

# GWML2 implementation (Australia)

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WMO HydroHub



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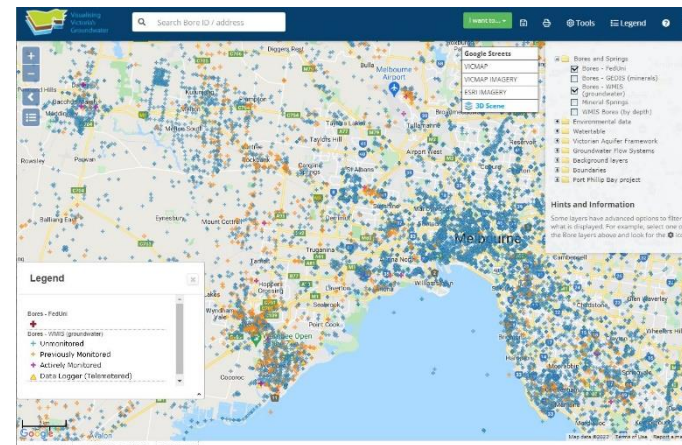
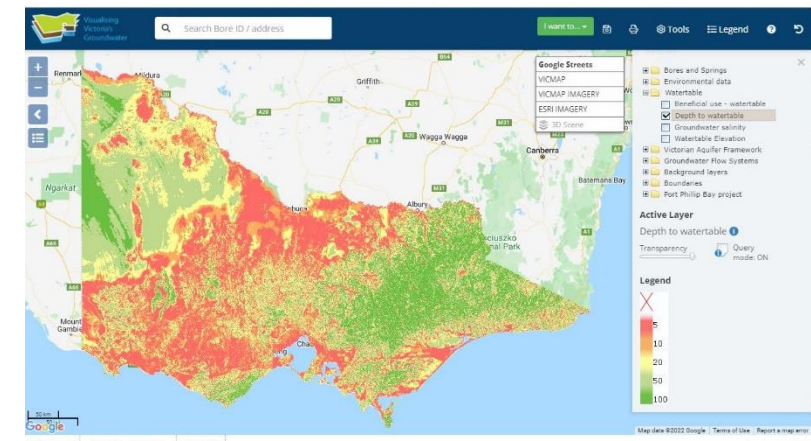
*An interoperative spatial information portal that federates groundwater data from disparate sources. >400k bores, >3M monitoring records, >450k chemistry records, etc.*

