



# NAD 1927 with ArcPad

November 29, 2006

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## Summary

Since there is no accurate or NGS-sanctioned transformation from WGS 1984 (the datum of GPS) to NAD 1927<sup>†</sup>, using NAD 1927 as the map projection in ArcPad will result in your GPS location displaying incorrectly in relation to background map data, and will result in an uncorrectable positional error in GPS positions recorded as GIS features in NAD 1927 in ArcPad.

Basically, NAD 1927 contains large local and regional distortions at the 10m level that cannot be quantified by a simple equation-based datum transformation. The datum transformation used by all versions of ArcPad (and the ArcGIS projection engine) to transform WGS 1984 to NAD 1927 is an equation-based datum transformation.

The ESRI Support Article at

<http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=23253>

alludes to this by saying that ArcPad 6 and older does not support grid-based datum transformations. (Please note that the same sort of error would occur with NAD27 UTM.)

ArcPad 7 does support grid-based datum transformations from NAD 1927 to NAD 1983 (HARN) in the form of NADCON tables that can be installed. However, since this is a conversion between NAD 1983 and NAD 1927, and not a conversion between WGS 1984 and NAD 1927, the same issue mentioned in the above Support Article would still apply in ArcPad 7.

## Recommended Workarounds

[1] 'Lie' to ArcPad and make it used NADCON. **NOTE: This option is not recommended, as it introduces a minimum of 1.5 meters of error.**

ArcPad allows you to specify the incoming datum of GPS coordinates. This is done in GPS Preferences > Datum tab. With Trimble GPS mapping receivers, GPS data is *always* output in WGS 1984 so the default setting (D\_WGS\_1984) is correct and generally speaking should never be changed<sup>†</sup>.

However, if for example you only have background images in NAD 1927 and need to see or record your GPS location as accurately as possible, you can 'lie' to ArcPad and tell it that the incoming GPS datum is 'D\_North\_American\_1983' so that it employs the

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\* See 'Modern Terrestrial Reference Systems Part 3,' Snay, Dr. Richard A. and Dr. Tomas Soler, "Modern Terrestrial Reference Systems (Part 1-4)," [online], <http://www.ngs.noaa.gov/CORS/Articles/Reference-Systems-Part-3.pdf>, under the subheading **Transforming Between Reference Frames**.

"While...NADCON [may be used] with pairs of other reference frames (NAD 27, NAD 83 (1986) and NAD 83 (HARN)), no NGS-sanctioned software exists for transforming coordinates from any member of one set [NAD 83 (CORS96), ITRFxx] to any member of the other."

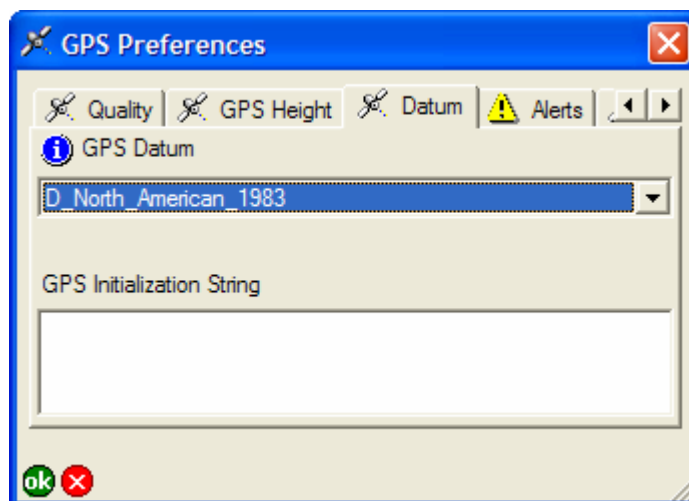
<sup>†</sup> If this setting is incorrect, ArcPad will incorrectly transform the incoming GPS datum to the datum of the map projection, resulting in errors that cannot be corrected or removed.

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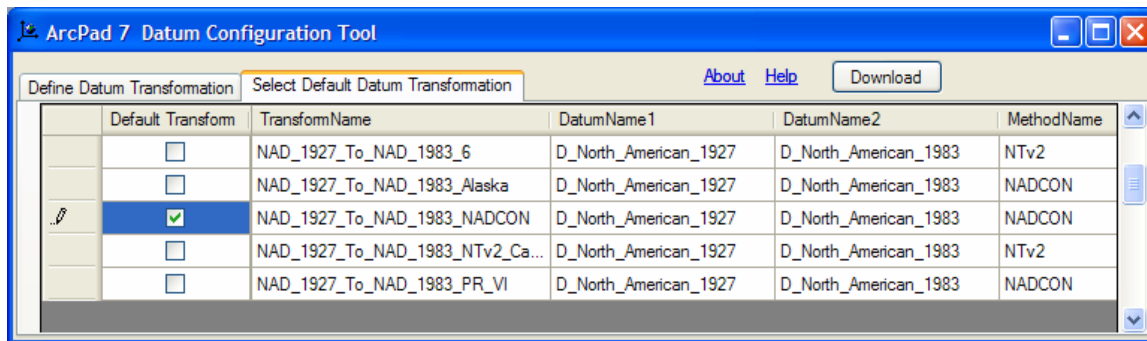
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NADCON datum transformation<sup>†</sup>. To do this, go to the Datum tab in GPS Preferences and change the GPS Datum.



