A User's Guide to the Maryland Coordinate System

By James P. Reger
1993 (revised 2013)

Introduction

Map users often have the need to refer to the location of some point on the map (or on the ground). Perhaps the easiest and most objective way to specify the location of some point is in terms of two coordinates, generally with reference to some standard, or fixed, position in the east-west direction and a position in the north-south direction.

Various types of coordinate systems are used to designate a location in some numerical fashion. Perhaps the most common is the use of latitude and longitude, but latitude and longitude pose complications when computations are involved. A remedy to such complications is the development of State Plane Coordinate Systems, or SPCS. Each State in the U.S. has its own SPCS.

In recent years, both the latitude-longitude system and the State coordinate systems have undergone changes. This short summary is aimed at helping the map user who may have used the Maryland coordinate system in the past to understand the changes that have occurred.

The North American Datum

The "North American datum" is a plane (or more precisely, a surface) to which horizontal positions in the United States, Canada, Mexico and Central America are accurately surveyed and referenced. For over half a century, maps in the U.S. had been based on the North American Datum of 1927, or NAD27. However, advances in space satellite and land-based technology have led to a "new and improved" set of "horizontal control points." After several years of work, the National Geodetic Survey (part of the National Oceanic and Atmospheric Administration) announced it had developed a new North American datum, known as NAD83 (although it was not scheduled to be implemented until 1986). NAD83 is based on the adjustment of 250,000 points, including 600 satellite Doppler stations. The 1983 data removed distortions associated with NAD27. Also, NAD83 fits the size, shape and center-of-mass location of the earth more accurately.

Table 1. Representative examples in Maryland of the shift (in meters) in latitude and longitude as a result of changing from NAD27 to NAD83. (1 meter = 3.2808 feet)

7.5-minute Quadrangle	County	Shift in Latitude	Shift in Longitude
Grantsville	Garrett	6 meters south	21 meters west
Bel Air	Harford	7 meters south	28 meters west
Gaithersburg	Montgomery	8 meters south	25 meters west
Leonardtown	St. Mary's	9 meters south	27 meters west
Berlin	Worcester	8 meters south	32 meters west

One result of replacing NAD27 with NAD83 was that the latitude and longitude coordinates for any given position in North America shifted slightly (Table 1). Although these shifts may seem very small to most people, they are important in various technical applications, such as navigation and GPS (global positioning systems).

The Maryland Coordinate System

A second result of adopting NAD83 was that all states also adopted new State coordinate systems that were based on NAD83 instead of NAD27. The original Maryland Coordinate System was adopted by authority of Chapter 628 of the Acts

of the Maryland General Assembly of 1939. It had its legal definition in terms of a specified map projection, an arbitrary reference latitude and longitude for positioning the grid on maps of Maryland, and the accepted NAD27.

During the 1987 session of the Maryland General Assembly, legislation was passed that established a new coordinate system for Maryland that is compatible with NAD83. Since the Maryland Coordinate System has its position and orientation defined in terms of latitude and longitude, it made sense to change the Maryland Coordinate System so that it retained, in principal, the same legal definition as the previous Maryland Coordinate System of 1939. The new law took effect July 1, 1987, but it provided a five-year transition period, during which either or both the 1939 grid or the 1987 grid could be used. After July 1, 1992, only the 1987 Maryland Coordinate System could be used.

Key differences between the 1939 and 1987 Maryland Coordinate Systems are highlighted in Table 2. If a picture is worth a thousand words, perhaps the depictions in Figure 1 of the 1939 and the 1987 Maryland Coordinate Systems will help clarify the information in Table 2.

In both the 1939 and the 1987 versions of the Maryland Coordinate System (Figure 1), a point's location is designated by actual distances from two imaginary lines, one running east-west and the other north-south through the point of origin. The 1939 system used feet; the 1987 system is metric (although conversion to feet is allowed). The origin of the Maryland Coordinate System has been fixed at a point southwest of the State so that all coordinates lie east and north of the imaginary origin. Distance in the east direction is called an Easting; distance north of the origin is called a Northing. Thus, any point can be identified by two values, or distances, from the origin - an Easting and a Northing. In the mathematical sense of graphs, all Maryland coordinates are in the 1st quadrant, which means Easting ("x values") and Northings ("y values") are positive numbers.

Table 2. Comparison of the technical aspects of the legal definitions of the 1939 and the 1987 Maryland Coordinate Systems.

