National Geodetic Survey Benchmarks – NGSBenchmarks.shp

The following is NGS documentation that should help explain the reasons for additional NDSWC attribution in the NGS Benchmarks layer . The first pages of documentation were downloaded from the NGS website (html address is printed below) and describe the attributes/domains for the horizontal and vertical control points with the fields of **POS_SRCE** and **ELEV_SRCE**. The second document is basically a dump of a XML documentation file that accompanied the state-wide shapefile download of North Dakota benchmarks. I've highlighted important sections of the two documents for ease in finding explanations, especially since both documents were used to determine the final definitions and field additions that I made. Two fields were added to the state-wide benchmark shapefile available from the NGS website. These two fields are named **H_AccType** for the horizontal accuracy type and **V_AccType** for the vertical accuracy type. Terminology for these fields were derived from the language used by NGS in the following two documents. The different types of NGS benchmarks are delineated in seven ways based on the **POS_SRCE** and **ELEV_SRCE** fields and are as follows:

NGS Precise Horizontal – Precise Vertical - Horizontal source is ADJUSTED and vertical source is ADJUSTED, ADJ UNCH, or POSTED. (see lines 151 and 167 in the second document for Geodetic definitions).

NGS Precise Horizontal – NonGeodetic Vertical - Horizontal source is ADJUSTED and vertical source is READJUST, N HEIGHT, RESET, COMPUTED, GPSCONLV, or LEVELING. (see lines 183-192 in the second document for Non-Geodetic definitions)

NGS Precise Horizontal – Lesser NonGeodetic Vertical - Horizontal source is ADJUSTED and vertical source is H LEVEL, GPS OBS, VERT ANG, SCALED, U HEIGHT, VERTCON. (see lines 183-192 in the second document for Non-Geodetic definitions)

NGS Precise Horizontal – No Vertical - Horizontal source is ADJUSTED and there is no vertical data.

NGS NonGeodetic Horizontal - Precise Vertical - Horizontal source is HD HELD1, HD HELD2, or SCALED and vertical source is ADJUSTED, ADJ UNCH, or POSTED. (see lines 183-192 in the second document for Non-Geodetic definitions)

NGS NonGeodetic Horizontal - NonGeodetic Vertical - Horizontal source is HD HELD1, HD HELD2, or SCALED and vertical source is READJUST, N HEIGHT, RESET, COMPUTED, GPSCONLV, or LEVELING. (see lines 183-192 in the second document for Non-Geodetic definitions)

NGS NonGeodetic Horizontal - Lesser NonGeodetic Vertical - Horizontal source is HD HELD1, HD HELD2, or SCALED and vertical source is H LEVEL, GPS OBS, VERT ANG, SCALED, U HEIGHT, VERTCON. (see lines 183-192 in the second document for Non-Geodetic definitions)

Hopefully this explains the methodology used to symbolize the benchmarks accurately.

- Rod Bassler, GIS Coordinator, ND State Water Commission, June 2015.

http://www.ngs.noaa.gov/cgi-bin/ds_lookup.prl?Item=CURRENT%20SURVEY%20CONTROL

CURRENT SURVEY CONTROL

DATA ITEM: Current Survey Control
DISPLAYED: Always, but the HEIGHT may be blank if the station is a horizontal control station only.
COMMENTS : Current Survey Control is identified by a '*' in cc8 and comes under the heading "*CURRENT SURVEY CONTROL" The horizontal datum in use is the North American Datum of 1983 (NAD 83). This datum also defines ellipsoid vertical height. The orthometric vertical datum in use in the conterminous United States and Alaska is the North American Vertical Datum of 1988 (NAVD 88). The orthometric vertical datum in Hawaii is referenced as Local Mean Sea Level (LMSL). This tag also applies to all orthometric heights in the United States territories that were determined prior to the establishment of the vertical datums listed below.

