

Advances in spatially enabled groundwater management

By

Dr Zaffar Sadiq Mohamed-Ghouse

Executive Consultant & Practice Leader, Spatial Information

&

Mr. Ray Evans

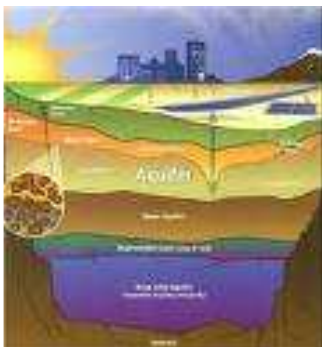
Principal Consultant - Groundwater

Sinclair Knight Merz, Australia

www.globalskm.com

22-25 January, India Geospatial Forum 2013

Hyderabad, India



SKM

SINCLAIR KNIGHT MERZ

achieve outstanding client success

SDI definition ...

“The SDI provides a basis for spatial data **discovery, evaluation, and application for users and providers within** all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general.”

--The SDI Cookbook
<http://www.gsdi.org>

Components of SDI

- Policies & Institutional Arrangements (governance, data privacy & security, data sharing, cost recovery)
- People (training, professional development, cooperation, outreach)
- Data (digital base map, thematic, statistical, place names)
- Technology (hardware, software, networks, databases, technical implementation plans)

- Douglas Nebert, 2009, US, Federal Geographic Data Committee Secretariat

State Observation Bore Network Data Catalogue

Data Source Summary_access2003 : Database (Access 2002 - 2003 file format) - Microsoft Access

Home Create External Data Database Tools Acrobat

Views Clipboard Font Rich Text Refresh All Records Sort & Filter Find

Navigation Pane

SOBN Data Catalogue

Bore ID: 100503 Exit

Bore ID:	100503	Installation/ Completion Report:	
Rig No:	1/87/8	Reference:	
Easting:	TBC	Pumping/ Summary/ General Report:	yes
Northing:	TBC	Reference 1:	SKM: Pratt
TOC Elevation (mAHD):	TBC	Reference 2:	
Monitored To:	27/08/1987	Reference 3:	
Monitored From:	11/02/2008	Reference 4:	
Current Bore Run:	ELV3	Reference 5:	
Historic Bore Run:	-	Reference 6:	
SKM - SOBN Audit 2006:	yes	Reference 7:	
SKM - Elevation Survey:	no	REF File No 1:	487
Thiess - SOBN Location Audit:	yes	REF File No 2:	
Driller's Weekly Report:	yes	REF File No 3,4,5:	482
Driller's Daily Report:	no	RWC REF Files:	yes
GEDIS Lithology Logs:	yes	Photos:	yes
GEDIS Stratigraphy Logs:	no	Mud_maps:	no ok
		Topographic Maps:	yes ok

Record: 1 of 2699 No Filter Search

Form View

SINCLAIR KNIGHT MERZ
SKM

Pratt - 1980 - assessment, Leighton Aveca Plains.pdf - Adobe Acrobat Standard

Pratt - 1980 - assessment, Leighton Aveca Plains.pdf


HYDROLOGICAL ASSESSMENT OF THE
LEIGHTON AVECA PLAINS
BY
A. PRATT

WITH CONTRIBUTIONS BY
A. LARLEY
R. HUGHES
J. MCELROY

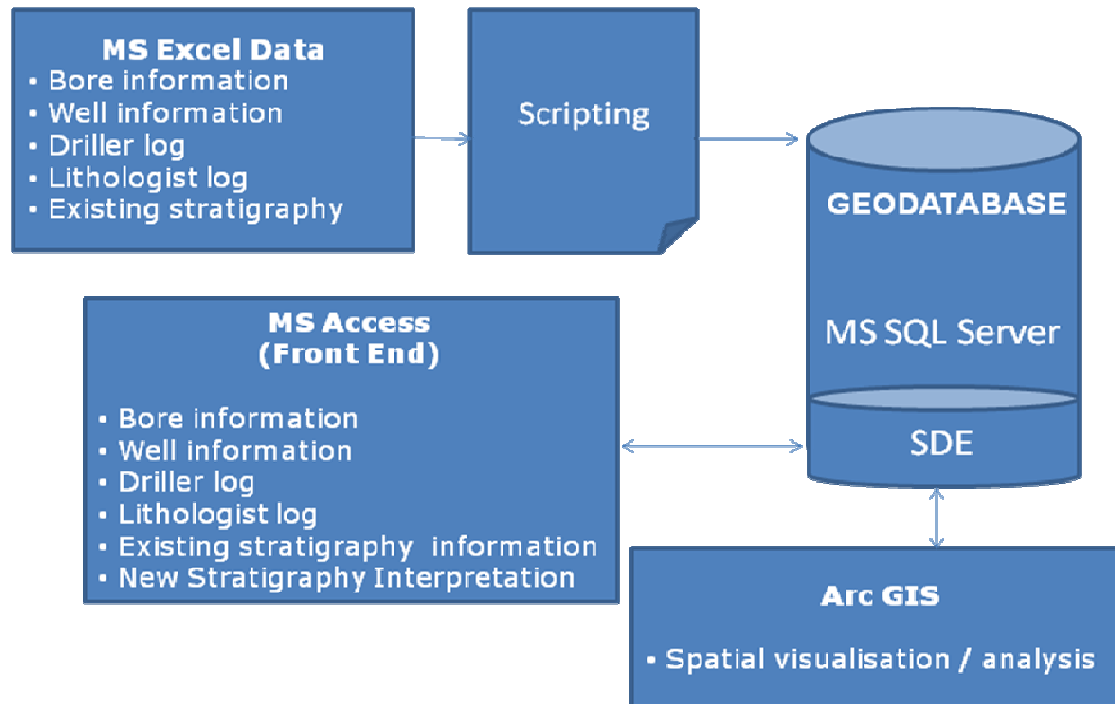
ISSUED BY
A. LARLEY - FEBRUARY 1988

SINCLAIR KNIGHT MERZ
HYDROLOGICAL LIBRARY

Adobe Photoshop Album Starter Edition 3.0 - 100503....



