understanding? How many of us are reminding and encouraging the technicians we supervise to return to the content they learned in school or training, and try to grow with it?

As a profession, we should value and cultivate these tools of presentation and study that inevitably run parallel with our technical toolbox. They’re the bridge that connects what we do as surveying experts with the greater community. We need that connection to be strong. ■

Gary Kent has been a professional surveyor with Schneider Geomatics since 1983 and is also owner of Meridian Land Consulting, LLC. He has chaired the joint ALTA/NSPS Committee on the Land Title Survey standards since 1995. He also sits on the Indiana State Board of Registration and lectures nationally.

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definitely not included in the bounds of what is described. What we are left with is not adverse possession but peaceable possession.

Depending upon the state, commonwealth, tribe, or territory in which the land resides, peaceable possession cases are argued under different rules from what applies to adverse possession. Peaceable possession is continuous and undisturbed by any attempts to dispossess the claimants.

Adverse possession requires open, notorious, exclusive, non-permissive, and actual possession for whatever period of time that state’s laws stipulate. Payment of taxes isn’t often a requirement because most assessors just want to be paid, and it doesn’t matter by whom. But payment of taxes can indicate a belief that one owns the land—or that one wants to. I know of two examples where payment of taxes in bad faith was meant to help swing the balance of evidence towards devious non-owners.

Hostility isn’t always required either, as mistaken claims meeting all the other requirements satisfy the statutes and courts in some jurisdictions, but the non-permissive part is always a factor. That simply means there has been no request to use the land (users either believing they have the right or having a “just do it” mindset) and that no one has allowed entry by saying, “Yeah, you can use my land.” Acquiescence, by lack of words or action to eject someone from the land or by preventing someone from entering in the first place, builds a case for peaceable possession. That of course means that there had to be some notice of the use or entry, being the notoriety aspect accompanying the open possession of the land.

This is a good place to point out that claims for possession, whether peaceable or adverse, don’t have to show that every square foot of the property is being used or is enclosed, or that it is used all year round. Claims can succeed where it is shown that the property was best suited for something less than full-time 100% occupation. That might be helpful in this situation. The biggest hurdle is, of course, having to file the suit for a court hearing. That’s not free. And hopefully the judge will understand real property law, too. ■

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 ASFP.



vantage point

You Can't Get There from Here

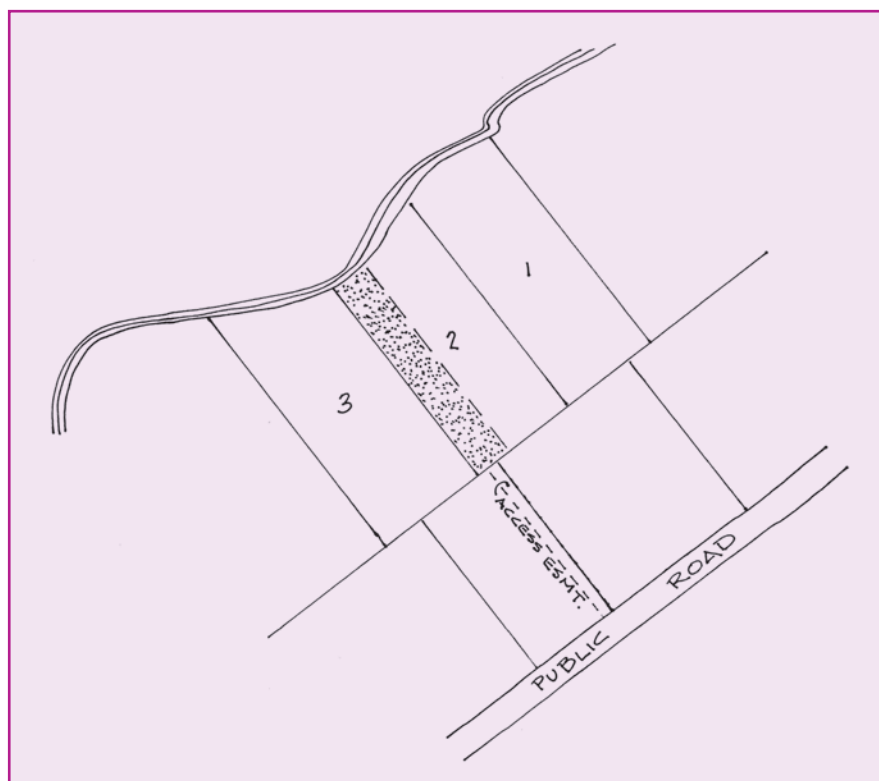


ver the past several years I've been on the sidelines of a sad affair about a landlocked property that has an access easement

but is still inaccessible. It isn't that the servient estate burdened by the easement won't allow the landlocked owner to use the easement. It isn't that there is an adverse claim to part of the landlocked property and the owners—or maybe I should say the assessed owners—are being denied use of their land. It is a matter of old deeds with multiple tracts that leave a gap where the access easement should connect. All of this translates to both unmarketable and uninsurable property.

