3

DESIGN MANUAL

LAND SURVEYS

Baltimore County
Department of Public Works Design Manual

Land Surveys

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Design Manual

LAND SURVEYS

I. GENERAL

The Land Survey Division of Baltimore County is responsible for providing land surveying services to Engineering, Land Acquisition, Recreation and Parks and other agencies within Baltimore County, as well as providing management of survey services that are performed by consultants for Baltimore County. The Land Survey Division is also responsible to install and maintain a network of Survey Control points throughout the county, which are made available to the public and private sectors. Standards developed by the Land Survey Division shall be followed when performing Land Surveying on projects to be reviewed and approved by Baltimore County.

II. ABBREVIATIONS

GIS-(#xxx)	Primary Survey Control Point
BCO(#xxx)	Secondary Survey Control Point
BCMD	Baltimore County Metropolitan District
BCD	Baltimore County Datum
NAD 83	North American Datum of 1983
NGVD 29	National Geodetic Vertical Datum of 1929
NAVD 88	North American Vertical Datum of 1988
MHW	Mean High Water
NGS	National Geodetic Survey
COMAR	Code of Maryland Regulations
COBAR	Code of Baltimore County Regulations

III. SURVEYING STANDARDS

The Minimum Standards of Practice for Land Surveyors, prepared and amended by the Maryland Department of Labor, Licensing, and Regulation, Board for Professional Land Surveyors, together with any standards developed by Baltimore County, shall be used in preparing surveys that will need to be approved by Baltimore County, or part of a multi-discipline project that will need approval by Baltimore County.

IV. SURVEYING DATUMS

A. Horizontal Datums

1. BCMD
   Baltimore County has two recognized datums for horizontal survey control. During the late 1930's, Baltimore County established a primary survey network, consisting of almost 700 traverse stations, for use in defining the limits of the Baltimore County Metropolitan District. The traverse network incorporated over 30 United States Coast and Geodetic Survey markers (Now known as the National Geodetic Survey). The entire network was also

connected to the Baltimore City Survey Control System so this new control traverse could be an extension of the Baltimore City system. This traverse network has been extended throughout the entire county. This datum has been the basis of many surveys for recorded and unrecorded subdivisions, right-of-ways, utilities, etc. Although this traverse information is still available, this is no longer maintained and is not the current horizontal datum for surveys in Baltimore County.

2. NAD 83
   On July 1, 1999, COBAR specified the North American Datum of 1983 as the current horizontal datum for surveys in Baltimore County. The current network consists of two types of markers: The GIS points are mostly 3-½ inch diameter brass discs set in concrete. Many had been included into the NGS database. The GIS markers make up the County's primary network and are stamped with the station name, such as "GIS-103". Most GIS points have an azimuth marker by the station so the two points will allow for the use of conventional surveying equipment. The BCO points can be spikes, nails, cross-cuts, iron bars, etc. and make up the secondary horizontal control network. The BCO points are typically set as two intervisible markers for use with conventional surveying equipment.

3. Conversions
   Due to the differences between the way the two systems were established, BCMD being a plane coordinate system and NAD being a geodetic system, as well as other factors, there is NO survey grade conversion which can be applied to convert from one system to the other. However, Baltimore County has developed spreadsheets to create rough mapping grade coordinates (< 0.1' to 3.0') between the two systems. Contact the Land Survey Division for this information. Actual field survey ties between the two systems must be performed to determine a local conversion for any particular site.

B. Vertical Datums

1. BCD
   Baltimore County currently has two recognized datums for vertical survey control. As part of the survey previously mentioned, (during the late 1930's) Baltimore County established a survey network, consisting of almost 300 benchmarks. This vertical datum, known as the Baltimore County Datum, was also an extension of the Baltimore City vertical control system. This datum has been the basis of many surveys which were used to design buildings, roads, utilities, etc. Although this benchmark information is still available, this is no longer the current vertical datum for surveys in Baltimore County.

2. NAVD 88
   On July 1, 1999, COBAR specified the North American Vertical Datum of 1988 as the current vertical datum for surveys in Baltimore County. The current network consists of two types of markers: The GIS points are mostly 3-½ inch diameter discs set in concrete. Many had been included into the NGS database. The GIS markers make up the County's primary network and are stamped with the station name, such as "GIS-103". The BCO points can

be spikes, nails, cross-cuts, iron bars, etc. and make up the secondary vertical control network.

