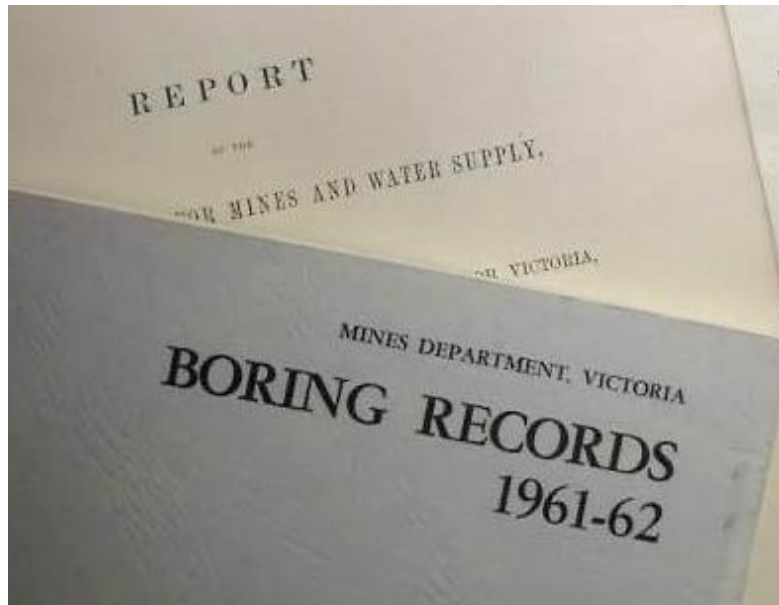


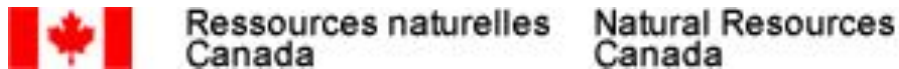
Launching the new VVG portal: eResearch experiments in data democracy



Peter Dahlhaus
Andrew Macleod



Soft launch June 2012



An interoperative spatial information portal that federates groundwater data from disparate sources.

Primarily for research and investigation.

Non-governance (or is it? (unique?)).




Federates around 80 groundwater data sets from 8 custodians. Some data are real-time, some are scheduled updates, some are linked data

Layers

- ☒ Depth to watertable (DELWP)
- ☐ Groundwater salinity (DELWP)
- ☐ Surface elevation (DELWP)
- ☐ Bores - GEDIS (minerals)
- ☐ Bores - DELWP WMIS (groundwater)
- ☐ Bores - FedUniSpatial (groundwater)
- ☐ Mineral Springs
- ☐ EPA Victoria Sites
- ☐ Waterwatch and EstuaryWatch sites
- ☐ Geology (DEDJTR GSV)

Query mode: Bores

 **Advanced aquifer tools (new)**

Info Legend Search Comment

Depth to watertable (DELWP)

- Less than 5 metres
- 5 to 10 metres
- 10 to 20 metres
- 20 to 50 metres
- Greater than 50 metres

Depth to watertable

[Report a map error](#)

Bore Details:: 59539

[Printable Version](#)

BORE DETAILS

AQUIFER

MONITORING

CHEMISTRY

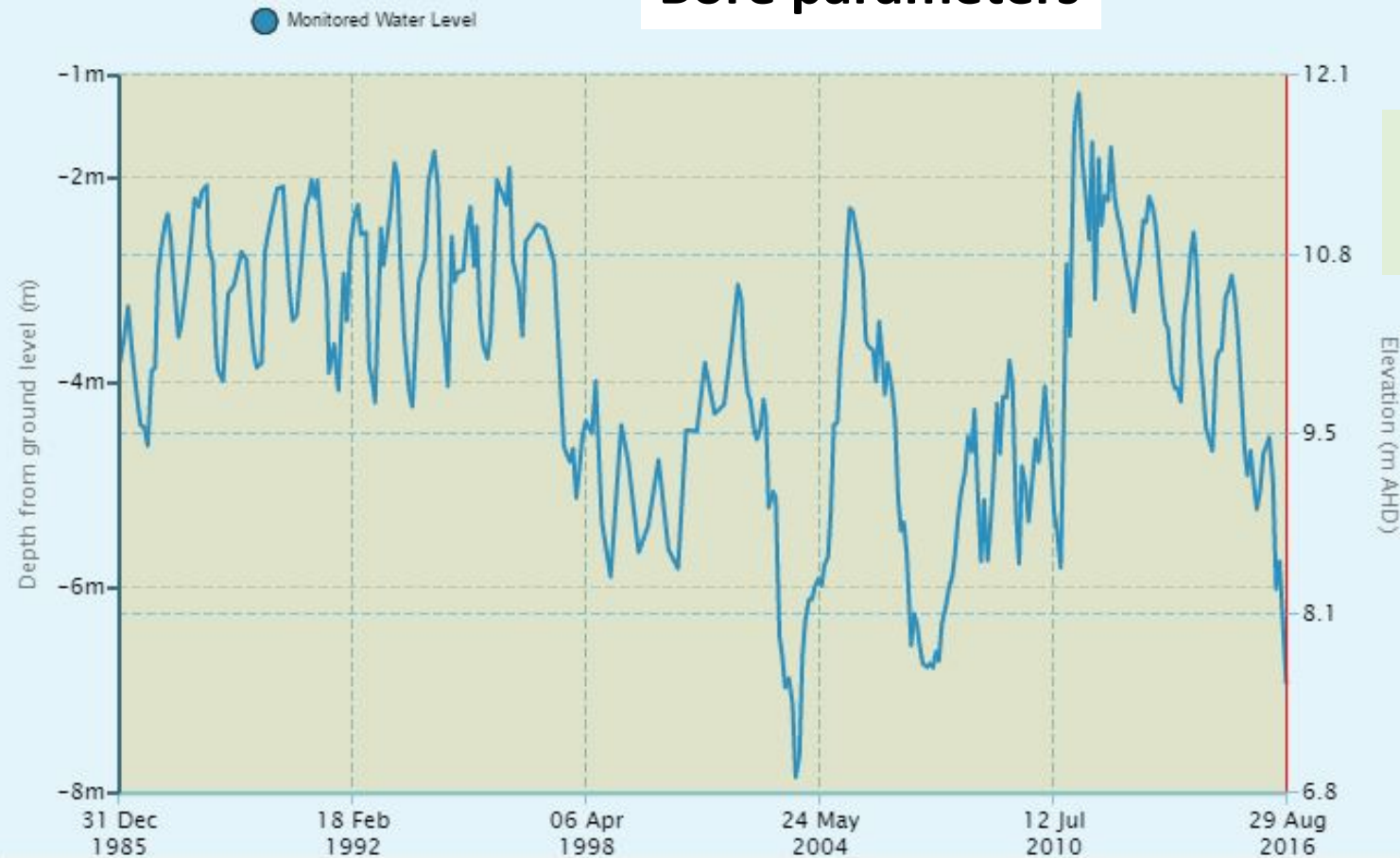
LITHOLOGY

STRATIGRAPHY

ATTACHMENTS

Monitoring for bore: 59539

Bore parameters



Information on over 400,000 bores
accessed from the source databases



Layers

- ☐ Depth to watertable (DELWP)
- ☐ Groundwater salinity (DELWP)
- ☐ Elevation of basement (DELWP)
- ☐ Surface elevation (DELWP)
- ☒ Bores - GEDIS (minerals)
- ☒ Bores - DELWP WMIS (groundwater)
- ☐ Bores - FedUniSpatial (groundwater)

Query mode: Bores

[Advanced aquifer tools \(new\)](#)

