

National Ground-Water Monitoring Network Tip Sheet on Developing Web Services for the Network

In order to incorporate data for your list of sites into the NGWMN, one or more web services meeting the NGWMN requirements are needed. Most cooperators need to set up these services, but if existing services meet the requirements, they could be used. There are relatively few requirements for these services, which are listed below, but there are several 'best practices' that will help to either ease the connection of these services or to make them more robust or complete.

Once services are available to serve data to NGWMN for selected sites, a representative from the providing organization will need to work with the USGS to develop a crosswalk between fields in the service and the Network. See the [NGWMN Minimum Data Elements Tip Sheet](#) for a list of required fields. Contact the NGWMN administrators (gwdp_help@usgs.gov) to initiate the crosswalk process once your services are ready.

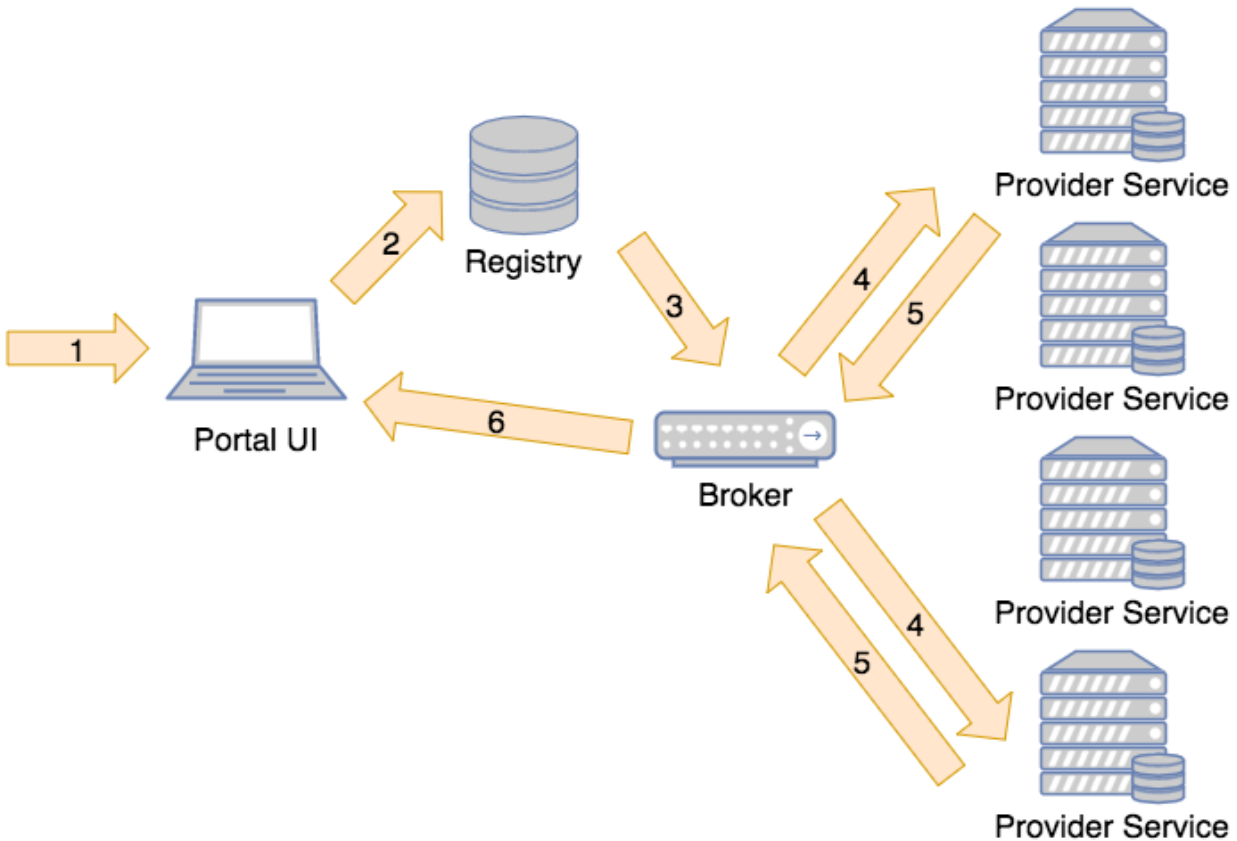
What is a Web Service?

