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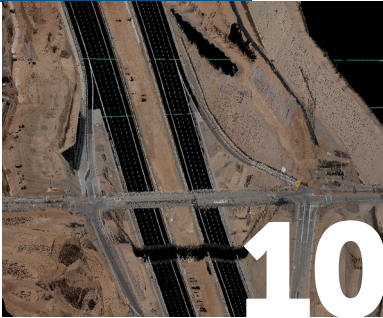


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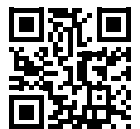
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guest editorial

Should a College Degree be a Required Element of Professionalism?

I recently attended a continuing education seminar where amendments to our state land surveyors act were being discussed. Running through the various texts, we came to the section of our act that outlines requirements for licensure as a Surveyor Intern. The most notable change to this section concerned educational requirements to sit for the fundamentals of surveying examination. With the intent to increase licensure, our act was amended to allow candidates with a baccalaureate degree in any subject including 24 hours of surveying courses to qualify for the exam. Prior to the change, a candidate needed a baccalaureate in land surveying or related science plus the requisite 24 hours of surveying.

Personally, I support the change and found it relatively insignificant. However, a passionate discussion began when the audience was asked to voice its opinion regarding the amendment and the value of requiring a four-year degree at all. While we generally acknowledged the need to increase our numbers, opinions were mixed on the degree requirement. Some proposed a technical associates degree. Others were hell bent on the four-year requirement, rationalizing ... "if we want to be on par with engineers and architects we need to keep it".

I interjected that I would like to see a non-degreed path to licensure. Something requiring a combination of college course work and on the job experience. One of the guest speakers responded to my comment, retorting ... "in some States you cannot be considered a professional without a college degree". As a non-degreed surveyor, I fully understand my bias on the topic, nevertheless, this comment got under my skin. Whether it is true or not is not the issue—rather why does the opinion exist at all? After all, I considered myself a professional.

I founded my own survey firm shortly after obtaining my license, problem solved with attorneys, engineers, planners and many other design and legal professionals over my thirty-three-year career. I can't recall a single time that my professionalism has been called into question. Quite the opposite, I remember receiving complements for my professional conduct. The thought that my life's work in the survey profession is somehow relegated to a lower status, simply for not possessing a college degree, is disturbing.

That's not to say that I believe that obtaining a college degree is a bad thing or that schools are not preparing students adequately. To the contrary, obtaining a college degree should be rewarded as being the most desirous and quickest way to becoming licensed. However, it should be viewed from the proper perspective and assigned appropriate weight. After all, what unique knowledge is bestowed on a college student between eighteen and twenty-two years of age that so separates them from their non-student counterparts, that are actively working in the profession?

Is it the history of the U.S. Rectangular Survey System? If so, any authoritative book on land surveying will provide insight on that subject. Maybe some form of special math or science? I've taken college level math and science classes, but I can safely say that my high school courses would have sufficed to solve any survey computation I've encountered so far. Attorneys at law have some of the highest educational requirements of any profession; following this logic, lawyers as a group should be a paradigm of professionalism. These are our current and future judges, many ascending to high political positions, making and shaping the laws that govern us. But you need to look

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no farther than their billboard advertisements to find evidence to the contrary.

Professionalism manifests itself based on our beliefs and personal ethics that were developed over our lifetimes. In fact, our parents probably had a greater influence on our professional capacity than any college course or job training experience ever will. Professionalism can't be legislated into existence—which is the primary reason I rallied against mandatory continuing education before it was enacted in Illinois. It became clear to me early in my career, that if an individual did not possess the drive, commitment and most importantly the passion to continue learning on their own, no amount of mandated study would substitute. You either conduct yourself in a professional manner or you don't. There is no middle ground.

For reasons that escape me, we tend to compartmentalize things to the point of being meaningless—for instance, the topic of ethics. In my state of Illinois, surveyors are required to have taken two professional development

hours in ethics every renewal period. This is not entirely unreasonable, but what is it really teaching us? Ethics class for me typically consists of three to four real-life examples of abhorrently reckless surveyors attempting to cover up a mistake they made, resulting in damage to one or more parties. This is usually followed up with a short question and answer session. Where is the mistake? Was it ethical for said surveyor to withhold this information from his client? Blah, Blah, Blah. Of course not, it's a cover-up! And why was the reckless surveyor attempting to cover up their mistake? Because he doesn't want to pay for the damages and admit the embarrassing mistake. A perfect example of the ageless dilemma of choosing between right and wrong.

Certainly, there exists cases where the difference between right and wrong is nebulous, but in the end, it still comes down to a binary choice between right and wrong. Simply put, you can't be a professional without first being ethical. The two are mutually inclusive. You can't develop ethics over the span of two hours biannually—nor

can it be obtained in the four to five years spent earning a baccalaureate degree.

Mentioned earlier, but worth repeating, professionalism is based on our beliefs and personal ethics which combine to create our principals. Principles guide our moral compass and help us navigate the right and wrong in the decision process. In my opinion, this the only required element of professionalism. As practitioners of the profession, we are the sole arbiters of professional conduct and bear the responsibility for policing our peers. We do this through our state board of registration. Should we decide to define professionalism in terms of college, I believe that we will have effectively ceded our authority to the universities. ■

Donald Johnson is a licensed Land Surveyor in Illinois and Wisconsin. He currently serves as survey manager for Omega and Associates in Lisle, Illinois. Prior to this, Don co-founded and operated a small survey and engineering firm located in suburban Chicago.

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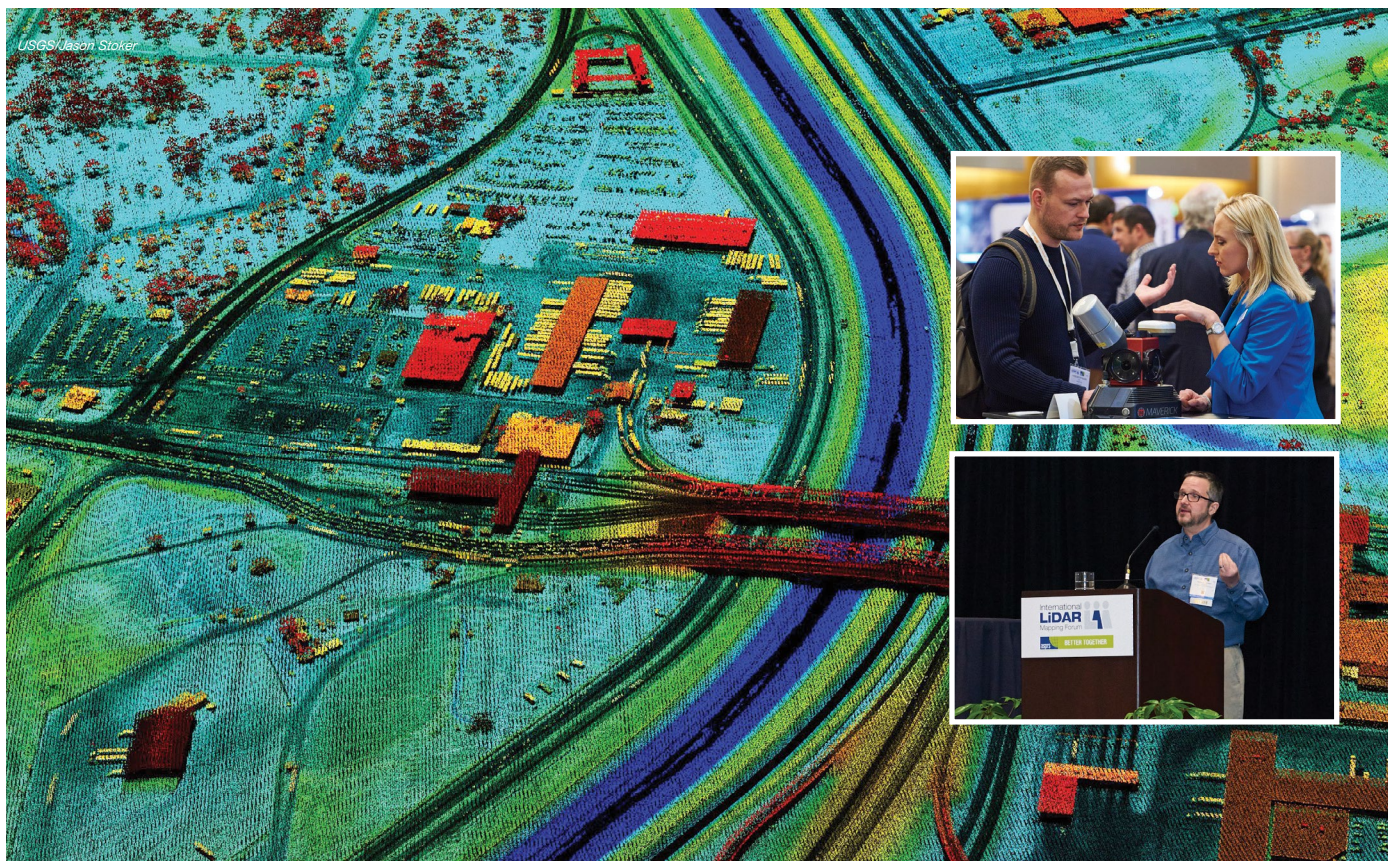
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Broadus, Butternut, and Bowling for Brass Caps

We recently spent a lot of time in Butternut, Wisconsin, and I'm still not sure we are walking away with a full bag of groceries. Regardless, it's time to move on to higher ground and inaugurate the greater landscape. The geometric dependence on the PLSS rules is inadvertently proving to be destructive under state authority.

Let's start with an observation by Jerry Broadus, Esq., P.S. from his work titled *"Boundary Law: The Rule of Monument Control in Washington"* published in 1984 by the *University of Puget Sound Law Review*. Broadus observes *"The case of Town v. Greer represents the culmination of a lengthy boundary dispute which arose from such a sale, and raises serious questions of the wisdom of presuming that the federal rules should control private land sales."* Well Mr.

Broadus, I'll see your Greer question, and up the ante with some misaligned state statutes. I too question the wisdom of introducing federal restoration rules when owners have respectfully stabilized a government line between competing chains of title.

