Demonstrations of GroundWaterML2 standard implementation – Canada

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WORLD METEOROLOGICAL ORGANIZATION

WMO HydroHub

Open Geospatial Consortium

Canada

Natural Resources Canada • Geological Survey of Canada
Ressources naturelles Canada • Commission géologique du Canada

Acknowledgements

- Boyan Brodaric – project leader
- Eric Boisvert, Heryk Julien, François Létourneau, Simon Gagnon
- Provincial and Territorial collaborators and data providers
- USGS collaborator and data provider

Freshwater in Canada

Shared responsability

- 20 federal departments
- 10 provinces and 3 territories with their own internal structures
- Indigenous people (First nations, Inuits and Métis)
- Municipal governments

- Water is under provincial and territorial jurisdiction, except for some special cases, such as transboundary watersheds/aquifers
  - Therefore, data managed by several jurisdictions

2003-2013 : Recommendations w.r.t Groundwater

Findings

1.Data is hard to find & use

2.Data gaps & poor quality

Recommendations

1.More online access

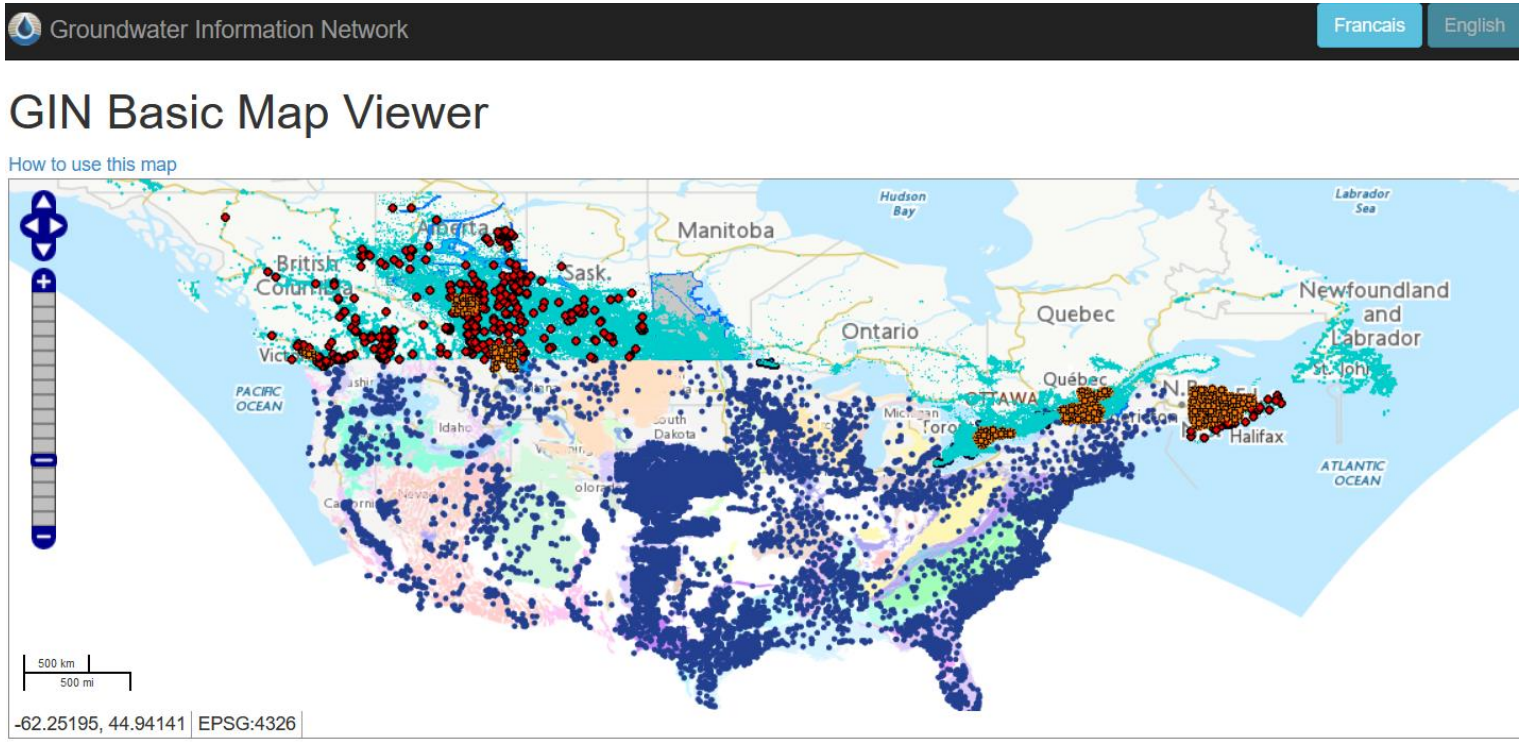
Consolidate data

2.More data (use, monitoring)

Better data quality

Groundwater Information Network

- Harmonize access to data from heterogenous sources
  - Standard model (involvement in **GWML** started here)
- Design principles
  - Providers keep control of data publishing
  - Data remains near the source
  - We don’t « alter » the data
- Access the data as if it was a single GWML based system

