Volume 30: Issue 4
October, 2019

LINES & POINTS

www.plsw.org

THE EQUALITY STATE SURVEYOR
PROFESSIONAL LAND SURVEYORS OF WYOMING

On The Cover

Cheyenne Corner Tablet set by PLSW Southeast Chapter
Photo By Mike Flaim
Hand Model: Mark Corbridge

CONTENTS

PUBLICATIONS COMMITTEE

2019 PLSW SUSTAINING MEMBERS

- Jason Dysthe - Frontier Precision Inc.
- John Baffert - Surv-KAP, LLC
- Chris Farnsworth - RDO Integrated Controls
- Kelly Goff - Underground Consulting Solutions
- Susan Hall - Trimble
- Tim Klaben - Berntsen International Inc.
- Troy Langston - Monsen Engineering

PLSW (Professional Land Surveyors of Wyoming; PO Box 8, Cheyenne, WY 82003) is a statewide organization of Land Surveyors registered to practice in the Equality State of Wyoming. PLSW is dedicated to improving the technical, legal, and business aspects of surveying in the State of Wyoming. PLSW is affiliated with the National Society of Professional Surveyors (NSPS) and the Western Federation of Professional Land Surveyors (WestFed).

Lines and Points is published by the Professional Land Surveyors of Wyoming.

Advertising Information

Digital-ready, full-color advertising with payment should be mailed to Lines & Points, P.O. Box 8, Cheyenne, WY 82003.

Advertising rates are as follows:	Year	Issue
Full Page	$810	$210
Half Page	$540	$140
Quarter Page	$310	$80
Business Card	$40	$10
Employment	Free	Free

Special Rates apply for PLSW Chapters and cover placements.

For more information please contact Jack Studley.

PRESIDENT'S MESSAGE

It seems the last message was only weeks ago, which must mean it has been a busy year. I hope you all have been busy as well, while still taking a little time to enjoy the summer that is now officially gone. It has been an exciting summer and I very much look forward to the cooler temperatures, snow and winding down that fall brings. Despite the busy year, there are several good things happening within the PLSW organization. To name a few, progress is being made with the outreach program to middle school and high school students, we are awarding a couple scholarships to applicants who are currently taking survey courses, and there is talk of a potential RTN network in the Wind River area. Fall Tech is just around the corner, so remember to bring silent auction and/or raffle items if you have them and more importantly bring your wallet to support the PLSW scholarship program! I look forward to seeing you all there.

Lyle J. Casciato, PLS, CFedS
President, Professional Land Surveyors of Wyoming

P.L.S.W. Technical Session

REGISTER ONLINE TODAY AT www.plsw.org

Dates: November 7th & 8th, 2019

Ramkota Hotel

Block Rate - $85/night - limited space

Speaker: David Morlan

David began surveying with the Bureau of Land Management Cadastral Survey (BLM) in 1979 and spent his entire 35+ year career with the BLM in Nevada. He gained his Nevada Professional Land Surveyor certification in 1991 and was selected as BLM Nevada Geographic Sciences Chief and Cadastral Survey Chief in 2004. David has instructed at the Federal Training Center in Phoenix Arizona as well as provided survey instruction to the University of Nevada Engineering Department through the Nevada Association of Land Surveyors (NALS), and has presented at several State Conferences. He was selected NALS Nevada Surveyor of the Year in 2006.

He continues to be active in NALS and shares his 40+ years of experience through workshops, conferences and consulting. Today's survey highlights and pleasures include co-presenting on the complexities and uniqueness's of several PLSS topics with his colleague, ex-boss and friend, Steve Parrish.

TOPICS:

Restoration of Lost or Obliterated Corners – 2009 Manual Chapters V, VI, and VII (full day)

Rules of restoring lost or obliterated corners; witness corners and line trees; methods of proportionate measure; irregular boundaries; meander corners; closing corners; nonriparian meander lines; grant boundaries. Actual survey problems are examined and discussed to highlight the principles and applications.

Research – Recovery – Remonumentation – Recordation (half day)

With the passing of time, natural deterioration of earthly materials, sometimes confusing writings, less than desirable drawings and hazy memories the task of "finding the survey" becomes overwhelming. Experience, endurance, connections and mentors are essential elements of any successful search for the "surveyor's path" and the monuments left to mark that path. A.C. Mulford, in his 1912 treatise "Boundaries and Landmarks" sums up our responsibilities with the following statement from page 87:

"The problems of boundary lie at the foundation of all surveying, for one must know where a line is before he can measure it, and the solution of these problems calls for the same powers of accurate observation and of consecutive and logical thought that are demanded for successful work in any branch of modern science."

ANNOUNCEMENTS

FLATIRONS, INC.
Surveying, Engineering & Geomatics

Immediate Job Opening for Flatirons Surveying, Inc.
Title: Professional Land Surveyor
Location: Boulder, Colorado
Details: Employment Type – Full Time
Website: www.flatironsinc.com

We are a well-established employee-owned Colorado Land Surveying and Engineering company with our main office in Boulder, and satellite offices in Longmont and Denver. We provide professional land surveying services throughout Colorado and many western states. We are currently seeking a responsible charge Licensed Professional Land Surveyor with licensure in Wyoming and/or New Mexico for a position in our Boulder office. Licensure in additional states is a plus.