Both Broadus' reference to Greer and our previous outing in Wisconsin with Boerst were mashed around in appeals after the lower courts "got it right". Regarding Greer, Broadus also says *"The actions of the parties*



Dave White's

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“It is ironic that laws seemingly put in place to stabilize the PLSS under state authority are actually decoupling the cadastre from land titles.”

to the first sale evidenced a construction of a boundary line that represented a reasonable interpretation of the deed. Fairness would require adherence to the expectations of the parties to the transaction first creating the boundary. The court's earlier presumption, however, that a deed using such a description would be controlled by the federal government rules, essentially allowed the grantee to attempt a form of "land-grabbing" when the quarter corner was finally discovered. If the court had, in the original case, held the parties to an equitable solution, a wasteful and lengthy dispute would have been avoided." Greer involved an original homespun aliquot division by the owners after the patent, where Boerst focused on acquiescence in lieu of original corners. The comparisons might seem a little apple-orangey until we see the appellate courts' bad habit of dialing



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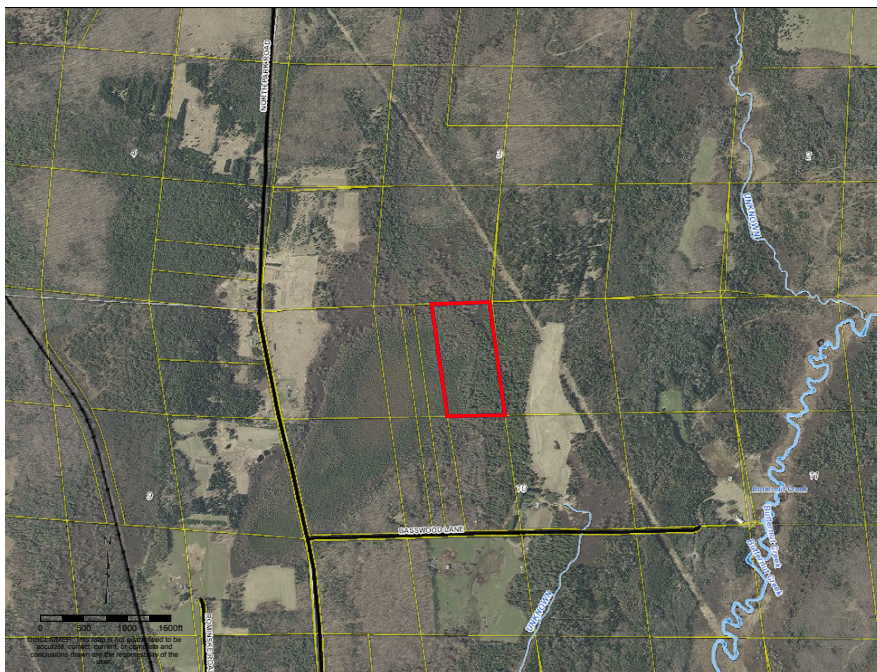
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The red polygon is not geometrically rectangular but it is most certainly the east half of the northeast one-quarter of the northwest one quarter of Section 10.

1-800-BLM-RULE and ordering a rectangular pizza. Broadus touches on something very important in Washington State *"Many boundary disputes could properly be resolved by using the rule of monument control as a rule of construction, thereby allowing the court to weigh the equities of the dispute before it, rather than as a rule of law to be contrasted with the Statute of Frauds."*

Now I'll be the first to admit that I think Cajun Style Visine sounds like a winner until you actually use it. I look at the following statutes with experience and come to a similar conclusion. Colorado has codified C.R.S. 38-44-113 as follows: *"Establishment of boundary corner.-The establishment of a boundary corner through acquiescence confirmed by a court of competent jurisdiction, or by written agreement pursuant to section 38-44-112, shall not alter the location or validity of any existing or properly restored public land survey monument in the vicinity. Such existing or properly restored public land survey monument may be used to control future land surveys in the region when such surveys are not related to the boundary corner established by acquiescence or agreement."* I have two hang ups with this. 1.) Chains of title are disrupted by a legislative assumption that owners have occupied something other than their deeded lands. This forces an adverse possession where one may not exist and new descriptions may unnecessarily be ordered.

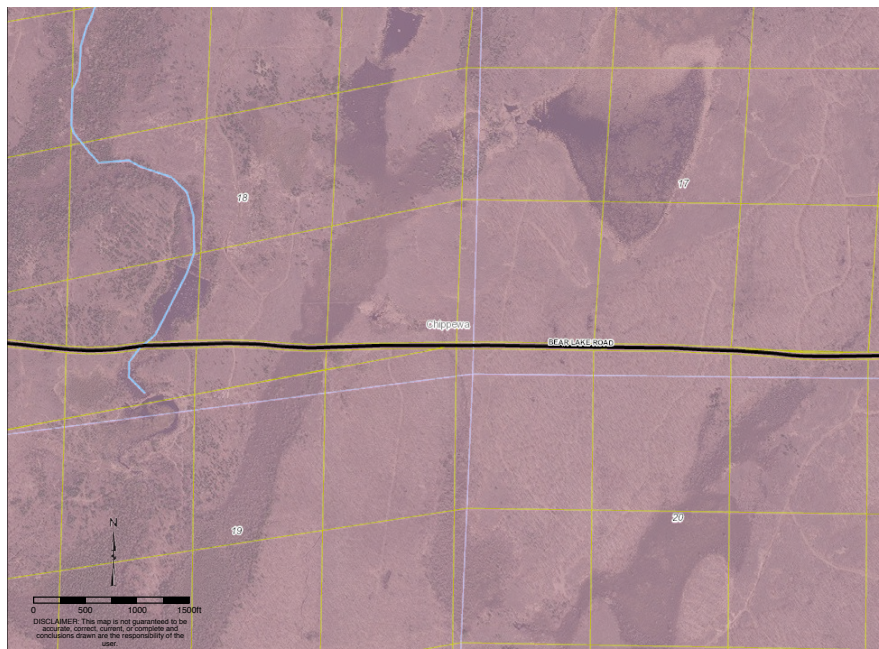
2.) Subjective methods of subsequent subdivisions were employed after patent. This includes a "no survey at all" option accompanying a conveyance. Establishing a proper restoration standard of an original aliquot portion that was cut and marked after patent is as equally subjective. One of the very few written standards a court can refer to is the BLM manual. Unfortunately the manual's instructions are intended to

restore corners on untitled land whereas we are retracing the boundaries marking chains of titled land cut after the patents.

We previously touched on Wisconsin Statute 893.24 "Adverse possession; section lines" which reads:

"(1) A written instrument or judgment that declares the boundaries of real estate adversely possessed under s. 893.29, 1995 stats., or s. 893.25, 893.26 or 893.27 does not affect any section line or any section subdivision line established by the United States public land survey or any section or section subdivision line based upon it." This seems like a no brainer to me and I wholly expect adverse possession would require a defiance of title lines. However we saw an appellate court in Wisconsin coagulate extrinsic evidence of acquiescence into a definition of adverse possession and shoehorn it into this law. The local chains of title are now apparently decoupled from the PLSS in what appear to be metes and bounds descriptions. The descriptions walked into the courtroom as aliquot and magically left as colonial. Sounds like a step backwards for the PLSS.

It is ironic that laws seemingly put in place to stabilize the PLSS under state authority are actually decoupling the cadastre from land titles. Ill-conceived legislation does nothing more than attempt to promote measurements as some higher form of evidence in the order of precedence.



Examples of a delaminated cadastre fester up in the GIS. We have three interpretations with the road, the yellow local parcel lines, and the white township layer.

We see the C.R.S. try to soften the blow to the owners by detaching what owners occupy from their title merely based on a “proper” restoration of the PLSS. When the function of the PLSS becomes self-serving, it no longer suits its intended purpose of stabilizing the boundaries of private land titles and could over time fade away from the law like the ceremonial livery of seisin. The need to perpetuate land title with stability is nothing new, nor is it dependent on a national or square cadastre. This continent has seen non-rectangular title pass over four centuries in the colonial states, as well as the latter formed states of Kentucky, Ohio, West Virginia, Tennessee, and Texas. However, the legislative presumption that acquiescence is somehow prohibited from supporting a PLSS line is undermining the chains of title that are dependent on aliquot descriptions. Respectfully, original monuments can limit the bounds of a grant and adverse possession would include the transfer of extra land beyond a title line harmonized with a PLSS line. However as Broadus points out boundary evidence is best employed under rules of construction rather than the rule of law and the federal rules for surveying in a vacuum of title may contrast the Statute of Frauds.

SELF-STUDY GUIDE (References)

- Google the following search terms to find the article references:
- Jerry Broadus Boundary Law: The rule of monument control in Washington
- Boerst v. Opperman for both appellate and Supreme Court decisions
- San Juan County v. Ayer
- Town v. Greer, 53 Wash. 350, 102 P.239. (You may have to dig through a review journal to find this gem from 1909.)
- Boundary agreements Colorado C.R.S.
- Livery of seisin
- Statute of Frauds
- Boundary dispute sheds light on complex issue-David Ziemer

Feel free to send feedback to me at rls43185@gmail.com or to the editor. ■

Jason Foose is the County Surveyor of Mohave County Arizona. He originally hails from the Connecticut Western Reserve Township 3, range XIV West of Ellicott's Line Surveyed in 1785 but now resides in Township 21 North, Range 17 West of the Gila & Salt River Base Line and Meridian.

The Barbershop Barrister

The most profound thing that I've read thus far in three years of writing Decided Guidance came out of the circuit court in Boerst. "If you are going to treat the line as being acquiesced to, you have to treat the corner as being acquiesced to." That sounds as simple as two knuckleheads yamming it up on the street corner, doesn't it? Well, I assure you it's a heck of a lot deeper than Lenny and Squiggy cat callin' at the dames from the stoop. The depth of that sentiment stabilizes the ground, with the record, with the actual notice, and harmonizes the competing chains of title. Jim Hankins PLS, of Illinois just stepped in to the barbershop this month looking to offer his two cents on Boerst. I yield the megaphone to Jim:



Jason,

Every once in a while something comes along that grabs your attention. I have long enjoyed your opinions, but Boerst v. Opperman got my attention. I have researched and included this case in one of my seminars. You are absolutely right about the folly of the parties to this case. It amounts to what has to be a multi-generational dispute between neighbors. You must be aware of the location of Ashland County. It being on the southern shores of Lake Superior, the Packers must seem like Southerners. It appears to me that in the long winter months they must dream about something to fight about.

What I don't understand about this case is why the court did not rule "what part of no don't you understand?" You will recall that the original GLO surveyors did not set "concrete monuments" at corners; so where did this 600' out in space monument come from? This also an interesting case in "you get as much justice as you can afford". To take a case to the Supreme Court costs a lot of money. Is the value of a triangularly shaped piece of farmland on the shores (not littoral) of Lake Superior worth that kind of money? This is more of a classic case of one land owner beating the other over the head with the judiciary until one of them runs out of money.

I have enclosed a copy of an article that I read in my research of this case from the Wisconsin Law Journal that might fit into your closing arguments (see self-study for google search terms). It cuts a very thin piece of cheese between Boundary by Acquiescence and best available evidence. I think that after 80 some years after the lower court ruled that the road was the section line; it would be hard for the Wisconsin Supreme Court to find that anyone's constitutional right beyond what is occupied would hold any water.

Thanks for an interesting article. I look forward to your conclusions.
Jim Hankins, PLS

This month's column features a Colorado Statute. Back in 1984 Jerry Broadus of Washington called foul. He observed "The court's earlier presumption, however, that a deed using such a description would be controlled by the federal government rules, essentially allowed the grantee to attempt a form of "land-grabbing" when the quarter corner was finally discovered." Well, unfortunately the worst thing about being a pessimist is when you are right and Broadus hit the nail on the head. Lana Shore submitted her account of a recent attempt of land grabbing under the rubber band of righteousness. Her neighbor presented his winning lottery ticket in the parcel pick four by hitting the Powerball on the center of section. Lana was able to stand her ground while the ink was still drying on the Mylar. My thoughts on tip-toeing through the federal tulips when retracing private claims? Well, there's nothing like bowling a strike in the wrong lane.

Check out "Rising to the Challenge-The Professional Land Surveyors of Colorado Help a Homeowner in a Property Dispute" on the newly-formatted TAS website in the July 2018 issue.

