ANZLIC
the Spatial Information Council

National Nested Grid (NNG)

Specification Guideline – 2012

The following organizations are represented on the ANZLIC National Nested Grid Workgroup:

- Australian Antarctic Division (AAD)
- Australian Bureau of Statistics (ABS)
- Australian Government - Office of Spatial Policy (OSP)
- Australian Hydrographic Office (AHO)
- Australian Navy Metrology and Oceanography (ANMO)
- Australian Urban Research Infrastructure Network (AURIN)
- Bureau of Metrology (BoM)
- Commonwealth Scientific and Industrial Research Organisation(CSIRO) Marine & Atmosphere
- Commonwealth Scientific and Industrial Research Organisation – (CSIRO) Soil & Terrestrial
- Commonwealth Scientific and Industrial Research Organisation – (CSIRO) soil (ASRIS)
- Commonwealth Scientific and Industrial Research Organisation – (CSIRO) landscape/DEM
- Commonwealth Scientific and Industrial Research Organisation – (CSIRO) soil GlobalSoilMap.net
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) – soil TERN Soil and Landscape Facility
- Cooperative Research Centre Spatial Information (CRCSI)
- Geoscience Australia (GA)
- Integrated Marine Observing System (IMOS)
- Land Information New Zealand (LINZ)
- Lockheed Martin Australia (LMA) - Unlocking Landsat Archive (ULA) Project
- New South Wales - Land and Property Information (LPI)
- Public Sector Mapping Agency (PSMA)
- Terrestrial Ecosystem Research Network (TERN)
- Terrestrial Ecosystem Research Network (TERN) AusCover - WA
- Victoria – Department of Sustainability & Environment (DSE)

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- Glenn Frankish LMA for technical drafting of the document
- Dr T.O. Chan DSE for coordinating the development of the specification

PREFACE

This Guideline was prepared by the Australian New Zealand Land Information Council (ANZLIC) National Nested Grid (NNG) Workgroup.

This Guideline provides the detailed specification of a spatial framework to organise new or existing grid cell (also called raster or gridded) data for people who are data users, data custodians or responsible for data capture or generation. This guideline provides the spatial consistency needed for efficient sharing and reuse of grid cell data that is generated and managed in different sources and multiple resolutions.

The reasons for production of this Guideline are as follows:

- The rapid growth in grid cell (raster) based data availability and analysis;
- The need to meet international obligations in sharing grid cell data;
- That government decision making processes are increasingly reliant on this type of data;
- The increasing desire to share information across domains and observation types; and
- The strong interest of the ANZLIC Council to sponsor standards that underpin the Australia and New Zealand spatial data infrastructures.

The specifications in this guide are selected based on the context of use discussed in a workshop and the details gathered through an online survey of the members of the Workgroup and their nominated participants. The context of use includes the following:

- International collaboration using datasets based on gridded data;
- Maintaining the accuracy of the observations stored in a gridded dataset;
- Future proofing measurements and observations in grid cell format in relation to changes in datums, map projections and the specifications that define the shape of the earth surface; and
- Computer manipulation of the measurements stored in grid cell format.

The Guideline does not contribute to the authority of the contained data. The specifications are a set of compromises and will not suit all requirements. The basis for evaluation and selection of the components of this Guideline uses the following criteria:

- Feedback from key domain and jurisdictional representatives;
- Ensuring consistency across domains considered;
- Impact on future data management tasks; and
- Reuse of existing data.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

1.1.1 GENERAL CONFORMANCE

This specification guide does not replace the need to build geospatial solutions but provides the spatial consistency needed to allow two or more organisations to work with greater data interoperability and ensure that there will be a minimum of rework and re-sampling required to use existing or new data and to use the final fused results.

As the size of this data increases with the improvement of sensors and collection frequencies, the cost of reformatting this data for analyses begins to impinge the ability to do the analyses. This can be reduced by adoption of a set of agreed specifications for Australian and New Zealand as detailed in this National Nested Grid (NNG) document.

This specification guide represents a set of specifications for spatial location and resolution for grid cell data that is accepted by jurisdictions of the Australia & New Zealand Land Information Council (ANZLIC). Government and other agencies in these jurisdictions are expected to adopt the aspirational specifications in managing their grid cell data as far as practical to facilitate sharing and reuse of the data. While this may be adopted via institutional administrative arrangements, this is not mandated by any legal means. In practice, this guide provides a point of coordination for managing gridded data and the details are expected to be reviewed regularly. This document is to be kept as a living document to reflect data custodians and users needs.

1.2 SCOPE CLAUSE

This specification guide defines the common hierarchical grid system, in which grid cell data from different sources and formats are managed. The guide covers the following elements:

- Coordinate system
- Datum
- Point of origin of individual grid layers in the hierarchical grid system (upper left corner)
- Cell size (resolution)

1.2.1 Coordinate system

All coordinate systems described are spatial reference systems specified by their corresponding European Petroleum Survey Group (EPSG) codes. They cover projected grids that are based on one or more map projections and unprojected grids, based on latitude and longitude. Each EPSG code specifies the required parameter set to define the reference system and is used as a consistent referencing mechanism for the coordinate systems in this guide.

1.2.2 Datum

The datums specified in this guide are consistent with the choice of the spatial reference systems adopted for the unprojected and projected nested grids. No change of datum away from the one proscribed is allowed to maintain compliance with the NNG specification.

1.2.3 Point of Origin

The point of origin of the unprojected grid is the (0,0) lat-lon coordinate of the global unprojected grid specified in the guide. This is the point where the prime meridian crosses the equator.

The point of origin of each projected grid system in the guide specifies the (x,y) coordinates (in metres) of the upper left (north-west) corner of the grid system. The point, which may be just inside or outside the extent specified in the corresponding EPSG code, is chosen arbitrarily for two purposes. One purpose is to ensure that the grid covers the agreed land mass and extended boundaries concerned, i.e., Australia, New Zealand and the Antarctica. The other purpose is to ensure the coordinates of the grid cells at different resolution will remain as whole round numbers, not decimal numbers. The latter could bring unnecessary storage and computational issues in future.

1.2.4 Cell Size

The cell sizes for this guide are selected on two direct considerations:

(a) Reasonable coverage of the main grid sizes of importance to the user community:
  - (i) while the original nominated cell sizes for the unprojected grid are in degrees, minutes and seconds, they are converted into decimal degrees for ease of computation
  - (ii) the grid sizes for projected grids are in metres (m)

(b) Maintaining a "nesting" of cells, or alignment of cells of different resolutions.

Nesting is a desirable property but the cell sizes nominated for this guide do not support a simple consistent nesting sequence. To resolve this issue all the required cell sizes are included but distributed between 2 series of cell sizes. Each series is designed to support a simple nesting sequence.

This "dual series" of supported resolutions applies to both the projected and unprojected specification for each grid via a set sequence of supported resolutions. All the resolutions specified in the cell size tables (Table 2 in section 2.2.4 and Table 4 in section 2.3.4) are supported by this guide, it is up to the user to decide if the nesting property is important for their application and enforce the series selection if required.

From the consultation process used for creating this guide, the user community indicated that, as a general trend, the unprojected grid was more suited to the larger cell sizes and that map projection was more suitable for the coverage with smaller cell sizes. The cell size range is summarised in Table 1.