*Primarily for research and investigation.*

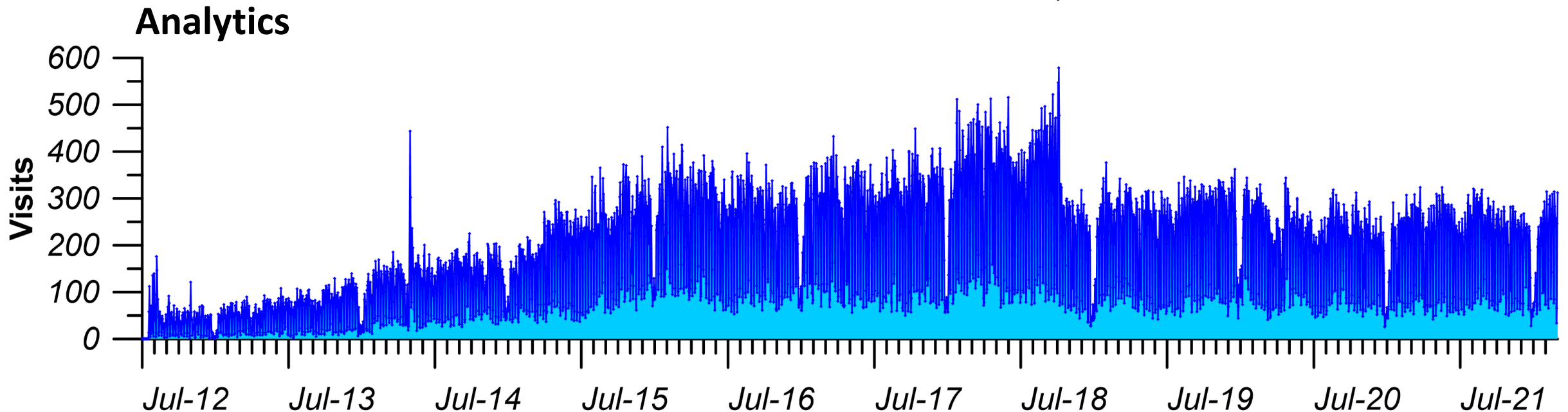
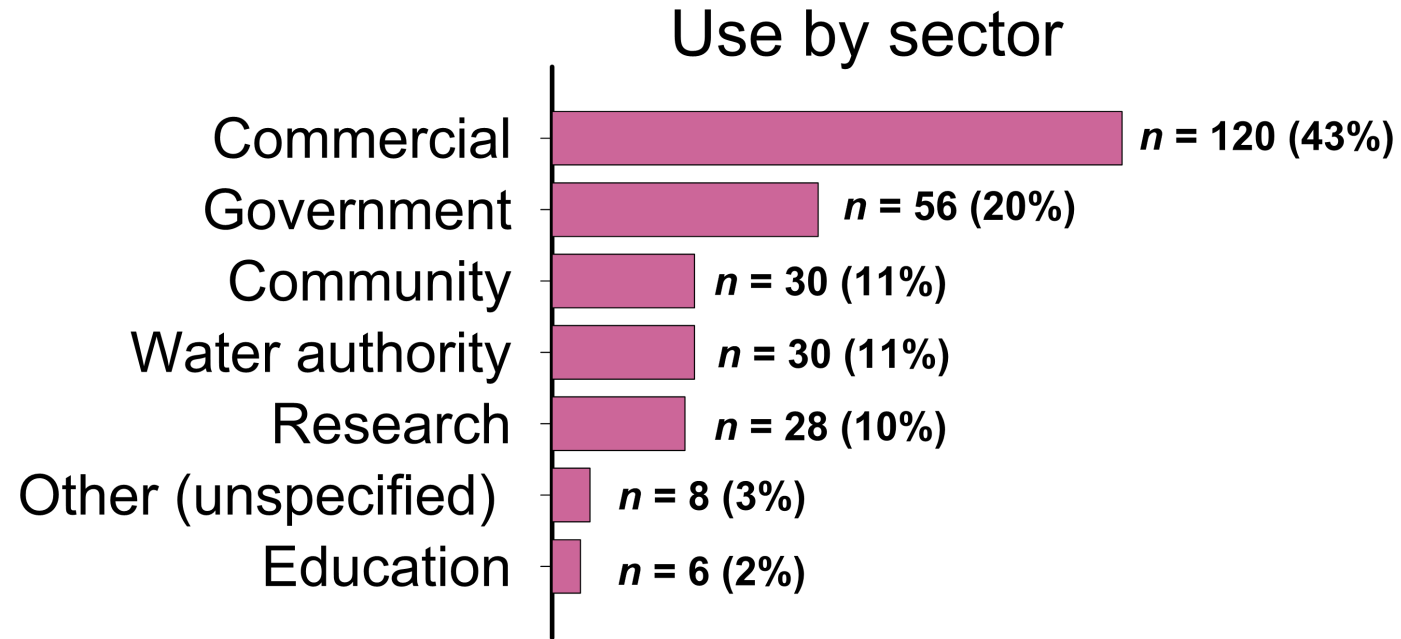
*Non-government portal (unique?).*

Dahlhaus et al. 2016

<https://doi.org/10.2166/hydro.2015.169>



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



## VVG used in OGC interoperability experiments

Groundwater Interoperability Experiment 2 (GW2IE) 2012 - 2016

OGC WaterML2: Part 4 – GroundWaterML2 (GWML2) 2016 -

Second Environmental Linked Features Interoperability Experiment (SELFIE) 2018 - 20

*Mostly collaborations of participants from organisations in European Union, North America & Oceania*



GW2IE meeting, Vienna, May 2014



SELFIE Workshop meeting, Leuven, June 2019

# GWML2 Interoperability Experiment

- Tested the GWML2 model by implementing services
  - Based on Victorian State Government and FedUni research bore data
- Physical model xml-implementation
- WaterWell
  - Borehole construction
    - Headworks
    - Casing
    - Screening
    - Filtration
  - Lithological logs
  - Stratigraphic logs

```
<gwml2wc:bholeConstruction>
  ▼<gwml2wc:Screen gml:id="feduni.borehole.construction.26654.screen.1">
    ▼<gwml2wc:screenElement>
      ▼<gwml2wc:ScreenComponent gml:id="feduni.borehole.construction.26654.screen.component.3193">
        ▼<gwml2wc:from>
          ▼<swe:Quantity>
            <swe:uom code="m" xlink:href="http://qudt.org/vocab/unit#Meter" xlink:title="metre"/>
            <swe:value>9.5</swe:value>
          </swe:Quantity>
        </gwml2wc:from>
        ▼<gwml2wc:to>
          ▼<swe:Quantity>
            <swe:uom code="m" xlink:href="http://qudt.org/vocab/unit#Meter" xlink:title="metre"/>
            <swe:value>11.5</swe:value>
          </swe:Quantity>
        </gwml2wc:to>
        <gwml2wc:screenInternalDiameter xlink:href="http://www.opengis.net/def/nil/OGC/0/unknown"/>
      </gwml2wc:ScreenComponent>
    </gwml2wc:screenElement>
  </gwml2wc:Screen>
</gwml2wc:bholeConstruction>
```