Hydrogeological mapping



Hydrogeological mapping STRATIGRAPHY INTERPRETATION TOOL

Bores for SRW Hydrogeology Mapping-Stand Alone Version

SRW Hydrogeology

Bores for Southern Rural Water Hydrogeology Mapping

Log Source	Depth From	Depth To	Description
GEDIS	.00000	1.52000	RED SANDY CLAY
GEDIS	1.52000	3.05000	LIMESTONE
GEDIS	3.05000	6.10000	WHITE SAND
GEDIS	6.10000	16.76000	YELLOW SAND
GEDIS	16.76000	21.34000	YELLOW CLAY
GEDIS	21.34000	23.17000	YELLOW SANDY CLAY
GEDIS	23.17000	37.80000	YELLOW SAND
GEDIS	37.80000	38.10000	YELLOW CLAY
GEDIS	38.10000	45.72000	YELLOW SAND
GEDIS	45.72000	47.55000	SANDSTONE
GEDIS	47.55000	50.90000	YELLOW SAND
GFDIS	50.90000	52.12000	SANDSTONE

Geologist's Log

Log Source	Depth From	Depth To	Description
GEDIS	.00000	1.52000	RED SANDY CLAY
GEDIS	1.52000	3.05000	LIMESTONE
GEDIS	3.05000	6.10000	WHITE SAND
GEDIS	6.10000	16.76000	YELLOW SAND
GEDIS	16.76000	21.34000	YELLOW CLAY
GEDIS	21.34000	23.17000	YELLOW SANDY CLAY
GEDIS	23.17000	37.80000	YELLOW SAND
GEDIS	37.80000	38.10000	YELLOW CLAY
GEDIS	38.10000	45.72000	YELLOW SAND
GEDIS	45.72000	47.55000	SANDSTONE
GEDIS	47.55000	50.90000	YELLOW SAND
GFDIS	50.90000	52.12000	SANDSTONE

Stratigraphy

Scenario	Author	Company	Stratigraphy Source	Stratigraphy Description	Depth From	Depth To	Hgu Code	Flag	Comments
1	SF	SKM	MELBOURNE_HYI		.00000	1.52000	101	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYI		1.52000	101.50000	110	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYI		101.50000	136.25000	303	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYI		127.10000	276.15000	404	1	MELBOURNE SUPERCEDES AT LOAD1
-1	SF	SKM	MELBOURNE_HYI		.00000	1.52000	101		
-1	SF	SKM	MELBOURNE_HYI		1.52000	101.50000	110		
-1	SF	SKM	MELBOURNE_HYI		101.50000	136.25000	303		
-1	SF	SKM	MELBOURNE_HYI		127.10000	276.15000	404		

Stratigraphy Interpretation

Author: ZAFFAR Company: SKM

Scenario: -1 Stratigraphy Source: MELBOURNE_HYDRO_1 Retire Stratigraphy

Depth From: Depth To: HGU Code HGU Name If the check box is enabled, the value recorded is

1.	0	1.52000	101	Unnamed alluvium	<input type="checkbox"/>	Stratigraphy F
2.	1.52000	101.50000	110	Bridgewater Formation	<input type="checkbox"/>	Stratigraphy F
3.	101.50000	136.25000	303	Brighton Group	<input type="checkbox"/>	Stratigraphy F
4.	136.25	276.15000	404	Fyansford Formation	<input type="checkbox"/>	Stratigraphy F
5.					<input type="checkbox"/>	Stratigraphy F
6.					<input type="checkbox"/>	Stratigraphy F
7.					<input type="checkbox"/>	Stratigraphy F
8.					<input type="checkbox"/>	Stratigraphy F
9.					<input type="checkbox"/>	Stratigraphy F
10.					<input type="checkbox"/>	Stratigraphy F
11.					<input type="checkbox"/>	Stratigraphy F
12.					<input type="checkbox"/>	Stratigraphy F
13.					<input type="checkbox"/>	Stratigraphy F
14.					<input type="checkbox"/>	Stratigraphy F
15.					<input type="checkbox"/>	Stratigraphy F

Comments:

This interpretation has corrected the basic depth from .0000 to 0

Stratigraphy saved

Saved 4 rows

OK

No Filter Search

Bore Interpretation System for Hydrogeology Mapping

[View Bore/Well Data](#) [Stratigraphic Interpretation](#)

Enter a Bore ID: [View](#)

Bore Details

Bore Id	101014	Map Sheet	n/a	RLNS	n/a
Bore Source	GMS	Easting	2376480	Latitude	-36.99
Bore Depth	25.9	Northing	2500200	Longitude	143.612
Completed Date	15/06/1971	Datum	GDA94	RLNS DEM	207.04
		Projection	VICGRID94	RLNS Source	n/a

Bore Flag 1

Well Details #1

Well Source	GMS	TDS	n/a	WL	n/a
SCRN From	0	TDS Date	01/01/1900	RWL	n/a
SCRN To	n/a	TDS Source	n/a	WL Date	01/01/1900
Aquifer Code		TDS Flag	n/a	WL Source	n/a
				WL Flag	n/a
EC	n/a	Date Created	23/06/2010		
EC Date	01/01/1900				
EC Source	n/a				
EC Flag	n/a				

Web Interface

Enter a Bore ID: [View](#)

Map Sheet n/a Surface HGU 1005 Surface HGU Name Undifferentiated Quaternary Basalt

Driller's Log

Log Source	Depth From	Depth To	Description
GEDIS	0	2.44	RED BROWN CLAYS
GEDIS	2.44	4.57	DARK GREY CLAYS
GEDIS	4.57	12.19	MED TO SOFT GREY BASALT
GEDIS	12.19	13.41	BROWN HONEYCOMB BASALT
GEDIS	13.41	24.69	GREY BASALT
GEDIS	24.69	25.6	BROWN HONEYCOMB BASALT
GEDIS	25.6	25.91	LIGHT PUGGY GREY CLAY

Geologist's Log

Log Source	Depth From	Depth To	Description
------------	------------	----------	-------------