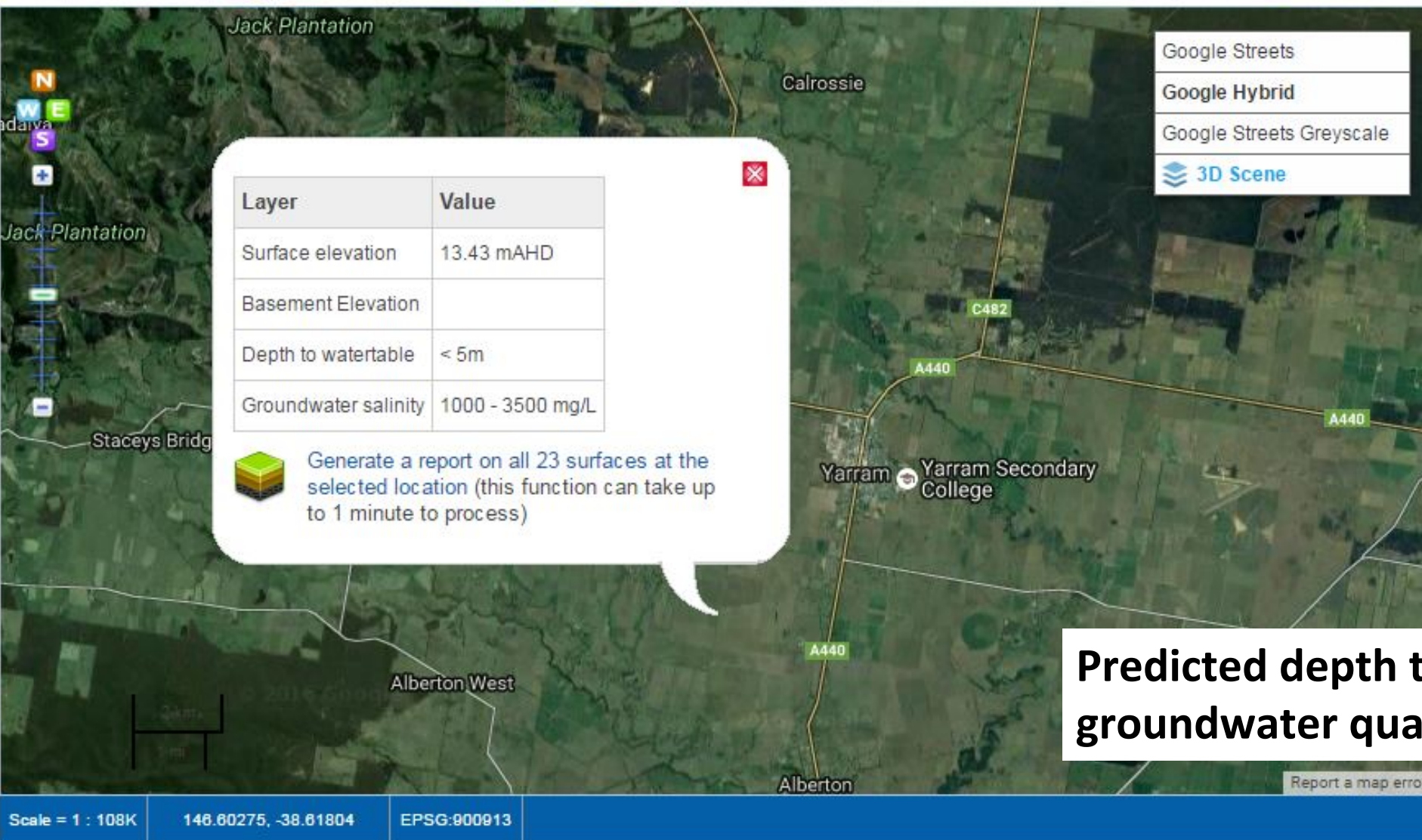
[Info](#)
[Legend](#)
[Search](#)
[Comment](#)

Bores - DELWP WMIS (groundwater)

- + Unmonitored
- + Previously Monitored
- + Monitored

Bores - GEDIS (minerals)

Report a map error



- Google Streets
- Google Hybrid
- Google Streets Greyscale
- 3D Scene

Layers

- ☐ Depth to watertable (DELWP)
- ☐ Groundwater salinity (DELWP)
- ☐ Elevation of basement (DELWP)
- ☐ Surface elevation (DELWP)
- ☐ Bores - GEDIS (minerals)
- ☐ Bores - DELWP WMIS (groundwater)
- ☐ Bores - FedUniSpatial (groundwater)
- ☐ Mineral Springs
- ☐ EPA Victoria Sites
- ☐ Geology (DEDJTR GSV)

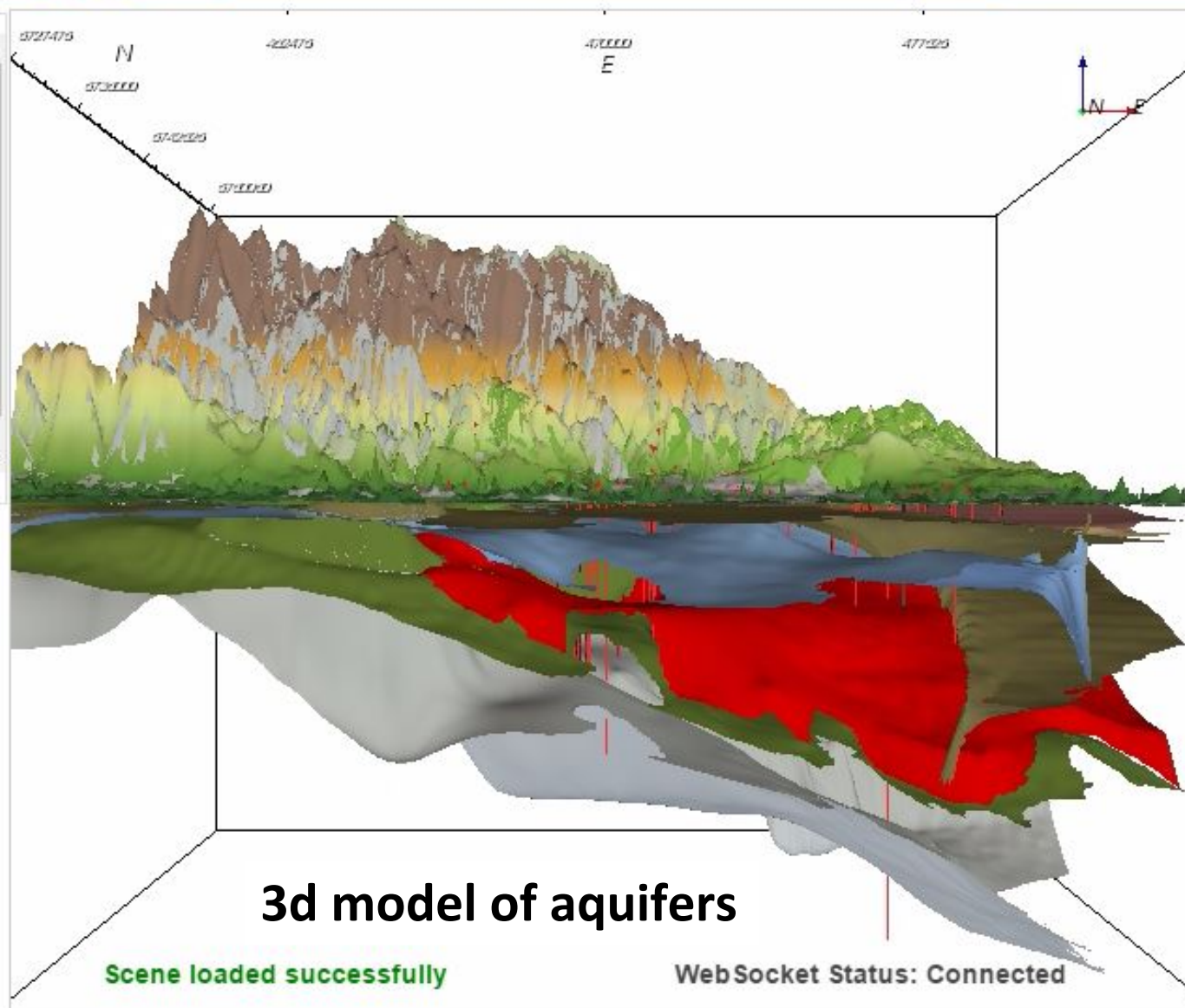
Query mode: Drill Virtual Borehole ▼

Advanced aquifer tools (new)

Info Legend Search Comment

Predicted depth to watertable and groundwater quality

- ☒ Bore Group
- ☒ Surface
- ☒ Ground Surface
- ☒ Quaternary Aquifer
- ☒ Upper Tertiary / Quaternary Aqu
- ☒ Upper Tertiary / Quaternary Aqu
- ☒ Upper Tertiary Aquifer (fluvial)
- ☒ Upper Tertiary Aquitard
- ☒ Upper Mid-Tertiary Aquifer
- ☒ Upper Mid-Tertiary Aquitard
- ☒ Lower Mid-Tertiary Aquifer
- ☒ Lower Tertiary Aquifer
- ☒ Lower Tertiary Basalts



Tools

- ☒ Toggle Perspective
- ☒ Toggle Axis
- ☒ Reset View
- ☒ Top
- ☒ Bottom
- ☒ North
- ☒ South
- ☒ East
- ☒ West
- ☒ Slice Front
- ☒ Slice Back

Cross Section Tools

- ☒ Toggle slice mode on/off
- ☒ Cut Slice
- ☒ Reset Slicer

Vertical Exaggeration: (15)

Quality (100%)

Interaction Quality (15%)

Interaction Bundle (12)

