The DSDATA Format

Overview

Information about survey monuments (aka "marks") stored in the National Geodetic Survey's Integrated Database (NGS IDB) may be retrieved and displayed in a variety of methods. One standard is known as a datasheet, an ASCII text file consisting of rigorously formatted lines of 80 columns. The name of the format of a datasheet is called "Digital Survey Data" or DSDATA format. Whether a user is extracting one datasheet, or many, the data is put into one file, and often referred to as "a DSDATA file."

When multiple datasheets are extracted for a user, the datasheets are presented in one DSDATA file in the order requested by the user. Users should be aware that not every survey monument in the NGS IDB contains information that is publishable (i.e. available to the public). The non-publishability reason for each such station will be given as part of the retrieval.

All examples of DSDATA found below will be presented in Courier format, colored red.

The most common method of retrieving datasheets in the DSDATA format is through the NGS web page, where a Perl script runs queries via an NGS program called "datasheet95". As such, users often will see this as their first line, when retrieving DSDATA files:

```
PROGRAM = datasheet95, VERSION = X.X
```

That line is metadata, telling the user how the DSDATA file itself was retrieved. The next line is the first line of actual DSDATA, and is the first line of the first datasheet to be retrieved.

The first line of each datasheet is:

```
1        NATIONAL GEODETIC SURVEY,   Retrieval Date = Month Day, Year
```

Note that in the DSDATA format, every line except line 1 of every datasheet has a blank space in the first column.

Datasheets do not have an official "last line" format. As such, when there are multiple datasheets in one DSDATA file, they can be separated by identifying their first lines, as per above. The final line of a DSDATA file does have an official format. The last line of a correctly retrieved DSDATA file is:

```
***retrieval complete.
```

If that retrieval was performed on the NGS web page, there is often one final non-DSDATA line of metadata, showing how long the retrieval took:

```
Elapsed Time = 00:00:21
```

The second line of each datasheet begins with a blank space in column 1, followed by the six-character Permanent Identifier (PID) in columns 2-7, a blank space in column 8 and then a row of asterisks that begins in column 9, for example:

```
 AB1234 ************************************************************************
```

The remaining lines of each datasheet can be broken down into sections, where each section contains multiple 80 character lines. The sections are:

- Basic Metadata
- Current Survey Control
- Accuracy
- Data Determination Methodology
- Projections
- Azimuth Marks
- Superseded Survey Control
- Monumentation
- History
- Description and Recovery

Each section will be described in detail below.

Basic Metadata

The Basic Metadata Section contains information to help identify the kind of mark, its name, and where it can generally be found. Each line will contain one data item, though not every data item is displayed on every datasheet. The data items which may occur on datasheets, in the order they will appear, are listed in the tables below.

<table>
<tr><td>Data Item</td><td>Special Category Header</td></tr>
<tr><td>When Displayed</td><td>Only when mark belongs to one or more of the categories shown in the examples below.</td></tr>
<tr><td>Comments</td><td>Marks can belong to more than one of these categories. In such a case all of the appropriate categories will be displayed</td></tr>
<tr><td colspan="2">Examples:<pre>
 AF9520 CORS   - This is a GPS Continuously Operating Reference Station.
 HV8128 FBN   - This is a Federal Base Network Control Station.
 HV9260 CBN   - This is a Cooperative Base Network Control Station.
 RF0849 PACS   - This is a Primary Airport Control Station.
 RF0850 SACS   - This is a Secondary Airport Control Station.
 DM9926 HT_MOD   - This is a Height Modernization Survey Station.
 AE8289 WATER LEVEL - This is a Water Level Survey Control Monument.
 TV1513 DATUM ORIG   - This is a Vertical Datum Origin Point.
 CJ0500 TIDAL BM   - This is a Tidal Bench Mark.
</pre></td></tr>
</table>

Data Item	***Designation***
When Displayed	Always
Comments	The designation is often called the "name" of the mark. Often the DESIGNATION line does not match exactly with the STAMPING line (see later).

Examples:
`HV1846  DESIGNATION -  MERIDIAN STONE`
`RF0849  DESIGNATION -  CARIPORT`
`CA0570  DESIGNATION -  MP 77-5015`
`AA8531  DESIGNATION -  66-26`	

Data Item	***CORS Identifier***
When Displayed	When the mark is either a Continuously Operational Reference Station (CORS) or is *associated with* one
Comments	"Associated with" means it is either the Antenna Reference Point (ARP) of a CORS, a CORS monument, or a Ground Reference Point (GRP). CORS identifiers are always four character alphanumeric values.

Examples:
`AF9520  CORS_ID      -  WES2`
`DP3834  CORS_ID      -  AC53`
`DJ3083  CORS_ID      -  GAIT`
`DP4062  CORS_ID      -  WES2`
`AF9647  CORS_ID      -  GODE`	

Data Item	***Permanent Identifier (aka "PID")***
When Displayed	Always
Comments	The PID is also found on the left side (columns 2-7) of each datasheet record. The PID is always 2 upper case letters followed by 4 numbers.

Examples:
`DP3834  PID          -  DP3834`
`RF0849  PID          -  RF0849`
`TV0007  PID          -  TV0007`
`AB1234  PID          -  AB1234`	

Data Item	***State/County***
When Displayed	Always, but County may be blank.
Comments	"State" can mean an actual state, or the District of Columbia or one of a number of insular areas. The 2-character abbreviation for all other areas is specific to NGS and does not necessarily follow any other official style or rule. Some states may not have counties. Boroughs may be used for Alaska; Parishes are used for Louisiana; Districts and/or Islands for American Samoa.

Examples:
`FV1057  STATE/COUNTY-  CA/SAN LUIS OBISPO`
`HV4442  STATE/COUNTY-  DC/DISTRICT OF COLUMBIA`
`BW0029  STATE/COUNTY-  LA/POINTE COUPEE`
`AA4438  STATE/COUNTY-  FM/KOSRAE`
`TT4608  STATE/COUNTY-  AK/MATANUSKA-SUSITNA`
`DE7254  STATE/COUNTY-  AS/EASTERN (DISTRICT)`
`AD9914  STATE/COUNTY-  ON/HASTINGS`	

Data Item	***Country***
When Displayed	Always
Comments	NGS has certain restrictions on publication of points outside of the USA

Examples:

```
HV1846  COUNTRY     -  US
AB9729  COUNTRY     -  BARBADOS
AA4438  COUNTRY     -  FEDERATED STATES OF MICRONESIA
AD9914  COUNTRY     -  CANADA
```

Data Item	***USGS Quadrangle***
When Displayed	Always, but may be blank
Comments	This is the name of the USGS 7.5 minute series map sheet which shows the area of the mark. The mark may or may not appear as a map feature. NGS sometimes publishes data according to the USGS quadrangle (quad) system, for which the USGS quad sheet name is used as a reference.

Examples:

```
FA3038  USGS QUAD   -  ELLENDALE (2019)
RF0850  USGS QUAD   -  CARIBOU (2018)
TV1290  USGS QUAD   -  CAMUY (2018)
FV1057  USGS QUAD   -  CYPRESS MOUNTAIN (2018)
```

Data Item	***National Topographic System Map Sheet for Canada***
When Displayed	Always, but may be blank
Comments	When a USGS topographic quadrangle or a Canadian NTS Map Sheet map name is known, a station listing of all datasheets within each map's mapping area can be found by using these web pages: https://www.ngs.noaa.gov/cgi-bin/ds_quads.prl https://www.ngs.noaa.gov/cgi-bin/ds_quads_sf.prl

Examples:

```
TN1099  NTS MAPSHEET-  SAGE CREEK (2020)
TT3837  NTS MAPSHEET-  WHITE PASS (2020)
TD0631  NTS MAPSHEET-  ALTONA (2020)
OG0249  NTS MAPSHEET-  NIAGARA (2020)
```

Current Survey Control

The Current Survey Control Section contains the most recent geodetic coordinates available for the mark, even if those coordinates are not in the most recent datum or datum realization of the National Spatial Reference System (see Appendix A). Each line will contain one data item, though not every data item is displayed on every datasheet.
The top of this section will consist of three lines:

```
AB1234
AB1234                             *CURRENT SURVEY CONTROL
AB1234  ___________________________________________________________________________
```

After these header lines, each subsequent line will contain one data item, though not every data item is displayed on every datasheet. The data items which may occur on datasheets, in the order they will appear, are listed in the tables below.

Data Item	***Latitude and Longitude***
When Displayed	Always, but may be blank
Comments	The "*" in column 8 indicates "current survey control". This is followed by the horizontal datum (and possibly realization of that datum) to which the latitude and longitude refer. This is always the most recent datum/realization for which data is available at this mark. This is usually NAD 83 (North American Datum of 1983) and its realization is some year from 1986 forward. Next are the geodetic latitude and longitude of the mark, always presented as integer degrees, integer minutes and decimal seconds and a hemisphere identifier. Finally on this line is the method by which these coordinates were determined. The methods can be:

Method	**Description**	**Decimal Places**
ADJUSTED	A Least squares adjustment of geodetic survey data.	5
HD_HELD1	Differentially corrected hand held GPS observations or other comparable positioning techniques with an estimated accuracy of +/- 3 meters.	2
HD_HELD2	Autonomous hand held GPS observations.	1
SCALED	Scaled from a topographic map.	0
NO CHECK	Only having one tie	5

Examples:

```
TV1513* NAD 83(2011) POSITION- 18 27 32.23742(N) 066 06 59.20112(W)   ADJUSTED
AA9751* NAD 83(2007) POSITION- 26 03 56.01136(N) 080 09 28.78373(W)   ADJUSTED
MD1797* NAD 83(1997) POSITION- 41 02 52.48524(N) 084 48 11.27812(W)   ADJUSTED
DE6217* NAD 83(CORS) POSITION- 61 09 20.65443(N) 149 51 47.59515(W)   ADJUSTED
FX4609* NAD 83(1986) POSITION- 36 23 38.43636(N) 076 15 54.40005(W)   ADJUSTED
DM4608* NAD 83(PA11) POSITION- 19 59 32.00165(N) 155 14 25.45474(W)   ADJUSTED
AA4394* NAD 83(MA11) POSITION- 13 26 37.07548(N) 215 20 36.19639(W)   ADJUSTED
RO1161* NAD 83(1996) POSITION- 46 48 57.62190(N) 095 51 06.57714(W)   NO CHECK
DN8535* NAD 83(1986) POSITION- 18 05 37.87   (N) 065 28 16.89   (W)   HD_HELD1
GL0314* NAD 83(1986) POSITION- 36 43 47.0    (N) 102 30 46.8    (W)   HD_HELD2
AA0006* NAD 83(1986) POSITION- 24 33 25.     (N) 081 48 23.     (W)   SCALED
```

Data Item	***Ellipsoid Height***
When Displayed	Only when an ellipsoid height has been determined for this point.
Comments	The "*" in column 8 indicates "current survey control". This is followed by the horizontal datum (and possibly realization of that datum) to which the ellipsoid height refers. This is always the most recent datum/realization for which data is available at this mark. This is usually NAD 83 (North American Datum of 1983) and its realization is some year from 1986 forward. Next is the ellipsoid height of the mark, always presented as a real number followed by its units and the date when the height was adjusted. Finally on this line is the method by which this coordinate was determined. The methods can be:

Method	**Description**	**Decimal Places**
ADJUSTED	A Least squares adjustment of geodetic survey data.	3
NO CHECK	Only having one tie	3

Examples:

```
AF9522* NAD 83(2011) ELLIP HT-   108.914 (meters)        (08/??/11)   ADJUSTED
AA9751* NAD 83(2007) ELLIP HT-   -24.834 (meters)        (02/10/07)   ADJUSTED
MC1594* NAD 83(1995) ELLIP HT-   167.940 (meters)        (04/01/98)   ADJUSTED
AA4394* NAD 83(MA11) ELLIP HT-    56.273 (meters)        (06/27/12)   ADJUSTED
DE7243* NAD 83(PA11) ELLIP HT-    65.548 (meters)        (06/13/13)   ADJUSTED
DE6217* NAD 83(CORS) ELLIP HT-    53.785 (meters)        (04/??/03)   ADJUSTED
AA4446* NAD 83(PA11) ELLIP HT-   200.400 (meters)        (06/27/12)   NO CHECK
```

Data Item	***Epoch of Horizontal Datum Realization***
When Displayed	Only when the horizontal datum being used has an epoch.
Comments	The attempt to regularize all data in a datum realization at one common epoch was not attempted until 2007. All datum realizations since then have a reference epoch. As such, if the latest datum realization for this mark is 2007 or later, it will be displayed. Prior to NAD 83 (2007) realization, epoch dates were only used for marks in regions of episodic and/or continuous horizontal crustal motion where the position changes in time. The epoch date indicates the time the published horizontal coordinates are valid. This date will only be displayed if the latest datum realization available at this mark predates 2007.

Examples:

```
HV1846* NAD 83(2011) EPOCH   -  2010.00
AB5034* NAD 83(2007) EPOCH   -  2007.00
AA9751* NAD 83(2007) EPOCH   -  2002.00
DE7243* NAD 83(PA11) EPOCH   -  2010.00
AA4394* NAD 83(MA11) EPOCH   -  2010.00
DE6217* NAD 83(CORS) EPOCH   -  2003.00
EV3471* NAD 83(1992) EPOCH   -  1991.35
```

Data Item	***Orthometric Height***
When Displayed	Only when an orthometric height has been determined for this point.

Comments	The "*" in column 8 indicates "current survey control". This is followed by the vertical datum to which the orthometric height refers. This is always the most recent datum for which data is available at this mark. The possible vertical datums encountered are listed in Appendix B. Next is the orthometric height of the mark, always presented as a real number in meters then a real number in feet[1]. Finally, on this line is the method by which this coordinate was determined. The methods can be:

Method	Description	Decimal Places (meters) (feet)
ADJUSTED	Digital output of a least squares adjustment of geodetic leveling data.	3 (m) 2 (f)
GPS OBS	Determined in a 3-D least squares adjustment of GPS survey data. Published to the nearest cm. – determined by either 2cm/5cm ellipsoid height standards and a high resolution national geoid model or by FAA procedures. Published to the nearest dm. Determined from GPS-observed heights using non-ht mod procedures.	2 (m) 1 (f) 1 (m) 0 (f)
H=h-N	Determined in a 3-D least squares adjustment of GPS survey data. This method of determining the orthometric height is used when there is no NAVD88 control in the area; the control for the adjustment is established by subtracting the geoid height from an ellipsoid height. It has the same precision as GPS OBS above.	2 (m) 1 (f) 1 (m) 0 (f)
LEVELING	Precise leveling that was not adjusted in a least squares adjustment of geodetic leveling data.	2 (m) 1(f)
ADJ UNCH	Manually entered (unverified) output of a least squares adjustment of geodetic leveling data.	3 (m) 2 (f)
POSTED	Pre-1991 precise leveling forced to fit the NAVD88 data; excluded for various reasons from the NAVD 88 general adjustment adjusted. (Use with caution)	3 (m) 2 (f)
READJUSTED	Precise leveling readjusted as required due to crustal motion or other cause.	2 (m) 1(f)
N HEIGHT	Computed from precise leveling connected at only one published bench mark for GPS check.	2 (m) 1(f)
RESET	3rd order height computed from precise leveling generally connected to a single NSRS bench mark. For precise details please see *http://www.ngs.noaa.gov/PUBS_LIB/Benchmark_4_1_2011.pdf*	2 (m) 1(f)
COMPUTED	Computed from precise leveling using uncorrected height differences.	2 (m) 1 (f)
GPSCONLV	GPS controlled leveling. Differential leveled orthometric height reference to only one GPS HT_MOD (see "GPS OBS" above) orthometric height. (Use with caution)	2 (m) 1 (f)
H LEVEL	Leveling between control points not connected to bench mark. (T-height in the bluebook)	1 (m) 0 (f)
VERT ANG	Elevations derived using vertical angles such as in triangulation or in some case in precise traverses.	1 (m) 0 (f)
VERTCON	The NAVD 88 height was computed by applying the VERTCON shift value to the NGVD 29 height (displayed under SUPERSEDED SURVEY CONTROL.)	0 (m) 0 (f)
NOT PUB	The station is in a dynamic region with known vertical motion.	0 (m) 0 (f)
SCALED	The orthometric height was scaled from a topographic map.	0 (m) 0 (f)

[1] Heights in meters are converted to U.S. Survey Feet by using the conversion factor H(USSF) = H(m) x (39.37/12.00). Height in feet is rounded to 1 less decimal place than the corresponding height in meters.

Examples: (Orthometric Height)

```
HV1846* NAVD 88 ORTHO HEIGHT -     5.204 (meters)       17.07  (feet) ADJUSTED
TU0894* LMSL    ORTHO HEIGHT -   666.771 (meters)     2187.56  (feet) ADJUSTED
AA9751* NAVD 88 ORTHO HEIGHT -     0.7   (meters)        2.    (feet) GPS OBS
FX4609* NAVD 88 ORTHO HEIGHT -     3.    (meters)       10.    (feet) SCALED
AI9450* LMSL    ORTHO HEIGHT -     3.23  (meters)       10.6   (feet) LEVELING
DV0269* NAVD 88 ORTHO HEIGHT -   446.890 (meters)     1466.17  (feet) POSTED
DU1065* NAVD 88 ORTHO HEIGHT -   400.403 (meters)     1313.66  (feet) READJUSTED
DB1234* NAVD 88 ORTHO HEIGHT -    -1.78  (meters)       -5.8   (feet) N HEIGHT
DV0615* NAVD 88 ORTHO HEIGHT -   330.18  (meters)     1083.3   (feet) RESET
DH6678* NAVD 88 ORTHO HEIGHT -    49.54  (meters)      162.5   (feet) GPSCONLV
EV4083* NAVD 88 ORTHO HEIGHT -   921.8   (meters)     3024.    (feet) H LEVEL
DE7925* LMSL    ORTHO HEIGHT -     1.4   (meters)        5.    (feet) VERT ANG
DU1581* NAVD 88 ORTHO HEIGHT -   370.06  (+/-2cm)     1214.1   (feet) VERTCON
AU3336* NAVD 88 ORTHO HEIGHT -          **(meters)           **(feet) NOT PUB
EV3708* NAVD 88 ORTHO HEIGHT -  1126.    (meters)     3694.    (feet) SCALED
```

Data Item	***Epoch of Orthometric Height and warning messages***
When Displayed	Only when the orthometric height is in a dynamic region (LA, MS, AL, FL).
Comments	

Examples:

```
BH1164* NAVD 88 EPOCH        -  2009.55
BH1164  **This station is located in a suspected subsidence area (see below).
BH1164  **This station is included in the VTDP model (see below).

BH1890* NAVD 88 EPOCH        -  2009.55
BH1890  **This station is located in a suspected subsidence area (see below).
```

Data Item	***Orthometric Height warning messages (without Epoch)***
When Displayed	Only when the orthometric height is in Southeast Texas.
Comments	

Examples:

```
AW0590* NAVD 88 ORTHO HEIGHT       4.400 (meters)       14.44  (feet) ADJUSTED
AW0590  **This station is in an area of suspected vertical motion (see below).
```

After all of the above data items in the Current Survey Control Section are displayed (or skipped if appropriate), there will be one separator line, like so:

```
AB1234  _______________________________________________________________________
```

After this separator line, further information about the <u>Current Survey Control</u> will continue.

Data Item	***Historic Geoid Undulation – used for orthometric height determination***
When Displayed	When the published orthometric height was determined using a different geoid model than the currently published geoid.
Comments	When this is outside a region where NGS computes a geoid model, models from external groups have sometimes been used.

Examples:

```
AA4457  LMSL orthometric height was determined with geoid model      OSU 91A
DH3084  GUVD04 orthometric height was determined with geoid model    EGM96
JS4670  NAVD 88 orthometric height was determined with geoid model   GEOID90
MC1717  NAVD 88 orthometric height was determined with geoid model   GEOID93
AE7554  NAVD 88 orthometric height was determined with geoid model   GEOID96
AJ2697  NAVD 88 orthometric height was determined with geoid model   GEOID99
DM4612  LMSL orthometric height was determined with geoid model      GEOID09
DP1257  NAVD 88 orthometric height was determined with geoid model   GEOID12A
```

Data Item	***Historic Geoid Undulation***
When Displayed	When the published orthometric height was determined using a different geoid model than the currently published geoid.
Comments	When this is outside a region where NGS computes a geoid model, models from external groups have sometimes been used. This line only appears if the previous (Orthometric Height / Geoid Header) line appears. It is formatted identically to the next line (Current Geoid Undulation), so care should be taken not to confuse the two lines. Although the DSDATA shorthand is "GEOID HEIGHT", the correct name for the value on this line is "Geoid Undulation"

Examples:

```
 TW0516  GEOID HEIGHT    -        54.660 (meters)                     EGM96
 JS4670  GEOID HEIGHT    -       -27.690 (meters)                     GEOID90
 MC1717  GEOID HEIGHT    -       -35.28  (meters)                     GEOID93
 AB9840  GEOID HEIGHT    -       -41.272 (meters)                     GEOID96
 AI4325  GEOID HEIGHT    -       -29.428 (meters)                     GEOID99
 DM4612  GEOID HEIGHT    -        18.10  (meters)                     GEOID09
 DO8631  GEOID HEIGHT    -        32.953 (meters)                     GEOID12A
```

Data Item	***Current Geoid Undulation***
When Displayed	Always for points in regions with a current NGS hybrid geoid model.

Comments	This line is formatted identically to the previous line (Historic Geoid Undulation), so care should be taken not to confuse the two lines. Although the DSDATA shorthand is "GEOID HEIGHT", the correct name for the value on this line is "Geoid Undulation."
	