It's All About the Data



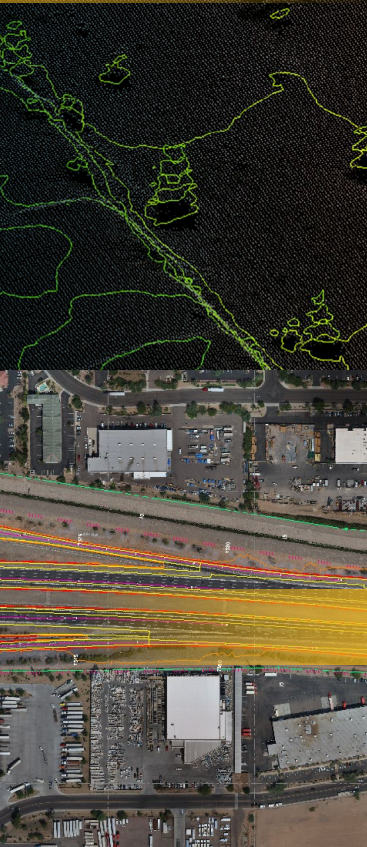
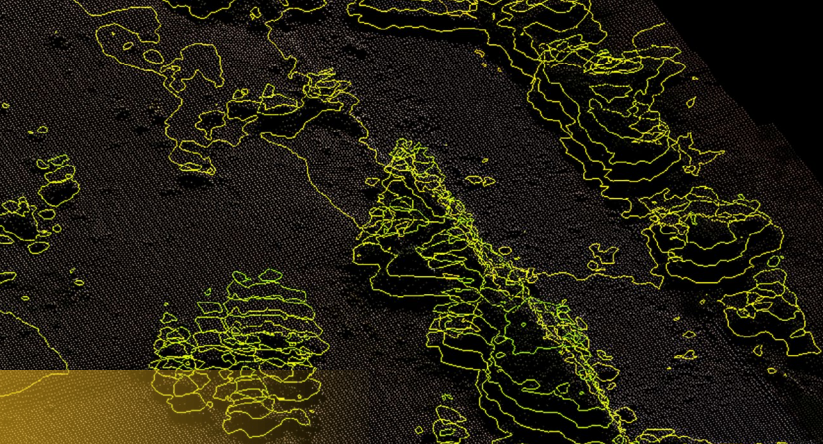
Marco Training a group of new UAV pilots



A visit to Take-Off Professionals

We are in the dawn of a new era for industry. It has taken the foresight of some visionary folks and the better part of my life for the new age of measurement to arrive. Back in about 1992 an electronics engineer smilingly told me that his profession had a greater impact on land surveying than it did on electronics industry itself, and old Jim Shaw was right. What we didn't realize was about that same time in Phoenix two different guys had a pow-wow that would also alter the course of geospatial measurement as we knew it.

» JASON FOOSE, PS



Top Center:
Contour lines of a photogrammetry flight prior to removing vegetation.

Bottom Center:
Overlaying linework on a recent photogrammetry model helps stakeholders to better define timelines.

Right: Marco inspects one of the small drones used by their clients to fly smaller sites.

I had the distinct honor of chatting with Marco Cecala of Take Off Professionals (TOPS) and Tom Pastuszak, General Manager of Technology Solutions, about their quarter century old visions and how they have shaped the threshold we are passing through today. On the other side of the portal stands the next relay with TOPS General Manager, Terry Dagen poised to grab the baton of technology and ready to sprint off into the future. TOPS is the fulfillment of Marco's foresight and old school business ethic of complete customer service. Marco grew up in his family's retail jewelry business and reminisced about sweeping the shop floor at the young age of five and developing his customer focused business ethics along the way. So how did he end up in a geospatial data profession?

Tom was running the local Spectra Physics dealership around 1991 and Marco was working with a civil construction firm that bought lasers and software from Tom. Tom became GM of Spectra Physics Laserplane Phoenix in 1996. Electronic measurement had emerged and digital design software was gaining a foothold with the co-current emergence of the personal computer. Data collection boxes were the interface between the available technologies but automation and integration was just a distant promise in those days of Compuserve, serial ports, and 1200 bps baud rates. While we were all enamored by a glorified calculator that would record topo shots and spit out radial staking data, Tom saw a much larger picture where man, measurement, and movin' dirt were integrated by all of these emerging technologies. Then one day back in 1997, Marco entered Tom's store to buy a level and the rest is history...

What does TOPS do? They create digital models for machine control and earthmov-

ing. Okay, what does TOPS really do? TOPS pulls all the data sources together and resolves a fully functional working model tailored to suit each individual client's wants and needs. That's a tall order in the era of fudge it or forget it fly-by-nights that Yelp files under design firms. In fact, TOPS has been successfully implementing digital models respectfully longer than the following virtual icons; Google-5 years (1998), Amazon-1 year (1994), Netflix-4 years (1997), and since I brought them up, Yelp-11 years (2004). Two recessions, a real estate crash, and a dot com bubble later, TOPS is still churning out custom fit digital models for clients big and small.

TOPS leverages the intelligence of automated technology in its own business model which has resulted in a seamless project user interface. Project partners appreciate the opportunity to electronically handoff their plan rolls, cad files, and work orders via the personalized web portal. That bottom line alone equates to man hours

and daily fuel savings wasted in crosstown traffic jams. Connectivity is being harnessed by TOPS to incorporate their expertise as the complete solution of digital control throughout the life of the project. When the design slams head on into the walls of project reality, TOPS portal is accessible 24/7/365 to receive the dynamic work orders and plan modifications. With one hand on the gusher and one to hit the call button, a contractor can simply get TOPS on the “old blower” and hash out the fix. That my friends is the difference between building a crash course digital model and being a project solutions service provider.

Project solutions provider sounds big and it is big. TOPS is providing solutions for the \$916 million Loop 202 South Mountain Freeway around Phoenix.

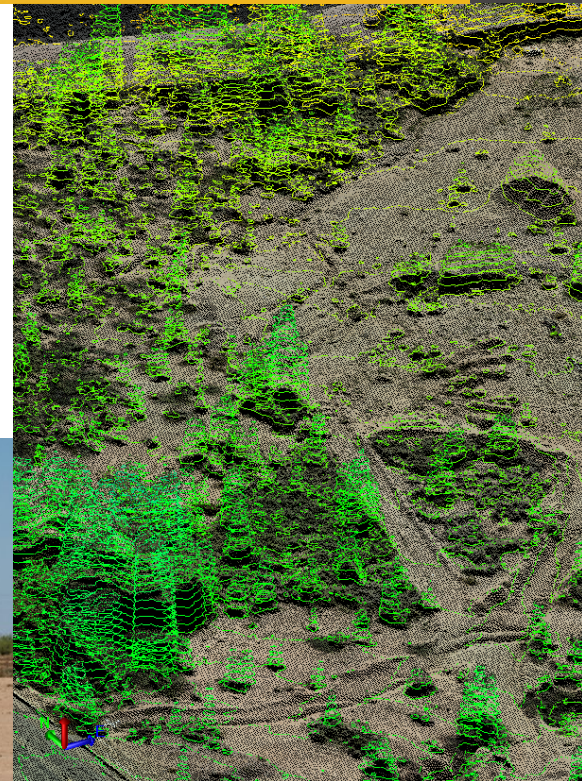
“Providing a client with pre-construction intelligence is extremely valuable and has a direct influence on the bottom line.”



Above: Marco Launches the Trimble UX5,
Below: Marco and Terry go over preflight inspection for a drone mission.

That is the largest single highway project in Arizona's state history and one heck of a load count. There's dirt, subgrade, finish grade, utility conflicts, drainage structures, pavement, signage, and a host of requisite unforeseen challenges that just seem to fester up in a huge project. TOPS is that value based service provider that is saving the taxpayer money through the efficient orchestration of data and

quality control up front. When, not if, the conflicts show up, TOPS can get out in front of conflicts to flag the solution points for the design team and do it way before any iron burns a single drop of fuel or any person torches the project wage resources. It's all about doing it right the first time or what the big bean counters might call economic efficiency. Incidentally a dollar to the small bean counter is worth as

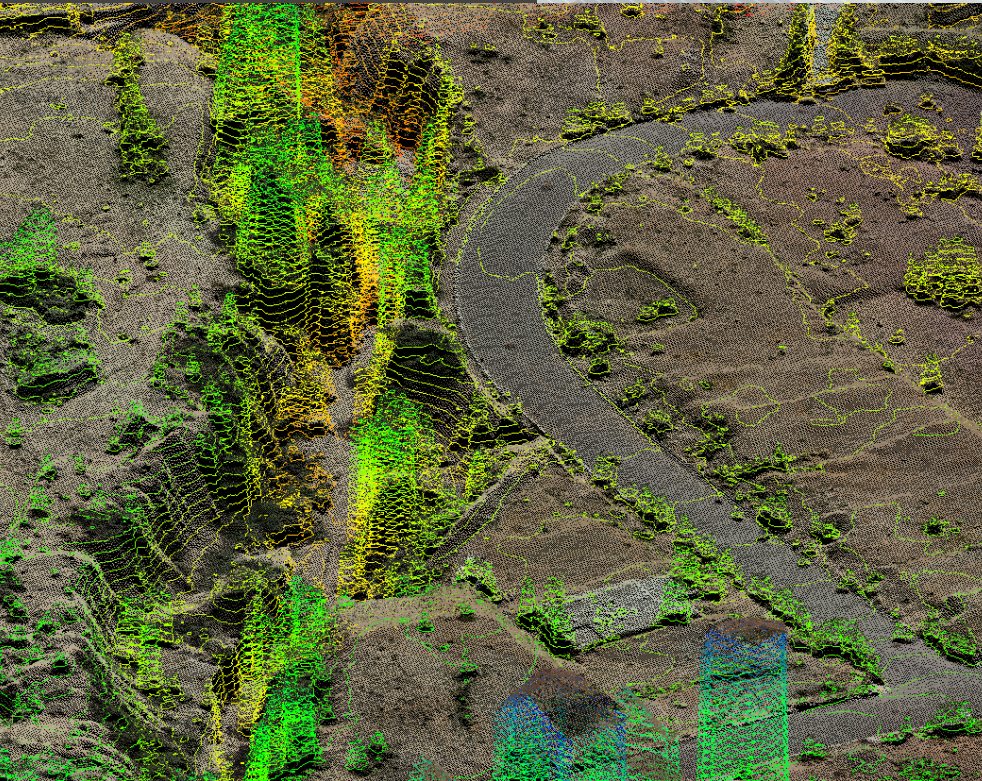


much as a dollar to the big bean counter so all of TOPS services are scalable up or down. Digitally speaking custom home sites, small pavement sections, and retail pad sites are the same basic creature as a twenty mile highway project. Marco uses the analogy of 3D printing on the ground. Whether it's a matchbox car or a full size polymer self-guided tour bus the printing process is the same. The value of deliverables can be measured in bandwidth, or around the boardroom table, or even by a warm handshake on the future site of your dream home. In any event the client is reaping the benefit of cost savings, project efficiency, and time by leveraging the services provided by TOPS.

TOPS

TAKE-OFF PROFESSIONALS

modeling team has an impressive toolbox at their disposal. Marco summed it up like this “TOPS innovative data service will meet our clients needs regardless of the manufacturer or system type. Carlson, Leica, Topcon, Trimble, we have the resources to work with them all, no matter what software the engineers used for the design, be it Civil 3D, MicroStation or any other design software, we will provide the client with the final 3D model in the proper format required for your equipment.” The team sorts through the client’s data and runs a stringent quality control analysis against the plans. Identifying any loopholes, busts, and anomalies early in the game provides an upfront opportunity to mitigate costly tear outs, back charges, retrofits, and redesigns. Certain designs can clearly specify what a professional conceives to be a solution to a problem. However, such design may not adequately reflect a practical application toward building the solution. TOPS uses model integration as a dry run at how well the concept can be



Aerial topo results after a creek flood. Dense vegetation often times requires backfill with traditional survey topo shots.