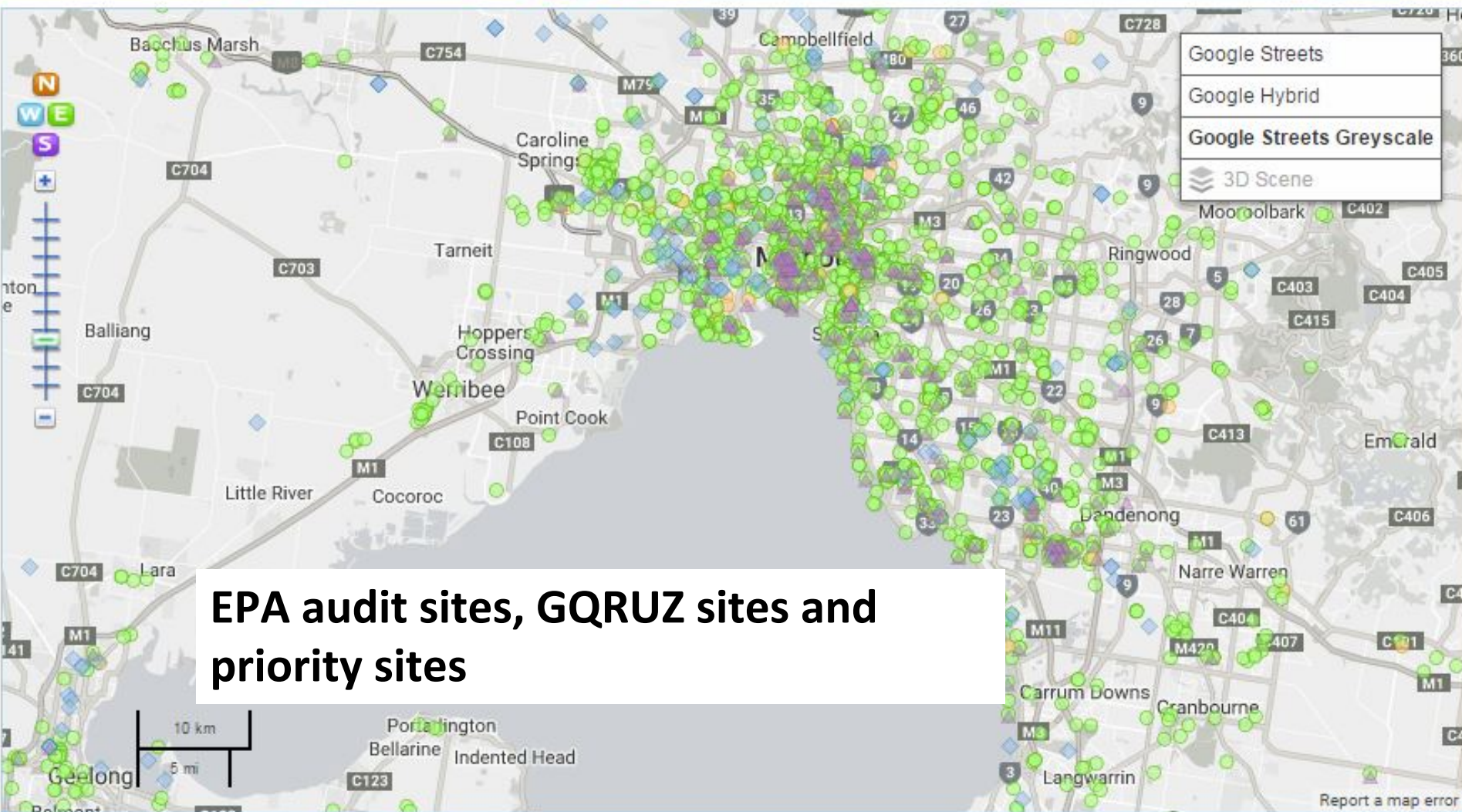
Quick Start Instructions

ROTATE: Left Mouse + Drag

ZOOM: Right Mouse + Drag (or scroll wheel)

PAN: Left Mouse + Right Mouse + Drag

SELECT Bore: Left Mouse + Double Click



EPA audit sites, GQRUZ sites and priority sites

Layers

- ☐ Depth to watertable (DELWP)
- ☐ Groundwater salinity (DELWP)
- ☐ Elevation of basement (DELWP)
- ☐ Surface elevation (DELWP)
- ☐ Bores - GEDIS (minerals)
- ☐ Bores - DELWP WMIS (groundwater)
- ☐ Bores - FedUniSpatial (groundwater)
- ☐ Mineral Springs
- ☒ EPA Victoria Sites
- ☐ Geology (DEDJTR GSV)

Query mode: **EPA Victoria sites**

Advanced aquifer tools (new)

Info Legend Search Comment

EPA Victoria Sites

epa_env_audit_points_view

EPA audit reports

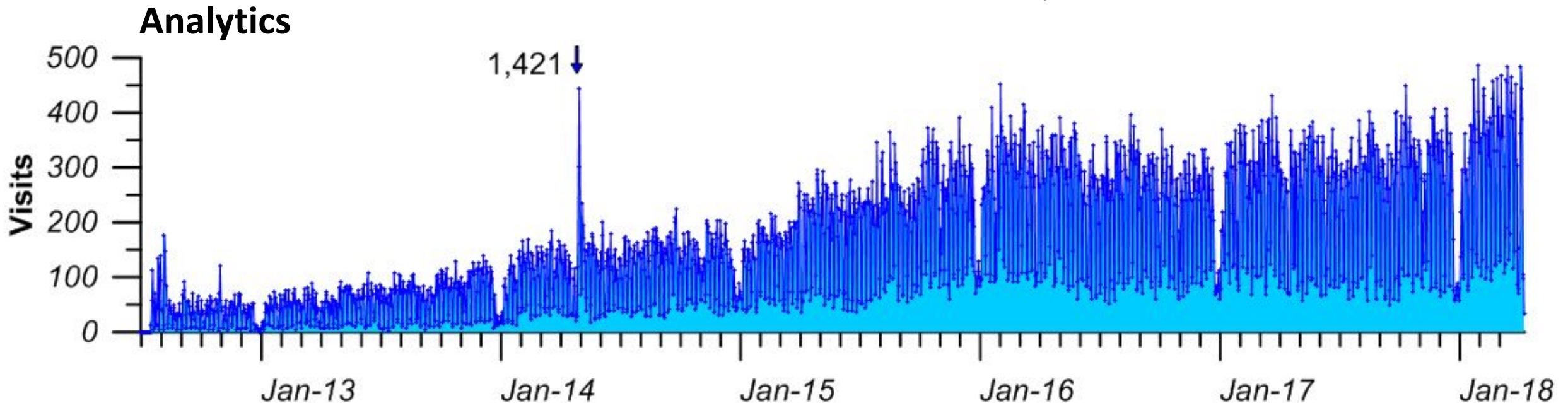
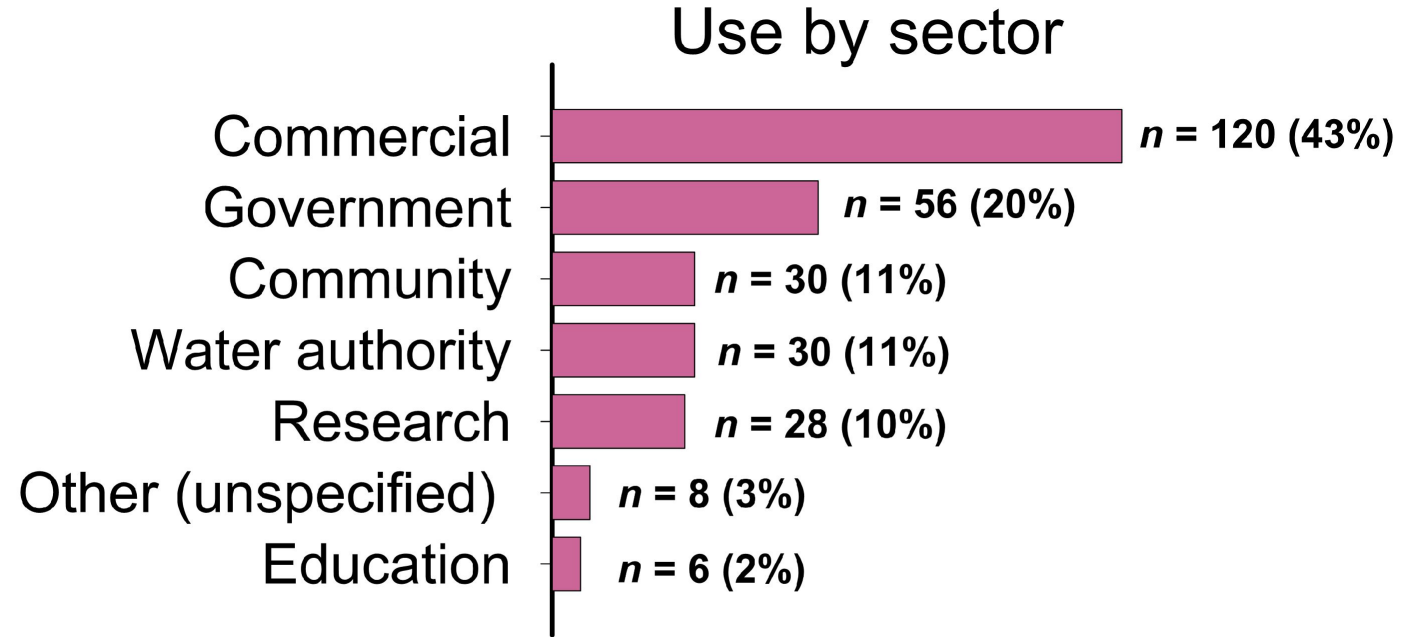
EPA audit site (no report)

