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THE EQUALITY STATE SURVEYOR

LINES & POINTS

PROFESSIONAL LAND SURVEYORS OF WYOMING

AFFILIATE — AMERICAN CONGRESS ON SURVEYING AND MAPPING
MEMBER — WESTERN FEDERATION OF PROFESSIONAL SURVEYORS

CHRIS HAMILTON, VICE-PRESIDENT ROBERT L. ST. CLAIRE, PRESIDENT RICK HUDSON, SEC.-TREAS.

VOLUME 5 NO. 4 DECEMBER 1993

WES Preliminary Schedule
HARN:NGS

APPROVED_____ REJECTED_____ DATE_____

MEMBERSHIP APPLICATION

NAME_____ WY REG. NO. _____

(Please indicate preferred mailing address) DATE_____

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TOWN/CITY_____ STATE_____ ZIP _____

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BUSINESS ADDRESS: _____

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TOWN/CITY_____ STATE_____ ZIP _____

EMPLOYER_____

YOUR TITLE _____

States other than Wyoming in which you are registered: _____

Additional information or comments (optional): _____

CLASS OF MEMBERSHIP APPLIED FOR: (check one only and please submit dues with application, prorated for the remainder of the calendar year)

_____ MEMBER, ANNUAL DUES $75 (Persons duly registered, PLS or PE&LS, in Wyoming.)

AFFILIATE MEMBER

_____ Associate Member, annual dues $50. (Persons employed under the direction of a PLS and working toward PLS registration in Wyoming.)

_____ Special Member, annual dues $50. (Not meeting above qualifications but with a particular interest in, or association with, the profession of land surveying.)

_____ Special Member, student, annual dues $15. (Pursuing a post secondary academic course of study, and currently enrolled.)

_____ Sustaining Member, annual dues $100. (Persons, institutions or corporations desiring to assist PLSW financially.

I AGREE TO OBSERVE THE CONSTITUTION AND BY-LAWS OF THE PROFESSIONAL LAND SURVEYORS OF WYOMING AND THE CHAPTER TO WHICH I WILL BELONG AND TO SUPPORT SAID ORGANIZATIONS IT THEIR ENDEAVORS.

_____ _____

(APPLICANT'S SIGNATURE) SPONSOR'S SIGNATURE (For Affiliate Member applicants only.)

NOTE: All portions of the state have chapters. Chapter dues or assessments may vary in amount. Applications are considered by the Board of Directors at quarterly meetings. Send completed application to PLSW, c/o R.L. Hudson, Sec./Treas., P.O. Box 784, Thermopolis, Wyoming 82443.

BLM News

This letter is to inform you of official cadastral surveys in Wyoming that have been accepted from October 1, 1993, through December 31, 1993, and are now available in the Survey Records Office, Wyoming State Office, Bureau of Land Management, 2515 Warren Avenue, Cheyenne, Wyoming 82001.

The accepted surveys are listed below by township, range, type of survey, meridian, and acceptance date.

Sixth Principal Meridian, Wyoming

Township and Range	Type of Survey	Meridian	Accepted
T. 54 N., R. 70 W.	Dependent Resurvey	6 P.M.	12/10/1993
T. 55 N., R. 70 W.	Dependent Resurvey	6 P.M.	12/10/1993

As other surveys are completed, I will advise you of their acceptance. You may circulate this letter among the membership of the Professional Land Surveyors of Wyoming.

John P. Lee, Chief,
Branch of Cadastral Survey

HARN . . . Continued from page 13

then NAD 83/86 to NAD 83/9X. Since most coordinate users work in SPC or UTM grid coordinates rather than latitude/longitude, the process actually becomes a four step procedure. SPC/UTM NAD 27 to lat/long NAD 27; lat/long NAD 27 to lat/long NAD 83/86; lat/long NAD 83/86 to lat/long NAD 83/9X; and finally lat/long NAD 83/9X to SPC/UTM NAD 83/9X.

At this point users should determine the quality of the positional information and whether it warrants the transformation from NAD 83/86 to NAD 83/9X. If the positional accuracy is generally worse than one meter (3.2 feet) then the transformation from NAD 83/86 to NAD 83/9X can probably be ignored. Numerous software developers have incorporated NADCON into a variety of surveying and mapping related packages. Users should review their software to ensure the latest NADCON version 2.10 is included.

NGS also distributes a package developed by the U.S. Army Corps of Engineers, Engineer Topographic Command called CORPSCON. CORPSCON provides an extremely user friendly method to perform computations relating State Plane Coordinates and latitudes/longitudes on both NAD 27 and NAD 83/86, using algorithms developed by NGS. CORPSCON (v2.0) and the soon to be released updated version 3.01 which incorporates a utility to compute UTM coordinates, utilize older versions of NADC0N to provide the transformation between NAD 27 to NAD 83/86, but cannot resolve the transformation between NAD 83/86 and NAD 83/9X as previously discussed. NGS has sold hundreds of copies of CORPSCON (v2.0) and will continue to distribute v3.0l because of the ease in handling State Plane Coordinates, however, users must remember that computations with CORPSCON do not provide for the relationship between NAD 83/86 and NAD 83/9X and NADCON v2.l0 is still required to perform those transformations.

CONCLUSION

Development of High Accuracy Reference Networks has provided dramatically improved coordinate data for a wide range of surveying, mapping and geophysical applications. As NGS pursues the completion of the national HARN, states will be encouraged to provide resources to densify to improve network accessibility. During that time NGS will support continuous updates of the horizontal component of the National Geodetic Reference System. Support to the surveying and mapping community to integrate the new coordinate information will be provided by NGS State Geodetic Advisors and headquarters personnel by developing new software, seminars/workshops and technical reports. Questions concerning HARN development and impact can be referred to the author at 301-443-8684 or by writing to the Chief, National Geodetic Survey, 11400 Rockville Pike, Room 429C, Rockville, Maryland 20852.