American Samoa: American Samoa Vertical Datum of 2002 (ASVD02)
Guam: Guam Vertical Datum of 2004 (GUVD04)
Northern Marianas: Northern Marianas Vertical Datum of 2003 (NMVD03)
Puerto Rico: Puerto Rico Vertical Datum of 2002 (PRVD02)
U.S. Virgin Islands: Virgin Islands Vertical Datum of 2009 (VIVD09)

NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums. Care should be taken not to "mix" current datum(s) with past datum(s) within a project.

NAD83 (1986) indicates positions on the NAD83 datum for the North American Adjustment, completed in 1986.
NAD83 (nnnn) indicates positions on the NAD83 datum for the North American Adjustment, but readjusted to a State High Accuracy Reference Network (HARN) on the date shown in (nnnn).
NAD83 (CORS) indicates positions which are part of the CORS network.

There are various Horizontal Control sources, as specified below:

ADJUSTED = Least squares adjustment (Rounded to 5 decimal places.)

HD_HELD1 = The horizontal coordinates were determined by differentially corrected hand held GPS observations or other comparable positioning techniques and have an estimated accuracy of +/- 3 meters. (Rounded to 2 decimal places.)

HD_HELD2 = Autonomous hand held GPS observations. (Rounded to 1 decimal place.)

SCALED = Scaled from a topographic map. (Rounded to 0 decimal places.)

NAVD 88 orthometric heights are displayed where available. If there was a height for the station on the National Geodetic Vertical Datum of 1929 (NGVD 29), then that height will be displayed under SUPERSEDED SURVEY CONTROL.

There are various Vertical Control sources, as specified below:

ADJUSTED = Direct Digital Output from Least Squares Adjustment of Precise Leveling. (Rounded to 3 decimal places.)

ADJ UNCH = Manually Entered (and NOT verified) Output of Least Squares Adjustment of Precise Leveling. (Rounded to 3 decimal places.)

POSTED = Pre-1991 Precise Leveling Adjusted to the NAVD 88 Network After Completion of the NAVD 88 General Adjustment of 1991. (Rounded to 3 decimal places.)

READJUST = Precise Leveling Readjusted as Required by Crustal Motion or Other Cause. (Rounded to 2 decimal places.)

N HEIGHT = Computed from Precise Leveling Connected at Only One Published Bench Mark. (Rounded to 2 decimal places.)

RESET = Reset Computation of Precise Leveling. (Rounded to 2 decimal places.)

COMPUTED = Computed from Precise Leveling Using Non-rigorous Adjustment Technique. (Rounded to 2 decimal places.)

GPSCONLV = Leveled Orthometric Height tied to GPS HT_MOD Orthometric Height. (Rounded to 2 decimal places.)

LEVELING = Precise Leveling Performed by Horizontal Field Party. (Rounded to 2 decimal places.)

H LEVEL = Level between control points not connected to bench mark. (Rounded to 1 decimal places.)

GPS OBS = Computed from GPS Observations. (Rounded to 1 decimal places.)

VERT ANG = Computed from Vertical Angle Observations. (Rounded to 1 decimal place; If No Check, to 0 decimal places.)

SCALED = Scaled from a Topographic Map. (Rounded to 0 decimal places.)

U HEIGHT = Unvalidated height from precise leveling connected at only one NSRS point. (Rounded to 2 decimal places.)

VERTCON = The NAVD 88 height was computed by applying the VERTCON shift value to the NGVD 29 height. (Rounded to 0 decimal places.)

NOTE: NAVD 88 and NGVD 29 heights in meters are converted to U.S. Survey Feet by using the conversion factor: U.S. Survey Feet = (39.37 / 12.00) x meters Height in feet is rounded to 1 less decimal place than the corresponding height in meters.