epa_priority_sites_points_view

gqrUZ_05102016

Primary impact

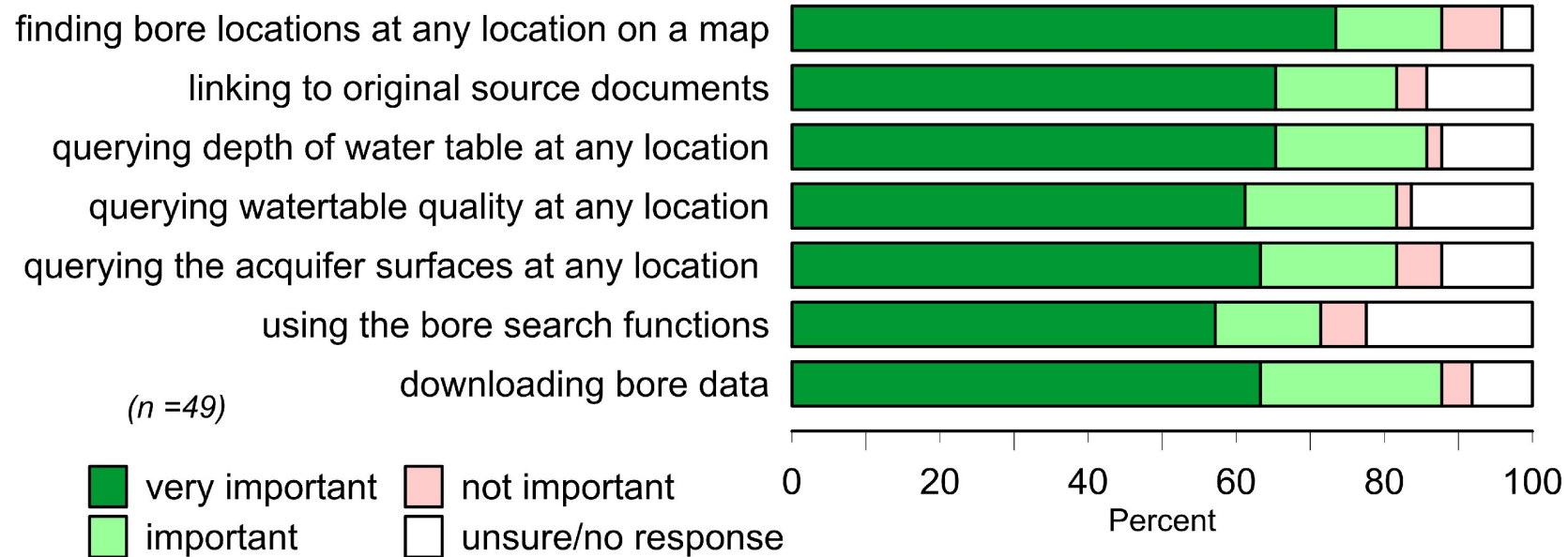
The VVG portal is frequently used by a wide cross-section of society



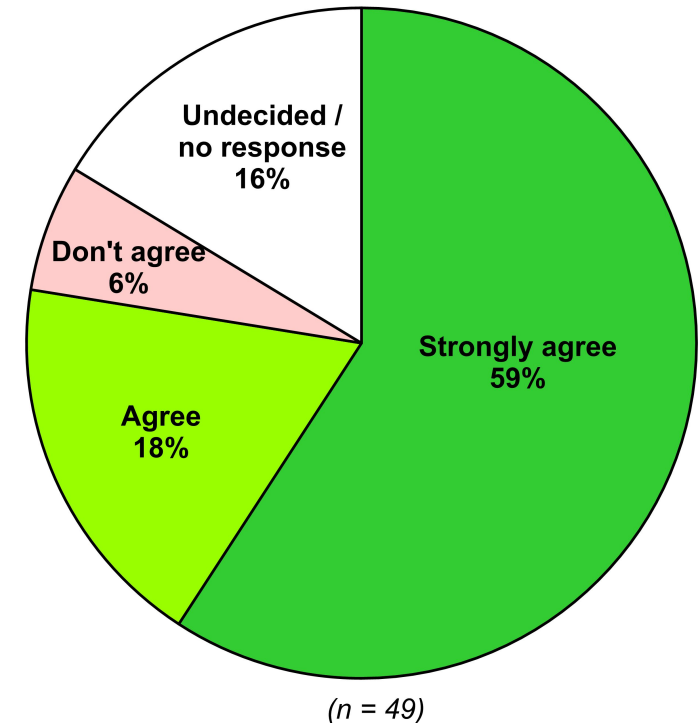
Practice impact

The portal has changed the way people find groundwater data

Assessed importance of VVG functions in decision making



VVG data provides a better basis for groundwater resource management.



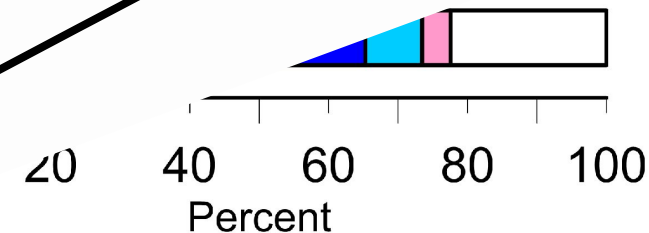
Sector impact

The provision of multiple groundwater data sources within a single internet portal
Victorian groundwater industry

Journal of Hydroinformatics: 18/2 March 2016 (open access)

Making the invisible visible: the impact of federating groundwater data in Victoria, Australia

Peter Dahlhaus, Angela Murphy, Andrew MacLeod, Helen Thompson,
Kirsten McKenna and Alison Ollerenshaw