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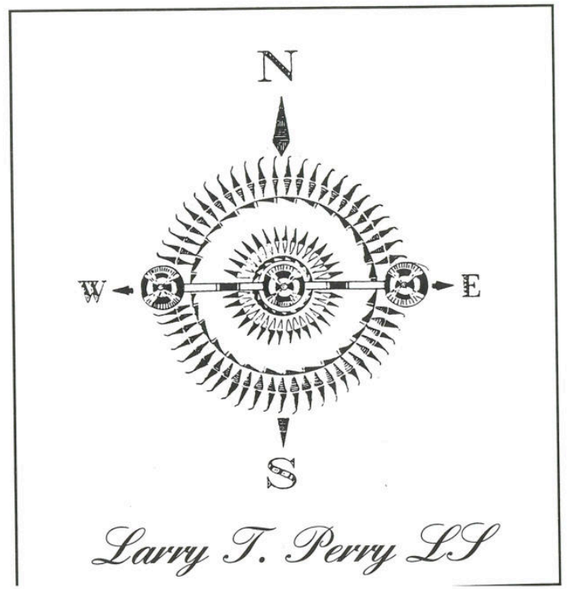
North Arrow Nook

Where's Your North?



Larry T. Perry LS

Editorial Potpourri

• **NEW PLSW MEMBER** - The newest member of PLSW is Robert J. Jackson, PLS of Custer, South Dakota. He works for the USDA – Forest Service in Spearfish. Welcome Robert.

• **PLSW MEMBERSHIP** - If you are not a member of PLSW, join now. We need your support. An application is included in this issue. If you are a member, recruit a new member.

• **SUPPORT OUR ADVERTISERS** - Advertisers help make this publication possible. Please support them.

• **LOCAL PLSW NEWS** - Send us a summary of your chapters activities for publication. The deadline for the next issue of *Lines and Points* will be 15 MAR 1994.

• **PLSW BOARD MEETINGS** - The next meeting of the Board of Directors will be held at the annual convention in Riverton. All members are welcome.

• ***LINES AND POINTS* FAX** - The Lines and Points fax number is 307-235-5604.

• **CONTINUING EDUCATION** - NCEES and NSPE see "no compelling justification for any jurisdiction to adopt a continuing professional competency requirement as a prerequisite to renewal of a registered professional engineer's or land surveyor's license."

• **NEWS FROM ACSM/NSPS –**

• European countries do not have mandatory continuing education. They have almost universal involvement by their registered professionals and, do not understand why we find it necessary to mandate continuing education by law! (Advanced Civilizations)

• NSPS representatives assisted scouts at the Boy Scouts National Jamboree who were attempting the Surveying Merit Badge. John Lewis will be in charge of future NSPS Boy Scout activities.

• Financially, ACSM is in the black. Membership renewal for 1993 was just under 84% which, is the highest renewal rate in recent years.

• ACSM will offer 1/2 dues for the first year for newly registered land surveyors.

• **METROPOLITAN STATE COLLEGE OF DENVER** - Metro State is phasing out their Surveying and Mapping program.

Front Cover Artwork
By Ray Blaha – Casper

NOTE: Prints of cover artwork are available. Look for advertisement in next issue or contact Ray Blaha.

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PLSW (Professional Land Surveyors of Wyoming) is a statewide organization of Registered Land Surveyors licensed 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 American Congress on Surveying and Mapping and the Western Federation of Professional Land Surveyors.

Editorial Staff: John Hibsman, Steve Strang, Don Davis.

Lines and Points subscription $50/year

Advertising Information

Camera ready advertisements with payment should be mailed to *Lines & Points,* PLSW, Box 904, Casper, WY 82602.

Advertising rates are as follows:

	Year	Issue
Full page	$300	$80
Half page	$175	$50
Quarter page	$100	$30
Business card	$ 30	$10
Classified	40¢ per word/issue	
Employment	Free	

Special Rates for PLSW Chapters

Deadline for spring issue – 15 MAR 1994

Message From The President

Bob St. Claire

Another busy year for PLSW has come to a close. Even though we have accomplished a lot, there still remains much to do. Lately we've spent a considerable amount of time on the convention, ironing out several problems with WES and in the end compromising a little more than we wanted. Some of this was due to misunderstandings with WES and some due to problems with the meeting rooms at the facility. We did not get our brochure out like I wanted to because of the late date in finalizing the schedule with WES. In fact, our schedule, as I understand it, may still be subject to minor changes. Even so, I feel that we have a very good program for surveyors at this convention.

All day Thursday is our seminar, "Corner Evidence Analysis" by Dennis J. Mouland. A luncheon on Thursday will feature Paul Scherbel and Dennis Bland giving a presentation on restoring the corner monuments of the State of Wyoming. On Friday morning, Mr. Mouland will present another program entitled "Ethics for Professionals".

In addition there are several other good programs on Friday afternoon and Saturday morning that are of interest to surveyors. These include a presentation on GPS/GIS by Jack Dozzi from Horizons Aerial Surveys, "A picture is Worth 100 Shots" by Kevin Black, a PLS with the Bureau of Reclamation, "The Midwest Floods of 1993" by Roy Kopsky, "Water Development on the Wind River Indian Reservation" by Barry Gutwein, "The Dry Fork Energy Storage Project" by Larry Baccari, "Surveyors & Engineers, Wherefore Art Thou Metre Stick" by Jerry Crews & T. Dwane Moore, "The Last of the Mega Projects, Denver International Airport" by Gary Mass, and a discussion with the State Board about continuing education. Since the State Board was the number one concern of our members according to our poll, it will give you the chance to ask them questions that concern our profession. In addition there are special luncheon programs, banquets and other social events. We urge all of our members to attend and support these various events.

Our annual PLSW meeting is scheduled for Thursday afternoon and Friday morning. The election of new officers will be slightly different this year. We will introduce the candidates for the various offices at the beginning of the convention and you will have all day to meet and ask them questions before you vote. Of course if you don't attend the convention you can mail in your ballot beforehand. We will then announce the results of the election during the meeting and have installation of the new officers.

