

## **APPENDIX N**

# **HISTORY OF THE NATIONAL TOPOGRAPHIC MAP SERIES (NTMS), NATMAP SERIES AND GEODATA VECTOR PRODUCT**

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## Background

The National Mapping Division (NMD) within Geoscience Australia was formerly known as the Australian Surveying and Land Information Group (AUSLIG). The change to Geoscience Australia occurred in September 2001. Prior to AUSLIG, the organisation was known as the Division of National Mapping, producing maps badged as NATMAPs. The organisation has been, since its inception, the Australian Government's civilian surveying, mapping and land information agency. One of NMD's major responsibilities is the provision and maintenance of topographic mapping information at national scales.

The majority of the 1:100 000 and 1:250 000 topographic mapping program was shared by the civilian organisation and Australia's defence mapping organisation named variously as the Royal Australian Survey Corps (RASvy), Directorate of Strategic Military Geographic Information (DSMGI) and the Defence Topographic Agency (DTA), now renamed as the Defence Imagery and Geospatial Organisation (DIGO). A small number of map sheets were also produced by State mapping agencies.

## 1:100 000 scale NTMS Maps (AGD66 Datum)

The production of the 1:100 000 NTMS was coordinated by the Division of National Mapping and its successor the Australian Surveying and Land Information Group, who carried out the compilation of the map material in conjunction with private sector producers. This map series has a standard sheet size of 0.5 degrees of latitude by 0.5 degrees of longitude. Maps were compiled for the whole of Australia, and published maps were limited to the more populated and developed coastal fringe of the continent. Compilations inside 'the red line' (a boundary line delineating the extents of Australia's remote areas) were not fair drawn or published, however they provided a primary reference source for use in the production of the 1:250 000 map series.

Overall positional control for the 1:100 000 map series was based on the Australian Geodetic Network using the 1966 adjustment and the Australian National Spheroid (Readers are referred to 'The Australian Geodetic Datum: Technical Manual', National Mapping Council of Australia, Special Publication 10, for more information on this geodetic datum.)

The base data for the map compilation material was obtained through the stereographic observation of aerial photography. The aerial photography was generally flown at a nominal scale of 1:80 000 in blocks that equated to 1:250 000 map sheets. Some photography was at a larger scale, and a variety of specialised aerial photography cameras were used internally, namely the Wild RC-8, RC-9, RC-10 and Zeiss RMK brand/models. External contractors used other cameras. All these cameras were calibrated on a regular basis on goniometer calibration equipment.

Propagation of positional control through the blocks of photography was carried out by slotted template adjustment until the mid 1970's when a method using analytical block adjustments was introduced. In some areas radar altimetry was used to extend vertical control. As with the cameras, a number of stereo plotters were used for the plotting of detail and production of contours on the compilation material. Wild B8 and Kern PG2 plotters were used by this organisation, with others plotters being used by external contractors. Stereographic models from all plotters were sampled to ensure they complied with the appropriate accuracy specifications.

Finally, all map compilation material was checked against a variety of source information. Extensive field checking was carried out on the ground and from the air, with local authorities also being consulted. Larger scale reference material and supplementary photography was also used as source information.

Contact negatives were then produced from the final map compilations. Each negative was printed down on scribing material as a guide for the cartographer to manually scribe the detail according to prescribed map specifications. Subsequent production steps were similar to those described in more detail in the following section entitled '1:250 000 scale NTMS Maps (AGD66 Datum).

The national coverage for the 1:100 000 NTMS was completed in 1988.

### 1:250 000 scale NTMS Maps (AGD66 Datum)

NTMS maps sheets at 1:250 000 scale were published by the Division of National Mapping and a number were published under the AUSLIG logo. RASvy published the Joint Operation Graphics (JOG). The NTMS and JOG series replaced their predecessor, the R502 Series, which consisted largely of uncontoured maps at the same scale. The maps were produced on the Australian Map Grid (AMG), based on the AGD66 datum.

A total of 544 sheets comprising the NTMS/JOG series provided the first nationwide coverage of published, fully contoured, topographic maps.

Because many of the NTMS sheets were converted by RASvy to their specifications and re-published as JOG maps, there are many sheets available today with identical reliability dates but published by both agencies. Most of the first edition 1:250 000 scale NTMS and JOG maps were derived manually from 1:100 000 scale topographic maps and compilations. Some were derived from 1:100 000 and 1:50 000 digital data.

The following procedures were used to develop the 1:250 000 map production material (repmat). Where 1:100 000 maps were published the relevant map repmat was used. In the remote areas where 1:100 000 maps were not published, the relevant 1:100 000 compilation material was used.