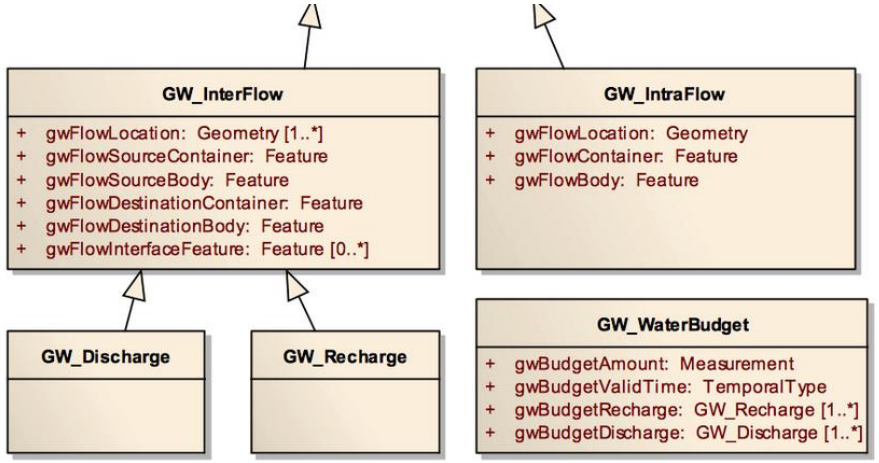


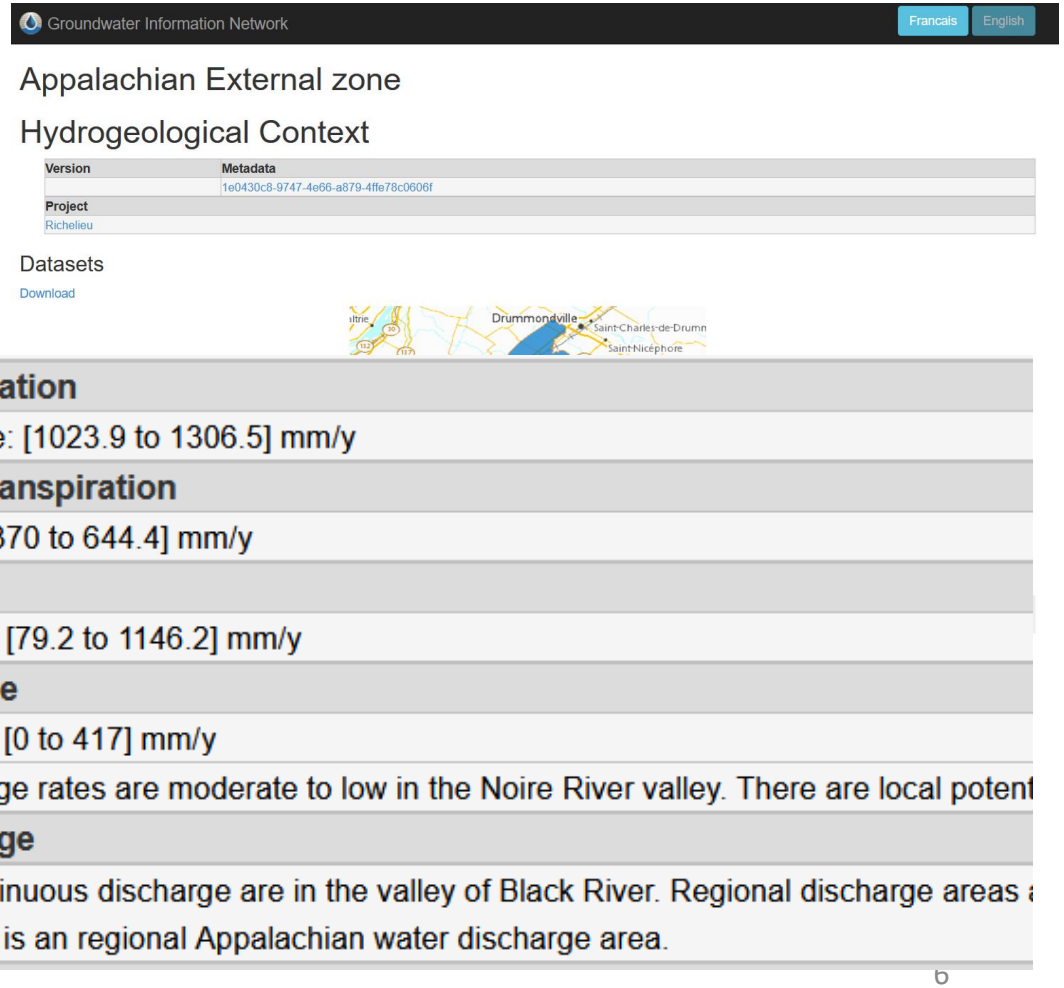
About to be replaced

https://gin.gw-info.net

How GWML helps ?