Table 1: Cell size range and preferred projection type

Projection Type	Applicable Range
Unprojected	10˚ - 0.0002778˚ (Decimal Degrees, ~1”)
Projected	1000m to 1m

1.2.5 Out of Scope

The following are out of scope of the current Guideline:

(a) Lattice based data collections, i.e., data collected at sample points located at line intersections of a pre-defined grid (lattice).
(b) Metadata. This is covered by other relevant ISO and OGC standards in particular the ISO19115-2, ISO19139-2 specifications. These standards are endorsed for use by ANZLIC and this guide does not change this status.
(c) New projection specification. This guide only considers the well-known projections in use at the time of writing.
(d) The well-known specialist projection, UTM, is excluded as each UTM zone has a limited coverage,

1.3 APPLICATION CLAUSE

This Guide specifies the fundamental parameters that define the extents and positions of grid cells in a set of agreed nested grids. The nested grids in turn form a consistent framework to organise the marine and terrestrial attributes needed to describe and assess the social, economic and environmental conditions of Australia, New Zealand and Antarctica.

1.4 REFERENCE DOCUMENTS

Normative Reference

N/A

Informative Reference

CHAN, T., FRANKISH, G. and FARRELL, S.2010. A National Grid Cell Data Infrastructure: Significance of a Hierarchical Grid System and Cooperative Research Centre. *Paper presented at GSDI 12 World Conference: Realising Spatially Enabled Societies*. 19-22 October 2010. Singapore. Accessible at http://www.gsdi.org/gsdiconf/gsdi12/papers/78.doc

Related documents

N/A

1.5 DEFINITIONS CLAUSE

Term	Definition
C-Squares	geocoding convention developed by Tony Rees of CSIRO and adopted by many marine and atmospheric research projects.
Cell	A single area where the data value is constant or represents a single observed value. A cell is defined by a location and an extent (resolution) value.
Grid	A pattern of regularly spaced lines in two dimensions. It is often used to represent collection of data points observations that are equally spaced in the principle coordinate directions, each data point may be represented by a lattice point or a cell.
Grid layer	A grid that has a defined cell resolution.
Hierarchical Grid System	A collection of grid layers with cells of a higher resolution grid layer nested within cells of a next lower resolution grid layer. Each hierarchical grid system conforms to a defined coordinate system.
Lattice	Collection of points at the line intersections of a Grid area.
WMO Squares	A well-known geocoding convention based on the grid specification adopted by the World Meteorological Organisation.

SECTION 2 GRIDS

2.1 INTRODUCTION

These specifications here are organised into two sections according to the respective coordinate systems.

(a) Unprojected Grid Specification.
This relates to grid systems that are not referencing a map projection and use geographic coordinates that give varying cell sizes.

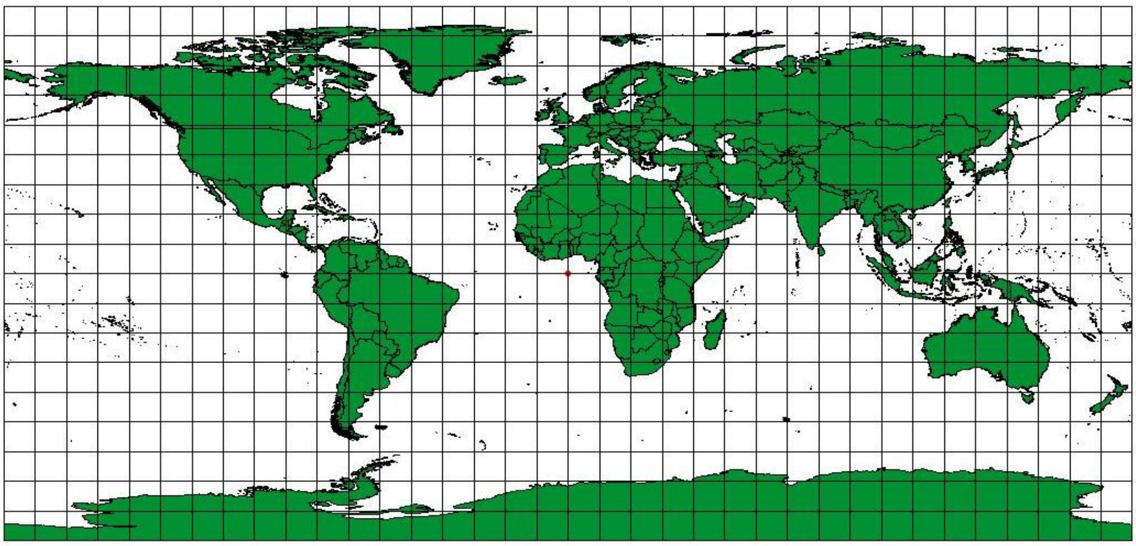
(b) Projected Grid Specification.
This relates to grid systems, each of which references a projected map system in its definition. Within this section of the specification there are references to 3 map projections for each region of interest to the ANZLIC community.

In each section, the other elements of the specification, that of: datum, point of origin and cell sizes, are described.

2.2 UNPROJECTED GRID SPECIFICATION

2.2.1 Coordinate System

A key use case for unprojected data is derived from the need to share information between international jurisdictions and contribute to global spatial data infrastructure and research projects. To aid this objective the starting point chosen for the reference is based on the WMO Squares concept[1] (Figure 1). This is a uniform 10 x 10 degree grid centred on the origin of the latitude and longitude (0,0) as denoted by the small red dot at the centre of Figure 1.



[1] It is important to note that WMO squares is a geocoding concept and not a coordinate system but it is a regular well known geographic reference as well.

Figure 1: WMO Squares / Top level Nested Grid

2.2.2 Datum

The NNG uses the ITRF 2005 datum[2].

2.2.3 Point of Origin

The point of origin is the latitude and longitude (0,0), highlighted in red near the centre in Figure 1 WMO Squares.

2.2.4 Cell Size

The suggested resolutions supported begin at the same level as WMO squares concept, for example, the 10˚x10˚ grid, the coarsest resolution. The subsequent resolutions are listed in Table 2.

Table 2: Supported cell sizes for unprojected NNG

Cell Size – Decimal Degrees	Cell Size – Degrees	Series 1	Series 2
10	10° 0' 0"	X	x
5	5° 0' 0"	X	x
2.5	2° 30' 0"		x
1	1° 0' 0"	X	
0.5	0° 30' 0"	X	x
0.25	0° 15' 0"		x
0.1	0° 6' 0"	X	
0.05	0° 3' 0"	X	x
0.025	0° 1' 30"		x
0.01	0° 0' 36"	X	
0.005	0° 0' 18"	X	x
0.0025	0° 0' 9"	X	x
0.0008333[3]	0° 0' 3"	X	Unsupported
0.0002778	0° 0' 1"	X	Unsupported

[2] This datum's EPSG code is 6869. This is used by several CRS, any of which can be used as a suitable basis for the unprojected grid, For example, EPSG 4896 CRS is an ITRF 2005 based system

[3] Note this is not a rational number and care must be taken with the mathematics associated with accumulating these types of values. i.e. computational error may be significant when using large grids and small resolutions.

2.3 PROJECTED GRID SPECIFICATION

2.3.1 Coordinate System

For the projected NNG specification there needs to be a "region" approach used as it is not feasible or good practice to assign grids outside their defined regions. To this end the projected system will use the most appropriate projection for the region considered. This is not seen as an impediment to most calculations as projected grids are much more commonly used for the definition of land oriented measurements. The three regions that need to be considered separately are:

(a) Mainland Australia and Tasmania (MAT)
(b) New Zealand
(c) Antarctica

In addition to the three separate regions, there is also global position and orientation of the landmass to consider in the choice of projection. Many respondents to the consultation process used to acquire information to this specification guide have indicated that an "equal area" projection is justified when the target audience for the information is interested in an "accounting" type function, i.e., this projection allows simple area and coverage calculations. This suits MAT quite well but for the Antarctic the projection does not suit the mathematics particularly well and for New Zealand already has an established projection in use to achieve this objective.