We will have the written committee reports available for review all day Thursday and have the committee chairman available at the annual meeting for presentations and to answer any questions. We will also have our Save Our Surveyor entries posted for your review. During the day you can vote for your favorite and we will announce the winners during the meeting. If you have any other suggestions that may help streamline our meeting, please attend our pre-convention board meeting late Wednesday afternoon, February 3rd at the Holiday Inn.

Our Handbook Guidelines Committee will have the guidelines for the composition and printing of the book completed before convention. We hope that they will also have the other parts of the present handbook scanned. John Lee of the BLM has already scanned our State Laws and has them available on disc. Once we get it all on disc, it will be easier to update and standardize for printing. We will be asking for volunteers to work on those portions of the book that need completing and/or updating.

On a personal note, I was down with pneumonia for a month and did not get to attend the PLSW Board meeting on December 4th and the SBRPELS Board meeting in Cheyenne on December 17th. I want to thank the other members of the Board for taking up the slack, especially Chris Hamilton for running the PLSW Board meeting for me, and Herb Stoughton for representing us at the SBRPELS meeting. As President, this has been an exciting and fulfilling year for me. It's been a lot of work but the job is well worth it. I would highly recommend it to any of our members who are undecided about trying it.

HARN . . . Continued from page 12

be determined across a state, providing positional accuracies relative to the NAD 83 coordinate system that are no worse than 10 to 15 cm (Strange, Love 1991).

Following the A-Order adjustment, the B-Order Network is adjusted constraining only the newly determined A-Order positions. Upon completion of the A and B-Order adjustments, the data is loaded into the NGS Data Base and distributed to the public. Final adjustment of HARN surveys usually requires 3 to 4 months processing and analysis by NGS upon completion of the field operations. Since the VLBI stations defined the original NAD 83/86 solution, the new coordinates are still related to the original datum - NAD 83; however, they are tagged with the adjustment date to ensure proper identification, for example Florida is tagged NAD 83/90, NAD 83/91 for Delaware, Maryland, Oregon and Washington, NAD 83/92 for Colorado, Idaho and Montana. NAD 83/9X will be used to designate any HARN adjustment for purposes of further discussion. Users of positional information should take great care to properly identify coordinate adjustment dates in the preparation of plats, maps, reports and electronic data storage systems.

NGRS READJUSTMENT

Once the HARN adjustment has been completed, the geodesist -in charge of the project will also provide a readjustment of all horizontal control previously published in the state/region. This task requires retrieving thousands of records of conventional triangulation, traverse and trilateration observations, as well as GPS data submitted to NGS prior to the HARN. To insure network integrity, the readjustment must include areas surrounding the project area to whatever depth necessary to maintain the stated accuracy of the existing control. For example, following the completion of the Maryland/Delaware HARN, the horizontal networks in the neighboring regions of New Jersey, Pennsylvania, Virginia and West Virginia were readjusted to a depth of approximately 50 to 70 km. These readjusted data may also differ from the original NAD 83/86 by the approximately 0.3 to 0.8 meters defined previously. This "feathering, technique has been adopted for all 13 states completed to date (Alabama-1992, Arizona-1992, California-1992, Colorado-1992, Delaware-1991, Florida-1990, Idaho-1992, Louisiana-1992, Maryland-1991, Montana-1992, Oregon-1991, Tennessee-1990, Washington-1991 and Wisconsin-1991). A limited HARN was completed for Alaska in 1992. Due to the size of Alaska and limited access to existing control, a full state-wide readjustment of the NGRS is not planned at this time, although studies are still underway.

Since the change in coordinate (latitude/longitude) values, is small compared with the NAD 27 to NAD 83/86 readjustment (0.3 to 1 meter vs. 10 to 400 meters) the importance of adjustment "labels" as noted previously cannot be overemphasized. In addition, the readjustment applies only to those data that have been "Blue Booked" and submitted to NGS for adjustment and publication. Readjustments of the existing network can take from 4 to 6 months to complete following the HARN adjustment. While the readjustment will make the conventional network more consistent over a larger area, it will NOT improve the order of accuracy of stations other than those directly observed in the HARN. State Plane Coordinates (SPC) and Universal Transverse Mercator (UTM) Grid coordinates will exhibit changes equal to the changes in latitude/longitude. There is no systematic change to these coordinate systems (origins, central meridians, standard parallels etc.).

Any previous surveys tied to the NGRS but not submitted to NGS will now be inconsistent with the national network and should be readjusted as soon as the new coordinate information is available. To ensure positional integrity, local networks for Federal, state or local requirements should retrieve the original GPS observations and readjust their networks with respect to the new values published by NGS. If the original observations are no longer available, datum transformations can be applied to the existing coordinate values, however, they may distort the data beyond its original level of accuracy.

Some concern has been expressed that once completed the nationwide jigsaw puzzle of state HARNs would require a national readjustment - NAD 2000. Adjustments completed to date indicate that independent networks at the B-Order level have been completely consistent, probably due to the extremely rigid ties to the VLBI network and great care placed on network design. Future readjustments should only be necessary in regions of limited network densification and active crustal motion such Alaska, California or Hawaii.

COORDINATE TRANSFORMATIONS

The NADCON (North American Datum Conversion) software was released by NGS in January, 1990, to provide an accurate (better than 1 meter) consistent and easy to use method of transforming between NAD 27 and NAD 83/86. NADCON was adopted as the preferred method of transformation by a Federal Register notice in August, 1990.

NADCON relies on data from the NGRS to produce tales of gridded shift values in latitude and longitude for the conterminous U.S. (CONUS) Alaska, Hawaii and Puerto Rico/Virgin Islands. NAD 27 to NAD 83/86 transformations using NADCON have an uncertainty of approximately 0.15 meter (0.5 feet) nationwide. Slightly higher uncertainties are noted in Alaska and Hawaii, slightly lower in Puerto Rico/Virgin Islands.