Stratigraphy

Scenario	Author	Company	Stratigraphy Source	Stratigraphy Description	Depth From	Depth To	Hgs Code
-1	DPI_BENDIGO	DPI	DPI	Surface alluvium	0	5	1000
-1	DPI_BENDIGO	DPI	DPI	Tertiary Basalt (upper)	5	26	1005
1	DPI_BENDIGO	DPI	DPI	Surface alluvium	0	5	1000
1	DPI_BENDIGO	DPI	DPI	Tertiary Basalt (upper)	5	26	1005

Stratigraphy Interpretation

Scenario [Select Scenario](#)

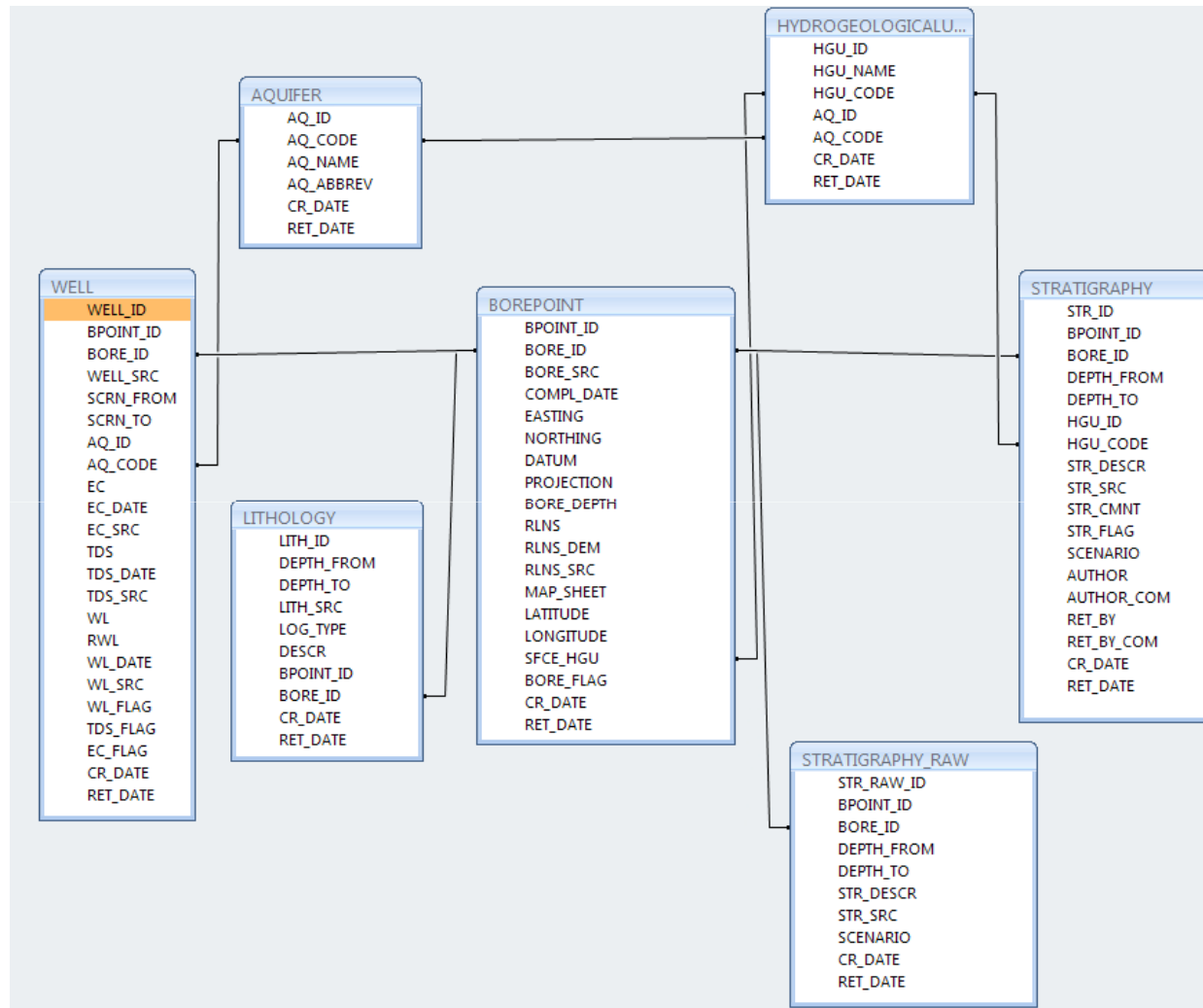
Author Company Stratigraphy Source Stratigraphy Flag Rebre Stratigraphy