	A message always present follows in the text of the description:
	
	`Significant digits in the geoid height do not necessarily reflect accuracy.`
	`GEOID18 height accuracy estimate available here.`

Examples:

```
MC1717  GEOID HEIGHT    -        -35.305 (meters)                     GEOID18
DM4612  GEOID HEIGHT    -         18.273 (meters)                     GEOID12B
DP1257  GEOID HEIGHT    -        -26.427 (meters)                     GEOID18
AB9235  GEOID HEIGHT    -        -41.015 (meters)                     EGM08
```

Data Item	***Cartesian Coordinates (3 lines)***
When Displayed	When adjusted latitude, longitude and ellipsoid height are all available
Comments	Using the latest available realization of the datum and well known conversion formulae, the Cartesian coordinates of the mark will be presented on three lines, in order of X, then Y, then Z. These values represent earth-centered earth-fixed coordinates, where the X axis follows zero degrees longitude, the Z axis follows positive 90 degrees latitude and the Y axis completes a right hand system. Each line begins with the datum realization used (columns 10-21), a space, the Cartesian identifier (X, Y or Z) in column 23, 2 more spaces, a dash, a space and then the value of the coordinate, followed by the units. At the end of the line is the method by which these coordinates were determined which is always computed.

Examples:

```
 AB9840  NAD 83(2011) X  -  2,354,872.888 (meters)                     COMP
 AB9840  NAD 83(2011) Y  - -5,591,286.773 (meters)                     COMP
 AB9840  NAD 83(2011) Z  -  1,961,212.692 (meters)                     COMP
 DJ4766  NAD 83(2011) X  -     12,757.928 (meters)                     COMP
 DJ4766  NAD 83(2011) Y  - -4,503,816.937 (meters)                     COMP
 DJ4766  NAD 83(2011) Z  -  4,501,620.558 (meters)                     COMP
```

Data Item	***Laplace Correction***
When Displayed	For marks that have an adjusted latitude and longitude and that are within areas that have an NGS hybrid deflection of the vertical model.
Comments	The Laplace correction is the quantity which, when added to an astronomic azimuth, yields a geodetic azimuth. The simplified Laplace equation, which assumes horizontal lines of sight (cotangent of zenith angle ~ zero) and which assumes a clockwise reference frame during model development is: LAPLACE CORR = (a - A) = η * tan(ϕ) where: a = geodetic azimuth A = astronomic azimuth η = deflection of the vertical in the prime-vertical plane (E/W component) ϕ = geodetic latitude Caution: The sense of the sign (a-A vs A-a) of the Laplace correction is not consistent in geodetic literature. However, NGS will always use the formula listed above. This data item will list the Laplace correction as a real number, followed by its units and lastly list the hybrid deflection of the vertical model from which it was derived.

Examples:

```
TV0950  LAPLACE CORR    -         -0.30  (seconds)                    DEFLEC18
MC1378  LAPLACE CORR    -          0.34  (seconds)                    DEFLEC18
DM4612  LAPLACE CORR    -         24.94  (seconds)                    DEFLEC12B
```

Data Item	***Dynamic Height***
When Displayed	For marks with a both an NAVD88 height and modeled gravity (see next data item).
Comments	The dynamic height of a mark is not a true height (in that it is not a length), but is actually the geopotential number at the mark, divided by normal gravity of the GRS-80 ellipsoid at 45 degrees latitude (γ_{45} = 9.806199203 m/s^2). The source of a dynamic height is always *computed*. The North American Vertical Datum of 1988 (NAVD 88) and the International Great Lakes Datum of 1985 (IGLD 85) were co-defined by computing geopotential numbers at survey marks in a least squares adjustment of leveling and gravity data across the North American continent. These geopotential numbers are the underlying value that connects the two datums. Orthometric heights in NAVD 88 may be computed from geopotential numbers using one formula and dynamic heights in IGLD 85 may be computed from geopotential numbers, using a different formula.

Examples:

```
DH0672  DYNAMIC HEIGHT  -       147.626 (meters)      484.34  (feet) COMP
AE8289  DYNAMIC HEIGHT  -       184.373 (meters)      604.90  (feet) COMP
LF0799  DYNAMIC HEIGHT  -       279.738 (meters)      917.77  (feet) COMP
```

Data Item	***Modeled Gravity***
When Displayed	When available.
Comments	The interpolated gravity value which was used in the NAVD 88 general adjustment. One mGal is 0.001 Gals. 1 Gal is 1 cm/s^2.

Examples:

```
AE8289  MODELED GRAVITY -    980,748.1    (mgal)                       NAVD 88
AA2018  MODELED GRAVITY -    979,511.2    (mgal)                       NAVD 88
LF0799  MODELED GRAVITY -    980,086.8    (mgal)                       NAVD 88
```

Accuracy

The Accuracy Section describes how well the mark was determined. Prior to 2007, the accuracy of latitude and longitude of marks was described through the Horizontal Order. With the release of NAD 83(NSRS2007), in compliance with the FGDC Geospatial Positioning Accuracy Standards, NGS ceased using order and began describing the actual accuracies of latitude, longitude and ellipsoid height (if available) in two ways: Network Accuracy and Local Accuracy. This has not yet been done for orthometric heights; Vertical Order and Class remains the only accuracy measure.

The top of this section does not have one consistent identifier. In fact, the entire accuracy section might be entirely excluded, if there is neither a Horizontal Order, Ellipsoid Height Order, Vertical Order nor an FGDC Geospatial Accuracy for the mark. As such, these four data items are described below, but users may find none of them available.

Data Item	***Horizontal (latitude/longitude) Order***
When Displayed	When the most current latitude and longitude for a passive mark were determined in a least squares adjustment of geodetic survey data prior to 2007, or when the most current coordinate information available for a CORS is in a realization of NAD 83 prior to NAD 83(2011).
Comments	Horizontal Order and Class can be found in the FGCS document "Standards and Specifications for Geodetic Control Networks". Despite the breakdown of Horizontal Order into Order and Class, the DSDATA format only displays the Horizontal Order. Some CORS will have this additional text appear: `Formal positional accuracy estimates are not available for this CORS because its coordinates were determined in part using modeled velocities. Approximate one-sigma accuracies for latitude, longitude, and ellipsoid height can be obtained from the short-term time series. Additional information regarding modeled velocities is available on the CORS Coordinates for MYCS2 web page: https://www.ngs.noaa.gov/CORS/coords.shtml.`

Examples:

```
 DE6217  HORZ ORDER      -  SPECIAL (CORS)
 EV3471  HORZ ORDER      -  A
 DH2508  HORZ ORDER      -  FIRST
 DH2518  HORZ ORDER      -  SECOND
 DH2489  HORZ ORDER      -  THIRD
```

Data Item	***Ellipsoid Height Order***
When Displayed	Only when the most current ellipsoid height information available for a mark is in a realization of NAD 83 prior to NAD 83(2007).
Comments	The Ellipsoid Height Order was created by NGS. It was never adopted by the FGCS and has since been superseded by the FGDC Geospatial Positioning Accuracy Standards. Still, marks whose most current GPS derived ellipsoid height is not in NAD 83(NSRS2007) or later realizations will display this field. The description of each order and class is seen below:

Ellipsoid Height Order/Class	**Maximum Height Difference Accuracy**
FIRST CLASS 1	0.5 mm/√km
FIRST CLASS 2	0.7 mm/√km
SECOND CLASS 1	1.0 mm/√km
SECOND CLASS 2	1.3 mm/√km
THIRD CLASS 1	2.0 mm/√km
THIRD CLASS 2	3.0 mm/√km
FOURTH CLASS 1	6.0 mm/√km
FOURTH CLASS 2	15.0 mm/√km
FIFTH CLASS 1	30.0 mm/√km
FIFTH CLASS 2	60.0 mm/√km

The ellipsoid height difference accuracy (b) is computed from 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

Examples

```
DE6217  ELLP ORDER      -  SPECIAL (CORS)
EV3471  ELLP ORDER      -  FIRST     CLASS I
MC1594  ELLP ORDER      -  FOURTH    CLASS I
```

<table>
<tr><th>Data Item</th><th>Vertical (orthometric height) Order and Class</th></tr>
<tr><td>When Displayed</td><td>When the most current orthometric height was determined in a least squares adjustment of geodetic leveling data.</td></tr>
<tr><td>Comments</td><td>Vertical Order and Class can be found in the FGCS document “Standards and Specifications for Geodetic Control Networks”.

Bench marks with unknown order will display a '?'. Vertical control which were determined only for the purpose of supplying a height for horizontal distance reductions are assigned an order of 'THIRD'. If these types of heights do not have supporting observations then the Order is displayed as 'THIRD ?'.

Class 0 is used for special cases of orthometric vertical control as follows:
<table>
<tr><th>Vertical Order/Class</th><th>Tolerance Factor</th></tr>
<tr><td>FIRST CLASS 0</td><td>2.0 mm or less</td></tr>
<tr><td>SECOND CLASS 0</td><td>8.4 mm or less</td></tr>
<tr><td>THIRD CLASS 0</td><td>12.0 mm or less</td></tr>
</table>

"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 marks during the time interval between different leveling epochs. Adjusted NAVD 88 heights are computed for posted bench marks by supplemental adjustments. 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.

GPS CONSTRAINED LEVELED HEIGHT. The height was determined by differential leveling referenced to only one NSRS GPS Height Mod determined height. Therefore this height should be used with CAUTION.</td></tr>
</table>

```
Examples:
 AJ7184  VERT ORDER      -  FIRST     CLASS I
 DH0672  VERT ORDER      -  FIRST     CLASS II
 DH1182  VERT ORDER      -  SECOND    CLASS 0
 DH2734  VERT ORDER      -  SECOND    CLASS I
 HV1900  VERT ORDER      -  SECOND    CLASS II (See Below)
 DH2742  VERT ORDER      -  THIRD
 TV1034  VERT ORDER      -  THIRD ?
 DH1401  VERT ORDER      -  * POSTED, SEE BELOW
 FG0744  VERT ORDER      -  ? (See Below)
 EV3471  VERT ORDER      -  * READJUSTED, SEE BELOW
 DH6678  VERT ORDER      -  THIRD
```

"See below" notes are pointing to messages within the text of the datasheet concerning the vertical order.

```
Examples:
  HV1900.The vertical order pertains to the NGVD 29 superseded value.
  DH1401.* This is a POSTED BENCH MARK height.
  EV3471.* This is a READJUSTED BENCH MARK height.
  DH6678.The height was determined by differential leveling referenced
  DH6678.to only one NSRS GPS Height Mod determined height. Therefore
  DH6678.this height should be used with CAUTION.
```

Data Item	***FGDC Geospatial Positioning Accuracy Standard (8 lines)***
When Displayed	When the most current latitude and longitude were determined in a least squares adjustment of geodetic survey data in the NAD 83 (2007) realization or later.
Comments	The definitions of Network Accuracy and Local Accuracy are found in the FGDC Geospatial Positioning Accuracy Standards. The Network Accuracy value is displayed directly on the datasheet. The Local Accuracy listing may be extensive and therefore it is available in a linked, separate document called the "Local and Network Accuracy Data Sheet". See Appendix C. In the DSDATA format, the Network Accuracy of a mark is a value that represents the uncertainty of its coordinates with respect to the geodetic datum at the 95 percent confidence level. Since the datum is considered to be best expressed by the Continuous Operating Reference Stations (CORS), which are held fixed during the adjustment, Network accuracy values at CORS sites are considered to be infinitesimal (approach zero). Therefore, no local accuracies are displayed in DSDATA. See Appendix C for more information. Of the 8 lines which report the FGDC Geospatial Positioning Accuracy Standard in DSDATA, 7 of them never change. Only the 6^{th} line changes. In the examples below, the highlighted line is the only one that users will see change on any given datasheet. The 6^{th} line contains the following information, in order: • Horizontal (circular) 95% confidence ("2 sigma in 2 dimensions") • Ellipsoidal height 95% confidence ("2 sigma in 1 dimension") • Standard Deviation of latitude ("1 sigma in 1 dimension") • Standard Deviation of longitude ("1 sigma in 1 dimension") • Standard Deviation of ellipsoid height ("1 sigma in 1 dimension") • Correlation coefficient between latitude and longitude Of these, only the first two are required by the FGDC standard. The other four elements are considered useful by NGS and therefore displayed. Note that Network Accuracy may be too large for the mark to be used in a precision survey. Nonetheless, at this time, NGS provides such values as useful information, with a cautionary note to take care when working with such marks.

