

# Projections, Datums, And Transformations In ArcPad 7 – Getting It Straight

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## Purpose

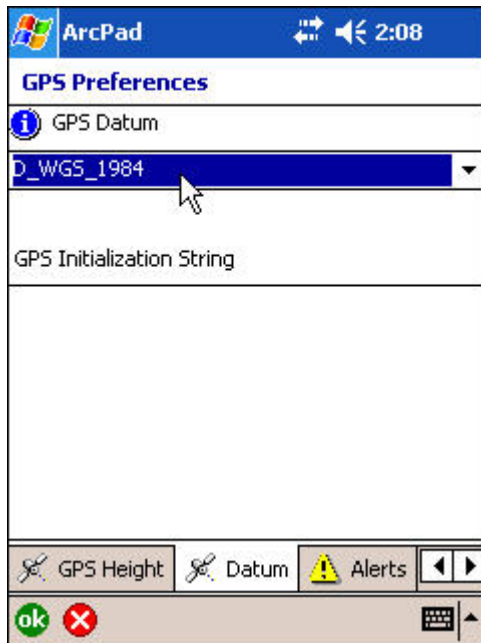
This guidance is intended to help users understand ArcPad's use of projections, datums, and transformations. General ArcPad functionality is not discussed here, as it is well documented in *Using ArcPad* and in the *ArcPad Reference Guide*. All references to ArcPad refer specifically to ArcPad 7.

## Background


ArcPad automatically converts latitude and longitude from a GPS receiver to coordinates that are expressed in terms of the current map's projection and datum. In order for this stealthy, behind-the-scenes, on-the-fly conversion to proceed as intended, users must establish three things.

1. The datum of incoming GPS latitude and longitude.
2. The current map's intended projection and datum.
3. The parameters necessary to transform coordinates from the GPS datum to coordinates of the map's datum.

These three steps are described in more detail below.



### Step 1 – Establish The GPS Datum

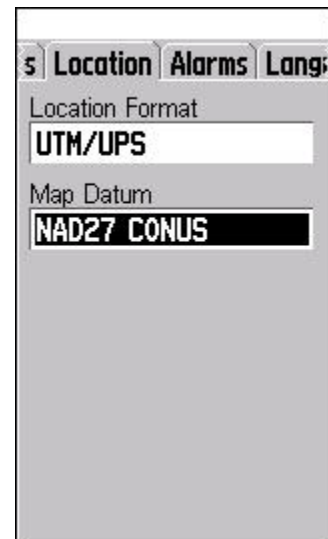
The datum of incoming GPS coordinates is established by making a selection from the **GPS Datum** dropdown list. To do so, tap  – **GPS Preferences...** – **Datum**, as at left.

ArcPad will “expect” to receive GPS coordinates referenced to this datum, and will make all subsequent actions based on that expectation. **D\_WGS\_1984** is the default.

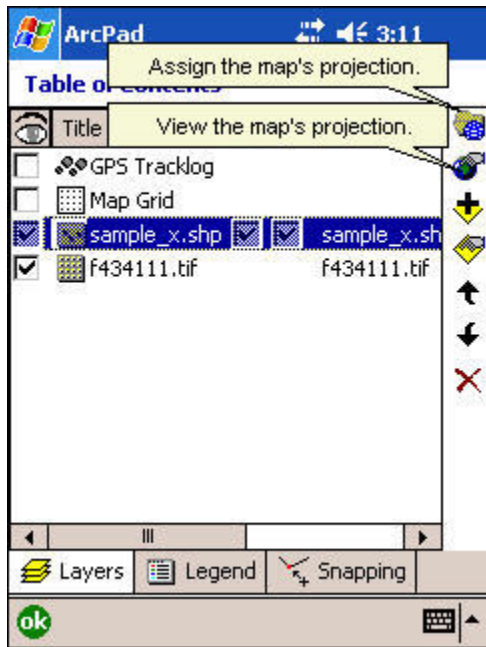
This GPS datum is not related in any way to the projection or datum of ArcPad's current map.

Most GPS receivers issue coordinates only in WGS84. However, when Garmin coordinates are sent to ArcPad, they are referenced to the Garmin's current **Map Datum**.

For instance, if a Garmin's **Map Datum** is set as illustrated at right, the GPS coordinates issued to ArcPad will also be referenced to **NAD27 CONUS**, not **WGS84**. Therefore, Garmin users must set **Map Datum** to **WGS84** to avoid a datum mis-match in ArcPad.