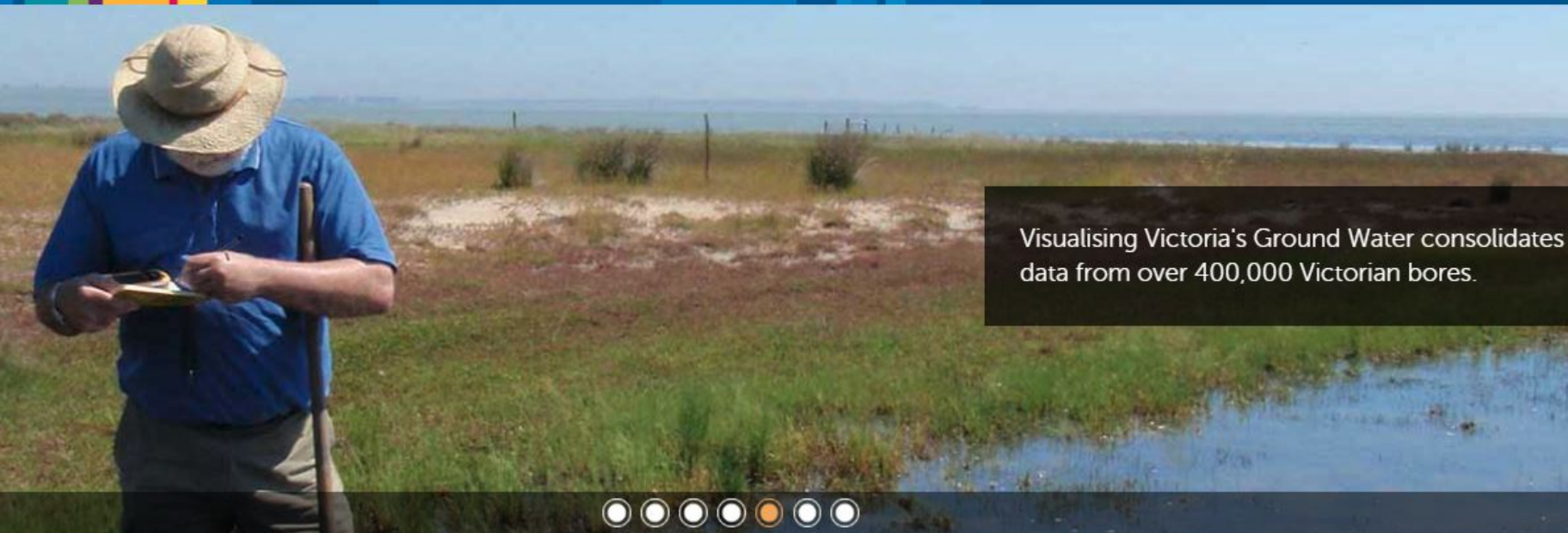


very useful

reasonably useful

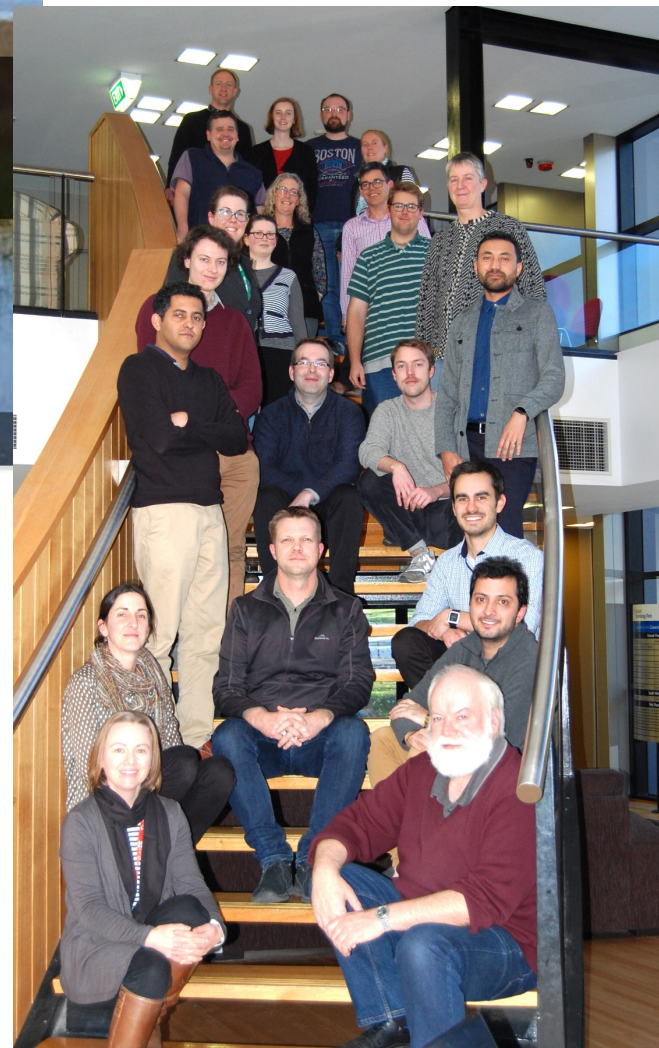
not useful

unsure/no response

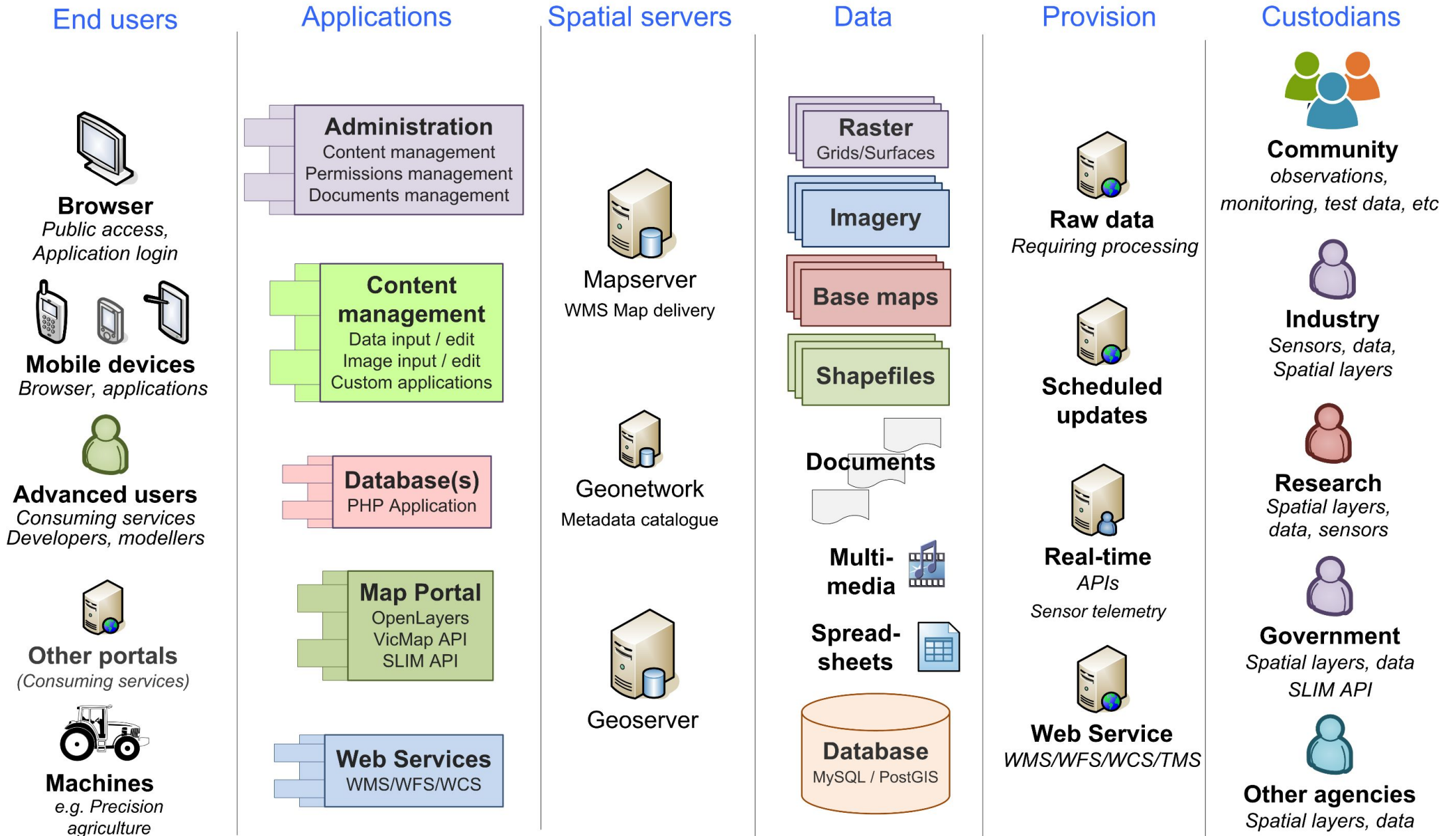


The VVG has spawned around 30 spatial data portals

OUR RESEARCH THEMES



CeRDI Spatial Data Infrastructure (generalised)



Data interoperability

Full interoperability requires adopting common:

systems - communication protocols (e.g. for web services);

syntax - representation language (e.g. Extensible Markup Language (XML), JavaScript Object Notation (JSON) or others);

structure - data schema (e.g. GWML1);

semantics - content vocabulary (e.g. for water quality parameters);

and

pragmatics - best practices in the collection and use of the data

Open Geospatial Consortium: an international consortium of companies, government agencies and universities that develops publically available international spatial data standards for data interoperability.

OGC^(R) standards are technical documents that detail interfaces or encodings used by software developers.



Groundwater Interoperability Experiment 2 (GW2IE)

http://external.opengis.org/twiki_public/HydrologyDWG/GroundwaterInteroperabilityExperiment2

GWML2 interoperability experiment

Aims:

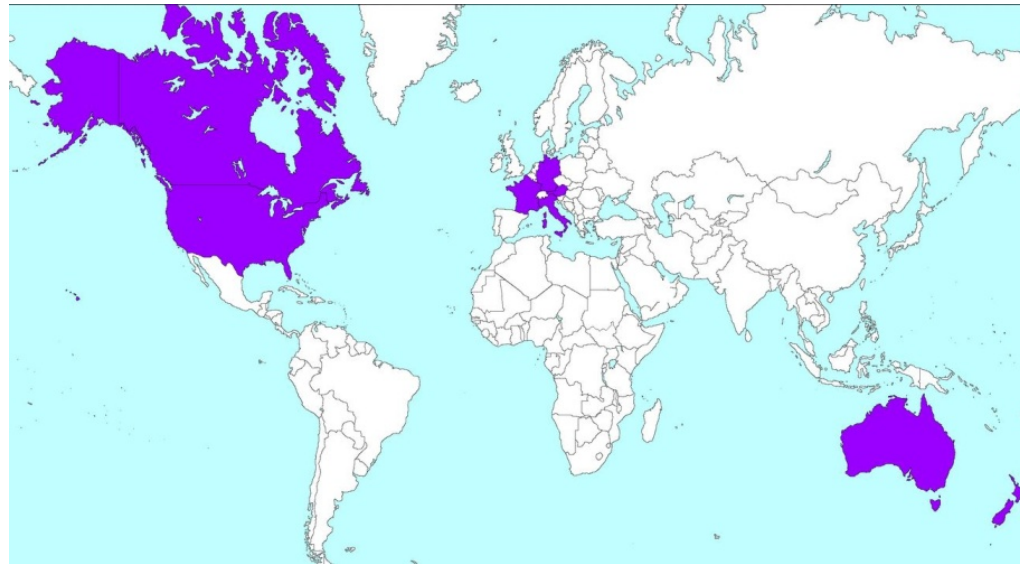
- Develop an international groundwater information model
- Develop a GML application schema, for groundwater data
- Harmonize existing models (GWML, INSPIRE)