Examples of all 8 lines:

```
AF9522  Network accuracy estimates per FGDC Geospatial Positioning Accuracy
AF9522  Standards:
AF9522         FGDC (95% conf, cm)     Standard deviation (cm)     CorrNE
AF9522            Horiz  Ellip           SD_N   SD_E   SD_h      (unitless)
AF9522  -------------------------------------------------------------------
AF9522  NETWORK     0.64   2.08           0.28   0.24   1.06      0.00974253
AF9522  -------------------------------------------------------------------
AF9522  Click here for local accuracies and other accuracy information.
```

Further examples of line 6:

```
DH4086  NETWORK     1.99   1.86           0.92   0.66   0.95      0.00223690
DH4693  NETWORK    42.60 142.75          13.72  18.42  72.83     -0.67188060
DG7236  NETWORK     0.57   1.55           0.25   0.21   0.79      0.07601452
```

Data Determination Methodology

The Data Determination Methodology Section describes how values in the Current Survey Control Section and Accuracy Section were determined. Each data item may take 1 or more lines, and as a general rule, only those coordinates reported earlier in the datasheet will have a corresponding data item printed in this section.

Data Item	***Horizontal Coordinate Methodology***
When Displayed	When a latitude and longitude are displayed in the Current Survey Control section.
Comments	

Examples:

```
DG7236.The horizontal coordinates were established by GPS observations
DG7236.and adjusted by the National Geodetic Survey in June 2012.

LF0938.The horizontal coordinates were scaled from a map and have
LF0938.an estimated accuracy of +/- 6 seconds.

UV4444.The horizontal coordinates were established by classical geodetic methods
UV4444.and adjusted by the National Geodetic Survey in July 1986.

LF0803.The horizontal coordinates were established by autonomous hand held GPS
LF0803.observations and have an estimated accuracy of +/- 10 meters.

EV3471.The horizontal coordinates were established by VLBI observations
EV3471.and local terrestrial surveys and adjusted by the
EV3471.National Geodetic Survey in April 1992.

AA3512.The horizontal coordinates were determined by differentially corrected
AA3512.hand held GPS observations or other comparable positioning techniques
AA3512.and have an estimated accuracy of +/- 3 meters.

DF5754.Due to the release of the International GNSS Service (IGS) 2014
DF5754.realization of the International Terrestrial Reference Frame of 2014
DF5754.(ITRF2014), NGS reprocessed all NOAA CORS Network and some IGS stations
DF5754.using data collected between 1/1/1996 and 1/30/2017. The resulting ITRF2014
DF5754.epoch 2010.00 coordinates, referred to as Multi-Year CORS Solution 2
DF5754.(MYCS2), were transformed to NAD 83 (2011/PA11/MA11) maintaining the
DF5754.currently published epoch of 2010.00.
DF5754
DF5754.Additional information on MYCS2 is available at
DF5754.https://geodesy.noaa.gov/CORS/coords.shtml
```

Data Item	***Horizontal Datum Information (possibly including epoch)***
When Displayed	When the most current latitude and longitude is in either the NAD 83(CORS96/MARP00/PACP00), NAD 83(NSRS2007) or NAD 83(2011/MA11/PA11) realizations

Comments	Occasionally, there will be an additional line like this:
	
	`AA4394.The horizontal coordinates are valid at the epoch date displayed above`
	`AA4394.which is a decimal equivalence of Year/Month/Day.`

Examples:

```
DE6217.The datum tag of NAD 83(CORS) is equivalent to NAD 83(CORS96).

FA3373.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
FA3373.See www.ngs.noaa.gov/web/surveys/NSRS2007 for more information.

UW7975.NAD 83(2011) refers to NAD 83 coordinates where the reference
UW7975.frame has been affixed to the stable North American tectonic plate. See
UW7975.NA2011 for more information.

AA4394.NAD 83(MA11) refers to NAD 83 coordinates where the reference
AA4394.frame has been affixed to the stable Mariana tectonic plate.

AA3563.NAD 83(PA11) refers to NAD 83 coordinates where the reference
AA3563.frame has been affixed to the stable Pacific tectonic plate.
```

Data Item	***Vertical Coordinate Methodology***
When Displayed	

Comments	Sometimes warnings are given:
	
	`LF0803.WARNING-Repeat measurements at this control monument indicate possible`
	`LF0803.vertical movement.`
	
	`LF0803.No vertical observational check was made to the station.`

Examples:

```
DG7236.The orthometric height was determined by GPS observations and a
DG7236.high-resolution geoid model.

AE8289.The orthometric height was determined by differential leveling and
AE8289.adjusted by the NATIONAL GEODETIC SURVEY
AE8289.in July 1999.
```

Data Item	***Commonality with CO-OPS Stations***
When Displayed	If a mark is or is associated with a Water Level Mark, a Tidal Bench Mark, or is a Vertical Datum point.
Comments	There should be at least one Vertical Mark Number (VM #) for the mark.

Examples:

```
AE8289.This Water Level Mark is designated as VM 13392
AE8289.by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.

CJ0500.This Tidal Bench Mark is designated as VM 4064
CJ0500.by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
```

Data Item	***Photograph Notice***
When Displayed	When photographs are available for the mark.
Comments	
Examples: `MC1833. Click photographs - Photos may exist for this station.`	

Data Item	***Cartesian Coordinate Methodology***
When Displayed	When adjusted Horizontal Position and Ellipsoid Height are available.
Comments	These values represent earth-centered earth-fixed coordinates, where the X axis follows zero degrees longitude, the Z axis follows positive 90 degrees latitude and the Y axis completes a right hand system.

Examples:
`DG7236.The X, Y, and Z were computed from the position and the ellipsoidal ht.`
`DE6217.The XYZ, and position/ellipsoidal ht. are equivalent.`	

Data Item	***Laplace Correction Methodology***
When Displayed	For stations that have an adjusted position and that are within areas that have a geoid model with a derived vertical deflection model.
Comments	The Laplace correction is the quantity which, when added to an Astronomic azimuth, yields a geodetic azimuth. The simplified Laplace equation, which assumes horizontal lines of sight (cotangent of zenith angle ~ zero) and which assumes a clockwise reference frame during model development is: LAPLACE CORR = (a - A) ABBREVIATION DEFINITION = (eta) * tan(geodetic latitude) where: a = Geodetic azimuth A = Astronomic azimuth eta = Deflection of the vertical in the prime-vertical plane, an east-west component. The reader is cautioned that the Laplace equation has also been derived by others using a counterclockwise reference frame, which leads to subtracting the Laplace correction from the astronomic azimuth to yield a geodetic azimuth: Laplace corr = (A - a). However, NGS uses a clockwise reference frame.
Examples: `AE8289.The Laplace correction was computed from DEFLEC12B derived deflections.`	

Data Item	***Ellipsoid Height Methodology***
When Displayed	When an ellipsoid height is displayed in the Current Survey Control section.
Comments	Currently, only one ellipsoid height in the NGS IDB is determined with a method other than by GPS observations.

Examples:

```
AE8289.The ellipsoidal height was determined by GPS observations
AE8289.and is referenced to NAD 83.
HV4442.The ellipsoidal height was determined by classical geodetic methods
HV4442.and is referenced to NAD 83.
```

Data Item	***Dynamic Height Methodology***
When Displayed	For stations with an NAVD88 height and Modeled Gravity.
Comments	The dynamic height of a benchmark is the height at a reference latitude of the geopotential surface through the benchmark. This value is of interest because two stations with different orthometric heights may have similar geopotential due to undulations of the geopotential reference surface (geoid). The source of a dynamic height is always computed. The reference latitude for the United States is North 45 degrees. Dynamic heights were computed from geopotential heights (geopotential numbers) which were obtained for all bench marks in the general adjustment of the North American Vertical Datum of 1988 (NAVD88). A dynamic height referenced to the International Great Lakes Datum of 1985 is then obtained by dividing the adjusted NAVD88 geopotential height of a bench mark by the normal gravity value (G) computed on the Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45 degrees latitude (G = 980.6199 gal). A related unit for measuring geopotential is the geopotential number (C), which was adopted by the IAG in 1955. The geopotential number equals the dynamic height multiplied by the normal gravity at the reference latitude: C = H(dynamic) * gamma(ref). The geopotential number (C) is measured in geopotential units (g.p.u.), where: 1 g.p.u. = 1 kgal meter = 1000 gal meter. Since local gravity near sea level is approximately 0.98 kgal, the magnitude of geopotential numbers (C) are approximately that of orthometric height in meters, which leads to better intuitive understanding.

Examples:

```
AE8289.The dynamic height is computed by dividing the NAVD 88
AE8289.geopotential number by the normal gravity value computed on the
AE8289.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
AE8289.degrees latitude (g = 980.6199 gals.).
```

Data Item	***Modeled Gravity Methodology***
When Displayed	When Available
Comments	The interpolated gravity value which was used in the NAVD 88 general adjustment.
Examples: `AE8289.The modeled gravity was interpolated from observed gravity values.`	

After all is said and done, there still are numerous special messages which appear in DSDATA formatted datasheets which cannot easily be categorized as above. A few examples should serve to make the point without attempting to be exhaustive:

```
DE7243.The current NAD 83 position and ellipsoid height are consistent
DE7243.with AMERICAN SAMOA CORS ASPA coordinates revised in February 2013
DE7243.to account for displacement due to the September 29, 2009 Samoa
DE7243.Island earthquake.

DE7243.The PID for the ASPA CORS ARP is AJ5871.

MC1594.This mark is at Fremont Airport (14G)
```

Projections

The Projections Section displays planar coordinates for the mark, using a mathematical projection applied to the curvilinear (geodetic) coordinates seen earlier. Each data item appears in order, and addresses the three projections which are currently part of the DSDATA format: State Plane Coordinates (SPC), Universal Transverse Mercator (UTM) and U.S. National Grid (USNG).

