NTv2-CPD transformation grid
plus Lord Howe Island & Norfolk Island

Purpose / Aim
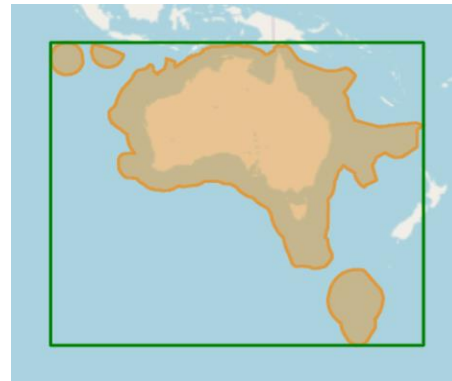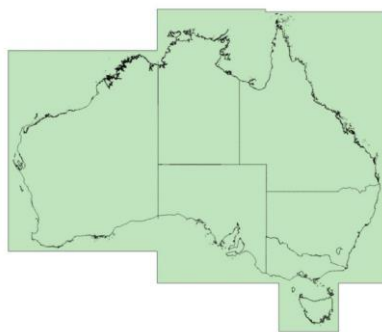A custom NTv2-CPD transformation grid which extends to include offshore land areas is required.
This document describes *gda94_gda2020_CPD_plus_lordhowe_norfolk.gsb*
https://portal.spatial.nsw.gov.au/portal/home/item.html?id=f39d633067ba44b6962fa99fdfcf70a0

Background
Official GDA94 <> GDA2020 transformations, including 7-parameter transformations and NTv2 grids, are available from https://www.icsm.gov.au/datum/gda-transformation-products-and-tools.

The NTv2 grids (NTv2-CON and NTv2-CPD) are valid only for 'mainland' Australian extents (plus separate grids for Christmas and Cocos Islands), while the 7-parameter transformation is valid for all GDA2020 extents. See Gowans_APAS2018 and Common_Australian_EPSG_Codes_and_Transformations_Information_Sheet for more information on NTv2 grid format and extent.

Figure 1: (Left) NTv2-CPD grid extents with eastern most extent at 154.1^{o}E
(Right) 7-parameter transformation extent, covering all onshore and offshore GDA2020 extents.

NSW Foundation datasets held by NSW Government agencies currently cover mainland NSW, as well as offshore land area(s) around Lord Howe Island (approx 159°E Longitude). A need has also been identified to cater for Norfolk Island (approx 168°E; NSW Surveyor General authority also covers Norfolk Island).

NSW Foundation datasets should generally be transformed using the NTv2-CPD grid (Gowans_APAS2018). However, where a dataset contains both onshore as well as offshore data outside the NTv2-CPD grid extent:
- Some software (e.g. FME) also allows the nomination of a fallback transformation (e.g. 7-parameter)
- Some software (e.g. ESRI) will silently fail; A custom 'NTv2-CPD-plus-offshore' grid is required.

Custom NTv2-CPD-plus-LordHowe-Norfolk grid extents
Consultation with data custodians and stakeholders has identified the following extents for a custom grid.
- NTv2-CPD (EPSG:8447) with eastern bounds 154.1^{o}E (see also Gowans_APAS2018)
- plus Lord Howe Island and surrounds:
  - [N,S,W,E: -31°17'S, -32°20'S, 158°48'E, 159°54'E]
  - = LHI Habitat Protection Zone, plus National Park Zone per LHI Zoning-Map
- plus Norfolk Island and surrounds:
  - [N,S,W,E: 28°38'S, -29°45'S, 167°40'E, 168°20'E]
  - = Norfolk Special Purpose Zone (scaled off web service info to nearest metre, see Figure 2)

- Note: NTv2-CPD uses 54 arc-second spacing and includes conformal and distortion components.
  New offshore areas use 60 arc-second spacing and include conformal component only.
- Note: These extents attempt to be objective, by adopting existing defined delineations.
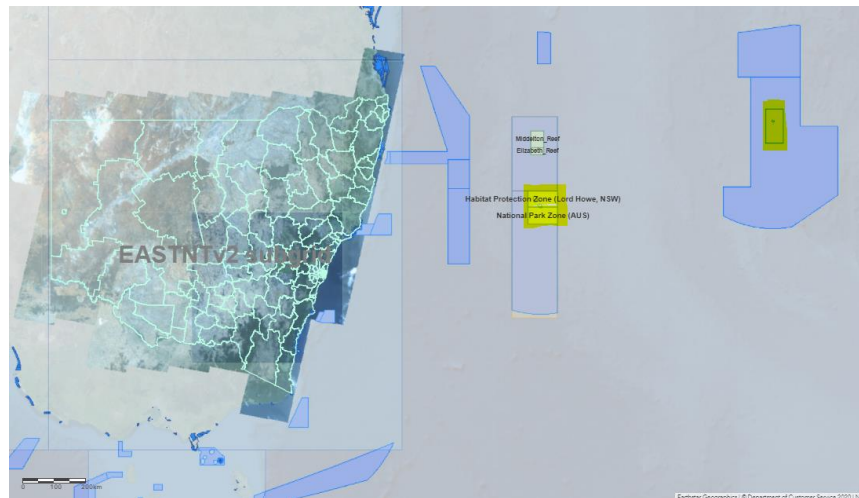
Figure 2: NTv2-CPD extents over mainland NSW;
Additional areas over Lord Howe Island and Norfolk island are highlighted yellow.
The above map and sources are available for viewing at this link.

Other reference information:
- This custom NTv2 grid is created by the Department of Customer Service (Spatial Services, Geodesy)
  - 'grid shift' components for new offshore areas are computed at 60 arc-second grid intervals, using in-house software 'gdatran2020.exe', modified to cater for this larger extent.
  - The conformal component is derived from EPSG:8048 7-parameter conformal transformation.
  - There is no additional distortion component defined for these offshore areas.
  - grid shift values are converted to binary, and the new grid area(s) are then combined with the official NTv2-CPD grid (binary) *GDA94_GDA2020_conformal_and_distortion.gsb* available from https://github.com/icsm-au/transformation_grids

- This custom grid is available via Portal
  https://portal.spatial.nsw.gov.au/portal/home/item.html?id=f39d633067ba44b6962fa99fdfcf70a0
  and is listed in the GDA2020 Portal Services
  - compressed (ZIP folder):   38176 KB
  - when uncompressed: 81193 KB

- On gsb file naming:
  - The transformation file was originally named in keeping with the original ICSM gsb grids:
    gda94_gda2020_conformal_and_distortion_plus_lordhowe_norfolk.gsb

    Unfortunately, the file name has proven too long for some applications / file paths.
    As a result, the following name has been adopted from 05/04/2022
    gda94_gda2020_CPD_plus_lordhowe_norfolk.gsb

    In all respects other than file name, these files are identical.

- Any additonal questions can be directed via the DCS Customer Hub.