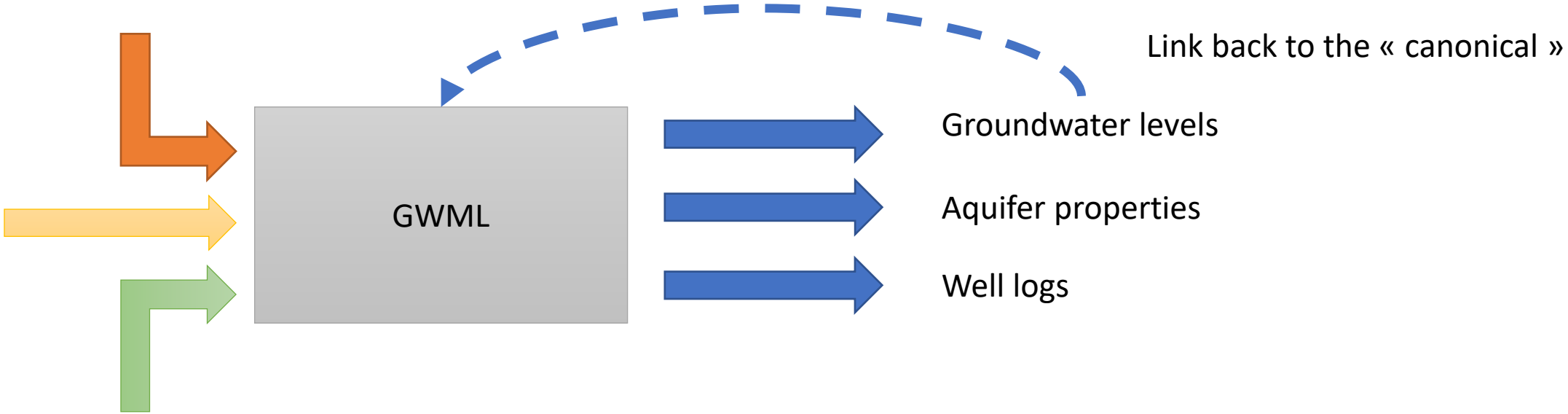
- Harmonize access to data from heterogenous sources
  - Data integration
    - Contextualization
    - Reporting
    - Linkage



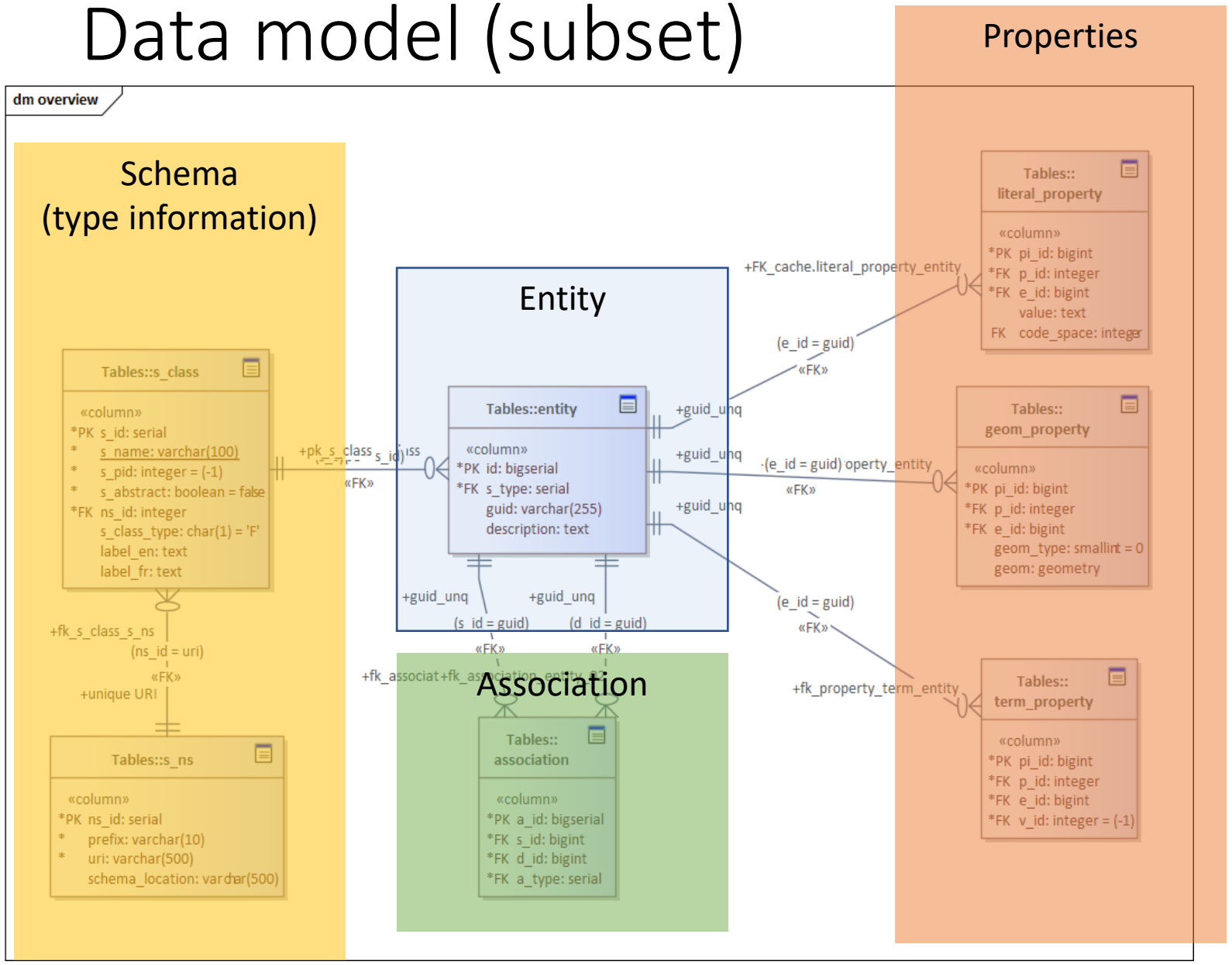


How GWML helps ?

