Appendix M - The Geocentric Datum of Australia

1. Introduction

A geocentric datum is a reference surface, which has as its origin the Earth's centre of mass. The new Geocentric Datum of Australia (GDA) is based on the Australian Fiducial Network (AFN), which fits into a global geodetic framework.

The AFN comprises eight highly accurate survey marks across Australia each with a permanently tracking Global Positioning System (GPS) receiver. It has been established by AUSLIG (which subsequently amalgamated with AGSO to form Geoscience Australia) for geodetic surveying and scientific purposes. The AFN was used as the foundation to determine geocentric coordinates for the Australian National Network (ANN). The ANN comprises 70 survey points across Australia at approximate 500 km spacings each having latitude and longitude on the GDA. GPS data has been obtained at each of the 70 survey points allowing ANN points to be linked into the framework provided by the AFN.

The AFN and ANN are the basis of a unique national geocentric coordinate system, which, with regional networks, provide the fundamental framework for all geographic information over Australia.

1.1 Changes which will occur

Conversion to the GDA will be most noticeable on mapping products. With the geocentric datum, the map projection and mapping grid zones will remain the same.

The borders of maps will have the same latitude and longitude but will be in slightly different positions on the ground. This means detail on existing maps cannot be joined with corresponding detail on maps under the new system. The impact of this 'displacement' will be greater on large-scale maps compared with small-scale maps.

There will be a shift, or displacement, of approximately 200 meters across Australia in a north-east direction between coordinates of points on the existing Australian Geodetic Datum compared with coordinates of the same points on the Geocentric Datum.

During the transition to a fully operational geocentric datum, map makers may choose to print overlaps on the northern and eastern edges of maps produced on a geocentric datum to enable them to be joined to maps on existing datums.

1.2 The benefits

The adoption of a geocentric datum will allow for a single standard for the collection, storage and use of geographic data. A geocentric datum is the best fitting reference surface for the whole earth and provides direct compatibility with GPS.

By adopting a single geocentric datum, Australia is well placed to take advantage of the widespread benefits of satellite based positioning systems.

2. Technical Specifications - GDA94

2.1 Terminology

Datum	Geocentric Datum of Australia (GDA)
Geographical coordinate set (latitude and longitude)	Geocentric Datum of Australia 1994 (GDA94)
Grid coordinates (Universal Transverse Mercator)	Map Grid of Australia 1994 (MGA94)

2.2 Definition

Reference Frame	ITRF92 (International Terrestrial Reference Frame 1992)
Epoch	1994.0
Ellipsoid	GRS80
Semi-major axis (a)	6,378,137.0 meters
Inverse flattening (1/f)	298.257222101

2.3 National transformation parameters - AGD84 TO GDA94

(Bursa-Wolf model)

Parameter	**Value**
DX (m)	-117.763
DY (m)	-51.510
DZ (m)	139.061
R_X (secs)	-0.292
R_Y (secs)	-0.443
R_Z (secs)	-0.277
Sc (ppm)	-0.191

Note

There are two different ways of applying the sign conventions for the rotations. In both cases the sign convention is the same (a positive rotation is an anti-clockwise rotation, when viewed along the positive axis towards the origin). However, some software packages assume the rotations to be of the position around the coordinate axes, while the method historically used in Australia (as with the parameters above) assumes the rotations to be of the coordinate axes. The only difference in the formula is a change in the signs of the angles in the rotation matrix. If the sign of the rotation parameters and the formulae used are consistent the correct results will be obtained. The only way to be absolutely sure which method or parameters are required is to test them using a known input and output for a set of parameters, as shown in 'The Geocentric Datum of Australia Technical Manual' at: www.icsm.gov.au/icsm/gda/gdatm/index.html (Select options GDA, Technical Manual & then GDA Technical Manual).

3. Sample User Defined Coordinate system

The datum will be user defined in ARC/INFO export files. Sample definitions for typical 1:250 000 and 1:100 000 Scale WORKING DATABASE and GEODATA ArcInfo Projection (.prj) files are given below:

WORKING DATABASE – Sample Coordinate System Description (as defined in a Projection File):

```
Projection    TRANSVERSE
Datum         USER_DEFINED 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000
Zunits        NO
Units         METERS
Spheroid      GRS1980
Xshift        0.0000000000
Yshift        0.0000000000
Parameters
0.99960000 /* scale factor at central meridian
 147  0  0.000 /* longitude of central meridian
 0  0  0.000 /* latitude of origin
500000.00000 /* false easting (meters)
10000000.00000 /* false northing (meters)
```

Note: The same information may be expressed differently, for example by giving the Major and Minor axes for GSR 1980.

GEODATA – Sample Coordinate System Description (as defined in a Projection File):

```
Projection    GEOGRAPHIC
Datum         USER_DEFINED 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000
Zunits        NO
Units         DD
Spheroid      GRS1980
Xshift        0.0000000000
Yshift        0.0000000000
Parameters
```