Hydrogeological mapping – Visualisation of Aquifers

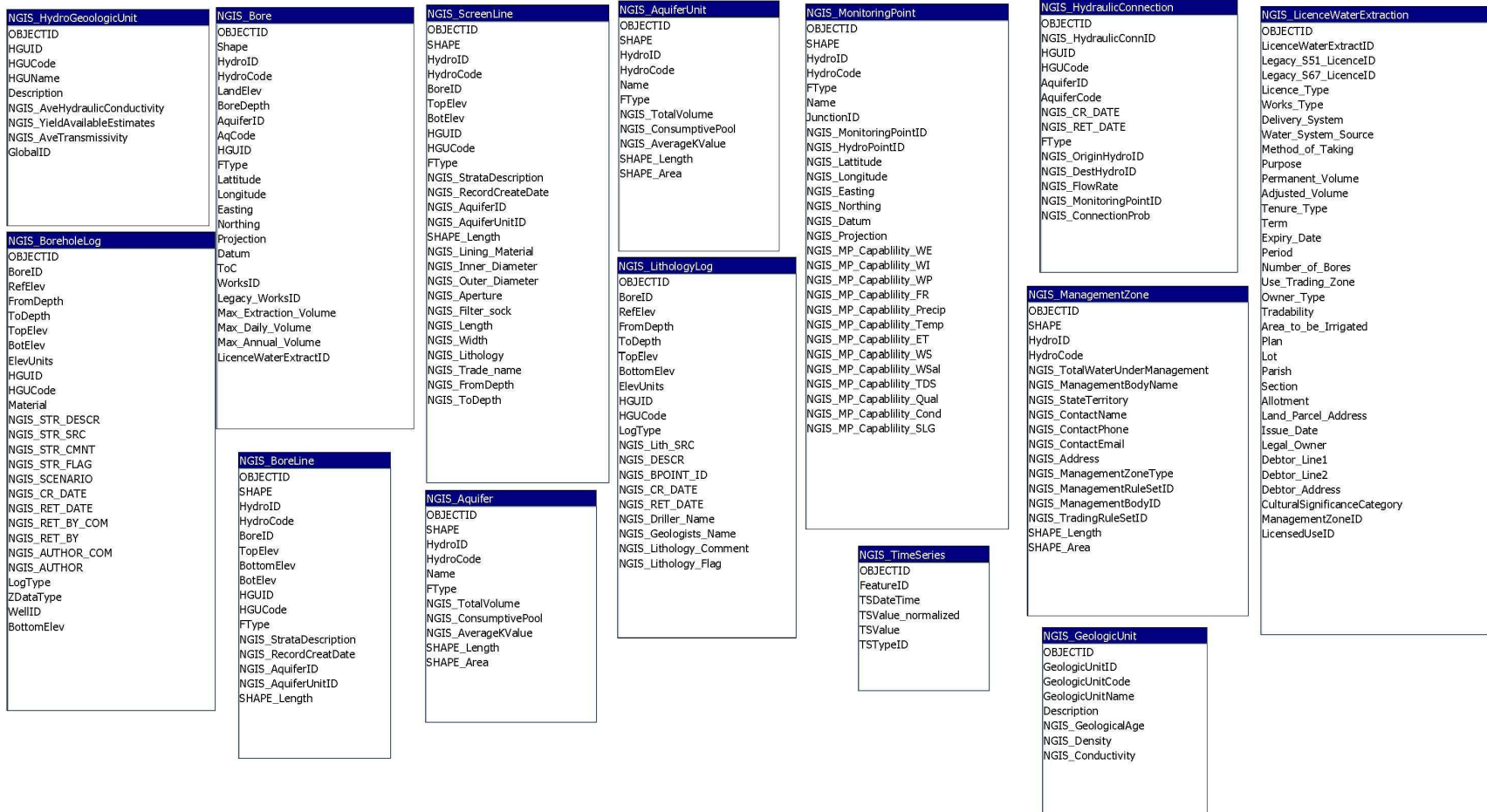


INTEGRATED SPATIAL DATA MODEL FOR MANAGING BORE STRATIGRAPHIC AND HYDROLOGICAL INFORMATION



National Groundwater Information System (NGIS) – Phase 1

Relationships for NGIS_Prototype_Demo_DB
 Tuesday, 27 April 2010



Concept: SKM and Continuum consulting
 Client : Australian National Water Commission