NGS revised the NADCON program in February, 1992 (version 2.10) to accept transformation grids that are defined for individual HARN states/regions. These grids are developed from the readjusted NGRS data existing at the time of the HARN to approximate the change between the original NAD 83/86 and the new adjustment NAD 83/9X, and are defined by the state/regional initials followed by the acronym HPGN (High Precision GPS Network - HARNs were called HPGNs when the software was being redesigned.) For example, the grids developed to model the difference between NAD 83/86 and NAD 83/90 in Florida are labeled FLHPGN. The precision of the NADCON grids is directly related to the number of existing NGRS stations used in the definition of the HARN. Grids for Tennessee are accurate to approximately 12 cm, while grids for Florida are accurate to approximately 5 cm. Computation of NADCON grids generally requires 1 to 2 months following the state-wide readjustments.

Realizing that many users of coordinate data, especially Geographic/Land Information Systems have already made the transition from NAD 27 to NAD 83/86, the new NADCON grids can be applied directly to their data to be compatible with the HARN values. However, coordinates still on NAD 27 must be transformed using a two step process, NAD 27 to NAD 83/86,

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Alabama . . . continued from page 11

certain courses would be an impossible task without creating a large bureaucracy. Moreover, adds board member Hastings, the board did not want to give certain groups a "lock" on the business of providing continuing education activities. Instead, the board is scheduled to meet in January to conduct audits of 5% of renewal forms to ensure that professional engineers' PDHs comply.

Charles Forman, program director for engineering in the professional and management development program in the college of continuing studies at the University of Alabama, is a proponent of prior approval.

"People can't guarantee their continuing education course will qualify," Forman says. "There's some confusion over what meets the requirements right now. But in a year or two people will be wiser about what to select."

Mike Bangham dislikes the idea of prior approval. "You have to treat people as professionals," says Bangham, senior manager of advanced systems development for McDonnell Douglas Corp. in Huntsville, Alabama. "If you mandate what classes are approved you're putting an undue burden on people."

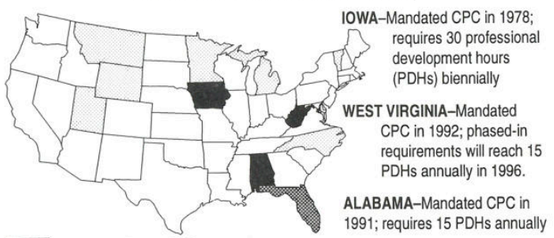
And what about the argument that without prior approval PEs can accumulate professional development hours that amount o little more than coffee and donuts?

Says Bangham: "In my case I took classes I thought enhanced my skills. I could see (people who are) not very interested in improving their skills going through the motions and not benefiting themselves. But I believe professional engineers are people of integrity and honesty." Bangham himself took teleconference seminars through Auburn University in addition to regular training he receives from McDonnell Douglas.

Still other Alabama registrants lament that few choices for valuable CPC activities exist, while others contend ample opportunities are available. Universities, companies, and professional associations have rushed to provide PEs with selections. For instance, David Volkert & Associates and Proctor/Davis/Ray Engineers both have developed brown bag seminars – in-house continuing education courses presented during lunch – and Auburn developed a program that broadcasts three-hour teleseminars at 15 locations across the state.

Volkerts & Associates CEO King has nothing but glowing words about Alabama's mandatory CPC requirements. "I say overall there is a payback for professional engineers and their companies. Knowing how far this advances one's competency is a difficult question, but I think there is a return."

Continuing Professional Competency for Engineers: What the States Have to Say



IOWA–Mandated CPC in 1978; requires 30 professional development hours (PDHs) biennially

WEST VIRGINIA–Mandated CPC in 1992; phased-in requirements will reach 15 PDHs annually in 1996.

ALABAMA–Mandated CPC in 1991; requires 15 PDHs annually

Has mandatory CPC program

Has voluntary CPC program

Has "enabling legislation" allowing the state engineering board to set CPC requirements

HARN . . . continued from page 6

and specifications from the FGCC for GPS surveys define entirely new orders of accuracy A and B-Order (5 mm + 1:10,000,000 and 8 mm + 1:1,000,000 respectively) Ties to HARN stations should allow GPS users to provide project oriented control with virtually no adjustment to the observational data. Carefully designed GPS surveys using broadcast ephemeris can achieve near B-Order quality with little effort. Users in existing HARN areas have indicated excellent results.

HARN IMPLEMENTATION

HARN implementation requires a group or staff of concerned users to develop the basic plan for the design. This would include selecting station locations, and allocating resources to implement the project. NGS encourages HARN design to utilize as many existing horizontal NGRS control points as possible. While these marks would not be held fixed in the network adjustment, they provide important continuity between the HARN solution and the existing NAD 83/86 adjustment. Accuracy of the coordinate transformation solution is dependent on the number and distribution of stations common to both networks. In addition, existing stations reduce the number of new monuments to be set.

While the B-Order survey will provide an improved set of ellipsoidal heights, their precision seldom exceeds the relative accuracy requirements associated with third-order conventional spirit leveling as defined by the FGCC. Ellipsoidal heights are usually accurate from 3 to 7 centimeters (cm) relative to adjacent stations, and approximately 20 cm with respect to the coordinate system (Strange, Love 1991). To provide consistent orthometric heights, as many existing NGRS vertical control points (bench marks) as possible should also be part or the network. Bench mark connections improve the orthometric height component of the adjustment and help to improved knowledge of the local geoid. If bench marks cannot be directly tied with GPS, then every effort should be made to provide precise geodetic leveling ties between existing vertical control monuments and the HARN stations.

Density of HARN stations is dependent on the requirements defined by the state or locality. NGS is developing a Nation-wide HARN at the A-Order level with approximately 1300 stations spaced approximately 100 km apart. Other Federal and state agencies have been encouraged to densify this network with B-Order control to the 25 to 50 km spacing level using their own equipment, field operations or a private contractor. NGS currently anticipates completion of the national HARN during 1995.