# GWML2 Interoperability Experiment

- Victorian Aquifer Framework
  - Modelled Raster surfaces represented as GWML2 features
  - Aquifer, FluidBody
- Victorian Mineral Springs Database + GDE's
  - GW\_Spring
  - Groundwater flows, interactions
    - Discharge / Recharge

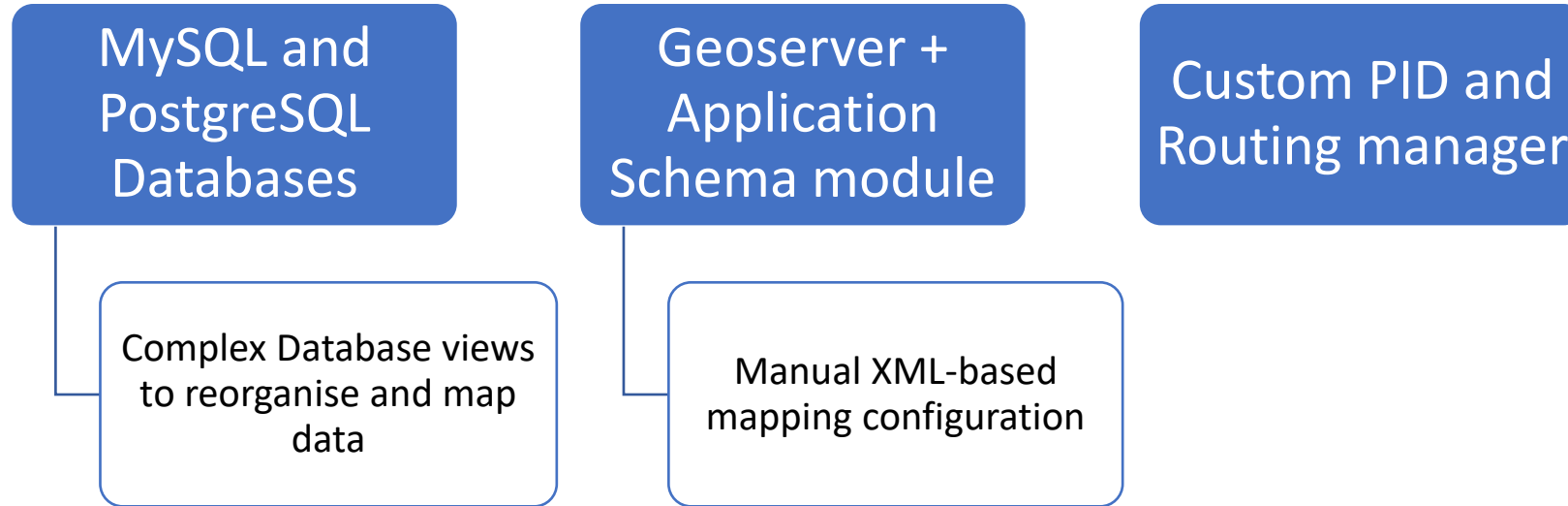
```
<gwm12w:GW_Spring gml:id="feduni.spring.1">
  <gml:description>Groundwater discharge seep at edge of Water Reserve (CHW pine plantation)</gml:description>
  <gml:identifier codeSpace="http://www.vvg.org.au/">https://id.cerdi.edu.au/feduni/data/gwml2/sp</gml:identifier>
  <gml:name codeSpace="http://www.vvg.org.au/">CS001</gml:name>
  <gml:name codeSpace="http://www.vvg.org.au/">Mannings Lane</gml:name>
  <gwm12w:gwSpringName>CS001</gwm12w:gwSpringName>
  <gwm12w:gwSpringLocation>
    <gml:Point gml:id="feduni.spring.1.location" srsDimension="3" srsName="urn:ogc:def:crs:EPSG::31470">
      <gml:pos>-37.513019 143.940469 0</gml:pos>
    </gml:Point>
  </gwm12w:gwSpringLocation>
  <gwm12w:gwSpringReferenceElevation>
    <gwm12w:Elevation>
      <gwm12w:elevation axisLabels="m AHD" srsDimension="1" srsName="http://www.opengis.net/def/crs/epsg/31470/urn:ogc:unit:metre" uomLabels="metre">558.4846191000000000</gwm12w:elevation>
      <gwm12w:elevationAccuracy xlink:title="SKM GPS"/>
      <gwm12w:elevationType xlink:title="Relative Level Natural Surface"/>
      <gwm12w:elevationMeasurementMethod xlink:href="http://www.opengis.net/def/nil/ogc/0/unknown"></gwm12w:elevationMeasurementMethod>
    </gwm12w:Elevation>
  </gwm12w:gwSpringReferenceElevation>
  <gwm12w:gwSpringType xlink:title="Freshwater"/>
  <gwm12w:gwSpringCauseType xlink:title="Seep"/>
  <gwm12w:gwSpringBody xlink:href="https://id.cerdi.edu.au/feduni/data/gwml2/fluidbody/feduni.fluidbody"></gwm12w:gwSpringBody>
  <gwm12w:gwSpringUnit xlink:href="https://id.cerdi.edu.au/feduni/data/gwml2/aquifer/feduni.aquifer"></gwm12w:gwSpringUnit>
  <gwm12w:gwSpringPersistence xlink:title="perennial"/>
</gwm12w:GW_Spring>
```