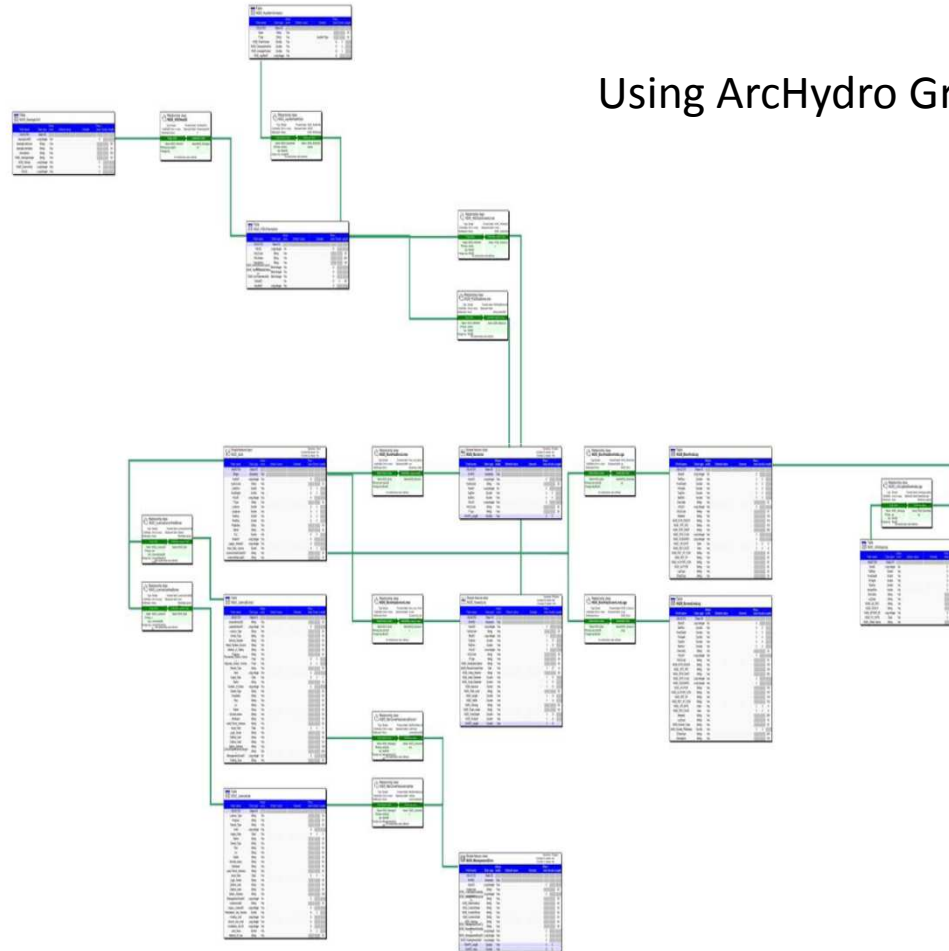


National Groundwater Information System (NGIS) – Phase 2

NGIS Prototype Geodatabase
Stage 1 schema diagram

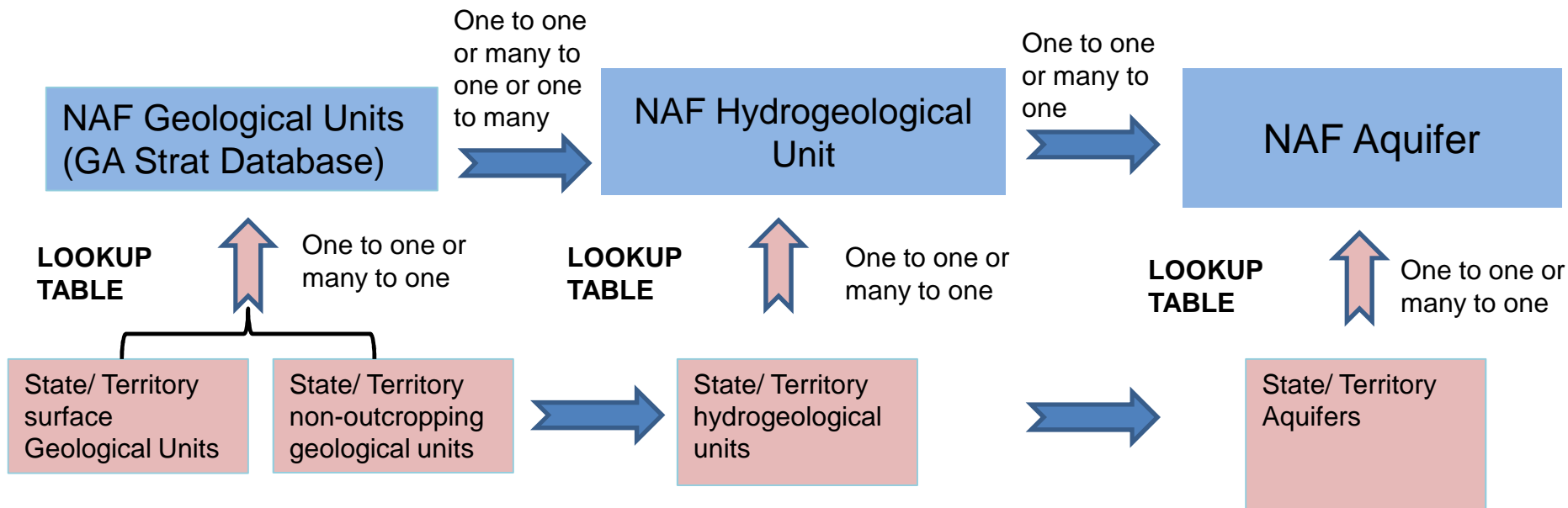
Australian Bureau of Meteorology

Using ArchHydro Groundwater Data Model



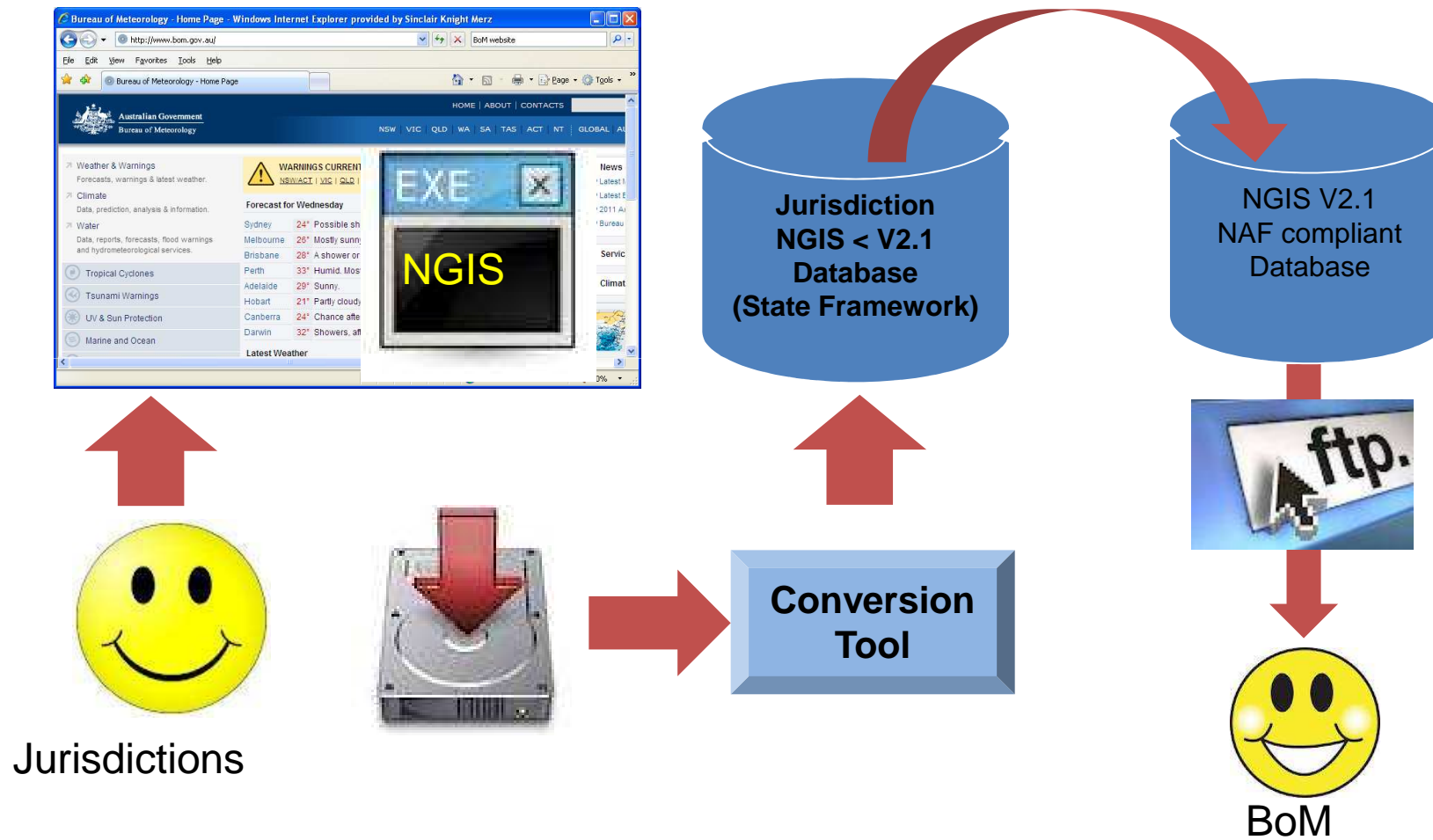
National Aquifer Framework (NGIS – Phase 2)