HARN ADJUSTMENT

The intent of the HARN is to improve the positional relationship of control points in the NGRS and reduce network distortion remaining from the NAD 83/86 adjustment. To achieve this goal, the positions of existing less than B-Order NGRS stations used in the HARN are not constrained in the adjustment. Positional constraints come from several sources including the active VLBI stations at Mojave, California; Platteville, Colorado; Richmond, Florida (now destroyed by Hurricane Andrew) and Westford, Massachusetts; the A-Order Eastern Strain Network, and previously established A and B-Order stations from existing HARNs. From these constraints, a limited network of A-Order stations can

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High Accuracy Reference Networks Development, Adjustment and Coordinate Transformation

David R. Doyle
National Geodetic Survey
U. S. Coast and Geodetic Survey

ABSTRACT

Numerous states have implemented or are in the process of developing state-wide High Accuracy Reference Networks (HARN) conjunction with the National Geodetic Survey's (NGS) program to institute a nation-wide upgrade of the National Geodetic Reference System (NGRS). These networks are designed to provide state-wide coverage of highly accurate B-Order (8mm + 1:1,000,000) or better, easily accessible horizontal control points from which to further develop or densify geodetic control using the Global Positioning System (GPS) for a variety of applications. Upon completion, a state-wide readjustment of all existing horizontal control in the NGRS is performed to ensure network consistency. The readjustments from the original North American Datum of 1993, adjustment of 1986 (NAP 83/86) to the HARNs have typically shown coordinate changes of approximately 0.3 to 1.0 meter (1 to 3 feet). This coordinate difference must be accounted for in many applications which require datum transformation of previously determined coordinate information. This paper will address tile topics concerning HARN development, implementation, adjustment and datum transformations.

North American Datum of 1983

Completed in July 1986, the NAD 83/86 was the result of an intensive 12 year effort by NGS and the Geodetic Survey of Canada to readjust and redefine the horizontal coordinate system for North America. The readjustment involved millions of conventional geodetic surveying observations including directions, distances, astronomic positions and azimuths from approximately 5,000 individual triangulation, traverse and trilateration projects performed since 1817.

A key element of this program was the adoption of an earth-centered reference ellipsoid, Geodetic Reference System 1980 (GRS 80) to ensure consistency between the coordinate system a future developments in satellite positioning systems. The orientation of the coordinate system was defined primarily by very Long Baseline Interferometry (VLBI) and Transit satellite (Doppler) observations. Only 5 GPS derived control points participated in the original NAD 83/86 adjustment. When published, NAD 83/86 coordinate data was much more relatively consistent than the North American Datum of 1927 (NAD 27) and the relationship to the defined coordinate system was improved to approximately 1 meter.

HIGH ACCURACY REFERENCE NETWORKS

While all HARNs are certainly unique in their design, implementation and intended use, there are many similarities that can allow for generalization about the entire concept. As stated previously, the basic intent is to provide a set of precisely and accurately determined monumented control points that are:

1) "GPSable": Most existing geodetic control points in the NGRS were established prior to the development of satellite surveying and navigation systems. Consequently, clear horizons required for satellite signal acquisition were never a require-

2) Easily Accessible: Many of the existing NGRS stations were established in locations that are difficult to reach. Mountain tops were popular sites to reduce the required heights for observation towers. Many control points also require special arrangements to occupy such as four wheel drive vehicles, special passes or permits or, in some cases back packing or pack animals!

3) Regularly Spaced: Current NGRS stations are not necessarily placed at regularly spaced intervals. Depending upon the area, original control density and network maintenance, existing stations can be from 5 to 100 or more kilometers (km) apart.

4) High Accuracy: Those NGRS stations that are available for convenient GPS use can be of a variety of positional tolerances. Horizontal positioning standards of First, Second or Third-order (1:100,000, 1:50,000/1:20, 000 and 1:10,000 respectively) as defined by the Federal Geodetic Control Committee (FGCC) provide adequate control points for a wide range of surveying applications. However, GPS relative positioning capabilities can be considerably better than the existing control, thereby distorting the observational information to fit the network. Many users find this condition to be unacceptable.

HARNs are designed to eliminate or significantly reduce the problems listed above. First, by the very nature of the technology HARN stations must be "GPSable", thereby providing GPS users with a set of points that can generally be assured to have very good satellite visibility. This results in reduced reconnaissance time trying to locate control stations that can be occupied with GPS equipment.

Field operations efforts are also reduced by having easily accessible station sites within local driving range (25 to 50 kilometers) Locations that can be reached by car or light truck, generally 24 hours a day within 30 to 45 minutes from anywhere in a state reduce the requirements for special arrangements. GPS observers can drive directly to the station sites, usually without making any special arrangements with landowners or managers. Government agencies or private companies therefore provide reduced response time to requests for new surveys, and special equipment that might be required for other purposes is not tied up for GPS survey operations.

Last, and probably most important, HARNs provide positional quality undreamed of only a few years ago. Standards

Continued on page 12

Alabama Steps Into Continuing Ed Spotlight . . Continued from page 10

designed something that hopefully would become a model for other states. Since iowa began the process (in 1978), you might say we are the first of a new wave."

Also riding the wave is West Virginia, which became the latest state to adopt such requirements when the West Virginia State Board of Registration for Professional Engineers approved mandatory CPC requirements in July. PEs must comply to renew their licenses next year. And eight other state legislatures have passed laws enabling state engineering boards to establish such requirements (see map.)

The new wave for mandatory CPC started when Alabama legislators demanded by law in 1991 that all state boards put continuing education requirements in place by 1993. Alabama PEs had lobbied for a voluntary approach like the one taken since 1984 by Florida – the only state with voluntary CPC requirements.

The National Council of Examiners for Engineering and Surveying (NCEES) in August incorporated into its model law NSPE's position that continuing professional competency should be voluntary, not mandatory. NSPE sees "no compelling justification for any jurisdiction to adopt a continuing professional competency requirement as a prerequisite to renewal of a registered professional engineer's or land surveyor's license."

Paul Taylor, past president of NCEES and a member of the Alabama engineering board, used to favor voluntary CPC requirements, too. Taylor changed his mind after being involved in crafting CPC requirements for the past two years. "I think it's the nature of people that any time they're told something is mandatory they buck up. When people first start talking to me (about continuing education) they're very angry and adamant about wanting to know why we're cramming this down their throats, until they see how easy it really is to meet the requirements.