To accommodate these differences the workgroup chose not to enforce a universal projection for these three regions. The projection selected for each is based on the needs for the region it serves.

Table 3: Appropriate map projections for the three key regions of Australia and New Zealand

Region	Projection Title	Projection EPSG code	Point of Origin
Mainland Australia and Tasmania	Australian Equal Area Albers (Figure 2)	3577	-2690000, -1000000
New Zealand	New Zealand Transverse Mercator 2000 (Figure 3)	2193	9830000, 6217000
Antarctica	Antarctic Polar Stereographic (Figure 4)	3031	-3000000, -3000000

The extents defined in the table above cover the main land mass and nearby islands of each region of interest. For outlying islands that are not in the projected extents the projection choice is not defined in this specification and may be subject to revision of this specification. At present covering these outlying cases the unprojected grid specification should be used by preference.

2.3.2 Datum

All three projections are based on datum specified in the projection details.

2.3.3 Point of Origin

The points of origin of the three projections are marked by the upper left corners of the grid systems illustrated in Figure 2, 3 and 4 below. The coordinates of each point are documented in Table 3 above.

Each point of origin has been selected to ensure that the resulting grid covers the full area of the region in question. The origin may not align with the coordinates of the upper left (North-west) corner of the projection definition.

Appendix A (steps 15 & 16) illustrates the logic of the choice of the origin to cover the region of interest.

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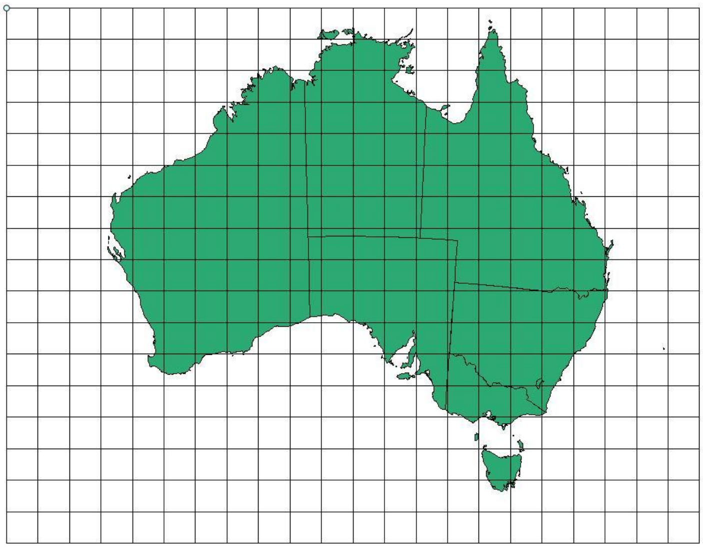


Figure 2: Australian National Nested Grid Coverage based on EPSG 3577

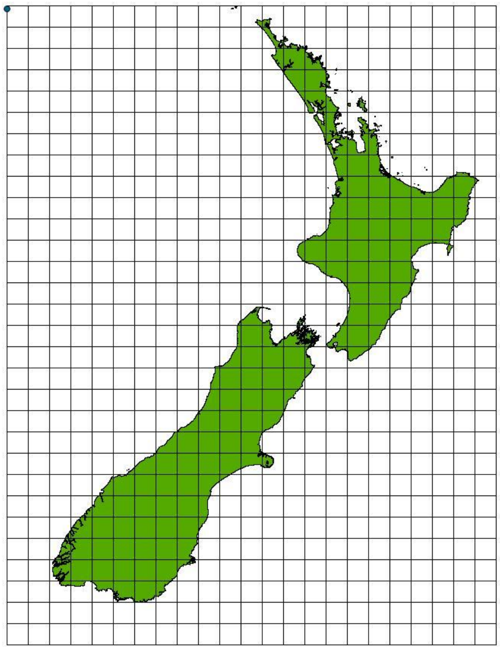


Figure 3: New Zealand National Nested Grid based on EPSG 2193

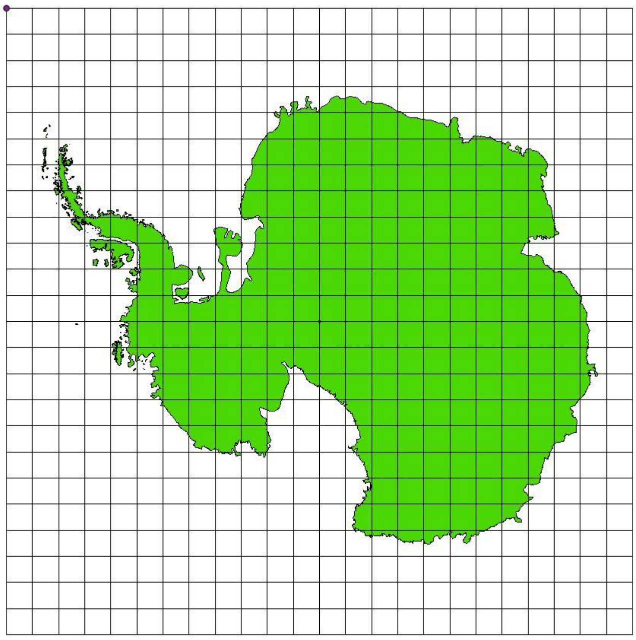


Figure 4: Antarctic Nested Grid based on EPSG 3031

2.3.4 Cell Size

Table 4: Supported cell sizes for projected NNG

Cell Resolution	Series 1	Series 2
1000m	x	x
500m	x	x
250m	x	
100m		x
50m	x	x
25m	x	
10m		x
5.0m	x	x
2.5m	x	
1.0m		x

3 NNG COMPLIANCE

3.1 Compliance Validation

The specification of the four parameters of NNG in the sections above allows the easy validation of the compliance of an existing grid cell dataset to the NNG. The computational procedures are illustrated in Appendix B for reference.

3.2 Compliance: Value of Constrained Cell Resolutions

The constrained cell resolutions of the NNG allow the efficient resampling of data for customised analyses. This is illustrated by a scenario of data upscaling as described in Appendix C.

Appendix A

GRID GENERATION PROCEDURE

A1 Scope:

This procedure is only applied to the development of projected grids for the National Nested Grid Project.

A2 Software Required

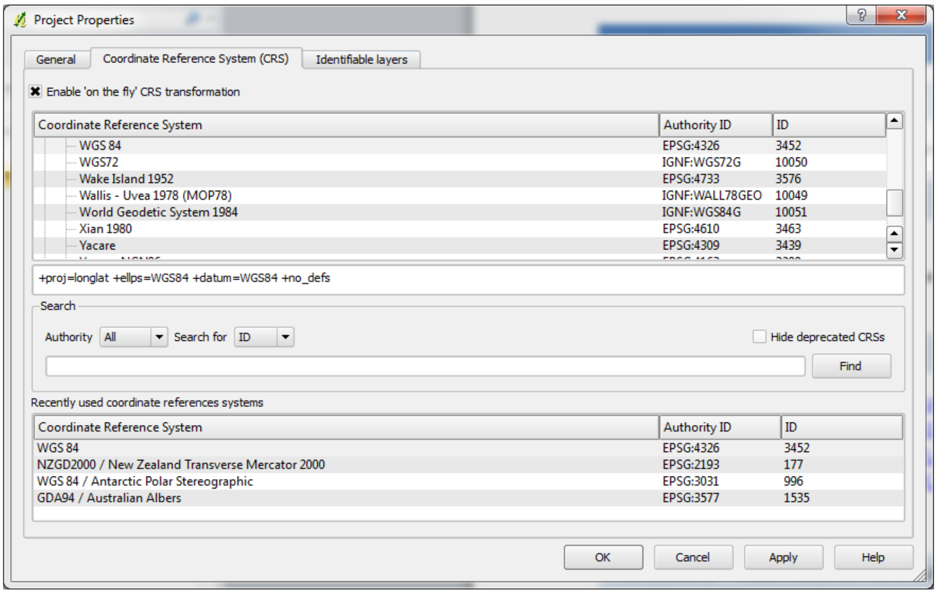
- QGIS 1.6
- QGIS 1.6 plugin "Shapefile Structure Viewer and Editor" from (http://www.bc-consult.com/free/bccshpv.html)