EXAMPLES :_____

AA0000 *CURRENT SURVEY CONTROL

AA0000

NGS has adopted a realization of NAD83 called NAD83(2007), short for NAD83 (NSRS2007), for the distribution of coordinates at passive geodetic control monuments. This realization approximates (but is not, and can never be, equivalent to) the more rigorously defined NAD 83 (CORS96) realization in which continuously Operating Reference Stations (CORS) coordinates are distributed. NAD 83 (NSRS2007) was created by adjusting GPS data collected during various campaign-style geodetic surveys performed between the mid-1980's and 2005. For this adjustment, NAD 83 (CORS96) positional coordinates for approximately 700 CORS were held fixed (predominately at the 2002.0 epoch for the stable North American plate, but 2007.0 in Alaska and western CONUS) to obtain consistent positional coordinates for approximately 70,000 passive marks, as described by Vorhauer [2007]. Derived NAD 83(NSRS2007) positional coordinates should be consistent with corresponding NAD 83(CORS96) positional coordinates to within the accuracy of the GPS data used in the adjustment and the accuracy of the corrections applied to these data for systematic errors, such as refraction. In particular, there were no corrections made to the observations for vertical crustal motion when converting from the epoch of the GPS survey into the epoch of the adjustment, while the NAD 83(CORS96) coordinates do reflect motion in all three directions at CORS sites. For this reason alone, there can never be total equivalency between NAD 83(NSRS2007) and NAD 83(CORS96).

Note: NGS has not computed NAD83 (NSRS2007) velocities for any of the approximately 70,000 passive marks involved in this adjustment. Also, the positional coordinates of a passive mark will make reference to an "epoch date". Epoch dates are the date for which the positional coordinates were adjusted, and are therefore considered "valid" (within the tolerance of not applying vertical crustal motion). Because a mark's positional coordinates will change due to the dynamic nature of the earth's crust, the coordinates of a mark on epochs different

than the listed "epoch date" can only be accurately known if a 3-dimensional velocity has been computed and applied to that mark.

