National Atlas of Groundwater Dependent Ecosystems (GDE)

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Acknowledgement

- Australian National Water Commission (NWC)
- Australian Bureau of Meteorology (BoM)
- Commonwealth Scientific Industrial Research Organisation (CSIRO)
- Cohga, Pty Ltd, Australia
- Jurisdictions (State Governments, Groundwater Departments)
Background

The National Water Commission (NWC) engaged SKM to develop the GDE Atlas to address a knowledge gap in the understanding and management of groundwater dependant ecosystems (GDEs) across Australia.

The primary aim of the GDE Atlas was to create a consistent, nationwide inventory of GDEs in the form of web-based tool (Developed on Open Source platform) displaying ecological and hydrogeological information on GDEs. It is an important tool to help bring the identification and assessment.

The GDE Atlas comprises maps that show the location of both known and potential GDEs across Australia, as well as ecological and hydrogeological information for each GDE. The database containing the GDE mapping is hosted by the Bureau of Meteorology (BOM) and is accessible through their website (http://www.bom.gov.au/water/groundwater/gde/index.shtml).
WHAT THE ATLAS SHOWS

⇒ Series of spatial layers showing potential for groundwater interaction
⇒ ‘Known’ GDEs
⇒ Ecosystems are classified into 2 general types:
  – Ecosystems that rely on SUBSURFACE presence of groundwater (vegetation)
  – Ecosystems that rely on the SURFACE expression of groundwater (rivers, wetlands, springs)
SPATIAL LAYERS ARE:

- **ID layers**
  - Landscapes that use water in addition to rain

- **IDE layers**
  - Ecosystems that use water in addition to rain

- **GDE layers**
  - Ecosystems that potentially use groundwater
Step 1 – MODIS pIDE

Normalise to highlight large landscape features such as wetlands and fringing vegetation of floodplains.

Areas of bare soil or rock are identified by having a very low likelihood.

Example: Northern Australia using pIDE

Riparian vegetation, surrounded by non vegetated flood plain

Step 2 – Normalised MODIS Likelihood 1 to 10

Classify the greenness of landscapes as slow changing and no change

Step 3 – Landsat NDVI angle analysis

Step 4 – Landsat derived Forest

Determine where MODIS is used in preference to Landsat

Determine

achieve.
Step 5 – MODIS and Landsat outputs combined to create the final ID layer, interim layer - scale 1 to 10 (left) and final layer scale 6 to 10 (right)

Delineates active vegetation and areas of surface water inundation. The finer resolution of the Landsat data enables small scale features such as riparian vegetation within floodplains to be highlighted that was not delineated by the MODIS data (areas of blue surrounded by red).
IDE Layer (rivers, wetlands, springs)
Process for identifying GDEs

Remote sensing – Task 4

- MODIS
- Landsat

  Grided Remote Sensing Layer (likelihood pixels 1 to 10)
  - Shows likelihood of inflow dependence

  Grided ID Layer (all pixels of likelihood >5)
  - Shows inflow dependent landscapes

Identifying GDEs – Task 5

  GIS Analysis rules

  Feature Layers

  GIS Analysis datasets

  Polygon IDE Layer (all polygons of likelihood >5)
  - Shows inflow dependent ecosystems

  Potential GDE Layers (all polygons of probability >5 AND with supporting GIS data)
  - Derived GDE layers, showing:
    - GDE potential (H/M/L)
  - GDEs identified in previous study:
    - Field validated
    - Desk top

GDEs derived in previous studies

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- Derived GDE layers, showing:
  - GDE potential (H/M/L)
- GDEs identified in previous study:
  - Field validated
  - Desk top
Atlas of Groundwater Dependent Ecosystems
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Data Management

- Development of a robust spatial data model
- Scripting and programming for data loads and quality checks for data integrity
- Metadata population at feature level and global level ISO 19115:2003 standard
- Development of classes based on database attributes to support cartography
- Build topological consistency across GDE and Reference layers
- Develop spatial indexes to enable fast searches for spatial attributes
- Compilation of heterogeneous and varying data quality into one consistent layer across the nation
- Package the data downloads river basin wise as zip files
- Fine tune and optimisation of database and web
- Updatability process for the atlas
Web Development

- Built on Linux, Postgresql/PostGIS, Map Server, Open Layers, WEAVE
- Conducted web based user survey
- Conducted user requirement workshop and acceptance workshop (Virtual)
- Scripting and programming for integrating SDM to web atlas
- Web based cartography
- Development of text based web site to comply with the Australian Government Standard on Web Content Accessibility Guidelines (WCAG) 2.0
- Developed Atlas product adhering to the contract requirements clause to follow Australian Government standards: W3C, OGC, WCAG 2.0, ISO
- Development of web based Help System, FAQ and Glossary
- Regular meetings with BoM to ensure the delivery meets the BoM Standards
Atlas of Groundwater Dependent Ecosystems

About the GDE Atlas
The National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) presents the current knowledge of GDEs across Australia. The Atlas significantly extends our knowledge of GDEs with the creation of nation-wide maps showing the ecosystems that rely on Australia’s groundwater resources.

The GDE Atlas has been developed by the National Water Commission as part of the Groundwater Action Plan. One of the key aims of the Action Plan is to improve Australia’s understanding of GDEs and to facilitate the consideration of GDEs in water management.

The GDE Atlas is a management tool that enables the presence and the water needs of GDEs to be brought into the water planning and allocation process. It informs users where the groundwater requirements of ecosystems should be considered.