3. Conversions
   Due to the differences between the way the two systems were established, BCD being a plane system and NAVD being a geodetic system as well as other factors, there is NO survey grade conversion which can be applied to convert from one system to the other. However, Baltimore County has created charts that give approximate differences between the BCD, NGVD 29, NAVD 88 and several other systems. Copies of the charts are shown on **Design Manual plates SU-1 and SU-2**. Actual field survey ties between the two systems must be performed to determine a local conversion for any particular site.

C. Adjustments to the County Datums

NGS has adjusted and readjusted the horizontal and vertical values of the stations within their database as changes in technology allowed for more accurate global positioning of the stations. Baltimore County may also readjust the GIS and BCO horizontal positions and vertical elevations to be consistent with the National system. It is therefore necessary to identify the readjustment date (NAD 83 (1988), NAD 83 (1991), NAD 83 (2007) etc.) and any other information needed to allow the users of the drawings to know the exact version of the datum being used in the preparation of the plats or plans.

V. MARYLAND COORDINATE SYSTEM IN BALTIMORE COUNTY

The NGS created the definitions/parameters for all of the State Plane Coordinate System (SPCS) zones for the United States. When the State of Maryland and subsequently Baltimore County adopted the North American Datum of 1983 (NAD 83) as their official datum, they adopted the NGS definitions for a particular plane coordinate system (Maryland is zone 1900). While NAD 83 is a geodetic datum, with positions expressed in latitudes and longitudes, the SPCS allow for computations to be performed, in each zone, using North and East coordinates instead of latitudes and longitudes.

The North and East coordinates will be unique to each zone and cannot be utilized with another zone's North and East coordinates. The SPCS for each zone allow for a conversion between a North and East coordinate, which is unique to each zone, and a latitude and longitude that could be used for geodetic (across zone) calculations. The SPCS allows the calculation for lengths of lines, areas of land, volumes etc. to be done using simple coordinate geometry and at the same time positioning it at a specific place on the earth. This system allows projects all across the state to be connected to each other on the same grid.

The Maryland state plane, being a mathematically defined flat surface, cannot and does not coincide with the ground surface of Baltimore County. Therefore, distances measured on the ground are usually not equal to corresponding distances on the state plane grid. A possible problem may occur when lengths, areas, volumes etc. calculated on the grid are used to define lengths, areas, volumes, areas, etc. on the ground. This difference, in Baltimore County, can range from 0.00' to 0.05' per 1000

feet. Although this may not be a large difference, and not as big of a difference as other parts of the state, the areas of land used for conveyance of property, tax assessment, zoning density, etc. are calculated using ground measurements and not distances on a mathematically defined grid. Likewise lengths of construction materials for roadways, buildings, bridges, pipelines, etc. are also based on ground measurements. These are a few of the more obvious areas where mixing ground and grid distances may cause a problem.

This section was included to make surveyors and engineers aware of the difference between grid and ground differences when working with a SPCS and that mixing between the two may impact a field-run survey or the engineers' design of a project.

VI. COUNTY BOUNDARY LINES

The location of a parcel of land along a county, city or state political subdivision line is a critical issue in that it will determine emergency responses, voting precincts, public school attendance, utility service, taxes, etc. for the people living on the parcel. The Land Survey Division has information defining the outlines of Baltimore County with the surrounding counties, Baltimore City and Pennsylvania. This information should be obtained prior to any field run survey. Any surveys that depict the outline of Baltimore County shall be submitted for review by the Land Survey Division.

VII. WATER BOUNDARIES

Baltimore County has hundreds of miles of waterfront land that adjoins tidal waters. While most of the parcels that adjoin the tidal waterfront stop at the MHW line, there are exceptions. These exceptions can be determined by researching the chain of title of the parcel of land. The parcels that bind on the MHW line need to have the MHW line determined to properly define the limits and area of the parcel of land. The National Oceanic and Atmospheric Administration, National Ocean Service, Center for Operational Oceanographic Products and Services has information for determining the MHW at sites along the Chesapeake Bay.

Mean Sea Level (MSL) is a tidal datum determined over a 19-year National Tidal Datum Epoch. It pertains to local (at a specific site) mean sea level and should not be confused with fixed datums such as BCD, NGVD 29 or NAVD 88. This means there is NO common BCD, NGVD 29 or NAVD 88 elevation that represents the MSL or MHW line along the entire Baltimore County waterfront.

The last change in the National Tidal Epoch Datum was released in 2003. The current datum is the National Tidal Epoch Datum (1983-2001). This superseded the National Tidal Epoch Datum (1960-1978). The changes in the National Tidal Epoch Datum occur around the time of the 19-year cycle. Any surveys that retrace property lines that adjoin tidal waters and bind along the MHW must be determined by the local MHW elevation at that site in order for the line to be established properly.