Aspect	1939 Coordinate System	1987 Coordinate System
Map Projection	Lambert conformal projection of the Clarke spheroid of 1866	Lambert conic conformal projection of the geodetic reference system of 1980
North American Datum	NAD27	NAD83
Latitude of Origin(at the 77th meridian)	37°50' North latitude	37°40 North latitude
Central Meridian	77°00 West longitude	77°00' West longitude
Standard Parallel 1	38°18 North latitude	38°18' North latitude
Standard Parallel 2	39°27 North latitude	39°27' North latitude
False Easting(at the 77th meridian)	800,000 feet	400,000 meters
False Northing(at the latitude of origin)	0 feet	0 meters
Latitude/Longitude at artificial origin (0,0)	37°48' 00.06798" N/ 79°46' 07.35361" W	37°34' 38.14264" N/ 81°31' 45.07877" W

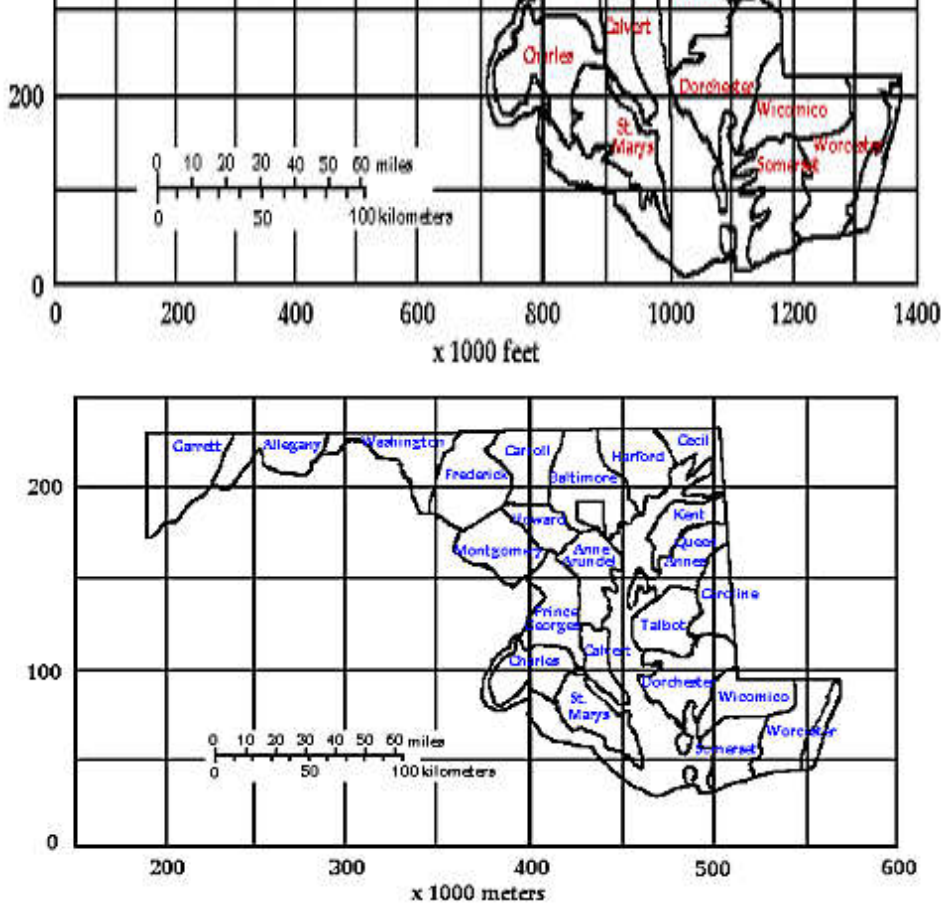

Figure 1. Maps of the Maryland Coordinate System of 1939 (top) and 1987 (bottom), depicted on 100,000-foot and 50,000-meter grids, respectively. (Numbers on the grids must be multiplied by 1,000 to obtain the complete Easting or Northing values.) The "central meridian" (77° West longitude) is shown by the bold line; the "latitude of origin" is marked by the intersection of the central meridian and the base line. Note that the 0 meter Easting of the 1987 grid cannot be shown on this page at this scale.