"I believe continuing education should be mandatory, especially since we're struggling to improve the recognition and stature of engineers as a profession," Taylor adds. "I think that is the most important thing that having mandatory requirements does."

Alabama requires PEs and land surveyors to earn a minimum of 15 professional development hours (PDHs) per year to maintain registration, and up to 15 extra PDHs can be applied to the following year. Examples of activities that count toward the continuing education requirements include attending seminars, meetings, or videotaped conferences sponsored by professional associations, corporation, or colleges; completing a college course; making presentations; and publishing papers. The activities can cover technical, ethical, or managerial topics.

Generally, one PDH equals one hour or 50 minutes spent on continuing education. Successful completion of a university semester would translate into 45 PDHs, while auditing such a course would constitute 15 PDHs.

Alabama license renewal applications, which have a continuing education form on the back side, have been arriving steadily at the Alabama board. Hines estimates that about 100 per day were processed early last month. With 56 days remaining until the renewal deadline, 2663 of 12,868 PE's and Land Surveyors licensed in Alabama had turned in their forms.

T. Keith King, president and chief executive officer of David Volkert & Associates Inc., sent his renewal and continuing education form in. "I felt for the past several years I've been exposed to at least the minimum requirements and that proved to be the case this year," says King, a member of NPSE's Registration nand Qualifications for Practice Committee. "I did not have any problems. There was no additional burden."

Still, others feel the requirements are a millstone. The board worries whether professional engineers will find them troublesome enough to drop their licensure. According to the Alabama registration board, 528 registrants gave up their licenses in 1992. While the board does not know exactly how many of those cancellations can be attributed to the mandatory continuing education requirements, the figure is approximately 200 cancellations more than usual.

Alabama's requirements seek to minimize the loss of registrants by creating an inactive status for those who verify to the board that they do not practice engineering, such as retired engineers or those in managerial or nonengineering positions. NCEES plans to study the issue further and make its recommendations next year.

Nor does the Alabama board want its CPC requirements to be considered too stringent and become a deterrent to licensure for any of the 72% of engineers nationwide who aren't professional engineers.

Taylor believes in the end that the continuing education requirements will only enhance Alabama PEs' competency and the public's health and safety. "The term 'professional engineer' by definition and by public recognition proves that a person has demonstrated through an examination that they've met the minimum requirements to be a professional. Continuing education requirements just further that concept by demonstrating on a continual basis an acceptable level of competency."

After attending a four-day General Electric Co. seminar on low voltage systems, Larry Creech, chief electrical engineer for Proctor/Davis/Ray Engineers Inc. in Lexington, Kentucky, agrees with Taylor. At the seminar, Creech learned about new solid state circuit breaker control technology.

"I see (continuing education) as part of limiting liability," Creech says. "In some areas you can get in trouble when you're specifying equipment you're not familiar with. You could cause problems for the manufacturer or the building and cost your company money to correct it."

So far this year, the only trouble Creech, one of 6218 out-of-state PEs registered in Alabama, has experienced is uncertainty about what qualifies as a PDH.

The Alabama board, like Iowa's decided that prior approval of

Continued on page 12

Double Proportionate Measurement

by Paul Reid, PLS

When consulting with other surveyors I find some confusion on certain aspects of reestablishing a corner by double proportionate measurement. This article is intended to address and clarify some of the issues of confusion.

Double proportion is a basic procedure typically used to reestablish the position of a **"lost"** township or section corner of the public land survey system. Double proportionate measurement essentially being a combination of two single proportions, one latitudinally and one longitudinally. The position in departure (longitudinal position) to reestablish the corner is determined by single proportioning the cardinal equivalents of the record measurements, between the nearest recovered corners to the east and west of the lost corners. Similarly, the position of the northing (latitudinal position) is determined by single proportioning cardinal equivalents of the record measurements, between the nearest recovered corners to the north and south of the lost corner.

The **"cardinal equivalents"** is a source of confusion to many. It comes from Section 5-25 of the 1973 Manual of Surveying Instructions, which states in part:

"Lengths of proportioned lines are comparable only when reduced to their cardinal equivalents."

What is meant by cardinal equivalents is that the latitudes of the record meridional measurements and the departures of the record latitudinal measurements, are used. For example, consider a latitudinal line with a record measurement of N.86 E., 80.07 chains. The departure of the line is 79.875 chains, which is the measurement disregarding the record directions and is used as the record proportional element for that line.

Where the record bearings are close to cardinal directions, not using the cardinal equivalents will only result in a small positional error. However, the further the hearing move from The cardinal directions, the greater the positioning error if the cardinal equivalents are not used. It's a good habit to always use the cardinal equivalents of a line, even if it only makes a small difference.

Another source of confusion has been what to use as the record measurements for proportioning, when there are multiple surveys of record for a line. The record measurements to use in such a situation, are usually from the latest acceptable survey. For example, if the original survey a township was made in 1875, and subsequent resurveys were made in 1917 and 1967, the measurements from the 1967 survey would ordinarily be used. The 1967 measurements should be of a higher accuracy than the 1875 and 1917 measurements, and are more likely to reestablish a "lost" corner to it's true position.

Record measurements to use in proportioning can also be made of a combination of surveys. For example, the lines south and east of a lost section corner may have been surveyed in 1871 by one surveyor, and the lines to the north and west in 1883 by another surveyor. In this instance, both records would be used for the proportional elements.

Another source of confusion and potential positional error comes from the use of state plane coordinates in a double proportionate positions. Because of the grid angle the northing coordinate of the proportional meridional line and the easting coordinate of the proportioned latitudinal line, will not necessarily equate to the correct position to reestablish the corner. The further from the central meridian, the larger the grid angle (delta alpha in the Wyoming system) and the greater potential discrepancy.

One way to avoid the problem is to convert state plane coordinates of the controlling corners, to geographic positions. The double proportion can then be made using differences in geographic positions, and the end result converted back to state plane.

