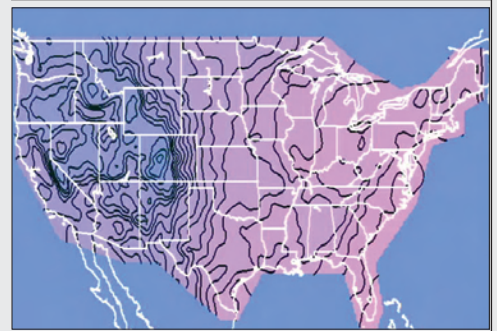# Vertical Datum

NEW MAPPING STUDIES CONVERT TO UPDATED VERTICAL DATUM

WHAT IS A VERTICAL DATUM?

A vertical datum is a base measurement point (or set of points) from which all elevations are determined. Without a common datum, surveyors would calculate different elevation values for the same location. Historically, that common set of points has been the National Geodetic Vertical Datum of 1929 (NGVD29). However, as a result of advances in technology, an updated vertical datum was created and has been officially adopted by the Federal Government as a new basis for measuring heights: the North American Vertical Datum of 1988 (NAVD88).

WHY IS FEMA USING NAVD88?

NAVD88 is more compatible with modern surveying and mapping technologies like Global Positioning Systems (GPS). It also is more accurate than the previous national vertical datum, NGVD29, which no longer is supported by the Federal Government.

FEMA's Map Modernization effort provides an excellent opportunity to incorporate NAVD88 into flood hazard information. This change will support the accurate measurement of elevation by FEMA and National Flood Insurance Program (NFIP) stakeholders, and will avoid the problems of maintaining information based on an obsolete datum.

HOW DOES FEMA'S USE OF NAVD88 AFFECT YOU?

The most frequent users of vertical datum include floodplain managers, surveyors, engineers, builders, and insurance agents and companies. Historically, the most common vertical datum used by FEMA has been NGVD29. Many existing documents (e.g., Flood Insurance Rate Maps [FIRMs], Elevation Certificates, Flood Insurance Studies [FISs]) provide elevation values based on the old datum.

When working with these documents, elevation values based on different vertical datums cannot be used together directly. All the information being used (elevation values on FIRMs, Elevation Certificates, other maps and documents) must be reviewed to ensure they are all based on the same datum,

- Determine what datums are used on the documents.
- If the datums are the same, continue to use the maps and other information together.
- If the datums are different, stop and convert all the elevation numbers to the same datum before using the information.

Every user of elevation data on FEMA's products needs to be aware of the datums on which their elevation values are based, differences in datums among the different

WHO IS AFFECTED?

Property owners should not be affected by a vertical datum change. Insurance rates (where elevation data are required and rates aren't grandfathered) and building codes will be based on the Base Flood Elevations (BFEs)* shown on new Digital Flood Insurance Rate Maps (DFIRMs). However, users of elevation data from multiple sources (e.g., a FIRM and Elevation Certificate) must take care that the elevation values are based on the same vertical datum. If they are not, the values must be converted to the same datum before they are used. Failure to do so can result in improper design (e.g., building at the wrong elevation) or misrating the insurance premium. These users include floodplain managers, surveyors, builders, and insurance agents.

* Base Flood Elevation – The water-surface elevation resulting from a flood that has a 1-percent chance of occurring in any given year.

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data sources they are using, the required datum conversion, and how to apply it. Particular care must be taken when comparing elevation data on a new FIRM panel using NAVD88 with data from a previous FIRM panel that was produced using NGVD29. The user must be sure to convert elevation values to one common vertical datum. For example, insurance agents and companies must be especially careful about using elevations based on similar vertical datums when using the NFIP's "grandfathering" rule for rating. They must avoid using a Base Flood Elevation (BFE) value from a FIRM based on NGVD29 with a building's lowest floor elevation (LFE) from an Elevation Certificate based on NAVD88. The error could be significant if they are not first converted to the same vertical datum. Similarly, when calculating a new premium with a BFE based on NAVD88 and a building's LFE based on NGVD29 from an older Elevation Certificate, the elevations should be converted to the same vertical datum.

Elevations in NGVD29 | **Elevations in NAVD88**

111' NGVD29 (LFE)

110' NAVD88 (LFE)

109' NGVD29 (BFE)

108' NAVD88 (BFE)

Flood Elevation

WHAT IS THE EFFECT OF THE DATUM CHANGE ON FLOOD HAZARD INFORMATION?