The qualified candidate shall be available full-time, and have a minimum of 5 years of land surveying licensure, with specific boundary and construction experience, and functional knowledge of AutoCAD Civil 3D, Microsoft Word and Excel. Must have a working knowledge of GPS equipment and coordinate transformations/projections.

Individual must have the ability to supervise personnel, work with a project team, demonstrate self-motivation, the ability to communicate clearly, and manage projects.

This position has the potential for professional growth and personal advancement within the firm. Pay level and benefits will be commensurate with experience and qualifications.

We require that all employees be prompt, reliable, detail oriented, have good work ethics, have a positive attitude, work well with others and have good communication skills.

Our full-time employee benefits include: a work environment with room for advancement, the opportunity to work with state-of-the-art technology, a company sponsored Retirement Plan, company subsidized medical/dental insurance, paid vacation, and company paid life and accident insurance.

Wage Range: Commensurate with experience

Closing Date: Until filled.

Please submit a resume, cover letter, and salary requirements to hrdept@flatironsinc.com

You will only be contacted if we are interested in setting up an interview.

"Journeys: One Individual's Excursions into the Surveying and Mapping Professions: Volume I"

by Herbert W. Stoughton

Price: $30.00 (includes S&H)
Proceeds from the sale will be invested in the PLSW Scholarship fund.

Send orders to:
2821 Carey Avenue, Cheyenne, WY 82001

SCHERBEL ON SURVEYING

A compilation of parts of the
WYOMING STATUTES
and other items of interest to
PROFESSIONAL LAND SURVEYORS
Order from SURVEYOR SCHERBEL, LTD.
307-276-3347
Currently available in digital format only
for a cost of $40.
Revised and updated biennially.

T-O ENGINEERS

TO Engineers Employee Benefits (all positions):

- Flexible Schedule
- 1/2 Day Fridays
- Paid Holidays
- Vacation and Personal / Sick Leave
- Medical, Dental, Vision, and Life Insurance
- Flexible Spending Account
- 401 (k) Retirement Plan with Employer Match
- Discretionary Profit Sharing
- Training and Educational Opportunities

For more information about T-O Engineers and to apply for these positions, go to http://to-engineers.com/

Survey Department Manager (Heber City, Utah)

T-O Engineers is currently offering a $12,500 hiring incentive to the successful candidate. Enjoy a rewarding career with a thriving company in a desirable community neighboring Park City, Provo, and Salt Lake City!

T-O Engineers is seeking a Survey Department Manager to build our practice and mentor our existing survey staff in our Heber City, Utah office. This is an opportunity to build a team and build a practice with an established firm that is committed to the area and the profession. Candidates can expect to work alongside engineers and planners to support on-going survey demands and the freedom to pursue other lines of business and surveying opportunities. We have a robust staff of other licensed professional surveying staff to assist, but we are looking for a leader in our Utah market.

The ideal candidate will have a professional network in Utah and have ability to grow our existing survey practice in this market. The successful candidate will have a Utah PLS license or to the ability to become licensed in Utah within six months. Key traits for this position are strong communication, leadership, and organizational skills; team player; and ability to work outdoors and in a professional office environment on a wide variety of projects. Personal appearance must be professional in the field and office. The successful candidate will also work closely with Survey Staff in our other offices in Idaho, Washington, and Wyoming.

Position Requirements & Responsibilities Include: Utah PLS or the ability to become licensed in Utah within six months; established professional network in Utah; ability to lead business development and marketing in Utah; ability to obtain Idaho PLS a strong plus; strong communication, organization, and mathematical skills; ability to work outdoors and in a professional office environment; strong skills using AutoCAD / Civil 3D; Trimble Business Center, GPS/RTK and Robotic Total Station experience required; self-motivated, team-oriented individual willing to listen; and ability to work on challenging projects in a team environment.

Professional Land Surveyor (Spokane, WA)

T-O Engineers is seeking a Professional Land Surveyor to work in our Spokane office. The successful candidate will have a Washington PLS license. Must have strong math, communication, and organizational skills; be a team player; and work in a professional office environment on a wide variety of projects. Must be able to work under the direction of a senior PLS located in our Coeur d'Alene office. Professional appearance in the field and office is a must. Strong AutoCAD/Civil3D, Trimble Business Center skills, and GPS/RTK, Robotic Total Station experience is a plus. Candidate will be capable and willing to perform business development activities that will help our survey group in the Washington market.

Position Requirements & Responsibilities Include: Attained Washington PLS license, strong communication, organization and mathematical skills, ability and experience to independently manage projects and people, strong skills using AutoCAD Civil 3D and/or MicroStation is required, Trimble Business Center, GPS/RTK and Robotic Total Station experience preferred, self-motivated, team-oriented individual willing to listen and work on challenging projects in a team environment and lead business development and marketing in Washington.

Survey Crew Chief / LSIT (Cody, Wyoming)

T-O Engineers is looking for Land Surveyor In-Training / Survey Crew Chief or equivalent Survey Technician(s) in our Cody, Wyoming office. Four-year degree in Surveying and/or LSIT a plus. Must have strong math, communication, and organizational skills; be a good team player, physically fit with a willingness/enthusiasm to work outdoors and in a professional office environment on a wide variety of projects. Strong AutoCAD/Civil3D, Trimble Business Center and Trimble GPS/RTK, Robotic Total Station experience a major plus.