Metadata included with state-wide benchmark download from NGS

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 3 <idinfo>
 4 <citation>
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 6 <origin>NOAA, National Geodetic Survey</origin>
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 9 <edition>latest available</edition>
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16 <pubplace>NOAA Campus, Silver Spring, MD</pubplace>
17 <publish>NOAA, National Geodetic Survey</publish>
18 </pubinfo>
19 <othercit>
20 Questions concerning this data
21 may be addressed to
22 NGS Information Services Branch
23 EMail - ngs.software@noaa.gov
24 Phone - 301-713-3242
25 </othercit>
26 <onlink>&lt;http://www.ngs.noaa.gov/cgi-bin/datasheet.prl&gt;</onlink>
27 </citeinfo>
28 </citation>
29 <descript>
30 <abstract>
31 This data contains a set of geodetic control stations
32 maintained by the National Geodetic Survey.
33 Each geodetic control station in this dataset
34 has either a precise Latitude/Longitude used
35 for horizontal control or a precise Orthometric Height
36 used for vertical control, or both.
37
38 The National Geodetic Survey (NGS) serves
39 as the Nation's depository for geodetic data. The NGS
```

40 distributes geodetic data worldwide to a variety of
41 users. These geodetic data include the final results
42 of geodetic surveys, software programs to format,
43 compute, verify, and adjust original survey
44 observations or to convert values from one geodetic
45 datum to another, and publications that describe how to
46 obtain and use Geodetic Data products and services.
47 </abstract>
48 <purpose>
49 Provide a base of reference for latitude, longitude and height
50 throughout the United States.
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78 vertical control, ellipsoid height, benchmark,
79 orthometric height, latitude, longitude
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84 <placekey>The geographic limits of USA including trust Territories</placekey>
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Not restricted; Geodetic Data,
including software were developed and compiled with
U.S. Government funding; no proprietary rights may be
attached to them nor may they be sold to the U.S.
Government as part of any procurement of ADP products
or services.
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The NGS datasheet is a text document which summarizes
key geodetic information stored in the NGS database.
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Horizontal control stations (those with precise Latitude, Longitude)
were established in accordance with FGDC publications
"Standards and Specifications for Geodetic Accuracy Standards"
and "Geometric Geodetic Accuracy Standards and Specifications for
Using GPS Relative Positioning Techniques"
The final Latitude, Longitude of these stations were determined
by a least squares adjustments of the horizontal observations.
Horizontal control station have Latitude, Longitudes displayed
to 5 places and are identified by attribute POS_SRCE = 'ADJUSTED'

Lesser quality Latitude, Longitudes may also be preset in the dataset.
These are identified by a POS_SRCE attributes
HD_HELD1, HD_HELD2, or SCALED.
These lesser quality positions are described at:
<http://www.ngs.noaa.gov/cgi-bin/ds_lookup.prl?Item=SCALED>

Vertical control stations (those with precise Orthometric Heights)
were established in accordance with FGDC publications
"Standards and Specifications for Geodetic Accuracy Standards"
The final Orthometric Height of these stations were in most cases
determined by a least squares adjustments of the vertical observations
but in some cases may have been keyed from old survey documents.
Vertical control stations have Orthometric Heights displayed
to 2 or 3 places and are identified by attribute ELEV_SRCE of
ADJUSTED, ADJ UNCH, POSTED,READJUST,N HEIGHT,RESET,COMPUTED

Lesser quality Orthometric Heights may also be preset in the dataset.

178 These are identified by a ELEV_SRCE attributes
179 GPS_OBS, VERT_ANG, H_LEVEL, VERTCON, SCALED.
180 These lesser quality orthometric heights are described at:
181 <http://www.ngs.noaa.gov/cgi-bin/ds_lookup.prl?Item=SCALED>
182
183 IMPORTANT - Control stations do not always have both precise
184 Latitude, Longitude AND precise Orthometric Height.
185 A horizontal control station may have a orthometric
186 height associated with it which is of non geodetic quality.
187 These types of heights are displayed to 0, 1, or 2 decimal
188 places. Worst case being off by +/- 1 meter.
189 LIKEWISE - A Vertical control station may have a Latitude, Longitude
190 associated with it which is of non geodetic quality.
191 These types of Latitude, Longitudes are displayed to 0, 1 or 2 decimal
192 places. Worst case being off by +/- 180 meter.
193 Refer to <http://www.ngs.noaa.gov/cgi-bin/ds_lookup.prl?Item=SCALED>