Data Item	***Projection Header***
When Displayed	Sometimes…sometimes not…
Comments	

Examples:
`LF1400. The following values were computed from the NAD 83(1996) position.`
`UW8031. The following values were computed from the NAD 83(1986) position.`
`DK4055. The following values were computed from the NAD 83(2011) position.`
`DE6217. The following values were computed from the NAD 83(CORS) position.`	

Data Item	***State Plane Coordinates***
When Displayed	As long as latitude and longitude are not SCALED or HD_HELD
Comments	If the mark is near the boundary of a zone, then two SPCs will be given. The first will be for the zone in which the mark is, and the second for the neighboring zone. Coordinates are given first in meters and then feet (either U.S. Survey Feet or International Feet[2], depending on the legislation of the particular state). Scale Factor multiplied by ellipsoid distance equals grid distance. Convergence is also known as the mapping angle. Convergence plus grid azimuth yields geodetic azimuth. The second-term correction known as the Arc-to-Chord correction has not been included in the convergence. Scaled SPC values that are provided for stations which do not have adjusted horizontal control have no digits to the right of the decimal. Scaled SPC do not report a Scale Factor or Convergence, but report an Estimated Accuracy.

Examples:

```
JU3840;                     North         East      Units Scale Factor Converg.
JU3840;SPC DE      -    183,141.545   168,077.314   MT   1.00000754   -0 14 14.4
JU3840;SPC DE      -    600,856.89    551,433.65   sFT   1.00000754   -0 14 14.4
JU3840;SPC MD      -    220,765.451   503,974.763   MT   1.00004091   +0 45 37.1
JU3840;SPC MD      -    724,294.65  1,653,457.20   sFT   1.00004091   +0 45 37.1
LF1400;                     North         East      Units Scale Factor Converg.
LF1400;SPC IA S    -     77,345.066   314,791.926   MT   0.99999014   -1 26 35.2
LF1400;SPC IA S    -    253,756.27  1,032,779.84   sFT   0.99999014   -1 26 35.2
```

Data Item	***UTM Coordinates***
When Displayed	UTM zones are available worldwide, but coordinates are shown only for those stations with horizontal control.
Comments	UTM units are always in meters(MT).

Examples:

```
JU3840;UTM  18     - 4,389,115.247   432,341.668   MT   0.99965636   -0 30 11.6
LF1400;UTM  15     - 4,506,216.859   272,575.546   MT   1.00023667   -1 45 16.5
```

[2] See Appendix D

Data Item	***U.S. National Grid Coordinates***
When Displayed	When available.
Comments	The U.S. National Grid System is an alpha-numeric reference system that overlays the UTM coordinate system. It is a Federal Geographic Data Committee (FGDC) standard developed to improve public safety and commerce, as well as aid the casual GPS user. The USNG provides an easy to use geo-address system for identifying and determining locations with the help of a USNG gridded map and/or a USNG enabled GPS system. To learn how to read USNG coordinates see: http://www.fgdc.gov/usng/how-to-read-usng/index_html and follow the link "US National Grid (USNG)" in the second paragraph. For further information about the U.S. National Grid System, see the Federal Geographic Data Committee's Standard for the United States Nation Grid at: http://www.fgdc.gov/usng and select paper fgdc_std_011_2001_usng.pdf
Examples: LF0803_U.S. NATIONAL GRID SPATIAL ADDRESS: 15TTE7465897088(NAD 83)	

Azimuth Marks

The Azimuth Marks Section contains information about other marks nearby, to which an azimuth has been determined from the mark. Because some marks do not have any corresponding azimuth marks, this entire section is sometimes completely absent. When it is provided, there are always exactly two data items: The Primary Azimuth Mark and the Reference Objects (sometimes called the "box score" for the ASCII box which surrounds the information). All azimuths are referenced clockwise from north.

Data Item	***Primary Azimuth Mark***
When Displayed	Whenever a primary azimuth mark exists for this mark
Comments	If the mark is near the boundary of a zone, two SPCs will be given. The first will be for the zone in which the mark is, the second for the neighboring zone. Coordinates are given first in meters and then feet (either U.S. Survey Feet or International Feet[3], depending on the legislation of the particular state). Similarly, when near the border of a UTM zone, the coordinates of both the actual zone and neighboring zone will be given. The grid azimuth applies to the specified map projection only.

Examples:

```
JE1230:                 Primary Azimuth Mark                 Grid Az
JE1230:SPC KS N     -   PIPE AZ MK 2                         184 24 32.9
JE1230:SPC KS S     -   PIPE AZ MK 2                         184 08 38.2
JE1230:UTM  15      -   PIPE AZ MK 2                         187 33 41.3

KE0888:                 Primary Azimuth Mark                 Grid Az
KE0888:SPC KS N     -   D 345                                268 39 59.9
KE0888:UTM  15      -   D 345                                271 49 24.8
KE0888:UTM  14      -   D 345                                268 02 26.9

KE0906:                 Primary Azimuth Mark                 Grid Az
KE0906:SPC KS N     -   TOPEKA JCT SW BELL TEL TOWER         065 13 10.9
KE0906:UTM  15      -   TOPEKA JCT SW BELL TEL TOWER         068 22 35.1
```

[3] See Appendix D

Data Item	***Reference Objects(aka "Box Score")***
When Displayed	Whenever a primary azimuth mark exists for this mark
Comments	

Examples:

```
JE1230|---------------------------------------------------------------------|
JE1230| PID    Reference Object                     Distance      Geod. Az  |
JE1230|                                                           dddmmss.s |
JE1230| JE1233 PIPE 2 RM 3                                        00053     |
JE1230| JE1234 PIPE 2 RM 4                                        08453     |
JE1230| JE1236 PIPE AZ MK 2                                       1855221.4 |
JE1230| JE1229 PIPE                                 49.043 METERS 20828     |
JE1230| JE1768 PAULINE CULLEN VILLAGE TANK         APPROX. 2.8 KM 3285757.8 |
JE1230|---------------------------------------------------------------------|

KE0888|---------------------------------------------------------------------|
KE0888| PID    Reference Object                     Distance      Geod. Az  |
KE0888|                                                           dddmmss.s |
KE0888| KE0889 VASSAR RM 1                          11.755 METERS 04957     |
KE0888| KE1258 TOPEKA TV STA KTSB TOWER            APPROX.13.4 KM 0732001.8 |
KE0888| KE1256 TOPEKA TV STA KTWU MAST             APPROX.14.7 KM 0872426.8 |
KE0888| KE1259 TOPEKA RURAL DIST 2 TANK            APPROX.10.3 KM 0962057.5 |
KE0888| KE0887 VASSAR RM 2                          12.469 METERS 26856     |
KE0888| KE0880 D 345                                              2695826.8 |
KE0888|---------------------------------------------------------------------|

KE0906|---------------------------------------------------------------------|
KE0906| PID    Reference Object                     Distance      Geod. Az  |
KE0906|                                                           dddmmss.s |
KE0906| KE1256 TOPEKA TV STA KTWU MAST             APPROX. 2.1 KM 0104007.3 |
KE0906| KE1252 TOPEKA SECURITY ASSN FLAGPOLE       APPROX. 2.1 KM 0251155.0 |
KE0906| KE1241 TOPEKA KANS HWY PATROL TOWER        APPROX. 4.6 KM 0593815.4 |
KE0906| KE1238 TOPEKA JCT SW BELL TEL TOWER        APPROX. 4.9 KM 0663754.3 |
KE0906| KE0907 WEST RM 1                             9.221 METERS 13428     |
KE0906| KE0905 WEST RM 2                             9.791 METERS 31334     |
KE0906|---------------------------------------------------------------------|
```

Superseded Survey Control

The Superseded Survey Control Section contains information about coordinates on a mark which were previously authoritative, but which have been superseded by new information. Superseded data is provided for informational purposes only and should not be used as geodetic control. Even if there is no superseded data, this section will still appear, but with information that no superseded data is available. Each data item represents one type of superseded control coordinate set. Data items may appear multiple times as that control coordinate set is superseded.

Format is similar to 'Current Survey Control' but is not marked with '*' in column 8.

At the beginning of this section, a blank line, followed by a header and then another blank line will be printed, as such:

```
AI4422
AI4422                            SUPERSEDED SURVEY CONTROL
AI4422
```

After these lines the actual data items will be displayed in chronological order. However, if there is not any superseded control for this mark, a single line will be printed:

```
AJ1997.No superseded survey control is available for this station.
```

If there is at least one superseded control value, then it will be in one of the data items below.

Data Item	***Latitude and Longitude***
When Displayed	If there is at least one superseded control value, then it will be in one of the data items below.
Comments	Listed are the PID, followed by the horizontal datum and possibly realization of that datum to which the latitude and longitude refer. Next, after a dash, are the geodetic latitude and longitude of the mark, always presented as integer degrees, integer minutes and decimal seconds and a hemisphere identifier. Next on this line is the method by which these coordinates were determined, followed by a possible epoch date for which the latitude and longitude are considered valid. Lastly, the order of the latitude and longitude is listed (note, order is no longer used or maintained. A 0 signifies a position determined in the NAD 83 (2007) adjustment or later.) A c signifies a CORS position determined by the National Geodetic Survey. It should be noted that scaled and hand held positions rarely show up in superseded control as the positions are automatically removed from the IDB when an adjusted positions is loaded. The methods can be:

Method	**Description**	**Decimal Places**
AD	Adjusted - A Least squares adjustment of geodetic survey data.	5

Examples:

```
HV4442  NAD 83(2011)-  38 53 22.08241(N)   077 02 06.86507(W)  AD(2010.00)  0
HV4442  NAD 83(2007)-  38 53 22.08269(N)   077 02 06.86575(W)  AD(2002.00)  0
HV4442  NAD 83(1993)-  38 53 22.08258(N)   077 02 06.86520(W)  AD(        )  1
HV4442  NAD 83(1993)-  38 53 22.08377(N)   077 02 06.86378(W)  AD(        )  1
HV4442  NAD 83(1991)-  38 53 22.08253(N)   077 02 06.86514(W)  AD(        )  1
HV4442  NAD 83(1986)-  38 53 22.08215(N)   077 02 06.87581(W)  AD(        )  1
HV4442  NAD 27      -  38 53 21.68140(N)   077 02 07.95500(W)  AD(        )  1
HV4442  USSD        -  38 53 22.01200(N)   077 02 07.78200(W)  AD(        )  3
DO5451  NAD 83(2011)-  43 40 52.06776(N)   070 27 03.72437(W)  AD(2010.00)  c
```

Data Item	***Ellipsoid Height***
When Displayed	If there is at least one superseded control value, then it will be in one of the data items below.
Comments	Listed are the PID, followed by "ELLIP H". Next comes the date to which the ellipsoid height was adjusted. Next is the ellipsoid height of the mark, always presented as a real number followed by its units followed by the method by which this coordinate was determined. Finally, the order and class (1, 2, c) of the height may be listed. A **c** order and **c** class signifies that the height is a **CORS** determined by the National Geodetic Survey. (note, order/class is no longer used or maintained since the NAD 83 (2007) adjustment) The methods can be:

Method	Description	Decimal Places
GP	Obtained from GPS observations and adjusted in a Least squares adjustment.	3

Examples:

```
HD1334  ELLIP H (02/10/07)  313.502  (m)                GP(2002.00)
HD1334  ELLIP H (02/17/00)  313.588  (m)                GP(       ) 4 1
HV4442  ELLIP H (06/27/12)  149.151  (m)                GP(2010.00)
HV4442  ELLIP H (10/28/02)  149.201  (m)                GP(       ) 5 2
HV1847  ELLIP H (02/10/07)  -23.610  (m)                GP(2002.00)
HV1847  ELLIP H (06/29/94)  -23.626  (m)                GP(       ) 4 1
HV1847  ELLIP H (12/31/92)  -23.659  (m)                GP(       ) 4 2
DO5451  ELLIP H (03/??/13)   89.961  (m)                GP(2010.00) c c
```

Data Item	***Orthometric Height***
When Displayed	If there is at least one superseded control value, then it will be in one of the data items below.
Comments	Listed are the PID followed by the vertical datum to which the orthometric height refers. Next is the date in which the height was adjusted, followed by the orthometric height of the mark, always presented as a real number in meters then a real number in feet unless the height was determined by GPS. If this is the case the geoid model used to determine the height is listed. Finally, on this line is the method by which this coordinate was determined and its order and type if present. If the height is in a known subsidence region and took part in an area readjustment, the epoch date of the superseded height could follow. (Note: the method labeled LEVELING does not imply leveling submitted to NGS. Rather it was used as control in a horizontal (usually GPS) data project.)