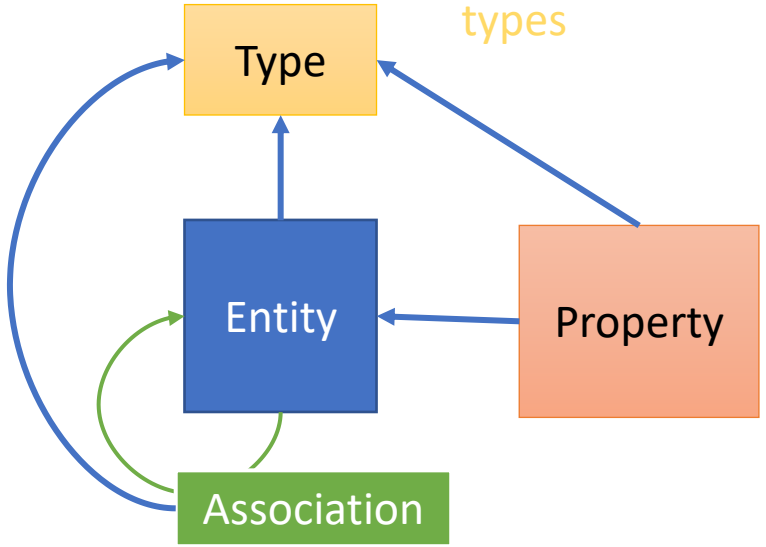
- Harmonized access to data from heterogenous sources
  - Data integration
    - Heterogeneous and at various level of completeness
  - Metamodel to derive products
    - Canonical representation



Data model (subset)



Entities, associations and properties have types



Entities are related to other entities

Entities have properties (properties are owned by Entities)

Abstracted model – in a nutshell

WELL_TABLE

well_id	sampled_feature	bhole_drilling_method	Well_use
2501317	NULL	CableToolDrilling	domestic

TERM_PROPERTIES_TABLE

entity_id	property_name	value
2501317	sampledFeature	NULL
2501317	bholeDrillingMethod	CableToolDrilling
2501317	gw_wellUse	domestic

Classes and properties

(some occurrence stats)

Entity types

s_name	c
CasingComponent	1,731,282
GW_Well	1,603,103
Elevation	1,567,119
Borehole	1,518,119
Casing	1,419,427
GW_GeologyLog	1,392,122
OM_Observation	1,159,873
SealingComponent	743,010
Sealing	588,246
ScreenComponent	576,809
Screen	566,916
SamplingFeatureComplex	95,698
SF_Specimen	95,364
FiltrationComponent	13,326
Filtration	12,730
GW_MonitoringSite	1,501
BoreCollar	223
MappedFeature	145

Property type is a « quantity »

p_name	c
to	2,550,702
from	1,763,218
startDepth	1,390,472
endDepth	1,326,352
casingExternalDiameter	1,283,927
gwWellTotalLength	1,186,416
screenExternalDiameter	440,952
casingInternalDiameter	398,702
screenHoleWidth	24,872
screenHoleLength	24,872
result	493
bholeNominalDiameter	213
positionalAccuracy	40
propertyMeasure	2
filterGrainSize	1

Property type is an « association »

p_name	c
bholeConstruction	2,587,319
casingElement	1,731,282
metaDataProperty	1,598,001
gwWellReferenceElevation	1,567,107
gwWellConstruction	1,517,892
gwWellGeology	1,390,472
relatedObservation	1,029,698
sealingElement	743,010
screenElement	576,809
relatedSamplingFeature	191,062
gwWellYield	75,935
gwWellStaticWaterDepth	54,934
filterElement	13,326
gwMonitoringHost	1,096
gwUnitProperty	816
bholeHeadworks	223
occurrence	140
gwFlowVolumeRate	85
gwUnitRecharge	54