A3 Data Required

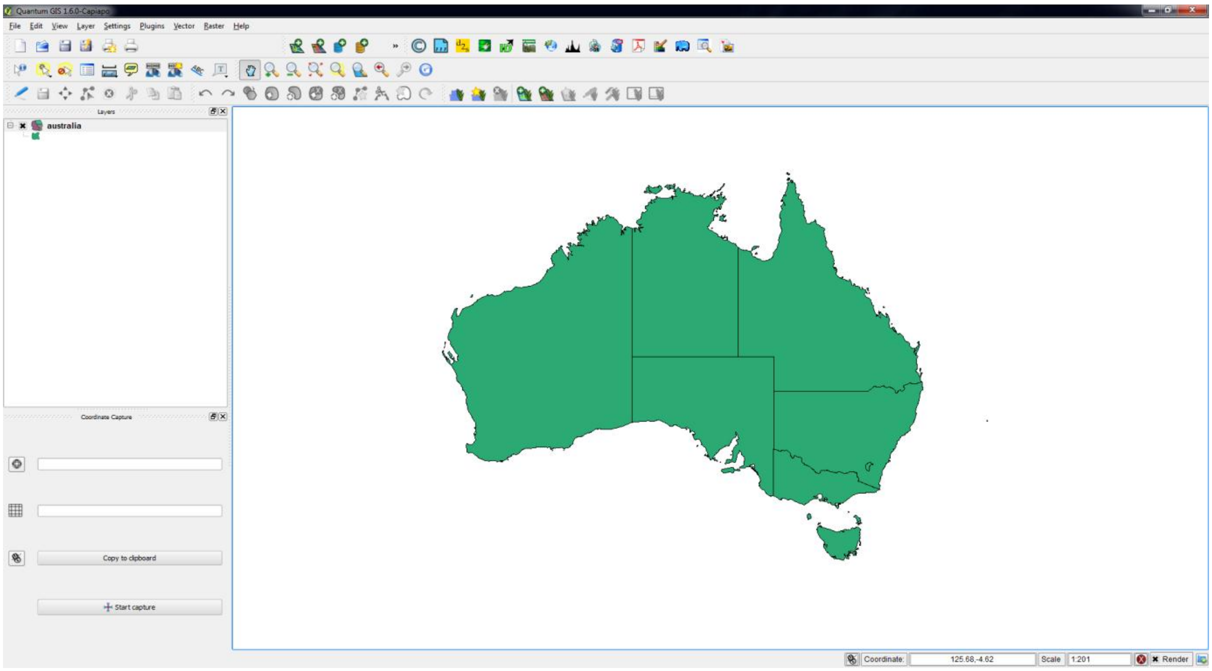
- Australian Outline Shapefile (NNG Specification\outlines\australia.shp)
- New Zealand Outline Shapefile (NNG Specification\outlines\nz_mainland_only_mp.shp)
- Antarctica Outline Shapefile (NNG Specification\outlines\world_NAME__ANTARCTICA.shp)

A4 Procedure – Australian Mainland and Tasmania National Nested Grid Generation

1. Start QGIS 1.6
2. Import Australian Outline from Shapefile (NNG Specification\outlines\Australia Outline\australia.shp)
3. Go to "Settings -> Properties"
    a. Ensure the "Enable 'on the fly' crs transformation" is checked



b. Ensure the EPSG:4326 coordinate system is selected
c. Hit apply and close



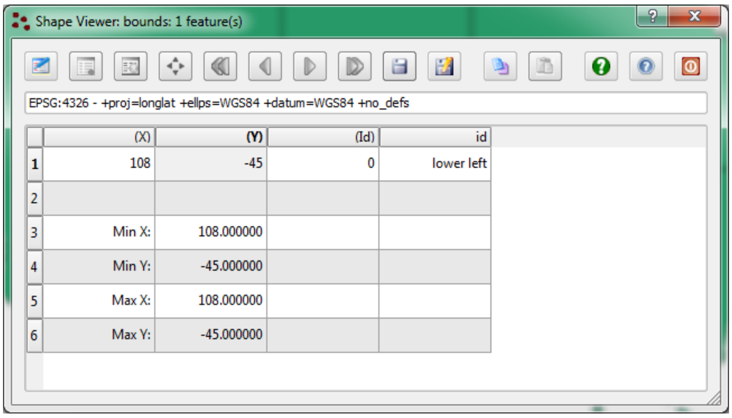
4. Note: this is a geographic projection to start with
5. Create a “Bounding box” in a new vector layer
   a. “Layer -> New -> New Shapefile Layer”
   b. Leave the type as point
   c. Add and attribute
      ▪ Name id
      ▪ Type Text data

- Width 80
- "Press "Add to Attribute list"

d. Press "OK" to complete the function
e. Save the Shapefile as "bounds.shp" in the "NNG Specification\Australia NNG" Directory

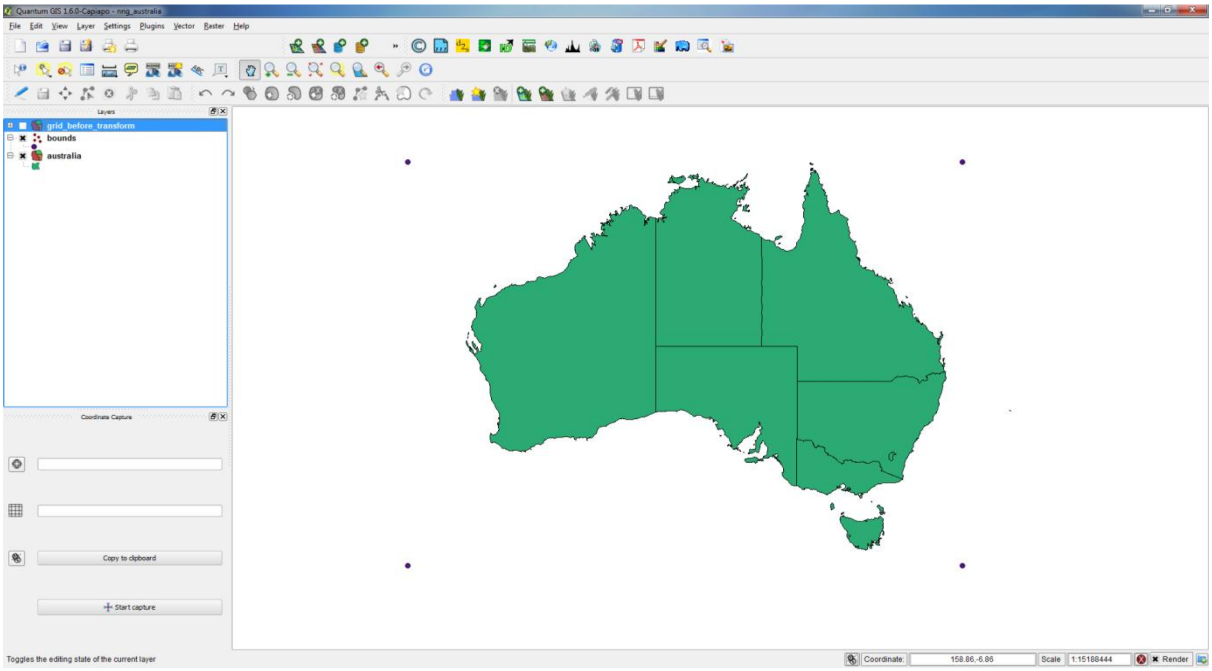
6. Edit the bounds layer to add the initial origin point
7. Create a approximate point
   a. "Toggle editing" with the bounds layer selected
   b. Select "Capture point"
   c. Using the cursor place a point in approximately the correct position using the mouse.
   d. Give this point the id "lower left" in the attribute box
   e. Save the edits using the save button on the edit toolbar
   f. "Toggle Editing" again to exit edit mode for this layer