The datum change does not change the relationship of the ground heights to the water surface. It does change the value assigned to those heights that are printed on the maps and other documents or encoded in digital data.

For example, the figure to the left shows a hypothetical building and nearby water surface. The LFE of the structure is 111 feet measured using NGVD29, but 110 feet using NAVD88. Similarly, the BFE is 109 feet measured using NGVD29, but 108 feet using NAVD88. The difference between the elevations is the same with both datums: 2 feet.

This figure also illustrates two other points raised previously:

1) The main effect of the datum change is a different value assigned to an elevation. For example, in the figure, the lowest floor of the same structure is assigned one value when measured using NAVD88 and a different value when measured using NGVD29. Elevations in a local area all shift by the same amount, so the relative relationships are not changed.

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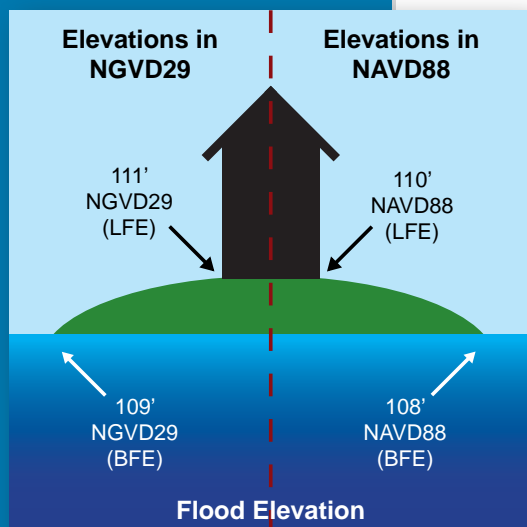
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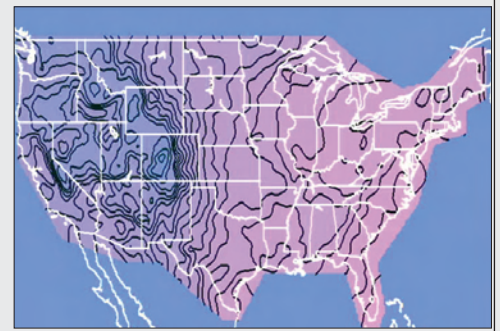
2) When comparing two values, they have to be measured from the same datum. For example, do not compare the LFE of the structure measured using NAVD88 (110 feet) with a BFE measured using NGVD29 (109 feet). This would yield an incorrect difference in elevations. Using this example, the difference would be incorrectly calculated to be 1 foot (110 – 109), compared to the correct elevation difference of 2 feet (110 – 108).

WHAT INFORMATION DOES FEMA PROVIDE ON CONVERTING BETWEEN VERTICAL DATUMS?

The difference between the two datums varies from location to location. FEMA provides guidelines regarding where conversion factors (offset values) should be calculated and the process for converting unrevised elevation data from old flood studies into new flood studies. The exact conversion factors will be listed in the accompanying FIS. General conversion factors also may be shown on the FIRM panel. Where a county boundary and a flooding source with unrevised NGVD29 flood elevations meet, an individual offset will be calculated and applied during the creation of the new DFIRM.

STAY INFORMED ABOUT THE CHANGE

Flood maps are changing, and so is the vertical datum being used. Floodplain managers, surveyors, engineers, builders, insurance agents and companies, and other users of elevation data from multiple sources (e.g., a FIRM and Elevation Certificate) must take care that the elevation values they use are based on the same vertical datum. If they are not the same, the values must be converted to the same datum before they are used. Failure to do so can result in improper design (e.g., building at the wrong elevation) or misrating the insurance premium. The property owners' risk is not affected by a vertical datum change because all elevations in the local area are changed by the same amount.

FURTHER INFORMATION

If additional details are needed, the following resources may be helpful.

- **For FEMA's guidelines regarding vertical datum conversions, visit:**

  http://www.fema.gov/library/viewRecord. do?id=2206 **and click on Appendix B.**

- **FEMA's NAVD88 policy, presented in Procedure Memorandum 41 (March 2006), can be found at:**

  http://www.fema.gov/plan/prevent/fhm/ pl_memo41.shtm

- **Additional information on vertical datums, including the conversion from NGVD29 to NAVD88 at any location, can be found by visiting the National Geodetic Survey site:**

  http://www.ngs.noaa.gov

- **For more information about flood insurance, visit:**

  http://www.floodsmart.gov

- **For additional details about FEMA's Map Modernization effort, go to:** http://www.fema.gov/plan/ prevent/fhm/mm_main.shtm