This position works as a member of a survey crew to perform boundary surveys, topographical surveys, construction surveys and aviation surveys for both public and private clients. This position is also responsible for offering direction and guidance to technicians and ensures that crews adhere to procedures set by the company, state statutes, and the survey industry. This is a full-time, benefited position.

What You Bring to the Team: 4-year surveying degree and/or LSIT strongly desired, 1-2 years of experience working on a survey field crew; knowledge of boundary law, construction calculations, and research methods; self-motivated, team-oriented individual with the ability to work on challenging projects in a team environment; knowledge of Trimble surveying equipment and software; ability to perform physically demanding work in all types of weather; and to maintain relationships with fellow employees and clients; strong communication and collaboration skills; and an insurable driving record.

Sparks Recieves NCEES Recognition

Sonja "Suzie" Sparks was recently honored by the National Council of Examiners for Engineering and Surveying at their Annual meeting in Washington D.C., for her dedicated service to the surveying profession.

On august 16, at the Omni Shoreham Hotel, Sparks was presented the NCEES Distinguished Examination Service Award, a recognition, according to NCEES, that was given to eight other engineering and surveying experts from around the United States.

"As an exam development volunteer for the past 12 years, Sparks has displayed a continuing commitment to the advancement of surveying licensure," according to an NCEES press release. "Her contributions to the Fundamentals of Surveying (FS) exam include developing new exam items, participating in studies to update the exam's specifications, and serving as committee chair."

The release adds, "(Sparks) has striven to develop an exam that is uniform, thorough, and fair in determining if exam candidates meet the minimum standards to become a surveying intern."

Sparks said she was "overwhelmed and humbled by the award."

After earning an AAS in Applied Science, Drafting at Caper College and a BS in Business Administration at the University of Arizona, Sparks' career took a turn in 1995 after she returned to Rawlins from Tucson, AZ., and she went to work as a draftsman for the late Martin Pedersen, a private land surveyor who owned Robert Jack Smith and Associates.

Then, one day, Sparks was sent to work outside of the office, which served a monumental moment in her young, auspicious career.

"(Pedersen) took me to the field one day," Sparks said, "and that's where I ended up staying."

From there, Sparks was obsessed, which is why she's stayed the course for almost 25 years. She went on to earn a BS in Mapping and Surveying from Metropolitan State College in Denver and went to work for the Bureau of Land Management in 2002.

"It was the ability to go to the field every day and do something that I loved," she said. "I would see parts of Wyoming that I have never seen in my life, and I grew up here. It's absolutely beautiful country, but every part of Wyoming has something to offer."

"At the time I earned my license, there were only two other women licensed in Wyoming, one in private practice and one with the Forest Service."

But being that Sparks is a woman, she had to make her name in an industry that is "traditionally not a woman's business."

Instead of trying to stick out as "different" in this male dominated realm, however, Sparks said she looked onto the men, her mentors and supervisors, for inspiration just like she did with Pedersen.

Instrumenting her surroundings to her benefit, Sparks' main responsibility nowadays as BLM's Branch Chief of the Cadastral Survey program, is assigning and approving BLM survey work on Federal interest lands.

Although her multi-state responsibilities include Wyoming and Nebraska, she spends most of her time in the office, something, despite being indoors, she feels still makes a great deal of difference.

"I love the people I work with, and I believe in the work we do," she said. "I believe that we're doing the right thing for the public every day."

As for the future, Sparks said she intends continuing what she's doing for as long as she is able.

"For myself, I'll work this job until I retire," she said. "As for the future of BLM, I just really believe in what we do as cadastral surveyors. I would encourage women to get involved in any technical profession. I believe that there are not enough women in scientific technology professions."

(Edited from article by Ray K. Erku from Rawlins Daily Times, Rawlins, Wyoming, published August 28, 2019)

New P.L.S.W. Logo Jackets

Men's Port Authority

The Port Authority jacket is constructed from a polyester stretch woven shell, which is then bonded to polyester microfleece with an added laminate film insert to repel water. Wind-resistant, water-resistant with stretch perfect for corporate or weekend wear.

Ladies Port Authority

Back of Jacket
(8-1/4 inch diameter)

The Young Gun is a 100% microfiber water resistant jacket. Has a western yolk accents on front and back. Features double snaps on waist, leather Velcro *closures* on cuffs and zipper underarm vents. Concealed hood and 3 exterior pockets and 4 interior pockets.

STS Jacket Young Guns

(Men's Sizes Only)

Front Left Chest
(3-3/8 inch diameter)

***Mail completed form with Checks**

Payable: Frontier Marketing
PO Box 2477
Cheyenne, WY 82003
Attn: Randy Rhodes
Questions Call: 307-778-1430

Port Authority $65.00 XS-XL
Port Authority $70.00 2XL-4XL
STS Jacket $125.00 XS-XL
STS Jacket $130.00 2XL-4XL

*** Shipping $15.00 per jacket (Cheyenne orders delivered)**

Customer Name: _____

Shipping Address: _____

PLSW contacts:
John Lee; jlee9901@aol.com; 307-760-0335
Suzie Sparks: s75spark@blm.gov; 307-775-6225
No shipping charge for Cheyenne address.
Printable order form available at www.plsw.org