VIII. PLAT/PLAN PREPARATION

A. General

The Survey Datum (See **Section IV, Survey Datums**) of the field survey(s) which were performed to prepare the drawings submitted to Baltimore County, must be labeled on the plan. The GIS, BCO and/or NGS stations, together with their horizontal and vertical values (if applicable), used to establish the local (on site) survey network shall also be noted.

B. Record Plats

Although Baltimore County has many requirements that must be completed for the development approval of a Record Plat, the field-run boundary survey that was performed must be properly represented on the plat. Any monumentation (e.g. stones, pipes, iron bars, etc.) that was found along the tract outline and used as part of the outline of the parcel must be shown and sufficiently "tied" to the outline of the land shown on the plat. Any markers that are set on the outline of the tract must meet COMAR specifications, as well as be shown and sufficiently "tied" to the outline of the land shown on the plat. The plat shall show the position (sufficiently "tied" to the outline of the land) of not less than four markers set in convenient places within, or along the perimeter or, the subdivision in a manner so that the position of one marker is visible from the position of one other marker.

C. Minor Subdivision Plats

Although Baltimore County has many requirements that must be completed for the development approval of a Minor Subdivision Plat, the field-run boundary survey that was performed must be properly represented on the plat. Any monumentation (e.g. stones, pipes, iron bars, etc.) that was found along the tract outline and held as part of the outline of the parcel must be shown and sufficiently "tied" to the outline of the land shown on the plat. Any markers that are set on the outline of the tract must meet COMAR specifications, as well as be shown and sufficiently "tied" to the outline of the land shown on the plat. The plat shall show the position (sufficiently "tied" to the outline of the land) of not less than four markers set in convenient places within, or along the perimeter of, the subdivision in a manner so that the position of one marker is visible from the position of one other marker.

D. Right-of-Way Plats

The main purpose of a Right-of-Way Plat is to define the limits of a parcel of real property for Baltimore County to obtain rights, in fee or easement, for the benefit of the public. The parcel of land being shown on the Right-of-Way Plat must be sufficiently defined so that the shape and area of the parcel can be computed solely from the information shown on the plat. The parcel must have sufficient "ties" (to field located property markers, coordinated positions, etc.) so the parcel can be positioned on the ground with certainty. The **Land Acquisition section** in

this Design Manual has procedures and specification for preparing Right-of-Way Plats. Right-of-Way Plats must also comply with the Minimum Standards of Practice for Land Surveyors, prepared and amended by the Maryland Department of Labor, Licensing, and Regulation, Board for Professional Land Surveyors.

E. Construction Plans

1. General
   Sufficient mathematical information must be on all construction plans so the position of the road, utility, building, etc. can be determined and computed with certainty. This information may be coordinates, bearings and distances, stationing and offsets or a combination of these methods. Sufficient profiles, inverts, spot grades, floor elevations or other vertical information is also required so the elevation of the road, utility, building, etc. can be determined with certainty. The main question that must be answered affirmatively is; *"Can a surveyor stake it out on the ground from this plan?"* The signed and approved plan is the official drawing for the designed item and, therefore, must not need to rely on any other information (e.g. electronic copy of plan) when the plan is being used for layout in the field.

2. Survey Control
   The local (on site) survey markers which were used for the design surveys (usually called traverse) to provide the data needed to design the road, sanitary, storm drain, water, building, etc. must be shown on the plan with the datum noted (See **Section IV, Surveying Datums**). The horizontal coordinates and vertical elevation of each traverse station shown on the plan(s) must be listed next to the station or in a table form.

3. Road
   The most common method used to define a road's horizontal alignment is using the centerline of the proposed paving. The coordinates of all PC's, PT's, PRC's, PCC's, PI's and other angle break points need to be on the plan(s). The bearing and distances for the straight portions of the roads need to be labeled and any curves need to have the central (or intersection) delta (Δ) angle, radius, arc length, chord bearing and distance and tangent listed by the curve or in table form. Vertical alignment is usually defined in a profile view with elevations of PVC's, PVI's, PVT's shown, as well as the elevations along the entire alignment or PGL at 25' or 50' intervals. Sufficient spot grades need to be shown at intersections or areas having relatively flat grades to insure the engineer's design to drain water from the road.

4. Sanitary Sewer
   All manholes, house connections, grinder pumps and other sanitary sewer structures must be (1) positioned by coordinates, (2) referenced by station and offset to a coordinated baseline, or (3) located by any method that will fix their position with certainty. Scaling a position off of a construction plan is not sufficient.