Examples:

```
HV1847  NAVD 88 (09/11/02)    8.4    (m)  GEOID99 model used   GPS OBS
HV1847  NAVD 88 (04/04/94)    8.38   (m)          27.5    (f) LEVELING    3
HV1847  NAVD 88 (02/03/93)    8.384  (m)          27.51   (f) SUPERSEDED  1 0
HV1847  NGVD 29 (08/12/92)    8.617  (m)          28.27   (f) ADJUSTED    1 0
HV1847  NGVD 29 (??/??/87)    8.625  (m)          28.30   (f) SUPERSEDED  1 0
HV1823  NGVD 29 (??/??/??)   45.774  (m)         150.18   (f) ADJUSTED
HV1823  NGVD 29 (07/19/86)   45.77   (m)         150.2    (f) LEVELING    3
HV2025  NGVD 29 (??/??/??)    7.028  (m)          23.06   (f) ADJUSTED    1 2
AI4425  NAVD 88 (04/25/01)   12.062  (m)          39.57   (f) SUPERSEDED  1 2
BH1890  NAVD 88 (03/12/08)    1.40   (m)  UNKNOWN model used   GP(2006.81)
BH1890  NAVD 88 (06/22/05)    1.43   (m)  GEOID03 model used   GP(2004.65)
```

At the end of the Superseded Control Section, users will find these closing lines, even if there are no NAD 27 nor NGVD 29 data in this section.

```
HV2025.Superseded values are not recommended for survey control.
HV2025
HV2025.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
HV2025.See file dsdata.txt to determine how the superseded data were derived.
```

Monumentation

The Monumentation Section contains information about the physical characteristics of the mark itself and its immediate surroundings.

There is no header for the Monumentation Section, although there will be a blank line separating it from the Superseded Survey Control Section (above) and the History Section (below).

Data Item	***Marker Type***
When Displayed	If a marker type exists in the NGS IDB
Comments	See FGCS Bluebook, Annex P section A.12 for a listing of all marker types.

Examples:

```
GB1392_MARKER: DB = BENCH MARK DISK
GB1311_MARKER: DS = TRIANGULATION STATION DISK
GB1313_MARKER: DR = REFERENCE MARK DISK
GB1367_MARKER: B = BOLT
GB1309_MARKER: DD = SURVEY DISK
AV6166_MARKER: W = UNMONUMENTED
```

Data Item	***Setting***
When Displayed	If the setting exists in the NGSIDB
Comments	See FGCS Bluebook, Annex P section A.29 for a listing of all setting (class) codes.

Examples:

```
GB1392_SETTING: 66 = SET IN ROCK OUTCROP
GB1381_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
GB1313_SETTING: 30 = SET IN A LIGHT STRUCTURE
GB2329_SETTING: 31 = SET IN A PAVEMENT SUCH AS STREET, SIDEWALK, CURB, ETC.
GB1301_SETTING: 36 = SET IN A MASSIVE STRUCTURE
```

Data Item	***Stamping***
When Displayed	If the stamping exists in the NGSIDB
Comments	These are the characters actually stamped upon the mark itself or upon a lid covering the mark and should be used in the identification of actual marks on site. The Stamping sometimes reflects the Designation, but there are frequent subtle differences, such as spaces between letters, or dates that may not be in the Designation, etc.

Examples:

```
GB1392_STAMPING: A 248 1951 1014.027
GB1311_STAMPING: ALBANY 1935 961.609
DO1560_STAMPING: USCG 15 BOUNDARY POINT 1992
JY0706_STAMPING: 39
JY0804_STAMPING: ELEV 803.82 BM
AB6022_STAMPING: OSU A 1995
```

Data Item	***Mark Logo***
When Displayed	Either when (a) there is a logo on the mark and that logo has been identified in the NGS IDB or (b) there is no logo on the mark, and that fact is identified in the NGS IDB.
Comments	
Examples: AB3306_MARK LOGO: NGS KZ2034_MARK LOGO: USE KZ2172_MARK LOGO: CGS DE5561_MARK LOGO: NONE	

Data Item	***Mark Setting Projection***
When Displayed	If the projection exists in the NGSIDB
Comments	Tells the user how much the mark projects above or is recessed from its setting
Examples: DO1124_PROJECTION: FLUSH DG7168_PROJECTION: RECESSED 5 CENTIMETERS JY1558_PROJECTION: PROJECTING 2 CENTIMETERS JY0878_PROJECTION: PROJECTING 8 CENTIMETERS	

Data Item	***Magnetic Materials***
When Displayed	If this information is in the NGSIDB
Comments	Tells the user whether the mark contains any ferrous materials See FGCS Bluebook, Annex P section A.10 for a listing of all magnetic property codes.
Examples: AB6022_MAGNETIC: N = NO MAGNETIC MATERIAL DG8016_MAGNETIC: R = STEEL ROD IMBEDDED IN MONUMENT DE5563_MAGNETIC: M = MARKER EQUIPPED WITH BAR MAGNET DE5469_MAGNETIC: I = MARKER IS A STEEL ROD DO1554_MAGNETIC: O = OTHER; SEE DESCRIPTION DG7181_MAGNETIC: S = STEEL SPIKE IMBEDDED IN MONUMENT	

Data Item	***Stability***
When Displayed	If this information is in the NGSIDB
Comments	An indicator as to whether the point is likely to move in space, either horizontally or vertically. Each line begins with "_STABILITY", unless there are multiple lines in which case it will begin with "+STABILITY". See FGCS Bluebook, Annex P section A.36 for a listing of all vertical stability codes.

Examples:

```
GB1496_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
GB1496+STABILITY: POSITION/ELEVATION WELL

GB1301_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

GB1323_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
GB1323+STABILITY: SURFACE MOTION
```

Data Item	***Satellite Visibility (Sky View)***
When Displayed	If this information exists in the NGSIDB
Comments	An indication as to whether the mark has a clear view of the sky (for determining whether GNSS satellites can be used to position the mark)

Examples:

```
KZ1900_SATELLITE: THE SITE LOCATION WAS REPORTED AS NOT SUITABLE FOR
KZ1900+SATELLITE: SATELLITE OBSERVATIONS - June 28, 2014

JY0717_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
JY0717+SATELLITE: SATELLITE OBSERVATIONS - August 01, 2009
```

Data Item	***Rod/Pipe Depth***
When Displayed	If this information exists in the NGSIDB
Comments	

Examples:

```
AT0760_ROD/PIPE-DEPTH: 25.6 meters
BH1890_ROD/PIPE-DEPTH: 2011 meters
```

Data Item	***Sleeve Depth***
When Displayed	If this information exists in the NGSIDB
Comments	This information is often given in the setting section

Examples:

```
AT0760_SLEEVE-DEPTH   : 18.2 meters
```

History

The History Section contains a chronological listing of the life of the mark, from its creation (monumentation) through each attempt to recover the mark that has been reported to NGS. There are only two data items, the monumentation (always just 1 line) and recovery attempts (multiple lines, one for each attempted recovery).

Prior to the monumentation line, there will always be a blank line followed by a header line, as such:

```
HD0697
HD0697  HISTORY     - Date     Condition        Report By
```

Data Item	***Monumentation Line***
When Displayed	Always
Comments	"Monumented" should be taken to mean "the event wherein this feature was first used as a survey mark" and not necessarily "the construction of the mark". If the date of the monumentation is not known this line will still be shown, but with "UNK" for its date.

Examples:

```
HD0697  HISTORY     - 1934     MONUMENTED       MOGS
HD1490  HISTORY     - 1989     MONUMENTED       NGS
HD0650  HISTORY     - 1928     MONUMENTED       CGS
AC7151  HISTORY     - 1989     MONUMENTED       MODNR
HV2025  HISTORY     - UNK      MONUMENTED       CGS
AJ2001  HISTORY     - UNK      MONUMENTED       RBNF
DI8986  HISTORY     - 1863     MONUMENTED       COASUR
```

Data Item	***Recovery Lines***
When Displayed	Whenever an attempted recovery was reported to NGS.
Comments	Only when there is actual evidence of its destruction will a mark be labeled as "destroyed". Otherwise, it will be listed as "not found". This is important as marks can be overlooked and found at later dates. See FGCS Bluebook, Annex P section A.2 for a listing of all possible condition codes.

Examples:

```
HD0697  HISTORY     - 1935     GOOD             CGS
HD0697  HISTORY     - 20010220 MARK NOT FOUND   SKW

HD0650  HISTORY     - 1959     MARK NOT FOUND   USGS
HD0650  HISTORY     - 19891011 GOOD             NGS
HD0650  HISTORY     - 20070913 GOOD             GEOCAC

AC7151  HISTORY     - 20090121 POOR             INDIV
AC7151  HISTORY     - 20090505 GOOD             MODNR

AJ2001  HISTORY     - 20000510 GOOD             NGS
AJ2001  HISTORY     - 20010301 MARK NOT FOUND   NGS
AJ2001  HISTORY     - 20140408 SEE DESCRIPTION  NGS
```

Description and Recovery

The Description and Recovery Section contains details which expand upon the History Section (above). Whereas the History Section merely lists one word descriptions (MONUMENTED or GOOD or POOR etc.), entire paragraphs of descriptive text about the mark are found in this section. There are two data items: the station description (1 entry) and station recoveries (multiple entries; 1 per recovery).