**Summary** – Set **GPS Datum** to **D\_WGS\_1984**, and make sure that GPS receivers are issuing WGS84 coordinates to ArcPad.



## Step 2 – Establish The Map Projection And Datum

The intended projection and datum of ArcPad's current map are established by a projection (.prj) file. The sequence ArcPad uses to determine a map's projection is described below.

1. The initial default projection for a new, empty ArcPad map is WGS84 latitude and longitude.
2. If a projection file named **arcpad.prj** is found in the **My Documents** folder, it then replaces WGS84 latitude and longitude as the default map projection.
3. If a layer or map with a different projection is added to a new, empty ArcPad map, that data's projection replaces the default projection.

If the projection of the map's first layer is undefined, a .prj file can be manually assigned by tapping the first icon along the **Table of Contents**' right margin, as at right, and making a selection from a folder containing .prj files.

A map's current projection may be viewed by tapping the second icon along the **Table of Contents**' right margin, as above.

**Summary** – Users should copy a projection file for their area of interest to the **My Documents** folder and rename it **arcpad.prj**, or else, make sure that the first layer or map added to a new, empty ArcPad map has a projection file that accurately reflects its feature's coordinates.

## Step 3 – Establish The Transformation Parameters


A transformation is required when incoming GPS coordinates are referenced to WGS84 and ArcPad's map datum is referenced to NAD27 (or to NAD83) because these datums are based on different ellipsoids. An ellipsoid is a stylized model of the earth's dimensions. Complications arise, however, as there are 21 different transformations that convert WGS84 coordinates to NAD27 coordinates, each one being suitable for a different portion of North America. Unfortunately, ArcPad defaults to a transformation best suited to the Caribbean.

Nevertheless, users can force Arcpad to use the transformation suitable for their particular area by creating a **DefaultTransforms.dbf** table, and placing it in their **...ArcPad/System** folder. This table contains only three fields, as described below.

1. **Transform** – Name of the transformation suitable for a user's area of interest.
2. **Datum\_1** – Name of the current map's datum described in **Step 2** above.
3. **Datum\_2** – The GPS datum described in **Step 1** above.

Follow these steps to create the **DefaultTransforms.dbf** table.

1. An ESRI document titled [Supported Geographic \(Datum\) Transformations](#) lists all supported transformations, as well as their area of intended use. Use this reference to determine the transformation best suited to an area of interest.

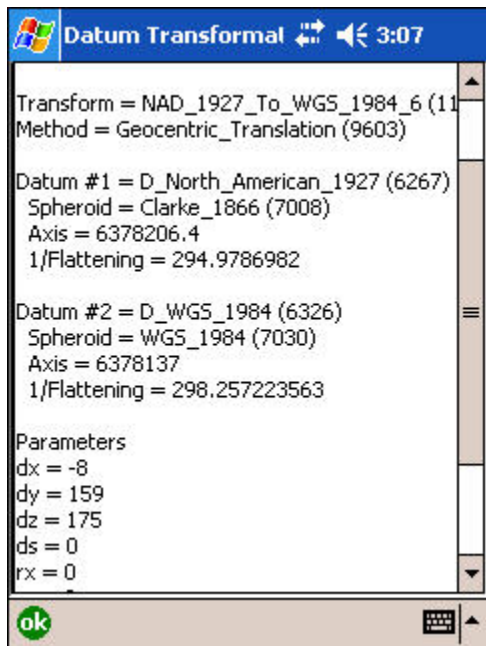
- In ArcPad, tap  – **Utilities – Export Projection Information...** This action writes several files to the `...ArcPad/System` folder. More on that later. Two of these files are named `Export_Transforms.csv` and `DefaultTransforms.dbf`.
- Copy and paste content for the desired datum transformation from fields **TransformName**, **DatumName1**, and **DatumName2** in table `Export_Transforms.csv` to the corresponding fields in table `DefaultTransforms.dbf`.
- Place the `DefaultTransforms.dbf` table in the `...ArcPad/System` folder.


For example, the table at right is suitable for transforming WGS84 coordinates to NAD27

Attributes of defaulttransforms			
OID	TRANSFORM	DATUM_1	DATUM_2
0	NAD_1927_To_WGS_1984_6	D_North_American_1927	D_WGS_1984

coordinates in the western continental United States.