Name Left Chest: _____ ☐NO NAME ☐NO BACK LOGO ☐NO FRONT LOGO

Size	XS	SM	MED	LG	XL		2XL	3XL	4XL		$ TOTAL
MEN'S	N/A					$65				$70	
LADIES						$65				$70	
STS						$125				$130	
SHIPPING						$15 PER				$15 PER	

NGS News

CORS ITRF2014 and New NAD83 Coordinates

NGS has completed its release of NOAA CORS Network (NCN) ITRF2014 epoch 2010.00 and NAD83 (2011) epoch 2010.00 coordinates, referred to as **Multi-Year CORS Solution 2 (MYCS2).**

As a reminder, NGS has reprocessed all NOAA CORS Network and some IGS stations using data collected between 1/1/1996 and 1/30/2017. These new coordinates are integrated into numerous NGS products and services, highlighted below.

Release Notes:

- All **NOAA CORS Network** (NCN) products, tools, webpages, and documentation are updated, including NCN station pages, NCN data download tools, Position and Velocity files (coord.txt), and RINEX file headers.
- **OPUS-S, OPUS-RS, and OPUS-Projects** are updated to provide users coordinates in the updated frames.
- The MYCS2 NAD 83 (2011) epoch 2010.00 coordinates are now available in **NGS Datasheets** and related products such as NGS Data Explorer, archived shapefiles, and output from DS World.
- **GPS satellite orbit files** available for download are also updated to be consistent with the ITRF2014 frame.
- There will be **limited support** for the IGS08 and older NAD83 (2011) epoch 2010.00 NCN coordinates **through December 2019**. Old coordinates are on the datasheets as superseded, for use in BETA OPUS processing (https://beta.ngs.noaa.gov/OPUS/), and displayed on NCN station short-term plots (short_08).

Send questions to NGS.CORS@noaa.gov or your Regional Geodetic Advisor.

GEOID 18

NGS has transitioned the GEOID18 model from BETA to production.

The coincident release of MYCS2 NAD83 coordinates and GEOID18 will minimize the changes to NGS' OPUS products.

Subscribe to GPSonBM News to get more information on GEOID18.

In Case You Missed It:

Why upgrade coordinates and models?

CORS ITRF2014 Coordinates

The CORS reprocessing campaign resulted in updated coordinates and velocities that address many changes since CORS coordinates were last updated in 2011, including but not limited to:

- Geophysical Processes (e.g., earthquakes, subsidence, plate motion),
- Equipment Changes, and
- New CORS with longer data sets since 2011.

Note: any changes after 1/30/2017 are not reflected in the updated coordinates because the reprocessing dataset had closed.

GEOID18

The majority of improvements in this hybrid geoid model comes from additional GPS on Bench Marks (GPSonBM) data pinning the model to the surface of NAVD 88, but there are also improvements in the underlying gravimetric geoid model.
These improvements include:

- better elevation data and improved digital elevation modelling techniques,
- new gravity data from satellite gravity missions,
- new airborne gravity data from the NGS GRAV-D program, and
- improved geoid modeling techniques.

These improvements will be realized more directly in the future when NGS switches to a purely gravimetric geoid model with the new datums in 2022.

GPS and Boundary Retracement

by Knud E. Hermansen
P.L.S., P.E., Ph.D., Esq.

INTRODUCTION

Much has been written about applying GPS to surveying. At relatively low cost, GPS provides a reliable means to get both relative and absolute positional information. The low cost of the technology has lead to a proliferation of GPS receivers, making this technology common not only among scientists and surveyors but also hunters, hikers, campers, fishermen, and landowners. Unfortunately, the proliferation of receivers has often resulted in the misuse of the technology in locating boundaries. This article will discuss some of the problems that occur and advantages gained in applying this technology to boundary retracement.

HISTORICAL SURVEYS

To understand the problems with using GPS in boundary retracement, knowledge of past survey practice is necessary. The early surveyors used the compass and chain and later the transit and tape in establishing many of today's boundaries. Land was inexpensive. Training was haphazard. Obstacles in the path of the survey were many. Virgin forests, wild animals, hostile Indians, and swarms of insects, to name a few, all took their toll of the surveyor's attention to his work. The chain and tape were unwieldy and inexpertly employed. Slope measurements were sometimes the norm. Correcting the chain and tape for sag, temperature differences, and stretching was seldom done. Magnetic readings were often erratic or failed to account for local attractions and diurnal variations. As a consequence, inconsistencies and errors in measurements were so common in early surveys that measurements were not held in high regard.

The science of geometry and mathematics is exact. The infinite depths of stellar space are measured with such exact nicety that the position of stars and planets can be calculated to the fraction of a second of time ... How can it be that in the ascertainment of one line of so small an area, bounded by four lines only, a difference of from 8 to 24 feet arises? It is evident that the methods pursued, and not a defective science, have brought about the different results, different maps. (Warren v. Boggs, 90 W.Va. 329, 332, 111 S.E. 331 (1922))

The science of mathematics is exact, but the different results reached in its application by different surveyors, is sometimes startling to the layman, when applied to what appears to be an ordinary survey. (Zirkle v. Three Forks Coal Company, 103 W.Va. 614, 626, 138 S.E. 371 (1927))

RULES OF CONSTRUCTION

To resolve ambiguities between what was marked and what was measured, the courts adopted rules, known as principles or rules of construction, that are meant to be applied in a consistent manner where there is conflicting information. One rule that is a fundamental principle in retracing a boundary is that the retracing surveyor is charged with following in the footsteps of the original surveyor. The original boundary fixed by the original surveyor, as imperfectly as the boundary may have been measured and documented, remains the boundary.