If the lines to be proportioned are at vastly different elevations, the cardinal equivalent distances of the record measurements need to be reduced to sea level. Otherwise a significant error can result because of difference in datums.

The use of cardinal equivalents is explained sufficiently in the B.L.M.'s "Cadastral Survey Training Course" purchased many years ago by P.L.S.W. If one is unclear on this issue I suggest a review of this course.

In summary, to insure a proper reestablishment of a corner by double proportion, always use the cardinal equivalents, the proper record measurements, and caution if using state plane coordinates.

Alabama Steps Into Continuing Ed Spotlight

A black eye to the profession. A legislative joke. Mickey Mouse requirements. Iowa legislation in 1978 mandating continuing professional competency (CPC) for professional engineers drew those comments and worse.

Sarah Hines, executive secretary of the Alabama State Board of Registration for Professional Engineers and Land Surveyors, recalls her initial reaction to Iowa's landmark law. "We thought it was the worst thing we had ever heard of," she says.

Today, Hines braces herself for reaction to Alabama's requirements, because that state has joined Iowa to become the second state requiring PEs to obtain minimum CPC standards to renew their licenses.

Iowa Engineering and Land Surveying Examining Board Executive Secretary Patricia Peters maintains that Iowa is not responsible for Alabama's continuing education requirements. "We were glad to share our information," Peters says. "But I don't think we really paved the way for other states. I don't think we made professional engineers like it any better."

So far, kinder, gentler words from PEs are heard about Alabama's CPC requirements, even as the first end-of-year deadline looms for compliance with the state mandate that CPC be a condition of license renewal.

J. Carroll Hastings had better say nice things about the

WACES/WTD Joint Committee off to a good start

The WACES-WTD (Wyoming Transportation Department) Co-op Committee held a constructive first meeting on November 19 in Casper, according to Ralph Goodson, WACES Transportation Committee Chairman. The purpose of the joint committee is to facilitate communication between the two groups.

When questioned about the Department's consultant selection process, WTD representatives admitted that it is not consistent, and often varies from one section to another. They also indicated the amount of detailing they require in plans apparently exceeds the normal plans produced in the private sector. Such details, they say, are often AASHTO and FHWA requirements. The Consultants responded that transportation work needs to be ongoing in order for them to maintain familiarity with WTD procedures and requirements.

WTD is considering using consultants in construction administration and construction surveying. Because of detailed performance requirements, it was suggested that they initially employ consultants for portions of a project. WTD will then access some specific expertise while consultants learn WTD procedures.

General concerns expressed by WTD people included roles and responsibilities of each party during the construction administration phase of a project, pavement design capabilities, and geology investigations done by the private sector.

An Aeronautics Division representative will be added to the Committee.

WTD is considering including consultants in their in-house training programs, not only as participants, but as part of the presentation team. Consultants may be requested to assist in developing a Pavement Management System for the State.

All agreed the private sector should actively support legislation benefitting the Department and consultants. Specifically discussed was the current dollar volume cut-off point which affects the hiring process. It was agreed that a minimum contract of $50,000 before initiation of a full selection procedure would be cost-effective for both the public and private sector.

All members of the joint committee were present. Representing WACES were Goodson, Bearlodge Ltd.; Bruce Yates, HKM; Darvin Dietz, Graham Dietz; Sean O'Malley, Jorgensen Engineering & LS; Frank Grimes, Nelson Engineering; and Joe Feeley, TSP Two.

Representing WTD were Dave Hanlin, Assistant Chief Engineer, Engineering; Dave Pople, State Bridge Engineer, Pat Persson, District Construction Engineer; Gary Brown, Engineering Services Engineer; Thomas Atkinson, State Materials Engineer; and Richard Stapp, State Construction and Maintenance Engineer.

The next meeting will be held in Riverton in conjunction with the WES Convention in early February.

Board of Directors Meeting Summary

The Board of Directors fall meeting was held in Rock Springs on Saturday, December 1993. The meeting, hosted by the Southwest Chapter, was held at the offices of Johnson Fermelia Co., Inc.; Director Andy Shauers having made the arrangements.

Vice President Chris Hamilton, on behalf of ailing President Bob St. Claire, called the meeting to order at 9:23 A.M. Thirteen members were present including three members of the hosting Southwest Chapter. All chapters were represented.

Minutes of the September 18 board meeting in Jackson were presented by Secretary Rick Hudson, discussed and approved. The Treasurer's Report was presented and consisted of the Hilltop National Bank statement, itemized expenses and balance sheet, all dated December 3, 1993. The report was accepted as presented.

A written report, by John Steil, NSPS Area 7 Director, was presented by Herb Stoughton and discussed by those present. John's report concerns ACSM's petition to the Interstate Commerce Commission regarding railroad abandonment and the fact that track removal equates to monument destruction in many instances.

Another written report, prepared by our "WestFed" delegate Paul Reid, was presented by Southeast Director Pete Hutchison. The report detailed the meeting held in Denver on September 11, 1993.

The final delegate report was the written report by our NSPS Governor, Becky J. Braman, and delivered by Pete Hutchison. Her report addressed the meeting on October 31, 1993, in Minneapolis. Various topics were discussed, including the aforementioned matter of railroad abandonment.

The board voted to send a letter to ICC concerning this matter, said letter to be prepared by Herb Stoughton and to be supportive of ACSM's petition.

Committee reports were presented by Pete Hutchison, "SOS" Honorarium; and Herb Stoughton, Education and Professional Practice. Pete reminded all members of PLSW to submit entries for the "SOS" competition - exemplary examples of Certified Land Corner Recordation certificates - by the January 15, 1994, deadline. Herb reported on upcoming seminars and workshops, the ongoing need for member comments regarding various committee proposals and the results of the Laramie County Community College and University of Wyoming surveying education questionnaire.

