Improving groundwater governance using spatial intelligence

By

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Amsterdam
Typical bore well data management...

- Bore data
- Decommissioned Can’t Find
- Costing Summary
- Risk Maintenance
- Cost value references
<table>
<thead>
<tr>
<th>Bore ID:</th>
<th>100503</th>
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<tbody>
<tr>
<td>Rig No:</td>
<td>1/87/8</td>
</tr>
<tr>
<td>Easting:</td>
<td>TBC</td>
</tr>
<tr>
<td>Northing:</td>
<td>TBC</td>
</tr>
<tr>
<td>TOC Elevation (mAH):</td>
<td>TBC</td>
</tr>
<tr>
<td>Monitored To:</td>
<td>27/08/1987</td>
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<td>Monitored From:</td>
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<tr>
<td>SKM - SOBN Audit 2006:</td>
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<tr>
<td>SKM - Elevation Survey:</td>
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<tr>
<td>Thiess - SOBN Location Audit:</td>
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<tr>
<td>Driller's Weekly Report:</td>
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<tr>
<td>Driller's Daily Report:</td>
<td>no</td>
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<tr>
<td>GEDIS Lithology Logs:</td>
<td>yes</td>
</tr>
<tr>
<td>GEDIS Stratigraphy Logs:</td>
<td>no</td>
</tr>
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</table>

**Installation/Completion Report:**

- Reference:
- Pumping Summary/General Report: yes
- Reference 1:
- Reference 2:
- Reference 3:
- Reference 4:
- Reference 5:
- Reference 6:
- Reference 7:
- REF File No 1:
- REF File No 2:
- REF File No 3,4,5:
- RWC REF Files: yes
- Photos: yes
- Mud maps: no
- Topographic Maps: yes
Pyramid Creek Salt Interception Scheme

Mobile Database for PCSIS (Sprint DB Pro)

Data Extracts
Automatic Report Generation

KaioneSync

MS ACCESS Database for PCSIS

Reports

Bore Report Generation for PCSIS
Custom Bore Selection

The File the Reports are Linking to is Listed Below:

Pyramid_Creek_SaltInterception_Scheme_Bore_Report

Bore Report for PCP 27

SKM
Hydrogeological mapping

**MS Excel Data**
- Bore information
- Well information
- Driller log
- Lithologist log
- Existing stratigraphy

**Scripting**

**MS Access (Front End)**
- Bore information
- Well information
- Driller log
- Lithologist log
- Existing stratigraphy information
- New Stratigraphy Interpretation

**GEODATABASE**
- MS SQL Server
- SDE

**Arc GIS**
- Spatial visualisation / analysis
## Bores for Southern Rural Water Hydrogeology Mapping

### Geologist's Log

<table>
<thead>
<tr>
<th>Log Source</th>
<th>Depth From</th>
<th>Depth To</th>
<th>Description</th>
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<tbody>
<tr>
<td>BEDS</td>
<td>10,000</td>
<td>15,000</td>
<td>RED SANDY CLAY</td>
</tr>
<tr>
<td>BEDS</td>
<td>15,500</td>
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<td>LIMESTONE</td>
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<tr>
<td>BEDS</td>
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<td>50,000</td>
<td>WHITE SAND</td>
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<td>BEDS</td>
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### Stratigraphy Interpretation

**Stratigraphy**

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<th>Scenario</th>
<th>Author</th>
<th>Company</th>
<th>Stratigraphy Source</th>
<th>Stratigraphy Description</th>
<th>Depth From</th>
<th>Depth To</th>
<th>HGU Code</th>
<th>Flag</th>
<th>Comments</th>
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<tr>
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<td>MELBOURNE SUPERDESED AT L04</td>
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<td>101,500</td>
<td>136,250</td>
<td>363</td>
<td>1</td>
<td>MELBOURNE SUPERDESED AT L04</td>
</tr>
</tbody>
</table>

**Navigation Pane**

- **Stratigraphy saved**: Saved 4 rows.
Bore Interpretation System for Hydrogeology Mapping

View Bore/Well Data  |  Stratigraphic Interpretation

Enter a Bore ID: 101014

Bore Details

<table>
<thead>
<tr>
<th>Bore ID</th>
<th>Map Sheet</th>
<th>Longitude</th>
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<th>Datum</th>
<th>Projection</th>
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Well Details #1

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Driller's Log

<table>
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<tr>
<th>Depth From</th>
<th>Depth To</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
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<td>RED BROWN CLAYS</td>
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<tr>
<td>2.44</td>
<td>4.97</td>
<td>DARK GREY CLAY</td>
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<tr>
<td>4.97</td>
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<td>BROWN HONEYCOMES BASALT</td>
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<td>GREY BASALT</td>
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Geologist's Log

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<thead>
<tr>
<th>Depth From</th>
<th>Depth To</th>
<th>Stratigraphy Source</th>
<th>Stratigraphy Description</th>
<th>Depth From</th>
<th>Depth To</th>
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<td>Surface alteration</td>
<td>0</td>
<td>5</td>
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<tr>
<td>12.19</td>
<td>13.41</td>
<td>DPI</td>
<td>Tertiary Basalt (upper)</td>
<td>5</td>
<td>26</td>
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</tbody>
</table>

Stratigraphy

Scenario  | Author | Company | Stratigraphy Source | Stratigraphy Description | Depth From | Depth To |
----------|--------|---------|---------------------|--------------------------|------------|----------|
-1        | DPI_BERDO | DPI | DPI  | Surface alteration | 0          | 2        |
-1        | DPI_BERDO | DPI | DPI  | Tertiary Basalt (upper) | 5          | 26       |
1         | DPI_BERDO | DPI | DPI  | Surface alteration | 0          | 5        |
1         | DPI_BERDO | DPI | DPI  | Tertiary Basalt (upper) | 5          | 26       |