Prior to the Station Description data item, a blank line and a header line, and another blank line will be printed, as such:

```
HV1331
HV1331                              STATION DESCRIPTION
HV1331
```

Data Item	***Station Description***
When Displayed	If original description is available

Comments	The description often dates to the date of monumentation (see History Section, above). However it sometimes dates to the first visit by NGS (or C&GS, etc.) to the mark. The description format has evolved through time. The authoritative reference for descriptions is the FGCS bluebook, Annex P. A possible current format is as follows: The first line will have "DESCRIBED BY..." followed by the agency who submitted the description. The first paragraph may give the general location of the station and the landowner and/or the person to contact for station access. The second paragraph may give a "to-reach". The to-reach begins at a well-known location that will remain through time, such as the junction of state, federal or interstate highways. Legs along the route are given as right or left turn, compass direction followed, road name (if any), distance traveled in kilometers or miles and leg terminating feature. The to-reach often ends with the phrase "to the station on the left/right". If a third paragraph is present it contains details of the survey mark that is observed, then the monument in which the mark is set, then ties are given FROM features in the vicinity of the station TO the station, with horizontal distances reported to the closest 0.1 m (0.1 ft.). A vertical tie is encouraged to assist with recovery of stations that may become buried. A fourth paragraph may be added to include notes, such as obstructions to GPS visibility or hazards of station occupation. There is no limit to the length of the description. Some are very short, others very long. Many pre-1900 descriptions are either missing entirely or were digitized by hand from very short, hand-written descriptions and do not fulfill the general purpose of a description.

Examples:

```
HV1877'DESCRIBED BY COAST AND GEODETIC SURVEY 1926
HV1877'AT WASHINGTON.
HV1877'AT WASHINGTON, ON K STREET NORTHWEST, WEST OF KEY BRIODGE, AT A
HV1877'STONE ARCH OVER THE STREET (THE ONLY REMAINS OF THE OLD AQUEDUCT
HV1877'BRIDGE), AT THE WEST WING WALL OF THE NORTH ABUTMENT, ON THE
HV1877'WATER TABLE BELOW THE FORMER CANAL LEVEL, 11 FEET FROM THE WEST
HV1877'END OF THE WING WALL, AND ABOUT 7 FEET BELOW THE TOP OF THE WALL.
HV1877'THE BOTTOM OF A SQUARE HOLE.

HV4442'DESCRIBED BY COAST AND GEODETIC SURVEY 1913 (OBF)
HV4442'STATION IS CENTER OF TIP OF WASHINGTON MONUMENT.

HD0697'DESCRIBED BY COAST AND GEODETIC SURVEY 1935
HD0697'2.5 MI W FROM ELWOOD.
HD0697'2.5 MILES WEST ALONG THE ST. LOUIS-SAN FRANCISCO RAILWAY FROM
HD0697'ELWOOD, GREENE COUNTY, 31 POLES EAST OF MILEPOST 191, AND 12
HD0697'YARDS SOUTH OF THE CENTERLINE OF THE TRACK.  A STATE SURVEY
HD0697'STANDARD DISK, STAMPED 101 1934 AND SET IN THE TOP OF A CONCRETE
HD0697'POST.
```

Data Item	***Station Recoveries***
When Displayed	Whenever a station recovery attempt was reported to NGS

Comments	Recoveries of the mark in good condition tend to be short, but when deviations are noted from either the station description or a previous station recovery, detailed text is provided.
	
	Every Recovery begins with its own dated header lines (blank/header/blank) as such:
	`CA2250`
	`CA2250                          STATION RECOVERY (1940)`
	`CA2250`
	
	After these header lines will be one line beginning with "RECOVERY NOTE BY..." followed by the agency who submitted the recovery including the name of the group, the year (again) and the initials of the person's name who wrote the recovery text. Following that will be the actual recovery note.

Examples:

```
HD1490'RECOVERY NOTE BY US POWER SQUADRON 1991 (LDM)
HD1490'RECOVERED IN GOOD CONDITION.

HV1400'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2001 (RWA)
HV1400'RECOVERED AS DESCRIBED.

HV1903'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1999 (DW)
HV1903'BLDG. IS NOW THE LEVINE SCHOOL OF MUSIC, SALLIE MAE HALL.

HV1823'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1946 (JMN)
HV1823'FENCE HAS BEEN MOVED ABOUT 75 FEET OUTWARD FROM RESERVOIR.
HV1823'STATION IS 20 FEET N OF THE S EDGE OF THE TOP OF THE BANK,
HV1823'AND 20 FEET E OF THE W EDGE OF THE TOP OF THE BANK.  OTHERWISE,
HV1823'AS DESCRIBED.  STATION IS IN GOOD CONDITION.
```

Appendix A: Horizontal Datums and Datum Realizations

There have been three nationwide horizontal datums in the National Spatial Reference System since 1900. They are:

Name	Abbreviation	Year first established
U.S. Standard Datum[4]	USSD	1901
North American Datum of 1927	NAD 27	1933
North American Datum of 1983	NAD 83	1986

While the first two of these were occasionally expanded or corrected in small portions, the datum remained the same on a large scale. All three of these datums were established using terrestrial line-of-sight techniques, although some early space geodetic techniques (pre-GPS) were used in NAD 83. The rise of GPS almost immediately after the initial release of NAD 83 meant (a) that errors in NAD 83 were immediately being detected and (b) those errors could be corrected with much less effort using GPS than the initial line-of-sight surveys of NAD 83 itself.

Therefore, starting in 1990, NGS began performing state-by-state GPS surveys in an attempt to improve NAD 83. Originally, these surveys were called High Precision GPS networks (HPGNs) but soon after a new acronym was settled on: High Accuracy Reference Network (HARN).   State HARNs proved to be a significant improvement over the original datum realization and an important resource for all users of GPS positioning (Purcell 2007). The field observations for the HARNs began in Tennessee in 1989 and concluded in Indiana in 1997.

As NGS finished each survey, the resulting HARNs latitude, longitude and ellipsoid heights were published. Then all horizontal data in the NGS IDB, both classical and GPS, were adjusted to the higher order stations. A technique to minimize inconsistencies across state boundaries was employed. These new coordinates referenced to the NAD 83 were now published using a parenthetical year, such as: "NAD 83(1990)." That parenthetical year went by various names, but ultimately came to be called a "datum tag." Once the use of datum tags became policy at NGS, the original release of NAD 83 came to be called "NAD 83(1986)" to reflect its original release date.

As the HARNs went on, another new effort was taking shape: the establishment of the CORS (Continuously Operating Reference Station) network. NGS soon realized the strength of these "active" control stations (as opposed to the traditional survey mark which is "passive" in that it does not broadcast any information about itself). Additionally, the use of GPS for height determination had progressed. The use of GPS with an accurate geoid model to determine better orthometric heights was being quickly developed. With these two major improvements to the use of GPS as a geodetic surveying tool, NGS decided to engage in another round of state-by-state surveys, with the explicit intent of determining accurate heights. These surveys were called the Federal Base Network (FBN) surveys. Upon the completion of each of these, another statewide adjustment was performed using the FBNs as control. This adjustment was performed on GPS observations alone; the classical surveys were not to be included as the shift in coordinates would not be detectable for these stations.

[4] After being expanded into Mexico and Canada, this datum was adopted by all three countries and by mutual agreement was re-named the "North American Datum" in 1913. This was not a new datum, just a new name and expansion of the USSD.

Like the HARNs, this could mean the coordinates associated with an FBN adjustment would be given a datum tag. Unfortunately, it wasn't always that simple.

It was not uncommon for the following events to have occurred at NGS:

1) NGS performed a state-wide readjustment (e.g. 1992), and published coordinates of latitude and longitude as "NAD 83(1992)" and ellipsoid heights on the GPS stations.
2) NGS later performed an FBN survey in the same state (e.g. 2001) and did a new adjustment. For the most part, a new datum tag and its coordinates were only adopted if the majority of the published stations within the adjustment shifted in latitude/longitude and/or ellipsoid height by 5cm or more; a limit established by the NGS Executive Steering Committee to minimize unwarranted coordinate updates in anticipation of the upcoming general National Readjustment.

The datasheet would show the original datum realization such as NAD 83(1992) of the latitude and longitude *and* ellipsoid for those states whose FBN results were within the 5 cm shift criteria. For those states adopting new FBN coordinates, the datasheet would have the FBN datum realization, NAD 83(2001) for example. There were instances where only a few stations' shifts exceeded 5 cm and NGS only updated those few station coordinates rather than the entire state. In those instances the original datum tag was retained.

Published coordinates display only one datum tag. Therefore, to accurately discuss what occurred between 1986 and 2007 at a specific station is difficult. One should be extremely cautious with the term "NAD 83(YYYY)" where YYYY is anything between 1986 and 2007.

Meanwhile, a growing disconnect between passive and active control (CORS) occurred between the late 1990s and the early 2000s. The CORS coordinates, provided in the International Terrestrial Reference Frame (ITRF), were going through multiple transformations in order to provide consistent NAD83 coordinates. This resulted in CORS NAD83 coordinates known as: NAD 83 (CORS93), NAD 83 (CORS94), and the long-standing NAD 83 (CORS96) epoch (2002.00).

With NGS requiring users to tie their GPS surveys to both the published NAD83 (CORS) coordinates - and to published passive control (usually in a HARN or FBN realization) inconsistencies between these two systems were becoming apparent. As the NAD 83(CORSxx) coordinates aged and newer passives surveys were performed, it became increasingly more difficult to achieve reliable adjustment results.

Therefore, as anticipated at the beginning of the FBN statewide surveys, in 2007, NGS engaged in an adjustment of all GPS vectors existing in the NSRS for the regions of CONUS, Alaska, Puerto Rico and the U.S. Virgin Islands. 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 2003.0 in Alaska and 2007.0 in western CONUS) to obtain consistent positional coordinates for approximately 70,000 passive marks, as described in the NSRS2007 report. Rather than define a new datum, NGS chose to continue the tradition of calling this a datum realization. Breaking with tradition however, the datum tag assigned was not a year, but was rather "NSRS2007", creating "NAD 83(NSRS2007)". Despite the official name, the DSDATA formatted datasheets and other NGS products often used a shorthand version as "NAD 83(2007)". The adjustment of 2007 was NGS' first attempt to account for crustal motion in the entire nation (rather than just in the Pacific coastal states). In an attempt to bring CORS and passive control closer together, only the NAD 83(CORS96) coordinates were (ostensibly) held fixed for the adjustment. This wasn't entirely successful, but the details are too extensive for this document. Suffice to say that NAD 83(NSRS2007) and NAD 83(CORS96) are very closely related realizations, but not identical. For further information about the relationship between NAD 83(NSRS2007) and NAD 83(CORS96), please see section 11 of the GEOCON v1.0 Technical Report.

In 2011, NGS again adjusted all GPS vectors. This was driven by the adjustment of all CORS data that NGS had performed in 2010, called “MYCS1”. NGS took this opportunity to improve NSRS2007 in many ways. The regions were expanded to include Hawaii, Guam, CNMI and American Samoa. The realization of CORS and passive control were made the same and given one name, NAD 83(2011), and the epoch of all of the data in the adjustment was made 2010.0 without regard for where it was in the world.

In 2019, due to the release of the IGS14 realization of the ITRF2014 reference frame, NGS again, reprocessed the NOAA CORS Network and some IGS stations using data collected between 1/1/1996 and 1/30/17. The resulting ITRF2014 coordinates and velocities, referred to as MYCS2, were transformed to NAD 83. Due to the small changes and the upcoming 2022 new datums, the GPS vectors were not readjusted and the current reference frame NAD 83(2011) and epoch 2010.00 were retained.