Regions:

North America

Europe

Australasia



5 years, 57 meetings

GWML2 interoperability experiment

Use Cases



Agreed entities



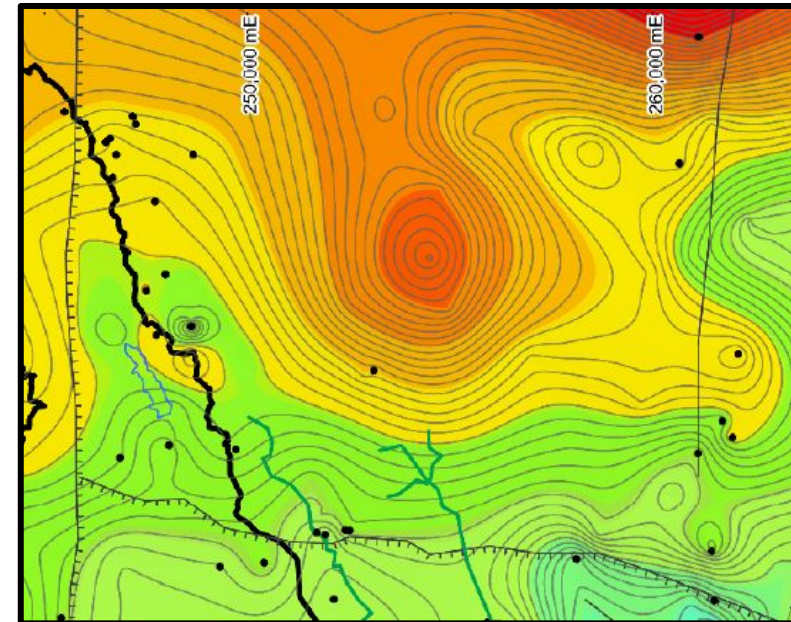
Conceptual Schema



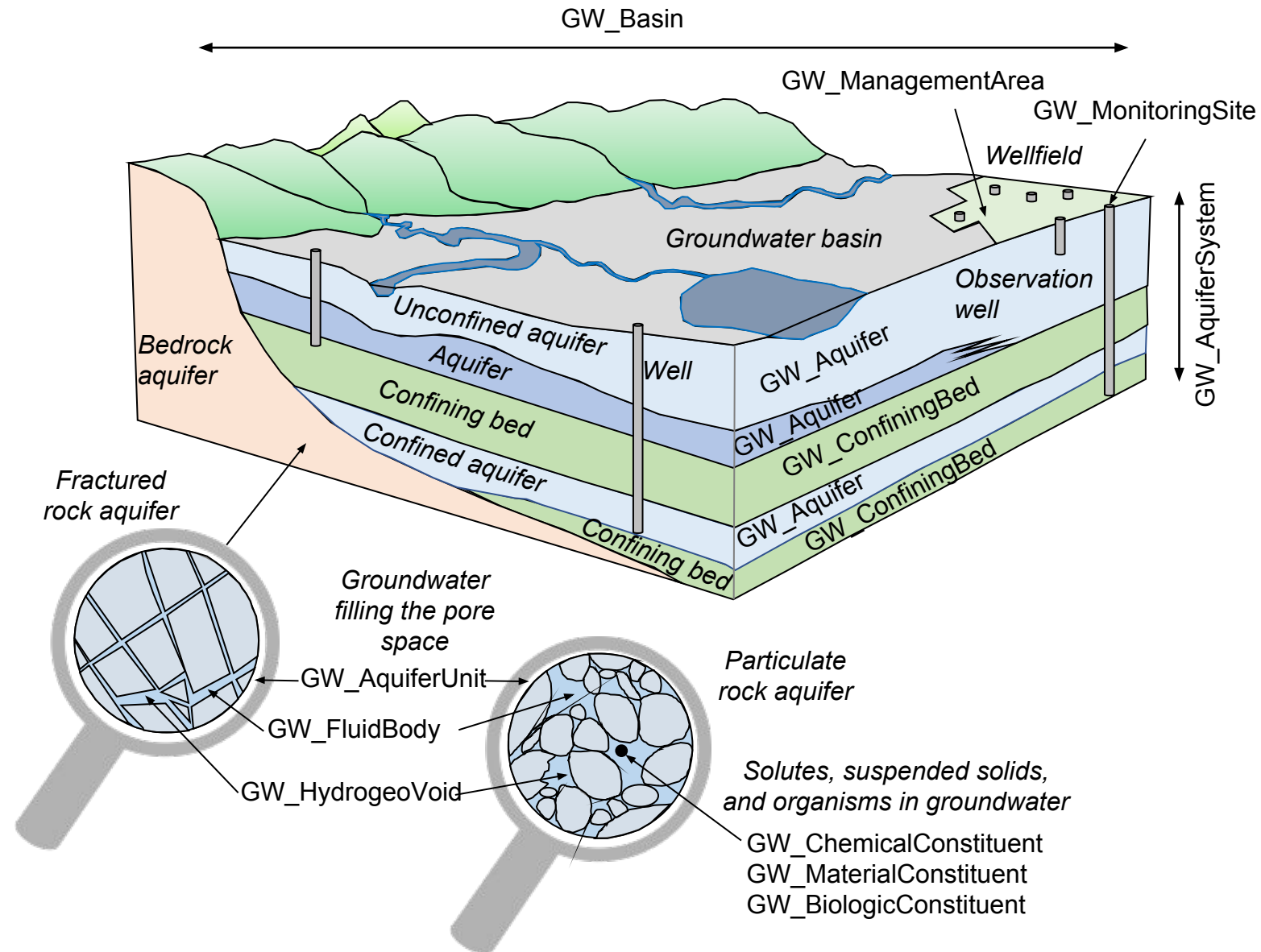
Logical Schema



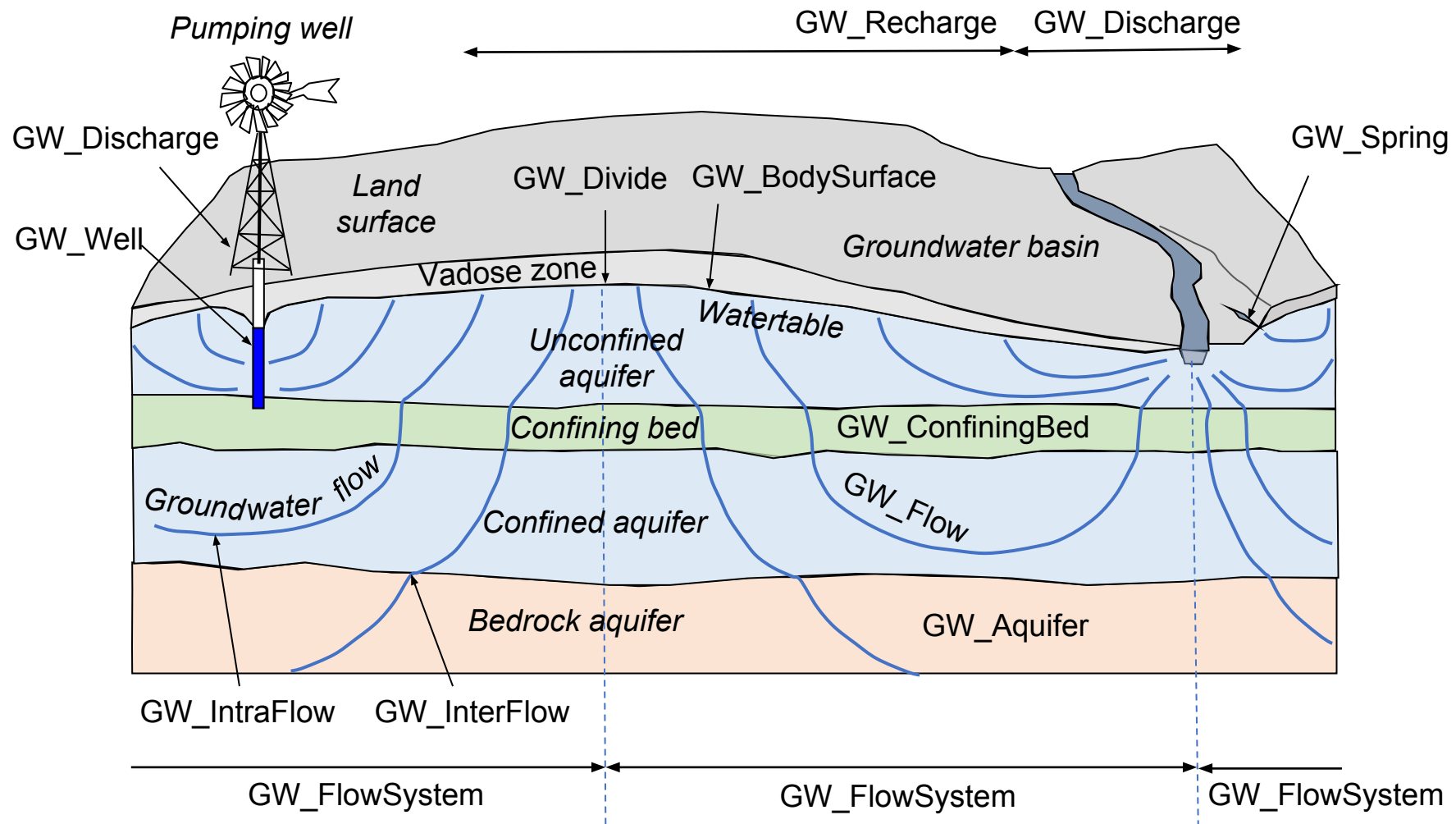
Physical Schema



Entities: HydrogeoUnits, Voids, Fluid Bodies



Entities: Flow, Well



OGC WaterML



Hydrogeology Journal
<https://doi.org/10.1007/s10040-018-1747-9>

PAPER

Enabling global exchange of groundwater data: GroundWaterML2 (GWML2)