A “Web Service” is a program that allows one computer system talk to another computer system over the Internet. Web services do not have a visual interface, such as text boxes, radio buttons, and drop downs. They can send, request, and process data.

A website typically has two pieces: There is the user interface (UI) you see on a webpage and there are the Web Services that provide the data for the UI. For instance, when a hydrograph is presented on a web site, the services provide the list of values and the UI presents them in a nice graphical format. The services are useful outside of the website as well. For instance, a researcher needing up to access water levels for a scientific model can use the services directly to feed data into their model.

How are the data provider web services used in the NGWMN Data Portal?

The NGWMN data portal implements a service-oriented approach to aggregating the data from many data providers into a single output with a common format. When a user requests data through either the Portal’s [user interface](#) or [web service](#), the NGWMN system will look up the providers of the data requested in the NGWMN Well Registry, request that data from the providers’ services, apply the parsing rules for those datasets, aggregate the response and return it to the user. This chain of processes happen on-demand when a user requests data and is usually completed within a matter of seconds depending on the size of the dataset requested. To efficiently fulfill user data requests, the service response from data providers is cached. This cache is updated between daily and weekly depending on the data type and load on the system. If a user requests a dataset that is not cached, the NGWMN system will retrieve that data in order to fulfill the request.



NGWMN Web Service Requirements

- Set up separate services for:
 - Water Levels
 - Water Quality (only needed if your agency is going to be serving water-quality data)
 - Lithology
 - Construction (screens and casings)
- Must be publicly accessible (no authentication required)
- Must be queryable by the unique site_no used in the well registry
- The site_no can't contain spaces or special characters, is case sensitive and be unique across an agency's network
- Must support either REST or SOAP protocols
- Must return XML
- Must return the minimum data elements (see [Minimum Data Elements Tip Sheet](#))
- Water quality data services must follow the guidelines laid out in the [Standard Elements for Water Quality Data Web Services Tip Sheet](#)
- If any of the minimum data elements are not available from your agency database for some or all sites, include the field in the appropriate service and insert 'unknown' for any unavailable data element

Note: Some data elements are provided to the portal from the Well Registry Management System rather than through web services. The Minimum Data Elements Tip Sheets describes the source of each data element (which web service or the Well Registry).

NGWMN Web Service Suggestions and Best Practices

- Make service read-only
- Use REST protocol
- Use a standard schema
 - WaterML2 for water levels: WaterML2: <http://www.waterml2.org/>
 - GWML2 for lithology & construction information: https://portal.opengeospatial.org/files/?artifact_id=68887&version=1
 - WQX for water quality: <https://www.epa.gov/storet/wqx/>
- Use a standard service protocol (e.g. WFS or SOS)
 - Sensor Observation Service Specification: <http://www.opengeospatial.org/standards/sos>
 - Web Feature Service Specification: <https://www.opengeospatial.org/standards/wfs>
- For water level and water quality services, provide the name of the original data providing agency for each measurement or result if appropriate
- For continuous measurements, calculate and provide daily values rather than instantaneous values
- Use defined and possibly standard vocabularies for units of measure, lithologic units, water quality methods, and construction elements
 - The Unified Code for Units of Measure for units fields: <http://unitsofmeasure.org/trac>
 - Geoscience Vocabularies for lithology terms: <http://resource.geosciml.org/>
 - National Environmental Methods Index for water quality methods: <https://www.nemi.gov/home/>
 - ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure): <https://www.astm.org/Standards/D2488.htm>
- Services should serve XML from 'live' data (e.g., coming from a transactional database) so that as new data and updates occur, the XML served by your services is always up to date. Do not serve data from static files.
- Build services anticipating additional server load from NGWMN traffic. All data will at a minimum be requested daily.