What sets TOPS apart as a leader in the industry? From what I’ve seen the TOPS corporate culture itself establishes their role as an industrial leader. The team’s project doctrine incorporates customer service as the foundation and customer satisfaction as a closing item on the project punch list. As cliché as it sounds the rest of the project just falls into place under that philosophy. A talented and resourceful staff adopts the client’s success under their personal ownership which naturally leverages a positive atmosphere of quality assurance. The TOPS



An orthomosaic image shows the quality of imagery possible with UAVs.

applied within the limitations of construction techniques and budgeted equipment. Furthermore, integrating various modeled surfaces with logical construction phasing meets golden rule of dirt work-only move it once- and that keeps everybody grinning. For example, analyzing the combined operations of sewer installation, road building, and lot drainage in a residential subdivision may reveal a cost savings by changing the order of events. Perhaps building a road and sewer first may offset a shortage in lot material by placing the road and sewer spoils across the house pads. Or conversely removing an excess of overlot material might require undue wear and tear on design roads causing rework if the roads were finished first. Providing a client with this type of preconstruction intelligence has a direct influence over the bottom line and is extremely valuable to a client.

So what's on the horizon? Civil Integrated Management. CIM is commonly defined as the technology-enabled collection, organization, managed accessibility, and the use of accurate data and information throughout the life cycle of a transportation asset. The Federal Highway Administration and state DOT's are embracing this concept as the highway sibling of BIM (Building Information Modeling). This is a wholesale technological leap from traditional paper records, manual measurement, and reac-

tionary maintenance. As the sun sets on the first century of the automotive highway, we see a completely new era of comprehensive asset management emerging before our eyes. CIM is the fruition of the last few decades technologies pulled together by our connectivity with the cloud and implemented for the benefit of the public at large.

We live in a time when just about everything could be digitally controlled to

some extent. 3D modeling is of course the backbone of the automated construction project. Project owners and developers are realizing the benefits of the financial control that automation can provide throughout a project. The bottom line from the top brass is controlling project risk. Connectivity to the cloud is the latest accelerant to automation and provides real time opportunities to implement 3D modeling. The industry is becoming ever more dependant on strong models crafted people that are willing to professionally dedicate themselves to productivity and innovation. A quarter of a century of product development and process refinement has proven that automation is a profitable endeavor for the construction and design industries. Early innovators like Marco and Tom are the Neil Armstrong and Buzz Aldrin of our industry and this visit with Takeoff Professionals is yet another refreshing example of the future emerging before us. ■

Note: Photographs by Rebecca Wilks.

Jason Foose is a Professional Surveyor licensed in multiple jurisdictions.



Progress aerial topo surface for a large highway project.



As built drone topo for subdivision grading.

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The American Surveyor Rifle captures the surveyor's legacy. The engravings were hand drawn to fit the rifle precisely and capture the tools of the trade. From the solar compass to the total station, the advancement of technology is captured in the engravings. With only 50 numbered rifles being made, this is an exclusive rifle to own. It will become an heirloom item to share with future generations.

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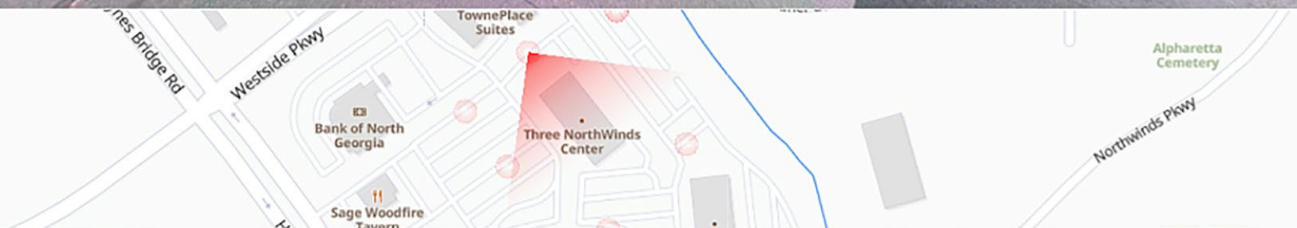
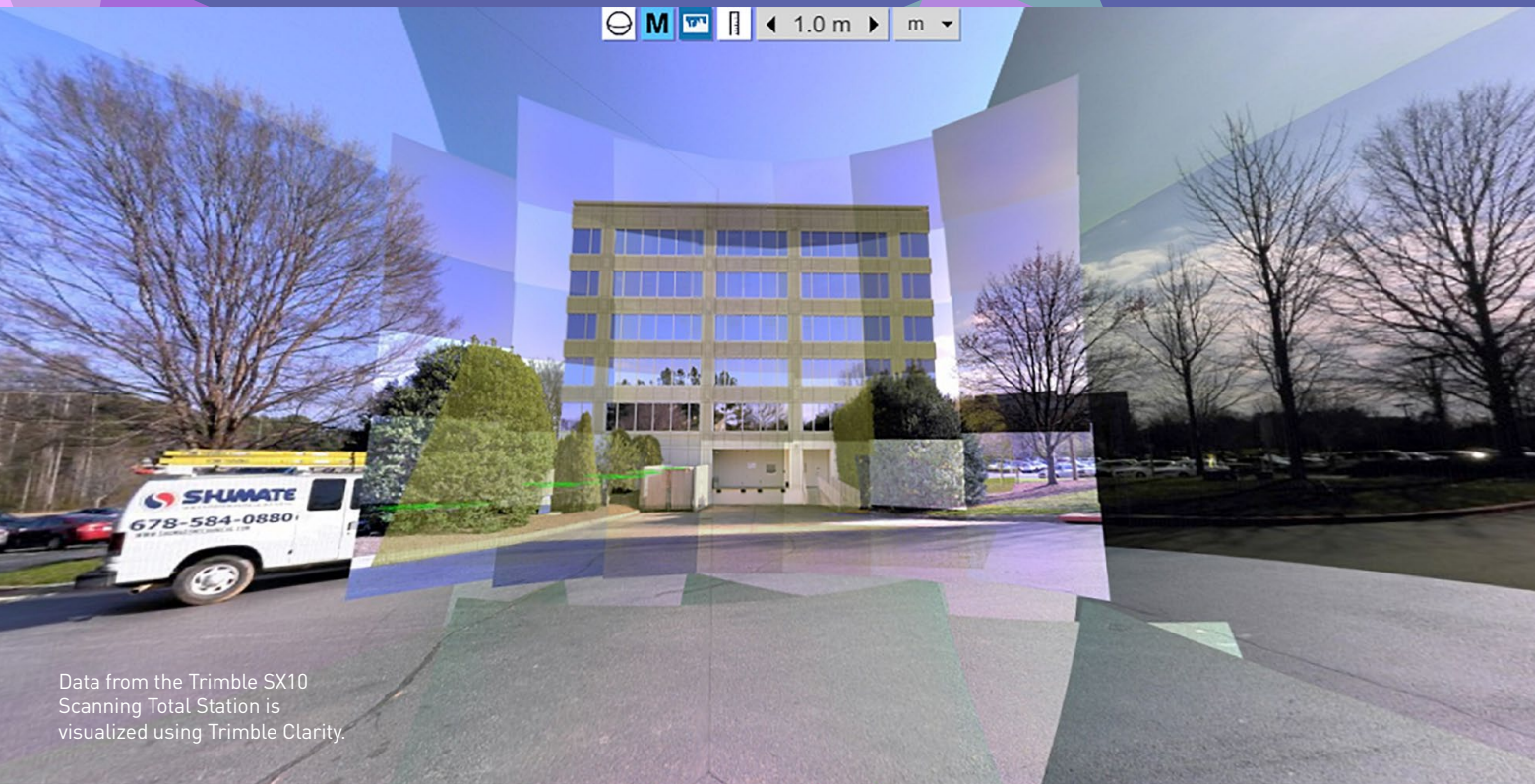
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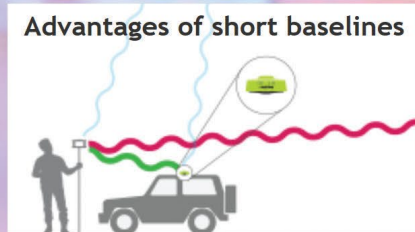


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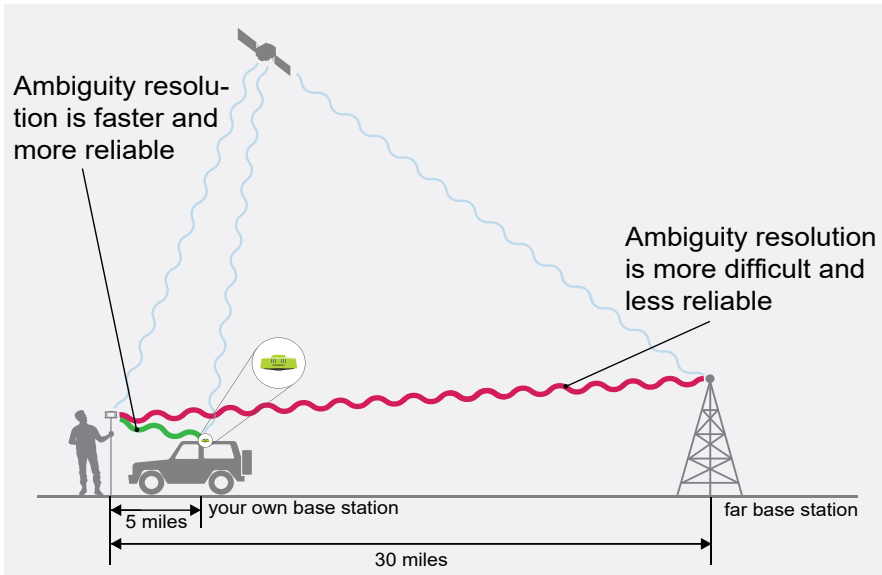
**Who Moved
My Base?**



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Advantages of your own base station and short baselines



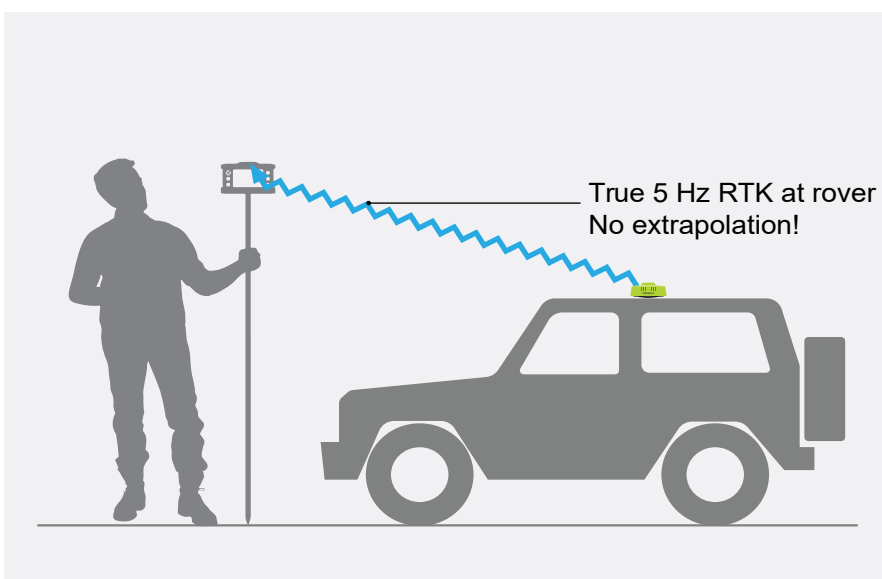
1. Shorter baselines provide significantly better **reliability** because the ambiguities are much easier to resolve and the correct ambiguity solution has an obvious contrast.