There are multiple surveying and title aspects to this story, which I have simplified a bit in the sketch. It is a particularly troubling tale right now because the owner who had wanted to sell the land finally passed away at age 101 before the title could be straightened out. It is her children (none of them exactly youthful, either) who are now trying to bring the sale to completion at this point.

The property in question is comprised of three tracts, each described by metes and bounds in chains and links. As is probably evident by the sketch, this is wetlands, so it isn't buildable, but it is perfect for a wildlife conservation area, a purpose the land on the other side of the creek already serves. The difficulty is that the middle of the three tracts making up the property bounded by the creek is the one that connects to the access easement over the property fronting on the public road. The access easement benefits all three tracts, so that isn't the problem. That front property is owned by other family members, and there is no antipathy here, only a legal problem.



Instead, the holdup is that the shaded area of the middle tract is not included in the deeds within the family as it moved from one generation to another. Somewhere along the line, deeds have somehow not included that strip, likely from a scrivener's error. The title to that strip seems to have been omitted way back in the chain, its source not yet found. And if the easement leads to that strip for which ownership isn't known, then any entry through that shaded area to reach the rest of Tracts 1, 2, and 3 constitutes trespass.

Without legal access, the property is uninsurable. Title insurance companies will raise exceptions for properties lacking

access to a public road—if they will even write a policy. Without access, the property is also unmarketable, meaning a reasonably prudent purchaser isn't likely to buy "as is."

How can this be resolved? The top answer is a quiet title action. We mostly think of quieting title as quelling any adverse claims to a property. But no one else claims this land. The descendants of the deceased centenarian believe they own it, just as their mother had believed she owned it. Over many years, various members of the family certainly have been paying taxes on it. There isn't clearly what we call color of title, meaning documentation that gives rise to the belief that a tract is part of a conveyance, because the tract is

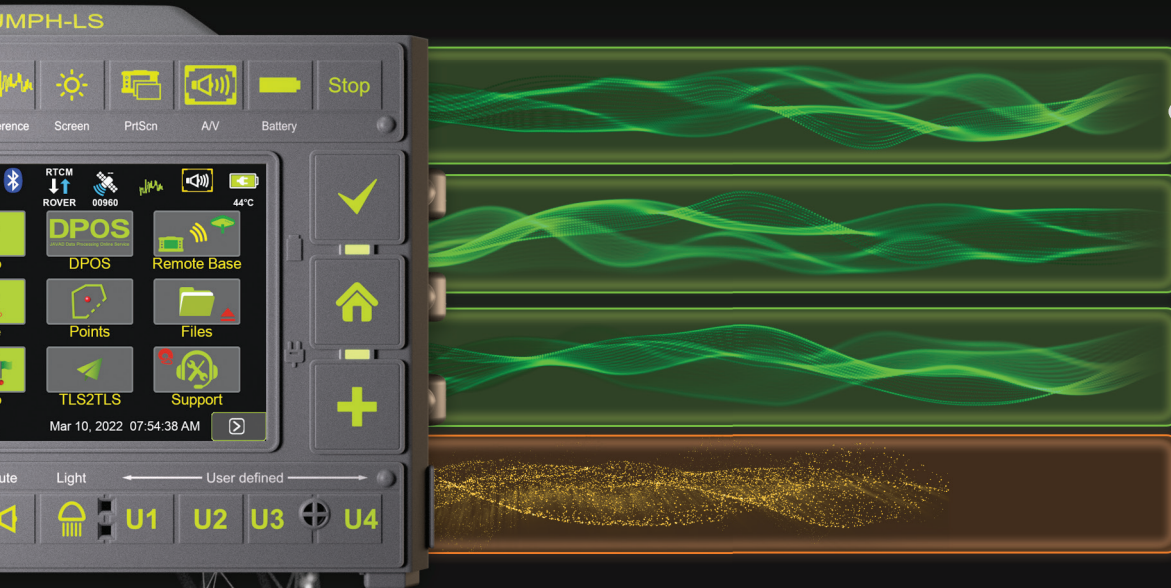
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