WFS request


```
▼<wfs:GetFeatureResponse xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:cv="http://www.opengis.net/cv/0.2/gml32" xmlns:x="http://ns.test.org" xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
 xmlns:swe="http://www.opengis.net/swe/2.0" xmlns:om="http://www.opengis.net/om/2.0" xmlns:spec="http://www.opengis.net/samplingSpecimen/2.0" xmlns:sam="http://www.opengis.net/sampling/2.0"
 xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:n29="http://gin.gw-info.net" xmlns:wfs="http://www.opengis.net/wfs/2.0" xmlns:gmt1="urn:x-gin:metadata" xmlns:gww="http://www.opengis.net/gwml-well/2.2"
 xmlns:gwml2="http://www.opengis.net/gwml-main/2.2" xmlns:gwml2f="http://www.opengis.net/gwml-flow/2.2" xmlns:gwml2c="http://www.opengis.net/gwml-wellconstruction/2.2" xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:gsmlb="http://www.opengis.net/gsml/4.1/GeoSciML-Basic" xmlns:gsmle="http://www.opengis.net/gsml/4.1/GeoSciML-Extension" xmlns:gmt="urn:x-gin:metadata:2.0" xmlns:m="urn:x-gin:mediator:2.0"
 xmlns:gwml_req="http://www.opengis.net/req/gw_well/" xmlns:wml2="http://www.opengis.net/waterml/2.0" xmlns:def="http://www.opengis.net/def/gwml/phenomenon/" xmlns:schema="https://schema.org/"
 gml:id="wfs.76693" count="10" timeStamp="2022-03-16T11:18Z">
  ▼<wfs:boundedBy>
    ▼<gml:Envelope srsName="http://www.opengis.net/def/crs/epsg/0/4326">
       <gml:lowerCorner>44.5083201891166 -140.420657201397</gml:lowerCorner>
       <gml:upperCorner>68.2233214821593 -55.7993921544602</gml:upperCorner>
     </gml:Envelope>
   </wfs:boundedBy>
  ▼<gml:member>
    ▼<gsmlb:MappedFeature gml:id="gin.4138">
       <gml:name codeSpace="urn:x-gin:cached-resource">https://gin.geosciences.ca/GinService/rs/FeatureTypes/AbstractFeature/gin.4138</gml:name>