8. Refine the Position of the origin
   a. "Select the bounds layer" (Note: it should be selected already)
   b. Select the "Plugins -> Vector ->Shapefile Viewer" function
   c. Edit the point position to be exactly the E108,N-45 coordinate

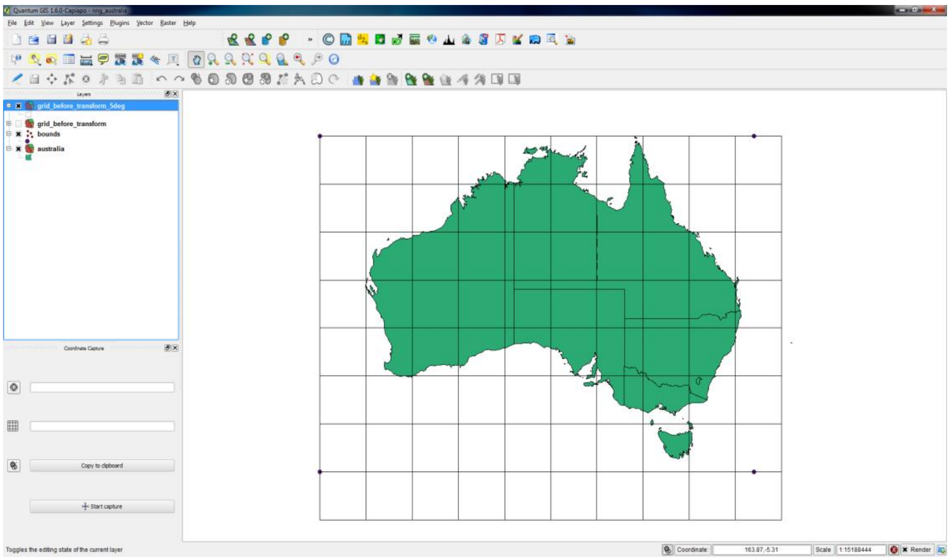


   d. Save the point and exit the dialog

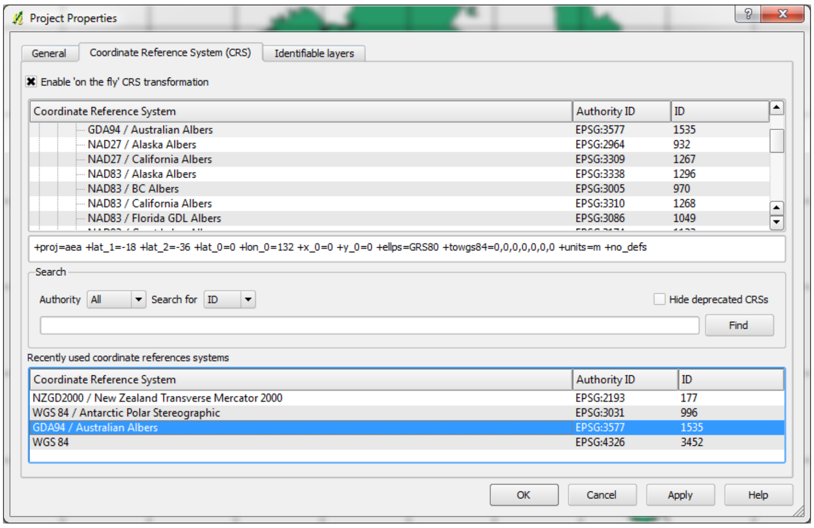
9. Repeat step 7 and 8 with the E155,N-45 Coordinate labeling it as "lower right"
10. Repeat step 7 and 8 with the E155,N-10 Coordinate labeling it as "upper right"
11. Repeat step 7 and 8 with the E108,N-10 Coordinate labeling it as "upper left"
12. The points should not be visible in QGIS



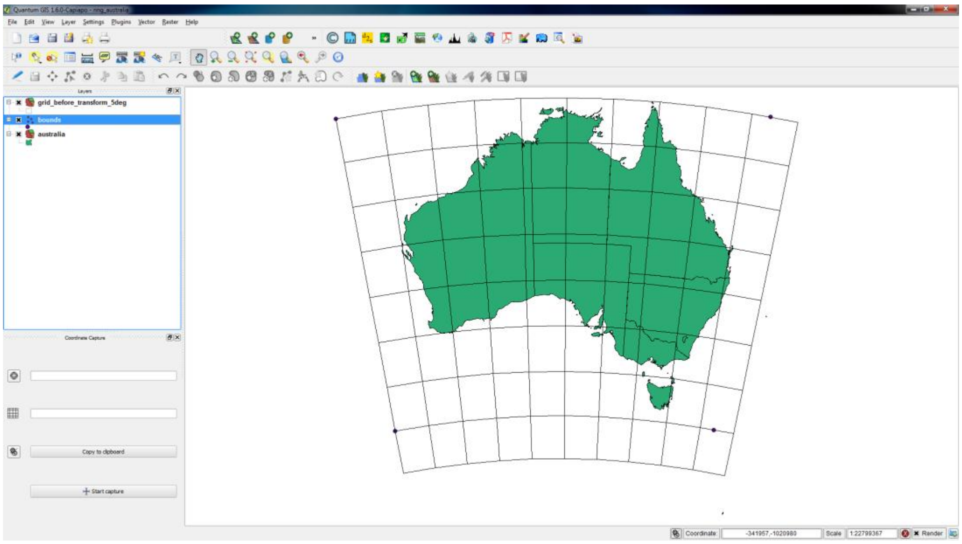
13. Create an unprojected grid for future reference
    a. Select “Vector -> research tools -> vector grid”
    b. Select the “bounds” layer in the dialog
    c. Press update extends from layer
    d. Enter 5 in the X parameter box
    e. Enter a file name grid_before_transform_5deg.shp when the “browse” dialog box opens
    f. Press “OK”
    g. Add the layer to the TOC and make the fill value “none”



14. Test the “on the fly projection” capability of QGIS
    a. Select “Settings -> project properties”
    b. Find the “EPSG 3577” projection using the “find” function in the dialog.



c. Select the EPSG 3577 projection
d. Press "apply" (Note: the map will disappear)
e. Close the dialog
f. And do a full zoom