5. Storm Drain

All manholes, inlets, junction chambers and other storm drain structures must be (1) positioned by coordinates, (2) referenced by station and offset to a coordinated baseline, or (3) located by any method that will fix their position with certainty. Scaling a position off of a construction plan is not sufficient.

6. Water
   All fire hydrants, valves, tees, meters, vaults, house connections, and other water related structures must be (1) positioned by coordinates, (2) referenced by station and offset to a coordinated baseline, or (3) located by any method that will fix their position with certainty. Scaling a position off of a construction plan is not sufficient.

7. Buildings
   Buildings are typically positioned using dimensions from the building corners to the property lines. Many times the face of a building is intended to be parallel or perpendicular to a property line or a physical feature such as an existing curb or another building. The intent of the designer in these situations must be reflected by using duplicated dimensions to that feature or noted on the plan. Coordinates may also be used to position a building. The number of building corners coordinated or dimensioned to property lines will vary with each site, however the number that is needed for a particular site is the number necessary to position the proposed building in only one place on the site.

8. Structures
   Bridges, culverts, ponds or other structures may use a coordinated baseline to position the structure. The structure can be shown with station and offsets to the baseline or using dimensions. The baseline could also run along a specific part of the structure (e.g. the centerline of a bridge roadway, centerline of dam).

9. Miscellaneous
   Parking lots, walls and fences are a few of the many items that are in this category. Parking lots need particular care to make sure the parking bays, drive aisles, islands, etc. are all dimensioned with widths and/or lengths. Spot grades (together with any proposed contour lines) need to be placed at the corners of bays, end of islands and throughout the paved area to insure the engineer's design to drain the water off of the lot is achieved. The curb needs to be positioned with dimensions from the building(s), property lines or in a way that clearly shows where the curb is to be built. The radius of any islands, curved curb lines, or other curved area need to be shown on the plan. Scaling information off of a construction plan is not sufficient. The positioning data needs to be shown on the drawing.

   Any walls being used to assist in a change of the elevations of the ground (i.e. retaining walls) need to have the proposed top and bottom of wall elevations shown of the plan. Sufficient information is required to position the wall on the site horizontally. Changes in a wall alignment, horizontal or vertical, must be labeled.

Fences, signs and other items that are typically installed after a site is graded may not need proposed elevations shown for the improvement, however the horizontal position needs to be determinable from the information shown on the plan.

To Convert **TO** Baltimore County Metropolitan District Elevations (Baltimore County Datum BCD):

FROM:	NAVD 88 Elevations (GIS)	**ADD:**	1.7 ft. **
FROM:	Mean Low Tide (Coast & Geodetic Survey – 1902) Elevation *	**ADD:**	0.275 ft.
FROM:	B&O Railroad (Unadjusted) Elevations	**ADD:**	0.443 ft.
FROM:	1899-1900 Adjusted USGS Elevations (Not Used After 1929)	**ADD:**	0.743 ft.
FROM:	Standard Sea Level Elevation (Accepted Mean Tide)*	**ADD:**	0.811 ft.
FROM:	NGVD 29 Elevations	**ADD:**	0.811 ft.
FROM:	U.S. Coast & Geodetic Survey Elevations (Estab. 1902, Adjusted 1929)	**ADD:**	0.811 ft.
FROM:	U.S. Geological Survey Elevations	**ADD:**	0.811 ft.
FROM:	B&O Railroad Elevations (Adjusted 1907)	**ADD:**	0.811 ft.
FROM:	Mean High Water Elevation*	**ADD:**	1.371 ft.
FROM:	Pennsylvania Railroad Elevations (B.M.s 87, 89, 101)	**ADD:**	1.435 ft.
FROM:	Highest Tide Elevation (August 23, 1933) Barre & Light Streets*	**ADD:**	8.676 ft.

To Convert **TO** NAVD 88 Elevations (GIS):

FROM:	Baltimore County Metropolitan District Elevations (BCD)	**SUBTRACT:**	1.7 ft. **
FROM:	NGVD 29	**SUBTRACT:**	0.9 ft. **

* Tidal / Water elevations are time and site-specific. Conversions must reference site and date to be meaningful.

** May vary as much as 0.3' from actual elevation at various locations. For more information, or if precision greater than 0.1' is required, contact the Land Survey Division, Bureau of Engineering and Construction.