      ▼<gsmlb:observationMethod>
        ▼<swe:Category>
           <swe:value>http://resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis_from_multiple_sources</swe:value>
         </swe:Category>
       </gsmlb:observationMethod>
      ▼<gsmlb:positionalAccuracy>
        ▼<swe:Quantity>
           <swe:uom xlink:href="http://www.opengis.net/def/uom/UCUM/0/m" xlink:title="m"/>
           <swe:value>100.0</swe:value>
         </swe:Quantity>
       </gsmlb:positionalAccuracy>
      ▼<gsmlb:specification>
        ▼<gwml2:GW_Aquifer gml:id="gin.4137">
           <gml:identifier codeSpace="http://www.ietf.org/rfc/rfc2616">https://geoconnex.ca/features/GW_HydrogeoUnit/59</gml:identifier>
           <gml:name codeSpace="urn:x-gin:gwie:fr">Sables littoraux</gml:name>
           <gml:name codeSpace="urn:x-gin:gwie:en">Littoral sands</gml:name>
           <gml:name codeSpace="urn:x-gin:cached-resource">https://gin.geosciences.ca/GinService/rs/FeatureTypes/AbstractFeature/gin.4137</gml:name>
          ▼<gsmlb:observationMethod>
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             </swe:Category>
           </gsmlb:observationMethod>
           <gsmlb:occurrence xlink:href="#gin.4138" xlink:title="gin.null"/>
          ▼<gwml2:gwUnitRecharge>
            ▼<gwml2f:GW_Recharge gml:id="gin.4139">
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```
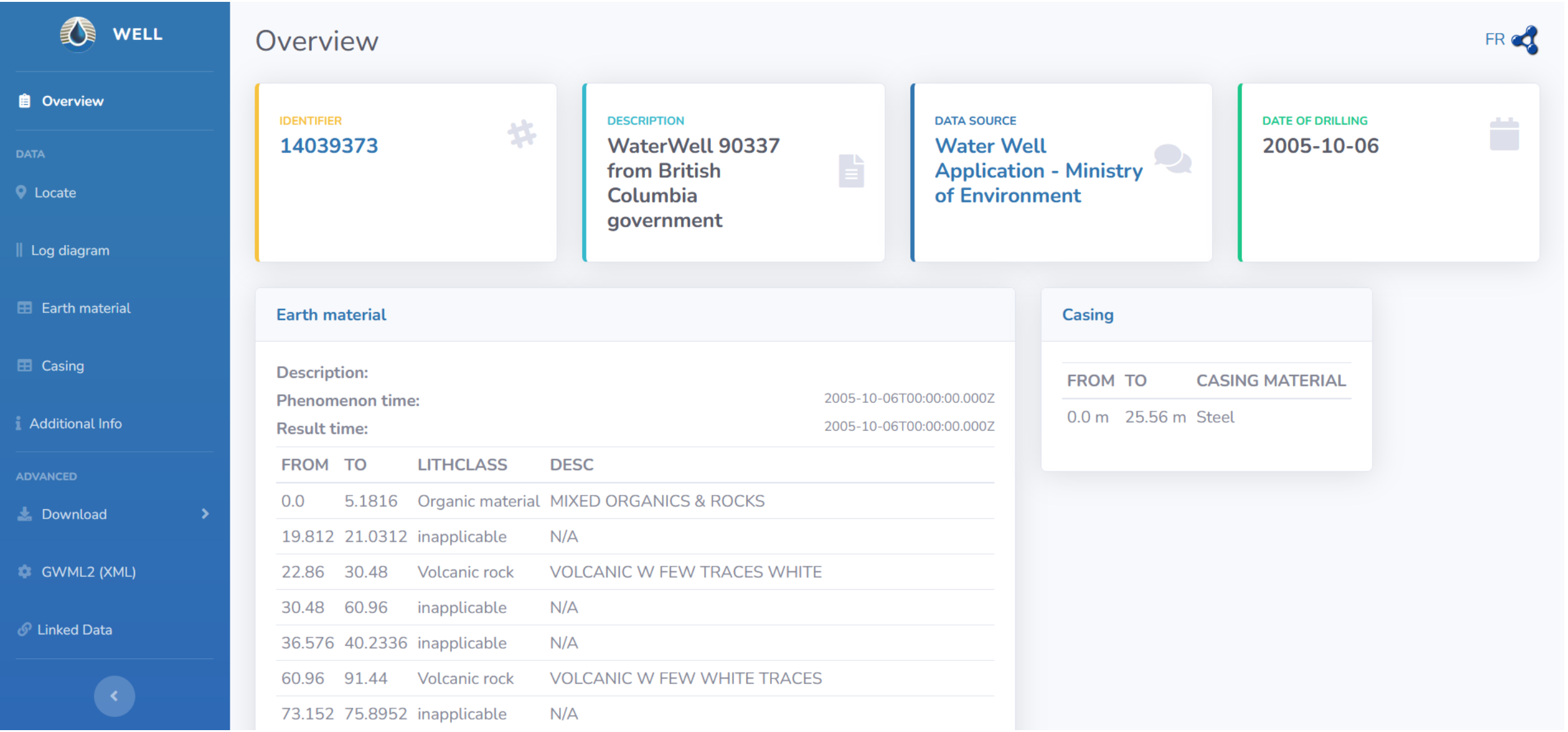

HTML view


WELL
Overview
DATA
Locate
Log diagram
Earth material
Casing
Additional Info
ADVANCED
Download
GWML2 (XML)
Linked Data
Overview
FR
IDENTIFIER
14039373
DESCRIPTION
WaterWell 90337 from British Columbia government