194 for a description of the various type of methods used in determining
195 the Latitude, Longitude, and Orthometric Height.
196
197 Attribute POS_CHECK and ELEV_CHECK indicate whether or not
198 an observational check was made to the position and/or orthometric height.
199 Care should be taken when using "No Check" coordinates.
200
201 If attribute ELEV_SRCE = 'VERTCON' then the Orthometric Height was
202 determined by applying NGS program VERTCON to an Old NGVD 29 height.
203 In most areas VERTCON gives results to +/- 2 cm.
204 See <http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html> for a more
205 detailed explanation of VERTCON accuracy.
206
207 Ellipsoid Heights are also present in the dataset.
208 The ellipsoid heights consist of those determined using a precise
209 geoid model, which are displayed to 2 decimal places and are considered
210 good to +/- .005 meters, and those displayed to 1 decimal place and are
considered
211 only good to +/- .5 meters
212 </attraccr>
213 <qattracc>
214 <attraccv>95 percent confidence level for geodetic quality data.</attraccv>
215 <attracce>
216 Geodetic Data are continuously being processed;
217 their standards and specifications are being reviewed for next
218 publication release. "Standards and Specifications for Geodetic Control
Networks",
219 1984 and "Geometric Geodetic Accuracy Standards
220 and Specifications for Using GPS Relative
221 Positioning Techniques," FGCS (formally FGCC)

publication version 5.0 1989, are most current
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FGCS sponsored testing in cooperation with equipment
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This dataset DOES NOT include destroyed marks.
All other non-publishable marks are NOT included.
Non-publishable criteria is available at
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Horizontal positional accuracy statements pertain
to horizontal control stations only.
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Positional Accuracy explanation contained in
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Techniques," FGCS (formally FGCC) publication
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Vertical positional accuracy statements pertain
to vertical control stations only.
i.e. Those with geodetic quality Orthometric Heights.
Orthometric Height accuracy explanation is contained in
FGDC publication "Standards and Specifications for Geodetic Control Networks"
with the exception of vertical control of class 0
POSTED and READJUSTED Heights which are described at:
<http://www.ngs.noaa.gov/cgi-bin/ds_lookup.prl?Item=VERT%20ORDER>

Ellipsoid height accuracy explanation contained in
"Geometric Geodetic Accuracy Standards and
Specifications for Using GPS Relative Positioning
Techniques," FGCS (formally FGCC) publication
version 5.0, 1989. (see table 1, p6).
The accuracies for ellipsoid heights are described at:
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The geodetic data must be
submitted in the digital formats specified in the
FGCS (formally FGCC) publication "Input Formats
and Specifications of the National Geodetic Survey
Data Base" which describes the formats and
procedures for submission of data for adjustment
and assimilation into the National Geodetic Survey
Data Base. Separate volumes of this publication
refer to horizontal (volume 1), vertical (volume
2), and gravity (volume 3) control, and are
available from NOAA, National Geodetic Survey,
1315 East-West Hwy, Code N/CGS1, Silver Spring,
MD, 20910 (1-301-713-3242). Note guidelines for
submission of three-dimensional Global Positioning
System (GPS) relative positioning data are
contained in annex L to volume 1.
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The National Geodetic Survey
produces geodetic data. Geodetic data comprise
the results of geodetic surveys to determine,
among other things, latitude, longitude, height,
scale, and orientation control. The National
Geodetic Survey original field survey project
observations and final reports are accessioned

into records system of the National Archives and Records Administration of the U.S.A. These surveys provide information valuable for a variety of uses in the mapping, charting and surveying community.

The NGS' final product is the geodetic data sheet. Geodetic data sheets are comprehensive summaries of all published information for a given geodetic reference point, including: the geographic position and/or height based on the current reference datum, condition of the survey mark when it was last visited, a description of where the point is located and how to reach it, and an explanation of the terms used in the data sheet. In support of these geodetic data, the NGS provides software, publications, and various user services, including geodetic advisor program, instrument calibration, surveying standards, and technical workshops.