The scope of the GDE Atlas
The Atlas is the most complete inventory on the location and characteristics of GDEs in Australia. It incorporates previous fieldwork, literature and mapping of GDEs. Nation-wide layers of remote sensing data have been developed, as well as mapping layers that show the presence of GDEs. The attributes of each GDE identified are also included in the Atlas.

The GDEs that have been extensively mapped in the Atlas are:
• vegetation ecosystems (those ecosystems that rely on groundwater at, or beneath the watertable), and
• surface water ecosystems (those ecosystems that rely on groundwater once it has been discharged to the surface), such as rivers, wetlands and springs

Less extensive mapping of subterranean GDEs (caves and aquifers) is also included. The map of subterranean GDEs consists of previously available information collated into a single repository within the GDE Atlas.
Spatial Identify Tool

Spatial Identify
Opens the Spatial Identify Grid in a window

<table>
<thead>
<tr>
<th>Ecosystem Type</th>
<th>Supplied Ecosystem Type</th>
<th>Name</th>
<th>State</th>
<th>Eco-Hydrogeological Zone</th>
<th>Drainage Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland</td>
<td>Artificial/ highly modified wetlands (dams, ring tanks, irrigation channels, drains, canals)</td>
<td>QLD</td>
<td></td>
<td>Bogie River Hills</td>
<td>PIONEER RIVER</td>
</tr>
<tr>
<td>River</td>
<td>Connector</td>
<td>PIONEER RIVER</td>
<td>QLD</td>
<td>Bogie River Hills</td>
<td>PIONEER RIVER</td>
</tr>
</tbody>
</table>
Report Tool

- Output Format: pdf
- Map Title: Groundwater Dependent Ecosystem Map
- Map Description: 

[Image: Report Tool interface with options for output format, map title, and description]
Zoom to Location Tool
Download Tool

Click to download data for a selected location
GDE Tips Tool

GDE Class: Ecosystems that rely on the surface expression of groundwater
Ecosystem Type: Wetland
Eco-Hydrogeological Zone: Wyong
Drainage Basin: MACQUARIE-TUGGERAH LAKES
Geomorphology: Deeply dissected sandstone plateaus.
Maximise Interface Tool

Maximise the interface to view more of the map
Help Tool

Attribute Search

On the Layers panel, right-click on a layer and set as active.

Quick Search:

Layers
- Groundwater Dependent Ecosystems...
  - All ecosystem features
  - No ecosystems analysed
- Reliant on subsurface...
- Reliant on surface...
- Subterranean (Subterranean)
- Inflow Details
  - Set Active
  - Clear Selection
  - Zoom To Selection
  - No
- IDE (IDE)
- Metadata

Help
Click to open the Help window
Uses of the GDE Atlas

- The health of GDEs is a significant concern for water managers and needs to be better considered in water planning processes.

- The GDE Atlas is a critical resource to fill the knowledge gap of where GDEs occur, and is a key tool for enabling the water requirements of GDEs to be considered in planning processes.

- Importantly, the Atlas will underpin future management decisions and help to protect vulnerable environmental assets.

- Interprets and synthesises a lot of information.

- Remote sensing, ID layer, IDE layers
  - For further interpretation, e.g.
    - Plantation water use
    - Potential water use where ecosystems have not been mapped (e.g. NT)
Uses of the GDE Atlas

GDE layers

- Can be used for further interpretation:
  - Add additional detail to smaller areas
  - Inform further studies. Where is more detailed information required?

- Can be used as is:
  - Risk prioritisation - where is integrated management a higher priority?
  - Inform on broad scale vegetation water requirements
  - Relative importance of groundwater in surface water ecosystems
  - Identifies springs
  - Risks to GDEs from Groundwater development
User Feedback

- Impressed with the Atlas Functionality
- Highly interactive
- More than expected functions in the Atlas
- Good speed
- Nice free text search on location
- Download of data
Way Forward

- Build a tool to allow users to tag field photos of GDEs / Share local information about GDEs

- Build Web Mapping Service (WMS) to allow users to load GDE information as reference layer in their local computer.

- Build graphical user interface to update and modify GDE data.

- Build specific application tools on top of GDE atlas for Mining, Groundwater and Surface water, Planning domains...

- Build field data capture application through GPS enabled mobile mapping technology to update the GDEs positional accuracy and relevant field information
Summary

- Project delivered on time and budget for $4.6 USD Million in 18 months.
- Development of a robust spatial data model to support 4 million GDE features on an open source web mapping platform.
- Development of new algorithms to map Evapo Transpiration (ET) using 10 years of temporal remote sensing data which was used to create the remote sensing layers covering entire Australia termed as Inflow Dependent Ecosystems.
- Scripting and programming for data loads and quality checks for data integrity.
Summary ...

- Metadata population at feature level and global level ISO 19115:2003 standard
- Development of classes based on database attributes to support cartography
- Build topological consistency across GDE and Reference layers
- Develop spatial indexes to enable fast searches for spatial attributes
- Compilation of heterogeneous and varying data quality into one consistent layer across the nation
- Package the data downloads river basin wise as shape files for use in local GIS and .Kmz for use in Google Earth
- Fine tune and optimisation of database and web
Summary ...

→ Updatability process for the atlas
→ Built on Linux, Postgresql/PostGIS, Map Server, Open Layers, WEAVE
→ Conducted web based user survey
→ Conducted user requirement workshop and acceptance workshop (Virtual)
→ Scripting and programming for integrating SDM to web atlas
→ Web based cartography to support colour blind users
The National Atlas of Groundwater Ecosystems demonstrates an innovative approach to a national problem, spatially enabling and collating numerous data sets into a cohesive and comprehensible solution.

Thank You!

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