Stratigraphy Interpretation

<table>
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<tr>
<th>Scenario</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>DPI</td>
<td></td>
</tr>
</tbody>
</table>

Web Interface
Hydrogeological mapping – Visualisation of Aquifers
INTEGRATED SPATIAL DATA MODEL FOR MANAGING BORE STRATIGRAPHIC AND HYDROLOGICAL INFORMATION

National Groundwater Information System (NGIS) – Phase 1

Concept: SKM and Continuum consulting
Client: Australian National Water Commission
National Groundwater Information System (NGIS) – Phase 2

Australian Bureau of Meteorology

Using ArcHydro Groundwater Data Model
Interim Groundwater Dataset as part of Australian Geofabric

• SKM was engaged by the Bureau of Meteorology to develop consistent national spatial groundwater datasets as part of the Geofabric.

• The project involved collecting and collating aquifer extent, salinity, elevation and uncertainty information and populating a pre-defined geodatabase.

• To address different definitions of the same aquifers across jurisdictional boundaries, it was necessary to develop a national aquifer framework to allow each of the jurisdictional datasets to be transferred into a nationally consistent dataset.

• The development of the framework included consultation with each of the relevant State and Territory jurisdictions in a series of workshops.

• The outcomes of the workshops and existing frameworks were simulated to develop a list of 24 aquifers across Australia.

• The project also involved developing a relationship between the geological units (both outcropping and sub-surface) to aquifers and using this relationship to develop a consistent GIS layer of the “Land Surface Aquifer” (surface expression of the aquifers whether saturated or not) and the “Watertable Aquifer” (extent of the first saturated aquifer).

• The extents of sub-surface aquifers, groundwater salinity and aquifer yield data provided by the jurisdictions was also translated into the nomenclature of the “interim aquifer framework”.

SKM
National Aquifer Framework (NGIS – Phase 2)

Jurisdiction NGIS < V2.1 Database (State Framework)

Conversion Tool

NGIS V2.1 NAF compliant Database

Jurisdictions

BoM
Atlas of Groundwater Dependent Ecosystems

About the GDE Atlas

The National Atlas for Groundwater Dependent Ecosystems addresses a critical knowledge gap in the understanding and management of Groundwater Dependent Ecosystems.

The GDE Atlas is part of NWC’s Groundwater Action Plan, which aims to improve our understanding of the impact of water management and external influences on GDEs.

As a key tool, the GDE Atlas helps informed decision making that influences the future of GDEs by bringing the identification and assessment of the water needs of GDEs into the planning and allocation process.

The scope of the GDE Atlas

The Atlas captures the current state of knowledge of GDEs across Australia. The Atlas provides a central portal to present existing information on GDEs, to help identifying location and characteristics of GDEs which have not previously been identified and to help identifying GDEs which occur on lists of important ecosystems, and the ecosystem services provided by the GDEs.

The Atlas includes terrestrial vegetation, wetlands, baseflow, estuarine and subsurface GDEs.
National Atlas of Groundwater Dependent Ecosystems (GDE)

Concept: SKM
Client: Australian National Water Commission
National Atlas of Groundwater Dependent Ecosystems (GDE)

Concept: SKM
Client: Australian National Water Commission
Single Inflow Dependent Ecosystem Layer for GDE Atlas

Combination of Landsat and MODIS analysis based on rules

Modis Analysis 2001 – 2010 (CSIRO)
Example GDE Attributes

- Location
- Ecosystem type
- Ecohydrogeological Zone information
- Inflow Dependent Ecosystem information
- Groundwater connection
- Likelihood of being a GDE
- Confidence in identification
- Information from literature
- Groundwater source
- Nature of groundwater connection
- Occurrence on lists of important ecosystems
- Ecosystem services
- References
Adding or Replacing Layers

- Import to SDE with PostGres as backend DB
- Export the PostGres Table to an archive file format
- If a replacement delete the existing table from the Web Server Database (PostGres)
- Import archive file to Web Server Database (PostGres)
Updating GDE Atlas

- Export existing GDE data to an ESRI Geodatabase format (This would preferably be ArcSDE within PostGres. ArcSDE within MS SqlServer, etc would require extra steps to convert to PostGIS format.

- Use Arc Map to do the edits (spatial or attribute edits).

- For large bulk replacements features would be deleted using Arcmap in an edit region and loaded from other feature datasets as supplied by jurisdictions.

- ArcSDE is used to maintain Version Control and be used to assign the create_date and retire_date columns of respective GDE Layers in the data model.
3D GIS for Groundwater comprises of 3D geometry, 3D topology, semantics and appearance.
- Representing 3D geometry from a spatial database perspective for groundwater data has been a challenge.

- Although, 3D geometry has been well represented for above surface features for eg. 3D city models, but there are limitations in representing subsurface features such as groundwater data in 3D geometry.

- There are data models such as ArcHydro groundwater with 2.5D representation, still the true 3D geometry which includes 3D topology for groundwater related features from a spatial database perspective has to be explored.

- By representing true 3D geometry the users will be able to analyse (query) the spatial data from a 3D perspective and generate better visualisation from true 3D.

- Absence of remote sensors to depict the reality below ground and limited data models across the 3rd dimension for subsurface features are the problems across this area.

- Another interesting problem in groundwater related 3D features is the spatial semantics.
Thank You

Questions?

Email: zsadiq@globalskm.com

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