2. Shorter baseline has better **accuracy** because most of errors (like atmospheric and tropospheric effects) are common and cancel.

3. Shorter baseline ambiguities are resolved much **faster**. In longer baselines, incorrect ambiguities may pose as being correct in the statistical evaluations and it takes longer to isolate incorrect ambiguities.

4. Shorter baselines make it feasible to work in **difficult** areas (under tree canopy and in urban environments) because ambiguities have better contrast and are easier to resolve.

5. **Beast Mode RTK** is available only via our TRIUMPH-2 and TRIUMPH-1M base station. It makes ambiguity resolution up to 5 times faster because base station transmits base data 5 times per second. 5-Hz Beast Mode RTK is totally different from the up to 100-Hz RTK that is done by extrapolating the same 1-Hz data 100 times per second AFTER the ambiguities are fixed. This extrapolation technique does not improve the ambiguity resolution speed and is mainly used in applications like machine control after the ambiguities are fixed.



6. In addition to savings due to speed and reliability, it saves you RTN and communication charges. A complete system, Base + Rover + Radio + Controller & Controller Software, starts at **\$19,990**. 0% financing available (\$1,537.69 per month for 13 months) to active license US Professional Land Surveyors (PLS). Extended finance terms also available

Hybrid RTK

Triple-Check your RTK results and ...

It triple checks the accuracy of RTK solutions by post-processing and CORS processing. In addition, if RTK can't get a fix (because of bad environment or bad communication with Base) Hybrid RTK comes to your rescue... automatically.

Nine Automatic Steps of Hybrid RTK

Confidence and Speed... Unlimited!

You do this ▾

1

Downloading base data.

When your RTK job is finished, go to your base and in Base/Rover screen click "**Stop Base**". Base data will be downloaded to TRIUMPH-LS via fast Bluetooth automatically. All of the following steps will be performed automatically too when WiFi/Internet connection is established.

The screenshot shows the Base/Rover screen of the TRIUMPH-LS. At the top, there are buttons for 'Disconnect' and 'Stop Base', along with a timer showing 56s and 57ep. Below these, there are status indicators for 'Receiving' and 'OK'. The main area is divided into two sections: 'UHF5hz' and 'Office base1'. The 'UHF5hz' section contains settings for Base ID (0), Ref. Frame (WGS84(ITRF2008)), Format (RTCM 3.0 Min), Period (0.2 Sec), Frequency (454.45000 MHz), Mod. Band (D16QAM, 25.0 KHz), FEC Scrm (On, On), and Out. Power (40/16 mW/dBm). The 'Office base1' section contains coordinates (N 47972.8921ft, E 4615.1342ft, H 1188.9363ft), 2D Delta (1.1 ft), Azimuth (---), and Ant. Type (JAVTRIUMPH_2A NONE). At the bottom, there are buttons for 'From Base', 'To Base', 'Recall', 'Copy As', and 'Done'.

Automated steps ▾

2

Base data downloaded.

3

Awaiting DPOS server connection.

4

Rover points and base data sent to DPOS. Awaiting DPOS to process base-rover.

5

Rover points processed with base (relative).

6

Base data sent to DPOS to be processed with CORS data. Awaiting CORS data.

7

Base processed with CORS and corrections applied. (Absolute)

8

Base and rover points sent for CORS processing.

9

Rover points individually processed with CORS data.

DPOS options

The screenshot shows the 'DPOS configuration' screen. It has a title bar 'DPOS configuration' and a list of options with checkboxes. The first two options, 'Send to DPOS automatically' and 'Process all Points with raw GNSS files', are checked. The next three options, 'Base-Processing only', 'Base-Processing + Base Shift', and 'Base-Processing + CORS-Processing + Base Shift', are unchecked. At the bottom, there are buttons for 'Esc' and 'OK'.

LIVE at www.javad.com



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Why follow a workflow designed for yesterday's equipment?

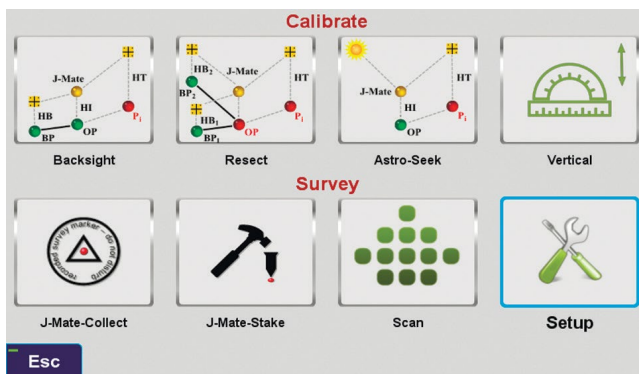
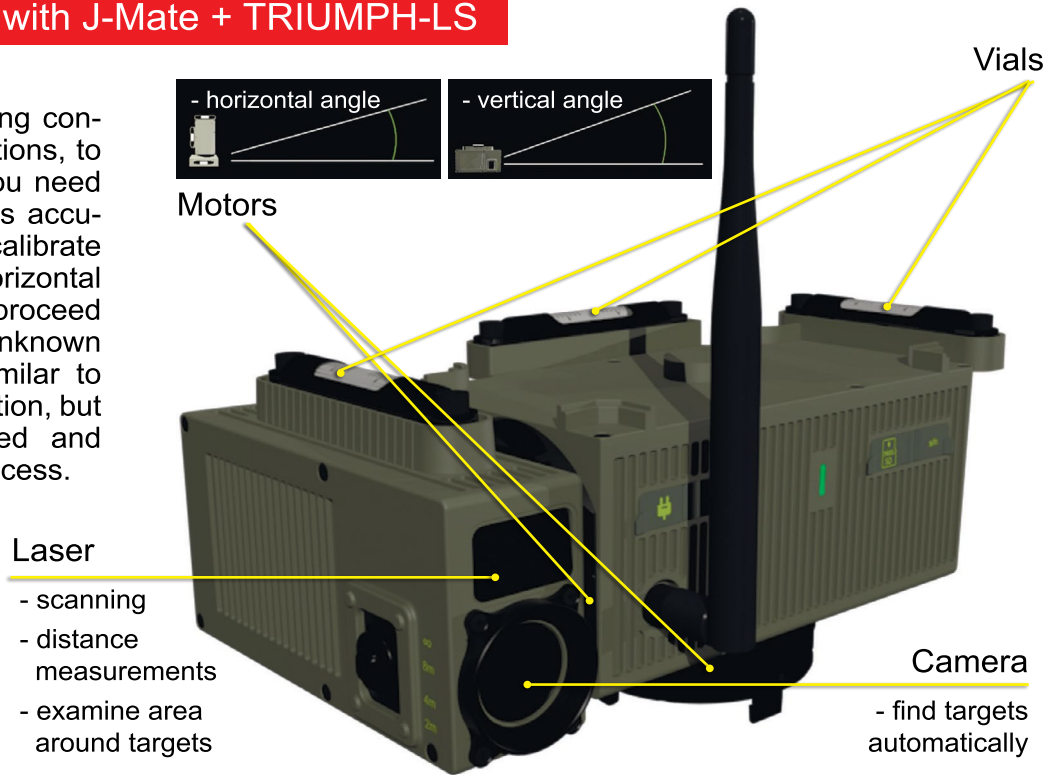
This is J-Mate

J-Mate features a **camera** that can also find targets automatically, and a **laser module** for accurate distance measurements. It scans and examines the area around the intended target to ensure reliable identification. Two **precision encoders** measure vertical and horizontal angles to the target. Three **precision vials** allow a visual check on levelness of the instrument.



Take control with J-Mate + TRIUMPH-LS

Similar to using conventional total stations, to use the J-Mate you need first to establish its accurate position and calibrate its vertical and horizontal encoders. Then proceed to shoot the unknown points. This is similar to using any total station, but we have improved and automated the process.



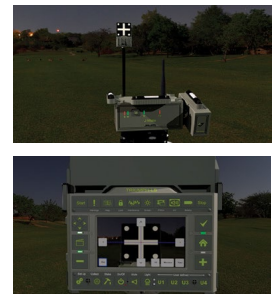
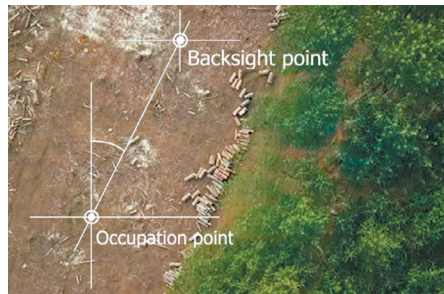
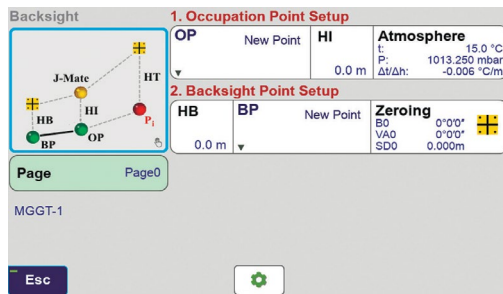
With J-Mate you can establish your occupied position via three different ways: 1) **Backsight**; 2) **Resection**; or 3) our new **Astro-Seek** (more of that later).

When you click the **Setup icon** of the J-Mate screen you get access to parameters that tunes J-Mate to your desire.

After the J-Mate is calibrated, you can proceed with your work as normal via the Collect or Stake icon.

Backsight icon

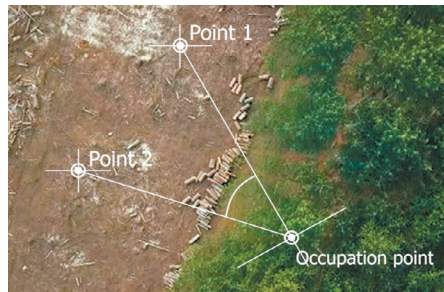
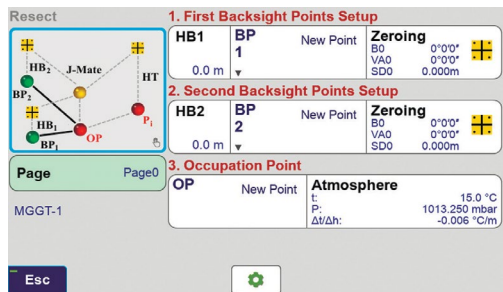
If GNSS signals are available at the job site, click the J-Mate Backsight icon.



This screen appears which guides you to determine the accurate positions of the Occupation Point and the Backsight Point, to establish an azimuth and calibrate the J-Mate angular encoders.

Reset icon

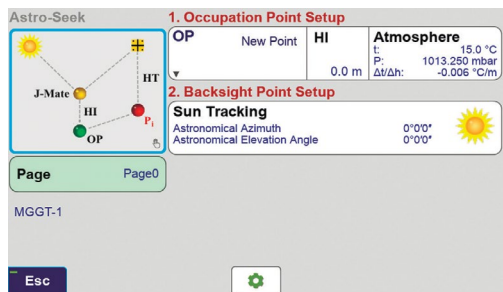
If GNSS signals are not available at the Occupation Point, click the “J-Mate-Reset” icon



Shoot two or more known points to establish an accurate position and calibrate the encoders. Then continue to shoot the unknown points.

Astro-Seek icon

And now our new feature!