Once this change is made, if your map projection is set to a coordinate system employing NAD 1927, the NADCON datum transformation will be used by default. Please note that there are several NAD 1927 to NAD 1983 datum transformations available in ArcPad, so you will need to run the Datum Configuration Tool (available with ArcPad 7.0.1 in the ArcPad 7.0.1 Program Group) to set the default datum transformation to NAD\_1927\_To\_NAD\_1983\_NADCON. *If you do not do this the default NADCON transformation is for Alaska.*



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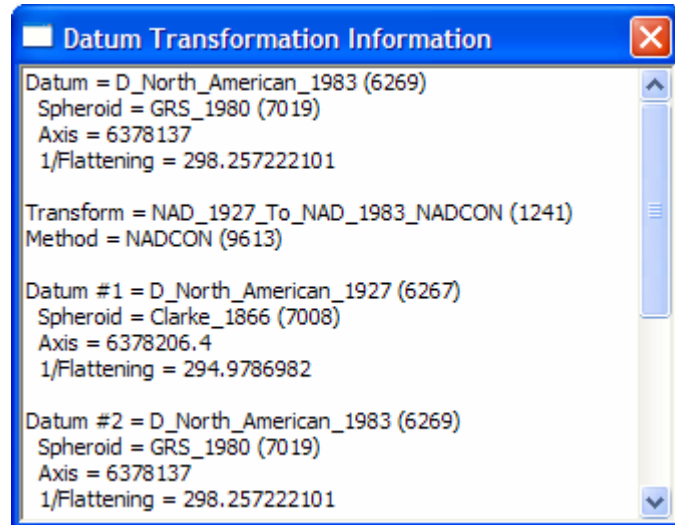
<sup>†</sup> Please note that if you are using US Coast Guard Beacon as your DGPS source (e.g. Trimble GeoBeacon or Beacon-on-a-Belt receiver), corrections are supplied by that system in terms of NAD 1983, so your GPS positions being passed to ArcPad really are NAD 1983. In this particular case you could accurately record data in NAD 1927 map projection using ArcPad.

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To verify this, click on the  button on the Datum page, and ArcPad will display the datum transformation that is being used in your current map.



**NOTE:** Since there is approximately a 1 meter difference between WGS 1984 and NAD 1983 (CORS96), and NADCON contains regional distortions, using this workaround will result in at least a 1.5 meter positional error<sup>§</sup>.

[2] Use ArcGIS or ArcPad to re-project NAD 1927 data to NAD 1983, then collect GPS data in NAD 1983.

ArcPad 7 contains a utility to re-project shapefiles. This utility is found under Tools > Utilities > Reproject shapefile.

  
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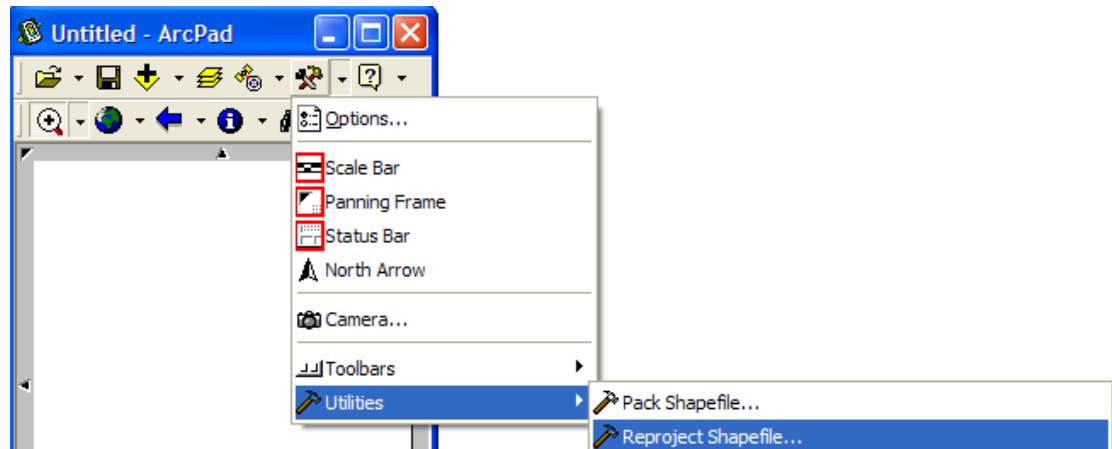


<sup>§</sup> Unless you are using US Coast Guard Beacon DGPS and not post-processing your GPS data.

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This utility will employ NADCON to convert between NAD 1927 and NAD 1983.

If your map projection is NAD 1983, ArcPad 7.0.1 will correctly transform WGS 1984 GPS coordinates to NAD 1983.

**NOTE:** ArcPad 7.0 and 6.x all employ a 'zero' datum shift between WGS 1984 and NAD 1983 by default. Therefore it is recommended that you upgrade to 7.0.1 or set the default datum transform to the 8494 (NAD\_1983\_To\_WGS\_1984\_5) datum transformation. For more information on how to do this with ArcPad 7.0 or 6.x, please refer to the ArcPad User Guide or ArcPad Reference Guide, found in c:\Program Files\ArcPad\Help on a PC with ArcPad installed, or available on ESRI's Website at <http://support.esri.com/index.cfm?fa=knowledgebase.documentation.viewDoc&PID=26&MetalD=1126> for ArcPad 7.

## Conclusion

Using NAD 1927 as your map projection with ArcPad 7.0.1 will only be accurate if you are using US Coast Guard Beacon real-time corrections, and you tell ArcPad that the incoming GPS datum is NAD 1983. 'Lying' to ArcPad by telling it that the datum is NAD 1983 when it is really WGS 1984 will result in at least 1 meter of error. Leaving the datum at WGS 1984 and collecting data in NAD 1927 will result in 40 feet or more of error.

Regardless, continued use of NAD27 conversion for any GPS project induces 1 meter or more of error relative to a WGS84\_NAD83 datum conversion. This approach is not recommended for data collection where accuracy requirements are 1:24,000 or higher (+/- 10 meters). It is strongly recommended that when using sub-meter GPS, ArcPad users transform their GIS to NAD83 before using GPS.

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