MEASUREMENTS AND LIMITATIONS

In adherence to this fundamental principle, the courts have held that original monuments or the former location of the monuments are superior to measurements in determining the location of boundaries. Research and field reconnaissance are often more important than the precision of measurements in locating the position of the original monuments. Put in other words, the gathering and reduction of measurements, while important, is seldom a persuasive factor or a critical aspect of boundary retracement. Lines of occupation, witness marks, and memories of the elderly are more compelling than the measurements. It is often disconcerting to the non-surveyor to be told that in fixing old boundaries, the law favors the old hedge that meanders several meters off a straight line rather than sophisticated equipment that can measure to the nearest centimeter. These concepts are well stated by the Ohio court in Sellman v. Schaaf:

The primary function of the second surveyor is to find first where the boundaries were established by the first surveyor … The essential rule governing the resurvey is to follow the steps of the first surveyor. ... Conveyances are presumed to be made according to a prior actual survey. It is said that the primary purpose of construction is to follow the footsteps of the surveyor on the ground. ... A survey is the locating and marking on the ground of the land described in a grant. Once a tract has been located by survey, and its boundaries have been marked, those boundaries cannot be altered by a subsequent survey. In making a resurvey, the duty of the surveyor is merely to locate the monuments placed by the original surveyor, or, where such monuments no longer

exist, the places where they originally stood. ... All lands are supposed to be actually surveyed, and the intention of the grant is to convey the land according to the actual survey. It is therefore said that the real purpose of a boundary inquiry is to follow the steps of the surveyor on the ground, and all calls will be construed with this in mind. ... It has been declared that all the rules of law adopted for guidance in locating boundary lines have been to the end that the steps of the surveyor who originally projected the lines on the ground may be retraced as nearly as possible; further, that in determining the location of a survey, the fundamental principle is that it is to be located where the surveyor ran it. Any call, it has been said, may be disregarded, in order to ascertain the footsteps of the surveyor in establishing the boundary of the tract attempted to be marked on the land; and the conditions and circumstances surrounding the location should be taken into consideration to determine the surveyor's intent. ... The original survey must govern if it can be retraced. It must not be disregarded. So, too, the places where the corners were located, right or wrong, govern, if they can be found. In that case a hedge planted on the line established by original survey stakes was better evidence of the true line than that shown by a recent survey. In making a resurvey it is the surveyor's duty to relocate the original lines and corners at the places actually established and not to run independent new lines, even though the original lines were full of errors. (Sellman v. Schaaf, 26 Ohio.App.2d 35, 41-43, 269 N.E.2d 60, 65-66 (1971))

As the precision of measurements increase, the accuracy decreases. (In the context of this article, precision refers to the repeatability of the measurements while accuracy refers to the correlation with the original boundary.) In many boundary retracement surveys, there is an indirect correlation between precise measurements and accurate measurements. Precise measurements become less useful in finding the position of original corners than more imprecise measurements that better replicate the original measurements. Measurements that replicate the deficiencies of the original equipment are more accurate in locating the original bounds than precise measurements that remove or are not influenced by local magnetic anomalies and terrain conditions between two points on the earth's surface.

With these articulations in mind, a person probably has a better chance of successfully retracing the original location of an ancient boundary using a compass and chain rather than a GPS receiver — if the chain and compass were used to establish the original boundary. The reason is that a compass and chain will likely incorporate

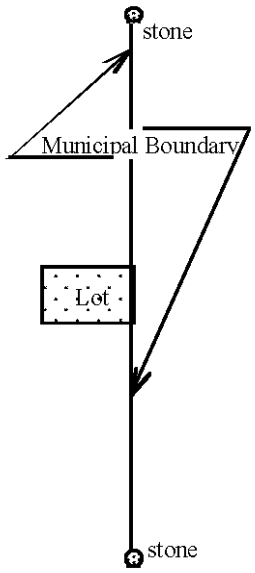
all the local attractions and imprecisions inherent in the work of the original surveyor. Using the compass and chain, the retracement surveyor will be closer to the lines marked by the original surveyor (i.e., the original surveyor's footsteps).

Consider an example to illustrate these concepts. Two people attempt to locate the same property boundary. The first uses a plastic tape and compass to locate approximate corner locations, wanders about, and finds the old remains of stakes set by the original surveyor. In subsequent measurements, the first person makes a series of imprecise and even faulty measurements between the stakes. The first person subsequently documents these faulty measurements on a plan depicting the boundary. A second person using GPS equipment makes a series of precise measurements to reestablish the boundaries according to the measurements found in the deed. Not realizing that old measurements found in deeds often contained errors in feet and sometimes hundreds of feet, the second person goes about marking off the deed measurements with a precision unknown in the past. Unable to find the original stakes or thinking them set in error, the second person marks corners according to the precise measurements they have obtained with the GPS receiver. The second person produces a plan showing precise measurements between the corners set. As between the two, the courts would find that the first person has performed a more accurate survey according to the legal rules applicable to boundary retracement.