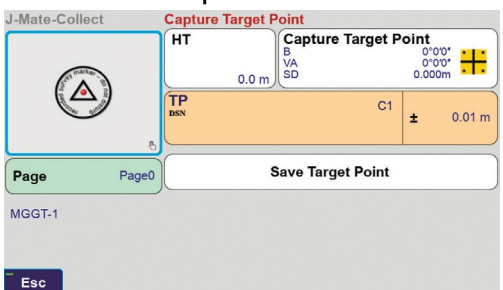


We have added a new innovative

feature to the J-Mate that it can automatically calibrate itself via its automatic Sun or other astronomical objects-Seeking feature.

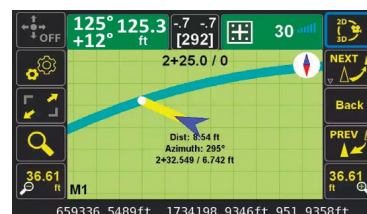
J-Mate-Collect

After calibration is performed, click the J-Mate-Collect icon to shoot the unknown points.



J-Mate-Stake

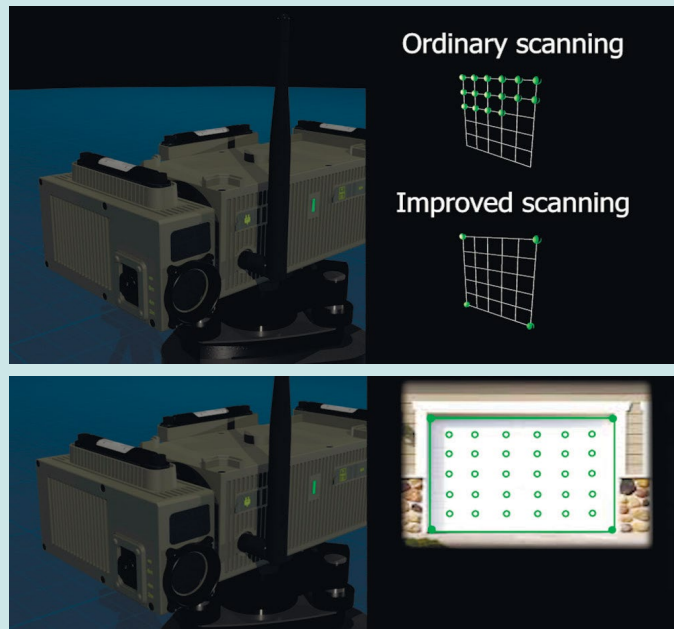
Click the J-Mate-Stake icon to use for stakeout.



The functions and features of the J-Mate stakeout are very similar to our conventional GNSS stakeout: RTK solutions guide you to the stake points. But with the J-Mate the camera follows the “+” sign that you carry and then the encoders and laser measurements (shown on screenshots) provide guidance to the stakeout features. This is similar to Visual Stakeout and other useful and innovative features of our TRIUMPH-LS GNSS RTK stakeout.

Smart laser scanner

J-Mate is also a camera-aided, smart laser scanner. The camera identifies redundant points that do not need to be scanned, but instead can be copied or interpolated from other readings without loss of information. That is, if the camera identifies a completely uniform flat area, it only scans the four corners of that area and interpolates in between. This feature can increase the effective speed of the scanner to much higher than its native 10-points-per-second speed.



The scanning feature can also be used to find items like wires and poles and “closest-in-view” items and shoot them automatically.

Seize the day with J-Mate + TRIUMPH-LS



**And all
components
fit in this small
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So we have a “**Total GNSS**” with a “**Robotic Total Station**” and a “**Smart Laser Scanner**”. We call it our “**Total Solution**” and it can be operated by one person to perform jobs.

Where Have You Been With Your TRIUMPH-LS Lately

"Got some shots that he could not get with our gr5's."

"I often get 2 days of work done, in a day."

"The LS has increased our productivity 2:1."

"Truly amazing with a 4" grape vine directly overhead and the tree cover."

"I got some ridiculous 'fixes' today in some horrible situations. Reset receiver, moved around, etc. Tried to get a bad fix but had a hard time doing it."

"I often get 2 days of work done, in a day."

"Btw, pardon my French, but holy shit. I got some ridiculous 'fixes' today in some horrible situations. Reset receiver, moved around, etc. Tried to get a bad fix but had a hard time doing it."

"Since I got the Javad system, I go places NEVER BEFORE possible, and WITH confidence, because, the quality checks are there."

"This thing is bad ass!"



WITH CONFIDENCE

When Jarrod Black PLS, a surveying and mapping director for Georgia-based Rochester &

Associates Inc., wants to get project data into a client's hands, he considers a few questions: What level of detail do they require? How much skill do they have dealing with 3D data files? Are they set up with the right kind of software/hardware?

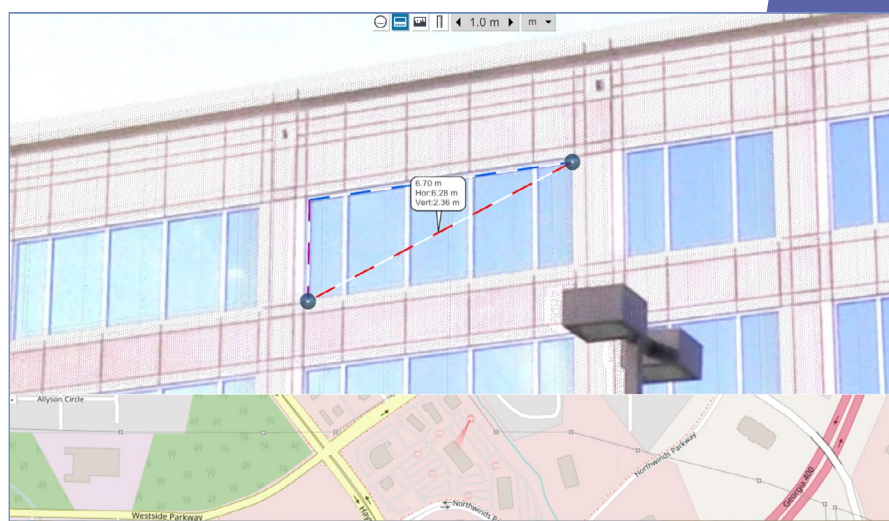
The answers help Black determine if a simpler and quicker report can satisfy their needs, especially if the client—often a structural engineer or architect—only wants to visualize the space, get a sense of scale and go a bit beyond 2D plan sheets.

Black's thought process underscores the challenge surveyors face when they want to share information from massive data sets collected from their optical, photogrammetry and scanning systems. That is: the powerful data and software can be too cumbersome and technical for some stakeholders to work with.

In these situations, having a just-right tool to satisfy a minimal requirement can make all the difference in fast, efficient communication.

Easier viewing, sharing

In 2016 during the Trimble Dimensions user conference, Black talked with Trimble software developers about the need for a software-agnostic viewer that could run on a browser. In the summer of 2017, Trimble invited him to take a sneak peek at its



Clients can better understand project conditions through shared views of the data.

solution, Trimble Clarity, a cloud-based application included in the Trimble Connect collaboration platform, before it was released at the INTERGEO conference.

Trimble Clarity makes it possible for industry professionals, whether land surveyors, civil engineers, land developers or site managers, to easily visualize and share three-dimensional point cloud data with clients. It also directly integrates with Trimble Business Center, enabling users to publish their 3D point cloud and imaging deliverables from the Trimble SX10 Scanning Total Station or other Trimble VISION instruments.

"I used to spend hours creating a zip drive, FedExing it over, or uploading the

data," Black says. "Clarity makes it extremely easy for a client who just wants to peruse the data without having a whole lot of skill in doing anything point-cloud based. I can email them a link, they click on the link, and within a couple of minutes they are looking at the data. It also has some nice tools."

These include the ability to perform 3D measurements, annotate objects and quickly collaborate with project stakeholders, such as the structural engineers and architects with whom Black typically uses the software.

"The other thing that's nice is if I do make some changes or any type of revision, the site is automatically updated," Black said, "so I'm not constantly needing to upload these massive files."



Surveyors and clients are better able to communicate by using features for measuring and annotating high-density 3D scan data.

Avoiding a data-sharing headache

The growth of 3D data in geospatial and related industries is creating a pressing need for tools that increase utilization of the large data files to move data analysis from the specialist to the generalist.

As hardware has become less expensive, more surveyors are making use of the wide range of data capture technologies, and as a result, are collecting massive data sets. But while the process of collecting the data may be straightforward, what to do with the data is not.

At a recent Trimble Business Center user group, many of the pain points shared by 40 attendees centered on one theme: “We have successfully collected a bunch of data, but we don’t really know what to do with it.”

When data becomes too massive to store, process and share, it becomes an intellectual property problem. For example, one customer won’t let their surveyors use the mobile mapping scanners because they are running out of hard-drive space.

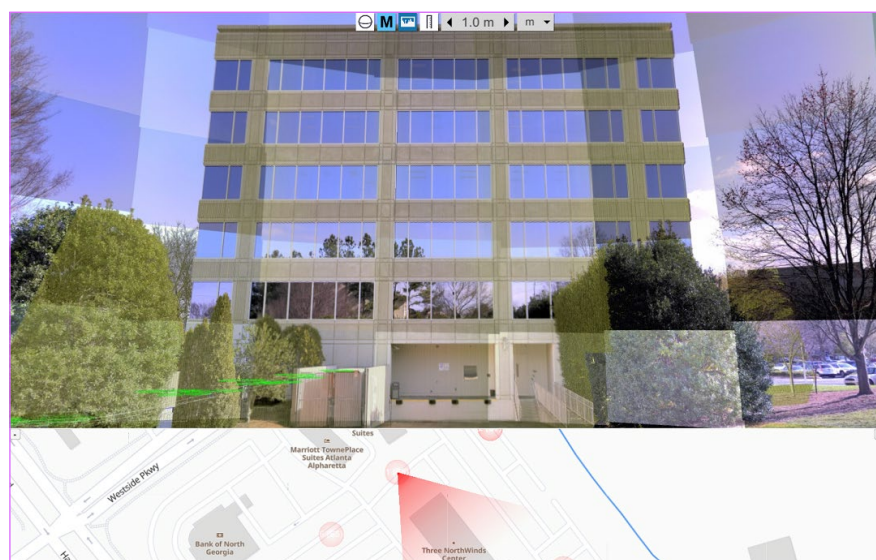
Technology, however, continues to improve around connectivity, cloud computing and Application Programming Interfaces (APIs), which is easing storage

challenges and empowering more seamless information and data exchanges between disparate groups.

Leaping into the cloud

Geospatial technology providers are moving to the cloud to help customers avoid the need for massive \$10K computers and

\$8K desktop licenses needed to store and process data. The cloud allows data to stay in place so users can work on it from different browsers and devices. The cloud also serves to lower the barrier of entry by keeping the data in one place and available through the web. Once the data is stored in the cloud, it should not have to move



Georeferenced scans automatically appear in the map to enhance the sense of scale for the client.

again, which also reduces time needed to make it deliverable.

Because Trimble Clarity is housed in the cloud, users can create station-based views of their point cloud data. The point clouds created in Clarity do not require heavy Graphics Processing Unit (GPU) local processors to run. Instead, Clarity manipulates the point cloud data into a 2.5-dimension view with depth in the image to enable accurate measurement.

"It's invaluable to the end user because it's bringing a scale into your computer," Black said. He added, "If you're just looking at plan sheets, it's very hard for you to visualize the space. This tool allows you to visualize the space and also get a sense of the scale."

This is possible because Clarity places the user in a view that is very light weight and easy to understand, with the goal of any user being able to successfully navigate the software in the first minute. Clarity also lowers the barrier of entry by working on any platform or device.

"If we use it for nothing else than to check our survey drawings," Black said, "it's a very good tool for that."