DATA SOURCE
Water Well Application - Ministry of Environment
DATE OF DRILLING
2005-10-06
Earth material
Description:
Phenomenon time: 2005-10-06T00:00:00.000Z
Result time: 2005-10-06T00:00:00.000Z
FROM TO LITHCLASS DESC
0.0 5.1816 Organic material MIXED ORGANICS & ROCKS
19.812 21.0312 inapplicable N/A
22.86 30.48 Volcanic rock VOLCANIC W FEW TRACES WHITE
30.48 60.96 inapplicable N/A
36.576 40.2336 inapplicable N/A
60.96 91.44 Volcanic rock VOLCANIC W FEW WHITE TRACES
73.152 75.8952 inapplicable N/A
Casing
FROM TO CASING MATERIAL
0.0 m 25.56 m Steel

HTML view

Log diagram

Additional Info

ADVANCED

Download

GWML2 (XML)

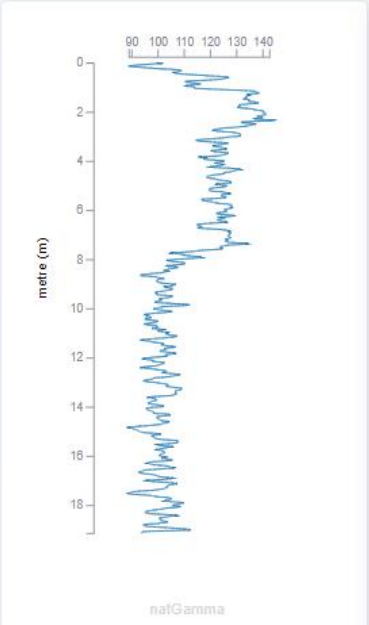
Linked Data

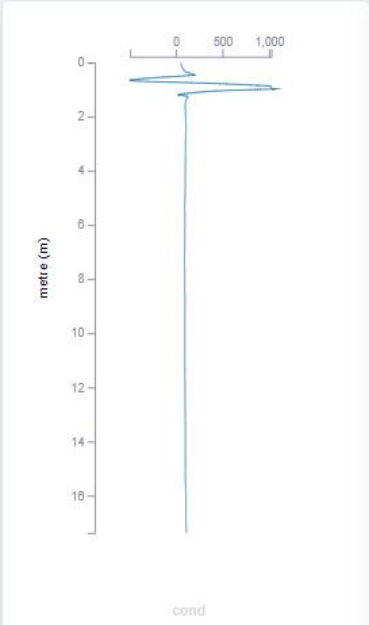
Additional Info

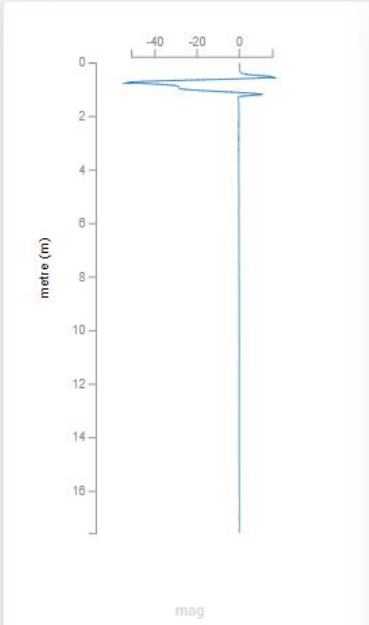
Total length:	19.0
Elevation:	233.568 null , Origin elevation
Status:	N/A
Drilling Method:	N/A

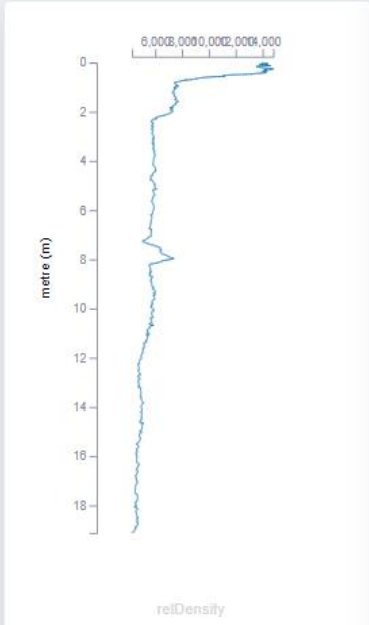
Locate

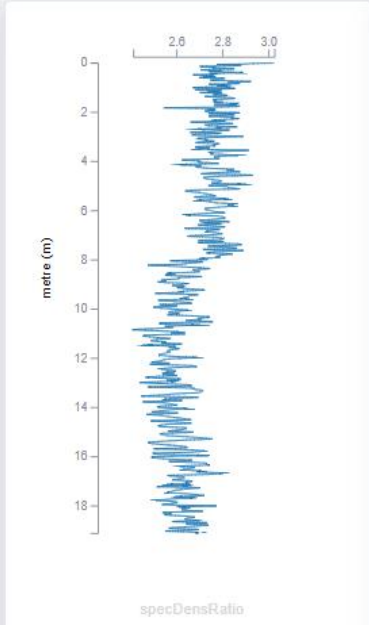
Coordinates: -97.30938184325659, 49.24331620718253 (longitude/latitude)

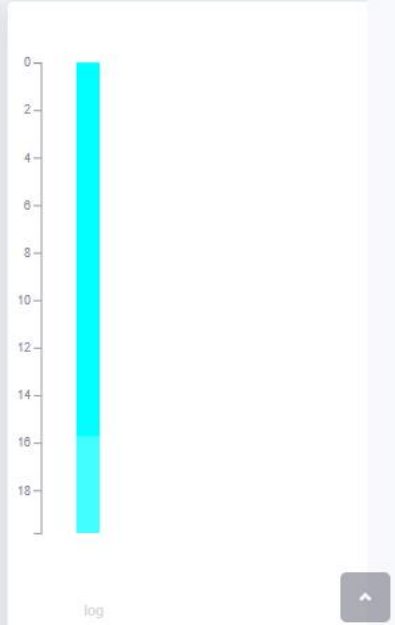








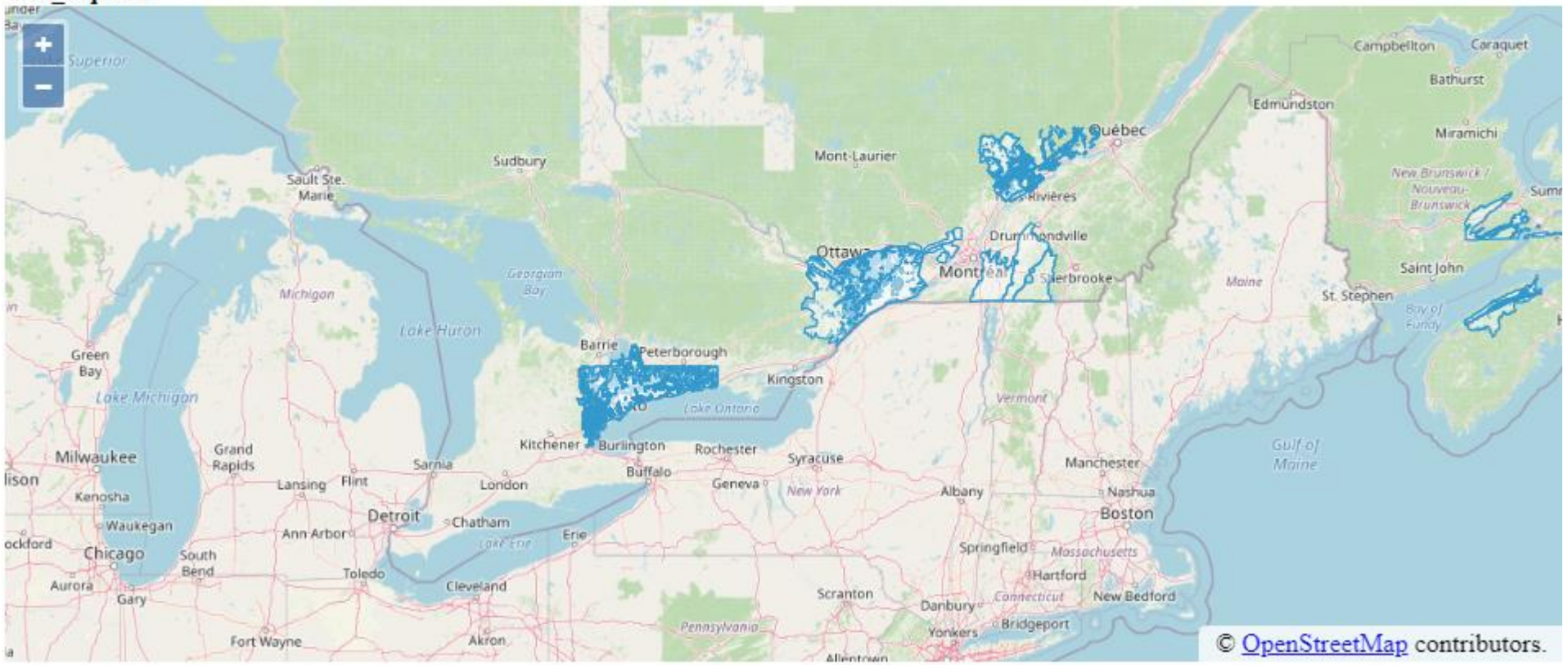




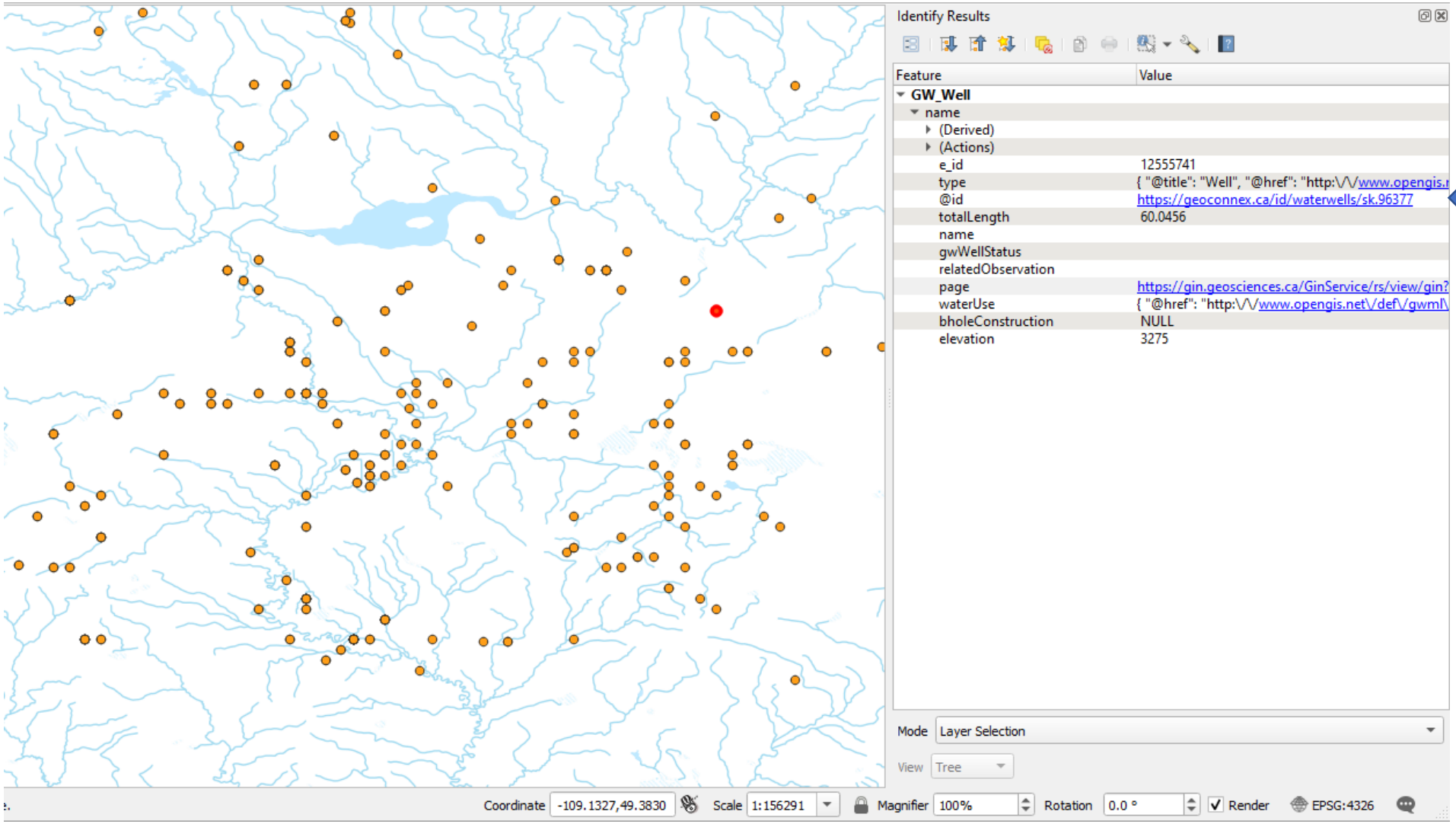
OGCApi (beta)

Collection

GW_Aquifer



QGIS



Canonical representation

Pro and cons

- No « mapping » - it’s a metamodel
  - Database is complex, but flexible
- Fast – mostly depend on database performance
- Not limited to GWML
- Supports polymorphism
- Much better at handling complex properties
- Can be parallellized or distributed (Future work)
- Caveat
  - No way to add more data types without getting back to the code (but very doable)
  - **Not an easy database to work with in SQL, manual editing is a chore**

Caveat