Boyan Brodaric¹ · Eric Boisvert² · Laurence Chery³ · Peter Dahlhaus⁴ · Sylvain Grellet³ · Alexander Knoch⁵ ·
François Létourneau² · Jessica Lucido⁶ · Bruce Simons⁷ · Bernhard Wagner⁸

Received: 12 February 2017 / Accepted: 16 February 2018
© The Author(s) 2018

2)

Is ma

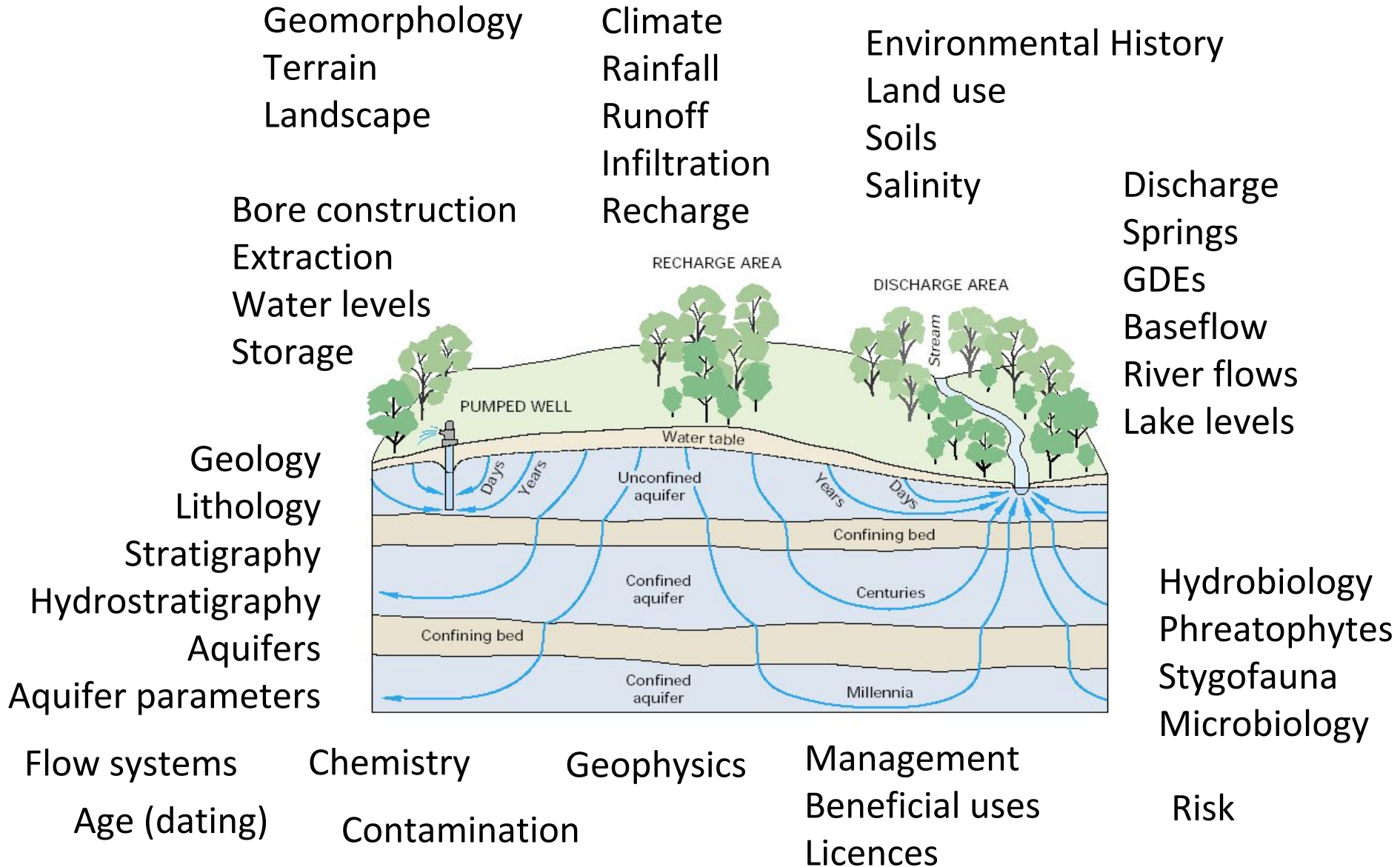
Standar

Google OC

to find it!



So what constitutes groundwater data?



But what about the qualitative data?

Data often overlooked by scientists (hydrogeologists), but it can be critically important.



Redoximorphic features in saprolite, Dundas Tableland, Vic



Examples include observations about landscape features, soil colours, vegetation types, seeps, springs, wetland ecosystems, and anecdotal information from long-term occupiers of the land.

VICTORIA

STATE RIVERS AND WATER SUPPLY COMMISSION

1947

THE
UNDERGROUND WATER RESOURCES
OF VICTORIA

Dup. Copy
3557-48
17 Mines Department Victoria

GROUNDWATER
INVESTIGATION
PROGRAM
REPORT
1972

Original data
sources are
valuable



Fig. 17.—The Percussive
"Dimboola No. 1"
Borehole

TELEGRAPHIC ADDRESS: DRILLING, MELBOURNE
CABLE ADDRESS: DRILLING, MELBOURNE
CODES: LIEBER'S
WESTERN UNION

MANAGING DIRECTOR
J. E. ELLIOTT

Goldfields Diamond Drilling Co. Prop. Ltd.
ENGINEERS, MANUFACTURERS, BORING CONTRACTORS
AND MACHINERY MERCHANTS