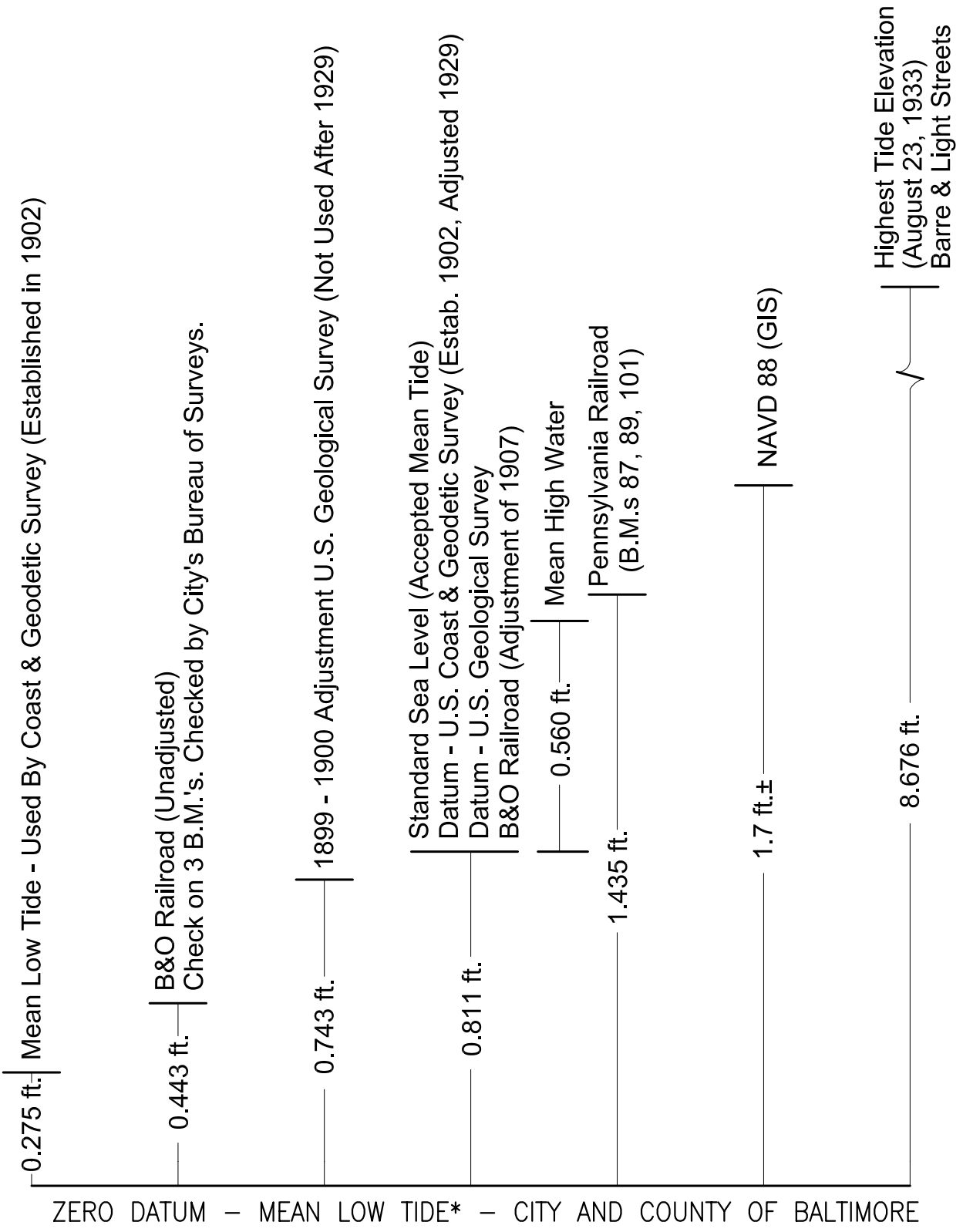
DEPARTMENT OF PUBLIC WORKS
DESIGN MANUAL – LAND SURVEYS

ELEVATION DATUM CONVERSIONS

ISSUED: JULY 26, 2001
REVISED:
REVISED:

PLATE
SU-1

9/17/2008 5:56 PM
SU-1.dwg



Information obtained from Department of Public Works of Baltimore City

* Zero Datum selected in 1902. From 1902 to 1954, Mean Low Tide has risen 0.56'. This will not affect comparison of survey datums.

DEPARTMENT OF PUBLIC WORKS

DESIGN MANUAL – LAND SURVEYS

CHART OF DATUMS

ISSUED: September 18, 2008
REVISED:
REVISED:

PLATE

SU-2