On May 17, 2020, the International GNSS Service (IGS) replaced the IGS14 reference frame with the newer IGb14 GNSS geodetic reference frame. The IGb14 is aligned in origin, scale and orientation to the International Terrestrial Reference Frame of 2014 (ITRF2014), just as IGS14 was aligned with ITRF2014.

In summary, the DSDATA format shows horizontal datums and datum realizations on datasheets. Of the nationwide ones, these datums or datum realizations can be, in chronological order of their creation:

USSD
NAD 27
NAD 83(1986)
NAD 83(YYYY) where YYYY will fall between 1990 and 2001 (including all HARNs and FBNs)
NAD 83(CORS) which is short for NAD 83(CORS96)
NAD 83(2007) which is short for NAD 83(NSRS2007)
NAD 83(2011)

There have been, however, numerous regional horizontal datums over the years. Rather than give the particulars of each one, a simple list is provided so that users can interpret the datum as presented in the data sheet.

Name	Abbreviation in DSDATA format
Horizontal Datums in Alaska	
Anchorage Point Astro Datum	AKAN
Barter Island Datum of 1948	AKBA
Camp Colona 1890 Datum	AKCC
Kripniyuk Kwiklokchun Datum	AKFW
Flaxman Island Datum of 1912	AKFX
Golofnin Bay 1899 Datum	AKGO
Iliamna Astro Datum	AKIL
Mary Island Point Simpson Astro Datum	AKMI
Point Barrow Datum 1945	AKPB
Point Clarence Astro Datum	AKPC
Prince William Sound Datum	AKPW
Southeast Alaska Datum	AKSE
St. George 1897 Datum	SG1897
St. George 1952 Datum	SG1952
St. Lawrence 1952 Datum	SL1952
St. Michael 1952 Datum	SM1952
St. Paul 1897 Datum	SP1897
St. Paul 1952 Datum	SP1952
Unalaska Datum	AKUN
Valdez Datum	AKVD
Yakutat 1897 Datum	AKYA
Yukon Datum	AKYK
Horizontal Datums in CONUS	
Bessel Spheroid	USBS
California Standard Datum	USCA
Charleston and Savannah Datum	USCH
El Paso Datum	ELPS
Independent Astro Datum 1880	USIA
Missouri River Commission Datum	MORC
New Orleans Mobile Datum	USNO
Puget Sound	USPU
Vicksburg Natchez Datum	USVN
Horizontal Datums in non-CONUS	
American Samoa Datum of 1962	ASD 62
Guam Datum of 1963	GU1963
Johnston Island Datum of 1961	JI1961
Midway Astro Datum of 1961	MAD61
Old Hawaiian Datum	OLD HI
Puerto Rico Datum	PR
Wake-Eniwetok Datum of 1960	WE1960
Wake Island Astro Datum of 1952	WK1952

Appendix B: Vertical Datums

The various vertical datums encountered in the DSDATA format can be seen in the list below.

Vertical Datum	Full Name	Region
`NAVD 88`	North American Vertical Datum of 1988	CONUS and Alaska
`PRVD02`	Puerto Rico Vertical Datum of 2002	Puerto Rico
`ASVD02`	American Samoa Vertical Datum of 2002	American Samoa
`NMVD03`	Northern Marianas Vertical Datum of 2003	CNMI
`GUVD04`	Guam Vertical Datum of 2004	Guam
`VIVD09`	Virgin Islands Vertical Datum of 2009	U.S. Virgin Islands
`LMSL`	Local Mean Sea Level	Any coastal area without an official vertical datum
`NGVD 29`	National Geodetic Vertical Datum of 1929	CONUS and Alaska

Appendix C: The Local and Network Accuracy Data Sheet

Since the conclusion of the 2007 National Readjustment, NGS has published network and local accuracies for GPS stations. For publication purposes, the network accuracy of a control point is a value that represents the uncertainty of its coordinates with respect to the geodetic datum at the 95 percent confidence level. The datum is considered to be best expressed by the Continuous Operating Reference Stations (CORS). Network accuracy values at CORS sites are considered to be infinitesimal (approach zero). The Local Accuracy of a control point is a value that represents the uncertainty of its coordinates relative to other directly connected, adjacent control points at the 95-percent confidence level. This value represents the relative positional error which surveyors can expect between survey marks in a locality. It also represents an approximate average of the individual local accuracy values between this control point and other observed control points used to establish its coordinates although, in general, all of the immediately surrounding stations will not necessarily have been used in the survey which established the original coordinates.

A link is provided from the main page of the datasheet to the corresponding local accuracy page which lists all local accuracies to passive control stations directly tied to the PID.

Appendix D: U.S. Survey Foot vs International Foot

For historical reasons which will not be addressed herein, two definitions of "foot" exist, both in use in the United States and both tied to the meter. These two feet are the U.S. Survey Foot and the International Foot. As such, NGS will always identify which type of foot is being used. The conversions to meters for both types are as follows:

1 International Foot = 0.3048 meters (exact)
1 U.S. Survey Foot = 1200/3937 meters (exact)

Appendix E: Deflection and Geoid Sources

There are a variety of deflection and geoid sources which could be displayed on a datasheet in the DSDATA format. Due to space limitations, some of these sources are abbreviated. A tabular listing of both types is found below.

Deflection Sources	
Abbreviation in DSDATA	**Full Name of Source**
ADJOPERA	Adjusted Opera
DCAR97	The DCAR97 Gravimetric Deflection of the Vertical Model
DEFLEC90	The DEFLEC90 Gravimetric Deflection of the Vertical Model
DEFLEC93	The DEFLEC93 Gravimetric Deflection of the Vertical Model
DEFLEC96	The DEFLEC96 Hybrid Deflection of the Vertical Model
DEFLEC99	The DEFLEC99 Hybrid Deflection of the Vertical Model
DEFLEC09	The DEFLEC09 Hybrid Deflection of the Vertical Model
DEFLEC12A	The DEFLEC12A Hybrid Deflection of the Vertical Model
DEFLEC12B	The DEFLEC12B Hybrid Deflection of the Vertical Model
DEFLEC18	The DEFLEC18 Hybrid Deflection of the Vertical Model
DMEX97	The DMEX97 Gravimetric Deflection of the Vertical Model
LAPAZ60	Blue Book Astronomic/Laplace Azimuth 60 Record
NAD83180	NAD 83 180 Model
NAD83360	NAD 83 360 Model
OTHER	Anything not otherwise on this table
PNAD83M	Post NAD 83 180 Model
PRENAD83	Pre-NAD 83 Deflection
SCALED	Scaled (approximate)
UNADJFLD	Unadjusted Field
USDOV2009	The USDOV2009 Gravimetric Deflection of the Vertical Model
USDOV2012	The USDOV2012 Gravimetric Deflection of the Vertical Model

Geoid Sources	
Abbreviation in DSDATA	**Full Name of Source**
CARIB97	The CARIB97 model is a high resolution gravimetric geoid height model covering the region 9-28N, 86-58W. All computations were performed in the ITRF94(1996.0) reference frame. The geoid heights are relative to a geocentric GRS-80 reference ellipsoid.
EGM96	EARTH GRAVITY MODEL 96 Global Geopotential Model.
EGM08	The Earth Gravity Model 2008 Global Geopotential Model. EGM08 provides a global coverage; used as a reference field.
FFT MET	FFT Method
GEOID90	GEOID90 was the first high-resolution geoid model for the United States computed at the National Geodetic Survey. It did not contain data for Alaska, Hawaii nor Puerto Rico.
GEOID93	GEOID93 was the second high-resolution geoid model for the United States computed at the National Geodetic Survey. It contained data for CONUS, Hawaii and Puerto Rico, though Alaska was not added until the ALASKA94 model.
G96SSS	The G96SSS model is a gravimetric geoid model for the conterminous United States, suitable for scientific investigations. Geoid heights are referred to the GRS80 ellipsoid, and the computations were performed in the ITRF94(1996.0) reference frame.
GEOID96	GEOID96
GEOID99	GEOID99 is a refined model of the geoid in the United States, including Alaska, Hawaii, and Puerto Rico & the U.S. Virgin Islands, which supersedes the previous models GEOID90, GEOID93, and GEOID96.
GEOID03	GEOID03 is a refined model of the geoid in the conterminous United States (CONUS), which supersedes the previous models GEOID90, GEOID93, GEOID96, and GEOID99.
GEOID06	GEOID06 is a refined hybrid geoid mode for Alaska only. GEOID06 converts between the U.S. ellipsoidal datum, NAD 83, and the U.S. vertical datum, NAVD 88. GEOID06 is built largely on the USGG2003 gravimetric geoid.
G99SSS	G99SSS is a gravimetric geoid that served as the basis for GEOID99 within the conterminous United States only.
GEOID09	This model is intended for converting between the NAD83 ellipsoid reference frame and vertical datums NAVD88, GUVD04, ASVD02, NMVD03, PRVD02 and VIVD09.
GEOID12	GEOID12 is a refined hybrid model of the geoid in the United States and other territories, which supersedes the previous models GEOID09, GEOID06, GEOID03, GEOID99, GEOID96, GEOID93, and GEOID90. This model is intended for converting between the NAD83 ellipsoid reference frame resulting from the National Adjustment of 2011 and vertical datums NAVD88, GUVD04, ASVD02, NMVD03, PRVD02 and VIVD09.
GEOID12A	After detecting significant defects in the control data used to create GEOID12, GEOID12A was developed as a replacement.
GEOID12B	GEOID12B is identical to GEOID12A everywhere, except in Puerto Rico and Virgin island region.
GEOID18	GEOID18 is a refined hybrid model of the geoid in the United States and other territories, which supersedes the previous model, GEOID12B. This model is intended for converting between the NAD83 ellipsoid reference frame resulting from the National Adjustment of 2011 and vertical datums NAVD88, PRVD02 and VIVD09.
GEOIDXU	GEOIDX-US Hybrid GEOID
MEXICO97	The MEXICO97 model is a high resolution gravimetric geoid height model covering the region 14-33N, 119-86W. All computations were performed in the ITRF94 (1996.0) reference frame. The geoid heights are relative to a geocentric GRS-80 reference ellipsoid.
OSU89B	OSU 89B
OSU91A	OSU 91A
SCALED	Scaled, Approximate
TENN MD	Tennessee Geoid
RAPOU78	POST NAD83 180 MODEL
RAPPO78	NAD83 180 Model
RAPSU86	360 MODEL
UNADJFL	Unadjusted Field

USGG2003	USGG2003 is a gravimetric geoid that served as the basis for GEOID03 within the conterminous United States only. USGG2003 is very similar to G99SSS differing only in the use of GSFC00.1 instead of KMS98 for the offshore gravity field.
USG2006	USGG2006
USGG2009	USGG2009 refers to a NAD83 ellipsoid, centered in the ITRF00 reference frame.
USGG2012	USGG2012 is a refined gravimetric model of the geoid in the United States and other territories, which supersedes the previous models USGG2009 and USGG2003.
UNKNOWN	Other