

# Vertical Datum Change for Arizona DFIRMs

<http://www.map9-m.com>



New "modernized" Digital Flood Insurance Rate Maps (DFIRMs) will be produced for all Arizona counties over the next few years. Because one of FEMA's goals is to convert all flood maps to the North American Vertical Datum of 1988 (NAVD88), the new FIRM, as well as the accompanying Flood Insurance Study, will reflect the newer, more accurate vertical datum.

## What Is a Vertical Datum?

A vertical datum is a set of constants that defines a system for the comparison of elevations. A vertical datum is important because all elevations need to be referenced to the same system. Otherwise, surveys using different datums would have different elevations for the same surface point. The current FIRM in Arizona reference the National Geodetic Vertical Datum of 1929 (NGVD29). FEMA desires to update FIRM to a more accurate vertical datum - NAVD88.

## Why Is the Vertical Datum Changing?

A datum needs to be updated periodically because geologic changes to the surface of the earth occur; these changes are due to subsidence and uplift or gradual changes in sea level. In addition, the older vertical datum (NGVD29) was flawed because of erroneous assumptions that mean sea level at different tidal stations represent the same elevation (zero). With an outdated vertical datum, surface points at 0.0 foot NGVD29 have, in fact, different elevations for a variety of reasons. With GPS and a more accurate geodetic network, we can now better measure these elevation differences, further warranting the use of the new vertical datum. FEMA's map modernization efforts to convert its inventory of paper maps to GIS-based DFIRMs provide an opportunity to expedite the use of NAVD88.

## When Is the Vertical Datum Changing and Who Will Be Impacted?

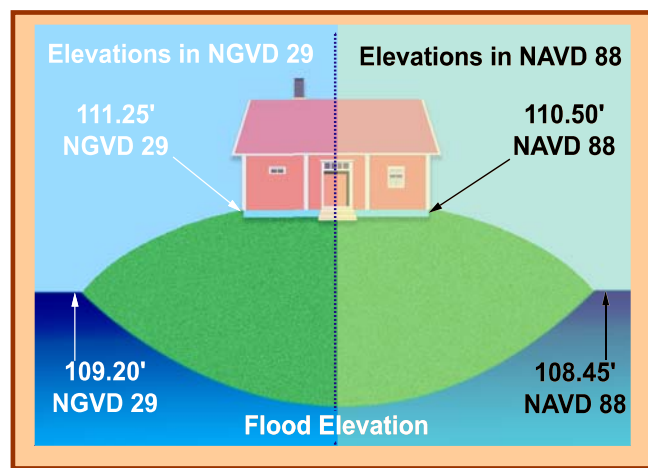
A vertical datum change impacts those who work with elevation data, such as engineers and surveyors, as well as community floodplain administrators across the area. Elevations in NAVD88 should be used for floodplain management and flood insurance purposes (e.g., elevation certificates) the day that a new FIRM referenced to that datum becomes effective. FEMA is still in the initial stages of map production in Arizona, but most counties will have new effective FIRM by 2007. This change should be noted by anyone who uses an Arizona FIRM panel, particularly when comparing elevation data on a new FIRM panel with data from an old FIRM that was produced in NGVD29.

## How are Unrevised NGVD29 Flood Elevations Converted to NAVD88?

To ensure that all elevations used on a FIRM are based on a common reference system, a FIRM must reference a single, vertical datum. Therefore, contractors producing FIRM in Arizona will establish conversion factors (offsets) to be applied to unrevised 1% annual chance (100-year) flood elevations.

To effect a vertical datum conversion, three components of the effective Flood Insurance Study have to be converted: Base Flood Elevations on a FIRM, flood profiles, and the floodway data table.

The figure to the right illustrates how elevation numbers in NGVD29 or NAVD88 can vary at one location, but the actual elevation is the same in both vertical datums.



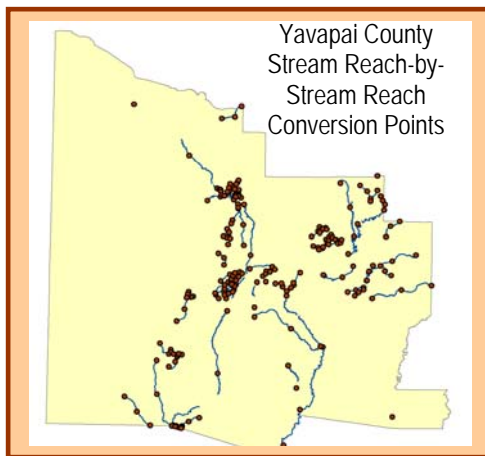
## How are Unrevised NGVD29 Flood Elevations Converted to NAVD88? (con't)

The most precise way of converting between NGVD29 and NAVD88 would be to compute a different offset value for each set of horizontal coordinates, but this would yield an infinite number of different offsets. Current FEMA guidelines, dictate that conversion factors between NGVD29 and NAVD88 are determined at 7½-minute quadrangle corners located in or within 2.5 miles from the jurisdiction receiving a new FIRM. The U.S. Army Corps of Engineers' CORPSCON software is used to determine the vertical offsets between the two vertical datums that differ as a function of horizontal location. To simplify the process for converting unrevised elevation data from old flood studies into new flood studies, FEMA allows either:

- A uniform offset to be applied to an entire county when the maximum error in using a standard offset value is no more than 0.25 foot (3 inches) for that county.

For example, the table to the right shows the corner coordinates for Cochise County, AZ used to determine whether a single, countywide vertical datum calculation can be applied. The offset value between NGVD29 and NAVD88 calculated for Cochise County did not meet specifications for use as a single, countywide conversion factor.

USGS Quadrangle Corner Coordinates Cochise County, AZ		
Latitude	Longitude	Conversion
31.750° N	110.125° W	2.67 ft
31.750° N	109.250° W	3.20 ft
31.875° N	109.250° W	3.49 ft
32.000° N	109.625° W	2.58 ft



- If the offset from the average conversion factor falls outside of the acceptable range of 0.25 foot from the average, an alternative vertical datum conversion process is used, such as calculation of a watershed-by-watershed or stream-by-stream offsets. In Arizona, a uniform offset cannot be applied to many of the counties because the variations between NGVD29 and NAVD88 are too great.

For example, Yavapai County, AZ has a wide variety of geologic structures which causes the variations between NGVD29 and NAVD88 to be extreme. The figure at the left shows the points used to calculate a datum conversion on a stream-by-stream basis for the county.

The table to the right summarizes a vertical datum conversion factor strategy for counties in Arizona.

### Is Further Information Available?

FEMA's *Guidelines and Specifications* regarding vertical datum conversions can be found online at: [http://www.fema.gov/pdf/fhm/fm\\_gsab.pdf](http://www.fema.gov/pdf/fhm/fm_gsab.pdf).

Additional information on vertical datums can be found by contacting the National Geodetic Survey, Vertical Network Branch, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, MD (<http://www.ngs.noaa.gov>)

County	Conversion Strategy
Apache	TBD
Coconino	Stream Reach-by-Stream Reach
Cochise	Stream-by-Stream
Gila	Stream-by-Stream
Graham	TBD
Greenlee	TBD
La Paz	Single Countywide
Maricopa	TBD
Mohave	TBD
Navajo	TBD
Pima	TBD
Pinal	Stream-by-Stream
Santa Cruz	TBD
Yavapai	Stream Reach-by-Stream Reach
Yuma	Stream-by-Stream