This dataset contains certain information extracted from the above mentioned data sheet.
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Geodetic Data- horizontal positional datum
conversion, use program NADCON (version 2.1)

Geodetic Data - vertical positional datum
conversion, use program VERTCON (version 2.0)

These programs provide indirect spatial reference
data and are available from NOAA, National
Geodetic Survey at
&lt;http://www.ngs.noaa.gov/PC_PROD/pc_prod.shtml&gt;
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The current attributes and their meaning are shown below.

#FeatureId
Temporary unique ID assigned to this station.

DATA_DATE-
The date when this information was retrieved from the NGS database.

DATA_SRCE-
Data Source where the information for the mark came from.
You should use this link to obtain a full datasheet for the mark
or obtain the datasheets from <http://www.ngs.noaa.gov/cgi-bin/datasheet.prl>
if you intend to use the data for survey control.

DEC_LONG-
Decimal equivalent of the LONGITUDE
Always displayed to 10 decimal places, but you should
see POS_SRCE and POS_ORDER to determine the true accuracy.

DEC_LAT-
Decimal equivalent of the LATITUDE

PID-
Permanent Identifier assigned by NGS to each mark

493
494 NAME-
495 Station Name (a.k.a. Designation)
496
497 STATE-
498 State Code
499
500 COUNTY-
501 County Name
502
503 QUAD-
504 USGS Topographic Quad Map Name
505
506 LATITUDE-
507 Latitude in Deg-Min-Sec format
508
509 LONGITUDE-
510 Longitude in Deg-Min-Sec format
511
512 POS_DATUM-
513 Datum of the LATITUDE,LONGITUDE
514 Should always be NAD83
515
516 DATUM_TAG-
517 Datum Tag of the LATITUDE,LONGITUDE
518 NAD83 (1986) indicates positions on the NAD83 datum for the
519 North American Adjustment, completed in 1986.
520 NAD83 (nnnn) indicates positions on the NAD83 datum for the
521 North American Adjustment, but readjusted to a State High
522 Accuracy Reference Network (HARN) on the date shown in (nnnn).
523 NAD83 (CORS) indicates positions which are part of the CORS
524 network.
525
526 POS_SRCE-
527 Position Source for the LATITUDE,LONGITUDE
528
529 ADJUSTED = Least squares adjustment.
530 (Lat,Lon Rounded to 5 decimal places.)
531
532 HD_HELD1 = Differentially corrected hand held GPS observations.
533 (Lat,Lon Rounded to 2 decimal places.)
534
535 HD_HELD2 = Autonomous hand held GPS observations.
536 (Lat,Lon Rounded to 1 decimal places.)
537
538 SCALED = Scaled from a topographic map.

(Lat,Lon Rounded to 0 decimal places.)
ELEVATION-
Present if available.
The Orthometric Height in METERS indicating the height above the Geoid.

ELEV_DATUM-
Datum of the ELEVATION

ELEV_SRCE-
Elevation Source for the ELEVATION

ADJUSTED = Direct Digital Output from Least Squares Adjustment
of Precise Leveling.
(Rounded to 3 decimal places.)

ADJ UNCH = Manually Entered (and NOT verified) Output of
Least Squares Adjustment of Precise Leveling.
(Rounded to 3 decimal places.)

POSTED = Pre-1991 Precise Leveling Adjusted to
the NAVD 88 Network After Completion of
the NAVD 88 General Adjustment of 1991.
(Rounded to 3 decimal places.)

READJUST = Precise Leveling Readjusted as Required
by Crustal Motion or Other Cause.
(Rounded to 2 decimal places.)

N HEIGHT = Computed from Precise Leveling Connected
at Only One Published Bench Mark.
(Rounded to 2 decimal places.)

RESET = Reset Computation of Precise Leveling.
(Rounded to 2 decimal places.)

COMPUTED = Computed from Precise Leveling Using
Non-rigorous Adjustment Technique.
(Rounded to 2 decimal places.)

LEVELING = Precise Leveling Performed by Horizontal
Field Party.
(Rounded to 2 decimal places.)

H LEVEL = Level between control points not connected
to bench mark.
(Rounded to 1 decimal places.)

585
586 GPS OBS = Computed from GPS Observations.
587 (Rounded to 1 decimal places.)
588
589 VERT ANG = Computed from Vertical Angle Observations.
590 (Rounded to 1 decimal place;
591 If No Check, to 0 decimal places.)
592
593 SCALED   = Scaled from a Topographic Map.
594 (Rounded to 0 decimal places.)
595
596 U HEIGHT = Unvalidated height from precise leveling
597 connected at only one NSRS point.
598 (Rounded to 2 decimal places.)
599
600 VERTCON = The NAVD 88 height was computed by applying the
601 VERTCON shift value to the NGVD 29 height.
602 (Rounded to 0 decimal places.)
603
604 ELLIP_HT-
605 Present if available.
606 The ellipsoid height in METERS referenced to GRS80 ellipsoid.
607
608 ELLIP_SRCE-
609 Ellipsoid Ht Source for the ELLIP_HT
610 Should always be GPS_OBS when present.
611
612 POS_ORDER-
613 Order of accuracy for the LATITUDE,LONGITUDE
614 Should be one of the following-
615 A,B,1,2,3
616
617 Order and class for Orders 1, 2, and 3
618 are defined in the Federal Geodetic Control Committee publication