The first item of old business was presented by Herb, as chairman of the Standards, Ethics and Professional Practice Committee, and concerned the petitions submitted to the Board of Registration for Professional Engineers and Professional Land Surveyors by the Wyoming Land Surveyor's Council. Herb read the letter that has been prepared to accompany the Memorandum for Record and distributed the final draft version of said memo. A general discussion, concerning "wash-out" surveys, followed and copies of a letter, from Nancy Parke, Governmental Affairs Director for NSPS, were distributed. A motion was carried wherein Herb will deliver the PLSW response, based on the above mentioned Memorandum for Record, to the board of registration at it's meeting in Cheyenne on December 17.

Applications for new membership were presented by Secretary Hudson. The applications of Robert J. Jackson, as a member, and Brad Steil, as an associate member, were approved. Welcome to PLSW!

Northeast Director Jeff Lewis presented his chapter's nomination, for 1993 Honorary Member, of Bryce Rumph. The board confirmed honorary membership and Bryce will be acknowledged at the annual state meeting in Riverton next February.

Congratulations Bryce!

The next matter of new business was the distribution of the 1994 Budget Worksheet and a general presentation by Treasurer Rick Hudson. Requests for budget items should be returned by January 15, 1994, for presentation to the board at the meeting prior to the annual state meeting at Riverton.

The following dates and sites were selected for board meetings in 1994: Wednesday evening, February 2, Riverton; Saturday, May 7, in Rawlins or Saratoga; Friday afternoon, July 15, in Gillette (with dedication of the northeast corner of Wyoming on Saturday); and Saturday, November 5, in Cody. There will be an additional meeting in Riverton following the annual state meeting, as required by our By-laws.

Herb, as Chairman of the Manual of Practice Revision Committee, distributed the NSPS draft version of "Minimum Standards of Practice For Professional Surveying", stated that an additional set of draft standards will be distributed later and mentioned the "State of Missouri" draft that has been previously distributed. He led a general discussion and asked that responses be sent -to his committee not later that January 15, 1994.

Mention was made, by Herb, that "Supernet" observations have been completed; that there are currently two different NAD 83 values for stations; and that NAVD 88 values have been published and are available from NGS.

A general discussion, led by Chris and Herb, concerned the new teleconferencing course from the University of Wyoming on boundary surveying. The new catalog from UW gives a brief course outline and lists Raymond Connin as the instructor. Two members volunteered to view the video and written material, if available, and report back to the board of directors. Funds were authorized, if necessary.

A break for lunch, on the premises, followed and the meeting was reconvened at 1:23 P.M. with the presentation of Harvey Copeland's written report of the Certified Land Corner Recordation Committee. The report, with its supporting documentation, will be presented to the board of registration by Herb Stoughton on December 17th. It was agreed that a letter of transmittal be prepared and a meeting, if necessary, between our committee and the LS members of the board of registration, be held prior to the Wyoming Engineering Society convention in Riverton next February.

Chris Hamilton and Pete Hutchison led a general discussion concerning the upcoming WES convention, the PLSW sponsored seminar, and our annual state meeting. A tentative agenda was circulated and discussed. A motion was carried wherein WES members may attend the seminar for the same fee as PLSW members, that being $10.

Following an announcement soliciting nominations for the engineering project of the year (WES) and candidates for the 1994 PLSW general election, the meeting was adjourned at 2:47 P.M.

Dated this 20th day of December, 1993.
R.L. Hudson,
Secretary/Treasurer

Annual Convention
Riverton, Wyoming

THURSDAY, FEBRUARY 3, 1994

TIME	EVENT
8-Noon	Preconference Workshop: "Corner Evidence Analysis" Dennis J. Mouland, L.S. Glenwood Springs, CO
9:00	WACERS Business Meeting
10:00	WACES Executive Board
Noon	Luncheon: Restoring the Wyoming Corner Monuments Paul Scherbel & Dennis Bland
1:00	Risk Management for Design Professionals
1:00-4:00	Preconference Workshop (Cont'd) "Corner Evidence Analysis"
4:00-5:30	WACES & PLSW – Business Meeting
6:30	Ice Breaker – Exhibit Introduction/Visitation Cards
8:30	Casino Nite - Fund Raiser for Scholarship Fund

FRIDAY, FEBRUARY 4, 1994

TIME	EVENT
7:00	Continental Breakfast
7:00	Inter-Society Roundtable Discussions
8:00	ASCE Business Meeting
8:00	Exhibits
9:00	Opening Session President Sally Steadman
	CONCURRENT SESSIONS
9:15	"Master Blaster – Snow Control on Teton Pass.– Ken Sweeden
9:15-11:30	Ethics for Professionals Dennis Mouland
10:00	GEO Textiles – "World Wide Mu-mus?" Dean Sandri
10:45	Glenwood Canyon – Engineering to Match Mother Nature Joe Kracum
11:30	Exhibits
12:00	WES Joint Luncheon: "Wyoming 2000 – Where's the Action?" Ken Ericksen, Former Administrator/ Manager
1:00	Exhibits
2:00	New Developments in GPS/GIS and Other Funny GI's – Jack Dozzi, Horizons Aerial Surveys
2:45	A Picture is Worth a 100 Shots Kevin Black, PLS USER Phoenix
3:30	Midwest Floods of 1993 Roy Kopsky, Jr., Civil Engineer USCE St. Louis
4:15	Water Development on the Wind River Indian Reservation Barry Gutwein
5:00-6:00	Exhibitor Beer Break – Drawings
7:30	Banquet "Pennies From Heaven" Bill Young – Speaker
	Dance

SATURDAY, FEBRUARY 5

TIME	EVENT
7:00	Continental Breakfast
7:00	Past President's Breakfast
8:30	Dry Fork Energy Storage Project Larry Baccari
9:15	Surveyors & Engineers: "Wherefore Art Thou Metre Stick?" Jerry Crews & T. Dwane Moore
10:00	The Last of the Mega Projects – Denver international Airport Gary Mass
11:00	State Board Discussion – Continuing Education
12:00	Member Luncheon: Mining Law Changes "Wasting Away in Margaritaville" Bob Peck
3:00	WES Business Meeting
6:00	Attitude Adjustment Hour
7:30	Banquet and Dancing