```
INSERT INTO cache.query_result (q_id,e_id,level)
 SELECT DISTINCT -1 as q_id,n0.id,0 as lvl FROM
 (SELECT id FROM cache.entity WHERE s_type IN (47,73,46,82,50,45) ) n0
 INNER JOIN  (SELECT c.*,u.ucum_uri,u.uom_label FROM cache.quantity_property c INNER JOIN cache.s_uom
u ON c.uom = u.uom_id WHERE c.p_id = 61) n1 ON n0.id = n1.e_id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 47) n2 ON n0.id = n2.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (50) ) n3 ON n2.d_id = n3.id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 48) n4 ON n3.id = n4.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (51)) n5 ON n4.d_id = n5.id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 49) n6 ON n5.id = n6.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (53) ) n7 ON n6.d_id = n7.id
 INNER JOIN  (SELECT c.*,u.ucum_uri,u.uom_label FROM cache.quantity_property c INNER JOIN cache.s_uom
u ON c.uom = u.uom_id WHERE c.p_id = 54) n8 ON n7.id = n8.e_id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 47) n9 ON n0.id = n9.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (50) ) n10 ON n9.d_id = n10.id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 48) n11 ON n10.id = n11.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (51) ) n12 ON n11.d_id = n12.id
 INNER JOIN  (SELECT s_id,d_id FROM cache.vw_all_assoc WHERE a_type = 49) n13 ON n12.id = n13.s_id
 INNER JOIN  (SELECT id FROM cache.entity WHERE s_type IN (53) ) n14 ON n13.d_id = n14.id
 INNER JOIN  (SELECT c.*,u.ucum_uri,u.uom_label FROM cache.quantity_property c INNER JOIN cache.s_uom
u ON c.uom = u.uom_id WHERE c.p_id = 54) n15 ON n14.id = n15.e_id
 WHERE  ( ( n1.main_value > 100 AND n8.main_value > 10 ) OR n15.main_value < 6 ) OFFSET 0 LIMIT 7
```

Thank you!

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