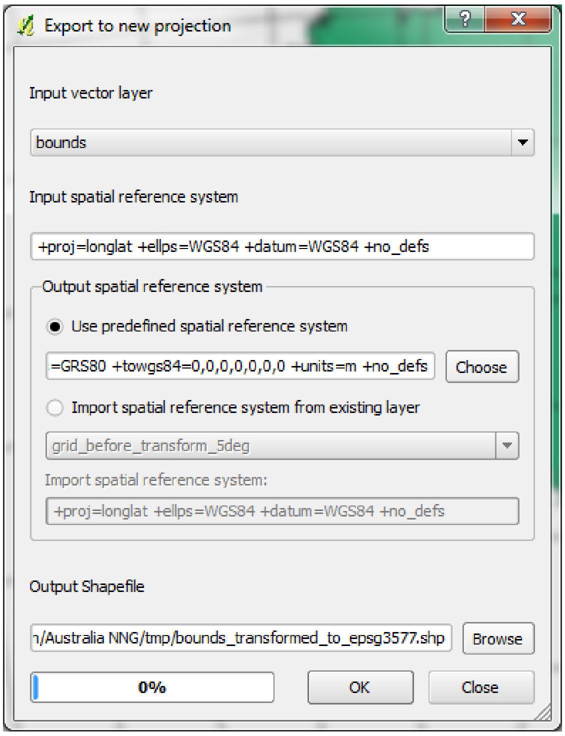


g. Note the "bend" of the lines of equal latitude in this projection. This is significant as choosing a "top left" coordinate in this projection must take this into account.[4]

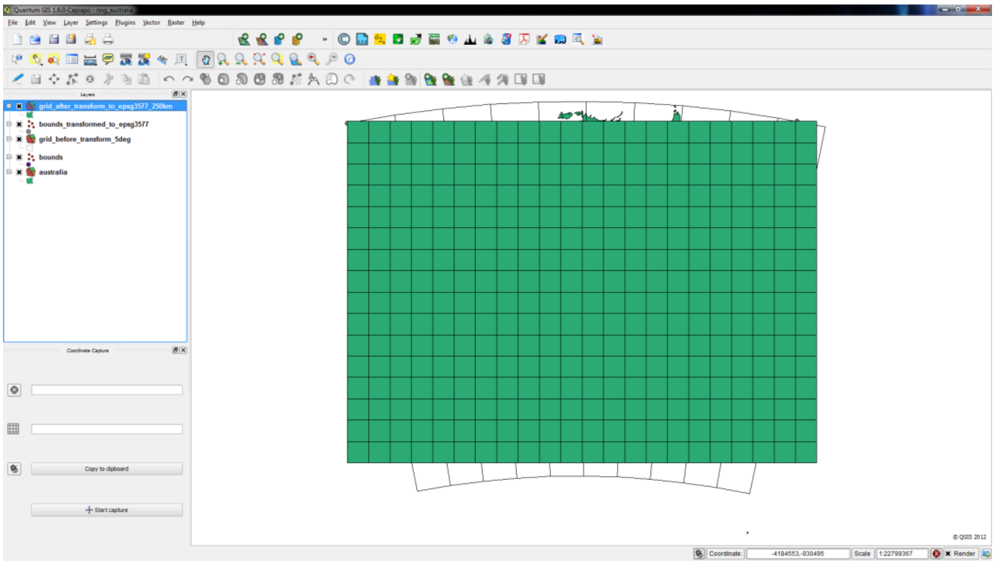
15. Investigate the consequences of creating a grid system in this coordinate reference frame
    a. Select "Vector- > data management tools -> export to new projection "
    b. Select the "bounds" layer to be the "input vector layer"

[4]This particular issue causes a lot of confusion.

c. Make the "output spatial reference system" to be the EPSG:3577 projection

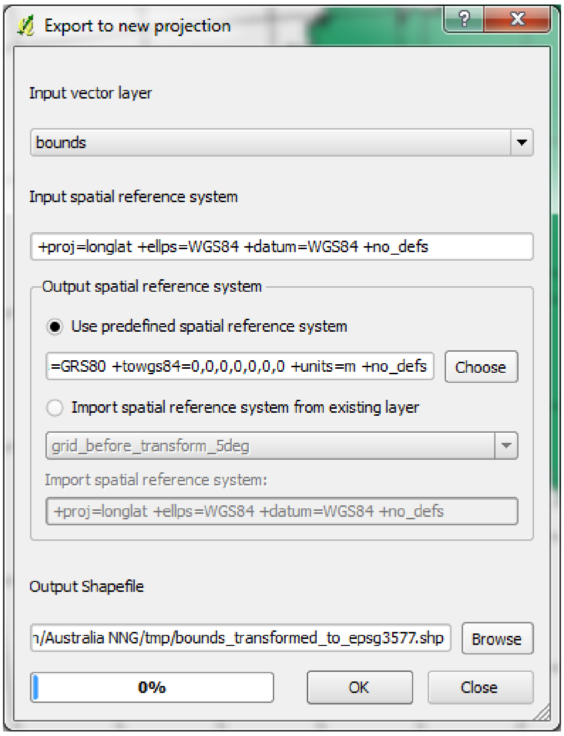


d. Press OK
e. Add layer to the TOC
f. Select the "bounds_transformed_to epsg3577" layer
g. Select "Vector -> research tools -> vector grid"
h. Select the "bounds_transformed_to_epsg3577" layer in the dialog
i. Press update extends from layer
j. Enter 250000 (metres) in the X parameter box
k. Enter a file name grid_after_transform_to_epsg3577_250km when the "browse" dialog box opens
l. Press "OK"
m. Add the layer to the TOC and make the fill value "none"

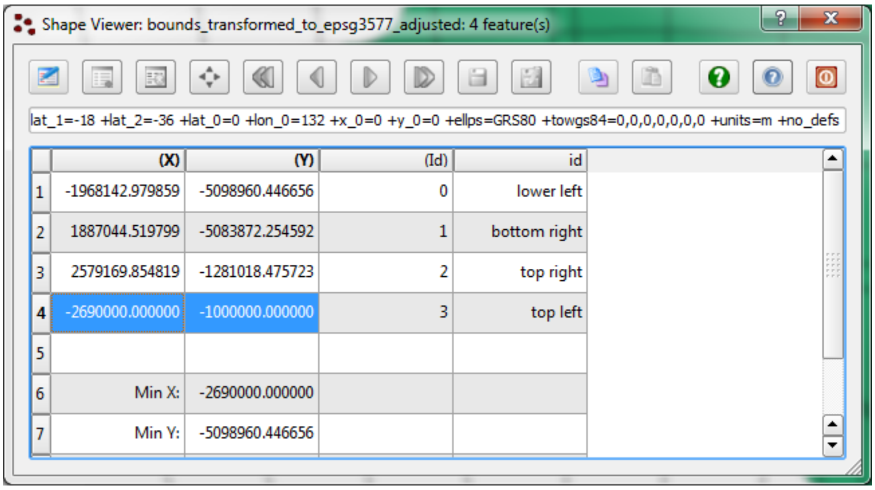


n. From this grid we can see that the regular grid in the EPSG 3577 projection does not take into account the "upward" bend caused by this projection and indicated that the choice of the "extents" of the validity of the projection is not a good choice for the NNG origin for this domain.