ArcPad interrogates `DefaultTransforms.dbf` before referring to its internal transformation table, and will use the listed transformation if it finds a record matching the current GPS datum and the current ArcPad map datum. If no match is found, it proceeds to use its internal transformation table.




Once the `DefaultTransforms.dbf` table has been created and placed in the `...ArcPad/System` folder, users can tap the  icon above the **GPS Datum** dropdown list (described in **Step 1**) to discover or confirm the active transformation. For a WGS84 to NAD27 transformation in the western U.S., the result should look like that at left.

**Summary** - Create a table named `DefaultTransforms.dbf` that matches an intended combination of GPS datum and ArcPad map datum, and place it in the `...ArcPad/System` folder.

#### Additional Information

This section provides additional information on the datums, ellipsoids, transformations, and projections supported by ArcPad. Most of this text is taken verbatim from Chapter 13 of the *ArcPad Reference Guide*.

In ArcPad, tap  – **Utilities – Export Projection Information...** This action writes five files to the `...ArcPad/System` folder, as described below. These are copies of internal ArcPad files that are provided solely for the user's reference, and editing them has **no effect** on ArcPad.

- `Export_Datums.csv` - Lists all of the datums, and their corresponding ellipsoids.
- `Export_Spheroid.csv` - Lists all of the ellipsoids' parameters.

3. **Export\_Transforms.csv** - Lists all of the datum transformation parameters embedded in ArcPad. This is the file whose content may be copied and pasted to create a user's custom **DefaultTransforms.dbf** table described in **Step 3** above.
4. **Export\_TransformMethods.csv** – Lists all of the supported datum-to-datum transformations built into ArcPad.
5. **Export\_Projections.txt** - Lists all of the ArcGIS Projection Engine projections, and notes whether or not each projection is supported by ArcPad.

Two datum configuration files also appear in the **...ArcPad/System** folder that **do have an effect** on ArcPad. By default these files are empty, but they include all of the fields required by ArcPad.

1. **Transforms.dbf** - This file allows users to add customized datum transformation parameters that are searched before internal datum transformations are referenced. This means that the data in this configuration file will override datum transformations embedded within ArcPad. To modify the **Transforms.dbf** file, users must supply two datum names and all of the associated transformation parameters between these two datums. ArcPad will attempt to match these two datum names to the current GPS datum and ArcPad map datum, and use the associated parameters if a match is found.

The purpose of the **Transforms.dbf** table is to facilitate creation of a new datum-to-datum transformation that ArcPad does not provide internally.

2. **DefaultTransforms.dbf** - Sometimes there is more than one set of parameters to transform between two datums. By default, ArcPad will use the first match it finds in its internal tables. The **DefaultTransforms.dbf** file forces ArcPad to use a specific datum transformation if there is more than one available for a given pair of datum names.

**DefaultTransforms.dbf** is empty initially, but users can copy and paste content to it from the **Export\_Transforms.csv** file as described in **Step 3** above.

### **A Suggested Strategy To Facilitate Alternating Use Of Multiple Transformations**

Users could create several different versions of the **DefaultTransforms.dbf** table, one for each situation they periodically encounter.

For instance, those transforming between WGS84 and NAD83 might need two versions of **DefaultTransforms.dbf**. One version would be for use with an NDGPS differential correction source, and the other version for autonomous use, or with a CORS or WAAS correction source. Here's a suggested strategy.

Differential Correction	Autonomous (none), CORS, or WAAS	NDGPS
Transform	NAD_1983_To_WGS_1984_5	NAD_1983_To_WGS_1984_1
Datum_1	D_North_American_1983	D_North_American_1983
Datum_2	D_WGS_1984	D_WGS_1984

- Using information in the table (above) as a guide, create two versions of **DefaultTransforms.dbf**. One version would be for use with an NDGPS differential correction source, and the other for autonomous use, or with a CORS or WAAS correction source.

- Name the two files `DefaultTransforms_NDGPS.dbf` and `DefaultTransforms_Auto_CORS_WAAS.dbf` respectively.
- File them somewhere other than the `...ArcPad/System` folder.

Then, as needed for each GPS mission:

- Delete the `DefaultTransforms.dbf` table from the `...ArcPad/System` folder.
- Copy either `DefaultTransforms_NDGPS.dbf` or `DefaultTransforms_Auto_CORS_WAAS.dbf` as appropriate from their folder to the `...ArcPad/System` folder.
- Rename the copied file to `DefaultTransforms.dbf`.