To ensure accurate registration of all the required drafting materials (clear film, scribe sheets, masks, photographic film etc.), the materials were pre-punched on the same large format, register punch. Reference grids and graticules were computer-generated and plotted on a separate layer of stable base drafting film. Map corner-marks were placed on all separate layers, e.g. hydrography, roads, contours etc. which were then reduced photographically to 1:250 000 scale on a large format Klimsch 'Super Autohorika 101' camera using the same camera setting for all material of the one map area.

A pre-punched clear film was registered to the graticule and all six reduced film positives of each layer registered to the relevant section of the 1:250 000 scale graticule, trimmed, butt joined and fixed to the clear film. A contact negative was produced from each of these assemblies. Each negative was printed down on scribing material as a guide for the cartographer to manually scribe the detail according to prescribed map specifications. Map detail was displaced if necessary to avoid overprinting and to ensure a cartographically acceptable product. Masks were cut on 'peelcote' type material to provide infill for area features such as lakes, built-up areas etc.

A colour proof of the line-work was used as a guide to type positioning on a clear film overlay. Type was added to the proof on completion of the overlay. The proof was thoroughly checked for accuracy, completeness and correct registration of detail. After proof corrections were carried out the final reproduction material used for platemaking by the printer was produced. Checking forms were used for quality control throughout the production process.

The national coverage for the 1:250 000 NTMS was completed in 1988.

### GEODATA TOPO-250K Series 1 (AGD66 Datum)

This 1:250 000 scale topographic vector product was initiated and produced by the Australian Surveying and Land Information Group (AUSLIG), the predecessor of the National Mapping Division of Geoscience Australia. This was an initiative to capture for the first time a nationwide topographic digital data set at 1:250 000 scale, based principally on the conversion of existing published 1:250 000 maps to digital ArcInfo format.

GEODATA TOPO-250K contained a medium scale vector representation of the topographic features of Australia, and comprised 540 tiles, with three themes per tile. These themes were: Hydrography (drainage networks including watercourses, lakes, wetlands and offshore features); Infrastructure (systems for the transportation of goods and services, i.e. roads, railways and associated structures, along with localities, built-up areas and aeronautical features so that these services may be located; and Relief (a series of spot elevations, chosen so as to give a representative picture of the terrain).

This product was primarily sourced from the 1:250 000 National Topographic Map Series (NTMS) and the Royal Australian Survey Corps' Joint Operations Graphics (JOG) map reproduction material. This repmat was scanned and formed the basis for the digital data, with some additional data being captured via manual digitising processes. Digital information was also provided for Tasmania, and two map areas in Western Australia, by their respective state authorities. Where NTMS and JOG maps were published with identical reliability dates, the NTMS material was used. Selective 'corridor' revision from satellite imagery and other source material was conducted on a number of tiles during the life of this program.

As the TOPO-250K data were digitised from existing map production material, some features were subject to cartographic displacement. This vector data was tested and validated by AUSLIG using a mixture of UNIX scripts and ArcInfo commands which were independent of the production system. Graphical tests were used to check such things as structure, polygon closure, minimum size of polygons and topological relationships.

The national coverage was completed in 1994.

### **GEODATA-250K Series 2 & 1:250 000 scale NATMAPs (GDA94 Datum)**

Following the completion of the GEODATA TOPO-250K Series 1 Vector product program in 1994, it was apparent that the existing paper map products needed to be updated. However, there was also a demand for incorporating all map features into the vector data product. At the same time it was recognised that efficiencies could be gained from producing the paper map and digital data product using parallel production methods. AUSLIG (now known as the National Mapping Division of Geoscience Australia) specified the production of a central database comprising the information to be included in both products as well as features that are specific to either the data (eg. hypsometric areas) or the map (eg. grid and graticule). From this database, the map features and layout could be extracted to produce a postscript file for reprostat production, and the data features extracted to form the GEODATA TOPO-250K Series 2 tile. This central database was (and is still) referred to as the 'Working Database' and is held in ArcInfo format. It contained five themes per tile, comprised of up to 32 ArcInfo coverages or 'layers' per tile. This database formed the key data source for ongoing future revisions of both map and data products at 1:250 000 scale.

Revision of the content of the maps and digital data was based on source information gathered by the NMD and its predecessor the AUSLIG, but was carried out by private sector producers. Geo-referenced satellite imagery was a key source for plotting the position of features. Visual interpretation of the imagery was aided and supplemented by information from a wide variety of sources. Field verification trips were conducted by AUSLIG during the life of the program, and this also involved contacting a range of local government authorities, private companies and individuals as deemed appropriate in an effort to collect new up-to-date information for incorporation into the product. Other external agencies that could provide appropriate additional field-verification information were also involved in this process.