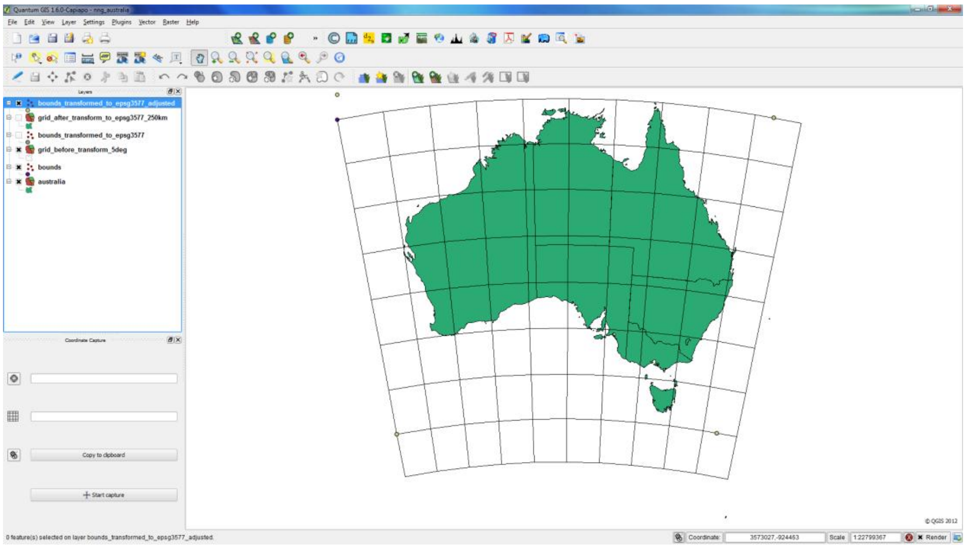
16. Revising the origin of this grid to ensure coverage in EPSG coordinates
   a. Hide the grid_after_transform_to_epsg3577 layer
   b. Select the "bounds" layer
   c. Select "Vector - > data management tools -> export to new projection "
   d. Select the "bounds" layer to be the "input vector layer"
   e. Make the "output spatial reference system" to be the EPSG:3577 projection
   f. Set the output file to "bounds_transformed_to epsg3577_adjusted"



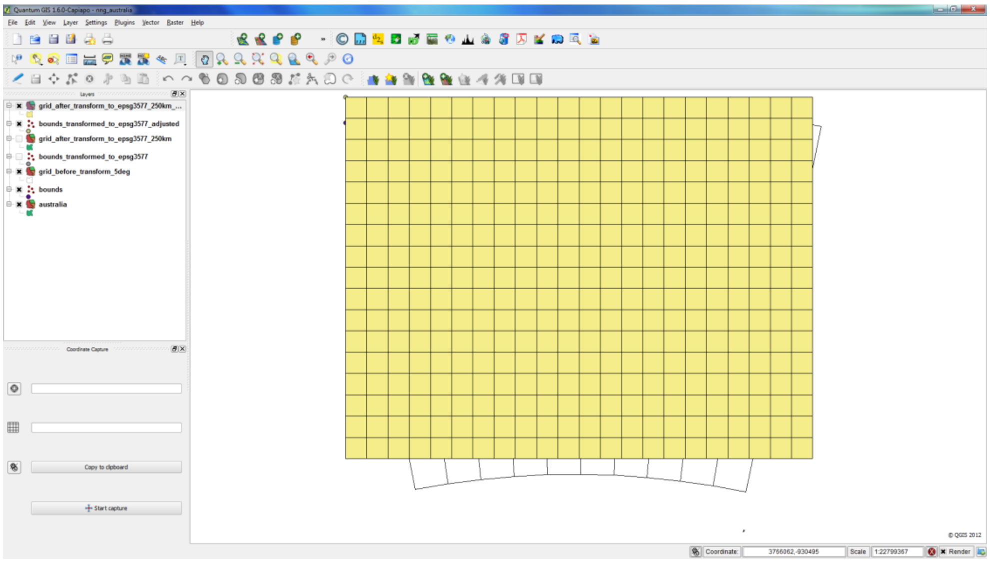
g. Press OK
h. Add layer to the TOC
i. Select the "bounds_transformed_to epsg3577_adjusted" layer
j. Select "Vector -> research tools -> vector grid"
k. Select the "bounds_transformed_to_epsg3577_adjusted" layer in the dialog
l. Select the "Plugins -> Vector ->Shapefile Viewer" function
m. Edit the "top left" point position to be exactly the -2690000, -1000000



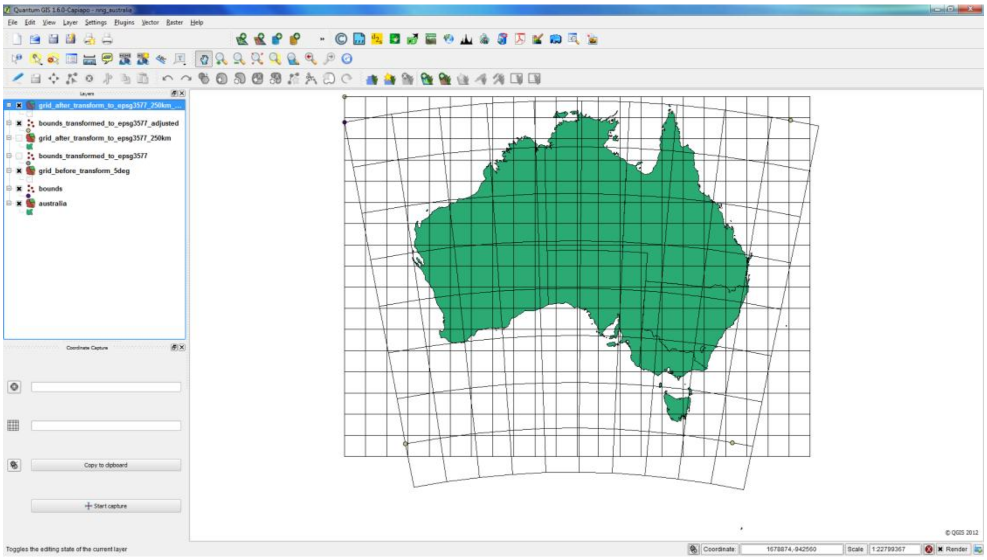
n. Save the point and exit the dialog



o. Select “Vector -> research tools -> vector grid”
p. Select the “bounds_transformed_to_epsg3577_adjusted” layer in the dialog
q. Press update extends from layer
r. Enter 250000 (metres) in the X parameter box
s. Enter a file name “grid_after_transform_to_epsg3577_250km_adjusted” when the “browse” dialog box opens
t. Press “OK”



u. Make the grid transparent



v. The entire region of interest is now covered with a rectangular grid in the EPSG3577 coordinate reference system.

17. Conclusion
   a. Projection EPSG 3577, origin -2690000, -1000000
   b. Note 1: technically the origin is outside the specified bounds of the projection. This cannot be avoided as the unprojected bounds cannot be represented in a regular grid pattern in this projection.

Appendix B

PROCEDURE OUTLINE FOR NNG COMPLIANCE

(a) Assume you have selected a resolution for the grid
(b) Assume 25m Grid
(c) Calculate the top left coordinate of the first cell in the local grid
(d) Take the NNG origin and subtract the origin values from corresponding local grid values
(e) For each difference divide by the resolution being used
(f) Check the Diff X is a whole number. If yes proceed to (g) else stop the grid is not aligned with the NNG
(g) Check the Diff Y is a whole number. If yes then the grid is NNG compliant otherwise it is not aligned with the NNG.

B1 Example: Grid Validity 1 – Projected Grid incompatible cell definition

Consider a 25 metre cell centred at coordinate 1143525, -4180414 the EPSG3577 coordinate reference system.

Is this cell compatible with the National Nested Grid Specification?

(a) Calculate the top left coordinate of the cell. (1143525 – 12.5 = 1143512.5), (-4180414 – 12.5=-4180426.5)
(b) The NNG origin is -2690000, -1000000
(c) Hence the difference values are 3833512.5, -3180426.5
(d) Divide the differences by 25 result in 153340.5 , -127217.06
(e) The first difference value is not a whole number hence the easting is not compliant with NNG
(f) The second difference value is not a whole number hence the northing is not compliant with the NNG.

B2 Example: Grid Validity 2 – Projected Grid compatible cell definition

Consider a 25 metre cell centred at coordinate 1143512.5, -4180437.5 the EPSG3577 coordinate reference system.
Is this cell compatible with the National Nested Grid Specification?