It follows that the ability to replicate with great precision the nominal measurements in the deed and project them upon the ground with GPS technology is seldom the best way to retrace old boundaries. Accordingly, the proliferation of GPS receivers in the hands of laypersons lacking a knowledge of the legal rules of construction does not make the layperson any more qualified to locate the boundary than placing an X-ray in the hands of a layperson makes a layperson qualified to give a medical opinion on the condition of a patient.

GEODETIC V. PLANE SURVEYING

Another problem that GPS appears to thrust upon both layperson and surveyor alike is what can be termed the "geodesy" factor. The ancient boundary measurements were more times than



not slope distances measured by laying the chain on the ground or roughly elevating the chain to avoid the natural debris and litter found upon the ground surface. More recent boundary measurements use distances merely corrected to local horizontal. GPS measurements, on the other hand, produce vectors between co-observing stations lending a natural preference to a three-dimensional mathematical approach. The length of the vectors could be reduced to the ellipsoid or the conformal mapping plane. In some areas, the differences between these derived GPS measurements and local horizontal distances could be considerable.

MISSING EVIDENCE

GPS technology in the hands of surveyors often cause the surveyor to forsake a thorough search for evidence along the boundary. When a surveyor employs a compass and tape or has to traverse along or near a boundary, the surveyor often discovers a great deal of evidence that helps locate the position of the original boundary. Old stone walls, ancient blazes on trees, rusted remains of wire fence, support stones for the split rail fence, cut lines, etc. are often discovered in surveying along a boundary using traditional methods of surveying. With GPS technology, many surveyors forego the difficult and time consuming walk along the boundary, preferring instead to set up near one corner location, obtain measurements, then drive to a location near the next corner location.

As a result, evidence that could help re-establish the position of the original boundary remains undiscovered and ignored. Encroachments along the boundary remain undetected and unresolved. The new technology may increase the speed and efficiency of the survey work but does so at the sake of decreasing the information used and the reliability of the surveyor's opinion.

PROBLEMS UNDETECTED

Even in the hands of a surveyor knowledgeable about the rules of construction and geodesy, GPS causes problems — although ethics no doubt requires the problems be revealed rather than put aside. Consider the diagram showing a small lot that was meant to be bounded on a municipal boundary. In the past, a surveyor creating the lot or retracing the lot should have established the lot's easterly boundary by locating the two ends of the municipal boundary and fixing the lot boundary to coincide with the municipal boundary. However, economics and the errors resulting from traversing long distances often precluded or forced the surveyor to make certain assumptions regarding the position of the municipal boundary (e.g., the existing fence line was on the municipal boundary). The surveyor then located the lot boundary based on these assumptions. Even with the knowledge that such assumptions were often tenuous at best, the surveyor took great comfort from knowing that a subsequent surveyor was no more likely or able to retrace the municipal boundary than the earlier surveyor so any problems would likely remain undetected and undiscovered. With the advent and proliferation of GPS, the situation changes drastically. Previously it would have taken days to traverse between the stones and locate the municipal boundary. Now, the municipal boundary can be located relatively precisely in a matter of hours by occupying the stone corners with GPS receivers. Surveyors that were relatively secure in the knowledge that any errors would likely remain undetected until long after their demise are suddenly faced with the possibility that their errors will be revealed during the next survey of the area — either by their own subsequent work using GPS technology or the work of a competitor using GPS technology.

ADVANTAGES OF GPS

The results of the discussion so far begs the question why use GPS in boundary retracement? GPS appears to pose problems in the hands of the layperson and the surveyor alike in retracing boundaries. The fact is that GPS can be used to great advantage in boundary retracement by knowledgeable surveyors. It provides an efficient means of locating the position of evidence within a relative or absolute geometric framework — especially if the evidence is separated by long distances or terrain difficult to traverse. Without question, it can provide precise coordinates of properly re-established corners or in fixing the position of new corners in a subdivision. The publication of precise coordinate values (with datum) will provide the future surveyor with a credible piece of evidence to locate the former position of a corner long after the original monument or its replacement have disappeared. Consequently, while a compass and chain may be the best tools to locate the original boundaries, the GPS receiver may be the best tool to tie

LINES AND POINTS ARTICLE ROTATION SUBMISSION SCHEDULE BY CHAPTER

Responsible Chapter	First Call Date	Last Call Date	Publication Date
Southwest Chapter	THANK YOU!! (SEE "*GPS AND BOUNDARY RETRACEMENT*" IN THIS ISSUE)		
Northeast Chapter	December 1	December 15, 2019	January 1, 2020
Northwest Chapter	March 1	March 15	April 1, 2020
West Chapter	June 1	June 15	July 1, 2020
Central Chapter	September 1	September 15	October 1, 2020
South Central Chapter	December 1	December 15, 2020	January 1, 2021
Southeast Chapter	March 1	March 15	April 1, 2021
Upper Platte Chapter	June 1	June 15	July 1, 2020

boundary evidence into a geometric framework and memorialize the location of corners for future recovery. The acceptability and credibility of GPS measurements in boundary retracement will increase as more boundaries are set by the use of precise GPS measurements or later memorialized by GPS measurements. Put in other words, when the tool of the original surveyor is a GPS receiver, the GPS receiver in the hands of the retracement surveyor will be accorded great weight in re-establishing the boundary set by the GPS technology.