In the Maryland grid, north-south lines are parallel to each other, east-west lines are parallel to each other, and the two are mutually perpendicular. However, in the map projection that is involved (Lambert conic conformal), lines of longitude (meridians) are not parallel to each other, but diverge toward the equator. And the lines of latitude (parallels), although parallel to each other, appear as broadly curved lines convex toward the equator. The relationship between latitude/longitude and the Maryland grid is clearly defined in the law. Only the 77th meridian (line of longitude) is parallel to a north-south grid line. And as specified in the 1987 law, the "latitude of origin," or base line, of the State grid is perpendicular to the 77th meridian, and that base line is parallel to a "line of latitude" only at latitude 37°40 North where it crosses the 77th meridian.

Converting Grid Coordinates from the 1939 to the 1987 Maryland Coordinate System

If you need to determine the 1987 grid coordinates for some point in Maryland, how you proceed depends on several things. For example, if you know the 1939 grid coordinates for a point, the conversion to the 1987 grid coordinates is quite simple (if rounding to the nearest 10 feet is acceptable). The conversion from a 1939 coordinate (in feet) to a 1987 coordinate (in feet) is expressed by:

Easting value (1939 grid) + 512,420 feet = Easting value (1987 grid)
Northing value (1939 grid) + 60,750 feet = Northing value (1987 grid).

If metric units are desired, divide the Easting and Northing values in feet by 3.28 feet/meter.

Example: Given the 1939 grid Easting of some point as 428,690 feet, then the 1987 grid Easting is:
428,690 + 512,420 feet = 941,110 feet;
or in metric: 941,110 ft. ÷ 3.28 ft./meter = 286,850 meters.

To determine a coordinate by yourself, it helps to have a map that depicts the State grid, at least as "tick marks" around the margin of the map. If, on the other hand, the map you are using does not show either the 1987 or the 1939 State grid, you will most likely need assistance.

Likewise, conversions from some system other than the 1939 grid present difficulties. For example, converting latitude/longitude coordinates to State grid coordinates is mathematically complicated. One also must know whether the latitude/longitude coordinates are based on NAD27 or NAD83. That type of computation is most easily handled by special computer programs designed specifically for converting among various map coordinate systems.

Several State agencies may be able to help with grid conversion problems. Among them are:

Maryland Geological Survey	State Highway Administration	Maryland Department of Planning
2300 St. Paul Street Baltimore, MD 21218-5210 phone (410) 554-5500	State Geodetic Advisor, Mailstop 101 707 N. Calvert Street Baltimore, MD 21201 phone (410)545-8963	301 W. Preston Street Baltimore, MD 21201-2365 phone (410) 225-4450

If the conversion involves one or a very few points, these three agencies may be able to perform the conversions for you at no cost. The conversions are performed by computer with special grid-conversion software.

The frequent user of the Maryland coordinate system may wish to have the capability of performing the grid conversions. The U.S. Army Corps of Engineers has developed **Corpscon**, a Microsoft-Windows-based program which allows the user to convert coordinates between Geographic, State Plane, Universal Transverse Mercator (UTM) and US National Grid systems on the North American Datum of 1927 (NAD 27), the North American Datum of 1983 (NAD 83) and High Accuracy Reference Networks (HARNs). Corpscon uses the National Geodetic Survey (NGS) program Nadcon to convert between NAD 27, NAD 83 and HARNs. Corpscon, Version 6.0, performs vertical conversions to and from the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88). Vertical conversions are based on the NGS program Vertcon and can be performed for the continental U.S. only. Corpscon, Version 6.0, will also calculate geoid-ellipsoid separations based on the NGS program GeoidXX (XX = 90, 93, 96, 99, and 03). Geoid-ellipsoid separations can be calculated for the Continental U.S., Alaska, Hawaii and Puerto Rico/U.S. Virgin Islands. Corpscon is available only as downloadable program at http://www.agc.army.mil/Missions/Corpscon.aspx (104 MB for the standard version). If you need only latitude-longitude and grid conversions, a “minimal” version (7 MB) is also available. Also refer to the Corpscon Frequently Asked Questions page at http://www.agc.army.mil/Missions/Corpscon/FAQs.aspx.

Compiled by the Maryland Geological Survey, 2300 St. Paul Street, Baltimore, MD 21218
This electronic version of "Fact Sheet No.8 " was prepared by R.D. Conkwright, Division of Coastal and Estuarine Geology, Maryland Geological Survey. Please send comments on this page to Dale Shelton (dshelton@dnr.state.md.us)