# GWML2 Interoperability Experiment

- Hydrochemistry
  - O&M service delivering chemistry observations
  - Controlled vocabulary for Observed Properties (skos)
  - Linked to GWML2 features (tested querying + filtering)
    - Feature of Interest (bore/well) - proximal
    - Parameter (hack) to real world (aquifer/fluid body) – ultimate FOI

```
<om:parameter>
  ▼ <om:NamedValue>
    <om:name xlink:href="http://www.opengis.net/req/gw_fluidbody/fluidbody_sf_ufoi" xlink:title="ultimate_foi"/>
    <om:value>https://id.cerdi.edu.au/feduni/data/gwml2/fluidbody/feduni.borehole.fluidbody.46081.27001</om:value>
  </om:NamedValue>
</om:parameter>
<om:observedProperty xlink:href="http://environment.data.gov.au/def/property/chloride_concentration" xlink:role="skos:Concept"
xlink:title="Chloride ions"/>
<om:featureOfInterest xlink:href="https://id.cerdi.edu.au/feduni/data/gwml2/well/feduni.well.46081" xlink:role="gwml2w:GW_Well"/>
<om:result>
  ▼ <swe:Quantity>
    <swe:uom code="mg/l" xlink:href="http://environment.data.gov.au/def/unit/MilligramsPerLitre" xlink:title="mg/l"/>
    <swe:value>349.0</swe:value>
  </swe:Quantity>
</om:result>
```

# Technical Architecture





# SELFIE Updates and Lessons

- Improved Persistent Identification (PID) and URI Management
- Content Negotiation (Conneg) by encoding type
  - Implemented new representations in HTML and (experimental) JSON-LD
- Our Use Case
  - Federating / harmonising information about the same bore/well from different data providers, data sources and schema's/API's
- Lessons

CeRDI SELFIE Search

## Well 46217

Meta Information Resource (MIR) for <https://geo.org.au/id/well/46217>

Type	feature,well	<a href="#">JSON-LD</a>
Identifier	<a href="https://geo.org.au/id/well/46217">https://geo.org.au/id/well/46217</a>	
Name(s):	46217,ARDNO 2	

### Representations

**Information from GEDIS - Geoscience Victoria (GSV)** ([view on GeoVic](#))

Borehole	<a href="#">XML (gsml)</a> <a href="#">HTML</a> <a href="#">JSON-LD</a>
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**Water Management Information System (WMIS) - Victorian Government (DELWP)** ([view on WMIS](#))

Well/Borehole	<a href="#">XML (gwml2)</a> <a href="#">HTML</a> <a href="#">JSON-LD</a>
Observations (Water quality)	<a href="#">XML</a> <a href="#">JSON-LD</a>

### Relationships

## Lessons, Challenges, Future Work

- Ease of implementation is vital
- The combination of domain/informatics/technical expertise helps a lot
- Many solutions exist now that weren't available at the time of GWML2IE
  - Geoserver features-templating Extension
  - Content Negotiation by Profile
- Extracting meaning with use of Semantic tech and Ontological knowledge
- High volume time-series and sensor data

A close-up photograph of clear water cascading over dark, wet rocks. The water is in motion, creating white foam and splashes. The background is slightly blurred, showing more rocks and some greenery.

**Thank you!**



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**Logo of the  
presenter's Institution**