Australian Bureau of Meteorology



Link between State/Territory frameworks and NAF

National Aquifer Framework (NGIS – Phase 2)



Client: Australian Bureau of Meteorology

Australian National Water Commission

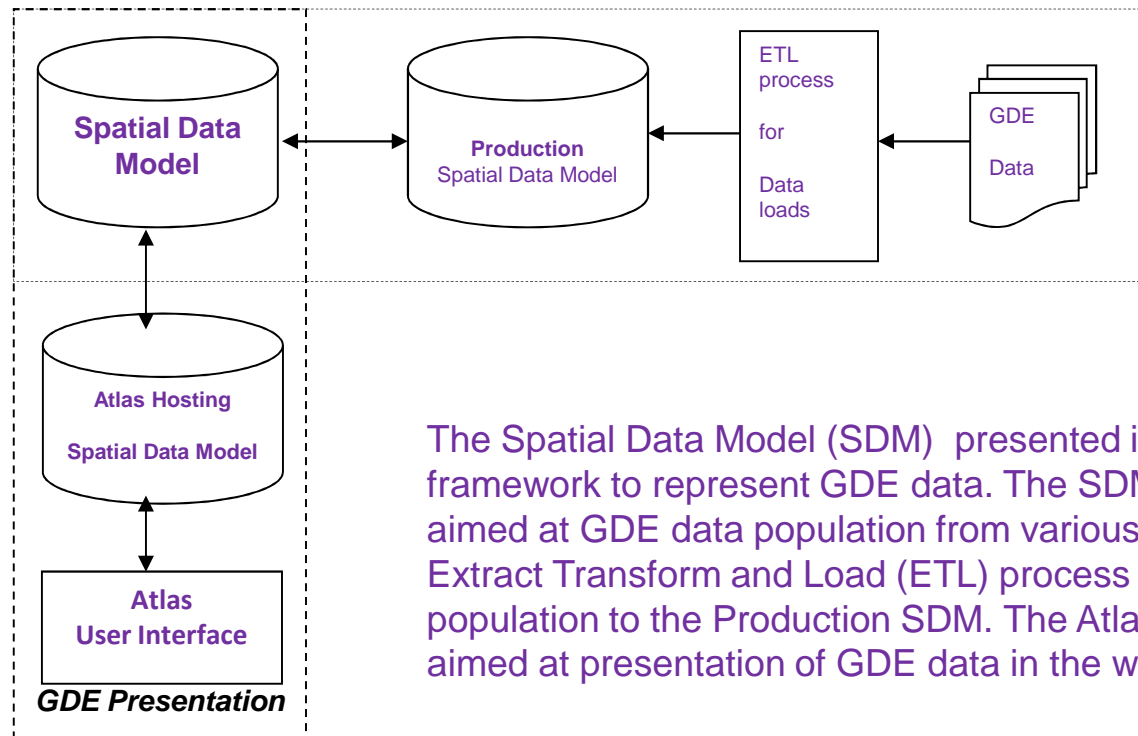
The screenshot shows a web browser window titled "GDE Atlas Home: Water Information: Bureau of Meteorology". The address bar shows the URL "http://jwdev.bom.gov.au/water/groundwater/gde/index.shtml". The browser interface includes a menu bar (File, Edit, View, Favorites, Tools, Help), a search bar, and a navigation bar with links for HOME, ABOUT, CONTACTS, and a search field. Below the navigation bar, there are regional links for NSW, VIC, QLD, WA, SA, TAS, ACT, NT, and GLOBAL/AUSTRALIA/ANTARCTICA. The main content area features the title "Atlas of Groundwater Dependent Ecosystems" and sections for "About the GDE Atlas", "The scope of the GDE Atlas", and "GDE Atlas" (with sub-links for About, Glossary, Open GDE Atlas, and Open GDE Atlas (accessible version)). A sidebar on the right contains "Related links" (Rain, River & Storage Data), "Water links" (Water Act 2007, Water Regulations 2008, Water Market Reports, Water Dictionary, Publications, News, Contact Us), and a "Stay informed" subscription button. At the bottom right, there is an "Available on the App Store" banner with a smartphone icon. The status bar at the bottom shows "Done", "Local intranet", and "105%".