CONCLUSION

In conclusion, the proliferation of GPS technology if not used properly can cause problems and errors in retracing boundaries. The technology must be combined in conjunction with a thorough knowledge of the limitations of earlier surveys and the rules of construction. The ease of GPS should not detract from the surveyor's responsibility to search for and retrace the original surveyor's footsteps.

GPS has many advantages for the retracing surveyor. GPS technology allows measurements to be gathered relatively quickly in a short time. Consequently, evidence can be tied into a geometric framework with much less effort. Old boundaries (once properly reestablished) and new boundaries can be defined more precisely and faster by using GPS technology.

Knud E. Hermansen is a licensed land surveyor, civil engineer, and attorney at law. He teaches at the University of Maine and specializes in boundaries, title, and land development.

CHEYENNE CORNER TABLETS

By Jack Studley, PLS, Cheyenne City Surveyor (Retired)

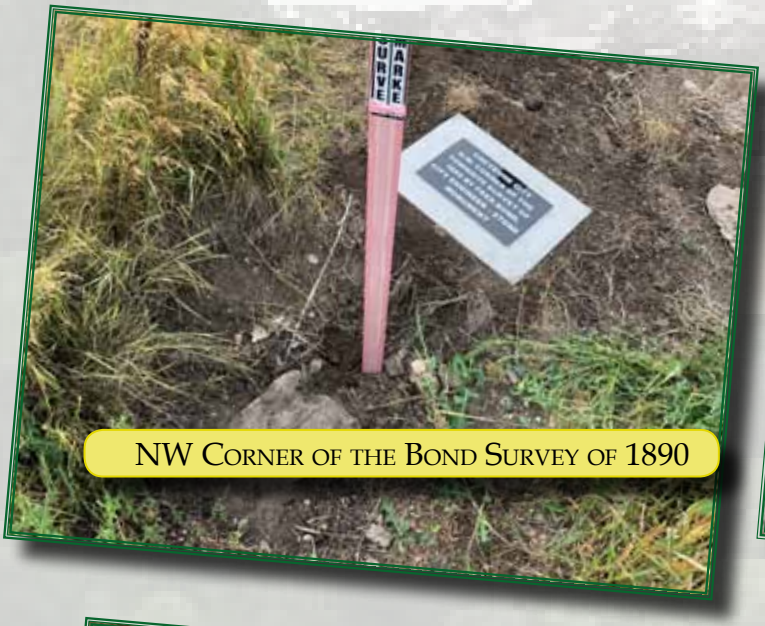
S. E. Chapter Crew Setting Info Tablets at the Cheyenne City Corners.

When I became the Cheyenne City Surveyor back in 2007, the S.E. Chapter decided it was time to complete the project started in 1985 to locate or restore the original corners of the City of Cheyenne as they were set back in the late 19th Century. The first survey was completed in 1867 by Gen. Grenville Dodge as the Chief Engineer of the Union Pacific Railroad, for the construction of our first transcontinental railroad. Cheyenne was to be a major hub for changing engines and as the point of dispatch for maintenance of the railroad. With the initial development of the area, Dodge surveyed the first layout of the City of Cheyenne, and immediately started selling off lots. The non-railroad founding fathers of Cheyenne did not think this was the appropriate way to dispose of lands in the townsite area and complained to the Interior Dept., thinking that the City should actually own these lots and be receiving the sale revenues. With this in mind a second survey or a GLO Townsite survey was requested and completed in 1870. These two surveys paralleled each other, but not one of the corners or boundary lines were coincidental. Then with Wyoming Statehood in 1890, the new State Statutes required all incorporated Cities and Towns to be accompanied by a completed boundary survey. In this case, for reasons unknown to me at this time, Fred Bond the Cheyenne City Engineer, completed what was an apparent attempt to retrace the Dodge survey of 1867 for recording with the State as the corporate limits of the City. Each of these surveys (3) were officially accepted in some manner or form by a governing body, giving each of them legitimate legal standing. Oh what fun we have interpreting these intertwined relationships.

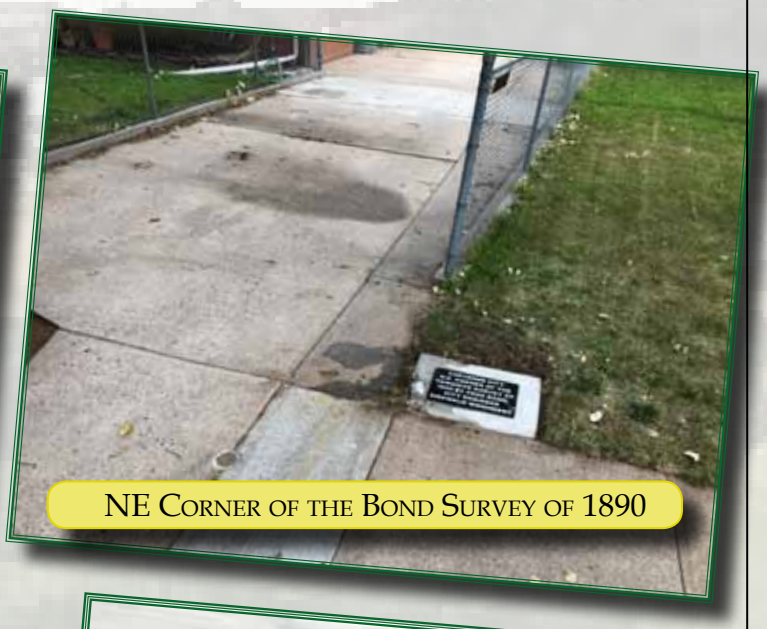
None of the Dodge survey corner monuments were found; and two of the original survey stones for each of the GLO and Bond surveys were finally found, each along the Western boundary lines. It took five years to complete the restorative survey of these corners, but only three to get the informational tablets made and set in place. Members of the S.E. Chapter of PLSW set the tablets one Saturday morning in September, to inform and mark the found and reestablished original corner positions of the City of Cheyenne.