BOND AND FREE STORES
STURT & DODDS STS., SOUTH MELBOURNE
PHONE 5414

HEAD OFFICE:
205 STURT STREET, SOUTH MELBOURNE
PHONE 3890

ELIZABETH STREET P.O. BOX 45

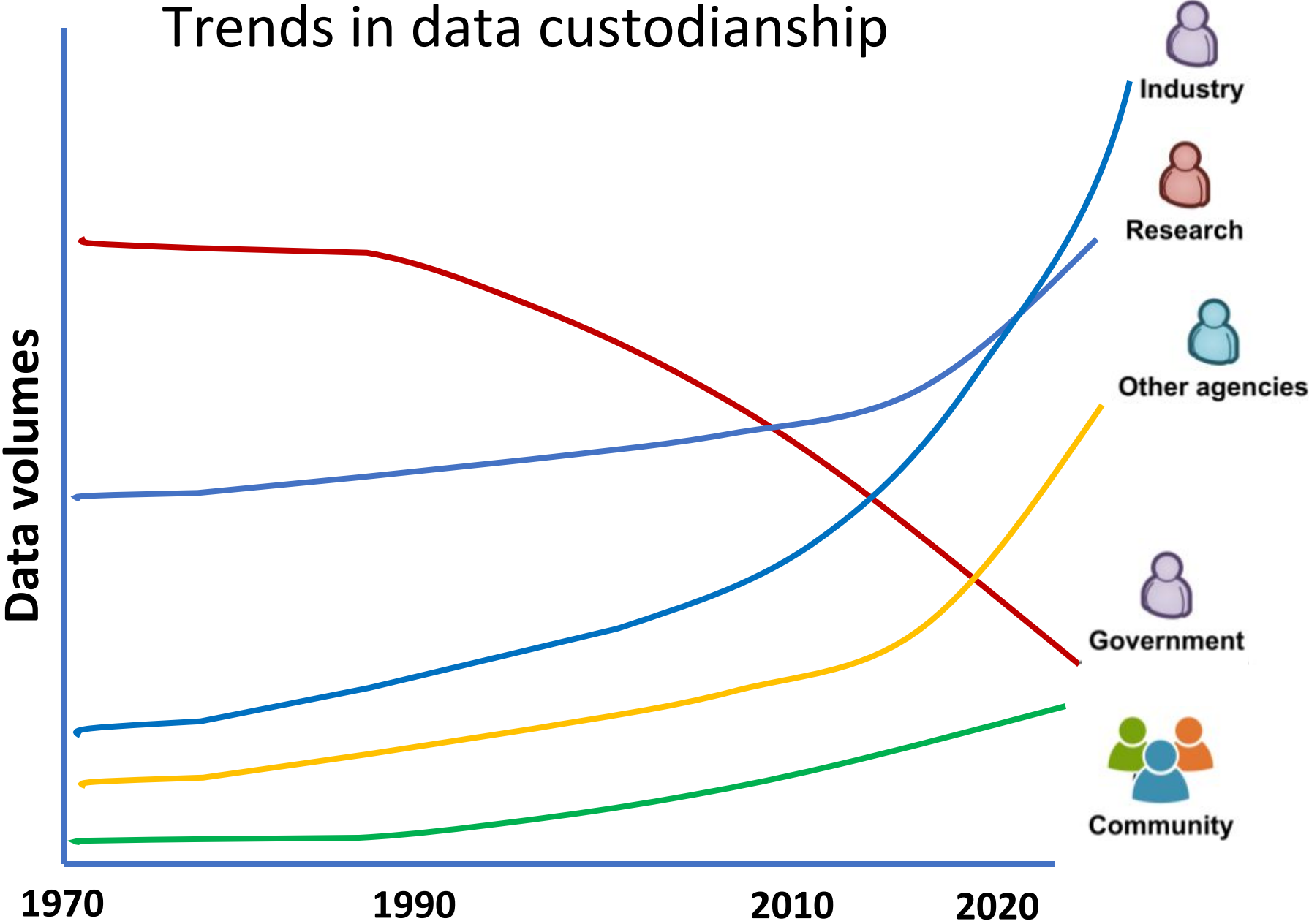
Melbourne, 20th October, 1924.
VICTORIA

The Secretary for Mines,
Department of Mines,
MELBOURNE.

REPORT
OF THE
STATE RIVERS AND WATER SUPPLY
COMMISSION
VICTORIA.
MINES DEPARTMENT, VICTORIA
BORING RECORDS
1961-62

Archival boring records are
particularly important sources
of information.

Trends in data custodianship



Does not include
social data

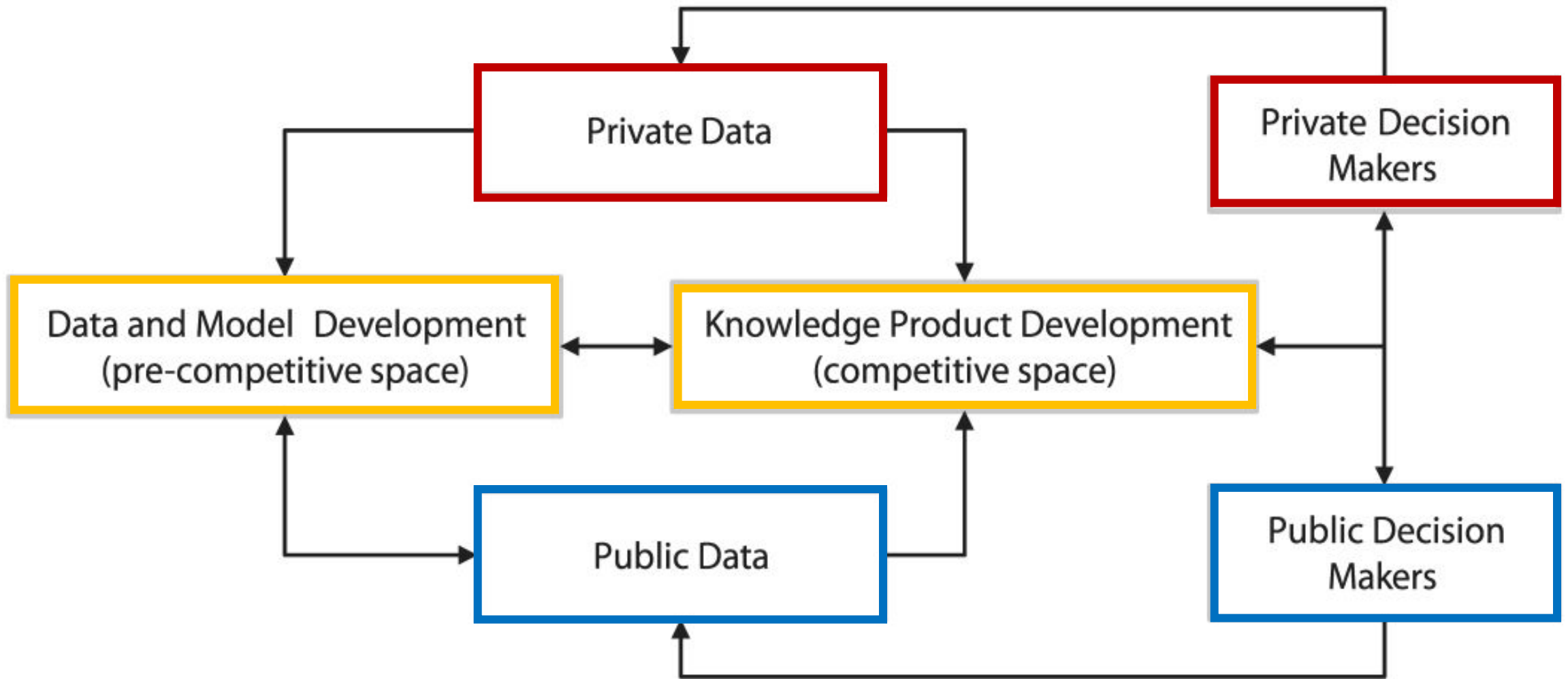
DATA REGIMES

Data Dictatorship: Data is controlled and its use restricted. Distribution of data is based on perceived necessity.

Data Aristocracy: Data analysts and scientists are required to provide meaning, and they have the power.

Data Anarchy: Users feel underserved and create their own datasets from available sources. Data sharing is ad-hoc.

Data Democracy: Everybody gets timely and equitable access to data. Users are empowered and they often own some of the data.



Antle, J.M., Basso, B., Conant, R.T., Godfray, H.C.J., Jones, J.W., Herrero, M., Howitt, R.E., Keating, B.A., Munoz-Carpena, R., Rosenzweig, C., Tittone, P. and Wheeler, T.R. (2017). Towards a new generation of agricultural system data, models and knowledge products: Design and improvement. *Agricultural Systems*. DOI:<http://dx.doi.org/10.1016/j.agsy.2016.10.002>.

Data Democracy can interoperably federate:

- ✓ Public and private data**
- ✓ Big data, sensors, internet of things**
- ✓ Legacy data**
- ✓ Crowdsourced data**

To answer the frequently asked hydrogeological questions

To dynamically generate conceptual and predictive models

To make new discoveries and avoid repeating past mistakes

To reduce time wasted in litigious conflicts

Welcome to the new VVG - Please try out the new [map portal](#).

Note: We will be working on updating the website content over the next 2-3 weeks.

> **3M**
monitoring
records

> **4.5K**
bore data

350K borehole intervals
10K attachments and links

1.3K
users

> **450K**
chemical
analysis records

monitored water level



Milliequivalent per litre (mEq/L)

2.4 1.2 0.0 1.2 2.4

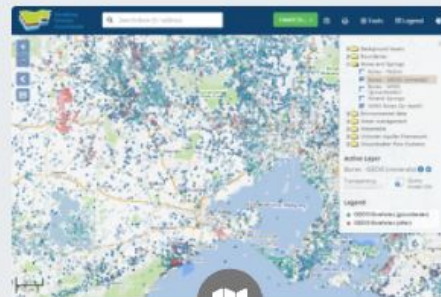
Na + K Cl

Ca HCO₃ + CO₃

Mg SO₄

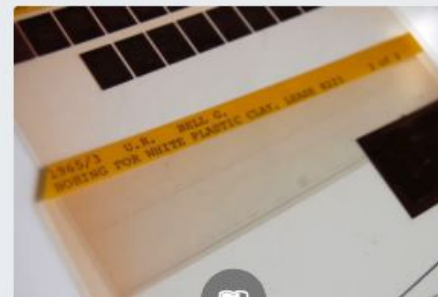
Cations Anions

beta.vvg.org.au



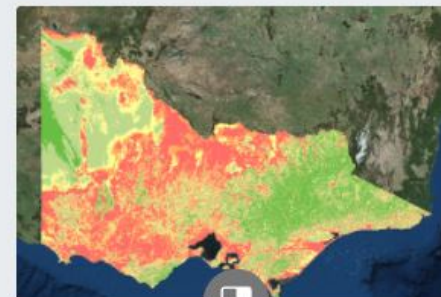
Map portal

An interoperative web-GIS that federates groundwater data from disparate sources to



E-Library

Search and access over 1,589 groundwater and other related resources: reports, fact



Data Catalogue

Open access to the datasets featured in VVG. You can use it however you like to build apps