Hosted by : Australian Bureau of Meteorology

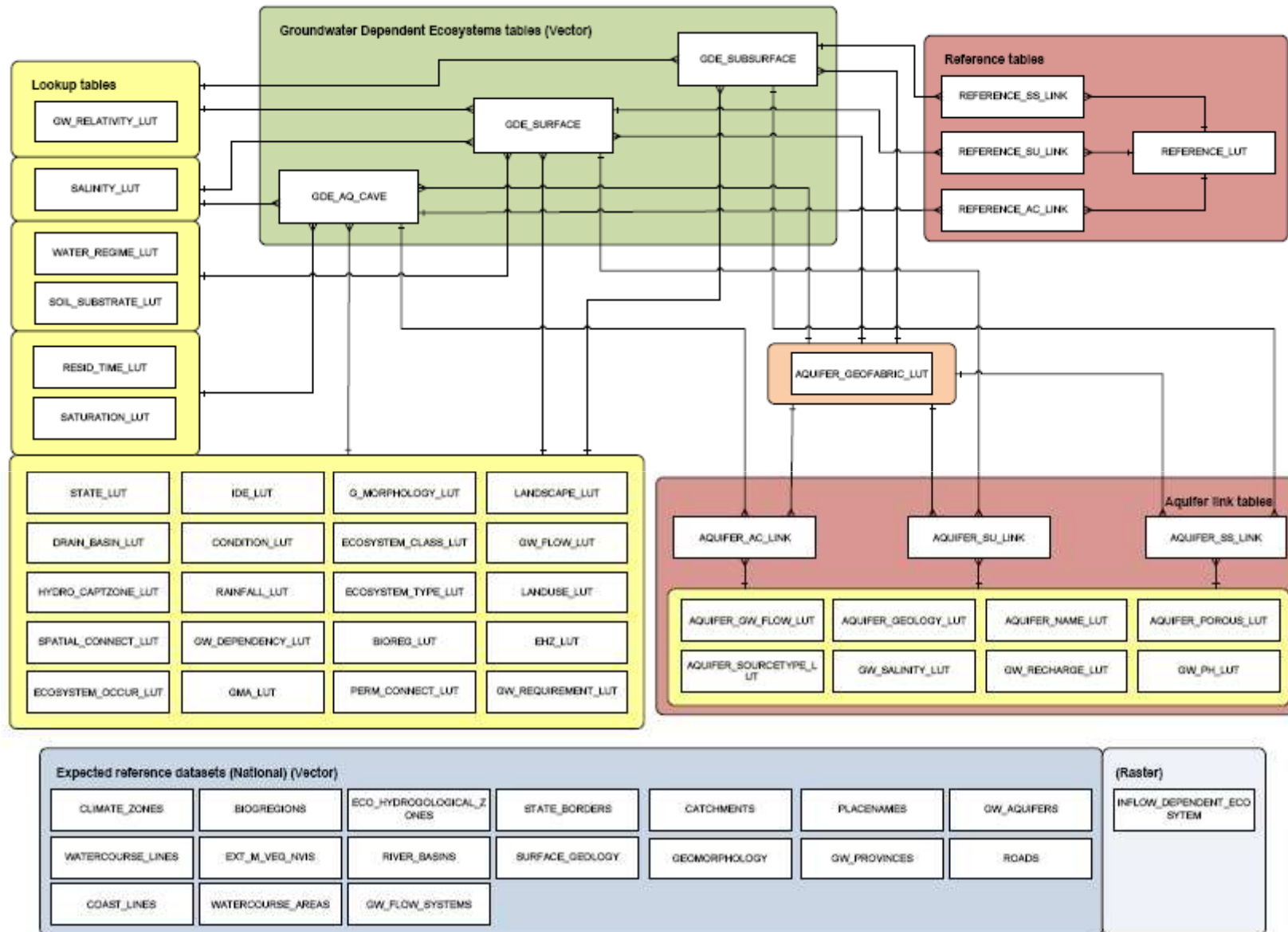
National Atlas of Groundwater Dependent Ecosystems (GDE)

Spatial Data Model



The Spatial Data Model (SDM) presented is a basic framework to represent GDE data. The SDM Production is aimed at GDE data population from various sources. An Extract Transform and Load (ETL) process enables GDE data population to the Production SDM. The Atlas Hosting SDM is aimed at presentation of GDE data in the web based Atlas.

National Atlas of Groundwater Dependent Ecosystems (GDE)



National Atlas of Groundwater Dependent Ecosystems (GDE)

The screenshot shows a web browser window with the URL `au-d12364/pca_demo/`. The page title is "Groundwater Dependent Ecosystems - Eco-Hydrogeological Zone (EHZ) Review". The interface is divided into several sections:

- Map Contents (Left Panel):** A list of map layers with checkboxes. Checked items include: GDEEdit, Review Points, GDE_Review1, Populated Places, EHZ, Major Watercourses, Watercourse Areas, Coastline And Borders, Rainfall District, Climate Zone, River Basins, NVIS Existing Major Vegetation, NVIS Pre 1750 Major Vegetation, Groundwater Provinces, Bioregions, EHZ, Bioregions/HEZs, Groundwater Flowsystems, GDEImagery, and Map Base.
- Map (Right Panel):** A map of Australia showing various colored regions representing different EHZs. Labels for "BROOME" and "DARWIN" are visible.
- Add Comment (Right Panel):** A form for adding and editing review points. It includes:
 - Edit:** A dropdown menu set to "Review Points".
 - Create Review Points:** A section with a pencil icon.
 - Edit Review Points:** A section with a crosshair icon.
 - Edit Review Points Attributes:** A form with the following fields:
 - Review Points: 46
 - U_COMMENT: amalgamate with olive are
 - COMMENTS_ID: 46
 - USER_CREATED: bruce wilson
 - USER_RETIRED: (empty)
 - CR_DATE: 4/03/2011 4:00:46 PM
 - RT_DATE: (empty)

GDE Atlas Map: Water Information: Bureau of Meteorology - Windows Internet Explorer provided by Sinclair Knight Merz

http://www.bom.gov.au/water/groundwater/gde/map.shtml

File Edit View Favorites Tools Help

Australian Government
Bureau of Meteorology

HOME | ABOUT | CONTACTS

NSW VIC QLD WA SA TAS ACT NT AUSTRALIA GLOBAL ANTARCTICA

Bureau Home » Water Information » GDE Atlas Home » GDE Atlas Map

Water Information Regulations Standards News and events About

GDE_LOAD.GDE_O.V_AC_MODEL (782 records)
GDE_LOAD.GDE_O.V_SS_MODEL (3,010,781 records)
GDE_LOAD.GDE_O.V_SU_MODEL (696,201 records)

Atlas of Groundwater Dependent Ecosystems

text version maximise map

Quick Search

Layers

- Ground water dependent ecosystems...
 - Reliant on surface...
 - All ecosystem features
 - No ecosystems analysed
 - Reliant on subsurface...
 - All ecosystem features
 - No ecosystems analysed
- Subterranean (Caves and aquifers)
 - All ecosystem features
 - No ecosystems analysed
- Inflow dependent ecosystems (IDEs)
 - IDE (rivers, springs, wetlands),...
 - IDE (vegetation),...
 - Gridded ID Layer
 - Gridded Remote Sensing Layer
- Base map
 - Places
 - State and Territory borders