You may recall the previous articles about the conduct of the surveys to locate or reestablish these corners in LINES & POINTS (see July 2011, October 2011, April 2012, and January 2013). The S.E. Chapter then set about fund raising for the materials needed to produce a lasting inscribed tablet to be set at each of the corners. The Wyoming historical Society contributed $800 to the effort; the City of Cheyenne provided the services of their cemetery crews for the etching of the granite slabs; and the S.E. Chapter members provided funding and labor to bring the project to completion.

I am hoping to make arrangements for a guided bus tour of each corner site in conjunction with the WES Conference in February 2020, here in Cheyenne. So, be thinking about joining us for the bus tour, and oh by the way, attending our scheduled PLSW Annual Meeting as well. Hoping to see many of you then!

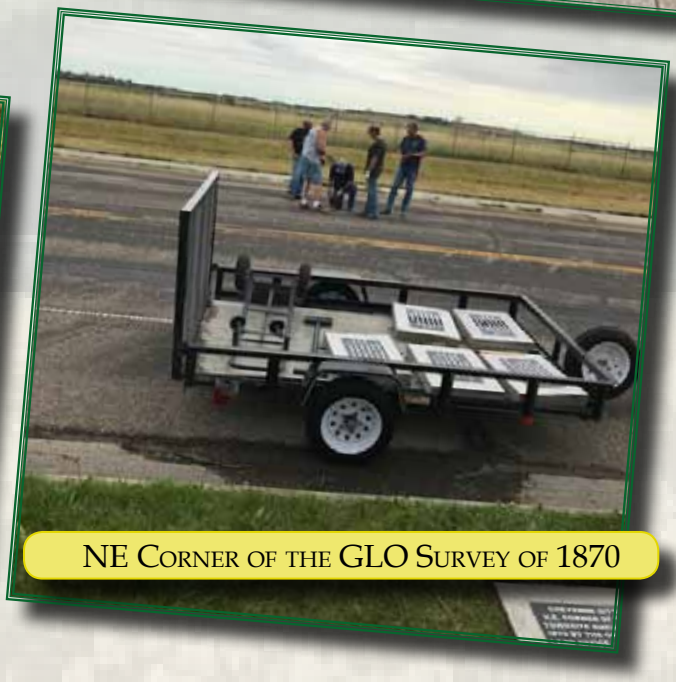


NW Corner of the Bond Survey of 1890



NE Corner of the Bond Survey of 1890

NW Corner of the GLO Survey of 1870



NE Corner of the GLO Survey of 1870

SW Corner of the GLO Survey of 1870

SE Corner of the GLO Survey of 1870

Major Magnetic Incident Will Occur for the First Time in 300 Years

Stephen Regenold (www.gearjunkie.com)

The last time Greenwich, England, had zero magnetic declination, King Charles II was on the throne. But in a couple of weeks (after 6 September 2019), true north and magnetic north will align in the prime meridian for the first time in 300 years.

This is important for anyone who uses a compass to navigate. Usually, there is a degree of difference between true north and magnetic north. For precise navigation, compass users need to adjust.

If you did not know already, there is more than one "north" on Earth: magnetic north is determined by our planet's magnetic field lines, and true north refers to a geographic line along the meridian.

Depending on where you are on Earth, the angle between true north and magnetic north varies in the U.S., for example, the angle of declination can range from 20 degrees west or east.

We all know the earth is constantly moving, but so is its magnetic field. "The line of zero declination, called the agonic, is moving westward as a present rate of around 20 km [about 12.5 miles] per year," said the British Geological Survey (BGS).

This year, that westward movement is closing the gap between true and magnetic north just over Greenwich, England. This is noteworthy because Greenwich is home of the Royal Greenwich Observatory, and, more importantly, the point of zero degrees longitude.

Also known as the prime meridian, it is the birthplace of universal time. "The observatory paved the way for a global reference system for maps and navigation that we know today as the Greenwich Meridian, and with it, Greenwich Mean Time (GMT)," said the BGS.

Basically everyone, from 17th-century astronomers to modern-day outdoor enthusiasts, uses the Greenwich Meridian. It is the reference point for all the other longitudinal meridians, many charts and maps, and world time zones.

And for the next 2 weeks, compass reading just got easier, at least in England. For much of the rest of the world, magnetic north and true north still compete, and sometimes confuse, people employing compasses to navigate in the woods.

But, the world - and compass needles - keep turning, so this convenient moment of synchronicity in Greenwich will not last land.

LINES AND POINTS
P.O. BOX 8
CHEYENNE, WY 82003

Please Recycle