(a) Calculate the top left coordinate of the cell. (1143512– 12.5 =1143500), (-4180437.5 – 12.5=--4180450)
(b) The NNG origin is -2690000, -1000000
(c) Hence the difference values are 3833500, -3180450
(d) Divide the differences by 25 result in 153340 , -127218
(e) The first difference value is a whole number hence the easting is compliant with NNG

(f) The second difference value is a whole number hence the northing is compliant with the NNG.

B3 Example: Grid Validity 3 – Unprojected Grid incompatible cell definition

Consider a 0.05 degree cell centred at coordinate 144.025, -34.0 in an unprojected coordinate system.

Is this cell compatible with the National Nested Grid Specification?

(a) Calculate the top left coordinate of the cell. (144.025– 0.025 =144), (-34.0– 0.025=-34.025)
(b) The NNG origin is 0.0, 0.0
(c) Hence the difference values are 144, -34.025
(d) Divide the differences by 0.05 result in 2880 , -680.5
(e) The first difference value is a whole number hence the easting is compliant with NNG
(f) The second difference value is not a whole number hence the northing is not compliant with the NNG.

B4 Example: Grid Validity 4 – Unprojected Grid compatible cell definition

Consider a 0.05 degree cell centred at coordinate 144.025, -34.025 in an unprojected coordinate system.

Is this cell compatible with the National Nested Grid Specification?

(a) Calculate the top left coordinate of the cell. (144.025– 0.025 =144), (-34.025– 0.025=-34.05)
(b) The NNG origin is 0.0, 0.0
(c) Hence the difference values are 144, -34.05
(d) Divide the differences by 0.05 result in 2880 , -681
(e) The first difference value is a whole number hence the easting is compliant with NNG
(f) The second difference value is a whole number hence the northing is compliant with the NNG.

Appendix C

UP SCALING PROCESS

If data is available at a lower resolution and it is desired to conduct an analysis at a smaller resolution normally the data would be "sampled" into the finer grid from the larger grid resulting in merged grid of values. This process is "up scaling".

In the case of the NNG this process is made easy as the grids with different (but constrained) resolutions have a guaranteed alignment within the NNG Scheme. In simple terms the lower resolution data can be assigned to lower grid values with no loss of fidelity that might arise from a resampling application.

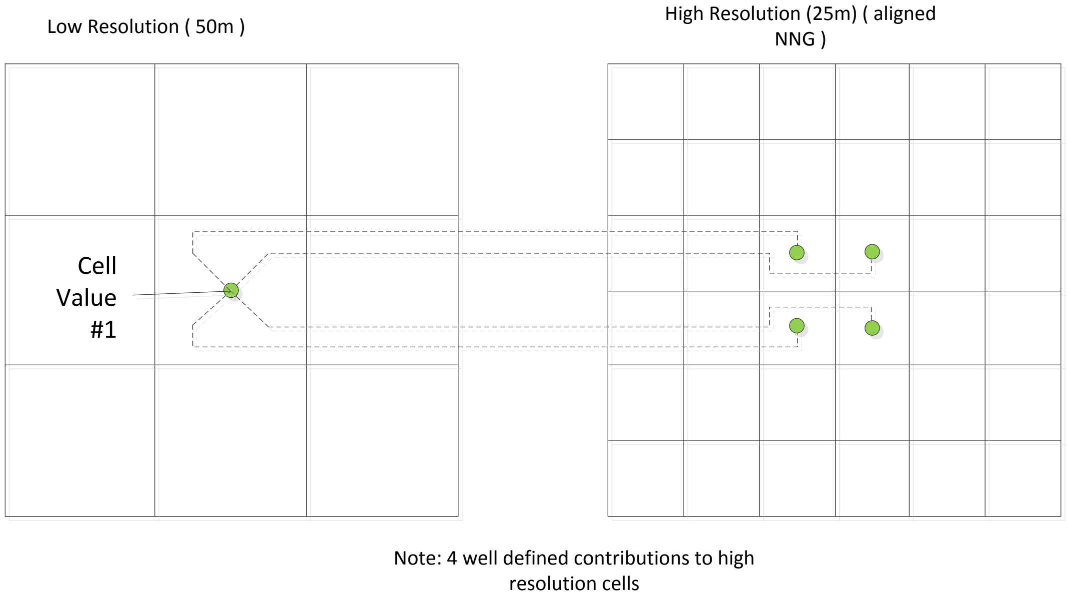


Figure 5: Assigning values to higher resolutions in NNG

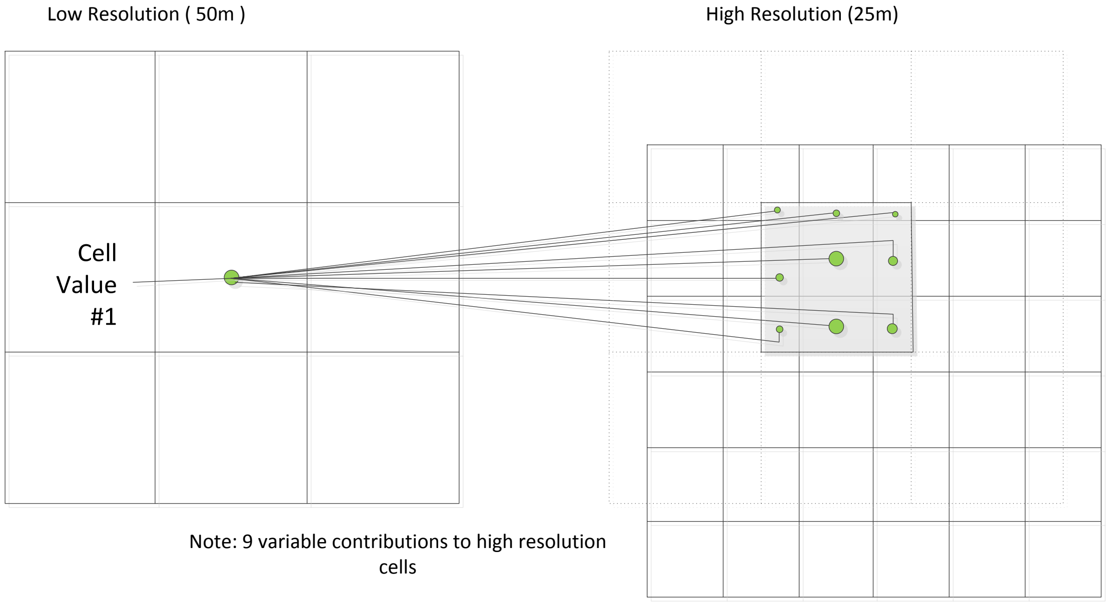


Figure 6: Assigning values to non NNG aligned cells

Appendix D

SUMMARY OF NATIONAL NESTED GRID SURVEY RESULTS

Key Stakeholders were provided with a Survey Link. The results received are summarized below.
Key Findings – Common • Projected and unprojected grid systems are both required for the use of gridded data. • Current usage patterns are driven by a combination of target application and sensor. • Policy making support activities are a key driver for remote sensing using gridded data.
Key findings unprojected grids • Unprojected grids should be aligned with international conventions such as WMO squares. • There is no "preferred" cell size discernible from the client base only a trend to higher resolution data is detectable. • There is significant support for including cell sizes to 1s resolution.

Key findings for projected grids
• Projected grids should be appropriate for the area being described.
    ○ Australia and Tasmania
    ○ New Zealand Mainland
    ○ Antarctica
• There is no identifiable need for a single projection for all territories.

• UTM is used by a significant number of the remote sensing community. • Equal area projections are beneficial but not essential for this specification guide.