619 "Standards and Specifications for Geodetic Control Networks".
620
621 In addition-
622 Order A stations have a relative accuracy of
623 5 mm +/- 1-10,000,000 relative to other A-order stations.
624
625 Order B stations have a relative accuracy of
626 8 mm +/- 1- 1,000,000 relative to other A- and B-order stations.
627
628 POS_CHECK-
629 Y=Observational Check was made for the position,
630 N=NO Observational Check was made for the positions

ELEV_ORDER-
Order of accuracy for the ELEVATION
Should be 1,2, or 3 for Vertical Control Stations.
Will be blank for stations used for Horizontal Control only.

Also see attribute DIST_RATE which is used for some
vertical control stations.

Elevation order and class for 1, 2, and 3
are defined in the Federal Geodetic Control
Committee publication "Standards and Specifications for Geodetic
Control Networks". In addition-

Vertical control which were determined only for the purpose of
supplying a height for Horizontal Distance Reductions are
assigned an order of 3.

Class 0 is used for special cases of
orthometric vertical control as follows-

Vertical Order/Class	Tolerance Factor
1 class 0	2.0 mm or less
2 class 0	8.4 mm or less
3 class 0	12.0 mm or less

ELEV_CLASS-
Should be 0, 1, or 2
See details under ELEV_ORDER

ELEV_CHECK-
Y=Observational Check was made for the orthometric height,
N=NO Observational Check was made for the orthometric heights
VERTCONED-
Y=Orthometric Height was determined by applying VERTCON
to an old NGVD 29 height.
N=Orthometric Height determined by observations.
DIST_RATE-
Distribution rate for POSTED and READJUSTED benchmarks
which do not have an Order and Class are as follows
"Posted bench marks" are vertical control points in the NGS data
base which were excluded from the NAVD 88 general adjustment.
Some of the bench marks were excluded due to large adjustment
residuals, possibly caused by vertical movement of the bench marks
during the time interval between different leveling epochs.
Adjusted NAVD 88 are computed for posted bench marks by

supplemental adjustments.

A range of mean distribution rate corrections is listed for each posted bench mark in the data portion of the publication. A summary table of the mean distribution rates and their codes is listed below. The mean distribution rate corrections which were applied to the original leveling observations is a good indication of the usefulness of the posted bench marks' adjusted NAVD 88 heights.

Distribution Rate Code	Distribution Rate Correction
"a"	0.0 thru 1.0 mm/km
"b"	1.1 thru 2.0 "
"c"	2.1 thru 3.0 "
"d"	3.1 thru 4.0 "
"e"	4.1 thru 8.0 "
"f"	greater than 8.0 mm/km

POSTED BENCH MARKS SHOULD BE USED WITH CAUTION. As is the case for all leveling projects, the mandatory FGCS check leveling two-mark or three-mark tie procedure will usually detect any isolated movement (or other problem) at an individual bench mark. Of course, regional movement affecting all the marks equally is not detected by the two- or three-mark tie procedure.

ELLP_ORDER-
Order of accuracy for the ELLIP_HT
Should be 1,2,3,4, or 5 if present.

The following ellipsoid height order and class relative accuracy standards have not yet been adopted by the Federal Geodetic Control Subcommittee, but are currently in use by NGS-

Ellipsoid Height Classification	Maximum Height Difference Accuracy
1 class 1	0.5 (mm)/sqrt(km)
1 class 2	0.7
2 class 1	1.0
2 class 2	1.3
3 class 1	2.0
3 class 2	3.0
4 class 1	6.0
4 class 2	15.0

5	class 1	30.0
5	class 2	60.0

The ellipsoid height difference accuracy (b) is computed from a
a minimally constrained correctly weighted least squares adjustment
by-
b = s / sqrt(d)

where
b = height difference accuracy
s = propagated standard deviation of ellipsoid height
difference in millimeters between control points
obtained from the least squares adjustment.
d = horizontal distance between control points in kilometers

ELLP_class-
Class of accuracy for ELLIP_HT
Should be 1 or 2
See details under ELLP_ORDER

FIRST_RECV-
Date when the station was first monumented
or in the case of landmarks, first observed.

LAST_RECV-
Date when the station was last recovered.

LAST_COND-
Last recovered condition of the mark.
Should be one of the following-
MONUMENTED
FIRST OBSERVED
GOOD
POOR
MARK NOT FOUND
SEE DESCRIPTION
DESTROYED

LAST_RECBY-
Agency who reported the last condition of the mark.

STABILITY-
The stability of the mark may have 1 of 4 codes as indicated below-
A = MOST RELIABLE AND EXPECTED TO HOLD POSITION/ELEVATION WELL
B = PROBABLY HOLD POSITION/ELEVATION WELL
C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO SURFACE MOTION

769 - E.G. FROST HEAVE, ETC
770 D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
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774 available at <http://www.ngs.noaa.gov/cgi-bin/datasheet.prl>
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