One of Black's recent projects included gathering point cloud data for multiple levels of a historic building. Using Clarity, Black was able to share just enough 3D information so the architect could get dimensions to order and place new furniture and understand the placement of certain utilities.

"It gave them a good sense of the scale spatially," Black said. "It brought the spatial realm into their computer."

Tools for Chasing BIM

In addition to needing a way to share complicated data sets simply, more geomatics professionals are also interested in aligning



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versatility it's the optimal tool for cadastral, construction, or topo surveys; a range of GIS jobs from data collection to inspection and maintenance; as well as for non-traditional geospatial professionals. The 5.3" screen neatly displays the new workflow using a camera to ensure 2D centimeter accuracy handheld and 3D centimeter accuracy with monopole setup.

Learn more at
www.spectrageospatial.com

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GEOSPATIAL

with Building Information Modeling, the information-centric process for improving efficiency and productivity of construction projects. BIM offers many opportunities for surveyors to provide more and richer deliverables to professionals across the design, build and operate lifecycle.

But the act of purchasing a laser scanner doesn't turn a surveyor into a BIM service

provider. That level of service requires the surveyor to provide deeper understanding of the data to improve process and project outcomes.

With tools such as Trimble Connect and Trimble Clarity, surveyors now have the ability to communicate with multiple trades through a single project management environment. These types of software are part of software fleet that connects a surveyor to the entire virtual BIM process so they can go beyond measuring property lines and building foundation footprints to provide rich, BIM-ready deliverables, and be rewarded by contractors for bringing more to the entire process.

Choosing a 3D viewer

With so much riding on data utilization, it's important to consider the various features and support for any 3D viewer. These can include:

- communication tools, such as annotations and markups
- measurement tools, such as "snapping to" for measuring on the vertical without any horizontal movements
- navigation tools to move around within the viewer
- file formats, and whether the software is flexible in handling different kinds
- pricing models, whether subscription-based or desktop point of sale
- data security, such as how data is stored, whether it can be stored in the cloud, what happens to data when it is erased, and what local governance laws allow
- privacy, such as whether data is being collected on your software use and how it will be used, such as with cookies

Probably one of the greatest advantages to a cloud-based 3D viewing software is its ability to be automatically updated.

Whatever the features, the overarching goal needs to be solving collaboration problems.

"The potential for our clients is that we don't have to give them huge dumps of data," Black said. "They are just pointing to a web browser and going forward." ■

John Fomby is product manager, cloud strategies, for Trimble.

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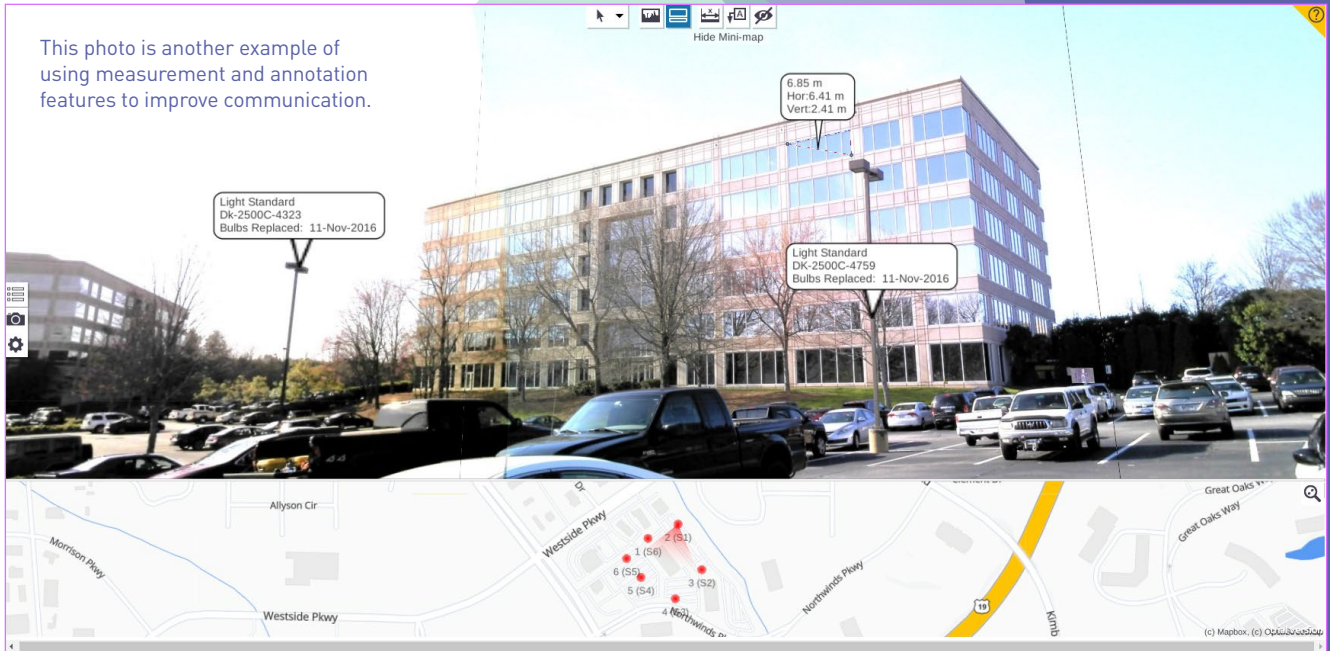


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This photo is another example of using measurement and annotation features to improve communication.



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SURVEY: SOME- TIMES IT'S THE PITS

» LARRY TROJAK

A photograph of a surveyor, a woman with long dark hair and sunglasses, wearing a light-colored vest over a dark shirt and dark pants. She is standing on a rocky, uneven surface, likely a quarry. She is holding a long, thin metal pole vertically in her right hand, which has a surveying instrument attached to the top. In her left hand, she holds a small electronic device, possibly a data collector or a smartphone. The background is a large, steep, light-colored rock face under a clear sky. The ground is covered with loose rocks and some sparse vegetation.

Quarry surveys
are just one of this
Maine surveyor's jobs



While not one to dote on the challenges facing women in the workforce today,

Tara Hartson will concede that there's still "room for improvement" in the attitudes of some toward a female surveyor, and can cite some interesting anecdotes to back that up. In a career field in which women make up only 10% of the workforce and serve largely male-dominated industries such as construction, mining, etc., perhaps that's really not surprising. Attitudes notwithstanding, the Ellsworth, Maine surveyor loves the work she does, gets a great deal of personal and professional satisfaction in the service she provides on behalf of her employer, Herrick & Salsbury Land Surveyors (H&S), and, 11 years into a tenure at that firm, has no plans to go elsewhere in the foreseeable future—except perhaps up.



Finding Her Way

Tara Hartson's path to surveying was anything but direct. Initially focused on a career in music education, she first attended a college in Maine, but quit upon finding the school was more party than practice.

"Not long afterward, my sister was accepted to St. Olaf College in Northfield, Minn., and I thought I could apply there as well," said

"... a woman came out and was so excited to see a female surveyor that she totally ignored my colleague who was standing right next to me."



Using a Topcon GR-5 base/receiver and a Tesla controller running Topcon Magnet 5 software, Tara Hartson collects coordinates and elevations to prepare an existing conditions topo site plan.

Hartson. "I was accepted into the school's biology program and was fairly happy doing that and music. However, with no money available to come home during school breaks, I started taking some summer geology courses at nearby Carleton College and thought that perhaps landscape architecture might be a good area to pursue. So, with a long-term goal of getting my master's degree, I interned for a bit with an architectural firm."

During that internship, which included a good deal of data entry from surveyors working for the firm, Hartson realized how much she enjoyed the survey side of the business and knew immediately that was the path she needed to pursue.

"It was like a light bulb went on and suddenly it all made sense," she said. "I knew I wanted to work in the outdoors, but I also knew the job had to have a brain component to it—survey provided both of those. So instead of working on my master's, I transferred credits and, in two years, got my BS in surveying engineering technology from the University of Maine, Orono. After completion of school, I interned at H&S and in 2007 Stephen Salsbury, the owner, offered me a position with them."

Idle Robot

Immediately upon starting at H&S, because she was new and young, Hartson became

the *de facto* technology expert for the company. Her first assignment involved using the firm's GPS in a mining application.

"One of our clients was capping an old mine site to stop it from leaching—it was an environmental hazard," she said. "So we were working with a geotechnical firm, and, using GPS, I would come out every day and shoot elevations to make sure the cap was to the design standards. Steve told me I was going to be at their beck and call—and I was. It was my introduction to the world of survey and it kind of reaffirmed my career choice."

Around that same time, H&S had just purchased a new robotic total station which,

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Trojak, continued from page 32

while advanced for the time, left Hartson less than impressed.

"I refused to use it because, even though it had a lot of potential, the technology wasn't quite there yet," she said. "I would run a traverse and come back and it wouldn't close properly—it just made me nervous. Steve tried to get things right, sending it back repeatedly to the dealer to have them look at it, but I still wasn't comfortable with it. So, essentially, it sat there for ten years and we just used other total stations to get the job done."

Last year, in a continuing effort to upgrade its equipment, H&S purchased a Topcon GT-505 robotic total station, a lighter, yet undeniably more powerful version of earlier models. This time, it passed the Hartson test. "Not surprisingly,

it's like night and day compared to that older gun," she said. The technology is much more accurate, it's much faster, it allows for hybrid positioning, and, when we need to, we can have a one-person operation. Most importantly, I have a nice level of confidence in it."

With Her, Permitting

Much of H&S's business includes boundary and topo surveys, land-use permitting, easements and rights of way, wetland mapping, elevation certificates, and more. The land-use permitting mentioned in that list of offerings includes

"I knew I wanted to work in the outdoors, but I also knew the job had to have a brain component to it —survey provided both."

work with area gravel pits, a business segment which H&S has captured well.

"Handling permits for almost all of the gravel pits in this area is definitely one of our strengths, said Hartson. "There is a decent amount of development in this area and, as a result, aggregate is in demand. However, operators of the pits generally don't like to deal with the permitting issues, so they leave that to us. We come in, and, using either a Topcon GR-5 GPS with a Tesla controller or a Sokkia GCX3 GPS with an SHC5000 controller, do all the topo work

they need to ensure they are in compliance with local, state and federal regulations and get them permitted."

Due largely to their location—in an area dotted with lakes and rivers and roughly ten miles from the Atlantic ocean—elevation certificates or Letter of Map Amendments (LOMA) represent another decent piece of H&S's business. A LOMA is usually issued because a property which is actually on natural high ground above the

base flood elevation, has been inadvertently mapped as being in a floodplain.

As Hartson puts it: "If someone is buying a house, and there's even a remote risk the tide could one day take that house away, the bank will require flood insurance. Yet, many of the maps aren't terribly accurate and may put the house in the flood zone. So we get hired by the bank of the purchaser to do a LOMA to determine how much that flood insurance really should cost. Using GPS, we will do a topo of the house in question to get a more accurate read: what elevation is this house really at? What is the risk factor? It's not just a big part of our services, it's an important one."

Anecdotally Speaking

Of course, the anecdotes mentioned earlier warrant clarification. In the course of all the permitting visits Hartson has made in her 11 years with H&S, she said workers in the pits have been overwhelmingly welcoming.

Handling permitting for almost all the Ellsworth-area gravel pits is one of Herrick & Salsbury's strengths. The firm has been a proponent of GNSS technology for over a decade.