Server Options (not limited to the list below)

- GeoServer
 - WMS1.3.0 & WFS2.0 compliant service options built-in (from database table or view)
 - Support for Oracle, SQL Server, Postgres, MySQL
 - Reference: <http://geoserver.org/>
- ArcGIS Server
 - If given the option, store data in tables rather than layers

- o 52N ArcGIS Server has SOS compliant [service extension](#)
- o WMS1.3.0 & WFS1.1 service built-in (from geodatabase or map)
- o Reference: <http://www.esri.com/software/arcgis/arcgisserver>
- o Advice on opening ArcGIS firewall ports: <https://community.esri.com/thread/120161>
- MapServer
 - o WMS1.3.0 & WFS2.0 compliant service options built-in (from mapfile)
 - o Reference: <http://mapserver.org/>
- CUHHSI Hydrologic Information System
 - o HydroServer publishes data in WaterML1.1 WaterOneFlow web services
 - o Reference: <https://www.cuahsi.org/AboutHIS>

NGWMN Web Service Examples:

Montana Bureau of Mines and Geology – REST Services from GeoServer

Lithology:

http://mbmgwic.mtech.edu:8080/geoserver/ows?FILTER=%3CFilter%20xmlns%3D%22http%3A%2F%2Fwww.opengis.net%2Fogc%22%3E%3CPropertyIsEqualTo%3E%3CPropertyName%3Egwic%3Agwicid%3C%2FPropertyName%3E%3CLiteral%3E133384%3C%2FLiteral%3E%3C%2FPropertyIsEqualTo%3E%3C%2FFilter%3E&INFO_FORMAT=text/xml&service=WFS&version=1.0.0&request=GetFeature&typeName=gwic:vwNationalNetworkLithology&

Casing:

http://mbmgwic.mtech.edu:8080/geoserver/ows?Filter=%3CFilter%20xmlns%3D%22http%3A%2F%2Fwww.opengis.net%2Fogc%22%3E%3CPropertyIsEqualTo%3E%3CPropertyName%3Egwic%3Agwicid%3C%2FPropertyName%3E%3CLiteral%3E133384%3C%2FLiteral%3E%3C%2FPropertyIsEqualTo%3E%3C%2FFilter%3E&INFO_FORMAT=text/xml&service=WFS&version=1.0.0&request=GetFeature&typeName=gwic:vwNationalNetworkCasing&

Screen:

http://mbmgwic.mtech.edu:8080/geoserver/ows?Filter=%3CFilter%20xmlns%3D%22http%3A%2F%2Fwww.opengis.net%2Fogc%22%3E%3CPropertyIsEqualTo%3E%3CPropertyName%3Egwic%3Agwicid%3C%2FPropertyName%3E%3CLiteral%3E133384%3C%2FLiteral%3E%3C%2FPropertyIsEqualTo%3E%3C%2FFilter%3E&INFO_FORMAT=text/xml&service=WFS&version=1.0.0&request=GetFeature&typeName=gwic:vwNationalNetworkCompletion&

Water Levels:

<http://mbmgwic.mtech.edu:8080/geoserver/ows?Filter=%3CFilter%20xmlns%3D%22http%3A%2F%2Fwww.opengis.net%2Fogc%22%3E%3CPropertyIsEqualTo%3E%3CPropertyName%3Egwic%3Agwicid%3C%2FPropertyName%3E%3CLiteral%3E133384%3C%2FLiteral%3E%3C%2FPropertyIsEqualTo%3E%3C%2F>

Filter%3E&INFO_FORMAT=text/xml&service=WFS&version=1.0.0&request=GetFeature&typeName=gwic:vwNationalNetworkWaterLevelsDailyAverage&

Water Quality:

http://mbmaggwic.mtech.edu:8080/geoserver/ows?Filter=%3CFilter%20xmlns%3D%22http%3A%2F%2Fwww.opengis.net%2Fogc%22%3E%3CPropertyIsEqualTo%3E%3CPropertyName%3Egwic%3Agwicid%3C%2FPropertyName%3E%3CLiteral%3E133384%3C%2FLiteral%3E%3C%2FPropertyIsEqualTo%3E%3C%2FFilter%3E&INFO_FORMAT=text/xml&service=WFS&version=1.0.0&request=GetFeature&typeName=gwic:vwNationalNetworkWaterQualityParameters&

Texas Water Development Board – Services from SQL Server 2000

Well Construction:

<http://www2.twdb.texas.gov/apps/GWWS/GroundWaterServices.aspx/GetCasingForWellNumber?wellNumber=4254301>

Water Levels:

<http://www2.twdb.texas.gov/apps/GWWS/GroundWaterServices.aspx/GetWaterLevels?wellNumber=4254301>

Water Quality:

<http://www2.twdb.texas.gov/apps/GWWS/GroundWaterServices.aspx/GetWaterQualityData?wellNumber=6031317>