The maps were produced on the Map Grid of Australia (MGA), based on the GDA94 datum. The majority of producers involved in the production of maps and data under the Series 2 revision cycle used ArcInfo as their base production tool. ArcInfo format was the specified delivery format for the Working Database and TOPO-250K Series 2 tile. Another key feature of this program was the introduction of non-standard sheet lines for some map and data areas. Strong customer feedback was received about the availability of maps where the majority of the map was covered with sea and only a very small area of land was shown. Customers were also clearly frustrated by the break up of major cities or features across two map areas. Because of this, AUSLIG reviewed all traditional sheet lines and where practical, these were altered to provide optimum representation of the landmass and key map features. As a result, many map sheets were extended beyond the bounds of the traditional map areas and some map areas were rotated to cover an area of 1.5° latitude and 1° longitude. As a result of amending these sheet extents, the total number of 1:250 000 scale NATMAPs based on the GDA94 datum was reduced to 513 sheets.

The first map sheet in the new 1:250 000 NATMAP style was printed in March 1998, and national coverage of the revised maps generated from the GEODATA-250K Series 2 program was completed in 2003.

### **Revision & conversion of 1:100 000 scale NTMS maps (AGD66) to NATMAP format (GDA94)**

The first revised 1:100 000 scale map printed in the new NATMAP style was printed in May 2000. This map, together with subsequent editions of the 1:100 000 maps, were produced on the new Map Grid of Australia (MGA), based on the GDA94 datum. Only a relatively small number of 1:100 000 map sheets in this series were selected for revision and subsequent publication (on a priority basis) from the national coverage.

As with the 1:250 000 scale NATMAPS, revision of the content of these maps was based on source information gathered by AUSLIG but carried out by private sector producers. Geo-referenced satellite imagery was a key source for plotting the position of features. Where recent aerial photography was available, it was also used to identify features seen on satellite imagery. Visual interpretation of the imagery was aided and supplemented by contact with local government and state mapping agencies as well as other groups such as mining companies, forestry groups, private land holders, emergency services and so on. These groups were a very important source of up-to-date and reliable information. Information obtained from various field trips was also incorporated where available, in conjunction with these other sources.

The producers involved in the production of the maps used ArcInfo, Microstation, Intergraph or CorelDraw as their production tool. The digital data produced in these various formats was archived internally within the organisation. However, at the time of archiving it was not planned to convert and upgrade this vector data into a format that would meet the quality standards expected of a GEODATA TOPO-100K data set that could be supplied to customers.

### **Revision of GEODATA–250K Series 2 and 1:250 000 NATMAPS (GDA94 Datum)**

A revision program to update the GEODATA TOPO–250K Series 2 Vector product (Geoscience Australia's fundamental topographic data set), and generate associated revised 1:250 000 maps, began in 2003. Several new criteria were established when determining the elements for this revision process, to enable the product to be enhanced with respect to content and accuracy. Some of these elements included;

- A “targeted” approach in the selection of map & data work units to be revised, based on a priority and needs approach, with areas containing major urban areas receiving early attention. Areas considered subject to major change, or requiring an enhancement of detail, were given priority.
- A recognition that the previous NATMAP product needed to be reviewed with respect to the level, and type of, detail shown on the map (or where omissions had taken place during that series). Map areas were assessed according to the density of population, and the adequacy of the level of feature capture reviewed eg. additional Homesteads and water point features were required to be added in the less densely populated areas.
- Enhancing and revitalising a program of field verification work, strengthening communications with local government, state and private enterprise authorities and individual contributors, in an effort to obtain up-to-date, reliable source information.
- Upgrading the early GEODATA TOPO–250K Series 2 data & maps to an equivalent level of Specification used for the latter work units in the program, and incorporating any subsequent specification amendments occurring during the life of that program.

This GEODATA–250K Series 2 revision program is still in progress.

### **TOPO-250K Seamless Database project (GDA94 Datum)**

Running in parallel with the revision of GEODATA TOPO–250K Series 2 and 1:250 000 NATMAPS has been a project to merge all 513 1:250 000 Working Database tiles into one continuous and complete dataset of Australia in an ArcGIS GeoDatabase format. This GeoDatabase will be the foundation for future revision of the 1:250 000 map product and its source digital data. Additionally, it will allow the provision of on-line nationwide topographic data coverage over the World Wide Web, and in the future the possibility of on-demand printing of unique maps for custom specified dimensions and use.

### **Future GEODATA-100K and associated 1:100 000 map program (GDA94 Datum)**

A program for the initiation of the first version of the GEODATA TOPO-100K Vector product, together with the production of associated map products, is planned for mid-2004.