“At the beginning, I’m sure it was different for them to see a woman doing what had always been done by a man,” she said. “But out of all the people in all the pits I covered doing permitting, I can only recall one guy whom I could tell genuinely didn’t like dealing with me. On the other side of the coin, we were recently doing a residential job and a woman came out and was so excited to see a female surveyor that she totally ignored my colleague who was standing right next to me.”

Unfortunately for all surveyors, some people, feeling confident about where their property boundaries are, allow their contentious side to come out when they hear otherwise. Other times it’s just overreacting to the unknown. Case in point: Hartson recalled one time a resident came out to greet them in a way none of them expected.

“This past spring, I knocked on a door to introduce ourselves and the owner came to the door with a gun,” she said. “One of our guys settled him down, I explained what we were there for, and things were fine from then on. In fact, on our last day, we stopped by to tell him we were all done, and he said: ‘I put some lunch money on your dash,’ ‘You just never really know what to expect and I think that’s part of what I like about this job.’”

Small Wonder

Given their inventory of some of the latest Topcon and Sokkia survey gear, it’s obvious that H & S has a handle on technology and staying abreast of its changes. Membership in the Maine Society of Land Surveyors means a yearly gathering, which allows for an exchange of such ideas. And workshops, needed to maintain current licensing, are generally attended by vendors who bring their latest offerings.

“Steve also has a knack for sniffing out the latest and the greatest stuff online,” said Hartson. “And it doesn’t hurt that we just added two people right out of college—guys who recently had access to all the newest technology. Picking out equipment with them was great because they came with a knowledge set that really helped us make decisions. The GT-505 is proof of that.”

Three of the surveyors on staff at H & S: owner Stephen Salsbury, Hartson and Benjamin Bartlett, hold Professional Land



Using a Sokkia GCX3 paired with a Sokkia SHC5000 mobile tablet—also running Magnet 5 software—Hartson locates a granite post marking a property boundary corner. The receiver utilizes a cellular data connection to provide a virtual reference station, giving real time positioning without having to return to the office to process collected data.

Surveyors licenses (Salsbury is also qualified as a code enforcement officer). Rounding out the H & S team are Daniel Sawyer, survey technician and Stacey Clement and Lisa Salsbury who share the office manager function. That staff of five full-time employees has remained fairly constant over the years, according to Hartson.

“Generally speaking, there’s almost no turnover here; when people come on board, they stay here until they retire,” she said. “We have a fairly new crew right now

because of two recent retirements and one gentleman’s passing. In the history of the company, most people get hired and stay on for 40 years. I’m more than a quarter of the way there already and I feel like I’m just getting started.” ■

Larry Trojak of Minnesota-based Trojak Communications is a freelance marketing content specialist. He writes extensively for the geopositioning, utility, aggregate processing, recycling, construction, and demolition markets.



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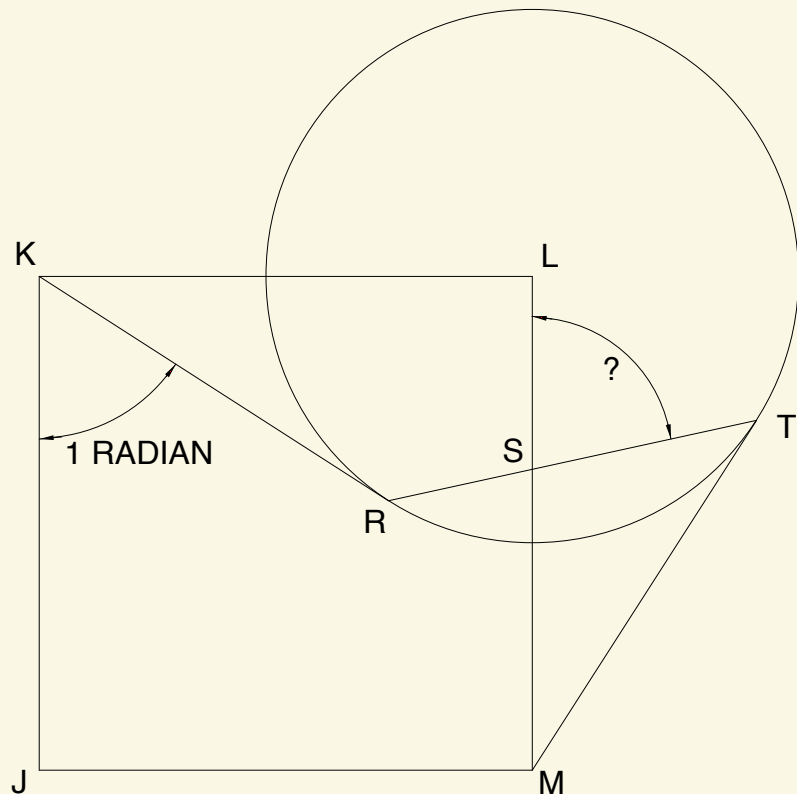
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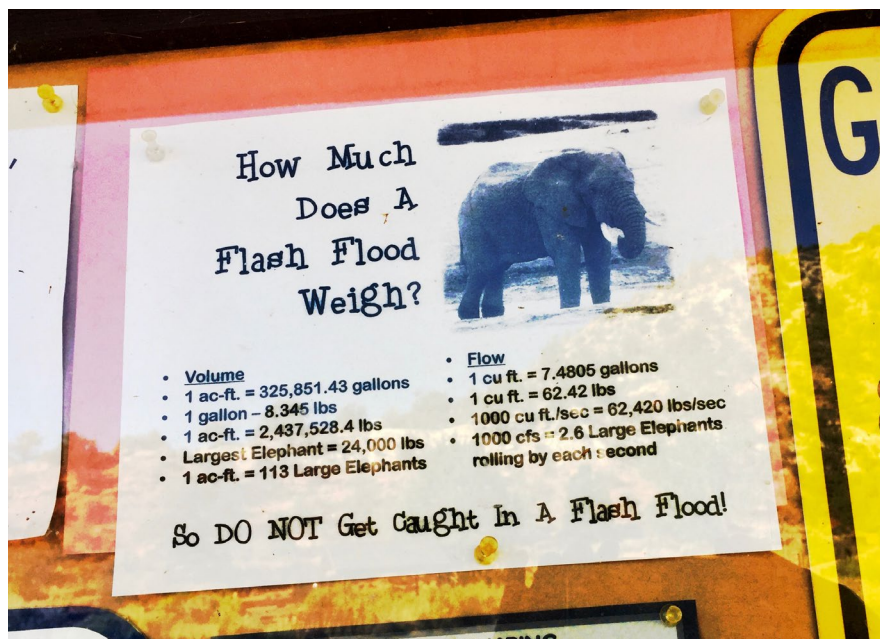
At the Corner of the Box

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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.





A sign meant to be an attention grabber in Escalante's Petrified Forest State Park: While not native to the US (mammoths having disappeared long ago), most of us can understand comparisons to modern elephants.

surface have some likelihood of flooding, any area with steep slopes can be subject to rapid runoff and elevated waters as a result. Inlets will be overwhelmed, streams will quickly rise, and in areas with constricted flow (urban or rural), water levels can suddenly increase many feet. Areas that have experienced wildfires are particularly prone, as intense heat creates a chemical reaction that seals soil from being able to absorb moisture, like a glaze. Flash floods occur because soils cannot absorb water as fast as they are receiving it.

On our way out to Moab, we had stopped in St. George, Utah, where the weather turned suddenly dark and torrentially wet. The street scene image shows the aftermath of a ten minute storm after a blazingly hot, dry day. I could not resist taking a photo of an appropriately named street with an unintended paved river running down its center and overflowing gutters racing like rapids more than a foot deep.

Meanwhile, back home on the East coast it was thunderstorm season, and both my county and a few other areas made the news on receiving mass quantities of water over a short period of time. The next township over from mine has requested Pennsylvania's governor to ask for a presidentially-declared disaster so that recovery funds might assist the many wiped out businesses and damaged homes. A little further east, my brother's township experienced 8 inches of rain in a day. Since during Superstorm Sandy the

water had come within inches of his home's slab on grade foundation (but inundated his neighbors up to 4 feet), I was concerned. Once again he was fine, but a main intersection half a mile away was underwater and

residents in a nearby retirement development had to be evacuated by boat.

How much does a flash flood weigh? That may seem like a silly question, but sometimes it's necessary to be silly to catch people's attention. In Escalante, Utah's Petrified Forest State Park, the bulletin board on the side of the campground restroom contains the usual warnings about keeping food locked up and away from bears, but also warnings about avoiding the dangers of flash floods—in terms of elephants. Starting with an explanation of the weight of gallons and acre-feet of water, we are logically brought to the understanding that one acre-foot has the volume of 113 large elephants. Flow is explained in cubic feet and pounds per second, culminating in the calculation that “1000 cfs = 2.6 Large Elephants rolling by each second.” The moral appears in large font at the bottom of the sheet: “So DO NOT get caught in a flash flood!” That's good advice for all of us. ■

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.

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Flashy (but not in a good way)

I am just back from a hiking vacation in Moab, Utah, visiting Arches National Park and Canyonlands National Park and marveling at the visual history of how our planet formed through deposited layers preserved as they turned to stone. It is amazing to see evidence of the former inland seas, with coral and fish fossils up there at elevations between 4,000 and 6,000 feet above current sea level. It was easy for me to understand the soils in this context, but I'm not sure the general public understands how a place like this can be prone to flooding.

In the parks, the rangers warned of areas to avoid if it even vaguely looked like rain. The hard packed soils and high (or exposed) bedrock would quickly flood, and canyon trails could be deadly.

The Moab skies were cloudless most days, but a few evenings featured some short but heavy thunderstorms (bringing the temperature down below 103). Our next hikes showed us water-filled depressions and wet marks indicating how high the water had reached on some of the rocky walls lining the trails. This is flash flood country.

What does that mean? The National Weather Service defines flash flooding as "flooding that begins within 6 hours and often within 3 hours of heavy rainfall (or other cause)." NOAA's National Severe Storms Laboratory further describes flash flooding as combining "the destructive power of a flood with incredible speed and unpredictability." To understand this hazard, we need to pay attention to several factors: the intensity of the rainfall, the duration of the rainfall, and the topography, vegetation, soils, and impervious surfaces in the area.



This appropriately named street in St. George, Utah is a little drier than it was a few minutes before, when it was completely under water during a sudden ten minute downpour and it was too wet to get a good photo.

Flash flooding happens so quickly that people are generally unable to respond in time to get out of its way.

I recall driving on a highway in southern New Mexico a few years ago when the sky suddenly loosed so much water from the black clouds overhead that visibility plummeted to zero, and the few cars on the road all pulled over to the highest points we could find. Despite a deep drainage ditch in the median, within just a few minutes

the highway was under about four inches of water. Luckily the storm was less than ten minutes long, or we could all have been swept away; it takes only 12 inches to float most cars (and about six inches to reach water-incompatible mechanical and electrical parts on their undersides).

It is difficult to explain the dangers of flash flooding to people who think it can't happen to them. While we might recognize that urbanized areas with lots of impervious

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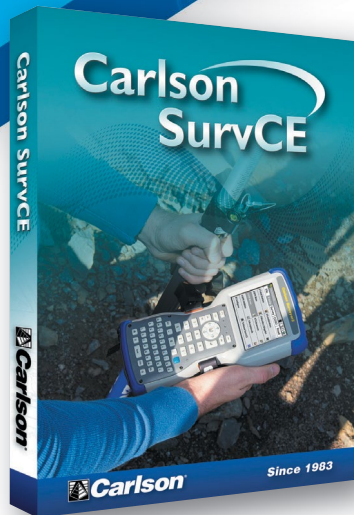
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