Legend

Advanced Search

Location

TABLE OF CONTENTS

Current Scale: 50,000,000 Selection Size: 0

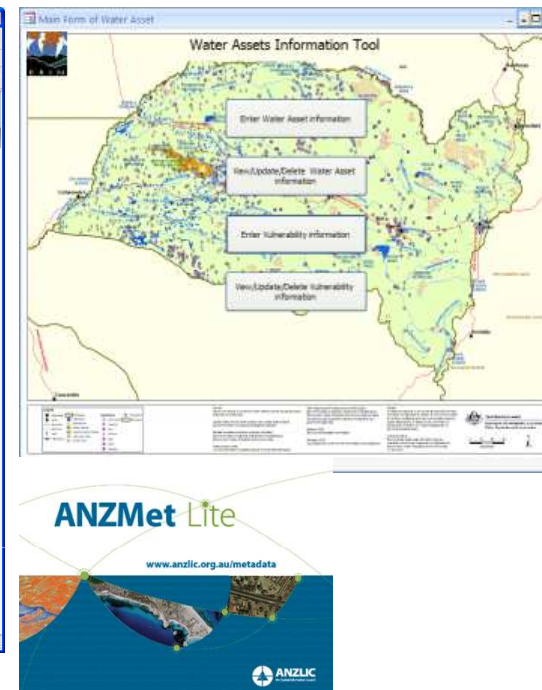
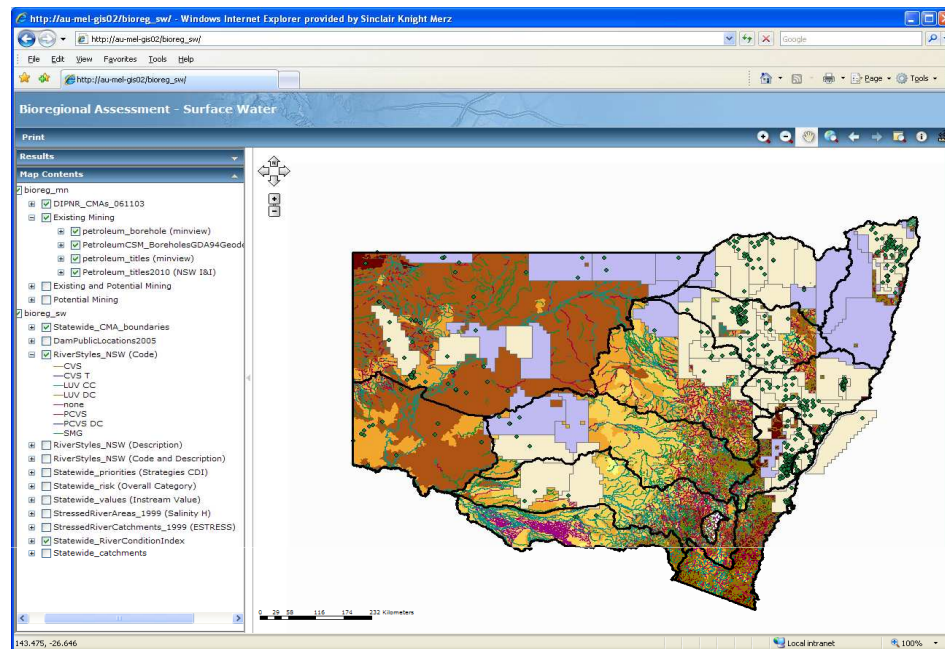
Local intranet 100%



Concept: SKM

Client : Australian National Water Commission

Coal Seam Gas and Coal Mining Phase 1- Bioregional Assessment



The project objective was to assess potential impact of mining activities on water assets across five CMAs in New South Wales.

- Identification of water asset and its environmental, economy, socio-cultural and hydrological properties.
- Challenges come in form of disparate data and its varying data quality
- Web mapping service was set to assist in the screening process, mainly to collaborate and communicate spatial information to the specialist
- Data Model developed
- Process Automation
- In summary, SKM have developed a robust system which has provenance of data and ability to perform audit trail for Coal Seam Gas and Coal Mining related assessments.

Way forward ...

3D GIS for Groundwater

3 D geometry
(true representation)

- Topology
- Semantics

Aquifer Geometry
Topological relation to surfaces
Potentiometry, flow ..

Skyline

Union3D

effective spatial
analysis

3D queries

Inside3D

Intersect3D

Difference3D

Accurate
Visualisation

Visualising the results of the query

Improves better
decision making

3D GIS for Groundwater comprises of 3D geometry, 3D topology, semantics and appearance

SINCLAIR KNIGHT MERZ

SKM

Way forward ...

- 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 2.5 D 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 sub surface features are the problems across this area.
- Another interesting problem in groundwater related 3D features is the spatial semantics

Revisiting Components of SDI

- Policies & Institutional Arrangements (governance, data privacy & security, data sharing, cost recovery)
- People (training, professional development, cooperation, outreach)
- Data (digital base map, thematic, statistical, place names)
- Technology (hardware, software, networks, databases, technical implementation plans)

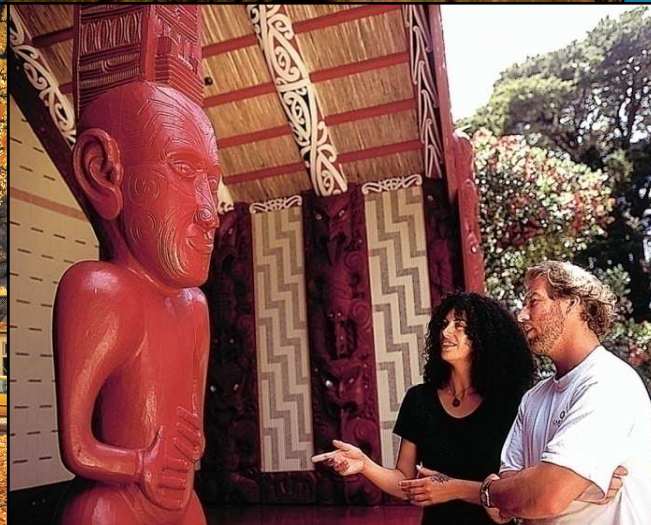
IEEE IGARSS 2013

Melbourne, 21 – 26 July 2013



Dr Peter Woodgate & Prof Simon Jones
Co-Chairs, Local Organising Committee IGARSS2013

Australia and New Zealand – opportunity of a lifetime!!



Thank You

Questions?

Email : zsadiq@globalskm.com

***Building sustainable
water resources
using the strength of
Spatial Information!***